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CALIBRATION OF GAIA-RVS: FIRST WEEKS AROUND ECLIPTIC POLES

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Abstract. At the beginning of the Gaia mission, it will be necessary to calibrate the 3 instruments, and to have data for performance check. A particular scanning mode will be used, allowing quick multiple observations over a small number of sources. This mode and the selection of corresponding sources are described.

Keywords: Stars: fundamental parameters; Techniques: radial velocities; Surveys: Gaia.

1 Introduction

During the first few weeks of the Gaia mission, a very particular mode of the scanning law will be implemented, allowing repeated scans of small areas around ecliptic poles (EPs). The aim is to observe at least four times per day a limited subset of stars in order to perform the early calibration of the three instruments on board of Gaia.

To meet this goal, it is important to have before launch a very good knowledge of these stars. For the RVS this means not only radial velocities, but also high-resolution spectra over the spectral range (847- 874 nm). As the satellite's detailed scanning parameters will not be known long in advance, all the bright stars within an area up to 2 degrees from either EP are presently under study. We present here the first selection of these objects, based on a realistic simulation of the scanning in EP-mode. The ground based procedure to collect the missing information is not identical in the NEP and SEP because of telescope availability.

2 Ecliptic Poles Scanning Law (EPSL)

The normal scanning law for Gaia allows the observation of the whole sky in 6 months, some areas being more observed than others.

At the beginning, a special mode will cause the areas around the ecliptic poles to be observed at each transit, i. e. twice every 6 hours, the density of the coverage decreasing with the distance to pole. A narrow band the width of which is the height of focal plane will be observed regularly, turning around the ecliptic poles.

Figure 1, taken from Voss & Bastian (2007), shows the progressive scanning of the sky near an ecliptic pole over 15 days. Presently about 1 to 2 months of EPSL scanning are foreseen. However the figure shows the scanning for astrometric and photometric instruments; the height of the RVS field is only 4/7 from it, in the upper half of the total field.

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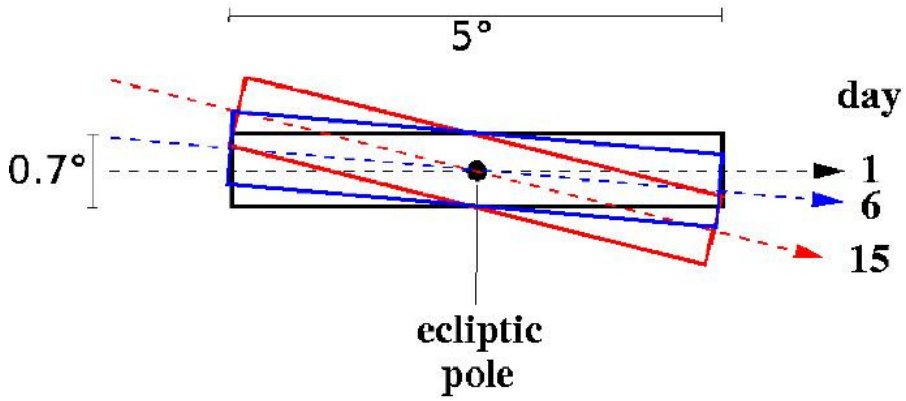

Fig. 1. Progressive coverage of the ecliptic pole area : black, blue and red zones are the sky areas scanned on days 1; 6 and 15, with a small rotation everyday. The common area with several transits is not a circle. (*from Voss & Bastian, 2007)*

3 Requirements on stars

The selection criteria were defined in several steps; and observations started before the last definition.

- These stars should be close enough to poles (1 degree at the beginning, extended later to 2 degrees), for enough transits during this rather short period; a high-resolution spectrum with good enough S/N (R∼40000 & S/N∼100) should be available for each one.

- The stars should be bright enough, but there are only very few bright stars around ecliptic poles. The limit was first set at V_t=11.5 (used for first NEP observations, together with a maximum polar distance of 1 degree); then brought down to 9 for SEP, together with the extension of the search radius to 2 degrees. The magnitude used is Vt, as the Tycho-2 catalogue is used.

- Unlike the RVS standards (see Crifo et al 2010; Soubiran et al 2012), double, multiple and variable stars are accepted, as well as early-type stars.

Figure 2 shows the final selection for each of the poles, vs Vt magnitude and polar distance. No object of the RVS standards list (see Crifo et al 2010) lays in the selection zones. The closest object of this list is indicated for each pole (heavy dark blue point).

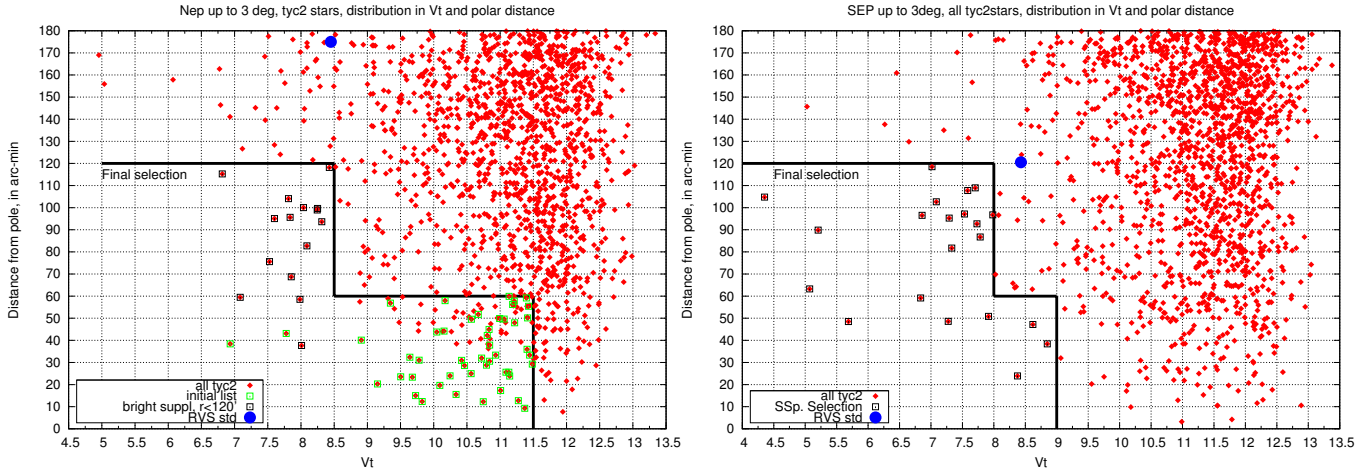

Fig. 2. Stars around each pole, magnitude/polar distance distribution. The objects kept are below the heavy dark lines. **Left:** NEP area. **Right:** SEP area.

NEP objects (63) are already observed at Pic du Midi with the Naraval spectrograph; SEP objects (21) should be observed at the end of 2012 with the RSA/ANU 2.3m echelle spectrograph at Siding Springs Observatory

(Australia).

4 Numerical simulations of scanning procedure

Unfortunately all the objects selected above will not be observed during the 1 to 2 months of EPSL, but only a fraction of them, the list of which depends on the launch date, as the sky will not be fully covered. Therefore the area covered at SEP by the RVS within these 1 to 2 months has been simulated with several possible launch dates, in order to evaluate the number of stars that might be really observed during this period.

Figure 3 show the areas scanned in 2 months by the RVS at SEP, for starts at October 1 and January 1. The selected objects are drawn in green. The non-selected objects are drawn in black. The stars within the RVS field for the considered 2 months are drawn in red.

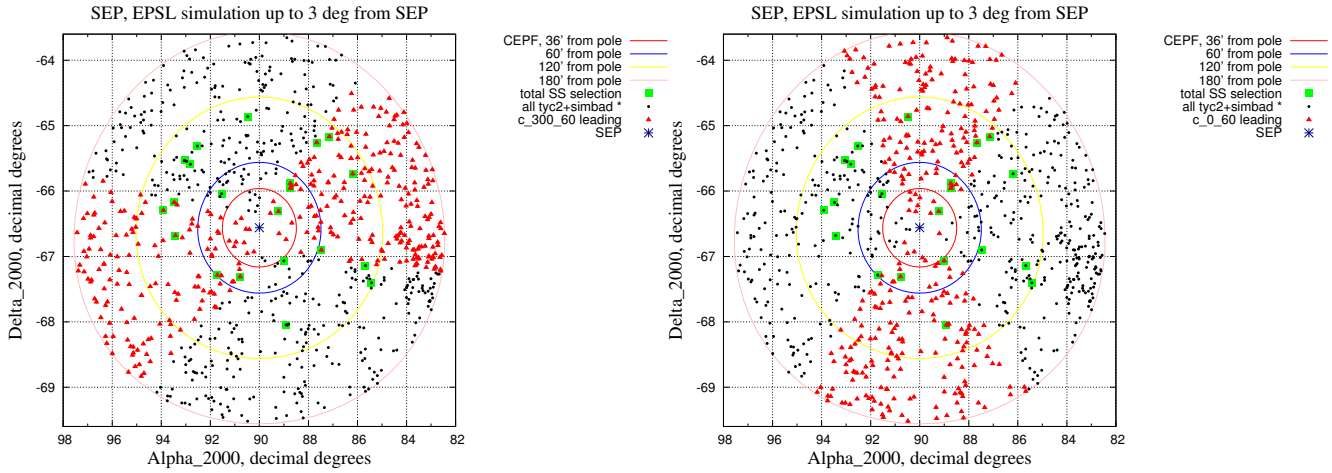

Fig. 3. Simulation of ESPL for 2 months at SEP. Green: the 21 reference objects; black: other objects (source: TYC2); red: objects in the RVS field during the 2 months. **Left:** Start on 1 october. **Right:** Start on 1 january.

At SEP, where there are only very few stars close to the pole, only 7 to 12 stars (of the 21) will be really observed: 1/3 to 1/2 of the total list.

5 Conclusion

The calibration of the RVS during the initial period will rely on a small number of stars, which must be really well-known. The requirement of high-resolution spectra available from the ground before launch over the RVS range is difficult to meet, particularly at SEP as only very few spectrographs are available.

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