The Flux Distributions of Be Stars in the Far-UV

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Abstract. The initial results of a program to investigate the far-UV (500-1700 A) spectra of Be stars using the Voyager ultraviolet spectrometers are presented. Observations of eleven Be stars, with spectral types from B0 through B7, obtained between March 1979 and July 1984 are discussed. The Voyager resolution (~15 A) allows only limited spectroscopic studies; shortward of 1150 A C III λ977 and Lyβ λ1025 are the most prominent spectral features. Two stars, γ Cas and 59 Cyg, showed enhanced C III λ977 absorption. The flux distributions of the Be stars were intercompared with those of reference stars with low projected rotational velocities and, in a parallel study, to predictions from rotating star models. The model calculations suggest that the observable effects of a high rotational velocity (V≥ 0.9 of critical velocity) on the flux distribution are small except in the FUV (λ <1150A). The Voyager flux distributions were found to be indistinguishable from those of the low v sin i reference stars. No evidence was found for critical rotation in Be stars. All observations were consistent with Be stars rotating at less than 0.85 of critical velocity.

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DISCUSSION FOLLOWING STALIO

Henrichs:

What is the exact physical mechanism that causes the difference in flux between a critically rotating star and a more slowly rotating star to occur only below 1200 Å?

Stalio:

According to the rotating models of Collins and Sonneborn, a star of given mass rotating at critical velocity (or about critical velocity) has atmospheric equatorial regions distended and cooler than the poles. The spectral energy distribution is flatter than that of the same star not rotating critically. The flattening of the energy distribution is such that if you take two stars of different masses – the more massive one with critical rotation – you may have equal slopes in the optical continuum (i.e. same $(B-V)_o$) for a given mass ratio, but different slopes in other spectral regions. In particular the critically rotating star has a measurable FUV (λ <1200) excess with respect to the lower mass star.

Harmanec:

What you have done is a very important study which should be continued. One question: What do you mean by saying that the energy distribution is not very sensitive to inclination?

Collins:

Actually there is a significant inclination effect on the flux distribution. I am not clear as to what your comparison was made with. If it is with stars of the same spectral type, how do you allow for changes in the spectral type of the rotator?

Stalio:

The dependence on i of the flux distribution of a critically rotating star is due both to the different temperature regions and to limb darkening. If we wouldn't have limb darkening the hot and cool regions would always present the same area to the observer and there would not be any dependence on i.

Snow:

Collins just commented that because rotation effects cause changes in stellar spectral types, a comparison such as this study is based on has to be done carefully. My question, directed primarily to Collins, is how likely is it that errors introduced by rotational bias in the spectral type compensate so that the spectral flux distributions of star pairs still match as well as shown?

Collins:

You can match the far UV flux distribution of a rapid rotator quite well by picking a non-rotating star of different mass. Evidence for this can be seen in the visual by the rotational displacement along the main sequence. Only for the extremely rapidly rotating models ($\omega > 0.9$) are there moderate departures from this.