

## THE RAPIDLY ROTATING GIANTS OF THE FK COMAE-TYPE

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We present new spectroscopic and photometric observations and discuss a small but important group of rapidly rotating G - K giants (FK Com=HD 117555, UZ Lib=BD-8°3999, HD 199178 possibly others) which are photometrically variable, show slightly redshifted and variable Ca II H and K emission and variable H $\alpha$  emission, show rotationally broadened spectral lines (50-100 km/s), and yet show no large radial velocity variations. Possible explanations of the properties of these stars are discussed and coalescence of a W UMa binary system seems to be the most probable evolutionary state.

The most extreme of the group, FK Com is discussed in detail. Its type, G2IIIa (Keenan, priv.comm.) implying  $M_V = -1$  (the IR indices are consistent with a giant) suggests a reduction of  $\log g$  (relative to Sun)  $-1.5$  to  $-2.5$ ; this can be only marginally reconciled with the dimensions of about  $5 R_\odot$  resulting from the photometric period 2.4 d. and  $V_{\text{rot}} \sin i$  about 100 km/s. The photometric variability (0.05 in I, 0.07 in R) is most probably due to spots asymmetrically distributed in longitude. The brightness minima observed by Chugainov in 1966 and 1974 and the new minimum observed in 1979 (JD 2443949.025) can be phased with one period  $2.3995 \pm 0.0002$  d. The erratic behavior of rotationally broadened spectral lines precludes obtaining a radial velocity orbit but an upper limit of 25 km/s for any periodic variations implies that the secondary must be a very low mass object. The strong H $\alpha$  emission is variable in relative intensity of its double peaks but has a constant full width in excess of 20 Å. The full half width at base implies rotational velocities of the order of 570 km/s; the half separation of peaks implies 300 km/s. Existence of an excretion disc of the type suggested by Webbink is possible.

### DISCUSSION

Vilhu: How did you notice these 3 stars? Just by looking for broad-lined giants which are not in any binary-star catalogues?

Ruciński: These stars are relatively bright, and the unusual nature of

FK Com (then identified only by HD-number) has been suspected since Merrill described its remarkable spectrum in 1948. Our intention is to bring attention to the fact that two similar stars exist and together they might form a group of objects quite important for the theory of stellar evolution (coalesced binaries? products of common-envelope evolution?)

Chen: How did you determine the giant nature of FK Comae?

Ruciński: Its giant nature is inferred from its spectral classification (line-intensity ratios) and infrared colors, which extend to a few microns. Obviously, this way we can determine only the pair of quantities ( $T_e$ ,  $\log g$ ) and not the three parameters ( $M$ ,  $L$ ,  $R$ ).

Kippenhahn: What are the ratios of centrifugal to gravitational force for these objects?

Ruciński: We do not know the masses and we have only rough ideas about the radii of these objects. So the ratio of the two forces is unknown. It is entirely possible that the spectral features of giants are indeed caused by the decrease of the surface gravity due to fast rotation. For example, FK Com might be less bright and distant than its luminosity class would indicate. The spatial velocity inferred from its proper motion is about 320 km/s per one kpc of distance to the star, whereas its spectroscopic parallax places it at 0.3-0.6 kpc, making its galactic velocity somewhat too large for a normal population I object.