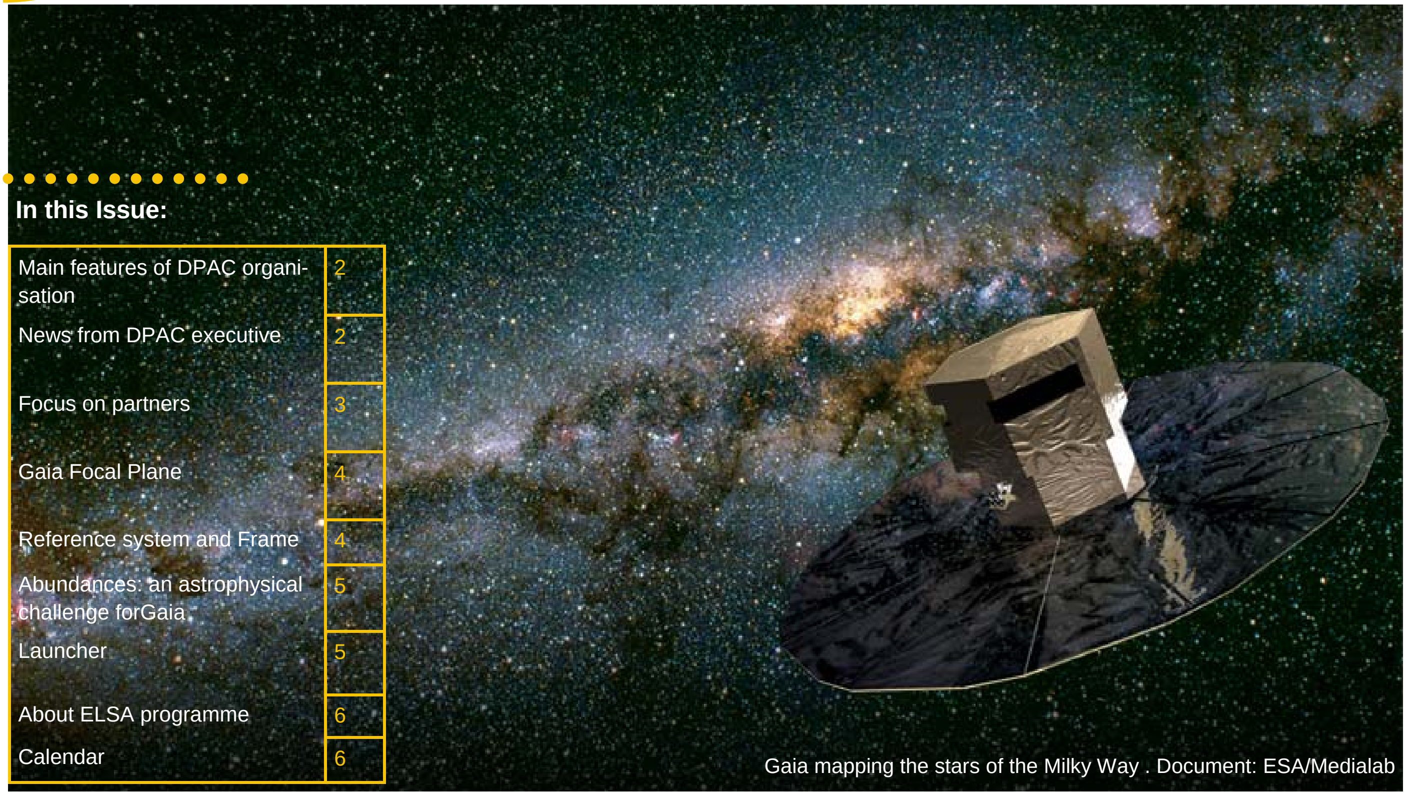
Gaia DPAC newsletter

N° 1 MARCH 20, 2008



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Gaia mapping the stars of the Milky Way . Document: ESA/Medialab

Editorial *by DPAC chair, F. Mignard*

You have in hand or before you on your screen the very first issue of the DPAC* Newsletter. The principle of creating this media in complement to the Gaia web has been agreed by the DPAC Executive Committee during its meeting of January 15-16, 2008. As with any Newsletter of a large project it aims to help the participants keep up with the latest organisational aspects and activities of the Consortium. The newsletter will have regular columns on the participating institutes, on scientific and technical topics relevant to Gaia and aiming at a larger audience than the DPAC members. The letter should be accessible within and outside the DPAC by the scientific community at large interested in Gaia and its expected achievements for planning their own research or just to maintain their link with the project. In each country, the institutions supporting the DPAC activities will also receive this letter so that they have easy insights on the most recent issues by just clicking on a document attached to their mail. Beyond the information provided by the Chair, the DPACE** or the Coordination Units leaders, the Editorial Board will seek contributions from within the DPAC to fill these regular columns. Thus the Letter will become a real thread between this large, but geographically dispersed, community covering a wide range of expertise but united around the same goal: to make Gaia a success.

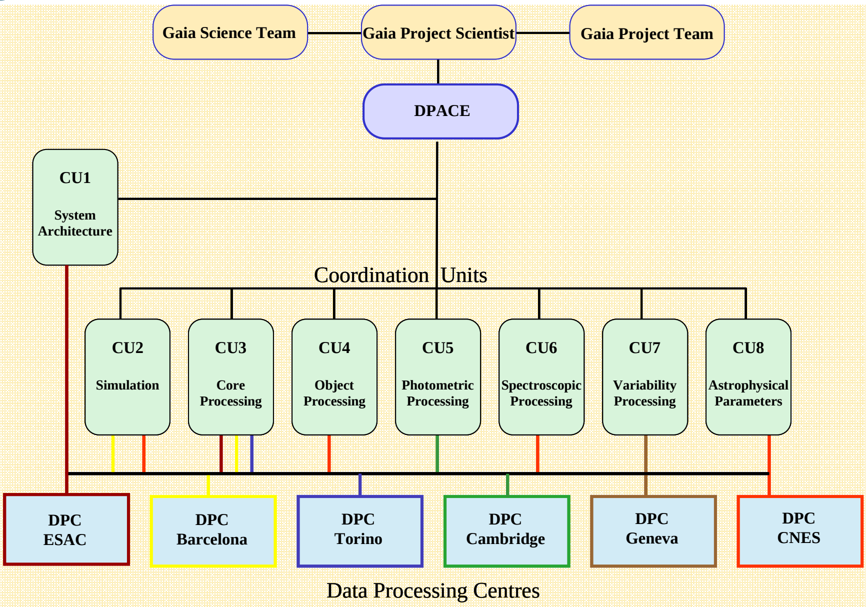
**DPAC: Data Processing and Analysis Consortium*
***DPACE: DPAC Executive*

Main features of DPAC organisation

The DPAC is basically organised around Coordination Units (CU). CUs are large and organisationally nearly autonomous structures. Their boundaries are determined by the data flow. They share common tools and adhere to strict interface and schedule. A single centralised data base is the heart of the system.

Each CU is supported by at least one Data Processing centre (DPC) where all the software will be integrated and run.

The DPAC is coordinated by an Executive Committee (DPACE) where all CU leaders have a seat. This Committee selects the chair and deputy, at the moment : F. Mignard & R. Drimmel. Currently, there are 8 CUs, 6 DPCs.



Information from DPAC Executive (DPACE)

The Steering Committee

The DPAC funding agencies and ESA have adopted an overall agreement (MLA: Multilateral Agreement) to define the terms and conditions ruling the commitment of the Parties for the Gaia data processing. For each of the major countries involved in the MLA this agreement lists the parts of the data processing they will support. The MLA establishes a Steering Committee to monitor the activities defined in the agreement, in particular regarding their funding side.

The Steering Committee has been formed and met for its first meeting on 17 January, 2008 in Paris. Besides ESA, it comprises one representative for each of the following countries: Belgium, France, Germany, Italy, Netherlands, Spain, Sweden, Switzerland, UK. Chris Castelli (UK representative) has been designated to chair the Steering Committee.

The System review

The DPAC system has undergone its first overall review (System Requirement Review) at the end of 2007. It started with the presentation of the documentation on the 1st of November and formally ended with the Review Board meeting on the 19th December. Both the DPAC and the SOC (Science Operation Centre at ESAC) were subjected to the review and together produced 46 reference documents and 54 supporting documents, available to the review panel. The review generated 166 RIDs (Review Item Discrepants or element pointed out by the review panel needing to be changed or clarified) with 26 classified as major. All these items were looked at in detail during a meeting between the DPAC and the Review panel on the 28-30 November. In total 128 actions were agreed with the DPAC and the SOC and are being implemented.

The Review board declared the review successful and insisted on the urgent need of establishing the Project Office.

The DPAC Logo

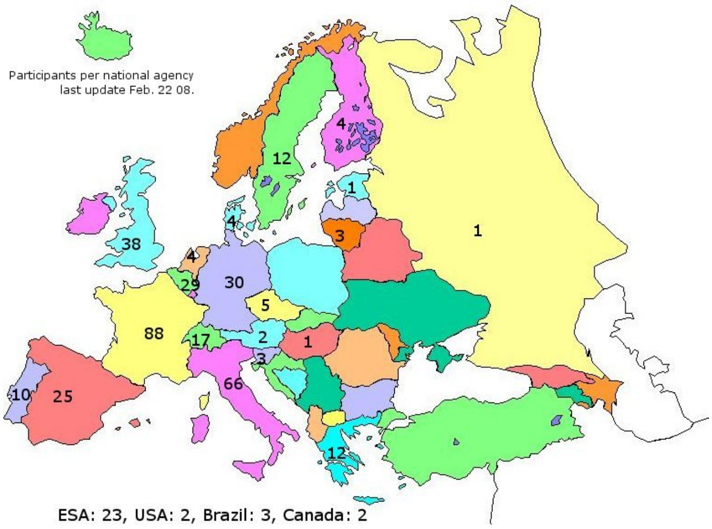
Soon after the formation of the DPAC in June 2006, a logo contest was launched where consortium members, their relatives and friends were invited to submit a proposal for a DPAC logo. More than 20 artworks were received from the Gaia community with variations in colours, superimposed texts, overall shape, etc. The final choice was made by the DPAC Executive and appears now in all the DPAC productions and presentations. The logo features a stylised spiral galaxy attached to the DPAC acronym; special versions showing the CU number are also available. This logo was designed by Tiziana Franconeri and produced by Effetti for INAF-OATo. To reproduce the same colours in your documents with an RGB setting you should use the colours as: BLUE RGB = (62,116,142) YELLOW RGB = (248,196,0).

Consortium main figures*

Note: All data released in this section are available at the following address (DPAC restricted)
http://gaia.esac.esa.int/dpacsvn/DPAC/docs/newsletter/NL_01/material

Participation per national agencies:

- ***Total: 385 persons***
- ***24 agencies***



The Max Planck Institute for Astronomy
by C.A.L. Bailer-Jones

The Max Planck Institute for Astronomy (MPIA) in Heidelberg is one of 80 research institutes of the Max Planck Society and is home to some 220 scientists, students, technicians and support personnel. Our main research areas are cosmology, galactic astrophysics and planet and star formation. We also have a major instrumentation program, having built or made contributions to numerous ground-based (e.g. VLT, LBT) and space-based instruments (Herschel, JWST), and we are partners in the major surveys SDSS and Pan-STARRS.

The MPIA hosts one of two Gaia teams in Heidelberg (the other is at ARI), funded primarily by the German space agency, the DLR http://www.dlr.de/en/. This team of four full-time postdocs, P. Tsalmantza, C. Tiede, K. Smith and C. Elting, led by C. Bailer-Jones, contribute to CU8 "Astrophysical Parameters" by developing algorithms to classify and interpret the Gaia data. We are building the Gaia classification machine - the "Discrete Source Classifier" - a probabilistic classifier to identify all Gaia sources. We also provide the algorithm for extracting physical parameters for single and binary stars from the BP/RP spectra and astrometry.

The group additionally maintains the CU8 data model and contributes to the galaxy parametriser. Team members have diverse backgrounds in astronomy, geodesy and computer science. In parallel to Gaia we are involved in related projects involving the application of pattern recognition methods to large data sets.

http://www.mpia.de/Public/menu_q2e.php

Leiden University
by Anthony Brown

Greetings from the Dutch Gaia team!

We contribute to CU5 "Photometric Processing" the algorithms for:

- the extraction of BP/RP spectra from the raw photometer data,
- the subsequent estimation of source colours,
- the calibration of the photometer PSFs,
- the BP/RP initial data treatment.

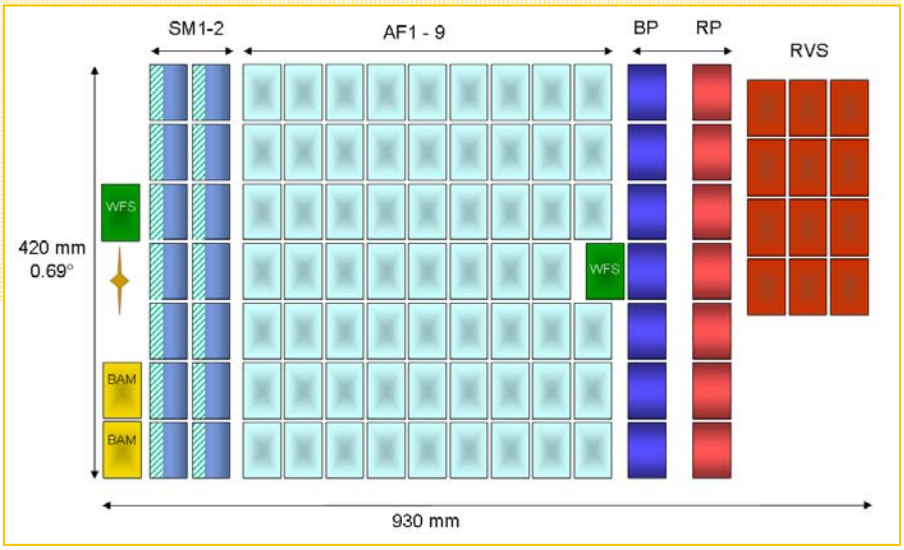
Algorithms for the disentangling of spectra in crowded fields are developed together with the CU5 teams in Rome and Teramo.

We have been funded so far by the Netherlands Organization for Scientific Research. From the middle of 2008 the Netherlands Research School for Astronomy will fund these efforts as part of their DPAC MLA commitment. The Leiden team consists of P. Marrese, a soon to be appointed postdoc, and myself. Leiden Observatory is one of five university astronomy departments in the Netherlands and has a long standing connection to Gaia through involvement in the early stages of the project and the Hipparcos mission. Many Gaia supporters can be found among Dutch astronomers, with interests ranging from the formation of our Galaxy to the characterization of exoplanets. The team also includes T. Prod'homme, an ELSA PhD student investigating the physics of charge transfer inefficiency in order to provide accurate models to support the DPAC efforts to handle the radiation damage to Gaia's CCDs. Another ELSA fellow will start working later this year on the attitude modelling for Gaia. Finally, S. Trager in Groningen contributes to the CU5 ground based preparations.

http://www.strw.leidenuniv.nl/

Gaia Focal Plane *by Paolo Tanga*

The light entering Gaia the optical system will be focused on a large array of 106 Charge Coupled Devices (CCDs), composing an incredible camera of about 930 Mega-pixels. With such a figure, it rates second in the world (after the Giga-pixel camera the PanSTARRS telescopes). On the other hand, it dominates by far in physical size: 42 X 93 cm^2. The apparent field covered on the sky is such that the full moon disk, having a focal plane diameter of 33 cm, comfortably fits inside. The picture represents the geometry of the focal plane, showing the different CCDs. During the sky scan, sources enter the detector area from left, and drift toward the right, thus providing a signal to all instruments. One can distinguish the Sky Mapper (SM, in charge of detecting an incoming source), the Astrometric Field (AF, receiving unfiltered light for astrometry), the Blue and Red enhanced Photometers (RP, BP, providing low resolution spectra in different ranges of wavelengths) and the Radial Velocity Spectrograph (RVS, providing high-resolution spectra for objects brighter than mag. 17). The wave-front sensor (WFS) and the basic-angle monitor (BAM) will be used for system checking and control during the mission. As of February 2008, the UK company e2v technologies has already produced more than 80 flight model CCDs for Gaia.



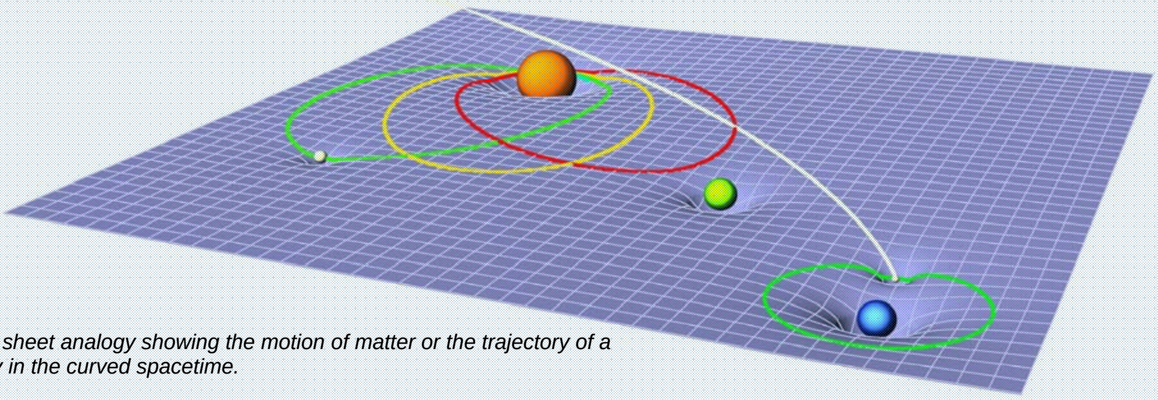
Geometry of Gaia's focal plane

Science items: Reference system and Frame *by Sergei Klioner*

One of the tricky issues in Gaia is to specify the reference system which the final Gaia catalogue will be referred to and to maintain the whole data processing chain consistent with that reference system.

Considering the expected accuracy of Gaia, the reference system and the modelling must be in agreement with Einstein's general relativity. Gaia was one of the driving forces for the IAU to adopt, in the year 2000, a fully general-relativistic reference system called Barycentric Celestial Reference System, BCRS.

The consistency of the modelling for Gaia must include motion of the solar system bodies, motion of Gaia (Gaia has the most stringent accuracy requirement among all ESA missions), light propagation (the complexity of the light propagation modelling for Gaia is unprecedented), time scales and time synchronization, relativistic definitions of the attitude and calibration parameters used in Gaia. All these issues were closely monitored by DPAC over the last few years and one can be sure that the Gaia catalogue, that is to say the Gaia Reference Frame, will be a consistent materialisation of the BCRS, directly accessible in the optical wavelengths.

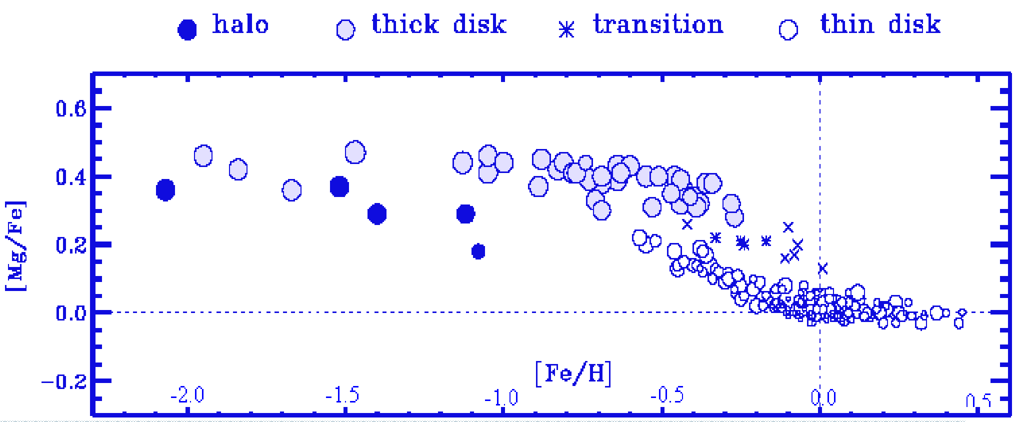


Rubber sheet analogy showing the motion of matter or the trajectory of a light-ray in the curved spacetime.

Abundances: an astrophysical challenge for Gaia *by Andreas Korn*

When astronomers talk about abundances, they usually mean the abundances of chemical elements. The composition of astrophysical objects yields a view of the Universe that is complementary to the dynamical picture. Gaia's primary focus is on this latter aspect of astrophysics. By collecting positions, distances and temporal changes of these quantities for roundabout one billion stars Gaia will take the classical field of astrometry into the 21st century. Combining these pieces of information with radial velocities (obtained from the Radial Velocity Spectrometer via the Doppler shift of spectral lines) will enable astronomers to study the full dynamics of the Galaxy based on a representative sample of the Galactic stellar inventory. But the ambition of DPAC goes well beyond collecting what astronomers refer to as the "6D" phase space information (three positional coordinates + three space-velocity components). Efforts are under way to make best possible use of the spectro-photometric and spectroscopic data to be collected by Gaia to classify the observed objects according to their main astrophysical properties: for stars these are temperature, gravitational acceleration and chemical abundances at the surface. This is where *astrophysics* in the true sense of the word starts.

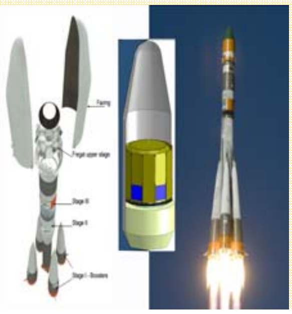
So what is the astrophysical significance of collecting abundance information? We know that our Galaxy is made up of a few major components: there are two disk components, one thin one thick, that form the spiral structure in the Galactic plane. Our Sun is a typical thin-disk star. There is the so-called bulge population of stars in the centre of our Galaxy that is old and has a high metal content. Surrounding the Galaxy there is the halo population, old, diverse and of more primitive composition. Kinematic studies attempting to assign a given star to one of these populations are hampered by the natural overlap that exists between the populations in terms of the (velocity) space they occupy. This is where the abundances come in: studies undertaken in recent years have shown that the four above-mentioned populations can be uniquely identified based on their chemical properties (see figure below as an example of this). In particular, abundance ratios of elements like magnesium and iron can indicate whether the population studied came into existence in a burst of star formation (like the thick-disk stars at elevated Mg/Fe levels) or whether it formed in a more quiescent fashion over billions of years (like the thin disk). This chemical fingerprint will be of particular importance for identifying the remnants of the Galactic formation process predicted to exist in the Galactic halo.



Analyses of roughly 100 stars in the immediate solar vicinity reveal the existence of three populations: the thin disk, the thick disk and the halo. The Sun is located at the origin among other thin-disk stars. Based on the abundance ratio of magnesium to iron, the two disk populations can be separated (to further distinguish the halo population from the thick disk, other abundance ratios need to be employed). Adapted from Fuhrmann 2004 (AN 325, 3).

Launcher *by Serge Mouret*

With more than 1736 launches by February 2008, the Soyuz-rockets are by far the world's most used and most reliable launch vehicles. In late 2011 Gaia will leave the European Space Centre in Sinnamary (French Guiana) to the L2 Lagrange point region on board of the latest version of the Soyuz rocket, the Soyuz-ST/FREGAT. Provided by the European-Russian organization Starsem, this Fregat distinct feature is the restartable upper stage - encapsulates in the fairing- which gives access to orbits beyond low-Earth orbit. Both the fairing size and the power of the Fregat upperstage allow to accommodate extended and heavy payload like Gaia with a launch mass above two tonnes and a total height of 3 m.



Initially placed on a parking orbit (to be confirmed), the Fregat, using its own navigation will bring Gaia on its transfer trajectory. Two days will have already passed after the launch when Fregat will be fired to propel Gaia on a trip at least 1 month to L2, 1.5 million km away from the Earth. Then, Gaia will be ready for its 5 years mission pinpointing the Galaxy. The launch scenario details are currently under discussion.

About ELSA: European Leadership in Space Astrometry

ELSA http://www.astro.lu.se/ELSA/index.html is a Marie Curie Research Training Network http://cordis.europa.eu/mariecurie-actions/rtn/home.html supported by the European Community's Sixth Framework Programme (FP6). The network contract was concluded between the European Commission and ELSA on 1st October 2006 and has a duration of 4 years.

ELSA has appointed a number of PhD students (ERS = Early Stage Researchers) and postdocs (ER = Experienced Researchers) to collaborate on specific problems related to the astrophysical, instrument modelling, algorithmic, numeric and software engineering aspects of Gaia. These activities complement, and are partly integrated into, the joint European effort to develop a complete scientific data analysis system for Gaia.

Today 14 institutes participate to ELSA program.

An ELSA School on the Science of Gaia http://www.astro.lu.se/ELSA/pages/N2info.html, has been held on November 19-28 2007 in Leiden. Most of the lectures given during the workshop are available on-line by following the link above. The workshop was organised jointly with the Lorentz Center, an international centre coordinating and hosting workshops in the sciences.

The main contact point for matters concerning the network as a whole is the ELSA Coordinator, Prof. Lennart Lindegren (*lennart@astro.lu.se*).

In future newsletter ELSA postdocs and PhD students will be invited to present their work.

Outreach activities *by Marco Delbo*

Gaia will observe a large number of asteroids with unprecedented astrometric accuracy. I have created an animation with the 5000 numbered asteroids, to show how the large majority of these minor bodies orbit the Sun between Mars and Jupiter in the region of the so called asteroid Main Belt. However, an important heritage of the last-century Planetary Science is the discovery of a population of these minor bodies with orbits crossing that of the Earth: I have prepared a second animation showing the so-called near-Earth asteroids as they move in the inner solar system together with the planets up to Mars. Feel free to download (*DPAC restricted)* the two movies and use them in your own Gaia presentations at
http://gaia.esac.esa.int/dpacsvn/DPAC/docs/newsletter/NL_01/material

Calendar of meetings

Date	Place	Who	Type	Resp.
08 - 09 April	Barcelona	CU5	Plenary	F. van Leeuwen / C. Jordi
10-11 April	Barcelona	CU3	Plenary	U. Bastian / J. Torra
14-15 April	IoA, Cambridge	DPAC Radiation Task Force	WG	F. van Leeuwen
17-18 April	ESTEC	GST	GST-23	T. Prusti
08-09 May	Lund	CU3	AGIS	L. Lindegren
07-09 May	Catania	CU7	Plenary	L. Eyer / A. Lanzafame
15-16 May	Liège	CU4	Plenary	D. Pourbaix / E. Gosset
22-23 May	Heidelberg	DPACE	DPACE-06	F. Mignard
26-27 May	Padua	CU8	1 day restricted / 1 day plenary	C. Bailer-Jones / A. Vallenari
09-11 June	Liège	CU6	Plenary	D. Katz / E. Gosset
16-19 June	ESAC	DPAC	Java08 (Java Workshop)	W. O'Mullane / J. Hoar

More information on calendar of Gaia : http://www.rssd.esa.int/index.php?project=Gaia&page=Calendar_of_meetings

This newsletter is published by DPAC Chair
To publish news or articles please contact: **nl_editorial_board@oca.eu**