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NSV 7457 Her: A PROBABLE W UMa STAR

The variability of NSV 7457 Her (=CSV 007268=BV 0103=BD+50°2255) was discovered by Geyer (Geyer et al., 1955) when he examined photographic observations made in Bamberg; the star was announced to be about $9^m.7$ (p) at maximum with an amplitude of 0.7 magnitude and rapid variations. Filatov (1960) mentions that the star has a short period and is probably of the RR type. After inspection of photographic plates taken from 1939 to 1959 at the Tadjikistan observatory, he gives a list of 17 times at which the star was at its maximum brightness.

To confirm the results obtained by GEOS (Groupe Européen d'Observations Stellaires) from visual estimates, NSV 7457 Her was photoelectrically measured during GEOS missions at the Jungfraujoch station. The measures were made with a cooled photometer equipped with filters on the Geneva photometric system, attached to the Observatory s 76 cm telescope. 204 measures in B and 204 in V were obtained between April 1991 and December 1992.

The first period searches were made in 1990 using 252 estimations of the author. The PDM (Stellingwerf, 1978) and Fourier (Horne and Baliunas, 1986) methods programmed by Patrick Wils were used. At this time, 0.2095 day was the more probable period but the double period was already foreseen as well. In fact, the sinusoidal shape of the light curve allowed to suppose that NSV 7457 Her could be as well a pulsating star as an eclipsing star (of the EW type).

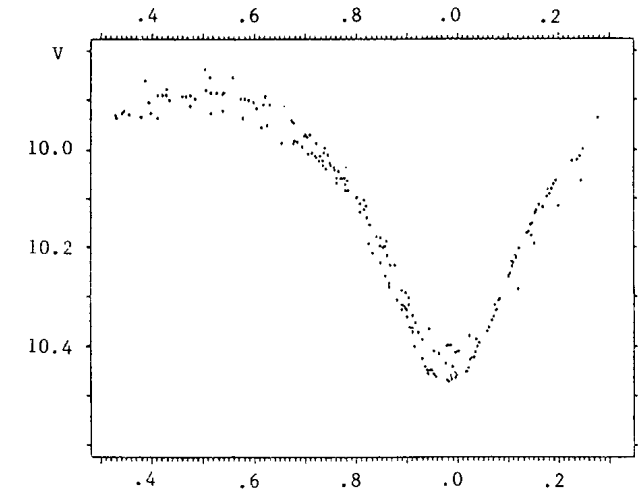
The following step was the determination of the larger possible number of extrema's instants from the photoelectric measures and the visual estimates of the GEOS members. 53 extrema (50 visual and 3 photoelectric) have been used in the linear regression giving the elements that now suit best to NSV 7457 Her (a triple weight has been given to the photoelectric moments). These elements are the following:

$$\text{Min JD hel} = 2447643.1786 + 0^d.4190306 \times E \qquad (1)$$
$$\pm 0.0023 \pm 0.0000025 \qquad \text{(confidence 95\%)}$$

The 204 photoelectric measures in V were also studied with the method of period search PDM from Patrick Wils. The more obvious periods obtained are 0.2095156 day and the double one.

The mean amplitude is 0.56 mag in V and M−m=0.50. It is clear that the light curve is not perfectly repetitive: the differences go up to nearly 0.1 magnitude, which is larger than the measures' accuracy (±0.03 mag).

Period=0^d.2095156



Min JD hel 2447643.1786+0^d.4190306×E

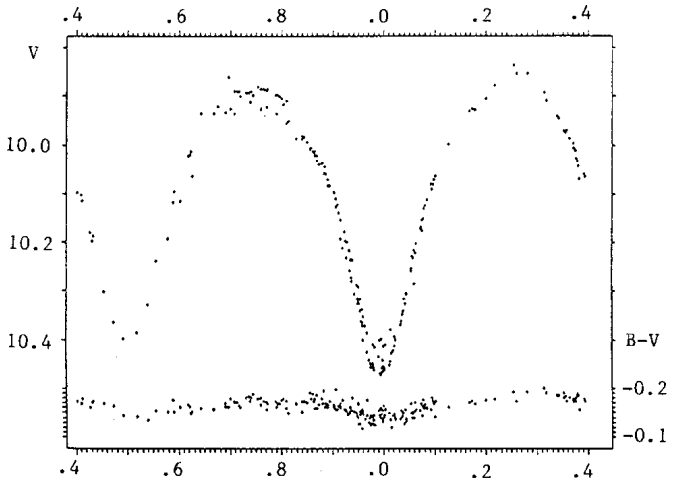


Figure 1. Composite light curves of the photoelectric measures

Filatov (1960) published 17 moments at which NSV 7457 Her was at maximum of light between 1943 and 1959. The accuracy of the period in ephemeris (1) theoretically just allows to go back to these years. Unfortunately, the tests came to a failure. In contrary a slight modification of the period of the present days came to a period suiting well enough the photographic maxima and the linear regression gives the following ephemeris:

$$\text{Max JD hel} = 2430850.002 + 0^d.2095038 \times E \qquad (2)$$
$$\pm 0.013 \pm 0.0000017 \qquad \text{(confidence 95\%)}$$

The period found is a little shorter than those suiting the current extrema and the photoelectric measures. A possible period change might have occurred.

This list of all the photoelectric measures of NSV 7457 Her can be obtained from the author. The B−V values corresponding to the Johnson and Morgan's system were calculated from the transformation formulae described by Meylan and Hauck (1981) using the star's class III.

If we plot the light curve of NSV 7457 Her with the period of $0^d.4190306$, its characteristics can be summarized as follows:

a. The magnitude of NSV 7457 Her varies from 9.85 to 10.45 in V.
b. Its primary minimum is generally a little deeper than its secondary.
c. Its maxima are clearly more rounded than its minima, but the ascending branches of the light curve are of the same length than the descending ones.
d. Its colour index B−V goes from 0.62 to 0.68.
e. It is always redder when it is less luminous.
f. The maxima and minima of the B−V colour curve are a little shifted compared with the ones of the V curve.

The period and the shape of the light curve of NSV 7457 Her are typical for eclipsing stars of the EW type. Nevertheless three peculiarities are to be examined in its case.

Firstly, the shape of the light curve varies and the maxima and minima do not have always the same shape. This is characteristic of binary stars having dark or luminous spots on the surface of at least one component. VZ Piscium is such a star (Maceroni et al., 1990).

Secondly, the B−V index mimics the V behaviour: the star is bluer when it is brighter in V. This can be found in contact binaries: if the binary star has a hot spot located near the contact point the star is bluer at maximum light when the spot is visible. CK Aqr has such a B−V colour curve (Le Borgne et al., 1989).

Thirdly, if we consider the period found with the moments of the Tadjikistan observatory's plates we can suppose that the period increased since the years 1943-59. This is the case when matter escapes from the system or when there is matter exchange between the components. In fact there is about the same number of W-type systems with an increasing period than with a decreasing one, whereas a few systems are alternating their tendency (Sarna, 1991).

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