Astrophysics with the 60 cm reflector
Photographic photometry: Nova RS Ophiuchi

M. Antal, J. Tremko, 1959BAICz..10..171A

The third outburst of Nova RS Oph was observed by C. Fernald on 1958 July 14:1 UT. This Nova was observed photographically at the Astronomical Institute Skalnaté Pleso by the object-glass Tessar of \( f = 500 \) mm, \( f/4.5 \) and a reflector of \( f = 3300 \) mm, \( D = 600 \) mm. On earlier photographs the brightness fluctuation of the Nova at minimum was confirmed. Based on our own visual observations and those of other authors a normal light curve was constructed. Also the colour index of the Nova and the duration above the absolute magnitude \( M = -4.2 \) were computed from the observations published.

2. Photographic observations

At Skalnaté Pleso, Nova RS Oph was observed visually and photographically. The photographic observations were performed by a Tessar object-glass of \( f = 500 \) mm, focal ratio \( 1:4.5 \). After the drop in brightness the Nova was observed with the 600 mm reflector of \( f = 3300 \) mm, the mirror of which is covered by a layer of aluminium. We exposed altogether 12 plates with photographic emulsions “Agfa Astro Platten panchromatisch” without colour filters. Some of the plates had multiple exposures. Since the declination of the Nova is negative, the photographs were exposed at very large zenith distances above the south-western horizon. The observations have not been corrected for atmospheric absorption. The measurements were carried out on a Soviet microphotometer MF – 2.

The comparison stars and their magnitudes have been taken from M. Bloch [1]. With regard to their own measurements the authors came to the conclusion that, the photographic magnitudes observed by the authors are listed in Table I (\( m_p \)). The mean

<table>
<thead>
<tr>
<th>JD</th>
<th>( m_p )</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2436395:447</td>
<td>11.64</td>
<td>Tessar</td>
</tr>
<tr>
<td>401:569</td>
<td>6.98</td>
<td>Tessar</td>
</tr>
<tr>
<td>402:431</td>
<td>8.90</td>
<td>Reflector</td>
</tr>
<tr>
<td>450:333</td>
<td>10.30</td>
<td>Reflector</td>
</tr>
<tr>
<td>450:342</td>
<td>10.21</td>
<td>Reflector</td>
</tr>
<tr>
<td>451:355</td>
<td>10.04</td>
<td>Reflector</td>
</tr>
<tr>
<td>451:360</td>
<td>9.90</td>
<td>Reflector</td>
</tr>
<tr>
<td>451:362</td>
<td>10.90</td>
<td>Reflector</td>
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<tr>
<td>452:353</td>
<td>10.22</td>
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<td>452:357</td>
<td>10.12</td>
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<td>453:353</td>
<td>9.86</td>
<td>Reflector</td>
</tr>
<tr>
<td>453:355</td>
<td>9.98</td>
<td>Reflector</td>
</tr>
<tr>
<td>453:357</td>
<td>9.93</td>
<td>Reflector</td>
</tr>
<tr>
<td>461:351</td>
<td>10.23</td>
<td>Reflector</td>
</tr>
</tbody>
</table>
Photographic photometry: Nova RS Ophiuchi

M. Antal, J. Tremko, 1959BAICz..10..171A

Shortly after maximum observed with Tessar

12 plates were exposed after decline with a camera in the Newton f/5.5 focus
Photographic photometry: Variable star YZ Bootis

J. Tremko, M. Antal: 1959BAICz..10..195T

The short-period Cepheid YZ Bootis was observed in the first half of February 1959 with the 24-in reflector of the Astronomical Institute of the Slovak Academy of Sciences at Skalnaté Pleso. The observation yielded 180 photographs on Agfa Astro plates without filter. The magnitudes of the comparison stars were linked to the star magnitudes of the North Polar Sequence. The light curve constructed from the observations showed 5 epochs of maxima and 4 epochs of minima. Based on these new observations the period of the variable, the asymmetry of the light curve and the amplitude of the light changes have been determined.
Photographic photometry: Variable star YZ Bootis

180 plates were exposed, 5 epochs of maxima 4 epochs of minima
LC asymmetric, probably variable in shape & brightness in maximum
Potoelectric photometry: The variable BS Aquarii - shape of light curve -

J. Tremko, D. Sajtak: 1964BAICz..15...91T

Variable BS Aqr was photoelectrically observed by the 24-inch, f/5.5 reflector of the Astronomical Institute at Skalnaté Pleso between September 1 and October 12, 1961, and again between August 31 and October 9, 1962. The photoelectric photometer was fitted in the Newton focus, not easily accessible.

14 epochs of minima in $V$ and 2 epochs of maxima in $B$ of the short-period pulsating variable were covered.
Upon analysing the observations as obtained during different nights we find that the shape of the light curve changes. In spite of the changes, however, the light curve stays smooth with no sensible deformations, undulations and humps. The slight undulation of the light curve, not exceeding 0.02\text{m}, only appears in the descending branch about phase $\varphi = 0.7\Phi$. The changes in the light curves are borne out by two extreme light curves as shown in Fig. 2 that had been selected on the basis of the data obtained by harmonic analysis. The light curve for J. D. 2437563 has of all analysed curves the highest values of the amplitudes of the first two harmonics. The light curve for J. D. 2437583 has the smallest amplitudes of the first four harmonics of all analysed curves and a considerable phase shift in the first four harmonics. Therefore, it is not a Fourier coefficient that can be determined.
Potoelectric photometry: The variable BS Aquarii - shapes of light curves -

J. Tremko, D. Sajták: 1964BAICz..15...91T

Depths of minima, heights of maxima periodically change in 3.5 d
Observations of minima: AR Aurigae
- light-time effect -

D. Chochol, K. Jůza, P. Mayer, J. Zverko, J. Žižňovský: 1968BAICz..39...69C

A binary with the primary known as a CP HgMn star.

Nine minima observed between January 1981 and September 1986

Binary period 4.13 d

Long period 27 years
Observations of minima: AR Aurigae  
- light-time effect -

D Chochol, K. Jůza, P. Mayer, J. Zverko, J. Žižňovský:  
1968BAICz..39...69C

<table>
<thead>
<tr>
<th>Triple system orbital parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solution No.</td>
</tr>
<tr>
<td>$P'$ (long period)</td>
</tr>
<tr>
<td>$P$ (eclipsing pair)</td>
</tr>
<tr>
<td>$JD_0$ (time of minimum)</td>
</tr>
<tr>
<td>$T'$ (time of periastron)</td>
</tr>
<tr>
<td>$A'$ (semi-amplitude)</td>
</tr>
<tr>
<td>$a'\sin i'$</td>
</tr>
<tr>
<td>$e'$ (eccentricity)</td>
</tr>
<tr>
<td>$\omega'$</td>
</tr>
<tr>
<td>$\Sigma(O-C)^2$</td>
</tr>
<tr>
<td>$\sigma$ (r.m.s.)</td>
</tr>
</tbody>
</table>

Contribution of a third-light a few % -> mass of the third body estimated to be ≈ 0.5M $\odot$ in the evolutionary phase of contraction to the main sequence.
1. A possible small shift of the secondary minimum towards shorter phases - apsidal motion
2. Irregular mass ejection from a subgiant secondary filling the Roche lobe (which would have to be a reversing process)
3. Light-time effect
Observations of minima: TX Herculis
- interacting binaries -


In conjunction with a cooperative program on eclipsing binaries TX Her was observed at the Skalnaté Pleso Observatory on eight nights between 1968 and 1973, near the times of minima. The three-colour observations, corresponding closely to the UBV system, were made by means of a photoelectric photometer attached to the 60 cm reflector of the Observatory. The variable was compared with the star HD 156925 of

Extending back to photographic observations, the curve becomes sinusoidal with a period of 48 years -> a third body of 0.34M☉ in the system.

However ...
Observations of minima: TX Herculis
- interacting binaries -


Primary minimum exhibits a considerable distortion at the minimum and the ascending branch on some nights, while in others the minima appear regular.

Secondary minimum is very regular.

Mass transfer from the secondary following its chromospheric activity.
Period increasing at $\Delta P/P = 1.5 \times 10^{-9}$. In TX Her mass transfer amounts to $4 \times 10^{-7} \, M_\odot$/year by means of clouds produced by chromospheric activity of the secondary, so the third body is not plausible explanation.
Observations of minima: U Cephei - interacting binaries -

G. A. Bakos, J. Tremko: 1973BAICz..24..298B

U Cep was observed photoelectrically at the Skalnaté Pleso Observatory on the nights in 1968 and 1969. The observations were made in the B spectral range. A description of the equipment used will appear in another paper. Both branches and the flat part of the primary minimum have been covered on seven nights. In addition there are three observations near the secondary minimum. The primary minimum is three magnitudes deep while the secondary is very shallow. It appears to be exactly half a period displaced from the primary. The observations have been listed.

Fig. 1. The mean light curve of U Cep for the primary and the secondary minimum. The abscissa is the phase and the ordinate, Δm, the magnitude difference between the variable and the comparison star.
Observations of minima: U Cephei
- interacting binaries -

G. A. Bakos, J. Tremko: 1973BAICz..24..298B

The depth of the minima successively reduced from Dec. 1968 to Aug. 1969 due to a luminous ring around the massive B star or a gas cloud trailing the primary.

Period increase: \( \Delta P/P = 6 \times 10^{-4} \)
Abstract. In this Letter we describe observational evidence of eclipses which strongly suggest that CH Cyg is a triple system with a very high inclination. We present U and V photoelectric photometry, along with optical and ultraviolet low- and high-resolution spectroscopy taken around the inferior spectroscopic conjunctions of the red giant in the symbiotic pair of CH Cyg.
A hot component eclipsed by a red giant once a 756 days in the inner binary.

The long, 14.5 year period, is due to a third component which may be a G-K dwarf.
ABSTRACT
We analyse V-band photometry of the aperiodic variability in T CrB. By applying a simple idea of angular momentum transport in the accretion disc, we have developed a method to simulate the statistical distribution of flare durations with the assumption that the aperiodic variability is produced by turbulent elements in the disc. Both cumulative histograms with Kolmogorov–Smirnov tests, and power density spectra are used to compare the observed data and simulations. The input parameters of the model $R_{\text{in}}$ and $\alpha$ are correlated on a certain interval and the most probable values are an inner disc radius of $R_{\text{in}} \sim 4 \times 10^9$ cm and a viscosity of $\alpha \simeq 0.9$. The disc is then weakly truncated. We find that the majority of turbulent events producing flickering activity are concentrated in the inner parts of the accretion disc.
Cataclysmic variables: T Coronae Borealis – flickering –

A. Dobrotka, L. Hric et al.: 2010MNRAS.402.2567D

Figure 1. Two examples of our V-band light curves. The upper panel shows data taken on 1996 April 23 and the lower panel shows data taken on 1997 January 15.

Figure 10. Three examples of the synthetic data compared to an observed light curve. The simulated runs are computed for $M_1 = 1.37 M_\odot$, $M_{\text{acc}} = 1.9 \times 10^{18} \text{ g s}^{-1}$ and $R_{\text{in}} = 3.5 \times 10^9 \text{ cm}$ and three different viscosities $\alpha = 0.01$, 0.50 and 10.0.
Chemically peculiar stars: 56 Arietis

J. Žižňovský, P. Shwartz, J. Zverko: 2000IBVS.4835....1Z

$P = 0.728$ days

Precession of rotational axis

Light curve changes in shape and amplitude

LC in the U filter in two seasons
Chemically peculiar stars: 56 Arieti

J. Žižňovský, P. Shwartz, J. Zverko: 2000IBVS.4835....1Z

Maximum in $U$ at phase 0.7 while in $B$, $V$ at 0.3

Shift of the minimum in the third season
Comets: Intensity distribution in 1961e (Humason), 1961f (Seki) and 1963b (Alcock)

V. Vanýsek, J. Tremko: 1964BAICz..15..233V

The mean color index of the comets is $B-V = +0.5$ to $+0.7$, the low CI of the Humason comet is an exception and can be attributed to CO$^+$ emission. The life-times of the parent and the excited molecules $C_2N_2:CN$ are approximately 1:30 and decreases when the coma suddenly brightens.

Focal diaphragms of different diameters were used centered on the cometary nucleus. With the Alcock 1963b comet transversal tracings in the hour angle were made through the head of the comet.
Comets: Intensity distribution in 1961e (Humason), 1961f (Seki) and 1963b (Alcock)

V. Vanýšek, J. Tremko: 1964BAICz..15..233V

1963b Alcock
Comets: Intensity distribution in 1961e (Humason), 1961f (Seki) and 1963b (Alcock)

V. Vanýsek, J. Tremko: 1964BAICz..15..233V

Fig. 4. The decrease of the brightness with the distance from the nucleus for comet Seki (1961f).

Fig. 5. The decrease of the brightness with the distance from the nucleus for comet Humason (1961e).
Technology – the first photometer
Automated photometer
Automatized photometer
The 'new' telescope with an OPTEC photometer
What could be investigated with the “60”
- my offer -

HD 47152 (HR 2425, 53 Aur) occultation binary

Speckle interferometry

$P = 13.7$ or $22.39$ years
What could be investigated with the “60”:

HD 47152 (HR 2425, 53 Aur)
J. Zverko, J. Žižňovský, Z. Mikulášek and I.Kh. Iliev
2008CoSka..38...467 (Proc. CP#AP Workshop, Vienna 2007)

SB2:
B9Mn + F0m composite spectrum
What could be investigated with the “60”:

HD 2913 (HR 132, 51 Psc, ADS 449A)
Double or multiple star, third component doubtful

2011AstBul...66..325Z

B9.5V \( v \sin i = 170 \, \text{km/s} \) + early MS F-type \( v \sin i = 50 \, \text{km/s} \)
What could be investigated with the “60”:

HD 90 569 (HR4101, CX Leo), occultation binary, long period orbit (?) \( P = 12658 \text{ d (34.6 y)} \)

Confusing duplicity:

1979.942 (phase 0.534) **two** components 0.02"

1979.362 and 1980.152 (phases 0.517 an 0.540) **unresolved** by speckle 0.03"

2009.909 (phase 0.397) **unresolved** by speckle 0.02"
What could be investigated with the “60”:

J. Zverko, J. Iliev, I.I. Romanyuk, I. Barzova et al. 2012AstBul...67...57Z

The companion spectrum not visible (not a SB2)

Radial velocities needed

Especially close to or at the RV curve peak which is expected to come in second half of 2030

(±0.007 from phase = 0)
What could be investigated with the „60“

HD 138527 (HR 5770, 12τ² Ser),
variable radial velocity -6.3 to -26.5 km/s

J. Zverko, I.Kh. Iliev, I.I. Romanyuk et al.: 2013AstBul..68...57Z

a possible companion detected, the light of which contributes by 15% to the total light of the system, its spectral lines not found

Radial velocities needed
What could be investigated with the „60“

HD 47964 (HR 2461, HIP 31992A), HIPPARCOS double, \( \Delta V_T = 2.8 \) mag

J. Zverko, I.I. Romanyuk, I.Kh. Iliev et al.

To be published in *Astrophysical Bulletin 68, Iss. 4 (2013)*

No signs of the companion found in our spectra,
Radial velocity varies +0.6 to +23 km/s
Radial velocities needed
HD 183986 (HR 7419, ADS 12545A), the brightest component of a visual triple star
Variable radial velocity -6.3 to +22.1 km/s

J. Zverko, I.I. Romanyuk, I.Kh. Iliev et al.
To be published in Astrophysical Bulletin 68, Iss. 4 (2013)

We disclosed signs of a component not mentioned so far,
„ADS 12545Ab“ in the spectrum,
Spectral type A5V, magnitude difference in $BV = 2.26$
What could be investigated with the „60“

HD 183986 (HR 7419, ADS 12545A)

Composite B9.5III + A5V

B9.5III : v sin i = 30 km /s
A5V: v sin i = 150 km /s

Composite B9.5III + A5V
I thank the organizers for inviting me to give a talk in this meeting.

Astronomical Institute provides computer utility.

I THANK YOU FOR YOUR ATTENTION