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DISCOVERY OF 5.66 DAY PERIODICITY OF HBC 379 = NTTS 041636+2743 = TAP 29 = LkCa 7

While T Tauri stars (TTS) are noted for their irregular variability on many time-scales, there are some early detections of quasi-periodicities on time-scales of a few days due to the rotational modulation. A likely explanation of the observed rotational modulation is the presence of dark (or hot) spots.

To search for the strict periodicities, photoelectric UBVR-photometry of about 70 TTS was made on Mt. Maidanak in 1986-1992. The results were published by Berdnikov et al. (1991), Grankin et al. (1991), and Shevchenko et al. (1991).

Observations of a number of new objects, so called "naked" TTS (Walter et al., 1988) were began by the author in 1990. In this paper we present the most important results of the search for periodicity of the object HBC 379 = NTTS 041636+2743 = TAP 29 = LkCa 7.

The star HBC 379 is a K7-MO V pre-main-sequence star discovered in the CaII H and K emission-line survey of Herbig et al. (1986). It is a variable ($12^m.3 < V < 12^m.6$) with weak H_α emission (E.W. = 4Å), strong lithium absorption (E.W. = 0.5Å), low obscuration ($E_{B-V} = 0.2$), slow surface rotation ($V \cdot \sin i < 11$ km/s), no infrared excess, bolometric luminosity of $\sim 1 L_\odot$, and raradial velocity consistent with membership in Tau dark cloud (Herbig et al., 1986, Hartmann et al., 1987). HBC 379 is also an x-ray source (Feigelson et al., 1987).

Our observations of HBC 379 were made in 1990-1991 on Mt. Maidanak using the 0.5m reflector with UBVR-pulse counting photometer. The limits of the light variations, average colours and number of observations are listed in Table I.

To search for a period in the light variability, the observations were analysed by the method of digital spectral analysis (Grankin et al., 1991). The analysis yields a period of 5.66 ± 0.005 days. Phase diagrams for light-curve in the UBVR filters for a period of 5.66 days are displayed in Figure 1.

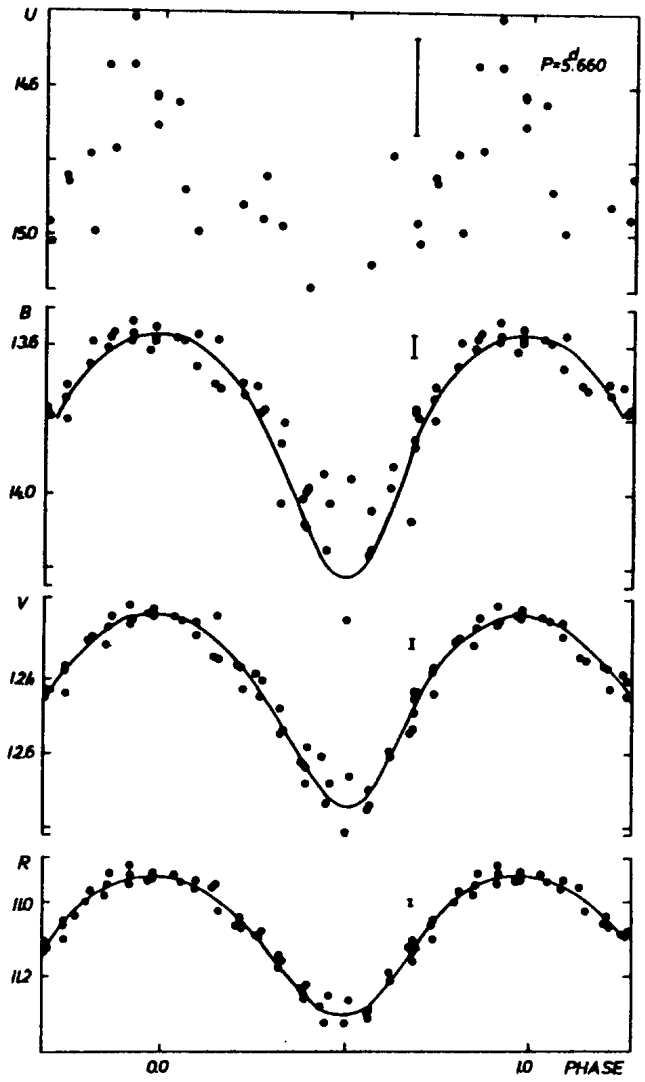

Figure 1. Phase diagram of HBC 379 in the UBVR filters (P=5.66 days). The observed data points are shown by filled dots and the solid line is a synthetic light-curve calculated with parameters given in Table II. Error bars show ± 1 standard deviation.

Table I. Photometric data of HBC 379

J.D. 2440000+	n	Vmax	Vmin	<V>	<U-B>	<B-V>	<V-R>
8182 - 8230	18	12.21	12.68	12.441	1.174	1.348	1.338
8503 - 8572	36	12.20	12.81	12.443	1.063	1.390	1.350

Table II. Parameters and results of HBC 379 spot model

Fixed parameters	
Rotation period:	5.66 days
Photospheric temperature:	3800 K
Limb Darkening Coefficient in B:	1.0
in V:	0.89
in R:	0.74
Results	
Spot temperature:	3400 $\pm$ 25 K
Rotation axis inclination:	$36^{o} \pm 1^{o}$
Spot polar distance:	$20^{o} \pm 1^{o}$
Spot radius (in degrees):	$65^{o} \pm 2^{o}$

The amplitudes of the periodic process change considerably for each filter ($0^{m}.37$ R, $0^{m}.52$ V, $0^{m}.65$ B). We studied the light variations appearing as a consequence of a dark spot on the photosphere of the star. The shape of the light-curve may depend on the position of the spot on the stellar surface, the orientation of the rotational axis relative to the observer, the size of the spot, and the temperature difference between the spot and the photosphere.

The range of spot properties for which we find acceptable fits to the observed light-curves and the actual parameters used for computing the synthetic light-curves is given in Table II. It should be noted that the spot size has a lower limit due to the large changes of the colour indices (> 0.15 mag). These changes are possible if the radius of the spot exceeds 50 degrees.

Persistency of a very large cold spot or a compact cluster of spots

(the fractional stellar surface covered by the spot ~30%) is difficult to explain in the frame of the hypothesis of solar-type magnetic activity. We mean the localization of the spot or the cluster of spots on one hemisphere of the stellar surface.

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