COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 2136

Konkoly Observatory
Budapest
1982 May 3

HU ISSN 0374-0676

ENERGY DISTRIBUTION IN THE SPECTRUM OF FU Ori

As known in 1936-1937 FU Ori increased its brightness from 16^m to 10^m during half a year. Since then it has been decreasing slowly, only $0^m.15$ in B, for ten years. However, more rapid fluctuations of brightness with an amplitude of about $0^m.1$ have been also observed. The flare of FU Ori appeared to be the first observable manifestation of a new type of variability of young stars. The investigations and characteristics of such stars were entirely described by Herbig (1966, 1977).

The observations were made in the range $\lambda\lambda$ 3110-8640 Å by the five-channel scanning spectrophotometer in the Cassegrain focus of the 0.7 m reflector AZT-8 at Crimean Astrophysical Observatory (Lagutin, 1979; Bukach, 1979). At λ 3750 Å the spectral width of exit slit was 23.4 Å and the step of scanning was 18 Å; in shortward spectral regions these parameters were two times less. Time integration for a counting was 4 sec, with a full-time record of one scan equal to 12 min.

φ_1 Ori was used as a standard star with the absolute energy distribution according to data from Charitonov et al. (1978) and Johnson and Mitchell (1975) corrected respectively for the absolute calibration of the primary standard α Lyr (Charitonov et al., 1980). The standard star was observed directly before or after scanning FU Ori so that the difference in the air mass was negligible. In order to reduce the contribution of noise to the final data every three serial countings of FU Ori at λ 3750 Å and five countings in shortward regions were smoothed. The absolute energy distribution of FU Ori was obtained on three nights: 27.I.80, 21.II.80, 26.III.80. The difference of the absolute energy distribution obtained on these nights was within the errors of observations. Figure 1 shows the dependence of the intrinsic spectral density E_λ (erg cm^{-2} sec^{-1} cm^{-1}) for these three dates.

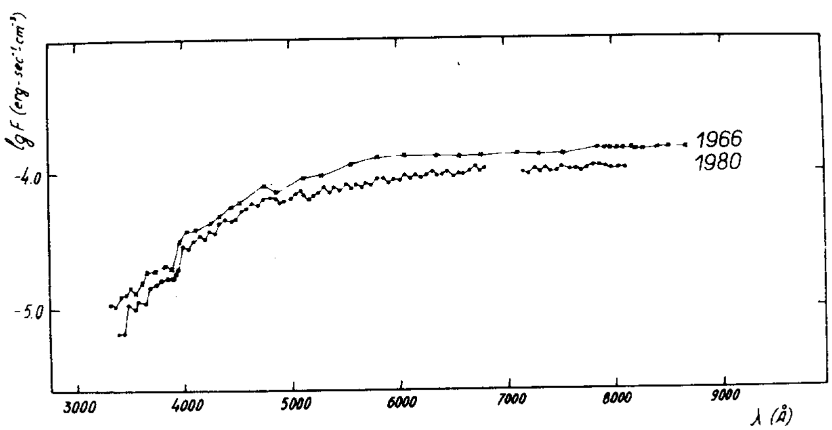

Figure 1

The r.m.s. error determined by the internal agreement does not exceed 12% in $\lambda < 3750$ Å, 3% in $\lambda\lambda$ 3750 - 6700 Å and 5% in more longward region. The same figure shows the run of the energy distribution in the spectrum of FU Ori obtained by Kuhi (1974) in 1966. According to Charitonov et al. (1980) the difference between our standards and the ones used by Kuhi (Hayes standards) does not exceed 3%. As it is seen in Figure 1 the brightness of FU Ori decreased approximately by 40% ($0^m.35$) as compared to 1966. This decrease of brightness agrees with the tendency that this star faded in B light (Herbig, 1977). Considering that the star is surrounded by a reflecting nebula, while comparing the observational data it is necessary to notice the difference of apertures: 17" in our observations and 10" - 14" in Kuhi's observations (Kuhi, 1974). Therefore, such difference cannot be the cause of the observed decrease of brightness.

Following the picture, the decrease of E_λ within the accuracy of the observations and calibration is the same for the whole spectral region $\lambda\lambda$ 3300 - 8000 Å . Hence, the observed decrease of brightness in 1966-1980 (by $0^m.35$) was not accompanied by the noticeable energy distribution variation in the spectrum of the star.

So, the result obtained allows to reject the hypothesis that the cooling of the star is responsible for the decrease of its brightness. Really, a simple calculation by Planck's formulae shows that, if a star with initial temperature 7500° (temperature of F2 type stars; according to the spectrum

FU Ori belongs to this class), is cooling so that at λ 5500 Å $E_{\lambda 5500}$ has decreased by 40%, then $E_{\lambda 8000}$ must decrease by 26% and $E_{\lambda 3600}$ by 66%, which is noticeably different from the observed energy distribution.

Herbig (1977) supposes that the decrease of brightness of FU Ori after the flare is connected with the decrease of brightness of the reflecting nebulae surrounding these stars that agrees with our observations. The same decrease of brightness in the reflecting nebula is also observed on direct photos of the star V 1057 Cyg (Herbig, 1977). In such a case the nebula flux must contribute a significant part of the total flux registered.

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