

## BIMODAL DISTRIBUTIONS OF ROTATIONAL VELOCITIES OF LATE B AND A-TYPE STARS

Royer, F.<sup>1,2</sup>, Zorec, J.<sup>3</sup> and Gómez, A. E.<sup>1</sup>

**Abstract.** Distributions of true rotational velocities are obtained for a sample of 1100 B9 to F-2-type main sequence single stars, cleansed from known binaries and objects with Am and Ap phenomena. The sample is highly homogeneous in  $v \sin i$  parameters and it is divided into six groups. Late B and early A-type stars have genuine bimodal distributions, due probably to distinct angular momentum losses during the evolution phases preceding the main sequence. Late A-type stars have a striking lack of low rotators and their bimodal-like distributions could be due to evolutionary effects.

### 1 Data and distributions of true rotational velocities

This study is based on the catalogue of homogeneous  $v \sin i$  data published by Royer et al. (2002). The studied stars are of luminosity classes V and IV only to represent the first main sequence (MS) evolutionary phases. Due to possible tidal braking effects, the known binaries and Am were taken out from the sample. Ap stars were also discarded, for their phenomena show up after they have complete the first third of their MS life span.

From the  $v \sin i$  distributions of each of the six stellar groups we obtained the respective distributions of true rotational velocities  $v$  assuming the inclination angles are randomly oriented. The transformations from  $v \sin i$  to  $v$  distributions were performed using Lucy's (1974) method.

### 2 Results and conclusions

Figure 1 shows the distributions obtained. We note there the following facts:

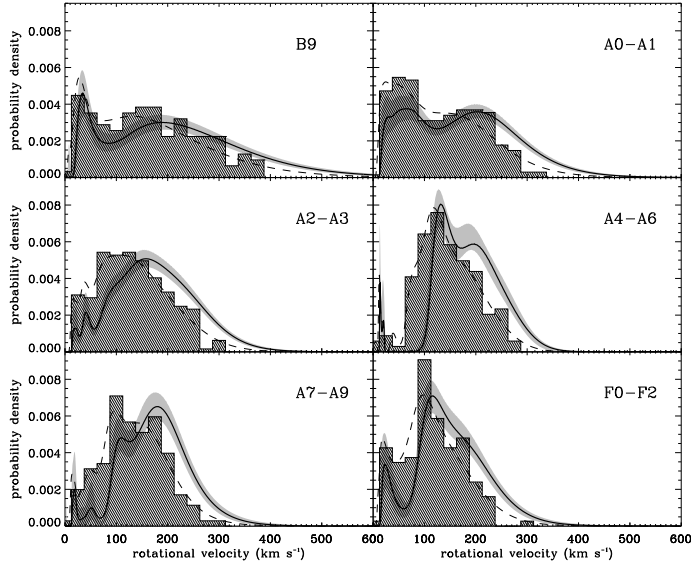
- Late B and early A-type have bimodal distributions, contrary to previous findings (Guthrie 1982, Abt & Morrel 1995). The presence of maxima around 50 and 200 km s<sup>-1</sup> may respond to formation processes and distinct angular momentum loss and its internal redistribution during the PMS phases;

---

<sup>1</sup> GEPI/CNRS UMR 8111, Observatoire de Paris–Meudon, Meudon, France

<sup>2</sup> Observatoire de Genève, Sauverny, Switzerland

<sup>3</sup> Institut d'Astrophysique de Paris, CNRS, Paris, France



**Fig. 1.** Distributions of apparent rotational velocities  $v \sin i$  (histogram and dashed line) and true equatorial velocities (solid line and associated error).

- In the groups with A2 to A9 stars there is a clear lack of rotators with  $v < 70 \text{ km s}^{-1}$ . The absolute minimum is for the A4-A8 group;
- A small excess of slow rotators appears in the F0-F2 group where atmospheres change from radiative to convective. Some stars may then undergo braking due to their convective atmospheres;
- The high velocity side of all stellar groups from A2 to F2 have double-like structures probably ought to evolution-fast rotation interplay effects;
- A great fraction of A-type stars have  $\Omega/\Omega_c > 0.5$ , in particular A4-A6-types. Due to gravitational darkening their envelopes may change from radiative (polar regions) to convective (equatorial regions).

## References

- Abt, H.A. & Morrel, N.I. 1995, ApJS, 99, 15  
 Guthrie, B.N.G. 1982, MNRAS, 198, 795  
 Lucy, L.B. 1974, AJ, 79, 745  
 Royer, F., Grenier, S., Baylac, M.O., Gómez, A.E., & Zorec, J. 2002, A&A, 393, 897