Research Networking Programmes

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*: Next Steps Towards Future Space Astrometry Missions**

Application Reference N°: 5994

1) Summary (up to one page)

The workshop brought together members of the European astrometry community to discuss future challenges on the road to the next generation of space astrometry meetings. The meeting was organised by the Steering Committee of the GREAT Research Network Programme.

Full details of the meeting are available at the workshop wiki site pages at http://great.ast.cam.ac.uk/Greatwiki/GaiaScienceMeetings/FutureAstrometryJul15

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

The Gaia mission (http://www.cosmos.esa.int/web/gaia) will deliver the next major breakthrough in astrometric sky surveys. The astrometry will be complemented by a complete multi-colour photometric survey and the largest radial velocity and spectroscopy survey ever undertaken. Needless to say that Gaia will have a tremendous impact on the mapping and understanding of the Milky Way, stellar astrophysics, solar system science, extra-galactic astrophysics, and fundamental physics. In addition Gaia will surely uncover surprises that may point to entirely new directions in which to take astronomy and astrophysics. As a result, a range of new questions will emerge as the Gaia data releases are analysed by the scientific community, and many of these questions will require the next level of astrometric data.

For more background we refer to the White Papers that were submitted as part of the exercise to define the L2 and L3 missions in the ESA science programme (available on the workshop wiki page).

This timely workshop discussed the future options for astrometric missions. The workshop took place from 6-8 July 2015 at the Institute of Astronomy in Cambridge, UK.

Topics addressed covered:

• Scientific drivers for the next space astrometry missions, community inputs.
• Technical drivers, i.e. maintenance of the astrometric frame established by Gaia.
• Mission options: global, differential, survey, targeted, different wavelength, repeating Gaia.
• What are credible technology paths toward a next mission; account for the lessons learned from Gaia.
• Research needed to reach the next level of astrometric accuracy.
• The ESA programmatic environment.
• The need for space — strengths, limitations and synergies with ground based astronomy, VLBI astrometry and reference frame efforts

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

The outcome of the meeting will be a 'white paper' in which concrete actions are identified that can be taken by the astrometry and wider astronomy community to ensure the next space astrometry mission.

The purpose of the 'White Paper' will be to:

Show that astrometry as a technique is essential to many exciting astronomy science cases

- Demonstrate community interest to continue doing space astrometry
- Reference for groups submitting proposals for space astrometry missions
    - science cases
    - high level requirements
    - mission concepts
    - technology options and limitation

The 'White Paper' will be developed by mid 2016, and thus of use for those proposing missions to the ESA M5 call. It is anticipated that a follow-up community meeting will be held April 2016 to discuss the draft of the paper.

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

Annex 4a: Programme of the meeting

The full programme together with links to the talk slides can be found at http://great.ast.cam.ac.uk/Greatwiki/GaiaScienceMeetings/FutureAstrometryJul15

Mon 6 Jul 2015	**What**	**Who**	**Institute**
13.00-13.30	Registration		
Session 1:			
13.30-14.00	**Introduction, goals of meeting**: Motivation of this meeting, followed by a summary of the future options for space astrometry	Anthony Brown	Leiden
14.00-14.45	**ESA perspective: long term programme, astrometry prospects**: What is the outlook for the ESA programme in the long term (next two decades or so)? How does astrometry fit into the programme?	Timo Prusti	ESA/ESTEC
14.45-15.30	**The Gaia2 case**: Motivation of the possibility to do another Gaia-like mission with an epoch difference of 15 years from Gaia. Science applications, possible improvements to Gaia.	Erik Hog	Niels Bohr Inst, Copenhagen
15.30-16.00	*Coffee*		
Session 2:			
16.00-16.45	**Differential astrometry mission options**: Discuss the options to do a narrow-field very high accuracy space astrometry mission. Science benefits. Technical issues.	Fabien Malbet	Grenoble
16.45-17.30	**Targeted astrometry missions missions for general relativity tests**: Discuss the drivers and options for astrometry missions targeted at GR tests.	Mario Gai	INAF-OATO
18.00	*Close Day 1*		
19.30	*Workshop Dinner*		
Tue 7 Jul 2015	**What**	**Who**	**Institute**
Session 3:			
09.00-10.00	**'Technical' needs for future space astrometry**: To what extent is it mandatory to have a future space astrometry mission. The astrometric reference frame established by Gaia (in the optical) will have to be maintained. Can this be done from the ground? Is space needed? For what purpose is the maintenance of the reference frame needed.	Francois Mignard	OCA, Nice
10.00-11.00	**Ground based astrometry, possibilities and limitations - Optical/IR**:What can realistically be achieved with Optical/IR astrometry from the ground (all-sky surveys and narrow-field instruments).	Alberto Krone-Martins	Lisbon

11.00-11.05	*Workshop Photo*		
11.05-11.30	*Coffee*		
Session 4:			
11.30-12.30	**Research needed to reach next level of (global) astrometric accuracy**: Assuming we wish to go for the next level of accuracy with a global astrometry mission such as Gaia; what scientific developments are needed to achieve this?	Sergei Klioner	TU Dresden
12.30-13.45	*Lunch:* Buffet in the Kavli Foyer		
Session 5:			
13.45-14.45	**Lessons learned from Gaia**:After a year of operations and data processing what can we say about the limitations that we will face in getting to the next accuracy level? Should different concepts be considered for the next mission? (See also the GREAT-PM8 Plenary, 23-24 June 2015, talks atGreatMeet-PM8 for Gaia status).	Alcione Mora, Dafydd Evans	ESA-ESAC/ IoA, Cambridge
14.45-15.45	**Maintaining astrometry expertise (education, careers, motivation)**: How do we maintain the expertise in astrometry (both ground and space based) over the next decades? In particular how does one motivate younger astronomers to get involved in a "service oriented" field like astrometry? What can we learn from the other large survey astronomy projects?	David Hobbs	Lund
15.45-16.15	*Coffee*		
Breakout Session 1:			
16.15-16.35	**Science drivers for future space astrometry missions, setting the scene**: What are the science drivers for the next astrometry mission? In which directions are the fields moving, i.e. are better positions/ parallax/proper motions desired or will other measurements be more important? Does it make sense to discuss this before we have Gaia results? How do the giant ground based telescopes fit in?	Nicholas Walton	IoA, Cambridge
16.35-18.00	**Breakout: exo-planets and Solar System Objects**	Lead: Hestroffer	IMCCE, Obs de Paris
	Breakout: Stars (includes the ISM) (held jointly with Galaxies)	Lead: Heiter	Uppsala
	Breakout: Galaxies (includes probes of fundamental physics) (held jointly with Stars)	Lead: McMillan	Lund
18.00	*Close Day 2*		
Wed 8 Jul 2015	**What**	**Who**	**Institute**
Breakout Session 2:			

09.00-11.00	**Breakout: Planets**	Lead: Hestroffer	IMCCE, Obs de Paris
	Breakout: Stars (held jointly with Galaxies)	Lead: Heiter	Uppsala
	Breakout: Galaxies (held jointly with Stars)	Lead: McMillan	Lund
11.00-11.30	*Coffee*		
Session 6: Reporting back from the breakouts			
11.30-11.50	**Breakout Summary: exo-planets and Solar System Objects**	Lead: Hestroffer	IMCCE, Obs de Paris
11.50-12.10	**Breakout Summary: Stars**	Lead: Heiter	Uppsala
12.10-12.30	**Breakout Summary: Galaxies**	Lead: McMillan	Lund
12.30-13.00	**Synthesis and Discussion** : How do we proceed from this workshop? Is a white paper (to whom?) the way to go? What about the non-European astronomy communities?	Anthony Brown	Leiden
13.00-14.00	*Lunch:* Buffet in the Hoyle Committee Room		
Session 7: Roadmap and White Paper			
14.00-16.00	Conclusions, outline of white paper, assignment of writing tasks	Anthony Brown	Leiden
16.00	*Close Meeting*		

Annex 4b: Full list of speakers and participants

Convenors

Dr. Anthony Brown	Leiden (NL)
Dr. Timo Prusti	ESTEC, ESA, Noordwijk (NL)
Dr. Nicholas Walton	IoA, Cambridge (UK)

Speakers

Dr. Dafydd Evans	IoA, Cambridge (UK)
Dr. Mario Gai	INAF, Torino (IT)
Dr. Ulrike Heiter	Uppsala (SE)
Dr. Daniel Hestroffer	Obs de Paris (FR)
Dr. David Hobbs	Lund (SE)
Prof. Erik Høg	Niels Bohr Institute, Copenhagen (DK)
Prof. Sergey Klioner	TU Dresden (DE)
Dr. Alberto Krone-Martins	SIM, Lisboa (PT)
Dr. Fabien Malbet	IPAG, Grenoble (FR)
Dr. Paul McMillan	Lund (SE)
Dr. Francois Mignard	OCA, Nice (FR)
Dr. Alcione Mora	ESAC, ESA, Villanueva de la Cañada (ES)

Participants

Dr. Frédéric Arenou	Obs de Paris, Meudon (FR)
Dr. Vasily Belokurov	IoA, Cambridge (UK)
Dr. Michael Biermann	ARI, Heidelberg (DE)
Dr. Alex Bombrun	ESAC, ESA, Villanueva de la Cañada (ES)
Dr. Deborah Busonero	INAF, Torino (IT)
Dr. Cristina Chiappini	AIP, Potsdam (DE)
Dr. Antoine Crouzier	IPAG, Grenoble (FR)
Dr. Francesca De Angeli	IoA, Cambridge (UK)
Dr. Claus Fabricius	Barcelona (ES)
Dr. Berry Holl	Obs Geneva, Versoix (SZ)
Dr. Carme Jordi	Barcelona (ES)
Dr. Sergey Koposov	IoA, Cambridge (UK)
Dr. Valery Lainey	Obs de Paris, Paris (FR)
Dr. Alain Leger	IAS, Orsay (FR)
Prof. Lennart Lindegren	Lund (SE)
Dr. Daniel Michalik	Lund (SE)
Dr. William O'Mullane	ESAC, ESA, Villanueva de la Cañada (ES)
Dr. Antonella Vallenari	INAF, Padua (IT)
Dr. Floor van Leeuwen	IoA, Cambridge (UK)