Minutes of the 12th GBOG meeting

Meeting held in Heidelberg, Germany, on 18-19 October 2012

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Contents

1 Overview of the meeting

The GBOG meeting on Thursday 18th and Friday 19th October followed on from a two day (Tuesday 16th and Wednesday 17th) meeting on how to reduce and analyse VLT FLAMES spectra of the GBOG South Ecliptic Pole (SEP) Survey. This is the spectroscopic follow-up of the GBOG CU3 observing programme to compile the Ecliptic Poles Catalogue (EPC). The GBOG SEP Survey will vastly increase the scientific value of the EPC, which includes only astrometry, by adding radial velocities and abundances. GBOG members plan to scientifically exploit this data set. The GBOG SEP Survey came about due to GBOG meetings and as such is one of the great successes of GBOG meetings.

As usual, the first part of the GBOG meeting was devoted to presentations of activities and status of observing programmes in each CU.

1.1 Participants

MA: M. Altmannn (CU3), ARI – Heidelberg
WT: W. Thuillot (CU4), IMCCE – Paris (via Skype)
EP: E. Pancino (CU5), OABO – Bologna
GS: G. Seabroke (CU6), MSSL – London
CS: C. Soubiran (CU6), LAB – Bordeaux
GC: G. Clementini (CU7), OABO – Bologna (via Skype)
UH: U. Heiter (CU8), Uppsala University
SE: S. Els (PO), ESA

Apologies: E. Joliet, R. Smart, P. Bendjoya, L. Wyrzykowski, L. Eyer, Y. Frmat

1.2 Agenda

CU3 status report by M. Altmann
CU4 status report by W. Thuillot
CU5 status report by E. Pancino
CU6 status report by C. Soubiran and G. Seabroke
CU7 status report by G. Clementini
CU8 status report by U. Heiter
Discussion session

2 Status of activities

Each representative gave a presentation consisting of a few slides. The pdf files are available at: `http://www.rssd.esa.int/wikiSI/index.php?title=GBOG_M12&instance=Gaia`

2.1 CU3 status report

2.1.1 VLBI quasar program - C. Soubiran (on behalf of G. Bourda)

Candidates for preparing the alignment between the radio frame and future Gaia frame in the optical domain are weak extragalactic radio sources from the NRAO VLA Sky Survey (NVSS). These need to be observed by the Very Long Baseline Interferometer (VLBI) to get sufficiently accurate positions. The VLBI observations will have different wavelengths to the NVSS so it is not guaranteed that all candidates are suitable.

Only 201 ICRF2 sources were found to be suitable (optically bright V¡18 and with no VLBI structure for an accurate position) to perform the alignment of the ICRF VLBI frame and the future Gaia optical frame. 447 weak extragalactic radio sources were selected from NVSS radio catalog as candidates to extend the number of reference sources for the alignment. The observing program is in 3 parts : VLBI detection (VLBI observations have different wavelengths than NVSS), imaging to select the point-like sources, astrometry to measure their position accurately.

398 sources were detected, on which 250 could be properly imaged (63%). Question raised as to whether programme finished or whether remaining 37% of sources will be imaged. Unanswered during the meeting because presented by CS on behalf of G. Bourda. G. Bourda later answered that the imaging programme is complete. The remaining 37% cannot be imaged for several reasons and will not be re-observed. Out of the 250 properly imaged, 119 were found to be point-like enough for the astrometry program. All the 119 sources have been observed in 2012 with the global VLBI network (EVN+VLBA) and the correlation is pending.

Northern hemisphere astrometry is currently being worked on. Southern hemisphere programme is currently being organised.

The 119 point-like sources will be included in the third International Celestial Reference Frame (ICRF3). Only point-like sources can be used for frame alignment. Extended sources cannot be used for frame alignment but are good for astrophysics.

Gaia's optical reference frame will become the ICRF because it is more accurate than the radio reference frame. Nevertheless, the Gaia reference frame needs to be linked to the radio reference frame so that both new and old radio observations can benefit from the optical ICRF from Gaia.

2.1.2 News from GBOT - M. Altmann

Most of the stars observed by Gaia are faint with position accuracies of $\sim$200 μas. Ground Based Optical Tracking (GBOT) of the Gaia satellite is not required to reach these accuracies. GBOT is required to reach accuracies of $<$30 μas, which is required for Gaia's brightest stars.

Contracts between ESA and observatories currently being set up to formalise the Network. The Liverpool Telescope, the Las Cambres Observatory Global Telescope and the European Southern Observatory telescopes are the backbone of the GBOT network.

Until first Astrometric Global Iterative Solution (AGIS) run 18 months after launch, GBOT will make daily observations of the Gaia satellite. One data point of Gaia's position with 10-20 mas per night is required. These data points will be sent weekly to the European Space Operations Centre (ESOC). GAIA-ESC-TN-0044 states that orbital maintenance requires GBOT astrometry of the Gaia satellite but can cope with gaps of 15 days. All GBOT observations will have to be re-processed after each AGIS run because each output of AGIS improves the reference frame.

Gaia will be brighter than quasars in the radio and so can be observed with VLBI to get ultra precise positions. A job at Dwingleoo is being advertised to work on radio GBOT.

A question was raised on whether the timestamp of observations is actually when the shutter opens, which depends on the type of shutter e.g. circular versus barndoor.

2.1.3 IGSL: M. Altmann (on behalf of R. Smart)

Requirements for the IGSL: to provide all sky positions, proper motions and magnitudes for all objects to a limit of R = 21 where possible, e.g. where the available large catalogues, $>$10 000 square degrees, reach that limit. In particular the galactic plane is not currently complete beyond R = 18 in the large schmidt based catalogs that make the bulk of the faint IGSL input. The parameters: positions, proper motions and magnitudes, will be provided on a best effort basis, nominally with precisions of 0.3", 10 mas/yr and 0.3 magnitudes respectively, but limited by the precision of the large catalogues. The CU3 QSO and Ecliptic Pole catalogues will be included to support directly the CU3 processes that require those resources. The IGSL also includes OGLE and PPMXL, which replaces GSC/UCAC for proper motions. value, err, source are new parallax fields added. The last version of the Initial Gaia Source List (IGSL) is version 3 due for release at the end of 2012 containing 1 billion objects.

The IGSL is dominated by Schmidt based catalogues hence bright objects ($>$19) within 4-5" of each other are not resolved. Most binaries are classified as non-star and a high percentage of objects in the Galactic plane are classified as non-star.

Discussion on use of IGSL:

- IDT select a subset of single, good astrometric sources from IGSL to compile the satellite attitude catalogue, which is the equivalent to a Gaia "input catalogue".
- The mock IGSL is based on the CU2 Universe Model.
- Data Processing Centre Torino may update the IGSL but will not be used in further Gaia processing, although it could be published separately.
- SE demonstrated the MDB Dictionary Tool showing the MDB CU3 AuxDate IGSL and DPC CU6 Aux tables, both of which require table descriptions.
- The IGSL will include G_{RVS}.

2.1.4 EPC: Photometry and Astrometry - M. Altmann

Northern photometry will be Ecliptic Pole Catalogue (EPC) 4.0 available soon. Southern field is less faint ($V < 23$) than northern field ($V < 26$). The original photometry includes 600 000 objects, of which 500 000 have the two colours necessary for G magnitude calculation.

EPC astrometry and photometry will be delivered to the IGSL in December and frozen then. The astrometry can be improved using Bordeaux astrometry but this will not be included in the IGSL. EPC spectra is too late to be included in the IGSL. GS suggested that bright EPC spectra could be useful for RVS commissioning and to be used as templates in CU6 processing. The latter would require a bespoke data model for the spectra.

SE said the ESA-DPAC ICD includes the EPC because Astrium will use it for commissioning. If CU6 want Astrium to do specific RVS tests, then CU6/GBOG should provide Astrium with EPC radial velocities and spectra.

2.1.5 EPC: Spectroscopy - E. Pancino

HR21 and LR2 spectra have the same input catalogue but because the robot randomly selects the stars for each filter set up, not all the stars are observed with each filter. GS again commented that bright UVES spectra (V = 12) can be used to both commission the RVS instrument and commission the CU6 daily pipeline. HR21 spectra are faint but their accurate radial velocities can be used to commission the CU6 global pipeline, which could be run at the end of the Ecliptic Pole Scanning Law. EPC stellar parameters and abundances can be used to commission the CU8 pipelines.

2.1.6 QSOs - M. Altmann (on behalf of A. Andrei)

SE said that CU4 assumed they can rely on 2D source reconstruction provided by CU5 to analyse QSO morphology but the charge transfer inefficiency issue complicates this.

2.2 CU4 status report

2.2.1 GaiaFUN-SSO - W. Thuillot (via Skype)

The main activity of CU4 relevant for GBOG is the setting of a follow-up network for astrometric alert of Solar System Objects. This network, Gaia-FUN-SSO, is composed at this date of 39 observing sites. The alerts will be triggered by DPCC (CNES in France) toward a central node. The goal of the network is to acquire astrometric measurements of the critical objects which could not be monitored by Gaia. The data will be sent subsequently to the Minor Planet Center which is the provider of auxiliary data used by Gaia for the identification of known objects. Training campaigns of observations have been organized since November 2011 and a second workshop of the Gaia-FUN-SSO network has been held in Paris in September 2012.

CS asked when first astrometric alerts will be published. WT said three months after launch, just after commissioning. This will include a validation phase, when there will be more alerts at the start to tune the system. Asteroids are no longer in the Gaia commissioning plan but they are in the DPAC initialisation plan.

Only the astrometric measurements are stored, not the images. The central node of this storage is the IMCCE Paris, which is secure for the entire mission time. This is outside of CNES, which is the CU4 data processing centre.

2.3 CU5 status report

2.3.1 SPSS - E. Pancino

CU5-DU13 is preparing its pre-launch delivery of flux tables for the calibration of Gaia photometry. It will not be possible to release the full grid of approximately 200 SPSS with the full set of observations. A restricted set of 109 SPSS observed in 22 promising nights (judged clear by the observers) will be delivered, and during the mission the S/N of these flux tables will be increased as all the observed data will be included, as well as the full set of SPSS will be delivered. Details of the pre-launch delivery and the status of DU13 activities can be found in EP-010 and EP-011.

Some effort is being dedicated to the building of a professional archive and database at the ASDC in Rome (`http://www.asdc.asi.it/`), which will be a good starting point in

case of a publication of the SPSS data in CU9 (see also Section 2.7.2).

Finally, some interest was raised by the Project Altair ballon tests, and by its future space mission project (`http://projectaltair.org/`), aimed at calibrating flux with an 0.1% accuracy, which could have an impact on Gaia calibrations as well.

2.3.2 Alert validation and meeting report - G. Seabroke

GS presented a summary of the Third Workshop on Gaia Science Alerts (GSA), held in Bologna on Sept. 6-7, 2012:

`http://www.ast.cam.ac.uk/ioa/wikis/gsawgwiki/index.php/Workshop2012:main`

The major discussion was on to proceed in practice, man power and resources. It is still not too late for observatories to join the alert validation network. GS presented the Follow-up and Alerts Verification Brochure, which details minimum telescope specifications to join the alert validation network:

`http://www.ast.cam.ac.uk/ioa/wikis/gsawgwiki/images/3/3e/Verificationbroc`
`pdf`

The next step is the signing of MOUs.

The exact purpose of GBOG was discussed: it is to provide calibration observations for Gaia, rather than conducting the Gaia Science Alerts verification. However, GBOG should be the forum where synergies between GBOT, Photometric Science Alerts (PSA) and Astrometric Science Alerts (ASA) are discussed. These synergies have already been discussed elsewhere but this has happened in an ad hoc way, which would have been better organised if it had been done through GBOG.

ACTION: Invite GBOT, PSA and ASA representatives to present their observing networks at the next GBOG meeting.

The discussion also involved the idea of a single Gaia brochure for observatories that would advertise how they can get involved in the Gaia observing networks: ASA, PSA, CU7 and GBOT. Given that these networks are being finalised, this idea will not be pursued.

2.4 CU6 status report

2.4.1 CU6 observations and catalogues - C. Soubiran

Gaia will be observing in the Ecliptic Pole Scanning Law (EPSL) during commissioning. There are not many spectra of stars close to the Ecliptic Poles so these are being observed in preparation for RVS commissioning (Crifo et al. 2012). The observations are single epoch and so may include variable or multiple stars and thus cannot provide additional Ground-Based Standards (GBS).

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. A discussion on whether UVES could be used. Its fibre mode has a hole in wavelength coverage over one of the calcium triplet lines. The slit mode does not have this but the targets are likely to be too bright to observe with UVES.

Uli Bastian attended this part of the meeting. It was discussed that RVS will need to be lucky to observe the two GBS close to each Ecliptic Pole and therefore he concluded that CU6 would rather a shorter commissioning period. This is because like CU3, CU6 will gain more with Gaia in nominal scanning law rather than EPSL during commissioning.

The final list of GBS will be submitted as a paper. 96% of stars passed the 300 m/s stability threshold. One more observation of each star will be conducted during the Gaia mission to check for long-term variability. NARVAL has the fewest observations because it is the most difficult for multiple observations. NARVAL cross-correlates spectra with a numerical mask made from synthetic templates. ELODIE only has two masks of F and K stars, which need to be corrected due to colour trends. All measurements are corrected to the SOPHIE scale.

2.4.2 G_{RVS}, Spectro Science Alerts, TN DK-015 - G. Seabroke

2.4.2.1 G_{RVS} Two new CU6 modules have been proposed: EstimateMagnitude and ComputeMagnitudeZeropoint:

- grvs_instr = -2.5Log(flux/s)
- Grvs_cal = grvs_instr + zeropoint
- zeropoint = Grvs_ref(SPSS) - grvs_instr(SPSS) (assume no colour term due to small RVS wavelength range)
- SPSS = absolutely flux calibrated
- Grvs_ref(SPSS) = SPSS spectrum convolved with nominal RVS response

- grvs_instr(SPSS) = RVS observation of SPSS

ComputeMagnitudeZeropoint will average over the RVS observations of SPSS to provide a daily zeropoint as function of RVS CCD and field of view. If EstimateMagnitude is limited to RVS integrated S/N > 100, $G_{\rm RVS}$ will only be calculated for $V < 14$.

To calculate Grvs_ref(SPSS), CU6 could either send nominal RVS response to CU5 to calculate Grvs_ref for each SPSS and include them in the CU5 auxiliary data catalogue. P. Sartoretti has spoken to C. Cacciari about this. Alternatively, CU6 would need access to SPSS spectra so they can convolve them with the nominal RVS response to calculate Grvs_ref for each one. EP confirmed that CU5 would calculate Grvs_ref for CU6.

2.4.2.2 Spectro Science Alerts The proposed baseline for Spectro Science Alerts (SSA) is to publish the RVS spectra of Photometric Science Alerts (PSA) and then after learning from PSA spectroscopic follow-up, issue SSA generated solely from RVS spectra later in the mission. This proposal was presented at latest Gaia Science Alerts Workshop in Bologna. Discussion there revealed that the proposal may not be compatible with the DPAC concept of extracting as much science as possible from their data products before releasing them. SSA RVS spectra will not have been processed by CU8. This issue needs to be discussed at DPACE.

2.4.2.3 CU6 auxiliary data GS showed DK-015 and explained CU6 auxiliary data as an example for other CUs to follow.

2.5 CU7 status report

2.5.1 CU7 Status - G. Clementini

High-resolution observations of Be stars in the Gaia RVS wavelength range are being conducted by P. Koubsky. Yves Fremat also works on Be stars in CU8 and they already talk together. GS noted that P. di Matteo is looking into Be stars as potential Spectro Science Alert triggers.

ACTION: GS to inform P. di Matteo about CU7's Be star GBOG program.

GS also noted that DK-015 asked for high-resolution, high S/N spectra to be added to the CU6 Auxiliary Catalogue to be used as templates in the CU6 pipeline. If time permits, CU7 GBOG spectra of Miras and Be stars could be added to the CU6 Auxiliary Catalogue.

2.6 CU8 status report

2.6.1 FGKM-type stars - U. Heiter

Benchmark stars are brighter than Gaia was going to observe. Primary Astrophysical Parameter standard stars will be observed by Gaia. SE said Gaia's SkyMapper used to have a bright limit of $G = 6$. The image cores saturate in SkyMapper but a new Astrium algorithm looks at the image wings to determine brightness, allowing Gaia to observe up to $G = 1.5$.

Benchmark stars are important for AP calibrations because their Teff, logg can be determined independently of spectroscopy. A list of $\sim$ 30 Benchmark Stars are currently being used for the Gaia-ESO calibrations. Thanks to GBOG programmes and ESO archives, libraries of high-resolution spectra in the range 480-1000nm have been built by the Bordeaux-Uppsala group. Their metallicity is being determined from standardized inputs (model atmospheres, line lists).

The key programme on AP reference stars at Pic du Midi with NARVAL, joint with CU6, is now at the last semester. In total more than 200 field + OC stars with $6 < V < 12$ have been observed and their spectra will be analysed with the same standardized inputs as the Benchmark Stars, as well as many other spectra retrieved from archives.

2.6.2 OBA-type stars - U. Heiter (on behalf of A. Lobel)

There is a large programme on OBA stars on-going at the Mercator telescope with the HERMES spectrograph. Benchmark Stars are observed with a S/N of $\sim$ 1000, while a filler programme aims at observing more than 2000 OBA stars with S/N $>$ 150. PIs of this programme are P. Royer (KU Leuven) & A. Lobel (ROB). It started in 2009 and as of September 2012, 421 OBA stars were observed. The aim is to obtain a uniform coverage of all spectral subtypes and luminosity classes of OBA type stars.

2.7 Discussion

2.7.1 Questions to S. Els

SE showed the Gaia Project Implementation Plan and explained that half a page summarising GBOG for the Multi-Lateral Agreement report was appropriate. He said an SRS for GBOG is not necessary and too late anyway. He encouraged each CU to write an auxiliary data technical note.

2.7.2 Census of GBOG programs for GAP/CU9

EP is putting together a document (EP-009) which provides a census of all the auxiliary data programs coordinated by GBOG, in view of a follow-up of the LoI sent by GBOG to GAP, for the preservation and publication, where appropriate, of Gaia auxiliary data. The document is expected to be completed at the beginning of 2013, and to be updated when necessary.

However, not all the auxiliary data projects within DPAC are coordinated by GBOG, because many concern theoretical libraries, or collections of literature or archival data, or are of different nature. Examples are the IGSL, or the CU8 libraries of stellar and galaxy templates. Not all these large efforts are documented, one excellent census was recently published by CU6 (DK-015). During the discussion it was agreed that GBOG should stimulate — through CU representatives — each CU to publish a census of their work on such libraries.

After the publication of EP-009, it was agreed that GBOG will try to publish a similar census of all the non-GBOG coordinated auxiliary data in DPAC. These preliminary surveys are a necessary basis to start a discussion among DPAC members and with future CU9 members about the usefulness or need of publishing certain datasets, and in which form. In other words, it is a preliminary work to fulfil the GBOG LoI proposal to GAP and CU9.

2.8 Next meeting

A vote will be organised to see if all GBOG members agree to have a physical meeting in spring instead of a telecon. Because of launch possibly in October, it might be better to discuss the auxiliary data that need to be ready for the early phases of the mission.

ACTION: MA to set up a doodle poll.

2.9 Actions for CU representatives

- All GBOG reps: review and revise GBOG M12 minutes (done)
- Organiser of next GBOG meeting: invite GBOT, PSA and ASA representatives to present their observing networks
- E. Pancino: finish EP-009
- G. Seabroke: prepare minutes and inform P. di Matteo about CU7's Be star GBOG program (done)
- M. Altmann: set-up doodle poll to decide on format of next meeting (done: `http://doodle.com/2mfr24hehcw26xvw`)

3 References

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