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OBSERVATION OF RAPID CHANGES IN THE LIGHT CURVES OF FK COMAE

FK Com (HD 117555) is the prototype of a small group of apparently single, rapidly rotating (v sin i > 50 km/s) G-K giants with strong Ca II H + K emission. The evolutionary status of the FK Com stars is peculiar and at present poorly understood, but the model proposed by Bopp and Stencel (1981), in which these stars result from the coalescence of W UMa binaries, successfully explains many of their properties, including the rapid rotation. Photoelectric photometry of FK Com reveals low amplitude light variations with a 2.40 day period (Chugainov 1966, 1976; Rucinski 1981). The light curves have a quasisinusoidal form with amplitudes in V between 0.08 mag and 0.14 mag; the light curves resemble those of the RS CVn variables. A survey of the properties of the stars in the group has been given by Bopp (1982). In the coalesced binary model for FK Comae the light variations are presumed to arise from inhomogeneities in surface brightness (starspots). In the other current model, proposed by Walter and Basri (1982), the giant component of FK Com is accompanied by a Roche-lobe filling companion of low mass, and the light variations are associated with a hot spot on the primary at the terminus of an accretion stream.

We carried out photometry of FK Comae ($\langle V \rangle \sim 8.0$) on 34 nights from 03 March 1982 to 25 August 1982 with the 38-cm reflector at Villanova University Observatory. The comparison star was HD 117567 and HD 117876 served as a check. A pair of narrow- and intermediate-band Hα filters was used, with additional observations at λλ 4530 and 7790. A description of the instrumentation and the filters is given by Dorren and Guinan (1982) and references therein. Use of the Hα filter pair permits a measure of the strength of the Hα emission to be determined in the form of an α-index:

$$\alpha = -2.5 \log (F_N/F_I) + \text{constant}$$

where F_N and F_I are the fluxes through the narrow and intermediate-band filters, respectively. Typically 40 to 60 minutes observations were obtained each night with each measure lasting about 40 s. Nightly means were formed from the observations. Corrections for the effects of differential atmospheric extinction were made. However, these corrections were very small because of the close angular proximity (7 arc min.) of the comparison star.

The observations at λ6585 obtained with the intermediate-band Hα filter are shown in Fig. 1. The phases were calculated according to the ephemeris of Chugainov (1976):

$$JD_{min} = 2442192.345 + 2.400E,$$

where zero phase corresponds to minimum light. The observations have been

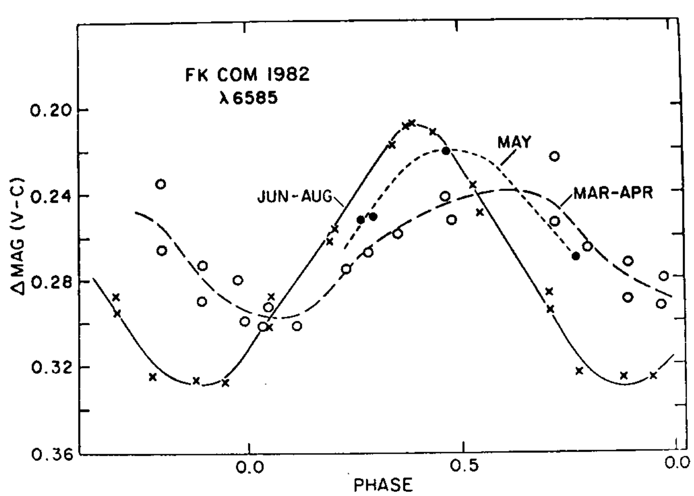

Figure 1

The λ6585 light curve of FK Com. The points are nightly means.

divided into groups according to date of observation. The hand drawn lines assist in following the chronological development of the light curve. It is clear that rapid, probably continuous changes took place in the amplitude and shape of the light curve and in the phase of the light minimum and maximum which shift about 0.15 phase in the direction of decreasing phase over the observing interval of five months. The amplitude increases from 0.06 mag in March-April to 0.12 mag in August for the λ6585 data, and, as shown in Figure 1, the brightness of the star at light maximum increased while the brightness at minimum light decreased over the interval studied. These changes in the light curve are consistent with the starspot model in which an increase in the extent of the subluminous regions or changes in their surface distribution can produce the observed changes. Furthermore, our λ4530 data show that the wavelength dependence of the light curve amplitude is indicative of cool, rather than hot spots. Preliminary spot modeling using the method described in Dorren et al. (1981) suggests spots about 900^{o}K cooler than the photosphere, and about 6% of the total stellar surface area spotted.

The differential α-index is plotted against Julian Date in Fig. 2 where

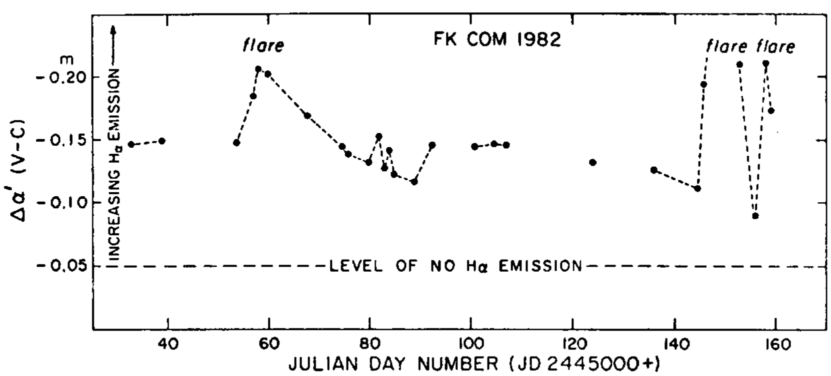

Figure 2

The nightly mean instrumental α-index with the approximate level of zero emission

the net Hα emission increases upwards in the plot. The broken line in the figure at Δα'(V-C) = 0.05 mag indicates the expected value of the index if the variable star had no Hα emission, and, as shown, Hα emission is always present. At least three significant Hα flare events were detected during the 1982 season, with the first flare episode near JD 2445058 being of longest duration. No appreciable enhancement in continuum radiation was observed during the flare events. Flares seem to be relatively common and long lasting and do not appear correlated with the photometric phase.

A fuller account of these observations will be published elsewhere.

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