The Gaia-FUN-SSO network : status and objectives

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Outline

- Gaia framework and goal
- the Gaia-FUN-SSO network
- Past and current actions
- Future

3 ground-based networks

GBOT network

✓ « GBOT »: Ground Based Optical Tracking for Gaia observation of the probe itself in order to guarantee the best orbital positioning. No alert but systematic astrometry of the probe

Science alerts network

✓« GREAT »: activity for complementary ground-based observation of transients: photometric & spectroscopic alerts

Gaia-FUN-SSO

✓Gaia Follow-Up Network for ground-based observation of peculiar/critical Solar System Objects

astrometry alerts for Solar System Objects

Need of ground-based SSO observations

- Solar System Objects : important part of the Gaia mission
- Gaia obs. for asteroids : prec. single meas.≈ 0.3-3 mas
- 300 000 asteroids (most known)
- including several NEAs, Trojans, Centaurs
- Other SSO: comets, natural satellites
- High astrometric accuracy but…

limiting factors for SSO ⟸

- Scanning law
- Sparse sampling
- Limiting magnitude

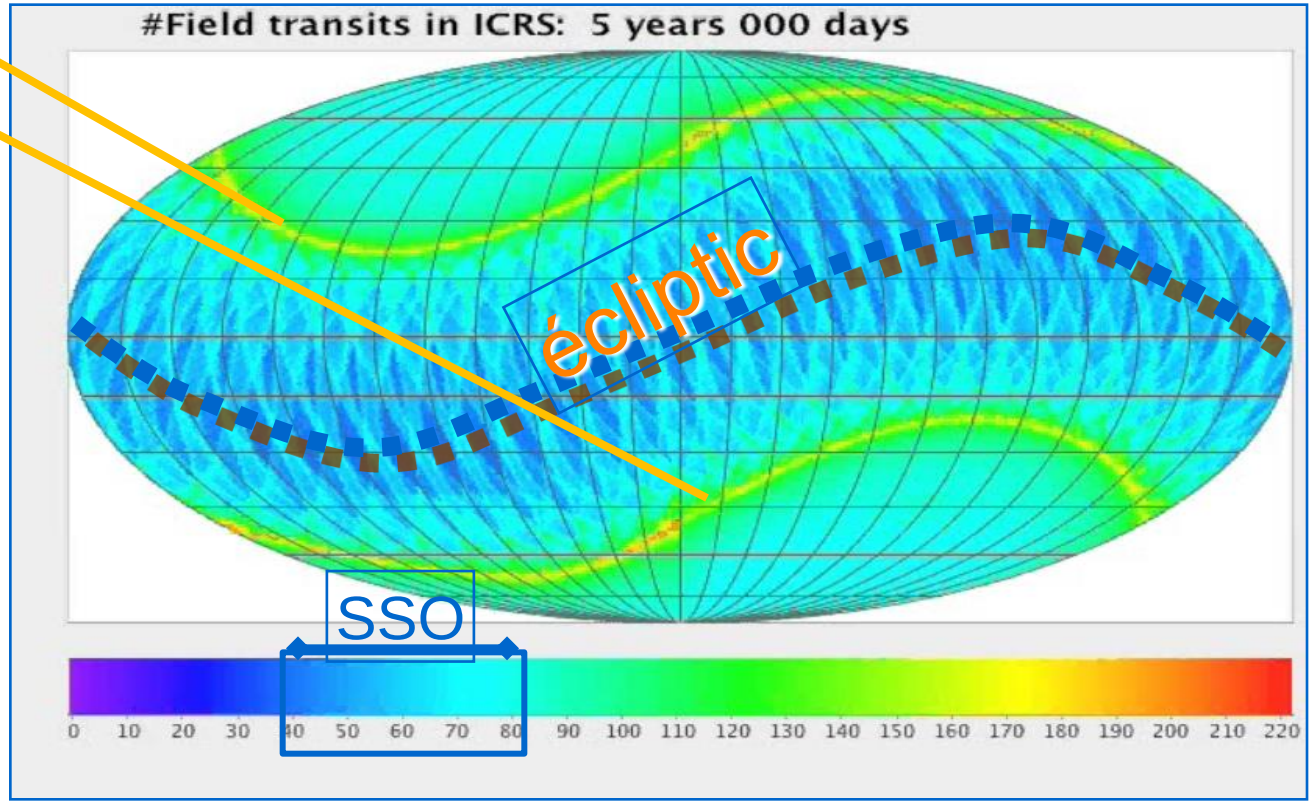
Complementary GB observations required

- to validate from the ground new detections by Gaia
- to avoid the loss of (fast) moving objects
- to help for identification of SSO
- to improve orbit poorly observed by Gaia

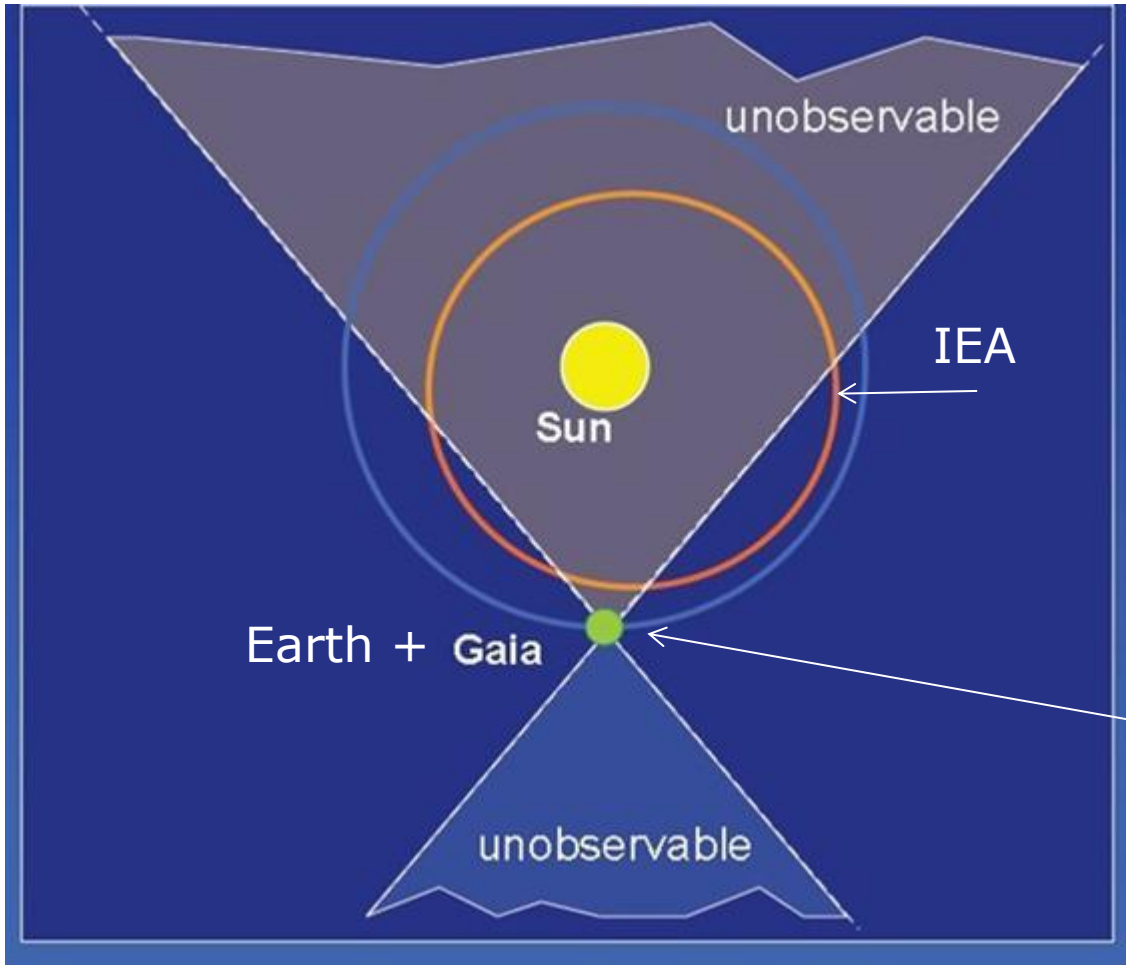
Gaia observations

Detection of New objects?

- 300 000 asteroids
- mag. V≤20
- scanning law
- around 60 obs./ SSO in 5 years
- **New objects = Near Earth Objects / MBA?**



Observable region in ecliptic

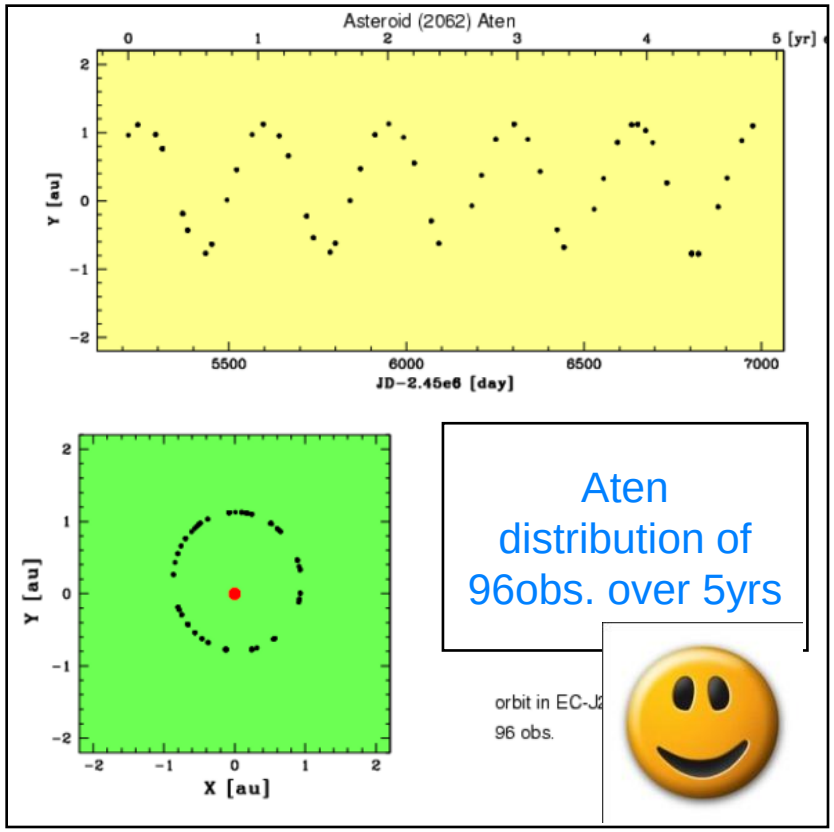


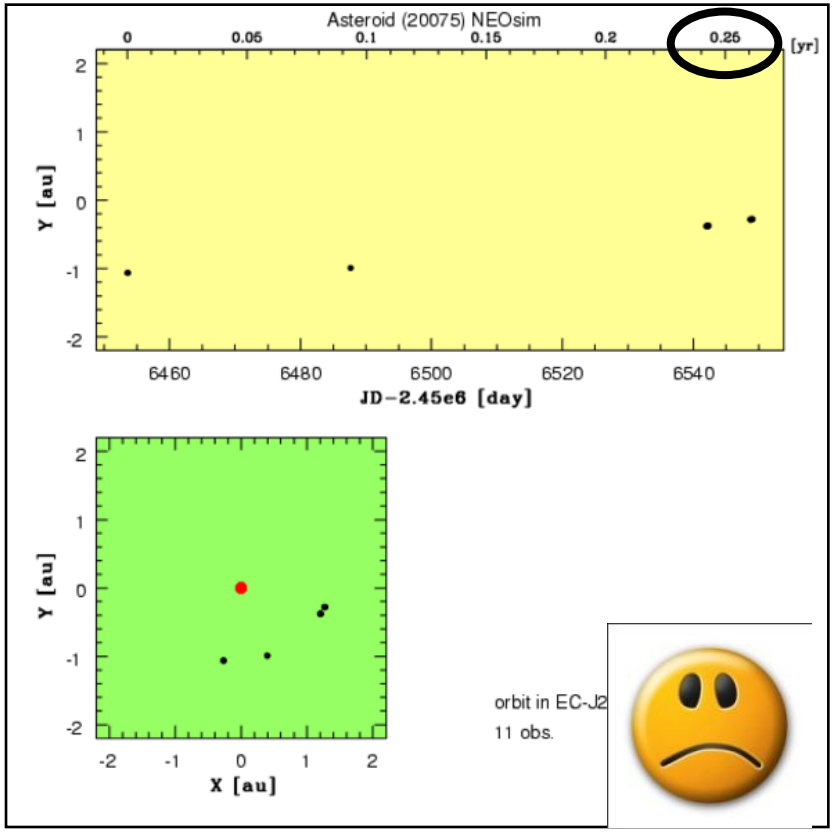
Gaia will observe at low Solar elongation ~ 45 deg.

Detection of Inner Earth Asteroids possible

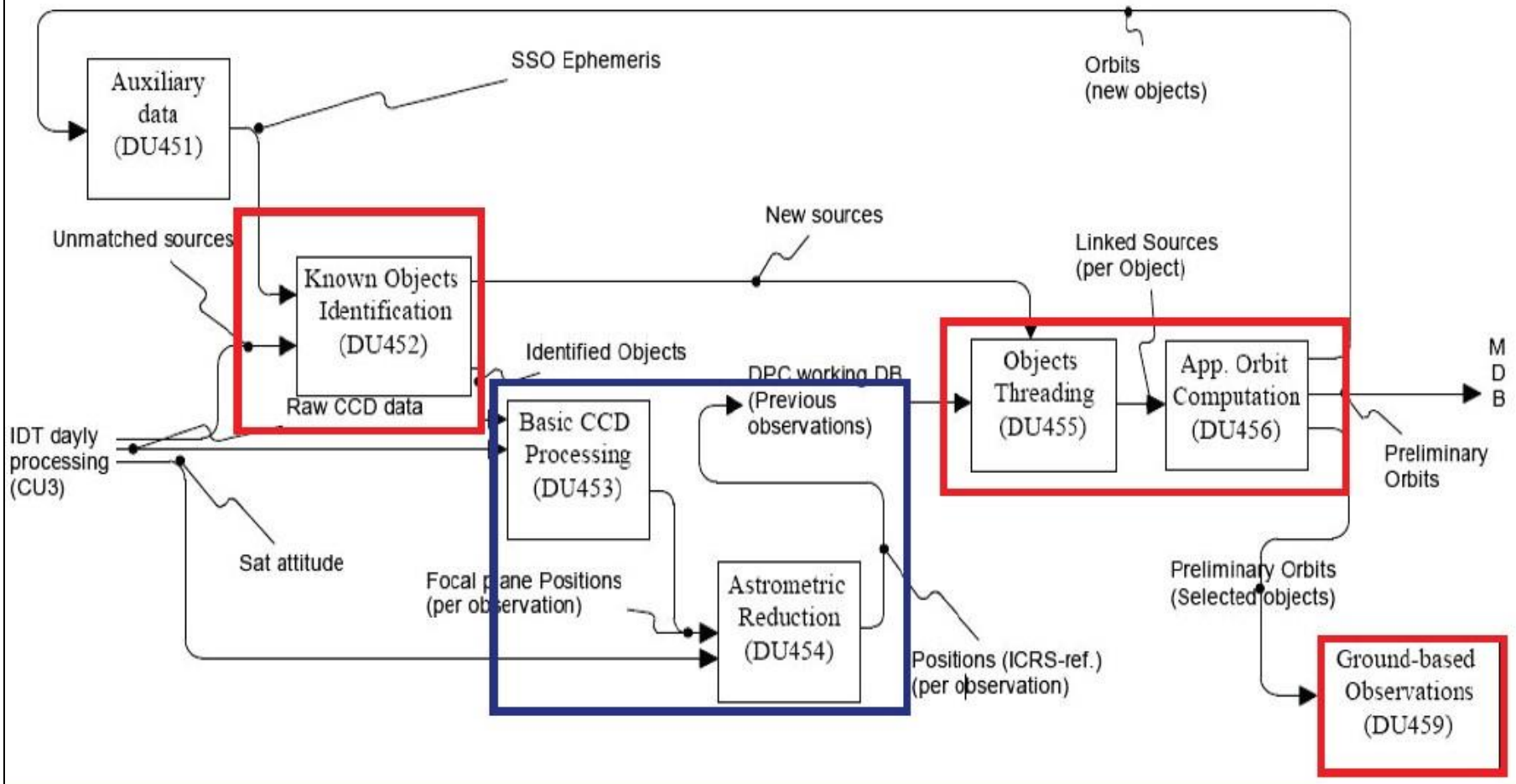
Earth
+ Gaia at L2
(1.5 Mkm)

Need of ground-based observations

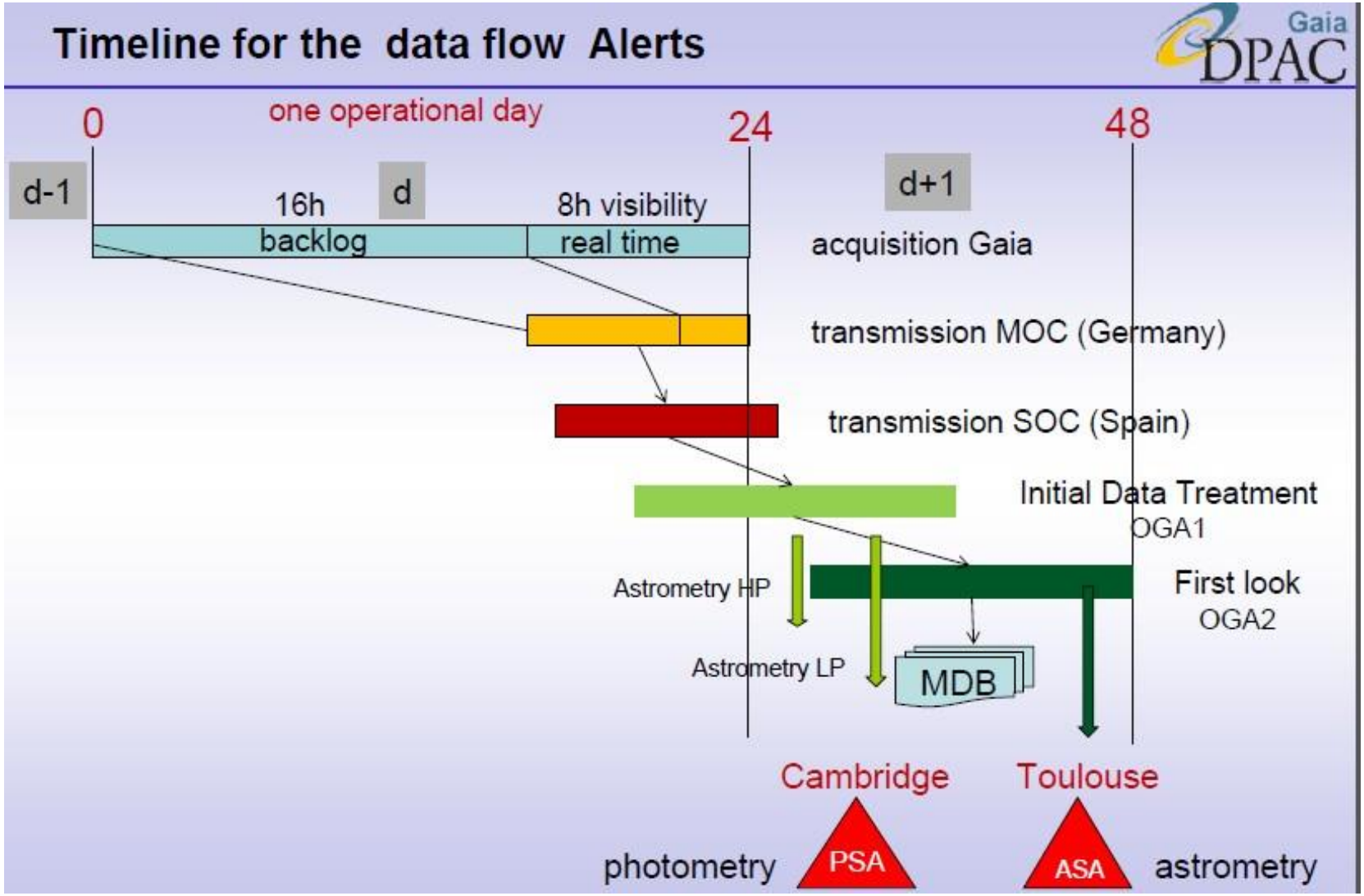




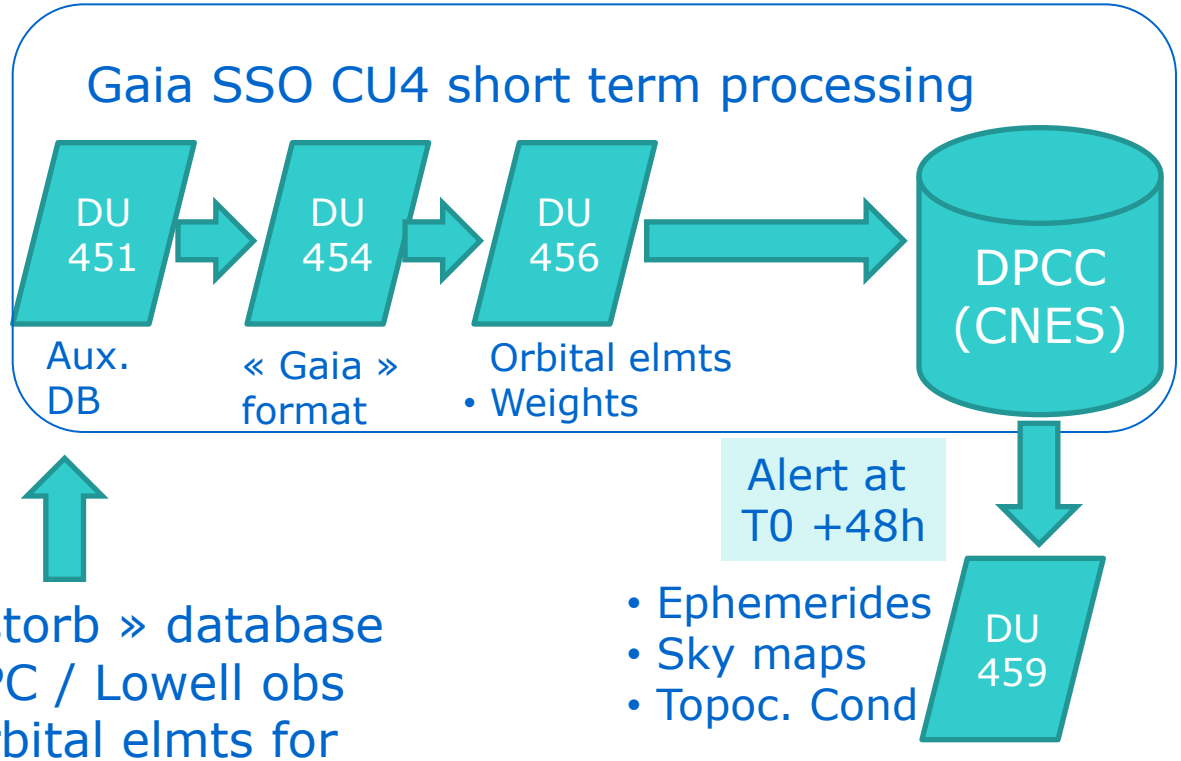
CU4 SSO: data flow (daily processing)

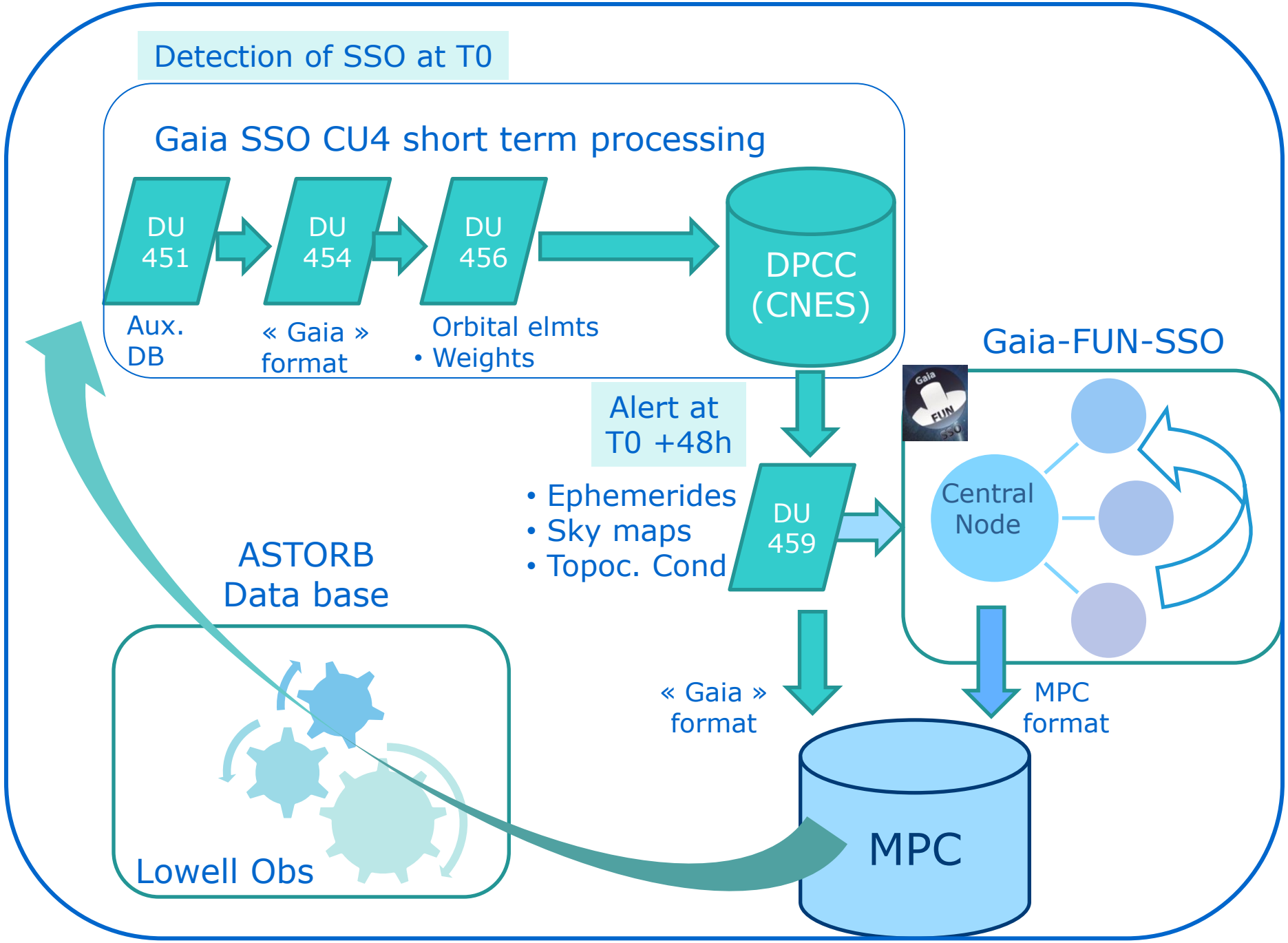


Alert timeline showing that after detection from the space and after the data processing, the astrometric alerts will be received by DU459 at least 24 to 48 hours later (Mignard, 2012)



Detection of SSO at T0




Detection of SSO at T0
Gaia SSO CU4 short term processing
DU 451
DU 454
DU 456
DPCC (CNES)
Aux. DB
« Gaia » format
Orbital elmts
• Weights
Gaia-FUN-SSO
Alert at T0 +48h
• Ephemerides
• Sky maps
• Topoc. Cond
DU 459
Central Node
ASTORB Data base
« Gaia » format
MPC format
Lowell Obs
MPC

- Gaia framework and goal
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- Past and current actions
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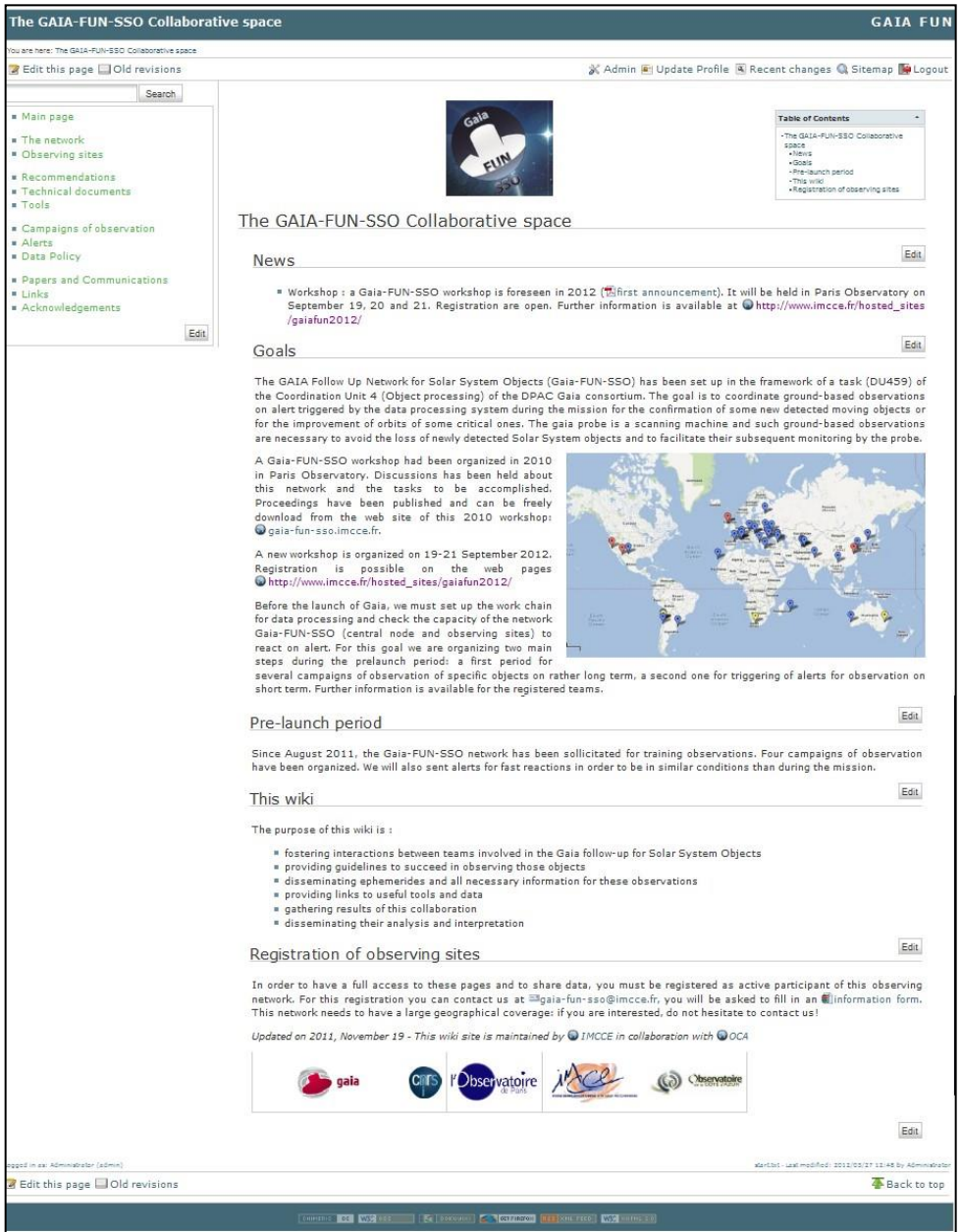
- The GAIA Follow Up Network for Solar System Objects (Gaia-FUN-SSO) has been set up in the framework of a task (DU459) of the Coordination Unit 4 (Object processing) of the DPAC Gaia consortium.

- The goal is to coordinate ground-based observations on alert triggered by the data processing system during the mission for the confirmation of some new detected moving objects or for the improvement of orbits of some critical ones.

- The gaia probe is a scanning machine and such ground-based observations are necessary to avoid the loss of newly detected Solar System objects and to facilitate their subsequent monitoring by the probe.

WIKI access at https://www.imcce.fr/gaia-fun-sso



Data repository :

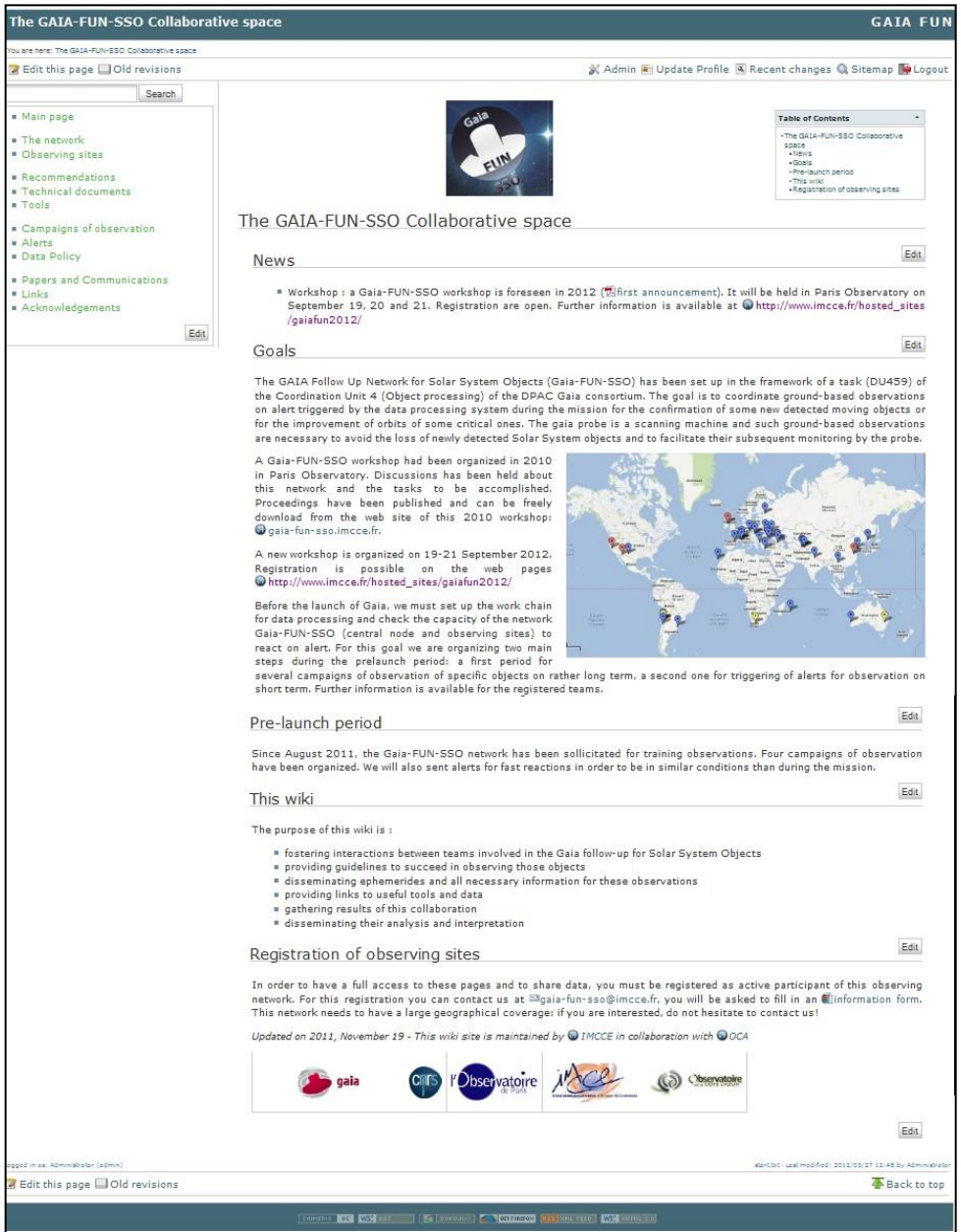
- Goals
- Observing method
- Tools
- Publications
- Links

Campaigns:

- Targets ephemerides
- Measurements
- Results (O-C)

Registration form

WIKI access at https://www.imcce.fr/gaia-fun-sso



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See.
B. Carry's talk

Registration form

Nov. 2014
Registration on
New pipeline

Gaia-FUN-SSO

Requirements

- Worldwide coverage
- Quite fast reaction on alert (less than 24 hours)
- Astrometry => UT time scale (better than 1 sec.)
- Reference stars => Field of view ~ 15 arcmin
- Limiting mag 20 => Diameter ~ 1 m

Gaia-FUN-SSO

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Network (Nov. 2014)

- Major part : 0.6-1m-class
- 6 Schmidt tel. :

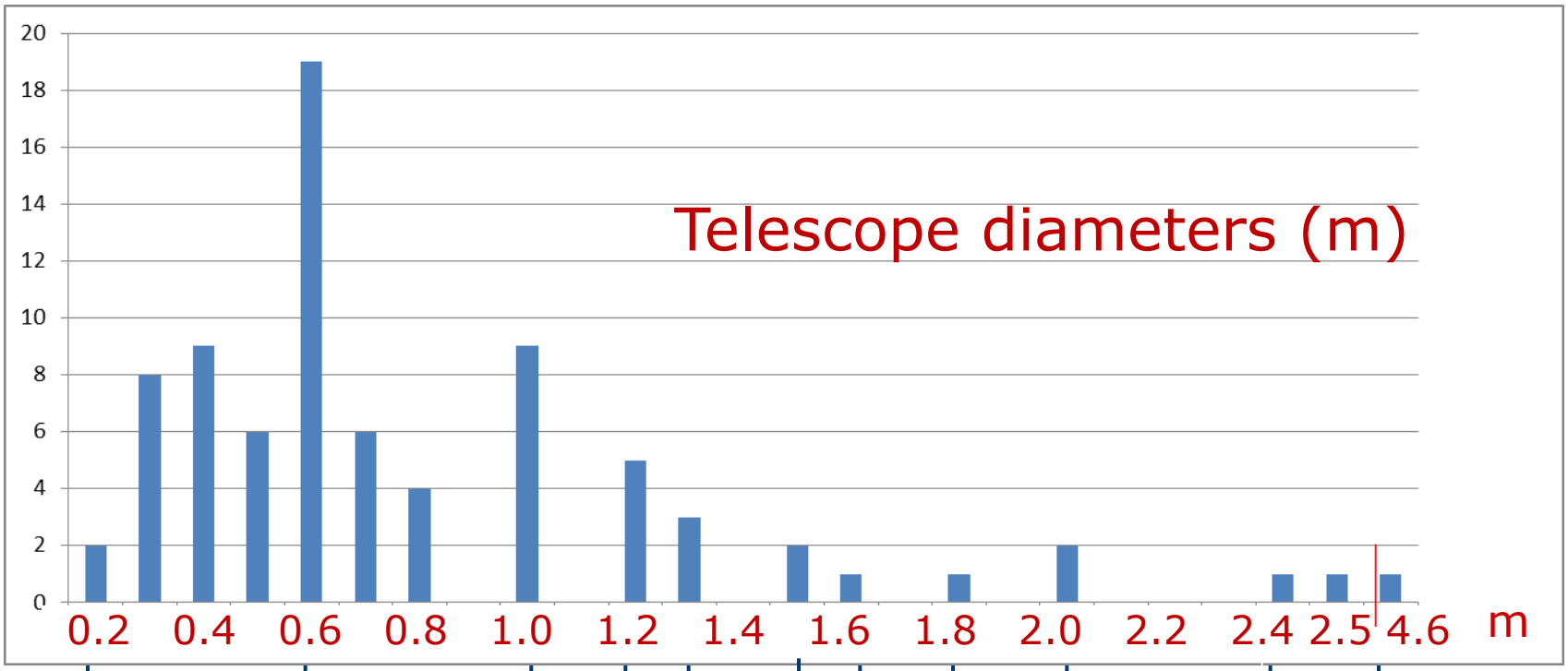
  Rozhen / Xuyi / Konkoly / Tatenburg / Kourovskaya / Xinlong
- 4 robotic tel. : Tarot 1 & 2 / Zadko / ESA-OGS
- 2 remote tel. : NM-Mayhill / Tubitak

Gaia-FUN-SSO: on November 2014

First period: 2010-2014
On the base of registration forms
(WIKI access)

- 57 observing Sites
- 80 operating instruments
- Volunteering base

Gaia-FUN-SSO



MPC 10
Tarot 1

MPC 809
Tarot 2

MPC
84
94
104
181
188
193
204
327
345
461
557
874
B18
C01
C89
C95
X-Ist.
X-Hels.

MPC
10
94
300
461
586
A84
D20
D39

MPC
119
511
809-Euler
D29
Z20

MPC
33
J04
X-India

MPC
188
809

MPC
874
Itajuba
Brazil

MPC
290
VATT
USA

MPC 071
NAO Rozhen,
Smolyan,
(Bulgaria)

MPC B18
Terskol Russia

MPC O44
Yunnan Obs.
Lijiang station
China

MPC 950 Target of Opp.
ING-WHT/IAC Roque
de los Muchachos Obs.,
Isaac Newton Group
Spain

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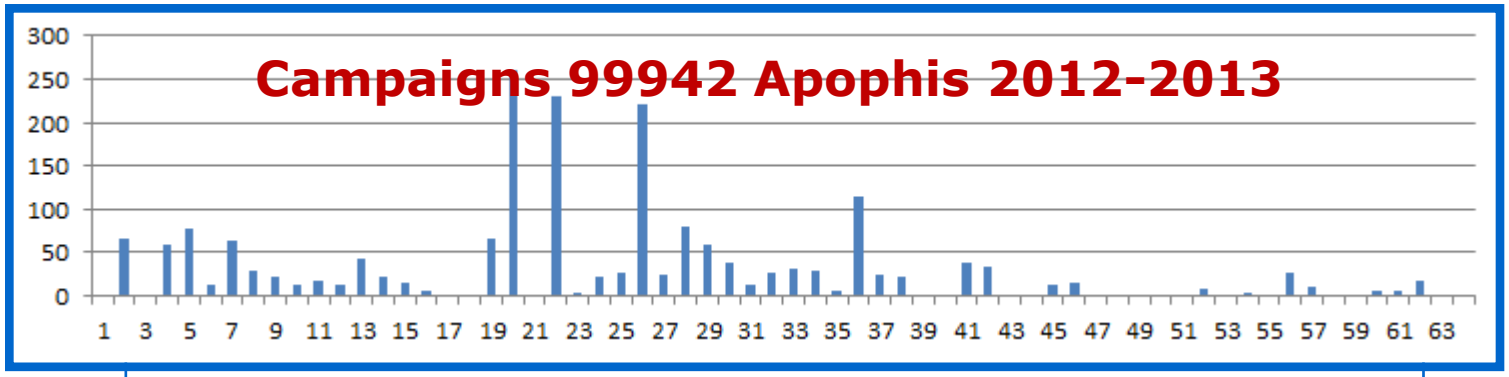
Gaia-FUN-SSO: 10 training campaigns

Dates	SSO	Stations	Nbr. Obs.
2011 Nov-Dec.	2005 YU55	**16:** 071, 084, 089, 181, 345, 461, 585, 586, A84, B04, B17, C20, D20, D39, G96, O44	1792
2012 Jan. 17-28 (on alert from MPC012)	2012 BS667	**4:** 461, A84, H15, C20 (H15 reaction time 1.4 day after detec.)	35
2012 Feb.-March	1996 FG3	**3:** B04, H15, O44	18
2012 Feb.-March	99 942 Apophis	**2:** B04, H15	51
2012 Dec.2013 Apr.	99 942 Apophis	**19:** 010, 071, 089, 119, 188, 300, 511, 585, 586, 950, A84, B04, B17, B18, C01, C20, D20, O44, Z20	4000
2013 Feb.-March	2012 DA14	**8:** 071, 084, 300, B04, C60, Istanbul, C20, O44	1465
2013 Aug.	2002 GT	**7:** 010, 971, 089, 300, 585, B04, C01	1331
2013 Oct.2014 Jan.	2013 TV135	**13:** 071, 089, 119, 121, 168, 981, A84, B04, B18, C01, C20, H15, O44	810
2014 Apr. (on alert from ESA SSA)	2007 HB15	**0**	0
2014 June (triangulation)	2014 HQ124	**3:** 089, 585, C20	217

Apophis campaigns : new results

PHA (2004 MN4 / 99 942) Diam.: 325 m Albedo 0.22
Much surveyed for assessment of impact prob.



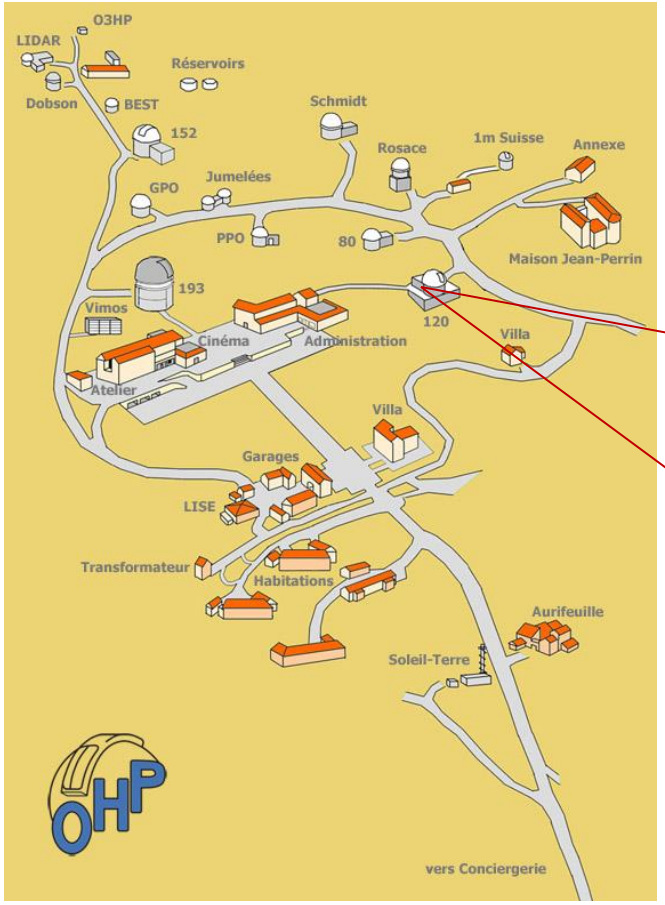
14/12/2012

13/3/2013

19 observing sites (Dec. 12 – Apr. 2013)
~2700 astrometric measures

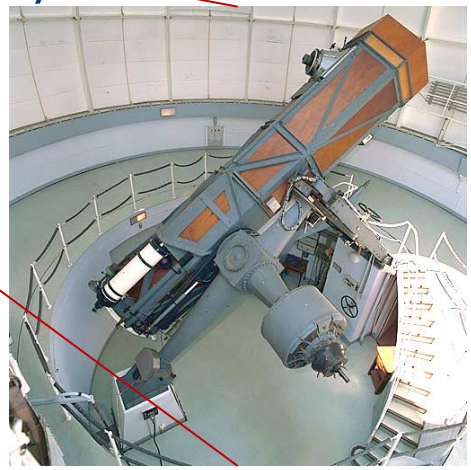
Paper1 : Bancelin et al. A&A 544, A15 (2012)
Paper2 : to be submitted to A&A

see D. Bancelin's and A. Ivantsov's talks



T120 will contribute to the Gaia follow-up

- Diameter: 1.2m
- Focal length: 7.2m
- Andore IKON-L 2048*2048
- FOV 13 arcmin 0.33 arcsec/pix
- Spectro Shelyak R ~ 600-1000



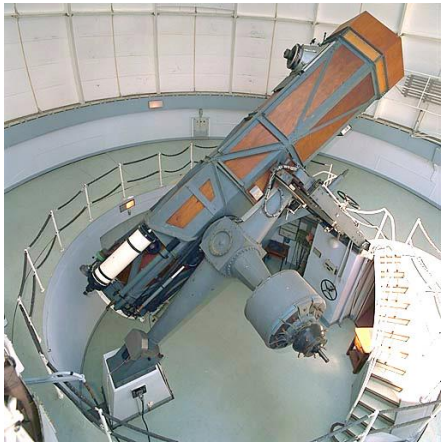
Combined observations at OHP (IAU code 511)

3 teams, 3 programs

- Gaia-FUN-SSO (W. Thuillot, B. Carry, P. Tanga, L. Jorda)
- Photometric Sc. Alerts (M. Dennefeld, J.-B. Marquette)
- QSO (S. Bouquillon, F. Taris)

T120 contributes to the Gaia follow-up:

- Observing runs 1 week/month
- 2014A: April – August 2014
- 2014B: Sept 2014- Feb. 2015



The Gaia-FUN-SSO workshops

Opportunity to exchange and initiate actions

- Paris Obs.,
- **29 Nov. 1 Dec. 2010**
- **Kick-off meeting**
- Web server

Proceedings on-line:

http://www.imcce.fr/langues/en/publications/colloques/gaiafun/

- Paris Obs.,

19-21 September 2012

- 38 attendees
- 12 countries
- 26 communications

http://www.imcce.fr/hosted_sites/gaiafun2012/

- Paris Obs.,

24-26 November 2014

- 48 attendees
- 12 countries
- 28 communications

Group photo
To be done!

http://www.imcce.fr/hosted_sites/gaiafun2014/

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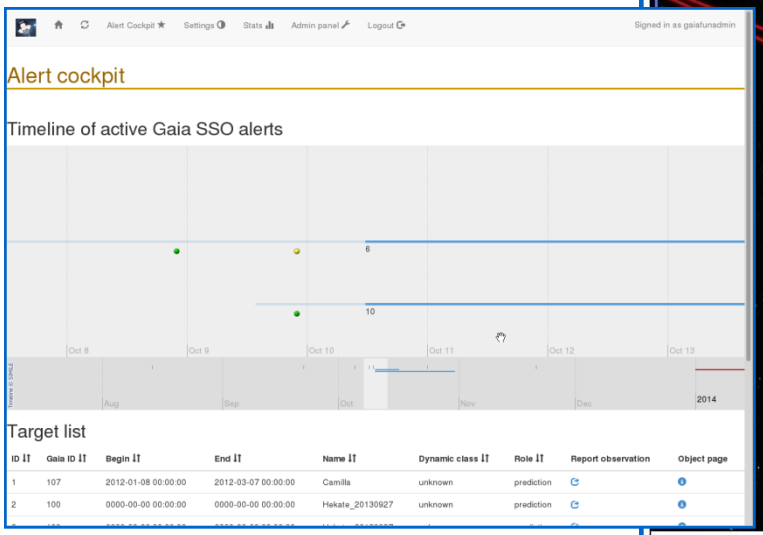
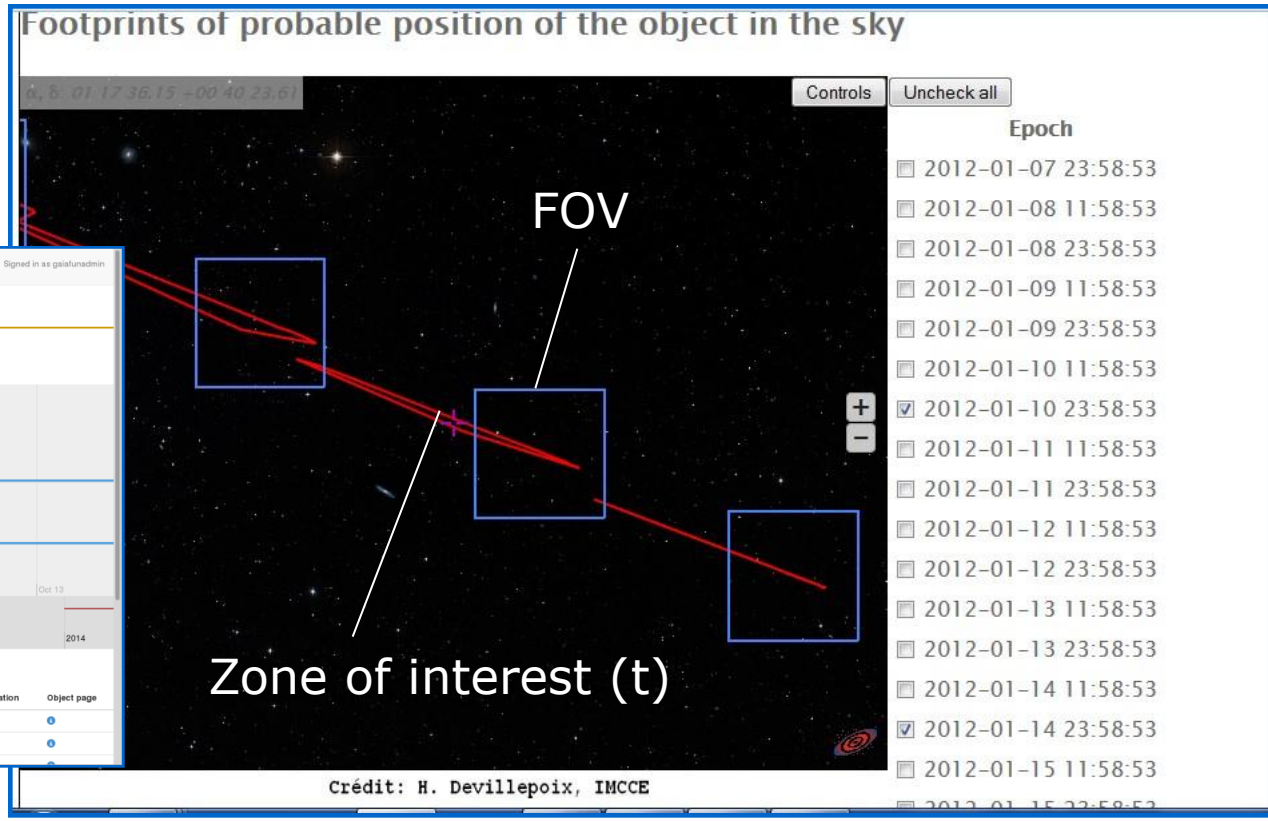
Entering a second phase: Pipeline & web interface

- Automatic dissemination of alerts
- Topocentic/local conditions
- Public but on registration
- To monitoring the network

See B. Carry's talk





What about for the next future?

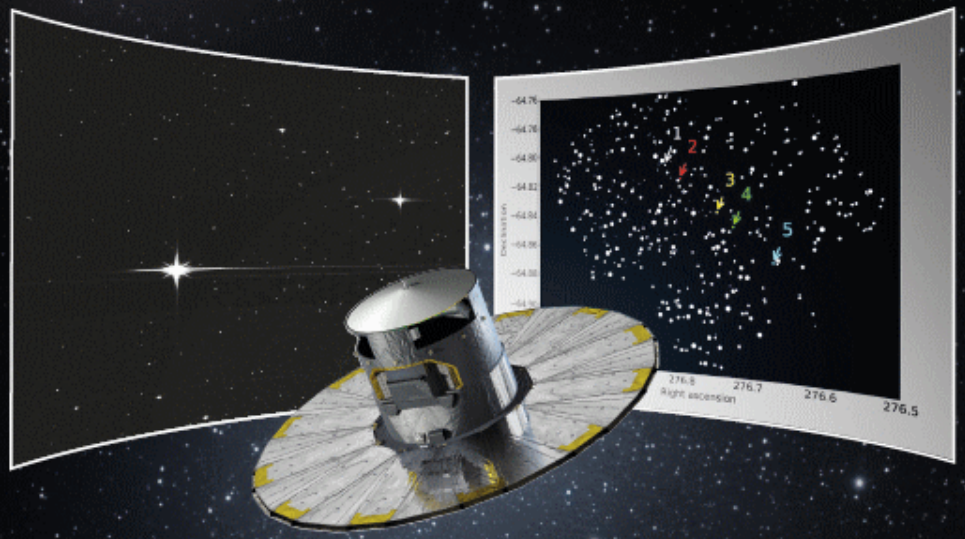
- Gaia-FUN-SSO ready to work
- Core of ground-based stations
- Public alerts through the new pipeline
- How many alerts ? => tuning phase
- Validation phase at first : role of OHP + some stations
- Public dissemination in a second step
- Operating mode as long as there will be SSO alerts…

Conclusion

- 2011-2014: set-up of the Gaia-FUN-SSO network
- Preliminary activities : satisfying results
- Waiting now for a validation phase (known objects)
- 2015: phase for tuning the alert flow
- Stations must stay ready to react
- Discussions during this meeting

Welcome to the third

Gaia-Fun-SSO Workshop



GAIA

FOLLOW-UP NETWORK FOR THE SOLAR SYSTEM OBJECTS

#3

IMCCE · Paris Observatory

From November 24 to November 26, 2014

77, avenue Denfert-Rochereau, 75014 Paris