Radial velocity measurements of B stars in the Scorpius-Centaurus association

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Abstract. We derive single-epoch radial velocities for a sample of 56 B-type stars members of the subgroups Upper Scorpius, Upper Centaurus Lupus and Lower Centaurus Crux of the nearby Sco-Cen OB association. The radial velocity measurements were obtained by means of high-resolution echelle spectra via analysis of individual lines. The internal accuracy obtained in the measurements is estimated to be typically 2-3 km s⁻¹, but depends on the projected rotational velocity of the target. Radial velocity measurements taken for 2-3 epochs for the targets HD120307, HD142990 and HD139365 are variable and confirm that they are spectroscopic binaries, as previously identified in the literature. Spectral lines from two stellar components are resolved in the observed spectra of target stars HD133242, HD133955 and HD143018, identifying them as spectroscopic binaries.

Key words. stars: early-type - stars: binaries: spectroscopic - stars: kinematics - stars: radial velocities in open clusters and associations: individual: Scorpius-Centaurus association.

1. Introduction

The Scorpius-Centaurus association is the nearest association of young OB stars to the Sun. Blaauw (1960, 1964) divided this association into three stellar subgroups: Upper Scorpius (US), Upper Centaurus Lupus (UCL) and Lower Centaurus Crux (LCC). LCC and UCL have roughly similar ages of about 16 – 20 Myr, while US is younger with an estimated age of ~ 5 Myr (Mamajek et al. 2002; Sartori et al. 2003). This complex OB association of unbound stars is of great interest because, as recently shown, it is related to the origins of nearby moving groups of low mass post-T Tauri stars with ages around 10 Myr: the β Pictoris Moving Group, the TW Hydra association, and the η...
and ε Chamaleonis groups (Mamajek et al. 2000; Ortega et al. 2000, 2004; Jilinski et al. 2005). In addition, the Scorpius-Centaurus association also appears to be the source of a large bubble of hot gas in which the Sun is plunged. All these structures are believed to have been possibly triggered by supernova explosions taking place in UCL and LCC during the last 13 Myr (Maíz-Apellániz 2001).

The technique adopted for investigating the origins of the β Pictoris Moving Group, for example, consists of tracing back the 3-D stellar orbits of the members of these moving groups until their main first orbits confinement was found, as well as the past mean positions of LCC and UCL. This enabled, investigator not only to determine the dynamical age of this moving group, but also to investigate properties of their birth clouds (Ortega et al. 2002, 2004). It is also possible to find the past positions of the possible supernovae that triggered the formation of these groups by tracing back the orbit of a runaway OB star, which could have been the result of a supernova explosion in LCC or UCL (see, for example, Hoogerwerf et al. 2001 and Vlemmings et al. 2004).

While the past evolution of these moving groups of low mass stars appears to be a relatively simple problem (as the dynamical ages are not so old), the dynamical evolution of the older and more numerous subgroups LCC and UCL appears to be more difficult. There is the possibility of the presence of several generations of hot stars during the mainstream of the OB association evolution (Garmany 1994). Substructure in LCC and UCL was found by de Bruijne (1999), based on Hipparcos data. The formation of the younger US subgroup could have been triggered by UCL some 6-8 Myr ago (Preibisch et al. 2001). All these studies require reliable radial velocities in order to calculate space velocities. In this paper we present single-epoch radial velocity (RV) measurements for 56 B-type stars members of LCC, UCL and US subgroups, to contribute to studies of their dynamics so as to unravel their origins.

2. Observations and reduction

A sample of 56 B-type stars from the Scorpius-Centaurus association was observed during observing runs in May 16-20 and July 7, 2002, with the 1.52m telescope equipped with the FEROS echelle spectrograph (Kaufer et al. 2000; resolving power R=48,000, wavelength coverage between 3900 and 9200 Å.) with a CCD detector at the European Southern Observatory (ESO) 1. The target stars were selected from the list in Humphreys & McElroy (1984) and from the comprehensive study of OB associations based on Hipparcos observations by de Zeeuw et al. (1999). The observed targets are listed in Table 1. From this sample, according to de Zeeuw et al. (1999), 15 targets are confirmed members of the LCC, while 15 stars are members of the UCL and 11 stars are from the US subgroup.

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1 Observations obtained under the ON/ESO agreement
For the remaining 15 stars in our sample, membership to any of these subgroups was not certain.

The spectra were reduced with the MIDAS reduction package and consisted of the following standard steps: CCD bias correction, flat-fielding, extraction, wavelength calibration, correction of barycentric velocity, as well as spectrum rectification and normalization. The one-dimensional spectra were then treated by tasks in the NOAO/IRAF data package. The signal-to noise ratio obtained in the observed spectra was typically larger than 100 and typical exposure times varied between 300 seconds for the brightest stars ($V \sim 3$) and 1200 seconds for stars with $V \sim 5$. Typical spectra are shown in Figure 1. The top panel corresponds to the target star HD 122980 and the bottom panel to HD 112092. Both stars have sharp lines with projected rotational velocities ($v \sin i$) less than 40 km s$^{-1}$. The spectral region displayed shows identifications of several lines that were used in the RV determinations. The FEROS bench spectrograph and set up have proven to have high spectral stability for RV measurements as concluded from a study of radial-velocity standard stars: an r.m.s. of 21 m s$^{-1}$ has been obtained for a data set of 130 individual measurements (Kaufer et al. 2000).

3. Analysis and discussion

The cross-correlation technique, which is used for precise RV determinations in later type stars, when applied to the hotter OB stars can be problematic as early type star spectra show few absorption lines. These lines are in many cases, intrinsically broad (up to a few hundreds km s$^{-1}$) due to stellar rotation. In addition, there is also the possibility of line variability affecting their line profiles (Steenbrugge et al. 2003). Therefore, the cross-correlation peak that defines the value of radial velocity can be very broad and contain important sub-structures caused by blending of spectral lines that appear to have different widths. In addition to having high $v \sin i$ values many OB stars are binary and it is not straightforward to apply the cross-correlation method and to identify them as double-lined binaries; in order to obtain the orbital solution a long set of observations is needed. Detailed cross-correlation technique analyses applied to determinations of radial velocities of early-type stars has been presented in a number of recent publications (see, for example, Verschueren et al. 1997; Verschueren et al. 1999a; Griffin et al. 2000). Griffin et al. (2000), in particular, discuss in detail the difficulties in obtaining accurate RV measurements from cross-correlation in early-type stars spectra.

In this study, having high-resolution observations covering a large spectral range, radial velocity values for the target stars were obtained from measurements of the positions of individual spectral lines of He I, C II, N II, O II, Mg II, Si II and Si III, relative to their rest wavelengths. Radial-velocity standard stars were not observed. (The adopted linelists can be found in Daflon et al. 2001, 2003.) We inspected and identified all un-
blended lines visible in the spectral range between 3798 Å (H\textsc{i}) and 7065 Å (He\textsc{i}) in each target star: the number of measurable lines varied between 10 and 74, depending on the star spectral type, rotation velocity, possible multiplicity, but also on the signal-to-noise of the obtained spectra. (We note, however, that for the double lined binary HD 133242, it was possible to measure positions only for 4 lines in component A and 6 lines in component B.) Mean radial velocities using all measurable lines (RV) and respective dispersions were calculated for the individual target stars.

In Table 1 we assemble our RV results as well as results from the literature. In the two first columns of this table we list the HD numbers of the observed stars with the respective spectral types; in the columns 3 and 4 we list the heliocentric Julian Date (HJD) and the measured radial velocities, plus the number of measured lines in brackets. In the other columns we list results from the literature: columns 5 and 6 list the RV\textsubscript{GCRV} and associated error or quality, from the General Catalogue of Radial Velocities (GCRV; quality flags A to E, or I for insufficient data); column 7 presents the projected rotational velocity from Brown & Verschueren (1997) and, when not available in this source, the $v\sin i$ was taken from the compilation of Glebocki & Stawikowski (2000); in column 9 we list, when available, literature references where information about duplicity can be found for the stars. The stars are separated according to the different subgroups in the Scorpius-Centaurus association, following the membership probabilities P(m) listed by de Zeeuw et al. (1999).

The internal precision of our RV determinations can be represented by the scatter obtained from the RV measurements line-by-line, which is listed in column 4 of Table 1. These are typically smaller than $\sim 2.0$ km s$^{-1}$ for stars with estimated $v\sin i$ smaller than 100 km s$^{-1}$. We note, however, that when the target $v\sin i$ are large, the uncertainties in the derived RVs can be significantly larger due to uncertainties in defining the line center. This can be seen in Figure 2, where we show the obtained line-to-line scatter versus the target projected rotational velocity (as taken from Brown & Verschueren 1997 and Glebocki & Stawikowski 2000).

In order to evaluate possible systematic effects that line selection could have on the RV results, we selected a homogeneous set of 28 spectral lines of H\textsc{i}, He\textsc{i}, Si\textsc{iii} and Mg\textsc{ii}, that could be measured in most of the studied spectra, and recalculated the mean radial velocity values for all possible stars. A comparison of the mean radial velocities RV with RV\textsubscript{28lines} (obtained using only the selected 28 lines) indicates that there are non-significant systematic differences between the two determinations $RV - RV\textsubscript{28lines} = -1.0$ km s$^{-1}$, with $\sigma = 3.1$ km s$^{-1}$. 
3.1. Membership

Table 1 lists the target stars according to their membership the 3 subgroups as assigned by de Zeeuw et al. (1999). Most of the stars in the Lower Centaurus Crux subgroup are flagged as binaries in the literature, except for HD103079, HD106490 and HD108483. For these 3 stars we measured radial velocities of $19.3 \pm 3.2, 15.3 \pm 3.2$ and $12.8 \pm 3.2$ km s$^{-1}$, respectively, with RV$_{\text{mean}} = 15.8 \pm 3.2$ km s$^{-1}$. This mean value is in general agreement with the mean radial velocity calculated by de Zeeuw et al. (1999) for LCC, which is of $12 \pm 2$ km s$^{-1}$. For the subgroup UCL, our sample has 2 non-binary stars (HD121790 and HD128345) and RV$_{\text{mean}} = 9.6 \pm 3.2$ km s$^{-1}$ which is $\sim 5$ km s$^{-1}$ higher than the de Zeeuw et al. (1999) mean value of $4.9 \pm 2$ km s$^{-1}$. For the Upper Scorpius subgroup all the sample stars have been flagged as binaries in the literature.

For the five target stars that had not been identified as members of any of the three subgroups in the Sco-Cen association (listed as ”others” in Table 1) and for which we have no information on duplicity, we can attempt to discuss their membership status based on the comparison of the radial velocities measured here and in the literature. We find that the measured radial velocities for HD109026 (RV$=4.0 \pm 2$ km s$^{-1}$) and HD110335 (RV$=4.8 \pm 2$ km s$^{-1}$) are consistent with the mean radial velocity for UCL of $4.9 \pm 2$ km s$^{-1}$. For the target star HD109026 we have RV$_{\text{GCRV}} = 2.5 \pm 2$ km s$^{-1}$, therefore it could be considered initially as having constant RV (within the uncertainties) and possibly a member of the Upper Centaurus Lupus subgroup. For HD110335, we find a larger discrepancy between our measurement (RV$=4.8 \pm 2$ km s$^{-1}$) and the RV value in the GCRV (RV$_{\text{GCRV}} = 12.5 \pm 2$ km s$^{-1}$). The RVs, however, are marginally consistent given the expected uncertainty brackets that affect the 2 determinations. If this is really the case, HD110335 could be also considered as a possible member of the UCL subgroup. In addition, the target star HD120640 (RV$_{\text{mean}} = -1.8 \pm 2$ km s$^{-1}$ from this study and RV$_{\text{GCRV}} = -4.7 \pm 2$ km s$^{-1}$) can be assumed here to have constant radial velocity. These measurements are consistent with the mean RV value of $-4.6 \pm 2$ km s$^{-1}$ listed by de Zeeuw et al. (1999) for this subgroup.

The two other stars in our sample of 'others’ (HD115846 and HD105937) for which we derived RV$=-21.8 \pm 2$ km s$^{-1}$ and RV$=22.7 \pm 2$ km s$^{-1}$, respectively, have values in the GCRV of RV$_{\text{GCRV}} = 3.0 \pm 2$ km s$^{-1}$ and RV$_{\text{GCRV}} = 15.0 \pm 2$ km s$^{-1}$. We found no information in the literature about these stars being confirmed binary stars, but the variation in RV for HD115846 exceeds the expected uncertainties: this target probably has a non-constant RV, which prevents further considerations about it belonging to any of the Sco-Cen subgroups. HD105937 has an RV only marginally constant within the uncertainties, but its mean RV is not compatible with any of the subgroups.
3.2. Duplicity

Results from a search for duplicity information for the targets stars (column 9; Table 1) indicate that a large number of stars in our sample are flagged as binaries in the literature. For most of these targets we have only one single-epoch RV measurement and our results alone cannot be used to infer duplicity. However, the RVs derived in this study can be added to RV databases and contribute to long term studies of their orbits. Only a small number of stars had not been previously flagged as binaries in the different studies in the literature. For this subsample of 10 stars, considered a priori as RV constants, it is possible to compare our RV values with the averaged radial velocities assembled in the GCRV. This comparison is shown in Figure 3. Our RV determinations compare favorably with the RVs from the GCRV with a scatter of the order of the estimated uncertainties. \( \text{RV}_{\text{GCRV}} - \text{RV} = 0.7 \) and \( \sigma = 4.9 \text{km s}^{-1} \). (This was calculated excluding one discrepant star, HD115846, which could be a binary system.) Taking into account the mean precision of RV determinations from the GCRV as \( \pm 5 \text{km s}^{-1} \), the external precision of our RV determinations may be evaluated as approximately \( \pm 5 \text{km s}^{-1} \).

For those targets with more than one epoch RV measurement in our study, a subsample showed radial velocity variations larger than the expected uncertainties: HD120307, HD142990 and HD139365. Since these had been previously identified as SBs in the literature (Levato et al. 1987 and Batten et al. 1989), our results confirm their duplicity. Four other stars with multiple epoch observations in this study showed a constant RV within the uncertainties: HD116087, HD130807, HD132200 and HD120640.

For 3 targets in our sample (HD133242, HD133955 and HD143018) we were able to separate and identify lines of two stellar components, classifying them as double lined spectroscopic binaries. Their combined spectra showing spectral lines from two stars are shown in Fig 4. Two of these stars (HD143018 and HD133955) were previously identified in Batten et al. (1999) as a spectroscopic binaries.

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Fig. 1. Sample spectra for two target stars. The top panel shows HD122980 and the bottom panel shows HD112092. The lines appearing in this spectral region are identified.
Table 1. Radial velocities of observed Sco-Cen OB stars

| HD     | Sp   | HJD     | RV [N] (km s\(^{-1}\)) | RV\(_{GCRV}\) (km s\(^{-1}\)) | eRV* (km s\(^{-1}\)) | Vsin i (km s\(^{-1}\)) | Duplicity |
|--------|------|---------|--------------------------|-------------------------------|-----------------------|------------------------|-----------|
| Lower Centaurus Crux |
| 98718  | B5Vn | 52411.0285 | 26.8±2.7 [19] | 9.4 | C | 340\(^a\) | ST |
| 103079 | B4V  | 52411.0425 | 19.3±1.0 [58] | 20.6 | B | 47\(^b\) |
| 105382 | B6IIe| 52413.0429 | 15.8±1.1 [50] | 16.4 | B | 75\(^b\) | ST |
| 106490 | B2IV | 52413.0617 | 15.3±1.5 [35] | 22.0 | B | 135\(^b\) |
| 106983 | B2.5V| 52411.0787 | 12.1±0.8 [50] | 15.8 | A | 65\(^b\) | VDH |
| 108257 | B3Vn | 52411.0875 | 19.9±2.7 [19] | 5.0 | C | 298\(^b\) | VDH |
| 108483 | B2V  | 52411.1008 | 12.8±1.4 [29] | 8.0 | C | 169\(^b\) |
| 109668 | B2IV-V| 52411.1127 | −0.1±1.4 [38] | 13.0 | C | 114\(^b\) | ST |
| 110879 | B2.5V| 52411.1177 | 56.9±2.5 [33] | 42.0 | D | 139\(^b\) | VDH |
| 110956 | B3V  | 52411.1229 | 15.6±0.7 [69] | 16.4 | B | 26\(^b\) | VDH |
| 112091 | B5Vne| 52411.1449 | 15.9±1.9 [19] | 13.0 | C | 242\(^b\) | VDH |
| 112092 | B2IV-V| 52411.1389 | 14.4±0.6 [72] | 13.9 | A | 34\(^b\) | VDH |
| 113073 | B5V  | 52415.1623 | 1.2±1.4 [29] | 6.0 | C | 140\(^b\) | VDH,ST |
| 113791 | B1.5V| 52411.1615 | 58.5±0.8 [72] | 14.3 | C | 15\(^b\) | SB8 |
| 116087 | B3V  | 52411.2216 | 12.3±1.6 [21] | 6.0 | C | 233\(^b\) | VDH,ST |
|        |      | 52414.1034 | 9.4±3.9 [10] | | | | |
| Upper Centaurus Lupus |
| 120307 | B2IV | 52413.1160 | 25.4±0.9 [54] | 9.1 | 65\(^b\) | SB8,SB8,ST |
|        |      | 52413.1562 | 7.4±0.8 [39] | | | | |
|        |      | 52414.1143 | 11.0±0.7 [31] | | | | |
| 121743 | B2IV | 52414.1453 | 9.6±0.8 [57] | 5.3 | 1.4 | 79\(^b\) | L87 |
| 121790 | B2IV-V| 52414.1523 | 9.2±1.4 [35] | 4.8 | B | 124\(^b\) | |
| 122980 | B2V  | 52414.1594 | 10.5±0.6 [74] | 9.6 | 2.8 | 15\(^b\) | L87 |
| 128345 | B5V  | 52414.1828 | 9.9±1.9 [25] | 8.0 | D | 186\(^b\) | |
| 129056 | B1.5III| 52414.1909 | 18.3±0.8 [72] | 5.4 | 0.6 | 16\(^b\) | VDH |
| 130807 | B5V  | 52414.1957 | 7.1±0.6 [67] | 7.3 | A | 27\(^b\) | VDH,ST |
|        |      | 52414.2150 | 7.2±0.5 [56] | | | | |
| 132200 | B2IV | 52414.2097 | 4.6±0.6 [70] | 8.0 | 0.9 | 32\(^b\) | VDH,L87,ST |
|        |      | 52414.2266 | 4.9±0.6 [55] | | | | |
| 133242A| B5V  | 52414.2599 | −52.5±0.7 [4] | 4.5 | C | 140\(^a\) | VDH |
| 133242B|       | 81.5±2.1 [6] | | | | | |
| 133955A| B3V  | 52414.2696 | 61.2±1.4 [10] | 9.8 | B | 135\(^b\) | SB8 |
| 133955B|       | −31.6±1.0 [10] | | | | | |
| 134687 | B3IV | 52414.2777 | 23.7±0.8 [74] | 13.5 | D | 13\(^b\) | SB8 |
| 136504 | B2IV-V| 52414.2904 | −5.7±1.1 [60] | 7.9 | C | 41\(^b\) | SB8,ST |
| 137432 | B4Vp | 52414.2976 | 6.3±1.0 [41] | −0.8 | E | 77\(^b\) | VDH,SB8 |
| 139365 | B2.5V| 52414.1535 | 33.3±2.3 [23] | −14.0 | E | 134\(^b\) | SB8 |
|        |      | 52414.3140 | −5.8±1.1 [25] | | | | |
| 140008 | B5V  | 52414.3210 | 2.6±0.8 [56] | 3.9 | B | 11\(^b\) | SB8,ST |
Table 1. Continued

| HD     | Sp       | HJD          | RV [N] (km s\(^{-1}\)) | RV\(_{GCRV}\) (km s\(^{-1}\)) | eRV\(^*\) (km s\(^{-1}\)) | V sin i (km s\(^{-1}\)) | Duplicity |
|--------|----------|--------------|-------------------------|-------------------------------|-----------------------------|-------------------------|-----------|
| 142669 | B2IV-V   | 52415.2944   | 2.5±1.0 [41]            | 3.3                           | E                           | 98\(^b\)                | SB8       |
| 142883 | B3V      | 52415.3002   | −54.3±0.5 [70]          | −27.5                         | E                           | 14\(^b\)                | SB8       |
| 142990 | B5V      | 52481.0065   | −5.6±3.5 [33]           | −12.1                         | 3.4                         | 178\(^b\)               | L87       |
|         |          | 52481.1270   |                         |                               |                             |                         |           |
| 143018A| B1V+     | 52414.3559   | 113.8±2.8 [25]          | −11.7                         | D                           | 100\(^b\)               | SB8       |
| 143018B|          |              | −173.6±3.2 [21]         |                               |                             |                         |           |
| 144217 | B0.5V    | 52414.3646   | 9.1±1.3 [43]            | −1.0                          | 91\(^b\)                   | SB8,VDH,L87,ST           |
| 144470 | B1V      | 52415.2873   | −0.6±1.1 [39]           | −4.4                          | 3.0                         | 100\(^b\)               | L87       |
| 147165 | B1III    | 52414.3498   | −25.6±1.2 [50]          | 2.5                           | 56\(^b\)                   | SB8,L87,ST               |
| 147888 | B3/B4V   | 52481.1481   | −3.8±2.3 [27]           | −6.8                          | 2.9                         | 175\(^a\)               | L87       |
| 147932 | B5V      | 52481.2006   | −2.8±2.7 [23]           | −11.0                         | 2.4                         | 186\(^a\)               | L87       |
| 148184 | B2Vne    | 52481.1797   | −4.7±2.1 [34]           | −19.0                         | 148\(^b\)                  | SB8,L87                 |
| 149438 | B0V      | 52414.3446   | 1.6±0.8 [43]            | 1.7                           | 0.8                         | 10\(^b\)                | L87       |
|         |          |              | −173.6±3.2 [21]         |                               |                             |                         |           |
| 104841 | B2IV     | 52411.0594   | −8.9±0.5 [73]           | 16.1                          | I                           | 25\(^b\)                | SB8       |
| 105435 | B2Vne    | 52411.0725   | 3.8±2.8 [15]            | 11.0                          | C                           | 298\(^b\)               | VDH       |
| 105937 | B3V      | 52413.0558   | 22.7±1.5 [33]           | 15.0                          | C                           | 129\(^b\)               | VDH       |
| 109026 | B5V      | 52411.1069   | 4.0±1.6 [31]            | 2.5                           | D                           | 188\(^b\)               | VDH       |
| 110335 | B6IVe    | 52481.0996   | 4.8±1.8 [23]            | 12.5                          | B                           | 250\(^a\)               | VDH       |
| 11123  | B0.5IV   | 52411.1357   | 9.8±0.7 [53]            | 10.3                          | A                           | 40\(^b\)                | VDH       |
| 115846 | B3IV     | 52481.97     | −21.8±1.6 [27]          | 3.0                           | 4.0                         | 168\(^b\)               | VDH       |
| 116072 | B2.5Vn   | 52411.1714   | 18.8±2.5 [21]           | 3.0                           | C                           | 233\(^b\)               | VDH       |
| 118716 | B1III    | 52413.1107   | 14.0±1.2 [32]           | 3.0                           | B                           | 114\(^b\)               | VDH       |
| 120640 | B2Vp     | 52413.1209   | −2.1±0.8 [63]           | −4.7                          | 0.8                         | 21\(^b\)                | VDH       |
|         |          | 52414.1219   | −1.5±0.6 [49]           |                               |                             |                         |           |
| 126341 | B2IV     | 52414.1712   | −21.1±1.0 [73]          | −21.5                         | B                           | 15\(^b\)                | VDH       |
| 132058 | B2III    | 52414.2050   | 0.1±1.0 [48]            | 0.2                           | 0.9                         | 92\(^b\)                | L87       |
| 132955 | B3V      | 52414.2424   | 5.1±0.5 [70]            | 3.7                           | 2.1                         | 8\(^b)                 | VDH       |
| 144218 | B2V      | 52414.3716   | 0.6±0.8 [57]            | −5.6                          | 0.8                         | 56\(^b\)                | VDH,L87,ST,SB8 |
| 151985 | B2IV     | 52414.3352   | 1.9±0.7 [56]            | 1.3                           | 0.7                         | 52\(^b\)                | L87,SB8   |

* A: errors ≤ 2.5 km s\(^{-1}\); B: 2.5 < errors ≤ 5.0 km s\(^{-1}\); C: 5.0 < errors ≤ 10.0 km s\(^{-1}\); D: errors ≥ 10 km s\(^{-1}\); E: too uncertain (from Table 3 of Barbier-Brossat & Figon 2000)

- a: from Glebocki & Stawikowski 2000
- b: from Brown & Vershueren 1997
- SB8 - Eighth Orbital Elements of Spectroscopic Binaries (Batten et al. 1989)
- L87 - Levato et al. (1987)
- VDH - Visual Double Stars in Hipparcos (Dommanget & Nys 2000)
- ST - Shatsky & Tokovinin (2002)
Fig. 2. The dependence of the internal r.m.s. errors of our radial velocity determinations on the star’s projected rotational velocities ($v \sin i$) taken from Brown & Verschueren (1997) and Glebocki & Stawikowski (2000).
Fig. 3. A Comparison between the radial velocities derived in this study with previously determined radial velocities from the GCRV (Barbier-Brossat & Figon 2000). The targets shown are those stars from our sample considered to be single stars. The adopted error bars for this study are the sigmas listed in column 4 of Table 1. The adopted error bars from the GCRV were calculated as the mean value of the range of uncertainties in RV corresponding to the quality flags A-D (listed in Table 1). For those stars with RV quality A and D we adopted uncertainties of 2.5 km s$^{-1}$ and 10 km s$^{-1}$, respectively. The x=y line representing perfect agreement is shown for comparison. The very discrepant point at (-21.8,3.0) represents the target star HD115846, which could be an unsuspected binary.
Fig. 4. Sample spectra of the double lined spectroscopic binaries HD133242, HD133955 and HD143018 showing the lines 4471 Å of He I and 4481 Å of Mg II.