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ROTATION PERIODS FOR FOUR LOW-MASS STARS IN THE TAURUS–AURIGA REGION WITH Ca II EMISSION

We present the results of a long-term photometric monitoring campaign for four stars in the Taurus–Auriga region that were found to have strong Ca II H and K emission by Herbig et al. (1986). The BVR observations were obtained during four runs from August 22, 1992 to December 29, 1995, at the Mt. Maidanak Observatory, Uzbekistan, using a 0.48m telescope equipped with a pulse counting FEU-79 photomultiplier tube. The mean error of one observation of a program star is typically $\pm$ 0$^m_.$01 in V, B$-$V, and V$-$R. The interval of observations, number of observations in V and B$-$V, limits of the light variations in V filter, mean magnitude and colours are listed in Table 1. Maidanak BVR photometry Data Bank is at Tashkent Astronomical Institute and available to anyone interested in.

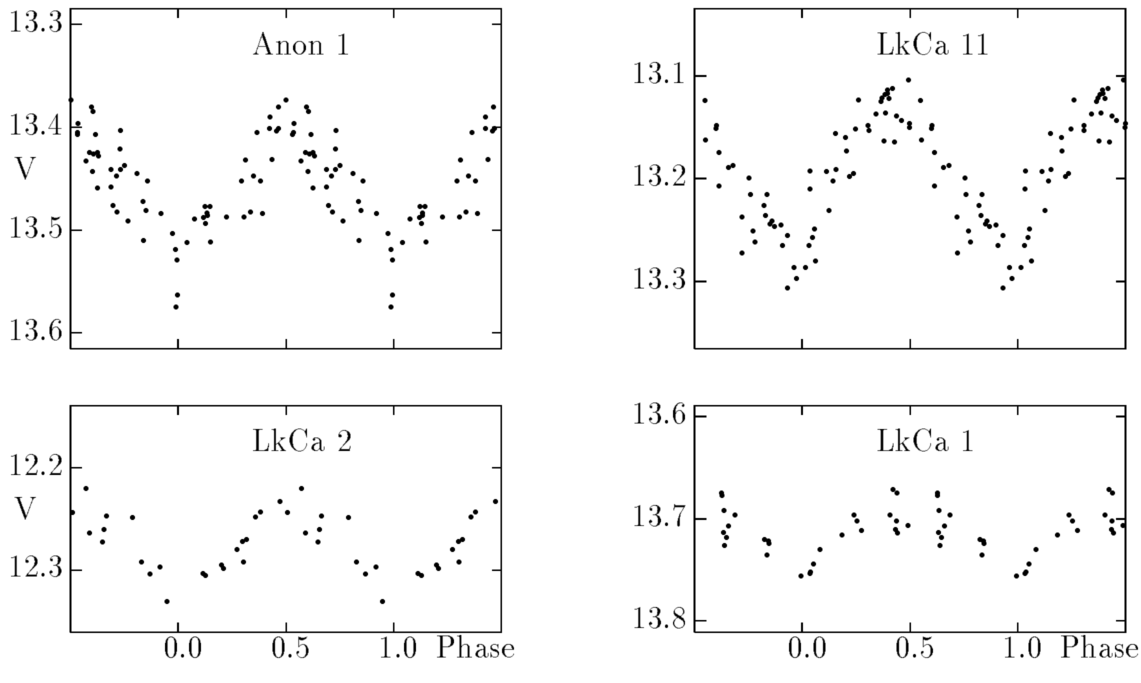

Figure 1. Phase diagrams for light curves in the V filter for 4 stars.

We report first detections of periodic light variations for Anon 1, LkCa 1, LkCa 2, and LkCa 11. A periodogram analysis reveals that all the Ca II stars have significant peaks in their power spectra. The most probable periods of these stars and their epoch of observations are listed in Table 1. Phase diagrams for light curve in the V filter for four stars are displayed in Figure 1.

Table 1

Name	Obs. Interval	n1	V_{max}	V_{min}	$<V>$	$<B-V>$	n2	$<V-R>$	Period (day)	Epoch of observ.
Anon 1	1992–95	60	13.37	13.58	13.45	1.85	38	1.84	6.493	1992–95
LkCa 1	1993–95	51	13.67	13.76	13.71	1.45	33	1.71	2.497+	1993–94
LkCa 2	1992–95	68	12.22	12.37	12.29	1.39	44	1.34	1.364*	1995
LkCa 11	1992–95	62	13.10	13.31	13.19	1.52	44	1.57	1.5396	1992–95

n1 - number of observations in V and B−V;
n2 - number of observations in V−R;
+ - two periods ($0^{d}.713$ and $1^{d}.661$) can be present, which produce fully equivalent folded light curves with P=$2^{d}.497$;
* - another period ($3^{d}.71$) produces fully equivalent folded light curve with P=1.364 day.

It should be noted that there are several other significant peaks in the power spectra for LkCa 1 and LkCa 2. The periods, which correspond to these peaks, are listed in the notes to Table 1. The spacing of the observations in time (one day) causes "false" periods. These periods can be calculated from the equation: $|\frac{1}{P} - \frac{1}{P_f}| = 1.0027$ (day^{-1}); where: P - is "true" period, P_f - are "false" periods. One of the periods is "true", the others are "false" periods. Both "true" and "false" periods produce fully equivalent folded light curves. In order to choose "true" period it is necessary to carry out further monitorings with observations more frequent than once a night.

The periodic variability of these objects can be interpreted as the rotational modulation of the stellar flux by a group of dark surface spots. These four Ca II stars, together with LkCa 3 ($7^{d}.2$), LkCa 4 ($3^{d}.3745$), LkCa 7 ($5^{d}.6638$), LkCa 14 ($3^{d}.35$), LkCa 15 ($5^{d}.85$), LkCa 16 ($5^{d}.6$), and LkCa 19 ($2^{d}.236$) monitored by Grankin (1992, 1993, 1994), Vrba et al. (1993), and Bouvier et al. (1993, 1995), form a sample of eleven objects from Herbig et al.'s list with known rotational periods. Thus, there is a high detection rate of rotational periods amongst Ca II stars in the sample considered. It should be noted that Anon 1, LkCa 4, LkCa 7, and LkCa 11 keep their rotational periods in intervals from 4 to 6 years (see also Grankin, 1994). The stability of rotational periods over several years indicates that the active region in each Ca II star remains on a definite meridian over this time scale. Properties of the active regions for these stars are similar to those of RS CVn stars.

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