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THE LIGHT VARIATIONS OF THE DELTA SCUTI STAR ϑ^2 TAURI

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1. OBSERVATIONS AND ANALYSIS

The bright member of the Hyades cluster ϑ^2 Tauri was announced to be a δ Scuti star by Horan (1977) and its light variability was confirmed by Duerbeck (1978). This star is a well known single line spectroscopic binary with high eccentricity (P = 140.7 d, e = 0.75), therefore it may be an interesting object for testing a possible interaction between pulsation and orbital motion. With this aim we decided to perform an intensive programme of photoelectric observations at the Merate Observatory. The star was observed from September 19, 1981 to January 31, 1982, and a total of about 1400 measurements (B filter) distributed over twenty nights were obtained. The measurements were assembled into normal points, each consisting of about five measurements, in order to get an optimum compromise between internal scatter and temporal resolution. Owing to the smallness of the light variations, the constancy of the comparison star (CF, HR 1422) and the quality of our measurements were verified observing the check star (CK, HR 1427) with the same frequency as the variable. The standard deviation of the (CF - CK) normal points is of 0.0040 mag (see Antonello and Mantegazza, 1982).

The amplitude of the light variations of ϑ^2 Tau changes greatly; the maximum amplitude (0.04 mag) was observed on J.D. 2444900 and the minimum amplitude (0.01 mag) on J.D. 2445001. Owing to the bad weather conditions, we could not make many observations during the periastron passage on J.D. 2444933; therefore, we observed again the star during the periastron passage on J.D. 2445355 (the epochs of the passages were computed by means of the formula T = 2436489.782 + n 140.728; Ebbighausen, 1959). This time we obtained about 400 measurements on five nights, from J.D. 2445353 to 2445358.

The least-squares power spectrum analysis of the first set of data show the presence of a dominant sinusoidal component with a frequency of 13.22 cycles/day (with a semiamplitude of 0.0085 mag) and several other components of lower excitation in the frequency interval between 12 and 16 c/d. Owing to the interference of the spectral patterns of such closely spaced components, it is difficult to find an analytical representation of the light curve as sum of sinusoids which is also physically significant. The analysis of the second set of data has given only two components: f_1 = 13.26 and f_2 = 12.03 c/d, with semiamplitudes of 0.0115 and 0.0066 mag, respectively. However, the fit of the data to these two sinusoids is not fully satisfactory. The component f_2 was found independently in the first set too (see Antonello and Mantegazza, 1982). However, in the first set this component has not the highest amplitude after f_1, and its semiamplitude is very small (0.0032 mag). The fact that these changes may be due to the effect of the periastron passage, which is badly covered in the first data set, cannot be guessed for the present.

2. THE PROBABLE ECLIPSE

There are possible variations on long timescales. These variations are probably real and do not seem to be correlated with the orbital motion. At the present, we are unable to explain them, except the significative low mean light level on the night 2445358 (about 0.04 mag below the mean luminosity), which may be explained by a partial eclipse. In figure 1, the data of the night 2445358 pre-whitened for the two sinusoids are represented. One can see a clear trend superimposed to the residual dispersion, which may be due in part to nondetected pulsation components. If we fit these points to a parabola, we find that the minimum is at J.D. 2445358.38. This is different from the predicted instant of minimum (J.D. 2445357.29). The difference between observed and computed epochs of the eclipse could be

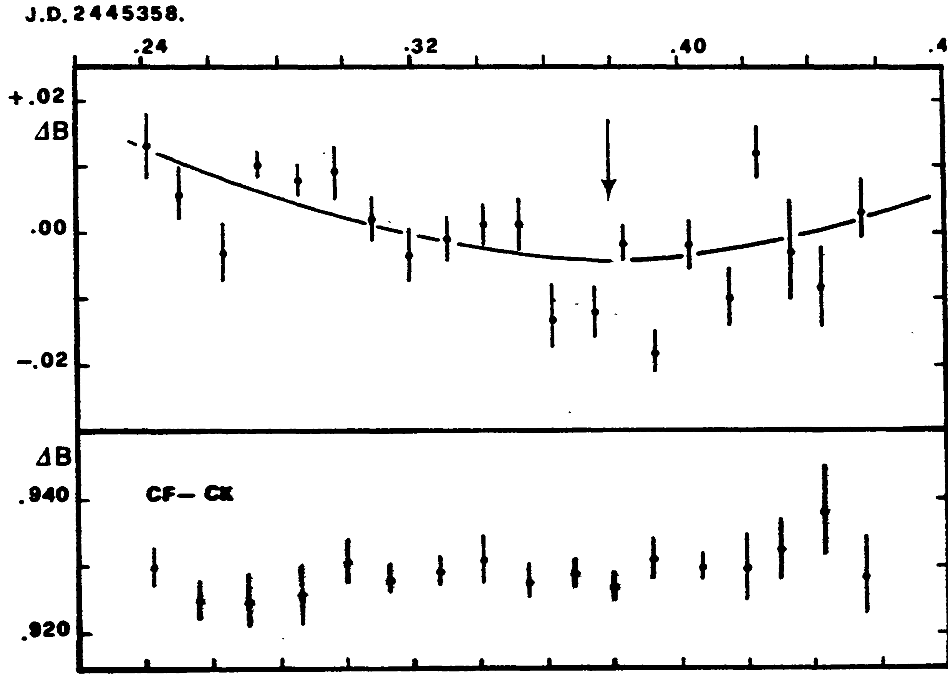

Figure 1. The probable eclipse observed in ϑ^2 Tau.

easily explained by an error of 0.017 d in the orbital period. This may be really the case, because the value of 140.728 d was computed by a least-squares fit on only three periastron passages (Ebbighausen, 1959). Hence, we analysed the radial velocities in the literature by means of a 10th order Fourier-gram. This method allows to utilize all the information contained in the radial velocity curve. A period of 140.734 ± 0.020 d was found (the required period is 140.745 d). A first evaluation gives a main sequence solar type star as secondary star. In order to confirm that ϑ^2 Tau is an eclipsing binary we will perform other observations.

Our observational result reminds the discovery of the eclipsing variable 16 Lac, which is also a well known β Cephei star (Jerzykiewicz, 1980); indeed the characteristics of the eclipses of this star are similar to the ones observed in ϑ^2 Tau (e.g. the depth is about 0.04 mag.).

As a concluding remark we have to say that the preliminary analysis of our data does not yeld strong evidence of interactions between pulsation and orbital motion.

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DISCUSSION

GURM: What is a number of pulsating stars among binaries?

BREGER: We know very little about the binary nature of Delta Scuti stars. Only about eight systems have been looked at in detail.