

LONG-TERM EVOLUTION OF STARSPOOT AND CHROMOSPHERIC ACTIVITY
AND SHORT-TERM LIGHT VARIABILITY OF HK LACERTAE

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ABSTRACT. On the basis of 11 years of UBV photometry the light and color variability of the long-period RS CVn binary HK Lac (KOIII) is discussed. From the U-B data, which reflect the chromospheric activity, a quasi-periodic variation with the cycle length of about 5.5 years is suspected. Less evidently, a 2.7 years long overall spot coverage cycle is seen from the V(max) data.

No cyclic variation is found from the B-V data representing the photospheric temperature conditions, although there is an indication that the star was the reddest around 1985, when the chromospheric activity was in maximum.

At that time, in late 1985, we observed the star on 6 nights in UBV color in order to detect short-term variability. Fluctuations up to 0.03 magn. on time scales of 20-30 minutes were likely present. The amplitude is the highest in U colour.

INTRCDUCTION

The long-period RS CVn binary HK Lac (KOIII) has already been investigated in several aspects. The rotational modulation and the long-term variability of the star was studied using starspot modelling and mostly V magnitudes (Olah and Hall, 1988 and references therein). Here we focus on short timescale variability and long-term colour variations using UBV photometry of HK Lac.

OBSERVATIONS

In October, 1985, UBV observations were made on HK Lac with the 50 cm and 1 m telescopes in the Piszkesteto mountain station of Konkoly Observatory. We used one-channel photometers with 3 x 10 sec integration times. The comparison star HD 210731 (C2) was frequently measured,

typically in every 15 minutes. The spectral type of C2 is F8 and its constancy was tested using check stars in the past 11 years of UBV photometry of this star. A total of 18 h 44 min observations was gathered on 6 nights (17, 20, 25, 26, 27, 28 October).

The long term variability of the star was studied by using UBV observations made between 1978-1985 (Olah and Hall, 1988) supplemented by additional measurements from 1986-87 (to be published later).

RESULTS

a. Investigating the long-term B-V and U-B colour behaviour and the maximum magnitude variations of HK Lac in the past 11 years the following picture can be drawn (Figure 1). The maximum brightness of the star probably shows a cycle of 2.7 years. In Figure 1, lower panel,

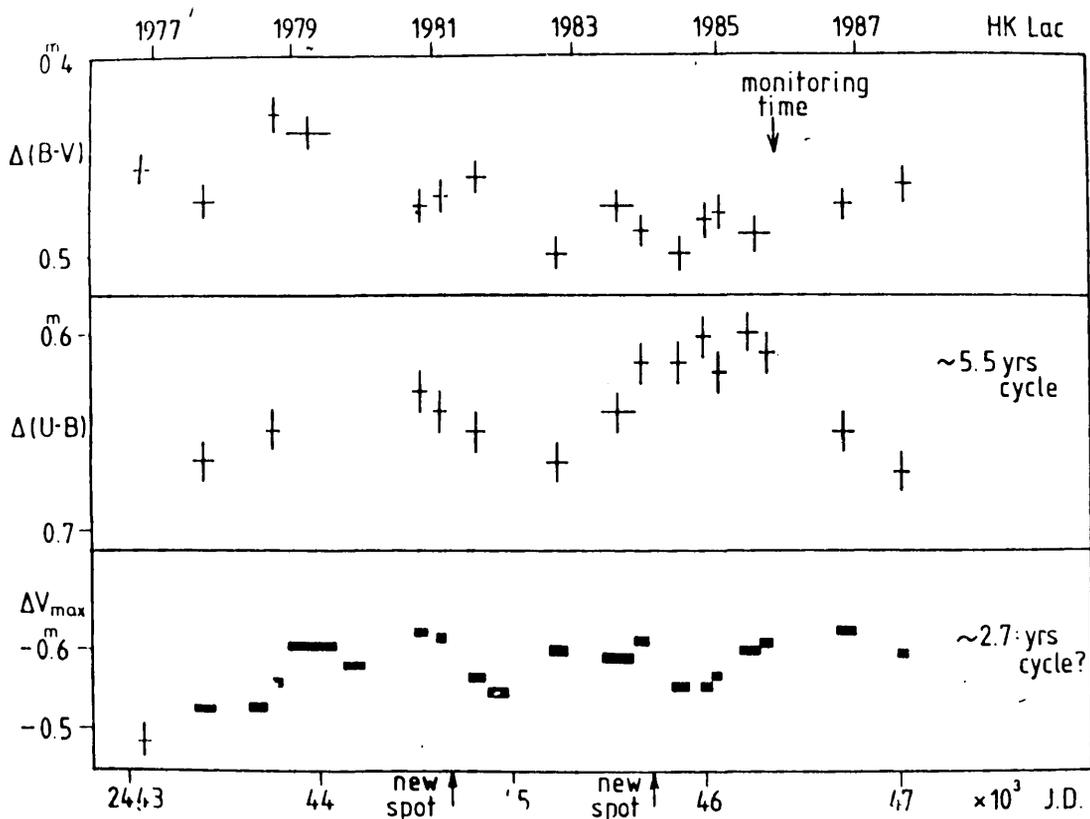


Figure 1. Long-term light and colour variability of HK Lac. The length of the symbols represent the length of the observing seasons. The vertical bars in the upper and middle panel and the vertical extent of the rectangles in the lower panel show the errors of the $\Delta(B-V)$, $\Delta(U-B)$ and $\Delta V(\max)$ values, respectively.

the $\Delta V(\max)$ is displayed, the $\Delta B(\max)$ and the $\Delta U(\max)$ show similar pattern. A quasi-periodic variation of 5.5 years cycle length is suspected from the U-B colour data (Figure 1, middle panel). The amplitude of this colour variation is the same as that of the $\Delta V(\max)$ variation, 0.08-0.1 magn. Finally, no cyclic variation was found in the B-V data (Figure 1, upper panel).

b. The three colour measurements of HK Lac possibly show short term fluctuations on 20 - 30 min timescale. This microvariability exceeds sometimes 0.03 magn. in U colour. Since the amplitude is small, it is not easy to separate the real fluctuations from those caused by short-term transparency variations. During the six nights' observations at least five fluctuations were recorded and considered to be real. One night UBV measurements are seen in Figure 2.

DISCUSSION

a. The variation of the $\Delta V(\max)$ magnitudes is connected with the variation of the overall spottedness of the star. In the lower panel of Figure 1 the times of the appearance of new spotted areas are also marked (Olah et al. 1988). After the new spotted area was born the overall spot coverage reaches its maximum value (i.e. $\Delta V(\max)$ is in minimum). The chromospheric activity of the star varies on a timescale twice as long as the spottedness, which is seen from the U-B data. According to the B-V colour index, the photospheric temperature conditions are not constant either. There is an indication that the star was the reddest around the time when the chromospheric activity was in

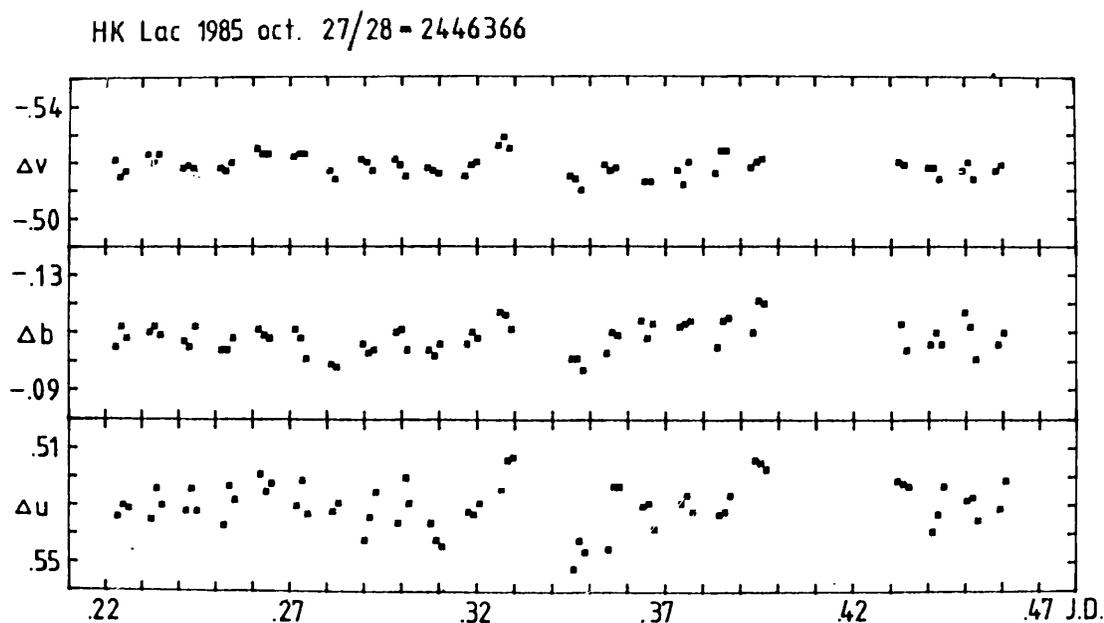


Figure 2. Example of the fluctuations observed in HK Lac in UBV.

maximum. The long-term variability of HK Lac shows a certain similarity with those long-term changes found in V711 Tau (Dorren et al., 1986, figures 2, 3) from optical and IUE data.

b. The observed microvariability in 1985 gives also an evidence of the enhanced chromospheric activity of the star. Similar behaviour was observed on another long-period RS CVn star λ Andromedae (G8IV-III) in 1978 (Baliunas et al., 1981) CaII H and K line intensities showed variability on a timescale of some ten minutes.

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