



Science Meeting – Scientific Report

The scientific report (WORD or PDF file - maximum of seven A4 pages) should be submitted online within two months of the event. It will be published on the ESF website.

Proposal Title: Third Gaia-FUN-SSO international workshop

Application Reference N°: 5603

1) Summary (up to one page)

The Gaia satellite has been launched on December 19, 2013 and the operation phase has begun in July 2014. During this mission, Solar System Objects (SSO) will be observed by Gaia and their state vector will be measured with an unprecedented precision. New objects will certainly be detected; among them probably interesting ones such as NEAs. Nevertheless, due to the constraints imposed by its scanning law, Gaia will not be able to monitor these objects and to improve their provisional orbital model. Therefore complementary ground-based observations are required. During the previous years, this ground based activity has been organized through the set-up of the Gaia-FUN-SSO network (Gaia Follow-Up Network for Solar System Objects). This task is performed in the frame of the DU459 task of the Coordination Unit 4 of the Gaia DPAC, devoted to the data processing of specific objects. Several training observation campaigns have been performed and, in 2014, the real Gaia astrometric alerts are arriving.

In order to inform the participants to this network, but also to attract possible new participants, we have organized the Gaia-FUN-SSO workshop in November 2014. This workshop has been held in Paris Observatory on 24-26 November. It was dedicated to the follow-up activity of the critical Solar System Objects detected by Gaia thanks to the Gaia-FUN-SSO network for observation on alert. Almost one year after the launch of Gaia, we are still waiting for the first triggering of alerts. But we are ready to process these alerts in order to diffuse them in the network. By organizing this workshop we wished to bring together the observers with some Gaia DPAC members in order to exchange about this activity. This goal has been reached thanks to many communications and time slots for discussion.

We organized this meeting thanks to a web page which can be accessed at the address http://www.imcce.fr/hosted_sites/gaiafun2014/ where much information is available.

2) Description of the scientific content of and discussions at the event (up to four pages)

The workshop Gaia-FUN-SSO was chaired by P. Tanga, deputy coordinator of the DPAC-CU4 for the SSO branch and W. Thuillot, leader of the DU459 in charge of the ground-based follow-up of Solar System Objects. 48 participants were registered and 45 attended this meeting.

28 communications have been done as described in the program given in Annex 4a. It included three sessions:

1. General context
2. Gaia-FUN-SSO context
3. Gaia-FUN-SSO context and related observations

A time slot for discussions at the end of each day has also been managed:

1. General context of the Gaia mission and Science Alert
2. The goal and activity of the Gaia-FUN-SSO network
3. Supplementary points, recommendations and conclusion

Five invited talks have been done:

1. Gaia status by *Timo Prusti (ESA)*
2. Interrelations between asteroid populations by *Mikael Granvik (University of Helsinki)*
3. The European NEO Coordination Centre and the Gaia opportunity by *Ettore Perozzi (Deimos, Spain) and the ESA SSA NEO Team*
4. Gaia as a Transient Survey by *Lukasz Wyrzykowski (Cambridge & Warsaw universities)*
5. The bumpy first year of GBOT by *Martin Altmann (Zentrum für Astronomie, Heidelberg)*

Therefore thanks to this program, we could hear the last news from the status of the Gaia Mission on date of the workshop, more specifically the status of the SSO data processing, and given also by their leaders, information on the related observing programs: Ground-Based Optical Tracking for the positioning of Gaia, Science alerts for the astrophysical transients, NEA ESA-SSA program for the NEA science organized at the European level. We also hear a specialist about a model of asteroid population from which we could derive some statistics on the possible discoveries.

Besides, on the side of the Gaia-FUN-SSO managers, we could describe the goal and structure of the network, the activities performed during the previous period when we organized several training campaigns of observation of NEAs, and the improvements performed for entering in the next period.

On the other hand, the participants from several countries could present their activity, the instrument used, the infrastructure and their recent results. Note that 12 foreign countries were represented in this workshop (Belgium, China, Finland, Germany, Israel, Italy, Kazakhstan, The Netherlands, Romania, Russia, Spain, Turkey, Ukraine).

We also had presentations related to software for the astrometric reduction and methods of observation.

During the discussion, in addition to rather basic questions related to the management of the network, some topics appeared of great importance:

- we discussed the data policy related to the Gaia data diffused through the alerts and how it will be possible to manage the dissemination through a network and the public access to these data.

- we also discussed the possibility to organize, in the framework of Gaia-FUN-SSO, the follow-up of asteroids discovered during the GBOT survey since it appeared that many new objects are discovered in this activity.

3) Assessment of the results and impact of the event on the future directions of the field (up to two pages)

This workshop allowed us to share some results obtained by the network participants:

- overview of several training campaigns of observations
- astrometric study of some peculiar Near-Earth Asteroids, such as 99942 Apophis and consequence for the improvement of its orbit
- triangulation experiment concerning another NEA, 2014 HQ124.

Several communications have also answered to some questions that any participant to the network may have:

- what is the status of the SSO observation by Gaia
- how is now structured the Gaia-FUN-SSO network
- which goals can we expect to reach
- how the network will work during the next period of verification phase for SSO

The impact of the workshop will be mainly :

- the implementation of the new method for dissemination of data when Gaia alerts will be triggered
- the improvement of the efficiency of observers better informed about the goals and the methods for reaching them.
- the next involvement in new campaigns concerning the validation of the GBOT discoveries of new asteroids. This point is particularly important, since these objects being observed at opposition (in the direction of the L2 point), we get complementary statistical information upon their physical properties with respect to those of the Gaia observations which are generally far from the opposition.

Since end of 2014, we came into a verification phase: the Gaia observations of well-known asteroids are pushed in the SSO Gaia short term data processing in order to validate the work chain which create the alerts. This verification phase is not yet satisfying but as soon as it will be, the Gaia-FUN-SSO participants will be solicited for

the validation of the Gaia-FUN-SSO pipeline. Due to the discussion held during the workshop, the participants will be well informed upon this operation.

- 4) **Annexes 4a) and 4b): Programme of the meeting and full list of speakers and participants**

Annex 4a: Programme of the meeting

The Scientific committee of this workshop which discussed the program was composed by:

- W. Thuillot, co-Chair, IMCCE, France, (thuillot (at) imcce.fr)
- P. Tanga, co-Chair, OCA, France, (Paolo.Tanga (at) oca.eu)
- B. Carry, IMCCE, Paris Observatory, France (bcarry (at) imcce.fr))
- A. Cellino, Torino obs., Italy, (cellino (at) oato.inaf.it)
- D. Hestroffer, IMCCE, Paris Observatory, France (hestro (at) imcce.fr))
- F. Mignard, OCA, France, (francois.mignard (at) oca.eu)
- E. Perozzi, Deimos, Spain (ettore.perozzi (at) deimos-space.com)
- L. Wyrzykowski, University of Warsaw, Poland (wyrzykow (at) ast.cam.ac.uk)

The program was:

Monday November 24

- Welcome address by M. Claude Catala, President of Paris Observatory
- Opening and practical information (Paolo Tanga & William Thuillot, co-chairmen)

Session 1 : General context

Chair: W. Thuillot

- Gaia status *by Timo Prusti (invited)*
- Updates on Gaia observations of Solar System *by Paolo Tanga*
- Interrelations between asteroid populations *by Mikael Granvik (invited)*
- The European NEO Coordination Centre and the Gaia opportunity *by Ettore Perozzi and the ESA SSA NEO Team (invited)*

Chair: D. Hestroffer

- Gaia as a Transient Survey *by Lukasz Wyrzykowski, (invited)*
- The bumpy first year of GBOT *by Martin Altmann (invited)*
- The Gaia-FUN-SSO network : status and *objectives by William Thuillot, B. Carry, P. David, J. Berthier, D. Hestroffer*
- Discussion 1: general context of the Gaia mission and Science Alert

Tuesday November 25

Session 2: Gaia-FUN-SSO context

Chair: P. Tanga

- The reservoir of solar system objects available to discovery by Gaia *by Benoit Carry*
- The Gaia FUN SSO pipeline *by Benoit Carry, Pedro David, William Thuillot, Jérôme Berthier*
- The Gaia-FUN-SSO observations campaign of Apophis: a preliminary test for the network *by David Bancelin, William Thuillot, Anatoliy Ivantsov, Josselin Desmars,*

Marcelo Assafin, Siegfried Eggl, Daniel Hestroffer, Patrick Rocher, Benoit Carry, Pedro David and the Gaia-FUN-SSO team

- On visual encounters between asteroids and background stars *by Anatoliy Ivantsov, Eggl S., Hestroffer D., Thuillot W., Assafin M.*
- Gaia FUN SSO triangulation observations of 2014 HQ124 *by Siegfried Eggl, E. Gerlach, S. Boettger, W. Thuillot, A. Baransky, A. V. Devyatkin, Bashakova, S. A. Rusov, O. V. Shulga, Y. Sybiryakova, Y. Kozryev, N. Kulichenko, V. Vovk*
- The SBG Telescope of the Astronomical Observatory of the Ural Federal University: Opportunities for Gaia-FUN-SSO *by Polina Zakharova and Eduard Kuznetsov*
- Astrometry and Photometry of Karin Asteroid Family Members *by Zeki Eker, Mirel Birlan, Murat Kaplan, Orhan Erece, Gurkan Aslan, Marcel Popescu, Alin Nedelcu*

Chair: E. Perozzi

- Turkish Facilities to meet Gaia Solar System TOO Observations *by Erece O., Zeki Eker, Murat Kaplan, Gurkan Aslan, Mirel Birlan*
- Pulkovo observations in last training campaigns of Gaia FUN SSO *by Denis Gorsharov, Devyatkin A.V., L'vov V.N., Tsekmeister S.D., Petrova S.N., Martyusheva A.A., Slesarenko V.Yu., Naumov K.N., Sokova I.A., Sokov E.N., Zinoviev S.V., Karashevich S.V., Ivanov A.V., Lyashenko A.G., Rusov S.A., Kouprianov V.V., Bashakova E.A., Melnikov A.V.*
- ISON participation in Gaia-FUN-SSO campaigns *by Yuriy Krugly, I. Molotov, V. Voropaev, L. Elenin, R. Inasaridze, V. Rummyantsev, A. Baransky, V. Kouprianov, I. Belskaya, A. Sergeev, V. Shevchenko, I. Slyusarev, N. Gaftonyuk, O. Burkhonov, Sh. Ehgamberdiev, K. Ergashev, A. Aliev, E. Litvinenko, Yu. Ivashchenko, D. Varda, E. Sinyakov, T. Namkhay, T. Kokina, N. Minikulov, S. Abdulloev, V. Nevsky, A. Matkin, A. Ivanov, M. Krugov, A. Kusakin, V. Kudak*
- POSTER: Capabilities of ISON observatories for GAIA-FUN-SSO support *by Elena Pavlova, G. Borovin, I. Molotov, M. Zakhvatkin, L. Elenin, Yu. Krugly, V. Rummyantsev, M. Krugov, R. Inasaridze, V. Ayvazian, O. Burkhonov, Sh. Ehgamberdiev*
- Discussion 2: the goal and activity of the Gaia-FUN-SSO network

Wednesday November 26

Session 3: Gaia-FUN-SSO context and related observations

Chair: A. Cellino

- Observations of NEAs with the Lijiang 2.4m telescope *by Zhang Xi-Liang*
- Perspectives of polarimetry for follow-up observations of Gaia's asteroids *by Irina Belskaya and Yuriy Krugly*
- Polarimetric observations of NEAs at RTT150. First results *by Irek Khamitov, Selcuk Helhel, Gizem Kahya, Suleyman Kaynar, Rustem Gumerov*
- Precision of astrometry measurements made using CoLiTec software for asteroids survey *by Sergii Khlamov, A. Ivantsov, V. Savanevich, A. Bryukhovetskiy, L. Elenin, M. Bezkravniy, N. Sokovikova, Ia. Movsesian*

- Asteroid observations for mass determination at RTT-150 in 2003-2014 by *Nadia Maigurova, Y. Chernetenko, L. Gudkova, R. Gumerov, I. Khamitov, O. Kochetova, G. Pinigin*
- Observations of small-size and low-elongation NEAs in RI NAO by *Yevgeniya Sybiryakova, O. Shulga, Ye. Kozyryev, N. Kulichenko, V. Vovk*
- Method of Determining Small Bodies' Orbits Based on an Exhaustive Search of Orbital Planes by *Dmitrii Vavilov D. and Yuri Medvedev*
- Determination of small Solar system bodies orbits elements on astrometrical observations with OMT-800 telescope by *Volodymyr Troianskyi, A.A. Bazey, V.I. Kashuba, V.V. Zhukov.*

Chair: B. Carry

- Astrophysics in Kazakhstan: past, present and future by *Vira Godunova, M. Andreev, O. Sergeev, V. Tarady, V. Reshetnyk*
- Astrophysics in Kazakhstan: past, present and future by *Chingis Omarov*
- Asteroid – comet monitoring by *Aldiyar Agishev*
- discussion 3: supplementary points, recommendations and conclusion
- *End of day 3 and closure of the meeting*

Annex 4b: Full list of speakers and participants

Speakers (invited speakers in boldface)

- Aldiyar Agishev (Al-Farabi Kazakh nat. univ., alldiyar_agyshev@mail.ru)
- Martin Altmann (ZAH Heidelberg, Germany, maltmann@ari.uni-heidelberg.de)
- David Bancelin (IMCCE, Paris Observatory, France, bancelin@imcce.fr)
- Irina Belskaya (Inst. Astron., Kharkiv National Univ., Ukraine, irina@astron.kharkov.ua)
- Benoît Carry (IMCCE, Paris Observatory, France, bcarry@imcce.fr)
- Siegfried Eggl (IMCCE, Paris Observatory, France, siegfried.eggl@imcce.fr)
- Zeki Eker (Akdeniz Univ., Dept Space Sc.Tech., Antalya, Turkey, eker@akdeniz.edu.tr)
- Orhan Erece (Akdeniz Univ., Spa. Sc.Tech., Antalya, Turkey, orhanerece@gmail.com)
- Vira Godunova (ICAMER Observatory,NASU, Ukraine, v_godunova@bigmir.net)
- Denis Gorshanov (Pulkovo observatory, Russia, dengorsh@mail.ru)
- Mikael Granvik (Dep. of Physics, University of Helsinki, Finland, mgranvik@iki.fi)
- Anatoliy Ivantsov (Technion , Israel Inst. Tech., Haifa, Israel, ivantsov@tx.technion.ac.il)
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- Nadia Maigurova (Nikolaev Observatory, Ukraine, nadia4mai@yahoo.com)
- Chingis Omarov (Fessenkov Astrophysical Institute, chingis.omarov@gmail.com)
- Elena Pavlova (Keldysh Inst. of Applied Math., Moscow, Russia, elenae312@gmail.com)
- Ettore Perozzi (Deimos Space, Spain, ettore.perozzi@deimos-space.com)
- Timo Prusti (ESA, ESTEC, the Netherlands, tprusti@rssd.esa.int)
- Yevgeniya Sybiryakova (Nikolaev Astron. observatory, Ukraine, evg_sibir@mail.ru)
- Paolo Tanga (OCA, France, Paolo.Tanga@oca.eu)
- William Thuillot (IMCCE, Paris Observatory, France, thuillot@imcce.fr)
- Volodymyr Troianskyi (Astron. Obs. of Odessa University, v.troianskyi@onu.edu.ua)
- Dmitrii Vavilov (Inst. of Applied Astron. of Russian Acad. Sc., Russia, dj_vil@bk.ru)
- Lukasz Wyrzykowski (IoA, Cambridge, UK & Warsaw, Poland, wyrzykow@ast.cam.ac.uk)
- Polina Zakharova (Ural Federal University, Russia, polina.zakharova@urfu.ru)
- Xiliang Zhang (Yunnan Observatories,CAS, China, zhangxiliang@ynao.ac.cn)

Other participants:

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- Jean-Pierre Rivet (OCA, France, jean-pierre.rivet@oca.eu)
- Vasilij Romyantsev (Crimean Astrophysical Observatory, rum@crao.crimea.ua)
- Marian Doru Suran (Astron. Institute of the Romanian Academy, suran@aira.astro.ro)