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LIGHT CURVES FOR XY UMa

The variable nature of XY UMa was first noted by Geyer et al. (1955), after which Geyer began a prolonged series of photometric observations, the results of which he reported in 1976. He gave a general explanation of the peculiarities of the data by employing the concept of evolving starspots. This idea has been reinforced by a wealth of corroborating evidence in this and similar cool "short period RS CVn" stars. (See e.g. Baliunas and Vaughan, 1985). Indeed, XY UMa, in terms of its chromospheric surface flux, may well be the most active of such systems (Gurzadyan, 1987).

Recently Heckert and Zeilik (1988) have reported new observations of the star, which they analysed in terms of a single spot group centred at a longitude not far from 270^{o}, a minimum radius of about 10^{o} and appearing at some intermediate latitude (approx. 40^{o}in an unspecified hemisphere).

The purpose of the present article is to report some similar studies on the BVR light curves of Jassur (1986), which he observed in Egypt during March 1979.

The starting parameters were taken from Budding and Zeilik (1987). Initial fits to the distorted light curves produced

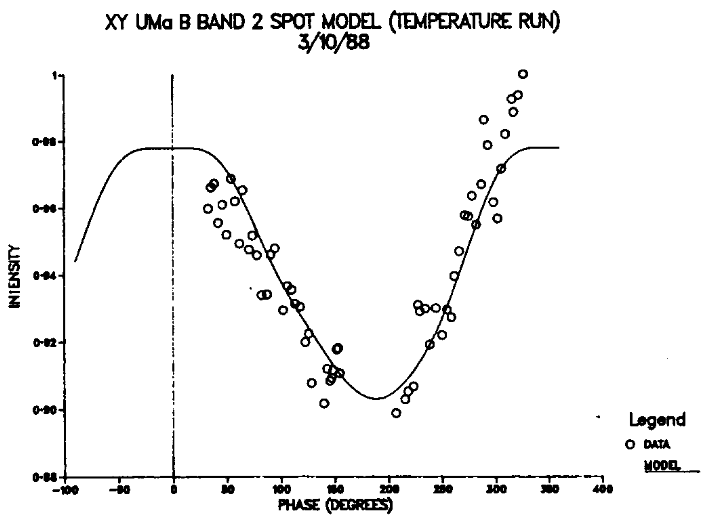

Figure 1: Model Maculation Wave Fit to the Initial Fit Residuals.

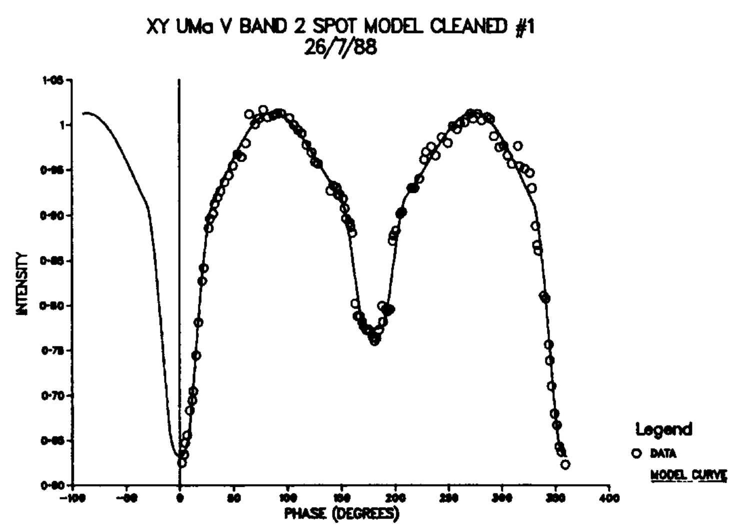

Figure 2: Final Fit to the corrected data. The "raw" light curve can be seen in Jassur (1986).

Geometric parameters $r_1 = 0.346$, $r_2 = 0.175$ and $i = 83.2^o$, not too far, but significantly different from the values of Budding and Zeilik. The fractional sizes of the two stars are larger after the re-run, and the inclination lower.

We next looked at the difference curve after subtracting this first order model from the light curve. This is analysed for maculation ("starspot") effects. Two spot groups were used. They appear to be centred at around longitudes 132^o and 220^o. They are of comparable size (approx. 15^o in radius) and have been fixed at intermediate latitudes. These spots were given small, but non-zero surface fluxes in the three colours, unlike the minimum area black spots of Heckert and Zeilik.

Finally the "cleaned" light curves were formed by taking out the calculated maculation effects from the original data. The basic geometric parameters specifying the fit to this new light curve do not change by very much from the initial fits (r_1=0.345, r_2= 0.190, $i = 84.0^0$). Correlated errors calculated for these quantities are of the order of 1%. These geometric values only varied within the expected error estimates in the three wavelength ranges. Although these are closer to the "adopted" final values of Budding and Zeilik, there is still some appreciable difference (r_1= 0.327, r_2= 0.168, $i = 88.2^o$).

The curve-fits were also checked by the codes of Wilson and Devinney (1971). The geometric parameters derived for the fit to the "clean" curve are essentially similar to the ones we gave before (i.e. rather different from those derived by Budding and Zeilik), apart from the fractional luminosity values. Banks (1989) has noted some slight systematic difference between the fractional luminosities obtained in the Wilson-Devinney code from those of the Budding program in various curve fitting experiments for eclipsing binaries, though geometric parameters tend to be effectively similar. The difference in luminosity values may be related to differences in the roles of assigned temperatures in the two procedures.

The conclusion arising from these present efforts therefore seems to present some challenge to the expectation given by Budding and Zeilik (1987) that the derived geometric parameters for "clean" light curves of the same system should always be essentially the same. They expected this to provide a general confirmation of methodological adequacy. On the basis of these present results this cannot be confirmed. Perhaps some systematic effects are at play in the case of XY UMa other than those which the maculation wave and eclipsing binary variation separating procedure of Budding and Zeilik takes into account, at least with a single iteration of the procedure.

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