COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 2666

Konkoly Observatory
Budapest
15 February 1985
HU ISSN 0374 - 0676

ON THE TYPE OF VARIABILITY OF THE STAR H42 IN THE ANDROMEDA GALAXY

Hubble (1929) classified H42 as a cepheid. Baade and Swope (1965) gave a period $P = 176^{d}.68$ on the basis of extensive observations. The light curve of H42 shows significant dispersion, particularly large in the minimum - up to 1^{m}. Cepheids in M31 usually have a dispersion smaller than $0^{m}.4$. Hence Baade and Swope considered the light curve of H42 as unstable and Sharov and Kholopov (1979) confirmed this conclusion. The above mentioned authors, however, considered the type of H42 as undefined. The luminosity of H42 corresponds to the period – luminosity relation. That is why this star is usually referred as a cepheid.

The aim of this paper is to show that H42 is a cepheid-like semi-regular star and to call attention to the very long period cepheids with $P > 50$ days, as well.

We redetermined the magnitudes of the comparison stars of H42 using three of the best plates obtained by the 2m telescope of Rozhen Observatory. The results are given in Table I. Our magnitudes of the B and C comparison stars are about $0^{m}.5$ fainter than Baade and Swope's ones. This difference must not be explained as a systematic variation in the magnitude scale. Baade and Swope's and our magnitudes of the comparison stars coincide (Ivanov, 1985 Fig.2). The stars B and C are exceptions.

Table I

Comparison star	A	B	C	D	E	F	G
B mag. (present paper)	17.7	18.9	19.2	19.7	20.0	20.3	20.6
Mag. (Baade and Swope)	17.7	18.4	18.7	19.6	19.83	20.31	20.62

We tied the magnitudes of Baade and Swope's observations to the comparison stars in Table I. We have evaluated B magnitudes of H42 using 17 plates (Table II). Our measurements are based on Arp's photoelectric standards in Baade's Field IV (Baade and Swope, 1963). We determined the period of H42 using a period-finding computer programme. Our period $P = 176^{d}.74$ coincides with that of Baade and Swope. We attempted to find periods using separately

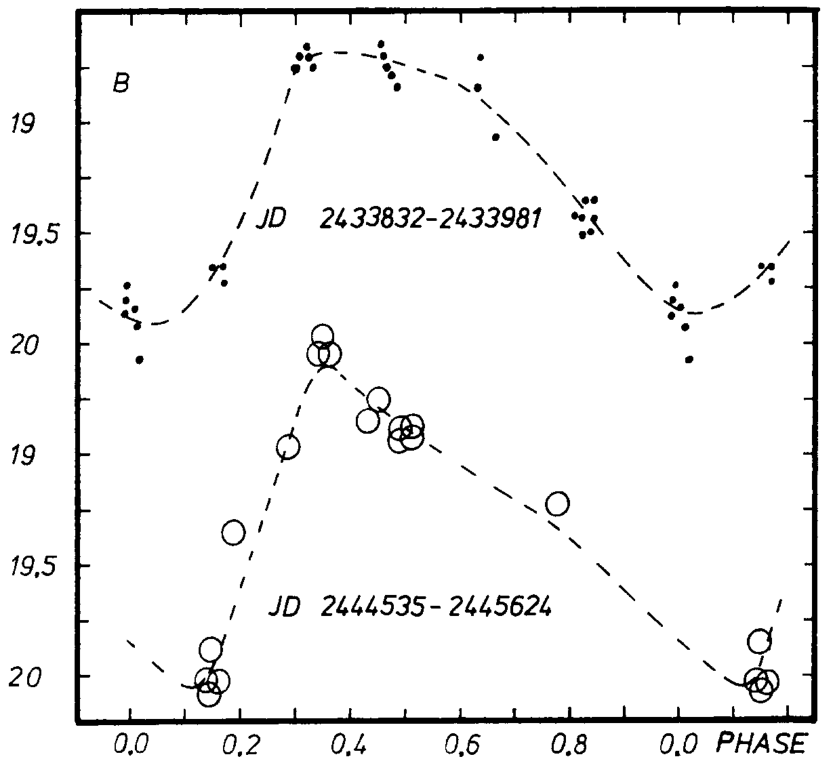

Figure 1

Table II

Photometry of H 42

J.D. 2440000+	B	J.D. 2440000+	B	J.D. 2440000+	B
4534.96	$19^{m}.35$	5284.24	$18^{m}.85$	5347.31	$19^{m}.23$
4881.56	20.05	5288.47	18.75	5622.48	18.55
4881.62	20.07	5295.25	18.94	5623.27	18.55
4882.42	19.88	5295.35	18.92	5623.35	18.55
4882.48	20.05	5296.25	18.92	5624.30	18.48
5242.59	18.98	5296.32	18.93		

the observations made by the following authors: Hubble (1929), Baade and Swope (1965), Sharov and Kholopov (1979) and our observations, as well. The period $176^{d}.74$ satisfies best the observations of the various authors. We conclude that the period has been constant. Both the amplitude and the shape of the light curve varied for the separate cycles (Figure 1). Our computer programme did not find any secondary period in the variations of the individual curves. The accidental variations are typical for the semi-regular stars.

In the Baade's Field III the cepheids with $P > 10^d$ show concentration to the inner edge of the arm S4 (Efremov, 1980). The location of H42 to the outer edge of the arm is not normal for the long period cepheids.

By our observations we obtained $\langle B \rangle = 19.5$. The absorption A_B in the region of H42 is varying from 0.8 to 1.2 (Ivanov, 1985). If we accept $(m-M)_o = 24.2$ for M31, we would obtain $M_{\langle B \rangle}$ from -5.5 to -5.9 . The period – luminosity relation predicts $M_B = -6^m.7$. It is well known that cepheids with $P > 100$ days do not lie in the straight line of the period– luminosity relation but below it. The luminosity of H42 is near that of the cepheids. However, there is not any explanation for the abnormal decline of the cepheids with $P > 100^d$ from the linear period– luminosity relation. We suppose that the luminosity of variables with $P > 100^d$ is not a convincing argument to refer H42 as a cepheid.

We have examined cepheids with $P > 50^d$ in the Magellanic Clouds. Neither the photoelectric observations nor the photographic ones give evidence for unstable light curves.

Recently Sasselov (1984) supposed the existence of a possible new type semi-regular variable, UU Her, which has a luminosity near that of the cepheids. H42 reminds of UU Her variables but both its amplitude and the shape of the light curve differs from the values typical of the UU Her stars.

A similar example in the Galaxy is the variable S Vul. This star is classified as a semi-regular one in the General Catalogue of Variable Stars (Kukarkin et al., 1969-1970). The visual light curves of Beyer (1930) support its belonging to the semi-regular stars. These visual observations cover 29 cycles. About ten individual light curves are well outlined. However, each one of the following authors: Fernie (1970), Mahmoud and Szabados (1980) made 20 observations and they suggested that S Vul was a classical cepheid. The photoelectric observations covered 6 cycles each but they did not outline well any individual light curve. Hence, these observations are insufficient for showing any variation in the shape of the light curve. The luminosity of S Vul is $M_V = -6.9$ (Caldwell, 1983). The radius obtained by the Wesselink method is $R = 249 \pm 11 R_\odot$. The values of M_V and R correspond to the respective values of cepheids. The O-C diagram in the paper of Mahmoud and Szabados, however, shows a 25-year cycle inherent to the UU Her stars. We consider the belonging of S Vul to the classical cepheids as a doubtful one.

We are grateful to D.D. Sasselov for the valuable discussion concerning the variable S Vul.

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