4th Radial Velocity Spectrometer Workshop
Monte-Rosa, 2002 September 13

Workshop summary

RVS-CoCo-006
(D. Katz, U. Munari)

1 Context & Objectives

1.1 Short term objectives

The main RVSWG short term objective is to fix the RVS design characteristics by the end of November. All the aspects which impact on the instrument design, should be reviewed, in order to converge on the spectrograph parameters at the 5th RVS workshop, which will be held in Paris, November 28-29. The main drivers of this deadline are the "Payload and Data-Handling Electronics" (PDHE) and the "CCD & Focal Plane Assembly demonstrator" industrial studies, which need defined and "frozen" spectrograph characteristics to proceed.

The specifications required by those two contracts are the following:

- **CCD read-out mode.** It has been decided at the Ljubljana 3rd RVS Workshop that the whole CCD should be read (see RVS-CoCo-005).
- **On-board processing/data combining.** In the RVS the on-board data treatment mainly concerns the data compression, in order to fit in the 0.25 Mbit/s currently allocated to the spectroscopic data (see Sect. 2.3). Source detection and windowing will studied by the "On-board Detection working group".
- **RVS "limiting magnitude" as function of Galactic coordinates**. This specification is mainly linked to the RVS performances in dense areas (See Sect. 3), i.e. how faint can the instrument collect spectra, and directly impacts on the RVS telemetric budget.
- **Resolution.** The resolution of the spectrometer, currently foreseen in the range R = [5 000 – 20 000], is a very important open issue for the RVS, because it impacts on most of the spectrograph aspects and in particular on its performances and therefore on its scientific case (see Sect. 1.2 and followings).
- **Tilt mechanism.** The precession motion of the satellite induces a sine transverse component in the motion of the spectra with respect to the CCD detectors. This transverse motion spreads the spectra over some lines, therefore increasing the RON noise, the total contaminating zodiacal light as well as the spectra overlapping rate. The transverse motion could be compensated by a tilt mechanism rotating the CCD focal plane or some optical component. The failure risk associated with a mechanism continuously rotating the RVS CCD during 5 or 6 years is currently quantified by the RVS consortium (see Sect. 2.1). Decision should be taken at the next RVS workshop, about the implementation or rejection of the tilt mechanism, comparing its merits with the failure risks.
- **Number and size of the CCD.** At the Ljubljana 3rd RVS Workshop, 2 scenarios were identified: (i) if the tilt mechanism is rejected: 6 CCD of 1010 (along scan) by 3930

(across scan) pixels, (ii) if the tilt mechanism is accepted: 3 CCD of 2020 by 3930 pixels (see RVS-CoCo-005).

1.2 Resolution issue

The question of the RVS resolution has been the driver of a very large fraction of the studies conducted in the RVSWG during the last year. It impacts on most of the RVS aspects:

- **RVS Radial velocity performances (non crowded area).** Two different regimes can be distinguished in the behaviour of RV performances vs. resolution, as function of magnitude. For the bright to “moderately” faint stars, a higher resolution leads to more accurate radial velocities, i.e. for a V = 15 K1V star, a resolution of R = 4 300 lead to a precision over the mission of σRV = 1.4 km/s and R = 17 250 to σRV = 0.7 km/s according to simulation performed by T. Zwitter on synthetic spectral libraries. Study performed by U. Munari on real spectra collected with the Asiago telescope have shown that a larger gain as function of resolution could be achieved when the zodiacal light and read-out noise did not increase with the resolution (as it is currently the case). Systems such as micro-mirror matrix, which could slow the increase of the noise with the resolution, are presently in a very early qualification stage for space application. Therefore, their use in GAIA is not foreseen. It should be also noted that even at R = 4 300, precisions of the order of σRV = 1-2 km/s could be reached. For the very faint stars, a lower resolution allows to observe slightly fainter targets, i.e. the same precision will be obtained for a K1V star at R = 17 250 and V = 17.75 and at R = 4 300 and V = 18 or 18.25, according to the simulations. The precisions presented here are internal precisions, not taking into account the possible calibration errors (See faint star observation below and Sect. 2.4) or a binary motion. The precisions on the faintest stars, being mission-average, will, in the case of binaries, be affected by the spread of the individual RVs. The effect should be small in the case of non-eccentric orbits well sampled in time, and larger in the case of eccentric and/or unevenly sampled orbits.
- **RVS Radial Velocity performances (crowded area).** The angular area covered on the sky by spectra will increase with the resolution and so will the rate of spectra overlapping in “dense area”. Two topics have been investigated in order to assess the impact of the crowding. Y. Viala and D. Morin have mapped the directions of the Galaxy, which are significantly crowded, as a function of resolution. T. Zwitter has studied the impact of the crowding on the RVS Radial Velocity performances. Both studies are presented in Sect. 3.
- **Spectral information.** For the bright enough star (a V=14.5 K1V star observed with a resolution of R = 10 000 will have a S/N of about 30 at the end of the mission), a higher resolution will provide more accurate spectral information (lower line blending rate and lower rate of dilution of the lines in the continuum) and therefore will give access to a broader range of stellar parameters. It should be noted, that the study of C. Soubiran (RVS-CS-001) has shown that at a resolution of R = 5 500, it is possible to match a spectrum against a grid of reference with a precision in the atmospheric parameters of: σTeff = 160 K, σlogg = 0.3 and σ[M/H] = 0.2 dex. On the other hand, according to F. Thevenin et al. study, the determination of individual abundances (e.g. Ti, Mg, Si, …) will require a resolution of at least R = 10 000. The ionised Calcium triplet displays very strong lines in FGK type stars. D. Katz will investigate if this would allows to derive Calcium abundances at R = 5 000 resolution, or if R = 10 000 is required.

  The classification/parameterization of the sources will not rely only on the RVS instrument. The role of the spectrograph should be defined taking into account the information that will be provided by the astrometric and photometric (BBP & MBP) instruments. Priority levels have been assigned to the different stellar and astrophysical parameters (see Sect. 4).

- **RVS/GAIA Science Case.** The RVS science case has an important overlapping with the spectral information above. Therefore, as the spectral information, it should be considered in the context of the other GAIA instrument performances. The RVS science case should be defined, also considering the ground and space instruments, existing or which will be built and operated in the next 15-20 years. Priority levels have been assigned to the different Galactic and Stellar science goals.
- **Telemetry.** The telemetry rate increases with the resolution. Telemetry budget as function of resolution are presented in section 2.3.
- **Faint star observation.** In the case of a V = 17 G3V star, about 600 photons should be collected, in the spectral range [8490-8740] A, in 16.5 s exposure time, per CCD and per transit. At R = 10 000 and assuming that the spectrum will be 3 rows wide, the 600 photons will be spread over 1800 pixels. Therefore, on the average 1/3 of photon is expected per pixel, per CCD, per transit. Two third and one sixth of photon are expected at R = 5 000 and R = 20 000 respectively. The hypothesis made so far is that the successive observations (6 CCD times 100 transits) could be summed to recover 200 photons per pixel (R = 10 000) at the end of the mission. This assumption is valid only if no systematic dominates the signal. This is an extremely important issue, which may have a major impact on the RVS limiting magnitude. It is discussed in Sect. 2.4.

1.3 4th RVS Workshop agenda

The goal of the 4th RVS workshop was to make a preliminary review of all the aspects that impact on the definition/choice of the RVS characteristics. The discussions/presentations were split in 4 sessions:

- RVS design, telemetry and on-board processing (Sect. 2)
- Impact of the crowding on the RVS RV performances (Sect. 3)
- RVS science case and priorities (Sect. 4)
- By December 2002, the characteristics of the RVS instrument should be defined. A new work breakdown has to be defined for the next RVS preparation phase. Preliminary ideas are presented in Sect. 5.

The list of action is summarized in Sect. 6 and web pages and workshop in Sect. 7.

2 RVS design, telemetry and on-board processing

2.1 RVS Consortium

The technical aspects of the RVS instrument will be reviewed during an 18 months study, due to start November 15. Its goal will be to establish the feasibility and to optimize the current RVS design with respect to: optical design, focal plane design, mechanical & thermal design, tilt mechanism, VPU & data-handling, and calibration procedures. This consortium, lead by M. Cropper (Mullard Space Science Laboratory), will be made of 5 academic laboratories:

- Mullard Space Science Laboratory (Mechanical and thermal design, VPU & data-handling, calibration)
- Observatoire de Meudon/GEPI (Optical design, tilt mechanism)
- Leicester University (CCD & Focal plane assembly)

- Astronomical Observatory of Padova and Asiago (Wavelength calibration)
- Ljubljana University (Wavelength calibration)

2.2 RVS wavelength range

As pointed out by M. David (RVS-MD-002), the limits of the RVS spectral range “are a little too tight to allow an optimal choice of the cross-correlation interval” if nominal 250 A are taken. In particular the 8498 A Ca II line is very close to the interval blue edge. However, the 250 A is just a reference number, much depending on the sharpness of the edge-transmission of the wavelength interval selecting filter. Therefore, it was decided to widen slightly the RVS spectral range baseline to [8480-8740] A (instead of [8490 – 8740] A). The wavelength interval will be fine tuned when the specifications for the optical design and the filter(s) will come-in.

2.3 Telemetry rate and on-board processing

Y. Viala and D. Morin have performed a first assessment of the RVS telemetric budget as a function of resolution, using the GSC II 2.2 catalogue and the GAIA scanning law implemented by L. Lindegren (SAG-LL-30, SAG-LL-35). This study will be carried on to take into account the impact of the crowding on the limiting magnitude. Assuming 2 pixels wide spectra, 6 detectors and a limiting magnitude in the GSC II 2.2 photographic band F = 18, they derived mission average telemetric rates of 9, 13 and 17 Mbit/s respectively for R = 5 000, 10 000 and 20 000. After compression the telemetric flow will have to fit in the 0.25 Mbit/s currently allocated to the RVS instrument. The above telemetric rates would thus imply compression ratios of respectively 37, 52 and 68.

A first compression step, already discussed at the Ljubljana 3rd RVS workshop, is to sum (after readjustment of the images, e.g. interpolation) the 6 detectors on-board, only sending one spectrum per star and per field transit to the earth. Some kind of median filtering could be added to the on-board treatment to correct for possible cosmic-ray events or cosmetic defects. Summing the CCD lead to a factor of compression of 6, and should therefore be completed by one or several other compression step(s).

Several compression approaches have been discussed:

- It has been proposed at the Ljubljana workshop to sum the lines across dispersion to send to the ground a single row per spectra. This would give an additional compression factor of 2 (but will add complexity to the data processing in dense areas).
- Another possibility, presented by U. Munari, would be to extract numerically on-board, in the faintest RVS targets (e.g. V=16-17), the 3 Ca II lines wavelength domain and to send only those 3 intervals to the ground. The compression factor achieved with this method is dependent upon the width that should be taken on each side of the Ca II lines to avoid that the unknown radial velocity shift the Ca line outside the extracted intervals (at 8600 A, 1 A corresponds to 35 km/s). F. Crifo will review the RV distributions of the different Galactic stellar populations. T. Zwitter will assess the RVS RV precisions, using only the Ca II wavelength range.
- M. Wilkinson has proposed an alternative to the numerical extraction of the 3 Ca II wavelength domains: i.e. an optical extraction, using filters centred on the Ca II lines, that block out most of the RVS wavelength domain. Such filters, once inserted in the

RVS optical path, will apply to all stars, even the brighter ones, and will not be removable during the mission. The advantages are a lower crowding and a lower telemetry rate. The disadvantages are less precise RV for the brighter stars (less usable lines) and the lost of most of the astrophysical information. D. Horville and F. Chemla will review the existing filters for Ca II selection.

- M. Cropper has presented solutions for the data compression: (i) On-board resolution reduction and re-sampling of the faintest stars, (ii) field summation on successive transits. M. Cropper will assess the feasibility and quantify the performances of those techniques.

In addition to the above compression methods, a "classical" numerical compression will be applied to the data. Note that, because of their low flux level, most of the RVS targets could be coded on a single byte.

2.4 Very low photon count issue

Each RVS CCD will collect, for a V = 17 G3V star, 600 photons per transit in the wavelength range [8490, 8740] A. In the configuration: R = 10 000 and 3 pixels wide spectra, the 600 photons will be spread on 1800 pixels. Therefore each pixel will receive on average 1/3 of photon per CCD, per transit. The hypothesis made so far, but not tested, is that the very small number of photons per pixel, per CCD and per transit could be compensated by a large number of observations (6 CCD times 100 transits), in order to recover 200 photons per pixel at mission end. This will be true only if no un-calibrated systematic (noise with a non-random pattern) dominates the signal at the level of 1/3 of photons.

Two RVS characteristics impact on the number of photons collected per pixel, per CCD, per transit:

- A tilt mechanism, compensating the transverse motion, would reduce the spectra width to one or two pixels (according to the "random" location of the stars with respect to the detectors raw).
- The number of photons collected per pixel increases with the same factor as the resolution decreases. This means that any potential problem (whose possible existence is not proven and has to be investigated) will appears for stars 0.75 mag fainter at R = 5 000 than at R = 10 000. It should be noted that only systematic errors would scale with the resolution. In the case of random noises (photon, RON, …) such as the one considered in the RV precisions (not accuracy) derivation, the decrease of the signal to noise ratio as the resolution increases is dominated by the increase of the spectral information, except for the very faint stars (see Sect. 1.2 RVS RV performances – non crowded area).

To investigate the issue of the very low number of photons collected for faint stars, it will be necessary to review the potential sources of noise or signal distortion (background, optics, detectors, …), looking for any possible systematic perturbation and estimating the accuracy with which they can be calibrated. This is a very important issue to be investigated both by the RVS Working Group and the RVS Consortium.

From a more general point of view, we should establish, in the short term, the RVS accuracy budget, i.e. to review the random and systematic noise sources which may affect the radial velocities, at all magnitudes (See Sect. 5).

3 Impact of the crowding on the RVS RV performances

The RVS instrument is an integral field spectrograph, dispersing the light of the whole field of view. As a consequence, in dense area, spectra will overlap. Two studies have been conducted to assess the impact of the crowding on the RVS science case and RV performances.

Y. Viala and D. Morin have used the GSC II 2.2 catalogue, to map the directions on the celestial sphere, where the CCD will be “full” of stars of magnitude V = 17 or brighter, i.e. the total surface covered by the spectra equals or exceeds the CCD surface. At the density for which the spectra surface equals the CCD surface, each star has 87% probability to overlap significantly (from 25 to 100% overlap) with one or more stars (one star: 27%, two stars: 27%, three stars: 18%, more than three stars: 15%) of magnitude V = 18 or brighter. The threshold corresponding to “full” CCD depends on the resolution and spectra width. Assuming 2 pixels wide spectra, the CCD will be “full” at: 14 500 stars/deg^2 (R = 5 000), 7 200 stars/deg^2 (R = 10 000), 3 600 stars/deg^2 (R = 20 000). As expected, the areas where the CCD will be “full” are located around the Galactic plane. They are shown in red on Fig. 1, for the resolutions R = 5 000, 10 000 and 20 000. The CCD will be “full” for 35% (R = 5 000), 75% (R = 10 000) and 95% (R = 20 000) of the sky between -10 and + 10 degrees Galactic latitude.

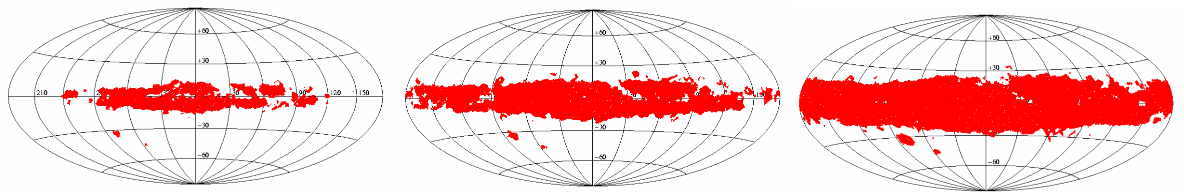

Fig. 1: Areas of the Galaxy where the CCD will be “full” of stars of magnitude V = 17 or brighter, for three resolutions, from left to right, R = 5 000, R = 10 000 and R = 20 000.

Once the “crowded areas” are identified, the second step is to establish the impact of several spectra overlap on the RVS RV performances. This question has been studied by T. Zwitter. He has estimated, by Monte-Carlo simulations, the RVS RV precisions as function of magnitude, resolution and stellar density. It appears that, except at relatively high densities, the crowding has a minor impact on the RV performances. T. Zwitter has derived the following precisions (at the end of the mission) for a V = 17 K1V star observed at R = 8 500: σRV = 6 km/s (no overlapping), σRV = 6.5 km/s (6 100 stars/degrees^2) and σRV = 13 km/s (40 000 stars/degrees^2). Those results are due to the higher level of impact by the zodiacal light and the read-out noise.

At intermediate Galactic latitude, the zodiacal light surface brightness is about V = 23 mag/arcsec^2. An R = 10 000, 3 pixel wide spectrum will cover 2700 arcsec^2 on the sky. Therefore the zodiacal light integrated over the spectrum surface is equivalent to a V ~ 14.5 mag star (the effect of the read-out noise will be of the same order of magnitude). Some few overlaps with “faint” stars have a minor effect with respect to the background and CCD noises. Of course, there are dense enough areas, where the number of overlaps becomes very large and the probability to be contaminated by “bright” stars is significant. The above discussion is in part based on the assumption that the contamination by “faint” stars is a white noise (i.e. do not contain any spectral signature at exact wavelength coincidence with corresponding signatures in the object’s spectrum). This should be true, because the scanning law cause a continuous variation of the sky orientation with respect to the spectral dispersion direction. Therefore, in most cases, on successive transits a spectrum is contaminated by different stars and their already very faint signal (only “faint” stars are considered here) average over the mission. Less frequent “bright” stars will imprint spectral signatures. Simulations performed by T. Zwitter show that, in this case, the information provided by the astrometric and photometric instruments could be used to model and subtract the background. T. Zwitter will carry on tests on its simulations of background subtraction and impact of the crowding. T. Zwitter, Y. Viala and D. Morin will derive a map of the RVS RV performances as a function of Galactic coordinates, taking into account the crowding, the number of transits and the variation of the zodiacal light surface brightness.

4 RVS objectives and priorities

The RVS scientific objectives and priorities have been addressed from two points of view: (i) astrophysical information (e.g. RV, v sin i, abundances, binarity or peculiarity detection, …), (ii) astrophysical topics (thin disk, thick disk, bulge, halo, stellar structure, binaries, …). Both aspects should be considered in the global context of the other GAIA instruments. The existing and future (15-20 next years) ground and space facilities should also be taken into account in the discussion.

In term of astrophysical information, the astrometric and photometric instruments will contribute in the determinations of the atmospheric parameters. The current estimate of the relative precision with which the atmospheric parameters of a V = 18 solar type star will be derived is: σTeff = 150 K, σlogg = 0.3, σ[Fe/H] = 0.2 dex and σAv = 0.1 (from C. Jordi and V. Vancevicius simulations), with respect to the synthetic spectra grid on which the colour indices were calibrated. The astrometric information should help refining the surface gravities determinations. At V = 15 (currently seen has the RVS limiting magnitude for the atmospheric parameters extraction), it is expected that the photometry will allow metallicity determination with a precision of σ[Fe/H] = 0.1 dex (TBC). Simulations are planned in the Photometry Working Group, to assess the performances of the photometry in the determination of the abundance of one or several alpha elements (depending on how many filters are devoted to this issue).
Considering the above astrometric/photometric performances and the general GAIA science case, the astrophysical informations that could be extracted from RVS data have been sorted by priority levels.

High level priorities

- Radial velocities
- Classification (Galaxy, “peculiar star”, “non-peculiar star”, …)

Intermediate level priorities

- Atmospheric parameters (Teff, log g, [Fe/H] or [M/H])
- Calcium abundance (3 strong Ca II lines)
- Other elements abundances
- Interstellar extinction (Diffuse Interstellar band – DIB 8620 A)
- Rotational velocities

Most of the specifications, in term of resolution, associated with the astrophysical diagnostics are defined: radial velocities can be obtained at any resolution, but higher resolutions will be favoured for bright stars and lower resolutions for faint ones (see the discussions on resolution/performances Sect. 1.2, very low photon count Sect. 2.4 and crowding Sect. 3); atmospheric parameters can be derived from low resolutions (but higher resolutions will give more accurate results); individual elements abundances, interstellar extinction and rotational velocities require resolutions R ≥ 10 000. U. Munari, using the Asiago Database of peculiar stars, will study the “peculiar stars” classification performances as function of resolution. D. Katz will study the Calcium abundances derivation performances as function of resolution.

One of the main contribution of the ground based telescopes to the general GAIA science case will probably comes from the multifiber and integral field spectrographs (optical as well as infrared). They will be particularly efficient in the study of dense areas with limited extension on the sky, such as the bulge. This is the reason why the bulge has been classified as intermediate priority. M. Wilkinson will review in more details the RVS bulge science case, in the context of 15-20 years ground observations, in order to refine its priority level. The RVS science cases, sorted by priority levels, are listed below:

Very high level priorities

- Perspective acceleration
- Thin disk
- Thick disk
- Halo
- Gravitational potential, Kz

High level priorities

- Reddening map
- Spiral arms
- Clusters
- Binary systems
- Pulsating stars & stellar structure

Intermediate level priorities

- Bulge

Low level priorities

- Local group dynamic

A lot of specifications were presented during the Monte-Rosa meeting, for most of the RVS/GAIA science goals (note that the specifications could be fulfilled by any GAIA instrument, not necessarily the RVS). They are extremely briefly summarized below, together with some older studies performed by RVS WG members. M. Wilkinson presented a very extensive review of the Galactic structure science case, prepared by himself, K. Kuijken, A. Robin, A. Vallenari, A.Helmi, M. Haywood, H.S. Zhao, J. Kleyna and G. Nelemans. The presentation can be downloaded on the RVS web page (http://wwwhip.obspm.fr/gaia/rvs/) and a summary will be available soon. They will carry on their review of the Galactic structure science case, in order to refine priority levels and specifications. The case of “bright” stars (V < 15) for which GAIA will provide accurate astrometry will also be considered.

- Perspective acceleration
    - σRV=10 km/s at V≥17 (>95% P.A. corrected) **(F. Arenou, M. Haywood)**
- Thin disk
    - σRV= 2-4 km/s at V≥16 **(RVS-CoCo-002)**
    - σ[alpha/Fe]~0.1 dex **(F. Thevenin)**
- Thick disk
    - Kinematics, V=18 **(G. Bertelli)**
    - σ[alpha/Fe]~0.1 dex **(F. Thevenin)**

- Halo
    - 2/3 accretion events σRV=20 km/s at V=18.5 **(A. Helmi, See RVS-CoCo-003)**
    - Rotation from RR Lyrae & BHB, σRV=10 km/s at V≥16 **(A. Spagna)**
- Gravitational potential, Kz
    - Radial velocities σRV=5-10 km/s + metallicities up to |b|~10 deg **(O. Bienayme)**
- Reddening map
    - σE(B-V)=0.1 σEW~35 mA **(U. Munari)**
- Spiral arms
    - Cepheids & super-giants V ≥ 15, σRV=1-2 km/s **(RVS-CoCo-002)**
- Clusters
    - V ≥ 14, σRV=1-3 km/s per transit **(RVS-CoCo-002)**
- Binary systems
    - 230000 SB R=5000 – 390000 R=20000, recom. R=20000 **(J.L. Halbwachs)**
    - Orbit recovery σRV=5 km/s **(D. Pourbaix)**
- Pulsating stars & stellar structure
    - Cepheids & RR Lyrae: Reddening, acc. RV & spe lines, R ≥15000 **(G. Bono)**
    - Kinematics of Miras: σRV=10 km/s **(M. Feast)**
    - RV Tau: Ca II line distortion + emission line + … R = 20000
      spec. type + subtype + limit. chemic. analysis R=10000 **(G. Wahlgren)**
- Bulge
    - σRV=10-20 km/s for V ≥ 17 **(G. Gilmore)**

5 Next RVS preparation phase

By December 2002, the characteristics of the RVS instrument should be fixed. A new work breakdown has to be defined for the next RVS preparation phase. Some ideas are proposed below (the list is not exhaustive and should be refined at the next RVS workshop):

- Optimization of the RVS instrument.
- **Definition of the calibration procedures & derivation of the accuracy budget.** This is one of the main priorities for the RVS preparation, already starting in the present phase (see Sect. 2.4).
- Implementation of the RVS simulator
- Implementation of GDASS algorithms
- Definition/optimization of the reduction and analysis algorithms
- Computation/observation of spectra database for:
    - Wavelength calibration
    - Reduction & analysis algorithms development/optimization

6 List of actions

F. Crifo:	- Review Milky-Way populations RV distributions for Calcium lines extraction (for telemetry reduction).
M. Cropper	- Investigate/test compression schemes.
M. Cropper & RVS cons.	- Investigate very low photon count issue.
D. Horville & F. Chemla	- Review filters availability for Ca II lines selection.
D. Katz	- Implement RVS simulator version 1.
D. Katz	- Activate “RVS accuracy budget” group.

D. Katz	- Study calcium abundance derivation performances as function of resolution.
U. Munari	- Study peculiar star classification performances as function of resolution.
Y. Viala & D. Morin:	- Refine telemetry budget taking into account the crowding.
M. Wilkinson et al.	- Review Galactic structure specifications.
M. Wilkinson et al.	- Review Bulge priority status
M. Wilkinson et al.	- Review bright stars science case and priority status
T. Zwitter	- Estimate RV precision using only the Ca II lines spectral domain.
T. Zwitter	- Test impact of background subtraction hypothesis on the crowding simulations.
T. Zwitter & Y. Viala	- RV performances as function of Galactic coordinates (taking into account the crowding, the number of transits, the zodiacal light variations).

7 Web pages and workshop

Web pages:

- RVS web page : http://wwwhip.obspm.fr/gaia/rvs
- Monte-Rosa web page: http://ulisse.pd.astro.it/GAIA2002/

Workshop:

- 5th RVS Workshop: 28-29 November Paris