Stellar Rotation
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New Homogeneous $v \sin i$ Determinations for B Stars in Galactic Open Clusters

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Abstract. We present new observations of projected rotational velocities of main sequence B stars in the galactic clusters NGC 2439, NGC 3293, NGC 3766, NGC 4755, NGC 7160 and h & χ Persei. 257 stars have been observed with three instruments, 207 of which are presented here. Projected rotational velocities have been determined by least-squares fit to synthetic spectra. Our $v \sin i$ scale is compared with that of Slettebak et al. (1975).

1. Introduction

Recently, Maeder et al. (1999) have drawn attention to the possibility that main-sequence B stars may rotate more rapidly in the SMC than in our Galaxy, suggesting an anticorrelation between $v \sin i$ and metallicity. This idea, however, was backed by indirect evidence only, i.e. the frequency of Be stars, which are themselves fast rotators.

In order to test how far the idea of Maeder et al. (1999) holds, we have started a large programme of observation of B stars in open clusters in the Galaxy, as well as in clusters and in the field of both Magellanic Clouds. We present in this work observations made in various galactic clusters, chosen from the list of Maeder et al. (1999). They are summarized in Table 1.

2. $v \sin i$ Determination

To measure $v \sin i$, we used the code first designed by Hill & Landstreet (1993) and modified by Erspamer (Erspamer & North 2002, 2003). This code allows to estimate simultaneously elemental abundances as well as radial velocity and

Table 1. Summary of the reduced observations: h & χ Per were observed with WIYN/HYDRA at Kitt-Peak (4400–4593 Å, $R \sim 24000$), and the other clusters with 1.52m/FEROS at La Silla (3800–9000 Å, $R \sim 48000$).

Cluster	# of stars	V range	M_V range	ST range
h & χ Per	157	9/13.5	−4.5/0.0	B0.5–A0
NGC 2439	7	8.9/11.25	−5.3/−3.0	B1–B4
NGC 3293	25	6.52/10.70	−6.2/−2.0	B1.5–B4
NGC 3766	5	8.16/9.06	−3.6/−2.7	B1.5–B2
NGC 4755	13	5.76/10.17	−7.0/−2.6	B0.5–B1 (+B9 I)

$v \sin i$, by fitting a synthetic spectrum to an observed one, for a given model atmosphere. It was used on the small interval 4460–4490 Å encompassing essentially the He I 4471 and Mg II 4481 lines. We let at least 4 parameters free: radial velocity, $v \sin i$, and the abundances of He and Mg.

The effective temperatures and surface gravities were estimated using Geneva photometry when available, or $uvby\beta$ photometry or, if neither of the latter was available, through UBV photometry.

The model atmospheres used are those of Kurucz (1995). The $T_{\rm eff}$ values were rounded off to the nearest thousand degrees and the $\log g$ values to the nearest half unit. We did not try to estimate better atmospheric parameters since our main goal is the $v \sin i$ determination, which does not depend much on them, rather than abundance determination. All computations are done in the LTE approximation. The helium line was computed using the theory of Barnard et al. (1974, 1975).

Our $v \sin i$ values are compared with those of Slettebak et al. (1975), for standard stars in the field. The agreement is good for moderate projected rotational velocities, while we are systematically above the equality line for fast rotators. This behaviour was already noticed by other authors (Royer et al., in preparation).

References

Barnard, A. J., Cooper, J., Smith, E. W., 1974, J. Quant. Spec. Rad. Trans. 14, 1025

Barnard, A. J., Cooper, J., Smith, E. W., 1975, J. Quant. Spec. Rad. Trans. 15, 429

Erspamer, D., North, P., 2002, A&A 383, 227

Erspamer, D., North, P., 2003, A&A 398, 112

Hill, G. M., Landstreet, J. D., 1993, A&A, 276, 142

Kurucz, R. L., 1995, private communication

Maeder, A., Grebel, E. K., Mermilliod, J.-C., 1999, A&A 346, 459

Slettebak, A., Collins, I. G. W., Boyce, P. B., White, N. M., & Parkinson, T. D., 1975, ApJS 29, 137