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A SEARCH FOR ROTATIONAL MODULATION OF T TAURI STARS
IN THE Tau AND Oph DARK CLOUDS

Many efforts were made in 1980 - 1990 by Rydgren and Vrba (1983), Vrba et al. (1984), Bouvier et al. (1986), Herbst et al. (1987), Shevchenko (1986) and others to search for any periodicity in T Tau stars caused by the rotational modulation of spotted photosphere. Some results of these searches were analysed by Bouvier (1989). The observed light and colour periodicity can be used to determine the rotational period, the temperature of the photosphere and spot as well as possible magnetic fields and accretion structures of T Tau stars.

To search for the periodicity and other data, photoelectric UBVR -photometry of T Tau stars was made on Mt. Maidanak using two 60-cm Zeiss reflectors with pulse counting photometers. 6 stars were observed in 1978-1982. 10-18 ones per year were observed in 1983-1986. Since 1987 the program "Rotor" including about 70 stars has been in progress.

The periodicity of T Tau light curves is analysed by modern methods of digital spectral analysis (Marple, 1987). The methods were adapted to real observational sets by K.N. Grankin. Preliminary results were published by Shevchenko (1986), Berdnikov et al. (1991), Grankin et al. (1991). In this paper we present the most important results of the search for periodicity of 46 T Tauri stars in the Tau and Oph dark clouds. The negative result of the periodicity search for 12 stars seems to be caused for great part by deficiency of observational data.

Values of the periodicity and observational data for 22 stars in TDC and ODC are listed in Table 1. The values in columns 2-4 refer to our own observational sets: amplitude, number of observations and epoch. Columns 5-8 give derived data for the periods discovered: value, statistical possibility, the epoch and amplitude of the periodic process. Column 9 presents the periods referenced by Bouvier (1989).

Table 1. A search for periods in T Tau stars

Star name	Amplitude Vmax-Vmin	n	Epoch JD 2440000+	Period days	Pos- sibi lity	Ep.of period 1900+	n	Per. <A > days
				*				**
SR 9	11.30-11.77	154	6607-8101	6.54*	0.99	86-90	0.35B	6.4
SR 12	13.17-13.44	106	6964-8100	3.50	0.90	90	0.20B	3.4
HARO 1-1	13.07-13.63	98	6974-8101	3.34*	0.92	87-88	0.25B	
HARO 1-8	13.88-14.24	84	6965-8101	14.58*	0.97	87-90	0.30B	
HARO 1-14	13.75-14.50	88	6964-8101	8.21*	0.98	87-88	0.40B	
V1121 OPH	11.13-11.62	128	6955-8123	8.50	0.90	90	0.22V	
V2058 OPH	12.60-13.09	143	6607-8101	6.90*	0.87	86-88	0.15B	
T TAU	9.80-10.20	276	6665-8259	2.80	0.75	86-90	0.03B	2.8
VY TAU	13.49-13.82	223	6379-8265	5.37*	0.97	85-90	0.10B	
AA TAU	12.55-13.90	212	6690-8265	8.17	0.90	87-90	0.43B	8.2
BP TAU	11.66-12.37	269	6679-8230	7.60	0.70	90	0.20B	7.6
DF TAU	11.30-13.92	515	3741-8271	7.11*	0.97	78-83	1.00B	8.5
DG TAU	11.81-13.04	438	4465-8271	15.24*	0.95	80-83	0.35B	
DI TAU	12.80-13.10	274	6710-8271	7.57	0.80	87-90	0.05B	7.9
DK TAU	11.57-13.85	227	7022-8271	8.20	0.95	87-90	0.90B	
DL TAU	12.60-13.89	222	7017-8270	9.40	0.95	87-90	0.40B	
DN TAU	12.14-12.50	222	6681-8265	6.30	0.85	87-90	0.14B	6.0
GI TAU	12.48-14.91	245	6681-8270	7.02	0.7?	87-90		
V410 TAU	10.69-11.22	333	6660-8271	1.872	0.99	86-90	0.33B	1.88
V819 TAU	12.25-12.44	61	8126-8270	5.60	0.94	90	0.19B	5.6
V827 TAU	12.09-12.30	26	8135-8163	3.75	0.97	90	0.19B	3.75
V830 TAU	13.10-13.30	58	8123-8270	2.75	0.97	90	0.20B	2.75

Notes:

- * the detailed information on SR-9, Haro 1-1, 1-14, and V2058 Oph is in Berdnikov et al. (1991), VY Tau in Grankin et al. (1991), DF, DG Tau in Shevchenko (1986).
- ** periods from published data referenced by Bouvier (1989), SR 12 : in Berdnikov et al. (1991) period is 10.2 with a low possibility.
- DF Tau : in 1978-1983 rotational modulation due to a hot spot was present. The spot disappeared after 1984. In 1985-1990 the periodicity is shown in a low possibility $7.1 < P < 8.3$
- DG Tau : see DF Tau. A hot spot disappeared after 1982. There is a 455-day cycle too. In 1986-1990 the possible period is $8.3 < P < 16.7$ days.
- GI Tau : one can see 7.0-7.5 day period against a very complex irregular variability.
- V410 Tau : very stable period 1.872 during 1986-1990.

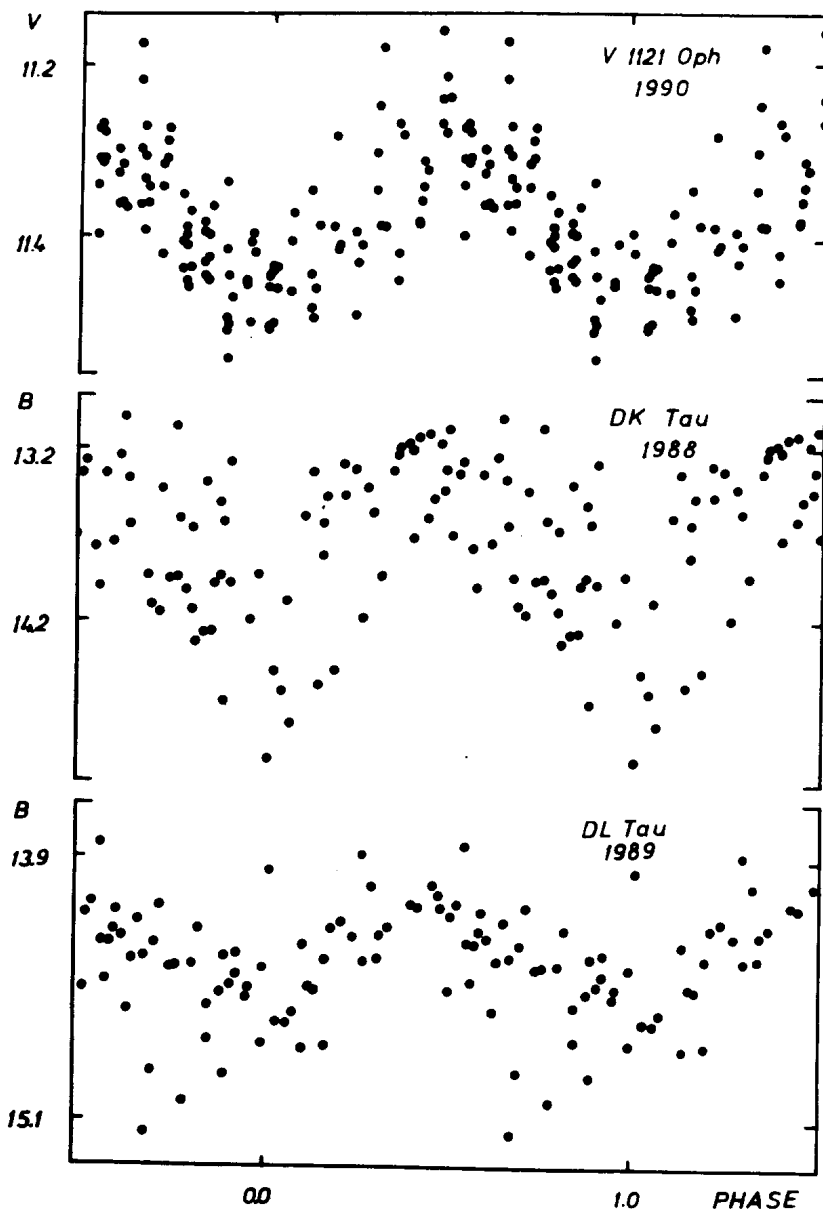


Figure 1. The folded light curve for V112 Oph (P=8.5 days), DK Tau (P=8.2 days) and DL Tau (P=9.4 days).

We refine and confirm periods recently discovered for 11 T Tau stars. The period of the rotational modulation for DF Tau due to a hot spot was discovered by Shevchenko (1986) and for the second time by Bertout et al. (1988).

Figure 1 shows summary light curves for three T Tau stars of our program. Their periods were found by the authors.

Though the observational data for 9 T Tau stars: RY, CI, CQ, DE, DR, DS, GK, HN, HP Tau are representative enough, we failed in attempting to find any periodicity in their light curves. For four more stars in TDC the periods may be suspected with a low possibility but in this case some difficulties appear with an irregular variability. On the other hand the periodicity may be of a different scale.

As we noticed recently (Berdnikov et al. 1991) the assumption of spotted rotating stars may meet with difficulties.

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References:

- Berdnikov L.N., Grankin K.N., Chernyshev A.V. et al., 1991, Pisma v Astron. Zh., 17, 1, 50.
- Bertout C., Basri G., Bouvier J., 1988, Astrophys. J., 330, 350.
- Bouvier J., 1989, Pre-publ. Inst. d'Astrophys. de Paris, N 294.
- Bouvier J., Bertout C., Benz W., Mayor M., 1986, Astron. Astrophys., 165, 110.
- Grankin K.N., Ibragimov M.A., Melnikov S. Ju., et al., 1991, IBVS, No. 3627.
- Herbst W., Booth J.F., Koret D.L. et al., 1987, Astron. J., 94, 137.
- Marple, Jr. S.L., 1987, Digital spectral analysis, Prentice-Hall New Jersey.
- Rydgren A.E., Vrba F.J., 1983, Astrophys. J., 267, 191.
- Shevchenko V.S., 1986, in "Flare Stars and Related Objects", ed. Mirzoyan L.V., Yerevan, p.230.
- Vrba F.J., Rydgren A.E., Chugainov P.F. et al., 1984, Bull. Am. Astron. Soc., 16, 988.