SF2A 2008
C. Charbonnel, F. Combes and R. Samadi (eds)

RADIAL VELOCITY STANDARDS FOR THE GAIA-RVS

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Abstract. The ESA GAIA mission (launch expected end 2011) , besides the 5 astrometric parameters and photometry for some 10^9 objects, will also produce radial velocities and short spectra for a few 10^8 stars, with a 1 to 15 km/s accuracy.

The calibration of radial velocities in the integral-field spectrograph will rely on a set of some 1000 bright RV-stable stars already observed with a much higher accuracy from the ground, on a few bright enough asteroids, and a set of some 10^5 stable stars selected later from the RVS measurements themselves. We present here a status report on the ongoing effort to construct the basic list with ground-based observations.

1 The RVS and the need for ground-based standards

The Radial Velocity Spectrometer (RVS) onboard GAIA is designed mainly for measuring radial velocities of the brightest GAIA targets. It is a slitless spectrograph, without onboard calibration device. It covers the spectral range (847 - 874) nm. The brightest stars ($V \leq 10$) will be observed with a resolution of 11500; and the fainter ones with a resolution of about 4000.

The RVS is a self-calibrating instrument relying on a set of about 1000 bright, stable objects with well-known RVs. This sample must be well-distributed over the sky to set the RV zero-point and is included in the iterative reduction process. As these objects will be regularly observed by GAIA (some 40 observations each, over the 5 years of mission), they will also allow a permanent check of the state and performances of the instrument.

2 Star selection

Bright asteroids and single stars with a good observational history are selected and re-observed before the start of the mission to insure a stability at the level of 300m/s until the end of mission (2017). Selection criteria for stars have been already given with some details (see Crifo et al, 2007) (HIP stars; $V \geq 6; G_{RVS} \leq 10$; F5-K; M dwarfs; not variable, not double or multiple; no disturbing neighbour in the selection window, i.e. within 80 arcsec; already well observed).

The stars are selected within the 3 following published lists: Nidever et al. (2002); Nordström et al. (2004; mostly CORAVEL data); Famaey et al. (2005; CORAVEL data). A provisional list of about 1400 stars is now defined, and used for the observations.

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3 On-going ground-based observations

Each candidate is re-observed at least once before launch to eliminate evident variables. Supplementary observations are made, depending on the observational history of the star, and for follow-up during the mission. The observing programme is running on the echelle spectrographs SOPHIE (OHP), NARVAL (TBL, Pic du Midi), and CORALIE (Swiss Euler telescope, La Silla), for a total of about 9 nights per semester. The observations started in 2006. The new data are stored in an on-purpose database, presently hosted at AIP-Potsdam.

NARVAL is the only spectrograph covering totally the RVS spectral interval, and these spectra will therefore also be used for comparing the velocities obtained either over the full spectral range, or only over the RVS range.

Figure 1 shows for asteroids the difference (O-C) between data and calculated predictions, as a function of the S/N ratio during the observation, for SOPHIE and previous ELODIE. Figure 2 shows for stars the comparison between the Sophie data and and previous data as published by Famaey (Coravel), Nordström (Coravel) or Nidever: the larger dispersion for Famaey and Nordström is due to lower Coravel accuracy.

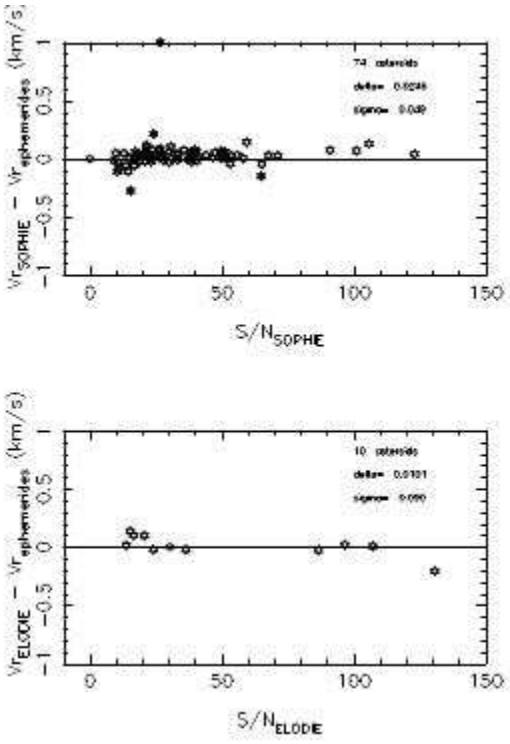

Fig. 1. Asteroids: O-C vs S/N, Sophie & Elodie

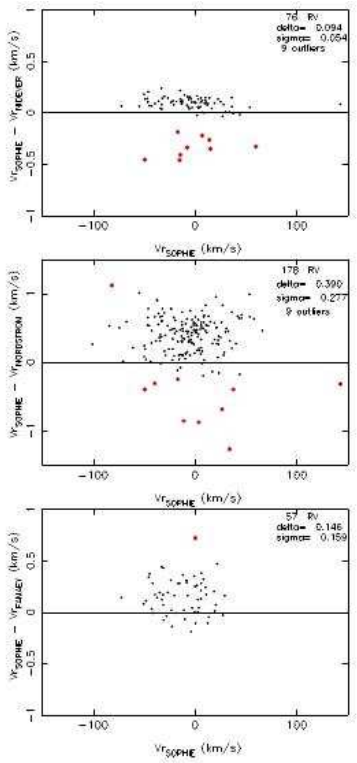

Fig. 2. Stars: Sophie vs Nidever, Nordström and Famaey

4 Conclusion

Good RV standards for the RVS, stable over a long period, must be used to control the accuracy of the RVS instrument zero point. Such a sample can be defined using bright, well-known stars and asteroids, and an important observational effort is underway to verify the stability of about 1000 such objects over the full sky.

References

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