

Gaia outreach features available to the scientific community

Carmen Blasco

Gaia: at the frontiers of astrometry

11/06/2010

- Web sites and general structure of a web page
- For scientists:
 - Public documents
 - Science performance web page
 - Image gallery
 - Posters
 - Information sheets
- For general public:
 - Little Books of Gaia


Web sites: Corporate level



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http://www.esa.int/esaSC/SEMZ4E1A6BD_index_0.html

ESA - Space Science - Gaia fact...



ESA Home

Space Science		09-Jun-2010
About Space Science		More about...
ESA's 'Cosmic Vision'	Gaia factsheet	• Gaia overview
Science & Technology in-depth	The Galactic census project	Related articles
Multimedia	Name Gaia was originally derived as an acronym for Global Astrometric Interferometer for Astrophysics. This reflected the optical technique of interferometry that was originally planned for use on the spacecraft. However, the working method has now changed. Although the acronym is no longer applicable, the name Gaia remains to provide continuity with the project.	• Why are things in space the shape that they are?
Science images	Description Gaia is a mission that will conduct a census of a thousand million stars in our Galaxy. It will monitor each of its target stars about 70 times during a five-year period, precisely charting their positions, distances, movements, and changes in brightness. Gaia is expected to discover hundreds of thousands of new celestial objects, such as extra-solar planets and failed stars called brown dwarfs. Within our own Solar System, Gaia should observe hundreds of thousands of asteroids.	• How many stars are there in the Universe?
Science videos		Related links
Animations		• The Interactive Books of Gaia
Downloads		
Sounds from space		
RSS feeds		
Media centre		
Press Releases		

Done

Web sites: Corporate level



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http://www.esa.int/esaSC/SEMZ4E1A6BD_index_0.html

ESA - Space Science - Gaia fact...

esa space science

Tools Help

http://www.esa.int/esaSC/SEMZ4E1A6BD_index_0.html

Science & Technology in-depth

Multimedia

Science images

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The Galactic census project

Name Gaia was originally derived as an acronym for Global Astrometric Interferometer for Astrophysics. This reflected the optical technique of interferometry that was originally planned for use on the spacecraft. However, the working method has now changed. Although the acronym is no longer applicable, the name Gaia remains to provide continuity with the project.

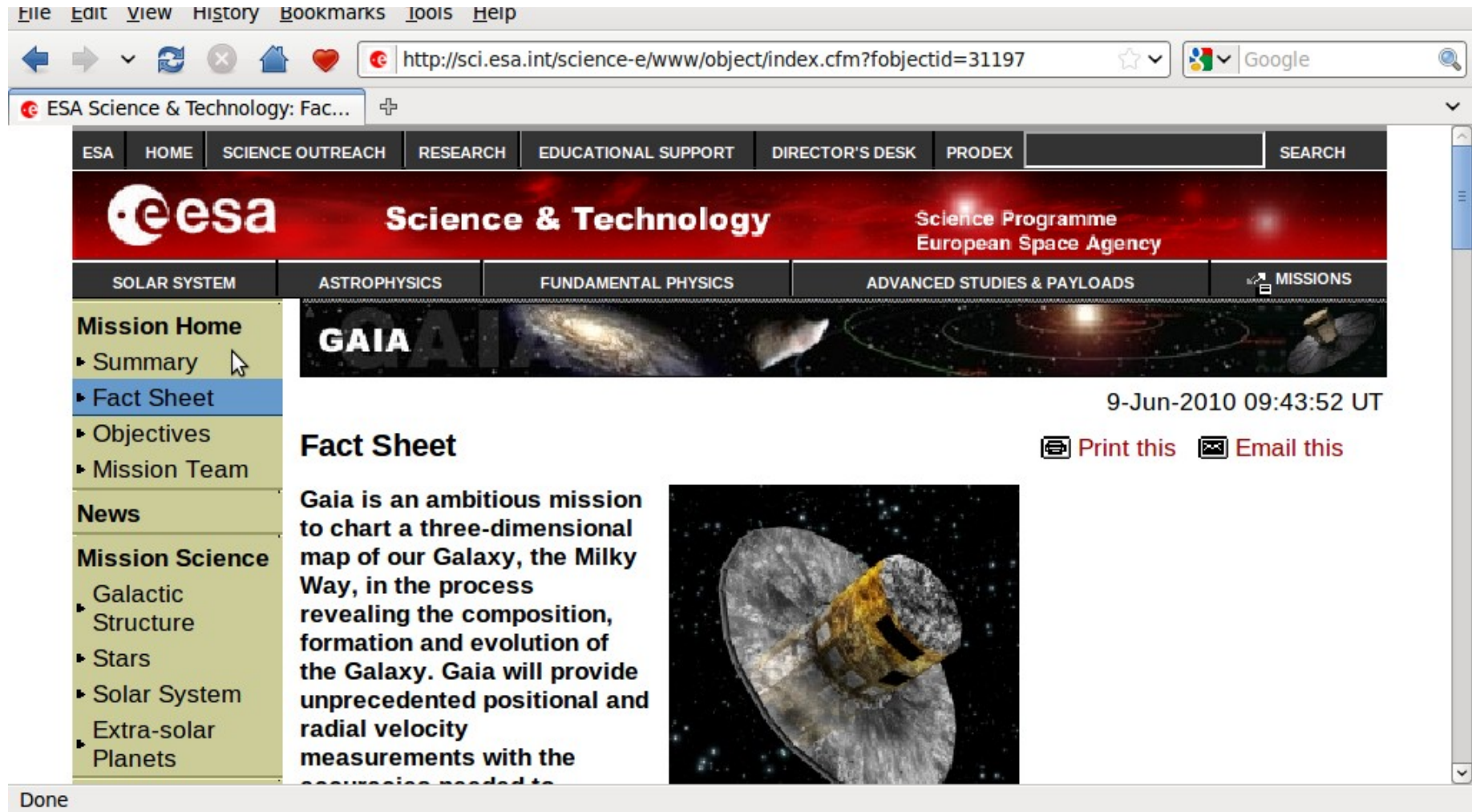
Description Gaia is a mission that will conduct a census of a thousand million stars in our Galaxy. It will monitor each of its target stars about 70 times during a five-year period, precisely charting their positions, distances, movements, and changes in brightness. Gaia is expected to discover hundreds of thousands of new celestial objects, such as extra-solar planets and failed stars called brown dwarfs. Within our own Solar System, Gaia should observe hundreds of thousands of asteroids.

- Why are things in space the shape that they are?
- How many stars are there in the Universe?

Related links

- The Interactive Books of Gaia

Done



The screenshot shows a web browser window displaying the ESA Science & Technology website. The browser's address bar shows the URL: <http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=31197>. The website's navigation menu includes: ESA, HOME, SCIENCE OUTREACH, RESEARCH, EDUCATIONAL SUPPORT, DIRECTOR'S DESK, PRODEX, and SEARCH. The main header features the ESA logo and the text "Science & Technology" and "Science Programme European Space Agency". Below the header, there are tabs for SOLAR SYSTEM, ASTROPHYSICS, FUNDAMENTAL PHYSICS, ADVANCED STUDIES & PAYLOADS, and MISSIONS. The "MISSIONS" tab is active, showing a "Mission Home" menu with options: Summary, Fact Sheet (highlighted), Objectives, and Mission Team. Below the menu, the "Fact Sheet" section is displayed, featuring a large image of the Gaia satellite and the text: "Gaia is an ambitious mission to chart a three-dimensional map of our Galaxy, the Milky Way, in the process revealing the composition, formation and evolution of the Galaxy. Gaia will provide unprecedented positional and radial velocity measurements with the accuracy needed to...". To the right of the text, there is a timestamp "9-Jun-2010 09:43:52 UT" and two buttons: "Print this" and "Email this". At the bottom of the browser window, the word "Done" is visible.

Web sites: Science & Technology level



File Edit View History Bookmarks Tools Help

http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=31197

ESA Science & Technology: Fac...

ESA HOME SCIENCE OUTREACH RESEARCH EDUCATIONAL SUPPORT DIRECTOR'S DESK PRODEX SEARCH

esa Science & Technology Science Programme European Space Agency

Tools Help

http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=31197

- MISSION TEAM
- News
- Mission Science
 - Galactic Structure
 - Stars
 - Solar System
 - Extra-solar Planets

Gaia is an ambitious mission to chart a three-dimensional map of our Galaxy, the Milky Way, in the process revealing the composition, formation and evolution of the Galaxy. Gaia will provide unprecedented positional and radial velocity measurements with the accuracy needed to

Web sites: Research & Scientific Support Department



Gaia: Calendar of meetings, conferences and events - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.rssd.esa.int/index.php?project=GAIA&page=Calendar_of_meetings

Research & Science Home ESA Public Web Site Sci-Tech Portal Gaia Public Web Site Gaia Sci-Tech Portal

esa Gaia European Space Agency

Astrophysics Missions Planetary Exploration Missions Solar Terrestrial Science Missions Fundamental Physics Missions Science Faculty

2-June-2010 14:53:29

Calendar of meetings, conferences & events

Scientific meetings
Please note: Attendance at these meetings is restricted to members of the Gaia Coordination Units

Previous meetings
List of previous scientific, technical & industrial meetings

<i>Title</i>	<i>Dates</i>	<i>Location</i>	<i>Convenor(s) / Local organiser(s)</i>
REMAT #7	3 - 4 June 10	Torino	Klioner
GBOT Software and Observations workshop	8 - 9 June 10	Paris Observatory	Altmann
CU6: Spectroscopic Processing #9	14 - 16 June 10	Observatoire de Paris	Katz
MLA steering committee meeting #6	18 June 10	Paris	Prusti
GST meeting #31	1 - 2 July 10	ESTEC	Prusti
DPACE #11	6 - 7 July 10	CNES	Mignard

Web sites: Research & Scientific Support Department



Gaia: Calendar of meetings, conferences and events - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.rssd.esa.int/index.php?project=GAIA&page=Calendar_of_meetings

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ESA Public Web Site Sci-Tech Portal

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DSPACE #11	6 - 7 July 10	CNES	Mignard

General structure of a web page



Gaia: Calendar of meetings, conferences and events - Mozilla Firefox

File Edit View History Bookmarks Tools Help

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2-June-2010 14:00:29

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GST meeting #31	1 - 2 July 10	ESTEC	Prusti
DPACE #11	6 - 7 July 10	CNES	Mignard

Public documents



Gaia: Library - Selected papers - Mozilla Firefox

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http://www.rssd.esa.int/index.php?project=GAIA&page=Library_selected_papers

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2-June-2010 16:27:43

Gaia library

The library collates selected papers and articles on the Gaia mission, and on scientific or technical topics relevant to Gaia. Included in this section are some key papers describing the project, links to reference documents and a list of acronyms, peer-reviewed papers on scientific topics covered by Gaia (see also astro-ph and ADS search links on the right-hand menu), conference proceedings and publications issued by ESA (see right-hand menu).

- 1. Livelink (restricted access documents)
- 2. Public access documents
 - 2.1. Conference proceedings & reports
 - 2.2. Selected papers
 - 2.3. Reference documents
 - 2.4. DPAC public documents

1. Livelink - the Gaia scientific document management system (restricted access documents)

Livelink is the document management system used for scientific documents from Gaia. Livelink is password protected and is intended to be used only by individuals working on Gaia. Users with a personal Gaia user name and password may access Livelink once they have logged on to MyPortal (see right-hand menu).

Quick access to Livelink (you must be logged in to MyPortal to access):
[Gaia Livelink Entry Page](#)

Reference Systems, Conventions and Notations for Gaia

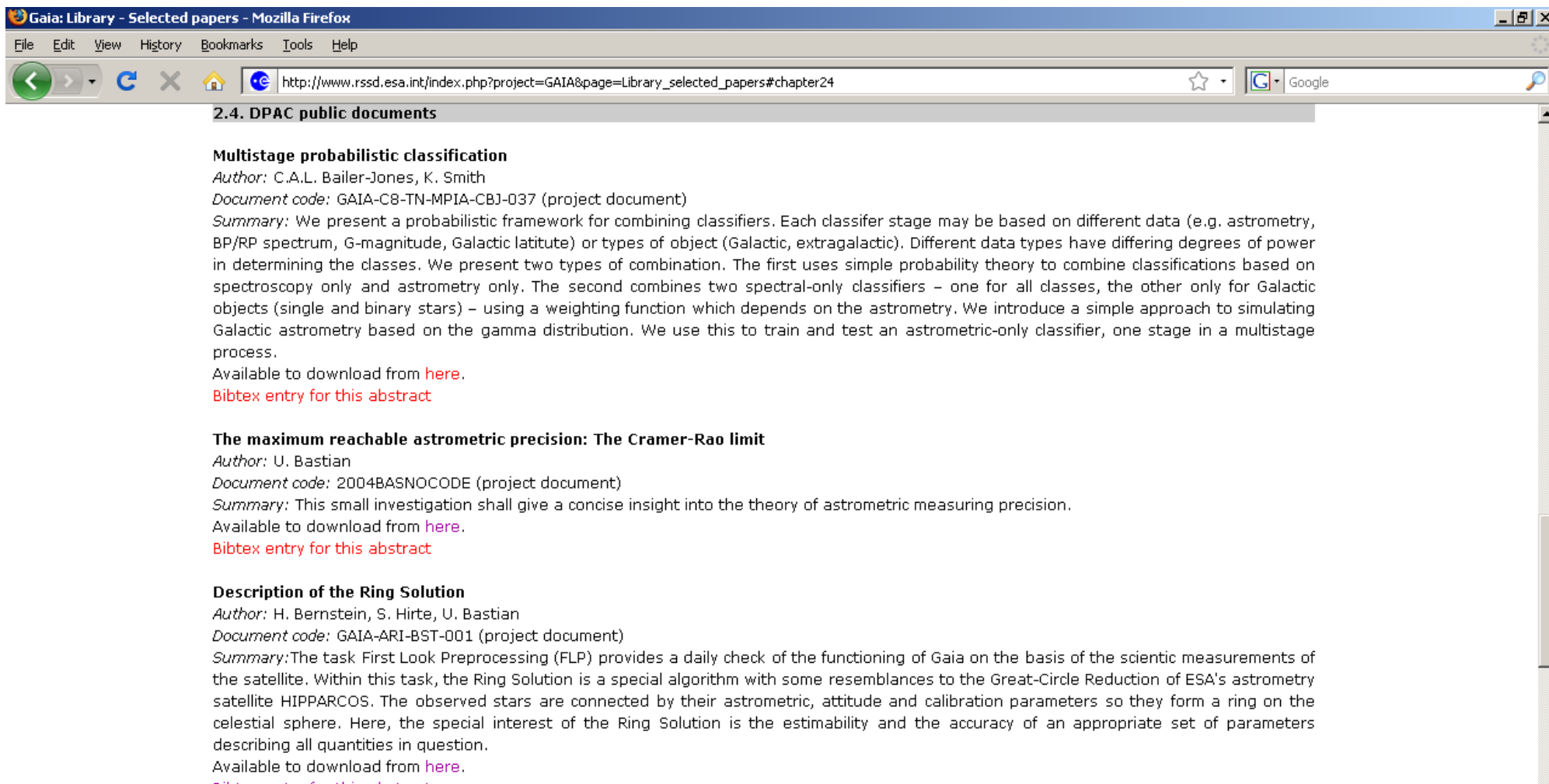
Author: U. Bastian
Published in: unpublished - project document

Library & Livelink

- Home
- News from Gaia
- Gaia in the media
- Gaia on ESA's web sites
- Gaia Resources**
- DPAC
- Who's who in Gaia?
- Library & Livelink**
- Science performance
- Tools, data & software
- Related sites
- Gaia Opportunities**
- For research
- Vacancies
- Gaia Visual Material**
- Image gallery
- Multimedia gallery
- Gaia Outreach**
- Flyers
- Posters
- Little Books of Gaia
- Gaia Interactive Books
- Make a Gaia Model
- Information sheets

Livelink

- Access the Gaia scientific document management system [Restricted access]
- DMS / PRISMA**
- Access the ESA Prisma Portal [Restricted access]
- Selected papers**
- Project description, reference documents, and other key scientific papers from Gaia
- Conference proceedings**
- Conference proceedings relevant to Gaia
- ESA publications**
- Gaia publications from ESA
- Preprints from astro-ph**
- General query form
- Gaia preprints from the past 12 months
- ADS abstract service**
- General query form
- Gaia peer-reviewed publications in 2010
- Gaia peer-reviewed publications in 2009
- Gaia peer-reviewed publications in 2008
- Gaia peer-reviewed publications in 2007



2.4. DPAC public documents

Multistage probabilistic classification
Author: C.A.L. Bailer-Jones, K. Smith
Document code: GAIA-C8-TN-MPIA-CBJ-037 (project document)
Summary: We present a probabilistic framework for combining classifiers. Each classifier stage may be based on different data (e.g. astrometry, BP/RP spectrum, G-magnitude, Galactic latitude) or types of object (Galactic, extragalactic). Different data types have differing degrees of power in determining the classes. We present two types of combination. The first uses simple probability theory to combine classifications based on spectroscopy only and astrometry only. The second combines two spectral-only classifiers – one for all classes, the other only for Galactic objects (single and binary stars) – using a weighting function which depends on the astrometry. We introduce a simple approach to simulating Galactic astrometry based on the gamma distribution. We use this to train and test an astrometric-only classifier, one stage in a multistage process.
Available to download from [here](#).
[Bibtex entry for this abstract](#)

The maximum reachable astrometric precision: The Cramer-Rao limit
Author: U. Bastian
Document code: 2004BASNOCODE (project document)
Summary: This small investigation shall give a concise insight into the theory of astrometric measuring precision.
Available to download from [here](#).
[Bibtex entry for this abstract](#)

Description of the Ring Solution
Author: H. Bernstein, S. Hirte, U. Bastian
Document code: GAIA-ARI-BST-001 (project document)
Summary: The task First Look Preprocessing (FLP) provides a daily check of the functioning of Gaia on the basis of the scientific measurements of the satellite. Within this task, the Ring Solution is a special algorithm with some resemblances to the Great-Circle Reduction of ESA's astrometry satellite HIPPARCOS. The observed stars are connected by their astrometric, attitude and calibration parameters so they form a ring on the celestial sphere. Here, the special interest of the Ring Solution is the estimability and the accuracy of an appropriate set of parameters describing all quantities in question.
Available to download from [here](#).

Science performance web page



Research & Science Home | ESA Public Web Site | Sci-Tech Portal | Gaia Public Web Site | Gaia Sci-Tech Portal

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Science Performance

Gaia will perform micro-arcsecond (μas) global astrometry down to 20-th magnitude by linking objects with both small and large angular distance in a network in which each object is connected to a large number of other objects in every direction.

Photometric observations will be collected, at the same angular resolution as the astrometric observations and for all objects observed astrometrically, to:

- enable **chromatic corrections** of the astrometric observations, and
- provide astrophysical information, such as interstellar reddenings and effective temperatures, for all observed objects.

Spectroscopic observations will be collected down to $V = 17$ mag, to:

- provide radial velocities through Doppler-shift measurements using cross-correlation;
- provide astrophysical information, such as interstellar reddening, atmospheric parameters, and rotation velocities, for stars brighter than $V \approx 13$ mag; and
- provide element abundances for stars brighter than $V \approx 12$ mag.

In the scientific performance assessments for Gaia, all known instrumental effects are included under the appropriate in-flight operating conditions (temperature, CCD operating mode, etc.). All error sources are included as random variables with typical/average/expected deviations (as opposed to best-case or worst-case deviations). All performance estimates include a 20% contingency margin. This margin is an ESA science margin, neither meant for nor available to the industrial system-level team. The scientific margin is assumed to cover, among others:

- "scientific uncertainties" in the on-ground data analysis, including uncertainties related to relativistic corrections, aberration corrections,

Navigation: Home, News from Gaia, Gaia in the media, Gaia on ESA's web sites, Gaia Resources, DPAC, Who's who in Gaia?, Calendar of meetings, Library & Livelink, Science performance, Related sites, Gaia Opportunities, For research, Vacancies, Gaia Visual Material, Image gallery, Multimedia gallery, Gaia Outreach, Flyers, Posters, Little Books of Gaia, Gaia Interactive Books, Make a Gaia Model.

Navigation: Astrometric performance, Photometric performance, Spectroscopic performance

Science performance web page



1. Astrometric performance

The end-of-mission parallax standard error, averaged over the sky, for unreddened B1V, G2V, and M6V stars shall comply with the following requirements:

	B1V	G2V	M6V
V < 10 mag	< 7 μas	< 7 μas	< 7 μas
V = 15 mag	< 25 μas	< 24 μas	< 12 μas
V = 20 mag	< 300 μas	< 300 μas	< 100 μas

The end-of-mission systematic parallax errors for unreddened B1V, G2V, and M6V stars shall be lower than 1 μas.

The astrometric standard errors are calculated following the recipe outlined in [GAIA-JDB-022](#). The standard-error calculation includes all known instrumental effects. For instrument-related residual calibration errors at ground-processing (DPAC) level, an appropriate calibration error is included. So-called residual "scientific calibration errors" (e.g., mismatch of the model PSF, sky-background estimation errors, etc.), all of which result from the on-ground data processing, are not included. These latter errors are assumed to be covered by the 20% science margin.

A simple performance model, including a V-I colour term representing the widening of the PSF at longer wavelengths, which reproduces the end-of-mission parallax-standard-error requirements listed above for an unreddened G2V star (V-I = 0.75 mag, V-G = 0.16 mag), and which provides a sensible interpolation in between the three data points, is:

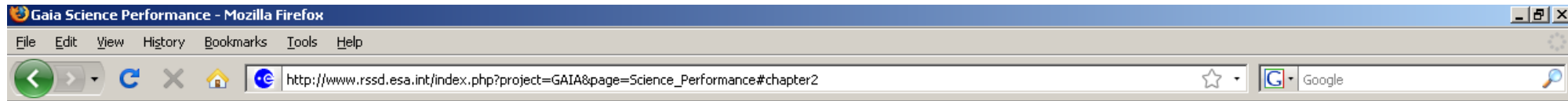
$$\sigma_n [\mu\text{as}] = \sqrt{(9.3 + 658.1 z + 4.568 z^2) [0.986 + (1 - 0.986) (V-I)]},$$

where

$$z = \text{MAX}[10^{0.4 (11.95 - 15)}, 10^{0.4 (G - 15)}].$$

For stars brighter than G = 11.95 mag, shorter CCD integration times (through the use of [TDI gates](#)) are nominally used to avoid saturation. The MAX function in the equation above allows to ignore this "complication" and provides a constant bright-star parallax noise floor, at $\sigma_n = 7$ μas, for stars with G < 11.95 mag.

Science performance web page



2. Photometric performance

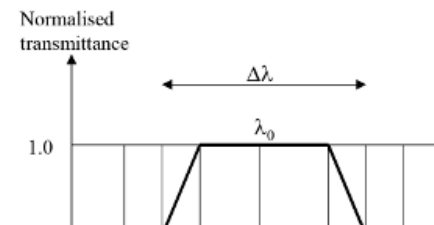
The end-of-mission photometric standard errors, averaged over the sky, for unreddened B1V, G2V, and M6V stars shall comply with the following requirements:

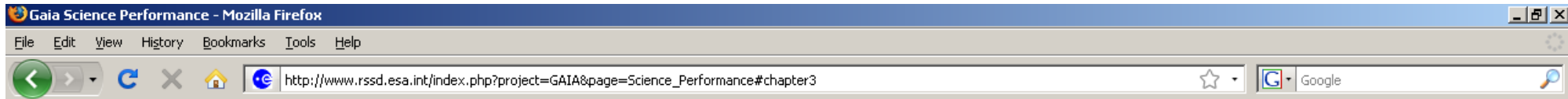
Photometric band	V [mag]	B1V	G2V	M6V
C1M344	15	< 10 mmag	< 15 mmag	< 100 mmag
	20	< 150 mmag	< 1000 mmag	-
C1M410	15	< 10 mmag	< 10 mmag	< 20 mmag
	20	< 60 mmag	< 200 mmag	< 1100 mmag
C1M549	15	< 8 mmag	< 8 mmag	< 8 mmag
	20	< 120 mmag	< 120 mmag	< 120 mmag
C1M965	15	< 20 mmag	< 10 mmag	< 10 mmag
	20	< 400 mmag	< 150 mmag	< 10 mmag

Note: all requirements at V = 20 mag, as well as the requirement at V = 15 mag for the C1M344 band, are formally considered as design goals.

The photometric bands defined in the table above are historical in nature [<http://adsabs.harvard.edu/abs/2006MNRAS.367..290J>] and have no direct physical interpretation for actual Gaia photometry, which is based on low-resolution, dispersive, spectro-photometry using the Blue and Red Photometers (BP and RP). With λ_0 defining the central wavelength of a band and $\Delta\lambda$ denoting the bandwidth (Full Width at Half Maximum), the bands are defined as follows (see also Table 4 in <http://adsabs.harvard.edu/abs/2006MNRAS.367..290J>):

Band	λ_0 [nm]	$\Delta\lambda$ [nm]
C1M344	343.5	47
C1M410	410	20
C1M549	549	22





3. Spectroscopic performance

The end-of-mission radial-velocity robust formal errors, averaged over the sky, for unreddened B1V, G2V, and K1IIIIMP (MP = metal-poor) stars shall comply with the following requirements:

Spectral type	V [mag]	Radial-velocity error [km/s]
B1V	7	<1
	12	<15
G2V	13	<1
	16.5	<15
K1IIIIMP	13.5	<1
	17	<15

The maximum instrumental systematic radial-velocity error, after calibration, shall be smaller than 300 m/s.

Radial-velocity robust formal errors are calculated following the recipe outlined in [GAIA-JDB-022](#). The calculation methodology requires, for all stars and magnitudes, that one single end-of-mission composite spectrum is first reconstructed by proper co-addition of all spectra collected during all CCD crossings throughout the mission lifetime. A single mission-averaged radial velocity is then extracted from this end-of-mission composite spectrum by cross correlation with a template spectrum. The spectroscopic performance requirements in the table above refer to this assumed procedure, although it is foreseen in the a posteriori on-ground data analysis by DPAC to actually derive single-field-of-view transit spectra, and to extract associated epoch radial velocities, whenever this proves possible in practice.

The robust-formal-error calculation includes all known instrumental effects. For instrument-related residual calibration errors at ground-processing (DPAC) level, an appropriate calibration error is included. So-called residual "scientific calibration errors" (e.g., template-mismatch errors, residual errors in the derivation of the locations of the centroids of the reference spectral lines used for the wavelength calibration, etc.), all of which result from the on-ground data processing, are not included.

This [table](#) and this [figure](#) provide the radial-velocity robust formal error, at the end of the mission, for a variety of stars as function of V magnitude. The data are based on [GAIA-C6-TN-OPM-PS-006](#) (access restricted to DPAC members) and have been scaled to meet the performance requirements summarised above.

Gaia Image gallery - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.rssd.esa.int/index.php?project=GAIA&page=Image_Gallery

Research & Science Home ESA Public Web Site Sci-Tech Portal Gaia Public Web Site Gaia Sci-Tech Portal

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2-June-2010 16:55:31


Image & movie gallery

The image gallery contains a selection of images and movies from the Gaia mission. The images are grouped into categories broadly covering Spacecraft, Payload, Service Module, Launch, Science and Operations.

Movies (click here to access 2 movies available)



Spacecraft (click here to access 5 pictures available)



Payload (click here to access 23 pictures available)

- Overview (2)

Image gallery



Image gallery: Gaia vodcast - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.rssd.esa.int/index.php?project=GAIA&page=IG_vodcast

- DPAC
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- Library & Livelihood
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- Gaia Services**
- FAQ
- Contact us
- Restricted Items**
- IT Services
- Document Portal
- My Portal
- Logged in as chlasco
- Logoff
- Search



Science@ESA, Episode 6
"Charting the Galaxy -
from Hipparcos to Gaia"

The main content area of the browser window displays a large image. The image features a central view through the Gaia telescope's field of view, showing a dense field of stars. A prominent yellow planet is visible in the center of the field. The image is framed by a teal border at the top and bottom. The bottom section of the image contains the text: "Science@ESA, Episode 6 'Charting the Galaxy - from Hipparcos to Gaia'".

Image gallery



Browser window: Gaia - Taking the Galactic Census - Mozilla Firefox
Address bar: http://www.rssd.esa.int/index.php?project=GAIA&page=index

Navigation: Research & Science Home, ESA Public Web Site, Sci-Tech Portal, Gaia Public Web Site, Gaia Sci-Tech Portal

Header: Gaia, European Space Agency

Sub-headers: Astrophysics Missions, Planetary Exploration Missions, Solar Terrestrial Science Missions, Fundamental Physics Missions, Science Faculty

Timestamp: 3-June-2010 17:48:06



Welcome to ESA's web site for the Gaia scientific community. For more about this and other Gaia web sites follow the ' [More about Gaia](#) ' link.

News & Announcements from Gaia

2010-05-11 Post-doc position on Gaia spectrometer pipeline development at the Astrophysikalisches Institut Potsdam (AIP)
Applications are invited for a post-doc position at the AIP to help develop elements of the spectroscopic pipeline of Gaia. The main task will be to continue the code development of the background model for the Gaia Radial Velocity Spectrometer (RVS), integration and testing of the code, and writing of documentation. The successful applicant will work in close collaboration with the Observatoire de Paris group that is leading the development of the RVS data reduction pipeline. The applicant should have experience with spectroscopic data and code development and preferably have a research profile related to Gaia science.
The initial appointment will be for one year, with extension to a second and a possible third year foreseen. Review of the applications will start immediately and continue until the position is filled. Salary is based on the German public service scale (TV-L; included are employer contributions to medical and dental insurance, maternity leave, and retirement benefits). The AIP is an equal opportunity employer and particularly encourages applications from women. It values diversity. For further questions please contact [Dr. Roelof de Jong](#). More details can be found at the following [web site](#).

2010-05-03 Postdoctoral position related to open clusters and Gaia in Bordeaux
The Laboratoire d'Astrophysique de Bordeaux (LAB) carries out observational, interpretative and theoretical research in various fields of astrophysics. In this context, applications are invited for a postdoctoral fellow to work on several research topics, including astrometry and spectroscopy of open clusters and young associations for probing the galactic disc in the perspective of Gaia. For more information, visit the following [web page](#). **Deadline for applications: June 1, 2010.**

2010-04-29 Release of the new issue of the DPAC Newsletter
The [DPAC Newsletter no. 8](#) is now available and there you will find information about the Critical Design Review of the Payload Module, how

Mission Status
Launch: August-2012
Now in phase C/D
Preliminary design review:
Completed June 2007
DPAC payload completed mid-2005
Picture of the Week

M4 mirror

Mercedes Ramos-Lerate
Forthcoming meetings
REMAT #7
3-4 June
Torino
GBT Software and Observations

Gaia - Taking the Galactic Census - Posters - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.rssd.esa.int/index.php?project=GAIA&page=Posters

Research & Science Home ESA Public Web Site Sci-Tech Portal Gaia Public Web Site Gaia Sci-Tech Portal

esa Gaia European Space Agency

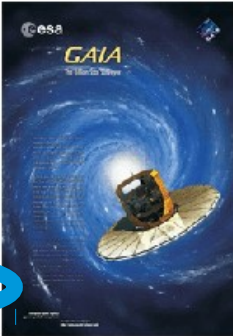
Astrophysics Missions Planetary Exploration Missions Solar Terrestrial Science Missions Fundamental Physics Missions Science Faculty


2-June-2010 16:35:53


Gaia Posters

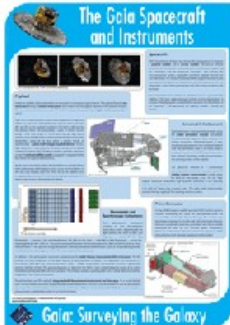
A number of general posters about the Gaia mission have been produced. Most of these were prepared by Jane Douglas, Young Graduate Trainee in the Gaia Project Scientist's Support Team, 2006-2007. The posters are available as pdf files in A1 format (594mm x 841mm); they can be scaled to any reasonable size for printing. Click on the image thumbnail, or the pdf link, to download the file.

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 - Information sheets

Gaia Mission Poster

Produced by: ESA Science
Available in a number of formats [here](#)

Industrial involvement in the Gaia spacecraft

Produced by: C. Blasco
Available as [pdf file](#) (16M).

Gaia Mission Overview

Produced by: J. Douglas
Available as [pdf file](#) (19M).

The Gaia Spacecraft and Instruments

Produced by: J. Douglas
Available as [pdf file](#) (16M).

Information sheets



Gaia: Information sheets: Accuracy - Mozilla Firefox

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- Data Analysis Principle [OBSOLETE]
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Information sheets

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- Science Topics
- Concept & technology study**
Extract from the report of the "Concept & technology study" published in 2000
- Other factsheets**
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Die Kleinen Gaia-Bücher
Die Kleinen Gaia-Bücher sind Zusammenfassungen der Gaia-Mission auf DIN-A4 großen Seiten, die sich zu kleinen Büchlein zusammenfalten lassen. Diese

- There are many resources available for you to make use of them
- Feedback and collaborations are welcome