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

Number 2778

Konkoly Observatory
Budapest
16 August 1985

HU ISSN 0374 - 0676

96 HERCULIS: A REMARKABLE EARLY-TYPE MULTIPLE SYSTEM

96 Her (HR 6738, HD 164852, BD+20°3649, SAO 85672) is a bright B star. The HD spectral type of 96 Her is B3. Hoffleit and Jaschek (1982) quote B3V.

Radial-velocity variations of 96 Her were discovered by Mitchell (1911) on 25 Yerkes spectrograms. He found a range from -98 to +74 km/s and reported the presence of four components. The derived period was 50.2 days. Frost et al. (1926) remeasured ten of his plates as single and remarked that: "no attempt was made to measure separately the components observed by Mitchell in the spectrum of this star". Miss A.M. Hobe at Lick measured two plates for radial velocity (Campbell and Moore, 1928). She observed and measured a faint second component on both plates. Later, Plaskett and Pearce (1930) presented 10 radial velocities based on fair He I and Ca II lines and on wide H I lines. They supposed that the observed range of RV is the result of accidental errors of measurement and refuted the binary nature of 96 Her. Kodaira (1971) measured radial velocities of Balmer lines from H beta to H 15 on 30 Mt. Wilson spectrograms of 96 Her. Taking into account also older observations (with exception of Mitchell's data), he concluded that 96 Her is a SB 1 and derived period of 40.04 days. He also stressed that:"reexamination of multiple lines in higher-dispersion spectrograph is necessary". The inspection on three LWR high-resolution spectra taken in August 1983 with the IUE satellite revealed striking variations of Mg II lines 2795, 2802, 2790, 2797 Å and also some Fe II lines within a three day interval.

This finding revived the suspicion that 96 Her is a multiple system and prompted us to start the ground-based observations.

Our observational material covers the period JD 45570-46136 and consists of:

1. 14 blue-violet (3650-4900 Å) spectrograms obtained with the Cassegrain spectrograph attached to the 1.88 m telescope of the David Dunlap Observatory (DDO). The reciprocal dispersion was 8Å/mm (with the exception of one 12Å/mm plate). Vacuum sensitized IIIa^{J} emulsion was used.
2. Two red (4800-6800 Å) and 13 blue-violet (3500-4900 Å) spectrograms secured with the coudè spectrograph of the 2 m RCC telescope of National Astronomical

Table I

Orbital elements of 96 Her AB

Period	12.4573	±	.008	days
T_{max}RV	45895.41	±	.02	J.D.
e	0.536	±	.008	
ω	$321^{\circ}.3$	±	$1^{\circ}.3$	
K_1	57.6	±	.9	km/s
K_2	57.5	±	.9	km/s
γ	-15.5	±	.4	km/s
$m_1 \sin^3 i$	0.591			$m_\odot$
$m_2 \sin^3 i$	0.592			$m_\odot$
$a_1 \sin^3 i$	12.0			$R_\odot$
$a_2 \sin^3 i$	12.0			$R_\odot$

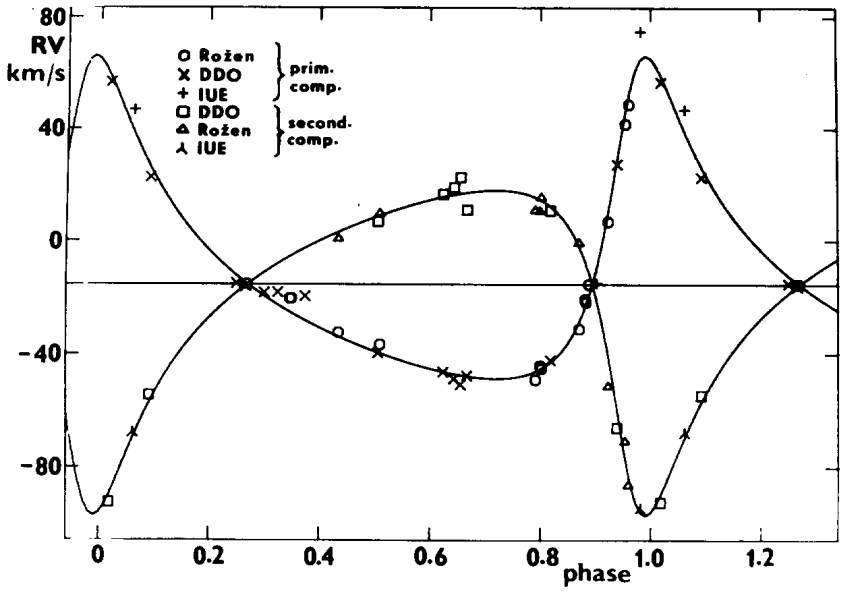

Figure 1: Radial velocities and computed curves for the spectroscopic pair 96 Her AB corresponding to the orbital solution of Table I. Phases are plotted from T max RV.

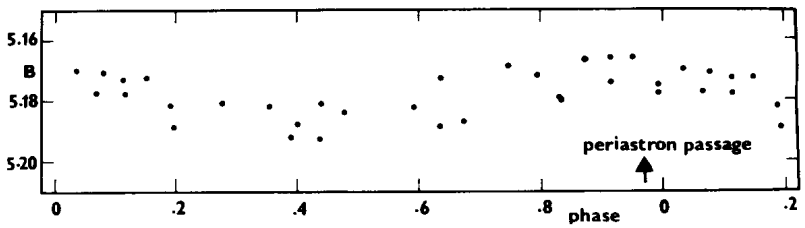

Figure 2: The light curve of 96 Her in B. Phases are derived from the orbital solution given in Table I and are counted from T max RV.

Observatory at Rožen (NAOR). The dispersion of the blue-violet spectra was 9Å/mm, while the red ones had a dispersion of 18Å/mm. Kodak IIaO emulsion was used (103aF emulsion for the red plates).

3. Three LWR high-resolution spectra taken with the International Ultraviolet Explorer (IUE), see Boggess et al. (1978) for a description of the IUE satellite and its instrumentation.

All the spectra were measured for radial velocity. The plates taken at NAOR were measured with the oscilloscopic comparator of the Observatory. The device was controlled by the multipurpose routine written by Y. Bellas. This routine was also used for deriving the radial velocity. The spectrograms obtained at DDO were digitized using the PDS microdensitometer, and the radial velocities were measured by fitting parabolas to the lower halves of the line profiles. The UV data were extracted form the plots produced with a software written by one of us (J.H.). More details on the reduction techniques will be given in the forthcoming study of 96 Her.

Many spectrograms show definite doubling of the lines (including the Balmer lines). On several plates 3 components are visible. This is undoubtedly the result of a higher quality of our observational material. The velocity of the third component varies on a short time scale. This fact suggests that there is another binary in the system. The spectra of the primary (A) and secondary (B) are comparable, with the lines of the secondary being slightly weaker. The spectrum of the third component is somewhat weaker. The spectral types and rotational broadening of all observable contributors to the spectra seem to be similar (B 2-3, v.sini 30-40 km/s). The available measurements of the radial velocity can be used only for deriving the elements of the system AB. Periodicities in the velocities derived from the components A and B were searched for with a period-finding program by Morbey (1978). The resulting period was 12.7 days. The orbital elements of the system 96 Her AB were then computed using the program SPEL - written by J.H. - which is based on direct minimization of the $(O-C)^2$. They are collected in Table I and displayed graphically as a phase diagram in Figure 1.

96 Her has been selected as one check star in the on-going international program of photoelectric monitoring of bright Be stars (Harmanec et al., 1980) and was observed in the period JD 45065-45178 at the Hvar Observatory. These observations reveal that the B magnitude of 96 Her varies with the orbital period of the system AB. The light curve is presented in Figure 2. The light maximum coincides with the time of periastron passage. We can speculate that a kind of pulsation driven by the tides is the source of the photometric variability.

Clearly, 96 Herculis is a very interesting early-type multiple system which deserves attention of spectroscopists and photometrists.

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