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# THE CHANGING LIGHT CURVE OF THE Ap STAR 41 TAURI

The Ap star 41 Tau≡HD 25823≡GS Tau was found to be variable by Rakos (1962). He reported a period of 11.94 d, a value also adopted by Blanco and Catalano (1972). Abt and Snowden (1973) discovered the spectroscopic binarity of 41 Tau and determined an orbital period of 7.227424 d. Wolff (1973) reported new and more accurate photometric measurements and established the synchronism between rotation and revolution. On the basis of the new value of the period, Rakos (1974) rediscussed his old photometric measurements: to our knowledge this is the last report about 41 Tau.

In December 1989 and January 1990 we intensively observed the $\delta$ Scuti star 44 Tau, located near 41 Tau, with the 50–cm reflector of Merate Observatory. Although the constancy of the comparison star 42 Tau was widely proved by several previous observers, we decided to measure 41 Tau in addition to the check star HD 25823 in order to test the stability of our instrumentation with a small amplitude, long period variable star. The results described here give very comfortable indications about this point. In each night a number of individual measurements ranging from 5 to 16 were collected and grouped into the normal points listed in the table (in the four columns the mean time of observation, the mean V magnitude, the number of measurements and the standard deviation of a single measurement are reported). The V standard magnitudes were calculated assuming V= 5.23 for the comparison star 42 Tau (*Bright Star Catalogue*).

As a first step, we performed a period search using a least-squares method and we were able to confirm the photometric period reported by Wolff (1973): the power spectrum is reported in the figure 1. As it can be noticed, owing to our time sampling, the alias peak at $1-f$ is as high as the peak at $f$=0.13 c/d. Once the value of the period was confirmed, we performed a Fourier analysis in order to evaluate the importance of the harmonic $2f$: the calculated semi-amplitudes are 0.010 mag and 0.004 mag for $f$ and $2f$, respectively. The standard deviation of the fit is 0.0018 mag: this is the expected value for our set of normal points obtained by averaging $N\sim 15$ measurements, performed by an instrumentation ( regarded as the ensamble of sky conditions, telescope, photometer and data acquisition system) characterized by a standard deviation of 0.007–0.008 mag (see the last column of the table); this is also the value obtained from the observations of the check star.

Table I

| Hel. J.D. 2447000.+ | V | N | s.d. | Hel. J.D. 2447000.+ | V | N | s.d. |
|---|---|---|---|---|---|---|---|
| 862.507 | 5.199 | 8 | 0.009 | 895.344 | 5.183 | 12 | 0.004 |
| 864.455 | 5.176 | 12 | 0.005 | 896.349 | 5.185 | 13 | 0.006 |
| 865.387 | 5.182 | 8 | 0.009 | 902.337 | 5.180 | 10 | 0.004 |
| 865.515 | 5.181 | 8 | 0.007 | 903.344 | 5.186 | 8 | 0.006 |
| 866.424 | 5.180 | 9 | 0.004 | 904.355 | 5.195 | 8 | 0.004 |
| 867.346 | 5.187 | 9 | 0.008 | 905.333 | 5.204 | 16 | 0.005 |
| 867.518 | 5.185 | 5 | 0.004 | 906.336 | 5.197 | 15 | 0.003 |
| 868.446 | 5.194 | 8 | 0.008 | 908.338 | 5.180 | 9 | 0.004 |
| 869.431 | 5.199 | 11 | 0.008 | 909.315 | 5.182 | 9 | 0.003 |
| 888.403 | 5.183 | 11 | 0.007 | 911.314 | 5.188 | 7 | 0.008 |
| 889.404 | 5.185 | 12 | 0.010 | 912.320 | 5.199 | 16 | 0.007 |
| 890.413 | 5.195 | 13 | 0.005 | 913.312 | 5.201 | 16 | 0.007 |
| 891.381 | 5.200 | 10 | 0.005 | 914.299 | 5.185 | 8 | 0.008 |
| 894.364 | 5.179 | 11 | 0.004 | 939.283 | 5.185 | 10 | 0.003 |

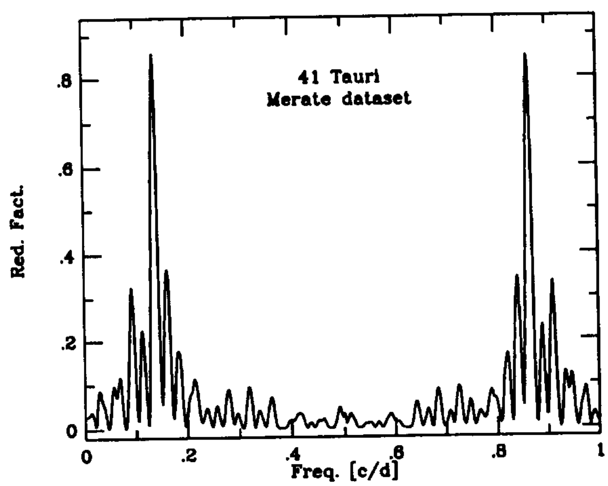


Figure 1

We repeated the analysis with the measurements reported by Wolff (1973): we obtained identical values for the frequency of the highest peak in the power spectrum and for the amplitude of the term with frequency $f$, but a different amplitude of the term with frequency $2f$ (0.002 mag). This discrepancy and a slight difference in the $\phi_{21} = \phi(2f) - 2\phi(f)$ parameter, where $\phi$'s are the phases, ($5.6 \pm 0.2$ rad for our measurements, $4.5 \pm 0.4$ rad for Wolff's ones) originate two different light curves, as it can be seen in the two panels of the fig. 2, where the two sets of measurements were reported with the respective least-squares interpolating light curve. The different mean magnitudes of the two curves are due to the fact that Wolff adopted for the comparison star 42 Tau a different V magnitude (V=5.196) than the one adopted by us. Both maxima of the two curves have been arbitrarily set to zero phase.

We can conclude that the shape of the light curve of 41 Tau is variable on a timescale of a few years. We also note that the light curves reported by Rakos (1974) for the years

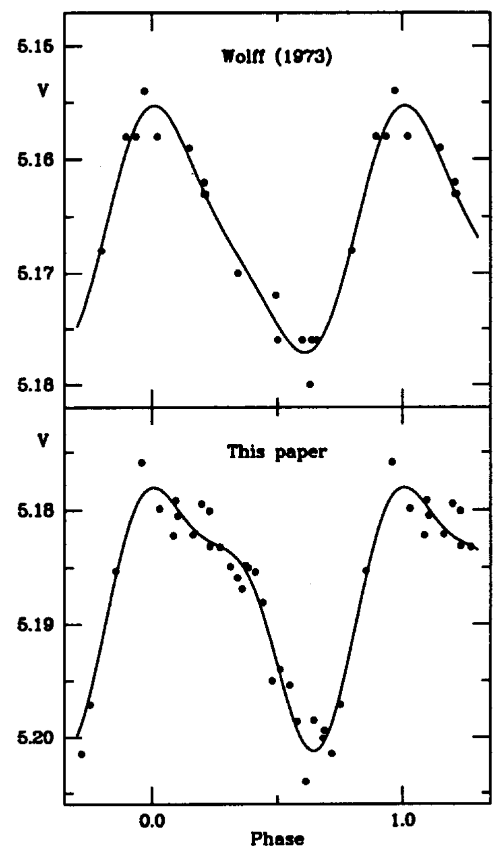


Figure 2

1960 and 1963-64 show a flat maximum, i.e. a third different behaviour. On the other hand the times of maximum light computed from the present measurements and those of Blanco and Catalano (1972) and Wolff (1973) have similar phases with respect to the ephemeris of the periastron passage (Abt and Snowden, 1973): 0.34, 0.42 and 0.42, respectively.


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