Stellar Rotation
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Correlation between $v \sin i$ and the Peculiar Velocities of Be Stars

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Abstract. Rough indications that $v \sin i$ is correlated with peculiar velocities exist only in the range $\overline{v_{\rm pec}} \gtrsim 40$ km s^{-1} of early-type Be stars. Further corrections of space velocities of Be stars for systematic movements of stellar groups to which they belong, as well as identifications of coeval stars have to be performed in order to decide whether the high rotation of some of them could be the consequence of gravitational encounters.

1. Introduction

We would like to know whether at least in some Be stars the fast rotation could be due to gravitational encounters, as suggested by Wolff et al. (1982). Other mechanisms have been also mentioned in the literature to produce fast rotating stars: mass transfer process in close binary systems (Packet 1981); early decoupling of magnetic fields from the surrounding medium, favored perhaps by a low metal content in the protostellar clouds (Maeder et al. 1999). A correlation between $v \sin i$ and space velocities was already found by Havnes (1968) for a small group of OB stars. Recently Rinehart (2000) showed, however, that B stars with and without emission lines have the same distributions of tangential velocities averaged over the whole sky, despite the fact that some Be stars can be runaway survivals of supernova explosions (Berger & Gies 2001).

2. Method

If the high rotational velocities of some Be stars were the consequence of gravitational encounters, it is expected that their average $v \sin i$ would be correlated with the respective space peculiar velocities. Using parallaxes, proper motions and radial velocities from the *Hipparcos* catalogue, we calculated the space velocities relative to the local standard of rest for more than 400 Be stars. We used the $v \sin i$ determined by Chauville et al. (2001, and in preparation). Each time the errors in parallaxes were $\pi/\Delta\pi < 4$, we calculated spectroscopic distances by introducing corrections for Be star overluminosity produced by the circumstellar envelope (Zorec & Briot 1991). We considered two stellar goups:

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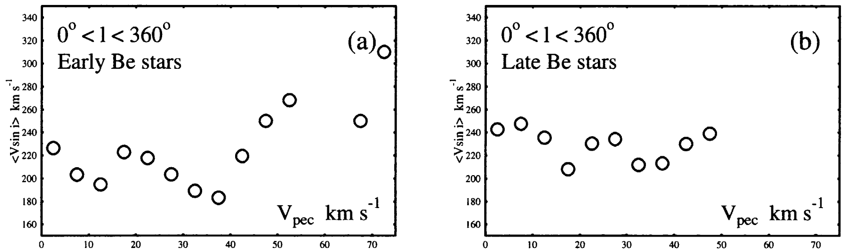

Figure 1. Sky-averaged $\overline{v \sin i}$ against $\overline{v_{\rm pec}}$ of early (a) and late Be stars (b)

"early" Be stars (spectral types hotter than B5) and "late" Be stars (spectra latter than B5).

3. Results and Conclusion

In both stellar groups the space velocities display Maxwellian distributions. A rough positive trend between $\overline{v \sin i}$ and $\overline{v_{\rm pec}}$ is obtained only for the "early" Be stars and in the range $\overline{v_{\rm pec}} \gtrsim 40$ km s^{-1}. Trends of $\overline{v \sin i}$ against $\overline{v_{\rm sp}}$ are different and more or less well defined according to the Galactic longitude sectors (opening angle $\Delta l = 90^o$). However, in each longitude sector there are many groups of stars and associations with their own spatial velocity and kinematical characteristics that also need to be taken into account in order to study properly the incidence of gravitational interactions on the stellar angular momentum. Many high velocity stars are isolated from groups and/or associations. Precise stellar orbits need then to be calculated to determine the coeval stellar groups to which they belong, where gravitational interactions could have been produced. We note that recently Hoogerverf et al. (2000, 2001) stressed that both scenarios: "binary-binary" encounters and "binary-supernova" may equally well operate to produce runaway stars. It should then not be excluded that several type of stellar encounters might have taken place in clusters or associations, which induced the fast rotation of some stars.

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