ON THE FREQUENCY OF FIELD GALACTIC Be STARS

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Abstract. Since Be stars belong to the high velocity tail of a single B star velocity distribution, the appearance of the Be phenomenon must be independent of the stellar mass. In the present paper we show that the shape of the distribution of the number fraction N(Be)/N(Be+B) against the spectral type can be explained in terms of the Balmer line emission efficiency as a function of the effective temperature.

1 Introduction

Field Be stars near the Sun represent a sample of objects in different stages of the main sequence evolutionary phase (MS). Several hypothesis have been put forward to explain the distribution of the frequency of Be stars against the spectral type. As Be stars belong to the high velocity tail of a single B star velocity distribution (Zorec et al. 2005, Martayan et. al. 2005), there is no physical reason that the fraction of Be stars be mass-dependent as apparently it comes up from statistics.

2 Method

In this contribution we show that the observed distribution of the frequency of Be stars is determined by the Balmer line emission efficiency as a function of the effective temperature. The probability of detecting a Be star can be written as:

$$\mathrm{d}N(Be,i) \propto P_{\mathrm{Be}} E_{H\alpha}(T_{\mathrm{eff}},\tau,i)\phi(\tau)N(T_{\mathrm{eff}})\sin i\,\mathrm{d}\tau\mathrm{d}i \tag{2.1}$$

where P_{Be} is the probability that a B star becomes Be; $E_{H\alpha}$ is the average intensity of the Hα emission produced by a circumstellar disc of opacity τ in the center of the Hα line seen under an aspect angle i; $\phi(\tau)$ is the probability the disc had an opacity τ; $N(T_{\mathrm{eff}})$ is the total number of stars having effective temperature T_{eff}; $\sin i$ is the probability of seeing the disc at an inclination i. The emission intensity factor is $E_{H\alpha}(T_{\mathrm{eff}},\tau,i) = S_{H\alpha}\Delta(i)(1-e^{-\frac{\tau}{\cos i}})$, where $S_{H\alpha}(T_{\mathrm{eff}})$ is the

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photoionization-, thus, $T_{\rm eff}$-dominated Hα line source function; $\Delta(i)$ contains geometrical parameters of the disc, which we assume be the same for all stars. The expected number of Be $N(Be)$ is then given by $N(Be) = \beta F(T_{\rm eff}, \tau_o) N(B + Be)$, where $N(B + Be)$ is the number of all stars in the studied mass or $T_{\rm eff}$ interval. Since we assume $P_{\rm Be}(M) = constant$, it comes up that $\beta = constant$ which implies the number of expected Be stars in a given mass range is not mass-dependent.

3 Results and Conclusions

Figure 1a shows $\overline{E(T_{\rm eff}, \tau)}$ against $T_{\rm eff}$ and τ_o. To represent $N(M)$ we used the total counts of B and Be stars per mass interval in the V = 7 magnitude limited volume around the Sun, so as to reflect closely the local IMF. Figure 1b shows the histogram of the observed fractions of Be stars and the histogram predicted by (2.1) with $\tau_o = 1$. Distributions resemble each other closely and maxima at B2 and from B7/8 are well accounted for. The maximum at B2 is due to the high Hα emission, while that at B7/8 is due to the increase of the IMF function. The slight excess of predicted Be stars in the cool extreme of the distribution can be due to stars that have not yet developed the Be phenomenon and to actual Be stars with too tiny or cool discs whose emission has remained unseen. There is enough fast rotating B stars, called Bn stars, which can fit the excess predicted in the low temperature side (Zorec 2004).

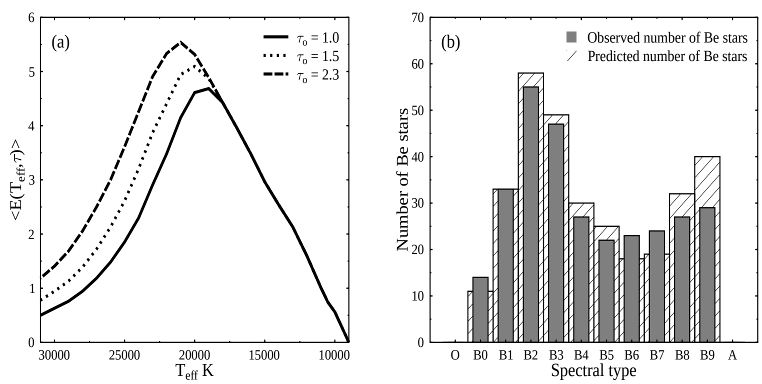

Fig. 1. (a): Emission intensity function in the Hα line as a function of $T_{\rm eff}$ and τ_o. (b) Observed and predicted number of Be stars

References

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