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# Emission of Continuum Radiation from Bright Be Stars

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Continuum radiation distribution observations of Be stars are presented in the wavelength region 3200-8000 Å. The effective temperature of Be stars are derived by comparing the observed energy distribution curves with the theoretical models. Various peculiarities detected in Be stars are discussed. Three Be stars are found to possess near-UV and near-IR excess radiation emission.

**Key Words: Be stars, Energy distribution, Excess emission.**

## INTRODUCTION

The Be stars are early-type stars which rotate close to their critical rotational velocity. Be stars are hot stars (B-type) which show emission of radiation at some members of Balmer hydrogen lines. The emission strength is highly variable[1-3]. The emission lines in Be stars is formed in the circumstellar envelope surrounding a normal B-type star. The surrounding envelope is accepted to be in the form of an equatorial disc[4-6]. The extended circumstellar envelope of Be star affect the continuum radiation distribution of the whole system. It produces the excess or deficiency in the radiation in the ultraviolet and/or infrared regions of the continuum spectrum. The monochromatic radiation distribution measurements are very important for deriving effective temperature of various types of Be stars. The study of Be stars play an important role in understanding the nature of circumstellar material and the dynamical processes connected with early-type stars. In the present communication we analyze the continuum radiation distribution data of four Be stars and one normal B-type star in the optical region.

## OBSERVATIONS AND REDUCTIONS

The stars of the present discussion are listed in Table 1. The spectrophotometric observations were secured on the 104 cm reflector of the Aryabhatta Research Institute of Observational Sciences (ARIES), Nainital, India during November 25, 1982. The Higher and Watts spectrum scanner at the Cassegrain Focus (f/13) of the reflector was used for obtaining continuous spectral scans in the wavelength range of 3200-8000 Å. The scanner was used in the first order with an exist slot of 50 Å pass band. The dispersion of the spectrum scanner being 70 Å $mm^{-1}$. A cooled (-20°C) photomultiplier EMI 9658B was used as a detector and standard dc techniques were employed for recording the signal.

TABLE-1
PROGRAMME STARS OF THE PRESENT STUDY

| S. No | Star Name | HR | $m_v$ | Sp. T. | v sin i | E (B-V) | $T_{eff}$(K) | Log $g_{eff}$ |
|---|---|---|---|---|---|---|---|---|
| 1. | Tau Ori | 1735 | 3.60 | B6III | 46 | 0.04 | 16000 | 3.5 |
| 2. | ---- | 1786 | 6.32 | B4IVne | 398 | 0.03 | 18000 | 4.00 |
| 3. | zeta Tau | 1910 | 3.00 | B4IIIpe | 310 | 0.05 | 20000 | 3.5 |
| 4. | 69 Ori | 2198 | 4.95 | B5Vne | 303 | 0.04 | 17000 | 4.0 |
| 5. | 48 Lib | 5941 | 4.98 | B5IIIpe | 393 | 0.06 | 11000 | 3.5 |

Along with Be stars, a comparison star tau Ori and a standard star $xi^2$ Cet were observed. Many reverse and forward scans of each programme star were obtained and all scans were reduced separately at a step of 100Å. Finally, the average of all the scans was obtained at a step of 100Å. The observed average continuum radiation data of each programme star was transformed to the standard system of magnitudes through the calibration of $xi^2$ Cet given by Taylor[7]. The standard deviation of the measurement does not exceed $\pm 0.^m03$ on an individual night.

The absolute monochromatic magnitudes of programme stars were corrected for interstellar reddening. The absolute monochromatic magnitudes of programme stars were de-reddened by using our own determined value of E (B-V) and adopting[8] the mean value of total-to-selective extinction R = 3.25. The de-reddened magnitudes were normalized to wavelength 5500 Å and are displayed in Fig. 1.

## RESULTS AND DISCUSSIONS

The observed normalized continuum radiation distribution data of the programme stars are displayed in Fig.1 (dots and crosses). The observed radiation (in terms of magnitude scale) distribution curves of programme stars are compared with the synthetic models[9] (continuous curves). In these comparisons we have assumed that log $g_{eff}$ = 3.5 for luminosity class III and log $g_{eff}$ = 4.0 for luminosity classes IV and V[10]. The value of the effective temperature ($T_{eff}$) and gravity ($\log g_{eff}$) of the best fitted models are given in the brackets along with each star are given in Table 1.

Regarding the behavior of the observed continuum radiation distribution of the programme stars, it is obvious (Fig.1) that the observed data of the normal B-type comparison star HR 1735 fits well with the synthetic model in the whole observed spectral range. The observed continuum radiation distribution of the star HR 1786 show near-ultraviolet and near-infrared excess emission of radiation. For this star, the radiation emission at H-alpha line was of moderate strength so as to just fill-up the underlying absorption.

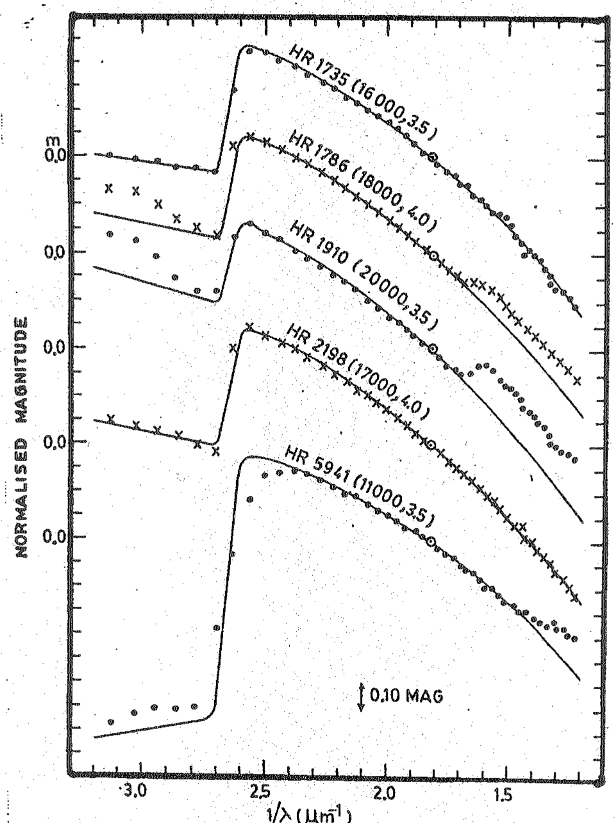


Fig. 1. Comparison of observed distribution of radiation of Be stars compared with theoretical models

The radiation emission was not strong enough so as to appear as an strong emission line above the continuum level. The present continuum radiation energy distribution of zeta Tau shows strong near-ultraviolet and near-infrared excess emission of radiation. The spectrophotometric tracings of zeta Tau also show H-alpha line strongly in emission. The behavior reveals that this star entered the Be-phase from the shell-phase.

The star HR 2198, behaves like a normal B-type star during November 25, 1982 as its observed radiation distribution curve fits well with the synthetic model. Inspection of the original spectrophotometric tracings of this star show H-alpha line in absorption. This further confirms that this star has entered into the normal B-phase during November 25, 1982. The Be star HR 5941 show moderate near-ultraviolet and near-infrared excess emission of radiation with moderate emission strength at H-alpha line emission.

## REFERENCES

1. J. Cuypers, L.A. Balona and F. Marang, *Astron. Astrophys. Suppl.*, **81**, 151 (1989).
2. L.A. Balona, J. Cuypers and F. Marang, *Astron. Astrophys. Suppl.*, **92**, 533 (1992).
3. S. Stefl, *Astron. Astrophys.*, **402**, 253 (2003).
4. S.M. Dougherty and A.R. Taylor, *Nature*, **359**, 808 (1992).
5. A. Quirrenbach, D.F. Buscher, D. Mozurkemich, C.A. Hummel and J.T.Armstrong, Astron. *Astrophys.*, **283**, L13 (1994).
6. L. Howells, I.A. Steele, J.M. Porter and J. Etherton, *Astron. Astrophys.*, **369**, 99 (2001).
7. B.J. Taylor, *Astrophys, J. Suppl.*, **54**, 259 (1984).
8. A.F.J. Moffat and Th. Schmidt-Kaler, *Astron. Astrophys*., **48**, 115 (1976).
9. R.L. Kurucz, *Astrophys. J. Suppl.*, **40**, 1 (1979).
10. E. Kontizas and E. Theodossiou, *Monthly Notices Roy. Astron. Soc.*, **192**, 745 (1980).
11. D. Hoffleit, The Bright Star Catalogue, Yale University, Observatory, New Haven, Connecticut, USA (1982).