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A catalog of rotational and radial velocities for evolved stars

II. Ib supergiant stars*,**

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Abstract. Rotational velocity $v \sin i$ and mean radial velocity are presented for a sample of 231 Ib supergiant stars covering the spectral region F, G and K. This work is the second part of the large survey carried out with the CORAVEL spectrometer to establish the behavior of the rotation for stars evolving off the main sequence (De Medeiros & Mayor 1999). These data will add constraints to the study of the rotational behavior in evolved stars, as well as solid information concerning tidal interactions in binary systems and on the link between rotation, chemical abundance and activity in stars of intermediate masses.

Key words. stars: supergiant – stars: late-type – stars: rotation – techniques: radial velocities – catalogs

1. Introduction

Since March 1986, an unprecedented systematic survey of a large and homogeneous sample of evolved stars with luminosity classes IV, III and II and Ib has been carried out at the Geneva Observatory to study the rotational behavior of evolved stars of low and intermediate masses. In addition to the study of the behavior of rotation as a function of effective temperature and mass for cool evolved stars, the data from this survey bring solid information on the presence of external rotational braking, on tidal interactions in binary systems and constraints on the link between rotation, chemical abundance and stellar activity. Although the major aim of such a survey is to obtain rotational velocities, the observational procedure has also produced about 4000 radial-velocity measurements. Consequently, this has revealed a number of new spectroscopic-binary stars, and additionally has confirmed the binary status for a large fraction of stars previously suspected to be radial-velocity variable. For some stars, the radial-velocity variations were followed with a suitable cadence to derive their orbital elements (De Medeiros & Udry 1999). The results of this survey for single stars and single-lined binary systems of luminosity classes IV, III and II, namely subgiant, giant and bright giant stars, including the rotational velocity $v \sin i$, the individual and mean radial velocities were presented by De Medeiros & Mayor (1999).

In the present work, we report the results of the survey for Ib supergiant stars covering the spectral region F, G and K. Section 2 gives the main characteristics of the sample and the observational procedure. The projected rotational velocities $v \sin i$ and the mean radial velocity values are given in Sect. 3.

2. The observational program

For the present step of the survey we have selected all the 231 Ib supergiant stars covering the spectral range F, G and K, from Burki & Mayor (1983). In fact, these authors have carried out, for about 10 years, a systematic radial velocity survey of cool supergiants in the northern and southern hemispheres mostly devoted to the study of binarity and variability. All the observations reported here were obtained with the two CORAVEL spectrometers (Baranne et al. 1979) mounted on the 1-m Swiss telescope at the Haute-Provence Observatory, Saint Michel (France), and on the 1.54-m Danish telescope at the ESO, La Silla (Chile). The radial velocities are obtained by cross-correlation of the stellar spectra with a physical binary (0, 1) template, built from the spectrum of a K2 III star (Arcturus) and incorporated in the spectrometers. The radial-velocity system is the one defined by Udry et al. (1999). The typical integration time was 5 min and the data reduction was made by using standard procedures (Duquennoy 1987; Duquennoy et al. 1991; De Medeiros & Mayor 1999).

In all cases, the radial-velocity uncertainty is derived from an instrumental error quadratically added to the photon noise

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* Based on observations collected at the Haute-Provence Observatory, Saint-Michel, France and at the European Southern Observatory, La Silla, Chile

** Table 1 is only available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via http://cdsweb.u-strasbg.fr/cgi-bin/qcat?J/A+A/395/97 and to the scintillation noise, which are estimated from the parameters of the observations (Baranne et al. 1979). Different studies in large data samples (e.g. Duquennoy et al. 1991; Udry et al. 1997; De Medeiros & Mayor 1999) show that the typical uncertainty for the CORAVEL radial velocity is about 0.3 km s^{-1} for low and moderate rotator stars, typically those with $v \sin i < 20$ km s^{-1}. For faster rotating stars, the uncertainty is somewhat larger. The rotational velocity $v \sin i$ was obtained through an appropriate calibration of the widths of the cc-dips as described by De Medeiros & Mayor (1999). For a complete discussion on the observational procedure, calibration and error analysis the reader is referred to these authors. However, let us recall that whereas for bright stars De Medeiros & Mayor (1999) have shown that CORAVEL $v \sin i$ values present un uncertainty of about 1.0 km s^{-1}, at least for stars with $v \sin i$ lower than about 30 km s^{-1}, for the bright giants and the Ib supergiants these authors have assumed conservatively an uncertainty of 2.0 km s^{-1}, because it is not possible to define precisely what are the limits on rotation and macroturbulence. For higher rotators, those with $v \sin i$ higher than 30 km s^{-1}, the estimations of De Medeiros & Mayor (1999) indicate an uncertainty of about 10%, independent of the luminosity class.

3. Contents

The main results of this part of the catalog are listed in Table 1, where stars appear in order of increasing HD number. This table presents the CORAVEL rotational velocity measurements as well as the mean radial velocity for single stars and for single-lined spectroscopic binaries. The columns:
1. HD number;
2. Spectral type;
3. $(B - V)$ color index;
4–5. Mean radial velocity RV and its uncertainty ϵ, on the number N of CORAVEL observations. In this case the uncertainty is given by max $(\epsilon_1/\sqrt{N}, \sigma/\sqrt{N})$, where ϵ_1 is the typical error for one single radial velocity measurement;
6. The radial velocity dispersion (rms) σ;
7. E/T, the ratio of observed to expected rms dispersion of the observations, when $N \geq 2$;
8. $P(\chi^2)$, the probability that the radial velocity of the star is constant;
9. N, the number of observations for each star;
10. The time span Δt of the observations;
11–12. Rotational velocity and its uncertainty;
13. Remarks.

The remarks SBO, SB and SB? indicate, respectively, those single-lined spectroscopic binaries for which the orbital parameters are available in the literature, those stars presenting a single–lined spectroscopic binary behavior on the basis of CORAVEL observations and the stars with a trend towards a single–lined spectroscopic binary behavior based on CORAVEL observations. Let us underline that, in addition to the unprecedented list of $v \sin i$ for Ib supergiants, the present work brings information on dynamic radial velocity variability for about 48 stars of such luminosity class.

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