Solar System Object alerts
Gaia-FUN-SSO activity

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- In collaboration with DPAC-CU4 members

- and the following observers:

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gaia

Purpose

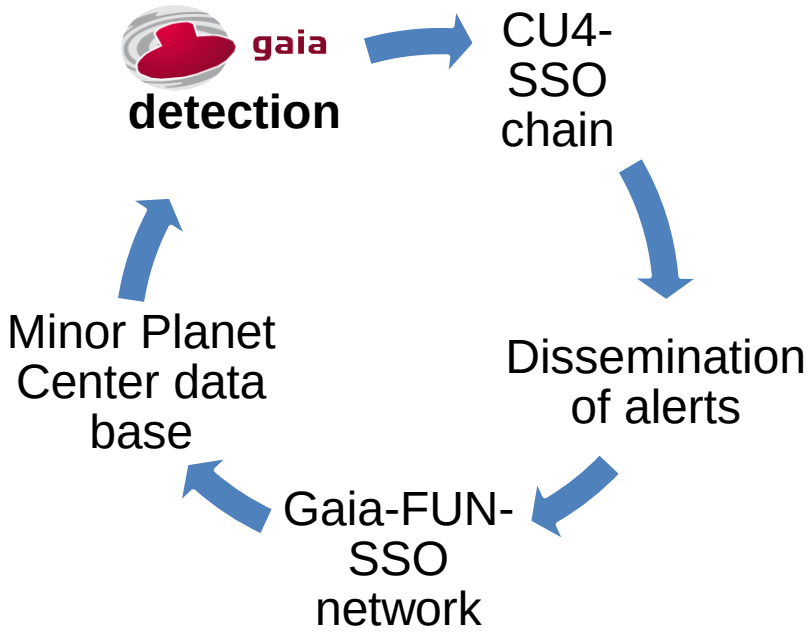
- To validate and exploite the Gaia detection of new moving objects
- To feed the SSO orbital data base used by Gaia (through MPC)
- To Optimize the Gaia identification of SSO
- Contribution to a bettter knowledge of the Solar System Structure

Detection of SSO is the basis for further studies on origin and evolution of the Solar System:

- Dynamical and physical characterization of peculiar objects
- Dynamical or physical families
- Taxonomy studies
- Threats to the Earth (NEOs)
- …

The means

- Triggering alerts for Ground based observations
- Geographical coverage => network of observatories (Gaia-FUN-SSO)
- Observations on alert on best effort basis
- Loop for feeding the Gaia auxiliary data base for identification



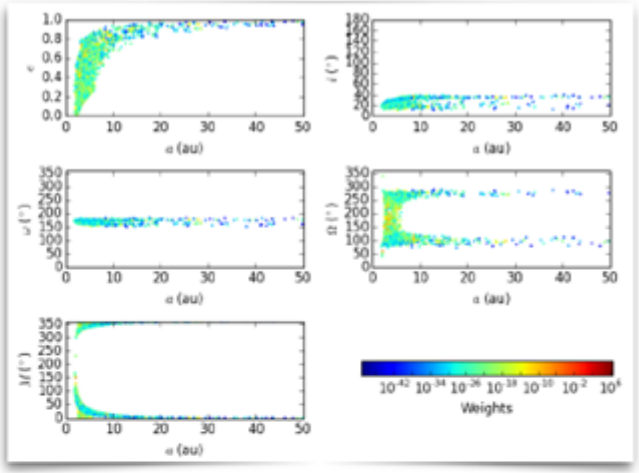
SSO-ST & Gaia-FUN-SSO activity

- In operation since mid-October 2016
- ~ Daily processing and diffusion of SSO alerts
- Triggering at best 48h after detection in space
- Short arc observed in space => bundle of possible orbits computed by a statistical ranging method (MCMC)
- Some difficulties to overcome…

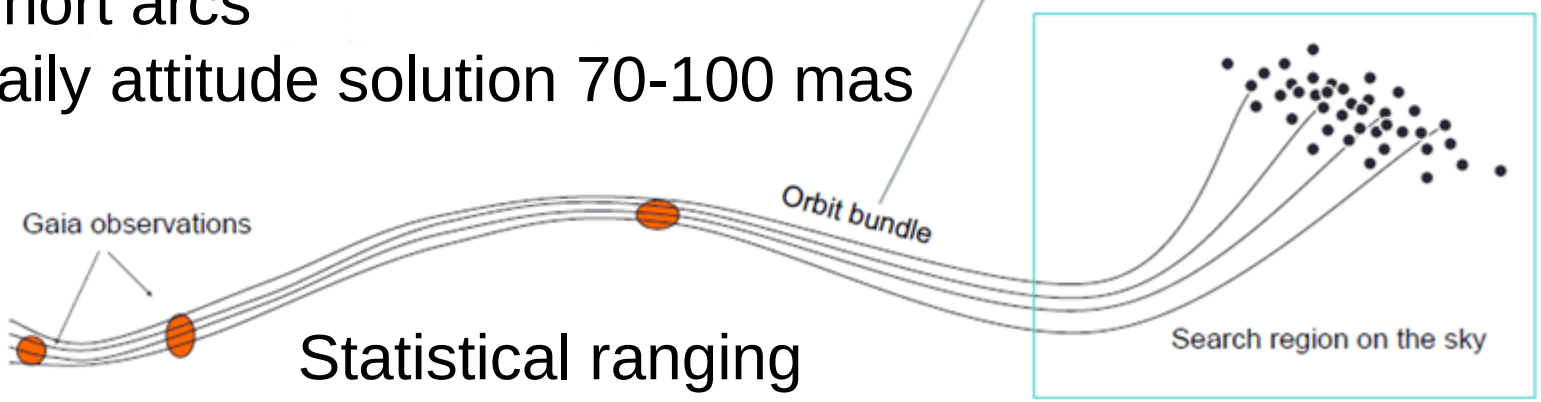
SSO-ST & Gaia-FUN-SSO activity

- **Identification of moving objects**
  - Artifacts (star spikes,…)
  - Crowdy fields

- **Transformation of coordinates**
  - Parallax effect
  - Short arcs
  - daily attitude solution 70-100 mas



K. Muinonen, G. Fedorets, Helsinki Univ.



Statistical ranging
MCMC => bundle of orbits
Oszkiewiczs 2009, Muinonen 2015

Tanga et al. 2016

gaia

SSO-ST & Gaia-FUN-SSO activity

- Dissemination of “ephemerides” at https://gaiafunsso.imcce.fr
- When success: ground based astrometric data are sent to MPC by the observers

The web site

https://gaiafunsso.imcce.fr

Gaia-FUN-SSO | Circulars | Gaia alert | Log in | Register | Help

Gaia Follow-Up Network for Solar System Objects

Goal

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 Gaia Data Processing and Analysis Consortium (DPAC). Its goal is to coordinate ground-based observations on alert triggered by the data processing system during the mission for the confirmation of newly detected moving objects or for the improvement of orbits of some critical targets. Gaia will scan the sky following a pre-defined scanning law and such ground-based observations are required to avoid the loss of newly detected Solar System objects and to facilitate their subsequent identification by the probe.

These pages provide an access to the alerts, including the ephemeris to help finding the targets, for the registered members of the Gaia Follow-up network. The network currently consists in about 80 observers in 27 observing sites, spread all over the world (November 2016).

Workshops

Three Gaia-FUN-SSO workshops dedicated to the astrometric follow-up of the Solar System Objects have already been organized in 2010, 2012 and 2014 in Paris Observatory. Discussions has been held about this network and the tasks to be accomplished, the capabilities of the observing sites and the preliminary actions already performed.

- Proceedings of the 2010 workshop have been published and can be freely downloaded here.
- Proceedings of the 2012 workshop have been published and can be freely downloaded here.
- Proceedings of the 2014 workshop have been published and can be freely downloaded here.

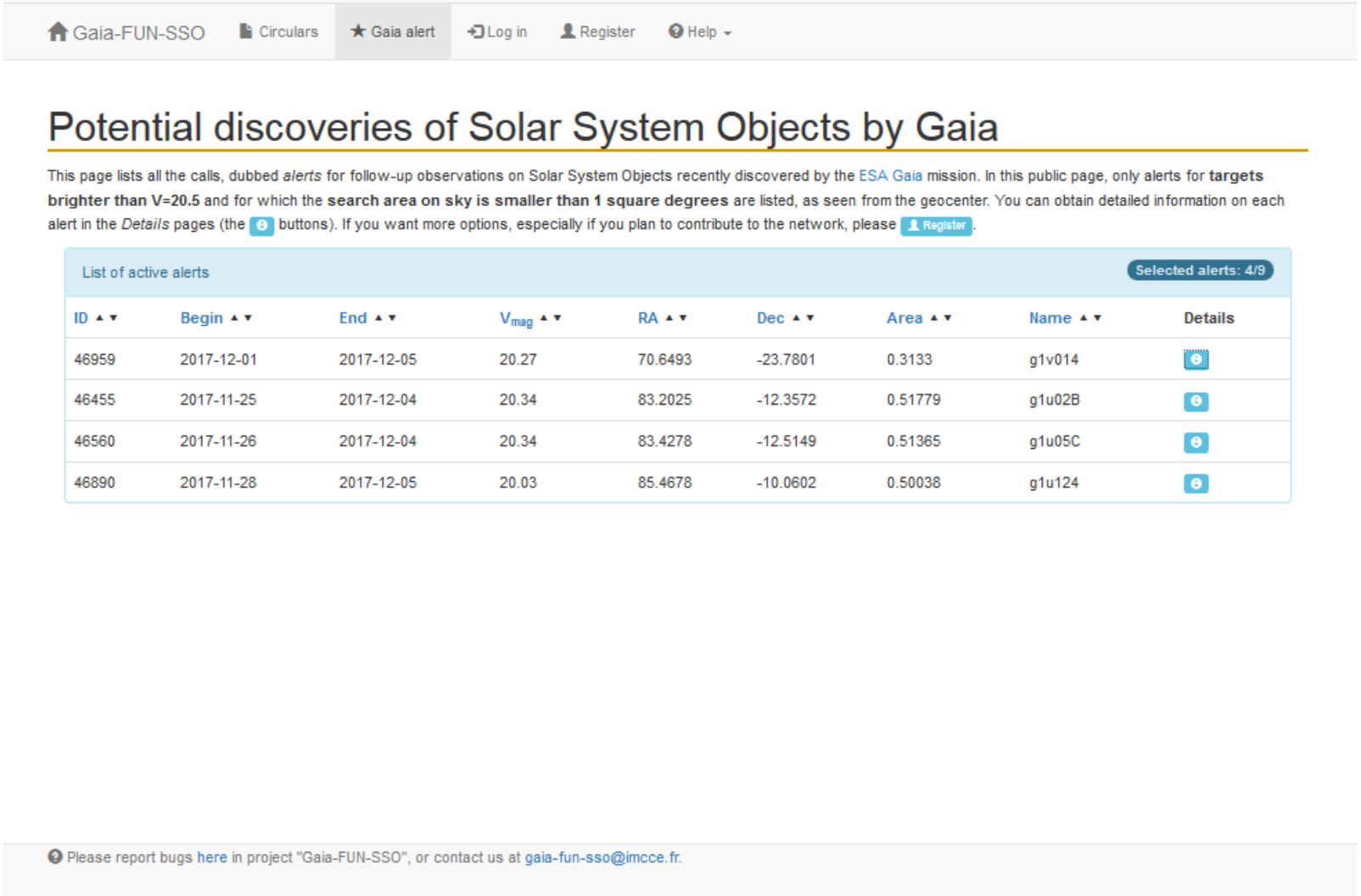
Registration

To get a full access to these pages and to share data, you must be registered as active participant of this observing network. For this registration, please use this form. This network needs to have a large geographical coverage: if you are interested, do not hesitate to contact us!

Please report bugs here in project "Gaia-FUN-SSO", or contact us at gaia-fun-sso@imcce.fr.

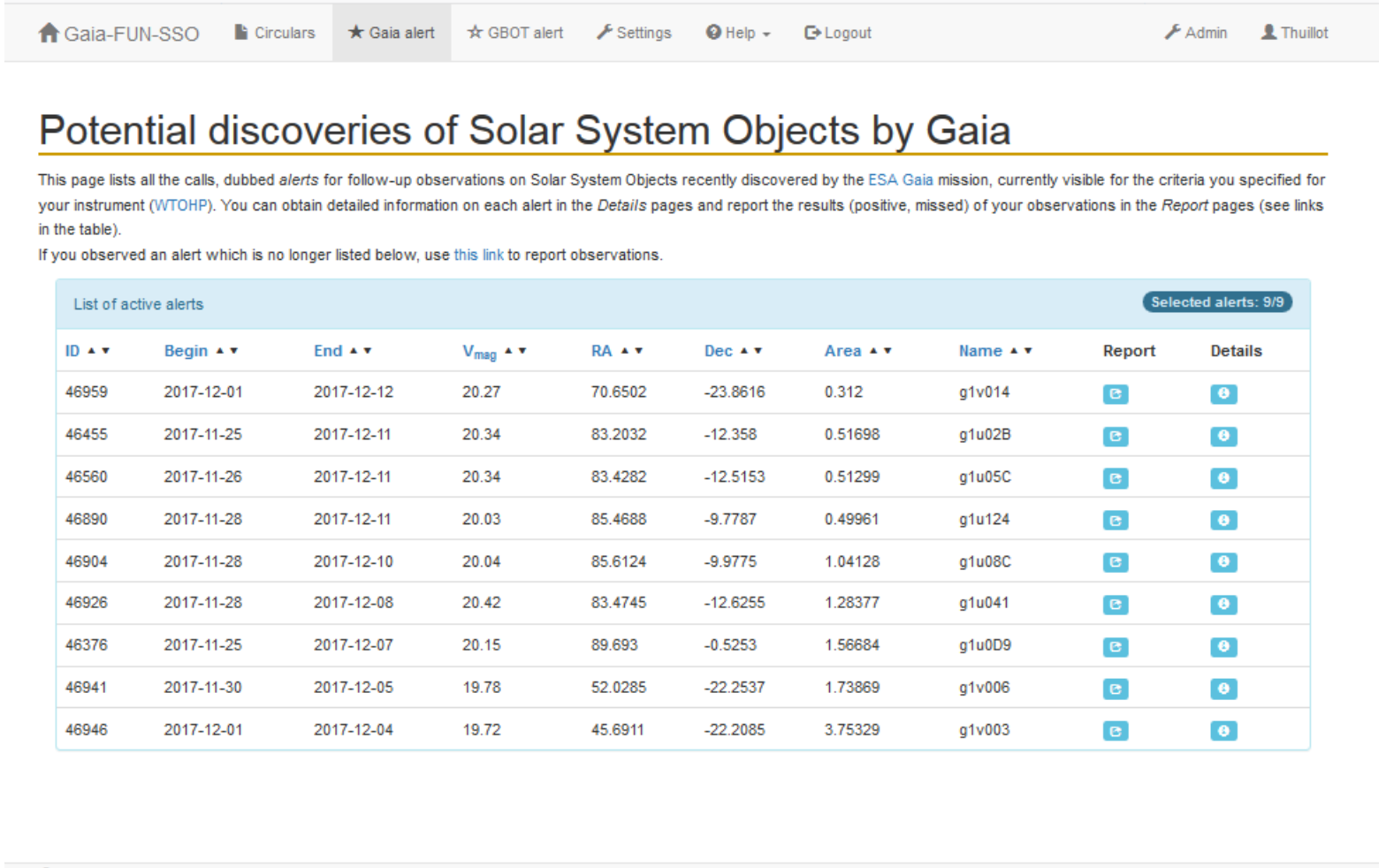
The web site

Public alerts : geocentric coordinates – restricted to research area < 1 sq. deg.



The web site

If registered : topocentric coordinates – all the current alerts for the site



Gaia-FUN-SSO ★ Gaia alert ☆ GBOT alert Settings Logout Admin Thuillot

https://gaiafunsso.imcce.fr

Detailed information on alert

You will find below detailed information on the target and its probable position on the plane of the sky.

Object Information

- **Gaia ID:** -4194967176
- **Database ID:** 10148
- **Name:** GAIA120
- **Magnitude (V):** $19.6^{+0.6}_{-0.3}$
- **Date of observation:** 11/13/2016

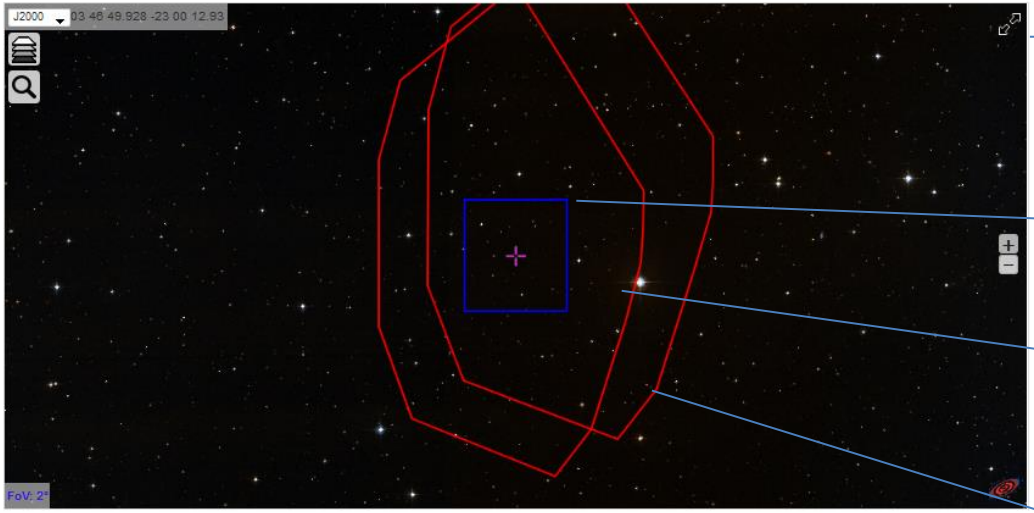
Report observation | Back to Gaia alerts

Instrument and Field of View

	Field of View	RA	Dec
☑	13x13 arcmin^2	03:55:02.880	-23:05:05.640

Information on the alert

Sky view with Aladin -- Object expected magnitude V= $19.6^{+0.6}_{-0.3}$



Sky map

Field of View 12x12 arcmin

Most probable zone (blue)

Zone to explore if not in the FoV (red) on date 1

and on date 2

Footprints of areas to search for (in red) and the field of view (in blue, 13x13 arcmin^2) of your device (**WTOHP**).
You can change your device and its parameters in your settings.

Available epochs 28

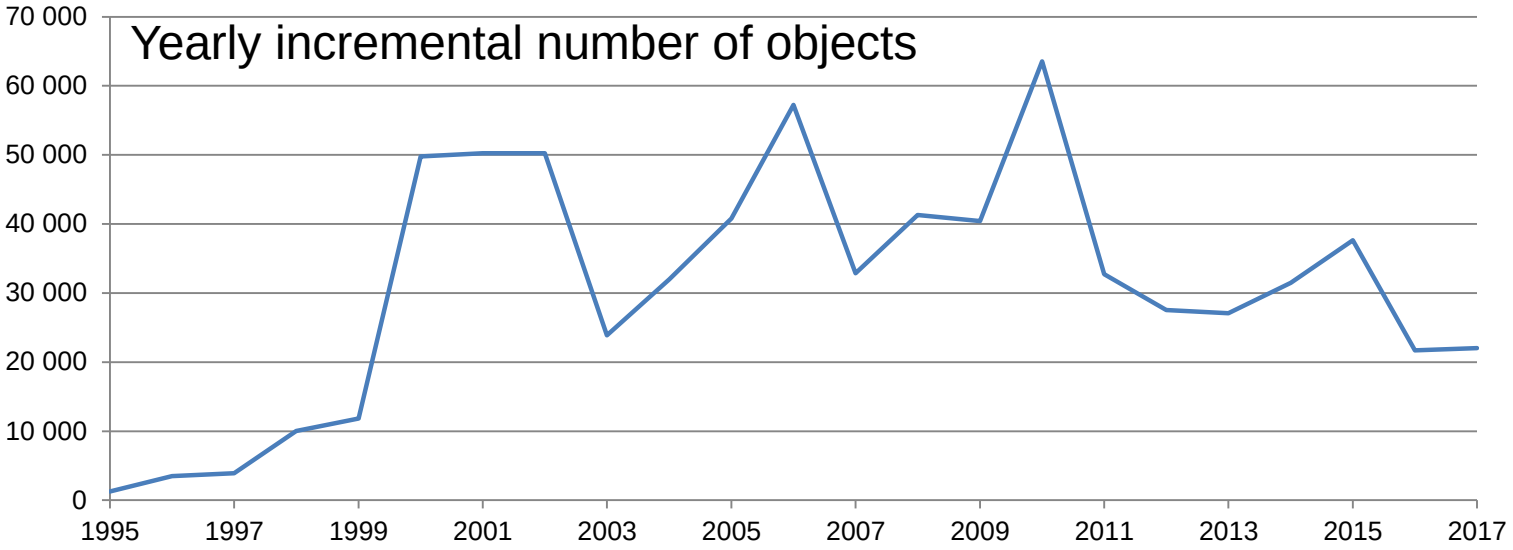
Check all | Uncheck all | Invert selection

Show?	Epoch	RA	Dec	V_{mag}	Area (deg^2)
☑	2016-11-28 01:17:05	03:55:02.880	-23:05:05.640	$19.6^{0.6}_{0.3}$	0.38922
☐	2016-11-28 07:17:05	03:54:47.448	-23:02:15.720	$19.6^{0.6}_{0.3}$	0.41358
☑	2016-11-28 13:17:05	03:54:32.568	-23:09:03.240	$19.6^{0.6}_{0.3}$	0.43921
☐	2016-11-28 19:17:05	03:54:17.400	-23:13:15.240	$19.6^{0.6}_{0.3}$	0.46539
☐	2016-11-29 01:17:05	03:54:01.776	-22:45:01.080	$19.6^{0.6}_{0.3}$	0.49262
☐	2016-11-29 07:17:05	03:53:46.488	-23:08:16.800	$19.6^{0.6}_{0.3}$	0.52176

Ephemerides

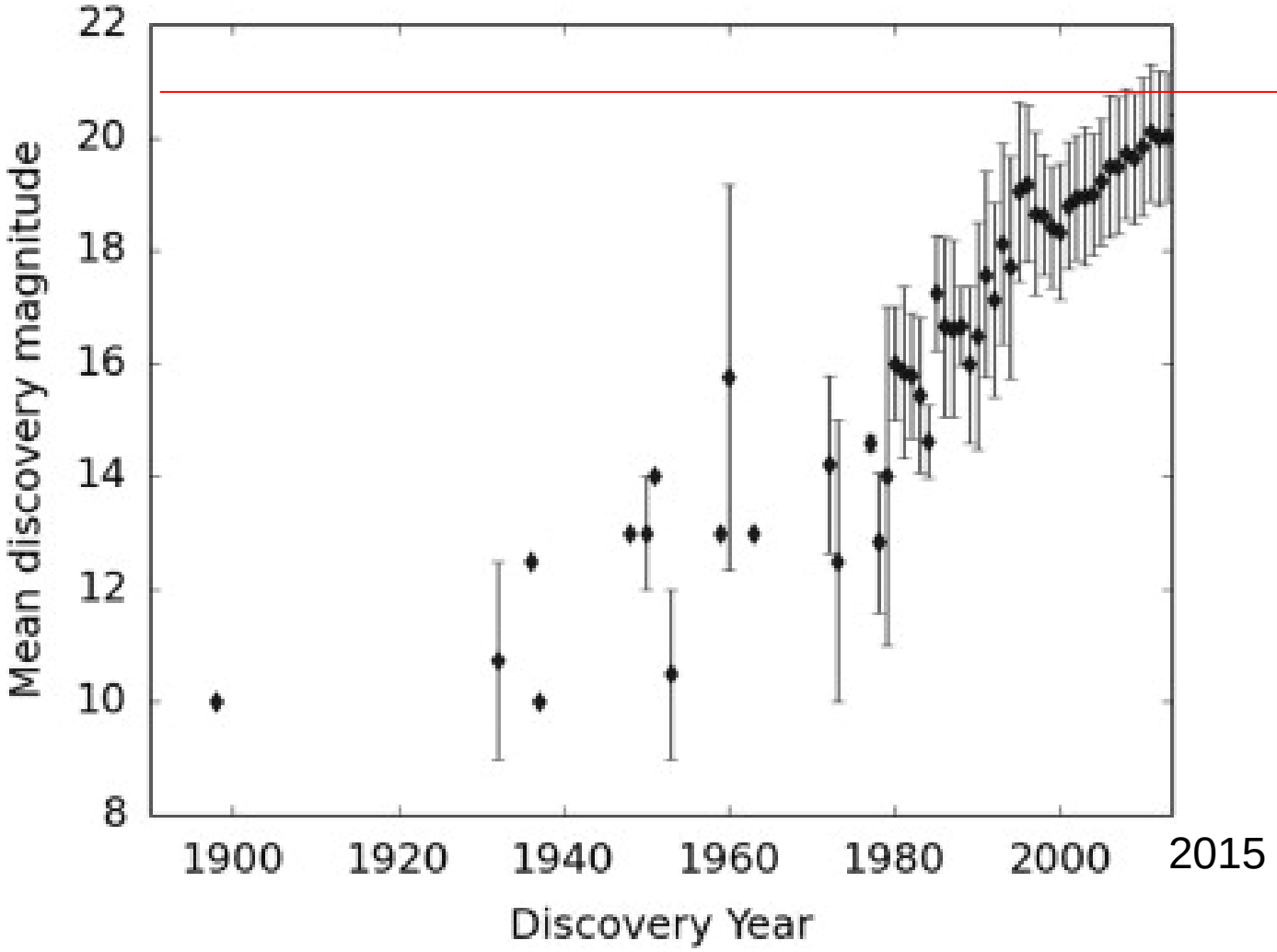
Minor Planet Center Statistics

Date of MPCs	**Total**	Numbered	Minor Planet Orbits M-Opp	1-Opp.	Named minor planets
2017 NOV. 4	**745411**	506410	126117	112884	21157



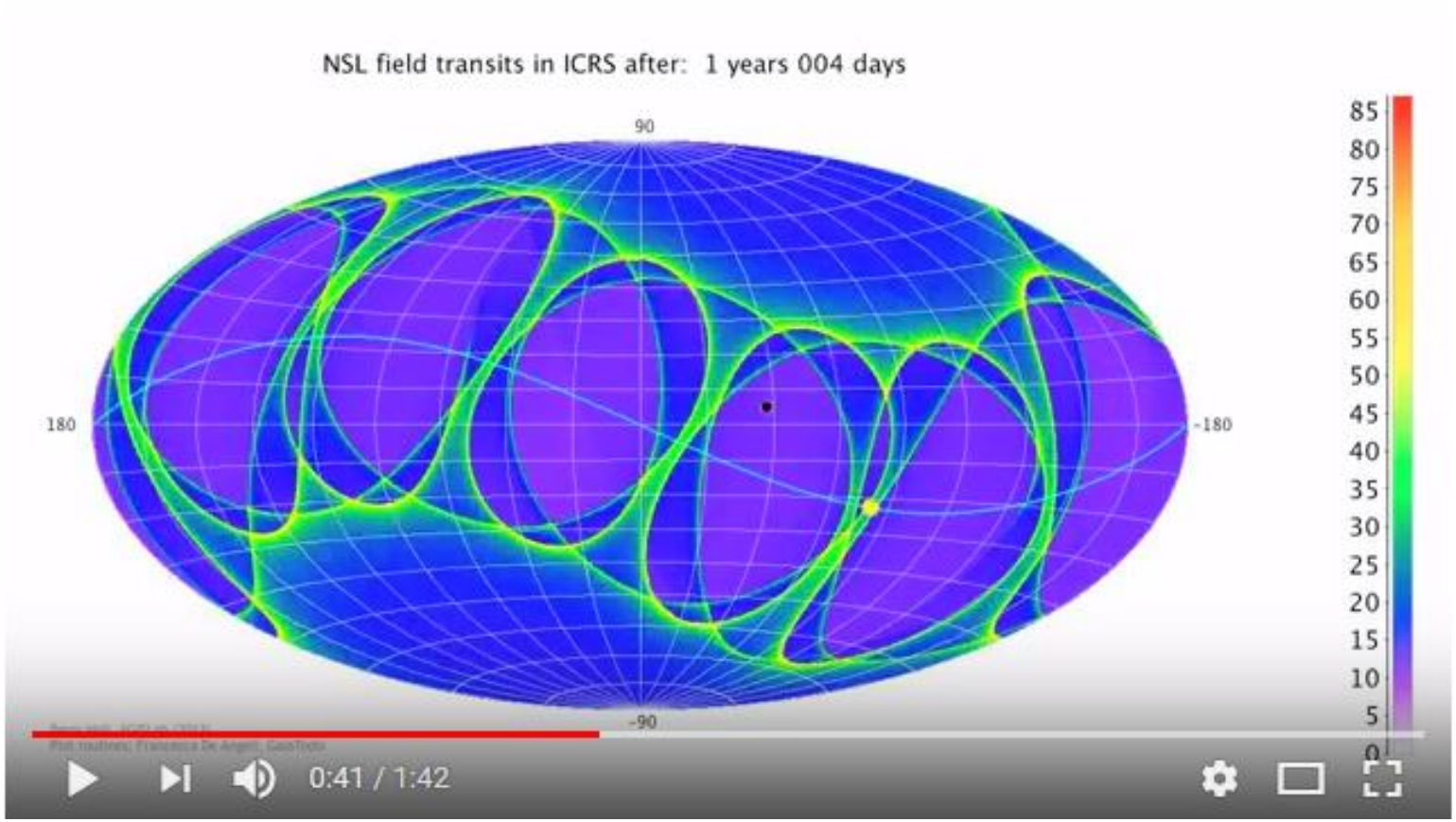
- Stats MPC at http://www.minorplanetcenter.net/iau/lists/ArchiveStatistics.html
- Number of new asteroids: still increasing => **~20 000 objects/year**

Minor Planet Center Statistics



Galache et al., 2015

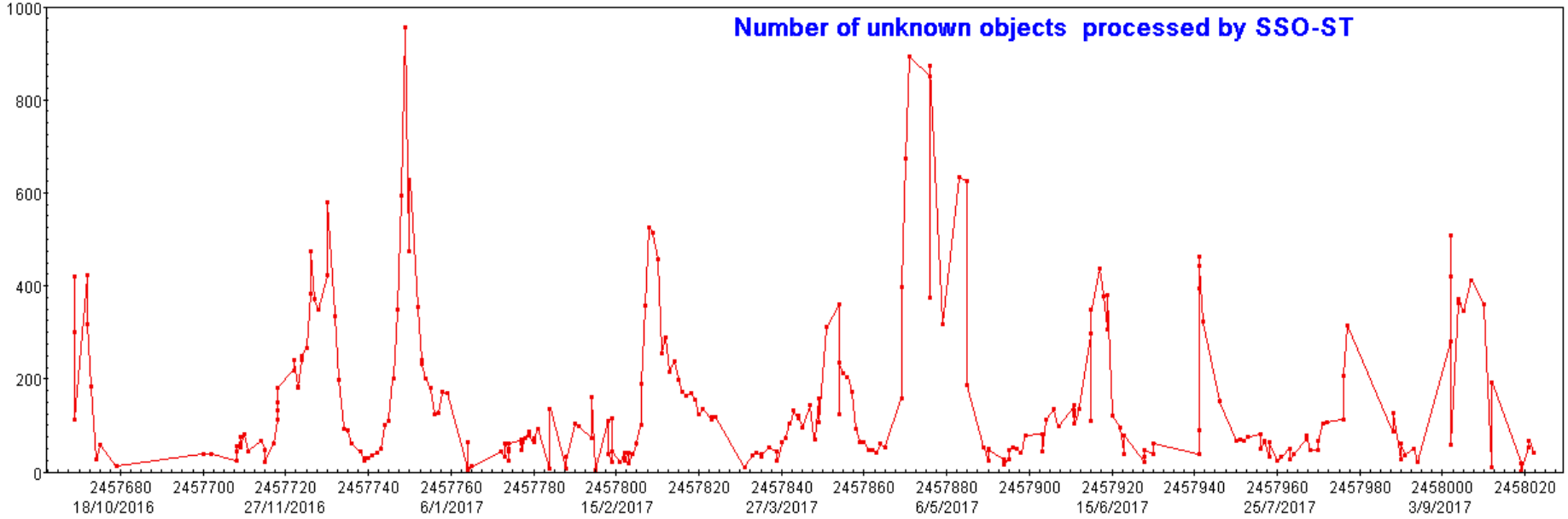
Gaia SSO-Short Term activity



- 1 year of Gaia measurement
- ESA simulation of the scanning law effect
- Heterogeneous exploration – mainly out of the ecliptic

Gaia SSO-Short Term activity

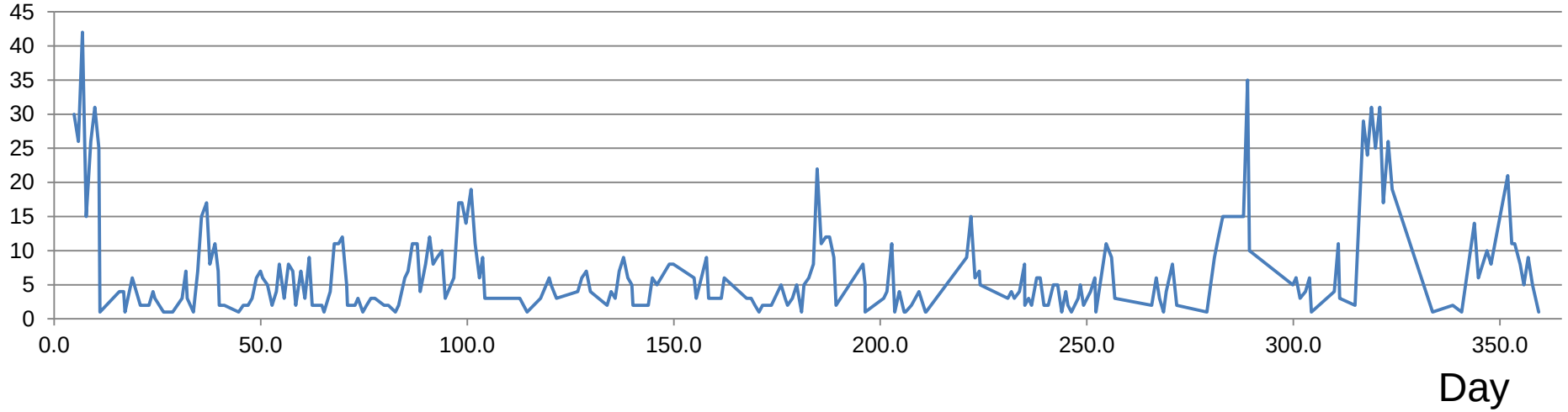
Oct.2016 Sept..2017



- 1 year of unknown **object data processed** by SSO-ST
- Total of ~43 000 alerts
- Average: 828/week 118/day
- All declinations & right ascensions
- Actually much less for one specific observatory

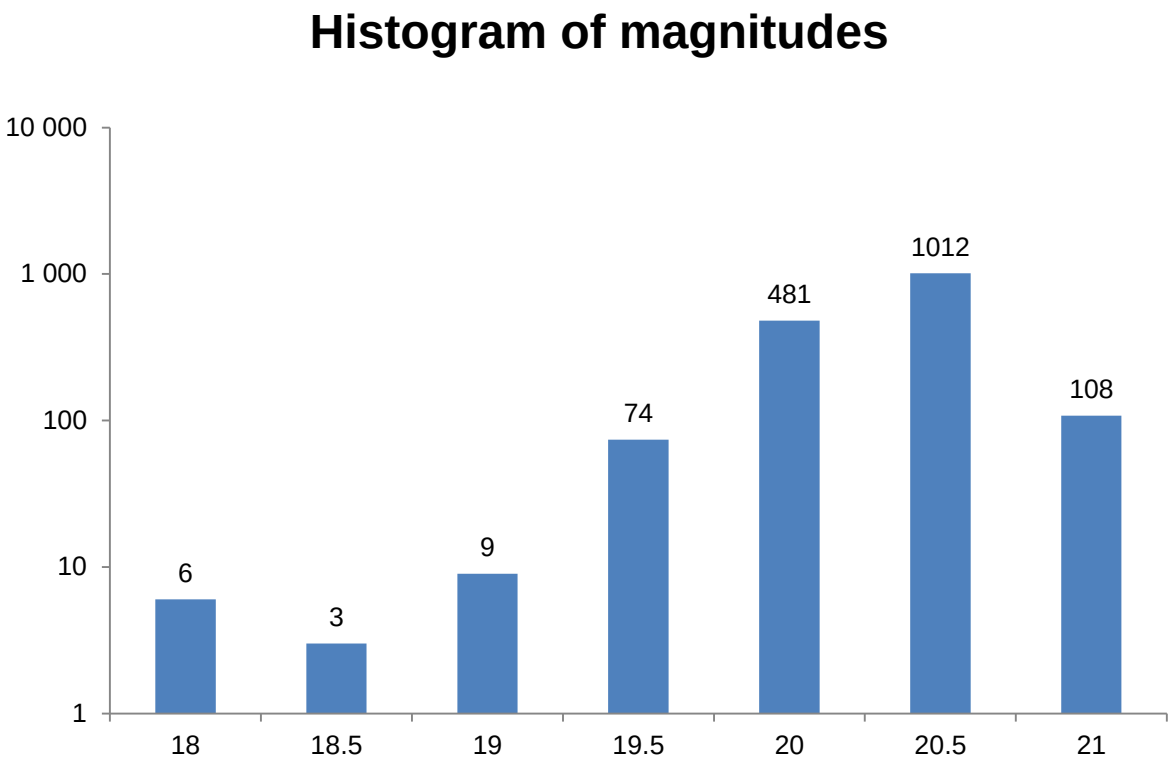
Gaia SSO-Short Term activity

Number of alerts published at gaiafunsso.imcce.fr



- Thousands of alerts processed during since Oct. 2016
- Filtering of candidates with nb. Transits > 3
- **1700 alerts** published from Nov. 2016 to Nov. 2017
- **Average of 5 alerts/day** for various RA and DEC
- Periodical peaks of activity

Gaia SSO-Short Term activity



- 1700 alerts published from Nov. 2016 to Nov. 2017
- Mainly magnitudes 20, 20.5

Gaia SSO-Short Term activity

- large number of registred observers: ~140
- But several observers/site and several do not register their instrument
- Total of detections on date : 13 detections on alert from the ground
- 11 objects received a designation from MPC
- Most of them : Gaia alerts allowed MPC to confirm previous detections
- 3 are dynamically compliant with the Gaia data

C2PU	Abastumani	OHP	Odessa	Tersken
MPC 010	MPC 119	MPC511	MPC583	MPC B18
1	2	7	1	2

#	alert designati	approx. Date	observatory	New design.	Orbit type	comment	reference MPC	observers
1	GA0142	04/10/2016	OHP-511			cf. ESA Tech. Note		W. Thuillot, N. Thouvenin
2	GAIA606	26/10/2016	OHP-511	2016 UV56 - 2001 AK10 - 2010 JW18	MBA	cf. ESA Tech. Note	MPS 740092	V. Robert, N. Thouvenin
3	g0T015	03/01/2017	OHP-511	2017 AD17 - 2014 EO51	MBA		MPS 757627	E. Saquet, V. Robert, W. Thuillot
3	g0T015	12/01/2017	OHP-511	2017 AD17 - 2014 EO51	MBA	re-observed on 12 Jan. linked with Gaia data	MPS 775980	M. Dennefeld, D. Gravallon, W. Thuillot
4	g0S004	02/01/2017	Odessa-583	2010 VP219 - 2012 FN61	MBA		MPS 755922	V. Troiansky, V. Kashuba
5	g1H006	28/02/2017	OHP-511	(490973) 2011 EH31	MBA		MPS 775923	E. Saquet, V. Robert, W. Thuillot
6	g1G010	01/03/2017	C2PU-010	2017 BR95		not transmitted to MPC?		J.P. Rivet
7	g1H013	02/03/2017	OHP-511	2017 EU8 - 2015 XV264	MBA		MPS 777839	E. Saquet, V. Robert, W. Thuillot
8	g1L008	27/03/2017	OHP-511	2017 FP158	MBA	OHP astrometry alone on the MPC DB	MPS 785881	W. Thuillot, F. Taris
9	g1M006	29/03/2017	OHP-511	2017 DG77 - 2010 XF36	MBA		MPS 785761	W. Thuillot, F. Taris
10	g1Y021	27/06/2017	Terskel - B18		NEA?			Y. Bufan, V. Godunova, A. Simon
11	g1Y031	27/06/2017	Terskel - B18	2017 MY7	Hungaria		MPS 804932 MPS803686	Y. Bufan, V. Godunova, A. Simon
12	g1j0D7	10/09/2017	Ambastumani-119	2017 RW16	MBA	linked with Gaia data	MPS 817144	R. Y. Inasaridze, V. Ayvazian, T. Mdzinarishvili
13	g1j03C	10/09/2017	Ambastumani-119					R. Y. Inasaridze, V. Ayvazian, T. Mdzinarishvili
12	g1j0D7	22/09/2017	OHP-511	2017 RW16	MBA	Follow-up of MPC119 detections	MPS 823993	M. Dennefeld, W. Brzezinska, M. Nowak, F. Spoto, W. Thuillot
13	g1j03C	22/09/2017	OHP-511			suivi des objets de MPC119 - linked with Gaia data		M. Dennefeld, W. Brzezinska, M. Nowak, F. Spoto, W. Thuillot

Conclusion

- Since Oct. 2016, new SSO are detected by Gaia.
- The (quasi-) daily dissemination is operating
- Many observers are registered
- but we need more feedback from them (even if negative obs.)
- **soon in operation** :
  - ✓ precision of the alerts - an improved algorithm will be implemented to publish smaller « red zones »
  - ✓ Estimated apparent velocity will be published
  - ✓ Ranking of the new objects candidates

Observers are still welcome!

See https://gaiafunsso.imcce.fr