*Stellar Rotation*
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# Rotational Velocity Distributions of A-Type Main-Sequence Stars

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**Abstract.** The different velocity distributions ($v \sin i$, and $v$) are determined for single, non peculiar, A-type main-sequence stars, using homogeneous data. These distributions, together with synthetic corrections on stellar magnitudes due to the rotation, are used to quantify the global effect of rotation on a simulated A-type main-sequence in the H-R diagram. The resulting effect is lower than (0.03, 0.006) in ($B - V$, $M_V$) for 95% of the stars.

## 1. Sample and $v \sin i$ Data

The sample of $v \sin i$ for A-type stars come from the values published by Royer et al. (2002a,b) who give homogeneous data, integrating the $v \sin i$ from Abt & Morrell (1995). The total sample gathers some 2050 B8- to F2-type stars. This source is very competitive with the exhaustive compilation of Głębocki & Stawikowski (2000), as far as the number of stars in the same spectral range is concerned, and is moreover homogeneous.

From the total sample, main sequence stars are selected using their luminosity class (IV, IV-V, V) and known binaries and peculiar stars are discarded. The resulting selection is divided in sub-groups according to their spectral class (B9, A0–A1, A2–A3, A4–A6, A7–A9, F0–F2).

## 2. Distribution of Rotational Velocities

For the different sub-groups, the distribution of $v \sin i$ is obtained, and smoothed using a Kernel method. The distribution of true projected rotational velocities, result of a deconvolution by a log-normal error law, is computed using the Lucy iterative scheme (1974). Finally this distribution is deconvolved by the distribution of inclinations (supposed randomly distributed) to obtain the distribution of true equatorial rotational velocities (Fig. 1).

The effects of rotation on the stellar magnitudes have been computed using a procedure described by Collins et al. (1991, see references therein) but slightly modified to account better for the polar flattening. In these computations, solid rotation is assumed and the von Zeipel theorem is used to characterize the effects of gravitational darkening. The stellar photosphere is then replaced by a mesh of plane parallel model atmospheres that each describe the local temperature

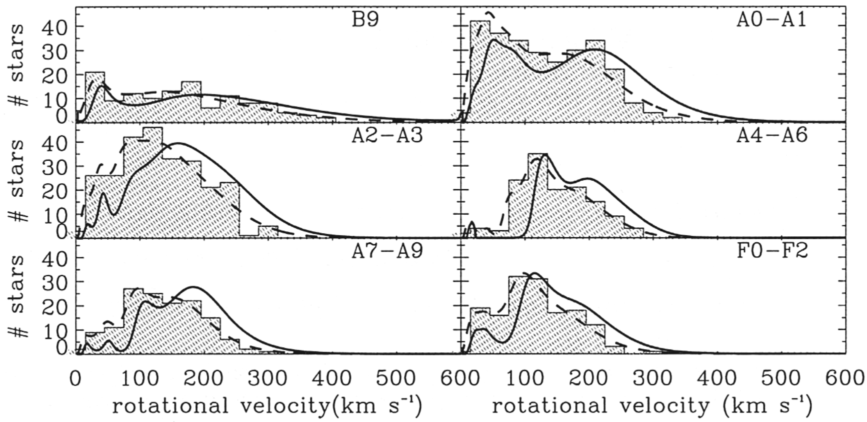


Figure 1. Rotational velocity distributions of single and normal main-sequence A-type stars. Grey histogram: $v \sin i$ data; dashed line: smoothed $v \sin i$ distribution, solid line: smoothed $v$ distribution.

and density distributions. These models are taken to be those of Kurucz (1994) obtained in LTE with the ATLAS9 code assuming a microturbulent velocity of 2 km/s. The simulated main-sequence ($T_{\rm eff} \in [7500, 11500]$, $\log g \in [3.5, 4.3]$) is given by the stellar populations synthesis model from Besançon (Robin & Crézé 1986; Bienaymé et al. 1987). The inclinations $i$ are chosen randomly, and $v$ according to the previously determined distributions.

The global effect of rotation remains very low, this is because only a few stars have angular velocities close to break-up. For 95% of the stars, the shift due to rotation is less than (0.03, 0.006) in ($B-V$, $M_V$). The effect is larger for stars with $B-V > 0.15$, and is mainly a consequence that the proportion of high rotators ($v > 100$ km s$^{-1}$) is higher for spectral types later than A4.

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