APERTURE PHOTOMETRY

AT THE

UNISA OBSERVATORY:

SYSTEM EVALUATION VIA LIGHT CURVES OF

ECLIPSING BINARIES

by

VANESSA PIETERS

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SUMMARY

The University of South Africa has built a small observatory for teaching and research. The 35cm Schmidt–Cassegrain reflector and the SSP–5A photometer with Johnson UBV filters were used to evaluate the local possibilities for aperture photometry. Extinction and transformation coefficients and zero points were determined with the RPHOT software package from standard star photometry. To determine the system limits, UBV light curves were obtained for four eclipsing binaries, ranging between magnitudes 7 and 13. In B the limit is 12,5, in U it is 12,0 and in V only 11,0 with large scatter even for bright objects. The rapidly varying sky background in an urban site may be a major cause. A related problem is the large, fixed photometer diaphragm, aggravating the bright sky situation. Possible solutions to this and other problems were suggested. The system can be used fruitfully, especially for single filter photometry of periodic and nonperiodic variables.

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CHAPTER 1

INTRODUCTION

1.1 Aperture photometry with small telescopes

The increasing prominence allotted to the findings from space based astronomy, as well as the new techniques which are making possible the construction of more large ground based reflectors with excellent optics, may easily create the impression that there is little use any more for small telescopes in serious scientific research. This impression is strengthened by the fact that, for budgetary reasons, major astronomical sites cut back on the use of their smaller telescopes when larger ones are acquired. However, as Shervais (1983) and Genet (1987) clearly indicate, this leaves a gap in our knowledge because there are projects for which

(1) larger telescopes are not suitable (for example, observation of brighter stars), and

(2) the short once–or–twice–a–year observing runs granted to any particular observer at a large telescope are not sufficient (for example, when an object must be continuously monitored over a long period).

Specifically with regard to the use of small telescopes (usually defined as 40cm or smaller) for aperture photometry, an important development has been the establishment of IAPPP – the International Amateur–Professional Photoelectric Photometry association. Interestingly, its precursor, the International Astronomical Association of Photoelectric Observers, IAAPO, was formed in 1961 by S. Archer, who was then in South Africa. This association lasted only five years, but active cooperation in serious scientific work between a small group of amateurs and professionals in the United States and New Zealand (note: the two hemispheres) continued in the late 1960s and the 1970s. Especially noteworthy was the work on RS CVn binaries by a professional, D.S. Hall, which was made possible by the observations supplied by amateurs who were able to provide the long–term coverage of these stars which was impossible at professional observatories. This and other projects and symposia eventually provided the impetus for the 1980 formation of IAPPP, which stimulates cooperation between amateurs and professionals in a mutually beneficial arrangement. Examples of projects which have been and could be undertaken, abound in IAPPP publications (Wolpert & Genet, 1983, 1984; Genet, Genet & Genet, 1987) and others, such as Percy (1986). It should be noted that many universities also have small student observatories and, although they may be run by professionals and aim to produce professionals, in other respects they more closely resemble the amateur situation, because of their limited size and typically nonideal location. IAPPP is also directed toward bringing them into the fold for serious research (Genet, 1987). It should be clear then, that small telescopes definitely have their role in the general field of astronomical research and more specifically in aperture photometry.

1.2 Aperture photometry at disadvantaged sites

In general, an astronomical site is considered to be disadvantaged either due to local climatic conditions which produce few cloud–free nights per year, or due to its location in a highly light and/or air polluted spot. Fernie (1983) makes the case for aperture photometry at a "climatically underprivileged" site – the David Dunlap Observatory near Toronto, Canada. According to Percy and Fernie (1986) this site experiences about 600 hours per year which are suitable for photometry. This is the equivalent of about 90 to 100 nights of photometry, which is certainly not insignificant. However, it must be noted that many of these hours are accumulated from two or three hour periods during nights which were otherwise nonphotometric. This is where the ease of access, emphasised by Hall (1986) plays a crucial role in determining whether such short photometric periods will in fact be utilised or simply go to waste.

1.3 Variable star observation in the southern hemisphere

Koch, in a report on photometry of close binary stars (which includes eclipsing binaries) to the International Astronomical Union mentions that "sustained productivity from the northern sky and a slight increase from the equatorial region have compensated for the considerable decrease of the contribution from the far southern sky" (In Swings, 1988, p 571). As the southern sky is certainly not devoid of interesting objects for photometric observation, this implies a need to use every available facility optimally. A related issue is the fact that many third world countries lie in the southern hemisphere, where a culture of science and even the necessary infrastructure and technical backup may be lacking. In 1988, J. Sahade, then President of the IAU, requested that the circumstances of astronomers in (socially) disadvantaged locations be noted and that they be brought into active ground based and space work. Clearly, a small South African observatory can make a contribution on both counts.

1.4 The Unisa Observatory (UNIOBS)

During 1987 the University of South Africa (Unisa), a correspondence teaching institution catering for approximately 120 000 students from South Africa and abroad, but also incorporating a small subdepartment of astronomy, decided to make funds available for the building of a modest student observatory. The Unisa Observatory was officially opened on 17 August 1992. Its main purpose is to acquaint astronomy students with the type of equipment they will encounter in large modern observatories. To this end, a small, computerised telescope was installed, backed up by instrumentation for aperture photometry, spectroscopy, solar observation, astrometry and photography. A CCD is envisaged for the future.

Quite apart from its teaching function, however, the observatory is also intended as a research facility for graduate and post–graduate students. Naturally this places more stringent demands on the quality of the site as well as the equipment as it must be able to produce scientifically meaningful results.

However, in the case of the Unisa Observatory, ease of access had to take precedence over clear, dark skies in the final choice of the most suitable site. The observatory was eventually built at the southern end of a brightly lit campus, about three kilometers south of the city centre. The site is certainly far from ideal from a light pollution perspective, but the choice in favour of ease of access has since been vindicated, in the sense that students from all over the country and even from neighbouring states are keen and able to enrol for undergraduate practical courses which include two weeks of daily (and nightly) work at the observatory. As there is no specific technical backup for the observatory and the general technical staff on campus must simply do what may be required, the on–campus location was in fact the only viable one.

Apart from this nonideal situation, budgetary constraints also dictated the purchase of advanced amateur rather than professional equipment. For aperture photometry this includes the 35cm computerised telescope, an automated SSP–5A photometer with UBV and clear filters, and the RPHOT software package. This study concerns itself with an evaluation of the first results obtained with this equipment at this site.

1.5 Outline of the study

In order to evaluate the Unisa system for aperture photometry, two basic sets of observations were done. First of all, standard star observations in order to determine extinction and transformation coefficients and zero points, so that later data could be reduced to the standard Johnson UBV magnitude system. And secondly, observations of four short–period eclipsing binaries, covering a range of magnitudes, in order to determine the system limits. Of course, each step in data acquisition and reduction also tested the efficacy of the acquired software package.

The results will be placed in perspective by first discussing the telescope, photometer and filter system, followed by a description of the standard reduction procedure and the way in which the software package handles the data. Then the results of standard star observations and the determination of extinction and transformation coefficients and zero points will be given, followed by a short theoretical description of eclipsing and close binaries, and finally the light curves obtained for the four short–period binaries and a comparison with published data for the same objects. Some suggestions for improvements to the system and for possible worthwhile research projects will be given at the end.

CHAPTER 2

THE TELESCOPE

2.1 General information

The telescope is a **35cm (14 inch) f/11 Celestron Compustar** – hence the name, **C14** – with **Schmidt–Cassegrain optics**. It has an **equatorial fork mount**, attached to a permanent pier. This rests on a solid pillar which is isolated from the observing deck and therefore from any vibrations from that source. The observatory building itself is isolated by means of a 3cm gap from a parking area and a technical building containing electrical power generators. It is situated at the southern end of the Unisa campus at the edge of a low hill. The implications of this situation in terms of light pollution will be discussed later. For the moment the characteristics of the telescope and its suitability for aperture photometry will be considered.

2.2 Optics

Although the Celestron Compustar is a **Cassegrain** telescope, it does not have the traditional configuration of a paraboloidal primary and hyperboloidal secondary mirror. Instead, both mirrors are **spherical** (actually, spheroidal). The configuration and optical path are depicted in figure 2.1.

The spheroidal figuring stems from considerations of **cost–effectiveness**. In the case of such a relatively small aperture the extra difficulty and cost involved in obtaining a paraboloidal figure are not warranted as the spheroid approximates the paraboloid quite well, close to the optical axis. Mathematically this can be seen quite clearly by considering the equation describing a circle with its centre at the origin:

$$x^2 + y^2 = r^2 \tag{2.1}$$

or, solving for x:

$$x = (r^2 - y^2)^{1/2},$$

and, rewriting:

$$x = r(1 - y^2/r^2)^{1/2}.$$

If one now considers a section through the primary mirror as being represented by the extreme right hand side of this circle and only this portion of the circle is taken into account, then y^2/r^2 is always very small (y_{max} = 175mm and r = 1524mm. See specifications given hereafter). Thus a binomial expansion may be performed, giving

$$x = r\{1 - y^2/2r^2 - y^4/8r^4 \ldots\} \tag{2.2}$$

Truncating equation 2.2 after the second term, one obtains

$$x = -(1/2r)y^2 + r$$

which clearly represents a parabola with vertex at A(r,0), its focus at F(r/2,0) and its centre of curvature at C(0,0), ie the same A, F and C as for the circle which now represents a section through the spheroidal mirror.

According to the manufacturers, in the case of the secondary, a slightly aspheric figure was obtained by final handfiguring (Celestron 11/14 Operating Manual).

The optical specifications for the telescope, given in the abovementioned manual, may be summarised as follows:

Optics: Schmidt–Cassegrain
Clear aperture: 350mm
Focal ratio: f/11
Focal length: 3910mm
Image scale: $0{,}014^{o}$/mm at Cassegrain focus

Primary mirror:
Figure: Spherical
Diameter: 361,99mm clear aperture
f/ratio: f/2,14
Radius of curvature: 1524mm
Material: Fine annealed pyrex

Secondary mirror:
Figure: Spherical (final handfiguring gives a slightly aspheric figure)
Diameter: 88,9mm
Radius of curvature: 440mm
Material: Fine annealed pyrex
Amplification ratio: 5,14

Central obstruction: 114mm
Corrector plate: True aspheric Schmidt curve on exterior; plane interior
Corrector thickness: 6,4mm
Back focus: ~ 350mm maximum from vertex of primary

Mirror coatings: Enhanced aluminium. Silicon monoxide (SiO) protective overcoat
Corrector plate coatings (on both sides of corrector plate): Magnesium fluoride (MgF_2); 1/4 wave thickness, optimised for 540nm (Celestron 11/14 Operating Manual)

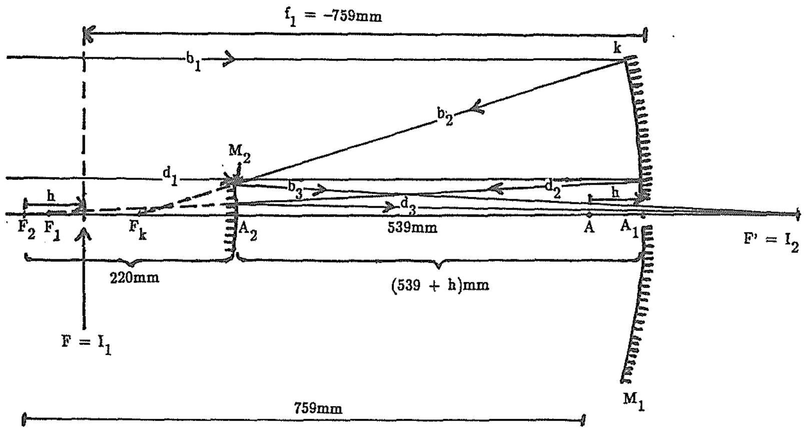


Figure 2.1: Optical configuration of the Celestron C14 telescope (corrector plate excluded)

In figure 2.1 a marginal ray b_1 strikes the primary mirror M_1 at a point k on its margin and is reflected into b_2. The ray b_2 is reflected into b_3 by the secondary mirror M_2 through the opening surrounding the vertex of the primary mirror, into the focus F' = I_2. Similarly a paraxial ray d_1 is reflected first into d_2 and then d_3 and finally reaches I_2.

However, three facts should be noted. First of all, the position of M_1 may be moved parallel to the optical axis, a distance h $\sim$ 30mm. If A_1 moves to A, then F moves to F_2 by the same amount and F' moves to the right. As different instruments used in conjunction with the telescope require F' to be at different distances behind the rear mirror cell, this ability to focus the telescope by moving the primary mirror is essential. The focus can in fact be moved 350mm to the back of the vertex of the primary.

The second noteworthy point is that the carriers of the reflected rays b_2 and d_2 intersect the optical axis at points F_1 and F_k which do not coincide. This reflects a positive spherical aberration, since the reflection of the marginal ray intersects the axis to the right of the reflection of the (nearly) paraxial ray, ie $F_1A_1 > F_kA_1$. M_2 partially compensates for this (about 1/4 of the spherical aberration introduced by the primary is reversed by the secondary)(Wolterbeek, 1993). For the rest, the correction is done by the Schmidt corrector plate, a cross-section of which is represented in figure 2.2.

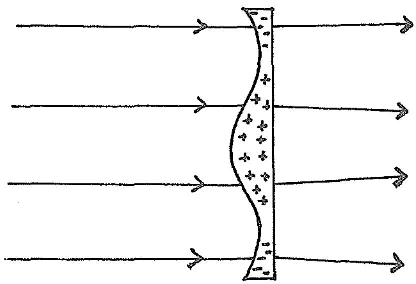


Figure 2.2: Schematic cross-section of Schmidt corrector plate

Clearly, as a result of the action of the Schmidt plate, the reflected marginal ray will intersect the optical axis at a slightly larger distance from the primary than it would have done in absence of the corrector plate, and vice versa for the reflected) paraxial ray. Therefore F_1 and F_k will more nearly coincide with $F = I_1$ (but not quite, in order to allow for the reverse spherical aberration introduced by M_2.

Thirdly, the focal length, f_1 of the primary is given as 759mm and not as half the radius of curvature ($r/2 = 762$mm). This is mainly due to the fact that $f_1 = r/2$ holds strictly only for paraxial rays. According to Wolterbeek (1993) a +3mm correction must be applied to the image distance for the primary, because of central obstruction of truly paraxial rays by M_2, longitudinal spherical aberration by non–paraxial rays and the influence of the corrector plate on them.

2.3 Suitability of the C14's optics for aperture photometry

2.3.1 Telescope type

A Cassegrain reflector is eminently suited for photometry, for several reasons.

In the first place it is easy to attach a photometer at the Cassegrain focus and easy for the observer to use it in that position.

Secondly, reflectors in general are more suitable than refractors since they are not subject to the chromatic aberration (noncoincidence of the foci of light of different wavelengths) caused by the differing refractive indices of glass for different wavelengths of light.

Moreover, in the case of a mirror telescope the light need not pass *through* the glass. Therefore a further advantage of a reflector is normally that the ultraviolet cutoff due to the restricted range of transmission of glass is not in evidence. However, this advantage is lost to some extent in the case of the Schmidt–Cassegrain configuration. While correcting for spherical aberration, the Schmidt corrector plate unfortunately also reinstates the ultraviolet cutoff found in the refractor telescope, because light must once again pass through a glass lens (Henden and Kaitchuk, 1990; hereafter H & K, 1990). However, the corrector plate is thin (in the case of the C14 it is 6,4mm thick) and so the effect is still much less pronounced than for a refractor where considerably thicker lens glass would be involved. It may be noted in passing that the C14 Schmidt plate coating of magnesium fluoride has an ultraviolet cutoff at a much shorter wavelength (115nm, according to Sterken and Manfroid, 1992; hereafter S & M, 1992) than the atmospheric cutoff and so in practice has no effect on ultraviolet transmission at all. The spectral reflectances of various glasses and coatings will be discussed in greater detail in the paragraphs that follow. Suffice it to say that, in the case of the Unisa system, the good results obtained in the ultraviolet (see chapter 9) indicate that the potentially negative effect of the corrector plate on short wavelength transmission has not manifested notably.

A mirror telescope implies the use of a reflective coating which may severely affect the passbands of photometric systems, since different chemicals have different spectral reflectances, ie they reflect light of different wavelengths differentially. Figure 2.3 depicts the spectral reflectances of gold, silver and aluminium (mirror coatings) and the transmittance of an achromat refractor (a multi–lens telescope using glass of different refractive indices to bring the foci of two different wavelengths into coincidence). As the figure shows, gold has a high reflectance in the infrared region, from about 700nm and beyond. Because a gold coating does not deteriorate as is the case with silver, it may be put to good use in infrared photometry. Silver coatings have very high reflectances beyond a wavelength of 600nm, but unfortunately deteriorate rapidly (due to tarnishing), especially for the shorter wavelength regions (S & M, 1992).

Clearly, from figure 2.3, the aluminium coating is effective over a wider spectral range, although it nowhere shows the outstanding reflecting properties which gold and silver have over a more restricted range. A deposit of evaporated ("enhanced") aluminium is therefore a commonly used mirror coating and is also the coating used in the case of the C14. Apart from its 90% reflectance over most of the wavelength range from the ultraviolet to the infrared, the aluminium coating is also chemically stable and so lasts considerably longer than would a silver coating (S & M, 1992).

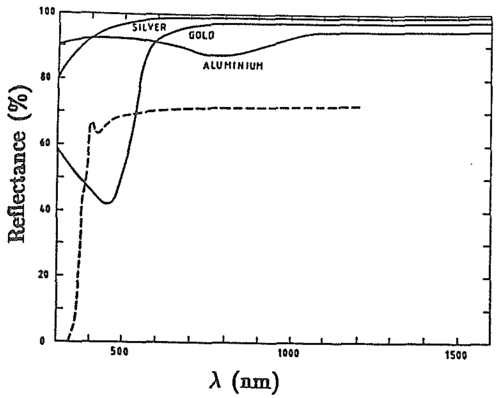


Figure 2.3: Spectral reflectances of gold, silver and aluminium mirror coatings. The transmission of a 38cm achromat is represented by the dashed line (After Wood, 1963).

Figure 2.3 confirms the superiority of the reflector over the refractor, even when the latter is corrected for chromatic aberration, as in the case of the achromat.

One problem with an aluminium mirror coating, however, is that it is soft and can easily be scratched during cleaning. For this reason it is covered with a protective overcoat of silicon monoxide (SiO), which also protects it against corrosion (from contact with the air). However, the entire primary is covered with SiO and this can cause ultraviolet transmission to deteriorate as the overcoating ages and converts to silicon dioxide (SiO_2) (H & K, 1990).

Having now considered the suitability of the Schmidt–Cassegrain optics of the C14 for aperture photometry, the next characteristic to be evaluated for suitability, is the C14's focal ratio.

2.3.2 F–ratio

If the telescope's f–ratio is small ("fast") this means that the light cone diverges rapidly. In such a case the photometer diaphragm (in the focal plane of the telescope) may need to be placed uncomfortably close to the main mirror. There will also be relatively little space for the filters and Fabry lens to fit between the diaphragm and the photocathode of the photomultiplier tube. Henden and Kaitchuk (1990) recommend an f–ratio of 8 or larger, while Sterken and Manfroid (1992) mention f–ratios of between 10 and 15 as being the most common in professional telescopes. At f/11 the Unisa telescope then falls well within the range of suitability for aperture photometry.

A related subject, because of its dependence on the focal length, is the image scale in the focal plane.

2.3.3 Scale in the focal plane

The image scale in the focal plane of the C14 is given as $0{,}014^{o}mm^{-1}$ or $50{,}4''mm^{-1}$ by the manufacturers. The image scale depends on the focal length, a simple rule of thumb guide being that, expressed in arcseconds per millimeter, it is approximately 200/f where f is in meters. (For the C14, f = 3,910m and so 200/f = $51{,}2''mm^{-1}$, which is close to the value supplied by the manufacturers). So, due to the inverse proportionality, large focal lengths reduce the image scale, giving higher spatial resolution and permitting study of crowded fields (S & M, 1992).

On a more practical level, the smaller the image scale, the easier it is to drill the diaphragm holes for aperture photometers, as the holes can be correspondingly larger as the image scale becomes smaller (H & K, 1990).

In general then, a longer rather than a shorter focal length is desirable for aperture photometry. The intermediate focal length of the C14 would normally be a good compromise. However, as will be seen later when discussing the diaphragm size of the Unisa photometer (which is large and fixed) a long focal length and correspondingly small image scale in the focal plane is in this case essential in order to obtain the best possible photometry results. A possible remedy would be the use of a Barlow lens to increase the effective focal length and correspondingly decrease the image scale in the focal plane (see chapter 10).

2.3.4 Size of objective

In the case of telescopes with small primary mirrors, the image is surrounded by significant diffraction rings and the Airy disc has a radius of

$$\theta(\text{rad}) = 1{,}22\lambda/\text{D}$$

where the objective diameter D and the measured wavelength λ are in the same units. The size of this disc and the amount of light distributed in diffraction rings farther out, then determines the lower limit for the photometer diaphragm in the case of telescopes with small D.

For larger telescopes the lower limit of diaphragm size is determined by atmospheric effects, since the Airy disc becomes very small. Diffraction effects also become negligible compared to atmospheric effects. According to Sterken and Manfroid (1992), depending on atmospheric conditions, somewhere between an objective size of 25 and 30cm these latter conditions become the prime determinants of the lower limit of useful diaphragm size. In this context, then, the C14 must be classed with "larger" telescopes as the seeing – and not the Airy disc or diffraction rings – determines the size of the smallest useful diaphragm. For purely academic interest, the Airy disc of the C14 for light of λ = 640nm, is

$$\theta(\text{rad}) = 1{,}22 \text{ x } 640/350 \text{ x } 10^{6}$$

$$= 2{,}265 \text{ x } 10^{6} \text{ rad}$$

$$= 0{,}467''.$$

Clearly an Airy disc of less than half an arcsecond can play no significant role in determining the lower limit of the diaphragm size.

The preceding discussion is in fact academic, as the SSP–5A photometer used with the C14 has a fixed 100" diaphragm size (see chapter 3). Nevertheless, figure 3.2 conveniently displays the fraction of light excluded from the diaphragm for perfect telescopes having various objective diameters.

Objective size is also a major determinant of the limiting magnitude measurable with a photoelectric photometer. In the case of the C14 the limiting visual magnitude observable is given by the manufacturers as 15. However, size of objective is not the only factor determining the limiting photometric magnitude. Seeing quality, background sky brightness, the filter used (ie the wavelength of the measured light), diaphragm size and whether the detector is a photomultiplier tube or photodiode all have an effect. Finally the desired accuracy of the measurements must also be considered. For this reason the limiting photometric magnitude for the C14 under local sky conditions and using the SSP–5A photometer with its 100" diaphragm, will be discussed in the light of actual data obtained with the system (see chapter 9).

2.3.5 The mount

A stable mount is indispensible for successful photometry. To this end the C14's equatorial fork mount is attached to a permanent pier, which in its turn is firmly fixed to a sturdy pillar. Vibration has been eliminated as far as possible by isolating the pillar from the observing deck and by isolating the observatory building as a whole from other potential sources of vibration on the surrounding campus.

2.3.6 Tracking

According to Sterken and Manfroid (1992) the telescope drive should be precise enough to keep an object well–centred in the diaphragm for at least ten minutes. If one is able to use such long integrations, fainter stars can be observed photometrically.

For the C14 and the Unisa system the situation is as follows: When doing multifilter, differential photometry of variable stars using the RPHOT software package, the maximum time allowed per filter is 40 seconds – therefore, a total of 120 seconds in the U,B and V filters. In general the tracking is good and stars remain centred for this period and even much longer. However, in certain positions, especially when observing low in the West, tracking becomes erratic and the star tends to move out of the 100" diaphragm within 80 to 100 seconds. Usually this necessitates recentring of the star in the diaphragm between measurements in each of the different filters.

Luckily a star does not have to be perfectly centred in the diaphragm in order for a valid measurement to be taken. Figure 2.4 indicates the recorded counts when a star moves across the 100" diaphragm of the SSP–5A photometer. Clearly the signal drops off quite sharply near the edge of the diaphragm, but is nearly constant over most of its diameter.

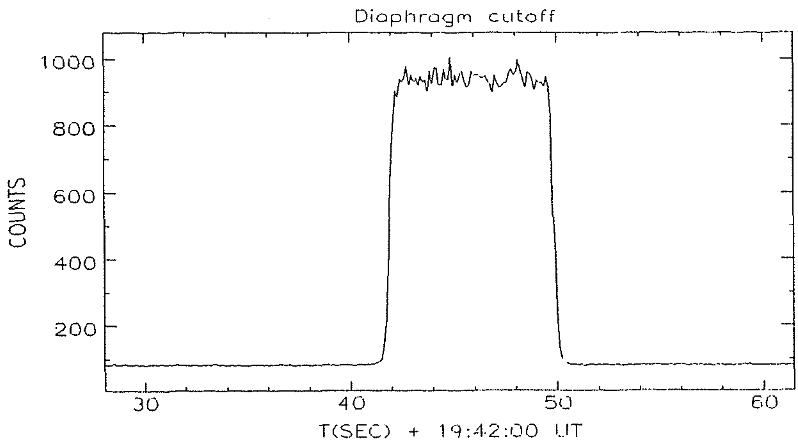


Figure 2.4: Recorded signal when a star moves across the 100" diaphragm of the SSP–5A photometer

2.3.7 Setting

In variable star photometry, where there is continual switching from the programme star to comparison and check stars, high precision data can only be obtained if the setting speed is fast. Otherwise atmospheric or instrumental changes may occur between measurements which are to be compared in differential photometry (S & M, 1992).

Also, the ratio of the time spent during integrations, to that spent outside integrations is a good indication of the efficiency of the equipment for setting (whether automatic or manual). For the C14 and variable star photometry this ratio is 3:2 – a sequence including 55 minutes of integration takes on average just over 80 minutes. According to Henden and Kaitchuk (1990) this ratio is very good for a manual system.

Setting is done via coordinates entered into the telescope's microcomputer and the slew speed is quite fast: The C14 slews through 180° (from rest) in 38 seconds. However, final centring must be done manually. Dome movement must also be done manually (electrically, but not computerised) and adds significantly to the setting time in the case of all-sky photometry.

Summary

In most respects the choice of the C14 for the Unisa Observatory is favourable for the practise of photoelectric photometry. Chromatic aberration and the ultraviolet cutoff are largely eliminated by the choice of a mirror telescope. Spherical aberration is compensated by the Schmidt corrector plate. The Cassegrain configuration allows easy attachment and use of a photometer. The aluminium mirror coating has a good spectral reflectance over a wide range of wavelengths and is chemically stable. The f/11 focal ratio is slow enough to allow sufficient space for all elements of the photometer. The relatively long focal length (3910mm) allows observation in fairly crowded fields as the image scale in the focal plane is 50,4"mm^{-1}. The 35cm objective is large enough so that light lost in diffraction rings is negligible. A sturdy equatorial fork mount and computerised setting ability are further advantages for aperture photometry. With certain exceptions, the tracking allows centring of an object in the photometer diaphragm, even over extended integration periods.

CHAPTER 3

THE PHOTOMETER

3.1 Types of photoelectric photometers

In contrast to **imaging photometry** by means of photographic plates or charge coupled devices (CCD cameras), **aperture photometry** does not employ an imaging detector, but makes use of the photoelectric effect to measure the light from stars. Usually only the light from a single object can be measured and so this object must be isolated by means of a diaphragm. In contrast, CCDs can measure all the objects in a field of a few arcminutes at a time and a single photographic plate can span some degrees. The resolution for 2–D imaging photometry is usually of the order of one arcsecond or even better, while for aperture photometry the spatial resolution is dependent on diaphragm size – normally between 10 and 100 arcseconds (S & M, 1992). Nevertheless, photoelectric aperture photometers have played an important role in astronomical research, especially since the basic detector device, the photomultiplier tube (PMT) came into its own after World War II (H & K, 1990; Kron, 1987).

Photoelectric photometers are however not all the same. Various types of photometers will be discussed in the following sections.

3.1.1 The sequential photometer

Possibly the most widely used photometer is one which measures a single object in a single filter passband at any particular moment. Such a photometer could be called a single star photometer or also a **sequential photometer**. In this case, light passes sequentially through each filter. Figure 3.1 is a schematic representation of such a photometer.

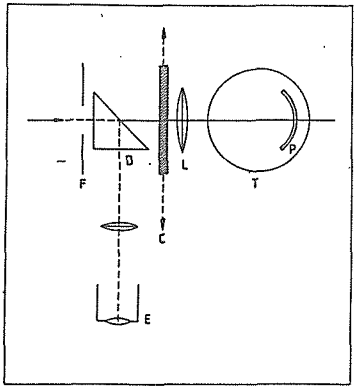


Figure 3.1: The sequential photometer (Adapted from Evans, 1968)

Light from the telescope passes through a diaphragm in the focal plane F and thence through a movable prism/flip mirror D into the viewing eyepiece E or through one of several filters mounted on a filter slide or filter wheel C. The Fabry lens at L images the objective (primary mirror or lens) onto the photocathode P inside the photomultiplier envelope T. Each of these components will be discussed in somewhat more detail as it has a bearing on the aperture photometer in use at the Unisa Observatory.

The **diaphragm** isolates the light from a selected star from that of neighbouring stars. However the diaphragm will always pass sky light as well as star light, in proportion to its surface area. Thus it would seem that the ideal would be the smallest possible diaphragm. However, the seeing (atmospheric turbulence) affects the size of the stellar image, as does any residual aberration in the optics. Also, the size of the Airy disc and diffraction pattern – which vary inversely with the objective size – must be taken into account, otherwise a significant fraction of a star's light may be excluded by too small a diaphragm (S & M, 1992).

The situation for a perfect telescope and perfect seeing is depicted in figure 3.2, showing the fraction of light excluded from various sizes of diaphragm for various objective diameters in geometric progression from 0,05m to 12,8m. According to Young (1970; 1974), for a perfect telescope the fraction ξ of the radiant flux excluded from a diaphragm of radius r decreases as 1/r. For a secondary mirror with obstructive diameter ρ times the primary mirror diameter D,

$$\xi(r) = \lambda[5rD(1 - \rho)]^{-1} \qquad (3.1)$$

with λ and D in the same units and r in radians. For the Unisa telescope and the fixed diaphragm size of 100" = 4,85 x 10^{-4} radians, with D = 350mm and ρ = 114,3/D = 0,327 (central obstruction = 114,3mm), $\xi(r)$ = 0,001. In other words, theoretically a 10" diaphragm would still allow 99% of a star's light to be included. However, as Sterken and Manfroid stress, relation 3.1 underestimates light losses, due to the assumptions of perfect seeing and perfect optics which are in reality never warranted. A diaphragm must, in other words, not be too small. However, it must also not be too large, especially for faint objects, as the photon noise from the surrounding sky would drown the faint signal from the star. Also, the possibility of inadvertently including faint stars in the diaphragm increases.

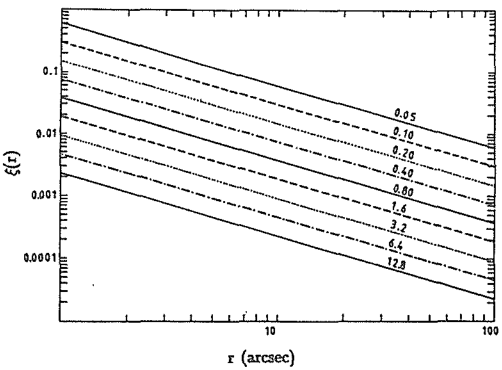


Figure 3.2: Fraction of light excluded from the diaphragm for a perfect telescope and perfect seeing. λ = 560nm. (Adapted from S&M, 1992).

The next photometer element reached by the light is the pivotable mirror ("**flip mirror**") which can be positioned to allow the observer to view the diaphragm (magnified via the eyepiece). This allows focusing of the telescope as well as centring of the star in the diaphragm. In the case of the SSP–5A photometer used at Unisa, the flip mirror and eyepiece *precede* the diaphragm in the light path and so an illuminated reticle indicates the position of the diaphragm in the field of view of the viewing eyepiece. At the end of a photometric measurement the flip mirror may again be used to ascertain whether the star was still centred (in other words, that significant light losses did not occur during the measurement because of poor tracking by the telescope). According to Sterken and Manfroid (1992) the diaphragm–viewing periscope requires separate focusing. Although this would usually be the case, for the Unisa SSP–5A photometer the viewing eyepiece is permanently focused on the diaphragm. Only the telescope objective may be moved to ensure that its focal plane coincides with the diaphragm.

When the flip mirror is removed from the light path, the light passes through one of several **filters**, mounted in a filter wheel or filter slide, as in the case of the Unisa photometer. The filter system will be discussed in more detail in the following chapter.

Next the light passes through the **Fabry lens, or field lens,** which forms a uniform, extrafocal image of the objective on the lightsensitive photocathode of the detector (the photomultiplier tube). Photocathodes are not equally sensitive everywhere, nor does their point of greatest sensitivity necessarily lie directly opposite the photometer diaphragm. So small movements of the star image in the diaphragm would cause large spurious variations in the measurements if it were focused to a sharp point on the photocathode and this point wandered between areas of varying sensitivity (Lallemand, 1962; S & M, 1992). If all the light from a star were concentrated in a single point, there would also be greater chance of inadvertent damage to the photocathode by exposure to a too luminous object (H & K, 1990).

The Fabry lens is usually a fixed component of the photometer and, since its focal length is given by

$$F_{Fab} = bf/D \qquad (3.2)$$

where D is the objective diameter, f the focal length of the telescope and b the diameter of the light spot on the detector, the Fabry lens is compatible with a restricted range of f–ratios. As it is a *lens*, in other words, light passes *through* it, its effect on the transmission of ultraviolet and infrared radiation must be kept in mind. Consequently, Fabry lenses are sometimes replaced by Fabry mirrors (S & M, 1992).

Finally, the Fabry lens forms an extrafocal image with uniform light distribution on the photoelectric detector. Up until now it has been tacitly assumed that this detector is a photomultiplier tube or PMT. However, it could also be a solid state detector – a photodiode or "positive–intrinsic–negative" (PIN) photodiode. Such a PIN photodiode has certain advantages as well as disadvantages when compared with the PMT. Being a quantum sensor its internal gain is unity, with the unfortunate consequence that all amplification of the signal must take place in external electronics and noise is introduced. Also, pulse counting techniques cannot be applied and must be replaced by DC photometry which is not so effective for measuring faint stars. However, PIN photodiodes also have major advantages over PMTs, mainly their very high quantum efficiency, linear response, wide spectral range, small size and mass and low price (H & K, 1990; S & M, 1992). The solid state detector differs from the PMT in other ways too. It requires a sharp image and so dispenses with the need for a Fabry lens. In addition, it is so small that it in effect also forms its own diaphragm and is placed directly in the focal plane of the telescope (Genet & Hall, 1989; H & K, 1990).

The photomultiplier tube as detector will be discussed in greater detail in section 3.2.

3.1.2 The simultaneous photometer

In a simultaneous photometer all the various spectral bands are measured at the same time. The colours are separated by means of a dispersive element like a prism or grating and then the produced spectrum of the star is divided by slots.

Finally, the measurements are done in the different slots defining the various passbands. A major advantage of the simultaneous design, is that measurements in the different passbands are truly done at the same time. Single–beam simultaneous photometers are also useful on nights which would be considered nonphotometric for sequential aperture photometers, as presumably all colours are equally affected by, for example, thin, uniform cloud (S & M, 1992).

3.1.3 The multi–star photometer

These photometers allow simultaneous measurement of a variable star and one or more comparison stars, thus eliminating variations in sky brightness or atmospheric transparency between measurements on the programme object and on comparison stars (S & M, 1992).

3.2 The photomultiplier tube

3.2.1 Theoretical base

A photomultiplier is "a light detector that produces pulses of charge proportional to the number of photons interacting" (S & M, 1992, p 65). Or, as Lallemand (1962, p 126) expresses it: "A photomultiplier is the combination of a photoemissive cell and a current amplifier in one envelope that makes possible a very large multiplication of the electron current emitted by the photosensitive layer. External photoelectric emission is the property possessed by certain substances that emit electrons, generally in vacuum, when they receive light or photons."

The functioning of a PMT, then, is based on the photoelectric effect – emission of electrons (and consequent generation of an electric current) when light of a particular wavelength strikes the surface of a photoemissive material, either a metal or a semiconductor. The incident light must have a certain minimum energy (in other words, maximum wavelength) before it can release electrons from a particular material. This energy, φ, the photoelectric work function, will just liberate an electron with zero kinetic energy at zero absolute temperature. When the infalling light has an energy

$$E = h\nu_0 = hc/\lambda_0 = \varphi, \tag{3.3}$$

in other words a threshold frequency ν_0 or wavelength λ_0, it will be able to liberate electrons from the material. Semiconductors have the highest photoelectric yield, the number of electrons released being proportional to the light intensity over a large brightness range.

The photomultiplier makes use of a photocathode from which electrons are released by the action of incident light. This is followed by several dynode stages at each of which emission of secondary electrons occurs upon being struck by electrons accelerated from the previous dynode through progressively higher positive potentials applied at each dynode stage. At each stage electron multiplication takes place, eventually leading to typically an amplification of 10^6. The only drawback is that electrons from the photocathode or dynodes can also be released by heat, and these electrons will likewise be multiplied by successive dynode stages. Finally, the electrons reach the anode and produce an output electric current which is proportional to the incident light except for contributions by, for example, thermionic emission of electrons as a result of heat or Ohmic leakage.

Some advantages of PMTs are

(1) rapid response time – even down to a fraction of a nanosecond;

(2) abillty to measure even very weak signals;

(3) the nature of the output, which allows pulse counting techniques to be used; and

(4) internal, noise–free amplification of the signal (H & K, 1990; Lallemand, 1962).

The **disadvantages** are mainly the reverse of the advantages listed earlier for the PIN photodiode, namely

(1) low quantum efficiency in the case of some PMTs;

(2) restrictions on the wavelength range (from near–infrared to near ultraviolet); and

(3) larger size and higher cost than a photodiode (H & K, 1990).

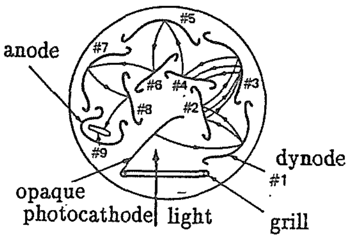
3.2.2 Types of photomultipliers

There are two main types of photomultiplier designs:

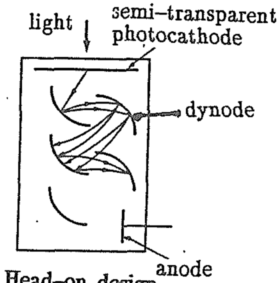
the **side–window** (opaque) type and

the **head–on** (semi–transparent) type.

In the former case the light enters from the side and photoelectrons are released from an opaque metal electrode as if "reflected" from it. In the head–on type the photocathode is placed immediately to the inside of the PMT window and the light must actually strike its front side but release photoelectrons from the back, so the thickness of this photocathode is critical: it may not exceed the escape depth of the electrons. However, according to Sterken and Manfroid (1992) the head–on type has better uniformity than the side–window design. A schematic diagram of the two designs is given in figure 3.3



Side–window design



Head–on design

Figure 3.3: Photomultiplier tube designs (Adapted from H & K, 1990)

3.2.3 Structure of a PMT

The main parts of a PMT are the **photocathode,** the **dynodes,** the **anode** and the **glass casing** in which everything else is enclosed.

The **casing** is made of glass so as to be transparent to the incident light. However, this means that the type of glass in part determines the wavelength range which is transmitted and can therefore be measured. Depending on the type of glass the ultraviolet cutoff may be anywhere from 350nm for lime or borosilicate crown glass, down to 115nm for MgF_2. In other words, in the case of magnesium fluoride this means practically no cutoff at all, since the atmospheric cutoff is above this (S & M, 1992).

As the **photocathode** is the first rung on the ladder of subsequent signal amplifications its **quantum efficiency** (QE) is crucial for PMT quality. Semiconductor materials are employed, because of their high photoelectron yield. However, photocathodes are still far from the ideal of 100% QE. Also, different parts of photocathodes are differentially sensitive – part of the reason for the introduction of a Fabry lens.

An important characteristic of the PMT is its spectral response range. As photoemission of electrons depends on the work function φ of the photocathode material (see equation 3.3), a minimum photon energy is required to release electrons and so there is a long wavelength cutoff due to the composition of the photocathode. As already mentioned, the short wavelength cutoff is determined by the glass casing. Various combinations of casing and photocathode materials therefore yield different spectral response ranges. A summary of different types of photocathodes and their main characteristics appears in table 3.1.

Response designation	Material	Type	λ_{max} ***	QE at λ_{max}
S-1	Ag-O-Cs	**O	800	0.40
S-3	Ag-O-Rb	O	420	0.55
S-4	Cs-Sb	O	400	13
S-5	Cs-Sb	O	340	18
S-8	Cs-Bi	O	365	0.77
S-9	Cs-Sb	S	480	5.3
S-10	Ag-Bi-O-Cs	S	450	5.6
S-11	Cs-Sb	S	440	15.7
S-13	Cs-Sb	S	440	14
S-17	Cs-Sb	O	490	21
S-19	Cs-Sb	O	330	24.4
S-20	Cs-Na-K-Sb	S	420	19
S-21	Cs-Sb	S	440	6.7
S-23	Rb-Te	S	240	2
S-24	Na-K-Sb	S	380	23
S-25	Cs-Na-K-Sb	S	420	13
*ERMA	Na-K-Sb-Cs	S	530	10.3

Table 3.1: Types and characteristics of photocathodes (Adapted from S & M, 1992)

* "extended red multi–alkali"

** O = opaque; S = semi–transparent

*** λ_{max} = wavelength of maximum quantum efficiency (QE)

In general, photocathodes with a wider spectral response are superior for most purposes. Also, colour sensitivity is generally temperature dependent, with blue sensitivity increasing as the temperature drops and vice versa for red sensitivity. In fact, the cutoff of the photocathode is a function of temperature, as shown in Gochermann (1990). Thus blue and red colour indices will be oppositely affected by cooling during the night.

The photoelectrons emitted by the cathode next strike the first **dynode**, liberating a number of secondary electrons, the number being dependent on the energy of the primary electrons. The average secondary emission coefficient is

$$\delta = AE^{\alpha} \tag{3.4}$$

where A is a constant, E is the interstage potential difference and α is a dynode coefficient dependent on the material (usually having a value around 0,7, according to S & M, 1992). For n dynodes the theoretical gain would be

$$G = \delta^{n} \tag{3.5}$$

but the cathode to first dynode collection efficiency f ($\sim$90%) and the transfer efficiency g between dynodes modify this to

$$G = f(g\delta)^{n} \tag{3.6}$$

where $g\delta \sim 5$. Depending on the number of dynode stages, a single photoelectron released by the cathode can result in the collection of millions of electrons at the anode. As dynode emission depends strongly on the interstage voltage, the voltage supply must be very well regulated. Unlike photoemission at the cathode, the emission of secondary electrons is not colour dependent and so temperature variations at the dynode stage do not affect electron transmission differentially for wavelength of incident light (the dynode temperature coefficient is independent of wavelength).

The anode stage and current measurement will be discussed separately in the next section.

3.2.4 Measurement of anode current

The anode receives the electrons from the last dynode and feeds it into a measuring circuit. Within a few percent the anode current is directly proportional to the intensity of the incident light, except at high currents where saturation occurs.

Measurement of anode current is done by one of two methods:

Direct current (DC) detection is the simplest and will be described in more detail when the SSP–5A is discussed.

The other, more complicated, method, is **pulse counting**. Ideally each photoelectron released from the cathode should result in an equal number of electrons reaching the anode. However, because the direction of release of secondary electrons is statistically dispersed, the multiplication at each stage is different. Thus the electron pulse at the anode has a varying height. Also, thermionically released electrons cause pulses. However, the latter are released by dynodes as well as the photocathode and so do not pass on average through as many stages of multiplication as do the photoelectrons. So the dark current pulses are normally much smaller than those caused by incident light. These pulses of low pulse height can be eliminated by means of a discriminator circuit, allowing each pulse which does pass through the discriminating window to be counted with equal weight, regardless of the pulse height. Thus each pulse corresponds directly to an incident photoelectron.

Pulse counting techniques have the advantages of exact integration times, direct information about photon statistics and signal–to–noise ratio, little drift, and non–measurement of dark emission. However, pulse counting equipment is larger and more complex and must be handled with greater care than is the case for DC equipment.

On the other hand, the DC technique does not enable the observer to discriminate against spurious pulses and so the signal–to–noise ratio deteriorates.

3.2.5 Evaluating PMT function

3.2.5.1 Sensitivity, drift and amplification

Luminous **sensitivity** is quantified as the ratio of the output current to the input flux. It may change slowly with time and this is referred to as **drift.** The **amplification** may be defined as the ratio of the anode output current to the photocathode current for a particular applied voltage.

The spectral radiant sensitivity S and quantum efficiency QE are related by

$$QE = 1240\ S/\lambda$$

with S in AW^{-1} and λ in nm (S & M, 1992).

3.2.5.2 Dark current

Dark current is what is measured when the tube is operated in complete darkness. It is due partly to **thermionic emission** of electrons from the cathode and dynodes, but also to **Ohmic leakage** between electrodes at the PMT base. A final source of dark current is **background radiation**, for example cosmic rays and the decay of radio–active isotopes in the PMT window.

3.2.5.3 Dead time

This applies only to pulse counting systems where the recorded count rate n may underestimate the true count rate N because some pulses follow each other too closely (at intervals less than the dead time τ) to be registered by the detection device. The relevant relationship is given by

$$N = n/(1 - n\tau).$$

3.3 The model SSP–5A photometer

3.3.1 The photometer system

Unisa's SSP–5A photometer is part of a system which is depicted in figure 3.4. (Unless otherwise stated, all diagrams and specifications in section 3.3 are taken from the Technical Manual of the SSP–5A).

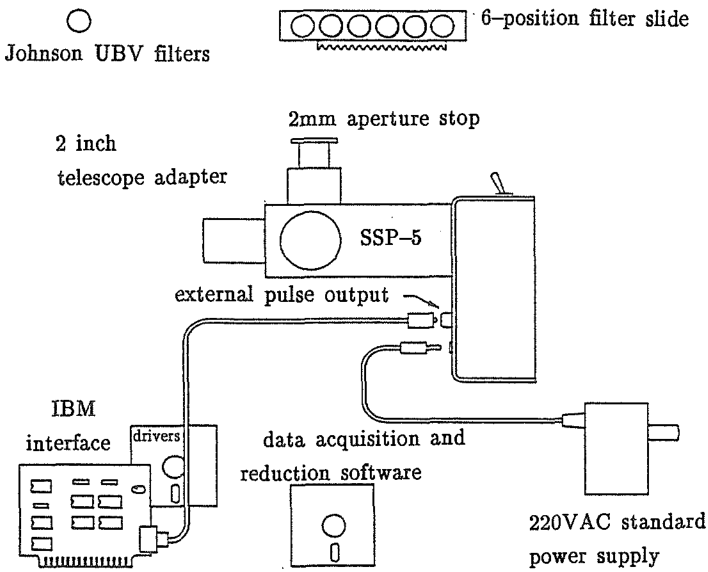


Figure 3.4: The SSP–5A photometer system and accessories

3.3.2 Detailed structure and function of the photometer

In order to place in perspective that which follows, figure 3.5 provides a cross–sectional view of the SSP–5A photometer head. Each element will be discussed separately.

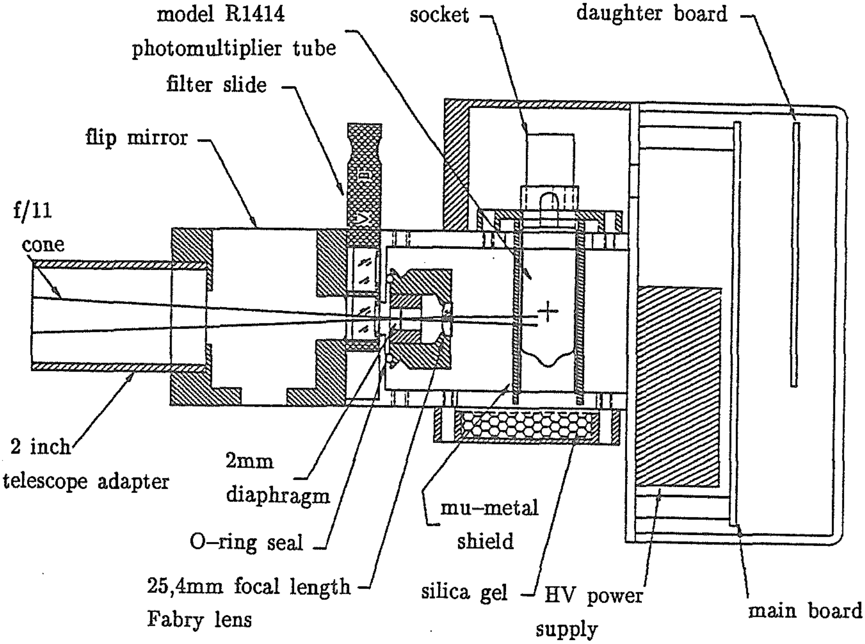


Figure 3.5: Cross–section of the SSP–5A

3.3.2.1 The flip mirror and viewing eyepiece

As depicted in figure 3.5, light enters the photometer through the telescope adapter and, depending on the flip mirror position, is directed either to the PMT or to the focusing eyepiece. The latter consists of a 25,4mm Ramsden ocular and an illuminated reticle with a central scribed ring defining the aperture field of view. This is required, as the flip mirror and focusing eyepiece precede the diaphragm in the light path. Once a star is centred in the ring, the flip mirror is rotated to allow the light through the aperture stop (diaphragm), which isolates the star from other stars and most of the sky background.

3.3.2.2 The aperture stop or diaphragm

The 2mm aperture, in combination with the image scale of 50,4" in the focal plane of the telescope, means that the diaphragm has a field of view of diameter 100". The diaphragm is fixed and so it is not possible to vary the diaphragm size. The effect of the large diaphragm will become apparent when the results for fairly faint objects are discussed in chapter 9. Although an object may still be visible in the eyepiece, its photometric signal may be lost against the overwhelmingly large sky background noise. A possible remedy for this problem may be the use of a Barlow lens (see chapter 10).

3.3.2.3 The Fabry lens

Once the light has passed through the diaphragm, a 25,4mm focal length Fabry lens images the entrance pupil onto the photocathode of the PMT. For an f/10 light cone the spot on the photocathode will have a diameter of 2,5mm. So, for the f/11 Celestron Compustar this spot will be proportionally smaller. The Fabry lens is suitable for telescopes with f–ratios between 7 and 20. It has a plano–convex shape and a 9mm diameter.

3.3.2.4 Filter slide

In the model SSP–5A this is in fact positioned between the flip mirror and the diaphragm. The filter slide is motorised and allows automatic computerised selection of any of six filters. The Unisa system uses only the Johnson U, B and V filters and a clear filter. The filter wheel is computer controlled and data acquisition automated via the SSP3CARD IBM interface. The filter system will be discussed in more detail in chapter 4.

3.3.2.5 The photomultiplier tube

The SSP–5A makes use of a **model R1414 side–on** PMT from the Hamamatsu Corporation. It is a **9–stage tube** with an operating voltage of –850VDC and a measured dark current of around 8pA at 25°C ambient temperature (after several hours of use).

The **spectral response is S–5**, similar to the S–4 response of the early RCA 1P21 tubes, except for an extended response in the ultraviolet. See figure 3.6 for the spectral response (S) and quantum efficiency (QE) of various PMTs, including type S–5. As can be seen from the figure, the QE of the S–5 is best in the shorter wavelength region, $\lambda < 450$nm, in other words, the ultraviolet and blue spectral regions. As mentioned earlier, the short wavelength cutoff of a PMT is determined by the nature of the tube glass. In this case, special ultraviolet transmitting glass lets wavelengths down to 185nm through. However, the Fabry lens, made of B270 glass and 2,9mm thick at its centre, cuts the UV–transmission to 50% at 315nm and 0% at 300nm.

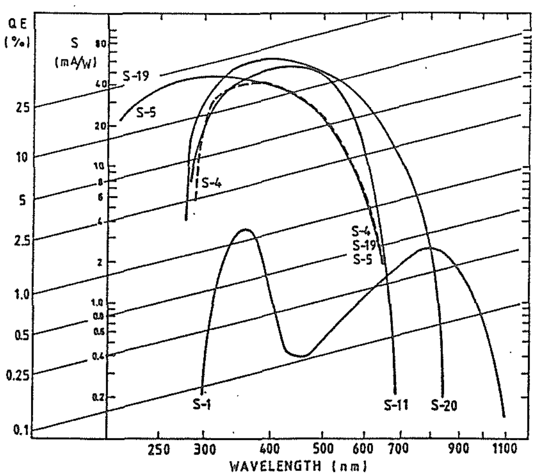


Figure 3.6: Spectral response and quantum efficiency of various PMTs.
The broken line represents the spectral response of the S4 photocathode of the RCA 1P21 tube. (From S & M, 1992).

The –850VDC **power supply** gives a **current amplification** of 10^6. The PMT gain is proportional to the 7th power of the applied voltage. In fact, for small values a percent change in gain occurs in response to 7 times this percent change in the applied voltage. So, for a 1V change at –850VDC

$$\Delta G\ (\%) = 7 \times \Delta E\ (\%)$$

$$= 7 \times (1 \times 100)/850\ (\%)$$

$$= 0{,}8\%$$

where ΔG is the percentage change in the gain and ΔE is the percentage gain in the applied voltage. A 0,8% change in PMT gain is equivalent to nearly a 0,01 magnitude error. After a 30 minute warm–up period the voltage stability for the SSP–5A is approximately 0,2V for periods of at least 15 minutes. The voltage is kept constant by a feedback mechanism.

In order to protect the PMT against external magnetic fields, it is surrounded by a **mu–metal shield** of high permeability. This shield is also brought to the same potential as the photocathode in order to prevent photoelectrons from being drawn to the glass tube. The danger of electric shock is reduced by connecting the shield to the high voltage supply through a 22MΩ current limiting resistor.

As mentioned in section 3.2.5.2, one of the contributing factors to dark current is Ohmic leakage. This usually occurs around tube pins and socket connectors. It can be decreased substantially by **dehumidifying** the tube in a desiccating chamber. Both tube and socket were placed in a vacuum desiccator before installation in the SSP–5A, but , in order to ensure continued dry operating conditions, a rechargeable silica gel cannister is used as an access cover on the side of the unit. The tube desiccant can be baked to reactivate it.

3.3.2.6 Preamplifier

The DC system employed in the SSP–5A photometer uses a **voltage–to–frequency converter** in the final stage. However, this V/F converter requires a minimum voltage in order to be able to function properly. Thus the output current from the anode of the PMT, which may be as low as 10^{-12}A for faint objects, must be additionally amplified. **Preamplification** takes place in two stages, the first of which is by means of a **current–to–voltage amplifier** with a gain of 7,9 x 10^6, in other words,

$$E_{out} = 7{,}9 \times 10^6 . I_{in}$$

where E_{out} is the output voltage and I_{in} the input current.

In the second stage a **low–noise amplifier** of just 1,5 gain inverts the signal because the voltage–to–frequency converter requires a negative voltage level.

The preamp output is connected to a **protection circuit** which turns off the high voltage power supply within a few milliseconds if the preamp output nears its saturation point, for example when a star which is too bright for the telescope–photometer combination is observed. In such a case, an **overvoltage LED** (light emitting diode) near the power switch turns on and the photometer may be operated again only after the offending light source has been shut out and the system switched off and on again.

3.3.2.7 Main circuit board

This is represented in figure 3.7.

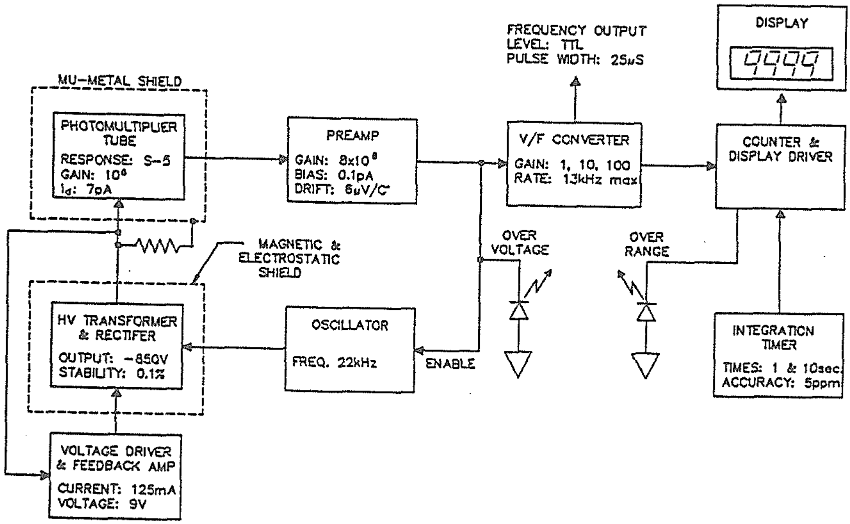


Figure 3.7: Power supply and signal processing circuit for the SSP–5A

The gain or scale of the V/F converter may be selected by setting a toggle switch to either 1, 10 or 100. The manufacturers estimate the gain linearity of the V/F converter to be better than 0,03% in the 10Hz to 10 kHz range at any one scale setting. The output from the V/F converter is fed to a 4–digit LED display. If the count exceeds the display capacity (ie 9999) an LED mounted next to the display turns on until the count is within the display range once more. This LED also flashes every time when the LED display is updated. A count of 13000 is over–range for the V/F converter and causes a blank display. Usually the problem can be solved by using a lower gain scale setting. The output of the V/F converter is also fed to the computer via the SSP3CARD IBM interface, where it is registered in a data file.

Integration times may be set to either 1s or 10s, by means of a toggle switch. The precision of the gate time is 0,0005% at 25°C.

3.3.3 The performance of the SSP–5A

In figure 3.8 the performance of the SSP–5A is compared with that of the SSP–3. This in fact represents a comparison between a PMT and a silicon photodiode detector. This figure reflects results from the manufacturer's testing of the two systems (in conjunction with a 28cm C11 telescope) and clearly shows that the PMT based system is more sensitive in the B and V passbands than is the case for the photodiode system. However, it should be noted that the low–light–limit will be higher than indicated (see the lines labelled "detector and amplifier noise") for the SSP–5A, as sky and signal noise will have a significant additional effect. This is not the case for the SSP–3 where instrument noise dominates. (The lower noise limits indicated in the figure were measured by taking the standard deviation of 10 consecutive dark count readings at either 1 or 10 seconds of integration). Note that a count of 10000 is the limit for the LED display, but does not indicate saturation in the 10 or 100 scales. When data is fed through the SSP3CARD IBM interface to the computer, readings of up to 13000 should technically be accepted. In fact, readings not exceeding 30000 are accepted. Beyond 30000 linearity is lost. In other words, a measurement of 2800 in the 1 scale will give 28000 in the 10 scale, but one of 3300 on the 1 scale will give perhaps a reading of 31000 on the 10 scale. However, all readings above 13000 are in fact *defined* as over–range for the preamplifier and the gain should be decreased if they occur.

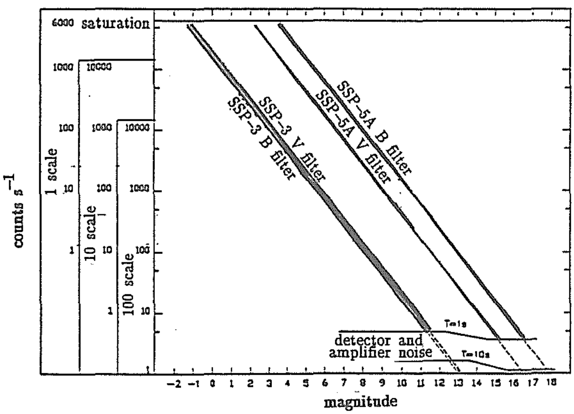


Figure 3.8: Display count versus magnitude for the SSP–5A compared with the SSP–3 photometer, using a 28cm aperture telescope

Finally, to put all of the preceding in easy perspective, figure 3.9 gives a simple representation of the surface features of the SSP–5A, to which reference has been made throughout section 3.3.

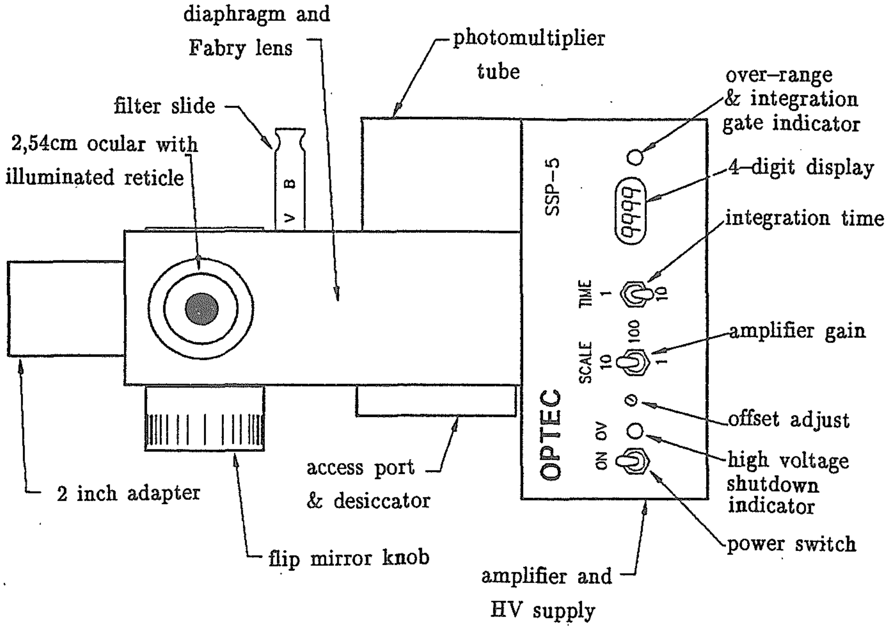


Figure 3.9: Identification of controls and features of the SSP–5A

Summary

Photoelectric photometers allow measurement of the light flux from stars – usually sequentially in various filter passbands and for one object at a time. Photometers incorporate one of two types of photoelectric detector, either a photodiode or a photomultiplier tube. PMTs may again be divided into those with a side–window (opaque) design and those with a head–on (semi–transparent) design. In addition the anode output may be measured by a DC or pulse–counting system.

The Unisa SSP–5A photometer uses a 9–stage side–on PMT with an S–5 spectral response. Anode current is measured by a DC system plus a voltage–to–frequency converter. Data acquisition is automated via an SSP3CARD IBM interface, as is movement of the filter slide. The photometer's major problem is the large (100") fixed diaphragm which causes faint stars to be drowned in sky background light, especially in the strongly light–polluted site where the photometer is used.

CHAPTER 4

THE PHOTOMETRIC SYSTEM: FILTERS

4.1 Fundamental characteristics of photometer filters

A filter is any device which by some means selects particular regions from the infrared, visible or ultraviolet portion of the electromagnetic spectrum. A filter can be described completely by its diameter and thickness and by its spectral transmission and reflection curve.

Filters can be *classified* in several ways. If they are classified according to **function**, then three broad categories appear:

(1) **Cutoff filters**, for instituting a definite short or long wavelength limit in cases where a non–constant component (eg the atmosphere) would otherwise serve as the cutoff.

(2) **Bandpass filters** for isolating a specific spectral region and rejecting others.

(3) **Neutral–density filters**, to decrease the luminous intensity uniformly in all wavelength regions, to allow photometry of bright objects which would otherwise cause detector saturation.

Bandpass filters are the most common ones in astronomical use. They are usually individually characterised by their **central wavelength** and their **FWHM (full width**

at half maximum). However, they can also be *categorised* in terms of their **bandwidth:**

(1) **Broad–band** – a bandwidth of 30 to 100nm, for example the UBV system.

(2) **Intermediate–band** – a bandwidth of 9 to 30nm, for example the Strømgren uvby system.

(3) **Narrow–band** – a bandwidth below 9nm.

Again, filters may also be divided into two groups on the basis of the **process** by which they allow light of certain wavelengths to be transmitted while other wavelengths are blocked. These are:

(1) those which produce selective transmission by means of **scattering or absorption** of light inside the filter material (gelatin or glass filters); and

(2) those which make use of **interference** effects (interference filters).

It should be borne in mind that, in order to produce meaningfully comparable results, the optical thickness of all the filters used in a photometer should be equal (optical thickness τ = geometric thickness x refractive index).

Filters *select* certain wavelength regions by *blocking* others. So they are **defined** by the amount of light that they block. They can be described quantitatively by their **transmittance/opacitance/optical density,** their **reflectance** and **absorptance.**

(1) **Transmittance** is the ratio of transmitted flux F^t to incident flux F^i (incident on the filter surface),

$$T = F^t/F^i.$$

Opacitance = 1 − T

Often the **optical density** is used, where

$$D = \log(1/T).$$

(2) **Reflectance** ρ is the ratio of the reflected radiant flux F^r to the incident flux,

$$\rho = F^r/F^i.$$

(3) **Absorptance** α is the ratio of radiant flux lost by absorption, F^a, to the incident flux,

$$\alpha = F^a/F^i.$$

So, finally, with all the incident flux accounted for by either absorption, reflection or transmission,

$$F^i = F^a + F^r + F^t$$

and

$$1 = \alpha + \rho + T.$$

As these quantities are all wavelength dependent, they may be written more completely as T_λ, ρ_λ and α_λ (Wolterbeek & Wargau, 1986; Wargau & Pieters, 1992).

4.2 Types of filters

4.2.1 Glass filters

Glass filters have several **advantages**, being relatively inexpensive, with a moderate thermal expansion and highly stable over time. However, they can break if not mounted properly (ie, if there are stresses acting on them).

High quality glass filters transmit light **uniformly** everywhere, no matter where or at what angle the light strikes the filter surface. The only effect is that of the optical path length, which will be increased (and consequently decrease the transmittance) if the light does not strike the filter perpendicular to its surface.

The transmission of glass filters is **temperature dependent**, increasing temperature causing a broadening of all absorption by the glass (therefore a decreased transmission overall) and a shift of the absorption spectrum to longer wavelengths. This increase in absorption generally, and shift towards the red, depends partly on the **expansion coefficient** of the glass and on the **thickness**. This dependence is depicted in figure 4.1 where the temperature coefficients (log $d\lambda/dT$) of the cutoff wavelength (log λ) for various optical and filter glasses are given. The straight line represents the relation for glass of 2mm thickness, with thicker filters above the line and thinner ones below it.

Young (1968) mentions the interesting phenomenon of **seasonal effects** in UBV photometry, producing a difference of about 0,04 mag between observations done in the two hemispheres (where, at any one time, the effects are of opposite sign).

Spectral leaks may occur with glass filters, such as the **red leak** of the U filter in the UBV system. According to Sterken and Manfroid (1992) a **blue leak** may also occur: High energy photons which are absorbed by the filter cause it to fluoresce at wavelengths to which the detector may be sensitive. Such defects can be prevented from affecting the final measurements either by introducing an additional cutoff filter which blocks the leak, or because the transmission of the glass casing of the PMT blocks it, or by observing in the red leak separately and applying an empirical correction to measurements with the leaky filter.

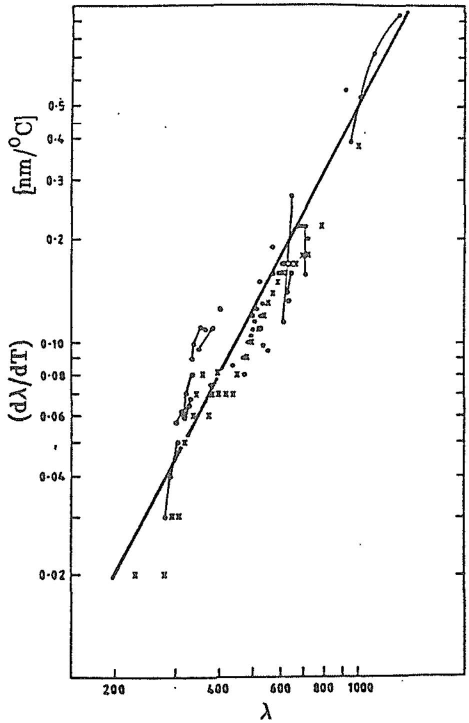


Figure 4.1: Temperature coefficient versus cutoff wavelength for various optical and filter glasses (From Young, 1974).

As the SSP–5A photometer makes use of glass filters as described above, other types of filters will only be mentioned briefly.

4.2.2 Other types of filters

These include:

(1) Gelatin filters – often used in photographic applications, but rarely in photoelectric photometry.

(2) Interference filters, based on the phenomenon of optical interference and acting like very thin Fabry–Perot interferometers.

(3) Custom–design filters, for specific purposes. For example, when observing objects with high radial velocities (for example, large redshifts) passbands far to the red or infrared may be required.

(4) Image–quality filters, for use with imaging devices such as CCDs, where the manufacturing tolerances are tighter than for aperture photometry.

(5) Neutral–density filters, which attenuate light independent of wavelength (in other words, neutrally) over a large wavelength range.

(6) Circular variable filters, often used in infrared photometry.

4.3 The Johnson UBV filters

The Johnson UBV system is a broad–band system and therefore especially suitable for use with smaller telescopes (with less light–gathering power).

When the system was designed and established by H L Johnson and W W Morgan in the 1950s, they had three aims in mind:

(1) to establish a system for aperture photometry, which would yield results comparable to the yellow and blue magnitudes of the International System;

(2) to obtain a third colour which would make possible a better determination of the properties of stars; and

(3) to establish a system which would reflect the Morgan–Keenan (M–K) spectral classification system.

The state–of–the–art photomultiplier tube at the time was the RCA 1P21 PMT and so the Johnson system was developed around it and the ultraviolet (U), blue (B) and visual (V) magnitudes as measured by three broad–band filters. Figure 4.2 gives the typical response function of the 1P21 PMT, while figure 4.3 gives the normalised transmission function of the Johnson UBV passbands.

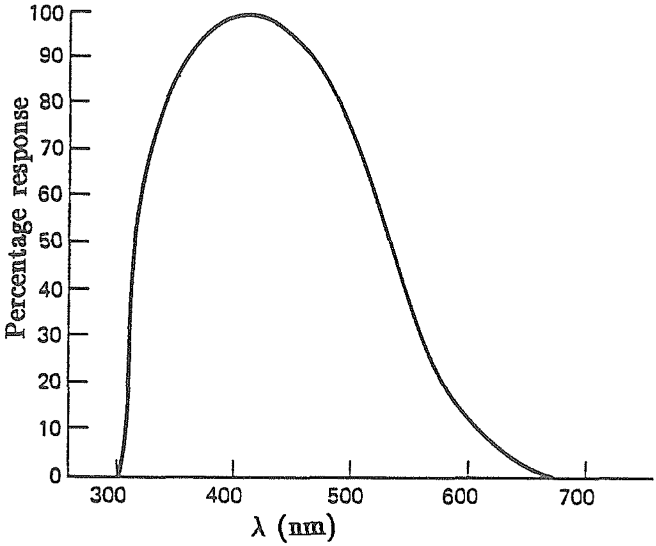


Figure 4.2: Typical response function of the 1P21 PMT (From H & K, 1990)

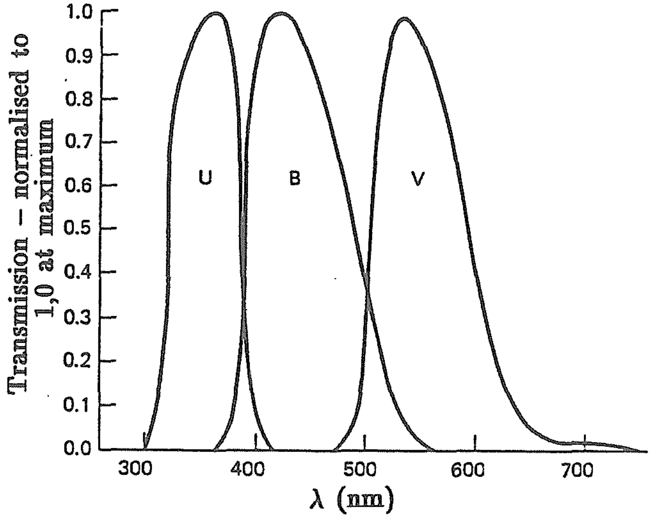


Figure 4.3: Normalised transmission function of the Johnson passbands (From H & K, 1990)

The **visual (V) filter** has its peak transmission around 550nm, in other words in the yellow region of the spectrum, and resembles the photovisual magnitude, m_V, of the International System very closely. As can be seen from an inspection of figures 4.2 and 4.3 the long wavelength cutoff is brought about by the 1P21 and not by the V filter.

The transmission peak of the **blue (B) filter** is around 430nm, but it transmits some light over almost the whole range to which the 1P21 is sensitive. It corresponds quite well with the blue photographic magnitude, m_{pg}, of the International System. In order to cut out the Balmer discontinuity, the B filter actually incorporates a second, ultraviolet blocking, filter.

The **ultraviolet (U) filter** peaks at 350nm, but is beset by two problems. First of all the short wavelength cutoff is not set either by the filter or the PMT, but by the earth's atmosphere (the UV transmission of which varies with altitude and atmospheric conditions). Secondly, the U filter has a red leak, which must be compensated for by one or another of the methods mentioned in section 4.2.1.

The Johnson U, B and V magnitudes are based directly on the results obtained by Johnson and Morgan using their particular filters and the RCA 1P21 PMT. In order to obtain scientifically comparable results with other PMT and filter combinations, other researchers must apply transformations to their results, transforming them to the Johnson system. This is done by means of observation of standard stars of which the U,B and V magnitudes have been well determined. The theory of this process will be discussed in detail in chapter 5 dealing with the standard reduction procedure.

4.4 The U, B, V and C filters for the SSP–5A

The SSP–5A UBV filters are made from combinations of Schott coloured glass. The glass types and thickness are computer optimised for the best fit with the Johnson system. However, the glass combinations are proprietary and are therefore not made available by the manufacturers. Physical specifications are listed in table 4.1. The filter–detector responses for the SSP–5A system and those of the original Johnson system are depicted in figure 4.4, while figures 4.5 and 4.6 respectively give the exact filter transmission and detector responsivity for the SSP–5A's UBV filters and the Hamamatsu R1414 PMT (graphs drawn from data supplied by the manufacturers).

Diameter	12,7 $\pm$ 0,15mm
Thickness	7,0 $\pm$ 0,3mm
Surface quality	80 – 50
Flatness	2 waves within centre 6mm
Wedge	not to exceed 5 arcminutes

Table 4.1: Physical specifications for the SSP–5A UBV filters

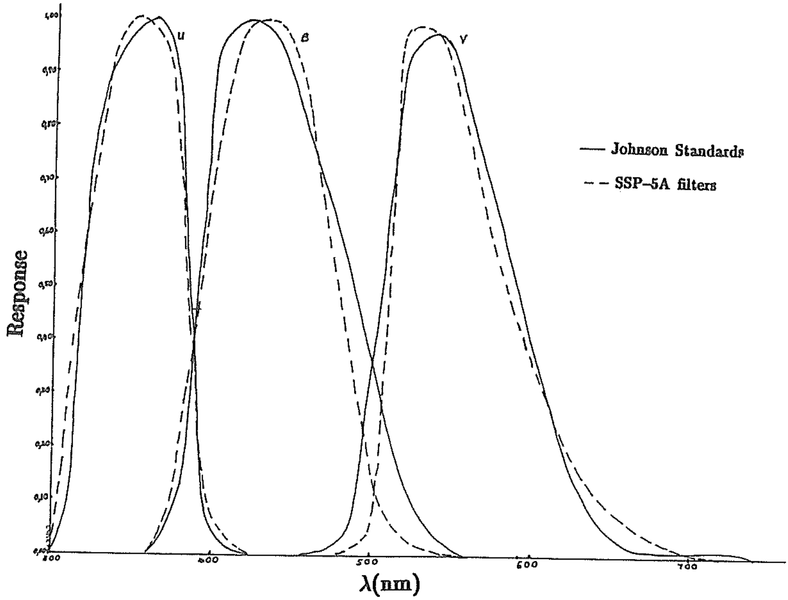


Figure 4.4: UBV response functions of the SSP–5A filters compared to the Johnson standards

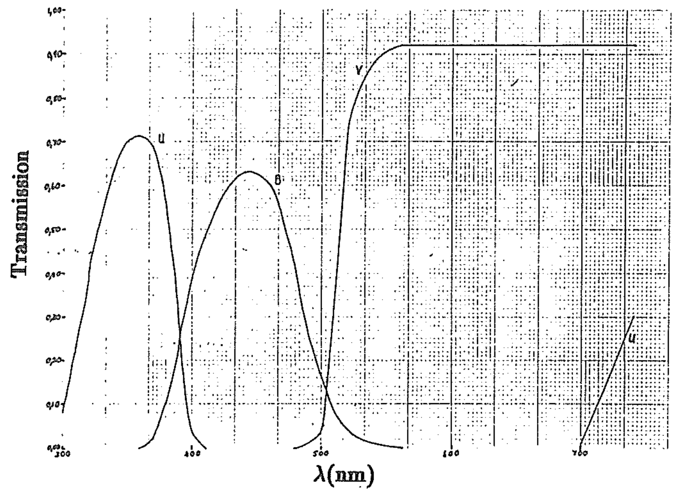


Figure 4.5: Transmission of SSP–5A UBV filters

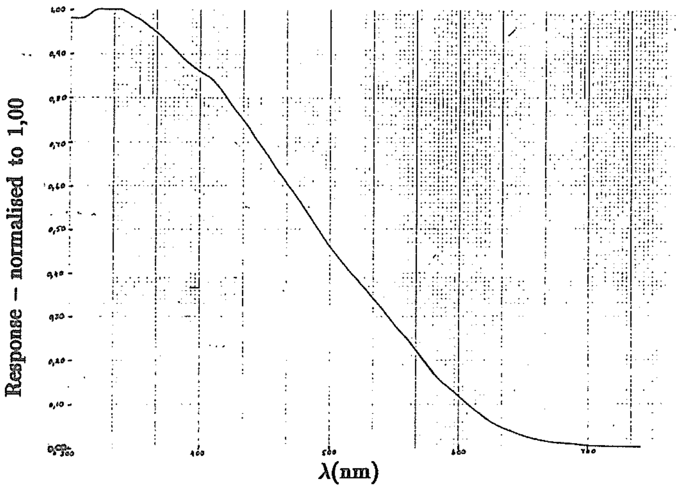


Figure 4.6: Normalised response of the Hamamatsu R1414 PMT

A clear filter (C) is also included in the SSP–5A filter system used at Unisa. (Red and infrared filters were also available, but were not acquired by the University). As noted in section 4.1, comparable measurements through different filters require that all must have the same optical thickness. Therefore, measurements of integral light over all wavelengths transmitted by the atmosphere and by the telescope optics, is done with this clear filter rather than with no filter at all.

4.5 Mounting and control of the SSP–5A filter system

The SSP–5A filters are mounted on a filter slide which can take six filters in all. This filter slide is moved by means of a 4–phase stepper motor run on a 12VDC power supply, which reaches it through a 9–pin connector connected to a computer via the SSP3CARD IBM interface. The computer also receives its count data via the same 9–pin connector and interface. Filter movement and data gathering are therefore fully automated.

Summary

Photometric filters may be classified by their function, bandwidth or mode of operation. They may be defined in terms of their spectral transmittance, reflectance and absorptance which is dependent on the materials used and the response to factors such as temperature. The Unisa system employs broad-band U, B and V filters which approximate the response of the original Johnson filters quite closely. A clear filter is also available. Filter movement is automated.

CHAPTER 5

THE STANDARD REDUCTION PROCEDURE

5.1 Working definition of data reduction

Photoelectric data must first be acquired (data **acquisition**), then reduced (data **reduction**) and finally analysed (data **analysis**). The process of data reduction is central to the whole process as it prescribes the procedure for data acquisition on the one hand while, on the other hand, being an essential determining factor for how scientifically meaningful the data analysis will be. In the case of photoelectric photometry, data reduction means that raw counts or meter deflections must somehow be translated into magnitudes which can be directly related to a standard system, in this case the system of Johnson UBV magnitudes.

Except where stated otherwise, this chapter is entirely based on the treatment of data reduction by Hardie (1962) and Henden and Kaitchuk (1990).

5.2 Steps in data reduction

Once raw instrumental measurements of stars and sky background have been obtained, the data can be reduced by executing the following steps:

(1) For **pulse counting techniques**, all the counts must be corrected to be per equal (consistent) time interval, for example, 1s or 10s. In addition, the dead–time correction should be applied.

Similarly, for **DC photometry** amplifier gain settings must be corrected to a consistent gain. If a voltage–to–frequency converter is employed, the counts must be adjusted to correspond to a consistent gain scale setting.

(2) **Sky background** must be subtracted from each star measurement, before conversion to magnitudes.

(3) **Instrumental magnitudes and colours** may now be calculated (magnitude *differences* between variable and comparison star in the case of differential photometry).

(4) **Extinction coefficients** must be determined and the extinction correction applied (except if differential photometry is to be left on the instrumental system).

(5) **Zero–point constants** and, if necessary, the **transformation coefficients** (to the Johnson system) must be determined by means of the standard stars observed.

(6) Instrumental magnitudes can now be **transformed to the standard system.**

(7) The transformed standard star magnitudes and colours can now be **compared with their accepted values**, in order to judge the photometric quality of the night. The nonvariation of the comparison star magnitudes after correction for extinction, should also be checked (in the case of differential photometry).

(8) Finally, any additional calculations such as time conversions to UT or JD, which are required to make the results unambiguous and internationally standardised, should be done.

Each of the abovementioned steps will now be discussed in more detail.

5.3 Preliminary steps

5.3.1 Dead–time correction

As already discussed in section 3.2.5.3. in the case of pulse counting techniques, there is a short time interval, the dead time τ (immediately after responding to one pulse) during which the device is unable to respond to another. Such a dead time exists for each of the three components, namely PMT, preamp and counter, with the result that the component with the longest dead time is the major contributor. The dead–time inaccuracy makes pulse counting nonlinear for bright sources where pulses may follow each other too fast for all to be detected.

The equation for the dead–time correction is

$$n = Ne^{-\tau N} \tag{5.1}$$

where

n = observed count rate in counts s^{-1}
N = "true" count rate for a perfect system, in counts s^{-1}
τ = dead–time coefficient, defined as $\tau = 1/N$ when the observed count rate falls to $1/e$ of the true count rate.

The technique for finding τ relies on the insignificant dead–time correction at low count rates, ie at low count rates

$$N \sim n.$$

By using an attenuator, for example a neutral density filter which decreases the count rate by a factor b,

$$N = bN_{att} \sim bn_{att} \tag{5.2}$$

at low count rates.

Equation 5.1 can now be rewritten as

$$n/N = e^{-\tau N}$$

$$\ln (N/n) = \tau N$$

and, in the light of 5.2:

$$\ln \left[\frac{bn_{att}}{n}\right] = \tau bn_{att}. \tag{5.3}$$

Stars of different brightnesses can now be observed with and without attenuator and a plot of $\ln (bn_{att}/n)$ versus bn_{att} will then give a line with gradient τ.

5.3.2 Achieving gain scale uniformity

In the case of DC photometry, as with the SSP–5A, the dead–time correction does not apply. However all measurements must be adjusted so that they reflect a consistent gain scale, even if they were originally taken with different gain scale settings because of different object brightnesses. This procedure rests on an assumption of linearity, ie that a count of 62 at gain 1, equals a count of 620 at gain 10 and 6200 at gain 100. Whether such an assumption is warranted can be tested easily by measuring moderately bright sources with each of the gain settings, making sure that the preamp over–range condition is not exceeded (where saturation would occur and nonlinearity is to be expected).

5.3.3 Subtracting sky background

This is a simple process of subtracting counts, but it may still be approached in one of three ways, depending on the observing procedure.

(1) Sky counts associated with a particular star may be taken either before or after sky–plus–star is measured.

(2) Or sky measurements may be done both before and after the star measurement and the mean of these two measurements subtracted from the sky–plus–star count.

(3) More complicated interpolations between sky measurements over a period of time may also be performed.

The suitability of each of these procedures will depend on how rapidly the sky brightness may fluctuate at a particular site. As will become clear in chapters 7 and 9, where the results of photometry at the Unisa Observatory are discussed, such brightness fluctuations may necessitate the discarding of certain data points.

5.4 Calculating instrumental magnitudes and colours

The relation between fluxes F_1 and F_2 and magnitudes m_1 and m_2 of two stars, may be simply written as

$$m_1 - m_2 = - 2{,}5 \log F_1 + 2{,}5 \log F_2. \qquad (5.4)$$

If star 2 is taken to be a reference star of magnitude zero and star 1 is the unknown, then

$$m_1 = q - 2{,}5 \log F_1 \qquad (5.5)$$

where q is a constant. The subscript 1 can now be replaced by λ to indicate the wavelength of observation:

$$m_\lambda = q_\lambda - 2{,}5 \log F_\lambda. \qquad (5.6)$$

However, F_λ refers to the *observed* flux which is related to the actual stellar flux F^*_λ, outside the earth's atmosphere, by

$$F_\lambda = \int \varphi_A(\lambda)\ \varphi_T(\lambda)\ \varphi_F(\lambda)\ \varphi_D(\lambda)\ F^*_\lambda\ d\lambda \qquad (5.7)$$

where

$\varphi_A(\lambda)$ = fractional transmission of earth's atmosphere
$\varphi_T(\lambda)$ = fractional transmission of telescope
$\varphi_F(\lambda)$ = fractional transmission of filter
$\varphi_D(\lambda)$ = efficiency of detector (1,0 corresponds to 100%).

In actual fact, F^*_λ is never determined, because the enumerated dependencies are not known exactly. However, by observing a set of known stars, each observatory can convert (transform) its instrumental (ie observed) magnitudes to a common standard system.

During photometric observations a detector produces an electrical output d_λ which is directly proportional to the observed stellar flux F_λ, ie

$$F_\lambda = Kd_\lambda$$

where d_λ is in current or counts per second and K is a constant of proportionality. Equation 5.6 can now be rewritten as

$$m_\lambda = q_\lambda - 2{,}5 \log K - 2{,}5 \log d_\lambda$$

or

$$m_\lambda = q'_\lambda - 2{,}5 \log d_\lambda \qquad (5.8)$$

relating the actual measurement d_λ to the instrumental zero point constant q'_λ and the instrumental magnitude m_λ.

For the colour index of a star (comparison between brightness in two different spectral regions)

$$m_{\lambda 1} - m_{\lambda 2} = q'_{\lambda 12} - 2{,}5 \log (d_{\lambda 1}/d_{\lambda 2}) \qquad (5.9)$$

For the v magnitudes and the b – v and u – b colour indices of the Johnson UBV system we may rewrite equations 5.8 and 5.9 as

$$v = c_v - 2{,}5 \log d_v \tag{5.10a}$$

$$b - v = c_{bv} - 2{,}5 \log (d_b/d_v) \tag{5.10b}$$

and

$$u - b = c_{ub} - 2{,}5 \log (d_u/d_b) \tag{5.10c}$$

representing the instrumental magnitudes, preparatory to final transformation to the Johnson system.

5.5 Correcting for extinction

In this context extinction refers to the attenuation of starlight by the earth's atmosphere (ie not interstellar extinction). The extinction–corrected magnitude is then an extra–atmospheric magnitude. **Calculations of first order extinction account largely for the effect of differing air masses, while second order extinction is colour dependent.**

5.5.1 Calculating the air mass

For a star at an apparent zenith distance of less than 60° (ie altitude $> 30^{\circ}$) a plane–parallel approximation for the amount of atmosphere between it and the observer is accurate to within 0,2 % and gives an air mass of

$$X = \sec z \tag{5.11}$$

where

$$\sec z = (\sin\varphi \sin\delta + \cos\varphi \cos\delta \cos H)^{-1} \tag{5.12}$$

where φ is the observer's latitude, δ the star's declination and H its hour angle. X is the air mass. When a star is directly overhead

$$\sec z = \sec 0^{o} = 1 \;;$$

in other words, it is said to have an air mass of 1.

For about an angular distance of 24^{o} either side of the zenith, X remains close to 1. Beyond that, it changes rapidly (Young, 1974) and at zenith distances greater than 60^{o} the plane–parallel approximation no longer holds and must be replaced by Bemporad's polynomial approximation

$$X = \sec z - 0{,}0018167 (\sec z - 1) - 0{,}002875 (\sec z - 1)^2 - 0{,}0008083 (\sec z - 1)^3 \tag{5.13}$$

where z is the apparent, not true, zenith distance. The apparent zenith distance z is the true distance Z, corrected for refraction by the formula

$$z = Z - (60{,}4'') \tan Z \tag{5.14}$$

(Hardie, 1962).

The air mass may also be found by means of tables or nomographs, but it is more usually included automatically in software programs for data reduction, as is the case for the RPHOT software package.

5.5.2 Calculating first order extinction coefficients

First order extinction corrections correct for the largest single contributor to the varying absorption of light in the earth's atmosphere, namely the variation in air mass. With the meaning of u, b and v as in equations 5.10a, b and c, and the subscript o indicating an extra–atmospheric value, we may write

$$v_o = v - k'_v X \quad (5.15a)$$

$$(b - v)_o = (b - v) - k'_{bv} X \quad (5.15b)$$

$$(u - b)_o = (u - b) - k'_{ub} X \quad (5.15c)$$

where k' is the principal extinction coefficient in units of magnitudes per air mass.

A method for finding the values of these coefficients, becomes apparent when the equations are rearranged to give:

$$v = k'_v X + v_o \quad (5.16a)$$

$$(b - v) = k'_{bv} X + (b - v)_o \quad (5.16b)$$

$$(u - b) = k'_{ub} X + (u - b)_o. \quad (5.16c)$$

Clearly a plot of the instrumental magnitudes and colours versus the air mass for the same star at varying air masses will yield the extra–atmospheric magnitudes and colours as the y–intercept and the extinction coefficients as the slope.

Of course this approach actually amounts to an assumption that atmospheric conditions affecting light absorption do not vary from place to place and from time to time in the course of a single night. It also ignores the colour dependence of extinction.

There are two commonly used methods for getting past these problems and determining the first order extinction coefficients.

(1) When observing a single variable star most of the night, a comparison star can be chosen as the extinction star. This immediately removes the effects of spatial and time variation and, provided the star is chosen to resemble the variable in spectral type, the effect of the colour dependence of extinction is also accounted for.

(2) A "quick" method, as far as observing time goes, involves observation, at various air masses, of a sample of A0 stars covering the region of sky in which the program observations are to be done. Using A0 stars means that $(b - v)_0 \cong (u - b)_0 \cong 0$ and so the extinction coefficients can be found directly by least-squares analysis from the instrumental magnitudes and colours and the air mass.

The importance of accurate determination of extinction, despite the difficulties involved, is stressed by Young (1974). According to Henden and Kaitchuk (1990), knowing the value of the extinction coefficients to an accuracy of 2 to 3% is considered acceptable by most professional astronomers.

5.5.3 Correcting for second order extinction

Second order extinction coefficients account for the colour dependence of extinction. Usually the second order extinction coefficient for (u − b), k''_{ub} is set to zero and so equation 5.15c remains unaltered. However the rest of 5.15 changes to

$$v_0 = v - k'_v X - k''_v (b - v) X \qquad (5.17a)$$

and

$$(b - v)_o = (b - v) - k'_{bv}X - k''_{bv}(b - v) X. \qquad (5.17b)$$

Determination of second order extinction coefficients depends on observing close pairs of stars of very different spectral type. They are usually referred to as "red–blue pairs" and should lie within a radius of 1^o from each other, so that they are at essentially the same air mass, thus allowing the first order extinction term to fall away. Again these stars must be observed at varying air masses, so that a plot may be obtained representing

$$\Delta v = k''_v (b - v) X + \Delta v_o \qquad (5.18a)$$

and

$$\Delta (b - v) = k''_{bv} (b - v) X + \Delta(b - v)_o \qquad (5.18b)$$

where Δ indicates the differences in magnitudes or colours of the two stars at each air mass. Once the second order extinction coefficients have been determined from these plots, the same data may also be used to determine first order coefficients. Second order coefficients should all be close to zero and have been found to be relatively constant, so they need not be determined every observing night.

The Moffat–Vogt correction to the (U – B) magnitude as well as the reasons why determination of k''_{ub} present special problems (so that it is usually set to zero) will be discussed in section 5.8, after the discussion of the transformation procedure.

5.6 Determining zero–points

As stated previously, the Johnson UBV system is defined by a set of standard stars measured with the particular PMT and filter set which Johnson and Morgan used originally. In order for other observers to be able to compare their results meaningfully with this standard system, it is necessary for them to measure Johnson and Morgan UBV standard stars, so as to enable them to transform their observations to the standard system.

The main reason for the difference in the results obtained with different photometer systems lies in the different **equivalent wavelengths of observation**. The equivalent wavelength, λ_{eq}, is actually an average wavelength, weighted by the response function of the equipment, and can be defined as

$$\lambda_{eq} = \frac{\int_0^{\infty} \lambda\varphi(\lambda)\ d\lambda}{\int_0^{\infty} \varphi(\lambda)\ d\lambda} \tag{5.19}$$

with $\varphi(\lambda)$ defined as the contents under the integral sign in equation 5.7. The effect of this may be illustrated as follows: If, for example, an observer works with a system of which λ_{eq} is slightly shifted to the short wavelength side of the standard system, the measured magnitude with this system will be slightly brighter than the accepted value if the star radiates increasingly towards the blue. As the difference in the equivalent wavelength is normally small, the standard magnitude, M, can be approximated by a Taylor expansion in λ_{eq} about the instrumental magnitude, m_o:

$$M = m_o + (\Delta m_o/\Delta\lambda_{eq})\Delta\lambda_{eq} + \ldots \tag{5.20}$$

The situation is illustrated in figure 5.1, from which it becomes clear that the bracketed term in equation 5.20 represents the slope of the star's continuum, which is proportional to its colour index in that wavelength region.

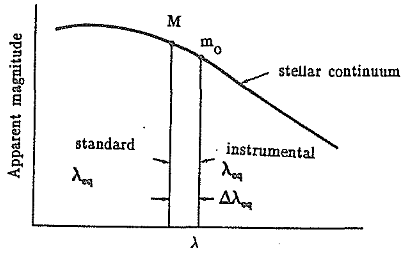


Figure 5.1: Difference between standard and instrumental λ_{eq}

Because of the proportionality mentioned above, an instrumental magnitude, $m_{\lambda o}$, can be transformed to the standard magnitude, M_λ, by an expression of the form

$$M_\lambda = m_{\lambda o} + \beta_\lambda C + \gamma_\lambda \qquad (5.21)$$

where β_λ and γ_λ are constants which are unique to the instrument in use and C is the standard colour index of the star in that wavelength region.

The transformation of an extinction–corrected colour index is found by applying equation 5.21 to each of the two spectral regions and finding the difference:

$$(M_{\lambda 1} - M_{\lambda 2}) = (m_{\lambda o1} - m_{\lambda o2}) + (\beta_{\lambda 1} - \beta_{\lambda 2})\, C + \gamma_{\lambda 1} - \gamma_{\lambda 2}$$

or

$$C = c_o + \beta_c C + \gamma_c \qquad (5.22)$$

here C is the standard colour index, c_o is the instrumental colour index and the st are constants. A constant δ may now be defined by

$$\delta = 1/(1 - \beta_c)$$

owing us to write

$$C = \delta c_o + \gamma_c \qquad (5.23)$$

pplying equations 5.21 and 5.23 to the extra–atmospheric results obtained after st and second order extinction correction, these equations become

$$V = v_o + \epsilon(B - V) + \zeta_v \qquad (5.24a)$$

$$(B - V) = \mu(b - v)_o + \zeta_{bv} \qquad (5.24b)$$

$$(U - B) = \psi(u - b)_o + \zeta_{ub} \qquad (5.24c)$$

iere ϵ, μ and ψ are now the transformation coefficients and ζ_v, ζ_{bv} and ζ_{ub} are e zero–point constants.

the set of equations 5.24 are rearranged with the zero–point constants alone on e left hand sides of the equations, these constants can easily be seen to equal the ındard value minus the extinction–corrected (ie extra–atmospheric) instrumental lue. Thus zero points can be calculated by solving these equations for each ındard star measured and then taking the averages. However, this presupposes ıt the transformation coefficients have first been determined. Otherwise, a plot the standard values against the extinction corrected instrumental values, will ıld the relevant transformation coefficient as the slope and the corresponding :o–point constant as the y–intercept.

5.7 Determining transformation coefficients

The transformation coefficients can be determined directly from equations 5.24 by measuring several stars of which the standard magnitudes and colours are known. However, if these equations are rewritten in differential form, so that what is eventually plotted is a magnitude *difference*, small variations in the instrumental values are magnified, yielding clearer results. Thus, in order to determine transformation coefficients, the transformation equations are normally used in the following form:

$$V - v_o = \epsilon(B - V) + \zeta_v \qquad (5.25a)$$

$$(B - V) - (b - v)_o = (1 - 1/\mu)(B - V) + \zeta_{bv}/\mu \qquad (5.25b)$$

$$(U - B) - (u - b)_o = (1 - 1/\psi)(U - B) + \zeta_{ub}/\psi. \qquad (5.25c)$$

(Equation 5.25b can easily be found from equation 5.24b by dividing throughout by μ, adding $(B - V)$ to both sides of the equation and then subtracting $(b - v)_o$ and $(B - V)/\mu$ from both sides also. Equation 5.25c is found from 5.24c in an analogous way). Plots of the left hand sides of equations 5.25a, b and c versus either B–V or U–B (the latter for equation c) yield slopes from which the transformation coefficients may be found.

The actual procedure of standard star measurement for determination of transformation coefficients, involves one of two methods.

(1) For **smaller telescopes**, with an aperture of 25cm or less, at least 10, but preferably 20 or more Johnson UBV standards are observed as close to the zenith as possible (so that varying extinction does not play such an important role). These standards should have a wide range of (B – V) and (U – B) colours. This method is suitable for smaller telescopes, because fairly bright stars can be chosen. In fact, even with larger telescopes – up to an aperture of 1m – this method is most often used.

(2) For larger telescopes cluster standards can be observed, thus eliminating the extinction problem. The faintness of cluster stars present a problem for small telescopes. What causes more difficulties however, is the fact that the red stars in clusters are generally fainter than the hot blue stars and add more error to the calculation of the coefficients.

As the transformation coefficients are related to the instrument itself, they do not change rapidly over time. They should be determined at least at the beginning and end of an observing season and somewhere in between. Average coefficients can be used in data reduction.

5.8 The Moffat–Vogt correction

In section 5.5.3 it was mentioned that the second order extinction coefficient for (U – B) is normally small and may be defined as zero. However, there are specific factors affecting just the U extinction and which may in fact cause it to require a larger correction, k''_{ub}, than the coefficient k''_{bv}. These factors are:

(1) the Balmer discontinuity,

(2) the second order colour term, and

(3) systematic nonlinear deviations resulting from the unwarranted assumption that k''_{ub} was constant in the original data from which the UBV system was set up.

The result of these dependencies is that the (U – B) colour term is not well defined. The usual approach is that the second order extinction term is simply set to zero. However, an alternative is to apply a correction developed by Moffat and Vogt (1977).

According to Moffat and Vogt, for any particular star, the residuals in (U – B) vary linearly with air mass, in other words

$$\Delta\,[(U - B) - (u - b)] = \gamma_1 + \gamma_2 X. \qquad (5.26)$$

If this equation is plotted out it becomes clear that γ_1 and γ_2 are linearly related, in other words,

$$\gamma_2 = \beta\gamma_1,$$

where

$$\beta \simeq -0{,}27.$$

Consequently equation 5.26 can be rewritten as

$$\Delta\,[(U - B) - (u - b)] = \gamma_1(1 + \beta X) \qquad (5.27)$$

where β is a constant and γ_1 depends on spectral type or colour. Correcting for (U – B) differences then actually implies determining γ_1. But γ_1 is neither a linear nor a unique function of (U – B). However, it is related linearly and uniquely to the colour factor q, defined as

$$q = (U - B) - 1{,}05\,(B - V), \qquad (5.28)$$

so that

$$\gamma_1 = \rho q. \qquad (5.29)$$

The (U – B) correction is then done as follows:

(1) Use equation 5.29 to determine q for each standard star.

(2) Determine γ_1 for each standard from equation 5.27 in the form

$$\gamma_1 = \frac{(U - B) - (u - b)}{1 + \beta X} \tag{5.30}$$

(3) Next, ρ can be determined from equation (5.28) and a plot of γ_1 versus q.

(4) (U – B) for all future stars can then be corrected using (see equation 5.24c)

$$(U - B) = \psi\,(u - b)_o + \zeta_{ub} + \rho q\,(1 + \beta X). \tag{5.31}$$

Applying the Moffat–Vogt correction can reduce the mean external error in (U – B) to about 0,02 magnitudes, which is about one third of what it would be without the correction. In all the extinction equations, k''_{ub} may be included in an analogous fashion to k''_{bv}.

In fact, setting $k''_{ub} = 0$ is even less appropriate than usual at times when for some reason or other there is a lot of dust in the upper atmosphere, as has been the case the past two years since the eruption of Mount Pinatubo (Gochermann et al., 1993; Grotheus & Gochermann, 1992). Because of the differential scattering effect of dust on light of different wavelengths, the second order extinction coefficients generally will be strongly affected. (First order coefficients too, because the dust moves and is not equally thick everywhere).

Summary

In order to obtain scientifically comparable results, raw photoelectric data must be corrected for a number of factors, mainly related to the transmission/absorption of light by the earth's atmosphere. In addition the data must be transformed to a standard system, to compensate as far as possible for the different responses of different sets of instruments. Correction for first order extinction is mainly a correction for the differing amount of atmospheric absorption of starlight due to varying air mass. Second order extinction correction, on the other hand corrects for the colour/wavelength dependence of atmospheric transmission of radiation. Transformation to the Johnson and Morgan standard UBV system entails observation of stars which have their magnitudes and colours standardised on this system and determining the coefficients and zero points required to transform the obtained, extinction–corrected instrumental magnitudes to the standard Johnson magnitudes.

Chapter 6 will deal with the reduction programme which forms part of the RPHOT software package used as part of the photometric system at the Unisa Observatory. The actual procedure and results obtained with the system, during the process of determining extinction and transformation coefficients and zero points will be discussed in chapter 7.

CHAPTER 6

DATA ACQUISITION AND REDUCTION BY MEANS OF THE RPHOT SOFTWARE PACKAGE

6.1 General information

The RPHOT software package is a data acquisition and reduction package for aperture photometry which, in conjunction with the SSP–5A photometer, allows computer controlled filter positioning and data acquisition. It is written in Lahey F77L version 4.01 Fortran and runs on any IBM compatible computer, operating under MS–DOS or PC–DOS. The package is able to log aperture photometry data and produce files containing reduced, standardised UBVRI or instrumental ubvric magnitudes. Light curves, occultation plots, extinction/transformation regression plots and periodograms can also be produced. The RPHOT flowchart is depicted in figure 6.1. (All information in this chapter is taken directly from the RPHOT User's Manual (1991), or from personal experience with the software package).

6.2 Setting the system parameters

In order to reduce the data, RPHOT requires prior information about the observatory, computer and photometer. These system parameters are entered into three ascii files called DPARMS.DAT (for data taking parameters), RPARMS.DAT (for reduction parameters) and PPARMS.DAT (for plotting parameters). When the system is used for the first time, these parameters must be adjusted by typing "PARMS" at the DOS prompt and then answering (Y)es to the query "Modify DPARMS.DAT?" By following the instructions on the screen plus those in the

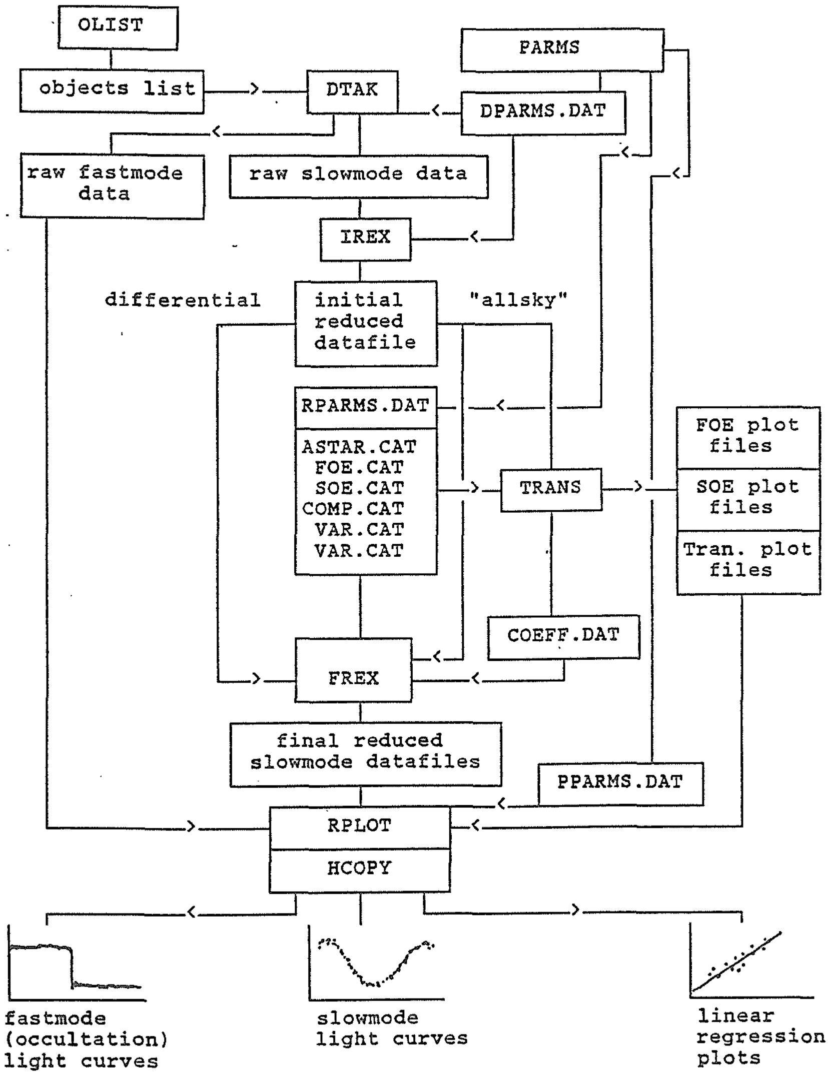


Figure 6.1: RPHOT flowchart

User's Manual, all three ascii files containing system parameters can then be corrected to reflect the local circumstances. On the **data taking parameters file**, this mainly entails concrete technical details such as, for example, establishing and entering the computer bus speed, the optimum SSP3CARD delay loop length, the optimum filter delay loop length and the particular slot in the filter slide where each filter is to be found.

In the case of the **reduction parameters file**, the programme requires the latitude and longitude of the observatory (for later air mass calculations). In addition, the V calculation may be done from the BV, VR or VI indices and one of these must be decided upon. In the case of the Unisa system, R and I filters are not available, so BV is used. Also, the long term averages of extinction and transformation coefficients are stored in RPARMS.DAT. As real long term averages are not yet available for the Unisa system, these parameters have been left as entered by the programme author, until it is possible to update them meaningfully.

The **plotting parameters file** contains information required for doing light curves, extinction and transformation plots, occultation traces, and hardcopy. Again the information must simply be updated to reflect the correct auxiliary devices and required formats. The contents of all three system parameters files may be found in Appendix 1.

6.3 The catalogues

Various star catalogues are included in the package, to be accessed by the reduction programmes. An observing list may be set up and the data taking programme run, even if a star has not yet been entered in the relevant catalogue. However, the catalogue entry must be done before any data reduction is undertaken, as both the initial reduction programme (IREX) and the final reduction programme (FREX) undertake a catalogue search for the objects input to them. A problem in the present RPHOT version (version 2.0) is that it is not case insensitive throughout as claimed by the author. When entering objects in the observing list programme (OLIST) – see next section – all letters must be capitals, otherwise they will not be recognised in certain catalogues, where all lower case letters are automatically converted to upper case. Nonadherence to capitals leads to an immense amount of later editing work, as the data taking programme (DTAK) also converts everything to upper case for the first line of data in any data set (see section 6.5), but not for the later lines, and so IREX and FREX recognise this as indicating two different objects.

The star catalogues will be discussed individually. In general, it may be noted that many stars are already included in the catalogues on the basis of the programme author's work. However, new stars may be added by using the programme ADDSTAR or, for example, MS DOS EDITOR.

6.3.1 ASTAR.CAT

ASTAR.CAT owes its name to the fact that it contains UBVRI standard stars of more or less spectral type A0. The criterion for inclusion in ASTAR.CAT is

$$B - V = V - R < 0{,}06.$$

These stars enable one to determine first order extinction coefficients when the transformation coefficients are unknown (because terms including (B – V) and (V – R) may be taken as approximately zero). ASTAR.CAT and FOE.CAT together contain all the standard stars used for first order extinction calculation.
In this catalogue, as in the others, the following information must be entered for each object: An identifier, the coordinates and their epoch, standard magnitudes and colours and (optionally) a common name for the object, the spectral type, and the source of the information. (For a variable, comparison and check star the magnitudes and colours are also optional – more about this in the sections on VAR.CAT and COMP.CAT).

6.3.2 FOE.CAT

FOE.CAT or First Order Extinction catalogue takes its name from its main purpose, namely finding first order extinction coefficients, transformation coefficients and zero points. It contains those standards which do not meet the criteria for inclusion in ASTAR.CAT. However, comparison and check stars may also be placed in FOE.CAT, in which case they must be explicitly entered in the reduction programmes. This option would normally be used in cases where standards are available and suitable as comparison and/or check stars for a particular variable. In the case of the Unisa system, this facility has made it possible to reduce data despite the fact that the catalogue which should normally be used for comparison and check stars (COMP.CAT) cannot in fact be used.

6.3.3 SOE.CAT

Second Order Extinction catalogue contains red–blue pairs of stars for second order extinction calculation.

6.3.4 COMP.CAT

Although a comparison star catalogue was included in version 1.0, it did not explicitly pair up the variable and its comparison and check stars. Therefore comparison and check stars had to be entered explicitly when requested by the reduction programmes. In version 2.0 COMP.CAT is designed to do the pairing itself. However, as mentioned previously, COMP.CAT can in fact not be used, but has been successfully circumvented by employing the FOE.CAT facility mentioned previously.

6.3.5 VAR.CAT

This catalogue is reserved for entering the programme variable stars. Here, as is the case for comparison and check stars, magnitudes and colours are optional as part of the logging procedure.

In OLIST and DTAK the catalogue in which a star appears is always asked for in the case of each object. The initial reduction programme (IREX) searches for each object in the catalogue specified for it and will stop execution if it is not found in the indicated place. When a catalogue name is requested for objects such as planets and asteroids (whose coordinates change) this is entered as M – for "moving object".

6.4 The observing list prompt

To obviate the need for entering object and catalogue names during actual observations, an observing list facility exists allowing the user to set up a list of all objects he wishes to observe, in the order he intends doing it, in advance of actual observations. This is done by simply calling up OLIST when in RPHOT. An output data file name must be chosen, the default being OLIST.DAT. Programme objects, comparison and check stars, standards and sky measurements must all be entered in the intended order. Two facilities exist, one for all–sky and one for differential photometry. In the case of an all–sky photometry block, each object is entered individually by name, together with the relevant catalogue. For differential photometry blocks, the process is simplified by merely specifying the variable, comparison and check star at the beginning and later indicating these simply by V, C and K respectively.

Sky measurements may be chosen to be compared only with following objects ("SKYNEXT" or simply "N"), only with preceding objects ("SKYLAST" or simply "L") or to be compared with preceding *and* following objects ("SKY" or simply

"S"). Interpolations will be done, from any "N" forwards until the reduction programme encounters another "N" or an "L". Similarly, interpolations will be done, from any "L" backwards, until it encounters another "L" or an "N". When OLIST is read by the data taking programme, only the immediately to be observed object appears on the screen. This means that, if a prompt for "SKYNEXT" appears on the screen, the observer has no way of knowing to which object this sky refers, if , for example, he should have lost track of the number of successive variable star measurements which have already been completed and is not sure whether the next object on the list is the variable yet again or already the comparison or a standard star. For convenience, then, it is easier always to take sky measurements *following* the star measurement rather than the other way around, as no confusion can then occur. Interpolation between sky measurements is also not advisable in the case of a strongly light polluted sky as in the case of the Unisa Observatory as variations in sky brightness can be very rapid. A sky measurement, in other words, should be applied only to the object measurement immediately preceding it. For these reasons, the observing sequence "object, SKYLAST" has been used in all cases. An example of an OLIST file appears in Appendix 2.

Once again the programme does not work exactly as specified. When entering "S", "N" or "L" in OLIST, it is supposed to accept a blank for the catalogue, but it does not do so. The only solution is to treat sky measurements as if they were "moving object" measurements and enter "M" for the catalogue. This is then accepted by the programme.

6.5 The data acquisition programme

DTAK may be run in one of three modes: SLOWMODE, FASTMODE or LOGMODE.

FASTMODE is used for events like occultations where a long series of integrations are required without user interaction and without needing comparison and sky readings. Up to 32000 consecutive integrations may be taken, but the limitation is that no user changes of filters, scales, integration times or objects are possible once integrations begin.

LOGMODE may be used for entering observations manually, via the keyboard, for example, if there is no interface with the photometer allowing automated data acquisition.

SLOWMODE is used for differential and all-sky photometry, in other words for real-time observations of variable stars, standards, comets, asteroids, etc.
This is the most versatile and flexible mode and allows changes to the filter, object observed, integration time or gain scale. Used in conjunction with the SSP3CARD IBM interface and the SSP-5A photometer, filter changes can be computer automated, counts can be automatically input and Universal Time can be automatically read from the system clock.

As SLOWMODE is used for variable star observation, this will be described in more detail.

After DTAK has asked for the mode and SLOWMODE has been chosen, the system clock must first be synchronised with UT time. Next, DTAK must be informed whether it must read objects and filters from an OLIST file and, if so, which one. Objects and filters may also be entered manually and this may be done at the beginning or end of the night, while using OLIST in between. An OLIST sequence may even be interrupted with the command ENDLIST and may be resumed after a number of manually entered objects have been observed. If the telescope's tracking is good, a choice will next be made in favour of doing all filter sets without pausing. This means that a chosen sequence, for example UBV will be executed without giving the observer the opportunity in between of checking that the object is still centred in the photometer diaphragm. Alternatively, the choice may be made in favour of pausing after every filter, either just during object integrations or during object as well as sky integrations (the latter possibly being necessary when observing in crowded fields, where a star could conceivably drift into the diaphragm during a sky measurement).

Integration time and gain scale setting must be entered next. RPHOT allows a choice of only two integration times : 1 second or 10 seconds. For variable star -

more especially eclipsing binary – observations, this will normally be 10 seconds. Usually this same integration time will be retained for the whole observing sequence. When the integration time is set on the computer, this must also be set manually, by means of a toggle switch, on the photometer itself as the latter setting is not automated. This also goes for the gain scale setting, where the choice is 1, 10 or 100, the latter being the most sensitive and appropriate for rather faint objects (about mag 10 or so), while scale 1 is required in the case of brighter standards (for example, mag 6 or brighter) otherwise the counts will be overrange for the voltage–to–frequency converter and consequently nonlinear. The gain scale of course in fact refers to the gain of the V/F converter. This will quite likely need to be changed for different objects during the night. The choice at the beginning of the run should be the appropriate one for the first object to be observed. During the actual observing run, the gain scale may be changed by entering "scale" in the place of the object prompt received from OLIST or the object query from DTAK. DTAK will then ask for the new scale. Manual changing of the scale on the photometer by means of a three–way toggle switch is required. If necessary, the integration time may be changed by entering "int" in response to the object prompt from OLIST or the object query from DTAK.

Once the integration time and gain scale have been entered in response to the initial queries from DTAK, the actual data taking loop commences, accompanied in the case of the SSP–5A photometer by an audible positioning of the filter slide.

The first query at the beginning of the data taking loop and following completion of each filter sequence is for the name of the object to be observed next. The object prompt from OLIST or from DTAK (which, even in the absence of OLIST defaults to the previous object entered) may be accepted, a different object entered, or one of the options listed in table 6.1 may be chosen. A list of these alternative options may also be obtained on the screen by typing "op" (for options).

```
In addition to entering the name of your object,
you may choose among the options below:

"FAST".....to log a "FASTMODE" event
"FILTER"...to change filters or filtering mode
"INT"......to change integration times
"OLIST"....resume reading objects from OLIST
"ENDLIST"..stop reading objects from OLIST
"AUTOOBJ"..do all filters in a set w/o pausing
"AUTOSKY"..do all filters in a SKY set w/o pausing
"PAUSE"....to kill AUTOOBJ and AUTOSKY; pause from
           now on after each filter
"SCALE"....to change gain scale
"TRIAL"....to try out different integration times
           before doing an observation
"FIX"......to edit the previous data record
"BAD"......to delete the previous data record
"END"......to end data taking and return to DOS
```

Table 6.1: Optional responses to the "Object?" query

"BAD" is the only item in table 6.1 which requires some further comment. It may be used to delete the previous line of data, which, in the case of a UBV sequence will mean that the filter slide will be reset to V and so will the screen position. This is most often used because of bad tracking by the telescope, causing the object to move out of the photometer diaphragm specifically during the integration on the last filter. Sudden rapid sky background variations due to lights going on or off or shining into the dome, may also mean that more lines of data may need to be deleted. This is obtained by repeatedly typing and entering "bad" in response to the "Object?" query. Another reason why it may be necessary to delete data, is that someone may have inadvertently turned the flip mirror when an integration was in progress, and so cut off the light to the photometer for a small period of time. Unfortunately "bad" always deletes the previous line of data, so if there is a problem with the U data alone, that measurement can only be repeated, if the B and V data are also deleted. In such a case it is probably better to type a comment relating to the problem and simply to edit out the offending data afterwards.

Following the "Object?" query, DTAK asks for the object's catalogue. If the OLIST prompt is correct, it may simply be accepted, otherwise the appropriate catalogue must be entered.

Next DTAK asks for the number of integrations. In SLOWMODE the maximum number is 400 in the case of non–programme objects or for single–filter observations of programme objects. For multi–filter observations of programme objects, a maximum of four integrations is allowed. Any line of data consists of four successive integrations in the same filter and the reduction programme IREX adds and finds the mean of these four counts. For a setting of 10 seconds on the integration time, this in fact means that the final integration times may be either 10, 20, 30 or 40 seconds, depending on the number of integrations requested. But, if 400 integrations of, say, 1 second each are requested (as could be done in single filter photometry, for example), what will in fact be reduced will amount to a single 400 second integration as IREX will consolidate all the data points into one.

If an error is discovered before the number of integrations is entered, entering "0" integrations will return the programme to the "Object?" query allowing any required changes to be made. Integrations start the moment the number of integrations is entered. If a problem is discovered after integration has commenced, pressing the "ESC" key will stop integration after the current integration and allow the programme to continue afterwards. This facility may also be used in cases where, for example, the diaphragm was not opened in time for the first integration.

Filter sequencing in DTAK is quite rigid. Within a particular filter sequence there may be no reversals in the sequence UBVRIC. In other words, UBV or UVRC are allowed, but not VBU or UBVU. The stepper motor counts the steps from the extreme position when the U filter is opposite the diaphragm in order to position the various filters correctly. The moment it "reverses", it returns to the extreme position again and any subsequent filter positioning is registered as part of a different filter set.

6.6 The initial reduction programme

Running IREX is the first step in reducing SLOWMODE data. This will

(1) consolidate consecutive lines of data done with the same filter on a non–programme object, reducing all these integrations to a single data point;

(2) issue a warning about a dispersion in counts of more than 3% in any one line of data, allowing the observer to decide whether to discard the particular data, or to accept it as valid;

(3) standardise data by adjusting them – on an assumption of perfect linearity – to what they would have been had an integration time of 10 seconds and a gain of 100 been used;

(4) perform the necessary sky subtractions; and

(5) search in COMP.CAT for the designated comparison and check stars for the programme object and request explicit identification of comparison and check stars if they are not in COMP.CAT. Normally this would be the case where standards are conveniently situated and can be used as comparison stars. Because COMP.CAT is not used in the case of the Unisa system, all comparison and check stars are entered in FOE.CAT and accessed from there.

The output file from IREX may be given any name, but the default is the name of he raw output data file (from DTAK) with the postscript ".R" added. An extract rom an IREX file is reproduced in figure 7.2 in the following chapter.

6.7 Extinction/transformation coefficients programme

Running the programme TRANS is essential in all–sky photometry, in order to olve for the extinction coefficients and zero points for that night. Transformation coefficients may need to be determined as well. Differential photometry also equires pre–determined extinction/transformation coefficients for accurate calculations. The equations used by TRANS follow closely the treatment by

Henden and Kaitchuk (1990) which was discussed in chapter 5 on the standard reduction procedure. Consequently these equations will not be repeated here.
TRANS allows a choice of three different modes:

6.7.1 Full extinction/transformation calculation

Answering "T" to the "MODE?" query will give a full calculation of first and second order extinction coefficients, transformation coefficients and zero points for all observed filters and colour indices – for the Unisa system, U, U – B, B – V, and V. When this mode is chosen, the programme assumes that transformation coefficients are initially unknown, and that therefore only ASTAR.CAT stars must be used for the first order extinction calculation, to minimise the uncertainties due to the estimated, default transformation coefficients. TRANS searches the catalogues for all the stars observed and lists them to the screen, sorted according to purpose.

The programme next turns to second order extinction calculation, giving the user the option of entering his own second order extinction coefficients rather than having the programme calculate them. If he chooses to input the relevant coefficients manually, he will be prompted for this and TRANS will then skip directly to the second order extinction calculation. Otherwise TRANS will identify the first red–blue pair found in the data, calculate the relevant second order extinction coefficients and then output each coefficient, together with its correlation coefficient. It will then repeat this procedure for each red–blue pair it finds in the data and will print the coefficients to the screen every time. Finally it will give a number–weighted average (over all the red–blue pairs) of the second order extinction coefficients. TRANS next allows the user three choices: either to use these obtained second order extinction coefficients in later calculations, to input his own coefficients manually, or to set the second order extinction coefficients to zero.
If the obtained coefficients seem suspect (absolute value > 0,06) manual input or setting to zero may be the best options. It should be noted that the plotting programme RPLOT may be used to view the linear regression plots for the second order extinction coefficients and that a better idea of the quality of the data may be obtained from this.

Following this, TRANS will calculate and print to the screen the first order extinction coefficients, their correlation oefficients and the names of the files receiving the plot data – as in the case of the second order extinction coefficients, for obtaining linear regression plots by means of RPLOT.

Finally, TRANS will calculate the transformation coefficients and zero points, using all observed stars catalogued in DTAK as being in FOE.CAT, ASTAR.CAT or SOE.CAT, except if the user specifies a maximum allowable air mass beyond which stars should not be used for transformation coefficient calculation. The transformation coefficients for U (EPU), U – B (PSI), B – V (MU) and V (EPS), together with the root mean square error in each colour will then be printed to the screen. Once all the coefficients and zero points have been calculated, the user has a choice of whether to write these to the file COEFF.DAT which contains the latest coefficients and zero points. When later doing reduction of, for example differential photometry data, the user will again have a choice between using the latest coefficients and zero points from COEFF.DAT, long term averages stored on RPARMS.DAT or to enter his own coefficients and zero points manually. If COEFF.DAT finds that certain coefficients were not determined on a particular night, it will enter the corresponding coefficients from the previous data record. However, it will set zero points to zero if they were not determined for a particular set of data. The contents of COEFF.DAT are reproduced in figure 7.9, as are the contents of RPARMS.DAT.

6.7.2 First order extinction calculation only

If the user feels confident of his second order and transformation coefficients and only requires first order extinction coefficients and zero points for a particular night, the choice of mode will be "F", where "F" now indicates "First order extinction" and no longer "Fastmode". The second order extinction and transformation coefficients from COEFF.DAT will be used and the first order extinction coefficients and their correlation coefficients will be output to the screen, together with the assumed transformation coefficients and their obtained zero points for the night, as well as the root mean square error.

6.7.3 Second order extinction and first order extinction calculation only

The choice here is "S" mode ("S" for "Second order extinction", not "Slowmode"). The programme makes use of the previous transformation coefficients from COEFF.DAT, but otherwise goes through all the steps outlined for "T" mode.

Apart from the different modes which may be selected with programme TRANS, the user may also choose whether to have the Moffat–Vogt correction (described in chapter 5) applied to obtain the second order extinction coefficient (RHO) for U – B.

It should be noted that differential instrumental magnitudes can be calculated for single filter observations, but that RPHOT does this by using the relations defining extinction in colour index,

$$K_y = K_x - K_{xy}$$

where x and y represent any two valid filters, for example ub, bv, etc, and the K's may represent either first or second order extinction. What this implies in terms of TRANS is that, for a particular instrumental magnitude to be calculated, TRANS data for at least two filters must already be in existence. These requirements are listed in table 6.3.

Instrumental magnitude desired	Required TRANS night data
u	UB
b	BV
v	BV or VR or VI
r	VR
i	VI

Table 6.2: Required TRANS data for single filter instrumental magnitudes

6.8 Final reduction programme

The final reduction programme, FREX, reads the IREX output file and the extinction/transformation coefficients stored either on COEFF.DAT or the long term averages stored in RPARMS.DAT, as well as the reduction parameters on RPARMS.DAT and calculates either standard Johnson UBV magnitudes or instrumental magnitudes for programme objects.

FREX will produce a separate file for each programme object observed and will append the data from subsequent nights to that same file. The default filename is the star's name (as used in OLIST and DTAK), followed by the postscript ".DAT". The contents of this file can then be printed, or fed to RPLOT in order to obtain a light curve in the case of differential photometry on variable stars.

If all–sky photometry, rather than differential photometry, is required for a particular object, then TRANS must first be run for the particular observing night, as FREX will immediately attempt to obtain extinction and transformation data for the particular night from COEFF.DAT and will stop execution if the data is not found.

FREX allows the user to choose whether to reduce all data to standard Johnson magnitudes ("J"), all data to instrumental magnitudes ("I") or some stars to Johnson and some to instrumental magnitudes ("M", for "mixed"). In the latter case the user will be asked to choose the magnitude system for each star explicitly.

How the final magnitudes will look in the case of differential photometry, also depends on the data available with respect to the comparison and check stars.

(1) If both multi–colour observations are done and standard UBV magnitudes entered in the catalogues for the comparison star then the reduced magnitudes for the programme star will be Johnson UBV magnitudes.

(2) If multi–colour observations are done on the comparison star, but its standard magnitudes are not known, these columns may be left blank in the relevant catalogue. FREX will then read zeros for these values and the reduced magnitudes for the programme star will be standard UBV magnitude *differences* between the programme object and the comparison star, in the sense: programme object minus comparison (see the results for BF PAV in chapter 9).

(3) If single filter observations are done, the reduced magnitudes will be differences (programme object minus comparison) on the instrumental system, irrespective of whether standard magnitudes have been entered for the comparison star.

(4) Reduced "Clear" magnitudes are always on the instrumental system.

FREX treats check stars like variable stars, comparing them to the comparison star and storing the obtained magnitudes to a file named as in the case of the variable. If these magnitudes vary over time, the user must then check whether the comparison or the check is varying. Clearly then, using a check star is only meaningful if the observer peruses this file with check star results and if sufficient data points are available for it. FREX itself does not alert the user to any problems with the nonvariability of the check or comparison stars.

6.9 The plotting programme

The plotting programme, RPLOT, can perform one of three options: slowmode plots (light curves), fastmode plots (occultations) and linear regression plots (for extinction and transformation coefficients).

6.9.1 Slowmode plots (light curves)

For this, RPLOT makes use of the output data file from FREX and then asks the user for the preferred axis notation ("graphics" or "text" mode) and the colour index or filter desired. The user also has the option of asking for a parabolic fit to the data, in which case a perpendicular will be dropped to the time axis, giving an indication of the probable time of minimum. A smoothing interval may be selected in the case of variables with fairly long periods, where only a few widely spaced observations are done per night. In the case of short period eclipsing binaries as were used in the present study, the smoothing interval is left in the default value of zero. Next, the time window must be selected: "L" for "last night only"; "A" for "all data on file"; "O" for "one night only" (a night other than the most recent one on which observations were done); "S" for "selected data" (between selected dates); or "F" for "folded phase plot." The latter only makes sense if different phases of the period have been observed on different occasions or the same phases also on different occasions. In such a case the programme searches for the period (in days) in a data file VPERIOD.DAT which may be updated by the user, and if the star's period is not entered there it asks for manual entry of the period. It then "folds" the data accordingly and produces a screen plot which shows the phase on the X – axis (rather than UT or heliocentric JD as is the case for other time windows). If a period is unknown, the user can try out various options by entering the period manually and seeing which gives the best light curve.

Once a light curve has been produced, it may either be sent to a printer/plotter to obtain hard copy, or it may be stored on a file for later copying, or it may simply be "discarded" for the moment and another plot requested.

6.9.2 Fastmode plots (occultations)

When fastmode data is logged, it does not pass through any reduction programmes, but passes directly to RPLOT, which will produce a plot of the raw counts or integrated counts versus time. The plot will be in terms of seconds measured from the minute of the first observation. If this spans more than 60 seconds, the user has the option of resetting the annotation to 0 at the minute marks. The programme further allows the option of plotting raw counts or integrated counts. Integrated counts are defined as

$$In = \frac{\sum_{i=1}^{n} [C_i - \langle C \rangle]}{\langle C \rangle}$$

where i = 1 is the first count in the desired time window and <C> is the average of all counts in the desired time window. In this case, point–to–point noise is essentially eliminated and occultations show up as a change in slope. Finally, the user may choose whether to plot all the data or just a subset time window.

6.9.3 Linear regression plots

These may be plotted from the plot files listed in the output data files from TRANS.

Examples of output files with results for first and second order extinction and transformation coefficients and zero points from TRANS as well as linear regression plots from RPLOT will be given in the following chapter. Samples from output files from FREX and of light curve plots will be given in chapter 9. Full data files may be found in the appendices.

Summary

The Unisa system makes use of the RPHOT software package. Provided that all system parameters have been entered correctly in the relevant files and all objects entered in the specified catalogues, the following programmes may be run successfully: OLIST for setting up an observing list; DTAK for data acquisition; IREX for initial reductions; TRANS for determination of extinction and transformation coefficients and zero points; FREX for final reductions of differential photometry data; and RPLOT for light curves, occultations and linear regression plots. Additional utility programmes are also available in RPHOT, but were not discussed here.

CHAPTER 7

DETERMINATION OF EXTINCTION AND TRANSFORMATION COEFFICIENTS FOR THE UNISA SYSTEM

7.1 Aim

Extinction coefficients for local atmospheric conditions were not available. Nor were transformation coefficients for the particular photometric system. The aim was therefore to determine preliminary values for these coefficients – to be stored in COEFF.DAT until long term averages can be found, suitable for RPARMS.DAT.

7.2 Procedure

A set of 20 UBV standard stars were chosen for a night of all–sky photometry aimed specifically at determining extinction and transformation coefficients. The stars were chosen from the lists provided in Henden and Kaitchuk (1990). They were selected by declination (South), right ascension (all culminating within an hour or two of midnight so that they would be observable an appreciable part of the night) and magnitude (fainter than + 4, so that they could be observed with this telescope and photometer combination without the necessity for a neutral density filter). The list of stars, together with their coordinates, UBV magnitudes and colours and spectral types, is given in table 7.1. Two of these stars, HR5401 and HR5444, were used as a red–blue pair for purposes of second order extinction determination, although they are in fact 1,7^{O} apart. This choice was made because experience had shown that using the pairs from Henden and Kaitchuk (1990) is locally not feasible as their equatorial declinations mean that they are drowned in brilliant campus and city light. The "red–blue pair" was observed more often than the other objects – five times, versus just twice for the objects used only for first order extinction and transformation calculation.

Four ten second integrations (equivalent to a single forty second integration) were done on each star in each filter (that is, U, B and V), using a gain scale setting of 1 in all cases since most objects were so bright that an overrange condition for the voltage–to–frequency converter would occur if they were observed at a gain of 10. Star observations were followed in all cases by sky observations of a single 10 second integration in each filter.

Afterwards the data was edited and subsequently reduced by means of the initial reduction programme (IREX) and the extinction and transformation programme (TRANS) run in T–mode (see chapter 6). Examples of the programme output will be given in each of the following sections.

Name	RA	DEC	V	B − V	U − B	SPEC
HR4519	11 43 15,0	–45 24 44,4	5,29	–0,12	–0,55	B8
HR4601	12 01 08,5	–73 56 07,8	6,45	1,22	0,98	K0
HR4624	12 06 18,1	–44 02 49,9	5,75	0,24	0,15	A2
HD106321	12 11 25,3	–45 25 45,3	5,31	1,43	1,58	K0
HR5019	13 15 47,1	–18 02 01,3	4,75	0,71	0,25	G6V
HR5401	14 23 58,1	–45 54 33,0	5,82	0,31	0,14	A3
HR5444	14 33 01,9	–46 01 41,6	5,54	1,49	1,71	K2
HR5489	14 41 54,7	–34 58 52,6	4,92	0,02	–0,04	A1
HR5509	14 44 16,4	–43 20 54,0	6,30	1,08	0,88	G5
HR5528	14 48 21,9	–43 22 11,1	4,32	–0,16	–0,62	B5
HR5530	14 47 55,0	–15 47 25,9	5,16	0,41	–0 04	F5IV
HR5580	14 56 09,7	–42 57 39,6	6,10	0,60	0,28	F8
HR5959	15 58 05,4	–08 16 17,1	5,55	0,04	–0,04	A1
HR6070	16 15 12,0	–28 29 29,3	4,77	0,02	–0,01	A0V
HR6371	17 07 04,6	–44 29 42,7	5,07	0,88	0,56	G5
HR6427	17,15 46,9	–44 10 17,9	6,64	0,20	0,05	A0
HR6446	17 18 00,7	–12 47 52,1	4,31	0,03	0,03	A1V
HR6460	17 20 35,3	–44 07 00,1	5,11	–0,05	–0,40	B8
HR6963	18 30 42,2	–05 56 59,9	6,36	0,02	–0,05	A0
HR7446	19 31 12,1	–07 08 24,7	4,96	–0,01	–0,87	B0,5I

Table 7.1: Observed UBV standard stars (Epoch 1950,0)

7.3 Results

7.3.1 Raw data from DTAK

The first portion of the raw data file from DTAK is reproduced in figure 7.1. Note that this is **not** a table of data but merely an illustration of the form and quality of the programme output. This argument applies to all the figures appearing henceforth about which the question could be raised why they are not designated as "tables". Complete data files may be found in the appendices.

The main point of note with regard to figure 7.1 is the stability of the counts – better than one percent within each line of data in almost all cases. Clearly the instrumental response is very stable over the period reflected here (about 52 minutes). In fact, this is generally true, as IREX (see next section) alerts the observer to any line of data in which there is a dispersion of 3% or larger and this happens very seldom – usually only in response to some sudden external change in sky brightness which went unnoticed during the actual observing run. However, on a very few occasions a sudden, unexplained, yet very marked elevation in the blue counts has been observed as a transient phenomenon lasting several minutes (see the B light curve for V759 CEN in chapter 9).

Of course such data points could simply be disregarded as spurious and discarded. However, because in each case only the blue counts have been involved, the data has been left unedited as a reminder that the phenomenon requires further investigation. On one occasion such a blue elevation was observed when automated filter movement was being demonstrated with diaphragm and telescope closed. This therefore implies an instrumental origin for the abnormal counts – perhaps an Ohmic leakage triggered specifically when the blue filter is in position and there is simultaneous gravitational flexure of some crucial part of the photometer. However, the mystery can only be solved if a careful record is kept of the exact circumstances pertaining whenever this phenomenon is observed.

```
FILENAME=VP930613                     RAW OUTPUT DATA FILE FROM "DTAK"
UT DATE= JUN 13 1993  TELESCOPE= C35              OBSERVER= VP
CONDITIONS=clear                                            DARK CNTS=54
MO-DY-YEAR    UT    CAT  OBJECT    FLT ----------COUNTS---------- INT SCLE COMMENTS
 6-13-1993 18: 8:57 S    HR5401     U    236    237    236    237  10 1
 6-13-1993 18: 9:38 S    HR5401     B   1341   1339   1337   1333  10 1
 6-13-1993 18:10:18 S    HR5401     V    642    640    642    636  10 1
 6-13-1993 18:11:35      SKYLAST    U     59      0      0      0  10 1
 6-13-1993 18:11:46      SKYLAST    B     98      0      0      0  10 1
 6-13-1993 18:11:56      SKYLAST    V    117      0      0      0  10 1
 6-13-1993 18:16:12 S    HR5444     U     78     78     78     79  10 1
 6-13-1993 18:16:52 S    HR5444     B    677    680    677    677  10 1
 6-13-1993 18:17:33 S    HR5444     V    788    786    786    787  10 1
 6-13-1993 18:18:28      SKYLAST    U     58      0      0      0  10 1
 6-13-1993 18:18:38      SKYLAST    B     97      0      0      0  10 1
 6-13-1993 18:18:49      SKYLAST    V    114      0      0      0  10 1
 6-13-1993 18:23:42 F    HR4519     U    806    814    809    807  10 1
 6-13-1993 18:24:23 F    HR4519     B   2950   2933   2945   2937  10 1
 6-13-1993 18:25: 3 F    HR4519     V    949    945    949    947  10 1
 6-13-1993 18:25:45      SKYLAST    U     61      0      0      0  10 1
 6-13-1993 18:25:55 M    SKYLAST    B    106      0      0      0  10 1
 6-13-1993 18:26: 6 M    SKYLAST    V    120      0      0      0  10 1
 6-13-1993 18:30:10 F    HR4601     U     75     74     75     74  10 1
 6-13-1993 18:30:51 F    HR4601     B    371    374    371    369  10 1
 6-13-1993 18:31:31 F    HR4601     V    390    392    389    394  10 1
 6-13-1993 18:32:16      SKYLAST    U     59      0      0      0  10 1
 6-13-1993 18:32:27 M    SKYLAST    B    110      0      0      0  10 1
 6-13-1993 18:32:37 M    SKYLAST    V    140      0      0      0  10 1
 6-13-1993 18:36:43 F    HR4624     U    268    269    267    271  10 1
 6-13-1993 18:37:23 F    HR4624     B   1548   1544   1543   1542  10 1
 6-13-1993 18:38: 4 F    HR4624     V    686    686    687    686  10 1
 6-13-1993 18:38:46      SKYLAST    U     61      0      0      0  10 1
 6-13-1993 18:38:57 M    SKYLAST    B     99      0      0      0  10 1
 6-13-1993 18:39: 7 M    SKYLAST    V    115      0      0      0  10 1
 6-13-1993 18:40:54 F    HD106321   U     88     88     89     88  10 1
 6-13-1993 18:41:34 F    HD106321   B    847    849    850    845  10 1
 6-13-1993 18:42:15 F    HD106321   V    941    937    943    944  10 1
 6-13-1993 18:42:57      SKYLAST    U     61      0      0      0  10 1
 6-13-1993 18:43: 7 M    SKYLAST    B     99      0      0      0  10 1
 6-13-1993 18:43:18 M    SKYLAST    V    115      0      0      0  10 1
 6-13-1993 18:48:10 F    HR5019     U    388    390    390    390  10 1
 6-13-1993 18:48:51 F    HR5019     B   2677   2655   2651   2655  10 1
 6-13-1993 18:49:31 F    HR5019     V   1593   1587   1579   1579  10 1
 6-13-1993 18:51: 4      SKYLAST    U     62      0      0      0  10 1
 6-13-1993 18:51:15 M    SKYLAST    B    104      0      0      0  10 1
 6-13-1993 18:51:25 M    SKYLAST    V    116      0      0      0  10 1
 6-13-1993 18:54:33 S    HR5401     U    250    251    250    250  10 1
 6-13-1993 18:55:13 S    HR5401     B   1405   1414   1408   1410  10 1
 6-13-1993 18:55:54 S    HR5401     V    656    654    657    654  10 1
 6-13-1993 18:56:41      SKYLAST    U     60      0      0      0  10 1
 6-13-1993 18:56:52 M    SKYLAST    B     95      0      0      0  10 1
 6-13-1993 18:57: 2 M    SKYLAST    V    108      0      0      0  10 1
 6-13-1993 18:58:27 S    HR5444     U     80     80     80     80  10 1
 6-13-1993 18:59: 7 S    HR5444     B    710    712    713    710  10 1
 6-13-1993 18:59:48 S    HR5444     V    809    812    812    812  10 1
 6-13-1993 19: 0:35      SKYLAST    U     59      0      0      0  10 1
 6-13-1993 19: 0:45 M    SKYLAST    B     95      0      0      0  10 1
 6-13-1993 19: 0:56 M    SKYLAST    V    108      0      0      0  10 1
```

Figure 7.1: Sample of raw output data file from DTAK

7.3.2 Initial reduced data file from IREX

The first portion of this file is reproduced in figure 7.2. Note how IREX has

(1) found the mean of each line of counts;

(2) adjusted all counts to represent a gain of 100;

(3) subtracted sky from star measurements; and

(4) has indicated to what use TRANS will be putting each count. Or rather, to what use it *could* put each count. In fact, because transformation coefficients were unknown, only counts marked "A" were used for first order extinction calculation. Those marked "S" were used for second order extinction calculation, and all of them (depending only on the air mass during a particular observation) for transformation calculations.

```
FILENAME=VP930613.R                  OUTPUT FILE FROM "IREX"
UT DATE= JUN 13 1993  TELESCOPE= C35                   OBSERVER= VP
CONDITIONS=clear                                                 DARK CNTS=54
MO-DY-YEAR      UT    CT USES OBJECT     FLT COUNTS
 6-13-1993 18: 8:57  S FS   HR5401      U   17750
 6-13-1993 18: 9:38  S FS   HR5401      B  123950
 6-13-1993 18:10:18  S FS   HR5401      V   52300
 6-13-1993 18:16:12  S FS   HR5444      U    2025
 6-13-1993 18:16:52  S FS   HR5444      B   58075
 6-13-1993 18:17:33  S FS   HR5444      V   67275
 6-13-1993 18:23:42  F F    HR4519      U   74800
 6-13-1993 18:24:23  F F    HR4519      B  283525
 6-13-1993 18:25: 3  F F    HR4519      V   82750
 6-13-1993 18:30:10  F F    HR4601      U    1550
 6-13-1993 18:30:51  F F    HR4601      B   26125
 6-13-1993 18:31:31  F F    HR4601      V   25125
 6-13-1993 18:36:43  F F    HR4624      U   20775
 6-13-1993 18:37:23  F F    HR4624      B  144525
 6-13-1993 18:38: 4  F F    HR4624      V   57125
 6-13-1993 18:40:54  F F    HD106321    U    2725
 6-13-1993 18:41:34  F F    HD106321    B   74875
 6-13-1993 18:42:15  F F    HD106321    V   82625
 6-13-1993 18:48:10  F F    HR5019      U   32750
 6-13-1993 18:48:51  F F    HR5019      B  255550
 6-13-1993 18:49:31  F F    HR5019      V  146850
 6-13-1993 18:54:33  S FS   HR5401      U   19025
 6-13-1993 18:55:13  S FS   HR5401      B  131425
 6-13-1993 18:55:54  S FS   HR5401      V   54725
 6-13-1993 18:58:27  S FS   HR5444      U    2100
 6-13-1993 18:59: 7  S FS   HR5444      B   61625
 6-13-1993 18:59:48  S FS   HR5444      V   70325
 6-13-1993 19: 4:21  A A    HR5489      U   68525
 6-13-1993 19: 5: 1  A A    HR5489      B  393750
 6-13-1993 19: 5:42  A A    HR5489      V  125725
 6-13-1993 19: 9:55  F F    HR5509      U    3200
 6-13-1993 19:10:36  F F    HR5509      B   43500
 6-13-1993 19:11:16  F F    HR5509      V   34700
 6-13-1993 19:13:44  F F    HR5528      U  221050
 6-13-1993 19:14:24  F F    HR5528      B  779700
 6-13-1993 19:15: 5  F F    HR5528      V  217950
 6-13-1993 19:17:33  F F    HR5580      U   10300
 6-13-1993 19:18:14  F F    HR5580      B   78500
 6-13-1993 19:18:54  F F    HR5580      V   40950
 6-13-1993 19:40:47  F F    HR5530      U   39200
 6-13-1993 19:41:28  F F    HR5530      B  225125
 6-13-1993 19:42: 8  F F    HR5530      V  100050
 6-13-1993 19:49:11  A A    HR5959      U   35050
 6-13-1993 19:49:51  A A    HR5959      B  206025
 6-13-1993 19:50:32  A A    HR5959      V   67825
 6-13-1993 19:57:43  A A    HR6070      U   71075
 6-13-1993 19:58:23  A A    HR6070      B  432125
 6-13-1993 19:59: 4  A A    HR6070      V  138350
```

Figure 7.2: Sample of initial reduced file from IREX

7.3.3 Extinction and transformation coefficients

7.3.3.1 Second order extinction coefficients

These were determined from 5 sets of UBV observations of 4 x 10 s each on the red–blue pair HR5444 and HR5401. As can be seen from the outprint reproduced in figure 7.3 and the plots in figure 7.4 the coefficients all lie around zero as they should, but the correlations are very poor. This can be attributed at least in part to the small number of data points. As these coefficients all have an absolute value less than 0,05 they were nevertheless considered acceptable and were written to the file COEFF.DAT from where they were extracted by the final reduction programme for differential photometry (FREX) and used in the reduction of the variable star data to be discussed in chapter 9. Because of the proximity of variable and comparison stars and their similarity in spectral type, extinction coefficients are considerably less important for differential photometry (as in this study) than they would be in the case of absolute photometry. Nevertheless it is clear that many more measurements of red–blue pairs need to be done to establish reliable second order extinction coefficients for the Unisa system (coefficients which could then be entered in RPARMS.DAT).

```
        --- SECOND ORDER EXTINCTION COEFFICIENTS ---
        PAIR £1; HR5444     /HR5401       5 OBSERVATION(S)

        Ku" =  0.032  COR= 0.092;  Plot data file= C:\RPHOT\KUPP1.DAT
    K(u-b)" =  0.044  COR= 0.426;  Plot data file= C:\RPHOT\KUBPP1.DAT
    K(b-v)" =  0.013  COR= 0.035;  Plot data file= C:\RPHOT\KBVPP1.DAT
Kv" {on b-v} = -0.022  COR= 0.021;  Plot data file= C:\RPHOT\KVPP1.DAT

Hit "ENTER" to process the next red-blue pair


=========== All red/blue pairs have now been processed ===========

The number-weighted average coefficients for the multiply observed pairs is:

Ku" =           0.032
K(u-b)" =       0.044
K(b-v)" =       0.013
Kv" {on b-v} = -0.022
```

Figure 7.3: Second order extinction coefficients, output from TRANS

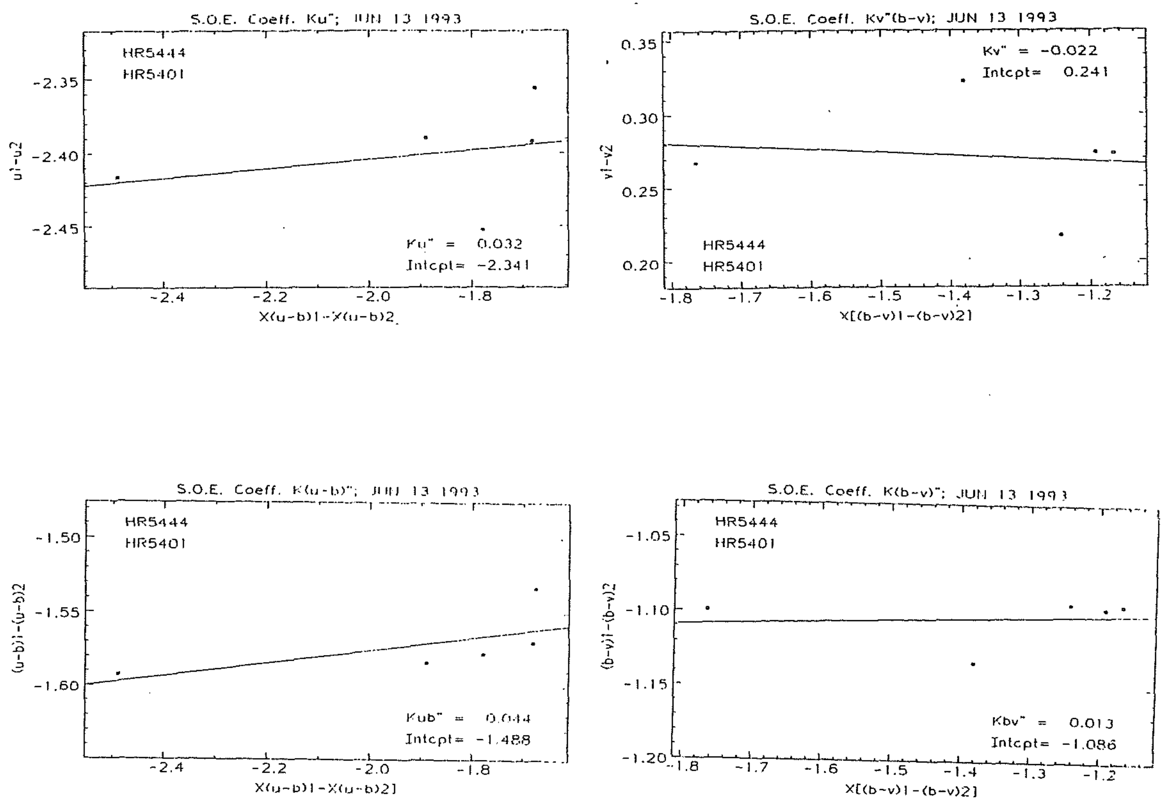


Figure 7.4: Plots of second order extinction coefficients by the programme RPLOT, based on data from TRANS

7.3.3.2 First order extinction coefficients

As the transformation coefficients had as yet not been determined, only those stars in ASTAR.CAT, in other words Johnson standards having –0,06 < B–V < 0,06, were used for first order extinction coefficient determination. This is the reason why, although 20 stars were observed at least twice each, the first order extinction coefficients were found from only 10 data points (two observations on each of five A stars). These coefficients are represented in figures 7.5 and 7.6 and in this case the correlations are considerably better than was the case for the second order extinction coefficients. Nevertheless, it is clear from the plots that the scatter is large and, furthermore, all the points except one lie at X < 1,2. Therefore, in order to determine more reliable first order extinction coefficients, more measurements are required at larger air mass. In the ideal case, each star should have been observed at least three times – once at the zenith and once at fairly large air mass either side of the zenith. Young (1974) recommends at least some measurements at air mass 2 to 4 ($z = 60^{\circ}$ to 75°) but no larger. A clustering of data points at smaller air masses is however to be expected always, as X < 1,1 for $z < 24^{\circ}$.

It should be noted that, during differential photometry of variable stars, not only standard stars but also comparison and check stars are used for first order extinction calculation. Therefore, although it will be seen in chapter 9 and from the appendices that standards were observed only once every 90 minutes during variable star observations, there were in fact five other observations interspersed throughout the same period, from which first order extinction was calculated. This then meets Young's (1974) criterion of three extinction measures per hour.

```
     ---- FIRST ORDER EXTINCTION COEFFICIENTS ----

From 10 pts; Ku'=      0.855  COR= 0.879; plot file= KUP.DAT
From 10 pts; K(u-b)'=  0.193  COR= 0.820; plot file= KUBP.DAT
From 10 pts; K(b-v)'=  0.255  COR= 0.857; plot file= KBVP.DAT
From 10 pts; Kv'=      0.374  COR= 0.740; plot file= KVP.DAT
```

Figure 7.5: First order extinction coefficients

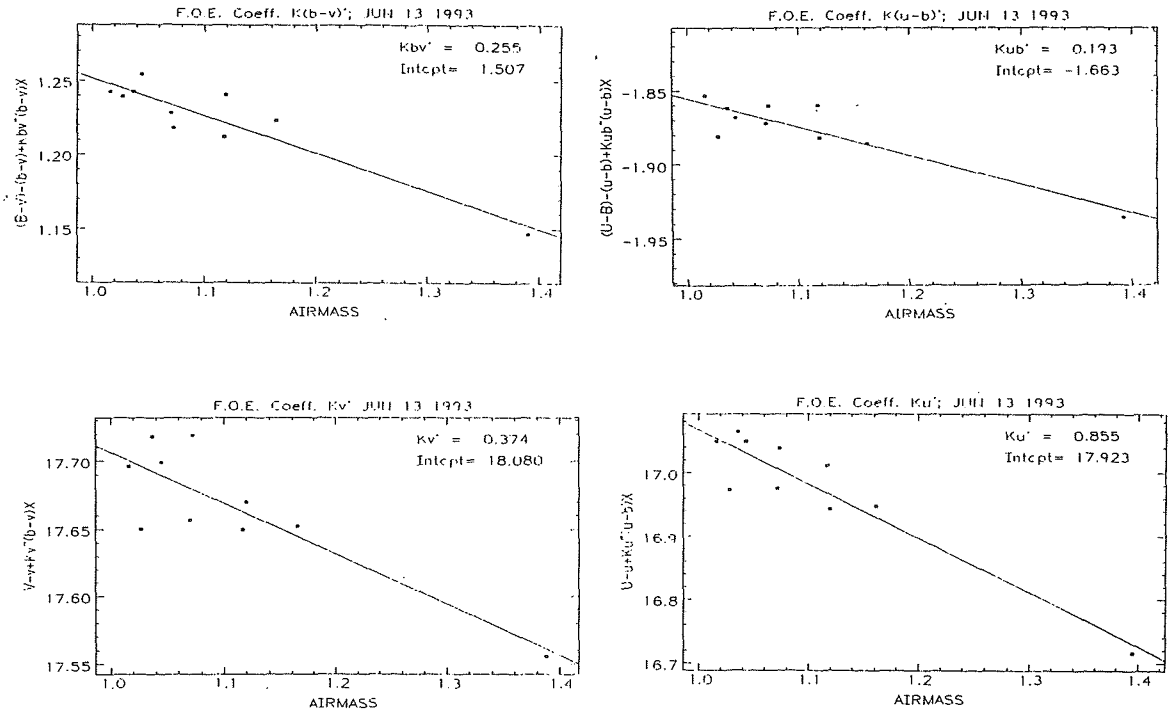


Figure 7.6: Linear regression plots of first order extinction coefficients

7.3.3.3 Transformation coefficients and zero points

The transformation coefficients calculation was limited to stars observed at an airmass of up to 1,5. The correlations in U–B and B–V are excellent, but those for U and V are mediocre. The root mean square errors in V and B–V are acceptable, but the nearly 0,07 magnitude errors in U and U–B are higher than 0,05 which, according to Henden and Kaitchuk (1990), is the upper limit of acceptability. The transformation coefficients and zero points as well as the root mean square errors as output by TRANS are reproduced in figure 7.7 and the linear regression plots for the transformation coefficients in figure 7.8. The Moffat–Vogt correction was not applied, so the axis labelling for U – B is incorrect and represents a flaw in the relevant programme.

```
                ---- TRANSFORMATION COEFFICIENTS ----
U:       EPU=  0.088            Zu= 17.929  COR= 0.454; plot file= EPU.DAT
U-B:     PSI=  1.049        Z(u-b)= -1.754  COR= 0.989; plot file= PSI.DAT
B-V:      MU=  1.090        Z(b-v)=  1.643  COR= 0.999; plot file= MU.DAT
V{B-V}: EPS= -0.032  Zv {on B-V}= 18.081  COR= 0.349; plot file= EPS.DAT

RMS error in  U  =  0.068 magnitudes
RMS error in U-B =  0.069 magnitudes
RMS error in B-V =  0.015 magnitudes
RMS error in  V  =  0.023 magnitudes (using B-V)
```

Figure 7.7 Transformation coefficients and zero points output from TRANS

7.4 The contents of COEFF.DAT versus that of RPARMS.DAT

Figure 7.9 displays the contents of COEFF.DAT. The data from 1990–28–11 were entered by the author of the software package, while the data from 1993–06–13 are those entered for observations done at the Unisa Observatory. For convenience the contents of RPARMS.DAT have also been reproduced in figure 7.9, as each parameter is defined there. The extinction and transformation coefficients on RPARMS.DAT are the long term averages for the Cabrillo Observatory, using an SSP–3A photometer (photodiode type) and a 25cm Schmidt–Cassegrain telescope. These may be compared with the COEFF.DAT results for the Unisa Observatory with its SSP–5A PMT photometer and 35cm Schmidt–Cassegrain telescope.

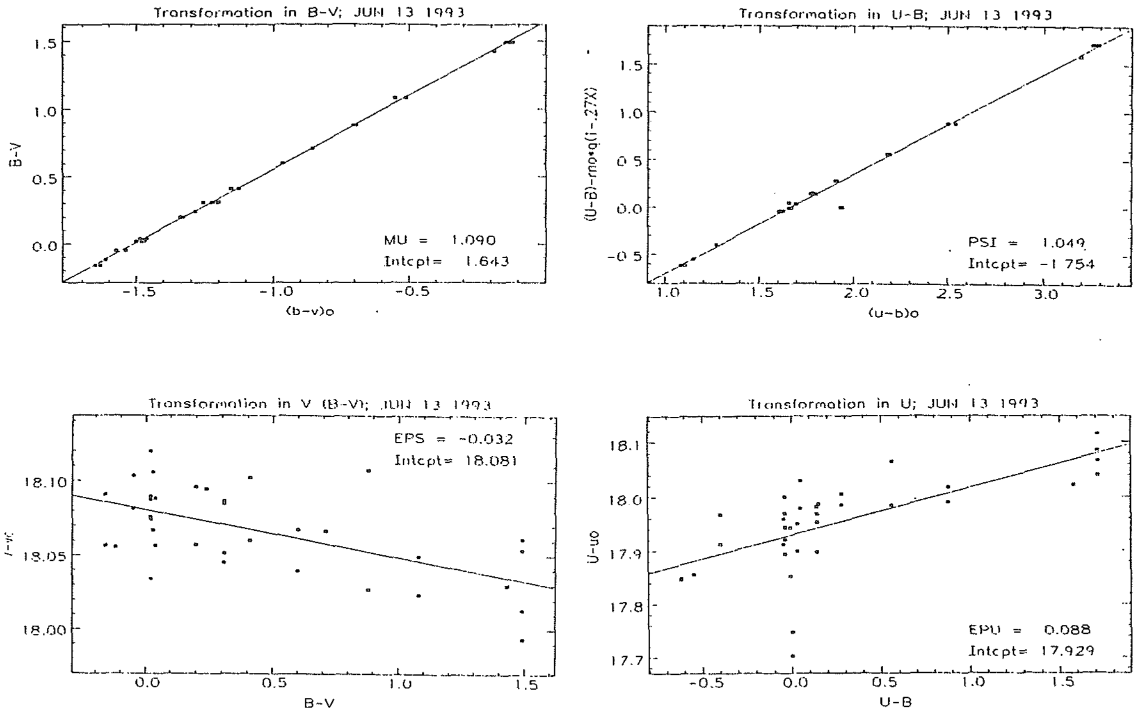


Figure 7.8: Linear regression plots of transformation coefficients and zero points

```
 FILENAME= COEFF.DAT      CONTAINS ALL FIRST, SECOND ORDER EXTINC./TRANS COEFFICI
ENTS
MMDDYY   KUP    KUBP   KBVP   KVP    KVRP   KVIP    KUPP KUBPP KBVPP  KVPP KRRPP KVRPP
 KVIPP    ZU     ZUB    ZBV    ZV      ZRR   ZVR    ZVI
            EPU    PSI    RHO    MU    EPS    EPR    TAU    ETA   KIIPP  EPI    ZII

112890  0.000 0.000 0.000 0.196 0.065 0.102  0.000 0.000 0.000 0.000 0.004 0.006
 0.004   0.000 0.000 0.000 15.678 15.682 0.616 0.649
          0.000 0.000 0.000 0.000 0.000-0.066 1.081 1.046 0.002-0.035 15.680
 61393  0.855 0.193 0.255 0.374 0.000 0.000  0.032 0.044 0.013-0.022 0.004 0.006
 0.004  17.929-1.754 1.643 18.081 15.682 0.616 0.649
          0.088 1.049 0.000 1.090-0.032-0.066 1.081 1.046 0.002******  0.000
```

```
**** RPARMS.DAT - CONTAINS DATA REDUCTION PARAMETERS FOR YOUR OBSERVATORY ***
DOS PATH TO INTERMEDIATE DATA FILES;     C:\RPHOT
PATH TO FINAL REDUCED DATA FILES;        C:\RPHOT
VAR FILE HEADER=UNISA OBSERVATORY  SSP-5A PHOTOMETER
PREFERRED INDEX FOR V CALCULATIONS;      BV
LONGITUDE (+WEST, -EAST, IN DEGREES)=  -28.20
LATITUDE (+NORTH, -SOUTH, IN DEGREES)= -25.77
FIRST ORDER EXT. IN U     ; KUP=       .24
FIRST ORDER EXT. IN VISUAL; KVP=       .196
FIRST ORDER EXT. IN U-B; KUBP=         .25
FIRST ORDER EXT. IN B-V; KBVP=         .225
FIRST ORDER EXT. IN V-R; KVRP=         .066
FIRST ORDER EXT. IN V-I; KVIP=         .102
SECOND ORDER EXT. IN U     ; KUPP=     .001
SECOND ORDER EXT. IN V (on b-v); KVPP= .028
SECOND ORDER EXT. IN V (on v-r); KRRPP=.000
SECOND ORDER EXT. IN V (on v-i); KIIPP=.000
SECOND ORDER EXT. IN U-B; KUBPP=       -.03
SECOND ORDER EXT. IN B-V; KBVPP=       -.037
SECOND ORDER EXT. IN V-R; KVRPP=       .007
SECOND ORDER EXT. IN V-I; KVIPP=       .007
TRANSFORMATION COEFF. FOR U; EPSILONU= -.05
TRANS. COEFF. FOR V (on b-v); EPSILON=  .000
TRANS. COEFF. FOR V (on v-r); EPSILONR=-.070
TRANS. COEFF. FOR V (on v-i); EPSILONI=-.038
TRANSFORMATION COEFF. FOR U-B; PSI=    1.0
MOFFATT/VOGT TRAN. COEFF. FOR U-B; RHO=.02
TRANSFORMATION COEFF. FOR B-V; MU=     1.036
TRANSFORMATION COEFF. FOR V-R; TAU=    1.082
TRANSFORMATION COEFF. FOR V-I; ETA=    1.050
```

Figure 7.9: Unisa coefficients on COEFF.DAT versus those of Cabrillo Observatory on RPARMS.DAT. Note that some parameters which are not relevant to the Unisa system are nevertheless reflected on COEFF.DAT. This is because COEFF.DAT draws on previous data for any parameters which are not entered for the most recent TRANS night.

Summary

In order to determine extinction and transformation coefficients, a night of all–sky photometry was done, using 20 Johnson UBV standard stars, including a red–blue pair for determining second order extinction. Because transformation coefficients were unknown, only A stars were used for first order extinction calculation. The count stability of the instrument is notable. Coefficients were of the desired order, but correlations and root mean square errors were in some cases unacceptable. Many more observations, including ones at higher air mass are required before long term averages can be entered on the reduction parameters file.

CHAPTER 8

ECLIPSING BINARIES

8.1 Definition

Binary stars are pairs of stars which are gravitationally linked, rather than merely optically closely aligned in the line of sight from earth. It is estimated that between 25% and 50% of all stars in the galaxy are members of binary or multiple stellar systems. **Eclipsing binaries** make up that relatively small percentage of all binary systems where the orbits are so aligned with respect to earth, that we are able to observe the passage of one star in front of the other, in other words an eclipse. Most of the time this simply means that earthbound observers measure a periodic drop in the total flux received from an apparently single object which cannot optically be resolved into its component stars.

This last sentence anticipates the **dual classification** of eclipsing binaries: they not only fall under the general classification of binary systems, but also form part of the broad class of **variable stars** and, more particularly, the **periodic variables**. In the case of other types of variable stars, the light variation is the result of intrinsic physical processes within the stars themselves, for example in the case of pulsating (periodic) or eruptive (nonperiodic) variables, whereas in the case of eclipsing binaries the light variation is the result of a chance geometric alignment with the line of sight to earth. For this reason some astronomers have felt that eclipsing variables should in fact not be included with the "intrinsic variables." However, consideration of the conditions for eclipse occurrence immediately reveals the folly of such a view. Figure 8.1 demonstrates the general principle that, the wider the binary orbit, the more precisely must the orbital plane be aligned with the line of sight from earth, in order for an eclipse to be witnessed.

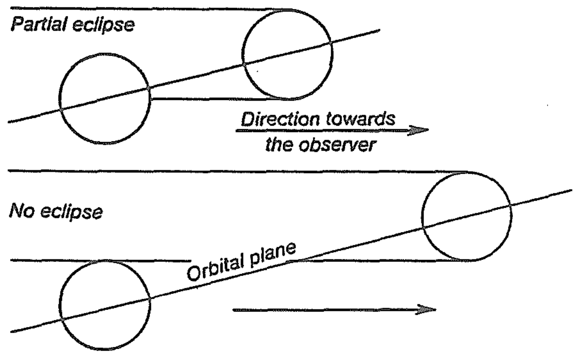


Figure 8.1: Conditions for eclipse occurrence

The figure shows clearly that eclipses are likely to be seen only in the case of binary systems with small orbits, in fact close binary systems. Consequently, the classification of close binary systems (a physical classification) will be discussed in the next section, followed by the classification of eclipsing binaries on the basis of light curve shape (an empirical, photometric classification).

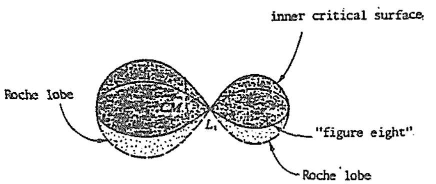
The significance of small orbital size lies in the fact that under such conditions of physical proximity, mutual interaction is inevitable between the components of the system. This may be dramatic in the case of eruptive variables, such as cataclysmic variables or novae, but even in the case of relatively quiescent, detached binaries the gravitational and magnetic field and the electromagnetic radiation from each star affects the other, causing phenomena such as tidal deformation, reflection effects, the formation of a shared gas and dust envelope, exceptionally strong photospheric and chromospheric activity and even mass transfer or mass loss (the latter giving rise to period changes). Thus the apparently clear dividing line between intrinsic variables and eclipsing variables (sometimes referred to as "mere" optical variables) disappears and the sensible approach is probably to **define eclipsing binaries as those objects where the geometrically produced variations in the light curve dominate those of physical origin** (as suggested by Hoffmeister, et al., 1985),

8.2 Close binary systems

8.2.1 The Roche model

The classification of close binary systems on a physical basis was first attempted by Kopal (1959). In the light of the formulation of the Roche–model by Plavec and Kratochvil (1964), Kopal finally came up with a classification differentiating between systems on the basis of the degree of contact (Kopal, 1971). Thus close binaries may be divided into three classes: detached, semi–detached and contact binaries, depending on their Roche geometry.

The Roche model deals with the gravitational equipotential surfaces around stars, the critical one being the lemniscate (sideways figure eight) where the equipotentials of the two stars just touch at a point on the line joining their centres of mass, called the inner Lagrange point, L_1 (see figure 8.2). This point is very important because a particle of matter at this point will experience an equal gravitational pull from each star. Any disturbance in the equilibrium can cause it to move across the Lagrange point into the gravitational domain of one or the other star. This is therefore the point where mass transfer/exchange between the two stars may be initiated in response to evolutionary changes occurring in them. The outer Lagrange point, L_2, is also important as this is the point from which mass may actually be lost from the system, again in response to evolutionary changes within the components of the system. The Roche model provides a convenient way of describing the various types of close binary systems.



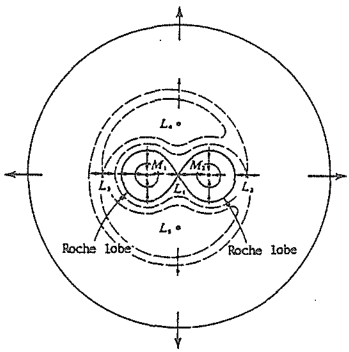


Figure 8.2: Roche equipotential surfaces

8.2.2 Detached systems

In the case of detached systems, neither star fills its Roche lobe and there is consequently no question of mass exchange or transfer between the two components. With Ω_i defined as the critical gravitational potential on the critical Roche potential surface and Ω_1 and Ω_2 representing the gravitational potential at the "surface" of stars 1 and 2 respectively, it holds for detached systems that: $\Omega_1 > \Omega_i$ and $\Omega_2 > \Omega_i$. In the case of detached systems, the primary component (the hotter star) is also the larger and more massive one and so the primary minimum (when the hotter star is eclipsed) constitutes a transit rather than an occultation.

A schematic representation of a detached system may be found in figure 8.3, where each type of system is represented in terms of its Roche geometry.

8.2.3 Semi-detached systems

Semi-detached systems consist of a massive primary component which does not fill its Roche lobe (the detached component) and a subgiant as secondary component, which does fill its Roche lobe. Primary minimum can result from either occultation or transit, depending on which star has the highest surface temperature. However, generally the primary minimum will occur as a result of an occultation of the smaller (usually hotter) main sequence star by the cooler post-main sequence subgiant. These systems are usually found in the light curve classification as Algol or Beta Lyrae systems (see sections 8.3.2 and 8.3.3).

Thus in the case of semi-detached systems one star is still on the main sequence while the other has evolved beyond it and now fills its Roche lobe. For the surface gravitational potentials it holds that: $\Omega_1 > \Omega_i$ and $\Omega_2 = \Omega_i$.

The periods of semi-detached systems usually lie between 0,4 days and several days.

8.2.4 Contact systems

In the case of contact systems both components fill or exceed their Roche lobes and are therefore in physical contact, so that mass loss, mass transfer or mass exchange is possible. For the gravitational potential, $\Omega_{1,2} < \Omega_i$. These systems are represented in terms of the light curve classification by W UMa systems, the star W UMa in fact serving as prototype for contact systems in general. The primary minimum can occur either during occultation or transit as the larger star is not necessarily the cooler one. For contact binaries the period varies between about 0,2 days and 1,0 day.

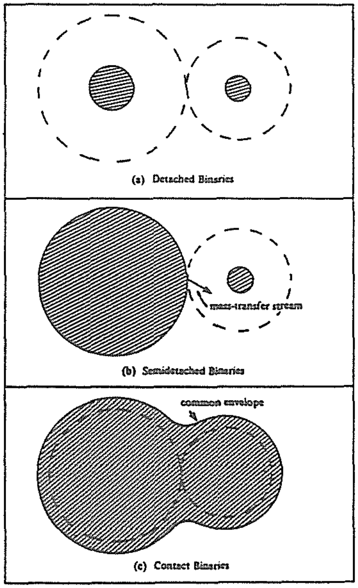


Figure 8.3: Roche classification of close binary systems (From Wargau & Pieters, 1992)

8.3 Classification on the basis of light curve shape

8.3.1 General considerations

A photometric light curve represents the variation over time of the flux received from a star or stellar system. The light curve may be taken over that portion of the electromagnetic spectrum for which the photometric detector is sensitive, or it may be taken only in certain selected filter passbands. Physical variability in individual stars may cause brightness (flux) variations, but for eclipsing binaries the primary cause of periodic variations is the eclipsing (either by occultation or transit) of one star by another, leading to a decrease in the integrated light received from the system as a whole. This leads to two "dips" in the light curve during any one complete period, as first one star moves in front of the other and then the roles are reversed. As the surface area which is blotted out during eclipse is the same, no matter which of the two stars passes in front of the other, it is not the relative sizes of the stars which determine the relative depths of the two minima. Rather, the surface temperature of the two stars is the determining factor, the eclipse of the hotter star leading to the primary (deepest) minimum with the greatest light loss.

The secondary minimum does not necessarily fall exactly in the centre (time–wise) between primary minima. Only if the orbit is circular or if the line of apsides (in the case of an elliptic orbit) lies directly along the line of sight to earth, will the secondary minimum fall exactly halfway between primary minima.

A full light curve analysis is beyond the scope of this study and so these two remarks must suffice to introduce the classification into Algols, β Lyrae systems and W UMa systems.

8.3.2 Algols

Algol systems (type EA) are characterised by a phase of constant brightness between eclipses, thus revealing their semi–detached nature. On the light curve this means that it forms a more or less horizontal line between eclipses, although quite often (as in the case of the prototype, Algol (β Persei) itself) there is a steady rise in brightness leading up to the secondary eclipse and a steady drop in brightness as the system moves towards the start of the primary eclipse. This may be explained as a reflection effect, the hotter star progressively "lighting up" the earthward facing side of its cooler companion as it moves in to eclipse it, and vice versa following the eclipse.

Depending on the relative temperatures of the two components of an Algol system, the two minima may be equally deep or they may differ markedly. If the eclipse is central (not just grazing) and the stellar radii are similar, the minimum will be sharp. If the eclipse is central, but the stellar radii differ widely, there will be a period of constant light diminution (horizontal line) in both minima.

A representation of various types of light curves, orbits and eclipse configurations is given in figure 8.4. The above description of an Algol light curve may also be compared with that of RR TrA, given in chapter 9.

The components of Algol systems are normally of spectral type B8 to M1, while the period is normally P > 0,4 days (Wolfschmidt, 1980).

Although Algols were initially defined purely empirically according to their light curve shape, the designation has since come to be associated with a physical definition. Plavec (1989) talks about "Algols, or more accurately semidetached binary systems with non–degenerate components, similar to Algol ..." (p ix). In the same vein, Guinan (1989) describes Algols as semi–detached binaries with a hot (B to F) nearly spherical primary and a cooler, less massive companion. The companion fills its Roche lobe after having evolved off the main sequence first and having transferred much of its initially greater mass to its now more massive companion.

Algols are considered to be especially interesting objects for several reasons. One is the fact of active mass transfer and mass loss, and of course the associated accretion disk formed around the detached component, as discussed for example by Smak (1989). Another interesting aspect is the position of Algols in stellar evolutionary history and the search for probable precursors and progeny, as undertaken, for example by De Greve (1989).

8.3.3 β Lyrae systems

In the case of β Lyrae systems (type EB) the light curve has a rounded character and the eclipses are not equally deep (see figure 8.4), indicating a difference in the surface temperatures of the two components. However, the maxima are sometimes also not equally bright. This phenomenon of asymmetry at maximum is called the O'Connell effect and has been explained by rotation of the individual stars and the presence/absence of star spots on the earth–facing side (Milone et al., 1987).

In the case of β Lyrae systems, the spectral types of the components usually fall in the range B8 to G3, while the periods are given by P $>$ 0,4 days(Wolfschmidt, 1980). Nowadays β Lyrae is no longer considered to be a prototype, but merely an example of a particular type of Algol system referred to as a Serpentid (Guinan, 1989).

8.3.4 W UMa systems

W UMa systems (EW) are particularly interesting in the context of this study as their contact nature and consequent short periods made them particularly suitable for purposes of testing the system with maximum gain per hour of observation. Consequently, two (possibly three) of the four eclipsing binaries chosen for this study are W UMa systems (RW PsA, BF Pav and possibly V759 Cen). For this reason W UMa systems will be discussed in slightly more detail than the Algols or β Lyrae systems.

In the case of W UMa systems the light curve is sinusoidal, with a constant light variation, in other words the beginning and end of an eclipse cannot be determined exactly. This occurs because, apart from the light variation due to eclipses, there is a secondary light variation due to orientation effects because of ellipsoidal distortion of the stellar shapes (see section 9.3.1.1). The light curves often show asymmetries which are partly variable with time. For example there may be varying heights at maximum (as mentioned previously for β Lyraes). The approximately equal depth of the two minima is characteristic of W UMa systems. Usually the difference between the two minima is no more than 0,1 to 0,2 magnitudes at most, while the mean amplitude is 0,75 magnitudes. Together with the short periods of under one day, these characteristics of the light curve indicate a contact system where the two components have more or less the same surface temperature.

W UMa systems are further classified into A and W types on the basis of whether the primary minimum is caused by transit or occultation (Binnendijk, 1970). In general the A types have earlier spectral types (about F8 to G0), their (B – V) values are < 0,59 mag and their temperatures higher than 6000K. Their mass ratio may be smaller than 0,54, yet there is usually not much of a temperature difference between them, although the smaller star may be slightly cooler. Thus the primary minimum results when the smaller star transits the larger and slightly hotter one. According to Whelan (1972) the W types are somewhat more numerous. In this case it is the smaller star which is the hotter, but simultaneously the less massive star and so the primary minimum occurs when it is occulted by the larger but cooler companion. In W types the spectral types are later than F8, with (B – V) values > 0,54mag. The mass ratio is usually greater than 0,3 and the temperature difference may be as much as 300K in favour of the less massive component. This is explained in terms of magnetic fields leading to star spots which cover up to 20% of the surface of the secondary (Eaton et al., 1980). Such star spots may even lead to flare activity which may explain nightly variations in the mean light curve. W Uma systems are also especially interesting because of the common circumstellar envelope in which they are enclosed.

Summary

In summary then, eclipsing binaries are also close binaries with the orbital plane aligned with the line of sight to earth. The smaller the orbit the greater the chance that an eclipse will be visible from earth. Although the primary light

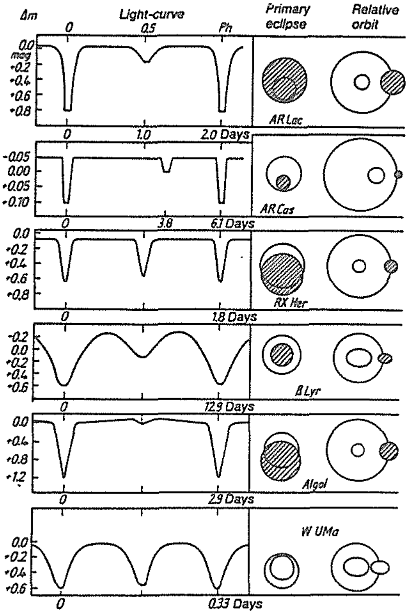


Figure 8.4: Light curves, orbits and eclipse configurations of various types of eclipsing binaries (Adapted from Hoffmeister et al., 1985)

variation in the case of eclipsing binaries occurs because the light from one star is periodically cut off when the other star passes in front of it, the very closeness of the stars leads to physical interactions between them which in their turn lead to variations in the light curve. Because of their suitability for aperture photometry, eclipsing binaries were chosen for the observational testing of the Unisa photometric system.

CHAPTER 9

LIGHT CURVES OF ECLIPSING BINARIES OBTAINED AT THE UNISA OBSERVATORY

9.1 Choosing the programme objects

The programme objects were chosen by declination, right ascension, magnitude and period.

As the Unisa Observatory is situated at -25^{O} 46', with the main campus lights and more especially the city lights to the North, this dictated that the declination be South of 25^{O} if at all possible. Only in one case (RW PsA at -27^{O} 06') did the star pass nearly overhead. The other programme objects ranged between -47^{O} and -62^{O}. The advantage of more southerly declinations is of course that the stars become more nearly circumpolar and so remain visible for longer periods of time.

Experience showed that the summer rainy season seldom allows photometric conditions between November and March at this site. Suitable programme objects visible during these months had to be abandoned one after the other as the months passed. Only towards the end of April was aperture photometry a feasible proposition weatherwise. Towards the end of September conditions turned unfavourable again (a somewhat unusually early onset of the next rainy season), but by then light curves had been obtained for the four programme objects. In order to be able to get as many observing hours as possible on a particular object on the same night, an attempt was made to select objects of which the right ascension caused them to be as close as possible to midnight culmination on those nights scheduled for observing. (Unisa students are part–time students, employed full–time in fields not usually related to their studies at all, so every clear night cannot necessarily be used as an observing night. Observing nights must be fitted in between other duties because, in the case of Unisa students, their studies do not constitute their prime responsibility). The right ascension of programme objects varied between 14^h for V759 Cen and 22^h for RW PsA, the former having been observed in early June and the latter during mid–September.

Once light curves had successfully been obtained for a 7th to 8th magnitude star (V759 Cen) it was decided to go somewhat fainter and RR TrA at 10th to 12th magnitude was selected and observed successfully. BF Pav at magnitude 12,8 to 13,4 proved to be beyond the system's limits and so RW PsA was observed (at 11th magnitude) to try to determine the system limits more exactly.

Finally, the periods of the eclipsing binaries were chosen so that two or three nights of observation would be sufficient to obtain a complete light curve. This implied periods of under a day, but not too close to either 1,0 or 0,5 days as this would mean that the same phase of the period would occur night after night. The periods varied between 0,17 days in the case of BF Pav and 0,7131 in the case of the Algol system RR TrA.

9.2 The observing sequence

In all cases the following observing sequence, which normally took about 80 minutes to complete, was followed: SCVVVVCVVVVCKVVVVCVVVV, where S means "standard", C is "comparison star", K is "check star" and V is the variable. An appropriate sky measurement was performed following every filter set done on any of the stars. Integration times for stars were 4 x 10s = 40s in each of the Johnson U, B and V filters, while for the sky measurements single 10s integrations were done in each filter. It should be noted that four successive filter sequences were done on the variable between each comparison star measurement. This was because of the short period of the variable in all cases. It was found from experience that, for example, successive measurements of standard, comparison and check could mean that an entire minimum was missed. Similarly, moving to a comparison or check star between each two variable star measurements would mean considerably fewer data points for the programme object. The standard was measured only once in each observing sequence as listed above. This meant one extinction measurement every 80 to 90 minutes, which is less than ideal. Consequently, whenever magnitudes and colours for comparison and check stars were well determined, these were also included for purposes of first order extinction determination.

9.3 The light curves

9.3.1 V759 Cen

9.3.1.1 Background

The binary nature of V759 Cen (HD 123732) was first discovered by Bond (1970) when he decided to observe photometrically a number of southern stars that showed diffuse or double lines spectroscopically. Sistero and Castore de Sistero (1975) first determined its period to be 0,3939513 days (from times of minima determined by UBV photoelectric photometry). As the amplitude of the eclipse is only 0,2 magnitudes deep and the two minima are very similar, the system has been variously classified as a W UMa system (Bond, 1970) and an ellipsoidal system (Sistero et al., 1990), the latter referring to systems where the orbital plane is so aligned that the stars do not eclipse each other, but small variations in magnitude nevertheless occur because both stars are distorted into ellipsoids as a result of their mutual gravitation and so radiate more light in the direction of earth when their elongated sides lie perpendicular to the line of sight than otherwise.

Bond (1970) provides a light curve for V759 Cen in the y filter of the Strømgren uvby system, at the same time indicating the corresponding Johnson V magnitudes (see figure 9.1), while Sistero et al.,(1990) provide an improved period of 0,39399903 days. The star's spectral type is variously given as F8 to G0V, while its V magnitude at maximum is given as between 7,4 and 7,6.

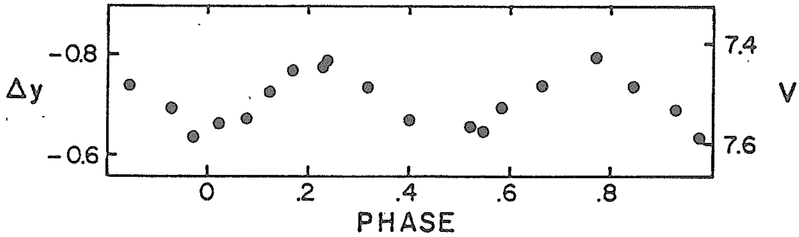


Figure 9.1: **Light curve of V759 Cen in Strømgren y, with Johnson V magnitudes also given** (From Bond, 1970)

9.3.1.2 Observations and results

Some preliminary remarks: Several nights of observation were done on V759 Cen as well as another object, RR Cen, during May 1993. Only when it was possible to reduce the data and obtain light curves, did the suspicion arise that, although everything appeared to be functioning perfectly, in fact the filter slide had been stuck in the U position throughout, and that all the light curves were in fact U light curves. The light curves obtained for RR Cen are reproduced in Appendix 4, purely as an illustration of the good quality of the U measurements, as mentioned previously in chapter 2.

When the problem with the filter slide had been rectified, it was decided to repeat observations on only one object in the 7 to 8 magnitude range and V759 Cen was chosen to be observed again on 14 and 15 June 1993. The raw data as well as the reduced data may be found in Appendix 5, while the light curves are reproduced here in figure 9.3. Table 9.1 gives the particulars for the programme star, its comparison and check stars and the Johnson standard observed, while a finding chart for V759 Cen is given in figure 9.2.

	Object	RA	Dec	V	B	B–V	U–B	Spec
V	V759 Cen	14 07 29	–47 32 00	7,5	7,7			F8
C	HD123794	14 07 46	–46 40 32	7,6	8,2			F2
K	HD123432	14 05 42	–48 08 50	7,6	8,7			K0
S	HR5401	14 23 58	–45 54 33	5,82		0,31	0,14	A3

Table 9.1: V759 Cen, comparison, check and standard stars (Epoch: 1950,0)

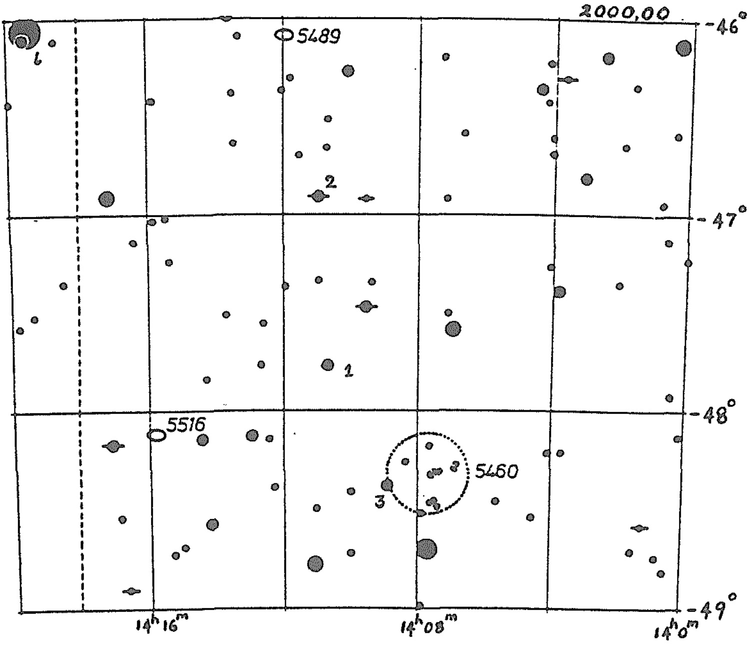


Figure 9.2: Finding chart for V759 Cen (1), HD123794 (2) and HD123432 (3)

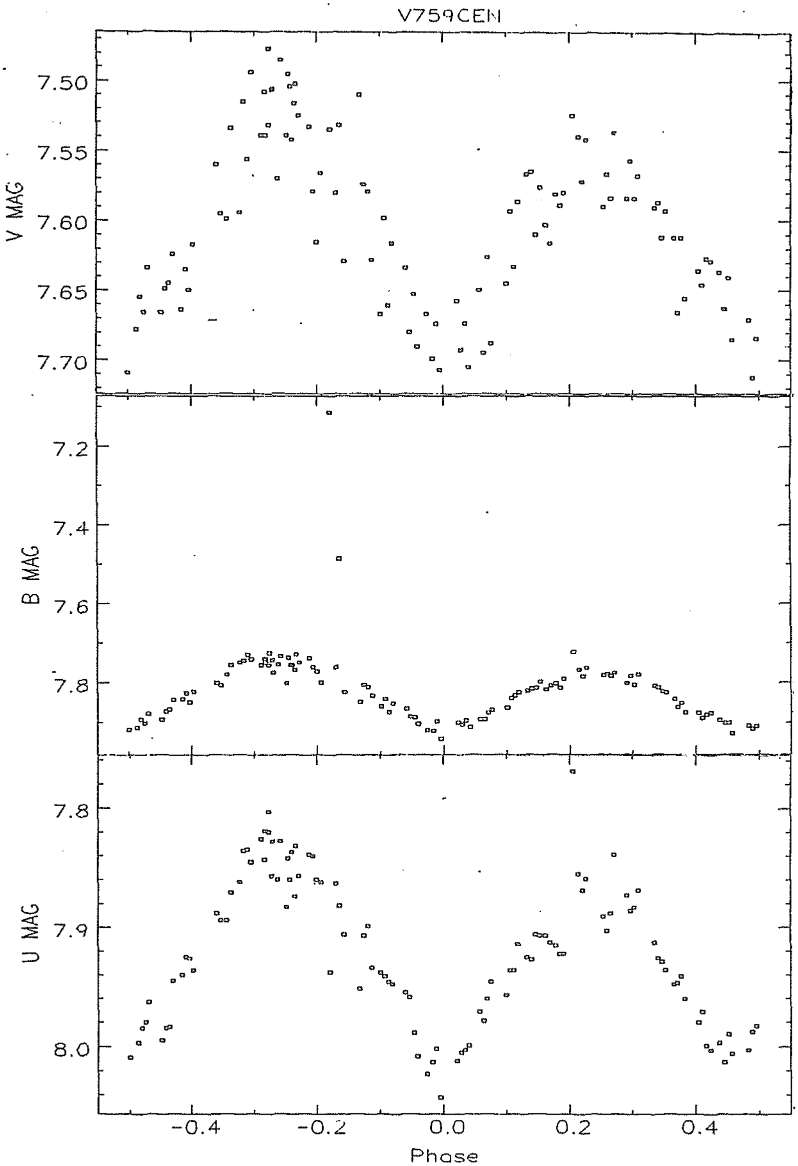


Figure 9.3: UBV light curves for V759 Cen

9.3.1.3 Discussion

The U, B and V light curves for V759 Cen are displayed in figure 9.3. All the figures are phase–folded plots, with standard Johnson UBV magnitudes plotted against phase where 0.0 represents primary minimum. Note the following:

(1) All the light curves show an amplitude of approximately 0,2 magnitude, in accordance with the results obtained elsewhere.

(2) The minima are approximately equal (as expected) but the maxima differ consistently by about 0,02 magnitudes. As the scatter is generally greater than this value, the apparent difference may not be real. However, on close inspection of the light curve of Bond (1970), it appears that the maximum immediately following primary minimum is depressed by about 0,01 magnitudes relative to the other – and this is the same maximum which appears depressed in the present results. It may also be noted that the almost triangular or pointed shape of the light curves obtained with the Unisa system, is also found in the light curve by Bond.

(3) The scatter is greater in the V filter (about 0,07 mag) than in the U filter (about 0,03 mag). Generally the scatter in the B filter is about 0,04 mag, but spurious data points are depressing the curve. The greater scatter in the V light curve may be explained by either or both of the following factors: (a) poor tracking by the telescope causing the star to move out of the diaphragm on the last measurements in the filter sequence (which happen always to be the V measurements); and (b) the variable sky background, which can – especially in the visual region of the spectrum – change in a splitsecond when street lights or the spray lights on sports fields or security lights for buildings are switched on or off. This means that a sky measurement taken immediately after a star measurement, does not necessarily reflect the same sky conditions as prevailed during the star measurement. Perusal of the (unedited) raw output data file VP930614 in Appendix 5 shows how, exactly at 17:00 UT a campus light was switched off, right in between the star and sky measurements. This particular data point was edited out before reductions and does not appear in the final reduced file 2V759–CEN.DAT (also in Appendix 5. Note the "2" in front of the file name.

This is because the "all–ultraviolet" results are on V759–CEN.DAT). Although poor tracking of the telescope (in certain positions) may have some effect, it is probably not a major cause of the scatter in V. Whenever there was doubt about a V measurement, it was repeated, followed immediately by sky measurements. The most likely cause for the large scatter in V is the rapidly varying sky background because of the city lights which radiate mainly in the visible region. A progressive, marked drop in the V counts from the first to the last of the four 10s integrations is often noticed, leading to the suspicion that the star has moved out of the centre of the diaphragm. Sometimes this appears to be the case and the count is repeated, only to find that the V counts now remain constant at the *lowest* value previously obtained.

The spurious points are not easily explained. The actual counts during the sudden blue elevation may be seen in VP930615 in Appendix 5. It should be noted that the elevation is very sudden and then peters out over a period of approximately 10 minutes. It is also noteworthy that neither the U nor the V counts are in any way affected. As already mentioned previously (in section 7.3.1) such exaggerated counts have been observed in the blue filter even when a dummy run was done, with the filters moving and the photometer counting, but the diaphragm closed (in other words, dark counts). The hypothesis put forward in section 7.3.1, namely about Ohmic leakage when a very specific physical configuration occurs, requires long term record keeping before it can be accepted or rejected.

(4) The V mag varies between about 7,48 and 7,71, in other words about 0,23 magnitudes, the excess being explainable in terms of the scatter. However, the V mag also corresponds quite well to the values of 7,4 to 7,6 and 7,6 to 7,8 obtained elsewhere (see section 9.3.1.1). In fact, it corresponds nearly perfectly with the value obtained from the CSI Catalogue accessed through the programme "CHART" at the South African Astronomical Observatory in Cape Town. This is the source of the magnitudes, spectral types and coordinates for variable, check and comparison stars given in table 9.1. The slightly fainter B magnitude, varying between about 7,7 and 7,9, is consistent with the spectral classification (F8), as is the even fainter U magnitude varying between 7,80 and 8,02.

(5) The signal–to–noise ratio in each filter was calculated on the basis of a 40s integration and gain of 100, using the mean of the highest and lowest counts (minus sky) obtained in the particular filter. For V759 Cen, $S/N > 100$ in all cases.

9.3.2 RR TrA

9.3.2.1 Background

RR TrA is classified as an Algol system on the basis of its light curve and according to Chambliss (1984) represents a semi-detached system of unusually small dimensions. The spectral type of the primary is given as B8, the period as 0,7131 days and the Johnson V magnitudes at maximum and primary minimum respectively as 10,57 and 12,34. The cool component was given as spectral type F5 by Koch (1973), but Li and Leung (1987) disagree and consider the secondary to be an evolved, mass-losing, F0IV star. The system's variability has been known since early in this century, but light curve analyses were done only much later, starting with Kwee et al. (1957), then Giuricin and Mardirossian (1981) and, even later, Chambliss (1984). Wood et al. (1980) give the depth of the secondary minimum as 0,1 magnitude. Yellow and blue light curves may be found in Kwee et al. (1957) and U, B and Y light curves in Li and Leung (1987). These light curves are reproduced in figure 9.4a and b respectively.

9.3.2.2 Observations and results

RR TrA was observed on 18, 19, 21, 22 and 25 June 1993. The raw data as well as the reduced data may be found in Appendix 6, while the light curves are reproduced here in figure 9.6. Table 9.2 gives the particulars for the programme star, its comparison and check stars and the Johnson standard observed, while a finding chart for RR TrA is given in figure 9.5.

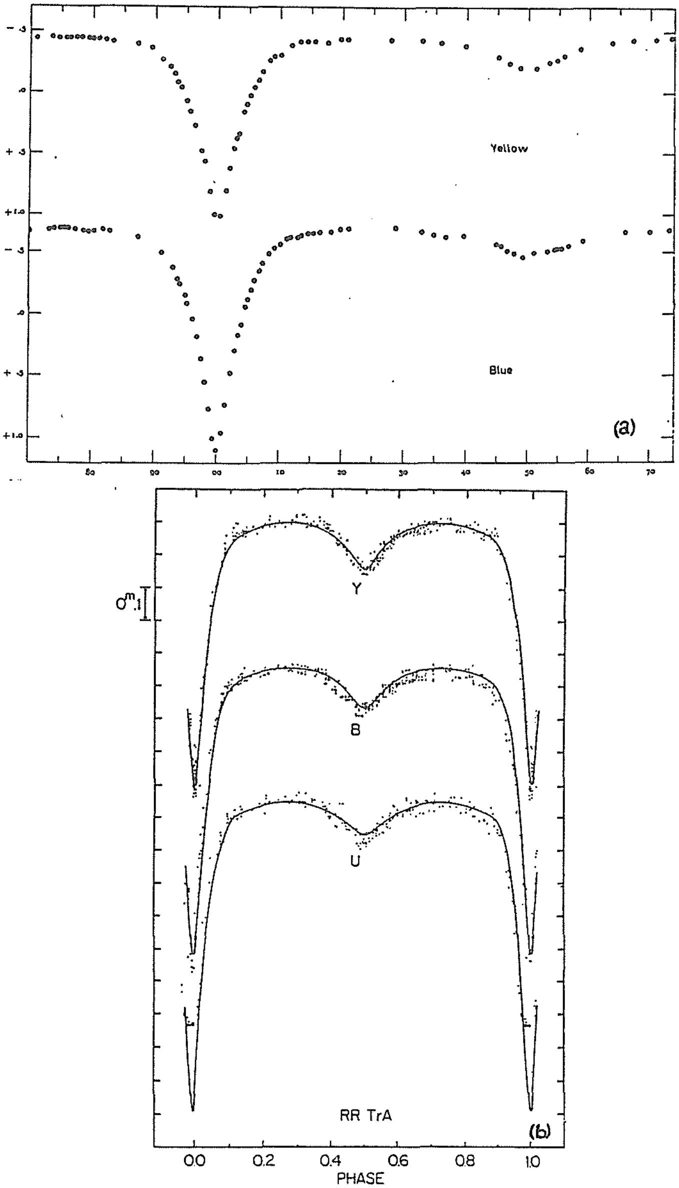


Figure 9.4: Light curves of RR TrA [(a) from Kwee et al., 1957; (b) from Li & Leung, 1987]

	Object	RA	Dec	V	B	B–V	U–B	Spec
V	RR TrA	16 13 51	–62 36 56	10,6	10,2			B8
C	HD146022	16 13 20	–62 26 46	10,2	10,3			B9
K	HD146485	16 15 49	–62 00 37	10,2	10,3			B9
S	HR6070	16 15 12	–28 29 29	4,77		0,02	–0,01	A0

Table 9.2: RR TrA, comparison, check and standard stars (Epoch: 1950,0)

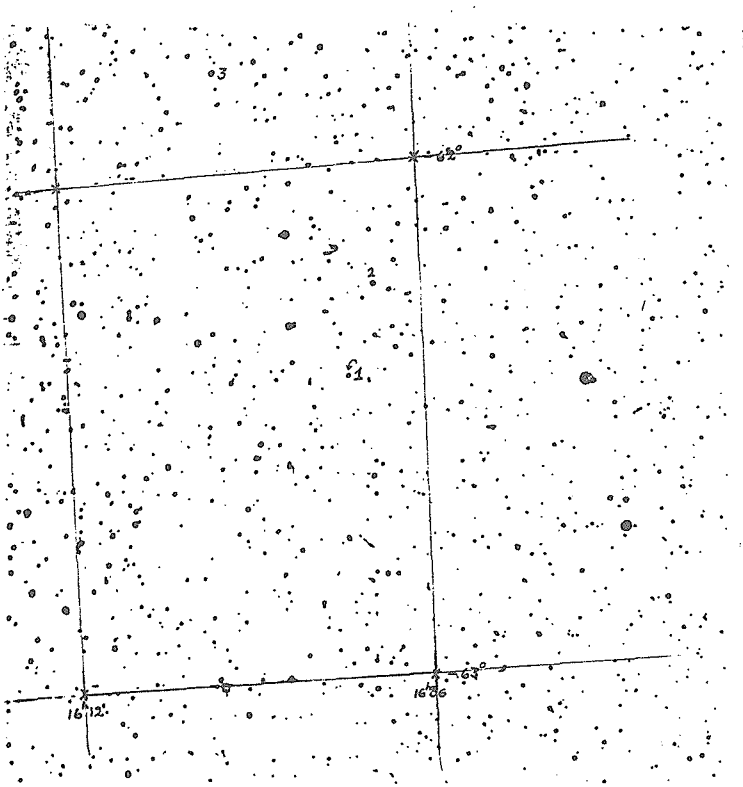


Figure 9.5: Finding chart for RR TrA (1), HD146022 (2) and HD146485 (3) (Epoch: 1875,0)

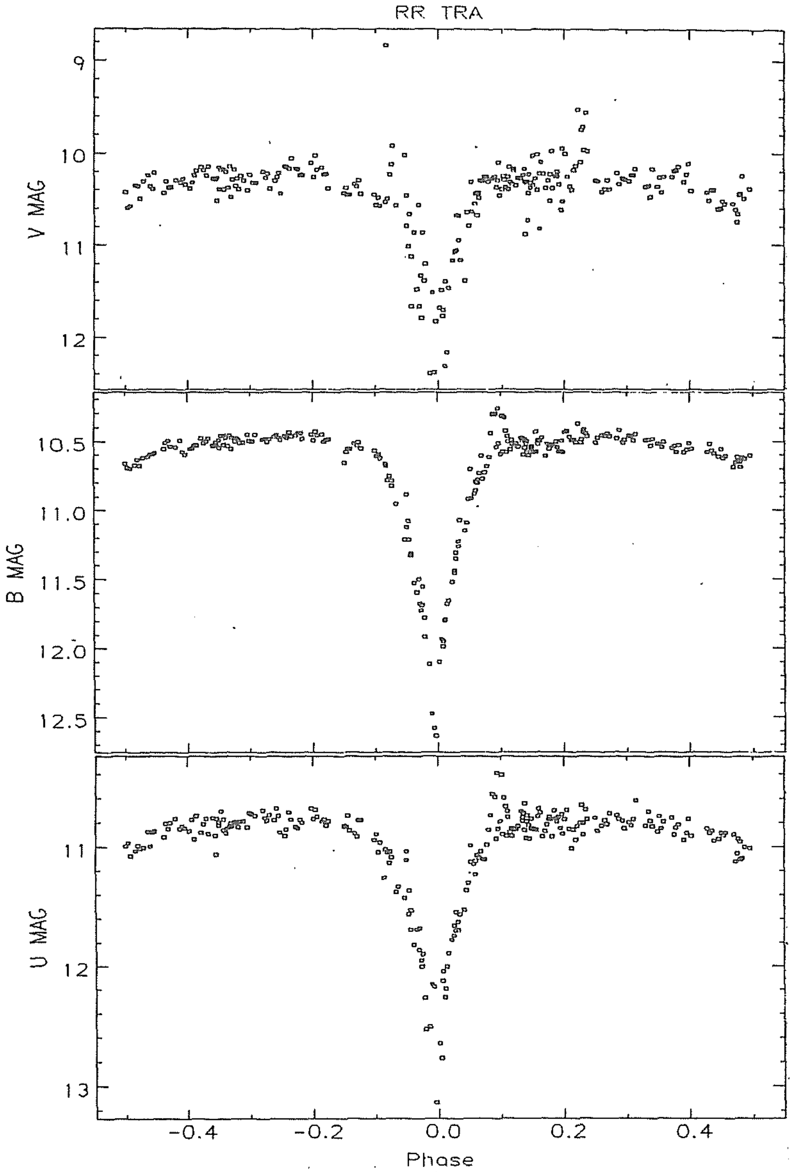


Figure 9.6: UBV light curves for RR TrA

9.3.2.3 Discussion

The phase-folded light curves for RR TrA in Johnson UBV magnitudes are displayed in figure 9.6. Note the following:

(1) The amplitude of the primary minimum is given by Wood et al. (1980) as 1,8 mag in V, with the V maximum at 10,6. The SIMBAD facility at the University of Strasbourg, France, gives an amplitude of 1,77 mag (10,57 to 12,34, also presumably in V). However, the Unisa results show a somewhat larger amplitude – possibly because at primary minimum the star is actually too faint for the system. This explanation seems to be supported by the observation that the amplitudes grow steadily larger from V to B to U. For V the variation is from 10,3 to 12,4, ie 2,1 mag. For B it runs from 10,5 to 12,7, ie 2,2 mag. And finally, for U it varies from 10,8 to 13,1 mag, ie a 2,3 mag amplitude.

If these results are now compared with the UBY light curves of Li and Leung (1987), the exact opposite is seen in terms of a progression in the amplitude at primary minimum. In their light curves, the U minimum is 1,78 mag deep, the B minimum is 0,87 mag deep and the Y minimum only 0,80 mag deep. Even though the two filter systems are not the same, nevertheless one would expect the same tendency in UBY as seen in UBV. This contrast in the results obtained with the two systems could lead one to consider the Unisa results with unwarranted suspicion, were it not that the light curves of Kwee et al. (1957) show a larger amplitude in blue than in yellow (similar to the present results) and also, considering the spectral types involved (B8 and F0), one expects a larger fractional loss of shorter wavelength light rather than longer wavelength light at primary minimum.

(2) The amplitude of the secondary minimum is 0,15 mag in B and V but 0,2 mag in U. This may be compared with the light curves of Li and Leung (1987) which likewise show a secondary minimum 0,15 mag deep in B and Y, but only 0,1 mag deep in U. A depth of 0,1 mag in V is the value given in Wood et al. (1980).

(3) The absolute magnitudes at maximum in the Unisa light curves are about 0,2 to 0,3 magnitudes brighter than the Wood et al. (1980) values or those registered

with SIMBAD. However, such discrepancies seem to be not uncommon between various data sets – compare, for example, the 0,2 mag discrepancy between the values found by various authors for V759 Cen.

(4) As in the case of V759 Cen, the light curves for RR TrA show the greatest scatter in V – about 0,42 mag in V versus about 0,22 mag in U and 0,14 mag in B.

(5) Because of the large brightness difference between maximum and primary minimum, the signal to noise ratio (and the associated magnitude error) was calculated for each filter for a 40s integration at gain 100, once for the highest counts and once for the lowest. At minimum this gave for the magnitude errors in U: $\pm$0,066; B: $\pm$0,023; V: $\pm$0,036; while at maximum it yielded U: $\pm$0,031: B: $\pm$0,012; V: $\pm$0,019. Clearly this can in no way account for the observed scatter. However, it is not to be expected either, as the S/N accounts only for so–called "photon noise" (which in itself is a misnomer in a DC system).

Note that the above magnitude errors were calculated using the formula in Henden and Kaitchuk (1990):

$$\Delta m = -2{,}5 \log [(c \pm c/\sqrt{N})/c],$$

where c is the mean number of counts and $\sqrt{N}$ is the signal to noise ratio. This calculation is of course only strictly applicable to a pulse counting system, but was employed here on the assumption that the very high linearity of amplification and voltage–to–frequency conversion claimed by the manufacturers of the SSP–5A indeed holds. If the formula for the S/N for DC systems using a V/F converter advocated by Henden and Kaitchuk (1990) is used, namely

$$S/N = \bar{c}/(s.d)$$

where $\bar{c}$ is the mean count and s.d. the standard deviation from a number of short integrations, then to a large extent it can be considered that the programme IREX already checks for an unacceptable S/N. It may be recalled that IREX finds the mean of the four 10s integrations in one line of data and checks for any deviations of 3% or larger, thus an S/N of 3% would at any rate be picked up immediately. Defined in this way, an unacceptable S/N could certainly not be the cause of any untoward scatter in the data.

(6) The light curve for RR TrA is considered a good test for the system, as it not only tests the system's response over a quite wide magnitude range, but also its sensitivity in picking up a small magnitude difference (a secondary minimum only 0,1 to 0,2 mag deep) at a standard magnitude between 10 and 11, which is reasonably faint for the system and the site. As both primary and secondary minima can be clearly seen, even in the V light curve, the system may be considered to have "passed" the test.

9.3.3 RW PsA

9.3.3.1 Background

According to Chambliss (1970), who also supplies a light curve in Y and B (see figure 9.7), RW PsA was first discovered to be variable by Hoffmeister on the basis of photographic observations made in Namibia (then South West Africa) in 1952–53. Chambliss' own photometric observations in 1969 yielded W Uma type light curves and a period of 0,3605 days. However, there does not seem to be clarity yet about the mass ratio of the two components (Van't Veer, 1978), whether it is an A or W type system and its associated evolutionary status (Van Hamme, 1982a, 1982b; Maceroni et al., 1985) including whether it is a thermally decoupled W Uma system (Lipari & Sistero, 1988) or in the phase of broken contact (Mochnacki, 1981).

Chambliss (1970) considered RW PsA to be of spectral type G6 with a V maximum of 11,05. The depths of primary and secondary minima found by him were 0,72 and 0,59 mag respectively in yellow light and 0,77 and 0,61 mag respectively in blue. SIMBAD gives the light variation in V as 11,3 to 11,8 mag, with approximately equal minima and a G8 spectral type.

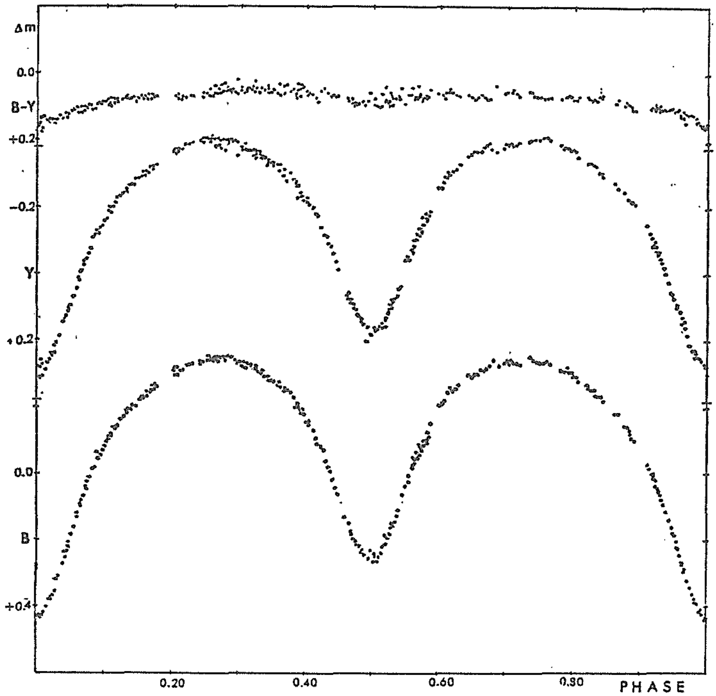


Figure 9.7: Light and colour curves for RW PsA (From Chambliss, 1970)

9.3.3.2 Observations and results

RW PsA was observed on 13 and 14 September 1993. The raw data as well as the reduced data may be found in Appendix 7, while the light curves are reproduced here in figure 9.9. Table 9.2 gives the particulars for the programme star, its comparison and check stars and the Johnson standard observed, while a finding chart for RW PsA is given in figure 9.8.

	Object	RA	Dec	V	B	B–V	U–B	Spec
V	RW PsA	22 06 55	–27 18 46	11,3	11,3			G8
C	HD210299	22 07 08	–27 11 21	10,9	11,6			G0
K	HD210427	22 08 02	–27 08 20	10,5	11,9			G0
S	HD213457	22 29 14	–43 31 14	6,91		0,98	0,77	G5

Table 9.3: RW PsA, comparison, check and standard stars (Epoch: 1950,0)

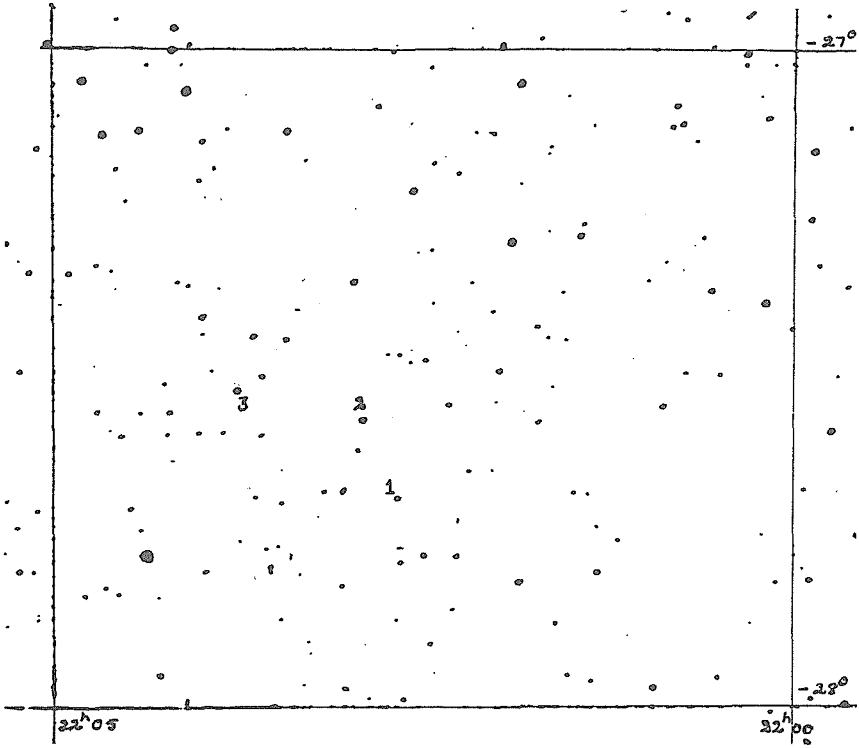


Figure 9.8: Finding chart for RW PsA (1), HD210299 (2) and HD210427 (3) (Epoch: 1875,0)

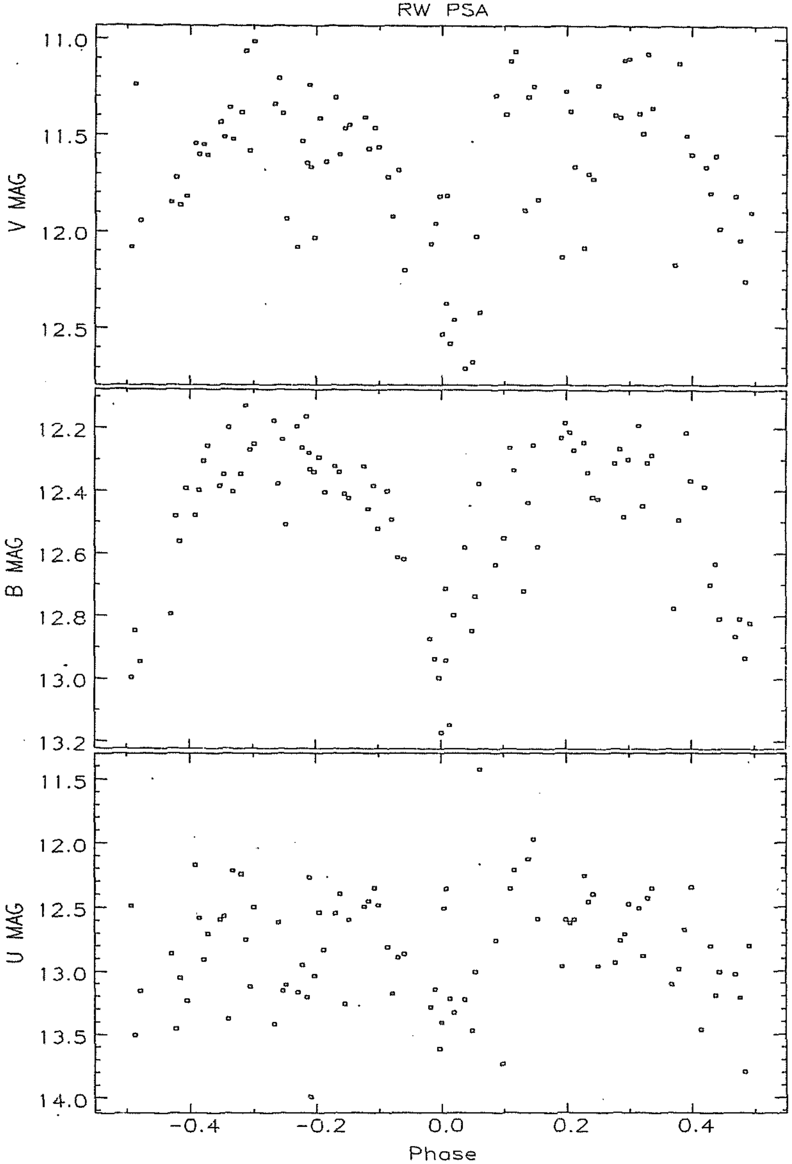


Figure 9.9: UBV light curves for RW PsA

9.3.3.3 Discussion

The UBV light curves obtained with the Unisa system are displayed in figure 9.9. Note the following:

(1) The very large scatter, especially in V and U. In U the scatter of about 0,90 mag is so large that only vague indications of the minima may be discerned, but the light curve is essentially worthless. V is slightly better, with a scatter of approximately 0,42 mag and reasonably clear minima and maxima, but a number of apparently spurious data points. The B light curve, with a scatter of about 0,26 mag is considerably better, but also contains apparently spurious data points.

(2) At maximum the V mag corresponds quite well to the value of 11,3 given by SIMBAD. However, the depths of both minima are exaggerated: 1,2 and 0,9 mag approximately, versus the 0,72 and 0,59 given by Chambliss (1970). No standard B magnitudes are available in the literature for comparison, but the amplitude in B corresponds quite well to that obtained by Chambliss (1970): 0,80 and 0,60 mag in the Unisa light curves, versus 0,77 and 0,61 mag in the Chambliss results.

(3) It appears that the system limits have been reached in the case of the B measurement and passed in the case of the V and U measurements. It is interesting to note that these limits fall almost exactly where they would be predicted on the basis of an S/N calculated by the method mentioned previously in connection with V759 Cen and RR TrA, where the counts over a 40s integration at gain 100 were treated as if they were the product of a pulse counting system. Referring back to figure 3.8 in chapter 3 where the saturation levels at each gain scale and using a 1s integration time are indicated for the SSP–5A photometer for B and V filters and using a 28cm (11 inch) telescope, it is also possible roughly to determine the magnitudes at which 10000 counts will be obtained through the B and V filters over a 40s integration at gain 100 with the 35cm telescope. With any telescope, 250 counts per second will give the required 10000 counts in 40s. Taking into account the greater light gathering power of the 35cm telescope, it will register 250 counts per second (the requirement for an S/N of 100) when the 28cm registers only $250 \times (11/14)^2 = 154$ counts. The corresponding magnitudes may now be read off from figure 3.8, using the column for the gain of 100. The cutoff for the B filter is at about mag 12,5, while for V it already occurs at about mag 11,0.

9.3.4 BF Pav

9.3.4.1 Background

BF Pav is a W Uma system for which a part period was already obtained by Hoffmann (1984), but with only one minimum. Both minima were obtained by Spencer Jones (1988) at the South African Astronomical Observatory and the resultant light curves in Johnson B and V are displayed in figure 9.10. The values given by Wood et al. (1980) and SIMBAD are magnitude 12,8 to 13,4 for the light variation in V, a period of 0,170 days and spectral type unknown. As is usual for a W Uma system, the minima appear to be more or less equally deep. This system is an example of a contact system with an extremely short period (just over four hours).

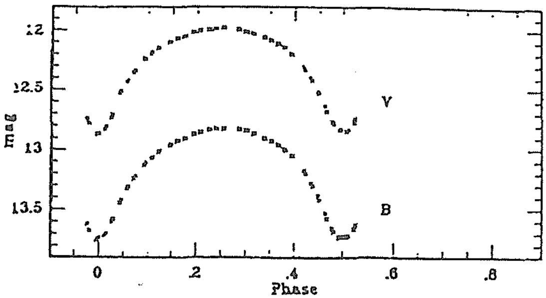


Figure 9.10: B and V light curves of BF Pav (From Spencer Jones, 1988)

9.3.4.2 Observations and results

BF Pav was observed on 21 August 1993. The raw and reduced data are in Appendix 8, while the light curves are reproduced in figure 9.12. Table 9.3 gives the particulars for the programme star and the Johnson standard observed, while the finding chart in figure 9.11 also shows the comparison and check stars used.

	Object	RA	Dec	V	B–V	U–B	Spec
V	BF Pav	18 41 10	–59 41 48	12,8			
S	HD189563	19 59 04	–45 20 10	6,57	1,22	1,22	K0

Table 9.4: BF Pav and Johnson standard (Epoch: 1950,0)

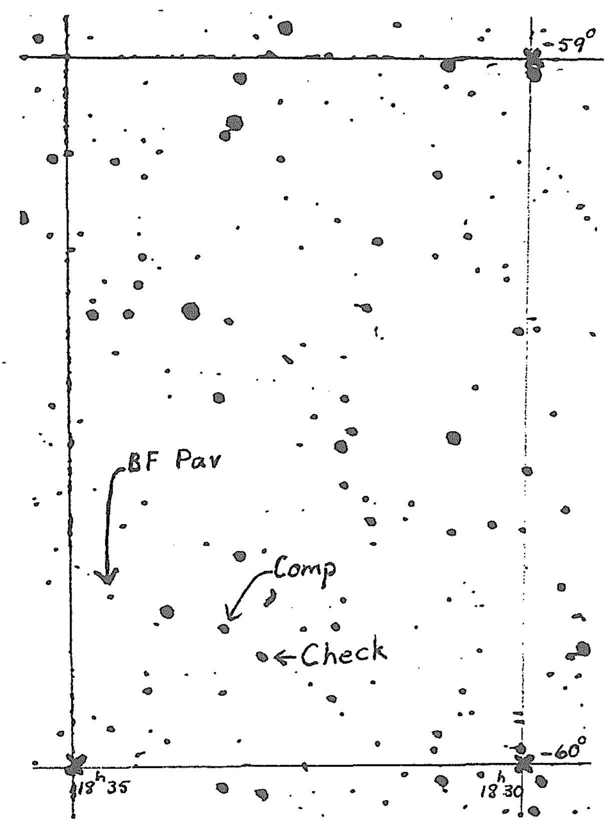


Figure 9.11: Finding chart for BF Pav, showing check and comparison stars (Epoch: 1875)

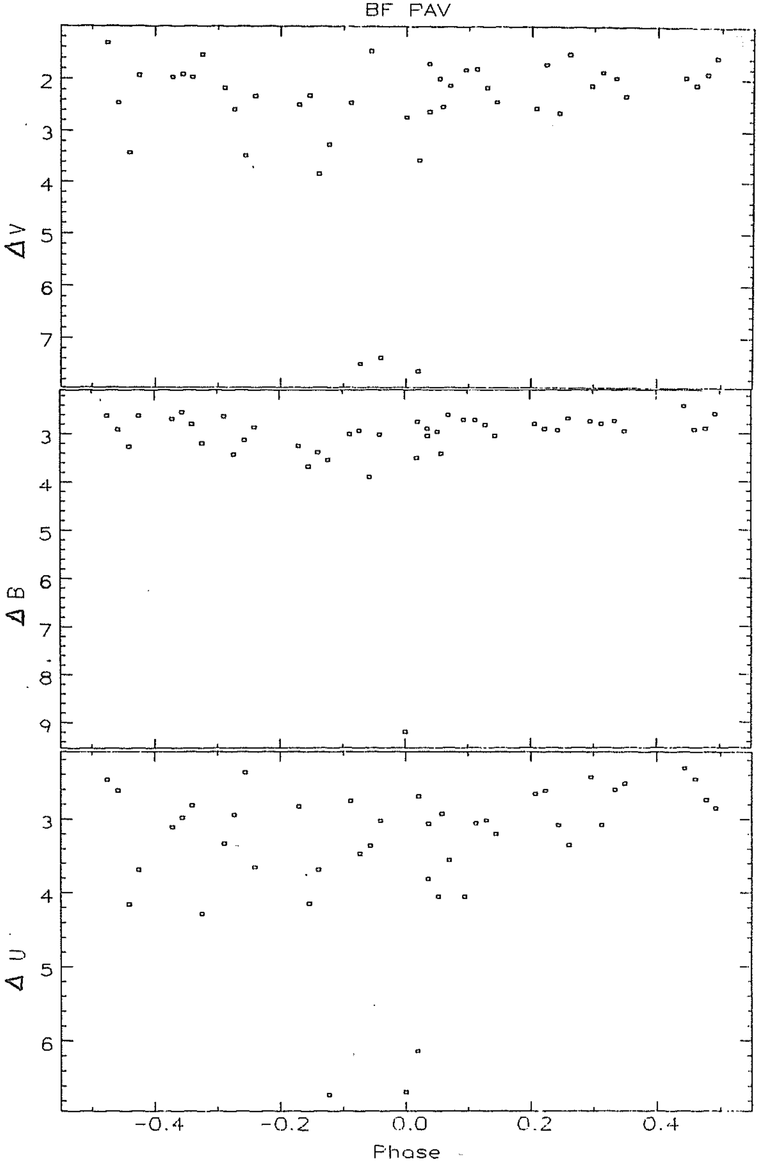


Figure 9.12: UBV light curves for BF Pav

9.3.4.3 Discussion

The light curves obtained for BF Pav appear in figure 9.12. These were done after the observation of RR TrA, as BF Pav was then convenient in terms of midnight culmination. It was clearly beyond the system limits and so RW PsA was observed afterwards, in order to determine these limits more exactly. Nevertheless, the following is noteworthy about the BF Pav light curves:

(1) The magnitudes given for BF Pav are not actual magnitudes, but magnitude *differences* between it and the comparison star for which the Johnson magnitudes were not known. In such a case the final reduction programme reduces everything to a magnitude difference in the sense "variable minus comparison" (see section 6.8).

(2) Before the data could be reduced at all, several data points had to be edited out as the star–plus–sky counts were lower than sky alone. Although BF Pav was at all times visible in the photometer eyepiece (although sometimes very faint) its signal is clearly drowned out by sky background noise due to the large diaphragm size (100"). It should also be noted that the observing night was chosen as close to new moon as possible, to give the system the best chance for a relatively dark sky. Clearly, the Unisa system cannot cope with magnitudes beyond about 12,5.

Summary

Light curves were obtained for four eclipsing binaries, ranging in magnitude from 7,4 (for V759 Cen at maximum) to 13,4 (for BF Pav at minimum). V light curves showed a large scatter even for the brighter objects. B light curves were considerably better and in fact quite good up to magnitude 12,5 approximately. As long as the object is still bright enough in U, the U light curves do not show the untoward scatter observed in V. The system limit in V seems to lie around 11th magnitude, while those in B and U are around mag 12,5 and 12,0 respectively.

CHAPTER 10

CONCLUSION

10.1 Limiting magnitudes for the Unisa aperture photometry system

The limiting magnitudes which may with success be observed photometrically with this system, differ for the various filter passbands. This is in large part due to the spectral response of the photomultiplier tube which is S–5 (see figure 3.6) and so has a higher quantum efficiency and spectral sensitivity in the ultraviolet and blue spectral regions than in the yellow and red.

The actual limits are set by

(1) the relatively small objective (35cm) of the telescope;

(2) the very large (100") photometer diaphragm which causes observations of faint stars to be drowned in sky light;

(3) the sensitivity of the PMT for the particular passband; and

(4) the bright, light–polluted sky at the site, which, in conjunction with (2), affects the signal to noise ratio adversely.

Judging from the light curves obtained for the Algol system RR TrA (see figure 9.6) and the W Uma system RW PsA (see figure 9.9), 11,0 should possibly be considered the limiting magnitude in V, 12,0 in U and 12,5 in B.

10.2 Problems and possible solutions

The Unisa aperture photometry system has had teething problems as is to be expected with any new system. This included such things as the computer–photometer cable which, when lengthened by the manufacturers, "got its wires crossed" in the literal sense and so could not convey the signal to move the filter slide. When this problem was solved, the slide itself got stuck in the U filter position and so a mass of unplanned, though excellent, ultraviolet results (see the light curves for RR Cen in Appendix 4) were inadvertently obtained. Such problems are transient. On the other hand, the Unisa system also has more serious drawbacks, of which at least some are soluble or, if not, then avoidable. These include the following:

(1) The inordinately large diaphragm size (100") cannot be changed, as the diaphragm is fixed inside the photometer. However, the image scale in the focal plane could effectively be halved by introducing a Barlow lens between telescope and photometer diaphragm, causing the diaphragm's field of view to be reduced to approximately 50". This solution will be practicable provided that, first of all, the Barlow lens plus the photometer housing fit between the rear mirror cell and the fork mount; and, secondly, a sufficiently sturdy and rigid attachment can be devised between telescope, Barlow lens and photometer. As the incoming light will have to pass through an additional glass lens, the spectral transmittance of the Barlow will have to be determined as it will also have its effect on the results obtained with the system.

(2) The tracking of the telescope is normally good, but when objects are observed in certain regions of the sky, for example low in the West, they may move out of the diaphragm within 60 to 120 seconds. This differential tracking accuracy, depending on the direction in which the telescope is pointing, is quite common, according to Sterken and Manfroid (1992). A quick calculation will give the percentage error in the tracking:

If a star were centred in the diaphragm and the telescope drive switched off, the star would take

$$[50''/(360 \times 60 \times 60)''] \times (24 \times 60 \times 60)s = 3{,}3s$$

to move from the centre to the edge of the diaphragm. In order to compensate perfectly for the earth's rotation, the drive must therefore move the telescope at a rate of 50" in 3,3s. Let us assume that the tracking is poor and that a star moves out of the diaphragm in 66s (the number being chosen for convenience of calculation). In order to keep the star perfectly centred for this period of time, the drive would have to move the telescope

$$(66/3{,}3) \times 50'' = 1000''.$$

However, if the star just moves out of the diaphragm after 66s, then the drive has either moved the telescope 1050" or only 950", in other words a tracking inaccuracy of 5%. Such a large error is extremely rare for the Unisa system. Where tracking errors do occur, the star usually reaches the edge of the diaphragm after about 100s, which implies a percentage tracking error of 3,3%.

There is evidence to suggest that the recoil from the action of the stepper motor which moves the filter slide, has a destabilising effect on the telescope drive when it is in a "vulnerable " position. It has on occasion been found to track a star perfectly for periods of 10 minutes and longer when all measurements were made in the same filter – and this in a position where the same star could not remain centred for even 120s when the filter slide was moved by its stepper motor for purposes of UBV photometry.

Two part–solutions may be possible: Determine the exact positions where the telescope tracking is less than ideal (over a period of time) and set up a graph or table from which future observers can read off whether it will be convenient to observe a particular object with multi–filter photometry at a particular time. A second part–solution may be to make considerably more use of single–filter photometry, where recoil from the action of the stepper motor is not a factor.

(3) Another problem is the rare, but very dramatic, abnormal elevation in the blue counts. Over a period of eight months and about forty observing nights, this phenomenon was observed on three occasions, each event lasting about ten minutes. If it is indeed caused by Ohmic leakage which occurs only when the telescope is in a certain position and the B filter is in place (see section 9.3.1.3), it may be

worthwhile to keep a record of the exact situation pertaining during each such event. Also, if it is in fact the result of Ohmic leakage, then regular reactivation of the desiccant should have a preventive effect.

(4) The large scatter in the V measurements may in part be due to the rapidly varying sky background in the visible region. However, the spectral response of the photometer and its varying sensitivity for different wavelength regions, generally favouring the blue and ultraviolet, may also contribute to the poorer light curve quality in V. Neither of these factors can be changed or removed. Possibly the only solution is to avoid relying heavily on V measurements for scientific data. In fact, wherever possible, V measurements might even be avoided completely.

(5) Whether atmospheric conditions are in fact optimal for aperture photometry, is not always obvious. A chart recorder or, better still, an oscilloscope which records counts after each 0,1s, could go a long way toward ensuring that photometry is only done when the conditions are actually photometric.

10.3 Possibilities of the system

Despite its drawbacks and disadvantages the aperture photometry system at Unisa may still be profitably used for research as well as teaching. As it is, it is capable of producing good light curves, especially in B and U, as long as stars are fairly bright. If the suggested modifications are implemented, notably with regard to a Barlow lens to decrease the field of view of the diaphragm, then it is possible that even fainter sources may be observed with success.

As mentioned in the previous section, single filter photometry may be a good option. When run in so-called "fastmode", as was done to obtain figure 2.4 where the diaphragm cutoff was tested, even a whole night of data (in any single filter) could be recorded without observer intervention. Or, even in "slowmode", repeated sets of integrations of anything between 1s and 4000s per integration could be obtained. With single filter photometry the options allowed by RPHOT become much more flexible and so the selected integration times can be adapted better to the object brightness.

For periodic variables, such as eclipsing binaries or the various classes of pulsating variables, single filter or multi–filter light curves can be obtained, provided the objects are reasonably bright. Both long and short period objects would be suitable.

Long term monitoring of objects subject to nonperiodic or quasiperiodic brightness variations such as flares or flickering, could be done. This is feasible because the competition for observing time is not strong and also because observation in "fastmode" allows uninterrupted measurements in any filter over long periods of time with a minimum of user interaction.

More generally, the Unisa Observatory could and should become actively engaged in cooperative projects with IAPPP, the International Amateur–Professional Photoelectric Photometry association, mentioned in chapter 1. Specific project suggestions, suitable for small telescopes at disadvantaged sites, abound in the IAPPP publications and could serve as an endless source of research ideas for future students and staff members.

As mentioned in the first chapter, the value of research work using small telescopes can easily be overlooked because of the dramatic advances in space based astronomy and the developments in large telescope optics. However, aperture photometry with a small telescope which is readily accessible and can be used for the study of those brighter objects which are not suitable for study with larger telescopes, or where lots of observing time over a long period is required, can make a real contribution, provided the objects and projects are chosen with care. In addition, the geographical location of the Unisa Observatory (in Africa, where telescopes and astronomers are few) can mean that it may sometime be a vital link in obtaining complete coverage of noteworthy astronomical events for which observatories at various longitudes are required. Also, being in the southern hemisphere where there has been an actual decline in the number of photometric studies during the previous decade (see chapter 1) the Unisa Observatory certainly has a role to play. As Hall (1986) concludes: " ... there are more stars than astronomers. Specifically, there are more relatively bright variable stars requiring photoelectric photometry by small telescopes than there are active observers with small telescopes equipped for photoelectric photometry – far more" (p 73).

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```
******* DPARMS.DAT - CONTAINS YOUR PHOTOMETER'S DATA-TAKING PARAMETERS *******
DTAK screen width, in columns       80
Photometer/computer/cabling set-up  A
I/O Port Address (e.g. 768)         768
SSP3CARD divide jumper setting      16
Computer bus speed, in Mhz          8
Optimum SSP3CARD delay loop length  300
Optimum SSPFLTR delay loop length   1910
DOS path to raw data output files   c:\rphot
DOS path to intermediate data files c:\rphot
dead-time coefficient (in seconds)  0
U filter is in slot number..........1
B filter is in slot number..........2
V filter is in slot number..........3
R filter is in slot number..........0
I filter is in slot number..........0
C filter is in slot number..........4
No. of gain settings (DC photometers)= 3
for gain scale=1       GAIN CALIBRATION=100.
for gain scale=10      GAIN CALIBRATION=10.
for gain scale=100     GAIN CALIBRATION=1.
```

```
*************** PPARMS.DAT - CONTAINS PLOTTING PARAMETERS ************
Monitor/graphics card=                 0
DOS path to raw data files =           C:\RPHOT
DOS path to intermediate data files =  C:\RPHOT
DOS path to final, reduced data files= C:\RPHOT
Graphics mode (video mem. or BIOS);    V
Screen plots will be in pen color =    14
Printed plots will be in pen color =    8
Transform x to column no.:   scale=       7.2701  zero pt=   -0.4155
Transform y to row no.:      scale=      -2.9453  zero pt=   24.6213
Printer port device name=              lpt1
Page format (landscape/portrait)=      LANDSCAPE
Printer no. and type=                   3 EPLQ
.PCX file format no. and screen type=   8 PCXSVGAC
Print resolution: 0,1,2,3              0
Use extended memory if available (y,n) Y
Page-top margin (hundredths of inches) 150
Page bottom margin (hundredths inches) 150
Page left margin (hundredths inches)   100
Page right margin (hundredths inches)  100
```

```
**** RPARMS.DAT - CONTAINS DATA REDUCTION PARAMETERS FOR YOUR OBSERVATORY ***
DOS PATH TO INTERMEDIATE DATA FILES;   C:\RPHOT
PATH TO FINAL REDUCED DATA FILES;      C:\RPHOT
VAR FILE HEADER=UNISA OBSERVATORY  SSP-5A PHOTOMETER
PREFERRED INDEX FOR V CALCULATIONS;    BV
LONGITUDE (+WEST, -EAST, IN DEGREES)=  -28.20
LATITUDE (+NORTH, -SOUTH, IN DEGREES)= -25.77
FIRST ORDER EXT. IN U     ; KUP=       .24
FIRST ORDER EXT. IN VISUAL; KVP=       .196
FIRST ORDER EXT. IN U-B; KUBP=         .25
FIRST ORDER EXT. IN B-V; KBVP=         .225
FIRST ORDER EXT. IN V-R; KVRP=         .066
FIRST ORDER EXT. IN V-I; KVIP=         .102
SECOND ORDER EXT. IN U     ; KUPP=     .001
SECOND ORDER EXT. IN V (on b-v); KVPP= .028
SECOND ORDER EXT. IN V (on v-r); KRRPP=.000
SECOND ORDER EXT. IN V (on v-i); KIIPP=.000
SECOND ORDER EXT. IN U-B; KUBPP=       -.03
SECOND ORDER EXT. IN B-V; KBVPP=       -.037
SECOND ORDER EXT. IN V-R; KVRPP=       .007
SECOND ORDER EXT. IN V-I; KVIPP=       .007
TRANSFORMATION COEFF. FOR U; EPSILONU= -.05
TRANS. COEFF. FOR V (on b-v); EPSILON=  .000
TRANS. COEFF. FOR V (on v-r); EPSILONR=-.070
TRANS. COEFF. FOR V (on v-i); EPSILONI=-.038
TRANSFORMATION COEFF. FOR U-B; PSI=    1.0
MOFFATT/VOGT TRAN. COEFF. FOR U-B; RHO=.02
TRANSFORMATION COEFF. FOR B-V; MU=     1.036
TRANSFORMATION COEFF. FOR V-R; TAU=    1.082
TRANSFORMATION COEFF. FOR V-I; ETA=    1.050
```

Appendix 2

```
FILE=oltra.dat    ; READ BY "DTAK" TO GET SCHEDULE OF OBJECTS
CAT OBJECT    FIL
 S HR7313      U          A HR5959      U          F HR6371      U
 S HR7313      B          A HR5959      B          F HR6371      B
 S HR7313      V          A HR5959      V          F HR6371      V
 M SKYLAST     U          M SKYLAST     U          M SKYLAST     U
 M SKYLAST     B          M SKYLAST     B          M SKYLAST     B
 M SKYLAST     V          M SKYLAST     V          M SKYLAST     V
 S HR7319      U          A HR6070      U          A HR6446      U
 S HR7319      B          A HR6070      B          A HR6446      B
 S HR7319      V          A HR6070      V          A HR6446      V
 M SKYLAST     U          M SKYLAST     U          M SKYLAST     U
 M SKYLAST     B          M SKYLAST     B          M SKYLAST     B
 M SKYLAST     V          M SKYLAST     V          M SKYLAST     V
 S HD184790    U          A HR6427      U          A HR6963      U
 S HD184790    B          A HR6427      B          A HR6963      B
 S HD184790    V          A HR6427      V          A HR6963      V
 M SKYLAST     U          M SKYLAST     U          M SKYLAST     U
 M SKYLAST     B          M SKYLAST     B          M SKYLAST     B
 M SKYLAST     V          M SKYLAST     V          M SKYLAST     V
 S HD184914    U          A HR6460      U          F HR7446      U
 S HD184914    B          A HR6460      B          F HR7446      B
 S HD184914    V          A HR6460      V          F HR7446      V
 M SKYLAST     U          M SKYLAST     U          M SKYLAST     U
 M SKYLAST     B          M SKYLAST     B          M SKYLAST     B
 M SKYLAST     V          M SKYLAST     V          M SKYLAST     V
 F HR5509      U          S HR7313      U          F HD189563    U
 F HR5509      B          S HR7313      B          F HD189563    B
 F HR5509      V          S HR7313      V          F HD189563    V
 M SKYLAST     U          M SKYLAST     U          M SKYLAST     U
 M SKYLAST     B          M SKYLAST     B          M SKYLAST     B
 M SKYLAST     V          M SKYLAST     V          M SKYLAST     V
 F HR5528      U          S HR7319      U          F HD191349    U
 F HR5528      B          S HR7319      B          F HD191349    B
 F HR5528      V          S HR7319      V          F HD191349    V
 M SKYLAST     U          M SKYLAST     U          M SKYLAST     U
 M SKYLAST     B          M SKYLAST     B          M SKYLAST     B
 M SKYLAST     V          M SKYLAST     V          M SKYLAST     V
 F HR5580      U          S HD184790    U          F HD192758    U
 F HR5580      B          S HD184790    B          F HD192758    B
 F HR5580      V          S HD184790    V          F HD192758    V
 M SKYLAST     U          M SKYLAST     U          M SKYLAST     U
 M SKYLAST     B          M SKYLAST     B          M SKYLAST     B
 M SKYLAST     V          M SKYLAST     V          M SKYLAST     V
 F HR5530      U          S HD184914    U          F HD213155    U
 F HR5530      B          S HD184914    B          F HD213155    B
 F HR5530      V          S HD184914    V          F HD213155    V
 M SKYLAST     U          M SKYLAST     U          M SKYLAST     U
 M SKYLAST     B          M SKYLAST     B          M SKYLAST     B
 M SKYLAST     V          M SKYLAST     V          M SKYLAST     V
```

```
FILE=olpsa.dat   ; READ BY "DTAK" TO GET SCHEDULE OF OBJECTS
CAT OBJECT   FIL
 F HD213457   U
 F HD213457   B
 F HD213457   V
 M SKYLAST    U
 M SKYLAST    B
 M SKYLAST    V
 F HD210299   U
 F HD210299   B
 F HD210299   V
   SKYLAST    U
   SKYLAST    B
   SKYLAST    V
 V RW PsA     U
 V RW PsA     B
 V RW PsA     V
   SKYLAST    U
   SKYLAST    B
   SKYLAST    V
 V RW PsA     U
 V RW PsA     B
 V RW PsA     V
   SKYLAST    U
   SKYLAST    B
   SKYLAST    V
 V RW PsA     U
 V RW PsA     B
 V RW PsA     V
   SKYLAST    U
   SKYLAST    B
   SKYLAST    V
 V RW PsA     U
 V RW PsA     B
 V RW PsA     V
   SKYLAST    U
   SKYLAST    B
   SKYLAST    V
 F HD210299   U
 F HD210299   B
 F HD210299   V
   SKYLAST    U
   SKYLAST    B
   SKYLAST    V
 V RW PsA     U
 V RW PsA     B
 V RW PsA     V
   SKYLAST    U
   SKYLAST    B
   SKYLAST    V
 V RW PsA     U
 V RW PsA     B
 V RW PsA     V
   SKYLAST    U
   SKYLAST    B
   SKYLAST    V
 V RW PsA     U
 V RW PsA     B
 V RW PsA     V
   SKYLAST    U
   SKYLAST    B
   SKYLAST    V
 V RW PsA     U
 V RW PsA     B
 V RW PsA     V
   SKYLAST    U
   SKYLAST    B
   SKYLAST    V
 F HD210299   U
 F HD210299   B
 F HD210299   V
   SKYLAST    U
   SKYLAST    B
   SKYLAST    V
 F HD210427   U
 F HD210427   B
 F HD210427   V
   SKYLAST    U
   SKYLAST    B
   SKYLAST    V
 V RW PsA     U
 V RW PsA     B
 V RW PsA     V
   SKYLAST    U
   SKYLAST    B
   SKYLAST    V
 V RW PsA     U
 V RW PsA     B
 V RW PsA     V
   SKYLAST    U
   SKYLAST    B
   SKYLAST    V
 V RW PsA     U
 V RW PsA     B
 V RW PsA     V
   SKYLAST    U
   SKYLAST    B
   SKYLAST    V
 V RW PsA     U
 V RW PsA     B
 V RW PsA     V
   SKYLAST    U
   SKYLAST    B
   SKYLAST    V
 F HD210299   U
 F HD210299   B
 F HD210299   V
   SKYLAST    U
   SKYLAST    B
   SKYLAST    V
 V RW PsA     U
 V RW PsA     B
 V RW PsA     V
   SKYLAST    U
   SKYLAST    B
   SKYLAST    V
 V RW PsA     U
 V RW PsA     B
 V RW PsA     V
   SKYLAST    U
   SKYLAST    B
   SKYLAST    V
 V RW PsA     U
 V RW PsA     B
 V RW PsA     V
   SKYLAST    U
   SKYLAST    B
   SKYLAST    V
 V RW PsA     U
 V RW PsA     B
 V RW PsA     V
   SKYLAST    U
   SKYLAST    B
   SKYLAST    V
```

Appendix 3

FILENAME=VP930613 RAW OUTPUT DATA FILE FROM "DTAK"
UT DATE= JUN 13 1993 TELESCOPE= C35 OBSERVER= VP
CONDITIONS=clear . DARK CNTS=54

MO-DY-YEAR	UT	CAT	OBJECT	FLT	COUNTS				INT	SCLE	COMMENTS
6-13-1993	18: 8:57	S	HR5401	U	236	237	236	237	10	1	
6-13-1993	18: 9:38	S	HR5401	B	1341	1339	1337	1333	10	1	
6-13-1993	18:10:18	S	HR5401	V	642	640	642	636	10	1	
6-13-1993	18:11:35		SKYLAST	U	59	0	0	0	10	1	
6-13-1993	18:11:46		SKYLAST	B	98	0	0	0	10	1	
6-13-1993	18:11:56		SKYLAST	V	117	0	0	0	10	1	
6-13-1993	18:16:12	S	HR5444	U	78	78	78	79	10	1	
6-13-1993	18:16:52	S	HR5444	B	677	680	677	677	10	1	
6-13-1993	18:17:33	S	HR5444	V	788	786	786	787	10	1	
6-13-1993	18:18:28		SKYLAST	U	58	0	0	0	10	1	
6-13-1993	18:18:38		SKYLAST	B	97	0	0	0	10	1	
6-13-1993	18:18:49		SKYLAST	V	114	0	0	0	10	1	
6-13-1993	18:23:42	F	HR4519	U	806	814	809	807	10	1	
6-13-1993	18:24:23	F	HR4519	B	2950	2933	2945	2937	10	1	
6-13-1993	18:25: 3	F	HR4519	V	949	945	949	947	10	1	
6-13-1993	18:25:45		SKYLAST	U	61	0	0	0	10	1	
6-13-1993	18:25:55	M	SKYLAST	B	106	0	0	0	10	1	
6-13-1993	18:26: 6	M	SKYLAST	V	120	0	0	0	10	1	
6-13-1993	18:30:10	F	HR4601	U	75	74	75	74	10	1	
6-13-1993	18:30:51	F	HR4601	B	371	374	371	369	10	1	
6-13-1993	18:31:31	F	HR4601	V	390	392	389	394	10	1	
6-13-1993	18:32:16		SKYLAST	U	59	0	0	0	10	1	
6-13-1993	18:32:27	M	SKYLAST	B	110	0	0	0	10	1	
6-13-1993	18:32:37	M	SKYLAST	V	140	0	0	0	10	1	
6-13-1993	18:36:43	F	HR4624	U	268	269	267	271	10	1	
6-13-1993	18:37:23	F	HR4624	B	1548	1544	1543	1542	10	1	
6-13-1993	18:38: 4	F	HR4624	V	686	686	687	686	10	1	
6-13-1993	18:38:46		SKYLAST	U	61	0	0	0	10	1	
6-13-1993	18:38:57	M	SKYLAST	B	99	0	0	0	10	1	
6-13-1993	18:39: 7	M	SKYLAST	V	115	0	0	0	10	1	
6-13-1993	18:40:54	F	HD106321	U	88	88	89	88	10	1	
6-13-1993	18:41:34	F	HD106321	B	847	849	850	845	10	1	
6-13-1993	18:42:15	F	HD106321	V	941	937	943	944	10	1	
6-13-1993	18:42:57		SKYLAST	U	61	0	0	0	10	1	
6-13-1993	18:43: 7	M	SKYLAST	B	99	0	0	0	10	1	
6-13-1993	18:43:18	M	SKYLAST	V	115	0	0	0	10	1	
6-13-1993	18:48:10	F	HR5019	U	388	390	390	390	10	1	
6-13-1993	18:48:51	F	HR5019	B	2677	2655	2651	2655	10	1	
6-13-1993	18:49:31	F	HR5019	V	1593	1587	1579	1579	10	1	
6-13-1993	18:51: 4		SKYLAST	U	62	0	0	0	10	1	
6-13-1993	18:51:15	M	SKYLAST	B	104	0	0	0	10	1	
6-13-1993	18:51:25	M	SKYLAST	V	116	0	0	0	10	1	
6-13-1993	18:54:33	S	HR5401	U	250	251	250	250	10	1	
6-13-1993	18:55:13	S	HR5401	B	1405	1414	1408	1410	10	1	
6-13-1993	18:55:54	S	HR5401	V	656	654	657	654	10	1	
6-13-1993	18:56:41		SKYLAST	U	60	0	0	0	10	1	
6-13-1993	18:56:52	M	SKYLAST	B	95	0	0	0	10	1	
6-13-1993	18:57: 2	M	SKYLAST	V	108	0	0	0	10	1	
6-13-1993	18:58:27	S	HR5444	U	80	80	80	80	10	1	
6-13-1993	18:59: 7	S	HR5444	B	710	712	713	710	10	1	
6-13-1993	18:59:48	S	HR5444	V	809	812	812	812	10	1	
6-13-1993	19: 0:35		SKYLAST	U	59	0	0	0	10	1	
6-13-1993	19: 0:45	M	SKYLAST	B	95	0	0	0	10	1	
6-13-1993	19: 0:56	M	SKYLAST	V	108	0	0	0	10	1	
6-13-1993	19: 4:21	A	HR5489	U	750	744	747	744	10	1	
6-13-1993	19: 5: 1	A	HR5489	B	4036	4037	4008	4057	10	1	
6-13-1993	19: 5:42	A	HR5489	V	1363	1369	1364	1365	10	1	
6-13-1993	19: 6:21		SKYLAST	U	61	0	0	0	10	1	
6-13-1993	19: 6:32	M	SKYLAST	B	97	0	0	0	10	1	
6-13-1993	19: 6:42	M	SKYLAST	V	108	0	0	0	10	1	
6-13-1993	19: 9:55	F	HR5509	U	91	91	91	91	10	1	
6-13-1993	19:10:36	F	HR5509	B	532	532	532	532	10	1	
6-13-1993	19:11:16	F	HR5509	V	458	454	454	454	10	1	

6-13-1993	19:11:57		SKYLAST	U	59	0	0	0	10	1
6-13-1993	19:12: 7	M	SKYLAST	B	97	0	0	0	10	1
6-13-1993	19:12:18	M	SKYLAST	V	108	0	0	0	10	1
6-13-1993	19:13:44	F	HR5528	U	2248	2284	2276	2274	10	1
6-13-1993	19:14:24	F	HR5528	B	7914	7867	7898	7905	10	1
6-13-1993	19:15: 5	F	HR5528	V	2288	2291	2294	2277	10	1
6-13-1993	19:15:49		SKYLAST	U	60	0	0	0	10	1
6-13-1993	19:15:59	M	SKYLAST	B	99	0	0	0	10	1
6-13-1993	19:16:10	M	SKYLAST	V	108	0	0	0	10	1
6-13-1993	19:17:33	F	HR5580	U	162	163	163	164	10	1
6-13-1993	19:18:14	F	HR5580	B	881	882	884	877	10	1
6-13-1993	19:18:54	F	HR5580	V	520	517	519	518	10	1
6-13-1993	19:19:35		SKYLAST	U	60	0	0	0	10	1
6-13-1993	19:19:46	M	SKYLAST	B	96	0	0	0	10	1
6-13-1993	19:19:56	M	SKYLAST	V	109	0	0	0	10	1
6-13-1993	19:40:47	F	HR5530	U	452	455	453	456	10	1
6-13-1993	19:41:28	F	HR5530	B	2367	2358	2355	2353	10	1
6-13-1993	19:42: 8	F	HR5530	V	1117	1117	1122	1118	10	1
6-13-1993	19:42:51		SKYLAST	U	62	0	0	0	10	1
6-13-1993	19:43: 2	M	SKYLAST	B	107	0	0	0	10	1
6-13-1993	19:43:12	M	SKYLAST	V	118	0	0	0	10	1
6-13-1993	19:49:11	A	HR5959	U	412	413	410	411	10	1
6-13-1993	19:49:51	A	HR5959	B	2168	2174	2186	2153	10	1
6-13-1993	19:50:32	A	HR5959	V	810	805	805	809	10	1
6-13-1993	19:51:28		SKYLAST	U	61	0	0	0	10	1
6-13-1993	19:51:39	M	SKYLAST	B	110	0	0	0	10	1
6-13-1993	19:51:49	M	SKYLAST	V	129	0	0	0	10	1
6-13-1993	19:57:43	A	HR6070	U	767	776	771	773	10	1
6-13-1993	19:58:23	A	HR6070	B	4414	4434	4425	4416	10	1
6-13-1993	19:59: 4	A	HR6070	V	1499	1503	1505	1491	10	1
6-13-1993	20: 0:13		SKYLAST	U	61	0	0	0	10	1
6-13-1993	20: 0:24	M	SKYLAST	B	101	0	0	0	10	1
6-13-1993	20: 0:35	M	SKYLAST	V	116	0	0	0	10	1
6-13-1993	20: 3:55	F	HR6371	U	206	206	204	204	10	1
6-13-1993	20: 4:35	F	HR6371	B	1601	1605	1612	1612	10	1
6-13-1993	20: 5:16	F	HR6371	V	1138	1136	1131	1128	10	1
6-13-1993	20: 5:56		SKYLAST	U	59	0	0	0	10	1
6-13-1993	20: 6: 6	M	SKYLAST	B	98	0	0	0	10	1
6-13-1993	20: 6:17	M	SKYLAST	V	112	0	0	0	10	1
6-13-1993	20: 9:26	F	HR6427	U	162	164	163	163	10	1
6-13-1993	20:10: 6	F	HR6427	B	739	746	741	740	10	1
6-13-1993	20:10:47	F	HR6427	V	360	360	361	361	10	1
6-13-1993	20:11:31		SKYLAST	U	59	0	0	0	10	1
6-13-1993	20:11:42	M	SKYLAST	B	99	0	0	0	10	1
6-13-1993	20:11:52	M	SKYLAST	V	117	0	0	0	10	1
6-13-1993	20:13:14	F	HR6460	U	837	834	832	830	10	1
6-13-1993	20:13:55	F	HR6460	B	3380	3364	3321	3374	10	1
6-13-1993	20:14:35	F	HR6460	V	1129	1131	1129	1126	10	1
6-13-1993	20:15:24		SKYLAST	U	60	0	0	0	10	1
6-13-1993	20:15:34	M	SKYLAST	B	101	0	0	0	10	1
6-13-1993	20:15:45	M	SKYLAST	V	115	0	0	0	10	1
6-13-1993	20:19:28	A	HR6446	U	1067	1062	1058	1059	10	1
6-13-1993	20:20: 9	A	HR6446	B	6499	6475	6491	6475	10	1
6-13-1993	20:20:49	A	HR6446	V	2237	2233	2233	2234	10	1
6-13-1993	20:21:32		SKYLAST	U	62	0	0	0	10	1
6-13-1993	20:21:43	M	SKYLAST	B	112	0	0	0	10	1
6-13-1993	20:21:53	M	SKYLAST	V	125	0	0	0	10	1
6-13-1993	20:25:50	A	HR6963	U	190	193	193	195	10	1
6-13-1993	20:26:30	A	HR6963	B	955	946	966	959	10	1
6-13-1993	20:27:11	A	HR6963	V	438	436	434	433	10	1
6-13-1993	20:27:50		SKYLAST	U	61	0	0	0	10	1
6-13-1993	20:28: 0	M	SKYLAST	B	118	0	0	0	10	1
6-13-1993	20:28:11	M	SKYLAST	V	144	0	0	0	10	1
6-13-1993	20:33:11	F	HR7446	U	767	767	776	770	10	1
6-13-1993	20:33:51	F	HR7446	B	2694	2659	2677	2696	10	1
6-13-1993	20:34:32	F	HR7446	V	1094	1106	1104	1088	10	1
6-13-1993	20:35:19		SKYLAST	U	62	0	0	0	10	1

6-13-1993	20:35:30	M	SKYLAST	B	131	0	0	0	10	1
6-13-1993	20:35:40	M	SKYLAST	V	161	0	0	0	10	1
6-13-1993	20:45:22	S	HR5401	U	240	241	244	242	10	1
6-13-1993	20:46: 2	S	HR5401	B	1374	1371	1372	1378	10	1
6-13-1993	20:46:43	S	HR5401	V	647	645	647	642	10	1
6-13-1993	20:48:11		SKYLAST	U	60	0	0	0	10	1
6-13-1993	20:48:22		SKYLAST	B	99	0	0	0	10	1
6-13-1993	20:48:32		SKYLAST	V	113	0	0	0	10	1
6-13-1993	20:51: 7	S	HR5444	U	80	80	80	80	10	1
6-13-1993	20:51:47	S	HR5444	B	670	668	669	663	10	1
6-13-1993	20:52:28	S	HR5444	V	764	767	761	769	10	1
6-13-1993	20:53:26		SKYLAST	U	61	0	0	0	10	1
6-13-1993	20:53:37		SKYLAST	B	98	0	0	0	10	1
6-13-1993	20:53:47		SKYLAST	V	115	0	0	0	10	1
6-13-1993	21: 0:13	F	HR4519	U	499	499	499	501	10	1
6-13-1993	21: 0:54	F	HR4519	B	2131	2163	2123	2094	10	1
6-13-1993	21: 1:35	F	HR4519	V	813	809	814	810	10	1
6-13-1993	21: 2:22		SKYLAST	U	63	0	0	0	10	1
6-13-1993	21: 2:33	M	SKYLAST	B	120	0	0	0	10	1
6-13-1993	21: 2:43	M	SKYLAST	V	153	0	0	0	10	1
6-13-1993	21: 5:46	F	HR4601	U	72	73	72	72	10	1
6-13-1993	21: 6:26	F	HR4601	B	341	336	343	340	10	1
6-13-1993	21: 7: 7	F	HR4601	V	387	386	388	382	10	1
6-13-1993	21: 7:54		SKYLAST	U	61	0	0	0	10	1
6-13-1993	21: 8: 5	M	SKYLAST	B	122	0	0	0	10	1
6-13-1993	21: 8:15	M	SKYLAST	V	164	0	0	0	10	1
6-13-1993	21:12:32	F	HR4624	U	191	190	190	191	10	1
6-13-1993	21:13:13	F	HR4624	B	1155	1163	1147	1142	10	1
6-13-1993	21:13:53	F	HR4624	V	603	602	599	603	10	1
6-13-1993	21:14:32		SKYLAST	U	63	0	0	0	10	1
6-13-1993	21:14:42	M	SKYLAST	B	121	0	0	0	10	1
6-13-1993	21:14:53	M	SKYLAST	V	160	0	0	0	10	1
6-13-1993	21:16:25	F	HD106321	U	79	79	79	79	10	1
6-13-1993	21:17: 6	F	HD106321	B	663	656	662	652	10	1
6-13-1993	21:17:46	F	HD106321	V	791	798	786	792	10	1
6-13-1993	21:18:31		SKYLAST	U	63	0	0	0	10	1
6-13-1993	21:18:41	M	SKYLAST	B	119	0	0	0	10	1
6-13-1993	21:18:52	M	SKYLAST	V	156	0	0	0	10	1
6-13-1993	21:22:40	F	HR5019	U	296	295	297	293	10	1
6-13-1993	21:23:21	F	HR5019	B	2164	2196	2164	2186	10	1
6-13-1993	21:25:27	F	HR5019	V	1377	1411	1390	1415	10	1
6-13-1993	21:26:23		SKYLAST	U	67	0	0	0	10	1
6-13-1993	21:26:34	M	SKYLAST	B	124	0	0	0	10	1
6-13-1993	21:26:44	M	SKYLAST	V	147	0	0	0	10	1
6-13-1993	21:29:18	S	HR5401	U	232	232	234	231	10	1
6-13-1993	21:29:58	S	HR5401	B	1324	1318	1299	1308	10	1
6-13-1993	21:30:39	S	HR5401	V	623	621	619	622	10	1
6-13-1993	21:31:21		SKYLAST	U	61	0	0	0	10	1
6-13-1993	21:31:31	M	SKYLAST	B	103	0	0	0	10	1
6-13-1993	21:31:42	M	SKYLAST	V	121	0	0	0	10	1
6-13-1993	21:33: 7	S	HR5444	U	80	80	80	80	10	1
6-13-1993	21:33:48	S	HR5444	B	678	679	678	679	10	1
6-13-1993	21:34:28	S	HR5444	V	790	792	798	790	10	1
6-13-1993	21:35:11		SKYLAST	U	61	0	0	0	10	1
6-13-1993	21:35:22	M	SKYLAST	B	103	0	0	0	10	1
6-13-1993	21:35:32	M	SKYLAST	V	118	0	0	0	10	1
6-13-1993	21:38:58	A	HR5489	U	680	684	682	678	10	1
6-13-1993	21:39:39	A	HR5489	B	3820	3834	3817	3794	10	1
6-13-1993	21:40:19	A	HR5489	V	1329	1326	1327	1311	10	1
6-13-1993	21:40:59		SKYLAST	U	63	0	0	0	10	1
6-13-1993	21:41:10	M	SKYLAST	B	107	0	0	0	10	1
6-13-1993	21:41:20	M	SKYLAST	V	120	0	0	0	10	1
6-13-1993	21:43:14	F	HR5509	U	89	90	90	89	10	1
6-13-1993	21:43:55	F	HR5509	B	508	507	509	511	10	1
6-13-1993	21:44:35	F	HR5509	V	442	447	444	447	10	1
6-13-1993	21:45:21		SKYLAST	U	62	0	0	0	10	1
6-13-1993	21:45:31	M	SKYLAST	B	103	0	0	0	10	1

6-13-1993	21:45:42	M	SKYLAST	V	123	0	0	0	10	1
6-13-1993	21:46:55	F	HR5528	U	2049	2038	2022	2022	10	1
6-13-1993	21:47:36	F	HR5528	B	7231	7194	7134	7112	10	1
6-13-1993	21:48:16	F	HR5528	V	2124	2132	2135	2124	10	1
6-13-1993	21:48:57		SKYLAST	U	62	0	0	0	10	1
6-13-1993	21:49: 8	M	SKYLAST	B	109	0	0	0	10	1
6-13-1993	21:49:18	M	SKYLAST	V	126	0	0	0	10	1
6-13-1993	21:50:38	F	HR5580	U	157	155	156	155	10	1
6-13-1993	21:51:18	F	HR5580	B	854	851	855	854	10	1
6-13-1993	21:51:59	F	HR5580	V	524	525	521	521	10	1
6-13-1993	21:52:52		SKYLAST	U	62	0	0	0	10	1
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6-13-1993	21:53:13	M	SKYLAST	V	122	0	0	0	10	1
6-13-1993	21:55:57	F	HR5530	U	405	410	409	411	10	1
6-13-1993	21:56:37	F	HR5530	B	2231	2221	2223	2208	10	1
6-13-1993	21:58:41	F	HR5530	V	1089	1088	1089	1086	10	1
6-13-1993	21:59:26		SKYLAST	U	65	0	0	0	10	1
6-13-1993	21:59:37	M	SKYLAST	B	112	0	0	0	10	1
6-13-1993	21:59:47	M	SKYLAST	V	128	0	0	0	10	1
6-13-1993	22: 3: 2	A	HR5959	U	427	423	426	426	10	1
6-13-1993	22: 3:42	A	HR5959	B	2223	2222	2218	2214	10	1
6-13-1993	22: 4:23	A	HR5959	V	811	805	811	811	10	1
6-13-1993	22: 5:26		SKYLAST	U	64	0	0	0	10	1
6-13-1993	22: 5:36	M	SKYLAST	B	111	0	0	0	10	1
6-13-1993	22: 5:47	M	SKYLAST	V	124	0	0	0	10	1
6-13-1993	22: 9:34	A	HR6070	U	821	823	821	831	10	1
6-13-1993	22:10:14	A	HR6070	B	4721	4674	4675	4674	10	1
6-13-1993	22:10:55	A	HR6070	V	1581	1552	1548	1555	10	1
6-13-1993	22:12: 0		SKYLAST	U	62	0	0	0	10	1
6-13-1993	22:12:11	M	SKYLAST	B	104	0	0	0	10	1
6-13-1993	22:12:22	M	SKYLAST	V	113	0	0	0	10	1
6-13-1993	22:15:35	F	HR6371	U	227	228	229	227	10	1
6-13-1993	22:16:16	F	HR6371	B	1772	1761	1786	1780	10	1
6-13-1993	22:16:56	F	HR6371	V	1236	1234	1243	1230	10	1
6-13-1993	22:17:47		SKYLAST	U	60	0	0	0	10	1
6-13-1993	22:17:57	M	SKYLAST	B	97	0	0	0	10	1
6-13-1993	22:18: 8	M	SKYLAST	V	108	0	0	0	10	1
6-13-1993	22:21: 0	F	HR6427	U	177	176	176	178	10	1
6-13-1993	22:21:41	F	HR6427	B	803	800	798	800	10	1
6-13-1993	22:22:21	F	HR6427	V	366	365	367	368	10	1
6-13-1993	22:23: 2		SKYLAST	U	60	0	0	0	10	1
6-13-1993	22:23:13	M	SKYLAST	B	96	0	0	0	10	1
6-13-1993	22:23:23	M	SKYLAST	V	107	0	0	0	10	1
6-13-1993	22:24:53	F	HR6460	U	934	925	931	940	10	1
6-13-1993	22:25:34	F	HR6460	B	3707	3711	3695	3687	10	1
6-13-1993	22:26:14	F	HR6460	V	1176	1167	1174	1179	10	1
6-13-1993	22:27:18		SKYLAST	U	61	0	0	0	10	1
6-13-1993	22:27:28	M	SKYLAST	B	102	0	0	0	10	1
6-13-1993	22:27:39	M	SKYLAST	V	110	0	0	0	10	1
6-13-1993	22:32:28	A	HR6446	U	1187	1186	1189	1189	10	1
6-13-1993	22:33: 9	A	HR6446	B	7145	7144	7110	7001	10	1
6-13-1993	22:33:49	A	HR6446	V	2366	2365	2364	2363	10	1
6-13-1993	22:34:58		SKYLAST	U	63	0	0	0	10	1
6-13-1993	22:35: 9	M	SKYLAST	B	115	0	0	0	10	1
6-13-1993	22:35:19	M	SKYLAST	V	115	0	0	0	10	1
6-13-1993	22:38:37	A	HR6963	U	243	243	242	245	10	1
6-13-1993	22:39:18	A	HR6963	B	1153	1155	1152	1145	10	1
6-13-1993	22:39:59	A	HR6963	V	461	462	464	463	10	1
6-13-1993	22:40:40		SKYLAST	U	62	0	0	0	10	1
6-13-1993	22:40:50	M	SKYLAST	B	108	0	0	0	10	1
6-13-1993	22:41: 1	M	SKYLAST	V	122	0	0	0	10	1
6-13-1993	22:44:58	F	HR7446	U	1389	1394	1401	1388	10	1
6-13-1993	22:45:39	F	HR7446	B	3925	3896	3878	3930	10	1
6-13-1993	22:46:19	F	HR7446	V	1335	1327	1327	1325	10	1
6-13-1993	22:47: 4		SKYLAST	U	62	0	0	0	10	1
6-13-1993	22:47:14	M	SKYLAST	B	112	0	0	0	10	1
6-13-1993	22:47:25	M	SKYLAST	V	124	0	0	0	10	1

6-13-1993	23: 7: 1	S	HR5401	U	207	207	208	207	10	1
6-13-1993	23: 7:41	S	HR5401	B	1223	1228	1237	1240	10	1
6-13-1993	23: 8:22	S	HR5401	V	623	626	622	623	10	1
6-13-1993	23: 9:25		SKYLAST	U	62	0	0	0	10	1
6-13-1993	23: 9:36		SKYLAST	B	110	0	0	0	10	1
6-13-1993	23: 9:46		SKYLAST	V	130	0	0	0	10	1
6-13-1993	23:13: 9	S	HR5444	U	78	77	78	78	10	1
6-13-1993	23:13:49	S	HR5444	B	636	632	635	638	10	1
6-13-1993	23:14:30	S	HR5444	V	762	763	764	761	10	1
6-13-1993	23:15:24		SKYLAST	U	62	0	0	0	10	1
6-13-1993	23:15:35		SKYLAST	B	110	0	0	0	10	1
6-13-1993	23:15:45		SKYLAST	V	129	0	0	0	10	1

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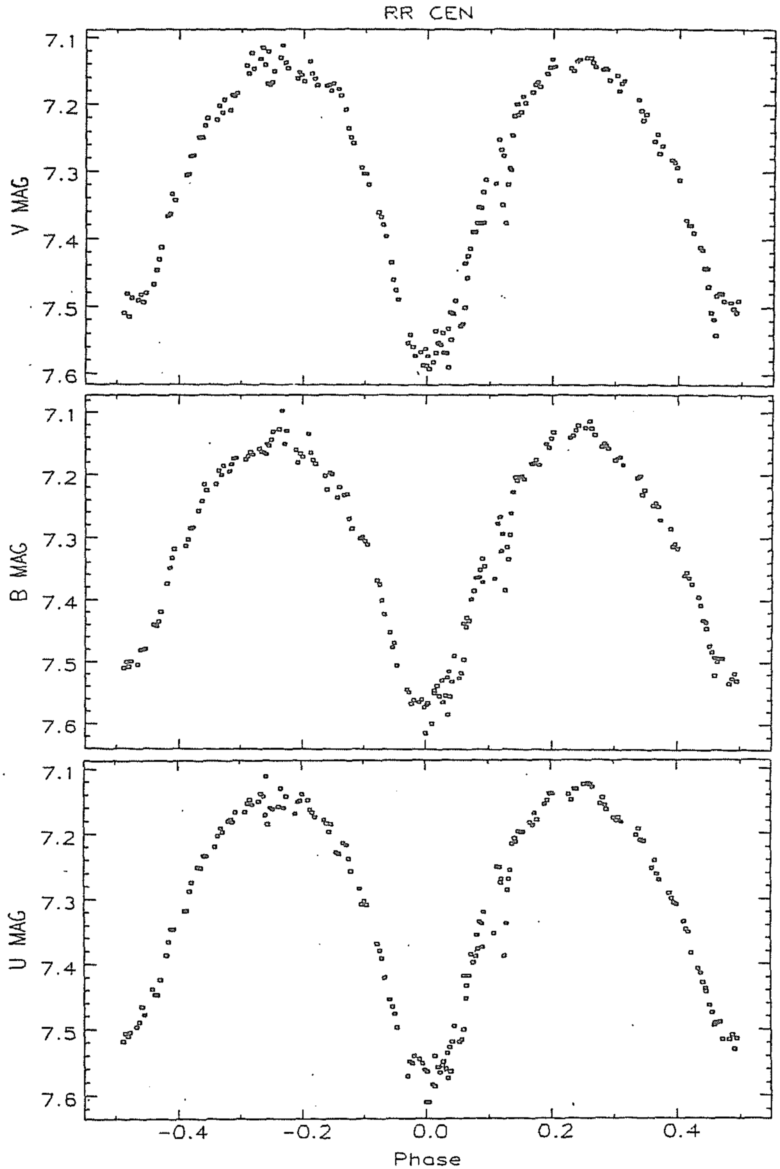
6-13-1993	18:16:12	S	FS	HR5444	U	2025
6-13-1993	18:16:52	S	FS	HR5444	B	58075
6-13-1993	18:17:33	S	FS	HR5444	V	67275
6-13-1993	18:23:42	F	F	HR4519	U	74800
6-13-1993	18:24:23	F	F	HR4519	B	283525
6-13-1993	18:25: 3	F	F	HR4519	V	82750
6-13-1993	18:30:10	F	F	HR4601	U	1550
6-13-1993	18:30:51	F	F	HR4601	B	26125
6-13-1993	18:31:31	F	F	HR4601	V	25125
6-13-1993	18:36:43	F	F	HR4624	U	20775
6-13-1993	18:37:23	F	F	HR4624	B	144525
6-13-1993	18:38: 4	F	F	HR4624	V	57125
6-13-1993	18:40:54	F	F	HD106321	U	2725
6-13-1993	18:41:34	F	F	HD106321	B	74875
6-13-1993	18:42:15	F	F	HD106321	V	82625
6-13-1993	18:48:10	F	F	HR5019	U	32750
6-13-1993	18:48:51	F	F	HR5019	B	255550
6-13-1993	18:49:31	F	F	HR5019	V	146850
6-13-1993	18:54:33	S	FS	HR5401	U	19025
6-13-1993	18:55:13	S	FS	HR5401	B	131425
6-13-1993	18:55:54	S	FS	HR5401	V	54725
6-13-1993	18:58:27	S	FS	HR5444	U	2100
6-13-1993	18:59: 7	S	FS	HR5444	B	61625
6-13-1993	18:59:48	S	FS	HR5444	V	70325
6-13-1993	19: 4:21	A	A	HR5489	U	68525
6-13-1993	19: 5: 1	A	A	HR5489	B	393750
6-13-1993	19: 5:42	A	A	HR5489	V	125725
6-13-1993	19: 9:55	F	F	HR5509	U	3200
6-13-1993	19:10:36	F	F	HR5509	B	43500
6-13-1993	19:11:16	F	F	HR5509	V	34700
6-13-1993	19:13:44	F	F	HR5528	U	221050
6-13-1993	19:14:24	F	F	HR5528	B	779700

6-13-1993	19:15: 5	F F	HR5528	V	217950
6-13-1993	19:17:33	F F	HR5580	U	10300
6-13-1993	19:18:14	F F	HR5580	B	78500
6-13-1993	19:18:54	F F	HR5580	V	40950
6-13-1993	19:40:47	F F	HR5530	U	39200
6-13-1993	19:41:28	F F	HR5530	B	225125
6-13-1993	19:42: 8	F F	HR5530	V	100050
6-13-1993	19:49:11	A A	HR5959	U	35050
6-13-1993	19:49:51	A A	HR5959	B	206025
6-13-1993	19:50:32	A A	HR5959	V	67825
6-13-1993	19:57:43	A A	HR6070	U	71075
6-13-1993	19:58:23	A A	HR6070	B	432125
6-13-1993	19:59: 4	A A	HR6070	V	138350
6-13-1993	20: 3:55	F F	HR6371	U	14600
6-13-1993	20: 4:35	F F	HR6371	B	150950
6-13-1993	20: 5:16	F F	HR6371	V	102125
6-13-1993	20: 9:26	F F	HR6427	U	10400
6-13-1993	20:10: 6	F F	HR6427	B	64250
6-13-1993	20:10:47	F F	HR6427	V	24350
6-13-1993	20:13:14	F F	HR6460	U	77325
6-13-1993	20:13:55	F F	HR6460	B	325875
6-13-1993	20:14:35	F F	HR6460	V	101375
6-13-1993	20:19:28	A A	HR6446	U	99950
6-13-1993	20:20: 9	A A	HR6446	B	637300
6-13-1993	20:20:49	A A	HR6446	V	210925
6-13-1993	20:25:50	A A	HR6963	U	13175
6-13-1993	20:26:30	A A	HR6963	B	83850
6-13-1993	20:27:11	A A	HR6963	V	29125
6-13-1993	20:33:11	F F	HR7446	U	70800
6-13-1993	20:33:51	F F	HR7446	B	255050
6-13-1993	20:34:32	F F	HR7446	V	93700
6-13-1993	20:45:22	S FS	HR5401	U	18175
6-13-1993	20:46: 2	S FS	HR5401	B	127475
6-13-1993	20:46:43	S FS	HR5401	V	53225
6-13-1993	20:51: 7	S FS	HR5444	U	1900
6-13-1993	20:51:47	S FS	HR5444	B	56950
6-13-1993	20:52:28	S FS	HR5444	V	65025
6-13-1993	21: 0:13	F F	HR4519	U	43650
6-13-1993	21: 0:54	F F	HR4519	B	200775
6-13-1993	21: 1:35	F F	HR4519	V	65850
6-13-1993	21: 5:46	F F	HR4601	U	1125
6-13-1993	21: 6:26	F F	HR4601	B	21800
6-13-1993	21: 7: 7	F F	HR4601	V	22175
6-13-1993	21:12:32	F F	HR4624	U	12750
6-13-1993	21:13:13	F F	HR4624	B	103075
6-13-1993	21:13:53	F F	HR4624	V	44175
6-13-1993	21:16:25	F F	HD106321	U	1600
6-13-1993	21:17: 6	F F	HD106321	B	53925
6-13-1993	21:17:46	F F	HD106321	V	63575
6-13-1993	21:22:40	F F	HR5019	U	22825
6-13-1993	21:23:21	F F	HR5019	B	205350
6-13-1993	21:25:27	F F	HR5019	V	125125
6-13-1993	21:29:18	S FS	HR5401	U	17125
6-13-1993	21:29:58	S FS	HR5401	B	120925
6-13-1993	21:30:39	S FS	HR5401	V	50025
6-13-1993	21:33: 7	S FS	HR5444	U	1900
6-13-1993	21:33:48	S FS	HR5444	B	57550
6-13-1993	21:34:28	S FS	HR5444	V	67450
6-13-1993	21:38:58	A A	HR5489	U	61800
6-13-1993	21:39:39	A A	HR5489	B	370925
6-13-1993	21:40:19	A A	HR5489	V	120325
6-13-1993	21:43:14	F F	HR5509	U	2750
6-13-1993	21:43:55	F F	HR5509	B	40575
6-13-1993	21:44:35	F F	HR5509	V	32200
6-13-1993	21:46:55	F F	HR5528	U	197075
6-13-1993	21:47:36	F F	HR5528	B	705875
6-13-1993	21:48:16	F F	HR5528	V	200275

6-13-1993	21:50:38	F	F	HR5580	U	9375
6-13-1993	21:51:18	F	F	HR5580	B	74750
6-13-1993	21:51:59	F	F	HR5580	V	40075
6-13-1993	21:55:57	F	F	HR5530	U	34375
6-13-1993	21:56:37	F	F	HR5530	B	210875
6-13-1993	21:58:41	F	F	HR5530	V	96000
6-13-1993	22: 3: 2	A	A	HR5959	U	36150
6-13-1993	22: 3:42	A	A	HR5959	B	210825
6-13-1993	22: 4:23	A	A	HR5959	V	68550
6-13-1993	22: 9:34	A	A	HR6070	U	76200
6-13-1993	22:10:14	A	A	HR6070	B	458200
6-13-1993	22:10:55	A	A	HR6070	V	144600
6-13-1993	22:15:35	F	F	HR6371	U	16775
6-13-1993	22:16:16	F	F	HR6371	B	167775
6-13-1993	22:16:56	F	F	HR6371	V	112775
6-13-1993	22:21: 0	F	F	HR6427	U	11675
6-13-1993	22:21:41	F	F	HR6427	B	70425
6-13-1993	22:22:21	F	F	HR6427	V	25950
6-13-1993	22:24:53	F	F	HR6460	U	87150
6-13-1993	22:25:34	F	F	HR6460	B	359800
6-13-1993	22:26:14	F	F	HR6460	V	106400
6-13-1993	22:32:28	A	A	HR6446	U	112475
6-13-1993	22:33: 9	A	A	HR6446	B	698500
6-13-1993	22:33:49	A	A	HR6446	V	224950
6-13-1993	22:38:37	A	A	HR6963	U	18125
6-13-1993	22:39:18	A	A	HR6963	B	104325
6-13-1993	22:39:59	A	A	HR6963	V	34050
6-13-1993	22:44:58	F	F	HR7446	U	133100
6-13-1993	22:45:39	F	F	HR7446	B	379525
6-13-1993	22:46:19	F	F	HR7446	V	120450
6-13-1993	23: 7: 1	S	FS	HR5401	U	14525
6-13-1993	23: 7:41	S	FS	HR5401	B	112200
6-13-1993	23: 8:22	S	FS	HR5401	V	49350
6-13-1993	23:13: 9	S	FS	HR5444	U	1575
6-13-1993	23:13:49	S	FS	HR5444	B	52525
6-13-1993	23:14:30	S	FS	HR5444	V	63350

___VARIABLE______COMPARISON____CHECK___

Appendix 4



Appendix 5

FILENAME=VP930614 . RAW OUTPUT DATA FILE FROM "DTAK"
UT DATE= JUN 14 1993 TELESCOPE= C35 OBSERVER= VP
CONDITIONS=clear , DARK CNTS=54

MO-DY-YEAR	UT	CAT	OBJECT	FLT	----------COUNTS----------				INT	SCLE	COMMENTS
6-14-1993	16:53:29	F	HR5401	U	257	256	256	255	10	1	
6-14-1993	16:54:10	F	HR5401	B	1445	1435	1440	1440	10	1	
6-14-1993	16:54:50	F	HR5401	V	673	674	673	667	10	1	
6-14-1993	16:55:60		SKYLAST	U	67	66	67	66	10	1	
6-14-1993	16:56:40	M	SKYLAST	B	131	131	129	129	10	1	
6-14-1993	16:57:21	M	SKYLAST	V	127	127	127	126	10	1	
6-14-1993	17: 5: 4	C	HD123794	U	105	106	105	106	10	1	
6-14-1993	17: 5:45	C	HD123794	B	372	372	370	370	10	1	
6-14-1993	17: 6:25	C	HD123794	V	230	229	229	228	10	1	
6-14-1993	17: 7:25		SKYLAST	U	65	0	0	0	10	1	
6-14-1993	17: 7:36		SKYLAST	B	125	0	0	0	10	1	
6-14-1993	17: 7:46		SKYLAST	V	122	0	0	0	10	1	
6-14-1993	17:10:45	V	V759 CEN	U	96	96	95	96	10	1	
6-14-1993	17:11:25	V	V759 CEN	B	331	332	332	332	10	1	
6-14-1993	17:12: 6	V	V759 CEN	V	231	232	230	231	10	1	
6-14-1993	17:14: 1		SKYLAST	U	65	0	0	0	10	1	
6-14-1993	17:14:11		SKYLAST	B	125	0	0	0	10	1	
6-14-1993	17:14:22		SKYLAST	V	125	0	0	0	10	1	
6-14-1993	17:15:14	V	V759 CEN	U	96	96	96	96	10	1	
6-14-1993	17:15:54	V	V759 CEN	B	335	333	334	333	10	1	
6-14-1993	17:16:35	V	V759 CEN	V	235	236	237	237	10	1	
6-14-1993	17:17:38		SKYLAST	U	65	0	0	0	10	1	
6-14-1993	17:17:48		SKYLAST	B	124	0	0	0	10	1	
6-14-1993	17:17:59		SKYLAST	V	126	0	0	0	10	1	
6-14-1993	17:18:58	V	V759 CEN	U	96	95	97	96	10	1	
6-14-1993	17:19:39	V	V759 CEN	B	334	334	331	332	10	1	
6-14-1993	17:20:19	V	V759 CEN	V	234	234	234	234	10	1	
6-14-1993	17:20:59		SKYLAST	U	65	0	0	0	10	1	
6-14-1993	17:21: 9		SKYLAST	B	124	0	0	0	10	1	
6-14-1993	17:21:20		SKYLAST	V	124	0	0	0	10	1	
6-14-1993	17:22:15	V	V759 CEN	U	97	96	96	96	10	1	
6-14-1993	17:22:56	V	V759 CEN	B	337	336	337	336	10	1	
6-14-1993	17:23:36	V	V759 CEN	V	235	236	235	236	10	1	
6-14-1993	17:24:21		SKYLAST	U	65	0	0	0	10	1	
6-14-1993	17:24:32		SKYLAST	B	122	0	0	0	10	1	
6-14-1993	17:24:42		SKYLAST	V	124	0	0	0	10	1	
6-14-1993	17:26:12	C	HD123794	U	107	106	106	106	10	1	
6-14-1993	17:26:52	C	HD123794	B	374	372	373	373	10	1	
6-14-1993	17:27:33	C	HD123794	V	231	230	229	228	10	1	
6-14-1993	17:28:17		SKYLAST	U	64	0	0	0	10	1	
6-14-1993	17:28:27		SKYLAST	B	118	0	0	0	10	1	
6-14-1993	17:28:38		SKYLAST	V	119	0	0	0	10	1	
6-14-1993	17:30:49	V	V759 CEN	U	97	95	96	96	10	1	
6-14-1993	17:31:30	V	V759 CEN	B	332	332	333	330	10	1	
6-14-1993	17:32:10	V	V759 CEN	V	229	228	228	229	10	1	
6-14-1993	17:33: 0		SKYLAST	U	60	0	0	0	10	1	
6-14-1993	17:33:11		SKYLAST	B	103	0	0	0	10	1	
6-14-1993	17:33:21		SKYLAST	V	111	0	0	0	10	1	light shining directly into dome switched off
6-14-1993	17:35:48	V	V759 CEN	U	93	93	93	94	10	1	
6-14-1993	17:36:29	V	V759 CEN	B	325	322	324	321	10	1	
6-14-1993	17:37: 9	V	V759 CEN	V	228	227	228	228	10	1	
6-14-1993	17:38:16		SKYLAST	U	60	0	0	0	10	1	
6-14-1993	17:38:27		SKYLAST	B	104	0	0	0	10	1	
6-14-1993	17:38:37		SKYLAST	V	112	0	0	0	10	1	
6-14-1993	17:39:28	V	V759 CEN	U	93	92	93	93	10	1	
6-14-1993	17:40: 9	V	V759 CEN	B	320	319	319	321	10	1	
6-14-1993	17:40:50	V	V759 CEN	V	225	227	227	227	10	1	
6-14-1993	17:41:32		SKYLAST	U	60	0	0	0	10	1	
6-14-1993	17:41:42		SKYLAST	B	105	0	0	0	10	1	
6-14-1993	17:41:53		SKYLAST	V	115	0	0	0	10	1	
6-14-1993	17:42:45	V	V759 CEN	U	93	93	93	93	10	1	

6-14-1993	17:43:25	V	V759 CEN	B	323	324	325	323	10	1
6-14-1993	17:44: 6	V	V759 CEN	V	229	229	229	230	10	1
6-14-1993	17:44:47		SKYLAST	U	60	0	0	0	10	1
6-14-1993	17:44:58		SKYLAST	B	105	0	0	0	10	1
6-14-1993	17:45: 8		SKYLAST	V	115	0	0	0	10	1
6-14-1993	17:47: 1	C	HD123794	U	102	102	101	102	10	1
6-14-1993	17:47:41	C	HD123794	B	355	355	357	357	10	1
6-14-1993	17:48:22	C	HD123794	V	226	225	226	224	10	1
6-14-1993	17:49: 2		SKYLAST	U	60	0	0	0	10	1
6-14-1993	17:49:13		SKYLAST	B	105	0	0	0	10	1
6-14-1993	17:49:23		SKYLAST	V	117	0	0	0	10	1
6-14-1993	17:54:14	C	HD123432	U	69	70	69	69	10	1
6-14-1993	17:54:55	C	HD123432	B	251	254	250	250	10	1
6-14-1993	17:55:35	C	HD123432	V	234	235	234	234	10	1
6-14-1993	17:56:16		SKYLAST	U	60	0	0	0	10	1
6-14-1993	17:56:27		SKYLAST	B	104	0	0	0	10	1
6-14-1993	17:56:37		SKYLAST	V	116	0	0	0	10	1
6-14-1993	17:58:29	V	V759 CEN	U	92	92	93	92	10	1
6-14-1993	17:59:10	V	V759 CEN	B	316	318	316	318	10	1
6-14-1993	17:59:50	V	V759 CEN	V	224	222	224	223	10	1
6-14-1993	18: 0:37		SKYLAST	U	60	0	0	0	10	1
6-14-1993	16: 0:47		SKYLAST	B	101	0	0	0	10	1
6-14-1993	18: 0:58		SKYLAST	V	113	0	0	0	10	1
6-14-1993	18: 1:44	V	V759 CEN	U	92	92	92	92	10	1
6-14-1993	18: 2:25	V	V759 CEN	B	315	318	318	319	10	1
6-14-1993	18: 3: 5	V	V759 CEN	V	225	225	225	225	10	1
6-14-1993	18: 3:48		SKYLAST	U	60	0	0	0	10	1
8-14-1993	18: 3:58		SKYLAST	B	100	0	0	0	10	1
6-14-1993	18: 4: 9		SKYLAST	V	112	0	0	0	10	1
6-14-1993	18: 5: 2	V	V759 CEN	U	92	93	92	93	10	1
6-14-1993	18: 5:43	V	V759 CEN	B	316	315	319	317	10	1
6-14-1993	18: 6:23	V	V759 CEN	V	221	222	222	222	10	1
6-14-1993	18: 7: 4		SKYLAST	U	60	0	0	0	10	1
6-14-1993	18: 7:15		SKYLAST	B	100	0	0	0	10	1
6-14-1993	18: 7:25		SKYLAST	V	110	0	0	0	10	1
6-14-1993	18: 8:12	V	V759 CEN	U	93	93	93	93	10	1
6-14-1993	18: 8:53	V	V759 CEN	B	319	320	320	321	10	1
6-14-1993	18: 9:33	V	V759 CEN	V	226	226	226	226	10	1
6-14-1993	18:10:16		SKYLAST	U	59	0	0	0	10	1
6-14-1993	18:10:27		SKYLAST	B	100	0	0	0	10	1
6-14-1993	18:10:37		SKYLAST	V	109	0	0	0	10	1
6-14-1993	18:15:35	C	HD123794	U	1032	1036	1031	1033	10	10
6-14-1993	18:16:16	C	HD123794	B	3568	3563	3589	3588	10	10
6-14-1993	18:16:56	C	HD123794	V	2197	2216	2207	2201	10	10
6-14-1993	18:17:38		SKYLAST	U	607	0	0	0	10	10
6-14-1993	18:17:48		SKYLAST	B	1002	0	0	0	10	10
6-14-1993	18:17:59		SKYLAST	V	1088	0	0	0	10	10
6-14-1993	18:19:27	V	V759 CEN	U	937	937	934	939	10	10
6-14-1993	18:20: 8	V	V759 CEN	B	3164	3176	3167	3141	10	10
6-14-1993	18:20:48	V	V759 CEN	V	2210	2212	2215	2214	10	10
6-14-1993	18:21:34		SKYLAST	U	605	0	0	0	10	10
6-14-1993	18:21:44		SKYLAST	B	1006	0	0	0	10	10
6-14-1993	18:21:55		SKYLAST	V	1085	0	0	0	10	10
6-14-1993	18:22:46	V	V759 CEN	U	935	935	935	936	10	10
6-14-1993	18:23:26	V	V759 CEN	B	3163	3197	3203	3206	10	10
6-14-1993	18:24: 7	V	V759 CEN	V	2225	2219	2225	2227	10	10
6-14-1993	18:24:59		SKYLAST	U	606	0	0	0	10	10
6-14-1993	18:25: 1		SKYLAST	B	998	0	0	0	10	10
6-14-1993	18:25:11		SKYLAST	V	1074	0	0	0	10	10
6-14-1993	18:26:13	V	V759 CEN	U	936	931	934	933	10	10
6-14-1993	18:26:53	V	V759 CEN	B	3147	3145	3137	3149	10	10
6-14-1993	18:27:34	V	V759 CEN	V	2176	2187	2186	2186	10	10
6-14-1993	18:28:16		SKYLAST	U	603	0	0	0	10	10
6-14-1993	18:28:26		SKYLAST	B	999	0	0	0	10	10
8-14-1993	18:28:36		SKYLAST	V	1066	0	0	0	10	10

6-14-1993	18:29:33	V	V759 CEN	U	938	933	935	936	10	10
6-14-1993	18:30:13	V	V759 CEN	B	3189	3174	3149	3154	10	10
6-14-1993	18:30:54	V	V759 CEN	V	2199	2191	2183	2193	10	10
6-14-1993	18:31:34		SKYLAST	U	600	0	0	0	10	10
6-14-1993	18:31:44		SKYLAST	B	966	0	0	0	10	10
6-14-1993	18:31:55		SKYLAST	V	1060	0	0	0	10	10
6-14-1993	18:35: 7	F	HR5401	U	269	268	270	272	10	1
6-14-1993	18:35:48	F	HR5401	B	1507	1512	1510	1500	10	1
6-14-1993	18:36:28	F	HR5401	V	676	674	674	676	10	1
6-14-1993	18:37:14		SKYLAST	U	59	0	0	0	10	1
6-14-1993	18:37:24	M	SKYLAST	B	97	0	0	0	10	1
6-14-1993	18:37:35	M	SKYLAST	V	105	0	0	0	10	1
6-14-1993	18:40: 5	C	HD123794	U	1038	1035	1038	1027	10	10
6-14-1993	18:40:46	C	HD123794	B	3557	3554	3554	3529	10	10
6-14-1993	18:41:26	C	HD123794	V	2153	2152	2144	2159	10	10
6-14-1993	18:42: 7		SKYLAST	U	602	0	0	0	10	10
6-14-1993	18:42:17		SKYLAST	B	976	0	0	0	10	10
6-14-1993	18:42:28		SKYLAST	V	1061	0	0	0	10	10
6-14-1993	18:44: 4	V	V759 CEN	U	928	926	929	937	10	10
6-14-1993	18:44:44	V	V759 CEN	B	3114	3109	3114	3113	10	10
6-14-1993	18:45:25	V	V759 CEN	V	2174	2158	2161	2153	10	10
6-14-1993	18:46:12		SKYLAST	U	604	0	0	0	10	10
6-14-1993	18:46:22		SKYLAST	B	964	0	0	0	10	10
6-14-1993	18:46:33		SKYLAST	V	1060	0	0	0	10	10
6-14-1993	18:47:28	V	V759 CEN	U	929	923	926	928	10	10
6-14-1993	18:48: 8	V	V759 CEN	B	3129	3111	3101	3127	10	10
6-14-1993	18:48:49	V	V759 CEN	V	2173	2176	2164	2180	10	10
6-14-1993	18:49:37		SKYLAST	U	603	0	0	0	10	10
6-14-1993	18:49:47		SKYLAST	B	970	0	0	0	10	10
6-14-1993	18:49:58		SKYLAST	V	1063	0	0	0	10	10
6-14-1993	18:50:55	V	V759 CEN	U	929	930	927	925	10	10
6-14-1993	18:51:35	V	V759 CEN	B	3088	3110	3096	3091	10	10
6-14-1993	18:52:16	V	V759 CEN	V	2144	2142	2139	2141	10	10
6-14-1993	18:52:59		SKYLAST	U	604	0	0	0	10	10
6-14-1993	18:53: 9		SKYLAST	B	963	0	0	0	10	10
6-14-1993	18:53:20		SKYLAST	V	1052	0	0	0	10	10
6-14-1993	18:54: 6	V	V759 CEN	U	928	929	930	924	10	10
6-14-1993	18:54:47	V	V759 CEN	B	3097	3094	3091	3106	10	10
6-14-1993	18:55:27	V	V759 CEN	V	2159	2145	2164	2155	10	10
6-14-1993	18:56: 9		SKYLAST	U	605	0	0	0	10	10
6-14-1993	18:56:19		SKYLAST	B	959	0	0	0	10	10
6-14-1993	18:56:30		SKYLAST	V	1042	0	0	0	10	10
6-14-1993	18:57:50	C	HD123794	U	1044	1042	1042	1054	10	10
6-14-1993	18:58:31	C	HD123794	B	3588	3575	3574	3574	10	10
6-14-1993	18:59:11	C	HD123794	V	2158	2163	2164	2164	10	10
6-14-1993	18:59:54		SKYLAST	U	604	0	0	0	10	10
6-14-1993	19: 0: 4		SKYLAST	B	961	0	0	0	10	10
6-14-1993	19: 0:15		SKYLAST	V	1046	0	0	0	10	10
6-14-1993	19: 1:44	V	V759 CEN	U	925	928	929	921	10	10
6-14-1993	19: 2:24	V	V759 CEN	B	3078	3085	3095	3068	10	10
6-14-1993	19: 3: 5	V	V759 CEN	V	2137	2162	2150	2160	10	10
6-14-1993	19: 3:47		SKYLAST	U	605	0	0	0	10	10
6-14-1993	19: 3:57		SKYLAST	B	965	0	0	0	10	10
6-14-1993	19: 4: 8		SKYLAST	V	1050	0	0	0	10	10
6-14-1993	19: 4:59	V	V759 CEN	U	923	926	921	921	10	10
6-14-1993	19: 5:39	V	V759 CEN	B	3002	3052	3028	3031	10	10
6-14-1993	19: 6:20	V	V759 CEN	V	2099	2089	2089	2093	10	10
6-14-1993	19: 7: 7		SKYLAST	U	602	0	0	0	10	10
6-14-1993	19: 7:17		SKYLAST	B	952	0	0	0	10	10
6-14-1993	19: 7:28		SKYLAST	V	1042	0	0	0	10	10
6-14-1993	19: 8:20	V	V759 CEN	U	926	930	930	924	10	10
6-14-1993	19: 9: 1	V	V759 CEN	B	3056	3051	3067	3045	10	10
6-14-1993	19: 9:41	V	V759 CEN	V	2130	2142	2146	2141	10	10
6-14-1993	19:10:22		SKYLAST	U	605	0	0	0	10	10
6-14-1993	19:10:33		SKYLAST	B	951	0	0	0	10	10

6-14-1993	19:10:43		SKYLAST	V	1034	0	0	0	10	10
6-14-1993	19:11:33	V	V759 CEN	U	921	920	923	919	10	10
6-14-1993	19:12:14	V	V759 CEN	B	3009	3033	3016	3019	10	10
6-14-1993	19:12:54	V	V759 CEN	V	2119	2100	2093	2106	10	10
6-14-1993	19:13:35		SKYLAST	U	604	0	0	0	10	10
6-14-1993	19:13:46		SKYLAST	B	962	0	0	0	10	10
6-14-1993	19:13:56		SKYLAST	V	1041	0	0	0	10	10
6-14-1993	19:15:40	C	HD123794	U	1050	1045	1047	1048	10	10
6-14-1993	19:16:21	C	HD123794	B	3584	3593	3589	3606	10	10
6-14-1993	19:17: 2	C	HD123794	V	2177	2177	2178	2169	10	10
6-14-1993	19:17:45		SKYLAST	U	606	0	0	0	10	10
6-14-1993	19:17:56		SKYLAST	B	959	0	0	0	10	10
6-14-1993	19:18: 6		SKYLAST	V	1048	0	0	0	10	10
6-14-1993	19:19:39	C	HD123432	U	697	701	697	700	10	10
6-14-1993	19:20:19	C	HD123432	B	2467	2476	2483	2482	10	10
6-14-1993	19:20:60	C	HD123432	V	2271	2283	2289	2281	10	10
6-14-1993	19:21:43		SKYLAST	U	605	0	0	0	10	10
6-14-1993	19:21:54		SKYLAST	B	966	0	0	0	10	10
6-14-1993	19:22: 4		SKYLAST	V	1068	0	0	0	10	10
6-14-1993	19:23:39	V	V759 CEN	U	919	916	911	918	10	10
6-14-1993	19:24:20	V	V759 CEN	B	3002	3021	3035	3028	10	10
6-14-1993	19:25: 0	V	V759 CEN	V	2132	2141	2137	2144	10	10
6-14-1993	19:25:39		SKYLAST	U	606	0	0	0	10	10
6-14-1993	19:25:50		SKYLAST	B	967	0	0	0	10	10
6-14-1993	19:26: 0		SKYLAST	V	1065	0	0	0	10	10
6-14-1993	19:26:48	V	V759 CEN	U	924	915	913	919	10	10
6-14-1993	19:27:29	V	V759 CEN	B	2999	3005	3004	3001	10	10
6-14-1993	19:28: 9	V	V759 CEN	V	2128	2122	2127	2116	10	10
6-14-1993	19:28:51		SKYLAST	U	606	0	0	0	10	10
6-14-1993	19:29: 1		SKYLAST	B	975	0	0	0	10	10
6-14-1993	19:29:12		SKYLAST	V	1064	0	0	0	10	10
6-14-1993	19:30:21	V	V759 CEN	U	915	910	910	915	10	10
6-14-1993	19:31: 2	V	V759 CEN	B	3010	2986	3013	3015	10	10
6-14-1993	19:31:42	V	V759 CEN	V	2152	2132	2106	2115	10	10
6-14-1993	19:32:25		SKYLAST	U	609	0	0	0	10	10
6-14-1993	19:32:36		SKYLAST	B	967	0	0	0	10	10
6-14-1993	19:32:46		SKYLAST	V	1054	0	0	0	10	10
6-14-1993	19:34:33	V	V759 CEN	U	916	911	909	911	10	10
6-14-1993	19:35:13	V	V759 CEN	B	2991	2997	3017	3022	10	10
6-14-1993	19:35:54	V	V759 CEN	V	2107	2111	2121	2132	10	10
6-14-1993	19:36:38		SKYLAST	U	610	0	0	0	10	10
6-14-1993	19:36:48		SKYLAST	B	967	0	0	0	10	10
6-14-1993	19:36:59		SKYLAST	V	1055	0	0	0	10	10
6-14-1993	19:38:44	C	HD123794	U	1048	1039	1044	1039	10	10
6-14-1993	19:39:24	C	HD123794	B	3550	3568	3555	3577	10	10
6-14-1993	19:40: 5	C	HD123794	V	2146	2155	2161	2133	10	10
6-14-1993	19:40:47		SKYLAST	U	607	0	0	0	10	10
6-14-1993	19:40:57		SKYLAST	B	962	0	0	0	10	10
6-14-1993	19:41: 8		SKYLAST	V	1059	0	0	0	10	10
6-14-1993	19:42:20	V	V759 CEN	U	909	909	905	908	10	10
6-14-1993	19:43: 0	V	V759 CEN	B	2963	2993	2958	2974	10	10
6-14-1993	19:43:41	V	V759 CEN	V	2120	2112	2119	2113	10	10
6-14-1993	19:45:44		SKYLAST	U	607	0	0	0	10	10
6-14-1993	19:45:54		SKYLAST	B	971	0	0	0	10	10
6-14-1993	19:46: 5		SKYLAST	V	1064	0	0	0	10	10
6-14-1993	19:47: 3	V	V759 CEN	U	903	900	899	907	10	10
6-14-1993	19:47:44	V	V759 CEN	B	2941	2949	2934	2982	10	10
6-14-1993	19:48:24	V	V759 CEN	V	2102	2106	2118	2105	10	10
6-14-1993	19:49: 7		SKYLAST	U	608	0	0	0	10	10
6-14-1993	19:49:18		SKYLAST	B	967	0	0	0	10	10
6-14-1993	19:49:28		SKYLAST	V	1076	0	0	0	10	10
6-14-1993	19:50:25	V	V759 CEN	U	903	905	908	907	10	10
6-14-1993	19:51: 5	V	V759 CEN	B	2951	2970	2944	2946	10	10
6-14-1993	19:51:46	V	V759 CEN	V	2127	2123	2123	2124	10	10
6-14-1993	19:52:28		SKYLAST	U	607	0	0	0	10	10

6-14-1993	19:52:38		SKYLAST	B	967	0	0	0	10	10
6-14-1993	19:52:48		SKYLAST	V	1068	0	0	0	10	10
6-14-1993	19:53:37	V	V759 CEN	U	905	905	899	898	10	10
6-14-1993	19:54:17	V	V759 CEN	B	2901	2904	2933	2915	10	10
6-14-1993	19:54:58	V	V759 CEN	V	2112	2088	2114	2095	10	10
6-14-1993	19:55:40		SKYLAST	U	609	0	0	0	10	10
6-14-1993	19:55:51		SKYLAST	B	980	0	0	0	10	10
6-14-1993	19:56: 1		SKYLAST	V	1085	0	0	0	10	10
6-14-1993	19:58:38	F	HR5401	U	271	272	272	273	10	1
6-14-1993	19:59:18	F	HR5401	B	1521	1535	1534	1530	10	1
6-14-1993	19:59:59	F	HR5401	V	695	694	695	693	10	1
6-14-1993	20: 0:42		SKYLAST	U	60	0	0	0	10	1
6-14-1993	20: 0:53	M	SKYLAST	B	95	0	0	0	10	1
6-14-1993	20: 1: 3	M	SKYLAST	V	105	0	0	0	10	1
6-14-1993	20: 3:11	C	HD123794	U	1028	1031	1039	1027	10	10
6-14-1993	20: 3:52	C	HD123794	B	3576	3565	3532	3557	10	10
6-14-1993	20: 4:32	C	HD123794	V	2198	2194	2208	2201	10	10
6-14-1993	20: 5:12		SKYLAST	U	612	0	0	0	10	10
6-14-1993	20: 5:23		SKYLAST	B	976	0	0	0	10	10
6-14-1993	20: 5:33		SKYLAST	V	1086	0	0	0	10	10
6-14-1993	20: 8: 8	V	V759 CEN	U	896	899	893	897	10	10
6-14-1993	20: 8:49	V	V759 CEN	B	2931	2924	2919	2936	10	10
6-14-1993	20: 9:29	V	V759 CEN	V	2115	2125	2132	2141	10	10
6-14-1993	20:10:21		SKYLAST	U	610	0	0	0	10	10
6-14-1993	20:10:31		SKYLAST	B	980	0	0	0	10	10
6-14-1993	20:10:42		SKYLAST	V	1094	0	0	0	10	10
6-14-1993	20:11:32	V	V759 CEN	U	900	900	897	898	10	10
6-14-1993	20:12:12	V	V759 CEN	B	2908	2888	2903	2888	10	10
6-14-1993	20:12:53	V	V759 CEN	V	2106	2111	2088	2086	10	10
6-14-1993	20:13:34		SKYLAST	U	611	0	0	0	10	10
6-14-1993	20:13:44		SKYLAST	B	978	0	0	0	10	10
6-14-1993	20:13:55		SKYLAST	V	1105	0	0	0	10	10
6-14-1993	20:14:50	V	V759 CEN	U	897	900	898	896	10	10
6-14-1993	20:15:30	V	V759 CEN	B	2927	2920	2917	2914	10	10
6-14-1993	20:16:11	V	V759 CEN	V	2146	2131	2133	2146	10	10
6-14-1993	20:16:52		SKYLAST	U	611	0	0	0	10	10
6-14-1993	20:17: 3		SKYLAST	B	998	0	0	0	10	10
6-14-1993	20:17:13		SKYLAST	V	1124	0	0	0	10	10
6-14-1993	20:18: 6	V	V759 CEN	U	898	897	895	891	10	10
6-14-1993	20:18:46	V	V759 CEN	B	2904	2907	2901	2890	10	10
6-14-1993	20:19:27	V	V759 CEN	V	2127	2137	2129	2115	10	10
6-14-1993	20:20:10		SKYLAST	U	617	0	0	0	10	10
6-14-1993	20:20:20		SKYLAST	B	1002	0	0	0	10	10
6-14-1993	20:20:31		SKYLAST	V	1138	0	0	0	10	10
6-14-1993	20:21:53	C	HD123794	U	1019	1020	1020	1013	10	10
6-14-1993	20:22:33	C	HD123794	B	3528	3510	3528	3513	10	10
6-14-1993	20:23:14	C	HD123794	V	2246	2245	2247	2249	10	10
6-14-1993	20:23:56		SKYLAST	U	616	0	0	0	10	10
6-14-1993	20:24: 6		SKYLAST	B	1015	0	0	0	10	10
6-14-1993	20:24:17		SKYLAST	V	1154	0	0	0	10	10
6-14-1993	20:25:28	V	V759 CEN	U	889	893	885	895	10	10
6-14-1993	20:26: 8	V	V759 CEN	B	2900	2892	2880	2903	10	10
6-14-1993	20:26:48	V	V759 CEN	V	2129	2126	2134	2140	10	10
6-14-1993	20:27:30		SKYLAST	U	611	0	0	0	10	10
6-14-1993	20:27:40		SKYLAST	B	997	0	0	0	10	10
6-14-1993	20:27:51		SKYLAST	V	1124	0	0	0	10	10
6-14-1993	20:28:44	V	V759 CEN	U	898	893	899	900	10	10
6-14-1993	20:29:25	V	V759 CEN	B	2937	2940	2931	2938	10	10
6-14-1993	20:30: 5	V	V759 CEN	V	2184	2180	2178	2173	10	10
6-14-1993	20:30:50		SKYLAST	U	614	0	0	0	10	10
6-14-1993	20:31: 1		SKYLAST	B	1002	0	0	0	10	10
6-14-1993	20:31:11		SKYLAST	V	1153	0	0	0	10	10
6-14-1993	20:32: 8	V	V759 CEN	U	895	899	896	899	10	10
6-14-1993	20:32:49	V	V759 CEN	B	2923	2906	2905	2898	10	10
6-14-1993	20:33:29	V	V759 CEN	V	2114	2124	2120	2126	10	10

6-14-1993	20:34:10		SKYLAST	U	612	0	0	0	10	10
6-14-1993	20:34:20		SKYLAST	B	991	0	0	0	10	10
6-14-1993	20:34:31		SKYLAST	V	1111	0	0	0	10	10
6-14-1993	20:35:30	V	V759 CEN	U	906	902	902	901	10	10
6-14-1993	20:36:11	V	V750 CEN	B	2945	2949	2952	2978	10	10
6-14-1993	20:36:51	V	V759 CEN	V	2146	2143	2145	2147	10	10
6-14-1993	20:37:32		SKYLAST	U	612	0	0	0	10	10
6-14-1993	20:37:43		SKYLAST	B	992	0	0	0	10	10
6-14-1993	20:37:53		SKYLAST	V	1109	0	0	0	10	10
6-14-1993	20:39:31	C	HD123794	U	1020	1017	1020	1025	10	10
6-14-1993	20:40:11	C	HD123794	B	3523	3523	3552	3494	10	10
6-14-1993	20:40:52	C	HD123794	V	2205	2208	2206	2209	10	10
6-14-1993	20:41:35		SKYLAST	U	613	0	0	0	10	10
6-14-1993	20:41:45		SKYLAST	B	1012	0	0	0	10	10
6-14-1993	20:41:56		SKYLAST	V	1140	0	0	0	10	10
6-14-1993	20:43:34	C	HD123432	U	700	699	698	702	10	10
6-14-1993	20:44:15	C	HD123432	B	2443	2436	2426	2420	10	10
6-14-1993	20:44:55	C	HD123432	V	2297	2289	2303	2288	10	10
6-14-1993	20:45:50		SKYLAST	U	615	0	0	0	10	10
6-14-1993	20:46: 1		SKYLAST	B	1013	0	0	0	10	10
6-14-1993	20:46:11		SKYLAST	V	1172	0	0	0	10	10
6-14-1993	20:47:41	V	V759 CEN	U	897	901	896	897	10	10
6-14-1993	20:48:22	V	V759 CEN	B	2945	2953	2940	2930	10	10
6-14-1993	20:49: 2	V	V759 CEN	V	2191	2171	2183	2183	10	10
6-14-1993	20:49:48		SKYLAST	U	617	0	0	0	10	10
6-14-1993	20:49:58		SKYLAST	B	1022	0	0	0	10	10
6-14-1993	20:50: 9		SKYLAST	V	1173	0	0	0	10	10
6-14-1993	20:51: 7	V	V759 CEN	U	898	894	898	899	10	10
6-14-1993	20:51:48	V	V759 CEN	B	2946	2953	2963	2958	10	10
6-14-1993	20:52:29	V	V759 CEN	V	2168	2183	2186	2186	10	10
6-14-1993	20:53:11		SKYLAST	U	615	0	0	0	10	10
6-14-1993	20:53:21		SKYLAST	B	1006	0	0	0	10	10
6-14-1993	20:53:31		SKYLAST	V	1152	0	0	0	10	10
6-14-1993	20:54:25	V	V759 CEN	U	899	896	894	897	10	10
6-14-1993	20:55: 6	V	V759 CEN	B	2932	2957	2964	2955	10	10
6-14-1993	20:55:46	V	V759 CEN	V	2185	2192	2183	2186	10	10
6-14-1993	20:56:28		SKYLAST	U	615	0	0	0	10	10
6-14-1993	20:56:39		SKYLAST	B	998	0	0	0	10	10
6-14-1993	20:56:49		SKYLAST	V	1150	0	0	0	10	10
6-14-1993	20:57:42	V	V759 CEN	U	905	905	898	901	10	10
6-14-1993	20:58:22	V	V759 CEN	B	2973	3013	2996	2985	10	10
6-14-1993	20:59: 3	V	V759 CEN	V	2189	2196	2204	2196	10	10
6-14-1993	20:59:50		SKYLAST	U	612	0	0	0	10	10
6-14-1993	21: 0: 0		SKYLAST	B	1001	0	0	0	10	10
6-14-1993	21: 0:11		SKYLAST	V	1136	0	0	0	10	10
6-14-1993	21: 1:34	C	HD123794	U	1009	1010	1015	1013	10	10
6-14-1993	21: 2:15	C	HD123794	B	3454	3468	3479	3473	10	10
6-14-1993	21: 2:55	C	HD123794	V	2241	2233	2243	2239	10	10
6-14-1993	21: 4: 2		SKYLAST	U	615	0	0	0	10	10
6-14-1993	21: 4:13		SKYLAST	B	1010	0	0	0	10	10
6-14-1993	21: 4:23		SKYLAST	V	1147	0	0	0	10	10
6-14-1993	21: 5:47	V	V759 CEN	U	908	902	909	902	10	10
6-14-1993	21: 6:27	V	V759 CEN	B	2981	2978	2994	2983	10	10
6-14-1993	21: 7: 8	V	V759 CEN	V	2166	2189	2155	2178	10	10
6-14-1993	21: 7:56		SKYLAST	U	616	0	0	0	10	10
6-14-1993	21: 8: 6		SKYLAST	B	1003	0	0	0	10	10
6-14-1993	21: 8:17		SKYLAST	V	1148	0	0	0	10	10
6-14-1993	21: 9: 8	V	V759 CEN	U	909	905	909	916	10	10
6-14-1993	21: 9:48	V	V759 CEN	B	3018	3037	3009	3032	10	10
6-14-1993	21:10:29	V	V759 CEN	V	2229	2222	2222	2218	10	10
6-14-1993	21:11:10		SKYLAST	U	617	0	0	0	10	10
6-14-1993	21:11:21		SKYLAST	B	1015	0	0	0	10	10
6-14-1993	21:11:31		SKYLAST	V	1173	0	0	0	10	10
6-14-1993	21:12:32	V	V759 CEN	U	904	908	910	911	10	10
6-14-1993	21:13:12	V	V759 CEN	B	2996	2997	2983	2985	10	10

6-14-1993	21:13:53	V	V759 CEN	V	2207	2212	2212	2205	10	10
6-14-1993	21:14:44		SKYLAST	U	617	0	0	0	10	10
6-14-1993	21:14:55		SKYLAST	B	1024	0	0	0	10	10
6-14-1993	21:15: 5		SKYLAST	V	1176	0	0	0	10	10
6-14-1993	21:15:56	V	V759 CEN	U	906	908	906	904	10	10
6-14-1993	21:16:36	V	V759 CEN	B	3051	3050	3035	3021	10	10
6-14-1993	21:17:17	V	V759 CEN	V	2233	2241	2215	2230	10	10
6-14-1993	21:17:60		SKYLAST	U	618	0	0	0	10	10
6-14-1993	21:18:10		SKYLAST	B	1022	0	0	0	10	10
6-14-1993	21:18:21		SKYLAST	V	1167	0	0	0	10	10
6-14-1993	21:25: 3	F	HR5401	U	252	254	252	253	10	1
6-14-1993	21:25:44	F	HR5401	B	1498	1509	1484	1505	10	1
6-14-1993	21:26:24	F	HR5401	V	678	681	680	682	10	1
6-14-1993	21:27:13		SKYLAST	U	61	0	0	0	10	1
6-14-1993	21:27:24	M	SKYLAST	B	178	0	0	0	10	1
6-14-1993	21:27:34	M	SKYLAST	V	118	0	0	0	10	1
6-14-1993	21:29:52	C	HD123794	U	100	99	100	100	10	1
6-14-1993	21:30:32	C	HD123794	B	348	347	348	348	10	1
6-14-1993	21:31:13	C	HD123794	V	225	225	228	227	10	1
6-14-1993	21:31:59		SKYLAST	U	61	0	0	0	10	1
6-14-1993	21:32:10		SKYLAST	B	103	0	0	0	10	1
6-14-1993	21:32:20		SKYLAST	V	119	0	0	0	10	1
6-14-1993	21:37:20	V	V759 CEN	U	910	913	908	911	10	10
6-14-1993	21:38: 1	V	V759 CEN	B	3057	3065	3081	3087	10	10
6-14-1993	21:38:41	V	V759 CEN	V	2289	2307	2303	2295	10	10
6-14-1993	21:39:28		SKYLAST	U	619	0	0	0	10	10
6-14-1993	21:39:38		SKYLAST	B	1049	0	0	0	10	10
6-14-1993	21:39:49		SKYLAST	V	1200	0	0	0	10	10
6-14-1993	21:40:52	V	V759 CEN	U	908	911	909	913	10	10
6-14-1993	21:41:32	V	V759 CEN	B	3055	3035	3046	3054	10	10
6-14-1993	21:42:13	V	V759 CEN	V	2278	2282	2266	2291	10	10
6-14-1993	21:44:56		SKYLAST	U	623	0	0	0	10	10
6-14-1993	21:45: 6		SKYLAST	B	1052	0	0	0	10	10
6-14-1993	21:45:17		SKYLAST	V	1220	0	0	0	10	10
6-14-1993	21:46:23	V	V759 CEN	U	908	906	911	903	10	10
6-14-1993	21:47: 3	V	V759 CEN	B	3073	3067	3059	3036	10	10
6-14-1993	21:47:44	V	V759 CEN	V	2259	2279	2279	2267	10	10
6-14-1993	21:48:29		SKYLAST	U	624	0	0	0	10	10
6-14-1993	21:48:40		SKYLAST	B	1039	0	0	0	10	10
6-14-1993	21:48:50		SKYLAST	V	1223	0	0	0	10	10
6-14-1993	21:49:54	V	V759 CEN	U	914	915	905	907	10	10
6-14-1993	21:50:34	V	V759 CEN	B	3110	3104	3103	3091	10	10
6-14-1993	21:51:15	V	V759 CEN	V	2327	2339	2346	2326	10	10
6-14-1993	21:52: 1		SKYLAST	U	624	0	0	0	10	10
6-14-1993	21:52:11		SKYLAST	B	1050	0	0	0	10	10
6-14-1993	21:52:22		SKYLAST	V	1228	0	0	0	10	10
6-14-1993	21:54:27	C	HD123794	U	986	986	980	988	10	10
6-14-1993	21:55: 7	C	HD123794	B	3371	3382	3367	3379	10	10
6-14-1993	21:55:48	C	HD123794	V	2262	2279	2268	2279	10	10
6-14-1993	21:56:32		SKYLAST	U	623	0	0	0	10	10
6-14-1993	21:56:43		SKYLAST	B	1055	0	0	0	10	10
6-14-1993	21:56:53		SKYLAST	V	1235	0	0	0	10	10
6-14-1993	21:58: 9	V	V759 CEN	U	910	909	906	912	10	10
6-14-1993	21:58:50	V	V759 CEN	B	3089	3106	3090	3089	10	10
6-14-1993	21:59:31	V	V759 CEN	V	2328	2335	2317	2327	10	10
6-14-1993	22: 0:14		SKYLAST	U	628	0	0	0	10	10
6-14-1993	22: 0:25		SKYLAST	B	1078	0	0	0	10	10
6-14-1993	22: 0:35		SKYLAST	V	1297	0	0	0	10	10
6-14-1993	22: 1:32	V	V759 CEN	U	906	911	907	907	10	10
6-14-1993	22: 2:13	V	V759 CEN	B	3064	3106	3111	3092	10	10
6-14-1993	22: 2:53	V	V759 CEN	V	2357	2367	2392	2376	10	10
6-14-1993	22: 3:37		SKYLAST	U	623	0	0	0	10	10
6-14-1993	22: 3:47		SKYLAST	B	1078	0	0	0	10	10
6-14-1993	22: 3:58		SKYLAST	V	1277	0	0	0	10	10
6-14-1993	22: 4:49	V	V759 CEN	U	901	906	906	910	10	10

6-14-1993	22: 5:30	V	V759 CEN	B	3102	3069	3105	3092	10	10
6-14-1993	22: 6:10	V	V759 CEN	V	2360	2367	2357	2337	10	10
6-14-1993	22: 6:56		SKYLAST	U	624	0	0	0	10	10
6-14-1993	22: 7: 7		SKYLAST	B	1074	0	0	0	10	10
6-14-1993	22: 7:17		SKYLAST	V	1309	0	0	0	10	10
6-14-1993	22: 8:12	V	V759 CEN	U	905	899	902	902	10	10
6-14-1993	22: 8:52	V	V759 CEN	B	3062	3063	3091	3101	10	10
6-14-1993	22: 9:33	V	V759 CEN	V	2421	2406	2421	2434	10	10
6-14-1993	22:10:18		SKYLAST	U	626	0	0	0	10	10
6-14-1993	22:10:28		SKYLAST	B	1092	0	0	0	10	10
6-14-1993	22:10:39		SKYLAST	V	1324	0	0	0	10	10
6-14-1993	22:12: 5	C	HD123794	U	965	975	974	961	10	10
6-14-1993	22:12:46	C	HD123794	B	3316	3322	3333	3305	10	10
6-14-1993	22:13:26	C	HD123794	V	2381	2374	2355	2336	10	10
6-14-1993	22:14:13		SKYLAST	U	628	0	0	0	10	10
6-14-1993	22:14:23		SKYLAST	B	1107	0	0	0	10	10
6-14-1993	22:14:34		SKYLAST	V	1377	0	0	0	10	10
6-14-1993	22:16:49	C	HD123432	U	698	695	698	698	10	10
6-14-1993	22:17:30	C	HD123432	B	2380	2404	2378	2384	10	10
6-14-1993	22:18:10	C	HD123432	V	2419	2411	2421	2445	10	10
6-14-1993	22:18:53		SKYLAST	U	628	0	0	0	10	10
6-14-1993	22:19: 4		SKYLAST	B	1111	0	0	0	10	10
6-14-1993	22:19:14		SKYLAST	V	1370	0	0	0	10	10
6-14-1993	22:20:49	V	V759 CEN	U	893	904	898	902	10	10
6-14-1993	22:21:29	V	V759 CEN	B	3029	3045	3041	3047	10	10
6-14-1993	22:22:10	V	V759 CEN	V	2390	2405	2382	2413	10	10
6-14-1993	22:22:53		SKYLAST	U	628	0	0	0	10	10
6-14-1993	22:23: 4		SKYLAST	B	1111	0	0	0	10	10
6-14-1993	22:23:14		SKYLAST	V	1370	0	0	0	10	10
6-14-1993	22:24:11	V	V759 CEN	U	900	899	901	894	10	10
6-14-1993	22:24:51	V	V759 CEN	B	3061	3104	3068	3065	10	10
6-14-1993	22:25:32	V	V759 CEN	V	2437	2432	2442	2412	10	10
6-14-1993	22:26:15		SKYLAST	U	626	0	0	0	10	10
6-14-1993	22:26:26		SKYLAST	B	1109	0	0	0	10	10
6-14-1993	22:26:36		SKYLAST	V	1348	0	0	0	10	10
6-14-1993	22:27:35	V	V759 CEN	U	897	897	887	891	10	10
6-14-1993	22:28:16	V	V759 CEN	B	3016	3018	2997	3021	10	10
6-14-1993	22:28:56	V	V759 CEN	V	2447	2453	2472	2454	10	10
6-14-1993	22:29:44		SKYLAST	U	630	0	0	0	10	10
6-14-1993	22:29:55		SKYLAST	B	1141	0	0	0	10	10
6-14-1993	22:30: 5		SKYLAST	V	1408	0	0	0	10	10
6-14-1993	22:32:21	V	V759 CEN	U	884	885	886	887	10	10
6-14-1993	22:33: 2	V	V759 CEN	B	3056	3011	3036	3022	10	10
6-14-1993	22:33:42	V	V759 CEN	V	2398	2408	2421	2400	10	10
6-14-1993	22:34:26		SKYLAST	U	634	0	0	0	10	10
6-14-1993	22:34:37		SKYLAST	B	1146	0	0	0	10	10
6-14-1993	22:34:47		SKYLAST	V	1424	0	0	0	10	10
6-14-1993	22:36: 2	C	HD123794	U	949	944	952	946	10	10
6-14-1993	22:36:42	C	HD123794	B	3285	3275	3304	3311	10	10
6-14-1993	22:37:23	C	HD123794	V	2397	2420	2411	2409	10	10
6-14-1993	22:38:10		SKYLAST	U	633	0	0	0	10	10
6-14-1993	22:38:21		SKYLAST	B	1153	0	0	0	10	10
6-14-1993	22:38:31		SKYLAST	V	1458	0	0	0	10	10
6-14-1993	22:39:50	V	V759 CEN	U	875	871	880	872	10	10
6-14-1993	22:40:31	V	V759 CEN	B	2964	2964	2966	2942	10	10
6-14-1993	22:41:11	V	V759 CEN	V	2435	2446	2448	2417	10	10
6-14-1993	22:42:16		SKYLAST	U	633	0	0	0	10	10
6-14-1993	22:42:26		SKYLAST	B	1164	0	0	0	10	10
6-14-1993	22:42:37		SKYLAST	V	1431	0	0	0	10	10
6-14-1993	22:43:36	V	V759 CEN	U	877	871	878	876	10	10
6-14-1993	22:44:16	V	V759 CEN	B	3014	3021	3015	3000	10	10
6-14-1993	22:44:57	V	V759 CEN	V	2498	2479	2472	2467	10	10
6-14-1993	22:45:49		SKYLAST	U	630	0	0	0	10	10
6-14-1993	22:45:59		SKYLAST	B	1147	0	0	0	10	10
6-14-1993	22:46:10		SKYLAST	V	1441	0	0	0	10	10

6-14-1993	22:47:17	V	V759 CEN	U	872	866	872	873	10	10
6-14-1993	22:47:58	V	V759 CEN	B	2971	2978	2985	2978	10	10
6-14-1993	22:48:38	V	V759 CEN	V	2455	2452	2431	2441	10	10
6-14-1993	22:49:47		SKYLAST	U	630	0	0	0	10	10
6-14-1993	22:49:58		SKYLAST	B	1143	0	0	0	10	10
6-14-1993	22:50: 8		SKYLAST	V	1419	0	0	0	10	10
6-14-1993	22:51:14	V	V759 CEN	U	871	871	865	876	10	10
6-14-1993	22:51:54	V	V759 CEN	B	2990	2986	2994	3005	10	10
6-14-1993	22:52:35	V	V759 CEN	V	2438	2448	2441	2430	10	10
6-14-1993	22:53:29		SKYLAST	U	628	0	0	0	10	10
6-14-1993	22:53:40		SKYLAST	B	1138	0	0	0	10	10
6-14-1993	22:53:50		SKYLAST	V	1423	0	0	0	10	10
6-14-1993	22:56:12	F	HR5401	U	218	219	218	218	10	1
6-14-1993	22:56:52	F	HR5401	B	1286	1282	1286	1282	10	1
6-14-1993	22:58:53	F	HR5401	V	654	648	648	649	10	1
6-14-1993	22:59:40		SKYLAST	U	63	0	0	0	10	1
6-14-1993	22:59:50	M	SKYLAST	B	114	0	0	0	10	1
6-14-1993	23: 0: 1	M	SKYLAST	V	136	0	0	0	10	1
6-14-1993	23: 1:46	C	HD123794	U	92	92	92	92	10	1
6-14-1993	23: 2:27	C	HD123794	B	322	322	320	323	10	1
6-14-1993	23: 3: 7	C	HD123794	V	241	241	240	240	10	1
6-14-1993	23: 3:52		SKYLAST	U	62	0	0	0	10	1
6-14-1993	23: 4: 2		SKYLAST	B	115	0	0	0	10	1
6-14-1993	23: 4:13		SKYLAST	V	146	0	0	0	10	1

2V759CEN.DAT ; UNISA OBSERVATORY SSP-5A PHOTOMETER

UT DATE	UT(CLR)	CLEAR	UT(V)	V	UT(U)	U	UT(U-B)	U-B	UT(B-V)	B-V	UT(V-R)	V-R	UT(V-I)
6-14-1993			17:17:53	7.616	17:16:32	7.913	17:16:52	0.111	17:17:33	0.192			
6-14-1993			17:22:22	7.581	17:21: 1	7.915	17:21:21	0.119	17:22: 2	0.222			
6-14-1993			17:26: 6	7.589	17:24:45	7.922	17:25: 6	0.115	17:25:46	0.225			
6-14-1993			17:29:23	7.580	17:28: 2	7.922	17:28:23	0.137	17:29: 3	0.210			
6-14-1993			17:37:57	7.525	17:36:36	7.769	17:36:57	0.056	17:37:37	0.198			
6-14-1993			17:42:56	7.540	17:41:35	7.855	17:41:56	0.096	17:42:36	0.228			
6-14-1993			17:46:37	7.572	17:45:16	7.869	17:45:36	0.091	17:46:17	0.213			
6-14-1993			17:49:53	7.542	17:48:32	7.859	17:48:52	0.104	17:49:33	0.221			
6-14-1993			18: 5:37	7.590	18: 4:16	7.891	18: 4:37	0.114	18: 5:17	0.192			
6-14-1993			18: 8:52	7.567	18: 7:31	7.903	18: 7:52	0.129	18: 8:32	0.212			
6-14-1993			18:12:10	7.584	18:10:49	7.888	18:11:10	0.110	18:11:50	0.200			
6-14-1993			18:15:20	7.537	18:13:59	7.839	18:14:20	0.074	18:15: 0	0.238			
6-14-1993			18:26:35	7.584	18:25:14	7.873	18:25:35	0.080	18:26:15	0.218			
6-14-1993			18:29:54	7.557	18:28:33	7.886	18:28:53	0.110	18:29:34	0.227			
6-14-1993			18:33:21	7.584	18:32: 0	7.883	18:32:20	0.084	18:33: 1	0.223			
6-14-1993			18:36:41	7.568	18:35:20	7.869	18:35:40	0.098	18:36:21	0.212			
6-14-1993			18:51:12	7.591	18:49:51	7.913	18:50:11	0.111	18:50:52	0.218			
6-14-1993			18:54:36	7.587	18:53:15	7.926	18:53:35	0.119	18:54:16	0.227			
6-14-1993			18:58: 3	7.612	18:56:42	7.929	18:57: 2	0.112	18:57:43	0.211			
6-14-1993			19: 1:14	7.593	18:59:53	7.936	19: 0:14	0.118	19: 0:54	0.233			
6-14-1993			19: 8:52	7.612	19: 7:31	7.948	19: 7:51	0.113	19: 8:32	0.230			
6-14-1993			19:12: 7	7.666	19:10:46	7.947	19:11: 6	0.091	19:11:47	0.196			
6-14-1993			19:15:28	7.612	19:14: 7	7.941	19:14:28	0.099	19:15: 8	0.240			
6-14-1993			19:18:41	7.656	19:17:20	7.960	19:17:41	0.092	19:18:21	0.220			
6-14-1993			19:30:47	7.636	19:29:26	7.980	19:29:47	0.113	19:30:27	0.240			
6-14-1993			19:33:56	7.646	19:32:35	7.971	19:32:56	0.092	19:33:36	0.243			
6-14-1993			19:37:29	7.627	19:36: 8	7.999	19:36:29	0.127	19:37: 9	0.254			
6-14-1993			19:41:41	7.629	19:40:20	8.003	19:40:40	0.133	19:41:21	0.248			
6-14-1993			19:49:28	7.637	19:48: 7	7.997	19:48:27	0.111	19:49: 8	0.258			
6-14-1993			19:54:11	7.663	19:52:50	8.013	19:53:11	0.120	19:53:51	0.238			
6-14-1993			19:57:33	7.641	19:56:12	7.990	19:56:32	0.099	19:57:13	0.260			
6-14-1993			20: 0:45	7.685	19:59:24	8.006	19:59:44	0.088	20: 0:25	0.243			
6-14-1993			20:15:16	7.671	20:13:55	8.003	20:14:16	0.103	20:14:56	0.237			
6-14-1993			20:18:40	7.712	20:17:19	7.988	20:17:39	0.079	20:18:20	0.204			
6-14-1993			20:21:58	7.684	20:20:37	7.983	20:20:57	0.082	20:21:38	0.226			
6-14-1993			20:25:14	7.709	20:23:53	8.009	20:24:13	0.100	20:24:54	0.208			
6-14-1993			20:32:36	7.678	20:31:15	7.997	20:31:35	0.094	20:32:16	0.235			
6-14-1993			20:35:52	7.655	20:34:31	7.985	20:34:52	0.102	20:35:32	0.238			
6-14-1993			20:39:16	7.666	20:37:55	7.980	20:38:16	0.087	20:38:56	0.236			
6-14-1993			20:42:38	7.634	20:41:17	7.963	20:41:38	0.095	20:42:18	0.244			
6-14-1993			20:54:49	7.666	20:53:28	7.995	20:53:49	0.109	20:54:29	0.227			
6-14-1993			20:58:16	7.649	20:56:54	7.985	20:57:15	0.119	20:57:56	0.224			
6-14-1993			21: 1:33	7.645	21: 0:12	7.984	21: 0:33	0.123	21: 1:13	0.222			
6-14-1993			21: 4:50	7.624	21: 3:29	7.945	21: 3:49	0.109	21: 4:30	0.219			
6-14-1993			21:12:55	7.664	21:11:34	7.940	21:11:54	0.104	21:12:35	0.178			
6-14-1993			21:16:16	7.635	21:14:55	7.925	21:15:15	0.104	21:15:56	0.192			
6-14-1993			21:19:40	7.650	21:18:19	7.926	21:18:39	0.084	21:19:20	0.200			
6-14-1993			21:23: 4	7.617	21:21:43	7.936	21:22: 3	0.120	21:22:44	0.206			
6-14-1993			21:44:28	7.560	21:43: 7	7.888	21:43:28	0.096	21:44: 8	0.241			
6-14-1993			21:48: 0	7.595	21:46:39	7.894	21:46:59	0.095	21:47:40	0.212			
6-14-1993			21:53:31	7.599	21:52:10	7.894	21:52:30	0.120	21:53:11	0.180			

6-14-1993	21:57: 2	7.534	21:55:41	7.871	21:56: 1	0.122	21:56:42	0.221
6-14-1993	22: 5:18	7.594	22: 3:56	7.862	22: 4:17	0.116	22: 4:58	0.155
6-14-1993	22: 8:40	7.515	22: 7:19	7.836	22: 7:40	0.100	22: 8:20	0.229
6-14-1993	22:11:57	7.556	22:10:36	7.835	22:10:57	0.110	22:11:37	0.174
6-14-1993	22:15:20	7.494	22:13:59	7.845	22:14:19	0.113	22:15: 0	0.247
6-14-1993	22:27:57	7.539	22:26:36	7.819	22:26:56	0.080	22:27:37	0.209
6-14-1993	22:31:19	7.477	22:29:58	7.803	22:30:18	0.088	22:30:59	0.248
6-14-1993	22:34:43	7.507	22:33:22	7.828	22:33:43	0.066	22:34:23	0.268
6-14-1993	22:39:29	7.570	22:38: 8	7.860	22:38:29	0.111	22:39: 9	0.184
6-14-1993	22:46:58	7.539	22:45:37	7.883	22:45:58	0.092	22:46:38	0.263
6-14-1993	22:50:44	7.504	22:49:23	7.860	22:49:43	0.114	22:50:24	0.251
6-14-1993	22:54:25	7.516	22:53: 4	7.874	22:53:25	0.115	22:54: 5	0.252
6-14-1993	22:58:22	7.525	22:57: 1	7.857	22:57:21	0.116	22:58: 2	0.224
6-15-1993	17:17:20	7.539	17:15:59	7.826	17:16:19	0.079	17:17: 0	0.216
6-15-1993	17:20:41	7.508	17:19:20	7.843	17:19:40	0.111	17:20:21	0.232
6-15-1993	17:23:59	7.532	17:22:38	7.820	17:22:58	0.074	17:23:39	0.224
6-15-1993	17:27:23	7.506	17:26: 2	7.857	17:26:22	0.121	17:27: 3	0.237
6-15-1993	17:34:52	7.485	17:33:31	7.828	17:33:52	0.105	17:34:32	0.248
6-15-1993	17:41:58	7.495	17:40:37	7.842	17:40:57	0.114	17:41:38	0.242
6-15-1993	17:45:15	7.542	17:43:54	7.837	17:44:15	0.087	17:44:55	0.215
6-15-1993	17:48:40	7.502	17:47:19	7.832	17:47:39	0.112	17:48:20	0.227
6-15-1993	18: 0:45	7.533	17:59:24	7.839	17:59:44	0.109	18: 0:25	0.204
6-15-1993	18: 4:28	7.579	18: 3: 7	7.840	18: 3:28	0.087	18: 4: 8	0.181
6-15-1993	18: 7:55	7.615	18: 6:34	7.860	18: 6:54	0.093	18: 7:35	0.156
6-15-1993	18:11:34	7.566	18:10:13	7.862	18:10:33	0.072	18:11:14	0.234
6-15-1993	18:19:39	7.535	18:18:18	7.938	18:18:39	0.758	18:19:19	-0.420
6-15-1993	18:24:58	7.580	18:23:37	7.863	18:23:58	0.108	18:24:38	0.180
6-15-1993	18:28:11	7.532	18:26:50	7.882	18:27:10	0.373	18:27:51	-0.046
6-15-1993	18:32:29	7.629	18:31: 8	7.906	18:31:28	0.088	18:32: 9	0.196
6-15-1993	18:46:13	7.510	18:44:52	7.952	18:45:13	0.117	18:45:53	0.339
6-15-1993	18:50:10	7.574	18:48:49	7.907	18:49:10	0.109	18:49:50	0.232
6-15-1993	18:53:36	7.579	18:52:15	7.899	18:52:35	0.096	18:53:16	0.233
6-15-1993	18:57: 6	7.628	18:55:45	7.934	18:56: 6	0.108	18:56:46	0.205
6-15-1993	19: 4:56	7.667	19: 3:35	7.938	19: 3:55	0.085	19: 4:36	0.193
6-15-1993	19: 8:30	7.598	19: 7: 9	7.941	19: 7:30	0.109	19: 8:10	0.243
6-15-1993	19:12: 3	7.661	19:10:42	7.946	19:11: 2	0.080	19:11:43	0.213
6-15-1993	19:15:37	7.616	19:14:16	7.948	19:14:37	0.104	19:15:17	0.237
6-15-1993	19:27:35	7.634	19:26:14	7.955	19:26:34	0.098	19:27:15	0.232
6-15-1993	19:31: 7	7.680	19:29:46	7.959	19:30: 6	0.081	19:30:47	0.206
6-15-1993	19:34:53	7.653	19:33:32	7.989	19:33:52	0.110	19:34:33	0.235
6-15-1993	19:38:15	7.690	19:36:54	8.008	19:37:14	0.110	19:37:55	0.214
6-15-1993	19:46:11	7.667	19:44:50	8.023	19:45:11	0.111	19:45:51	0.253
6-15-1993	19:52: 2	7.699	19:50:41	8.013	19:51: 1	0.099	19:51:42	0.222
6-15-1993	19:55:23	7.674	19:54: 2	8.002	19:54:22	0.113	19:55: 3	0.223
6-15-1993	19:58:51	7.707	19:57:30	8.042	19:57:50	0.111	19:58:31	0.233
6-15-1993	20:13:51	7.658	20:12:30	8.012	20:12:50	0.121	20:13:31	0.242
6-15-1993	20:17:27	7.693	20:16: 6	8.005	20:16:26	0.108	20:17: 7	0.212
6-15-1993	20:20:55	7.674	20:19:34	8.003	20:19:55	0.114	20:20:35	0.222
6-15-1993	20:24:32	7.705	20:23:11	7.999	20:23:32	0.095	20:24:12	0.207
6-15-1993	20:33:59	7.650	20:32:38	7.971	20:32:59	0.087	20:33:39	0.244
6-15-1993	20:37:42	7.695	20:36:21	7.979	20:36:41	0.095	20:37:22	0.197
6-15-1993	20:41: 4	7.626	20:39:43	7.960	20:40: 3	0.094	20:40:44	0.250
6-15-1993	20:44:28	7.688	20:43: 7	7.946	20:43:27	0.083	20:44: 8	0.181
6-15-1993	20:58:21	7.645	20:57: 0	7.957	20:57:20	0.101	20:58: 1	0.218
6-15-1993	21: 1:37	7.593	21: 0:16	7.936	21: 0:37	0.107	21: 1:17	0.246

6-15-1993	21: 4:59	7.633	21: 3:38	7.936	21: 3:58	0.109	21: 4:39	0.199
6-15-1993	21: 8:32	7.586	21: 7:11	7.914	21: 7:31	0.098	21: 8:12	0.238
6-15-1993	21:16:30	7.567	21:15: 9	7.925	21:15:29	0.113	21:16:10	0.254
6-15-1993	21:20:44	7.565	21:19:24	7.927	21:19:44	0.120	21:20:24	0.251
6-15-1993	21:24:40	7.610	21:23:19	7.906	21:23:39	0.099	21:24:20	0.204
6-15-1993	21:28:17	7.576	21:26:56	7.907	21:27:17	0.116	21:27:57	0.223
6-15-1993	21:33:26	7.603	21:32: 5	7.907	21:32:25	0.097	21:33: 6	0.215

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6-15-1993	17: 1:57	F	HR5401	V	687	684	683	682	10	1	
6-15-1993	17: 3:30		SKYLAST	U	66	0	0	0	10	1	
6-15-1993	17: 3:40	M	SKYLAST	B	130	0	0	0	10	1	
6-15-1993	17: 3:51	M	SKYLAST	V	123	0	0	0	10	1	
6-15-1993	17: 6: 3	C	HD123794	U	1075	1076	1078	1082	10	10	
6-15-1993	17: 6:43	C	HD123794	B	3784	3789	3795	3787	10	10	
6-15-1993	17: 7:24	C	HD123794	V	2305	2314	2302	2301	10	10	
6-15-1993	17: 8: 6		SKYLAST	U	661	0	0	0	10	10	
6-15-1993	17: 8:17		SKYLAST	B	1253	0	0	0	10	10	
6-15-1993	17: 8:27		SKYLAST	V	1220	0	0	0	10	10	
6-15-1993	17:10:16	V	V759 CEN	U	1003	996	995	998	10	10	
6-15-1993	17:10:56	V	V759 CEN	B	3480	3477	3467	3482	10	10	
6-15-1993	17:11:37	V	V759 CEN	V	2377	2373	2370	2364	10	10	
6-15-1993	17:12:19		SKYLAST	U	657	0	0	0	10	10	
6-15-1993	17:12:30		SKYLAST	B	1251	0	0	0	10	10	
6-15-1993	17:12:40		SKYLAST	V	1226	0	0	0	10	10	
6-15-1993	17:13:37	V	V759 CEN	U	988	998	1000	994	10	10	
6-15-1993	17:14:17	V	V759 CEN	B	3500	3515	3515	3501	10	10	
6-15-1993	17:14:58	V	V759 CEN	V	2406	2407	2410	2407	10	10	
6-15-1993	17:15:43		SKYLAST	U	657	0	0	0	10	10	
6-15-1993	17:15:53		SKYLAST	B	1241	0	0	0	10	10	
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6-15-1993	17:16:55	V	V759 CEN	U	1002	994	996	998	10	10	
6-15-1993	17:17:35	V	V759 CEN	B	3485	3473	3475	3456	10	10	
6-15-1993	17:18:16	V	V759 CEN	V	2387	2372	2360	2369	10	10	
6-15-1993	17:19: 6		SKYLAST	U	651	0	0	0	10	10	
6-15-1993	17:19:16		SKYLAST	B	1233	0	0	0	10	10	
6-15-1993	17:19:27		SKYLAST	V	1217	0	0	0	10	10	
6-15-1993	17:20:19	V	V759 CEN	U	991	992	990	994	10	10	
6-15-1993	17:20:59	V	V759 CEN	B	3489	3490	3500	3506	10	10	
6-15-1993	17:21:40	V	V759 CEN	V	2381	2383	2392	2400	10	10	
6-15-1993	17:22:21		SKYLAST	U	654	0	0	0	10	10	
6-15-1993	17:22:31		SKYLAST	B	1223	0	0	0	10	10	

6-15-1993	17:22:41		SKYLAST	V	1205	0	0	0	10	10
6-15-1993	17:24:14	C	HD123794	U	1082	1084	1083	1079	10	10
6-15-1993	17:24:54	C	HD123794	B	3785	3778	3794	3799	10	10
6-15-1993	17:25:35	C	HD123794	V	2306	2306	2292	2286	10	10
6-15-1993	17:26:18		SKYLAST	U	652	0	0	0	10	10
6-15-1993	17:26:28		SKYLAST	B	1213	0	0	0	10	10
6-15-1993	17:26:39		SKYLAST	V	1207	0	0	0	10	10
6-15-1993	17:27:48	V	V759 CEN	U	998	996	1000	997	10	10
6-15-1993	17:28:29	V	V759 CEN	B	3495	3518	3498	3518	10	10
6-15-1993	17:29: 9	V	V759 CEN	V	2395	2398	2398	2394	10	10
6-15-1993	17:29:59		SKYLAST	U	649	0	0	0	10	10
6-15-1993	17:30: 9		SKYLAST	B	1204	0	0	0	10	10
6-15-1993	17:30:20		SKYLAST	V	1187	0	0	0	10	10
6-15-1993	17:34:54	V	V759 CEN	U	961	960	971	962	10	10
6-15-1993	17:35:34	V	V759 CEN	B	3394	3380	3371	3379	10	10
6-15-1993	17:36:15	V	V759 CEN	V	2318	2315	2314	2320	10	10
6-15-1993	17:36:56		SKYLAST	U	619	0	0	0	10	10
6-15-1993	17:37: 7		SKYLAST	B	1087	0	0	0	10	10
6-15-1993	17:37:17		SKYLAST	V	1114	0	0	0	10	10
6-15-1993	17:38:11	V	V759 CEN	U	964	959	964	960	10	10
6-15-1993	17:38:52	V	V759 CEN	B	3332	3339	3331	3323	10	10
6-15-1993	17:39:32	V	V759 CEN	V	2276	2282	2275	2286	10	10
6-15-1993	17:40:19		SKYLAST	U	616	0	0	0	10	10
6-15-1993	17:40:29		SKYLAST	B	1085	0	0	0	10	10
6-15-1993	17:40:40		SKYLAST	V	1127	0	0	0	10	10
6-15-1993	17:41:36	V	V759 CEN	U	961	960	965	968	10	10
6-15-1993	17:42:16	V	V759 CEN	B	3384	3381	3393	3406	10	10
6-15-1993	17:42:57	V	V759 CEN	V	2331	2338	2331	2329	10	10
6-15-1993	17:43:40		SKYLAST	U	616	0	0	0	10	10
6-15-1993	17:43:51		SKYLAST	B	1082	0	0	0	10	10
6-15-1993	17:44: 1		SKYLAST	V	1134	0	0	0	10	10
6-15-1993	17:45:31	C	HD123794	U	1050	1043	1044	1043	10	10
6-15-1993	17:46:12	C	HD123794	B	3656	3655	3661	3654	10	10
6-15-1993	17:46:53	C	HD123794	V	2224	2222	2227	2226	10	10
6-15-1993	17:47:34		SKYLAST	U	615	0	0	0	10	10
6-15-1993	17:47:44		SKYLAST	B	1082	0	0	0	10	10
6-15-1993	17:47:55		SKYLAST	V	1124	0	0	0	10	10
6-15-1993	17:49:42	C	HD123432	U	708	709	707	709	10	10
6-15-1993	17:50:23	C	HD123432	B	2569	2584	2553	2549	10	10
6-15-1993	17:51: 3	C	HD123432	V	2327	2325	2339	2322	10	10
6-15-1993	17:51:45		SKYLAST	U	615	0	0	0	10	10
6-15-1993	17:51:55		SKYLAST	B	1076	0	0	0	10	10
6-15-1993	17:52: 6		SKYLAST	V	1134	0	0	0	10	10
6-15-1993	17:53:41	V	V759 CEN	U	961	962	967	954	10	10
6-15-1993	17:54:21	V	V759 CEN	B	3387	3385	3363	3354	10	10
6-15-1993	17:55: 2	V	V759 CEN	V	2311	2316	2311	2313	10	10
6-15-1993	17:55:51		SKYLAST	U	616	0	0	0	10	10
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6-15-1993	17:56:12		SKYLAST	V	1136	0	0	0	10	10
6-15-1993	17:57:24	V	V759 CEN	U	957	954	966	963	10	10
6-15-1993	17:58: 5	V	V759 CEN	B	3325	3331	3324	3317	10	10
6-15-1993	17:58:45	V	V759 CEN	V	2280	2286	2278	2276	10	10
6-15-1993	17:59:26		SKYLAST	U	616	0	0	0	10	10
6-15-1993	17:59:37		SKYLAST	B	1086	0	0	0	10	10
6-15-1993	17:59:47		SKYLAST	V	1148	0	0	0	10	10

6-15-1993	18: 0:51	V	V759 CEN	U	951	946	946	952	10	10	
6-15-1993	18: 1:31	V	V759 CEN	B	3320	3334	3310	3308	10	10	
6-15-1993	18: 2:12	V	V759 CEN	V	2346	2359	2345	2321	10	10	
6-15-1993	18: 3:11		SKYLAST	U	611	0	0	0	10	10	
6-15-1993	18: 3:21		SKYLAST	B	1106	0	0	0	10	10	
6-15-1993	18: 3:32		SKYLAST	V	1244	0	0	0	10	10	
6-15-1993	18: 4:30	V	V759 CEN	U	951	947	946	942	10	10	
6-15-1993	18: 5:10	V	V759 CEN	B	3250	3221	3200	3207	10	10	
6-15-1993	18: 5:51	V	V759 CEN	V	2299	2310	2292	2296	10	10	
6-15-1993	18: 6:35		SKYLAST	U	610	0	0	0	10	10	
6-15-1993	18: 6:45		SKYLAST	B	1056	0	0	0	10	10	
6-15-1993	18: 6:56		SKYLAST	V	1146	0	0	0	10	10	
6-15-1993	18: 8:41	C	HD123794	U	1033	1046	1041	1037	10	10	
6-15-1993	18: 9:21	C	HD123794	B	3633	3629	3626	3621	10	10	
6-15-1993	18:10: 2	C	HD123794	V	2292	2294	2293	2291	10	10	
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6-15-1993	18:10:56		SKYLAST	B	1051	0	0	0	10	10	
6-15-1993	18:11: 6		SKYLAST	V	1166	0	0	0	10	10	
6-15-1993	18:12:35	V	V759 CEN	U	928	933	941	935	10	10	
6-15-1993	18:13:16	V	V759 CEN	B	5697	5772	5775	5786	10	10	
6-15-1993	18:13:56	V	V759 CEN	V	2292	2284	2282	2269	10	10	
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6-15-1993	18:17:54	V	V759 CEN	U	939	947	946	941	10	10	
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6-15-1993	18:21:47	V	V759 CEN	B	3753	3880	3934	3851	10	10	
6-15-1993	18:22:28	V	V759 CEN	V	2282	2286	2292	2287	10	10	
6-15-1993	18:24:15		SKYLAST	U	610	0	0	0	10	10	
6-15-1993	18:24:25		SKYLAST	B	1006	0	0	0	10	10	
6-15-1993	18:24:36		SKYLAST	V	1126	0	0	0	10	10	
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6-15-1993	18:26: 5	V	V759 CEN	B	3150	3149	3147	3143	10	10	
6-15-1993	18:26:46	V	V759 CEN	V	2248	2253	2254	2267	10	10	
6-15-1993	18:27:37		SKYLAST	U	609	0	0	0	10	10	
6-15-1993	18:27:47		SKYLAST	B	1033	0	0	0	10	10	
6-15-1993	18:27:58		SKYLAST	V	1207	0	0	0	10	10	
6-15-1993	18:30:51	F	HR5401	U	267	271	272	273	10	1	
6-15-1993	18:31:32	F	HR5401	B	1527	1539	1537	1541	10	1	
6-15-1993	18:32:12	F	HR5401	V	697	701	700	702	10	1	
6-15-1993	18:32:54		SKYLAST	U	59	0	0	0	10	1	
6-15-1993	18:33: 4	M	SKYLAST	B	99	0	0	0	10	1	
6-15-1993	18:33:15	M	SKYLAST	V	106	0	0	0	10	1	
6-15-1993	18:35:17	C	HD123794	U	1031	1036	1044	1043	10	10	
6-15-1993	18:35:57	C	HD123794	B	3607	3602	3598	3593	10	10	
6-15-1993	18:36:38	C	HD123794	V	2250	2256	2250	2264	10	10	
6-15-1993	18:37:25		SKYLAST	U	608	0	0	0	10	10	
6-15-1993	18:37:36		SKYLAST	B	1017	0	0	0	10	10	
6-15-1993	18:37:46		SKYLAST	V	1202	0	0	0	10	10	
6-15-1993	18:39: 9	V	V759 CEN	U	917	914	918	919	10	10	

6-15-1993	18:39:50 V	V759 CEN	B	3065	3075	3083	3075	10	10
6-15-1993	18:40:30 V	V759 CEN	V	2234	2244	2227	2222	10	10
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6-15-1993	18:43: 6 V	V759 CEN	U	931	929	930	936	10	10
6-15-1993	18:43:47 V	V759 CEN	B	3118	3151	3128	3123	10	10
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6-15-1993	18:45:43	SKYLAST	V	1044	0	0	0	10	10
6-15-1993	18:46:32 V	V759 CEN	U	940	935	932	937	10	10
6-15-1993	18:47:12 V	V759 CEN	B	3131	3134	3132	3132	10	10
6-15-1993	18:47:53 V	V759 CEN	V	2172	2170	2174	2187	10	10
6-15-1993	18:48:39	SKYLAST	U	602	0	0	0	10	10
6-15-1993	18:48:50	SKYLAST	B	954	0	0	0	10	10
6-15-1993	18:49: 0	SKYLAST	V	1055	0	0	0	10	10
6-15-1993	18:50: 2 V	V759 CEN	U	929	929	933	923	10	10
6-15-1993	18:50:43 V	V759 CEN	B	3109	3104	3111	3109	10	10
6-15-1993	18:51:23 V	V759 CEN	V	2160	2155	2156	2146	10	10
6-15-1993	18:52:20	SKYLAST	U	603	0	0	0	10	10
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6-15-1993	18:54: 1 C	HD123794	U	1043	1050	1046	1048	10	10
6-15-1993	18:54:41 C	HD123794	B	3606	3616	3603	3637	10	10
6-15-1993	18:55:22 C	HD123794	V	2217	2214	2222	2226	10	10
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6-15-1993	18:56:30	SKYLAST	B	966	0	0	0	10	10
6-15-1993	18:56:41	SKYLAST	V	1082	0	0	0	10	10
6-15-1993	18:57:52 V	V759 CEN	U	928	927	929	929	10	10
6-15-1993	18:58:32 V	V759 CEN	B	3066	3078	3069	3060	10	10
6-15-1993	18:59:13 V	V759 CEN	V	2124	2130	2115	2141	10	10
6-15-1993	19: 0: 2	SKYLAST	U	602	0	0	0	10	10
6-15-1993	19: 0:12	SKYLAST	B	962	0	0	0	10	10
6-15-1993	19: 0:23	SKYLAST	V	1062	0	0	0	10	10
6-15-1993	19: 1:26 V	V759 CEN	U	928	930	923	933	10	10
6-15-1993	19: 2: 7 V	V759 CEN	B	3112	3115	3113	3117	10	10
6-15-1993	19: 2:47 V	V759 CEN	V	2175	2169	2179	2174	10	10
6-15-1993	19: 3:37	SKYLAST	U	603	0	0	0	10	10
6-15-1993	19: 3:47	SKYLAST	B	960	0	0	0	10	10
6-15-1993	19: 3:58	SKYLAST	V	1040	0	0	0	10	10
6-15-1993	19: 4:59 V	V759 CEN	U	926	931	928	925	10	10
6-15-1993	19: 5:39 V	V759 CEN	B	3070	3043	3033	3056	10	10
6-15-1993	19: 6:20 V	V759 CEN	V	2126	2139	2130	2116	10	10
6-15-1993	19: 7:12	SKYLAST	U	604	0	0	0	10	10
6-15-1993	19: 7:23	SKYLAST	B	960	0	0	0	10	10
6-15-1993	19: 7:33	SKYLAST	V	1058	0	0	0	10	10
6-15-1993	19: 8:33 V	V759 CEN	U	928	921	930	925	10	10
6-15-1993	19: 9:14 V	V759 CEN	B	3096	3097	3103	3095	10	10
6-15-1993	19: 9:54 V	V759 CEN	V	2157	2152	2160	2161	10	10
6-15-1993	19:10:42	SKYLAST	U	603	0	0	0	10	10
6-15-1993	19:10:52	SKYLAST	B	958	0	0	0	10	10
6-15-1993	19:11: 3	SKYLAST	V	1043	0	0	0	10	10
6-15-1993	19:12:42 C	HD123794	U	1047	1048	1050	1061	10	10
6-15-1993	19:13:22 C	HD123794	B	3640	3630	3649	3646	10	10

6-15-1993	19:14: 3	C	HD123794	V	2194	2187	2186	2195	10	10
6-15-1993	19:14:50		SKYLAST	U	607	0	0	0	10	10
6-15-1993	19:15: 0		SKYLAST	B	959	0	0	0	10	10
6-15-1993	19:15:11		SKYLAST	V	1055	0	0	0	10	10
6-15-1993	19:16:38	C	HD123432	U	697	698	699	700	10	10
6-15-1993	19:17:18	C	HD123432	B	2503	2479	2493	2487	10	10
6-15-1993	19:17:58	C	HD123432	V	2264	2258	2267	2272	10	10
6-15-1993	19:18:49		SKYLAST	U	604	0	0	0	10	10
6-15-1993	19:18:60		SKYLAST	B	965	0	0	0	10	10
6-15-1993	19:19:10		SKYLAST	V	1058	0	0	0	10	10
6-15-1993	19:20:31	V	V759 CEN	U	926	929	928	928	10	10
6-15-1993	19:21:11	V	V759 CEN	B	3064	3088	3094	3076	10	10
6-15-1993	19:21:52	V	V759 CEN	V	2143	2141	2139	2137	10	10
6-15-1993	19:22:43		SKYLAST	U	604	0	0	0	10	10
6-15-1993	19:22:53		SKYLAST	B	955	0	0	0	10	10
6-15-1993	19:23: 4		SKYLAST	V	1040	0	0	0	10	10
6-15-1993	19:24: 3	V	V759 CEN	U	928	932	925	927	10	10
6-15-1993	19:24:43	V	V759 CEN	B	3061	3053	3046	3034	10	10
6-15-1993	19:25:24	V	V759 CEN	V	2106	2097	2093	2091	10	10
6-15-1993	19:26:11		SKYLAST	U	604	0	0	0	10	10
6-15-1993	19:26:21		SKYLAST	B	962	0	0	0	10	10
6-15-1993	19:26:32		SKYLAST	V	1041	0	0	0	10	10
6-15-1993	19:27:49	V	V759 CEN	U	920	923	920	921	10	10
6-15-1993	19:28:29	V	V759 CEN	B	3050	3070	3039	3045	10	10
6-15-1993	19:29:10	V	V759 CEN	V	2135	2135	2123	2131	10	10
6-15-1993	19:29:57		SKYLAST	U	604	0	0	0	10	10
6-15-1993	19:30: 8		SKYLAST	B	961	0	0	0	10	10
6-15-1993	19:30:18		SKYLAST	V	1047	0	0	0	10	10
6-15-1993	19:31:11	V	V759 CEN	U	918	917	919	921	10	10
6-15-1993	19:31:51	V	V759 CEN	B	3013	3025	3009	3023	10	10
6-15-1993	19:32:32	V	V759 CEN	V	2087	2104	2098	2087	10	10
6-15-1993	19:33:21		SKYLAST	U	606	0	0	0	10	10
6-15-1993	19:33:32		SKYLAST	B	960	0	0	0	10	10
6-15-1993	19:33:42		SKYLAST	V	1045	0	0	0	10	10
6-15-1993	19:35: 3	C	HD123794	U	1064	1052	1061	1064	10	10
6-15-1993	19:35:43	C	HD123794	B	3635	3655	3649	3646	10	10
6-15-1993	19:36:24	C	HD123794	V	2192	2174	2163	2174	10	10
6-15-1993	19:37: 7		SKYLAST	U	603	0	0	0	10	10
6-15-1993	19:37:18		SKYLAST	B	942	0	0	0	10	10
6-15-1993	19:37:28		SKYLAST	V	1030	0	0	0	10	10
6-15-1993	19:39: 7	V	V759 CEN	U	915	920	914	906	10	10
6-15-1993	19:39:48	V	V759 CEN	B	2958	2975	2969	2983	10	10
6-15-1993	19:40:28	V	V759 CEN	V	2077	2084	2077	2075	10	10
6-15-1993	19:41:13		SKYLAST	U	604	0	0	0	10	10
6-15-1993	19:41:24		SKYLAST	B	936	0	0	0	10	10
6-15-1993	19:41:34		SKYLAST	V	1005	0	0	0	10	10
6-15-1993	19:44:58	V	V759 CEN	U	918	917	919	918	10	10
6-15-1993	19:45:38	V	V759 CEN	B	2979	2978	2964	2957	10	10
6-15-1993	19:46:19	V	V759 CEN	V	2049	2065	2072	2057	10	10
6-15-1993	19:47: 4		SKYLAST	U	606	0	0	0	10	10
6-15-1993	19:47:14		SKYLAST	B	939	0	0	0	10	10
6-15-1993	19:47:25		SKYLAST	V	1017	0	0	0	10	10
6-15-1993	19:48:19	V	V759 CEN	U	921	918	923	918	10	10
6-15-1993	19:48:59	V	V759 CEN	B	3023	3020	3036	3011	10	10
6-15-1993	19:49:40	V	V759 CEN	V	2104	2108	2095	2113	10	10

6-15-1993	19:50:27		SKYLAST	U	605	0	0	0	10	10
6-15-1993	19:50:38		SKYLAST	B	945	0	0	0	10	10
6-15-1993	19:50:48		SKYLAST	V	1036	0	0	0	10	10
6-15-1993	19:51:47	V	V759 CEN	U	913	907	912	909	10	10
6-15-1993	19:52:27	V	V759 CEN	B	2945	2951	2939	2945	10	10
6-15-1993	19:53: 8	V	V759 CEN	V	2060	2073	2066	2063	10	10
6-15-1993	19:53:52		SKYLAST	U	607	0	0	0	10	10
6-15-1993	19:54: 3		SKYLAST	B	946	0	0	0	10	10
6-15-1993	19:54:13		SKYLAST	V	1028	0	0	0	10	10
6-15-1993	19:57:54	F	HR5401	U	280	282	281	282	10	1
6-15-1993	19:58:34	F	HR5401	B	1582	1581	1588	1594	10	1
6-15-1993	19:59:15	F	HR5401	V	709	710	708	708	10	1
6-15-1993	20: 0: 0		SKYLAST	U	60	0	0	0	10	1
6-15-1993	20: 0:11	M	SKYLAST	B	95	0	0	0	10	1
6-15-1993	20: 0:21	M	SKYLAST	V	102	0	0	0	10	1
6-15-1993	20: 2:46	C	HD123794	U	1063	1064	1065	1059	10	10
6-15-1993	20: 3:26	C	HD123794	B	3663	3656	3655	3663	10	10
6-15-1993	20: 4: 7	C	HD123794	V	2192	2192	2194	2180	10	10
6-15-1993	20: 5: 0		SKYLAST	U	609	0	0	0	10	10
6-15-1993	20: 5:11		SKYLAST	B	952	0	0	0	10	10
6-15-1993	20: 5:21		SKYLAST	V	1038	0	0	0	10	10
6-15-1993	20: 6:47	V	V759 CEN	U	919	920	919	919	10	10
6-15-1993	20: 7:27	V	V759 CEN	B	3003	3022	3016	3012	10	10
6-15-1993	20: 8: 8	V	V759 CEN	V	2116	2111	2121	2123	10	10
6-15-1993	20: 9: 3		SKYLAST	U	611	0	0	0	10	10
6-15-1993	20: 9:13		SKYLAST	B	947	0	0	0	10	10
6-15-1993	20: 9:24		SKYLAST	V	1032	0	0	0	10	10
6-15-1993	20:10:23	V	V759 CEN	U	919	920	914	918	10	10
6-15-1993	20:11: 3	V	V759 CEN	B	3000	3015	2992	3000	10	10
6-15-1993	20:11:44	V	V759 CEN	V	2096	2097	2091	2085	10	10
6-15-1993	20:12:27		SKYLAST	U	610	0	0	0	10	10
6-15-1993	20:12:37		SKYLAST	B	957	0	0	0	10	10
6-15-1993	20:12:48		SKYLAST	V	1042	0	0	0	10	10
6-15-1993	20:13:51	V	V759 CEN	U	919	916	920	915	10	10
6-15-1993	20:14:32	V	V759 CEN	B	3025	3018	3031	3020	10	10
6-15-1993	20:15:12	V	V759 CEN	V	2136	2144	2150	2139	10	10
6-15-1993	20:15:55		SKYLAST	U	611	0	0	0	10	10
6-15-1993	20:16: 5		SKYLAST	B	969	0	0	0	10	10
6-15-1993	20:16:16		SKYLAST	V	1075	0	0	0	10	10
6-15-1993	20:17:28	V	V759 CEN	U	917	915	913	915	10	10
6-15-1993	20:18: 9	V	V759 CEN	B	2999	2998	3007	2984	10	10
6-15-1993	20:18:49	V	V759 CEN	V	2119	2127	2118	2126	10	10
6-15-1993	20:21:12		SKYLAST	U	610	0	0	0	10	10
6-15-1993	20:21:22		SKYLAST	B	981	0	0	0	10	10
6-15-1993	20:21:33		SKYLAST	V	1086	0	0	0	10	10
6-15-1993	20:23: 4	C	HD123794	U	1051	1046	1046	1046	10	10
6-15-1993	20:23:45	C	HD123794	B	3606	3625	3630	3635	10	10
6-15-1993	20:24:25	C	HD123794	V	2217	2226	2207	2230	10	10
6-15-1993	20:25:12		SKYLAST	U	612	0	0	0	10	10
6-15-1993	20:25:23		SKYLAST	B	976	0	0	0	10	10
6-15-1993	20:25:33		SKYLAST	V	1077	0	0	0	10	10
6-15-1993	20:26:55	V	V759 CEN	U	920	916	917	918	10	10
6-15-1993	20:27:36	V	V759 CEN	B	3005	3010	2997	3016	10	10
6-15-1993	20:28:16	V	V759 CEN	V	2163	2175	2163	2170	10	10
6-15-1993	20:29: 1		SKYLAST	U	610	0	0	0	10	10

6-15-1993	20:29:12		SKYLAST	B	971	0	0	0	10	10
6-15-1993	20:29:22		SKYLAST	V	1083	0	0	0	10	10
6-15-1993	20:30:38	V	V759 CEN	U	917	914	916	914	10	10
6-15-1993	20:31:18	V	V759 CEN	B	3016	3015	3016	2982	10	10
6-15-1993	20:31:59	V	V759 CEN	V	2143	2161	2144	2140	10	10
6-15-1993	20:32:41		SKYLAST	U	611	0	0	0	10	10
6-15-1993	20:32:51		SKYLAST	B	975	0	0	0	10	10
6-15-1993	20:33: 2		SKYLAST	V	1108	0	0	0	10	10
6-15-1993	20:33:60	V	V759 CEN	U	920	915	923	924	10	10
6-15-1993	20:34:40	V	V759 CEN	B	3045	3045	3051	3048	10	10
6-15-1993	20:35:21	V	V759 CEN	V	2192	2191	2195	2192	10	10
6-15-1993	20:36: 6		SKYLAST	U	612	0	0	0	10	10
6-15-1993	20:36:16		SKYLAST	B	983	0	0	0	10	10
6-15-1993	20:36:27		SKYLAST	V	1088	0	0	0	10	10
6-15-1993	20:37:24	V	V759 CEN	U	926	921	925	921	10	10
6-15-1993	20:38: 4	V	V759 CEN	B	3047	3049	3048	3046	10	10
6-15-1993	20:38:45	V	V759 CEN	V	2185	2168	2165	2174	10	10
6-15-1993	20:39:28		SKYLAST	U	612	0	0	0	10	10
6-15-1993	20:39:38		SKYLAST	B	982	0	0	0	10	10
6-15-1993	20:39:49		SKYLAST	V	1132	0	0	0	10	10
6-15-1993	20:41: 9	C	HD123794	U	1036	1035	1042	1045	10	10
6-15-1993	20:41:49	C	HD123794	B	3619	3616	3614	3638	10	10
6-15-1993	20:42:30	C	HD123794	V	2263	2267	2251	2265	10	10
6-15-1993	20:43:21		SKYLAST	U	613	0	0	0	10	10
6-15-1993	20:43:32		SKYLAST	B	997	0	0	0	10	10
6-15-1993	20:43:42		SKYLAST	V	1131	0	0	0	10	10
6-15-1993	20:46:10	C	HD123432	U	704	703	702	702	10	10
6-15-1993	20:46:50	C	HD123432	B	2495	2500	2480	2504	10	10
6-15-1993	20:47:31	C	HD123432	V	2369	2375	2352	2364	10	10
6-15-1993	20:48:16		SKYLAST	U	611	0	0	0	10	10
6-15-1993	20:48:27		SKYLAST	B	1006	0	0	0	10	10
6-15-1993	20:48:37		SKYLAST	V	1171	0	0	0	10	10
6-15-1993	20:51:17	V	V759 CEN	U	911	916	916	915	10	10
6-15-1993	20:51:57	V	V759 CEN	B	3050	3037	3022	3026	10	10
6-15-1993	20:52:38	V	V759 CEN	V	2204	2198	2199	2203	10	10
6-15-1993	20:53:23		SKYLAST	U	613	0	0	0	10	10
6-15-1993	20:53:33		SKYLAST	B	998	0	0	0	10	10
6-15-1993	20:53:44		SKYLAST	V	1147	0	0	0	10	10
6-15-1993	20:54:33	V	V759 CEN	U	925	920	916	916	10	10
6-15-1993	20:55:14	V	V759 CEN	B	3064	3078	3079	3060	10	10
6-15-1993	20:55:54	V	V759 CEN	V	2252	2247	2239	2234	10	10
6-15-1993	20:56:37		SKYLAST	U	614	0	0	0	10	10
6-15-1993	20:56:48		SKYLAST	B	999	0	0	0	10	10
6-15-1993	20:56:58		SKYLAST	V	1146	0	0	0	10	10
6-15-1993	20:57:55	V	V759 CEN	U	919	915	915	929	10	10
6-15-1993	20:58:35	V	V759 CEN	B	3096	3056	3045	3036	10	10
6-15-1993	20:59:16	V	V759 CEN	V	2222	2225	2215	2209	10	10
6-15-1993	21: 0: 8		SKYLAST	U	616	0	0	0	10	10
6-15-1993	21: 0:19		SKYLAST	B	996	0	0	0	10	10
6-15-1993	21: 0:29		SKYLAST	V	1170	0	0	0	10	10
6-15-1993	21: 1:28	V	V759 CEN	U	920	923	916	922	10	10
6-15-1993	21: 2: 8	V	V759 CEN	B	3070	3075	3075	3078	10	10
6-15-1993	21: 2:49	V	V759 CEN	V	2268	2264	2260	2263	10	10
6-15-1993	21: 3:37		SKYLAST	U	613	0	0	0	10	10
6-15-1993	21: 3:48		SKYLAST	B	1009	0	0	0	10	10

6-15-1993	21: 3:58		SKYLAST	V	1180	0	0	0	10	10
6-15-1993	21: 5:25	C	HD123794	U	1027	1022	1016	1023	10	10
6-15-1993	21: 6: 5	C	HD123794	B	3502	3524	3511	3484	10	10
6-15-1993	21: 6:46	C	HD123794	V	2254	2237	2254	2242	10	10
6-15-1993	21: 7:33		SKYLAST	U	615	0	0	0	10	10
6-15-1993	21: 7:43		SKYLAST	B	1012	0	0	0	10	10
6-15-1993	21: 7:54		SKYLAST	V	1184	0	0	0	10	10
6-15-1993	21: 9:26	V	V759 CEN	U	917	917	916	915	10	10
6-15-1993	21:10: 6	V	V759 CEN	B	3074	3074	3070	3065	10	10
6-15-1993	21:10:47	V	V759 CEN	V	2278	2280	2269	2286	10	10
6-15-1993	21:11:45		SKYLAST	U	615	0	0	0	10	10
6-15-1993	21:11:56		SKYLAST	B	1009	0	0	0	10	10
6-15-1993	21:12: 6		SKYLAST	V	1180	0	0	0	10	10
6-15-1993	21:13:41	V	V759 CEN	U	922	918	917	919	10	10
6-15-1993	21:14:21	V	V759 CEN	B	3083	3073	3101	3103	10	10
6-15-1993	21:15: 1	V	V759 CEN	V	2288	2290	2285	2282	10	10
6-15-1993	21:15:53		SKYLAST	U	619	0	0	0	10	10
6-15-1993	21:16: 4		SKYLAST	B	1013	0	0	0	10	10
6-15-1993	21:16:14		SKYLAST	V	1178	0	0	0	10	10
6-15-1993	21:17:36	V	V759 CEN	U	918	917	923	917	10	10
6-15-1993	21:18:16	V	V759 CEN	B	3090	3086	3092	3080	10	10
6-15-1993	21:18:57	V	V759 CEN	V	2245	2252	2241	2239	10	10
6-15-1993	21:19:48		SKYLAST	U	614	0	0	0	10	10
6-15-1993	21:19:59		SKYLAST	B	1008	0	0	0	10	10
6-15-1993	21:20: 9		SKYLAST	V	1175	0	0	0	10	10
6-15-1993	21:21:13	V	V759 CEN	U	921	924	921	922	10	10
6-15-1993	21:21:54	V	V759 CEN	B	3124	3119	3101	3138	10	10
6-15-1993	21:22:34	V	V759 CEN	V	2287	2274	2275	2277	10	10
6-15-1993	21:23:25		SKYLAST	U	618	0	0	0	10	10
6-15-1993	21:23:36		SKYLAST	B	1006	0	0	0	10	10
6-15-1993	21:23:46		SKYLAST	V	1169	0	0	0	10	10
6-15-1993	21:26:22	V	V759 CEN	U	923	916	914	925	10	10
6-15-1993	21:27: 2	V	V759 CEN	B	3101	3085	3083	3115	10	10
6-15-1993	21:27:43	V	V759 CEN	V	2268	2257	2263	2258	10	10
6-15-1993	21:28:38		SKYLAST	U	617	0	0	0	10	10
6-15-1993	21:28:48		SKYLAST	B	1015	0	0	0	10	10
6-15-1993	21:28:59		SKYLAST	V	1172	0	0	0	10	10
6-15-1993	21:31:23	F	HR5401	U	263	263	266	263	10	1
6-15-1993	21:32: 3	F	HR5401	B	1512	1507	1519	1503	10	1
6-15-1993	21:32:44	F	HR5401	V	697	695	696	694	10	1
6-15-1993	21:33:43		SKYLAST	U	61	0	0	0	10	1
6-15-1993	21:33:54	M	SKYLAST	B	100	0	0	0	10	1
6-15-1993	21:34: 4	M	SKYLAST	V	114	0	0	0	10	1
6-15-1993	21:36:10	C	HD123794	U	102	101	101	102	10	1
6-15-1993	21:36:51	C	HD123794	B	353	355	357	353	10	1
6-15-1993	21:37:31	C	HD123794	V	228	229	230	228	10	1
6-15-1993	21:38:33		SKYLAST	U	617	0	0	0	10	10
6-15-1993	21:38:43		SKYLAST	B	1015	0	0	0	10	10
6-15-1993	21:38:54		SKYLAST	V	1177	0	0	0	10	10 end

Appendix 6

FILENAME=VP930618 . RAW OUTPUT DATA FILE FROM "DTAK"
UT DATE= JUN 18 1993 TELESCOPE= c35 OBSERVER= VP/WFW
CONDITIONS=very good . DARK CNTS=533

MO-DY-YEAR	UT	CAT	OBJECT	FLT	----------COUNTS			----------	INT	SCLE	COMMENTS
6-18-1993	19:13:22	A	HR6070	U	916	915	917	919	10	1	
6-18-1993	19:14: 3	A	HR6070	B	5103	5085	5100	5093	10	1	
6-18-1993	19:16:38	A	HR6070	V	1674	1679	1679	1682	10	1	
6-18-1993	19:17:29		SKYLAST	U	62	0	0	0	10	1	
6-18-1993	19:17:40	M	SKYLAST	B	111	0	0	0	10	1	
6-18-1993	19:17:50	M	SKYLAST	V	105	0	0	0	10	1	
6-18-1993	19:22:59	F	HD146022	U	671	670	671	668	10	10	
6-18-1993	19:23:39	F	HD146022	B	1305	1310	1306	1304	10	10	
6-18-1993	19:24:20	F	HD146022	V	1134	1133	1139	1131	10	10	
6-18-1993	19:25:17		SKYLAST	U	610	0	0	0	10	10	
6-18-1993	19:25:28		SKYLAST	B	1001	0	0	0	10	10	
6-18-1993	19:25:38		SKYLAST	V	1045	0	0	0	10	10	
6-18-1993	19:28:12	V	RR TRA	U	641	642	642	643	10	10	
6-18-1993	19:28:52	V	RR TRA	B	1229	1219	1225	1228	10	10	
6-18-1993	19:29:33	V	RR TRA	V	1123	1119	1132	1127	10	10	
6-18-1993	19:30:19		SKYLAST	U	608	0	0	0	10	10	
6-18-1993	19:30:29		SKYLAST	B	1022	0	0	0	10	10	
6-18-1993	19:30:40		SKYLAST	V	1051	0	0	0	10	10	
6-18-1993	19:31:24	V	RR TRA	U	640	640	642	642	10	10	
6-18-1993	19:32: 4	V	RR TRA	B	1219	1226	1227	1225	10	10	
6-18-1993	19:32:45	V	RR TRA	V	1118	1127	1123	1129	10	10	
6-18-1993	19:33:21		SKYLAST	U	607	0	0	0	10	10	
6-18-1993	19:33:32		SKYLAST	B	1005	0	0	0	10	10	
6-18-1993	19:33:42		SKYLAST	V	1044	0	0	0	10	10	
6-18-1993	19:34:20	V	RR TRA	U	640	642	641	645	10	10	
6-18-1993	19:35: 1	V	RR TRA	B	1228	1225	1228	1220	10	10	
6-18-1993	19:35:41	V	RR TRA	V	1119	1114	1122	1120	10	10	
6-18-1993	19:36:17		SKYLAST	U	605	0	0	0	10	10	
6-18-1993	19:36:27		SKYLAST	B	1001	0	0	0	10	10	
6-18-1993	19:36:38		SKYLAST	V	1042	0	0	0	10	10	
6-18-1993	19:37:20	V	RR TRA	U	641	638	641	641	10	10	
6-18-1993	19:38: 1	V	RR TRA	B	1221	1225	1228	1230	10	10	
6-18-1993	19:38:41	V	RR TRA	V	1116	1116	1106	1113	10	10	
6-18-1993	19:39:18		SKYLAST	U	607	0	0	0	10	10	
6-18-1993	19:39:28		SKYLAST	B	1001	0	0	0	10	10	
6-18-1993	19:39:39		SKYLAST	V	1034	0	0	0	10	10	
6-18-1993	19:42:10	F	HD146022	U	666	665	666	667	10	10	
6-18-1993	19:42:51	F	HD146022	B	1304	1306	1300	1310	10	10	
6-18-1993	19:43:31	F	HD146022	V	1131	1131	1131	1130	10	10	
6-18-1993	19:44:12		SKYLAST	U	605	0	0	0	10	10	
6-18-1993	19:44:22		SKYLAST	B	993	0	0	0	10	10	
6-18-1993	19:44:33		SKYLAST	V	1028	0	0	0	10	10	
6-18-1993	19:45:39	V	RR TRA	U	639	639	637	637	10	10	
6-18-1993	19:46:19	V	RR TRA	B	1212	1216	1215	1220	10	10	
6-18-1993	19:46:60	V	RR TRA	V	1110	1116	1123	1122	10	10	
6-18-1993	19:47:39		SKYLAST	U	605	0	0	0	10	10	
6-18-1993	19:47:50		SKYLAST	B	983	0	0	0	10	10	
6-18-1993	19:48: 0		SKYLAST	V	1029	0	0	0	10	10	
6-18-1993	19:48:49	V	RR TRA	U	638	639	641	639	10	10	
6-18-1993	19:49:29	V	RR TRA	B	1221	1212	1222	1212	10	10	
6-18-1993	19:50:10	V	RR TRA	V	1111	1109	1116	1118	10	10	
6-18-1993	19:50:52		SKYLAST	U	607	0	0	0	10	10	
6-18-1993	19:51: 2		SKYLAST	B	988	0	0	0	10	10	
6-18-1993	19:51:13		SKYLAST	V	1028	0	0	0	10	10	
6-18-1993	19:52: 0	V	RR TRA	U	639	638	640	641	10	10	
6-18-1993	19:52:41	V	RR TRA	B	1218	1217	1210	1215	10	10	
6-18-1993	19:53:22	V	RR TRA	V	1114	1113	1120	1133	10	10	
6-18-1993	19:54: 5		SKYLAST	U	603	0	0	0	10	10	
6-18-1993	19:54:16		SKYLAST	B	983	0	0	0	10	10	
6-18-1993	19:54:26		SKYLAST	V	1031	0	0	0	10	10	
6-18-1993	19:55:20	V	RR TRA	U	645	642	639	640	10	10	

6-18-1993	19:56: 0	V	RR TRA	B	1218	1219	1220	1211	10	10
6-18-1993	19:56:41	V	RR TRA	V	1114	1115	1110	1111	10	10
6-18-1993	19:58: 0		SKYLAST	U	605	0	0	0	10	10
6-18-1993	19:58:11		SKYLAST	B	998	0	0	0	10	10
6-18-1993	19:58:21		SKYLAST	V	1036	0	0	0	10	10
6-18-1993	20: 1:21	F	HD146022	U	668	667	666	667	10	10
6-18-1993	20: 2: 2	F	HD146022	B	1294	1304	1294	1293	10	10
6-18-1993	20: 2:42	F	HD146022	V	1129	1124	1125	1124	10	10
6-18-1993	20: 3:19		SKYLAST	U	605	0	0	0	10	10
6-18-1993	20: 3:29		SKYLAST	B	1000	0	0	0	10	10
6-18-1993	20: 3:39		SKYLAST	V	1033	0	0	0	10	10
6-18-1993	20:13:13	F	HD146485	U	654	653	653	654	10	10
6-18-1993	20:13:54	F	HD146485	B	1323	1321	1322	1316	10	10
6-18-1993	20:14:34	F	HD146485	V	1156	1162	1167	1170	10	10
6-18-1993	20:15: 9		SKYLAST	U	605	0	0	0	10	10
6-18-1993	20:15:20		SKYLAST	B	986	0	0	0	10	10
6-18-1993	20:15:30		SKYLAST	V	1024	0	0	0	10	10
6-18-1993	20:17:23	V	RR TRA	U	639	638	638	639	10	10
6-18-1993	20:18: 3	V	RR TRA	B	1202	1205	1207	1205	10	10
6-18-1993	20:18:44	V	RR TRA	V	1108	1103	1104	1100	10	10
6-18-1993	20:19:19		SKYLAST	U	606	0	0	0	10	10
6-18-1993	20:19:30		SKYLAST	B	987	0	0	0	10	10
6-18-1993	20:19:40		SKYLAST	V	1026	0	0	0	10	10
6-18-1993	20:20:21	V	RR TRA	U	637	636	639	636	10	10
6-18-1993	20:21: 1	V	RR TRA	B	1203	1193	1198	1193	10	10
6-18-1993	20:21:42	V	RR TRA	V	1099	1097	1097	1106	10	10
6-18-1993	20:22:53		SKYLAST	U	603	0	0	0	10	10
6-18-1993	20:23: 4		SKYLAST	B	987	0	0	0	10	10
6-18-1993	20:23:14		SKYLAST	V	1029	0	0	0	10	10
6-18-1993	20:23:57	V	RR TRA	U	639	638	633	634	10	10
6-18-1993	20:24:37	V	RR TRA	B	1182	1189	1185	1193	10	10
6-18-1993	20:25:18	V	RR TRA	V	1094	1097	1089	1095	10	10
6-18-1993	20:25:54		SKYLAST	U	606	0	0	0	10	10
6-18-1993	20:26: 4		SKYLAST	B	973	0	0	0	10	10
6-18-1993	20:26:15		SKYLAST	V	1017	0	0	0	10	10
6-18-1993	20:27: 4	V	RR TRA	U	634	635	637	639	10	10
6-18-1993	20:27:45	V	RR TRA	B	1187	1187	1189	1182	10	10
6-18-1993	20:28:25	V	RR TRA	V	1095	1097	1092	1086	10	10
6-18-1993	20:28:58		SKYLAST	U	604	0	0	0	10	10
6-18-1993	20:29: 9		SKYLAST	B	978	0	0	0	10	10
6-18-1993	20:29:19		SKYLAST	V	1021	0	0	0	10	10
6-18-1993	20:32:21	F	HD146022	U	668	669	672	666	10	10
6-18-1993	20:33: 2	F	HD146022	B	1290	1289	1289	1286	10	10
6-18-1993	20:33:42	F	HD146022	V	1110	1119	1109	1112	10	10
6-18-1993	20:34:20		SKYLAST	U	604	0	0	0	10	10
6-18-1993	20:34:30		SKYLAST	B	979	0	0	0	10	10
6-18-1993	20:34:41		SKYLAST	V	1009	0	0	0	10	10
6-18-1993	20:35:41	V	RR TRA	U	634	632	637	636	10	10
6-18-1993	20:36:21	V	RR TRA	B	1174	1179	1174	1176	10	10
6-18-1993	20:37: 2	V	RR TRA	V	1080	1087	1082	1076	10	10
6-18-1993	20:37:40		SKYLAST	U	604	0	0	0	10	10
6-18-1993	20:37:51		SKYLAST	B	973	0	0	0	10	10
6-18-1993	20:38: 1		SKYLAST	V	1011	0	0	0	10	10
6-18-1993	20:39:18	V	RR TRA	U	6322	6288	6342	6310	10	100
6-18-1993	20:39:58	V	RR TRA	B	11582	11619	11590	11577	10	100
6-18-1993	20:40:39	V	RR TRA	V	10795	10692	10787	10756	10	100
6-18-1993	20:41:19		SKYLAST	U	6017	0	0	0	10	100
6-18-1993	20:41:30		SKYLAST	B	9746	0	0	0	10	100
6-18-1993	20:41:40		SKYLAST	V	10092	0	0	0	10	100
6-18-1993	20:42:25	V	RR TRA	U	6299	6282	6288	6318	10	100
6-18-1993	20:43: 5	V	RR TRA	B	11520	11592	11634	11620	10	100
6-18-1993	20:43:46	V	RR TRA	V	10789	10739	10801	10742	10	100
6-18-1993	20:44:25		SKYLAST	U	6019	0	0	0	10	100
6-18-1993	20:44:36		SKYLAST	B	9664	0	0	0	10	100
6-18-1993	20:44:46		SKYLAST	V	9988	0	0	0	10	100

6-18-1993	20:45:33	V	RR TRA	U	6270	6301	6289	6294	10	100
6-18-1993	20:46:13	V	RR TRA	B	11575	11485	11486	11478	10	100
6-18-1993	20:46:54	V	RR TRA	V	10673	10648	10708	10650	10	100
6-18-1993	20:47:37		SKYLAST	U	6001	0	0	0	10	100
6-16-1993	20:47:48		SKYLAST	B	9673	0	0	0	10	100
8-18-1993	20:47:58		SKYLAST	V	9884	0	0	0	10	100
6-18-1993	20:53:45	A	HR6070	U	968	970	965	966	10	1
6-18-1993	20:54:25	A	HR6070	B	5324	5301	5291	5268	10	1
6-18-1993	20:57:23	A	HR6070	V	1735	1743	1737	1740	10	1
6-18-1993	20:58:10		SKYLAST	U	62	0	0	0	10	1
6-18-1993	20:58:21	M	SKYLAST	B	98	0	0	0	10	1
6-18-1993	20:58:31	M	SKYLAST	V	95	0	0	0	10	1
6-18-1993	21: 2:26	F	HD146022	U	670	668	671	668	10	10
6-18-1993	21: 3: 6	F	HD146022	B	1295	1301	1291	1294	10	10
6-18-1993	21: 3:47	F	HD146022	V	1102	1105	1097	857	10	10
6-18-1993	21: 4:24		SKYLAST	U	605	0	0	0	10	10
6-18-1993	21: 4:34		SKYLAST	B	979	0	0	0	10	10
6-18-1993	21: 4:45		SKYLAST	V	1005	0	0	0	10	10
6-18-1993	21: 7: 8	V	RR TRA	U	6240	6234	6235	6214	10	100
6-18-1993	21: 7:49	V	RR TRA	B	11184	11188	11178	11169	10	100
6-18-1993	21: 8:30	V	RR TRA	V	10601	10630	10580	10636	10	100
6-18-1993	21: 9: 6		SKYLAST	U	6023	0	0	0	10	100
6-18-1993	21: 9:16		SKYLAST	B	9851	0	0	0	10	100
6-18-1993	21: 9:26		SKYLAST	V	10033	0	0	0	10	100
6-18-1993	21:10:12	V	RR TRA	U	6208	6184	6206	6201	10	100
6-18-1993	21:10:53	V	RR TRA	B	11071	11068	11027	11032	10	100
6-18-1993	21:11:33	V	RR TRA	V	10475	10516	10486	10449	10	100
6-18-1993	21:12: 8		SKYLAST	U	5925	0	0	0	10	100
6-18-1993	21:12:19		SKYLAST	B	9651	0	0	0	10	100
6-18-1993	21:12:29		SKYLAST	V	10023	0	0	0	10	100
6-18-1993	21:14:14	V	RR TRA	U	6220	6217	6212	6200	10	100
6-18-1993	21:14:54	V	RR TRA	B	10910	10989	10961	10921	10	100
6-18-1993	21:15:35	V	RR TRA	V	10490	10506	10551	10521	10	100
6-18-1993	21:16:10		SKYLAST	U	5994	0	0	0	10	100
6-18-1993	21:16:21		SKYLAST	B	9668	0	0	0	10	100
6-18-1993	21:16:31		SKYLAST	V	10059	0	0	0	10	100
6-18-1993	21:17:39	V	RR TRA	U	6196	6159	6197	6188	10	100
6-18-1993	21:18:20	V	RR TRA	B	10904	10908	10901	10928	10	100
6-18-1993	21:19: 0	V	RR TRA	V	10412	10460	10457	10540	10	100
6-18-1993	21:19:37		SKYLAST	U	5999	0	0	0	10	100
6-18-1993	21:19:48		SKYLAST	B	9783	0	0	0	10	100
6-18-1993	21:19:58		SKYLAST	V	10124	0	0	0	10	100
6-18-1993	21:22:57	F	HD146022	U	666	666	669	668	10	10
6-18-1993	21:23:37	F	HD146022	B	1292	1289	1295	1290	10	10
6-18-1993	21:24:18	F	HD146022	V	1104	1111	1111	1100	10	10
6-18-1993	21:24:57		SKYLAST	U	605	0	0	0	10	10
S-18-1993	21:25: 7		SKYLAST	B	977	0	0	0	10	10
6-18-1993	21:25:18		SKYLAST	V	1010	0	0	0	10	10
6-18-1993	21:27: 1	V	RR TRA	U	6156	6177	6151	6176	10	100
6-18-1993	21:27:41	V	RR TRA	B	10670	10667	10610	10671	10	100
6-18-1993	21:28:22	V	RR TRA	V	10361	10419	10434	10318	10	100
8-18-1993	21:29:40		SKYLAST	U	6005	0	0	0	10	100
6-18-1993	21:29:51		SKYLAST	B	9784	0	0	0	10	100
6-18-1993	21:30: 1		SKYLAST	V	10084	0	0	0	10	100
6-18-1993	21:31:14	V	RR TRA	U	6168	6160	6149	6146	10	100
6-18-1993	21:31:54	V	RR TRA	B	10541	10564	10588	10599	10	100
6-18-1993	21:32:35	V	RR TRA	V	10378	10409	10381	10476	10	100
8-18-1993	21:33:41		SKYLAST	U	5993	0	0	0	10	100
6-18-1993	21:33:51		SKYLAST	B	9773	0	0	0	10	100
6-18-1993	21:34: 2		SKYLAST	V	10159	0	0	0	10	100
6-18-1993	21:35:30	V	RR TRA	U	6123	6129	6158	6144	10	100
6-18-1993	21:36:10	V	RR TRA	B	10621	10608	10632	10563	10	100
6-18-1993	21:36:51	V	RR TRA	V	10519	10531	10576	10523	10	100
6-18-1993	21:38: 6		SKYLAST	U	6015	0	0	0	10	100
6-18-1993	21:38:16		SKYLAST	B	9825	0	0	0	10	100

6-18-1993	21:38:27		SKYLAST	V	10310	0	0	0	10	100
6-18-1993	21:39:38	V	RR TRA	U	6131	6123	6139	6127	10	100
6-18-1993	21:40:18	V	RR TRA	B	10594	10567	10532	10512	10	100
6-18-1993	21:40:59	V	RR TRA	V	10567	10333	10495	10480	10	100
6-18-1993	21:41:41		SKYLAST	U	6031	0	0	0	10	100
6-18-1993	21:41:51		SKYLAST	B	9814	0	0	0	10	100
6-18-1993	21:42: 2		SKYLAST	V	10187	0	0	0	10	100
6-18-1993	21:44:11	F	HD146022	U	666	669	672	668	10	10
6-18-1993	21:44:52	F	HD146022	B	1297	1296	1303	1302	10	10
6-18-1993	21:45:32	F	HD146022	V	1120	1124	1118	1126	10	10
6-18-1993	21:46:14		SKYLAST	U	603	0	0	0	10	10
6-18-1993	21:46:24		SKYLAST	B	993	0	0	0	10	10
6-18-1993	21:46:35		SKYLAST	V	1022	0	0	0	10	10
6-18-1993	21:59:10	F	HD146485	U	654	654	657	655	10	10
6-18-1993	21:59:51	F	HD146485	B	1322	1332	1330	1334	10	10
6-18-1993	22: 0:32	F	HD146485	V	1194	1202	1197	1194	10	10
6-18-1993	22: 1:11		SKYLAST	U	606	0	0	0	10	10
6-18-1993	22: 1:22		SKYLAST	B	992	0	0	0	10	10
6-18-1993	22: 1:32		SKYLAST	V	1043	0	0	0	10	10
6-18-1993	22: 3:50	V	RR TRA	U	6042	6014	6018	6021	10	100
6-18-1993	22: 4:31	V	RR TRA	B	10066	10024	10054	10121	10	100
6-18-1993	22: 5:11	V	RR TRA	V	10496	10509	10433	10506	10	100
6-18-1993	22: 6: 3		SKYLAST	U	5957	0	0	0	10	100
6-18-1993	22: 6:13		SKYLAST	B	9526	0	0	0	10	100
6-18-1993	22: 6:24		SKYLAST	V	10254	0	0	0	10	100
6-18-1993	22: 7:14	V	RR TRA	U	6004	6011	6037	6055	10	100
6-18-1993	22: 7:55	V	RR TRA	B	10067	10167	10120	10152	10	100
6-18-1993	22: 8:35	V	RR TRA	V	10598	10630	10593	10651	10	100
6-18-1993	22: 9:21		SKYLAST	U	5967	0	0	0	10	100
6-18-1993	22: 9:31		SKYLAST	B	9500	0	0	0	10	100
6-18-1993	22: 9:42		SKYLAST	V	10345	0	0	0	10	100
6-18-1993	22:10:26	V	RR TRA	U	6042	6053	6040	6048	10	100
6-18-1993	22:11: 7	V	RR TRA	B	10149	10101	10165	10183	10	100
6-18-1993	22:11:47	V	RR TRA	V	10627	10569	10566	10611	10	100
6-18-1993	22:12:29		SKYLAST	U	5934	0	0	0	10	100
6-18-1993	22:12:39		SKYLAST	B	9539	0	0	0	10	100
6-18-1993	22:12:50		SKYLAST	V	10373	0	0	0	10	100
6-18-1993	22:13:45	V	RR TRA	U	6044	6064	6019	6050	10	100
6-18-1993	22:14:26	V	RR TRA	B	10198	10293	10267	10193	10	100
6-18-1993	22:15: 6	V	RR TRA	V	10693	10634	10736	10718	10	100
6-18-1993	22:15:50		SKYLAST	U	5946	0	0	0	10	100
6-18-1993	22:16: 0		SKYLAST	B	9525	0	0	0	10	100
6-18-1993	22:16:11		SKYLAST	V	10406	0	0	0	10	100
6-18-1993	22:18: 3	F	HD146022	U	6564	6542	6554	6535	10	100
6-18-1993	22:18:43	F	HD146022	B	12537	12570	12603	12616	10	100
6-18-1993	22:19:24	F	HD146022	V	11463	11506	11423	11490	10	100
6-18-1993	22:20: 0		SKYLAST	U	5953	0	0	0	10	100
6-18-1993	22:20:11		SKYLAST	B	9582	0	0	0	10	100
6-18-1993	22:20:21		SKYLAST	V	10622	0	0	0	10	100
6-18-1993	22:25: 6	V	RR TRA	U	6088	6085	6093	6104	10	100
6-18-1993	22:25:47	V	RR TRA	B	10573	10578	10542	10587	10	100
6-18-1993	22:26:27	V	RR TRA	V	11138	11171	11209	11156	10	100
6-18-1993	22:27:16		SKYLAST	U	5953	0	0	0	10	100
6-18-1993	22:27:27		SKYLAST	B	9665	0	0	0	10	100
6-18-1993	22:27:37		SKYLAST	V	10807	0	0	0	10	100
6-18-1993	22:28:33	V	RR TRA	U	6115	6106	6098	6091	10	100
6-18-1993	22:29:13	V	RR TRA	B	10734	10693	10734	10685	10	100
6-18-1993	22:29:54	V	RR TRA	V	11364	11321	11385	11305	10	100
6-18-1993	22:30:34		SKYLAST	U	5948	0	0	0	10	100
6-18-1993	22:30:45		SKYLAST	B	9736	0	0	0	10	100
6-18-1993	22:30:55		SKYLAST	V	10942	0	0	0	10	100
6-18-1993	22:31:45	V	RR TRA	U	6104	6128	6126	6142	10	100
6-18-1993	22:32:26	V	RR TRA	B	10770	10839	10797	10780	10	100
6-18-1993	22:33: 6	V	RR TRA	V	11361	11336	11385	11398	10	100
6-18-1993	22:34:17		SKYLAST	U	5975	0	0	0	10	100

6-18-1993	22:34:27		SKYLAST	B	9720	0	0	0	10	100
6-18-1993	22:34:38		SKYLAST	V	10785	0	0	0	10	100
6-18-1993	22:35:58	V	RR TRA	U	6126	6114	6115	6128	10	100
6-18-1993	22:36:38	V	RR TRA	B	10856	10886	10832	10877	10	100
6-18-1993	22:37:19	V	RR TRA	V	11173	11177	11223	11198	10	100
6-18-1993	22:38:22		SKYLAST	U	5970	0	0	0	10	100
6-18-1993	22:38:33		SKYLAST	B	9722	0	0	0	10	100
6-18-1993	22:38:43		SKYLAST	V	10728	0	0	0	10	100
6-18-1993	22:47:44	A	HR6070	U	890	898	891	887	10	1
6-18-1993	22:48:25	A	HR6070	B	5065	5056	5052	5050	10	1
6-18-1993	22:49: 5	A	HR6070	V	1660	1659	1670	1671	10	1
6-18-1993	22:49:47		SKYLAST	U	63	0	0	0	10	1
6-18-1993	22:49:57	M	SKYLAST	B	103	0	0	0	10	1
6-18-1993	22:50: 8	M	SKYLAST	V	102	0	0	0	10	1
6-18-1993	22:52:42	F	HD146022	U	6567	6564	6595	6578	10	100
6-18-1993	22:53:22	F	HD146022	B	12734	12785	12749	12801	10	100
6-18-1993	22:54: 3	F	HD146022	V	11775	11703	11712	11704	10	100
6-18-1993	22:54:39		SKYLAST	U	6007	0	0	0	10	100
6-18-1993	22:54:50		SKYLAST	B	9801	0	0	0	10	100
6-18-1993	22:55: 0		SKYLAST	V	10715	0	0	0	10	100
6-18-1993	22:56:33	V	RR TRA	U	6243	6237	6238	6217	10	100
6-18-1993	22:57:14	V	RR TRA	B	11278	11306	11311	11305	10	100
6-18-1993	22:57:54	V	RR TRA	V	11188	11161	11161	11172	10	100
6-18-1993	23: 0:12		SKYLAST	U	5988	0	0	0	10	100
6-18-1993	23: 0:22		SKYLAST	B	9755	0	0	0	10	100
6-18-1993	23: 0:33		SKYLAST	V	10533	0	0	0	10	100
6-18-1993	23: 1:24	V	RR TRA	U	6240	6230	6255	6241	10	100
6-18-1993	23: 2: 4	V	RR TRA	B	11382	11301	11365	11311	10	100
6-18-1993	23: 2:45	V	RR TRA	V	11171	11313	11298	11296	10	100
6-18-1993	23: 3:26		SKYLAST	U	5999	0	0	0	10	100
6-18-1993	23: 3:37		SKYLAST	B	9760	0	0	0	10	100
6-18-1993	23: 3:47		SKYLAST	V	10626	0	0	0	10	100
6-18-1993	23: 4:35	V	RR TRA	U	6258	6249	6248	6251	10	100
6-18-1993	23: 5:16	V	RR TRA	B	11390	11436	11378	11370	10	100
6-18-1993	23: 5:56	V	RR TRA	V	11282	11266	11217	11196	10	100
6-18-1993	23: 6:37		SKYLAST	U	6001	0	0	0	10	100
6-18-1993	23: 6:47		SKYLAST	B	9717	0	0	0	10	100
6-18-1993	23: 6:58		SKYLAST	V	10694	0	0	0	10	100
6-18-1993	23: 7:47	V	RR TRA	U	6258	6263	6251	6262	10	100
6-18-1993	23: 8:27	V	RR TRA	B	11441	11490	11435	11476	10	100
6-18-1993	23: 9: 8	V	RR TRA	V	11262	11158	11264	11248	10	100
6-18-1993	23: 9:48		SKYLAST	U	5996	0	0	0	10	100
6-18-1993	23: 9:59		SKYLAST	B	9759	0	0	0	10	100
6-18-1993	23:10: 9		SKYLAST	V	10615	0	0	0	10	100
6-18-1993	23:12: 3	F	HD146022	U	6569	6610	6581	6591	10	100
6-18-1993	23:12:44	F	HD146022	B	12638	12634	12639	12597	10	100
6-18-1993	23:13:24	F	HD146022	V	11731	11690	11762	11696	10	100
6-18-1993	23:14: 6		SKYLAST	U	6007	0	0	0	10	100
6-18-1993	23:14:17		SKYLAST	B	9802	0	0	0	10	100
6-18-1993	23:14:27		SKYLAST	V	10975	0	0	0	10	100
6-18-1993	23:15:27	V	RR TRA	U	6243	6251	6253	6273	10	100
6-18-1993	23:16: 8	V	RR TRA	B	11513	11580	11580	11479	10	100
6-18-1993	23:16:48	V	RR TRA	V	11353	11396	11424	11484	10	100
6-18-1993	23:17:49		SKYLAST	U	6002	0	0	0	10	100
6-18-1993	23:17:59		SKYLAST	B	9824	0	0	0	10	100
6-18-1993	23:18:10		SKYLAST	V	10699	0	0	0	10	100
6-18-1993	23:18:58	V	RR TRA	U	6309	6270	6293	6282	10	100
6-18-1993	23:19:38	V	RR TRA	B	11614	11635	11652	11612	10	100
6-18-1993	23:20:19	V	RR TRA	V	11490	11530	11520	11468	10	100
6-18-1993	23:21: 7		SKYLAST	U	6040	0	0	0	10	100
6-18-1993	23:21:18		SKYLAST	B	9858	0	0	0	10	100
6-18-1993	23:21:28		SKYLAST	V	10777	0	0	0	10	100
6-18-1993	23:22:15	V	RR TRA	U	6300	6275	6287	6274	10	100
6-18-1993	23:22:55	V	RR TRA	B	11667	11726	11704	11687	10	100
6-18-1993	23:23:36	V	RR TRA	V	11547	11572	11589	11501	10	100

6-18-1993	23:24:23		SKYLAST	U	6011	0	0	0	10	100
6-18-1993	23:24:34		SKYLAST	B	9877	0	0	0	10	100
6-18-1993	23:24:44		SKYLAST	V	10857	0	0	0	10	100
6-18-1993	23:25:40	V	RR TRA	U	6289	6293	6293	6290	10	100
6-18-1993	23:26:20	V	RR TRA	B	11794	11826	11796	11825	10	100
6-18-1993	23:27: 1	V	RR TRA	V	11611	11582	11492	11570	10	100
6-18-1993	23:27:47		SKYLAST	U	5990	0	0	0	10	100
6-18-1993	23:27:57		SKYLAST	B	9890	0	0	0	10	100
6-18-1993	23:28: 8		SKYLAST	V	10836	0	0	0	10	100
6-18-1993	23:29:35	F	HD14602?	U	6570	6592	6592	6571	10	100
6-18-1993	23:30:16	F	HD146022	B	12846	12827	12777	12877	10	100
6-18-1993	23:30:56	F	HD146022	V	11734	11834	11879	11806	10	100
6-18-1993	23:31:34		SKYLAST	U	6045	0	0	0	10	100
6-18-1993	23:31:44		SKYLAST	B	10094	0	0	0	10	100
6-18-1993	23:31:55		SKYLAST	V	11021	0	0	0	10	100
6-18-1993	23:34: 1	F	HD146485	U	6470	6452	6444	6466	10	100
6-18-1993	23:34:41	F	HD146485	B	13071	13047	13113	13105	10	100
6-18-1993	23:35:22	F	HD146485	V	12307	12203	12300	12262	10	100
6-18-1993	23:36: 3		SKYLAST	U	6045	0	0	0	10	100
6-18-1993	23:36:13		SKYLAST	B	9943	0	0	0	10	100
6-18-1993	23:36:23		SKYLAST	V	10890	0	0	0	10	100
6-18-1993	23:38: 6	V	RR TRA	U	6355	6305	6306	6310	10	100
6-18-1993	23:38:46	V	RR TRA	B	12060	12065	12046	12070	10	100
6-18-1993	23:39:27	V	RR TRA	V	11683	11721	11771	11756	10	100
6-18-1993	23:40: 7		SKYLAST	U	6038	0	0	0	10	100
6-18-1993	23:40:18		SKYLAST	B	9992	0	0	0	10	100
6-18-1993	23:40:28		SKYLAST	V	10947	0	0	0	10	100
6-18-1993	23:41:18	V	RR TRA	U	6334	6328	6334	6336	10	100
6-18-1993	23:41:58	V	RR TRA	B	12140	12102	12010	12061	10	100
6-18-1993	23:42:39	V	RR TRA	V	11727	11768	11706	11718	10	100
6-18-1993	23:43:26		SKYLAST	U	6030	0	0	0	10	100
6-18-1993	23:43:37		SKYLAST	B	9960	0	0	0	10	100
6-18-1993	23:43:47		SKYLAST	V	11031	0	0	0	10	100
6-18-1993	23:44:48	V	RR TRA	U	6332	6339	6345	6344	10	100
6-18-1993	23:45:28	V	RR TRA	B	11994	12044	11992	12042	10	100
6-18-1993	23:46: 9	V	RR TRA	V	11663	11767	11713	11726	10	100
6-18-1993	23:46:49		SKYLAST	U	6019	0	0	0	10	100
6-18-1993	23:46:60		SKYLAST	B	10020	0	0	0	10	100
6-18-1993	23:47:10		SKYLAST	V	10948	0	0	0	10	100
6-18-1993	23:47:53	V	RR TRA	U	6343	6325	6342	6342	10	100
6-18-1993	23:48:34	V	RR TRA	B	12036	12064	12082	12036	10	100
6-18-1993	23:49:14	V	RR TRA	V	11707	11686	11643	11757	10	100
6-18-1993	23:49:52		SKYLAST	U	6045	0	0	0	10	100
6-18-1993	23:50: 2		SKYLAST	B	9991	0	0	0	10	100
6-18-1993	23:50:13		SKYLAST	V	10826	0	0	0	10	100
6-18-1993	23:51:16	F	HD146022	U	6582	6616	6580	6571	10	100
6-18-1993	23:51:57	F	HD146022	B	12886	12813	12984	12866	10	100
6-18-1993	23:52:37	F	HD146022	V	11858	11886	11924	11803	10	100
6-18-1993	23:53:12		SKYLAST	U	6034	0	0	0	10	100
6-18-1993	23:53:22		SKYLAST	B	9990	0	0	0	10	100
6-18-1993	23:53:33		SKYLAST	V	10890	0	0	0	10	100
6-18-1993	23:54:22	V	RR TRA	U	6331	6341	6345	6341	10	100
6-18-1993	23:55: 2	V	RR TRA	B	12094	12120	12128	12103	10	100
6-18-1993	23:55:43	V	RR TRA	V	11748	11794	11750	11723	10	100
6-18-1993	23:56:19		SKYLAST	U	6051	0	0	0	10	100
6-18-1993	23:56:29		SKYLAST	B	10072	0	0	0	10	100
6-18-1993	23:56:39		SKYLAST	V	10948	0	0	0	10	100
6-18-1993	23:57:23	V	RR TRA	U	6366	6345	6350	6379	10	100
6-18-1993	23:58: 3	V	RR TRA	B	12186	12118	12123	12094	10	100
6-18-1993	23:58:44	V	RR TRA	V	11784	11779	11753	11777	10	100
6-18-1993	23:59:22		SKYLAST	U	6029	0	0	0	10	100
6-18-1993	23:59:32		SKYLAST	B	9956	0	0	0	10	100
6-18-1993	23:59:43		SKYLAST	V	10922	0	0	0	10	100
6-19-1993	0: 0:23	V	RR TRA	U	6342	6373	6383	6365	10	100
6-19-1993	0: 1: 3	V	RR TRA	B	12184	12224	12236	12152	10	100

6-19-1993	0: 1:44	V	RR TRA	V	11914	11827	11836	11769	10	100
6-19-1993	0: 2:22		SKYLAST	U	6073	0	0	0	10	100
6-19-1993	0: 2:32		SKYLAST	B	10159	0	0	0	10	100
6-19-1993	0: 2:43		SKYLAST	V	11019	0	0	0	10	100
6-19-1993	0: 3:25	V	RR TRA	U	6338	6341	6367	6378	10	100
6-19-1993	0: 4: 6	V	RR TRA	B	12188	12184	12215	12255	10	100
6-19-1993	0: 4:46	V	RR TRA	V	11837	11816	11881	11820	10	100
6-19-1993	0: 5:24		SKYLAST	U	6056	0	0	0	10	100
6-19-1993	0: 5:34		SKYLAST	B	10052	0	0	0	10	100
6-19-1993	0: 5:45		SKYLAST	V	10918	0	0	0	10	100
6-19-1993	0: 8:41	A	HR6070	U	768	762	766	764	10	1
6-19-1993	0: 9:22	A	HR6070	B	4613	4620	4663	4688	10	1
6-19-1993	0:10: 2	A	HR6070	V	1602	1605	1597	1592	10	1
6-19-1993	0:11: 2		SKYLAST	U	63	0	0	0	10	1
6-19-1993	0:11:13	M	SKYLAST	B	106	0	0	0	10	1
6-19-1993	0:11:23	M	SKYLAST	V	108	0	0	0	10	1
6-19-1993	0:14:38	F	HD146022	U	6607	6624	6594	6593	10	100
6-19-1993	0:15:19	F	HD146022	B	12918	12878	12901	12883	10	100
6-19-1993	0:15:59	F	HD146022	V	11992	11923	12011	11964	10	100
6-19-1993	0:16:40		SKYLAST	U	6084	0	0	0	10	100
6-19-1993	0:16:50		SKYLAST	B	10250	0	0	0	10	100
6-19-1993	0:17: 1		SKYLAST	V	11127	0	0	0	10	100
6-19-1993	0:18: 2	V	RR TRA	U	6355	6359	6364	6380	10	100
6-19-1993	0:18:43	V	RR TRA	B	12281	12236	12208	12235	10	100
6-19-1993	0:19:23	V	RR TRA	V	11943	11848	11834	11847	10	100
6-19-1993	0:19:60		SKYLAST	U	6041	0	0	0	10	100
6-19-1993	0:20:10		SKYLAST	B	10145	0	0	0	10	100
6-19-1993	0:20:21		SKYLAST	V	11056	0	0	0	10	100
6-19-1993	0:21:12	V	RR TRA	U	6393	6347	6373	6371	10	100
6-19-1993	0:21:52	V	RR TRA	B	12176	12181	12205	12217	10	100
6-19-1993	0:22:33	V	RR TRA	V	11897	11899	11962	11963	10	100
6-19-1993	0:23:11		SKYLAST	U	6074	0	0	0	10	100
6-19-1993	0:23:21		SKYLAST	B	10085	0	0	0	10	100
6-19-1993	0:23:32		SKYLAST	V	11072	0	0	0	10	100
6-19-1993	0:24:27	V	RR TRA	U	6383	6379	6337	6399	10	100
6-19-1993	0:25: 8	V	RR TRA	B	12188	12294	12294	12312	10	100
6-19-1993	0:25:48	V	RR TRA	V	12037	11961	11979	11957	10	100
6-19-1993	0:27: 1		SKYLAST	U	6044	0	0	0	10	100
6-19-1993	0:27:12		SKYLAST	B	10193	0	0	0	10	100
6-19-1993	0:27:22		SKYLAST	V	11236	0	0	0	10	100
6-19-1993	0:28: 6	V	RR TRA	U	6376	6397	6363	6372	10	100
6-19-1993	0:28:48	V	RR TRA	B	12260	12329	12341	12381	10	100
6-19-1993	0:29:27	V	RR TRA	V	12096	12126	12086	12077	10	100
6-19-1993	0:30: 3		SKYLAST	U	6080	0	0	0	10	100
6-19-1993	0:30:13		SKYLAST	B	10254	0	0	0	10	100
6-19-1993	0:30:23		SKYLAST	V	11302	0	0	0	10	100
6-19-1993	0:31:55	F	HD146022	U	6586	6573	6636	6574	10	100
6-19-1993	0:32:35	F	HD146022	B	13143	13189	13276	13226	10	100
6-19-1993	0:33:16	F	HD146022	V	12583	12667	12731	12794	10	100
6-19-1993	0:33:54		SKYLAST	U	6121	0	0	0	10	100
6-19-1993	0:34: 5		SKYLAST	B	10519	0	0	0	10	100
6-19-1993	0:34:15		SKYLAST	V	11888	0	0	0	10	100
6-19-1993	0:35:15	V	RR TRA	U	6402	6382	6388	6412	10	100
6-19-1993	0:35:56	V	RR TRA	B	12585	12623	12527	12609	10	100
6-19-1993	0:36:36	V	RR TRA	V	12808	12882	12837	12851	10	100
6-19-1993	0:37:12		SKYLAST	U	6137	0	0	0	10	100
6-19-1993	0:37:23		SKYLAST	B	10636	0	0	0	10	100
6-19-1993	0:37:33		SKYLAST	V	12144	0	0	0	10	100
6-19-1993	0:38:20	V	RR TRA	U	6405	6382	6400	6393	10	100
6-19-1993	0:39: 1	V	RR TRA	B	12699	12712	12767	12746	10	100
6-19-1993	0:39:41	V	RR TRA	V	13194	13181	13189	13144	10	100
6-19-1993	0:41: 3		SKYLAST	U	6141	0	0	0	10	100
6-19-1993	0:41:13		SKYLAST	B	10834	0	0	0	10	100
6-19-1993	0:41:24		SKYLAST	V	12426	0	0	0	10	100
6-19-1993	0:42:38	V	RR TRA	U	6396	6425	6391	6407	10	100

6-19-1993	0:43:18	V	RR TRA	B	12807	12778	12803	12786	10	100
6-19-1993	0:43:59	V	RR TRA	V	13288	13251	13209	13314	10	100
6-19-1993	0:45:21		SKYLAST	U	6158	0	0	0	10	100
6-19-1993	0:45:32		SKYLAST	B	10938	0	0	0	10	100
6-19-1993	0:45:42		SKYLAST	V	12598	0	0	0	10	100
6-19-1993	0:46:51	V	RR TRA	U	6444	6445	6399	6404	10	100
6-19-1993	0:47:32	V	RR TRA	B	12956	12891	12812	12802	10	100
6-19-1993	0:48:12	V	RR TRA	V	13336	13362	13402	13331	10	100
6-19-1993	0:48:48		SKYLAST	U	6139	0	0	0	10	100
6-19-1993	0:48:59		SKYLAST	B	10946	0	0	0	10	100
6-19-1993	0:49: 9		SKYLAST	V	12907	0	0	0	10	100
6-19-1993	0:50:10	F	HD146022	U	6613	6591	6606	6591	10	100
6-19-1993	0:50:51	F	HD146022	B	13586	13614	13653	13587	10	100
6-19-1993	0:51:32	F	HD146022	V	13767	13851	13691	13725	10	100
6-19-1993	0:52: 7		SKYLAST	U	6169	0	0	0	10	100
6-19-1993	0:52:17		SKYLAST	B	11078	0	0	0	10	100
6-19-1993	0:52:28		SKYLAST	V	12957	0	0	0	10	100
6-19-1993	0:53:49	F	HD146485	U	6511	6517	6503	6523	10	100
6-19-1993	0:54:29	F	HD146485	B	13846	13929	13833	13952	10	100
6-19-1993	0:55:10	F	HD146485	V	14263	14258	14303	14401	10	100
6-19-1993	0:55:45		SKYLAST	U	6162	0	0	0	10	100
6-19-1993	0:55:55		SKYLAST	B	11269	0	0	0	10	100
6-19-1993	0:56: 6		SKYLAST	V	13085	0	0	0	10	100
6-19-1993	0:57:48	V	RR TRA	U	6437	6419	6445	6431	10	100
6-19-1993	0:58:28	V	RR TRA	B	12996	13063	12970	12962	10	100
6-19-1993	0:59: 9	V	RR TRA	V	13827	13892	13865	13840	10	100
6-19-1993	0:59:49		SKYLAST	U	6193	0	0	0	10	100
6-19-1993	0:59:60		SKYLAST	B	11217	0	0	0	10	100
6-19-1993	1: 0:10		SKYLAST	V	13177	0	0	0	10	100
6-19-1993	1: 0:57	V	RR TRA	U	6467	6428	6419	6424	10	100
6-19-1993	1: 1:37	V	RR TRA	B	12992	13040	12981	12938	10	100
6-19-1993	1: 2:18	V	RR TRA	V	13753	13659	13689	13614	10	100
6-19-1993	1: 2:56		SKYLAST	U	6181	0	0	0	10	100
6-19-1993	1: 3: 6		SKYLAST	B	11049	0	0	0	10	100
6-19-1993	1: 3:17		SKYLAST	V	12946	0	0	0	10	100
6-19-1993	1: 3:59	V	RR TRA	U	6427	6449	6433	6437	10	100
6-19-1993	1: 4:39	V	RR TRA	B	12992	13056	13107	12992	10	100
6-19-1993	1: 5:20	V	RR TRA	V	13683	13883	13996	13922	10	100
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6-19-1993	1: 7:58	V	RR TRA	B	13151	13136	13135	13249	10	100
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6-19-1993	1: 9:28		SKYLAST	B	11193	0	0	0	10	100
6-19-1993	1: 9:39		SKYLAST	V	13173	0	0	0	10	100
6-19-1993	1:13:12	F	HD146022	U	6620	6628	6638	6618	10	100
6-19-1993	1:13:52	F	HD146022	B	13668	13665	13731	13683	10	100
6-19-1993	1:14:33	F	HD146022	V	13900	13929	13950	13970	10	100
6-19-1993	1:15:14		SKYLAST	U	6172	0	0	0	10	100
6-19-1993	1:15:25		SKYLAST	B	11094	0	0	0	10	100
6-19-1993	1:15:35		SKYLAST	V	13141	0	0	0	10	100
6-19-1993	1:16:31	V	RR TRA	U	6458	6433	6436	6424	10	100
6-19-1993	1:17:12	V	RR TRA	B	13049	12993	12990	12990	10	100
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6-19-1993	1:18:45		SKYLAST	U	6170	0	0	0	10	100
6-19-1993	1:18:56		SKYLAST	B	11079	0	0	0	10	100
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6-19-1993	1:19:48	V	RR TRA	U	6426	6417	6413	6425	10	100
6-19-1993	1:20:29	V	RR TRA	B	12958	12975	12937	12964	10	100
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6-19-1993	1:21:47		SKYLAST	U	6142	0	0	0	10	100
6-19-1993	1:21:58		SKYLAST	B	11110	0	0	0	10	100
6-19-1993	1:22: 8		SKYLAST	V	12993	0	0	0	10	100

6-19-1993	1:22:52	V	RR TRA	U	6432	6404	6431	6417	10	100
6-19-1993	1:23:32	V	RR TRA	B	13032	13132	13145	13079	10	100
6-19-1993	1:24:13	V	RR TRA	V	13863	13742	13688	13813	10	100
6-19-1993	1:24:48		SKYLAST	U	6163	0	0	0	10	100
6-19-1993	1:24:58		SKYLAST	B	11281	0	0	0	10	100
6-19-1993	1:25: 9		SKYLAST	V	13184	0	0	0	10	100
6-19-1993	1:25:50	V	RR TRA	U	6425	6426	6435	6455	10	100
6-19-1993	1:26:30	V	RR TRA	B	13220	13117	13155	13175	10	100
6-19-1993	1:27:11	V	RR TRA	V	14090	14077	14134	14184	10	100
6-19-1993	1:27:50		SKYLAST	U	6186	0	0	0	10	100
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6-19-1993	1:32:17	A	HR6070	U	491	488	485	482	10	1
6-19-1993	1:32:58	A	HR6070	B	3378	3476	3410	3433	10	1
6-19-1993	1:33:38	A	HR6070	V	1340	1350	1334	1329	10	1
6-19-1993	1:34:39		SKYLAST	U	65	0	0	0	10	1
6-19-1993	1:34:50	M	SKYLAST	B	124	0	0	0	10	1
6-19-1993	1:35: 0	M	SKYLAST	V	143	0	0	0	10	1
6-19-1993	1:37:40	F	HD146022	U	662	660	660	660	10	10
6-19-1993	1:38:21	F	HD146022	B	1373	1362	1351	1357	10	10
6-19-1993	1:39: 1	F	HD146022	V	1403	1414	1396	1401	10	10
6-19-1993	1:39:41		SKYLAST	U	613	0	0	0	10	10
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6-19-1993	1:40: 2		SKYLAST	V	1305	0	0	0	10	10
6-19-1993	1:40:58	V	RR TRA	U	642	639	644	641	10	10
6-19-1993	1:41:39	V	RR TRA	B	1310	1313	1309	1311	10	10
6-19-1993	1:42:19	V	RR TRA	V	1413	1412	1413	1409	10	10
6-19-1993	1:42:57		SKYLAST	U	620	0	0	0	10	10
6-19-1993	1:43: 7		SKYLAST	B	1124	0	0	0	10	10
6-19-1993	1:43:18		SKYLAST	V	1340	0	0	0	10	10
6-19-1993	1:44: 1	V	RR TRA	U	642	645	642	641	10	10
6-19-1993	1:44:42	V	RR TRA	B	1321	1308	1318	1322	10	10
6-19-1993	1:45:22	V	RR TRA	V	1446	1432	1423	1407	10	10
6-19-1993	1:46: 2		SKYLAST	U	619	0	0	0	10	10
6-19-1993	1:46:12		SKYLAST	B	1135	0	0	0	10	10
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6-19-1993	1:48:32	V	RR TRA	V	1461	1477	1477	1473	10	10
6-19-1993	1:49: 9		SKYLAST	U	620	0	0	0	10	10
6-19-1993	1:49:19		SKYLAST	B	1160	0	0	0	10	10
6-19-1993	1:49:30		SKYLAST	V	1405	0	0	0	10	10
6-19-1993	1:50:31	V	RR TRA	U	643	645	646	643	10	10
6-19-1993	1:51:12	V	RR TRA	B	1356	1354	1362	1363	10	10
6-19-1993	1:51:52	V	RR TRA	V	1510	1507	1511	1502	10	10
6-19-1993	1:52:38		SKYLAST	U	623	0	0	0	10	10
6-19-1993	1:52:48		SKYLAST	B	1165	0	0	0	10	10
6-19-1993	1:52:58		SKYLAST	V	1412	0	0	0	10	10
6-19-1993	1:53:52	F	HD146022	U	659	660	662	659	10	10
6-19-1993	1:54:32	F	HD146022	B	1413	1409	1410	1407	10	10
6-19-1993	1:55:13	F	HD146022	V	1504	1520	1534	1527	10	10
6-19-1993	1:55:49		SKYLAST	U	625	0	0	0	10	10
6-19-1993	1:55:59		SKYLAST	B	1204	0	0	0	10	10
6-19-1993	1:56:10		SKYLAST	V	1483	0	0	0	10	10
6-19-1993	1:57: 6	V	RR TRA	U	643	645	647	646	10	10
6-19-1993	1:57:47	V	RR TRA	B	1360	1370	1368	1365	10	10
6-19-1993	1:58:28	V	RR TRA	V	1548	1533	1527	1521	10	10
6-19-1993	1:59: 4		SKYLAST	U	623	0	0	0	10	10
6-19-1993	1:59:14		SKYLAST	B	1202	0	0	0	10	10
6-19-1993	1:59:25		SKYLAST	V	1468	0	0	0	10	10
6-19-1993	2: 0:17	V	RR TRA	U	645	646	645	647	10	10
6-19-1993	2: 0:57	V	RR TRA	B	1375	1372	1367	1369	10	10
6-19-1993	2: 1:38	V	RR TRA	V	1559	1545	1541	1551	10	10
6-19-1993	2: 2:14		SKYLAST	U	627	0	0	0	10	10
6-19-1993	2: 2:25		SKYLAST	B	1202	0	0	0	10	10

6-19-1993	2: 2:35		SKYLAST	V	1492	0	0	0	10	10
6-19-1993	2: 3:21	V	RR TRA	U	645	645	647	647	10	10
6-19-1993	2: 4: 1	V	RR TRA	B	1376	1377	1380	1370	10	10
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6-19-1993	2: 5:22		SKYLAST	U	626	0	0	0	10	10
6-19-1993	2: 5:33		SKYLAST	B	1209	0	0	0	10	10
6-19-1993	2: 5:43		SKYLAST	V	1480	0	0	0	10	10
6-19-1993	2: 6:30	V	RR TRA	U	644	644	644	643	10	10
6-19-1993	2: 7:10	V	RR TRA	B	1368	1379	1372	1381	10	10
6-19-1993	2: 7:51	V	RR TRA	V	1583	1574	1567	1579	10	10
6-19-1993	2: 8:28		SKYLAST	U	626	0	0	0	10	10
6-19-1993	2: 8:39		SKYLAST	B	1218	0	0	0	10	10
6-19-1993	2: 8:49		SKYLAST	V	1511	0	0	0	10	10
6-19-1993	2: 9:47	F	HD146022	U	659	661	661	661	10	10
6-19-1993	2:10:27	F	HD146022	B	1442	1446	1451	1453	10	10
6-19-1993	2:11: 8	F	HD146022	V	1645	1647	1620	1631	10	10
6-19-1993	2:11:56		SKYLAST	U	632	0	0	0	10	10
6-19-1993	2:12: 6		SKYLAST	B	1258	0	0	0	10	10
6-19-1993	2:12:17		SKYLAST	V	1580	0	0	0	10	10
6-19-1993	2:15:40	F	HD146485	U	654	653	651	649	10	10
6-19-1993	2:16:20	F	HD146485	B	1473	1466	1486	1490	10	10
6-19-1993	2:17: 1	F	HD146485	V	1758	1743	1731	1728	10	10
6-19-1993	2:17:36		SKYLAST	U	631	0	0	0	10	10
6-19-1993	2:17:46		SKYLAST	B	1278	0	0	0	10	10
6-19-1993	2:17:56		SKYLAST	V	1671	0	0	0	10	10
6-19-1993	2:24:14	A	HR6070	U	229	228	225	226	10	1
6-19-1993	2:24:55	A	HR6070	B	2016	1939	2002	1920	10	1
6-19-1993	2:25:35	A	HR6070	V	1032	1021	1013	1008	10	1
6-19-1993	2:26:39		SKYLAST	U	68	0	0	0	10	1
6-19-1993	2:26:49		SKYLAST	B	150	0	0	0	10	1
6-19-1993	2:26:60		SKYLAST	V	200	0	0	0	10	1

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MO-DY-YEAR	UT	CAT	OBJECT	FLT	----------COUNTS			----------	INT	SCLE	COMMENTS
6-19-1993	17: 8:10	A	HR6070	U	794	791	793	792	10	1	
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6-19-1993	17:11: 6	A	HR6070	V	1595	1592	1600	1603	10	1	
6-19-1993	17:11:48		SKYLAST	U	61	0	0	0	10	1	
6-19-1993	17:11:59	M	SKYLAST	B	102	0	0	0	10	1	
6-19-1993	17:12: 9	M	SKYLAST	V	99	0	0	0	10	1	
6-19-1993	17:16: 8	F	HD146022	U	65	65	65	65	10	1	
6-19-1993	17:16:48	F	HD146022	B	127	126	125	126	10	1	
6-19-1993	17:17:29	F	HD146022	V	109	109	109	109	10	1	
6-19-1993	17:18:18		SKYLAST	U	60	0	0	0	10	1	
6-19-1993	17:18:28		SKYLAST	B	98	0	0	0	10	1	
6-19-1993	17:18:39		SKYLAST	V	100	0	0	0	10	1	
6-19-1993	17:29:28	V	RR TRA	U	6283	6255	6275	6265	10	100	
6-19-1993	17:30: 9	V	RR TRA	B	11920	11898	11951	12031	10	100	
6-19-1993	17:30:49	V	RR TRA	V	12055	12121	12020	12054	10	100	
6-19-1993	17:31:41		SKYLAST	U	5952	0	0	0	10	100	
6-19-1993	17:31:51		SKYLAST	B	10079	0	0	0	10	100	
6-19-1993	17:32: 1		SKYLAST	V	11586	0	0	0	10	100	
6-19-1993	17:33: 9	V	RR TRA	U	6225	6234	6236	6243	10	100	
6-19-1993	17:33:50	V	RR TRA	B	12227	12074	12038	11971	10	100	
6-19-1993	17:34:30	V	RR TRA	V	12284	12405	12361	12414	10	100	
6-19-1993	17:36:32		SKYLAST	U	5968	0	0	0	10	100	
6-19-1993	17:36:42		SKYLAST	B	10065	0	0	0	10	100	
6-19-1993	17:36:53		SKYLAST	V	11820	0	0	0	10	100	
6-19-1993	17:37:57	V	RR TRA	U	6266	6266	6256	6241	10	100	
6-19-1993	17:38:38	V	RR TRA	B	12027	12043	12054	12104	10	100	
6-19-1993	17:39:18	V	RR TRA	V	12662	12578	12687	12559	10	100	
6-19-1993	17:40:43		SKYLAST	U	5989	0	0	0	10	100	
6-19-1993	17:40:53		SKYLAST	B	10058	0	0	0	10	100	
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6-19-1993	17:42: 1	V	RR TRA	U	6276	6237	6254	6268	10	100
6-19-1993	17:42:42	V	RR TRA	B	11991	12039	12018	12105	10	100
6-19-1993	17:43:22	V	RR TRA	V	12500	12471	12458	12457	10	100
6-19-1993	17:44: 9		SKYLAST	U	5946	0	0	0	10	100
6-19-1993	17:44:20		SKYLAST	B	10000	0	0	0	10	100
6-19-1993	17:44:30		SKYLAST	V	11437	0	0	0	10	100
6-19-1993	17:46: 1	F	HD146022	U	6482	6480	6496	6454	10	100
6-19-1993	17:46:42	F	HD146022	B	12629	12711	12679	12693	10	100
6-19-1993	17:47;22	F	HD146022	V	12423	12438	12363	12310	10	100
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6-19-1993	17:48:14		SKYLAST	B	9997	0	0	0	10	100
6-19-1993	17:48:24		SKYLAST	V	11505	0	0	0	10	100
6-19-1993	17:49:38	V	RR TRA	U	6253	6274	6259	6248	10	100
6-19-1993	17:50:18	V	RR TRA	B	11990	11980	12068	12017	10	100
6-19-1993	17:50:59	V	RR TRA	V	12052	11972	11865	11843	10	100
6-19-1993	17:51:44		SKYLAST	U	5963	0	0	0	10	100
6-19-1993	17:51:55		SKYLAST	B	9764	0	0	0	10	100
6-19-1993	17:52: 5		SKYLAST	V	10913	0	0	0	10	100
6-19-1993	17:52:59	V	RR TRA	U	6250	6275	6289	6271	10	100
6-19-1993	17:53:39	V	RR TRA	B	11883	11932	11863	11919	10	100
6-19-1993	17:54:20	V	RR TRA	V	11732	11788	11704	11605	10	100
6-19-1993	17:55: 1		SKYLAST	U	5941	0	0	0	10	100
6-19-1993	17:55:11		SKYLAST	B	9816	0	0	0	10	100
6-19-1993	17:55:22		SKYLAST	V	10877	0	0	0	10	100
6-19-1993	17:56:17	V	RR TRA	U	6273	6278	6275	6294	10	100
6-19-1993	17:56:57	V	RR TRA	B	11926	11978	11930	11985	10	100
6-19-1993	17:57:38	V	RR TRA	V	11716	11777	11728	11702	10	100
6-19-1993	17:58:20		SKYLAST	U	5938	0	0	0	10	100
6-19-1993	17:58:30		SKYLAST	B	9786	0	0	0	10	100
6-19-1993	17:58:41		SKYLAST	V	10815	0	0	0	10	100
6-19-1993	17:59:31	V	RR TRA	U	6296	6274	6266	6279	10	100
6-19-1993	18: 0:12	V	RR TRA	B	12045	11989	11980	11993	10	100
6-19-1993	18: 0:52	V	RR TRA	V	11745	11740	11692	11577	10	100
6-19-1993	18: 1:33		SKYLAST	U	5988	0	0	0	10	100
6-19-1993	18: 1:43		SKYLAST	B	9772	0	0	0	10	100
6-19-1993	18: 1:54		SKYLAST	V	10889	0	0	0	10	100
6-19-1993	18: 3: 4	F	HD146022	U	6528	6494	6501	6519	10	100
6-19-1993	18: 3:45	F	HD146022	B	12599	12642	12655	12569	10	100
6-19-1993	18: 4:25	F	HD146022	V	11444	11555	11634	11611	10	100
6-19-1993	18: 5:11		SKYLAST	U	5951	0	0	0	10	100
6-19-1993	18: 5:21		SKYLAST	B	9753	0	0	0	10	100
6-19-1993	18: 5:31		SKYLAST	V	10760	0	0	0	10	100
6-19-1993	18: 7:11	F	HD146485	U	6401	6379	6358	6376	10	100
6-19-1993	18: 7:52	F	HD146485	B	12788	12907	12785	12806	10	100
6-19-1993	18: 8:32	F	HD146485	V	12157	12076	12084	12150	10	100
6-19-1993	18: 9:20		SKYLAST	U	5940	0	0	0	10	100
6-19-1993	18: 9:31		SKYLAST	B	9773	0	0	0	10	100
6-19-1993	18: 9:41		SKYLAST	V	10882	0	0	0	10	100
6-19-1993	18:11:34	V	RR TRA	U	6299	6270	6301	6303	10	100
6-19-1993	18:12:15	V	RR TRA	B	11975	11994	12050	12041	10	100
6-19-1993	18:12:55	V	RR TRA	V	11900	11907	12077	11979	10	100
6-19-1993	18:13:53		SKYLAST	U	5956	0	0	0	10	100
6-19-1993	18:14: 4		SKYLAST	B	9907	0	0	0	10	100
6-19-1993	18:14:14		SKYLAST	V	11351	0	0	0	10	100
6-19-1993	18:15:16	V	RR TRA	U	6273	6284	6289	6270	10	100
6-19-1993	18:15:57	V	RR TRA	B	12049	12125	12095	12067	10	100
6-19-1993	18:16:37	V	RR TRA	V	12144	12059	12142	12258	10	100
6-19-1993	18:18: 0		SKYLAST	U	5987	0	0	0	10	100
6-19-1993	18:18:11		SKYLAST	B	9938	0	0	0	10	100
6-19-1993	18:18:21		SKYLAST	V	11443	0	0	0	10	100
6-19-1993	18:19:20	V	RR TRA	U	6289	6293	6290	6272	10	100
6-19-1993	18:20: 0	V	RR TRA	B	12088	12094	12044	12102	10	100
6-19-1993	18:20:41	V	RR TRA	V	12292	12256	12244	12210	10	100
6-19-1993	18:21:24		SKYLAST	U	5934	0	0	0	10	100
6-19-1993	18:21:34		SKYLAST	B	9949	0	0	0	10	100

6-19-1993	18:21:45		SKYLAST	V	11443	0	0	0	10	100
6-19-1993	18:22:50	V	RR TRA	U	6287	6279	6284	8281	10	100
6-19-1993	18:23:30	V	RR TRA	B	12089	12093	12041	12074	10	100
6-19-1993	18:24:11	V	RR TRA	V	12121	12297	12276	12265	10	100
6-19-1993	18:26:19		SKYLAST	U	5952	0	0	0	10	100
6-19-1993	18:26:29		SKYLAST	B	9874	0	0	0	10	100
6-19-1993	18:26:40		SKYLAST	V	11423	0	0	0	10	100
6-19-1993	18:27:58	F	HD146022	U	6482	6512	6533	6489	10	100
6-19-1993	18:28:39	F	HD146022	B	12720	12794	12628	12788	10	100
6-19-1993	18:29:20	F	HD146022	V	12238	12207	12208	12168	10	100
6-19-1993	18:30:27		SKYLAST	U	5954	0	0	0	10	100
6-19-1993	18:30:37		SKYLAST	B	9865	0	0	0	10	100
6-19-1993	18:30:48		SKYLAST	V	11331	0	0	0	10	100
6-19-1993	18:31:55	V	RR TRA	U	6296	6290	6292	6250	10	100
6-19-1993	18:32:35	V	RR TRA	B	11958	11954	12023	11982	10	100
6-19-1993	18:33:16	V	RR TRA	V	11957	12004	11869	11896	10	100
6-19-1993	18:35: 4		SKYLAST	U	5935	0	0	0	10	100
6-19-1993	18:35:14		SKYLAST	B	9737	0	0	0	10	100
6-19-1993	18:35:25		SKYLAST	V	10865	0	0	0	10	100
6-19-1993	18:36:18	V	RR TRA	U	6279	6281	6288	6281	10	100
6-19-1993	18:36:59	V	RR TRA	B	11904	11891	11942	11995	10	100
6-19-1993	18:37:39	V	RR TRA	V	11764	11774	11813	11748	10	100
6-19-1993	18:38:25		SKYLAST	U	5940	0	0	0	10	100
6-19-1993	18:38:36		SKYLAST	B	9584	0	0	0	10	100
6-19-1993	18:38:46		SKYLAST	V	10805	0	0	0	10	100
6-19-1993	18:39:39	V	RR TRA	U	6306	6321	6279	6311	10	100
6-19-1993	18:40:20	V	RR TRA	B	11927	12018	11963	11962	10	100
6-19-1993	18:41: 0	V	RR TRA	V	11621	11648	11661	11621	10	100
6-19-1993	18:43: 7		SKYLAST	U	5932	0	0	0	10	100
6-19-1993	18:43:17		SKYLAST	B	9640	0	0	0	10	100
6-19-1993	18:43:28		SKYLAST	V	10892	0	0	0	10	100
6-19-1993	18:44:20	V	RR TRA	U	6289	6306	6282	6263	10	100
6-19-1993	18:45: 1	V	RR TRA	B	11947	11983	11985	11964	10	100
6-19-1993	18:45:41	V	RR TRA	V	11620	11733	11717	11783	10	100
6-19-1993	18:46:39		SKYLAST	U	5956	0	0	0	10	100
6-19-1993	18:46:50		SKYLAST	B	9754	0	0	0	10	100
6-19-1993	18:47: 0		SKYLAST	V	11067	0	0	0	10	100
6-19-1993	18:50:10	A	HR6070	U	903	895	899	906	10	1
6-19-1993	18:50:51	A	HR6070	B	5059	5076	5060	5063	10	1
6-19-1993	18:51:31	A	HR6070	V	1671	1660	1667	1672	10	1
6-19-1993	18:52:23		SKYLAST	U	60	0	0	0	10	1
6-19-1993	18:52:33	M	SKYLAST	B	99	0	0	0	10	1
6-19-1993	18:52:44	M	SKYLAST	V	107	0	0	0	10	1
6-19-1993	18:57:33	F	HD146022	U	65	65	65	66	10	1
6-19-1993	18:58:13	F	HD146022	B	128	128	127	128	10	1
6-19-1993	18:58:54	F	HD146022	V	120	120	121	121	10	1
6-19-1993	18:59:51		SKYLAST	U	59	0	0	0	10	1
6-19-1993	19: 0: 1		SKYLAST	B	100	0	0	0	10	1
6-19-1993	19: 0:12		SKYLAST	V	114	0	0	0	10	1
6-19-1993	19: 1:60	V	RR TRA	U	6289	6304	6335	6324	10	100
6-19-1993	19: 2:40	V	RR TRA	B	12120	12018	12095	12138	10	100
6-19-1993	19: 3:21	V	RR TRA	V	12137	12102	12114	12121	10	100
6-19-1993	19: 4:15		SKYLAST	U	5850	0	0	0	10	100
6-19-1993	19: 4:25		SKYLAST	B	9929	0	0	0	10	100
6-19-1993	19: 4:36		SKYLAST	V	11342	0	0	0	10	100
6-19-1993	19: 5:45	V	RR TRA	U	6322	6276	6289	6314	10	100
6-19-1993	19: 6:26	V	RR TRA	B	12142	12170	12155	12207	10	100
6-19-1993	19: 7: 6	V	RR TRA	V	12411	12466	12463	12406	10	100
6-19-1993	19:25:14		SKYLAST	U	5965	0	0	0	10	100
6-19-1993	19:25:24		SKYLAST	B	9780	0	0	0	10	100
6-19-1993	19:25:35		SKYLAST	V	11268	0	0	0	10	100
6-19-1993	19:26:23	V	RR TRA	U	6341	6303	6314	6312	10	100
6-19-1993	19:27: 4	V	RR TRA	B	12072	12087	12149	12101	10	100
6-19-1993	19:27:44	V	RR TRA	V	12190	12057	12053	11993	10	100
6-19-1993	19:28:29		SKYLAST	U	5944	0	0	0	10	100

6-19-1993 19:28:40		SKYLAST	B	9818	0	0	0	10	100
6-19-1993 19:28:50		SKYLAST	V	11149	0	0	0	10	100
6-19-1993 19:29:46	V	RR TRA	U	6295	6298	6292	6303	10	100
6-19-1993 19:30:27	V	RR TRA	B	12154	12085	12207	12038	10	100
6-19-1993 19:31: 7	V	RR TRA	V	11778	11849	11777	11891	10	100
6-19-1993 19:31:52		SKYLAST	U	5957	0	0	0	10	100
6-19-1993 19:32: 3		SKYLAST	B	9748	0	0	0	10	100
6-19-1993 19:32:13		SKYLAST	V	10868	0	0	0	10	100
6-19-1993 19:33:32	F	HD146022	U	6555	6563	6578	8558	10	100
6-19-1993 19:34:13	F	HD146022	B	12716	12750	12713	12724	10	100
6-19-1993 19:34:53	F	HD146022	V	11607	11983	11827	11832	10	100
6-19-1993 19:35:36		SKYLAST	U	5946	0	0	0	10	100
6-19-1993 19:35:46		SKYLAST	B	9671	0	0	0	10	100
6-19-1993 19:35:57		SKYLAST	V	10760	0	0	0	10	100
6-19-1993 19:37: 2	V	RR TRA	U	6335	6333	6316	6344	10	100
6-19-1993 19:37:43	V	RR TRA	B	12127	12122	12111	12067	10	100
6-19-1993 19:38:23	V	RR TRA	V	11621	11620	11693	11695	10	100
6-19-1993 19:40:38		SKYLAST	U	5977	0	0	0	10	100
6-19-1993 19:40:48		SKYLAST	B	9683	0	0	0	10	100
6-19-1993 19:40:59		SKYLAST	V	10767	0	0	0	10	100
6-19-1993 19:41:55	V	RR TRA	U	6315	6329	6328	6286	10	100
6-19-1993 19:42:35	V	RR TRA	B	12090	12079	12077	12117	10	100
6-19-1993 19:43:16	V	RR TRA	V	11551	11672	11621	11572	10	100
6-19-1993 19:44: 7		SKYLAST	U	5943	0	0	0	10	100
6-19-1993 19:44:18		SKYLAST	B	9672	0	0	0	10	100
6-19-1993 19:44:28		SKYLAST	V	10700	0	0	0	10	100
6-19-1993 19:45:20	V	RR TRA	U	6328	6310	6321	6310	10	100
6-19-1993 19:46: 1	V	RR TRA	B	12140	12091	12106	12018	10	100
6-19-1993 19:46:41	V	RR TRA	V	11456	11447	11492	11431	10	100
6-19-1993 19:47:36		SKYLAST	U	5953	0	0	0	10	100
6-19-1993 19:47:47		SKYLAST	B	9620	0	0	0	10	100
6-19-1993 19:47:57		SKYLAST	V	10472	0	0	0	10	100
6-19-1993 19:49:22	V	RR TRA	U	6333	6361	6333	6309	10	100
6-19-1993 19:50: 3	V	RR TRA	B	11958	11927	11907	11974	10	100
6-19-1993 19:50:43	V	RR TRA	V	11204	11193	11205	11264	10	100
6-19-1993 19:51:34		SKYLAST	U	5937	0	0	0	10	100
6-19-1993 19:51:44		SKYLAST	B	9528	0	0	0	10	100
6-19-1993 19:51:55		SKYLAST	V	10331	0	0	0	10	100
6-19-1993 19:53:13	F	HD146022	U	6577	6581	6589	6582	10	100
6-19-1993 19:53:54	F	HD146022	B	12541	12601	12584	12570	10	100
6-19-1993 19:54:34	F	HD146022	V	11163	11173	11188	11206	10	100
6-19-1993 19:55:19		SKYLAST	U	5944	0	0	0	10	100
6-19-1993 19:55:29		SKYLAST	B	9506	0	0	0	10	100
6-19-1993 19:55:40		SKYLAST	V	10132	0	0	0	10	100
6-19-1993 19:57:19	F	HD146485	U	6431	6442	6416	6402	10	100
6-19-1993 19:57:59	F	HD146485	B	12757	12726	12685	12754	10	100
6-19-1993 19:58:40	F	HD146485	V	11432	11426	11465	11506	10	100
6-19-1993 19:59:31		SKYLAST	U	5949	0	0	0	10	100
6-19-1993 19:59:42		SKYLAST	B	9481	0	0	0	10	100
6-19-1993 19:59:52		SKYLAST	V	10073	0	0	0	10	100
6-19-1993 20: 1:32	V	RR TRA	U	6312	6309	6344	6302	10	100
6-19-1993 20: 2:13	V	RR TRA	B	11825	11853	11777	11814	10	100
6-19-1993 20: 2:53	V	RR TRA	V	11016	11063	10981	10915	10	100
6-19-1993 20: 3:44		SKYLAST	U	5924	0	0	0	10	100
6-19-1993 20: 3:54		SKYLAST	B	9394	0	0	0	10	100
6-19-1993 20: 4: 5		SKYLAST	V	9994	0	0	0	10	100
6-19-1993 20: 5: 2	V	RR TRA	U	6309	6298	6329	6301	10	100
6-19-1993 20: 5:43	V	RR TRA	B	11796	11874	11827	11921	10	100
6-19-1993 20: 6:23	V	RR TRA	V	10888	10855	10805	10813	10	100
6-19-1993 20: 7:17		SKYLAST	U	5926	0	0	0	10	100
6-19-1993 20: 7:28		SKYLAST	B	9315	0	0	0	10	100
6-19-1993 20: 7:38		SKYLAST	V	9959	0	0	0	10	100
6-19-1993 20:10:23	V	RR TRA	U	6310	6322	6334	6301	10	100
6-19-1993 20:11: 3	V	RR TRA	B	11799	11801	11791	11718	10	100
6-19-1993 20:11:44	V	RR TRA	V	10868	10745	10706	10771	10	100

6-19-1993	20:12:30		SKYLAST	U	5941	0	0	0	10	100
6-19-1993	20:12:41		SKYLAST	B	9411	0	0	0	10	100
6-19-1993	20:12:51		SKYLAST	V	9863	0	0	0	10	100
6-19-1993	20:13:55	V	RR TRA	U	6306	6308	6319	6322	10	100
6-19-1993	20:14:35	V	RR TRA	B	11727	11819	11800	11782	10	100
6-19-1993	20:15:16	V	RR TRA	V	10852	10819	10754	10860	10	100
6-19-1993	20:16: 6		SKYLAST	U	5958	0	0	0	10	100
6-19-1993	20:16:16		SKYLAST	B	9373	0	0	0	10	100
6-19-1993	20:16:27		SKYLAST	V	9936	0	0	0	10	100
6-19-1993	20:17:26	F	HD146022	U	6573	6595	6579	6580	10	100
6-19-1993	20:18: 6	F	HD146022	B	12511	12556	12531	12595	10	100
6-19-1993	20:18:47	F	HD146022	V	10895	10883	10803	10885	10	100
6-19-1993	20:19:46		SKYLAST	U	5945	0	0	0	10	100
6-19-1993	20:19:56		SKYLAST	B	9432	0	0	0	10	100
6-19-1993	20:20: 7		SKYLAST	V	9924	0	0	0	10	100
6-19-1993	20:21:11	V	RR TRA	U	6316	6328	6292	6330	10	100
6-19-1993	20:21:52	V	RR TRA	B	11826	11743	11826	11846	10	100
6-19-1993	20:22:33	V	RR TRA	V	10695	10746	10671	10608	10	100
6-19-1993	20:23:16		SKYLAST	U	5945	0	0	0	10	100
6-19-1993	20:23:26		SKYLAST	B	9341	0	0	0	10	100
6-19-1993	20:23:37		SKYLAST	V	9812	0	0	0	10	100
6-19-1993	20:24:39	V	RR TRA	U	6317	6329	6316	6318	10	100
6-19-1993	20:25:20	V	RR TRA	B	11805	11749	11757	11809	10	100
6-19-1993	20:26: 0	V	RR TRA	V	10719	10663	10704	10654	10	100
6-19-1993	20:26:56		SKYLAST	U	5956	0	0	0	10	100
6-19-1993	20:27: 6		SKYLAST	B	9310	0	0	0	10	100
6-19-1993	20:27:17		SKYLAST	V	9754	0	0	0	10	100
6-19-1993	20:28:14	V	RR TRA	U	6316	6336	6309	6332	10	100
6-19-1993	20:28:55	V	RR TRA	B	11712	11700	11787	11771	10	100
6-19-1993	20:29:36	V	RR TRA	V	10649	10563	10647	10653	10	100
6-19-1993	20:30:21		SKYLAST	U	5943	0	0	0	10	100
6-19-1993	20:30:31		SKYLAST	B	9340	0	0	0	10	100
6-19-1993	20:30:42		SKYLAST	V	9689	0	0	0	10	100
6-19-1993	20:31:56	V	RR TRA	U	6360	6328	6335	6330	10	100
6-19-1993	20:32:37	V	RR TRA	B	11772	11743	11676	11810	10	100
6-19-1993	20:33:17	V	RR TRA	V	10531	10611	10567	10514	10	100
6-19-1993	20:34: 7		SKYLAST	U	5903	0	0	0	10	100
6-19-1993	20:34:18		SKYLAST	B	9250	0	0	0	10	100
6-19-1993	20:34:28		SKYLAST	V	9544	0	0	0	10	100
6-19-1993	20:38:19	A	HR6070	U	992	989	995	991	10	1
6-19-1993	20:38:59	A	HR6070	B	5442	5460	5470	5453	10	1
6-19-1993	20:39:40	A	HR6070	V	1746	1744	1751	1748	10	1
6-19-1993	20:40:34		SKYLAST	U	61	0	0	0	10	1
6-19-1993	20:40:44	M	SKYLAST	B	97	0	0	0	10	1
6-19-1993	20:40:55	M	SKYLAST	V	93	0	0	0	10	1
6-19-1993	20:44:26	F	HD146022	U	6585	6611	6596	6612	10	100
6-19-1993	20:45: 6	F	HD146022	B	12607	12514	12574	12641	10	100
6-19-1993	20:45:47	F	HD146022	V	10772	10723	10754	10829	10	100
6-19-1993	20:47:23		SKYLAST	U	5971	0	0	0	10	100
6-19-1993	20:47:34		SKYLAST	B	9510	0	0	0	10	100
6-19-1993	20:47:44		SKYLAST	V	9745	0	0	0	10	100
6-19-1993	20:49:11	V	RR TRA	U	6303	6323	6325	6320	10	100
6-19-1993	20:49:51	V	RR TRA	B	11786	11716	11873	11770	10	100
6-19-1993	20:50:32	V	RR TRA	V	10744	10678	10691	10722	10	100
6-19-1993	20:51:26		SKYLAST	U	5956	0	0	0	10	100
6-19-1993	20:51:36		SKYLAST	B	9391	0	0	0	10	100
6-19-1993	20:51:47		SKYLAST	V	9812	0	0	0	10	100
6-19-1993	20:52:53	V	RR TRA	U	6300	6347	6321	6326	10	100
6-19-1993	20:53:34	V	RR TRA	B	11774	11864	11771	11823	10	100
6-19-1993	20:54:14	V	RR TRA	V	10790	10724	10716	10651	10	100
6-19-1993	20:55: 2		SKYLAST	U	5921	0	0	0	10	100
6-19-1993	20:55:12		SKYLAST	B	9381	0	0	0	10	100
6-19-1993	20:55:23		SKYLAST	V	9808	0	0	0	10	100
6-19-1993	20:56:25	V	RR TRA	U	6311	6307	6312	6319	10	100
6-19-1993	20:57: 5	V	RR TRA	B	11751	11804	11754	11819	10	100

6-19-1993 20:57:46	V	RR TRA	V	10669	10652	10696	10694	10	100
6-19-1993 20:58:29		SKYLAST	U	5934	0	0	0	10	100
6-19-1993 20:58:40		SKYLAST	B	9452	0	0	0	10	100
6-19-1993 20:58:50		SKYLAST	V	9853	0	0	0	10	100
6-19-1993 20:59:49	V	RR TRA	U	6296	6285	6326	6304	10	100
6-19-1993 21: 0:29	V	RR TRA	B	11870	11859	11897	11843	10	100
6-19-1993 21: 1:10	V	RR TRA	V	10923	10856	10873	10789	10	100
6-19-1993 21: 1:56		SKYLAST	U	5938	0	0	0	10	100
6-19-1993 21: 2: 6		SKYLAST	B	9372	0	0	0	10	100
6-19-1993 21: 2:17		SKYLAST	V	9760	0	0	0	10	100
6-19-1993 21: 3:31	F	HD146022	U	6586	6609	6591	6637	10	100
6-19-1993 21: 4:12	F	HD146022	B	12544	12632	12619	12576	10	100
6-19-1993 21: 4:52	F	HD146022	V	10777	10736	10761	10747	10	100
6-19-1993 21: 5:47		SKYLAST	U	5960	0	0	0	10	100
6-19-1993 21: 5:58		SKYLAST	B	9382	0	0	0	10	100
6-19-1993 21: 6: 8		SKYLAST	V	9666	0	0	0	10	100
6-19-1993 21: 7:27	V	RR TRA	U	6309	6294	6305	6325	10	100
6-19-1993 21: 8: 8	V	RR TRA	B	11685	11710	11805	11715	10	100
6-19-1993 21: 8:48	V	RR TRA	V	10650	10673	10644	10685	10	100
6-19-1993 21: 9:40		SKYLAST	U	5957	0	0	0	10	100
6-19-1993 21: 9:51		SKYLAST	B	9327	0	0	0	10	100
6-19-1993 21:10: 1		SKYLAST	V	9760	0	0	0	10	100
6-19-1993 21:10:57	V	RR TRA	U	6327	6328	6325	6319	10	100
6-19-1993 21:11:38	V	RR TRA	B	11716	11703	11680	11647	10	100
6-19-1993 21:12:18	V	RR TRA	V	10665	10634	10753	10709	10	100
6-19-1993 21:13: 4		SKYLAST	U	5932	0	0	0	10	100
6-19-1993 21:13:14		SKYLAST	B	9298	0	0	0	10	100
6-19-1993 21:13:25		SKYLAST	V	9728	0	0	0	10	100
6-19-1993 21:14:17	V	RR TRA	U	6290	6289	6268	6261	10	100
6-19-1993 21:14:57	V	RR TRA	B	11644	11588	11630	11619	10	100
6-19-1993 21:15:38	V	RR TRA	V	10553	10624	10620	10604	10	100
6-19-1993 21:16:31		SKYLAST	U	5918	0	0	0	10	100
6-19-1993 21:16:42		SKYLAST	B	9304	0	0	0	10	100
6-19-1993 21:16:52		SKYLAST	V	9794	0	0	0	10	100
6-19-1993 21:17:49	V	RR TRA	U	6304	6295	6302	6295	10	100
6-19-1993 21:18:29	V	RR TRA	B	11621	11719	11701	11694	10	100
6-19-1993 21:19:10	V	RR TRA	V	10588	10616	10617	10598	10	100
6-19-1993 21:20: 4		SKYLAST	U	5922	0	0	0	10	100
6-19-1993 21:20:14		SKYLAST	B	9277	0	0	0	10	100
6-19-1993 21:20:25		SKYLAST	V	9697	0	0	0	10	100
6-19-1993 21:21:45	F	HD146022	U	6560	6584	6580	6569	10	100
6-19-1993 21:22:25	F	HD146022	B	12468	12543	12508	12402	10	100
6-19-1993 21:23: 6	F	HD146022	V	10659	10708	10647	10786	10	100
6-19-1993 21:24: 1		SKYLAST	U	5934	0	0	0	10	100
6-19-1993 21:24:12		SKYLAST	B	9372	0	0	0	10	100
6-19-1993 21:24:22		SKYLAST	V	9779	0	0	0	10	100
6-19-1993 21:26:33	F	HD146485	U	6438	6435	6447	6403	10	100
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6-19-1993 21:27:54	F	HD146485	V	11293	11355	11245	11321	10	100
6-19-1993 21:28:42		SKYLAST	U	5930	0	0	0	10	100
6-19-1993 21:28:52		SKYLAST	B	9378	0	0	0	10	100
6-19-1993 21:29: 3		SKYLAST	V	9787	0	0	0	10	100
6-19-1993 21:30:54	V	RR TRA	U	6323	6322	6329	6316	10	100
6-19-1993 21:31:35	V	RR TRA	B	11719	11644	11684	11712	10	100
6-19-1993 21:32:15	V	RR TRA	V	10725	10741	10705	10689	10	100
6-19-1993 21:33:12		SKYLAST	U	5938	0	0	0	10	100
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6-19-1993 21:34:28	V	RR TRA	U	6302	6303	6287	6304	10	100
6-19-1993 21:35: 8	V	RR TRA	B	11811	11752	11691	11790	10	100
6-19-1993 21:35:49	V	RR TRA	V	10815	10763	10808	10732	10	100
6-19-1993 21:36:45		SKYLAST	U	5958	0	0	0	10	100
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6-19-1993 21:38: 9	V	RR TRA	U	6316	6304	6302	6308	10	100

6-19-1993 21:38:50	V	RR TRA	B	11674	11759	11696	11715	10	100
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6-19-1993 21:40:26		SKYLAST	U	5950	0	0	0	10	100
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6-19-1993 21:40:47		SKYLAST	V	9734	0	0	0	10	100
6-19-1993 21:42:18	V	RR TRA	U	6312	6299	6318	6330	10	100
6-19-1993 21:42:58	V	RR TRA	B	11764	11801	11736	11754	10	100
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6-19-1993 21:45: 1		SKYLAST	V	9626	0	0	0	10	100
6-19-1993 21:46:14	F	HD146022	U	6568	6597	6597	6606	10	100
6-19-1993 21:46:55	F	HD146022	B	12532	12557	12533	12575	10	100
6-19-1993 21:47:35	F	HD146022	V	10701	10606	10717	10744	10	100
6-19-1993 21:48:45		SKYLAST	U	5957	0	0	0	10	100
6-19-1993 21:48:55		SKYLAST	B	9358	0	0	0	10	100
6-19-1993 21:49: 6		SKYLAST	V	9811	0	0	0	10	100
6-19-1993 21:50:15	V	RR TRA	U	6298	6279	6271	6278	10	100
6-19-1993 21:50:56	V	RR TRA	B	11686	11699	11702	11662	10	100
6-19-1993 21:51:36	V	RR TRA	V	10745	10715	10697	10753	10	100
6-19-1993 21:53:37		SKYLAST	U	5956	0	0	0	10	100
6-19-1993 21:53:48		SKYLAST	B	9407	0	0	0	10	100
6-19-1993 21:53:58		SKYLAST	V	9924	0	0	0	10	100
6-19-1993 21:55: 6	V	RR TRA	U	6305	6317	6294	6312	10	100
6-19-1993 21:55:47	V	RR TRA	B	11724	11703	11775	11770	10	100
6-19-1993 21:56:27	V	RR TRA	V	10799	10774	10689	10751	10	100
6-19-1993 21:57:21		SKYLAST	U	5964	0	0	0	10	100
6-19-1993 21:57:32		SKYLAST	B	9426	0	0	0	10	100
6-19-1993 21:57:42		SKYLAST	V	9877	0	0	0	10	100
6-19-1993 21:58:41	V	RR TRA	U	6318	6306	6338	6312	10	100
6-19-1993 21:59:21	V	RR TRA	B	11761	11752	11714	11684	10	100
6-19-1993 22: 0: 2	V	RR TRA	V	10608	10642	10562	10548	10	100
6-19-1993 22: 1: 0		SKYLAST	U	5937	0	0	0	10	100
6-19-1993 22: 1:11		SKYLAST	B	9302	0	0	0	10	100
6-19-1993 22: 1:21		SKYLAST	V	9604	0	0	0	10	100
6-19-1993 22: 2:30	V	RR TRA	U	6303	6306	6308	6295	10	100
6-19-1993 22: 3:10	V	RR TRA	B	11613	11609	11660	11611	10	100
6-19-1993 22: 3:51	V	RR TRA	V	10436	10487	10519	10510	10	100
6-19-1993 22: 5: 4		SKYLAST	U	5967	0	0	0	10	100
6-19-1993 22: 5:14		SKYLAST	B	9332	0	0	0	10	100
6-19-1993 22: 5:25		SKYLAST	V	9728	0	0	0	10	100
6-19-1993 22:18:23	A	HR6070	U	954	953	953	955	10	1
6-19-1993 22:19: 3	A	HR6070	B	5355	5318	5318	5326	10	1
6-19-1993 22:19:44	A	HR6070	V	1714	1704	1710	1699	10	1
6-19-1993 22:20:28		SKYLAST	U	62	0	0	0	10	1
6-19-1993 22:20:39	M	SKYLAST	B	97	0	0	0	10	1
6-19-1993 22:20:49	M	SKYLAST	V	92	0	0	0	10	1
6-19-1993 22:24:37	F	HD146022	U	6630	6611	6628	6644	10	100
6-19-1993 22:25:18	F	HD146022	B	12650	12541	12492	12463	10	100
6-19-1993 22:25:58	F	HD146022	V	10651	10590	10640	10598	10	100
6-19-1993 22:26:51		SKYLAST	U	5996	0	0	0	10	100
6-19-1993 22:27: 2		SKYLAST	B	9457	0	0	0	10	100
6-19-1993 22:27:12		SKYLAST	V	9648	0	0	0	10	100
6-19-1993 22:28:29	V	RR TRA	U	6321	6335	6330	6322	10	100
6-19-1993 22:29:10	V	RR TRA	B	11560	11599	11560	11516	10	100
6-19-1993 22:29:50	V	RR TRA	V	10394	10331	10420	10397	10	100
6-19-1993 22:30:52		SKYLAST	U	5974	0	0	0	10	100
6-19-1993 22:31: 3		SKYLAST	B	9364	0	0	0	10	100
6-19-1993 22:31:13		SKYLAST	V	9583	0	0	0	10	100
6-19-1993 22:32: 9	V	RR TRA	U	6288	6308	6301	6334	10	100
6-19-1993 22:32:50	V	RR TRA	B	11572	11694	11620	11696	10	100
6-19-1993 22:33:30	V	RR TRA	V	10414	10369	10415	10410	10	100
6-19-1993 22:34:16		SKYLAST	U	5964	0	0	0	10	100
6-19-1993 22:34:27		SKYLAST	B	9348	0	0	0	10	100
6-19-1993 22:34:37		SKYLAST	V	9653	0	0	0	10	100

6-19-1993	22:35:40	V	RR TRA	U	6316	6297	6301	6328	10	100
6-19-1993	22:36:21	V	RR TRA	B	11616	11620	11664	11657	10	100
6-19-1993	22:37: 1	V	RR TRA	V	10515	10614	10656	10462	10	100
6-19-1993	22:37:52		SKYLAST	U	5961	0	0	0	10	100
6-19-1993	22:38: 2		SKYLAST	B	9428	0	0	0	10	100
6-19-1993	22:38:13		SKYLAST	V	9716	0	0	0	10	100
6-19-1993	22:39:16	V	RR TRA	U	6303	6305	6295	6300	10	100
6-19-1993	22:39:56	V	RR TRA	B	11558	11670	11575	11571	10	100
6-19-1993	22:40:37	V	RR TRA	V	10525	10559	10615	10583	10	100
6-19-1993	22:41:30		SKYLAST	U	5976	0	0	0	10	100
6-19-1993	22:41:40		SKYLAST	B	9420	0	0	0	10	100
6-19-1993	22:41:51		SKYLAST	V	9716	0	0	0	10	100
6-19-1993	22:43: 3	F	HD146022	U	6604	6629	6624	6614	10	100
6-19-1993	22:43:44	F	HD146022	B	12565	12564	12603	12578	10	100
6-19-1993	22:44:24	F	HD146022	V	10719	10780	10808	10738	10	100
6-19-1993	22:45:22		SKYLAST	U	5978	0	0	0	10	100
6-19-1993	22:45:32		SKYLAST	B	9513	0	0	0	10	100
6-19-1993	22:45:43		SKYLAST	V	9718	0	0	0	10	100
6-19-1993	22:46:55	V	RR TRA	U	6308	6287	6287	6309	10	100
6-19-1993	22:47:36	V	RR TRA	B	11563	11594	11576	11576	10	100
6-19-1993	22:48:16	V	RR TRA	V	10512	10479	10576	10504	10	100
6-19-1993	22:49:26		SKYLAST	U	5973	0	0	0	10	100
6-19-1993	22:49:36		SKYLAST	B	9475	0	0	0	10	100
6-19-1993	22:49:47		SKYLAST	V	9789	0	0	0	10	100
6-19-1993	22:50:49	V	RR TRA	U	6299	6291	6303	6313	10	100
6-19-1993	22:51:30	V	RR TRA	B	11674	11620	11673	11598	10	100
6-19-1993	22:52:10	V	RR TRA	V	10600	10560	10504	10606	10	100
6-19-1993	22:53: 5		SKYLAST	U	5967	0	0	0	10	100
6-19-1993	22:53:16		SKYLAST	B	9433	0	0	0	10	100
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6-19-1993	22:55: 6	V	RR TRA	B	11607	11574	11582	11588	10	100
6-19-1993	22:55:47	V	RR TRA	V	10611	10736	10682	10679	10	100
6-19-1993	22:56:34		SKYLAST	U	5968	0	0	0	10	100
6-19-1993	22:56:44		SKYLAST	B	9490	0	0	0	10	100
6-19-1993	22:56:55		SKYLAST	V	9861	0	0	0	10	100
6-19-1993	22:58:11	V	RR TRA	U	6290	6312	6295	6328	10	100
6-19-1993	22:58:51	V	RR TRA	B	11633	11550	11616	11647	10	100
6-19-1993	22:59:32	V	RR TRA	V	10784	10764	10772	10748	10	100
6-19-1993	23: 0:20		SKYLAST	U	5981	0	0	0	10	100
6-19-1993	23: 0:30		SKYLAST	B	9492	0	0	0	10	100
6-19-1993	23: 0:41		SKYLAST	V	9959	0	0	0	10	100
6-19-1993	23: 1:52	F	HD146022	U	6589	6639	6607	6600	10	100
6-19-1993	23: 2:33	F	HD146022	B	12661	12597	12683	12694	10	100
6-19-1993	23: 3:13	F	HD146022	V	10930	11036	10929	10952	10	100
6-19-1993	23: 4:17		SKYLAST	U	6017	0	0	0	10	100
6-19-1993	23: 4:28		SKYLAST	B	9589	0	0	0	10	100
6-19-1993	23: 4:38		SKYLAST	V	9832	0	0	0	10	100
6-19-1993	23: 6:15	F	HD146485	U	6480	6476	6466	6452	10	100
6-19-1993	23: 6:55	F	HD146485	B	12866	12844	12878	12882	10	100
6-19-1993	23: 7:36	F	HD146485	V	11279	11254	11287	11220	10	100
6-19-1993	23: 8:48		SKYLAST	U	6003	0	0	0	10	100
6-19-1993	23: 8:59		SKYLAST	B	9537	0	0	0	10	100
6-19-1993	23: 9: 9		SKYLAST	V	9790	0	0	0	10	100
6-19-1993	23:11: 8	V	RR TRA	U	6298	6300	6279	6293	10	100
6-19-1993	23:11:49	V	RR TRA	B	11511	11457	11563	11587	10	100
6-19-1993	23:12:29	V	RR TRA	V	10546	10494	10525	10488	10	100
6-19-1993	23:13:19		SKYLAST	U	5978	0	0	0	10	100
6-19-1993	23:13:30		SKYLAST	B	9553	0	0	0	10	100
6-19-1993	23:13:40		SKYLAST	V	9742	0	0	0	10	100
6-19-1993	23:14:39	V	RR TRA	U	6276	6281	6288	6250	10	100
6-19-1993	23:15:20	V	RR TRA	B	11570	11573	11564	11557	10	100
6-19-1993	23:16: 0	V	RR TRA	V	10485	10486	10586	10556	10	100
6-19-1993	23:17: 1		SKYLAST	U	6015	0	0	0	10	100
6-19-1993	23:17:11		SKYLAST	B	9537	0	0	0	10	100

6-19-1993	23:17:22		SKYLAST	V	9818	0	0	0	10	100	
6-19-1993	23:18:15	V	RR TRA	U	6291	6301	6267	6288	10	100	
6-19-1993	23:18:56	V	RR TRA	B	11656	11619	11568	11588	10	100	
6-19-1993	23:19:37	V	RR TRA	V	10745	10727	10716	10676	10	100	
6-19-1993	23:20:35		SKYLAST	U	5980	0	0	0	10	100	
6-19-1993	23:20:45		SKYLAST	B	9562	0	0	0	10	100	
6-19-1993	23:20:56		SKYLAST	V	10051	0	0	0	10	100	
6-19-1993	23:22: 3	V	RR TRA	U	6297	6269	6288	6269	10	100	
6-19-1993	23:22:43	V	RR TRA	B	11566	11516	11527	11506	10	100	
6-19-1993	23:23:24	V	RR TRA	V	10729	10760	10719	10689	10	100	
6-19-1993	23:24:25		SKYLAST	U	6017	0	0	0	10	100	
6-19-1993	23:24:38		SKYLAST	B	9541	0	0	0	10	100	
6-19-1993	23:24:46		SKYLAST	V	9931	0	0	0	10	100	
6-19-1993	23:25:60	F	HD146022	U	6592	6609	6607	6569	10	100	
6-19-1993	23:26:40	F	HD146022	B	12703	12696	12626	12652	10	100	
6-19-1993	23:27:21	F	HD146022	V	11003	11037	11026	11049	10	100	
6-19-1993	23:28:26		SKYLAST	U	5996	0	0	0	10	100	
6-19-1993	23:28:36		SKYLAST	B	9605	0	0	0	10	100	
6-19-1993	23:28:47		SKYLAST	V	10070	0	0	0	10	100	
6-19-1993	23:33:22	A	HR6070	U	868	868	867	866	10	1	
6-19-1993	23:36:48	A	HR6070	B	5051	5085	5055	5074	10	1	
6-19-1993	23:37:29	A	HR6070	V	1679	1668	1682	1654	10	1	
6-19-1993	23:38:36		SKYLAST	U	63	0	0	0	10	1	
6-19-1993	23:38:46		SKYLAST	B	99	0	0	0	10	1	
6-19-1993	23:38:56		SKYLAST	V	97	0	0	0	10	1	end

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CONDITIONS=clear . DARK CNTS=55

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6-21-1993	16:38:28	A.	HR6070	V	1230	1243	1229	1217	10	1	
6-21-1993	16:39:20		SKYLAST	U	65	0	0	0	10	1	
6-21-1993	16:39:31		SKYLAST	B	152	0	0	0	10	1	
6-21-1993	16:39:41		SKYLAST	V	176	0	0	0	10	1	
6-21-1993	16:46:47	F	HD146485	U	6372	6371	6392	6371	10	100	
6-21-1993	16:48: 6	F	HD146485	B	14187	14072	14161	14120	10	100	
6-21-1993	16:49: 6	F	HD146485	V	16823	16693	16522	16443	10	100	
6-21-1993	16:49:53		SKYLAST	U	6119	0	0	0	10	100	
6-21-1993	16:50: 3		SKYLAST	B	12231	0	0	0	10	100	
6-21-1993	16:50:14		SKYLAST	V	15444	0	0	0	10	100	
6-21-1993	16:52:41	F	HD146022	U	6401	6444	6436	6431	10	100	
6-21-1993	16:53:41	F	HD146022	B	13985	14030	13928	14006	10	100	
6-21-1993	16:54:37	F	HD146022	V	16125	16228	16155	16252	10	100	
6-21-1993	16:55:30		SKYLAST	U	6111	0	0	0	10	100	
6-21-1993	16:55:40		SKYLAST	B	12174	0	0	0	10	100	
6-21-1993	16:55:51		SKYLAST	V	15566	0	0	0	10	100	
6-21-1993	17: 1: 7	V	RR TRA	U	6256	6264	6290	6281	10	100	
6-21-1993	17: 3:42	V	RR TRA	B	13337	13396	13345	13384	10	100	
6-21-1993	17: 6: 3	V	RR TRA	V	17060	17605	17640	17699	10	100	
6-21-1993	17: 9:13		SKYLAST	U	6137	0	0	0	10	100	
6-21-1993	17: 9:24		SKYLAST	B	11930	0	0	0	10	100	
6-21-1993	17: 9:34		SKYLAST	V	14997	0	0	0	10	100	
6-21-1993	17:10:39	V	RR TRA	U	634	633	633	633	10	10	
6-21-1993	17:13: 6	V	RR TRA	B	1313	1314	1310	1313	10	10	
6-21-1993	17:15:53	V	RR TRA	V	1587	1575	1582	1592	10	10	
6-21-1993	17:18:37		SKYLAST	U	615	0	0	0	10	10	
6-21-1993	17:18:47		SKYLAST	B	1178	0	0	0	10	10	
6-21-1993	17:18:58		SKYLAST	V	1481	0	0	0	10	10	
6-21-1993	17:21: 5	V	RR TRA	U	628	632	632	632	10	10	
6-21-1993	17:21:46	V	RR TRA	B	1300	1302	1307	1296	10	10	
6-21-1993	17:22:27	V	RR TRA	V	1572	1571	1566	1571	10	10	
6-21-1993	17:23:14		SKYLAST	U	616	0	0	0	10	10	

6-21-1993	17:23:25		SKYLAST	B	1181	0	0	0	10	10	
6-21-1993	17:23:35		SKYLAST	V	1510	0	0	0	10	10	
6-21-1993	17:24:24	V	RR TRA	U	630	630	629	627	10	10	
6-21-1993	17:25: 4	V	RR TRA	B	1275	1272	1275	1278	10	10	
6-21-1993	17:26:54	V	RR TRA	V	1425	1454	1478	1484	10	10	
6-21-1993	17:27:41		SKYLAST	U	613	0	0	0	10	10	
6-21-1993	17:27:52		SKYLAST	B	1168	0	0	0	10	10	
6-21-1993	17:28: 2		SKYLAST	V	1457	0	0	0	10	10	sky dropped sharply
6-21-1993	17:29:38	F	HD146022	U	657	657	656	655	10	10	
6-21-1993	17:30:19	F	HD146022	B	1336	1332	1337	1325	10	10	
6-21-1993	17:33:50	F	HD146022	V	1388	1382	1358	1327	10	10	
6-21-1993	17:34:39		SKYLAST	U	609	0	0	0	10	10	
6-21-1993	17:34:49		SKYLAST	B	1080	0	0	0	10	10	
6-21-1993	17:34:60		SKYLAST	V	1270	0	0	0	10	10	
6-21-1993	17:37:33	V	RR TRA	U	623	628	630	626	10	10	
6-21-1993	17:38:14	V	RR TRA	B	1192	1184	1181	1183	10	10	
6-21-1993	17:38:54	V	RR TRA	V	1338	1315	1300	1277	10	10	
6-21-1993	17:39:46		SKYLAST	U	604	0	0	0	10	10	
6-21-1993	17:39:57		SKYLAST	B	1047	0	0	0	10	10	
6-21-1993	17:40: 7		SKYLAST	V	1256	0	0	0	10	10	
6-21-1993	17:41:19	V	RR TRA	U	618	619	618	615	10	10	
6-21-1993	17:41:60	V	RR TRA	B	1155	1155	1151	1149	10	10	
6-21-1993	17:42:41	V	RR TRA	V	1281	1278	1270	1280	10	10	
6-21-1993	17:43:32		SKYLAST	U	603	0	0	0	10	10	
6-21-1993	17:43:43		SKYLAST	B	1036	0	0	0	10	10	
6-21-1993	17:43:53		SKYLAST	V	1237	0	0	0	10	10	
6-21-1993	17:44:58	V	RR TRA	U	616	616	615	617	10	10	
6-21-1993	17:45:39	V	RR TRA	B	1148	1145	1145	1147	10	10	
6-21-1993	17:47:21	V	RR TRA	V	1287	1303	1326	1328	10	10	
6-21-1993	17:48:18		SKYLAST	U	603	0	0	0	10	10	
6-21-1993	17:48:28		SKYLAST	B	1054	0	0	0	10	10	
6-21-1993	17:48:39		SKYLAST	V	1290	0	0	0	10	10	
6-21-1993	17:49:54	V	RR TRA	U	616	618	617	616	10	10	
6-21-1993	17:50:34	V	RR TRA	B	1158	1145	1141	1142	10	10	
6-21-1993	17:51:15	V	RR TRA	V	1320	1331	1330	1330	10	10	
6-21-1993	17:52: 8		SKYLAST	U	605	0	0	0	10	10	
6-21-1993	17:52:18		SKYLAST	B	1065	0	0	0	10	10	
6-21-1993	17:52:29		SKYLAST	V	1286	0	0	0	10	10	
6-21-1993	17:54: 0	F	HD146022	U	658	657	656	656	10	10	
6-21-1993	17:54:41	F	HD146022	B	1331	1327	1337	1333	10	10	
6-21-1993	17:55:21	F	HD146022	V	1357	1361	1367	1352	10	10	
6-21-1993	17:55:58		SKYLAST	U	604	0	0	0	10	10	
6-21-1993	17:56: 9		SKYLAST	B	1062	0	0	0	10	10	
6-21-1993	17:56:19		SKYLAST	V	1286	0	0	0	10	10	
6-21-1993	17:57:40	V	RR TRA	U	616	616	616	615	10	10	
6-21-1993	17:58:21	V	RR TRA	B	1132	1128	1136	1128	10	10	
6-21-1993	17:59: 1	V	RR TRA	V	1287	1274	1277	1272	10	10	
6-21-1993	17:59:50		SKYLAST	U	604	0	0	0	10	10	
6-21-1993	18: 0: 1		SKYLAST	B	1043	0	0	0	10	10	
6-21-1993	18: 0:11		SKYLAST	V	1222	0	0	0	10	10	
6-21-1993	18: 1: 6	V	RR TRA	U	616	616	614	614	10	10	
6-21-1993	18: 1:46	V	RR TRA	B	1103	1104	1104	1098	10	10	
6-21-1993	18: 2:27	V	RR TRA	V	1237	1241	1226	1221	10	10	
6-21-1993	18: 3: 9		SKYLAST	U	604	0	0	0	10	10	
6-21-1993	18: 3:19		SKYLAST	B	1031	0	0	0	10	10	
6-21-1993	18: 3:30		SKYLAST	V	1202	0	0	0	10	10	
6-21-1993	18: 4:15	V	RR TRA	U	614	615	616	614	10	10	
6-21-1993	18: 4:55	V	RR TRA	B	1092	1094	1101	1084	10	10	
6-21-1993	18: 5:36	V	RR TRA	V	1155	1158	1148	1156	10	10	
6-21-1993	18: 6:29		SKYLAST	U	603	0	0	0	10	10	
6-21-1993	18: 6:39		SKYLAST	B	1006	0	0	0	10	10	
6-21-1993	18: 6:49		SKYLAST	V	1107	0	0	0	10	10	
6-21-1993	18: 8: 1	V	RR TRA	U	612	612	615	612	10	10	
6-21-1993	18: 8:42	V	RR TRA	B	1067	1065	1070	1069	10	10	
6-21-1993	18: 9:22	V	RR TRA	V	1120	1122	1112	1117	10	10	

6-21-1993	18:10:10		SKYLAST	U	606	0	0	0	10	10
6-21-1993	18:10:21		SKYLAST	B	1004	0	0	0	10	10
6-21-1993	18:10:31		SKYLAST	V	1081	0	0	0	10	10
6-21-1993	18:11:40	F	HD146022	U	657	657	660	661	10	10
6-21-1993	18:12:20	F	HD146022	B	1283	1287	1282	1275	10	10
6-21-1993	18:13: 1	F	HD146022	V	1160	1148	1152	1149	10	10
6-21-1993	18:13:58		SKYLAST	U	601	0	0	0	10	10
6-21-1993	18:14: 8		SKYLAST	B	976	0	0	0	10	10
6-21-1993	18:14:19		SKYLAST	V	1054	0	0	0	10	10
6-21-1993	18:15:36	V	RR TRA	U	608	610	609	609	10	10
6-21-1993	18:16:16	V	RR TRA	B	1032	1031	1028	1030	10	10
6-21-1993	18:16:57	V	RR TRA	V	1076	1067	1076	1077	10	10
6-21-1993	18:17:48		SKYLAST	U	602	0	0	0	10	10
6-21-1993	18:17:58		SKYLAST	B	979	0	0	0	10	10
6-21-1993	18:18: 9		SKYLAST	V	1061	0	0	0	10	10
6-21-1993	18:19:37	V	RR TRA	U	607	604	607	608	10	10
6-21-1993	18:20:17	V	RR TRA	B	1017	1013	1009	1018	10	10
6-21-1993	18:20:58	V	RR TRA	V	1059	1061	1052	1048	10	10
6-21-1993	18:21:40		SKYLAST	U	597	0	0	0	10	10
6-21-1993	18:21:51		SKYLAST	B	975	0	0	0	10	10
6-21-1993	18:22: 1		SKYLAST	V	1026	0	0	0	10	10
6-21-1993	18:22:52	V	RR TRA	U	607	607	608	607	10	10
6-21-1993	18:23:33	V	RR TRA	B	1016	1011	1016	1017	10	10
6-21-1993	18:24:14	V	RR TRA	V	1059	1061	1055	1065	10	10
6-21-1993	18:24:55		SKYLAST	U	598	0	0	0	10	10
6-21-1993	18:25: 5		SKYLAST	B	981	0	0	0	10	10
6-21-1993	18:25:16		SKYLAST	V	1047	0	0	0	10	10
6-21-1993	18:26: 3	V	RR TRA	U	608	606	607	607	10	10
6-21-1993	18:26:44	V	RR TRA	B	1026	1022	1024	1021	10	10
6-21-1993	18:27:24	V	RR TRA	V	1076	1080	1073	1077	10	10
6-21-1993	18:28: 5		SKYLAST	U	603	0	0	0	10	10
6-21-1993	18:28:16		SKYLAST	B	990	0	0	0	10	10
6-21-1993	18:28:26		SKYLAST	V	1055	0	0	0	10	10
6-21-1993	18:31:30	A	HR6070	U	889	888	892	894	10	1
6-21-1993	18:32:10	A	HR6070	B	5020	5012	5013	4981	10	1
6-21-1993	18:32:51	A	HR6070	V	1636	1637	1631	1624	10	1
6-21-1993	18:33:3[illegible]		SKYLAST	U	60	0	0	0	10	1
6-21-1993	18:33:45	M	SKYLAST	B	102	0	0	0	10	1
6-21-1993	18:33:56	M	SKYLAST	V	102	0	0	0	10	1
6-21-1993	18:37:12	V	RR TRA	U	60	60	60	60	10	1
6-21-1993	18:37:52	V	RR TRA	B	103	103	102	103	10	1
6-21-1993	18:38:33	V	RR TRA	V	106	106	107	106	10	1
6-21-1993	18:39:10		SKYLAST	U	59	0	0	0	10	1
6-21-1993	18:39:20		SKYLAST	B	97	0	0	0	10	1
6-21-1993	18:39:31		SKYLAST	V	104	0	0	0	10	1
6-21-1993	18:40:37	V	RR TRA	U	6047	6060	6055	6051	10	100
6-21-1993	18:41:18	V	RR TRA	B	10352	10294	10318	10338	10	100
6-21-1993	18:41:58	V	RR TRA	V	10577	10571	10611	10505	10	100
6-21-1993	18:42:36		SKYLAST	U	5964	0	0	0	10	100
6-21-1993	18:42:46		SKYLAST	B	9675	0	0	0	10	100
6-21-1993	18:42:57		SKYLAST	V	10430	0	0	0	10	100
6-21-1993	18:43:41	V	RR TRA	U	6058	6056	6057	6052	10	100
6-21-1993	18:44:22	V	RR TRA	B	10418	10456	10395	10425	10	100
6-21-1993	18:45: 2	V	RR TRA	V	10765	10810	10786	10846	10	100
6-21-1993	18:45:37		SKYLAST	U	5943	0	0	0	10	100
6-21-1993	18:45:48		SKYLAST	B	9699	0	0	0	10	100
6-21-1993	18:45:58		SKYLAST	V	10646	0	0	0	10	100
6-21-1993	18:46:47	V	RR TRA	U	6061	6060	6072	6060	10	100
6-21-1993	18:47:27	V	RR TRA	B	10454	10431	10438	10535	10	100
6-21-1993	18:48: 8	V	RR TRA	V	10885	10919	10946	10962	10	100
6-21-1993	18:48:47		SKYLAST	U	5938	0	0	0	10	100
6-21-1993	18:48:57		SKYLAST	B	9697	0	0	0	10	100
6-21-1993	18:49: 8		SKYLAST	V	10631	0	0	0	10	100
6-21-1993	18:50: 3	F	HD146022	U	6525	6520	6508	6521	10	100
6-21-1993	18:50:44	F	HD146022	B	12655	12613	12582	12579	10	100

6-21-1993	18:51:24	F	HD146022	V	11622	11609	11679	11593	10	100
6-21-1993	18:52:20		SKYLAST	U	5922	5922	5932	5941	10	100
6-21-1993	18:53: 0		SKYLAST	B	9737	9673	9741	9763	10	100
6-21-1993	18:53:41		SKYLAST	V	10677	10713	10693	10637	10	100
6-21-1993	18:56:10	V	RR TRA	U	6092	6078	6085	6081	10	100
6-21-1993	18:56:50	V	RR TRA	B	10668	10718	10733	10783	10	100
6-21-1993	18:57:31	V	RR TRA	V	11264	11251	11230	11318	10	100
6-21-1993	18:58:14		SKYLAST	U	5942	0	0	0	10	100
6-21-1993	18:58:24		SKYLAST	B	9822	0	0	0	10	100
6-21-1993	18:58:35		SKYLAST	V	10877	0	0	0	10	100
6-21-1993	18:59:22	V	RR TRA	U	6111	6084	6101	6077	10	100
6-21-1993	19: 0: 2	V	RR TRA	B	10802	10798	10828	10797	10	100
6-21-1993	19: 0:43	V	RR TRA	V	11381	11338	11312	11285	10	100
6-21-1993	19: 1:18		SKYLAST	U	5925	0	0	0	10	100
6-21-1993	19: 1:29		SKYLAST	B	9792	0	0	0	10	100
6-21-1993	19: 1:39		SKYLAST	V	10952	0	0	0	10	100
6-21-1993	19: 2:27	V	RR TRA	U	6100	6106	6102	6121	10	100
6-21-1993	19: 3: 8	V	RR TRA	B	10844	10762	10694	10757	10	100
6-21-1993	19: 3:48	V	RR TRA	V	11099	11162	11255	11308	10	100
6-21-1993	19: 4:29		SKYLAST	U	5951	0	0	0	10	100
6-21-1993	19: 4:39		SKYLAST	B	9669	0	0	0	10	100
6-21-1993	19: 4:50		SKYLAST	V	10697	0	0	0	10	100
6-21-1993	19: 5:47	V	RR TRA	U	6107	6120	6103	6097	10	100
6-21-1993	19: 6:27	V	RR TRA	B	10842	10846	10899	10914	10	100
6-21-1993	19: 7: 8	V	RR TRA	V	11150	11052	11138	11156	10	100
6-21-1993	19: 7:53		SKYLAST	U	5943	0	0	0	10	100
6-21-1993	19: 8: 3		SKYLAST	B	9676	0	0	0	10	100
6-21-1993	19: 8:14		SKYLAST	V	10812	0	0	0	10	100
6-21-1993	19: 9:11	F	HD146022	U	6508	6507	6525	6540	10	100
6-21-1993	19: 9:52	F	HD146022	B	12664	12627	12664	12675	10	100
6-21-1993	19:10:32	F	HD146022	V	11793	11809	12000	11943	10	100
6-21-1993	19:11:15		SKYLAST	U	5960	0	0	0	10	100
6-21-1993	19:11:25		SKYLAST	B	9992	0	0	0	10	100
6-21-1993	19:11:36		SKYLAST	V	11163	0	0	0	10	100
6-21-1993	19:13: 9	V	RR TRA	U	6120	6133	6143	6152	10	100
6-21-1993	19:13:50	V	RR TRA	B	11150	11129	11096	11142	10	100
6-21-1993	19:14:31	V	RR TRA	V	11790	11800	11918	11942	10	100
6-21-1993	19:15: 9		SKYLAST	U	5968	0	0	0	10	100
6-21-1993	19:15:20		SKYLAST	B	10027	0	0	0	10	100
6-21-1993	19:15:30		SKYLAST	V	11625	0	0	0	10	100
6-21-1993	19:16: 9	V	RR TRA	U	6145	6160	6140	6164	10	100
6-21-1993	19:16:49	V	RR TRA	B	11169	11189	11188	11221	10	100
6-21-1993	19:17:30	V	RR TRA	V	11836	11951	11924	11921	10	100
6-21-1993	19:18: 6		SKYLAST	U	5954	0	0	0	10	100
6-21-1993	19:18:16		SKYLAST	B	9981	0	0	0	10	100
6-21-1993	19:18:27		SKYLAST	V	11444	0	0	0	10	100
6-21-1993	19:19:21	V	RR TRA	U	6158	6133	6146	6144	10	100
6-21-1993	19:20: 1	V	RR TRA	B	11288	11274	11257	11296	10	100
6-21-1993	19:20:42	V	RR TRA	V	11925	11796	11853	11843	10	100
6-21-1993	19:21:29		SKYLAST	U	5932	0	0	0	10	100
6-21-1993	19:21:40		SKYLAST	B	9877	0	0	0	10	100
6-21-1993	19:21:50		SKYLAST	V	11453	0	0	0	10	100
6-21-1993	19:23: 8	V	RR TRA	U	6182	6165	6158	6138	10	100
6-21-1993	19:23:48	V	RR TRA	B	11454	11360	11394	11037	10	100
6-21-1993	19:24:29	V	RR TRA	V	11948	11826	11786	11686	10	100
6-21-1993	19:25: 8		SKYLAST	U	5875	0	0	0	10	100
6-21-1993	19:25:18		SKYLAST	B	9564	0	0	0	10	100
6-21-1993	19:25:29		SKYLAST	V	11201	0	0	0	10	100
6-21-1993	19:26:39	F	HD146022	U	6435	6446	6472	6452	10	100
6-21-1993	19:27:20	F	HD146022	B	12295	12333	12427	12299	10	100
6-21-1993	19:28: 0	F	HD146022	V	12130	12108	11993	12179	10	100
6-21-1993	19:28:48		SKYLAST	U	5860	0	0	0	10	100
6-21-1993	19:28:58		SKYLAST	B	9608	0	0	0	10	100
6-21-1993	19:29: 9		SKYLAST	V	11432	0	0	0	10	100
6-21-1993	19:30:38	V	RR TRA	U	6085	6081	6095	6109	10	100

6-21-1993	19:31:18	V	RR TRA	B	11131	11147	11146	11183	10	100
6-21-1993	19:31:59	V	RR TRA	V	11838	11901	12082	12015	10	100
6-21-1993	19:32:35		SKYLAST	U	5870	0	0	0	10	100
6-21-1993	19:32:45		SKYLAST	B	9658	0	0	0	10	100
6-21-1993	19:32:56		SKYLAST	V	11405	0	0	0	10	100
6-21-1993	19:33:39	V	RR TRA	U	6139	6100	6108	6138	10	100
6-21-1993	19:34:19	V	RR TRA	B	11163	11211	11234	11244	10	100
6-21-1993	19:34:60	V	RR TRA	V	11993	12024	11933	12033	10	100
6-21-1993	19:35:47		SKYLAST	U	5872	0	0	0	10	100
6-21-1993	19:35:57		SKYLAST	B	9671	0	0	0	10	100
6-21-1993	19:36: 8		SKYLAST	V	11422	0	0	0	10	100
6-21-1993	19:37:17	V	RR TRA	U	6130	6127	6151	6132	10	100
6-21-1993	19:37:57	V	RR TRA	B	11270	11319	11353	11327	10	100
6-21-1993	19:38:38	V	RR TRA	V	12120	12241	12221	12242	10	100
6-21-1993	19:39:30		SKYLAST	U	5899	0	0	0	10	100
6-21-1993	19:39:40		SKYLAST	B	9696	0	0	0	10	100
6-21-1993	19:39:51		SKYLAST	V	11536	0	0	0	10	100
6-21-1993	19:40:45	V	RR TRA	U	6140	6156	6130	6140	10	100
6-21-1993	19:41:26	V	RR TRA	B	11500	11440	11438	11421	10	100
6-21-1993	19:42: 6	V	RR TRA	V	12298	12386	12473	12523	10	100
6-21-1993	19:42:58		SKYLAST	U	5903	0	0	0	10	100
6-21-1993	19:43: 9		SKYLAST	B	9677	0	0	0	10	100
6-21-1993	19:43:19		SKYLAST	V	11736	0	0	0	10	100
6-21-1993	19:47:60	A	HR6070	U	867	867	867	861	10	1
6-21-1993	19:48:40	A	HR6070	B	4758	4789	4802	4840	10	1
6-21-1993	19:49:21	A	HR6070	V	1619	1616	1623	1618	10	1
6-21-1993	19:50: 2		SKYLAST	U	53	0	0	0	10	1
6-21-1993	19:50:13	M	SKYLAST	B	53	0	0	0	10	1
6-21-1993	19:50:23	M	SKYLAST	V	53	0	0	0	10	1
6-21-1993	19:56:17	V	RR TRA	U	6190	6154	6173	6175	10	100
6-21-1993	19:56:57	V	RR TRA	B	11632	11642	11624	11664	10	100
6-21-1993	19:57:38	V	RR TRA	V	12556	12517	12455	12582	10	100
6-21-1993	19:58:17		SKYLAST	U	5917	0	0	0	10	100
6-21-1993	19:58:27		SKYLAST	B	9768	0	0	0	10	100
6-21-1993	19:58:38		SKYLAST	V	11741	0	0	0	10	100
6-21-1993	19:59:33	V	RR TRA	U	6183	6190	6174	6182	10	100
6-21-1993	20: 0:14	V	RR TRA	B	11669	11650	11617	11649	10	100
6-21-1993	20: 0:55	V	RR TRA	V	12261	12149	12175	12228	10	100
6-21-1993	20: 1:29		SKYLAST	U	5897	0	0	0	10	100
6-21-1993	20: 1:39		SKYLAST	B	9582	0	0	0	10	100
6-21-1993	20: 1:50		SKYLAST	V	11384	0	0	0	10	100
6-21-1993	20: 3:51	V	RR TRA	U	6178	6170	6170	6180	10	100
6-21-1993	20: 4:31	V	RR TRA	B	11625	11613	11561	11515	10	100
6-21-1993	20: 5:12	V	RR TRA	V	12048	12045	11948	12174	10	100
6-21-1993	20: 6: 6		SKYLAST	U	5914	0	0	0	10	100
6-21-1993	20: 6:16		SKYLAST	B	9586	0	0	0	10	100
6-21-1993	20: 6:27		SKYLAST	V	11299	0	0	0	10	100
6-21-1993	20: 7:21	V	RR TRA	U	6194	6179	6170	6181	10	100
6-21-1993	20: 8: 2	V	RR TRA	B	11638	11609	11546	11642	10	100
6-21-1993	20: 8:42	V	RR TRA	V	12006	12070	12036	12098	10	100
6-21-1993	20: 9:35		SKYLAST	U	5887	0	0	0	10	100
6-21-1993	20: 9:46		SKYLAST	B	9569	0	0	0	10	100
6-21-1993	20: 9:56		SKYLAST	V	11059	0	0	0	10	100
6-21-1993	20:10:57	F	HD146022	U	6188	6202	6197	6198	10	100
6-21-1993	20:11:38	F	HD146022	B	11618	11533	11542	11568	10	100
6-21-1993	20:12:18	F	HD146022	V	11874	11892	11805	11808	10	100
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6-21-1993	20:13:10		SKYLAST	B	9464	0	0	0	10	100
6-21-1993	20:13:21		SKYLAST	V	10912	0	0	0	10	100
6-21-1993	20:14:35	V	RR TRA	U	6204	6223	6214	6186	10	100
6-21-1993	20:15:16	V	RR TRA	B	11499	11542	11506	11518	10	100
6-21-1993	20:15:56	V	RR TRA	V	11647	11578	11608	11595	10	100
6-21-1993	20:16:30		SKYLAST	U	5882	0	0	0	10	100
6-21-1993	20:16:41		SKYLAST	B	9447	0	0	0	10	100
6-21-1993	20:16:51		SKYLAST	V	10740	0	0	0	10	100

6-21-1993	20:17:28	V	RR TRA	U	6184	6201	6220	6212	10	100
6-21-1993	20:18: 8	V	RR TRA	B	11523	11515	11527	11563	10	100
6-21-1993	20:18:49	V	RR TRA	V	11488	11436	11527	11413	10	100
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6-21-1993	20:19:34		SKYLAST	B	9356	0	0	0	10	100
6-21-1993	20:19:45		SKYLAST	V	10708	0	0	0	10	100
6-21-1993	20:20:32	V	RR TRA	U	6203	6196	6175	6198	10	100
6-21-1993	20:21:13	V	RR TRA	B	11518	11553	11515	11452	10	100
6-21-1993	20:21:53	V	RR TRA	V	11416	11405	11492	11540	10	100
6-21-1993	20:22:31		SKYLAST	U	5865	0	0	0	10	100
6-21-1993	20:22:41		SKYLAST	B	9354	0	0	0	10	100
6-21-1993	20:22:52		SKYLAST	V	10644	0	0	0	10	100
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6-21-1993	20:24:11	V	RR TRA	B	11515	11483	11541	11550	10	100
6-21-1993	20:24:51	V	RR TRA	V	11442	11367	11333	11341	10	100
6-21-1993	20:25:28		SKYLAST	U	5855	0	0	0	10	100
6-21-1993	20:25:39		SKYLAST	B	9292	0	0	0	10	100
6-21-1993	20:25:49		SKYLAST	V	10485	0	0	0	10	100
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6-21-1993	20:27:29	F	HD146022	B	12287	12350	12203	12332	10	100
6-21-1993	20:28:10	F	HD146022	V	11355	11379	11425	11486	10	100
6-21-1993	20:28:51		SKYLAST	U	5867	0	0	0	10	100
6-21-1993	20:29: 2		SKYLAST	B	9325	0	0	0	10	100
6-21-1993	20:29:13		SKYLAST	V	10588	0	0	0	10	100
6-21-1993	20:31: 1	V	RR TRA	U	6222	6207	6208	6202	10	100
6-21-1993	20:31:42	V	RR TRA	B	11507	11617	11564	11606	10	100
6-21-1993	20:32:22	V	RR TRA	V	11639	11547	11496	11478	10	100
6-21-1993	20:33: 3		SKYLAST	U	5887	0	0	0	10	100
6-21-1993	20:33:14		SKYLAST	B	9327	0	0	0	10	100
6-21-1993	20:33:24		SKYLAST	V	10655	0	0	0	10	100
6-21-1993	20:34:17	V	RR TRA	U	6212	6207	6224	6205	10	100
6-21-1993	20:34:57	V	RR TRA	B	11538	11584	11611	11623	10	100
6-21-1993	20:35:38	V	RR TRA	V	11549	11499	11524	11538	10	100
6-21-1993	20:36:24		SKYLAST	U	5876	0	0	0	10	100
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6-21-1993	20:38:12	V	RR TRA	B	11572	11660	11603	11643	10	100
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6-21-1993	20:39:57		SKYLAST	B	9394	0	0	0	10	100
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6-21-1993	20:40:60	V	RR TRA	U	6222	6216	6208	6222	10	100
6-21-1993	20:41:40	V	RR TRA	B	11703	11614	11610	11659	10	100
6-21-1993	20:42:21	V	RR TRA	V	11843	11898	11961	11920	10	100
6-21-1993	20:43: 3		SKYLAST	U	5876	0	0	0	10	100
6-21-1993	20:43:14		SKYLAST	B	9475	0	0	0	10	100
6-21-1993	20:43:24		SKYLAST	V	11023	0	0	0	10	100
6-21-1993	20:44:24	F	HD146022	U	6501	6441	6467	6472	10	100
6-21-1993	20:45: 4	F	HD146022	B	12440	12466	12409	12389	10	100
6-21-1993	20:45:45	F	HD146022	V	12106	12119	12103	12043	10	100
6-21-1993	20:46:32		SKYLAST	U	5872	0	0	0	10	100
6-21-1993	20:46:42		SKYLAST	B	9513	0	0	0	10	100
6-21-1993	20:46:53		SKYLAST	V	11116	0	0	0	10	100
6-21-1993	20:48:28	V	RR TRA	U	6231	6226	6219	6222	10	100
6-21-1993	20:49: 8	V	RR TRA	B	11774	11741	11691	11753	10	100
6-21-1993	20:49:49	V	RR TRA	V	11985	12005	12063	12011	10	100
6-21-1993	20:50:27		SKYLAST	U	5865	0	0	0	10	100
6-21-1993	20:50:37		SKYLAST	B	9459	0	0	0	10	100
6-21-1993	20:50:48		SKYLAST	V	11119	0	0	0	10	100
6-21-1993	20:51:54	V	RR TRA	U	6221	6220	6236	6229	10	100
6-21-1993	20:52:35	V	RR TRA	B	11761	11754	11724	11765	10	100
6-21-1993	20:53:16	V	RR TRA	V	11935	11884	11904	11938	10	100
6-21-1993	20:53:57		SKYLAST	U	5901	0	0	0	10	100
6-21-1993	20:54: 8		SKYLAST	B	9536	0	0	0	10	100

6-21-1993	20:54:18		SKYLAST	V	11019	0	0	0	10	100
6-21-1993	20:55: 8	V	RR TRA	U	6229	6239	6233	6235	10	100
6-21-1993	20:55:48	V	RR TRA	B	11768	11724	11718	11836	10	100
6-21-1993	20:56:29	V	RR TRA	V	11894	11832	11864	11808	10	100
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6-21-1993	20:57:18		SKYLAST	B	9603	0	0	0	10	100
6-21-1993	20:57:28		SKYLAST	V	11031	0	0	0	10	100
6-21-1993	20:58:11	V	RR TRA	U	6238	6246	6232	6238	10	100
6-21-1993	20:58:52	V	RR TRA	B	11803	11704	11756	11730	10	100
6-21-1993	20:59:32	V	RR TRA	V	11819	11908	11977	11958	10	100
6-21-1993	21: 0:15		SKYLAST	U	5905	0	0	0	10	100
6-21-1993	21: 0:26		SKYLAST	B	9585	0	0	0	10	100
6-21-1993	21: 0:36		SKYLAST	V	11044	0	0	0	10	100
6-21-1993	21: 4:40	A	HR6070	U	925	929	934	935	10	1
6-21-1993	21: 5:20	A	HR6070	B	5193	5186	5194	5181	10	1
6-21-1993	21: 6: 1	A	HR6070	V	1680	1690	1683	1677	10	1
6-21-1993	21: 6:44		SKYLAST	U	61	0	0	0	10	1
6-21-1993	21: 6:54	M	SKYLAST	B	105	0	0	0	10	1
6-21-1993	21: 7: 5	M	SKYLAST	V	101	0	0	0	10	1
6-21-1993	21:11:43	F	HD146022	U	6480	6507	6505	6509	10	100
6-21-1993	21:12:24	F	HD146022	B	13176	13154	13346	13275	10	100
6-21-1993	21:13: 4	F	HD146022	V	11846	11855	11912	11868	10	100
6-21-1993	21:13:47		SKYLAST	U	5927	0	0	0	10	100
6-21-1993	21:13:58		SKYLAST	B	9973	0	0	0	10	100
6-21-1993	21:14: 8		SKYLAST	V	10794	0	0	0	10	100
6-21-1993	21:16:37	F	HD146485	U	6351	6403	6394	6384	10	100
6-21-1993	21:17:17	F	HD146485	B	12911	12910	12880	12855	10	100
6-21-1993	21:17:58	F	HD146485	V	12199	12219	12180	12297	10	100
6-21-1993	21:18:40		SKYLAST	U	5914	0	0	0	10	100
6-21-1993	21:18:50		SKYLAST	B	9607	0	0	0	10	100
6-21-1993	21:19: 0		SKYLAST	V	10737	0	0	0	10	100

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6-22-1993	19:24:31	A	HR6070	V	1634	1636	1646	1628	10	1	
6-22-1993	19:25:28		SKYLAST	U	61	0	0	0	10	1	
6-22-1993	19:25:38		SKYLAST	B	98	0	0	0	10	1	
6-22-1993	19:25:49		SKYLAST	V	97	0	0	0	10	1	
6-22-1993	19:30:47	F	HD146022	U	6507	6530	6514	6542	10	100	
6-22-1993	19:34:11	F	HD146022	B	12227	12288	12377	12272	10	100	
6-22-1993	19:34:51	F	HD146022	V	10791	10801	10830	10723	10	100	
6-22-1993	19:36:16		SKYLAST	U	5893	0	0	0	10	100	
6-22-1993	19:36:27		SKYLAST	B	9359	0	0	0	10	100	
6-22-1993	19:36:37		SKYLAST	V	9849	0	0	0	10	100	
6-22-1993	19:39:34	F	HD146485	U	6373	6344	6375	6366	10	100	
6-22-1993	19:40:14	F	HD146485	B	12696	12613	12670	12587	10	100	
6-22-1993	19:40:55	F	HD146485	V	11288	11229	11199	11282	10	100	
6-22-1993	19:42: 6		SKYLAST	U	5901	0	0	0	10	100	
6-22-1993	19:42:17		SKYLAST	B	9350	0	0	0	10	100	
6-22-1993	19:42:27		SKYLAST	V	9948	0	0	0	10	100	
6-22-1993	19:44:59	V	RR TRA	U	6205	6246	6217	6191	10	100	
6-22-1993	19:45:40	V	RR TRA	B	11376	11378	11439	11423	10	100	
6-22-1993	19:46:20	V	RR TRA	V	10693	10648	10608	10760	10	100	
6-22-1993	19:47:23		SKYLAST	U	5929	0	0	0	10	100	
6-22-1993	19:47:34		SKYLAST	B	9437	0	0	0	10	100	
6-22-1993	19:47:44		SKYLAST	V	10127	0	0	0	10	100	
6-22-1993	19:48:56	V	RR TRA	U	6217	6199	6204	6197	10	100	
6-22-1993	19:49:37	V	RR TRA	B	11266	11373	11383	11329	10	100	
6-22-1993	19:50:18	V	RR TRA	V	10810	10711	10674	10800	10	100	
6-22-1993	19:51:16		SKYLAST	U	5894	0	0	0	10	100	
6-22-1993	19:51:26		SKYLAST	B	9395	0	0	0	10	100	
6-22-1993	19:51:37		SKYLAST	V	10037	0	0	0	10	100	

6-22-1993	19:52:43	V	RR TRA	U	6208	6193	6191	6181	10	100
6-22-1993	19:53:24	V	RR TRA	B	11369	11382	11311	11372	10	100
6-22-1993	19:54: 4	V	RR TRA	V	10765	10818	10772	10847	10	100
6-22-1993	19:55: 2		SKYLAST	U	5920	0	0	0	10	100
6-22-1993	19:55:12		SKYLAST	B	9351	0	0	0	10	100
6-22-1993	19:55:23		SKYLAST	V	9951	0	0	0	10	100
6-22-1993	19:56:26	V	RR TRA	U	6194	6241	6197	6199	10	100
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6-22-1993	19:58:48		SKYLAST	U	5913	0	0	0	10	100
6-22-1993	19:58:58		SKYLAST	B	9374	0	0	0	10	100
6-22-1993	19:59: 9		SKYLAST	V	10033	0	0	0	10	100
6-22-1993	20: 0:26	F	HD146022	U	6510	6504	6528	6522	10	100
6-22-1993	20: 1: 7	F	HD146022	B	12378	12405	12391	12349	10	100
6-22-1993	20: 1:47	F	HD146022	V	10915	10946	10987	10939	10	100
6-22-1993	20: 2:38		SKYLAST	U	5913	0	0	0	10	100
6-22-1993	20: 2:48		SKYLAST	B	9517	0	0	0	10	100
6-22-1993	20: 2:59		SKYLAST	V	10078	0	0	0	10	100
6-22-1993	20: 4:57	V	RR TRA	U	6222	6204	6187	6172	10	100
6-22-1993	20: 5:38	V	RR TRA	B	11289	11353	11313	11297	10	100
6-22-1993	20: 6:18	V	RR TRA	V	10731	10778	10752	10727	10	100
6-22-1993	20: 8:23		SKYLAST	U	5901	0	0	0	10	100
6-22-1993	20: 8:34		SKYLAST	B	9287	0	0	0	10	100
6-22-1993	20: 8:44		SKYLAST	V	10001	0	0	0	10	100
6-22-1993	20:10:20	V	RR TRA	U	6196	6187	6188	6199	10	100
6-22-1993	20:11: 1	V	RR TRA	B	11336	11268	11358	11304	10	100
6-22-1993	20:11:41	V	RR TRA	V	10655	10751	10741	10781	10	100
6-22-1993	20:12:43		SKYLAST	U	5891	0	0	0	10	100
6-22-1993	20:12:54		SKYLAST	B	9378	0	0	0	10	100
6-22-1993	20:13: 4		SKYLAST	V	9995	0	0	0	10	100
6-22-1993	20:14:17	V	RR TRA	U	6216	6203	6177	6191	10	100
6-22-1993	20:14:58	V	RR TRA	B	11259	11167	11205	11201	10	100
6-22-1993	20:15:38	V	RR TRA	V	10571	10723	10720	10570	10	100
6-22-1993	20:16:30		SKYLAST	U	5885	0	0	0	10	100
6-22-1993	20:16:41		SKYLAST	B	9320	0	0	0	10	100
6-22-1993	20:16:51		SKYLAST	V	10006	0	0	0	10	100
6-22-1993	20:18:15	V	RR TRA	U	6202	6197	6201	6181	10	100
6-22-1993	20:18:55	V	RR TRA	B	11264	11183	11266	11275	10	100
6-22-1993	20:19:36	V	RR TRA	V	10672	10634	10649	10684	10	100
6-22-1993	20:20:41		SKYLAST	U	5909	0	0	0	10	100
6-22-1993	20:20:51		SKYLAST	B	9344	0	0	0	10	100
6-22-1993	20:21: 1		SKYLAST	V	9998	0	0	0	10	100
6-22-1993	20:22:15	F	HD146022	U	6529	6537	6532	6514	10	100
6-22-1993	20:22:56	F	HD146022	B	12318	12355	12335	12410	10	100
6-22-1993	20:23:36	F	HD146022	V	10959	11009	10917	11000	10	100
6-22-1993	20:24:44		SKYLAST	U	5891	0	0	0	10	100
6-22-1993	20:24:54		SKYLAST	B	9326	0	0	0	10	100
6-22-1993	20:25: 5		SKYLAST	V	10014	0	0	0	10	100
6-22-1993	20:26:26	V	RR TRA	U	6217	6190	6189	6182	10	100
6-22-1993	20:27: 6	V	RR TRA	B	11275	11325	11351	11388	10	100
6-22-1993	20:27:47	V	RR TRA	V	10830	10780	10781	10811	10	100
6-22-1993	20:28:50		SKYLAST	U	5899	0	0	0	10	100
6-22-1993	20:29: 1		SKYLAST	B	9353	0	0	0	10	100
6-22-1993	20:29:11		SKYLAST	V	9990	0	0	0	10	100
6-22-1993	20:30:18	V	RR TRA	U	6217	6176	6172	6188	10	100
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6-22-1993	20:32:45		SKYLAST	U	5884	0	0	0	10	100
6-22-1993	20:32:55		SKYLAST	B	9242	0	0	0	10	100
6-22-1993	20:33: 6		SKYLAST	V	9895	0	0	0	10	100
6-22-1993	20:34:46	V	RR TRA	U	6213	6212	6203	6215	10	100
6-22-1993	20:35:26	V	RR TRA	B	11305	11355	11219	11281	10	100
6-22-1993	20:36: 7	V	RR TRA	V	10642	10614	10705	10716	10	100
6-22-1993	20:37:52		SKYLAST	U	5917	0	0	0	10	100
6-22-1993	20:38: 2		SKYLAST	B	9344	0	0	0	10	100

6-22-1993	20:38:13		SKYLAST	V	9988	0	0	0	10	100
6-22-1993	20:39:41	V	RR TRA	U	6203	6193	6137	6176	10	100
6-22-1993	20:40:21	V	RR TRA	B	11347	11321	11297	11332	10	100
6-22-1993	20:41: 2	V	RR TRA	V	10661	10687	10673	10633	10	100
6-22-1993	20:42: 3		SKYLAST	U	5898	0	0	0	10	100
6-22-1993	20:42:13		SKYLAST	B	9272	0	0	0	10	100
6-22-1993	20:42:24		SKYLAST	V	9878	0	0	0	10	100
6-22-1993	20:43:32	F	HD146022	U	6509	6515	6471	6515	10	100
6-22-1993	20:44:12	F	HD146022	B	12295	12192	12253	12302	10	100
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6-22-1993	20:46:13		SKYLAST	U	5908	0	0	0	10	100
6-22-1993	20:46:23		SKYLAST	B	9295	0	0	0	10	100
6-22-1993	20:46:34		SKYLAST	V	9879	0	0	0	10	100
6-22-1993	20:47:45	V	RR TRA	U	6227	6223	6214	6228	10	100
6-22-1993	20:48:26	V	RR TRA	B	11306	11391	11265	11390	10	100
6-22-1993	20:49: 6	V	RR TRA	V	10605	10613	10573	10632	10	100
6-22-1993	20:49:59		SKYLAST	U	5900	0	0	0	10	100
6-22-1993	20:50:10		SKYLAST	B	9278	0	0	0	10	100
6-22-1993	20:50:20		SKYLAST	V	9788	0	0	0	10	100
6-22-1993	20:51:24	V	RR TRA	U	6240	6214	6240	6214	10	100
6-22-1993	20:52: 5	V	RR TRA	B	11306	11363	11353	11382	10	100
6-22-1993	20:52:45	V	RR TRA	V	10601	10553	10636	10527	10	100
6-22-1993	20:53:35		SKYLAST	U	5937	0	0	0	10	100
6-22-1993	20:53:46		SKYLAST	B	9285	0	0	0	10	100
6-22-1993	20:53:56		SKYLAST	V	9845	0	0	0	10	100
6-22-1993	20:55:16	V	RR TRA	U	6230	6207	6236	6241	10	100
6-22-1993	20:55:57	V	RR TRA	B	11396	11402	11434	11406	10	100
6-22-1993	20:56:37	V	RR TRA	V	10584	10639	10549	10592	10	100
6-22-1993	20:57:26		SKYLAST	U	5909	0	0	0	10	100
6-22-1993	20:57:37		SKYLAST	B	9344	0	0	0	10	100
6-22-1993	20:57:47		SKYLAST	V	9872	0	0	0	10	100
6-22-1993	20:58:48	V	RR TRA	U	6238	6231	6236	6217	10	100
6-22-1993	20:59:29	V	RR TRA	B	11352	11355	11311	11415	10	100
6-22-1993	21: 0: 9	V	RR TRA	V	10540	10676	10637	10566	10	100
6-22-1993	21: 1: 2		SKYLAST	U	5908	0	0	0	10	100
6-22-1993	21: 1:12		SKYLAST	B	9260	0	0	0	10	100
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6-22-1993	21: 5:20	A	HR6070	U	933	937	932	933	10	1
6-22-1993	21: 6: 1	A	HR6070	B	5128	5117	5106	5112	10	1
6-22-1993	21: 6:42	A	HR6070	V	1626	1629	1632	1623	10	1
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6-22-1993	21: 8:31	M	SKYLAST	V	96	0	0	0	10	1
6-22-1993	21:13:40	V	RR TRA	U	6254	6244	6247	6233	10	100
6-22-1993	21:14:21	V	RR TRA	B	11420	11358	11331	11420	10	100
6-22-1993	21:15: 1	V	RR TRA	V	10653	10720	10681	10708	10	100
6-22-1993	21:15:52		SKYLAST	U	5939	0	0	0	10	100
6-22-1993	21:16: 2		SKYLAST	B	9280	0	0	0	10	100
6-22-1993	21:16:13		SKYLAST	V	9989	0	0	0	10	100
6-22-1993	21:17:17	V	RR TRA	U	6260	6239	6251	6253	10	100
6-22-1993	21:17:57	V	RR TRA	B	11482	11461	11533	11535	10	100
6-22-1993	21:18:38	V	RR TRA	V	10901	10873	10813	10806	10	100
6-22-1993	21:19:33		SKYLAST	U	5913	0	0	0	10	100
6-22-1993	21:19:43		SKYLAST	B	9313	0	0	0	10	100
6-22-1993	21:19:54		SKYLAST	V	10058	0	0	0	10	100
6-22-1993	21:20:55	V	RR TRA	U	6268	6212	6244	6279	10	100
6-22-1993	21:21:35	V	RR TRA	B	11472	11560	11553	11562	10	100
6-22-1993	21:22:16	V	RR TRA	V	10876	10795	10740	10790	10	100
6-22-1993	21:23: 4		SKYLAST	U	5926	0	0	0	10	100
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6-22-1993	21:23:25		SKYLAST	V	10059	0	0	0	10	100
6-22-1993	21:24:32	V	RR TRA	U	6249	6267	6274	6254	10	100
6-22-1993	21:25:13	V	RR TRA	B	11493	11482	11462	11558	10	100
6-22-1993	21:25:53	V	RR TRA	V	10934	10962	10983	10889	10	100
6-22-1993	21:26:52		SKYLAST	U	5924	0	0	0	10	100

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6-22-1993	21:27:13		SKYLAST	V	10195	0	0	0	10	100
6-22-1993	21:28:17	F	HD146022	U	6520	6540	6518	6518	10	100
6-22-1993	21:28:57	F	HD146022	B	12316	12362	12335	12329	10	100
6-22-1993	21:29:38	F	HD146022	V	11118	11068	11133	11137	10	100
6-22-1993	21:31: 0		SKYLAST	U	5945	0	0	0	10	100
6-22-1993	21:31:11		SKYLAST	B	9483	0	0	0	10	100
6-22-1993	21:31:21		SKYLAST	V	10235	0	0	0	10	100
6-22-1993	21:33: 0	V	RR TRA	U	6268	6284	6293	6271	10	100
6-22-1993	21:33:41	V	RR TRA	B	11485	11526	11573	11504	10	100
6-22-1993	21:34:21	V	RR TRA	V	10895	10909	11019	10943	10	100
6-22-1993	21:39: 7		SKYLAST	U	5929	0	0	0	10	100
6-22-1993	21:39:17		SKYLAST	B	9390	0	0	0	10	100
6-22-1993	21:39:28		SKYLAST	V	10126	0	0	0	10	100
6-22-1993	21:40:33	V	RR TRA	U	6262	6289	6279	6256	10	100
6-22-1993	21:41:13	V	RR TRA	B	11605	11693	11587	11535	10	100
6-22-1993	21:41:54	V	RR TRA	V	10862	10932	10892	10930	10	100
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6-22-1993	21:43:16		SKYLAST	B	9332	0	0	0	10	100
6-22-1993	21:43:27		SKYLAST	V	10079	0	0	0	10	100
6-22-1993	21:44:41	V	RR TRA	U	6272	6252	6287	6278	10	100
6-22-1993	21:45:22	V	RR TRA	B	11508	11573	11621	11666	10	100
6-22-1993	21:46: 2	V	RR TRA	V	11057	11005	11066	10972	10	100
6-22-1993	21:47:15		SKYLAST	U	5937	0	0	0	10	100
6-22-1993	21:47:25		SKYLAST	B	9450	0	0	0	10	100
6-22-1993	21:47:35		SKYLAST	V	10159	0	0	0	10	100
6-22-1993	21:48:47	V	RR TRA	U	6302	6280	6282	6311	10	100
6-22-1993	21:49:28	V	RR TRA	B	11647	11631	11568	11632	10	100
6-22-1993	21:50: 8	V	RR TRA	V	10980	11087	11093	11040	10	100
6-22-1993	21:51: 4		SKYLAST	U	5962	0	0	0	10	100
6-22-1993	21:51:14		SKYLAST	B	9506	0	0	0	10	100
6-22-1993	21:51:24		SKYLAST	V	10224	0	0	0	10	100
6-22-1993	21:52:42	F	HD146022	U	6533	6545	6560	6557	10	100
6-22-1993	21:53:23	F	HD146022	B	12513	12496	12458	12494	10	100
6-22-1993	21:54: 3	F	HD146022	V	11173	11155	11131	11144	10	100
6-22-1993	21:54:55		SKYLAST	U	5951	0	0	0	10	100
6-22-1993	21:55: 6		SKYLAST	B	9448	0	0	0	10	100
6-22-1993	21:55:16		SKYLAST	V	10186	0	0	0	10	100
6-22-1993	21:56:33	V	RR TRA	U	6263	8285	6309	6292	10	100
6-22-1993	21:57:13	V	RR TRA	B	11610	11640	11641	11700	10	100
6-22-1993	21:57:54	V	RR TRA	V	11005	11026	10954	10968	10	100
6-22-1993	21:58:59		SKYLAST	U	5960	0	0	0	10	100
6-22-1993	21:59:10		SKYLAST	B	9459	0	0	0	10	100
6-22-1993	21:59:20		SKYLAST	V	10201	0	0	0	10	100
6-22-1993	22: 0:18	V	RR TRA	U	6290	6318	6287	6307	10	100
6-22-1993	22: 0:58	V	RR TRA	B	11662	11682	11676	11646	10	100
6-22-1993	22: 1:39	V	RR TRA	V	10984	10951	10987	11026	10	100
6-22-1993	22: 2:29		SKYLAST	U	5947	0	0	0	10	100
6-22-1993	22: 2:39		SKYLAST	B	9481	0	0	0	10	100
6-22-1993	22: 2:50		SKYLAST	V	10171	0	0	0	10	100
6-22-1993	22: 4: 6	V	RR TRA	U	6296	6298	6277	6286	10	100
6-22-1993	22: 4:47	V	RR TRA	B	11678	11681	11741	11655	10	100
6-22-1993	22: 5:27	V	RR TRA	V	11044	10990	11133	11112	10	100
6-22-1993	22: 6:23		SKYLAST	U	5982	0	0	0	10	100
6-22-1993	22: 6:33		SKYLAST	B	9479	0	0	0	10	100
6-22-1993	22: 6:43		SKYLAST	V	10215	0	0	0	10	100
6-22-1993	22: 7:45	V	RR TRA	U	6305	6307	6301	6347	10	100
6-22-1993	22: 8:25	V	RR TRA	B	11684	11677	11638	11679	10	100
6-22-1993	22: 9: 6	V	RR TRA	V	10942	11007	11028	11023	10	100
6-22-1993	22:10: 4		SKYLAST	U	5951	0	0	0	10	100
6-22-1993	22:10:15		SKYLAST	B	9463	0	0	0	10	100
6-22-1993	22:10:25		SKYLAST	V	10127	0	0	0	10	100
6-22-1993	22:11:36	F	HD146022	U	6559	6613	6595	6563	10	100
6-22-1993	22:12:16	F	HD146022	B	12436	12475	12542	12493	10	100
6-22-1993	22:12:57	F	HD146022	V	11124	11166	11188	11185	10	100

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6-22-1993	22:14: 6		SKYLAST	B	9592	0	0	0	10	100
6-22-1993	22:14:17		SKYLAST	V	10323	0	0	0	10	100
6-22-1993	22:15:51	V	RR TRA	U	6304	6341	6321	6287	10	100
6-22-1993	22:16:32	V	RR TRA	B	11796	11790	11798	11790	10	100
6-22-1993	22:17:12	V	RR TRA	V	11094	11163	11101	11128	10	100
6-22-1993	22:18:20		SKYLAST	U	5991	0	0	0	10	100
6-22-1993	22:18:30		SKYLAST	B	9517	0	0	0	10	100
6-22-1993	22:18:41		SKYLAST	V	10243	0	0	0	10	100
6-22-1993	22:20: 5	V	RR TRA	U	6307	6316	6311	6329	10	100
6-22-1993	22:20:45	V	RR TRA	B	11737	11703	11763	11680	10	100
6-22-1993	22:21:26	V	RR TRA	V	11152	11086	11078	11166	10	100
6-22-1993	22:22:24		SKYLAST	U	5975	0	0	0	10	100
6-22-1993	22:22:35		SKYLAST	B	9518	0	0	0	10	100
6-22-1993	22:22:45		SKYLAST	V	10269	0	0	0	10	100
6-22-1993	22:23:55	V	RR TRA	U	6346	6300	6314	6300	10	100
6-22-1993	22:24:35	V	RR TRA	B	11802	11771	11758	11892	10	100
6-22-1993	22:25:16	V	RR TRA	V	11106	11061	11019	11135	10	100
6-22-1993	22:26:17		SKYLAST	U	5961	0	0	0	10	100
6-22-1993	22:26:28		SKYLAST	B	9593	0	0	0	10	100
6-22-1993	22:26:38		SKYLAST	V	10273	0	0	0	10	100
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6-22-1993	22:28:21	V	RR TRA	B	11833	11830	11727	11825	10	100
6-22-1993	22:29: 2	V	RR TRA	V	11145	11046	11080	11106	10	100
6-22-1993	22:29:58		SKYLAST	U	5996	0	0	0	10	100
6-22-1993	22:30: 8		SKYLAST	B	9539	0	0	0	10	100
6-22-1993	22:30:19		SKYLAST	V	10212	0	0	0	10	100
6-22-1993	22:33:53	A	HR6070	U	879	876	879	877	10	1
6-22-1993	22:34:33	A	HR6070	B	5006	4986	5003	5027	10	1
6-22-1993	22:35:14	A	HR6070	V	1651	1654	1650	1647	10	1
6-22-1993	22:36: 7		SKYLAST	U	62	0	0	0	10	1
6-22-1993	22:36:17	M	SKYLAST	B	98	0	0	0	10	1
6-22-1993	22:36:28	M	SKYLAST	V	97	0	0	0	10	1
6-22-1993	22:40:25	V	RR TRA	U	63	63	63	62	10	1
6-22-1993	22:41: 6	V	RR TRA	B	118	117	117	118	10	1
6-22-1993	22:41:46	V	RR TRA	V	110	110	110	110	10	1
6-22-1993	22:42:47		SKYLAST	U	6006	0	0	0	10	100
6-22-1993	22:42:57		SKYLAST	B	9578	0	0	0	10	100
6-22-1993	22:43: 8		SKYLAST	V	10216	0	0	0	10	100
6-22-1993	22:44:13	V	RR TRA	U	6351	6326	6331	6352	10	100
6-22-1993	22:44:53	V	RR TRA	B	11873	11830	11790	11854	10	100
6-22-1993	22:45:34	V	RR TRA	V	11144	11107	11102	11144	10	100
6-22-1993	22:46:35		SKYLAST	U	6001	0	0	0	10	100
6-22-1993	22:46:45		SKYLAST	B	9622	0	0	0	10	100
6-22-1993	22:46:56		SKYLAST	V	10252	0	0	0	10	100
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6-22-1993	22:48:39	V	RR TRA	B	11903	11863	11778	11779	10	100
6-22-1993	22:49:20	V	RR TRA	V	11092	11133	11127	11222	10	100
6-22-1993	22:50:30		SKYLAST	U	5983	0	0	0	10	100
6-22-1993	22:50:40		SKYLAST	B	9565	0	0	0	10	100
6-22-1993	22:50:51		SKYLAST	V	10294	0	0	0	10	100
6-22-1993	22:52:20	V	RR TRA	U	6328	6355	6350	6321	10	100
6-22-1993	22:53: 1	V	RR TRA	B	11849	11812	11845	11814	10	100
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6-22-1993	22:54:39		SKYLAST	U	6020	0	0	0	10	100
6-22-1993	22:54:49		SKYLAST	B	9719	0	0	0	10	100
6-22-1993	22:54:60		SKYLAST	V	10470	0	0	0	10	100
6-22-1993	22:56:43	F	HD146022	U	6584	6577	6576	6590	10	100
6-22-1993	22:57:23	F	HD146022	B	12552	12587	12614	12725	10	100
6-22-1993	22:58: 4	F	HD146022	V	11479	11391	11425	11525	10	100
6-22-1993	22:59:27		SKYLAST	U	6010	0	0	0	10	100
6-22-1993	22:59:37		SKYLAST	B	9806	0	0	0	10	100
6-22-1993	22:59:47		SKYLAST	V	10619	0	0	0	10	100
6-22-1993	23: 1:56	V	RR TRA	U	6353	6363	6367	6370	10	100
6-22-1993	23: 2:37	V	RR TRA	B	11958	11986	12011	11977	10	100

6-22-1993	23: 3:17	V	RR TRA	V	11426	11336	11393	11411	10	100
6-22-1993	23: 4:28		SKYLAST	U	6041	0	0	0	10	100
6-22-1993	23: 4:39		SKYLAST	B	9734	0	0	0	10	100
6-22-1993	23: 4:49		SKYLAST	V	10498	0	0	0	10	100
6-22-1993	23: 5:55	V	RR TRA	U	6363	6329	6353	6356	10	100
6-22-1993	23: 6:36	V	RR TRA	B	11949	11968	11945	11977	10	100
6-22-1993	23: 7:16	V	RR TRA	V	11379	11384	11416	11334	10	100
6-22-1993	23: 8:27		SKYLAST	U	6029	0	0	0	10	100
6-22-1993	23: 8:38		SKYLAST	B	9775	0	0	0	10	100
6-22-1993	23: 8:48		SKYLAST	V	10583	0	0	0	10	100
6-22-1993	23:10: 2	V	RR TRA	U	6353	6342	6357	6356	10	100
6-22-1993	23:10:42	V	RR TRA	B	11964	11934	11995	11895	10	100
6-22-1993	23:11:23	V	RR TRA	V	11485	11437	11449	11390	10	100
6-22-1993	23:12:24		SKYLAST	U	6023	0	0	0	10	100
6-22-1993	23:12:35		SKYLAST	B	9763	0	0	0	10	100
6-22-1993	23:12:45		SKYLAST	V	10548	0	0	0	10	100
6-22-1993	23:13:52	V	RR TRA	U	6352	6354	6344	6325	10	100
6-22-1993	23:14:33	V	RR TRA	B	12031	12044	12031	11972	10	100
6-22-1993	23:15:13	V	RR TRA	V	11473	11440	11466	11485	10	100
6-22-1993	23:16:26		SKYLAST	U	6019	0	0	0	10	100
6-22-1993	23:16:37		SKYLAST	B	9859	0	0	0	10	100
6-22-1993	23:16:47		SKYLAST	V	10641	0	0	0	10	100
6-22-1993	23:18:13	F	HD146022	U	6576	6605	6579	6585	10	100
6-22-1993	23:18:53	F	HD146022	B	12761	12663	12633	12663	10	100
6-22-1993	23:19:34	F	HD146022	V	11641	11651	11598	11633	10	100
6-22-1993	23:20:36		SKYLAST	U	6030	0	0	0	10	100
6-22-1993	23:20:47		SKYLAST	B	9937	0	0	0	10	100
6-22-1993	23:20:57		SKYLAST	V	10727	0	0	0	10	100
6-22-1993	23:24:13	F	HD146485	U	6428	6445	6458	6448	10	100
6-22-1993	23:24:54	F	HD146485	B	13023	12999	13121	13097	10	100
6-22-1993	23:25:34	F	HD146485	V	12142	12067	12088	11985	10	100
6-22-1993	23:26:36		SKYLAST	U	6021	0	0	0	10	100
6-22-1993	23:26:46		SKYLAST	B	9850	0	0	0	10	100
6-22-1993	23:26:57		SKYLAST	V	10665	0	0	0	10	100
6-22-1993	23:33: 4	A	HR6070	U	784	784	779	783	10	1
6-22-1993	23:33:44	A	HR6070	B	4593	4564	4614	4597	10	1
6-22-1993	23:34:25	A	HR6070	V	1552	1553	1546	1553	10	1
6-22-1993	23:35:23		SKYLAST	U	63	0	0	0	10	1
6-22-1993	23:35:33		SKYLAST	B	112	0	0	0	10	1
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6-25-1993	18:46:30	A	HR6070	V	1627	1629	1633	1631	10	1	
6-25-1993	18:47:27		SKYLAST	U	64	0	0	0	10	1	
6-25-1993	18:47:37		SKYLAST	B	119	0	0	0	10	1	
6-25-1993	18:47:48		SKYLAST	V	109	0	0	0	10	1	
6-25-1993	18:51:46	F	HD146485	U	664	664	662	666	10	10	
6-25-1993	18:52:27	F	HD146485	B	1407	1395	1408	1406	10	10	
6-25-1993	18:53: 7	F	HD146485	V	1244	1262	1258	1262	10	10	
6-25-1993	18:53:56		SKYLAST	U	618	0	0	0	10	10	
6-25-1993	18:54: 6		SKYLAST	B	1089	0	0	0	10	10	
6-25-1993	18:54:17		SKYLAST	V	1108	0	0	0	10	10	
6-25-1993	18:57: 0	F	HD146022	U	6813	6744	6766	6779	10	100	
6-25-1993	18:57:41	F	HD146022	B	13794	13807	13817	13858	10	100	
6-25-1993	18:58:21	F	HD146022	V	11898	11920	12090	12045	10	100	
6-25-1993	18:59: 6		SKYLAST	U	6193	0	0	0	10	100	
6-25-1993	18:59:16		SKYLAST	B	10850	0	0	0	10	100	
6-25-1993	18:59:27		SKYLAST	V	10960	0	0	0	10	100	
6-25-1993	19: 2:32	V	RR TRA	U	6496	6485	6526	6508	10	100	
6-25-1993	19: 3:13	V	RR TRA	B	13024	12994	12917	12955	10	100	
6-25-1993	19: 3:53	V	RR TRA	V	11709	11765	11754	11798	10	100	
6-25-1993	19: 4:34		SKYLAST	U	6151	0	0	0	10	100	

6-25-1993 19: 4:44	SKYLAST	B	10756	0	0	0	10	100
6-25-1993 19: 4:55	SKYLAST	V	10815	0	0	0	10	100
6-25-1993 19: 5:38 V	RR TRA	U	6502	6479	6466	6495	10	100
6-25-1993 19: 6:19 V	RR TRA	B	12968	12927	12833	12859	10	100
6-25-1993 19: 6:59 V	RR TRA	V	11754	11777	11742	11631	10	100
6-25-1993 19: 7:43	SKYLAST	U	6175	0	0	0	10	100
6-25-1903 19: 7:53	SKYLAST	B	10671	0	0	0	10	100
6-25-1993 19: 8: 4	SKYLAST	V	10797	0	0	0	10	100
6-25-1993 19: 8:58 V	RR TRA	U	6484	6504	6474	6502	10	100
6-25-1993 19: 9:39 V	RR TRA	B	12930	12913	12935	12915	10	100
6-25-1993 19:10:18 V	RR TRA	V	11718	11667	11798	11803	10	100
6-25-1993 19:11: 7	SKYLAST	U	6138	0	0	0	10	100
6-25-1993 19:11:18	SKYLAST	B	10733	0	0	0	10	100
6-25-1993 19:11:28	SKYLAST	V	11002	0	0	0	10	100
6-25-1993 19:12:20 V	RR TRA	U	6477	6482	6471	6475	10	100
6-25-1993 19:13: 1 V	RR TRA	B	12928	12902	12870	12862	10	100
6-25-1993 19:13:41 V	RR TRA	V	11711	11722	11688	11657	10	100
6-25-1993 19:14:24	SKYLAST	U	6139	0	0	0	10	100
6-25-1993 19:14:34	SKYLAST	B	10721	0	0	0	10	100
6-25-1993 19:14:45	SKYLAST	V	10865	0	0	0	10	100
6-25-1993 19:15:41 F	HD146022	U	6763	6704	6742	6725	10	100
6-25-1993 19:16:21 F	HD146022	B	13673	13557	13652	13594	10	100
6-25-1993 19:17: 2 F	HD146022	V	11669	11715	11699	11710	10	100
6-25-1993 19:17:41	SKYLAST	U	6143	0	0	0	10	100
6-25-1993 19:17:51	SKYLAST	B	10656	0	0	0	10	100
6-25-1993 19:18: 1	SKYLAST	V	10712	0	0	0	10	100
6-25-1993 19:20: 5 V	RR TRA	U	6462	6462	6481	6466	10	100
6-25-1993 19:20:46 V	RR TRA	B	12849	12830	12891	12763	10	100
6-25-1993 19:21:26 V	RR TRA	V	11456	11570	11463	11431	10	100
6-25-1993 19:22: 8	SKYLAST	U	6109	0	0	0	10	100
6-25-1993 19:22:18	SKYLAST	B	10437	0	0	0	10	100
6-25-1993 19:22:29	SKYLAST	V	10488	0	0	0	10	100
6-25-1993 19:23:21 V	RR TRA	U	6466	6461	6448	6469	10	100
6-25-1993 19:24: 2 V	RR TRA	B	12793	12687	12720	12785	10	100
6-25-1993 19:24:42 V	RR TRA	V	11390	11455	11464	11436	10	100
6-25-1993 19:25:24	SKYLAST	U	6133	0	0	0	10	100
6-25-1993 19:25:35	SKYLAST	B	10370	0	0	0	10	100
6-25-1993 19:25:45	SKYLAST	V	10468	0	0	0	10	100
6-25-1993 19:26:40 V	RR TRA	U	6447	6450	6489	6456	10	100
6-25-1993 19:27:21 V	RR TRA	B	12808	12729	12797	12754	10	100
6-25-1993 19:28: 1 V	RR TRA	V	11528	11452	11456	11584	10	100
6-25-1993 19:28:57	SKYLAST	U	6119	0	0	0	10	100
6-25-1999 19:29: 7	SKYLAST	B	10523	0	0	0	10	100
6-25-1993 19:29:18	SKYLAST	V	10683	0	0	0	10	100
6-25-1993 19:31: 9 V	RR TRA	U	6471	6436	6487	6425	10	100
6-25-1993 19:31:50 V	RR TRA	B	12748	12716	12711	12712	10	100
6-25-1993 19:32:30 V	RR TRA	V	11328	11302	11306	11380	10	100
6-25-1993 19:33:26	SKYLAST	U	6092	0	0	0	10	100
6-25-1993 19:33:37	SKYLAST	B	10499	0	0	0	10	100
6-25-1993 19:33:47	SKYLAST	V	10581	0	0	0	10	100
6-25-1993 19:34:44 F	HD146022	U	6757	6727	6693	6748	10	100
6-25-1993 19:35:24 F	HD146022	B	13430	13390	13522	13404	10	100
6-25-1993 19:36: 5 F	HD146022	V	11453	11359	11204	11310	10	100
6-25-1993 19:37: 4	SKYLAST	U	6104	0	0	0	10	100
6-25-1993 19:37:14	SKYLAST	B	10341	0	0	0	10	100
6-25-1993 19:37:25	SKYLAST	V	10366	0	0	0	10	100
6-25-1993 19:39: 3 V	RR TRA	U	6468	6470	6438	6475	10	100
6-25-1993 19:39:43 V	RR TRA	B	12581	12676	12693	12603	10	100
6-25-1993 19:40:24 V	RR TRA	V	11188	11145	11107	11100	10	100
6-25-1993 19:41:12	SKYLAST	U	6099	0	0	0	10	100
6-25-1993 19:41:23	SKYLAST	B	10279	0	0	0	10	100
6-25-1993 19:41:33	SKYLAST	V	10303	0	0	0	10	100
6-25-1993 19:43:43 V	RR TRA	U	6462	6443	6466	6449	10	100
6-25-1993 19:44:23 V	RR TRA	B	12690	12689	12607	12704	10	100
6-25-1993 19:45: 4 V	RR TRA	V	11353	11270	11235	11313	10	100

6-25-1993	19:45:43		SKYLAST	U	6110	0	0	0	10	100
6-25-1993	19:45:54		SKYLAST	B	10308	0	0	0	10	100
6-25-1993	19:46: 4		SKYLAST	V	10491	0	0	0	10	100
6-25-1993	19:46:54	V	RR TRA	U	6429	6429	6420	6445	10	100
6-25-1993	19:47:34	V	RR TRA	B	12600	12655	12641	12616	10	100
6-25-1993	19:48:15	V	RR TRA	V	11365	11388	11393	11437	10	100
6-25-1993	19:49:10		SKYLAST	U	6068	6063	6091	6077	10	100
6-25-1993	19:49:50		SKYLAST	B	10325	10278	10303	10271	10	100
6-25-1993	19:50:31		SKYLAST	V	10504	10488	10464	10465	10	100
6-25-1993	19:51:41	V	RR TRA	U	6448	6447	6449	6413	10	100
6-25-1993	19:52:22	V	RR TRA	B	12640	12626	12628	12616	10	100
6-25-1993	19:53: 2	V	RR TRA	V	11360	11437	11406	11375	10	100
6-25-1993	19:53:48		SKYLAST	U	6087	0	0	0	10	100
6-25-1993	19:53:58		SKYLAST	B	10301	0	0	0	10	100
6-25-1993	19:54: 9		SKYLAST	V	10522	0	0	0	10	100
6-25-1993	19:55:28	F	HD146022	U	6676	6698	6694	6653	10	100
6-25-1993	19:56: 9	F	HD146022	B	13432	13450	13319	13306	10	100
6-25-1993	19:56:49	F	HD146022	V	11485	11441	11433	11498	10	100
6-25-1993	19:57:29		SKYLAST	U	6088	0	0	0	10	100
6-25-1993	19:57:40		SKYLAST	B	10328	0	0	0	10	100
6-25-1993	19:57:50		SKYLAST	V	10505	0	0	0	10	100
6-25-1993	19:58:45	V	RR TRA	U	6418	6405	6434	6420	10	100
6-25-1993	19:59:25	V	RR TRA	B	12692	12655	12646	12668	10	100
6-25-1993	20: 0: 6	V	RR TRA	V	11369	11348	11416	11459	10	100
6-25-1993	20: 0:46		SKYLAST	U	6084	0	0	0	10	100
6-25-1993	20: 0:57		SKYLAST	B	10230	0	0	0	10	100
6-25-1993	20: 1: 7		SKYLAST	V	10604	0	0	0	10	100
6-25-1993	20: 1:53	V	RR TRA	U	6402	6452	6441	6432	10	100
6-25-1993	20: 2:33	V	RR TRA	B	12616	12571	12613	12641	10	100
6-25-1993	20: 3:14	V	RR TRA	V	11445	11371	11409	11409	10	100
6-25-1993	20: 3:54		SKYLAST	U	6060	0	0	0	10	100
6-25-1993	20: 4: 5		SKYLAST	B	10246	0	0	0	10	100
6-25-1993	20: 4:15		SKYLAST	V	10477	0	0	0	10	100
6-25-1993	20: 5: 1	V	RR TRA	U	6395	6409	6420	6418	10	100
6-25-1993	20: 5:41	V	RR TRA	B	12566	12526	12459	12584	10	100
6-25-1993	20: 8:24	V	RR TRA	V	11367	11308	11317	11323	10	100
6-25-1993	20: 9:50		SKYLAST	U	6042	0	0	0	10	100
6-25-1993	20:10: 1		SKYLAST	B	10185	0	0	0	10	100
6-25-1993	20:10:11		SKYLAST	V	10463	0	0	0	10	100
6-25-1993	20:10:56	V	RR TRA	U	6428	6412	6416	6399	10	100
6-25-1993	20:11:37	V	RR TRA	B	12585	12583	12568	12556	10	100
6-25-1993	20:12:17	V	RR TRA	V	11251	11287	11273	11314	10	100
6-25-1993	20:12:58		SKYLAST	U	6046	0	0	0	10	100
6-25-1993	20:13: 8		SKYLAST	B	10106	0	0	0	10	100
6-25-1993	20:13:19		SKYLAST	V	10409	0	0	0	10	100
6-25-1993	20:17:48	A	HR6070	U	954	948	949	946	10	1
6-25-1993	20:18:29	A	HR6070	B	5231	5228	5228	5221	10	1
6-25-1993	20:19: 9	A	HR6070	V	1671	1661	1661	1660	10	1
6-25-1993	20:20: 4		SKYLAST	U	63	0	0	0	10	1
6-25-1993	20:20:15	M	SKYLAST	B	102	0	0	0	10	1
6-25-1993	20:20:25	M	SKYLAST	V	98	0	0	0	10	1
6-25-1993	20:23:47	V	RR TRA	U	6423	6419	6421	6380	10	100
6-25-1993	20:24:27	V	RR TRA	B	12472	12448	12504	12416	10	100
6-25-1993	20:25: 8	V	RR TRA	V	11234	11257	11225	11235	10	100
6-25-1993	20:25:48		SKYLAST	U	6025	0	0	0	10	100
6-25-1993	20:25:58		SKYLAST	B	10029	0	0	0	10	100
6-25-1993	20:26: 9		SKYLAST	V	10247	0	0	0	10	100
6-25-1993	20:27:11	V	RR TRA	U	6375	6414	6405	6389	10	100
6-25-1993	20:27:51	V	RR TRA	B	12484	12446	12464	12466	10	100
6-25-1993	20:28:32	V	RR TRA	V	11209	11161	11152	11297	10	100
6-25-1993	20:29:27		SKYLAST	U	6030	0	0	0	10	100
6-25-1993	20:29:37		SKYLAST	B	10033	0	0	0	10	100
6-25-1993	20:29:48		SKYLAST	V	10269	0	0	0	10	100
6-25-1993	20:30:50	V	RR TRA	U	6375	6378	6370	6387	10	100
6-25-1993	20:31:30	V	RR TRA	B	12386	12403	12366	12423	10	100

6-25-1993	20:32:11	V	RR TRA	V	11158	11191	11216	11165	10	100
6-25-1993	20:33: 9		SKYLAST	U	6019	0	0	0	10	100
6-25-1993	20:33:20		SKYLAST	B	9992	0	0	0	10	100
6-25-1993	20:33:30		SKYLAST	V	10197	0	0	0	10	100
6-25-1993	20:34:34	V	RR TRA	U	6376	6369	6378	6386	10	100
6-25-1993	20:35:14	V	RR TRA	B	12372	12373	12288	12341	10	100
6-25-1993	20:35:55	V	RR TRA	V	11046	11028	11001	11055	10	100
6-25-1993	20:36:51		SKYLAST	U	6003	0	0	0	10	100
6-25-1993	20:37: 2		SKYLAST	B	9914	0	0	0	10	100
6-25-1993	20:37:12		SKYLAST	V	10179	0	0	0	10	100
6-25-1993	20:38:32	F	HD146022	U	6636	6612	6601	6612	10	100
6-25-1993	20:39:12	F	HD146022	B	13053	13048	12981	12975	10	100
6-25-1993	20:39:53	F	HD146022	V	11103	11190	11122	11055	10	100
6-25-1993	20:40:45		SKYLAST	U	6005	0	0	0	10	100
6-25-1993	20:40:56		SKYLAST	B	9867	0	0	0	10	100
6-25-1993	20:41: 6		SKYLAST	V	10095	0	0	0	10	100
6-25-1993	20:42:34	V	RR TRA	U	6352	6340	6359	6344	10	100
6-25-1993	20:43:15	V	RR TRA	B	12189	12291	12183	12201	10	100
6-25-1993	20:43:55	V	RR TRA	V	10952	10954	10925	10891	10	100
6-25-1993	20:44:35		SKYLAST	U	5982	0	0	0	10	100
6-25-1993	20:44:45		SKYLAST	B	9737	0	0	0	10	100
6-25-1993	20:44:55		SKYLAST	V	10021	0	0	0	10	100
6-25-1993	20:45:54	V	RR TRA	U	6349	6360	6379	6366	10	100
6-25-1993	20:46:35	V	RR TRA	B	12322	12158	12180	12340	10	100
6-25-1993	20:47:15	V	RR TRA	V	10943	10954	10976	10964	10	100
6-25-1993	20:48: 3		SKYLAST	U	5960	0	0	0	10	100
6-25-1993	20:48:13		SKYLAST	B	9747	0	0	0	10	100
6-25-1993	20:48:24		SKYLAST	V	10028	0	0	0	10	100
6-25-1993	20:49:15	V	RR TRA	U	6367	6338	6344	6344	10	100
6-25-1993	20:49:55	V	RR TRA	B	12172	12209	12228	12154	10	100
6-25-1993	20:50:36	V	RR TRA	V	11031	10960	11014	11003	10	100
6-25-1993	20:51:16		SKYLAST	U	5961	0	0	0	10	100
6-25-1993	20:51:27		SKYLAST	B	9726	0	0	0	10	100
6-25-1993	20:51:37		SKYLAST	V	10048	0	0	0	10	100
6-25-1993	20:52:22	V	RR TRA	U	6329	6334	6327	6338	10	100
6-25-1993	20:53: 2	V	RR TRA	B	12173	12175	12148	12161	10	100
6-25-1993	20:53:43	V	RR TRA	V	10953	10927	11004	10985	10	100
6-25-1993	20:54:23		SKYLAST	U	5986	0	0	0	10	100
6-25-1993	20:54:33		SKYLAST	B	9774	0	0	0	10	100
6-25-1993	20:54:44		SKYLAST	V	10204	0	0	0	10	100
6-25-1993	20:56: 8	F	HD146022	U	6626	6623	6605	6590	10	100
6-25-1993	20:56:49	F	HD146022	B	12762	12865	12820	12814	10	100
6-25-1993	20:57:29	F	HD146022	V	11063	11040	11016	11014	10	100
6-25-1993	20:58:14		SKYLAST	U	5966	0	0	0	10	100
6-25-1993	20:58:25		SKYLAST	B	9709	0	0	0	10	100
6-25-1993	20:58:35		SKYLAST	V	10099	0	0	0	10	100
6-25-1993	20:59:29	V	RR TRA	U	6348	6297	6349	6333	10	100
6-25-1993	21: 0: 9	V	RR TRA	B	12093	12111	12111	12171	10	100
6-25-1993	21: 0:50	V	RR TRA	V	11014	10935	10973	10992	10	100
6-25-1993	21: 1:32		SKYLAST	U	5992	0	0	0	10	100
6-25-1993	21: 1:42		SKYLAST	B	9656	0	0	0	10	100
6-25-1993	21: 1:53		SKYLAST	V	10015	0	0	0	10	100
6-25-1993	21: 2:43	V	RR TRA	U	6354	6355	6356	6300	10	100
6-25-1993	21: 3:23	V	RR TRA	B	12072	12019	12064	12084	10	100
6-25-1993	21: 4: 4	V	RR TRA	V	10898	10888	10900	10910	10	100
6-25-1993	21: 4:58		SKYLAST	U	5987	0	0	0	10	100
6-25-1993	21: 5: 9		SKYLAST	B	9636	0	0	0	10	100
6-25-1993	21: 5:19		SKYLAST	V	9960	0	0	0	10	100
6-25-1993	21: 6:23	V	RR TRA	U	6316	6360	6363	6319	10	100
6-25-1993	21: 7: 3	V	RR TRA	B	12021	12037	11995	12073	10	100
6-25-1993	21: 7:44	V	RR TRA	V	10872	10869	10783	10856	10	100
6-25-1993	21: 8:39		SKYLAST	U	5942	0	0	0	10	100
6-25-1993	21: 8:50		SKYLAST	B	9537	0	0	0	10	100
6-25-1993	21: 8:60		SKYLAST	V	9941	0	0	0	10	100
6-25-1993	21:10: 5	V	RR TRA	U	6333	6306	6295	6311	10	100

6-25-1993	21:10:45	V	RR TRA	B	11974	11927	11882	11904	10	100
6-25-1993	21:11:26	V	RR TRA	V	10869	10855	10743	10779	10	100
6-25-1993	21:12:21		SKYLAST	U	5936	0	0	0	10	100
6-25-1993	21:12:32		SKYLAST	B	9494	0	0	0	10	100
6-25-1993	21:12:42		SKYLAST	V	9827	0	0	0	10	100
6-25-1993	21:13:58	F	HD146022	U	6597	6582	6563	6586	10	100
6-25-1993	21:14:38	F	HD146022	B	12648	12601	12655	12720	10	100
6-25-1993	21:15:19	F	HD146022	V	10876	10831	10638	10946	10	100
6-25-1993	21:16:22		SKYLAST	U	5960	0	0	0	10	100
6-25-1993	21:16:32		SKYLAST	B	9659	0	0	0	10	100
6-25-1993	21:16:43		SKYLAST	V	10028	0	0	0	10	100
6-25-1993	21:17:53	V	RR TRA	U	6323	6306	6326	6316	10	100
6-25-1993	21:18:33	V	RR TRA	B	12000	11926	11905	12049	10	100
6-25-1993	21:19:14	V	RR TRA	V	10821	10751	10777	10794	10	100
6-25-1993	21:20: 4		SKYLAST	U	5965	0	0	0	10	100
6-25-1993	21:20:14		SKYLAST	B	9558	0	0	0	10	100
6-25-1993	21:20:25		SKYLAST	V	9910	0	0	0	10	100
6-25-1993	21:21:22	V	RR TRA	U	6284	6329	6306	6298	10	100
6-25-1993	21:22: 2	V	RR TRA	B	12004	12057	11940	11946	10	100
6-25-1993	21:22:43	V	RR TRA	V	10809	10884	10833	10799	10	100
6-25-1993	21:23:44		SKYLAST	U	5955	0	0	0	10	100
6-25-1993	21:23:55		SKYLAST	B	9539	0	0	0	10	100
6-25-1993	21:24: 5		SKYLAST	V	9956	0	0	0	10	100
6-25-1993	21:25: 0	V	RR TRA	U	6305	6321	6318	6326	10	100
6-25-1993	21:25:41	V	RR TRA	B	11938	11926	12051	11933	10	100
6-25-1993	21:26:21	V	RR TRA	V	10819	10714	10774	10727	10	100
6-25-1993	21:27: 7		SKYLAST	U	5947	0	0	0	10	100
6-25-1993	21:27:17		SKYLAST	B	9520	0	0	0	10	100
6-25-1993	21:27:28		SKYLAST	V	9928	0	0	0	10	100
6-25-1993	21:28:20	V	RR TRA	U	6348	6342	6311	6309	10	100
6-25-1993	21:29: 1	V	RR TRA	B	11947	11964	11958	11943	10	100
6-25-1993	21:29:41	V	RR TRA	V	10746	10805	10777	10814	10	100
6-25-1993	21:30:28		SKYLAST	U	5964	0	0	0	10	100
6-25-1993	21:30:38		SKYLAST	B	9594	0	0	0	10	100
6-25-1993	21:30:49		SKYLAST	V	9953	0	0	0	10	100
6-25-1993	21:35:38	A	HR6070	U	952	951	954	955	10	1
6-25-1993	21:36:19	A	HR6070	B	5361	5365	5344	5339	10	1
6-25-1993	21:38:24	A	HR6070	V	1694	1692	1683	1688	10	1
6-25-1993	21:39:20		SKYLAST	U	61	0	0	0	10	1
6-25-1993	21:39:30	M	SKYLAST	B	97	0	0	0	10	1
6-25-1993	21:39:41	M	SKYLAST	V	93	0	0	0	10	1
6-25-1993	21:43:18	V	RR TRA	U	63	63	63	63	10	1
6-25-1993	21:43:59	V	RR TRA	B	118	119	119	118	10	1
6-25-1993	21:44:39	V	RR TRA	V	107	106	107	107	10	1
6-25-1993	21:45:28		SKYLAST	U	59	0	0	0	10	1
6-25-1993	21:45:39		SKYLAST	B	94	0	0	0	10	1
6-25-1993	21:45:49		SKYLAST	V	97	0	0	0	10	1
6-25-1993	21:46:43	V	RR TRA	U	6305	6332	6327	6333	10	100
6-25-1993	21:47:23	V	RR TRA	B	11890	11828	11804	11848	10	100
6-25-1993	21:48: 4	V	RR TRA	V	10630	10568	10614	10672	10	100
6-25-1993	21:48:47		SKYLAST	U	5954	0	0	0	10	100
6-25-1993	21:48:58		SKYLAST	B	9496	0	0	0	10	100
6-25-1993	21:49: 8		SKYLAST	V	9770	0	0	0	10	100
6-25-1993	21:50: 1	V	RR TRA	U	6323	6331	6312	6314	10	100
6-25-1993	21:50:41	V	RR TRA	B	11948	11915	11903	11910	10	100
6-25-1993	21:51:22	V	RR TRA	V	10654	10650	10705	10725	10	100
6-25-1993	21:52: 1		SKYLAST	U	5924	0	0	0	10	100
6-25-1993	21:52:12		SKYLAST	B	9399	0	0	0	10	100
6-25-1993	21:52:22		SKYLAST	V	9622	0	0	0	10	100
6-25-1993	21:53: 8	V	RR TRA	U	6301	6330	6330	6309	10	100
6-25-1993	21:53:49	V	RR TRA	B	11869	11831	11856	11855	10	100
6-25-1993	21:54:29	V	RR TRA	V	10609	10646	10594	10610	10	100
6-25-1993	21:55: 6		SKYLAST	U	5943	0	0	0	10	100
6-25-1993	21:55:16		SKYLAST	B	9422	0	0	0	10	100
6-25-1993	21:55:27		SKYLAST	V	9688	0	0	0	10	100

6-25-1993	21:57:26	F	HD146022	U	6570	6569	6574	6566	10	100
6-25-1993	21:58: 7	F	HD146022	B	12561	12549	12596	12631	10	100
6-25-1993	21:58:47	F	HD146022	V	10741	10757	10653	10661	10	100
6-25-1993	21:59:52		SKYLAST	U	5954	0	0	0	10	100
6-25-1993	22: 0: 2		SKYLAST	B	9547	0	0	0	10	100
6-25-1993	22: 0:13		SKYLAST	V	9785	0	0	0	10	100
6-25-1993	22: 1: 8	V	RR TRA	U	6307	6311	6338	6305	10	100
6-25-1993	22: 1:49	V	RR TRA	B	11820	11889	11936	11969	10	100
6-25-1993	22: 2:29	V	RR TRA	V	10647	10646	10668	10684	10	100
6-25-1993	22: 3:14		SKYLAST	U	5953	0	0	0	10	100
6-25-1993	22: 3:25		SKYLAST	B	9438	0	0	0	10	100
6-25-1993	22: 3:35		SKYLAST	V	9698	0	0	0	10	100
6-25-1993	22: 4:17	V	RR TRA	U	6332	6320	6304	6308	10	100
6-25-1993	22: 4:58	V	RR TRA	B	11827	11760	11894	11796	10	100
6-25-1993	22: 5:38	V	RR TRA	V	10526	10578	10631	10566	10	100
6-25-1993	22: 6:17		SKYLAST	U	5950	0	0	0	10	100
6-25-1993	22: 6:27		SKYLAST	B	9464	0	0	0	10	100
6-25-1993	22: 6:38		SKYLAST	V	9668	0	0	0	10	100
6-25-1993	22: 7:35	V	RR TRA	U	6311	6298	6318	6270	10	100
6-25-1993	22: 8:16	V	RR TRA	B	11863	11839	11820	11873	10	100
6-25-1993	22: 8:56	V	RR TRA	V	10538	10583	10538	10617	10	100
6-25-1993	22: 9:48		SKYLAST	U	5949	0	0	0	10	100
6-25-1993	22: 9:58		SKYLAST	B	9454	0	0	0	10	100
6-25-1993	22:10: 9		SKYLAST	V	9648	0	0	0	10	100
6-25-1993	22:10:56	V	RR TRA	U	6294	6311	6325	6344	10	100
6-25-1993	22:11:37	V	RR TRA	B	11849	11818	11828	11850	10	100
6-25-1993	22:12:17	V	RR TRA	V	10577	10562	10593	10553	10	100
6-25-1993	22:12:57		SKYLAST	U	5959	0	0	0	10	100
6-25-1993	22:13: 7		SKYLAST	B	9441	0	0	0	10	100
6-25-1993	22:13:17		SKYLAST	V	9764	0	0	0	10	100
6-25-1993	22:14:29	F	HD146022	U	6597	6567	6594	6602	10	100
6-25-1993	22:15: 9	F	HD146022	B	12683	12603	12657	12671	10	100
6-25-1993	22:15:50	F	HD146022	V	10739	10792	10759	10747	10	100
6-25-1993	22:16:39		SKYLAST	U	5979	0	0	0	10	100
6-25-1993	22:16:49		SKYLAST	B	9544	0	0	0	10	100
6-25-1993	22:16:60		SKYLAST	V	9790	0	0	0	10	100
6-25-1993	22:21: 1	F	HD146485	U	6438	6447	6418	6411	10	100
6-25-1993	22:21:41	F	HD146485	B	12769	12832	12866	12911	10	100
6-25-1993	22:22:22	F	HD146485	V	11177	11172	11146	11147	10	100
6-25-1993	22:23:23		SKYLAST	U	6005	0	0	0	10	100
6-25-1993	22:23:34		SKYLAST	B	9714	0	0	0	10	100
6-25-1993	22:23:44		SKYLAST	V	9887	0	0	0	10	100
6-25-1993	22:27:17	A	HR6070	U	919	920	913	914	10	1
6-25-1993	22:27:58	A	HR6070	B	5168	5173	5183	5217	10	1
6-25-1993	22:28:38	A	HR6070	V	1692	1693	1701	1695	10	1
6-25-1993	22:29:27		SKYLAST	U	63	0	0	0	10	1
6-25-1993	22:29:37		SKYLAST	B	110	0	0	0	10	1
6-25-1993	22:29:47		SKYLAST	V	107	0	0	0	10	1

RR-TRA.DAT ; UNISA OBSERVATORY SSP-5A PHOTOMETER

UT DATE	UT(CLR)	CLEAR	UT(V)	V	UT(U)	U	UT(U-B)	U-B	UT(B-V)	B-V	UT(V-R)	V-R	UT(V-I)
6-18-1993			19:35:49	10.442	19:34:28	10.830	19:34:48	0.172	19:35:29	0.219			
6-18-1993			19:39: 1	10.384	19:37:40	10.837	19:38: 0	0.252	19:38:41	0.198			
6-18-1993			19:41:57	10.456	19:40:36	10.744	19:40:57	0.185	19:41:37	0.099			
6-18-1993			19:44:57	10.452	19:43:36	10.867	19:43:57	0.301	19:44:37	0.104			
6-18-1993			19:53:16	10.338	19:51:55	10.887	19:52:15	0.359	19:52:56	0.181			
6-18-1993			19:56:26	10.361	19:55: 5	10.914	19:55:25	0.375	19:56: 6	0.167			
6-18-1993			19:59:38	10.298	19:58:16	10.780	19:58:37	0.271	19:59:18	0.208			
6-18-1993			20: 2:57	10.443	20: 1:36	10.780	20: 1:56	0.222	20: 2:37	0.110			
6-18-1993			20:25: 0	10.452	20:23:39	10.945	20:23:59	0.365	20:24:40	0.114			
6-18-1993			20:27:58	10.567	20:26:37	10.896	20:26:57	0.276	20:27:38	0.040			
6-18-1993			20:31:34	10.492	20:30:13	11.045	20:30:33	0.433	20:31:14	0.101			
6-18-1993			20:34:41	10.582	20:33:20	10.964	20:33:41	0.323	20:34:21	0.043			
6-18-1993			20:43:18	10.537	20:41:57	11.023	20:42:17	0.342	20:42:58	0.133			
6-18-1993			20:46:55	10.498	20:45:34	11.052	20:45:55	0.269	20:46:35	0.287			
6-18-1993			20:50: 2	10.234	20:48:41	11.136	20:49: 1	0.391	20:49:42	0.521			
6-18-1993			20:53:10	10.124	20:51:49	11.092	20:52: 9	0.295	20:52:50	0.698			
6-18-1993			21:14:46	10.020	21:13:24	11.431	21:13:45	0.275	21:14:26	1.194			
6-18-1993			21:17:49	10.459	21:16:28	11.111	21:16:49	0.026	21:17:29	0.666			
6-18-1993			21:21:51	10.665	21:20:30	11.364	21:20:50	0.172	21:21:31	0.550			
6-18-1993			21:25:16	11.128	21:23:55	11.532	21:24:16	0.204	21:24:56	0.201			
6-18-1993			21:34:38	11.479	21:33:17	11.693	21:33:37	0.098	21:34:18	0.117			
6-18-1993			21:38:51	11.673	21:37:30	11.680	21:37:50	0.004	21:38:31	0.003			
6-18-1993			21:43: 7	11.795	21:41:46	12.003	21:42: 6	0.290	21:42:47	-0.105			
6-18-1993			21:47:15	11.387	21:45:54	12.268	21:46:14	0.486	21:46:55	0.391			
6-18-1993			22:11:27	11.686	22:10: 6	12.647	22:10:27	0.542	22:11: 7	0.413			
6-18-1993			22:14:51	11.490	22:13:30	12.768	22:13:51	0.813	22:14:31	0.446			
6-18-1993			22:18: 3	11.708	22:16:42	12.047	22:17: 3	0.106	22:17:43	0.241			
6-18-1993			22:21:22	11.393	22:20: 1	12.194	22:20:22	0.407	22:21: 2	0.396			
6-18-1993			22:32:43	11.169	22:31:22	11.777	22:31:43	0.261	22:32:23	0.353			
6-18-1993			22:36:10	11.071	22:34:49	11.660	22:35: 9	0.230	22:35:50	0.369			
6-18-1993			22:39:22	10.681	22:38: 1	11.697	22:38:22	0.367	22:39: 2	0.670			
6-18-1993			22:43:35	10.954	22:42:14	11.694	22:42:34	0.424	22:43:15	0.310			
6-18-1993			23: 4:10	10.639	23: 2:49	11.126	23: 3:10	0.214	23: 3:50	0.277			
6-18-1993			23: 9: 1	10.551	23: 7:40	11.147	23: 8: 0	0.270	23: 8:41	0.331			
6-18-1993			23:12:12	10.677	23:10:51	11.118	23:11:12	0.311	23:11:52	0.119			
6-18-1993			23:15:24	10.484	23:14: 3	11.070	23:14:23	0.289	23:15: 4	0.297			
6-18-1993			23:23: 4	10.257	23:21:43	11.102	23:22: 4	0.342	23:22:44	0.516			
6-18-1993			23:26:35	10.256	23:25:14	11.104	23:25:34	0.386	23:26:15	0.469			
6-18-1993			23:29:52	10.314	23:28:31	10.985	23:28:51	0.307	23:29:32	0.368			
6-18-1993			23:33:17	10.277	23:31:56	10.859	23:32:16	0.250	23:32:57	0.339			
6-18-1993			23:45:43	10.305	23:44:22	10.932	23:44:42	0.379	23:45:23	0.241			
6-18-1993			23:48:55	10.466	23:47:34	10.853	23:47:54	0.320	23:48:35	0.051			
6-18-1993			23:52:25	10.398	23:51: 4	10.791	23:51:24	0.192	23:52: 5	0.202			
6-18-1993			23:55:30	10.293	23:54: 9	10.899	23:54:30	0.319	23:55:10	0.286			
6-19-1993			0: 1:59	10.391	0: 0:38	10.911	0: 0:58	0.321	0: 1:39	0.191			
6-19-1993			0: 5: 0	10.313	0: 3:39	10.753	0: 3:59	0.249	0: 4:40	0.188			
6-19-1993			0: 8: 0	10.337	0: 6:39	10.880	0: 6:59	0.315	0: 7:40	0.223			
6-19-1993			0:11: 2	10.188	0: 9:41	10.847	0:10: 2	0.354	0:10:42	0.303			
6-19-1993			0:25:39	10.236	0:24:18	10.706	0:24:39	0.233	0:25:19	0.238			
6-19-1993			0:28:49	10.167	0:27:28	10.784	0:27:48	0.311	0:28:29	0.308			
6-19-1993			0:32: 4	10.306	0:30:43	10.641	0:31: 4	0.157	0:31:44	0.180			
6-19-1993			0:35:43	10.230	0:34:22	10.739	0:34:42	0.243	0:35:23	0.268			

6-19-1993	0:42:52 10.352	0:41:31 10.847	0:41:52 0.289	0:42:32 0.200
6-19-1993	0:45:57 10.277	0:44:36 10.852	0:44:57 0.276	0:45:37 0.301
6-19-1993	0:50:15 10.403	0:48:54 10.860	0:49:14 0.275	0:49:55 0.176
6-19-1993	0:54:28 10.826	0:53: 7 10.682	0:53:28 0.156	0:54: 8-0.332
6-19-1993	1: 5:25 10.381	1: 4: 4 10.869	1: 4:24 0.258	1: 5: 5 0.228
6-19-1993	1: 8:34 10.297	1: 7:13 10.816	1: 7:33 0.291	1: 8:14 0.223
6-19-1993	1:11:36 10.231	1:10:15 10.775	1:10:35 0.227	1:11:16 0.324
6-19-1993	1:14:54 9.971	1:13:33 10.771	1:13:54 0.261	1:14:34 0.559
6-19-1993	1:24: 8 10.200	1:22:47 10.790	1:23: 8 0.253	1:23:48 0.344
6-19-1993	1:27:25 10.339	1:26: 4 10.756	1:26:25 0.182	1:27: 5 0.238
6-19-1993	1:30:29 10.619	1:29: 8 10.846	1:29:28 0.252	1:30: 9-0.045
6-19-1993	1:33:27 10.523	1:32: 6 10.891	1:32:26 0.294	1:33: 7 0.059
6-19-1993	1:48:35 10.402	1:47:14 11.015	1:47:35 0.498	1:48:15 0.087
6-19-1993	1:51:38 10.190	1:50:17 10.858	1:50:38 0.362	1:51:18 0.302
6-19-1993	1:54:48 10.142	1:53:27 10.943	1:53:48 0.429	1:54:28 0.367
6-19-1993	1:58: 8 9.526	1:56:47 10.830	1:57: 8 0.480	1:57:48 0.849
6-19-1993	2: 4:44 9.747	2: 3:22 10.656	2: 3:43 0.207	2: 4:24 0.739
6-19-1993	2: 7:54 9.961	2: 6:33 10.802	2: 6:53 0.389	2: 7:34 0.456
6-19-1993	2:10:58 9.558	2: 9:37 10.690	2: 9:57 0.288	2:10:38 0.886
6-19-1993	2:14: 7 9.975	2:12:46 10.771	2:13: 6 0.318	2:13:47 0.489
6-19-1993	17:37: 4 10.879	17:35:43 10.721	17:36: 4 0.098	17:36:44-0.279
6-19-1993	17:40:45 10.729	17:39:24 10.929	17:39:45 0.374	17:40:25-0.210
6-19-1993	17:45:33 10.320	17:44:12 10.933	17:44:33 0.379	17:45:13 0.226
6-19-1993	17:49:37 10.025	17:48:16 10.766	17:48:37 0.248	17:49:17 0.511
6-19-1993	17:57:14 10.011	17:55:53 10.856	17:56:13 0.426	17:56:54 0.420
6-19-1993	18: 0:35 10.221	17:59:14 10.743	17:59:34 0.227	18: 0:15 0.301
6-19-1993	18: 3:53 10.094	18: 2:32 10.718	18: 2:52 0.231	18: 3:33 0.404
6-19-1993	18: 7: 7 10.222	18: 5:46 10.915	18: 6: 7 0.433	18: 6:47 0.250
6-19-1993	18:19:10 10.520	18:17:49 10.754	18:18:10 0.209	18:18:50 0.014
6-19-1993	18:22:52 10.381	18:21:31 10.914	18:21:52 0.378	18:22:32 0.142
6-19-1993	18:26:56 10.252	18:25:35 10.699	18:25:55 0.168	18:26:36 0.286
6-19-1993	18:30:26 10.253	18:29: 5 10.767	18:29:25 0.265	18:30: 6 0.249
6-19-1993	18:39:31 9.943	18:38:10 10.731	18:38:30 0.254	18:39:11 0.553
6-19-1993	18:43:54 10.004	18:42:33 10.773	18:42:54 0.346	18:43:34 0.430
6-19-1993	18:47:15 10.256	18:45:54 10.694	18:46:15 0.266	18:46:55 0.167
6-19-1993	18:51:56 10.362	18:50:35 10.854	18:50:56 0.372	18:51:36 0.105
6-19-1993	19: 9:36 10.094	19: 8:15 10.803	19: 8:35 0.302	19: 9:16 0.416
6-19-1993	19:13:21 9.719	19:12: 0 10.897	19:12:21 0.482	19:13: 1 0.713
6-19-1993	19:33:59 10.298	19:32:38 10.760	19:32:59 0.250	19:33:39 0.211
6-19-1993	19:37:22 10.306	19:36: 1 10.868	19:36:22 0.383	19:37: 2 0.169
6-19-1993	19:44:38 10.422	19:43:17 10.825	19:43:38 0.353	19:44:18 0.032
6-19-1993	19:49:31 10.393	19:48:10 10.781	19:48:30 0.308	19:49:11 0.067
6-19-1993	19:52:56 10.290	19:51:35 10.813	19:51:56 0.358	19:52:36 0.153
6-19-1993	19:56:58 10.395	19:55:37 10.720	19:55:58 0.247	19:56:38 0.068
6-19-1993	20: 9: 8 10.214	20: 7:47 10.738	20: 8: 8 0.261	20: 8:48 0.265
6-19-1993	20:12:38 10.335	20:11:17 10.770	20:11:38 0.337	20:12:18 0.083
6-19-1993	20:17:59 10.273	20:16:38 10.787	20:16:58 0.276	20:17:39 0.236
6-19-1993	20:21:31 10.286	20:20:10 10.849	20:20:30 0.352	20:21:11 0.204
6-19-1993	20:28:48 10.302	20:27:26 10.798	20:27:47 0.329	20:28:28 0.158
6-19-1993	20:32:15 10.238	20:30:54 10.822	20:31:15 0.353	20:31:55 0.225
6-19-1993	20:35:51 10.241	20:34:29 10.770	20:34:50 0.278	20:35:31 0.252
6-19-1993	20:39:32 10.172	20:38:11 10.617	20:38:32 0.175	20:39:12 0.277
6-19-1993	20:56:47 10.361	20:55:26 10.824	20:55:46 0.323	20:56:27 0.130
6-19-1993	21: 0:29 10.356	20:59: 8 10.708	20:59:29 0.218	21: 0: 9 0.130

6-19-1993	21: 4: 1 10.477	21: 2:40 10.784	21: 3: 0 0.239	21: 3:41 0.057
6-19-1993	21: 7:25 10.175	21: 6: 4 10.832	21: 6:24 0.347	21: 7: 5 0.309
6-19-1993	21:15: 3 10.366	21:13:42 10.877	21:14: 3 0.349	21:14:43 0.151
6-19-1993	21:18:33 10.263	21:17:12 10.746	21:17:33 0.226	21:18:13 0.260
6-19-1993	21:21:53 10.423	21:20:32 10.846	21:20:52 0.294	21:21:33 0.119
6-19-1993	21:25:25 10.256	21:24: 4 10.790	21:24:24 0.288	21:25: 5 0.245
6-19-1993	21:38:30 10.258	21:37: 9 10.759	21:37:30 0.216	21:38:10 0.290
6-19-1993	21:42: 4 10.194	21:40:43 10.897	21:41: 3 0.365	21:41:44 0.338
6-19-1993	21:45:45 10.183	21:44:24 10.838	21:44:45 0.271	21:45:25 0.394
6-19-1993	21:49:54 10.142	21:48:33 10.814	21:48:53 0.297	21:49:34 0.382
6-19-1993	21:57:51 10.310	21:56:30 10.941	21:56:51 0.359	21:57:31 0.268
6-19-1993	22: 2:42 10.231	22: 1:21 10.885	22: 1:42 0.326	22: 2:22 0.330
6-19-1993	22: 6:17 10.112	22: 4:56 10.765	22: 5:16 0.263	22: 5:57 0.399
6-19-1993	22:10: 6 10.407	22: 8:45 10.907	22: 9: 5 0.342	22: 9:46 0.147
6-19-1993	22:36: 5 10.424	22:34:44 10.848	22:35: 5 0.265	22:35:45 0.153
6-19-1993	22:39:45 10.516	22:38:24 10.883	22:38:45 0.346	22:39:25 0.001
6-19-1993	22:43:16 10.397	22:41:55 10.864	22:42:16 0.290	22:42:56 0.171
6-19-1993	22:46:52 10.400	22:45:31 10.950	22:45:51 0.354	22:46:32 0.186
6-19-1993	22:54:31 10.608	22:53:10 10.934	22:53:31 0.305	22:54:11 0.003
6-19-1993	22:58:25 10.596	22:57: 4 10.884	22:57:25 0.308	22:58: 5-0.040
6-19-1993	23: 2: 2 10.520	23: 0:41 10.902	23: 1: 1 0.272	23: 1:42 0.100
6-19-1993	23: 5:47 10.548	23: 4:26 10.881	23: 4:46 0.263	23: 5:27 0.058
6-19-1993	23:18:44 10.551	23:17:23 10.900	23:17:44 0.209	23:18:24 0.137
6-19-1993	23:22:15 10.615	23:20:54 11.124	23:21:15 0.448	23:21:55 0.038
6-19-1993	23:25:52 10.659	23:24:30 10.934	23:24:51 0.277	23:25:32-0.019
6-19-1993	23:29:39 10.438	23:28:18 11.105	23:28:38 0.409	23:29:19 0.249
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6-21-1993	17:48:53 11.015	17:47:31 11.562	17:47:51 0.459	17:48:32 0.065
6-21-1993	17:53:33 11.666	17:51:10 11.693	17:51:30 0.334	17:52:42-0.348
6-21-1993	17:57:27 10.864	17:56: 6 11.820	17:56:26 0.314	17:57: 6 0.666
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6-21-1993	18: 8:39 11.333	18: 7:18 11.953	18: 7:38 0.238	18: 8:18 0.393
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6-21-1993	18:27:10 11.513	18:25:49 12.155	18:26: 9-0.246	18:26:49 0.961
6-21-1993	18:30:26 12.384	18:29: 4 12.174	18:29:24-0.371	18:30: 5 0.195
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6-21-1993	18:48:10 12.319	18:46:49 12.267	18:47: 9 0.412	18:47:50-0.520
6-21-1993	18:51:14 12.167	18:49:53 12.003	18:50:13 0.278	18:50:54-0.488
6-21-1993	18:54:20 11.461	18:52:59 11.892	18:53:19 0.238	18:53:59 0.192
6-21-1993	19: 3:43 11.078	19: 2:22 11.741	19: 2:42 0.292	19: 3:22 0.377
6-21-1993	19: 6:55 11.065	19: 5:34 11.547	19: 5:54 0.240	19: 6:34 0.243
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6-21-1993	19:20:43 11.390	19:19:21 11.530	19:19:41 0.346	19:20:22-0.239
6-21-1993	19:23:42 10.647	19:22:21 11.366	19:22:41 0.282	19:23:21 0.447
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6-21-1993	20: 7: 7 10.261	20: 5:45 10.566	20: 6: 5 0.250	20: 6:46 0.043
6-21-1993	20:11:24 10.381	20:10: 3 10.588	20:10:23 0.264	20:11: 3-0.076
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6-21-1993	20:25: 1 10.372	20:23:40 10.596	20:24: 0 0.250	20:24:40-0.043
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6-21-1993	20:48:33 10.275	20:47:12 10.830	20:47:32 0.290	20:48:12 0.264
6-21-1993	20:56: 1 10.308	20:54:40 10.757	20:55: 0 0.257	20:55:40 0.189
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6-22-1993	22: 7:49 10.325	22: 6:28 10.778	22: 6:48 0.226	22: 7:29 0.228
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6-22-1993	22:23:22 10.153	22:22: 1 10.881	22:22:22 0.399	22:23: 2 0.326
6-22-1993	22:27:36 10.187	22:26:15 10.812	22:26:35 0.301	22:27:16 0.327
6-22-1993	22:31:26 10.245	22:30: 5 10.767	22:30:25 0.265	22:31: 6 0.257
6-22-1993	22:35:12 10.148	22:33:51 10.893	22:34:11 0.411	22:34:52 0.331
6-22-1993	22:47:56 10.274	22:46:35 11.062	22:46:56 0.535	22:47:36 0.236
6-22-1993	22:51:44 10.157	22:50:23 10.797	22:50:43 0.307	22:51:24 0.335

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6-22-1993	22:59:51	10.402	22:58:30	10.861	22:58:51	0.325	22:59:31	0.122
6-22-1993	23: 9:27	10.148	23: 8: 6	10.834	23: 8:27	0.374	23: 9: 7	0.309
6-22-1993	23:13:26	10.292	23:12: 5	10.831	23:12:26	0.346	23:13: 6	0.184
6-22-1993	23:17:33	10.183	23:16:12	10.797	23:16:32	0.318	23:17:13	0.295
6-22-1993	23:21:23	10.283	23:20: 2	10.804	23:20:23	0.319	23:21: 3	0.195
6-25-1993	19: 9:57	10.280	19: 8:36	10.760	19: 8:57	0.230	19: 9:37	0.252
6-25-1993	19:13: 3	10.288	19:11:42	10.907	19:12: 3	0.374	19:12:43	0.238
6-25-1993	19:16:23	10.521	19:15: 2	10.765	19:15:23	0.223	19:16: 3	0.009
6-25-1993	19:19:45	10.394	19:18:24	10.820	19:18:45	0.266	19:19:25	0.154
6-25-1993	19:27:30	10.187	19:26: 9	10.771	19:26:30	0.312	19:27:10	0.272
6-25-1993	19:30:46	10.210	19:29:25	10.885	19:29:46	0.403	19:30:26	0.266
6-25-1993	19:34: 5	10.384	19:32:44	10.846	19:33: 5	0.302	19:33:45	0.153
6-25-1993	19:38:34	10.481	19:37:13	10.808	19:37:34	0.244	19:38:14	0.074
6-25-1993	19:46:28	10.360	19:45: 7	10.795	19:45:27	0.286	19:46: 8	0.141
6-25-1993	19:51: 8	10.398	19:49:47	10.838	19:50: 7	0.334	19:50:48	0.093
6-25-1993	19:54:19	10.252	19:52:58	10.792	19:53:18	0.279	19:53:59	0.262
6-25-1993	19:59: 6	10.302	19:57:45	10.790	19:58: 6	0.277	19:58:46	0.207
6-25-1993	20: 6:10	10.411	20: 4:49	10.839	20: 5: 9	0.371	20: 5:50	0.039
6-25-1993	20: 9:18	10.241	20: 7:57	10.721	20: 8:17	0.227	20: 8:58	0.257
6-25-1993	20:14:28	10.330	20:11: 5	10.733	20:11:25	0.228	20:13: 7	0.173
6-25-1993	20:18:21	10.329	20:17: 0	10.744	20:17:21	0.284	20:18: 1	0.122
6-25-1993	20:31:12	10.210	20:29:51	10.698	20:30:11	0.216	20:30:52	0.277
6-25-1993	20:34:36	10.278	20:33:15	10.761	20:33:35	0.273	20:34:16	0.207
6-25-1993	20:38:15	10.227	20:36:54	10.785	20:37:14	0.281	20:37:55	0.278
6-25-1993	20:41:59	10.390	20:40:38	10.741	20:40:58	0.249	20:41:39	0.095
6-25-1993	20:49:59	10.304	20:48:38	10.781	20:48:59	0.307	20:49:39	0.162
6-25-1993	20:53:19	10.261	20:51:58	10.685	20:52:19	0.229	20:52:59	0.194
6-25-1993	20:56:40	10.215	20:55:19	10.745	20:55:39	0.272	20:56:20	0.257
6-25-1993	20:59:47	10.441	20:58:26	10.882	20:58:46	0.373	20:59:27	0.050
6-25-1993	21: 6:54	10.144	21: 5:33	10.909	21: 5:53	0.441	21: 6:34	0.319
6-25-1993	21:10: 8	10.154	21: 8:47	10.856	21: 9: 7	0.379	21: 9:48	0.322
6-25-1993	21:13:48	10.173	21:12:27	10.716	21:12:47	0.283	21:13:28	0.259
6-25-1993	21:17:30	10.056	21:16: 9	10.774	21:16:29	0.318	21:17:10	0.407
6-25-1993	21:25:18	10.168	21:23:57	10.833	21:24:17	0.374	21:24:58	0.287
6-25-1993	21:28:47	10.177	21:27:26	10.846	21:27:46	0.400	21:28:27	0.262
6-25-1993	21:32:25	10.242	21:31: 4	10.776	21:31:25	0.330	21:32: 5	0.198
6-25-1993	21:35:45	10.246	21:34:24	10.796	21:34:45	0.311	21:35:25	0.235
6-25-1993	21:50:43	10.106	21:49:22	10.687	21:49:43	0.242	21:50:23	0.346
6-25-1993	21:54: 8	10.261	21:52:47	10.772	21:53: 7	0.277	21:53:48	0.232
6-25-1993	21:57:26	10.026	21:56: 5	10.697	21:56:25	0.279	21:57: 6	0.401
6-25-1993	22: 0:33	10.180	21:59:12	10.755	21:59:33	0.297	22: 0:13	0.278
6-25-1993	22: 8:33	10.160	22: 7:12	10.792	22: 7:33	0.339	22: 8:13	0.290
6-25-1993	22:11:42	10.236	22:10:21	10.778	22:10:42	0.275	22:11:22	0.268
6-25-1993	22:15: 0	10.231	22:13:39	10.825	22:14: 0	0.331	22:14:40	0.259
6-25-1993	22:18:21	10.387	22:17: 0	10.790	22:17:21	0.294	22:18: 1	0.099

Appendix 7

FILENAME=VP930913 . RAW OUTPUT DATA FILE FROM "DTAK"
UT DATE= SEP 13 1993 TELESCOPE= C35 OBSERVER= VP
CONDITIONS=clear . DARK CNTS=5

MO-DY-YEAR	UT	CAT	OBJECT	FLT	----------COUNTS			----------	INT	SCLE	COMMENTS
9-13-1993	17:56: 2	F	HD213457	U	736	739	737	735	10	10	
9-13-1993	17:56:42	F	HD213457	B	3115	3127	3120	3117	10	10	
9-13-1993	17:57:23	F	HD213457	V	3246	3213	3223	3228	10	10	
9-13-1993	17:58: 4		SKYLAST	U	589	0	0	0	10	10	
9-13-1993	17:58:14	M	SKYLAST	B	1056	0	0	0	10	10	
9-13-1993	17:58:25	M	SKYLAST	V	1115	0	0	0	10	10	
9-13-1993	18:14:26	F	HD210299	U	6036	6079	6100	6077	10	100	
9-13-1993	18:15: 6	F	HD210299	B	11799	11768	11737	11747	10	100	
9-13-1993	18:15:47	F	HD210299	V	11960	11992	12087	12190	10	100	
9-13-1993	18:16:34		SKYLAST	U	6026	0	0	0	10	100	
9-13-1993	18:16:44		SKYLAST	B	10860	0	0	0	10	100	
9-13-1993	18:16:55		SKYLAST	V	10867	0	0	0	10	100	
9-13-1993	18:19:29	V	RW PSA	U	5923	5945	5941	5934	10	100	
9-13-1993	18:20:10	V	RW PSA	B	11032	11058	11019	11049	10	100	
9-13-1993	18:20:50	V	RW PSA	V	11168	11162	11116	11123	10	100	
9-13-1993	18:21:33		SKYLAST	U	5922	0	0	0	10	100	
9-13-1993	18:21:44		SKYLAST	B	10516	0	0	0	10	100	
9-13-1993	18:21:54		SKYLAST	V	10852	0	0	0	10	100	
9-13-1993	18:22:55	V	RW PSA	U	5934	5927	5948	5935	10	100	
9-13-1993	18:23:36	V	RW PSA	B	11083	11101	11092	11112	10	100	
9-13-1993	18:24:16	V	RW PSA	V	11115	10987	11059	11066	10	100	
9-13-1993	18:25: 4		SKYLAST	U	5891	0	0	0	10	100	
9-13-1993	18:25:15		SKYLAST	B	10731	0	0	0	10	100	
9-13-1993	18:25:25		SKYLAST	V	10706	0	0	0	10	100	
9-13-1993	18:26:16	V	RW PSA	U	5932	5935	5924	5966	10	100	
9-13-1993	18:26:56	V	RW PSA	B	10901	10943	10841	10904	10	100	
9-13-1993	18:27:39	V	RW PSA	V	11073	11002	11051	11029	10	100	
9-13-1993	18:28:21		SKYLAST	U	5914	0	0	0	10	100	
9-13-1993	18:28:31		SKYLAST	B	10636	0	0	0	10	100	
9-13-1993	18:28:42		SKYLAST	V	10727	0	0	0	10	100	
9-13-1993	18:29:41	V	RW PSA	U	5972	5946	5964	5930	10	100	
9-13-1993	18:30:21	V	RW PSA	B	10972	10965	10955	10936	10	100	
9-13-1993	18:31: 2	V	RW PSA	V	10949	10985	10912	10959	10	100	
9-13-1993	18:31:44		SKYLAST	U	5926	0	0	0	10	100	
9-13-1993	18:31:55		SKYLAST	B	10553	0	0	0	10	100	
9-13-1993	18:32: 5		SKYLAST	V	10582	0	0	0	10	100	
9-13-1993	18:34:12	F	HD210299	U	6057	6088	6030	6087	10	100	
9-13-1993	18:34:52	F	HD210299	B	11762	11738	11780	11775	10	100	
9-13-1993	18:35:33	F	HD210299	V	11664	11754	11730	11800	10	100	
9-13-1993	18:36:21		SKYLAST	U	5931	0	0	0	10	100	
9-13-1993	18:36:31		SKYLAST	B	10543	0	0	0	10	100	
9-13-1993	18:36:42		SKYLAST	V	10083	0	0	0	10	100	
9-13-1993	18:38:44	V	RW PSA	U	5951	5945	5931	5952	10	100	
9-13-1993	18:39:25	V	RW PSA	B	10903	10792	10923	10888	10	100	
9-13-1993	18:40: 5	V	RW PSA	V	11711	11757	11812	11755	10	100	
9-13-1993	18:40:59		SKYLAST	U	5909	0	0	0	10	100	
9-13-1993	18:41: 9		SKYLAST	B	10399	0	0	0	10	100	
9-13-1993	18:41:20		SKYLAST	V	11485	0	0	0	10	100	
9-13-1993	18:44:50	V	RW PSA	U	5987	5953	5934	5965	10	100	
9-13-1993	18:45:30	V	RW PSA	B	10901	10824	10842	10801	10	100	
9-13-1993	18:46:11	V	RW PSA	V	11643	11657	11672	11670	10	100	
9-13-1993	18:46:52		SKYLAST	U	5929	0	0	0	10	100	
9-13-1993	18:47: 2		SKYLAST	B	10456	0	0	0	10	100	
9-13-1993	18:47:13		SKYLAST	V	11437	0	0	0	10	100	
9-13-1993	18:47:58	V	RW PSA	U	5988	5966	5952	5972	10	100	
9-13-1993	18:48:39	V	RW PSA	B	10719	10723	10698	10653	10	100	
9-13-1993	18:49:19	V	RW PSA	V	11554	11591	11569	11635	10	100	
9-13-1993	18:50: 1		SKYLAST	U	5922	0	0	0	10	100	
9-13-1993	18:50:12		SKYLAST	B	10255	0	0	0	10	100	
9-13-1993	18:50:22		SKYLAST	V	11237	0	0	0	10	100	
9-13-1993	18:51:16	V	RW PSA	U	6047	6126	6191	6199	10	100	
9-13-1993	18:51:56	V	RW PSA	B	10951	10932	10895	10908	10	100	
9-13-1993	18:52:37	V	RW PSA	V	11599	11641	11700	11535	10	100	

9-13-1993	16:53:14		SKYLAST	U	5942	0	0	0	10	100
9-13-1993	18:53:25		SKYLAST	B	10337	0	0	0	10	100
9-13-1993	16:53:35		SKYLAST	V	11414	0	0	0	10	100
9-13-1993	16:55:31	F	HD210299	U	6126	6125	6142	6139	10	100
9-13-1993	18:56:11	F	HD210299	B	11639	11616	11619	11616	10	100
9-13-1993	18:56:52	F	HD210299	V	11955	11960	11995	11957	10	100
9-13-1993	18:57:30		SKYLAST	U	5950	0	0	0	10	100
9-13-1993	18:57:40		SKYLAST	B	10339	0	0	0	10	100
9-13-1993	18:57:51		SKYLAST	V	11342	0	0	0	10	100
9-13-1993	19: 1:15	F	HD210427	U	6159	6127	6120	6156	10	100
9-13-1993	19: 1:56	F	HD210427	B	11810	11714	11779	11783	10	100
9-13-1993	19: 2:36	F	HD210427	V	12079	12147	12035	12047	10	100
9-13-1993	19: 3:19		SKYLAST	U	5946	0	0	0	10	100
9-13-1993	19: 3:30		SKYLAST	B	10285	0	0	0	10	100
9-13-1993	19: 3:40		SKYLAST	V	11255	0	0	0	10	100
9-13-1993	19: 4:37	V	RW PSA	U	6015	6011	5988	6007	10	100
9-13-1993	19: 5:17	V	RW PSA	B	10838	10511	10769	10766	10	100
9-13-1993	19: 5:58	V	RW PSA	V	11565	11532	11612	11576	10	100
9-13-1993	19: 6:13		SKYLAST	U	5952	0	0	0	10	100
9-13-1993	19: 9:23		SKYLAST	B	10297	0	0	0	10	100
9-13-1993	19: 8:34		SKYLAST	V	11156	0	0	0	10	100
9-13-1993	19:10:11	V	RW PSA	U	6009	6040	6065	6030	10	100
9-13-1993	19:10:51	V	RW PSA	B	10779	10817	10799	10833	10	100
9-13-1993	19:14: 9	V	RW PSA	V	11563	11606	11605	11631	10	100
9-13-1993	19:14:59		SKYLAST	U	6016	0	0	0	10	100
9-13-1993	19:15: 9		SKYLAST	B	10252	0	0	0	10	100
9-13-1993	19:15:19		SKYLAST	V	11234	0	0	0	10	100
9-13-1993	19:16:31	V	RW PSA	U	6054	6069	6065	6071	10	100
9-13-1993	19:17:11	V	RW PSA	B	10773	10747	10802	10743	10	100
9-13-1993	19:17:52	V	RW PSA	V	11483	11451	11431	11503	10	100
9-13-1993	19:19: 4		SKYLAST	U	6008	0	0	0	10	100
9-13-1993	19:19:14		SKYLAST	B	10093	0	0	0	10	100
9-13-1993	19:19:24		SKYLAST	V	11000	0	0	0	10	100
9-13-1993	19:20:26	V	RW PSA	U	6065	6035	6041	6015	10	100
9-13-1993	19:21: 6	V	RW PSA	B	10708	10636	10666	10676	10	100
9-13-1993	19:21:47	V	RW PSA	V	11356	11375	11443	11457	10	100
9-13-1993	19:22:36		SKYLAST	U	5983	0	0	0	10	100
9-13-1993	19:22:47		SKYLAST	B	10046	0	0	0	10	100
9-13-1993	19:22:57		SKYLAST	V	10929	0	0	0	10	100
9-13-1993	19:24:17	F	HD210299	U	6141	6143	6174	6176	10	100
9-13-1993	19:24:56	F	HD210299	B	11274	11315	11273	11342	10	100
9-13-1993	19:25:38	F	HD210299	V	11547	11495	11493	11570	10	100
9-13-1993	19:26:36		SKYLAST	U	6071	0	0	0	10	100
9-13-1993	19:26:47		SKYLAST	B	10123	0	0	0	10	100
9-13-1993	19:26:57		SKYLAST	V	10976	0	0	0	10	100
9-13-1993	19:28:19	V	RW PSA	U	6055	6056	6056	6068	10	100
9-13-1993	19:28:60	V	RW PSA	B	10574	10632	10650	10593	10	100
9-13-1993	19:29:40	V	RW PSA	V	11292	11275	11285	11218	10	100
9-13-1993	19:30:29		SKYLAST	U	6124	0	0	0	10	100
9-13-1993	19:30:40		SKYLAST	B	10152	0	0	0	10	100
9-13-1993	19:30:50		SKYLAST	V	11042	0	0	0	10	100
9-13-1993	19:31:49	V	RW PSA	U	6123	6095	6101	6098	10	100
9-13-1993	19:32:29	V	RW PSA	B	10680	10650	10703	10706	10	100
9-13-1993	19:33:10	V	RW PSA	V	11364	11425	11394	11302	10	100
9-13-1993	19:34:10		SKYLAST	U	6029	0	0	0	10	100
9-13-1993	19:34:21		SKYLAST	B	10109	0	0	0	10	100
9-13-1993	19:34:31		SKYLAST	V	10974	0	0	0	10	100
9-13-1993	19:35:52	V	RW PSA	U	6053	6094	6092	6092	10	100
9-13-1993	19:36:32	V	RW PSA	B	10677	10731	10686	10627	10	100
9-13-1993	19:37:13	V	RW PSA	V	11337	11352	11388	11363	10	100
9-13-1993	19:38: 6		SKYLAST	U	5990	0	0	0	10	100
9-13-1993	19:38:16		SKYLAST	B	9992	0	0	0	10	100
9-13-1993	19:38:27		SKYLAST	V	10932	0	0	0	10	100
9-13-1993	19:39:22	V	RW PSA	U	6095	6112	6095	6073	10	100
9-13-1993	19:40: 2	V	RW PSA	B	10565	10556	10593	10606	10	100
9-13-1993	19:40:43	V	RW PSA	V	11291	11308	11323	11393	10	100
9-13-1993	19:41:44		SKYLAST	U	6030	[illegible]	[illegible]	[illegible]	[illegible]	100

9-13-1993	19:41:54		SKYLAST	B	10071	0	0	0	10	100
9-13-1993	19:42: 5		SKYLAST	V	11074	0	0	0	10	100
9-13-1993	19:49:47	F	HD213457	U	770	773	769	769	10	10
9-13-1993	19:50:28	F	HD213457	B	3420	3416	3427	3414	10	10
9-13-1993	19:51: 9	F	HD213457	V	2928	2935	2927	2934	10	10
9-13-1993	19:51:53		SKYLAST	U	580	0	0	0	10	10
9-13-1993	19:52: 3	M	SKYLAST	B	956	0	0	0	10	10
9-13-1993	19:52:14	M	SKYLAST	V	1057	0	0	0	10	10
9-13-1993	19:56: 5	F	HD210299	U	6301	6249	6233	6262	10	100
9-13-1993	19:56:45	F	HD210299	B	11396	11365	11376	11325	10	100
9-13-1993	19:57:26	F	HD210299	V	11703	11629	11020	11739	10	100
9-13-1993	19:58: 7		SKYLAST	U	6023	0	0	0	10	100
9-13-1993	19:58:18		SKYLAST	B	10033	0	0	0	10	100
9-13-1993	19:58:28		SKYLAST	V	11011	0	0	0	10	100
9-13-1993	19:59:25	V	RW PSA	U	6119	6129	6127	6123	10	100
9-13-1993	20: 0: 5	V	RW PSA	B	10718	10692	10661	10696	10	100
9-13-1993	20: 0:46	V	RW PSA	V	11383	11367	11377	11249	10	100
9-13-1993	20: 1:37		SKYLAST	U	6059	0	0	0	10	100
9-13-1993	20: 1:47		SKYLAST	B	9965	0	0	0	10	100
9-13-1993	20: 1:58		SKYLAST	V	11116	0	0	0	10	100
9-13-1993	20: 2:48	V	RW PSA	U	6150	6137	6137	6134	10	100
9-13-1993	20: 3:29	V	RW PSA	B	10737	10727	10766	10759	10	100
9-13-1993	20: 4: 9	V	RW PSA	V	11458	11416	11439	11512	10	100
9-13-1993	20: 5: 7		SKYLAST	U	6052	0	0	0	10	100
9-13-1993	20: 5:17		SKYLAST	B	9947	0	0	0	10	100
9-13-1993	20: 5:28		SKYLAST	V	10924	0	0	0	10	100
9-13-1993	20: 6:24	V	RW PSA	U	6139	6173	6139	6165	10	100
9-13-1993	20: 7: 5	V	RW PSA	B	10760	10690	10809	10760	10	100
9-13-1993	20: 7:45	V	RW PSA	V	11354	11271	11255	11315	10	100
9-13-1993	20: 8:26		SKYLAST	U	6066	0	0	0	10	100
9-13-1993	20: 8:37		SKYLAST	B	9978	0	0	0	10	100
9-13-1993	20: 8:47		SKYLAST	V	10786	0	0	0	10	100
9-13-1993	20: 9:46	V	RW PSA	U	6132	6147	6120	6139	10	100
9-13-1993	20:10:27	V	RW PSA	B	10643	10636	10561	10622	10	100
9-13-1993	20:11: 7	V	RW PSA	V	11148	11071	11118	11176	10	100
9-13-1993	20:11:58		SKYLAST	U	6057	0	0	0	10	100
9-13-1993	20:12: 8		SKYLAST	B	9879	0	0	0	10	100
9-13-1993	20:12:19		SKYLAST	V	10710	0	0	0	10	100
9-13-1993	20:13:48	F	HD210299	U	6271	6274	6276	6238	10	100
9-13-1993	20:14:28	F	HD210299	B	11244	11242	11172	11240	10	100
9-13-1993	20:15: 9	F	HD210299	V	11607	11542	11626	11570	10	100
9-13-1993	20:16: 5		SKYLAST	U	6086	0	0	0	10	100
9-13-1993	20:16:15		SKYLAST	B	9843	0	0	0	10	100
9-13-1993	20:16:26		SKYLAST	V	10689	0	0	0	10	100
9-13-1993	20:17:52	V	RW PSA	U	6119	6155	6144	6138	10	100
9-13-1993	20:18:32	V	RW PSA	B	10480	10503	10400	10493	10	100
9-13-1993	20:19:13	V	RW PSA	V	10990	11055	10948	11017	10	100
9-13-1993	20:20: 4		SKYLAST	U	6038	0	0	0	10	100
9-13-1993	20:20:15		SKYLAST	B	9730	0	0	0	10	100
9-13-1993	20:20:25		SKYLAST	V	10716	0	0	0	10	100
9-13-1993	20:21:37	V	RW PSA	U	6143	6183	6141	6147	10	100
9-13-1993	20:22:18	V	RW PSA	B	10325	10385	10342	10351	10	100
9-13-1993	20:22:58	V	RW PSA	V	10895	10838	10899	10868	10	100
9-13-1993	20:23:58		SKYLAST	U	6067	0	0	0	10	100
9-13-1993	20:24: 8		SKYLAST	B	9657	0	0	0	10	100
9-13-1993	20:24:19		SKYLAST	V	10487	0	0	0	10	100
9-13-1993	20:25:23	V	RW PSA	U	6201	6187	6156	6142	10	100
9-13-1993	20:26: 4	V	RW PSA	B	10399	10401	10453	10404	10	100
9-13-1993	20:26:44	V	RW PSA	V	10920	10926	10951	10904	10	100
9-13-1993	20:28:14		SKYLAST	U	6078	0	0	0	10	100
9-13-1993	20:28:24		SKYLAST	B	9768	0	0	0	10	100
9-13-1993	20:28:35		SKYLAST	V	10565	0	0	0	10	100
9-13-1993	20:29:44	V	RW PSA	U	6143	6163	6177	6192	10	100
9-13-1993	20:30:25	V	RW PSA	B	10412	10413	10378	10357	10	100
9-13-1993	20:31: 5	V	RW PSA	V	11028	10936	11048	10938	10	100
9-13-1993	20:32: 2		SKYLAST	U	6109	0	0	0	10	100
9-13-1993	20:32:13		SKYLAST	B	9731	0	0	0	10	100

9-13-1993	20:32:23		SKYLAST	V	10484	0	0	0	10	100
9-13-1993	20:35:15	F	HD210299	U	6266	6262	6293	6281	10	100
9-13-1993	20:35:55	F	HD210299	B	11062	11010	11048	11084	10	100
9-13-1993	20:36:36	F	HD210299	V	11079	11104	11131	11157	10	100
9-13-1993	20:37:26		SKYLAST	U	6063	0	0	0	10	100
9-13-1993	20:37:38		SKYLAST	B	9681	0	0	0	10	100
9-13-1993	20:37:49		SKYLAST	V	10461	0	0	0	10	100
9-13-1993	20:39:26	F	HD210427	U	6302	6301	6286	6305	10	100
9-13-1993	20:40: 6	F	HD210427	B	11211	11169	11203	11220	10	100
9-13-1993	20:40:47	F	HD210427	V	11294	11352	11300	11323	10	100
9-13-1993	20:41:39		SKYLAST	U	6075	0	0	0	10	100
9-13-1993	20:41:50		SKYLAST	B	9717	0	0	0	10	100
9-13-1993	20:42: 0		SKYLAST	V	10507	0	0	0	10	100
9-13-1993	20:43:33	V	RW PSA	U	6194	6192	6188	6153	10	100
9-13-1993	20:44:14	V	RW PSA	B	10388	10459	10475	10331	10	100
9-13-1993	20:44:54	V	RW PSA	V	10838	10860	10871	10850	10	100
9-13-1993	20:45:47		SKYLAST	U	6122	0	0	0	10	100
9-13-1993	20:45:57		SKYLAST	B	9694	0	0	0	10	100
9-13-1993	20:46: 8		SKYLAST	V	10456	0	0	0	10	100
9-13-1993	20:47:30	V	RW PSA	U	6165	6182	6167	6183	10	100
9-13-1993	20:48:10	V	RW PSA	B	10407	10378	10416	10442	10	100
9-13-1993	20:48:51	V	RW PSA	V	10863	10902	10902	10865	10	100
9-13-1993	20:49:39		SKYLAST	U	6098	0	0	0	10	100
9-13-1993	20:49:50		SKYLAST	B	9664	0	0	0	10	100
9-13-1993	20:50: 0		SKYLAST	V	10499	0	0	0	10	100
9-13-1993	20:51:15	V	RW PSA	U	6196	6173	6179	6201	10	100
9-13-1993	20:51:56	V	RW PSA	B	10375	10267	10363	10368	10	100
9-13-1993	20:52:36	V	RW PSA	V	10866	10941	10868	10877	10	100
9-13-1993	20:53:25		SKYLAST	U	6108	0	0	0	10	100
9-13-1993	20:53:35		SKYLAST	B	9721	0	0	0	10	100
9-13-1993	20:53:46		SKYLAST	V	10399	0	0	0	10	100
9-13-1993	20:54:43	V	RW PSA	U	6169	6150	6171	6179	10	100
9-13-1993	20:55:23	V	RW PSA	B	10260	10328	10309	10311	10	100
9-13-1993	20:56: 4	V	RW PSA	V	10814	10807	10825	10763	10	100
9-13-1993	20:56:53		SKYLAST	U	6077	0	0	0	10	100
9-13-1993	20:57: 3		SKYLAST	B	9567	0	0	0	10	100
9-13-1993	20:57:14		SKYLAST	V	10321	0	0	0	10	100
9-13-1993	20:58:43	F	HD210299	U	6352	6311	6310	6315	10	100
9-13-1993	20:59:24	F	HD210299	B	10974	11019	11036	11043	10	100
9-13-1993	21: 0: 4	F	HD210299	V	11081	11075	11062	11079	10	100
9-13-1993	21: 1:14		SKYLAST	U	6103	0	0	0	10	100
9-13-1993	21: 1:24		SKYLAST	B	9658	0	0	0	10	100
9-13-1993	21: 1:35		SKYLAST	V	10510	0	0	0	10	100
9-13-1993	21: 3: 3	V	RW PSA	U	6174	6184	6186	6213	10	100
9-13-1993	21: 3:43	V	RW PSA	B	10454	10325	10385	10352	10	100
9-13-1993	21: 4:24	V	RW PSA	V	10849	10790	10791	10852	10	100
9-13-1993	21: 5:12		SKYLAST	U	6092	0	0	0	10	100
9-13-1993	21: 5:23		SKYLAST	B	9602	0	0	0	10	100
9-13-1993	21: 5:33		SKYLAST	V	10462	0	0	0	10	100
9-13-1993	21: 6:29	V	RW PSA	U	6191	6210	6180	6150	10	100
9-13-1993	21: 7:10	V	RW PSA	B	10401	10347	10358	10346	10	100
9-13-1993	21: 7:50	V	RW PSA	V	10969	10969	10957	10974	10	100
9-13-1993	21: 8:37		SKYLAST	U	6120	0	0	0	10	100
9-13-1993	21: 8:48		SKYLAST	B	9756	0	0	0	10	100
9-13-1993	21: 8:58		SKYLAST	V	10641	0	0	0	10	100
9-13-1993	21:10: 9	V	RW PSA	U	6196	6211	6184	6224	10	100
9-13-1993	21:10:49	V	RW PSA	B	10398	10350	10375	10365	10	100
9-13-1993	21:11:30	V	RW PSA	V	10986	10956	10992	10867	10	100
9-13-1993	21:12:32		SKYLAST	U	6099	0	0	0	10	100
9-13-1993	21:12:43		SKYLAST	B	9686	0	0	0	10	100
9-13-1993	21:12:53		SKYLAST	V	10473	0	0	0	10	100
9-13-1993	21:13:52	V	RW PSA	U	6229	6222	6167	6239	10	100
9-13-1993	21:14:32	V	RW PSA	B	10464	10388	10357	10385	10	100
9-13-1993	21:15:13	V	RW PSA	V	10821	10789	10858	10914	10	100
9-13-1993	21:16:11		SKYLAST	U	6101	0	0	0	10	100
9-13-1993	21:16:22		SKYLAST	B	9722	0	0	0	10	100
9-13-1993	21:16:32		SKYLAST	V	10478	0	0	0	10	100

9-13-1993	21:20: 7	F	HD213457	U	804	802	797	801	10	10
9-13-1993	21:20:47	F	HD213457	B	3547	3511	3531	3510	10	10
9-13-1993	21:21:28	F	HD213457	V	2933	2962	2957	2950	10	10
9-13-1993	21:22:12		SKYLAST	U	587	0	0	0	10	10
9-13-1993	21:22:23	M	SKYLAST	B	922	0	0	0	10	10
9-13-1993	21:22:33	M	SKYLAST	V	1020	0	0	0	10	10
9-13-1993	21:26:32	F	HD210299	U	6349	6332	6346	6386	10	100
9-13-1993	21:27:12	F	HD210299	B	11148	11030	11048	11099	10	100
9-13-1993	21:27:53	F	HD210299	V	11171	11289	11242	11284	10	100
9-13-1993	21:28:49		SKYLAST	U	6121	0	0	0	10	100
9-13-1993	21:28:59		SKYLAST	B	9908	0	0	0	10	100
9-13-1993	21:29:10		SKYLAST	V	11305	0	0	0	10	100
9-13-1993	21:30:31	V	RW PSA	U	6209	6196	6222	6214	10	100
9-13-1993	21:31:11	V	RW PSA	B	10368	10368	10396	10400	10	100
9-13-1993	21:34:18	V	RW PSA	V	11244	11269	11342	11261	10	100
9-13-1993	21:35:10		SKYLAST	U	6150	0	0	0	10	100
9-13-1993	21:35:20		SKYLAST	B	9976	0	0	0	10	100
9-13-1993	21:35:31		SKYLAST	V	11076	0	0	0	10	100
9-13-1993	21:36:35	V	RW PSA	U	6212	6216	6191	6219	10	100
9-13-1993	21:37:15	V	RW PSA	B	10449	10446	10500	10396	10	100
9-13-1993	21:37:56	V	RW PSA	V	11223	11234	11276	11259	10	100
9-13-1993	21:39:20		SKYLAST	U	6146	0	0	0	10	100
9-13-1993	21:39:30		SKYLAST	B	9879	0	0	0	10	100
9-13-1993	21:39:41		SKYLAST	V	10719	0	0	0	10	100
9-13-1993	21:40:59	V	RW PSA	U	6215	6266	6240	6239	10	100
9-13-1993	21:41:40	V	RW PSA	B	10411	10441	10355	10462	10	100
9-13-1993	21:44:22	V	RW PSA	V	10925	10899	10943	10546	10	100
9-13-1993	21:45:20		SKYLAST	U	6158	0	0	0	10	100
9-13-1993	21:45:30		SKYLAST	B	9700	0	0	0	10	100
9-13-1993	21:45:41		SKYLAST	V	10526	0	0	0	10	100
9-13-1993	21:46:47	V	RW PSA	U	6248	6254	6253	6254	10	100
9-13-1993	21:47:26	V	RW PSA	B	10405	10349	10366	10391	10	100
9-13-1993	21:48: 8	V	RW PSA	V	10880	10933	10922	10894	10	100
9-13-1993	21:48:59		SKYLAST	U	6145	0	0	0	10	100
9-13-1993	21:49: 9		SKYLAST	B	9729	0	0	0	10	100
9-13-1993	21:49:20		SKYLAST	V	10565	0	0	0	10	100
9-13-1993	21:50:40	F	HD210299	U	6376	6376	6401	6399	10	100
9-13-1993	21:51:21	F	HD210299	B	11146	11144	11122	11093	10	100
9-13-1993	21:52: 1	F	HD210299	V	11155	11115	11134	11211	10	100
9-13-1993	21:53:17		SKYLAST	U	6178	0	0	0	10	100
9-13-1993	21:53:28		SKYLAST	B	9791	0	0	0	10	100
9-13-1993	21:53:38		SKYLAST	V	10502	0	0	0	10	100
9-13-1993	21:54:57	V	RW PSA	U	6252	6233	6275	6271	10	100
9-13-1993	21:55:38	V	RW PSA	B	10442	10445	10431	10415	10	100
9-13-1993	21:59:54	V	RW PSA	V	10885	10866	10893	10865	10	100
9-13-1993	22: 0:58		SKYLAST	U	6220	0	0	0	10	100
9-13-1993	22: 1: 8		SKYLAST	B	9735	0	0	0	10	100
9-13-1993	22: 1:19		SKYLAST	V	10557	0	0	0	10	100
9-13-1993	22: 2:37	V	RW PSA	U	6257	6264	6279	6270	10	100
9-13-1993	22: 3:17	V	RW PSA	B	10299	10349	10430	10336	10	100
9-13-1993	22: 3:58	V	RW PSA	V	10873	10847	10844	10934	10	100
9-13-1993	22: 5: 3		SKYLAST	U	6197	0	0	0	10	100
9-13-1993	22: 5:14		SKYLAST	B	9866	0	0	0	10	100
9-13-1993	22: 5:24		SKYLAST	V	10596	0	0	0	10	100
9-13-1993	22: 6:32	V	RW PSA	U	6273	6257	6274	6283	10	100
9-13-1993	22: 7:13	V	RW PSA	B	10319	10302	10375	10306	10	100
9-13-1993	22: 7:53	V	RW PSA	V	10836	10807	10873	10847	10	100
9-13-1993	22: 8:43		SKYLAST	U	6221	0	0	0	10	100
9-13-1993	22: 8:53		SKYLAST	B	9804	0	0	0	10	100
9-13-1993	22: 9: 3		SKYLAST	V	10506	0	0	0	10	100
9-13-1993	22:10: 0	V	RW PSA	U	6258	6294	6303	6273	10	100
9-13-1993	22:10:41	V	RW PSA	B	10299	10366	10330	10352	10	100
9-13-1993	22:11:21	V	RW PSA	V	10867	10802	10934	10966	10	100
9-13-1993	22:12:14		SKYLAST	U	6222	0	0	0	10	100
9-13-1993	22:12:24		SKYLAST	B	9898	0	0	0	10	100
9-13-1993	22:12:35		SKYLAST	V	10658	0	0	0	10	100
9-13-1993	22:14: 9	F	HD210299	U	6401	6420	6465	6454	10	100

9-13-1993	22:14:50	F	HD210299	B	11250	11246	11244	11294	10	100
9-13-1993	22:15:30	F	HD210299	V	11430	11410	11400	11406	10	100
9-13-1993	22:16:55		SKYLAST	U	6217	0	0	0	10	100
9-13-1993	22:17: 6		SKYLAST	B	9934	0	0	0	10	100
9-13-1993	22:17:16		SKYLAST	V	10776	0	0	0	10	100
9-13-1993	22:18:42	F	HD210427	U	6423	6400	6409	6441	10	100
9-13-1993	22:19:22	F	HD210427	B	11408	11414	11389	11316	10	100
9-13-1993	22:20: 3	F	HD210427	V	11508	11564	11484	11517	10	100
9-13-1993	22:21: 1		SKYLAST	U	6199	0	0	0	10	100
9-13-1993	22:21:11		SKYLAST	B	9582	0	0	0	10	100
9-13-1993	22:21:22		SKYLAST	V	10701	0	0	0	10	100
9-13-1993	22:23: 6	V	RW PSA	U	6281	6279	6295	6286	10	100
9-13-1993	22:23:47	V	RW PSA	B	10402	10366	10454	10388	10	100
9-13-1993	22:24:27	V	RW PSA	V	11069	11034	11094	11065	10	100
9-13-1993	22:25:34		SKYLAST	U	6227	0	0	0	10	100
9-13-1993	22:25:44		SKYLAST	B	9980	0	0	0	10	100
9-13-1993	22:25:55		SKYLAST	V	10504	0	0	0	10	100
9-13-1993	22:26:54	V	RW PSA	U	6315	6299	6253	6296	10	100
9-13-1993	22:27:35	V	RW PSA	B	10436	10485	10435	10492	10	100
9-13-1993	22:28:15	V	RW PSA	V	11333	11358	11239	11258	10	100
9-13-1993	22:29:15		SKYLAST	U	6239	0	0	0	10	100
9-13-1993	22:29:26		SKYLAST	B	10022	0	0	0	10	100
9-13-1993	22:29:36		SKYLAST	V	11088	0	0	0	10	100
9-13-1993	22:30:45	V	RW PSA	U	6293	6290	6333	6334	10	100
9-13-1993	22:31:25	V	RW PSA	B	10478	10519	10545	10520	10	100
9-13-1993	22:32: 6	V	RW PSA	V	11530	11535	11459	11552	10	100
9-13-1993	22:32:57		SKYLAST	U	6284	0	0	0	10	100
9-13-1993	22:33: 6		SKYLAST	B	10126	0	0	0	10	100
9-13-1993	22:33:18		SKYLAST	V	11350	0	0	0	10	100
9-13-1993	22:34: 9	V	RW PSA	U	6311	6325	6327	6313	10	100
9-13-1993	22:34:50	V	RW PSA	B	10496	10566	10531	10554	10	100
9-13-1993	22:36:52	V	RW PSA	V	11337	11322	11394	11500	10	100
9-13-1993	22:37:38		SKYLAST	U	6250	0	0	0	10	100
9-13-1993	22:37:48		SKYLAST	B	10098	0	0	0	10	100
9-13-1993	22:37:59		SKYLAST	V	11159	0	0	0	10	100
9-13-1993	22:38:55	F	HD210299	U	6501	6444	6493	6456	10	100
9-13-1993	22:39:35	F	HD210299	B	11446	11396	11355	11385	10	100
9-13-1993	22:40:16	F	HD210299	V	11746	11673	11619	11545	10	100
9-13-1993	22:41: 2		SKYLAST	U	6265	0	0	0	10	100
9-13-1993	22:41:12		SKYLAST	B	10056	0	0	0	10	100
9-13-1993	22:41:23		SKYLAST	V	11076	0	0	0	10	100
9-13-1993	22:42:50	V	RW PSA	U	6321	6314	6329	6336	10	100
9-13-1993	22:43:30	V	RW PSA	B	10496	10468	10441	10490	10	100
9-13-1993	22:44:11	V	RW PSA	V	11220	11290	11230	11311	10	100
9-13-1993	22:44:59		SKYLAST	U	6237	0	0	0	10	100
9-13-1993	22:45:10		SKYLAST	B	10102	0	0	0	10	100
9-13-1993	22:45:20		SKYLAST	V	11070	0	0	0	10	100
9-13-1993	22:46: 6	V	RW PSA	U	6349	6352	6315	6333	10	100
9-13-1993	22:46:46	V	RW PSA	B	10690	10589	10671	10634	10	100
9-13-1993	22:47:27	V	RW PSA	V	11742	11805	11755	11620	10	100
9-13-1993	22:48:21		SKYLAST	U	6301	0	0	0	10	100
9-13-1993	22:48:31		SKYLAST	B	10210	0	0	0	10	100
9-13-1993	22:48:42		SKYLAST	V	11310	0	0	0	10	100
9-13-1993	22:49:58	V	RW PSA	U	6336	6320	6338	6327	10	100
9-13-1993	22:50:38	V	RW PSA	B	10531	10522	10530	10532	10	100
9-13-1993	22:51:19	V	RW PSA	V	11189	11329	11332	11228	10	100
9-13-1993	22:52: 4		SKYLAST	U	6282	0	0	0	10	100
9-13-1993	22:52:14		SKYLAST	B	10150	0	0	0	10	100
9-13-1993	22:52:25		SKYLAST	V	11048	0	0	0	10	100
9-13-1993	22:53:22	V	RW PSA	U	5559	5276	5278	5279	10	100
9-13-1993	22:54: 2	V	RW PSA	B	5278	5276	5278	5280	10	100
9-13-1993	22:54:43	V	RW PSA	V	5279	5279	5279	5279	10	100
9-13-1993	22:57:55	V	RW PSA	U	6334	6339	6355	6358	10	100
9-13-1993	22:58:36		SKYLAST	B	10663	10701	10672	10669	10	100
9-13-1993	22:59:16		SKYLAST	V	11500	11566	11493	11514	10	100
9-13-1993	23: 5:23	F	HD213457	U	808	805	805	808	10	10
9-13-1993	23: 6: 3	F	HD213457	B	3536	3550	3537	3546	10	10

9-13-1993	23: 6:44	F	HD213457	V	2985	2975	2976	2967	10	10
9-13-1993	23: 7:23		SKYLAST	U	606	0	0	0	10	10
9-13-1993	23: 7:34	M	SKYLAST	B	973	0	0	0	10	10
9-13-1993	23: 7:44	M	SKYLAST	V	1065	0	0	0	10	10
9-13-1993	23:10:50	F	HD210299	U	6495	6523	6539	6537	10	100
9-13-1993	23:11:31	F	HD210299	B	11667	11627	11726	11682	10	100
9-13-1993	23:12:11	F	HD210299	V	12053	12034	12051	12057	10	100
9-13-1993	23:12:59		SKYLAST	U	6346	0	0	0	10	100
9-13-1993	23:13:10		SKYLAST	B	10491	0	0	0	10	100
9-13-1993	23:13:20		SKYLAST	V	11444	0	0	0	10	100
9-13-1993	23:15:37	V	RW PSA	U	6399	6421	6404	6404	10	100
9-13-1993	23:16:17	V	RW PSA	B	11022	10945	10932	10905	10	100
9-13-1993	23:16:58	V	RW PSA	V	11531	11536	11639	11828	10	100
9-13-1993	23:17:51		SKYLAST	U	6351	0	0	0	10	100
9-13-1993	23:18: 2		SKYLAST	B	10555	0	0	0	10	100
9-13-1993	23:18:12		SKYLAST	V	11577	0	0	0	10	100
9-13-1993	23:19:18	V	RW PSA	U	6425	6415	6402	6410	10	100
9-13-1993	23:19:59	V	RW PSA	B	11057	11056	11038	11062	10	100
9-13-1993	23:20:39	V	RW PSA	V	11917	11837	11902	11916	10	100
9-13-1993	23:21:35		SKYLAST	U	6380	0	0	0	10	100
9-13-1993	23:21:46		SKYLAST	B	10534	0	0	0	10	100
9-13-1993	23:21:56		SKYLAST	V	11600	0	0	0	10	100
9-13-1993	23:22:52	V	RW PSA	U	6415	6409	6419	6411	10	100
9-13-1993	23:23:32	V	RW PSA	B	11084	11210	11172	11194	10	100
9-13-1993	23:24:13	V	RW PSA	V	11996	11967	12044	11952	10	100
9-13-1993	23:26:52		SKYLAST	U	6368	0	0	0	10	100
9-13-1993	23:27: 2		SKYLAST	B	10659	0	0	0	10	100
9-13-1993	23:27:13		SKYLAST	V	11729	0	0	0	10	100
9-13-1993	23:28:17	V	RW PSA	U	6435	6447	6437	6435	10	100
9-13-1993	23:28:56	V	RW PSA	B	11164	11173	11310	11220	10	100
9-13-1993	23:29:36	V	RW PSA	V	12162	12107	12060	12092	10	100
9-13-1993	23:30:44		SKYLAST	U	6401	0	0	0	10	100
9-13-1993	23:30:54		SKYLAST	B	10670	0	0	0	10	100
9-13-1993	23:31: 5		SKYLAST	V	11530	0	0	0	10	100
9-13-1993	23:32:18	F	HD210299	U	6525	6533	6542	6553	10	100
9-13-1993	23:32:59	F	HD210299	B	11809	11900	11842	11873	10	100
9-13-1993	23:33:39	F	HD210299	V	12395	12378	12459	12415	10	100
9-13-1993	23:34:22		SKYLAST	U	6377	0	0	0	10	100
9-13-1993	23:34:32		SKYLAST	B	10724	0	0	0	10	100
9-13-1993	23:34:43		SKYLAST	V	11755	0	0	0	10	100
9-13-1993	23:35:45	V	RW PSA	U	6425	6459	6451	6501	10	100
9-13-1993	23:36:25	V	RW PSA	B	11227	11243	11287	11283	10	100
9-13-1993	23:37: 6	V	RW PSA	V	12167	12159	12167	12182	10	100
9-13-1993	23:37:42		SKYLAST	U	6364	0	0	0	10	100
9-13-1993	23:37:52		SKYLAST	B	10744	0	0	0	10	100
9-13-1993	23:38: 3		SKYLAST	V	11508	0	0	0	10	100
9-13-1993	23:38:54	V	RW PSA	U	6465	6474	6480	6481	10	100
9-13-1993	23:39:35	V	RW PSA	B	11354	11382	11321	11372	10	100
9-13-1993	23:40:15	V	RW PSA	V	12338	12360	12298	12212	10	100
9-13-1993	23:40:52		SKYLAST	U	6407	0	0	0	10	100
9-13-1993	23:41: 2		SKYLAST	B	10800	0	0	0	10	100
9-13-1993	23:41:13		SKYLAST	V	11960	0	0	0	10	100
9-13-1993	23:42:15	V	RW PSA	U	6461	6482	6456	6473	10	100
9-13-1993	23:42:56	V	RW PSA	B	11382	11324	11361	11492	10	100
9-13-1993	23:43:36	V	RW PSA	V	12413	12353	12418	12330	10	100
9-13-1993	23:44:19		SKYLAST	U	6416	0	0	0	10	100
9-13-1993	23:44:29		SKYLAST	B	10780	0	0	0	10	100
9-13-1993	23:44:40		SKYLAST	V	12022	0	0	0	10	100
9-13-1993	23:45:32	V	RW PSA	U	6473	6504	6441	6463	10	100
9-13-1993	23:46:12	V	RW PSA	B	11446	11499	11465	11528	10	100
9-13-1993	23:46:53	V	RW PSA	V	12393	12384	12464	12406	10	100
9-13-1993	23:47:36		SKYLAST	U	6407	0	0	0	10	100
9-13-1993	23:47:47		SKYLAST	B	10845	0	0	0	10	100
9-13-1993	23:47:57		SKYLAST	V	12074	0	0	0	10	100
9-13-1993	23:48:51	F	HD210299	U	6570	6587	6600	6610	10	100
9-13-1993	23:49:31	F	HD210299	B	12107	12118	12128	12175	10	100
9-13-1993	23:50:12	F	HD210299	V	12776	12674	12772	12527	10	100

9-13-1993	23:50:49		SKYLAST	U	6415	0	0	0	10	100
9-13-1993	23:50:60		SKYLAST	B	10945	0	0	0	10	100
9-13-1993	23:51:10		SKYLAST	V	12117	0	0	0	10	100
9-13-1993	23:52:18	F	HD210427	U	6573	6610	6581	6615	10	100
9-13-1993	23:52:58	F	HD210427	B	12220	12247	12194	12261	10	100
9-13-1993	23:53:39	F	HD210427	V	12984	12962	12979	12959	10	100
9-13-1993	23:54:20		SKYLAST	U	6405	0	0	0	10	100
9-13-1993	23:54:31		SKYLAST	B	10983	0	0	0	10	100
9-13-1993	23:54:41		SKYLAST	V	12160	0	0	0	10	100
9-13-1993	23:55:50	V	RW PSA	U	6516	6491	6515	6510	10	100
9-13-1993	23:56:31	V	RW PSA	B	11693	11689	11654	11697	10	100
9-13-1993	23:57:11	V	RW PSA	V	12782	12779	12786	12704	10	100
9-13-1993	23:57:52		SKYLAST	U	6437	0	0	0	10	100
9-13-1993	23:58: 3		SKYLAST	B	11102	0	0	0	10	100
9-13-1993	23:58:13		SKYLAST	V	12385	0	0	0	10	100
9-13-1993	23:58:57	V	RW PSA	U	6508	6502	6474	6496	10	100
9-13-1993	23:59:38	V	RW PSA	B	11787	11737	11739	11662	10	100
9-14-1993	0: 0:18	V	RW PSA	V	12725	12805	12833	12817	10	100
9-14-1993	0: 0:54		SKYLAST	U	6420	0	0	0	10	100
9-14-1993	0: 1: 4		SKYLAST	B	11136	0	0	0	10	100
9-14-1993	0: 1:14		SKYLAST	V	12450	0	0	0	10	100
9-14-1993	0: 1:54	V	RW PSA	U	6506	6501	6512	6545	10	100
9-14-1993	0: 2:35	V	RW PSA	B	11818	11830	11824	11854	10	100
9-14-1993	0: 4:26	V	RW PSA	V	12798	12838	12533	12812	10	100
9-14-1993	0: 5:16		SKYLAST	U	6481	0	0	0	10	100
9-14-1993	0: 5:27		SKYLAST	B	11151	0	0	0	10	100
9-14-1993	0: 5:37		SKYLAST	V	12432	0	0	0	10	100
9-14-1993	0: 6:16	V	RW PSA	U	6551	6519	6530	6542	10	100
9-14-1993	0: 6:57	V	RW PSA	B	11829	11845	11876	11795	10	100
9-14-1993	0: 7:37	V	RW PSA	V	12995	12917	12958	12936	10	100
9-14-1993	0: 8:21		SKYLAST	U	6436	0	0	0	10	100
9-14-1993	0: 8:31		SKYLAST	B	11274	0	0	0	10	100
9-14-1993	0: 8:42		SKYLAST	V	12637	0	0	0	10	100
9-14-1993	0: 9:30	F	HD210299	U	6631	6669	6635	6640	10	100
9-14-1993	0:10:10	F	HD210299	B	12469	12462	12437	12454	10	100
9-14-1993	0:10:51	F	HD210299	V	13254	13273	13235	13232	10	100
9-14-1993	0:11:29		SKYLAST	U	6466	0	0	0	10	100
9-14-1993	0:11:39		SKYLAST	B	11295	0	0	0	10	100
9-14-1993	0:11:50		SKYLAST	V	12688	0	0	0	10	100
9-14-1993	0:12:51	V	RW PSA	U	6519	6548	6590	6550	10	100
9-14-1993	0:13:31	V	RW PSA	B	11946	12036	11972	11975	10	100
9-14-1993	0:14:12	V	RW PSA	V	12991	13112	13124	13106	10	100
9-14-1993	0:14:56		SKYLAST	U	6454	0	0	0	10	100
9-14-1993	0:15: 6		SKYLAST	B	11401	0	0	0	10	100
9-14-1993	0:15:17		SKYLAST	V	12729	0	0	0	10	100
9-14-1993	0:16:17	V	RW PSA	U	6566	6536	6563	6535	10	100
9-14-1993	0:16:57	V	RW PSA	B	11966	12004	11995	11955	10	100
9-14-1993	0:17:38	V	RW PSA	V	13208	13185	13261	13154	10	100
9-14-1993	0:18:29		SKYLAST	U	6487	0	0	0	10	100
9-14-1993	0:18:39		SKYLAST	B	11230	0	0	0	10	100
9-14-1993	0:18:50		SKYLAST	V	12739	0	0	0	10	100
9-14-1993	0:19:58	V	RW PSA	U	6551	6566	6564	6553	10	100
9-14-1993	0:20:39	V	RW PSA	B	12038	11924	12013	11946	10	100
9-14-1993	0:21:19	V	RW PSA	V	13130	13185	13265	13266	10	100
9-14-1993	0:22: 3		SKYLAST	U	6514	0	0	0	10	100
9-14-1993	0:22:13		SKYLAST	B	11392	0	0	0	10	100
9-14-1993	0:22:24		SKYLAST	V	12933	0	0	0	10	100
9-14-1993	0:23:18	V	RW PSA	U	6539	6546	6561	6546	10	100
9-14-1993	0:23:59	V	RW PSA	B	11995	12056	12101	12074	10	100
9-14-1993	0:24:39	V	RW PSA	V	13306	13357	13374	13392	10	100
9-14-1993	0:25:19		SKYLAST	U	6470	0	0	0	10	100
9-14-1993	0:25:30		SKYLAST	B	11453	0	0	0	10	100
9-14-1993	0:25:40		SKYLAST	V	12901	0	0	0	10	100
9-14-1993	0:30:33	F	HD213457	U	781	787	785	783	10	10
9-14-1993	0:31:14	F	HD213457	B	3362	3398	3378	3387	10	10
9-14-1993	0:31:54	F	HD213457	V	3029	3023	3033	3013	10	10
9-14-1993	0:32:37		SKYLAST	U	617	0	0	0	10	10

9-14-1993	0:32:47	M	SKYLAST	B	1056	0	0	0	10	10
9-14-1993	0:32:55	M	SKYLAST	V	1204	0	0	0	10	10
9-14-1993	0:36:31	F	HD210299	U	657	658	662	661	10	10
9-14-1993	0:37:12	F	HD210299	B	1260	1271	1262	1274	10	10
9-14-1993	0:37:52	F	HD210299	V	1391	1390	1353	1391	10	10
9-14-1993	0:38:28		SKYLAST	U	642	0	0	0	10	10
9-14-1993	0:38:39		SKYLAST	B	1170	0	0	0	10	10
9-14-1993	0:38:49		SKYLAST	V	1344	0	0	0	10	10
9-14-1993	0:40:10	V	RW PSA	U	646	652	653	646	10	10
9-14-1993	0:40:51	V	RW PSA	B	1231	1231	1227	1233	10	10
9-14-1993	0:41:31	V	RW PSA	V	1381	1381	1354	1356	10	10
9-14-1993	0:42: 8		SKYLAST	U	647	0	0	0	10	10
9-14-1993	0:42:18		SKYLAST	B	1173	0	0	0	10	10
9-14-1993	0:42:29		SKYLAST	V	1350	0	0	0	10	10
9-14-1993	0:43:39	V	RW PSA	U	6594	6596	6613	6592	10	100
9-14-1993	0:44:20	V	RW PSA	B	12502	12395	12476	12490	10	100
9-14-1993	0:45: 0	V	RW PSA	V	13956	13942	14032	14079	10	100
9-14-1993	0:45:40		SKYLAST	U	6535	0	0	0	10	100
9-14-1993	0:45:50		SKYLAST	B	11977	0	0	0	10	100
9-14-1993	0:46: 1		SKYLAST	V	13594	0	0	0	10	100
9-14-1993	0:46:48	V	RW PSA	U	6633	6611	6592	6595	10	100
9-14-1993	0:47:28	V	RW PSA	B	12528	12509	12564	12571	10	100
9-14-1993	0:48: 9	V	RW PSA	V	14024	14175	14044	14132	10	100
9-14-1993	0:48:46		SKYLAST	U	6569	0	0	0	10	100
9-14-1993	0:48:59		SKYLAST	B	11995	0	0	0	10	100
9-14-1993	0:49: 9		SKYLAST	V	13724	0	0	0	10	100
9-14-1993	0:49:56	V	RW PSA	U	6623	6624	6624	6632	10	100
9-14-1993	0:50:36	V	RW PSA	B	12590	12586	12553	12583	10	100
9-14-1993	0:51:17	V	RW PSA	V	14230	14154	14150	14190	10	100
9-14-1993	0:52:16		SKYLAST	U	6587	0	0	0	10	100
9-14-1993	0:52:27		SKYLAST	B	12158	0	0	0	10	100
9-14-1993	0:52:37		SKYLAST	V	13955	0	0	0	10	100
9-14-1993	0:54: 7	F	HD210299	U	6691	6695	6691	6696	10	100
9-14-1993	0:54:47	F	HD210299	B	13173	13235	13203	13154	10	100
9-14-1993	0:55:28	F	HD210299	V	14532	14792	14719	14760	10	100
9-14-1993	0:57:24		SKYLAST	U	6546	0	0	0	10	100
9-14-1993	0:57:35		SKYLAST	B	12222	0	0	0	10	100
9-14-1993	0:57:45		SKYLAST	V	14025	0	0	0	10	100
9-14-1993	0:59: 5	V	RW PSA	U	6637	6626	6625	6641	10	100
9-14-1993	0:59:46	V	RW PSA	B	12887	12927	12843	12776	10	100
9-14-1993	1: 0:26	V	RW PSA	V	14577	14532	14607	14650	10	100
9-14-1993	1: 1:38		SKYLAST	U	6597	0	0	0	10	100
9-14-1993	1: 1:49		SKYLAST	B	12299	0	0	0	10	100
9-14-1993	1: 1:59		SKYLAST	V	14378	0	0	0	10	100
9-14-1993	1: 3:18	V	RW PSA	U	6634	6649	6655	6647	10	100
9-14-1993	1: 3:59	V	RW PSA	B	12929	12894	12540	12583	10	100
9-14-1993	1: 4:39	V	RW PSA	V	14792	14695	14723	14730	10	100
9-14-1993	1: 5:27		SKYLAST	U	6604	0	0	0	10	100
9-14-1993	1: 5:38		SKYLAST	B	12376	0	0	0	10	100
9-14-1993	1: 5:48		SKYLAST	V	14396	0	0	0	10	100
9-14-1993	1: 6:42	V	RW PSA	U	6652	6627	6627	6674	10	100
9-14-1993	1: 7:23	V	RW PSA	B	12996	12925	12994	13139	10	100
9-14-1993	1: 8: 3	V	RW PSA	V	14858	14905	14844	14991	10	100
9-14-1993	1: 8:46		SKYLAST	U	6612	0	0	0	10	100
9-14-1993	1: 8:56		SKYLAST	B	12470	0	0	0	10	100
9-14-1993	1: 9: 7		SKYLAST	V	14583	0	0	0	10	100
9-14-1993	1: 9:57	V	RW PSA	U	6632	6648	6635	6643	10	100
9-14-1993	1:10:38	V	RW PSA	B	12967	13022	13022	12980	10	100
9-14-1993	1:11:18	V	RW PSA	V	14921	14828	14885	14979	10	100
9-14-1993	1:11:58		SKYLAST	U	6624	0	0	0	10	100
9-14-1993	1:12: 9		SKYLAST	B	12536	0	0	0	10	100
9-14-1993	1:12:19		SKYLAST	V	14628	0	0	0	10	100
9-14-1993	1:13:15	F	HD210299	U	6742	6740	6750	6711	10	100
9-14-1993	1:13:56	F	HD210299	B	13481	13466	13572	13555	10	100
9-14-1993	1:14:36	F	HD210299	V	15262	15202	15356	15360	10	100
9-14-1993	1:15:13		SKYLAST	U	6598	0	0	0	10	100
9-14-1993	1:15:24		SKYLAST	B	12627	0	0	0	10	100

9-14-1993	1:15:34		SKYLAST	V	14771	0	0	0	10	100
9-14-1993	1:16:36	F	HD210427	U	6715	6716	6705	6714	10	100
9-14-1993	1:17:16	F	HD210427	B	13710	13620	13557	13626	10	100
9-14-1993	1:17:57	F	HD210427	V	15464	15504	15457	15376	10	100
9-14-1993	1:18:40		SKYLAST	U	6606	0	0	0	10	100
9-14-1993	1:18:51		SKYLAST	B	12645	0	0	0	10	100
9-14-1993	1:19: 1		SKYLAST	V	14729	0	0	0	10	100
9-14-1993	1:23:24	F	HD213457	U	760	762	760	766	10	10
9-14-1993	1:24: 4	F	HD213457	B	3228	3225	3229	3205	10	10
9-14-1993	1:24:45	F	HD213457	V	3002	3017	3016	2938	10	10
9-14-1993	1:25:36		SKYLAST	U	624	0	0	0	10	10
9-14-1993	1:25:47		SKYLAST	B	1129	0	0	0	10	10
9-14-1993	1:25:57		SKYLAST	V	1321	0	0	0	10	10

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9-14-1993	18:14:25	F	HD213457	U	777	778	778	775	10	10	
9-14-1993	18:15: 5	F	HD213457	B	3384	3394	3370	3387	10	10	
9-14-1993	18:15:46	F	HD213457	V	2935	2970	2948	2941	10	10	
9-14-1993	18:16:36		SKYLAST	U	601	0	0	0	10	10	
9-14-1993	18:16:47	M	SKYLAST	B	1014	0	0	0	10	10	
9-14-1993	18:16:57	M	SKYLAST	V	1151	0	0	0	10	10	
9-14-1993	18:23:19	F	HD210299	U	6289	6311	6315	6312	10	100	
9-14-1993	18:23:59	F	HD210299	B	11590	11552	11577	11553	10	100	
9-14-1993	18:24:40	F	HD210299	V	12227	12242	12342	12297	10	100	
9-14-1993	18:25:34		SKYLAST	U	6112	0	0	0	10	100	
9-14-1993	18:25:44		SKYLAST	B	10258	0	0	0	10	100	
9-14-1993	18:25:55		SKYLAST	V	11718	0	0	0	10	100	
9-14-1993	18:27:35	V	RW PSA	U	6205	6230	6212	6216	10	100	
9-14-1993	18:28:16	V	RW PSA	B	11014	11016	10964	10959	10	100	
9-14-1993	18:28:56	V	RW PSA	V	12256	12206	12220	12241	10	100	
9-14-1993	18:29:60		SKYLAST	U	6110	0	0	0	10	100	
9-14-1993	18:30:10		SKYLAST	B	10263	0	0	0	10	100	
9-14-1993	18:30:21		SKYLAST	V	11786	0	0	0	10	100	
9-14-1993	18:31:45	V	RW PSA	U	6213	6199	6191	6171	10	100	
9-14-1993	18:32:25	V	RW PSA	B	10972	11073	10976	10967	10	100	
9-14-1993	18:33: 6	V	RW PSA	V	12317	12351	12367	12443	10	100	
9-14-1993	18:34: 3		SKYLAST	U	6139	0	0	0	10	100	
9-14-1993	18:34:13		SKYLAST	B	10320	0	0	0	10	100	
9-14-1993	18:34:24		SKYLAST	V	12137	0	0	0	10	100	
9-14-1993	18:35:36	V	RW PSA	U	6192	6207	6241	6185	10	100	
9-14-1993	18:36:17	V	RW PSA	B	10986	11063	11027	11145	10	100	
9-14-1993	18:36:58	V	RW PSA	V	12466	12391	12344	12224	10	100	
9-14-1993	18:37:46		SKYLAST	U	6120	0	0	0	10	100	
9-14-1993	18:37:56		SKYLAST	B	10313	0	0	0	10	100	
9-14-1993	18:38: 7		SKYLAST	V	11917	0	0	0	10	100	
9-14-1993	18:39: 7	V	RW PSA	U	6193	6201	6208	6192	10	100	
9-14-1993	18:39:47	V	RW PSA	B	10913	10885	10891	10934	10	100	
9-14-1993	18:42:15	V	RW PSA	V	11998	11961	12033	11977	10	100	
9-14-1993	18:43: 7		SKYLAST	U	6132	0	0	0	10	100	
9-14-1993	18:43:17		SKYLAST	B	10230	0	0	0	10	100	
9-14-1993	18:43:28		SKYLAST	V	11602	0	0	0	10	100	
9-14-1993	18:44:47	F	HD210299	U	6330	6363	6320	6347	10	100	
9-14-1993	18:45:28	F	HD210299	B	11515	11506	11484	11459	10	100	
9-14-1993	18:46: 9	F	HD210299	V	12239	12088	12013	11993	10	100	
9-14-1993	18:46:59		SKYLAST	U	6132	0	0	0	10	100	
9-14-1993	18:47: 9		SKYLAST	B	10043	0	0	0	10	100	
9-14-1993	18:47:20		SKYLAST	V	11281	0	0	0	10	100	
9-14-1993	18:48:41	V	RW PSA	U	6202	6216	6210	6201	10	100	
9-14-1993	18:49:22	V	RW PSA	B	10793	10742	10730	10732	10	100	
9-14-1993	18:50: 2	V	RW PSA	V	11590	11595	11614	11456	10	100	
9-14-1993	18:50:52		SKYLAST	U	6119	0	0	0	10	100	
9-14-1993	18:51: 2		SKYLAST	B	9997	0	0	0	10	100	
9-14-1993	18:51:13		SKYLAST	V	11035	0	0	0	10	100	

9-14-1993	15:52:23	V	RW PSA	U	6198	6198	6245	6152	10	100
9-14-1993	18:53: 3	V	RW PSA	B	10574	10569	10600	10564	10	100
9-14-1993	18:53:44	V	RW PSA	V	11248	11257	11323	11264	10	100
9-14-1993	18:54:40		SKYLAST	U	6106	0	0	0	10	100
9-14-1993	18:54:51		SKYLAST	B	9854	0	0	0	10	100
9-14-1993	18:55: 1		SKYLAST	V	10881	0	0	0	10	100
9-14-1993	18:56:25	V	RW PSA	U	6188	6225	6214	6211	10	100
9-14-1993	18:57: 9	V	RW PSA	B	10598	10608	10560	10537	10	100
9-14-1993	16:57:49	V	RW PSA	V	11236	11351	11261	11247	10	100
9-14-1993	16:58:41		SKYLAST	U	6163	0	0	0	10	100
9-14-1993	18:58:51		SKYLAST	B	9897	0	0	0	10	100
9-14-1993	18:59: 2		SKYLAST	V	10353	0	0	0	10	100
9-14-1993	19: 0: 6	V	RW PSA	U	6213	6217	6212	6216	10	100
9-14-1993	19: 0:46	V	RW PSA	B	10524	10593	10539	10587	10	100
9-14-1993	19: 1:27	V	RW PSA	V	11286	11245	11255	11259	10	100
9-14-1993	19: 2:20		SKYLAST	U	6131	0	0	0	10	100
9-14-1993	19: 2:30		SKYLAST	B	9907	0	0	0	10	100
9-14-1993	19: 2:41		SKYLAST	V	10852	0	0	0	10	100
9-14-1993	19: 3:55	F	HD210299	U	6356	6308	6349	6342	10	100
9-14-1993	19: 4:36	F	HD210299	B	11160	11216	11179	11264	10	100
9-14-1993	19: 5:16	F	HD210299	V	11349	11336	11413	11389	10	100
9-14-1993	19: 6:16		SKYLAST	U	6130	0	0	0	10	100
9-14-1993	19: 6:26		SKYLAST	B	9824	0	0	0	10	100
9-14-1993	19: 6:37		SKYLAST	V	10726	0	0	0	10	100
9-14-1993	19: 8:34	F	HD210427	U	6306	6300	6346	6351	10	100
9-14-1993	19: 9:14	F	HD210427	B	11276	11317	11240	11319	10	100
9-14-1993	19: 9:55	F	HD210427	V	11574	11557	11575	11555	10	100
9-14-1993	19:10:43		SKYLAST	U	6123	0	0	0	10	100
9-14-1993	19:10:54		SKYLAST	B	9863	0	0	0	10	100
9-14-1993	19:11: 4		SKYLAST	V	10712	0	0	0	10	100
9-14-1993	19:12:46	V	RW PSA	U	6215	6206	6246	6185	10	100
9-14-1993	19:13:26	V	RW PSA	B	10442	10435	10435	10444	10	100
9-14-1993	19:14: 7	V	RW PSA	V	11145	11158	11207	11179	10	100
9-14-1993	19:15: 0		SKYLAST	U	6120	0	0	0	10	100
9-14-1993	19:15:10		SKYLAST	B	9701	0	0	0	10	100
9-14-1993	19:15:21		SKYLAST	V	10745	0	0	0	10	100
9-14-1993	19:16:15	V	RW PSA	U	6194	6180	6139	6227	10	100
9-14-1993	19:16:56	V	RW PSA	B	10384	10403	10300	10406	10	100
9-14-1993	19:17:36	V	RW PSA	V	11038	10950	10885	10986	10	100
9-14-1993	19:19:27		SKYLAST	U	6102	0	0	0	10	100
9-14-1993	19:19:37		SKYLAST	B	9715	0	0	0	10	100
9-14-1993	19:19:47		SKYLAST	V	10595	0	0	0	10	100
9-14-1993	19:20:53	V	RW PSA	U	6202	6206	6221	6218	10	100
9-14-1993	19:21:34	V	RW PSA	B	10273	10311	10315	10288	10	100
9-14-1993	19:22:14	V	RW PSA	V	10980	10909	10978	10939	10	100
9-14-1993	19:23: 3		SKYLAST	U	6106	0	0	0	10	100
9-14-1993	19:23:14		SKYLAST	B	9583	0	0	0	10	100
9-14-1993	19:23:24		SKYLAST	V	10524	0	0	0	10	100
9-14-1993	19:24:21	V	RW PSA	U	6195	6168	6185	6186	10	100
9-14-1993	19:25: 2	V	RW PSA	B	10192	10166	10182	10136	10	100
9-14-1993	19:25:42	V	RW PSA	V	10817	10826	10786	10796	10	100
9-14-1993	19:26:32		SKYLAST	U	6090	0	0	0	10	100
9-14-1993	19:26:42		SKYLAST	B	9546	0	0	0	10	100
9-14-1993	19:26:53		SKYLAST	V	10407	0	0	0	10	100
9-14-1993	19:28:27	F	HD210299	U	6348	6329	6317	6318	10	100
9-14-1993	19:29: 8	F	HD210299	B	10942	10919	10955	10945	10	100
9-14-1993	19:29:48	F	HD210299	V	11117	11046	11076	11017	10	100
9-14-1993	19:30:37		SKYLAST	U	6115	0	0	0	10	100
9-14-1993	19:30:48		SKYLAST	B	9460	0	0	0	10	100
9-14-1993	19:30:58		SKYLAST	V	10310	0	0	0	10	100
9-14-1993	19:32: 7	V	RW PSA	U	6160	6169	6179	6192	10	100
9-14-1993	19:32:46	V	RW PSA	B	10088	10074	10095	10092	10	100
9-14-1993	19:33:28	V	RW PSA	V	10621	10611	10572	10600	10	100
9-14-1993	19:34:18		SKYLAST	U	6104	0	0	0	10	100
9-14-1993	19:34:28		SKYLAST	B	9383	0	0	0	10	100
9-14-1993	19:34:39		SKYLAST	V	10243	0	0	0	10	100

9-14-1993	19:35:49	V	RW PSA	U	6184	6172	6177	6154	10	100	
9-14-1993	19:36:30	V	RW PSA	B	9939	10025	10025	10011	10	100	
9-14-1993	19:37:10	V	RW PSA	V	10546	10536	10508	10541	10	100	
9-14-1993	19:38: 7		SKYLAST	U	6121	0	0	0	10	100	
9-14-1993	19:38:17		SKYLAST	B	9374	0	0	0	10	100	
9-14-1993	19:38:28		SKYLAST	V	10233	0	0	0	10	100	
9-14-1993	19:40:33	V	RW PSA	U	6183	6169	6184	6174	10	100	
9-14-1993	19:41:13	V	RW PSA	B	9992	9961	9998	9960	10	100	
9-14-1993	19:41:54	V	RW PSA	V	10429	10420	10494	10429	10	100	
9-14-1993	19:43:10		SKYLAST	U	6105	6109	6122	6114	10	100	
9-14-1993	19:43:50		SKYLAST	B	9429	9367	9419	9376	10	100	
9-14-1993	19:44:31		SKYLAST	V	10103	10079	10068	10009	10	100	
9-14-1993	19:45:54	V	RW PSA	U	6161	6156	6202	6136	10	100	
9-14-1993	19:46:34	V	RW PSA	B	9924	9965	9948	9914	10	100	
9-14-1993	19:47:15	V	RW PSA	V	10441	10452	10383	10435	10	100	
9-14-1993	19:48:10		SKYLAST	U	6110	0	0	0	10	100	
9-14-1993	19:48:21		SKYLAST	B	9381	0	0	0	10	100	
9-14-1993	19:48:31		SKYLAST	V	10189	0	0	0	10	100	
9-14-1993	19:56:43	F	HD213457	U	802	801	804	798	10	10	
9-14-1993	19:57:23	F	HD213457	B	3576	3561	3564	3552	10	10	
9-14-1993	19:58: 4	F	HD213457	V	2937	2970	2940	2956	10	10	
9-14-1993	19:59: 0		SKYLAST	U	588	0	0	0	10	10	
9-14-1993	19:59:11	M	SKYLAST	B	895	0	0	0	10	10	
9-14-1993	19:59:21	M	SKYLAST	V	984	0	0	0	10	10	
9-14-1993	20: 1:57	F	HD210299	U	623	624	624	623	10	10	
9-14-1993	20: 2:38	F	HD210299	B	1059	1069	1061	1068	10	10	
9-14-1993	20: 3:18	F	HD210299	V	1069	1076	1059	1065	10	10	
9-14-1993	20: 4:11		SKYLAST	U	603	0	0	0	10	10	
9-14-1993	20: 4:21		SKYLAST	B	923	0	0	0	10	10	
9-14-1993	20: 4:32		SKYLAST	V	985	0	0	0	10	10	
9-14-1993	20: 7:32	V	RW PSA	U	6175	6183	6158	6212	10	100	
9-14-1993	20: 8:12	V	RW PSA	B	9835	9864	9822	9797	10	100	
9-14-1993	20: 8:53	V	RW PSA	V	10214	10271	10282	10235	10	100	
9-14-1993	20: 9:46		SKYLAST	U	6136	0	0	0	10	100	
9-14-1993	20: 9:56		SKYLAST	B	9357	0	0	0	10	100	
9-14-1993	20:10: 7		SKYLAST	V	9994	0	0	0	10	100	
9-14-1993	20:11: 7	V	RW PSA	U	6190	6196	6178	6200	10	100	
9-14-1993	20:11:47	V	RW PSA	B	9830	9837	9827	9797	10	100	
9-14-1993	20:12:28	V	RW PSA	V	10224	10225	10291	10318	10	100	
9-14-1993	20:13:24		SKYLAST	U	6138	0	0	0	10	100	
9-14-1993	20:13:34		SKYLAST	B	9400	0	0	0	10	100	
9-14-1993	20:13:45		SKYLAST	V	9977	0	0	0	10	100	
9-14-1993	20:14:52	V	RW PSA	U	6158	6180	6158	6166	10	100	
9-14-1993	20:15:33	V	RW PSA	B	9733	9707	9776	9739	10	100	
9-14-1993	20:16:13	V	RW PSA	V	10274	10231	10221	10217	10	100	
9-14-1993	20:17:12		SKYLAST	U	6137	0	0	0	10	100	
9-14-1993	20:17:23		SKYLAST	B	9333	0	0	0	10	100	
9-14-1993	20:17:33		SKYLAST	V	9919	0	0	0	10	100	
9-14-1993	20:18:52	V	RW PSA	U	6159	6196	6175	6205	10	100	
9-14-1993	20:19:33	V	RW PSA	B	9771	9745	9760	9722	10	100	
9-14-1993	20:22:13	V	RW PSA	V	10250	10248	10251	10246	10	100	
9-14-1993	20:23: 5		SKYLAST	U	6087	0	0	0	10	100	
9-14-1993	20:23:15		SKYLAST	B	9323	0	0	0	10	100	
9-14-1993	20:23:26		SKYLAST	V	9947	0	0	0	10	100	
9-14-1993	20:24:33	F	HD210299	U	6374	6386	6391	6374	10	100	
9-14-1993	20:25:13	F	HD210299	B	10791	10765	10783	10839	10	100	
9-14-1993	20:25:54	F	HD210299	V	10735	10693	10683	10703	10	100	
9-14-1993	20:26:58		SKYLAST	U	6144	0	0	0	10	100	
9-14-1993	20:27: 8		SKYLAST	B	9350	0	0	0	10	100	
9-14-1993	20:27:19		SKYLAST	V	10021	0	0	0	10	100	endlist
9-14-1993	20:32:23	F	HD213457	U	814	811	814	816	10	10	
9-14-1993	20:33: 4	F	HD213457	B	3636	3640	3639	3638	10	10	
9-14-1993	20:33:44	F	HD213457	V	2998	2983	3002	2993	10	10	
9-14-1993	20:34:48		SKYLAST	U	593	0	0	0	10	10	
9-14-1993	20:34:59		SKYLAST	B	892	0	0	0	10	10	
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9-13-1993	17:57:23	F	F	HD213457	V	21138
9-13-1993	18:14:26	F	F C	HD210299	U	45
9-13-1993	18:15: 6	F	F C	HD210299	B	903
9-13-1993	18:15:47	F	F C	HD210299	V	1190
9-13-1993	18:19:29	V	V	RW PSA	U	14
9-13-1993	18:20:10	V	V	RW PSA	B	231
9-13-1993	18:20:50	V	V	RW PSA	V	290
9-13-1993	18:22:55	V	V	RW PSA	U	45
9-13-1993	18:23:36	V	V	RW PSA	B	366
9-13-1993	18:24:16	V	V	RW PSA	V	358
9-13-1993	18:26:18	V	V	RW PSA	U	25
9-13-1993	18:26:58	V	V	RW PSA	B	261
9-13-1993	18:27:39	V	V	RW PSA	V	312
9-13-1993	18:29:41	V	V	RW PSA	U	27
9-13-1993	18:30:21	V	V	RW PSA	B	374
9-13-1993	18:31: 2	V	V	RW PSA	V	369
9-13-1993	18:34:12	F	F C	HD210299	U	155
9-13-1993	18:34:52	F	F C	HD210299	B	1221
9-13-1993	18:35:33	F	F C	HD210299	V	1654
9-13-1993	18:38:44	V	V	RW PSA	U	37
9-13-1993	18:39:25	V	V	RW PSA	B	478
9-13-1993	18:40: 5	V	V	RW PSA	V	274
9-13-1993	18:44:50	V	V	RW PSA	U	31
9-13-1993	18:45:30	V	V	RW PSA	B	386
9-13-1993	18:46:11	V	V	RW PSA	V	224
9-13-1993	18:47:58	V	V	RW PSA	U	48
9-13-1993	18:48:39	V	V	RW PSA	B	443
9-13-1993	18:49:19	V	V	RW PSA	V	350
9-13-1993	18:51:16	V	V	RW PSA	U	199
9-13-1993	18:51:56	V	V	RW PSA	B	597
9-13-1993	18:52:37	V	V	RW PSA	V	206
9-13-1993	18:55:31	F	F C	HD210299	U	183
9-13-1993	18:56:11	F	F C	HD210299	B	1284
9-13-1993	18:56:52	F	F C	HD210299	V	625
9-13-1993	19: 1:15	F	F C	HD210427	U	193
9-13-1993	19: 1:56	F	F C	HD210427	B	1487
9-13-1993	19: 2:36	F	F C	HD210427	V	822
9-13-1993	19: 4:37	V	V	RW PSA	U	53
9-13-1993	19: 5:17	V	V	RW PSA	B	499
9-13-1993	19: 5:58	V	V	RW PSA	V	415
9-13-1993	19:10:11	V	V	RW PSA	U	20
9-13-1993	19:10:51	V	V	RW PSA	B	525
9-13-1993	19:14: 9	V	V	RW PSA	V	367
9-13-1993	19:16:31	V	V	RW PSA	U	57
9-13-1993	19:17:11	V	V	RW PSA	B	673
9-13-1993	19:17:52	V	V	RW PSA	V	467
9-13-1993	19:20:26	V	V	RW PSA	U	57
9-13-1993	19:21: 6	V	V	RW PSA	B	626
9-13-1993	19:21:47	V	V	RW PSA	V	479

9-13-1993	19:24:17	F F C	HD210299	U	88
9-13-1993	19:24:58	F F C	HD210299	B	1178
9-13-1993	19:25:38	F F C	HD210299	V	550
9-13-1993	19:29: 0	V V	RW PSA	B	430
9-13-1993	19:29:40	V V	RW PSA	V	226
9-13-1993	19:31:49	V V	RW PSA	U	75
9-13-1993	19:32:29	V V	RW PSA	B	576
9-13-1993	19:33:10	V V	RW PSA	V	397
9-13-1993	19:35:52	V V	RW PSA	U	100
9-13-1993	19:36:32	V V	RW PSA	B	688
9-13-1993	19:37:13	V V	RW PSA	V	428
9-13-1993	19:39:22	V V	RW PSA	U	64
9-13-1993	19:40: 2	V V	RW PSA	B	509
9-13-1993	19:40:43	V V	RW PSA	V	255
9-13-1993	19:49:47	F F	HD213457	U	1903
9-13-1993	19:50:28	F F	HD213457	B	24633
9-13-1993	19:51: 9	F F	HD213457	V	18740
9-13-1993	19:56: 5	F F C	HD210299	U	238
9-13-1993	19:56:45	F F C	HD210299	B	1334
9-13-1993	19:57:26	F F C	HD210299	V	663
9-13-1993	19:59:25	V V	RW PSA	U	67
9-13-1993	20: 0: 5	V V	RW PSA	B	727
9-13-1993	20: 0:46	V V	RW PSA	V	228
9-13-1993	20: 2:48	V V	RW PSA	U	88
9-13-1993	20: 3:29	V V	RW PSA	B	800
9-13-1993	20: 4: 9	V V	RW PSA	V	532
9-13-1993	20: 6:24	V V	RW PSA	U	81
9-13-1993	20: 7: 5	V V	RW PSA	B	782
9-13-1993	20: 7:45	V V	RW PSA	V	514
9-13-1993	20: 9:46	V V	RW PSA	U	78
9-13-1993	20:10:27	V V	RW PSA	B	737
9-13-1993	20:11: 7	V V	RW PSA	V	418
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9-13-1993	20:15: 9	F F C	HD210299	V	897
9-13-1993	20:17:52	V V	RW PSA	U	101
9-13-1993	20:18:32	V V	RW PSA	B	739
9-13-1993	20:19:13	V V	RW PSA	V	287
9-13-1993	20:21:37	V V	RW PSA	U	87
9-13-1993	20:22:18	V V	RW PSA	B	694
9-13-1993	20:22:58	V V	RW PSA	V	388
9-13-1993	20:25:23	V V	RW PSA	U	94
9-13-1993	20:26: 4	V V	RW PSA	B	646
9-13-1993	20:26:44	V V	RW PSA	V	360
9-13-1993	20:29:44	V V	RW PSA	U	60
9-13-1993	20:30:25	V V	RW PSA	B	659
9-13-1993	20:31: 5	V V	RW PSA	V	529
9-13-1993	20:35:15	F F C	HD210299	U	213
9-13-1993	20:35:55	F F C	HD210299	B	1370
9-13-1993	20:36:36	F F C	HD210299	V	669
9-13-1993	20:39:26	F F C	HD210427	U	224
9-13-1993	20:40: 6	F F C	HD210427	B	1484
9-13-1993	20:40:47	F F C	HD210427	V	810
9-13-1993	20:43:33	V V	RW PSA	U	65
9-13-1993	20:44:14	V V	RW PSA	B	719

9-13-1993	20:44:54	V			V RW PSA		V	399
9-13-1993	20:47:30	V			V RW PSA		U	76
9-13-1993	20:48:10	V			V RW PSA		B	747
9-13-1993	20:48:51	V			V RW PSA		V	384
9-13-1993	20:51:15	V			V RW PSA		U	79
9-13-1993	20:51:56	V			V RW PSA		B	627
9-13-1993	20:52:36	V			V RW PSA		V	489
9-13-1993	20:54:43	V			V RW PSA		U	98
9-13-1993	20:55:23	V			V RW PSA		B	735
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9-13-1993	21: 3:43	V			V RW PSA		B	777
9-13-1993	21: 4:24	V			V RW PSA		V	359
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9-13-1993	21: 7:50	V			V RW PSA		V	326
9-13-1993	21:10: 9	V			V RW PSA		U	105
9-13-1993	21:10:49	V			V RW PSA		B	686
9-13-1993	21:11:30	V			V RW PSA		V	477
9-13-1993	21:13:52	V			V RW PSA		U	113
9-13-1993	21:14:32	V			V RW PSA		B	677
9-13-1993	21:15:13	V			V RW PSA		V	368
9-13-1993	21:20: 7	F	F			HD213457	U	2140
9-13-1993	21:20:47	F	F			HD213457	B	26028
9-13-1993	21:21:28	F	F			HD213457	V	19305
9-13-1993	21:26:32	F	F	C		HD210299	U	232
9-13-1993	21:27:12	F	F	C		HD210299	B	1173
9-13-1993	21:30:31	V			V RW PSA		U	58
9-13-1993	21:31:11	V			V RW PSA		B	407
9-13-1993	21:34:18	V			V RW PSA		V	203
9-13-1993	21:36:35	V			V RW PSA		U	64
9-13-1993	21:37:15	V			V RW PSA		B	569
9-13-1993	21:37:56	V			V RW PSA		V	529
9-13-1993	21:40:59	V			V RW PSA		U	83
9-13-1993	21:41:40	V			V RW PSA		B	725
9-13-1993	21:44:22	V			V RW PSA		V	375
9-13-1993	21:46:47	V			V RW PSA		U	107
9-13-1993	21:47:28	V			V RW PSA		B	649
9-13-1993	21:48: 8	V			V RW PSA		V	342
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9-13-1993	21:52: 1	F	F	C		HD210299	V	652
9-13-1993	21:54:57	V			V RW PSA		U	40
9-13-1993	21:55:38	V			V RW PSA		B	648
9-13-1993	21:59:54	V			V RW PSA		V	320
9-13-1993	22: 2:37	V			V RW PSA		U	71
9-13-1993	22: 3:17	V			V RW PSA		B	488
9-13-1993	22: 3:58	V			V RW PSA		V	280
9-13-1993	22: 6:32	V			V RW PSA		U	51
9-13-1993	22: 7:13	V			V RW PSA		B	522
9-13-1993	22: 7:53	V			V RW PSA		V	333
9-13-1993	22:10: 0	V			V RW PSA		U	60

9-13-1993	22:10:41	V V	RW PSA	B	439
9-13-1993	22:11:21	V V	RW PSA	V	234
9-13-1993	22:14: 9	F F C	HD210299	U	218
9-13-1993	22:14:50	F F C	HD210299	B	1325
9-13-1993	22:15:30	F F C	HD210299	V	636
9-13-1993	22:18:42	F F C	HD210427	U	219
9-13-1993	22:19:22	F F C	HD210427	B	1500
9-13-1993	22:20: 3	F F C	HD210427	V	817
9-13-1993	22:23: 6	V V	RW PSA	U	58
9-13-1993	22:23:47	V V	RW PSA	B	423
9-13-1993	22:24:27	V V	RW PSA	V	262
9-13-1993	22:26:54	V V	RW PSA	U	49
9-13-1993	22:27:35	V V	RW PSA	B	440
9-13-1993	22:28:15	V V	RW PSA	V	209
9-13-1993	22:30:45	V V	RW PSA	U	29
9-13-1993	22:31:25	V V	RW PSA	B	390
9-13-1993	22:32: 6	V V	RW PSA	V	169
9-13-1993	22:34: 9	V V	RW PSA	U	69
9-13-1993	22:34:50	V V	RW PSA	B	439
9-13-1993	22:36:52	V V	RW PSA	V	229
9-13-1993	22:38:55	F F C	HD210299	U	207
9-13-1993	22:39:35	F F C	HD210299	B	1340
9-13-1993	22:40:16	F F C	HD210299	V	570
9-13-1993	22:42:50	V V	RW PSA	U	88
9-13-1993	22:43:30	V V	RW PSA	B	369
9-13-1993	22:44:11	V V	RW PSA	V	193
9-13-1993	22:46: 6	V V	RW PSA	U	36
9-13-1993	22:46:46	V V	RW PSA	B	436
9-13-1993	22:47:27	V V	RW PSA	V	421
9-13-1993	22:49:58	V V	RW PSA	U	48
9-13-1993	22:50:38	V V	RW PSA	B	379
9-13-1993	22:51:19	V V	RW PSA	V	222
9-13-1993	22:57:55	V V	RW PSA	U	267
9-13-1993	23: 5:23	F F	HD213457	U	1985
9-13-1993	23: 6: 3	F F	HD213457	B	25693
9-13-1993	23: 6:44	F F	HD213457	V	19128
9-13-1993	23:10:50	F F C	HD210299	U	183
9-13-1993	23:11:31	F F C	HD210299	B	1185
9-13-1993	23:12:11	F F C	HD210299	V	605
9-13-1993	23:15:37	V V	RW PSA	U	56
9-13-1993	23:16:17	V V	RW PSA	B	396
9-13-1993	23:16:58	V V	RW PSA	V	257
9-13-1993	23:19:18	V V	RW PSA	U	33
9-13-1993	23:19:59	V V	RW PSA	B	519
9-13-1993	23:20:39	V V	RW PSA	V	294
9-13-1993	23:22:52	V V	RW PSA	U	46
9-13-1993	23:23:32	V V	RW PSA	B	476
9-13-1993	23:24:13	V V	RW PSA	V	261
9-13-1993	23:28:17	V V	RW PSA	U	38
9-13-1993	23:28:58	V V	RW PSA	B	547
9-13-1993	23:29:38	V V	RW PSA	V	278
9-13-1993	23:32:18	F F C	HD210299	U	162
9-13-1993	23:32:59	F F C	HD210299	B	1132
9-13-1993	23:33:39	F F C	HD210299	V	657
9-13-1993	23:35:45	V V	RW PSA	U	96

9-13-1993	23:36:25	V		V	RW PSA	B	516
9-13-1993	23:37: 6	V		V	RW PSA	V	361
9-13-1993	23:38:54	V		V	RW PSA	U	68
9-13-1993	23:39:35	V		V	RW PSA	B	557
9-13-1993	23:40:15	V		V	RW PSA	V	342
9-13-1993	23:42:15	V		V	RW PSA	U	52
9-13-1993	23:42:56	V		V	RW PSA	B	610
9-13-1993	23:43:36	V		V	RW PSA	V	357
9-13-1993	23:45:32	V		V	RW PSA	U	63
9-13-1993	23:46:12	V		V	RW PSA	B	640
9-13-1993	23:46:53	V		V	RW PSA	V	338
9-13-1993	23:48:51	F	F	C	HD210299	U	174
9-13-1993	23:49:31	F	F	C	HD210299	B	1187
9-13-1993	23:50:12	F	F	C	HD210299	V	645
9-13-1993	23:52:18	F	F	C	HD210427	U	190
9-13-1993	23:52:58	F	F	C	HD210427	B	1245
9-13-1993	23:53:39	F	F	C	HD210427	V	761
9-13-1993	23:55:50	V		V	RW PSA	U	71
9-13-1993	23:56:31	V		V	RW PSA	B	581
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9-13-1993	23:58:57	V		V	RW PSA	U	73
9-13-1993	23:59:38	V		V	RW PSA	B	595
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9-14-1993	0: 6:16	V		V	RW PSA	U	100
9-14-1993	0: 6:57	V		V	RW PSA	B	562
9-14-1993	0: 7:37	V		V	RW PSA	V	327
9-14-1993	0: 9:30	F	F	C	HD210299	U	178
9-14-1993	0:10:10	F	F	C	HD210299	B	1161
9-14-1993	0:10:51	F	F	C	HD210299	V	568
9-14-1993	0:12:51	V		V	RW PSA	U	98
9-14-1993	0:13:31	V		V	RW PSA	B	581
9-14-1993	0:14:12	V		V	RW PSA	V	354
9-14-1993	0:16:17	V		V	RW PSA	U	63
9-14-1993	0:16:57	V		V	RW PSA	B	700
9-14-1993	0:17:38	V		V	RW PSA	V	463
9-14-1993	0:19:58	V		V	RW PSA	U	45
9-14-1993	0:20:39	V		V	RW PSA	B	588
9-14-1993	0:21:19	V		V	RW PSA	V	279
9-14-1993	0:23:18	V		V	RW PSA	U	78
9-14-1993	0:23:59	V		V	RW PSA	B	604
9-14-1993	0:24:39	V		V	RW PSA	V	456
9-14-1993	0:30:33	F	F		HD213457	U	1670
9-14-1993	0:31:14	F	F		HD21[illegible]57	B	23303
9-14-1993	0:31:54	F	F		HD213457	V	18205
9-14-1993	0:36:31	F	F	C	HD210299	U	175
9-14-1993	0:37:12	F	F	C	HD210299	B	968
9-14-1993	0:37:52	F	F	C	HD210299	V	448
9-14-1993	0:40:10	V		V	RW PSA	U	33
9-14-1993	0:40:51	V		V	RW PSA	B	575
9-14-1993	0:41:31	V		V	RW PSA	V	330
9-14-1993	0:43:39	V		V	RW PSA	U	65
9-14-1993	0:44:20	V		V	RW PSA	B	489

9-14-1993	0:45: 0	V		V	RW PSA	V	408
9-14-1993	0:46:48	V		V	RW PSA	U	39
9-14-1993	0:47:28	V		V	RW PSA	B	548
9-14-1993	0:48: 9	V		V	RW PSA	V	370
9-14-1993	0:49:56	V		V	RW PSA	U	39
9-14-1993	0:50:36	V		V	RW PSA	B	420
9-14-1993	0:51:17	V		V	RW PSA	V	239
9-14-1993	0:54: 7	F	F	C	HD210299	U	147
9-14-1993	0:54:47	F	F	C	HD210299	B	977
9-14-1993	0:55:28	F	F	C	HD210299	V	673
9-14-1993	0:59: 5	V		V	RW PSA	U	35
9-14-1993	0:59:46	V		V	RW PSA	B	534
9-14-1993	1: 0:26	V		V	RW PSA	V	214
9-14-1993	1: 3:18	V		V	RW PSA	U	42
9-14-1993	1: 3:59	V		V	RW PSA	B	511
9-14-1993	1: 4:39	V		V	RW PSA	V	339
9-14-1993	1: 6:42	V		V	RW PSA	U	33
9-14-1993	1: 7:23	V		V	RW PSA	B	544
9-14-1993	1: 8: 3	V		V	RW PSA	V	292
9-14-1993	1: 9:57	V		V	RW PSA	U	16
9-14-1993	1:10:38	V		V	RW PSA	B	462
9-14-1993	1:11:18	V		V	RW PSA	V	275
9-14-1993	1:13:15	F	F	C	HD210299	U	138
9-14-1993	1:13:56	F	F	C	HD210299	B	892
9-14-1993	1:14:36	F	F	C	HD210299	V	532
9-14-1993	1:16:36	F	F	C	HD210427	U	108
9-14=1993	1:17:16	F	F	C	HD210427	B	991
9-14-1993	1:17:57	F	F	C	HD210427	V	721
9-14-1993	1:23:24	F	F		HD213457	U	1380
9-14-1993	1:24: 4	F	F		HD213457	B	20928
9-14-1993	.:24:45	F	F		HD213457	V	16848

VARIABLE	COMPARISON	CHECK
RW PSA	HD210299	HD210427

RW-PSA.DAT ; UNISA OBSERVATORY SSP-5A PHOTOMETER

UT DATE	UT(CLR)	CLEAR	UT(V)	V	UT(U)	U	UT(U-B)	U-B	UT(B-V)	B-V	UT(V-R)	V-R	UT(V-I)
9-13-1993			18:28: 5	12.537	18:26:44	13.407	18:27: 5	0.220	18:27:45	0.634			
9-13-1993			18:31:31	12.376	18:30:10	12.363	18:30:31	-0.352	18:31:11	0.337			
9-13-1993			18:34:54	12.584	18:33:33	13.224	18:33:53	0.063	18:34:34	0.565			
9-13-1993			18:38:17	12.460	18:36:56	13.331	18:37:16	0.485	18:37:57	0.337			
9-13-1993			18:47:20	12.706	18:45:59	13.227	18:46:20	0.565	18:47: 0	-0.124			
9-13-1993			18:53:26	12.673	18:52: 5	13.472	18:52:25	0.562	18:53: 6	0.175			
9-13-1993			18:56:34	12.029	18:55:13	13.007	18:55:34	0.256	18:56:14	0.709			
9-13-1993			18:59:52	12.421	18:58:31	11.427	18:58:51	-0.943	18:59:32	-0.044			
9-13-1993			19:13:13	11.297	19:11:52	12.761	19:12:12	0.154	19:12:53	1.340			
9-13-1993			19:21:24	11.393	19:17:26	13.733	19:17:46	1.145	19:19:45	1.160			
9-13-1993			19:25: 7	11.113	19:23:46	12.357	19:24: 6	0.116	19:24:47	1.149			
9-13-1993			19:29: 2	11.064	19:27:41	12.215	19:28: 1	-0.081	19:28:42	1.270			
9-13-1993			18:28: 5	12.537	18:26:44	13.407	18:27: 5	0.220	18:27:45	0.634			
9-13-1993			18:31:31	12.376	18:30:10	12.363	18:30:31	-0.352	18:31:11	0.337			
9-13-1993			18:34:54	12.584	18:33:33	13.224	18:33:53	0.063	18:34:34	0.565			
9-13-1993			18:38:17	12.460	18:36:56	13.331	18:37:16	0.485	18:37:57	0.337			
9-13-1993			18:47:20	12.706	18:45:59	13.227	18:46:20	0.565	18:47: 0	-0.124			
9-13-1993			18:53:26	12.673	18:52: 5	13.472	18:52:25	0.562	18:53: 6	0.175			
9-13-1993			18:56:34	12.029	18:55:13	13.007	18:55:34	0.256	18:56:14	0.709			
9-13-1993			18:59:52	12.421	18:58:31	11.427	18:58:51	-0.943	18:59:32	-0.044			
9-13-1993			19:13:13	11.297	19:11:52	12.761	19:12:12	0.154	19:12:53	1.340			
9-13-1993			19:21:24	11.393	19:17:26	13.733	19:17:46	1.145	19:19:45	1.160			
9-13-1993			19:25: 7	11.113	19:23:46	12.357	19:24: 6	0.116	19:24:47	1.149			
9-13-1993			19:29: 2	11.064	19:27:41	12.215	19:28: 1	-0.081	19:28:42	1.270			
9-13-1993			19:36:55	11.893					19:36:35	0.828			
9-13-1993			19:40:25	11.302	19:39: 4	12.129	19:39:24	-0.268	19:40: 5	1.136			
9-13-1993			19:44:28	11.248	19:43: 7	11.974	19:43:27	-0.249	19:44: 8	1.006			
9-13-1993			19:47:58	11.836	19:46:37	12.592	19:46:57	0.012	19:47:38	0.745			
9-13-1993			20: 8: 1	12.136	20: 6:40	12.961	20: 7: 0	0.659	20: 7:41	0.095			
9-13-1993			20:11:24	11.273	20:10: 3	12.596	20:10:24	0.404	20:11: 4	0.909			
9-13-1993			20:15: 0	11.378	20:13:39	12.624	20:14: 0	0.400	20:14:40	0.833			
9-13-1993			20:18:22	11.664	20:17: 1	12.598	20:17:22	0.307	20:18: 2	0.605			
9-13-1993			20:26:28	12.090	20:25: 7	12.259	20:25:27	-0.018	20:26: 8	0.156			
9-13-1993			20:30:13	11.705	20:28:52	12.463	20:29:13	0.112	20:29:53	0.636			
9-13-1993			20:33:59	11.731	20:32:38	12.405	20:32:59	-0.015	20:33:39	0.689			
9-13-1993			20:38:20	11.241	20:36:59	12.961	20:37:20	0.535	20:38: 0	1.185			
9-13-1993			20:52: 9	11.397	20:50:48	12.934	20:51: 9	0.604	20:51:49	0.913			
9-13-1993			20:56: 6	11.408	20:54:45	12.763	20:55: 5	0.482	20:55:46	0.856			
9-13-1993			20:59:51	11.110	20:58:30	12.713	20:58:51	0.255	20:59:31	1.373			
9-13-1993			21: 3:19	11.101	21: 1:58	12.480	21: 2:18	0.199	21: 2:59	1.198			
9-13-1993			21:11:39	11.389	21:10:18	12.512	21:10:38	0.311	21:11:19	0.801			
9-13-1993			21:15: 5	11.491	21:13:44	12.881	21:14: 5	0.424	21:14:45	0.956			
9-13-1993			21:18:45	11.074	21:17:24	12.434	21:17:44	0.145	21:18:25	1.235			
9-13-1993			21:22:28	11.359	21:21: 7	12.359	21:21:27	0.081	21:22: 8	0.925			
9-13-1993			21:41:33	12.174	21:37:46	13.106	21:38: 6	0.315	21:40: 0	0.602			
9-13-1993			21:45:11	11.125	21:43:50	12.984	21:44:10	0.510	21:44:51	1.368			
9-13-1993			21:51:37	11.503	21:48:14	12.678	21:48:35	0.445	21:50:16	0.710			
9-13-1993			21:55:23	11.601	21:54: 2	12.350	21:54:23	-0.011	21:55: 3	0.766			
9-13-1993			22: 7: 9	11.664	22: 2:12	13.465	22: 2:33	1.026	22: 5: I	0.721			
9-13-1993			22:11:13	11.802	22: 9:52	12.805	22:10:12	0.110	22:10:53	0.899			
9-13-1993			22:15: 8	11.608	22:13:47	13.195	22:14: 8	0.551	22:14:48	1.026			

9-13-1993	22:18:36	11.989	22:17:15	13.005	22:17:36	0.193	22:18:16	0.819
9-13-1993	22:31:42	11.818	22:30:21	13.028	22:30:42	0.174	22:31:22	1.047
9-13-1993	22:35:30	12.049	22:34: 9	13.214	22:34:30	0.389	22:35:10	0.759
9-13-1993	22:39:21	12.261	22:38: 0	13.797	22:38:20	0.816	22:39: 1	0.674
9-13-1993	22:44: 7	11.905	22:41:24	12.804	22:41:45	-0.005	22:43: 6	0.917
9-13-1993	22:51:26	12.082	22:50: 5	12.490	22:50:25	-0.470	22:51: 6	0.916
9-13-1993	22:54:42	11.237	22:53:21	13.507	22:53:41	0.678	22:54:22	1.610
9-13-1993	22:58:34	11.945	22:57:13	13.156	22:57:33	0.215	22:58:14	1.002
9-13-1993			23: 5:10	-0.351u				
9-13-1993	23:24:13	11.849	23:22:52	12.862	23:23:12	0.078	23:23:53	0.946
9-13-1993	23:27:54	11.720	23:26:33	13.456	23:26:54	0.926	23:27:34	0.762
9-13-1993	23:31:28	11.864	23:30: 7	13.051	23:30:27	0.461	23:31: 8	0.699
9-13-1993	23:36:53	11.819	23:35:32	13.239	23:35:53	0.795	23:36:33	0.573
9-13-1993	23:44:21	11.545	23:43: 0	12.172	23:43:20	-0.276	23:44: 1	0.934
9-13-1993	23:47:30	11.601	23:46: 9	12.583	23:46:30	0.182	23:47:10	0.797
9-13-1993	23:50:51	11.550	23:49:30	12.908	23:49:51	0.572	23:50:31	0.756
9-13-1993	23:54: 8	11.606	23:52:47	12.708	23:53: 7	0.423	23:53:48	0.652
9-14-1993	0: 4:26	11.435	0: 3: 5	12.593	0: 3:26	0.212	0: 4: 6	0.949
9-14-1993	0: 7:33	11.511	0: 6:12	12.567	0: 6:33	0.214	0: 7:13	0.837
9-14-1993	0:11:41	11.359	0: 9: 9	13.376	0: 9:30	1.121	0:10:46	0.839
9-14-1993	0:14:52	11.522	0:13:31	12.216	0:13:52	-0.166	0:14:32	0.881
9-14-1993	0:21:27	11.385	0:20: 6	12.244	0:20:26	-0.081	0:21: 7	0.962
9-14-1993	0:24:53	11.064	0:23:32	12.751	0:23:52	0.609	0:24:33	1.065
9-14-1993	0:28:34	11.581	0:27:13	13.123	0:27:34	0.804	0:28:14	0.688
9-14-1993	0:31:54	11.016	0:30:33	12.502	0:30:54	0.269	0:31:34	1.235
9-14-1993	0:48:46	11.340	0:47:25	13.417	0:47:46	1.176	0:48:26	0.837
9-14-1993	0:52:15	11.205	0:50:54	12.614	0:51:15	0.251	0:51:55	1.173
9-14-1993	0:55:24	11.389	0:54: 3	13.155	0:54:23	0.874	0:55: 4	0.847
9-14-1993	0:58:32	11.935	0:57:11	13.108	0:57:31	0.558	0:58:12	0.573
9-14-1993	1: 7:41	12.082	1: 6:20	13.169	1: 6:41	0.879	1: 7:21	0.113
9-14-1993	1:11:54	11.532	1:10:33	12.950	1:10:54	0.647	1:11:34	0.731
9-14-1993	1:15:18	11.646	1:13:57	13.207	1:14:18	0.968	1:14:58	0.517
9-14-1993	1:18:33	11.666	1:17:12	13.992	1:17:33	1.556	1:18:13	0.666
9-14-1993	18:36: 7	11.240	18:34:46	12.268	18:35: 7	0.009	18:35:47	1.039
9-14-1993	18:40:17	12.034	18:38:56	13.037	18:39:16	0.639	18:39:57	0.305
9-14-1993	18:44: 9	11.414	18:42:47	12.544	18:43: 8	0.248	18:43:49	0.879
9-14-1993	18:49:29	11.637	18:46:18	12.835	18:46:38	0.411	18:48:14	0.768
9-14-1993	18:57:13	11.305	18:55:52	12.548	18:56:13	0.232	18:56:53	1.017
9-14-1993	19: 0:55	11.600	18:59:34	12.402	18:59:54	0.061	19: 0:35	0.739
9-14-1993	19: 5: 0	11.467	19: 3:39	13.263	19: 4: 0	0.824	19: 4:40	0.943
9-14-1993	19: 8:38	11.447	19: 7:17	12.599	19: 7:37	0.183	19: 8:18	0.976
9-14-1993	19:21:18	11.409	19:19:57	12.498	19:20:17	0.178	19:20:58	0.913
9-14-1993	19:24:47	11.570	19:23:26	12.457	19:23:47	0.010	19:24:27	0.888
9-14-1993	19:29:25	11.463	19:28: 4	12.352	19:28:25	-0.018	19:29: 5	0.921
9-14-1993	19:32:53	11.562	19:31:32	12.485	19:31:53	-0.021	19:32:33	0.960
9-14-1993	19:40:39	11.720	19:39:18	12.811	19:39:39	0.388	19:40:19	0.681
9-14-1993	19:44:21	11.924	19:43: 0	13.180	19:43:21	0.643	19:44: 1	0.570
9-14-1993	19:49: 5	11.683	19:47:44	12.891	19:48: 4	0.276	19:48:45	0.931
9-14-1993	19:54:26	12.202	19:53: 5	12.865	19:53:25	0.216	19:54: 6	0.418
9-14-1993	20:16: 4	12.067	20:14:43	13.287	20:15: 3	0.399	20:15:44	0.806
9-14-1993	20:19:39	11.960	20:18:18	13.148	20:18:38	0.217	20:19:19	0.977
9-14-1993	20:23:24	11.820	20:22: 3	13.617	20:22:24	0.615	20:23: 4	1.177
9-14-1993	20:29:24	11.817	20:26: 3	12.512	20:26:24	-0.386	20:28: 4	1.126

Appendix 8

FILENAME=VP930821 . RAW OUTPUT DATA FILE FROM "DTAK"
UT DATE= AUG 21 1993 TELESCOPE= C35 OBSERVER= VP
CONDITIONS=clear . DARK CNTS=5

MO-DY-YEAR	UT	CAT	OBJECT	FLT	COUNTS				INT	SCLE	COMMENTS
8-21-1993	17:57:39	F	HD189563	U	761	761	762	761	10	10	
8-21-1993	17:58:19	F	HD189563	B	4016	4020	4020	4049	10	10	
8-21-1993	17:59: 0	F	HD189563	V	3898	3887	3891	3903	10	10	
8-21-1993	18: 0:19		SKYLAST	U	596	0	0	0	10	10	
8-21-1993	18: 0:29	M	SKYLAST	B	985	0	0	0	10	10	
8-21-1993	18: 0:40	M	SKYLAST	V	1088	0	0	0	10	10	
8-21-1993	18:39:30	F	BFPAVC	U	6400	6396	6431	6429	10	100	
8-21-1993	18:40:10	F	BFPAVC	B	12763	12818	12746	12701	10	100	
8-21-1993	18:40:51	F	BFPAVC	V	11297	11220	11274	11271	10	100	
8-21-1993	18:44:26		SKYLAST	U	5899	0	0	0	10	100	
8-21-1993	18:44:37		SKYLAST	B	9399	0	0	0	10	100	
8-21-1993	18:44:47		SKYLAST	V	10100	0	0	0	10	100	
8-21-1993	18:46:28	V	BF PAV	U	5929	5945	5937	5907	10	100	
8-21-1993	18:47: 8	V	BF PAV	B	9497	9506	9505	9503	10	100	
8-21-1993	18:47:49	V	BF PAV	V	10112	10114	10074	10110	10	100	
8-21-1993	18:48:47		SKYLAST	U	5929	0	0	0	10	100	
8-21-1993	18:48:57		SKYLAST	B	9502	0	0	0	10	100	
8-21-1993	18:49: 8		SKYLAST	V	10016	0	0	0	10	100	
8-21-1993	18:51: 9	V	BF PAV	U	5912	5907	5908	5936	10	100	
8-21-1993	18:51:50	V	BF PAV	B	9511	9502	9462	9485	10	100	
8-21-1993	18:52:30	V	BF PAV	V	10072	10016	10104	10141	10	100	
8-21-1993	18:53:46		SKYLAST	U	5914	0	0	0	10	100	
8-21-1993	18:53:56		SKYLAST	B	9387	0	0	0	10	100	
8-21-1993	18:54: 7		SKYLAST	V	10083	0	0	0	10	100	
8-21-1993	18:55:24	V	BF PAV	U	5921	5901	5934	5919	10	100	
8-21-1993	18:56: 5	V	BF PAV	B	9547	9503	9616	9577	10	100	
8-21-1993	18:56:45	V	BF PAV	V	10263	10202	10219	10222	10	100	
8-21-1993	18:57:52		SKYLAST	U	5903	0	0	0	10	100	
8-21-1993	18:58: 2		SKYLAST	B	9320	0	0	0	10	100	
8-21-1993	18:58:13		SKYLAST	V	10005	0	0	0	10	100	
8-21-1993	19: 0:46	V	BF PAV	U	5945	5918	5915	5913	10	100	
8-21-1993	19: 1:27	V	BF PAV	B	9577	9525	9553	9539	10	100	
8-21-1993	19: 2: 7	V	BF PAV	V	10285	10182	10239	10259	10	100	
8-21-1993	19: 3:21		SKYLAST	U	5889	0	0	0	10	100	
8-21-1993	19: 3:31		SKYLAST	B	9405	0	0	0	10	100	
8-21-1993	19: 3:41		SKYLAST	V	10139	0	0	0	10	100	
8-21-1993	19: 4:58	F	BFPAVC	U	6422	6410	6434	6421	10	100	
8-21-1993	19: 5:38	F	BFPAVC	B	12673	12594	12547	12601	10	100	
8-21-1993	19: 6:19	F	BFPAVC	V	11136	11116	11150	11139	10	100	
8-21-1993	19: 7:14		SKYLAST	U	5909	0	0	0	10	100	
8-21-1993	19: 7:24		SKYLAST	B	9427	0	0	0	10	100	
8-21-1993	19: 7:35		SKYLAST	V	10102	0	0	0	10	100	
8-21-1993	19: 9:38	V	BF PAV	U	5935	5945	5921	5914	10	100	
8-21-1993	19:10:18	V	BF PAV	B	9569	9619	9591	9652	10	100	
8-21-1993	19:10:59	V	BF PAV	V	10316	10237	10262	10211	10	100	
8-21-1993	19:12: 4		SKYLAST	U	5916	0	0	0	10	100	
8-21-1993	19:12:14		SKYLAST	B	9323	0	0	0	10	100	
8-21-1993	19:12:25		SKYLAST	V	10060	0	0	0	10	100	
8-21-1993	19:14: 9	V	BF PAV	U	5933	5942	5944	5928	10	100	
8-21-1993	19:14:49	V	BF PAV	B	9551	9559	9577	9538	10	100	
8-21-1993	19:15:30	V	BF PAV	V	10240	10221	10180	10247	10	100	
8-21-1993	19:16:24		SKYLAST	U	5906	0	0	0	10	100	
8-21-1993	19:16:34		SKYLAST	B	9283	0	0	0	10	100	
8-21-1993	19:16:45		SKYLAST	V	10016	0	0	0	10	100	
8-21-1993	19:18: 4	V	BF PAV	U	5941	5968	5925	5925	10	100	
8-21-1993	19:18:45	V	BF PAV	B	9579	9532	9569	9621	10	100	
8-21-1993	19:19:25	V	BF PAV	V	10241	10179	10291	10229	10	100	
8-21-1993	19:20:17		SKYLAST	U	5908	0	0	0	10	100	
8-21-1993	19:20:28		SKYLAST	B	9329	0	0	0	10	100	
8-21-1993	19:20:38		SKYLAST	V	10082	0	0	0	10	100	
8-21-1993	19:21:53	V	BF PAV	U	5937	5941	5945	5955	10	100	
8-21-1993	19:22:34	V	BF PAV	B	9551	9632	9553	9518	10	100	
8-21-1993	19:23:14	V	BF PAV	V	10252	10221	10207	10230	10	100	

8-21-1993	19:24:12		SKYLAST	U	5918	0	0	0	10	100
8-21-1993	19:24:22		SKYLAST	B	9366	0	0	0	10	100
8-21-1993	19:24:33		SKYLAST	V	10106	0	0	0	10	100
8-21-1993	19:26:37	F	BFPAVC	U	6418	6405	6416	6411	10	100
8-21-1993	19:27:18	F	BFPAVC	B	12585	12579	12603	12582	10	100
8-21-1993	19:27:58	F	BFPAVC	V	11424	11321	11274	11293	10	100
8-21-1993	19:28:58		SKYLAST	U	5905	0	0	0	10	100
8-21-1993	19:29: 8		SKYLAST	B	9396	0	0	0	10	100
8-21-1993	19:29:19		SKYLAST	V	10138	0	0	0	10	100
8-21-1993	19:31:57	F	BFPAVK	U	5962	5965	5970	5961	10	100
8-21-1993	19:32:37	F	BFPAVK	B	10080	10079	10047	10034	10	100
8-21-1993	19:33:18	F	BFPAVK	V	10761	10776	10706	10656	10	100
8-21-1993	19:34:21		SKYLAST	U	5913	0	0	0	10	100
8-21-1993	19:34:32		SKYLAST	B	9359	0	0	0	10	100
8-21-1993	19:34:42		SKYLAST	V	10065	0	0	0	10	100
8-21-1993	19:37:17	V	BF PAV	U	5942	5969	5975	5950	10	100
8-21-1993	19:37:58	V	BF PAV	B	9555	9506	9455	9387	10	100
8-21-1993	19:38:39	V	BF PAV	V	9905	10005	10024	10048	10	100
8-21-1993	19:39:42		SKYLAST	U	5917	0	0	0	10	100
8-21-1993	19:39:53		SKYLAST	B	9228	0	0	0	10	100
8-21-1993	19:40: 3		SKYLAST	V	9887	0	0	0	10	100
8-21-1993	19:41:11	V	BF PAV	U	5949	5944	5953	5930	10	100
8-21-1993	19:41:51	V	BF PAV	B	9478	9498	9444	9504	10	100
8-21-1993	19:42:32	V	BF PAV	V	10172	10144	10066	10109	10	100
8-21-1993	19:44:20		SKYLAST	U	5901	0	0	0	10	100
8-21-1993	19:44:30		SKYLAST	B	9245	0	0	0	10	100
8-21-1993	19:44:41		SKYLAST	V	9893	0	0	0	10	100
8-21-1993	19:46:20	V	BF PAV	U	5933	5936	5948	5941	10	100
8-21-1993	19:47: 0	V	BF PAV	B	9473	9500	9490	9449	10	100
8-21-1993	19:47:41	V	BF PAV	V	10101	10150	10164	10118	10	100
8-21-1993	19:48:39		SKYLAST	U	5912	0	0	0	10	100
8-21-1993	19:48:49		SKYLAST	B	9257	0	0	0	10	100
8-21-1993	19:48:60		SKYLAST	V	10036	0	0	0	10	100
8-21-1993	19:50:25	V	BF PAV	U	5939	5953	5953	5942	10	100
8-21-1993	19:51: 5	V	BF PAV	B	9540	9576	9560	9490	10	100
8-21-1993	19:51:46	V	BF PAV	V	10252	10281	10274	10324	10	100
8-21-1993	19:52:44		SKYLAST	U	5925	0	0	0	10	100
8-21-1993	19:52:54		SKYLAST	B	9248	0	0	0	10	100
8-21-1993	19:53: 5		SKYLAST	V	10014	0	0	0	10	100
8-21-1993	19:54:39	F	BFPAVC	U	6379	6416	6423	6421	10	100
8-21-1993	19:55:19	F	BFPAVC	B	12581	12657	12524	12539	10	100
8-21-1993	19:55:60	F	BFPAVC	V	11297	11288	11316	11236	10	100
8-21-1993	19:56:47		SKYLAST	U	5949	0	0	0	10	100
8-21-1993	19:56:57		SKYLAST	B	9313	0	0	0	10	100
8-21-1993	19:57: 8		SKYLAST	V	10203	0	0	0	10	100
8-21-1993	19:58:55	V	BF PAV	U	5971	5987	5970	5992	10	100
8-21-1993	19:59:36	V	BF PAV	B	9628	9634	9554	9509	10	100
8-21-1993	20: 0:16	V	BF PAV	V	10333	10316	10332	10266	10	100
8-21-1993	20: 1:42		SKYLAST	U	5931	0	0	0	10	100
8-21-1993	20: 1:52		SKYLAST	B	9311	0	0	0	10	100
8-21-1993	20: 2: 2		SKYLAST	V	10159	0	0	0	10	100
8-21-1993	20: 3:15	V	BF PAV	U	5961	5970	5946	5941	10	100
8-21-1993	20: 3:56	V	BF PAV	B	9587	9609	9560	9601	10	100
8-21-1993	20: 4:36	V	BF PAV	V	10473	10430	10503	10476	10	100
8-21-1993	20: 5:22		SKYLAST	U	5927	0	0	0	10	100
8-21-1993	20: 5:32		SKYLAST	B	9327	0	0	0	10	100
8-21-1993	20: 5:43		SKYLAST	V	10276	0	0	0	10	100
8-21-1993	20: 8:10	V	BF PAV	U	5976	5980	5997	5961	10	100
8-21-1993	20: 8:50	V	BF PAV	B	9667	9696	9678	9606	10	100
8-21-1993	20: 9:31	V	BF PAV	V	10440	10473	10387	10359	10	100
8-21-1993	20:10:23		SKYLAST	U	5936	0	0	0	10	100
8-21-1993	20:10:33		SKYLAST	B	9387	0	0	0	10	100
8-21-1993	20:10:44		SKYLAST	V	10237	0	0	0	10	100
8-21-1993	20:12: 2	V	BF PAV	U	5986	5980	5979	5970	10	100
8-21-1993	20:12:43	V	BF PAV	B	9709	9664	9660	9701	10	100
8-21-1993	20:13:23	V	BF PAV	V	10558	10552	10558	10557	10	100
8-21-1993	20:15:27		SKYLAST	U	5933	0	0	0	10	100

8-21-1993	20:15:38		SKYLAST	B	9461	0	0	0	10	100
8-21-1993	20:15:48		SKYLAST	V	10426	0	0	0	10	100
8-21-1993	20:23:47	F	HD189563	U	786	789	790	790	10	10
8-21-1993	20:24:28	F	HD189563	B	4248	4241	4239	4229	10	10
8-21-1993	20:25: 8	F	HD189563	V	3888	3874	3883	3897	10	10
8-21-1993	20:26: 5		SKYLAST	U	599	0	0	0	10	10
8-21-1993	20:26:16	M	SKYLAST	B	909	0	0	0	10	10
8-21-1993	20:26:26	M	SKYLAST	V	953	0	0	0	10	10
8-21-1993	20:30:10	F	BFPAVC	U	647	649	646	648	10	10
8-21-1993	20:30:51	F	BFPAVC	B	1262	1261	1273	1270	10	10
8-21-1993	20:31:31	F	BFPAVC	V	1142	1139	1142	1133	10	10
8-21-1993	20:32:30		SKYLAST	U	598	0	0	0	10	10
8-21-1993	20:32:41		SKYLAST	B	942	0	0	0	10	10
8-21-1993	20:32:51		SKYLAST	V	1026	0	0	0	10	10
8-21-1993	20:35: 3	V	BF PAV	U	5999	5972	5986	5971	10	100
8-21-1993	20:35:43	V	BF PAV	B	9711	9717	9622	9703	10	100
8-21-1993	20:36:24	V	BF PAV	V	10425	10386	10510	10469	10	100
8-21-1993	20:37:15		SKYLAST	U	5923	0	0	0	10	100
8-21-1993	20:37:26		SKYLAST	B	9329	0	0	0	10	100
8-21-1993	20:37:36		SKYLAST	V	10265	0	0	0	10	100
8-21-1993	20:39: 9	V	BF PAV	U	5989	6002	5985	5989	10	100
8-21-1993	20:39:50	V	BF PAV	B	9669	9628	9671	9680	10	100
8-21-1993	20:40:30	V	BF PAV	V	10443	10413	10379	10342	10	100
8-21-1993	20:41:19		SKYLAST	U	5940	0	0	0	10	100
8-21-1993	20:41:30		SKYLAST	B	9432	0	0	0	10	100
8-21-1993	20:41:40		SKYLAST	V	10235	0	0	0	10	100
8-21-1993	20:43:26	V	BF PAV	U	6021	5985	5981	5987	10	100
8-21-1993	20:44: 6	V	BF PAV	B	9663	9672	9681	9677	10	100
8-21-1993	20:44:47	V	BF PAV	V	10390	10460	10438	10394	10	100
8-21-1993	20:45:41		SKYLAST	U	5954	0	0	0	10	100
8-21-1993	20:45:51		SKYLAST	B	9436	0	0	0	10	100
8-21-1993	20:46: 2		SKYLAST	V	10231	0	0	0	10	100
8-21-1993	20:47: 3	V	BF PAV	U	5988	6001	6006	5998	10	100
8-21-1993	20:47:44	V	BF PAV	B	9736	9780	9766	9738	10	100
8-21-1993	20:48:24	V	BF PAV	V	10441	10487	10442	10447	10	100
8-21-1993	20:49:14		SKYLAST	U	5961	0	0	0	10	100
8-21-1993	20:49:24		SKYLAST	B	9440	0	0	0	10	100
8-21-1993	20:49:34		SKYLAST	V	10203	0	0	0	10	100
8-21-1993	20:50:49	F	BFPAVC	U	6475	6472	6441	6441	10	100
8-21-1993	20:51:30	F	BFPAVC	B	12628	12559	12611	12594	10	100
8-21-1993	20:52:10	F	BFPAVC	V	11300	11306	11301	11241	10	100
8-21-1993	20:53: 0		SKYLAST	U	5952	0	0	0	10	100
8-21-1993	20:53:11		SKYLAST	B	9378	0	0	0	10	100
8-21-1993	20:53:21		SKYLAST	V	10214	0	0	0	10	100
8-21-1993	20:54:60	V	BF PAV	U	5998	5980	5999	5994	10	100
8-21-1993	20:55:40	V	BF PAV	B	9643	9671	9691	9599	10	100
8-21-1993	20:56:21	V	BF PAV	V	10320	10308	10324	10230	10	100
8-21-1993	20:57: 8		SKYLAST	U	5942	0	0	0	10	100
8-21-1993	20:57:19		SKYLAST	B	9342	0	0	0	10	100
8-21-1993	20:57:29		SKYLAST	V	9978	0	0	0	10	100
8-21-1993	20:59: 3	V	BF PAV	U	5993	6008	5987	5991	10	100
8-21-1993	20:59:44	V	BF PAV	B	9625	9608	9535	9542	10	100
8-21-1993	21: 0:24	V	BF PAV	V	10125	10239	10162	10182	10	100
8-21-1993	21: 1:35		SKYLAST	U	5951	0	0	0	10	100
8-21-1993	21: 1:46		SKYLAST	B	9354	0	0	0	10	100
8-21-1993	21: 1:56		SKYLAST	V	10064	0	0	0	10	100
8-21-1993	21: 3:24	V	BF PAV	U	5984	5977	5986	5988	10	100
8-21-1993	21: 4: 4	V	BF PAV	B	9623	9643	9638	9609	10	100
8-21-1993	21: 4:45	V	BF PAV	V	10274	10286	10244	10242	10	100
8-21-1993	21: 5:36		SKYLAST	U	5973	0	0	0	10	100
8-21-1993	21: 5:46		SKYLAST	B	9474	0	0	0	10	100
8-21-1993	21: 5:56		SKYLAST	V	10215	0	0	0	10	100
8-21-1993	21: 7: 7	V	BF PAV	U	5972	5998	5998	5988	10	100
8-21-1993	21: 7:48	V	BF PAV	B	9659	9613	9631	9579	10	100
8-21-1993	21: 8:28	V	BF PAV	V	10252	10278	10254	10242	10	100
8-21-1993	21: 9:24		SKYLAST	U	5972	0	0	0	10	100
8-21-1993	21: 9:35		SKYLAST	B	9329	0	0	0	10	100

8-21-1993	21: 9:45		SKYLAST	V	10072	0	0	0	10	100
8-21-1993	21:11:13	F	BFPAVC	U	6446	6420	6460	6449	10	100
8-21-1993	21:11:54	F	BFPAVC	B	12532	12541	12564	12555	10	100
8-21-1993	21:12:35	F	BFPAVC	V	11238	11236	11250	11264	10	100
8-21-1993	21:13:42		SKYLAST	U	5966	0	0	0	10	100
8-21-1993	21:13:53		SKYLAST	B	9439	0	0	0	10	100
8-21-1993	21:14: 3		SKYLAST	V	10136	0	0	0	10	100
8-21-1993	21:15:20	F	BFPAVK	U	6025	6030	6024	6022	10	100
8-21-1993	21:16: 1	F	BFPAVK	B	10173	10103	10066	10205	10	100
8-21-1993	21:16:41	F	BFPAVK	V	10776	10826	10746	10766	10	100
8-21-1993	21:17:32		SKYLAST	U	5989	0	0	0	10	100
8-21-1993	21:17:43		SKYLAST	B	9457	0	0	0	10	100
8-21-1993	21:17:53		SKYLAST	V	10137	0	0	0	10	100
8-21-1993	21:20:14	V	BF PAV	U	5992	5994	5997	5998	10	100
8-21-1993	21:20:54	V	BF PAV	B	9710	9631	9696	9703	10	100
8-21-1993	21:21:35	V	BF PAV	V	10409	10388	10359	10328	10	100
8-21-1993	21:22:37		SKYLAST	U	5968	0	0	0	10	100
8-21-1993	21:22:47		SKYLAST	B	9415	0	0	0	10	100
8-21-1993	21:22:58		SKYLAST	V	10190	0	0	0	10	100
8-21-1993	21:24: 5	V	BF PAV	U	5985	5998	6008	6006	10	100
8-21-1993	21:24:45	V	BF PAV	B	9723	9731	9734	9733	10	100
8-21-1993	21:25:26	V	BF PAV	V	10368	10311	10245	10284	10	100
8-21-1993	21:26:25		SKYLAST	U	5969	0	0	0	10	100
8-21-1993	21:26:36		SKYLAST	B	9426	0	0	0	10	100
8-21-1993	21:26:46		SKYLAST	V	10110	0	0	0	10	100
8-21-1993	21:27:53	V	BF PAV	U	5990	6002	6009	5992	10	100
8-21-1993	21:28:33	V	BF PAV	B	9659	9712	9706	9693	10	100
8-21-1993	21:29:14	V	BF PAV	V	10399	10418	10384	10331	10	100
8-21-1993	21:30:10		SKYLAST	U	5964	0	0	0	10	100
8-21-1993	21:30:21		SKYLAST	B	9451	0	0	0	10	100
8-21-1993	21:30:31		SKYLAST	V	10201	0	0	0	10	100
8-21-1993	21:31:51	V	BF PAV	U	5977	6011	6007	5976	10	100
8-21-1993	21:32:32	V	BF PAV	B	9741	9767	9811	9785	10	100
8-21-1993	21:33:12	V	BF PAV	V	10487	10518	10447	10417	10	100
8-21-1993	21:34: 9		SKYLAST	U	5984	0	0	0	10	100
8-21-1993	21:34:19		SKYLAST	B	9601	0	0	0	10	100
8-21-1993	21:34:30		SKYLAST	V	10198	0	0	0	10	100
8-21-1993	21:36: 2	F	BFPAVC	U	6444	6427	6450	6436	10	100
8-21-1993	21:36:43	F	BFPAVC	B	12587	12574	12601	12479	10	100
8-21-1993	21:37:23	F	BFPAVC	V	11377	11323	11396	11371	10	100
8-21-1993	21:38:26		SKYLAST	U	6003	0	0	0	10	100
8-21-1993	21:38:36		SKYLAST	B	9563	0	0	0	10	100
8-21-1993	21:38:47		SKYLAST	V	10244	0	0	0	10	100
8-21-1993	21:40:24	V	BF PAV	U	5975	5997	5994	5987	10	100
8-21-1993	21:41: 5	V	BF PAV	B	9757	9761	9773	9748	10	100
8-21-1993	21:41:46	V	BF PAV	V	10442	10417	10427	10397	10	100
8-21-1993	21:42:37		SKYLAST	U	5967	0	0	0	10	100
8-21-1993	21:42:48		SKYLAST	B	9489	0	0	0	10	100
8-21-1993	21:42:58		SKYLAST	V	10270	0	0	0	10	100
8-21-1993	21:44:16	V	BF PAV	U	5993	6017	5990	6007	10	100
8-21-1993	21:44:56	V	BF PAV	B	9760	9778	9755	9726	10	100
8-21-1993	21:45:37	V	BF PAV	V	10393	10441	10464	10450	10	100
8-21-1993	21:46:28		SKYLAST	U	5973	0	0	0	10	100
8-21-1993	21:46:38		SKYLAST	B	9623	0	0	0	10	100
8-21-1993	21:46:49		SKYLAST	V	10335	0	0	0	10	100
8-21-1993	21:48:23	V	BF PAV	U	6021	6028	6030	6028	10	100
8-21-1993	21:49: 4	V	BF PAV	B	9849	9754	9803	9855	10	100
8-21-1993	21:49:44	V	BF PAV	V	10477	10425	10431	10464	10	100
8-21-1993	21:50:35		SKYLAST	U	5978	0	0	0	10	100
8-21-1993	21:50:46		SKYLAST	B	9653	0	0	0	10	100
8-21-1993	21:50:56		SKYLAST	V	10404	0	0	0	10	100
8-21-1993	21:52:21	V	BF PAV	U	5991	6008	6008	6010	10	100
8-21-1993	21:53: 1	V	BF PAV	B	9834	9835	9808	9787	10	100
8-21-1993	21:53:42	V	BF PAV	V	10499	10437	10450	10459	10	100
8-21-1993	21:54:34		SKYLAST	U	5988	0	0	0	10	100
8-21-1993	21:54:45		SKYLAST	B	9601	0	0	0	10	100
8-21-1993	21:54:55		SKYLAST	V	10332	0	0	0	10	100

8-21-1993	21:58:34	F	HD189563	U	795	785	779	788	10	10
8-21-1993	21:59:14	F	HD189563	B	4218	4210	4199	4203	10	10
8-21-1993	21:59:55	F	HD189563	V	3874	3871	3864	3849	10	10
8-21-1993	22: 0:52		SKYLAST	U	606	0	0	0	10	10
8-21-1993	22: 1: 3	M	SKYLAST	B	925	0	0	0	10	10
8-21-1993	22: 1:13	M	SKYLAST	V	963	0	0	0	10	10
8-21-1993	22: 5:30	F	BFPAVC	U	6428	6449	6456	6434	10	100
8-21-1993	22: 6:10	F	BFPAVC	B	12685	12547	12690	12689	10	100
8-21-1993	22: 6:51	F	BFPAVC	V	11636	11637	11609	11754	10	100
8-21-1993	22: 7:39		SKYLAST	U	5984	0	0	0	10	100
8-21-1993	22: 7:50		SKYLAST	B	9789	0	0	0	10	100
8-21-1993	22: 8: 0		SKYLAST	V	10577	0	0	0	10	100
8-21-1993	22: 9:37	V	BF PAV	U	6002	6019	6026	6025	10	100
8-21-1993	22:10:18	V	BF PAV	B	9844	9860	9862	9817	10	100
8-21-1993	22:10:58	V	BF PAV	V	10638	10631	10638	10628	10	100
8-21-1993	22:12: 3		SKYLAST	U	5985	0	0	0	10	100
8-21-1993	22:12:13		SKYLAST	B	9695	0	0	0	10	100
8-21-1993	22:12:24		SKYLAST	V	10525	0	0	0	10	100
8-21-1993	22:13:37	V	BF PAV	U	6009	6041	6016	5992	10	100
8-21-1993	22:14:17	V	BF PAV	B	9840	9847	9817	9811	10	100
8-21-1993	22:14:58	V	BF PAV	V	10674	10720	10700	10663	10	100
8-21-1993	22:15:47		SKYLAST	U	6005	0	0	0	10	100
8-21-1993	22:15:58		SKYLAST	B	9723	0	0	0	10	100
8-21-1993	22:16: 8		SKYLAST	V	10560	0	0	0	10	100
8-21-1993	22:17:15	V	BF PAV	U	6009	6055	6006	6033	10	100
8-21-1993	22:17:55	V	BF PAV	B	9909	9795	9764	9834	10	100
8-21-1993	22:18:36	V	BF PAV	V	10623	10641	10623	10683	10	100
8-21-1993	22:19:29		SKYLAST	U	6011	0	0	0	10	100
8-21-1993	22:19:39		SKYLAST	B	9701	0	0	0	10	100
8-21-1993	22:19:50		SKYLAST	V	10611	0	0	0	10	100
8-21-1993	22:21:11	V	BF PAV	U	5999	6020	6005	6011	10	100
8-21-1993	22:21:51	V	BF PAV	B	9857	9796	9822	9863	10	100
8-21-1993	22:22:32	V	BF PAV	V	10686	10724	10722	10700	10	100
8-21-1993	22:23:32		SKYLAST	U	6008	0	0	0	10	100
8-21-1993	22:23:43		SKYLAST	B	9721	0	0	0	10	100
8-21-1993	22:23:53		SKYLAST	V	10653	0	0	0	10	100
8-21-1993	22:25:17	F	BFPAVC	U	6441	6415	6427	6428	10	100
8-21-1993	22:25:57	F	BFPAVC	B	12692	12632	12619	12679	10	100
8-21-1993	22:26:38	F	BFPAVC	V	11753	11840	11859	11730	10	100
8-21-1993	22:27:26		SKYLAST	U	5998	0	0	0	10	100
8-21-1993	22:27:36		SKYLAST	B	9731	0	0	0	10	100
8-21-1993	22:27:47		SKYLAST	V	10687	0	0	0	10	100
8-21-1993	22:29:32	V	BF PAV	U	6040	6044	6040	6044	10	100
8-21-1993	22:30:12	V	BF PAV	B	9930	10001	9967	9893	10	100
8-21-1993	22:30:53	V	BF PAV	V	10826	10888	10890	10854	10	100
8-21-1993	22:31:44		SKYLAST	U	6009	0	0	0	10	100
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8-21-1993	22:32: 5		SKYLAST	V	10755	0	0	0	10	100
8-21-1993	22:33:16	V	BF PAV	U	6030	6028	6065	6043	10	100
8-21-1993	22:33:56	V	BF PAV	B	9978	9977	9890	9984	10	100
8-21-1993	22:34:37	V	BF PAV	V	10777	10782	10810	10787	10	100
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8-21-1993	22:38: 3	V	BF PAV	B	10014	9976	9995	9984	10	100
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8-21-1993	22:41:22	V	BF PAV	U	6025	6049	6034	6045	10	100
8-21-1993	22:42: 2	V	BF PAV	B	9929	9950	9989	9941	10	100
8-21-1993	22:42:43	V	BF PAV	V	10826	10815	10821	10811	10	100
8-21-1993	22:43:47		SKYLAST	U	6014	0	0	0	10	100
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8-21-1993	22:44: 8		SKYLAST	V	10818	0	0	0	10	100
8-21-1993	22:45:57	F	BFPAVC	U	6417	6386	6415	6435	10	100

8-21-1993	22:46:37	F	BFPAVC	B	12799	12780	12726	12777	10	100	
8-21-1993	22:47:18	F	BFPAVC	V	12043	12021	12082	12138	10	100	
8-21-1993	22:48:17		SKYLAST	U	6033	0	0	0	10	100	
8-21-1993	22:48:27		SKYLAST	B	9994	0	0	0	10	100	
8-21-1993	22:48:38		SKYLAST	V	11231	0	0	0	10	100	
8-21-1993	22:50:48	F	BFPAVK	U	6074	6067	6081	6097	10	100	
8-21-1993	22:51:29	F	BFPAVK	B	10752	10767	10714	10739	10	100	
8-21-1993	22:52: 9	F	BFPAVK	V	11943	11994	11984	11969	10	100	
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8-21-1993	22:57:39	V	BF PAV	V	11575	11553	11604	11629	10	100	
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8-21-1993	22:58:41		SKYLAST	B	10143	0	0	0	10	100	
8-21-1993	22:58:52		SKYLAST	V	11556	0	0	0	10	100	
8-21-1993	23: 0:13	V	BF PAV	U	6060	6053	6076	6099	10	100	
8-21-1993	23: 0:54	V	BF PAV	B	10390	10385	10418	10400	10	100	
8-21-1993	23: 1:34	V	BF PAV	V	11651	11688	11667	11680	10	100	
8-21-1993	23: 2:24		SKYLAST	U	6050	0	0	0	10	100	
8-21-1993	23: 2:35		SKYLAST	B	10232	0	0	0	10	100	
8-21-1993	23: 2:45		SKYLAST	V	11588	0	0	0	10	100	
8-21-1993	23: 4: 2	V	BF PAV	U	6087	6047	6062	6039	10	100	
8-21-1993	23: 4:43	V	BF PAV	B	10461	10466	10418	10400	10	100	
8-21-1993	23: 5:23	V	BF PAV	V	11812	11782	11744	11751	10	100	
8-21-1993	23: 6:24		SKYLAST	U	6050	0	0	0	10	100	
8-21-1993	23: 6:35		SKYLAST	B	10252	0	0	0	10	100	
8-21-1993	23: 6:45		SKYLAST	V	11617	0	0	0	10	100	
8-21-1993	23: 8:23	V	BF PAV	U	6083	6082	6072	6067	10	100	
8-21-1993	23: 9: 3	V	BF PAV	B	10574	10514	10537	10516	10	100	
8-21-1993	23: 9:44	V	BF PAV	V	12027	12207	12095	12125	10	100	
8-21-1993	23:10:39		SKYLAST	U	6062	0	0	0	10	100	
8-21-1993	23:10:49		SKYLAST	B	10290	0	0	0	10	100	
8-21-1993	23:10:60		SKYLAST	V	11973	0	0	0	10	100	
8-21-1993	23:12:13	F	BFPAVC	U	6367	6415	6383	6416	10	100	
8-21-1993	23:12:54	F	BFPAVC	B	12839	12878	12823	12865	10	100	
8-21-1993	23:13:34	F	BFPAVC	V	12803	12749	12675	12756	10	100	
8-21-1993	23:14:23		SKYLAST	U	6039	0	0	0	10	100	
8-21-1993	23:14:34		SKYLAST	B	10246	0	0	0	10	100	
8-21-1993	23:14:44		SKYLAST	V	11721	0	0	0	10	100	
8-21-1993	23:19:36	F	HD189563	U	7627	7642	7600	7601	10	100	
8-21-1993	23:20:16	F	HD189563	B	3951	3950	3955	3948	10	10	
8-21-1993	23:20:57	F	HD189563	V	3822	3825	3822	3824	10	10	
8-21-1993	23:21:48		SKYLAST	U	616	0	0	0	10	10	
8-21-1993	23:21:58		SKYLAST	B	993	0	0	0	10	10	
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8-21-1993	17:59: 0	F	F	HD189563	V	28068
8-21-1993	18:39:30	F	F C	BFPAVC	U	515
8-21-1993	18:40:10	F	F C	BFPAVC	B	3358
8-21-1993	18:40:51	F	F C	BFPAVC	V	1166
8-21-1993	18:46:28	V	V	BF PAV	U	1
8-21-1993	18:47: 8	V	V	BF PAV	B	1
8-21-1993	18:47:49	V	V	BF PAV	V	87
8-21-1993	18:51: 9	V	V	BF PAV	U	2
8-21-1993	18:51:50	V	V	BF PAV	B	103
8-21-1993	18:52:30	V	V	BF PAV	V	1
8-21-1993	18:55:24	V	V	BF PAV	U	16
8-21-1993	18:56: 5	V	V	BF PAV	B	241
8-21-1993	18:56:45	V	V	BF PAV	V	222
8-21-1993	19: 0:46	V	V	BF PAV	U	34
8-21-1993	19: 1:27	V	V	BF PAV	B	144
8-21-1993	19: 2: 7	V	V	BF PAV	V	102
8-21-1993	19: 4:58	F	F C	BFPAVC	U	513
8-21-1993	19: 5:38	F	F C	BFPAVC	B	3177
8-21-1993	19: 6:19	F	F C	BFPAVC	V	1033
8-21-1993	19: 9:38	V	V	BF PAV	U	13
8-21-1993	19:10:18	V	V	BF PAV	B	275
8-21-1993	19:10:59	V	V	BF PAV	V	197
8-21-1993	19:14: 9	V	V	BF PAV	U	31
8-21-1993	19:14:49	V	V	BF PAV	B	273
8-21-1993	19:15:30	V	V	BF PAV	V	206
8-21-1993	19:18: 4	V	V	BF PAV	U	32
8-21-1993	19:18:45	V	V	BF PAV	B	246
8-21-1993	19:19:25	V	V	BF PAV	V	153
8-21-1993	19:21:53	V	V	BF PAV	U	27
8-21-1993	19:22:34	V	V	BF PAV	B	198
8-21-1993	19:23:14	V	V	BF PAV	V	122
8-21-1993	19:26:37	F	F C	BFPAVC	U	508
8-21-1993	19:27:18	F	F C	BFPAVC	B	3191
8-21-1993	19:27:58	F	F C	BFPAVC	V	1190
8-21-1993	19:31:57	F	F C	BFPAVK	U	52
8-21-1993	19:32:37	F	F C	BFPAVK	B	701
8-21-1993	19:33:18	F	F C	BFPAVK	V	660
8-21-1993	19:37:17	V	V	BF PAV	U	42
8-21-1993	19:37:58	V	V	BF PAV	B	248
8-21-1993	19:38:39	V	V	BF PAV	V	109
8-21-1993	19:41:11	V	V	BF PAV	U	43
8-21-1993	19:41:51	V	V	BF PAV	B	236
8-21-1993	19:42:32	V	V	BF PAV	V	230
8-21-1993	19:46:20	V	V	BF PAV	U	28
8-21-1993	19:47: 0	V	V	BF PAV	B	221
8-21-1993	19:47:41	V	V	BF PAV	V	97
8-21-1993	19:50:25	V	V	BF PAV	U	22
8-21-1993	19:51: 5	V	V	BF PAV	B	294
8-21-1993	19:51:46	V	V	BF PAV	V	269
8-21-1993	19:54:39	F	F C	BFPAVC	U	461
8-21-1993	19:55:19	F	F C	BFPAVC	B	3262
8-21-1993	19:56: 0	F	F C	BFPAVC	V	1081
8-21-1993	19:58:55	V	V	BF PAV	U	49
8-21-1993	19:59:36	V	V	BF PAV	B	270
8-21-1993	20: 0:16	V	V	BF PAV	V	153
8-21-1993	20: 3:15	V	V	BF PAV	U	28
8-21-1993	20: 3:56	V	V	BF PAV	B	262
8-21-1993	20: 4:36	V	V	BF PAV	V	195
8-21-1993	20: 8:10	V	V	BF PAV	U	43

8-21-1993	20: 8:50	V	V	BF PAV	B	275
8-21-1993	20: 9:31	V	V	BF PAV	V	178
8-21-1993	20:12: 2	V	V	BF PAV	U	46
8-21-1993	20:12:43	V	V	BF PAV	B	223
8-21-1993	20:13:23	V	V	BF PAV	V	130
8-21-1993	20:23:47	F F		HD189563	U	1898
8-21-1993	20:24:28	F F		HD189563	B	33303
8-21-1993	20:25: 8	F F		HD189563	V	29325
8-21-1993	20:30:10	F F	C	BFPAVC	U	495
8-21-1993	20:30:51	F F	C	BFPAVC	B	3245
8-21-1993	20:31:31	F F	C	BFPAVC	V	1130
8-21-1993	20:35: 3	V	V	BF PAV	U	59
8-21-1993	20:35:43	V	V	BF PAV	B	359
8-21-1993	20:36:24	V	V	BF PAV	V	183
8-21-1993	20:39: 9	V	V	BF PAV	U	51
8-21-1993	20:39:50	V	V	BF PAV	B	230
8-21-1993	20:40:30	V	V	BF PAV	V	159
8-21-1993	20:43:26	V	V	BF PAV	U	40
8-21-1993	20:44: 6	V	V	BF PAV	B	237
8-21-1993	20:44:47	V	V	BF PAV	V	190
8-21-1993	20:47: 3	V	V	BF PAV	U	37
8-21-1993	20:47:44	V	V	BF PAV	B	315
8-21-1993	20:48:24	V	V	BF PAV	V	251
8-21-1993	20:50:49	F F	C	BFPAVC	U	505
8-21-1993	20:51:30	F F	C	BFPAVC	B	3220
8-21-1993	20:52:10	F F	C	BFPAVC	V	1073
8-21-1993	20:55: 0	V	V	BF PAV	U	51
8-21-1993	20:55:40	V	V	BF PAV	B	309
8-21-1993	20:56:21	V	V	BF PAV	V	318
8-21-1993	20:59: 3	V	V	BF PAV	U	44
8-21-1993	20:59:44	V	V	BF PAV	B	224
8-21-1993	21: 0:24	V	V	BF PAV	V	113
8-21-1993	21: 3:24	V	V	BF PAV	U	11
8-21-1993	21: 4: 4	V	V	BF PAV	B	154
8-21-1993	21: 4:45	V	V	BF PAV	V	47
8-21-1993	21: 7: 7	V	V	BF PAV	U	17
8-21-1993	21: 7:48	V	V	BF PAV	B	292
8-21-1993	21: 8:28	V	V	BF PAV	V	185
8-21-1993	21:11:13	F F	C	BFPAVC	U	478
8-21-1993	21:11:54	F F	C	BFPAVC	B	3109
8-21-1993	21:12:35	F F	C	BFPAVC	V	1111
8-21-1993	21:15:20	F F	C	BFPAVK	U	36
8-21-1993	21:16: 1	F F	C	BFPAVK	B	680
8-21-1993	21:16:41	F F	C	BFPAVK	V	642
8-21-1993	21:20:14	V	V	BF PAV	U	27
8-21-1993	21:20:54	V	V	BF PAV	B	270
8-21-1993	21:21:35	V	V	BF PAV	V	181
8-21-1993	21:24: 5	V	V	BF PAV	U	30
8-21-1993	21:24:45	V	V	BF PAV	B	304
8-21-1993	21:25:26	V	V	BF PAV	V	192
8-21-1993	21:27:53	V	V	BF PAV	U	34
8-21-1993	21:28:33	V	V	BF PAV	B	242
8-21-1993	21:29:14	V	V	BF PAV	V	182
8-21-1993	21:31:51	V	V	BF PAV	U	9
8-21-1993	21:32:32	V	V	BF PAV	B	175
8-21-1993	21:33:12	V	V	BF PAV	V	269
8-21-1993	21:36: 2	F F	C	BFPAVC	U	436
8-21-1993	21:36:43	F F	C	BFPAVC	B	2997
8-21-1993	21:37:23	F F	C	BFPAVC	V	1123
8-21-1993	21:40:24	V	V	BF PAV	U	21
8-21-1993	21:41: 5	V	V	BF PAV	B	271
8-21-1993	21:41:46	V	V	BF PAV	V	151
8-21-1993	21:44:16	V	V	BF PAV	U	29
8-21-1993	21:44:56	V	V	BF PAV	B	132
8-21-1993	21:45:37	V	V	BF PAV	V	102
8-21-1993	21:48:23	V	V	BF PAV	U	49

8-21-1993	21:49: 4	V	V	BF PAV	B	162
8-21-1993	21:49:44	V	V	BF PAV	V	45
8-21-1993	21:52:21	V	V	BF PAV	U	16
8-21-1993	21:53: 1	V	V	BF PAV	B	215
8-21-1993	21:53:42	V	V	BF PAV	V	129
8-21-1993	21:58:34	F F		HD189563	U	1808
8-21-1993	21:59:14	F F		HD189563	B	32825
8-21-1993	21:59:55	F F		HD189563	V	29015
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8-21-1993	22: 6:10	F F	C	BFPAVC	B	2864
8-21-1993	22: 6:51	F F	C	BFPAVC	V	1082
8-21-1993	22: 9:37	V	V	BF PAV	U	33
8-21-1993	22:10:18	V	V	BF PAV	B	151
8-21-1993	22:10:58	V	V	BF PAV	V	109
8-21-1993	22:13:37	V	V	BF PAV	U	10
8-21-1993	22:14:17	V	V	BF PAV	B	106
8-21-1993	22:14:58	V	V	BF PAV	V	129
8-21-1993	22:17:15	V	V	BF PAV	U	15
8-21-1993	22:17:55	V	V	BF PAV	B	125
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8-21-1993	22:21:11	V	V	BF PAV	U	1
8-21-1993	22:21:51	V	V	BF PAV	B	114
8-21-1993	22:22:32	V	V	BF PAV	V	55
8-21-1993	22:25:17	F F	C	BFPAVC	U	430
8-21-1993	22:25:57	F F	C	BFPAVC	B	2925
8-21-1993	22:26:38	F F	C	BFPAVC	V	1109
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8-21-1993	22:30:12	V	V	BF PAV	B	187
8-21-1993	22:30:53	V	V	BF PAV	V	110
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8-21-1993	22:33:56	V	V	BF PAV	B	147
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8-21-1993	22:37:23	V	V	BF PAV	U	18
8-21-1993	22:38: 3	V	V	BF PAV	B	91
8-21-1993	22:38:44	V	V	BF PAV	V	247
8-21-1993	22:41:22	V	V	BF PAV	U	24
8-21-1993	22:42: 2	V	V	BF PAV	B	135
8-21-1993	22:42:43	V	V	BF PAV	V	1
8-21-1993	22:45:57	F F	C	BFPAVC	U	380
8-21-1993	22:46:37	F F	C	BFPAVC	B	2777
8-21-1993	22:47:18	F F	C	BFPAVC	V	840
8-21-1993	22:50:48	F F	C	BFPAVK	U	38
8-21-1993	22:51:29	F F	C	BFPAVK	B	614
8-21-1993	22:52: 9	F F	C	BFPAVK	V	589
8-21-1993	22:56:18	V	V	BF PAV	U	31
8-21-1993	22:56:59	V	V	BF PAV	B	206
8-21-1993	22:57:39	V	V	BF PAV	V	34
8-21-1993	23: 0:13	V	V	BF PAV	U	22
8-21-1993	23: 0:54	V	V	BF PAV	B	166
8-21-1993	23: 1:34	V	V	BF PAV	V	84
8-21-1993	23: 4: 2	V	V	BF PAV	U	9
8-21-1993	23: 4:43	V	V	BF PAV	B	184
8-21-1993	23: 5:23	V	V	BF PAV	V	155
8-21-1993	23: 8:23	V	V	BF PAV	U	14
8-21-1993	23: 9: 3	V	V	BF PAV	B	245
8-21-1993	23: 9:44	V	V	BF PAV	V	141
8-21-1993	23:12:13	F F	C	BFPAVC	U	356
8-21-1993	23:12:54	F F	C	BFPAVC	B	2605
8-21-1993	23:13:34	F F	C	BFPAVC	V	1025
8-21-1993	23:19:36	F F		HD189563	U	1458
8-21-1993	23:20:16	F F		HD189563	B	29580
8-21-1993	23:20:57	F F		HD189563	V	27643

VARIABLE	COMPARISON	CHECK
BF PAV	BFPAVC	BFPAVK

BF-PAV.DAT ; UNISA OBSERVATORY SSP-5A PHOTOMETER

UT DATE	UT(CLR)	CLEAR	UT(V)	V	UT(U)	U	UT(U-B)	U-B	UT(B-V)	B-V	UT(V-R)	V-R	UT(V-I)	V-I
5-21-1993			18:52: 1	2.737	18:50:40	6.680	18:51: 0	-2.007	18:51:40	6.455				
8-21-1993			18:52: 1	2.737	18:50:40	6.680	18:51: 0	-2.007	18:51:40	6.455				
8-21-1993			18:56:42	7.639	18:55:21	6.137	18:55:41	2.254	18:56:22	-4.133				
8-21-1993			19: 0:57	1.712	18:59:36	3.814	18:59:56	0.938	19: 0:37	1.183				
8-21-1993			19: 6:19	2.530	19: 4:58	2.927	19: 5:18	-0.419	19: 5:59	0.894				
8-21-1993			19:15:11	1.828	19:13:50	4.054	19:14:10	1.322	19:14:50	0.884				
6-21-1993			19:19:42	1.812	19:18:21	3.061	19:18:41	0.373	19:19:21	0.910				
5-21-1993			19:23:37	2.165	19:22:16	3.018	19:22:36	0.224	19:23:17	0.656				
6-21-1993			19:27:26	2.437	19:26: 5	3.198	19:26:25	0.170	19:27: 6	0.618				
5-21-1993			19:42:51	2.556	19:41:29	2.663	19:41:49	-0.114	19:42:30	0.243				
6-21-1993			19:46:44	1.724	19:45:23	2.619	19:45:43	-0.211	19:46:23	1.189				
8-21-1993			19:51:53	2.648	19:50:32	3.083	19:50:52	0.157	19:51:32	0.286				
6-21-1993			19:55:58	1.519	19:54:37	3.355	19:54:57	0.705	19:55:37	1.162				
8-21-1993			20: 4:28	2.125	20: 3: 7	2.432	20: 3:27	-0.259	20: 4: 8	0.618				
6-21-1993			20: 8:48	1.866	20: 7:27	3.078	20: 7:47	0.322	20: 8:28	0.929				
8-21-1993			20:13:43	1.973	20:12:22	2.604	20:12:42	-0.076	20:13:22	0.756				
6-21-1993			20:17:35	2.321	20:16:14	2.526	20:16:34	-0.366	20:17:15	0.630				
5-21-1993			20:40:36	1.961	20:39:15	2.312	20:39:35	-0.073	20:40:15	0.456				
8-21-1993			20:44:42	2.101	20:43:21	2.460	20:43:41	-0.339	20:44:22	0.820				
5-21-1993			20:48:59	1.395	20:47:38	2.743	20:47:56	-0.089	20:48:35	1.003				
8-21-1993			20:52:36	1.583	20:51:15	2.849	20:51:35	0.305	20:52:16	1.005				
8-21-1993			21: 0:33	1.322	20:59:12	2.476	20:59:32	-0.059	21: 0:12	1.296				
6-21-1993			21: 4:36	2.458	21: 3:15	2.616	21: 3:35	-0.250	21: 4:16	0.450				
6-21-1993			21: 8:57	3.421	21: 7:36	4.157	21: 7:56	0.831	21: 8:36	-0.152				
8-21-1993			21:12:40	1.936	21:11:19	3.683	21:11:39	1.046	21:12:20	0.683				
8-21-1993			21:25:47	1.972	21:24:26	3.107	21:24:46	0.441	21:25:26	0.712				
5-21-1993			21:29:38	1.911	21:28:17	2.977	21:28:37	0.445	21:29:17	0.634				
6-21-1993			21:33:26	1.970	21:32: 5	2.509	21:32:25	0.058	21:33: 5	0.829				
6-21-1993			21:37:24	1.545	21:36: 3	4.281	21:36:23	1.123	21:37: 4	1.650				
5-21-1993			21:45:58	2.172	21:44:36	3.333	21:44:56	0.689	21:45:37	0.460				
6-21-1993			21:49:49	2.592	21:48:28	2.944	21:48:48	-0.411	21:49:28	0.539				
8-21-1993			21:53:56	3.479	21:52:35	2.369	21:52:55	-0.735	21:53:36	-0.350				
8-21-1993			21:57:54	2.328	21:56:33	3.654	21:56:53	0.772	21:57:33	0.543				
8-21-1993			22:15:10	2.493	22:13:49	2.530	22:14: 9	-0.350	22:14:50	0.751				
6-21-1993			22:19:10	2.320	22:17:49	4.148	22:18: 9	0.526	22:18:49	1.356				
8-21-1993			22:22:48	3.540	22:21:27	3.684	22:21:47	0.253	22:22:27	-0.453				
6-21-1993			22:26:44	3.257	22:25:23	6.715	22:25:43	3.013	22:26:23	0.281				
5-21-1993			22:35: 5	2.455	22:33:44	2.756	22:34: 4	-0.208	22:34:44	0.557				
6-21-1993			22:38:49	7.504	22:37:28	3.469	22:37:48	0.227	22:38:28	-4.568				
5-21-1993			22:42:56	1.468	22:41:35	3.360	22:41:55	-0.356	22:42:35	2.425				
8-21-1993			22:46:55	7.381	22:45:34	3.024	22:45:54	-0.256	22:46:34	-4.363				
5-21-1993			23: 1:51	3.572	23: 0:30	2.696	23: 0:50	-0.100	23: 1:31	-0.824				
6-21-1993			23: 5:46	2.626	23: 4:25	3.062	23: 4:45	0.034	23: 5:26	0.427				
5-21-1993			23: 9:35	1.994	23: 8:14	4.054	23: 8:34	1.083	23: 9:15	0.973				
8-21-1993			23:13:56	2.128	23:12:35	3.556	23:12:55	0.918	23:13:35	0.483				

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