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TWO BRIGHT ECLIPSING BINARIES IN SAGITTARIUS: AN APPEAL TO SKILLED PHOTOMETRISTS

Two very interesting eclipsing binary stars have favorably placed eclipses this coming summer and fall, and a concentrated effort should be made to observe them. Both stars are very bright, fourth magnitude, but the eclipses are shallow, so that skilled photometrists are needed in order to obtain first quality data.

μ Sagittarii (HD 166937, V=$3^{m}_{.}86$, B8Ia) has long been known to be a single spectrum spectroscopic binary with a period of 180.45 days. Elvey (see Morgan and Elvey, 1938) detected photoelectrically a shallow partial eclipse approximately at the time of conjunction with the B8 supergiant behind the invisible secondary component. The eclipse was not too well covered by Elvey's observations, so the estimated depth of $0^{m}_{.}14$ in the blue, and the duration of 20 days, are to be considered as only approximate. The eclipse was subsequently observed by Hall (1941) with a photoelectric photometer sensitive in the infrared (effective wavelength about 8,000 A) who found about the same depth and duration.

As far as I know, the eclipses have not been observed since then, i.e. over a period of 38 years. Therefore the predicted eclipse, which is to come on June 3.85 (mid-eclipse) according to Rocznik Astronomiczny 1979, may easily be several days off.

Why is it important to observe μ Sagittarii? In 1978, I observed the star with the spectrographs on board of the satellites IUE and Copernicus (in the latter case, in collaboration with R.S. Polidan). There appears to exist a flux excess at wavelengths 1100 - 1500 A over the level we would expect for a B8 Ia supergiant. Moreover, the Copernicus scans indicate the presence of lines typical for a hotter star, approximately B2 V or even somewhat earlier. Thus it is very probable that the invisible secondary star is the hotter component. I am currently analyzing older observations as well as my own new spectra, which tend to support the existence of a hotter star, showing variations of line strengths and profiles compatible with this assumption.

If the secondary is indeed the hotter star, then the observed eclipse was the <u>secondary eclipse</u>, and there must be another and deeper eclipse. With the somewhat eccentric orbit of μ Sagittarii, this <u>primary eclipse</u> should come about 95 days after the secondary eclipse, i.e. this year it may be expected on about September 7. Its duration may be again some 20 days, but its depth in B should be larger and attain perhaps $0\overset{m}{.}3$ or even slightly more. It may appear surprising that such an eclipse of such a bright star should have passed unnoticed for so many years. But who observes bright stars nowadays? I predicted the preceding primary eclipse for March 10, 1979 (Plavec, 1979), but the star was not favorably placed for observations at that time. A private communication by Dr. Y. Kondo indicates that the far UV flux was considerably lower than usual on March 24, 1979. Considering the uncertainties in timing the mid-eclipse and in the duration of the eclipse, this appears to be a positive result.

An inspection of the <u>Copernicus</u> data from August, 1978 leads R.S. Polidan and me to suspect that there may be atmospheric eclipse effects in the spectrum preceding the bodily eclipse of the blue component. We have in μ Sgr a rare opportunity to determine the mass of a very luminous B8 supergiant, and perhaps even to study its atmospheric structure.

<u>υ (upsilon) Sagittarii</u> (HD 181615/6, V = $4\overset{m}{.}58$) is an even more fascinating object. Its double HD catalog number stems from the fact that the star appears to have a composite spectrum, approximately B8 Ia + F0 Ia, but both spectra appear to be produced in the same atmosphere, which is extremely hydrogen-poor. The star is therefore to be called a single-spectrum spectroscopic binary, and has a period of 138 days. Shallow eclipses were discovered by Gaposchkin (1945). More accurate observations were obtained photoelectrically in 1949 at the Lick Observatory (Eggen et al., 1950).

Both eclipses were observed by Eggen and Kron, and both are shallow. In the blue, the primary eclipse is about $0\overset{m}{.}10$ deep, and the secondary eclipse is about $0\overset{m}{.}05$ deep. In yellow, the depths are about $0\overset{m}{.}08$ and $0\overset{m}{.}06$, respectively. The light variation appears to be rather continuous, so my estimates of the duration of the eclipses are crude guesses only. The primary eclipse may last about 25 days, while the secondary eclipse appears to be broader and lasts perhaps 40 days. This disparity, if real, may be very important for our understanding of the system, as I will indicate below.

The next primary eclipse is predicted, by Rocznik Astronomiczny 1979, for June 6.68, and again for October 22.62. According to Eggen et al. the secondary eclipse follows the primary by 66 days, so that the secondary mid-eclipse can be expected on about August 12, 1979.

The fascinating thing about these eclipses is that -- as in μ Sgr -- the star whose spectrum is normally observed is eclipsed at the secondary eclipse. Thus, again, there should be a hotter component in the system. This hotter component was indeed discovered in the satellite UV by Duvignau, Friedjung and Hack (1979). It is most interesting to note that it appears impossible to assign a unique spectral type to this object: estimates at different wavelengths vary continuously through spectral types B and A. This is precisely what I have found in a number of interacting binary stars studied with the IUE (Plavec and Koch, 1978, 1979). The explanation we offered was that the object is actually a geometrically and optically thick disk surrounding the accreting star, in a binary system where the other component is probably losing mass at a very fast rate. The systems we observed include SX Cas, RX Cas, RW Per, W Ser, W Cru and V 367 Cyg. Another member of this group, β Lyrae, was already studied before (Hack et al., 1977).

It was noted in the case of SX Cas that the secondary eclipse (caused by the disk) is broader than the primary eclipse (Günther, 1960). If the same pattern is found in υ Sgr, then there probably exists a certain similarity between υ Sgr and the other stars listed above.

MIREK J. PLAVEC
Department of Astronomy
University of California
Los Angeles

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