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Light Curves for CG Cygni

Since the discovery of its variability by Stanley Williams (1922), CG Cygni has been the object of intense study. More recently Milone has shown that the system clearly has a migrating maculation ("Starspot") wave in its light curve (see Milone *et al.*, 1979). This bulletin details a re-analysis of Jassur's (1980) 1979 BVR data, employing the method and computer programs outlined by Budding and Zeilik (1987) who analysed a 1981 V Band light curve of this star. Jassur only studied the eclipses in his study.

The starting parameters were taken from Budding and Zeilik, in the expectation that once the maculation wave has been accounted for, the geometric parameters will remain constant with time. Initital fits to the distorted light curves produced the following parameters :

Primary Radius r_1	=	0.214
Secondary Radius r_2	=	0.224
Primary Luminosity L_1	=	60.08 %

We fixed the inclination at the final Budding and Zeilik value of 82.8 degrees for this initial model.

We then examined the difference curve obtained by subtracting this initial model from the light curve, and attempted to model it as a maculation wave. Two middle latitude spot groups of similar sizes (about 18 degrees in radius) located around the longitudes 126° and 246° were found to fit the data best. Following the procedure of Budding and Zeilik the spot fluxes were set to zero, thus producing minimum area spots. When these results are compared with those of Budding and Zeilik it appears that while the first spot had remained static between 1979 and 1981, the second increased in both radius and longitude.

The final light curves were formed by subtracting the calculated maculation effects from the original data. The basic parameters specifying this fit are :

Primary Radius r_1	=	0.223
Secondary Radius r_2	=	0.238
Inclination i	=	84 °
Primary Luminosity L_1	=	61.9 %

The correlated errors calculated for these quantities are of order 1 %. At first glance these appear to be appreciably different from those found by Budding and Zeilik :

Primary Radius r_1	=	0.241
Secondary Radius r_2	=	0.226
Inclination i	=	83 °
Primary Luminosity L_1	=	74.5 %

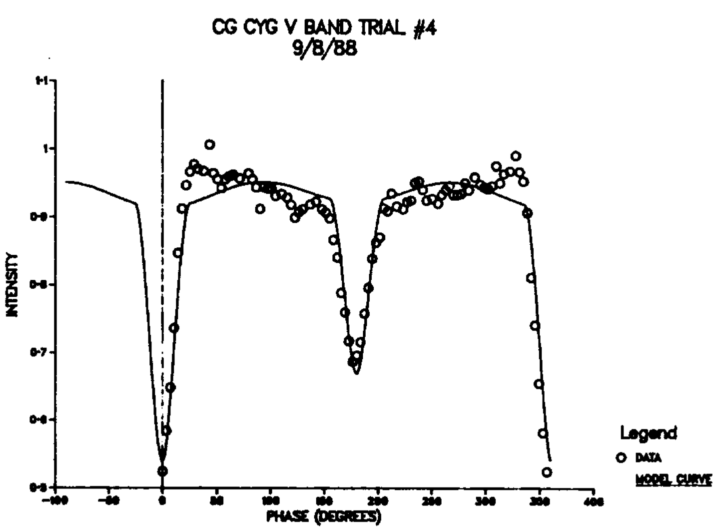

Figure 1 : The original V Band data is plotted against the best initial model fit (the straight line).

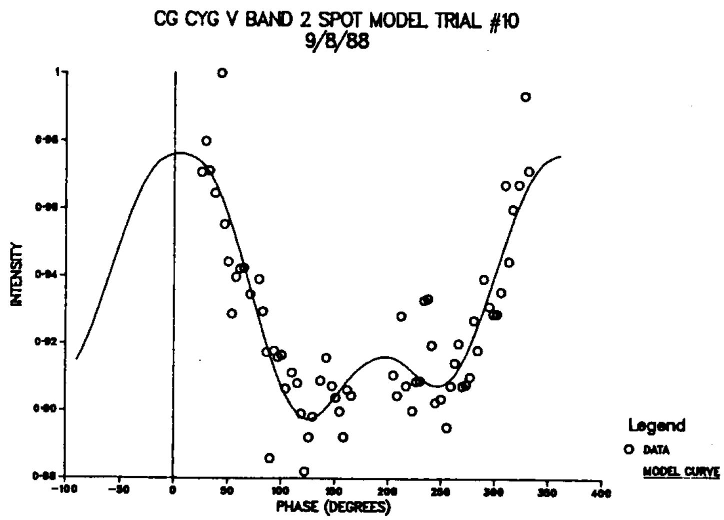

Figure 2 : The residuals from the initial V Band fit are plotted with the model light curve produced by the two dark spots discussed in the text.

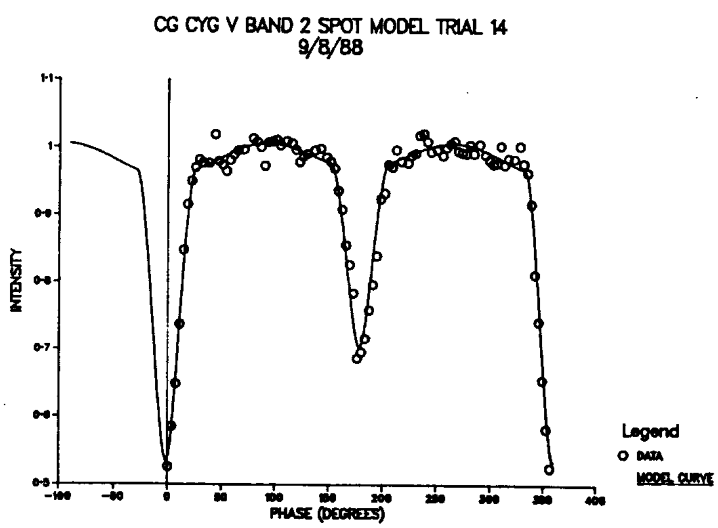

Figure 3 : The final model light curve is plotted against the spot corrected V Band data.

Mancuso *et al.* (1981) noted a genuine ambiguity between the transit and occultation hypothesis for systems with a mass ratio in the range between 0.79 and unity, as CG Cyg's does. They also showed that while all transit hypothesis minima could be at least roughly simulated by an occultation, the reverse is not true. In these ambiguous cases while the inclination of the system remains constant, the stellar radii are essentially transposed and the occultation Primary luminosity is that of the Transit case multiplied by the square of the ratio of the radii (r_2 / r_1). Thus the present study's results would be :

Primary Radius r_1	=	0.238
Secondary Radius r_2	=	0.223
Inclination i	=	83.0 °
Primary Luminosity L_1	=	70.5 %

These parameters were found to well within error of the results of Budding and Zeilik, and in view of the spectroscopically supported discussion of the Main Sequence-like character of the stars given by these authors, the transit solution would clearly give the preferable physical interpretation.

The results of this study can be seen to be in agreement with the transit model of Budding and Zeilik, and lends further support to their modeling procedure for RS CVn systems. However, the photometric evidence alone does show that the alternative occultation model (as considered by Jassur) is also feasible. The authors acknowledge Professor Zeilik's correspondence on this subject.

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