Auxiliary data for the Gaia data processing : Overview of the ground-based observing programs

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and the DPAC-GBOG Working Group

Ground **B**ased **O**bservations for **G**aia (**GBOG**)

The DPAC-GBOG Working Group was set up in 2006 to deal with new GB observations mandatory for the data processing

Tasks :

- **coordination within the DPAC** :
  - identify overlaps among needs, targets, facilities
  - avoid dupplicate efforts, optimize the observing time
  - frame a long-term observation plan

- **communication outside DPAC**
  - present well organized and motivated data acquisition plans to the observatories and time allocation committees *(TACs face a growing number of proposals claiming to be important for Gaia..)*

Follow up observations organised by the Gaia community or the science community at large do not enter in the area of responsibility of GBOG (e.g. GREAT wide-field spectroscopy, alerts,...)

What auxiliary data are needed ?

- **Data processing calibrations**
  - G, BP/RP flux calibration
  - RV zero point
- **Training datasets**
  - stellar parametrization
  - asteroid taxonomy
- **Calibration fields for the commissioning**
  - Astrometry, photometry, spectroscopy at the Ecliptic Poles
- **Reference frame**
  - Alignment of optical / radio, VLBI
  - QSO catalogue, morphology, optical monitoring
- **Tracking of the satellite** (GBOT)

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no pre-existing dataset fulfills the Gaia requirements in terms of homogeneity, precision, sky coverage, magnitude range, spectral interval

* **Establishing the Grid of Spectro-Photometric Standard Stars**
  PI : E. Pancino, EFOSC2@NTT (ESO, La Silla), LARUCQA@1.5m (San Pedro Martir, Mexico), LRS@TNG (Roque de los Muchachos), ROSS+REMIR@REM (La Silla), BFOSC@1.52m (Loiano), CAFOS@2.2m (Calar Alto)

* **Reference stars for radial velocities**
  PI : C. Soubiran, ELODIE@OHP-T193, SOPHIE@OHP-T193, NARVAL@TBL, CORALIE@Euler

* **Creating initial calibration fields for Gaia**
  PI : M. Altmann, ESO-MPIAT2.2/WFI, ESO/FLAMES/UVES, CTIO/4m+MOSAIC2, CFHT/Megacam

* **VLBI observing program of weak extragalactic radio sources for aligning the ICRF and the future Gaia frame**
  PI : G. Bourda, VLBI network (EVN+VLBA)

* **Reference stars for stellar parametrization**
  PI : U. Heiter, TBL/NARVAL, TNG/SARG, MERCATOR/HERMES

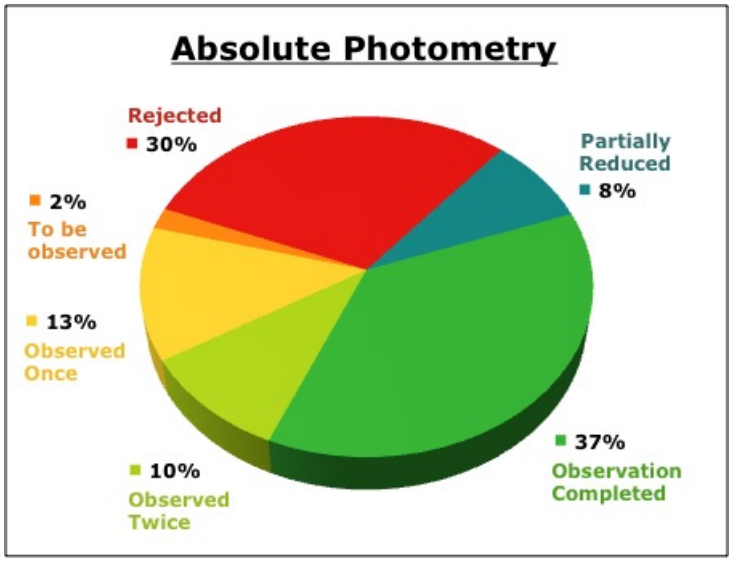
* **Astrophotometric variability, morphology of QSOs**
  PI : A. Andrei, CFHT-LS, SOAR-OI, ESO-MPIAT2.2/WFI

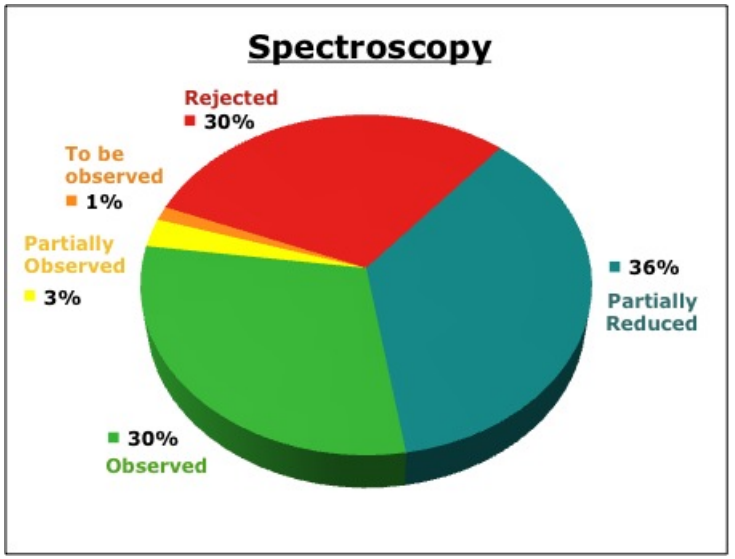
* **Spectroscopic observations of asteroids as a support to the Gaia space mission**
  PI : P. Tanga, Dolores@Telescopio Nationale Galileo

* **Spectral energy distributions of peculiar stars across the HR diagram**
  PI : Y. Frémat, ESO-NTT/EFOSC2

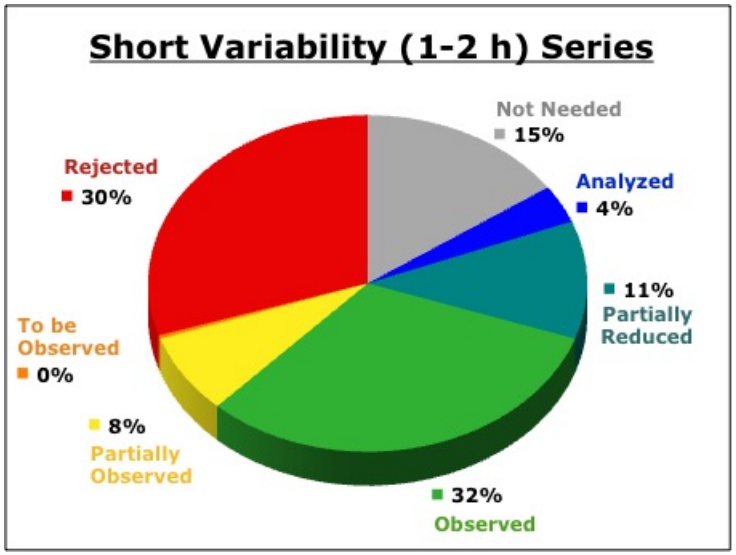
SpectroPhotometric Standard Stars (SPSS)

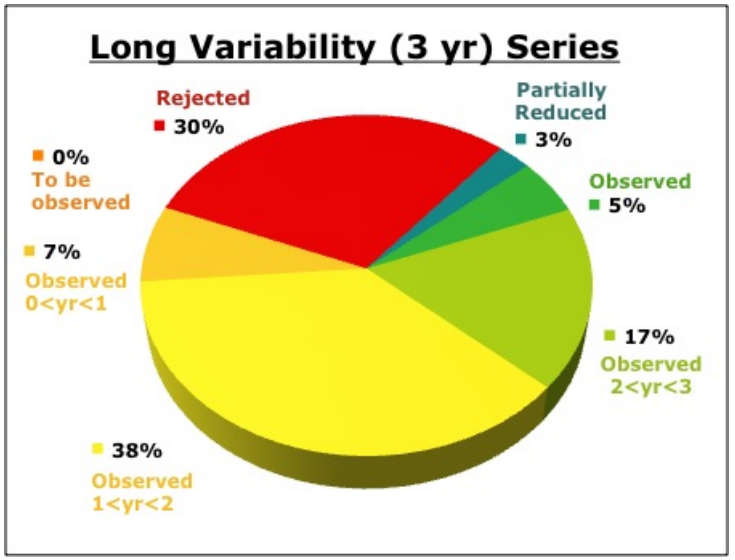
- calibrate all Gaia BP/RP spectra and G-band photometry
- ~200 of SPSS flux tables, Vega calibrated, accuracy few percent, strict quality constraints
- Primary SPSS calibrated on the three CALSPEC Pillars (Bohlin, 2007)
- Secondary SPSS (Gaia SPSS grid) calibrated on Primary SPSS
- observing facilities :
  - CAFOS @ 2.2 m Calar Alto telescope, absolute photometry and spectroscopy, C. Jordi
  - DOLoRes @ TNG La Palma telescope, absolute photometry and spectroscopy, E. Pancino
  - EFOSC2@ NTT La Silla telescope, absolute photometry and spectroscopy, E. Pancino
  - LaRuca @ 1.5 m San Pedro Martir telescope, relative photometry, variability , F. Figueras
  - ROSS @ REM La Silla robotic telescope, relative photometry, variability , E. Pancino
  - BFOSC @ Loiano Cassini telescope, relative photometry, variability , G. Altavilla
- ~300 observing nights since 2007





main campaigns : end 2012





auxiliary campaigns, long term monitoring : end ~2013-2014

several papers in preparation or planned

RV zero point

- no calibration lamp for the Gaia-RVS
- 1420 RV standard star candidates

(Crifo et al. 2010A&A...524A..10C)

- check RV stability at 300 m/s
- 70 observing nights since 2006
- end of pre-launch programme, 1st release in 2012
- 1 more RV measurement per star during operations

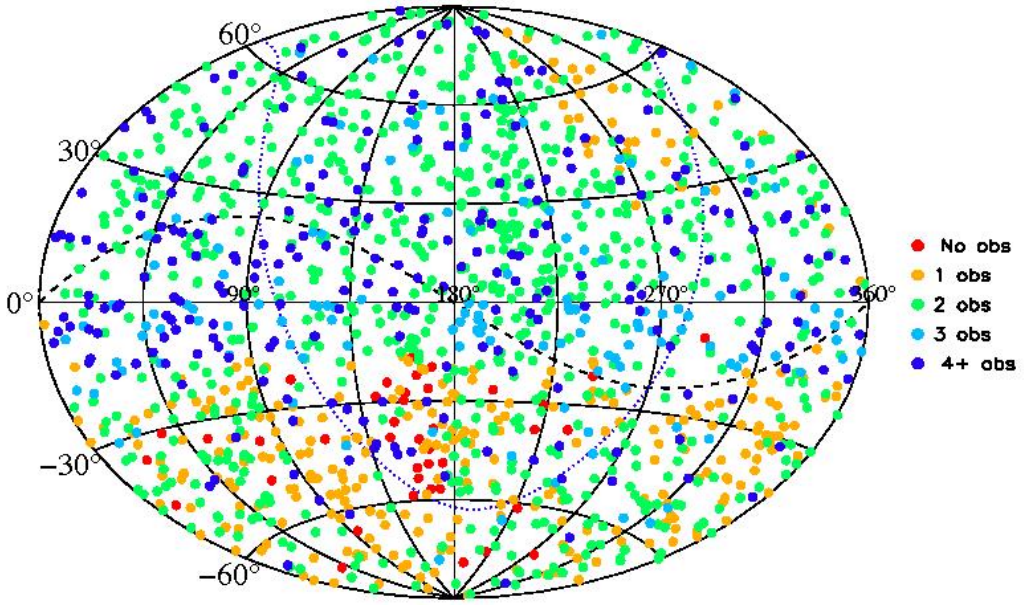
SOPHIE@OHP-T193

+ HARPS and ELODIE archives

NARVAL@TBL-Pic du midi

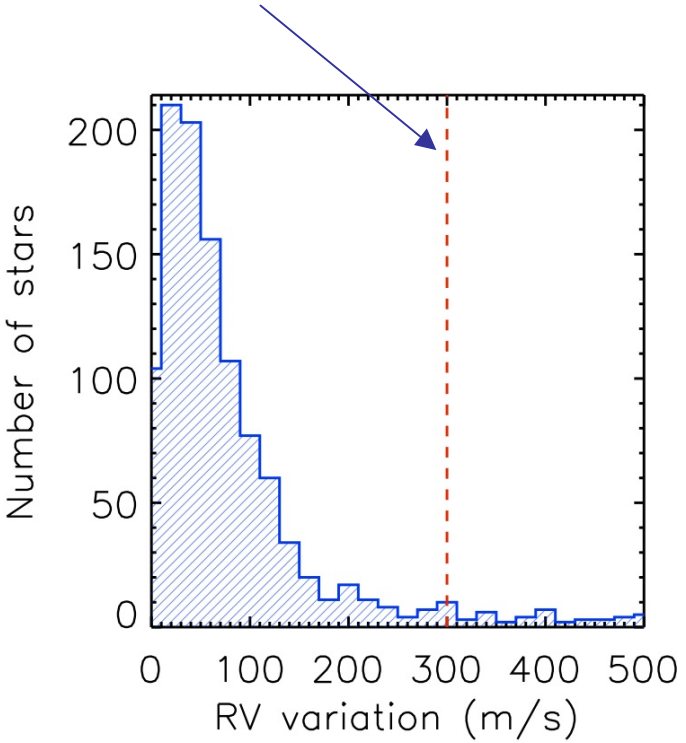
CORALIE@Euler La Silla

RVS standard stars



status of the observations as of February 2012

stability threshold for the RVS calibration stars



long term observing programs

- standard stars monitoring :
  - long term photometry for SPSS until 2014
  - RV variability of RVS standards until 2018
- stellar parametrization *(starts later)*
  - AP reference stars : TBL/NARVAL observations + archives --> several thousands of high quality spectra to be analysed homogeneously
- QSOs - reference frame
  - optical monitoring for variability and morphology studies
  - alignment of radio and Gaia reference frames : VLBI detection, imaging, and astrometry

gaia

Gaia DPAC
Data Processing & Analysis Consortium

support networks of telescopes

- Gaia-FUN-SSO, a Gaia Follow-Up Network for the Solar System Objects
- Network of small/medium telescopes in support of the variability pipeline
- Science Alerts Verification and Follow-up
- GBOT

Gaia-FUN-SSO
Follow-up Network
for Solar System Objects

Contact : William Thuillot, IMCCE, Paris

- **Goal**

improve knowledge of orbit for poorly observed targets
astrometric & photometric observations on alert (ASA)
Critical Objects (NEAs, comets,…)

- **Structure**

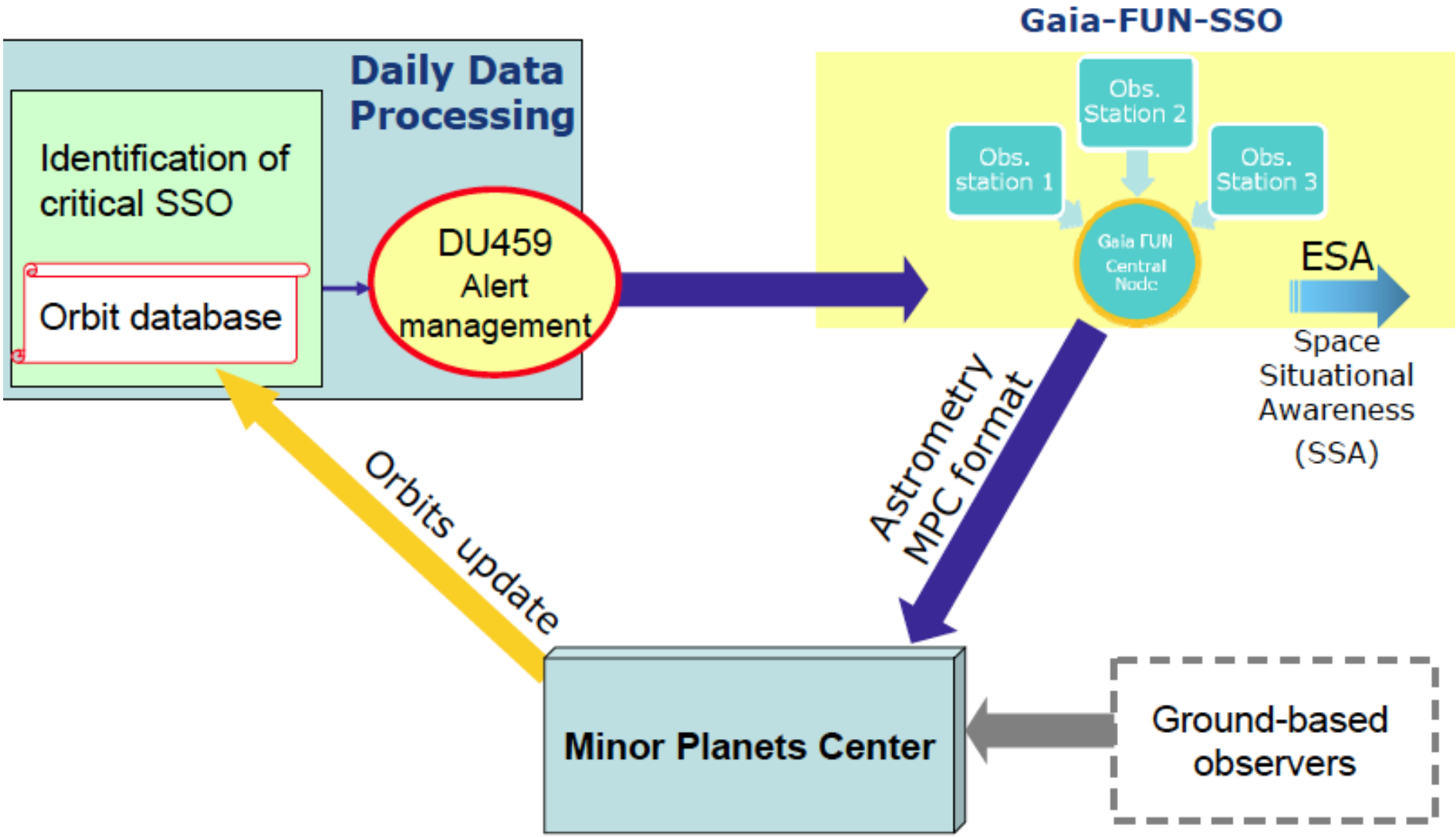
35 observing sites
51 operating telescopes
1 central node

- **Pre-launch activity 2011-2013**

training observation of asteroids (NEAs campaigns + alerts)

WIKI at https://www.imcce.fr/gaia-fun-sso/
Workshop Gaia-FUN-SSO : Paris, 2012 Sept 19-21
http://www.imcce.fr/hosted_sites/gaiafun2012/

Follow-up Network for SSO



courtesy Paolo Tanga

CU7 network of small/medium (1-2m) size telescopes involves about 12 people, 9/10 sites, 15 telescopes from 8 to 200 cm in size.

Contact :G. Clementini

L. Eyer: Geneva Observatory, Euler (1.2m La Silla Chile), 1.2m Mercator (La Palma – Canary Islands)

R. Hudec & J. Soldan: Astron. Inst. Ondrejov – Czech. Rep., (8,25.4,30,40,50,60cm)

T. Lebzelter: Leopold Figl Observatory – Austria, (1.5m – photometry & low resolution spectroscopy), and SMARTS (0.91.5m CTIO)

G. Clementini: Loiano Observatory – Bologna, Italy, (60cm, 1.5m photometry & low resolution spectroscopy)

V. Ripepi: Toppo di Castelgrande – Italy, (1.5m, photometry & low resolution spectroscopy)

K. Kolenberg: Network of small telescopes for Blazhko RR Lyrae stars (various sites spread all over the world)

M. Ibrahimov: Maidakan Observatory – Uzbekistan (1.5m, 1m, 2x60cm)

P. Koubsky: Astron. Inst. Ondrejov – Czech. Rep., (2m +Coude spectrographs, resolution from 5000 to 50000)

L. Szabados: Konkoly Observatory – Hungary (50,60/90cm, 1m)

variability studies + validation of alerts

Alerts Verification (DPAC) and Follow-up (science community at large)

Contact : Łukasz Wyrzykowski, IoA, Cambridge
http://www.ast.cam.ac.uk/ioa/research/gsawg/

science alerts will be the first Gaia data to be released

❑ Verification Phase to verify the robustness of issued alerts and fine-tune classification :

- last for ~3 months
- ~6 months after receiving the first Gaia data
- Italian-CU7-Variability network testing capability of a network of 5 telescopes to react promptly and in coordinated manner

❑ Follow-up network ...build in progress...

Follow-up network
...build in progress...

www.tinyurl.com/telescopes-for-gaia

34 instruments registered

Telescopes for Gaia

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Telescope/observatory name | Show all formulae

	A	B	C	D	E	F	G	H	I	J	K
1	Telescope/obse name	Location	Longitude (+ for E, - for W)	Latitude (+ for N, - for S)	Altitude [m]	Size [m]	Field-of-view, [deg^2]	Limit DEC	Limit HA	instruments	CCD siz [arcsec/p
2	pt5m	La Palma, Spain	-17°52'53.9	28°45'38.3	2332	0.5	10.2'x6.9'			QSI532 CCD	
3	Loiano	Bologna, Italy	11.33	44.26	785	1.5	13'x12.6'	-5 -- +70 optimal		BFOSC	0.58"
4	Belgian Mercator	La Palma, Spain	-17°52'42"	17°52'42"	2333	1.2	6.5'x6.5'			Merope, Hermes, Maia(soon)	
5	Swiss Euler	La Silla, Chile	-70.73	-29.2567	2347	1.2	10'x10'	=+29 deg (z=2)		Coralie (spectrograph), ECAM CCD	0.3"

Summary

- Auxiliary data assembled for the Gaia processing useful for other projects (catalogues of standard stars)
- National and local facilities play a crucial role
- Dedicated observing programs will continue during operations
- Need of auxiliary data may evolve after commissioning
- Networks of telescopes are being built for follow-up : new participants welcome. Opportunity to be involved in the Gaia exploitation with earliest data.