RADIAL VELOCITIES FOR THE STARS OF THE HIPPARCOS MISSION

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1 INTRODUCTION

A large fraction if not all of the programmes related to the study of the galactic structure, its kinematics and chemical evolution will require the knowledge of the third component of the velocity: the stellar radial velocity. But we will also need the radial velocity to be able to determine the true distribution of masses in the solar neighborhood (corrected by the crossing time of the stars in the sampled sphere). The radial velocity will allow the determination of the statistical parallax for a sample of stars lying beyond 100 parsec. At the very beginning of the development of the Hipparcos space mission, the very need for ground–based, complementary measurements has been recognized. However, in spite of the existence of new kinds of techniques or detectors, the task to provide radial velocities for the somewhat 118'000 stars of the Hipparcos Input Catalogue is quite enormous. All presently published stellar radial velocities determined since the beginning of this century represent at the most 20 to 25% of the total number of stars to be measured!

The aim of this short note is not to discuss the astrophysical programmes requesting radial velocities, but to call the attention of the community to the real percentages of the Hipparcos stars for which we will have a radial velocity, lets say in 1996. In spite of the big effort already made by different groups of observers, only a (small) fraction of certain types of stars will have their radial velocity determined in 1996 – except if new , dynamic programmes are started.

2 THE EXISTING PROGRAMMES OF RADIAL VELOCITY DETERMINATION

In Tables 1 and 2, a short summary of the different groups contributing to Hipparcos radial velocity determinations give the main characteristics of their instrument, limiting magnitude, precision, stellar parameters measured, spectral domain, number of measurements expected for each star and the names of colleagues contributing to these programmes.

J. Bergeron (ed.), Highlights of Astronomy, Vol. 9, 433–436.

Table I

Radial velocities for the stars of the Hipparcos mission

Northern hemisphere

Haute Provence Observatory					
	SPO	PPO	MARLY	AURELIE	CORAVEL
	200 Å/mm Schmidt 62cm	80 Å/mm 17cm	80 Å/mm 120cm	8 Å/mm 152cm	2 Å/mm 100cm
m_b limite	10	8.8	9	7	13
precision	4km/s	3.5	3.5	<1	0.2–0.5
aim	V_r	V_r	V_r Sp $W_{H\gamma}$	vsini T_{eff},Z/Z_o V_r	V_r vsini (Z/Z_o)
Spectr. type	B5—K2 3 mes/*	B5—K2 3 mes/*	B0—F5 3 mes/*	B8—F2 1 mes/*	F5 → M 2 mes/*
Participants:	*Fehrenbach* Burnage	*Duflot* Burnage Mannone	*Grenier* Burnage Briot Duflot Gerbaldi Halbwachs Oblak	*Grenier* Burnage Faraggiana Gerbaldi Gomez Peton	*Mayor* Duquennoy Prévot Pernier Turon et al.

Note: SPO denotes the Schmidt objective telescope from Haute–Provence Observatory, PPO the small prism objective telescope, MARLY, AURELIE and CORAVEL are the names of the different spectrometers used.

3 RADIAL VELOCITIES OF LATE SPECTRAL TYPE STARS

The cross–correlation technique to determine stellar radial velocities is extremely efficacious if the number of lines in the stellar spectrum is large and if the stellar rotation is low enough. In most cases the blue limit to apply this technique is F0I, F5III, F5V. No red limitation exists for the cross–correlation technique, and all the reddest objects can easily be measured. The blue limit at about F5V is mainly set by the strong increase of the stellar rotation for bluer spectral types. Thus the situation for the radial velocities of the Hipparcos mission stars is different for spectral types earlier or later than F5.

At the present time the only systematic efforts made to obtain radial velocities of the Hipparcos stars later than the spectral type F5 are done by using two Coravel spectrometers, one in each hemisphere: the Swiss 1–meter telescope at the Haute–Provence Observatory (France) and ESO's 1.54–meter Danish telescope at La Silla (Chile).

In the southern hemisphere, due to a generous allocation of observing time by ESO and the Danish board of Copenhagen University, a fairly large fraction of the late–spectral types will be measured during the next four years (Mayor et al. 1989). We have concentrated our efforts to achieve the completude (100%) of the Hipparcos "survey" stars as well as some specific programmes denoted "ls A" in Table 3.

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Table II

Southern hemisphere

	ESO Key program blue *	El Leoncito Observatory	ESO Key program red *
	152 cm Echellec + CCD 3.3 Å/mm	215 cm Boller & Chivens 29 40	154 cm CORAVEL 2 Å/mm
m_b limite	7.5	8 9	14.5
precision	0.3	1.5 3	0.3 – 0.5
aim	V_r vsini, T_{eff}, (Z/Z_o)	V_r, vsini Sp	V_r vsini, (Z/Z_o)
Spectral type	A normal B6–F2	Ap,Am B–A normal	F5–M
	2 mes/*	3–4 mes/* 1	2 mes/*
Participants	*Gerbaldi* Burnage Faraggiana Gomez Grenier	*Levato* Malaroda Grosso Morel	*Mayor* Turon, Crifo Duquennoy Grenon, Prévot Imbert, Maurice Andersen,Nordström Lindgren

Table III

Late spectral type stars of the Hipparcos mission (later than F5)

	Southern hemisphere				Northern hemisphere			
	Total	Survey	(ls A)	(ls B)	Total	Survey	(ls A)	(ls B)
N_{tot}	38722	13895	9173	15654	36592	15591	6767	14234
$\frac{N_{V_R}(1991)}{N_{tot}}$	59%	95%	95%	5%	18%	32%	17%	3%
$\frac{N_{v_r}(1996)}{N_{tot}}$	64%	100%	100%	10%	56%	100%	60%:	5%:

Note: (ls A): some selected programmes; (ls B): other proposals

As a by–product of this radial velocity survey the cross–correlation technique allows the determination of precise vsini and for F, G and early K stars an estimation of the stellar metallicity.

The percentage for 1991 is based on stars having at least one radial velocity measurement. The percentage for 1996 concerns stars expected to have two measurements by that time.

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Most of the measurements are done with a 60–second integration only, but after such a short integration time we already have a precision better than 0.5 km/s. The two measurements are done with a Δt interval of about two years. This Δt, combined with the precision achieved for the radial velocity, allows the detection of a very high fraction of spectroscopic binaries with periods less than 10^3 days (more than 80%, depending on the mass–ratio distribution adopted).

4 RADIAL VELOCITIES OF EARLY–TYPE STARS

For stars earlier than F5, radial velocity measurements will be done by prism objective or classical spectrography. Observations are done on different telescopes at Haute–Provence Observatory for the northern hemisphere, at La Silla ESO Observatory (Chile) (M. Gerbaldi et al. 1989) and El Leoncito Observatory in Argentina for stars in the southern hemisphere.

If the number of stars to be measured at ESO and El Leoncito represents a relatively moderate percentage of the whole number of blue stars, these measurements are of prime importance. Done at high resolution, these measurements will provide, in addition to the radial velocities, all the detailed information on the stellar atmosphere (Teff, log g, M_H, vsini). In particular all A stars for which a significant trigonometric parallax is expected from the Hipparcos mission are included in these surveys. In the northern hemisphere, some hopes exist that a large fraction of the blue stars of the INCA survey (taking into account existing radial velocities from the literature) will have their radial velocity determined in 1996. About 10'000 blue northern stars will be without V_r five years from now.

The situation is even worse for the southern hemisphere. The two specific surveys carried out at ESO and El Leoncito Observatories will produce a very small fraction (7%) of the radial velocities of southern blue stars. Existing velocities in the literature will slightly improve this percentage. For most southern blue stars of the Hipparcos mission radial velocities will probably not be established before 1996.

Table IV

Early type stars (Sp < F5)

	Southern hemisphere				Northern hemisphere			
	Total	Survey	ESO(*)	El Leoncito	Total	Survey	(ls A)	(ls B)
N_{tot}	20164	11473	352	1132	19302	10922	1830	6550
$\frac{N_{V_R}(1996)}{N_{tot}}$	22%	37%	100%	100%	52%	80%	39%	8%

Note: The percentages for 1996 are to be considered merely as estimates.
(*): Mostly A stars with significant trigonometric parallax, (ls A): some selected programmes, (ls B): other proposals

5 REFERENCES

Mayor M. et al., 1989, The Messenger **56**, 12
Gerbaldi M. et al., 1989, The Messenger **56**, 12