Gaia outreach features available to the scientific community

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Gaia: at the frontiers of astrometry

11/06/2010

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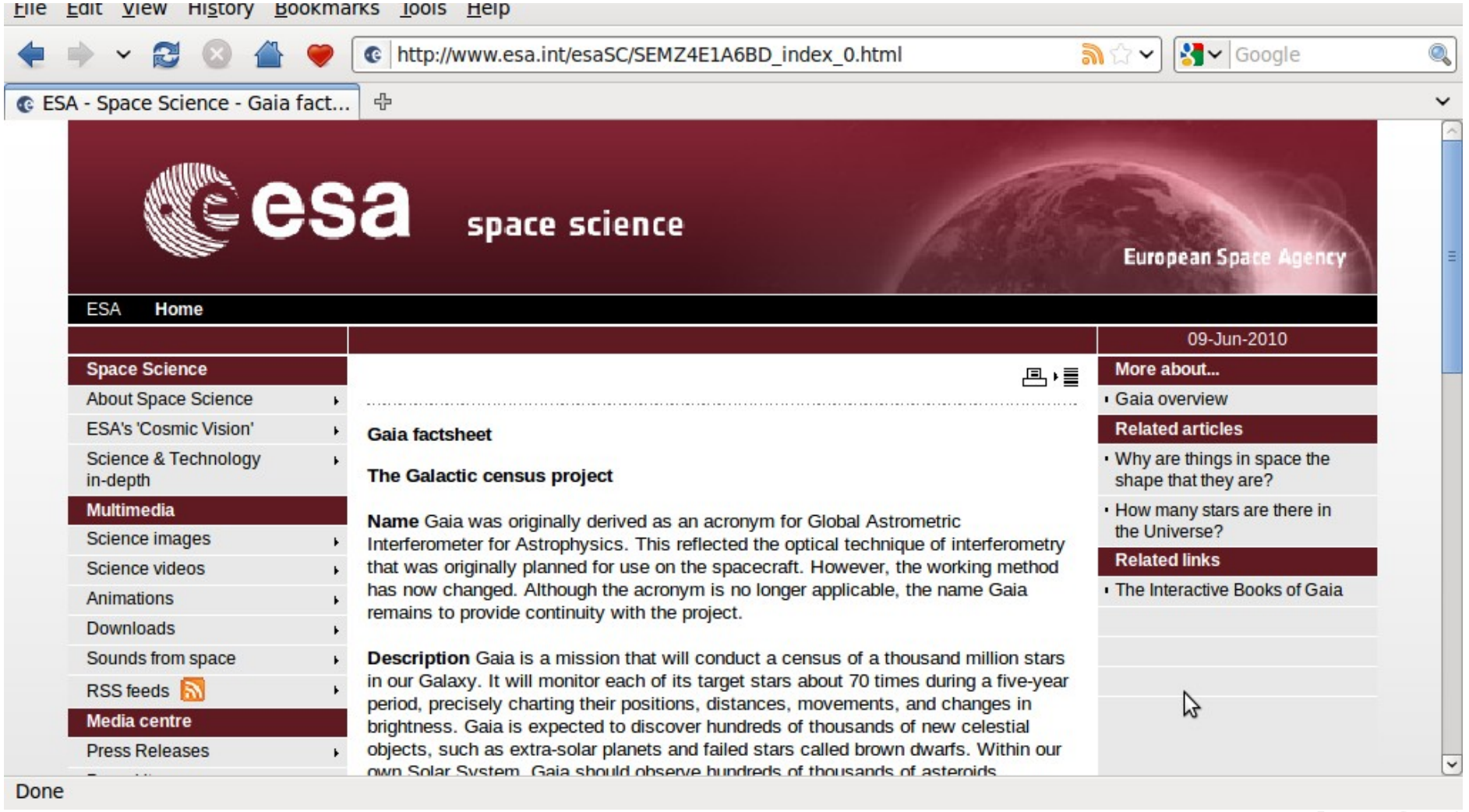
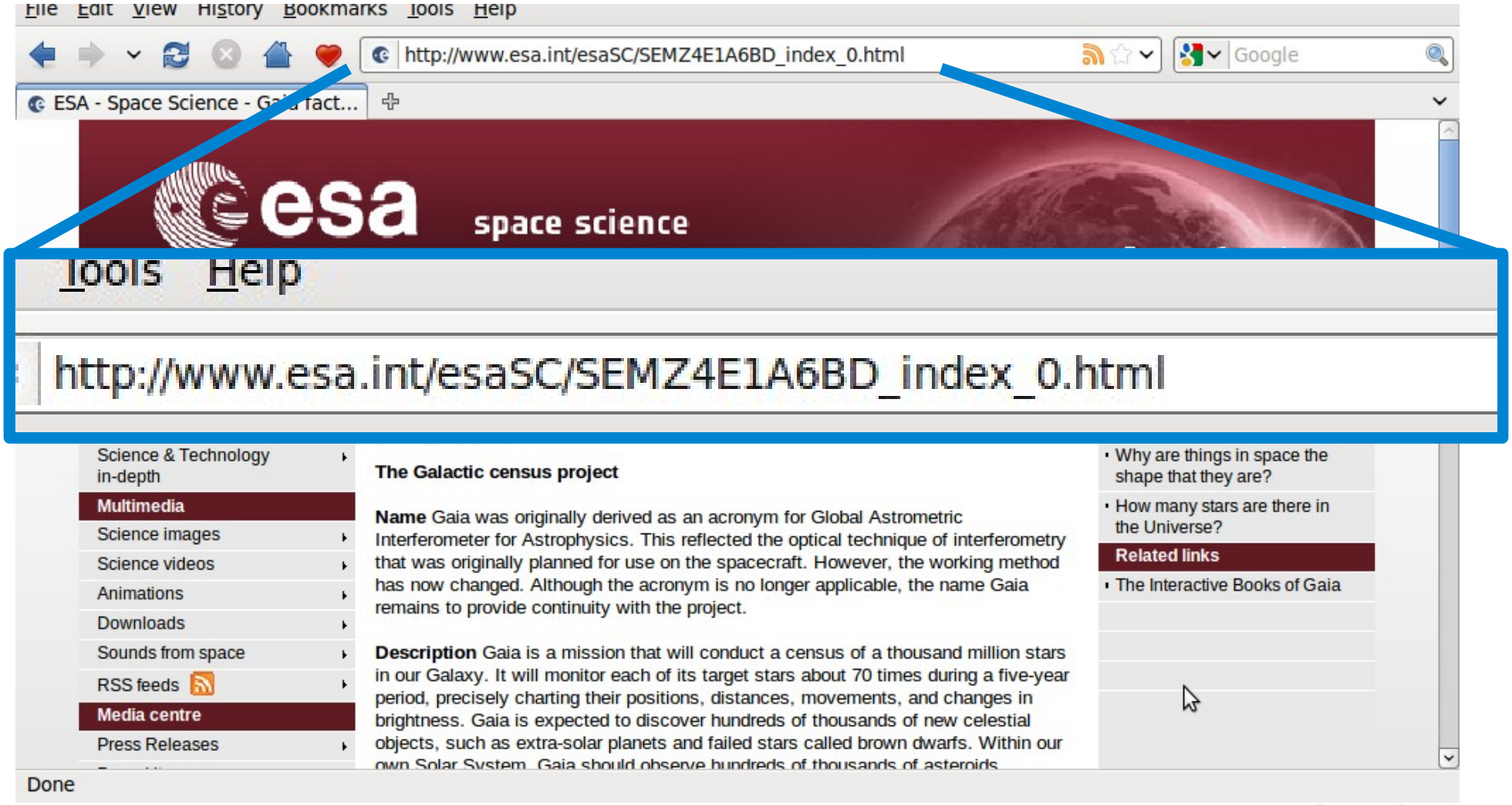
- For general public:
  - Little Books of Gaia

Web sites: Corporate level



Web sites: Corporate level



Web sites: Science & Technology level

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

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GAIA

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Fact Sheet

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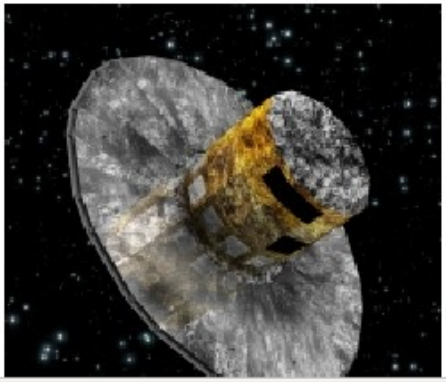
Gaia is an ambitious mission to chart a three-dimensional map of our Galaxy, the Milky Way, in the process revealing the composition, formation and evolution of the Galaxy. Gaia will provide unprecedented positional and radial velocity measurements with the



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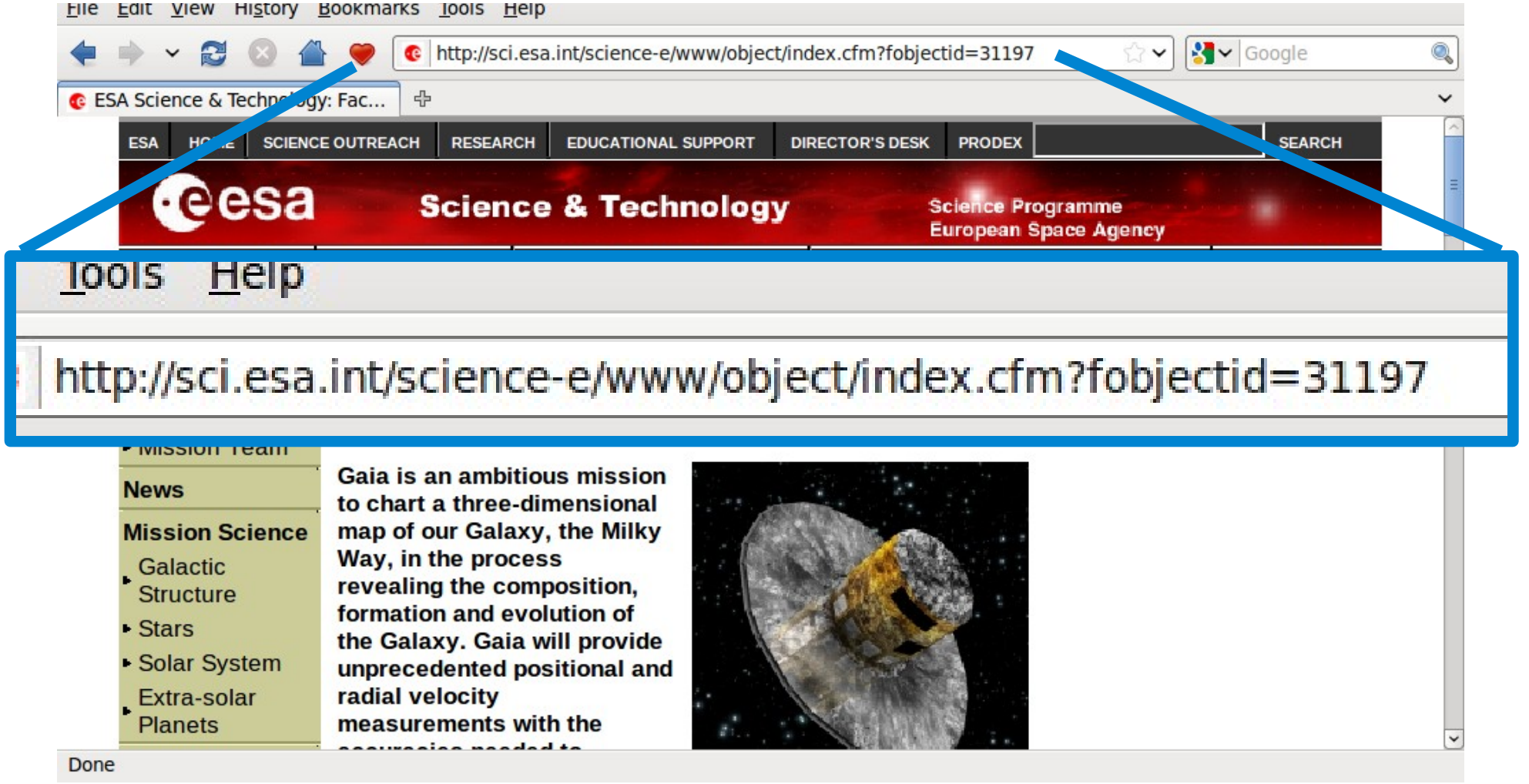
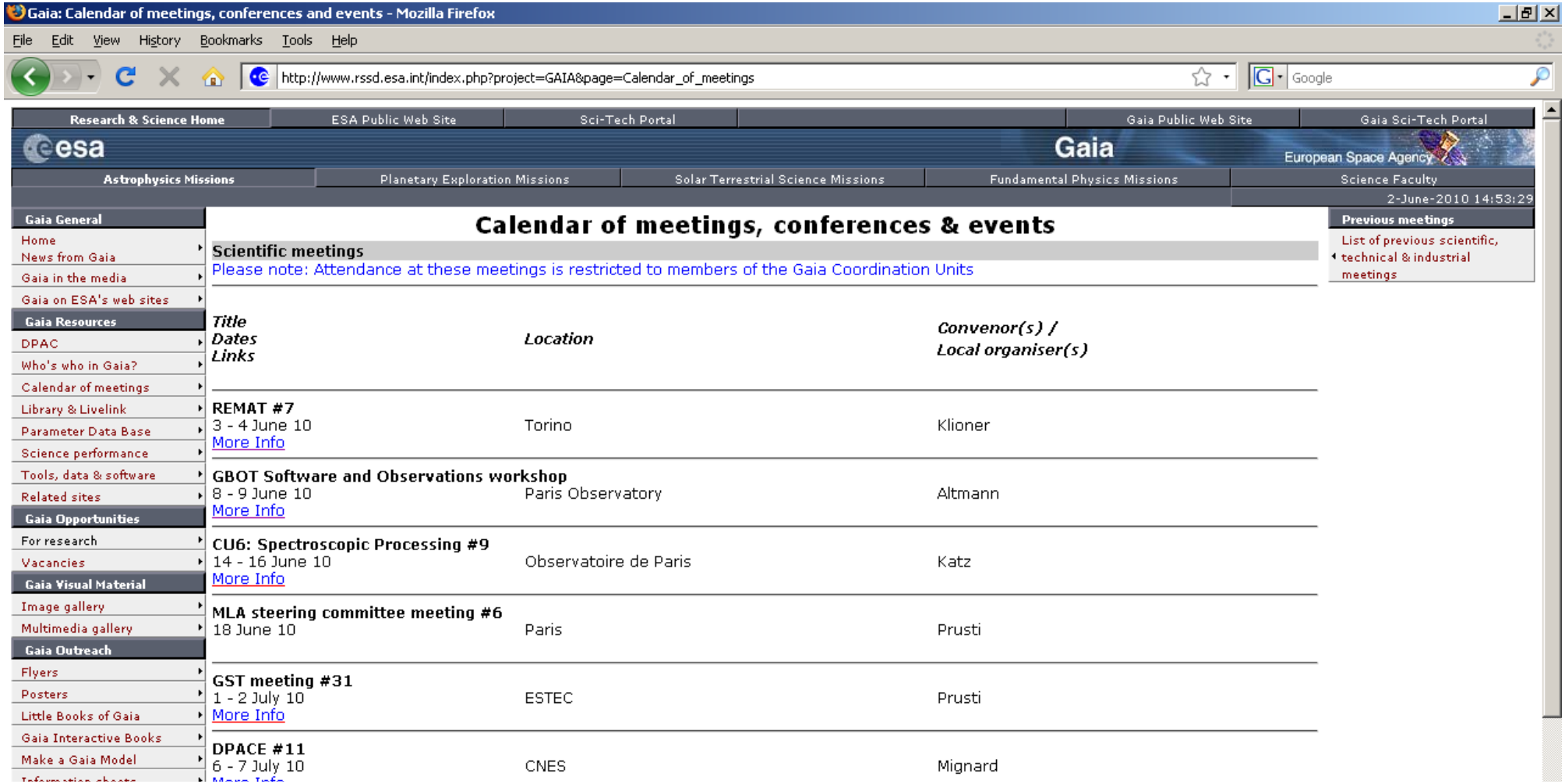
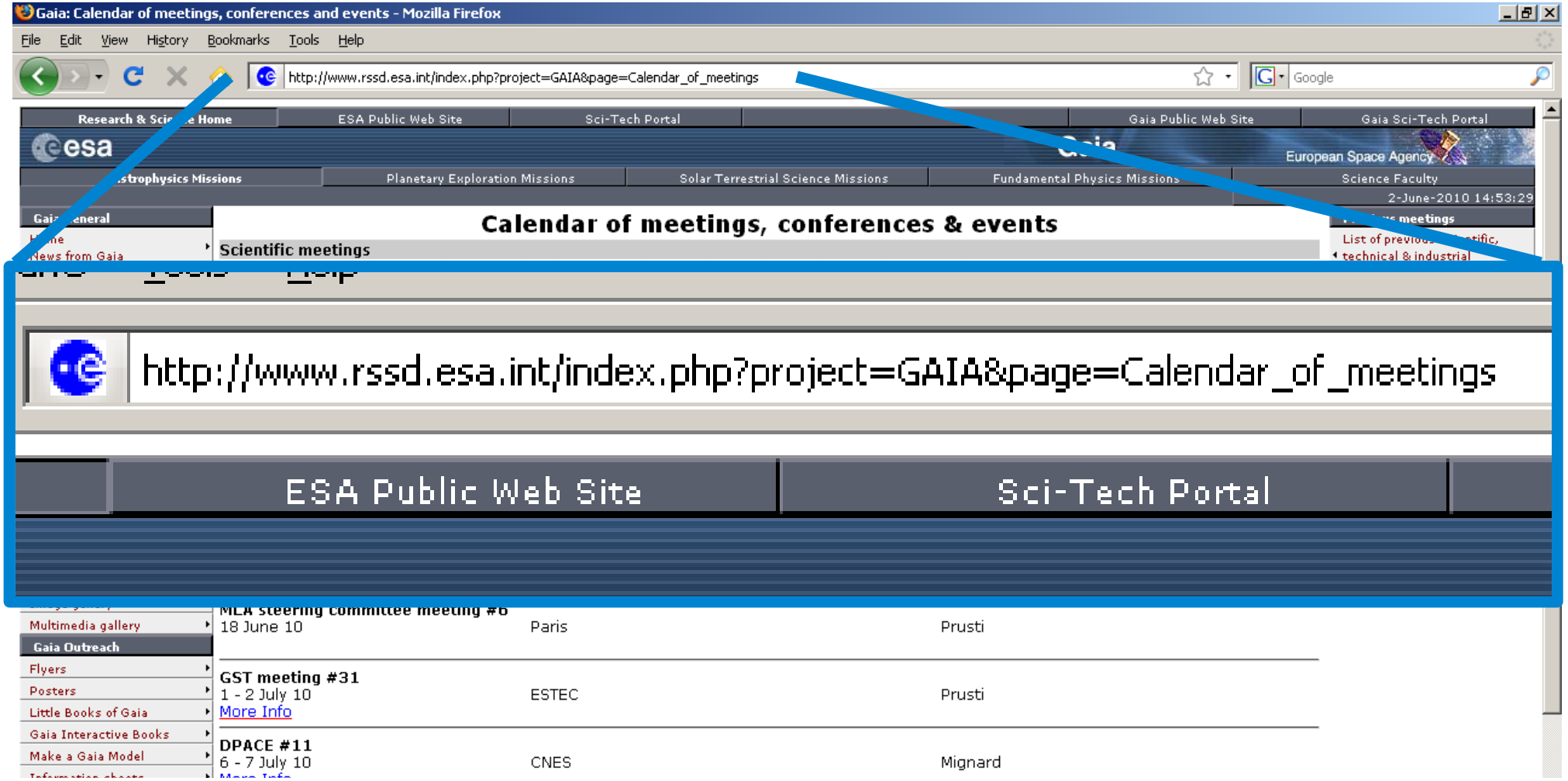
Web sites: Science & Technology level



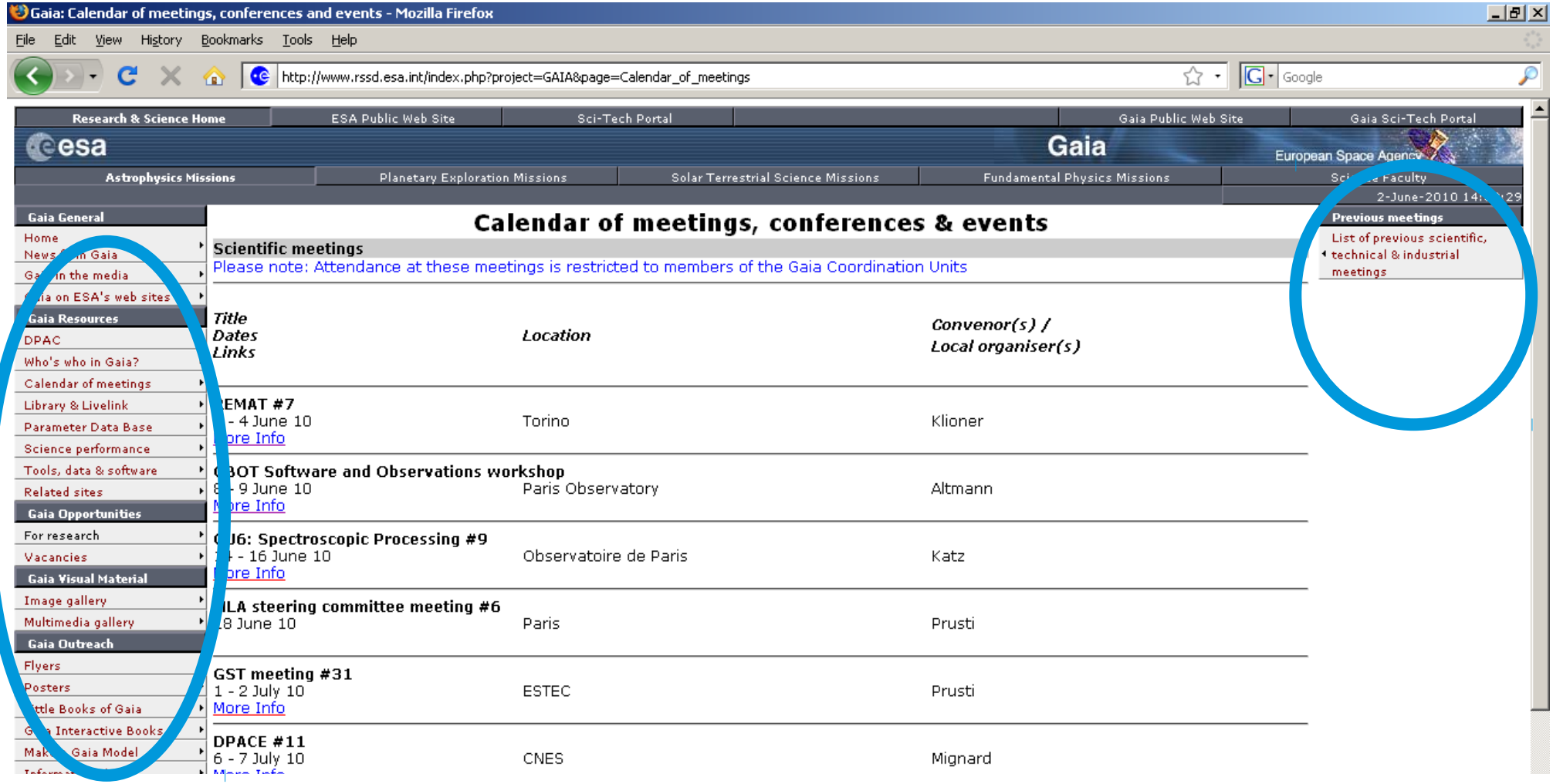
Web sites: Research & Scientific Support Department



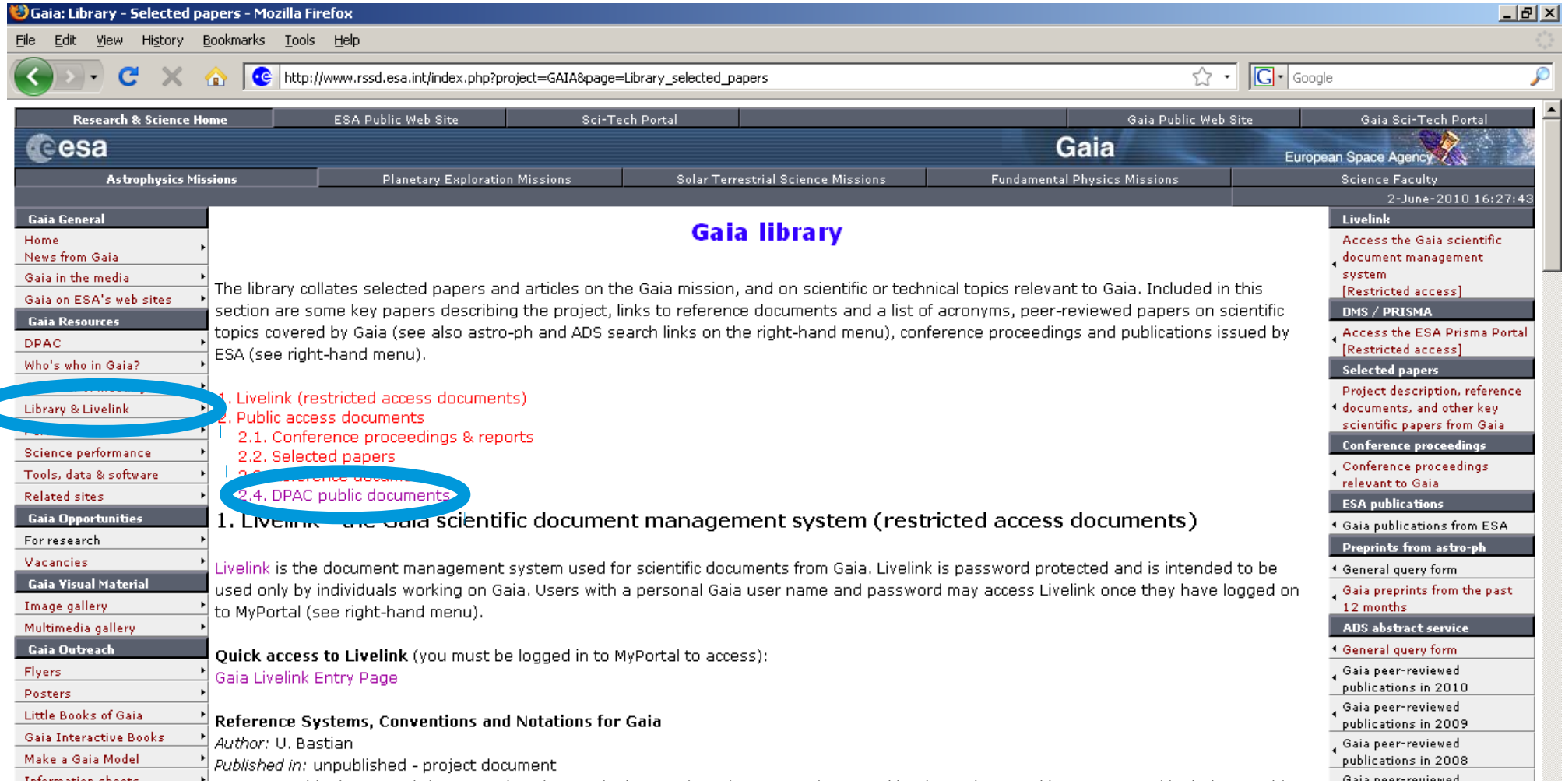
Web sites: Research & Scientific Support Department



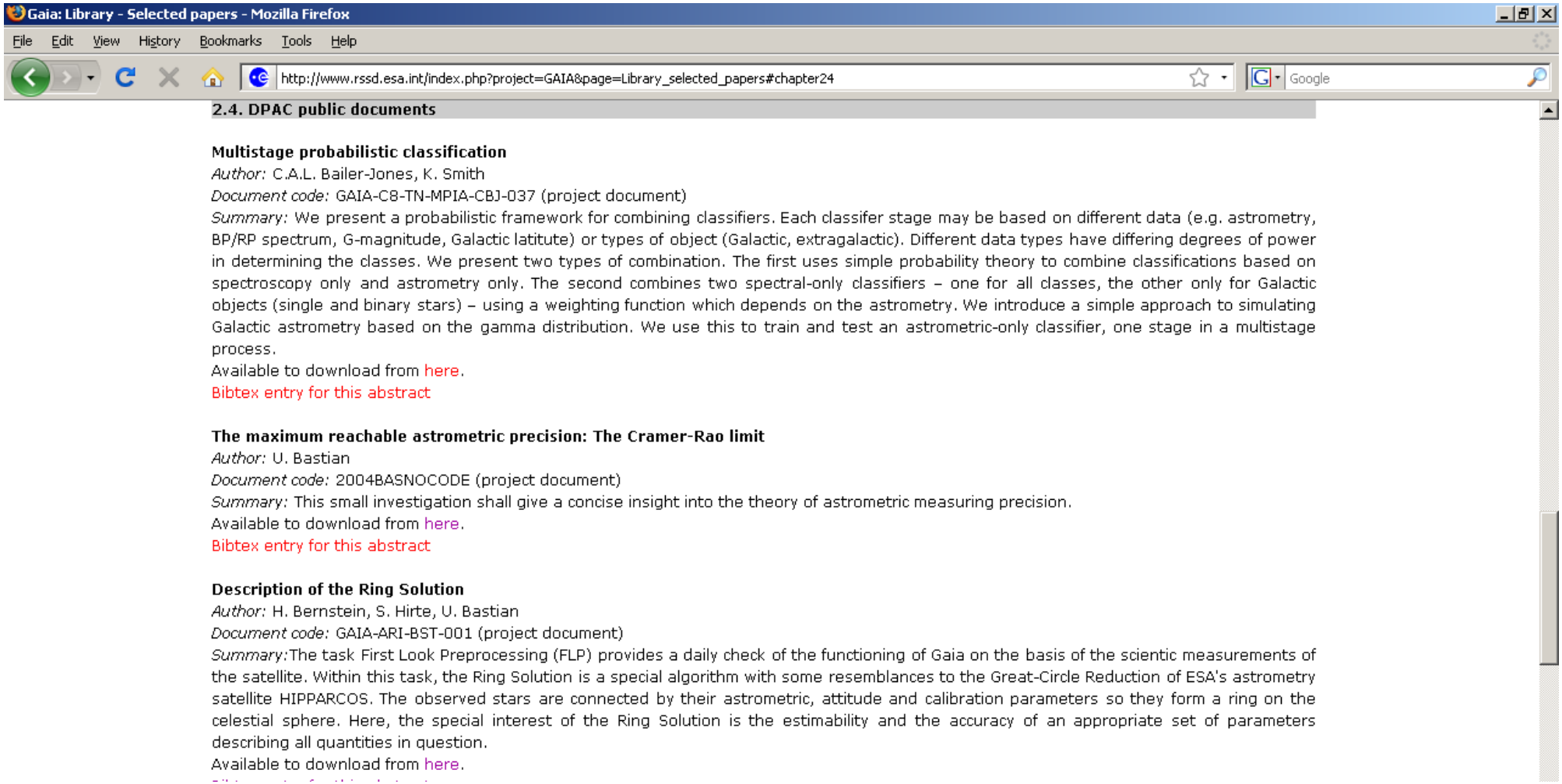
General structure of a web page



Public documents



Public documents



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 classifer stage may be based on different data (e.g. astrometry, BP/RP spectrum, G-magnitude, Galactic latitute) 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 scientic 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.
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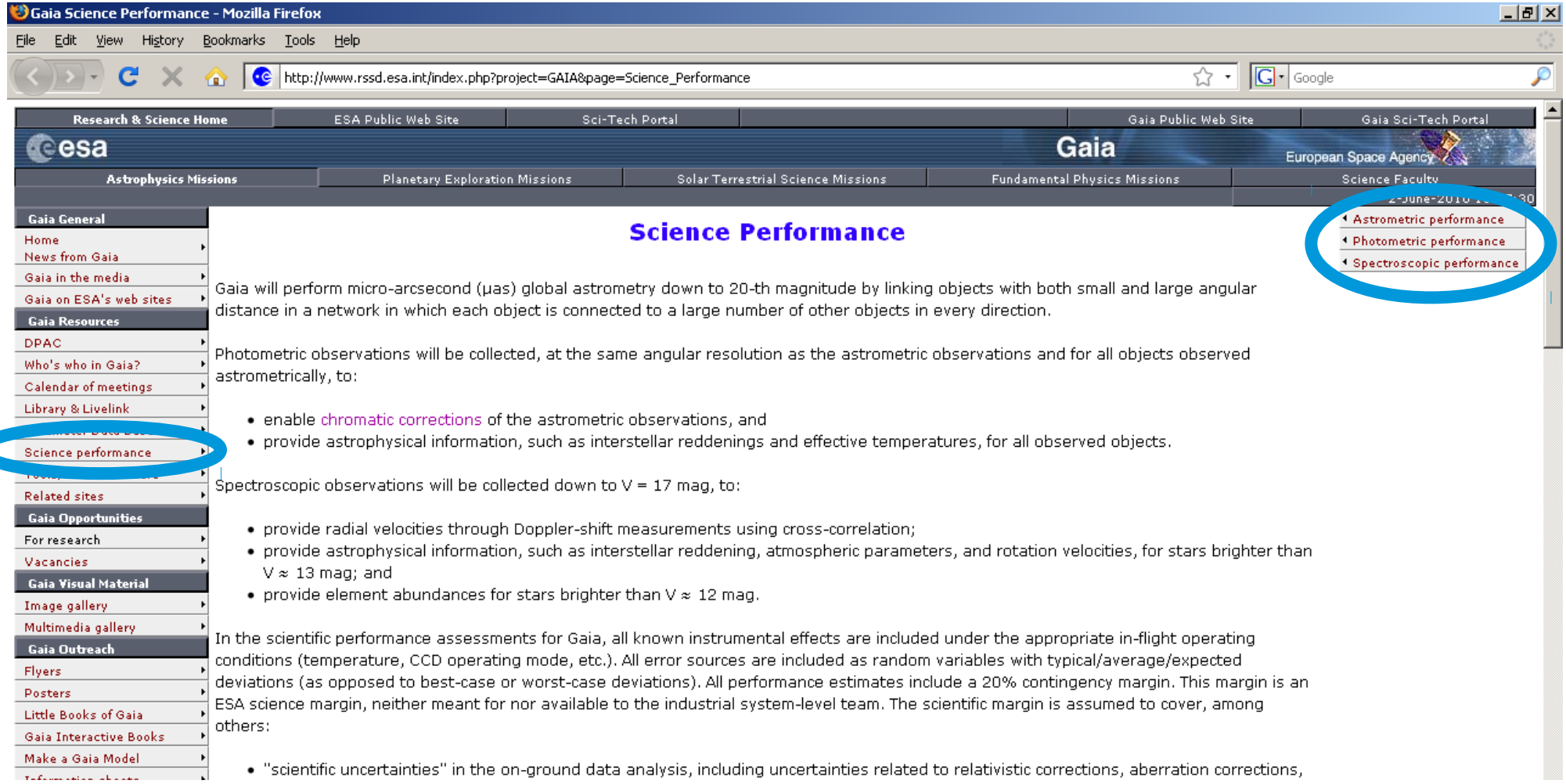
Science performance web page



Science performance web page

Gaia Science Performance - Mozilla Firefox

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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:

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

where

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

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 σ_π = 7 μas, for stars with G < 11.95 mag.

Science performance web page

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http://www.rssd.esa.int/index.php?project=GAIA&page=Science_Performance#chapter2

2. Photometric performance

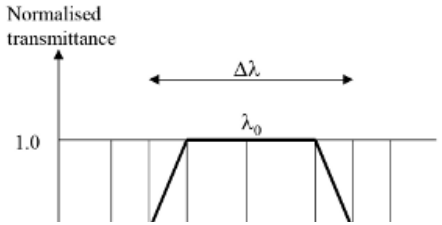
The end-of-mission photometric standard errors, averaged over the sky, for unreddened B1V, G2V, and M6V stars shall comply with the following requirements:

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



Science performance web page

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3. Spectroscopic performance

The end-of-mission radial-velocity robust formal errors, averaged over the sky, for unreddened B1V, G2V, and K1IIIMP (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
K1IIIMP	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.

Image gallery

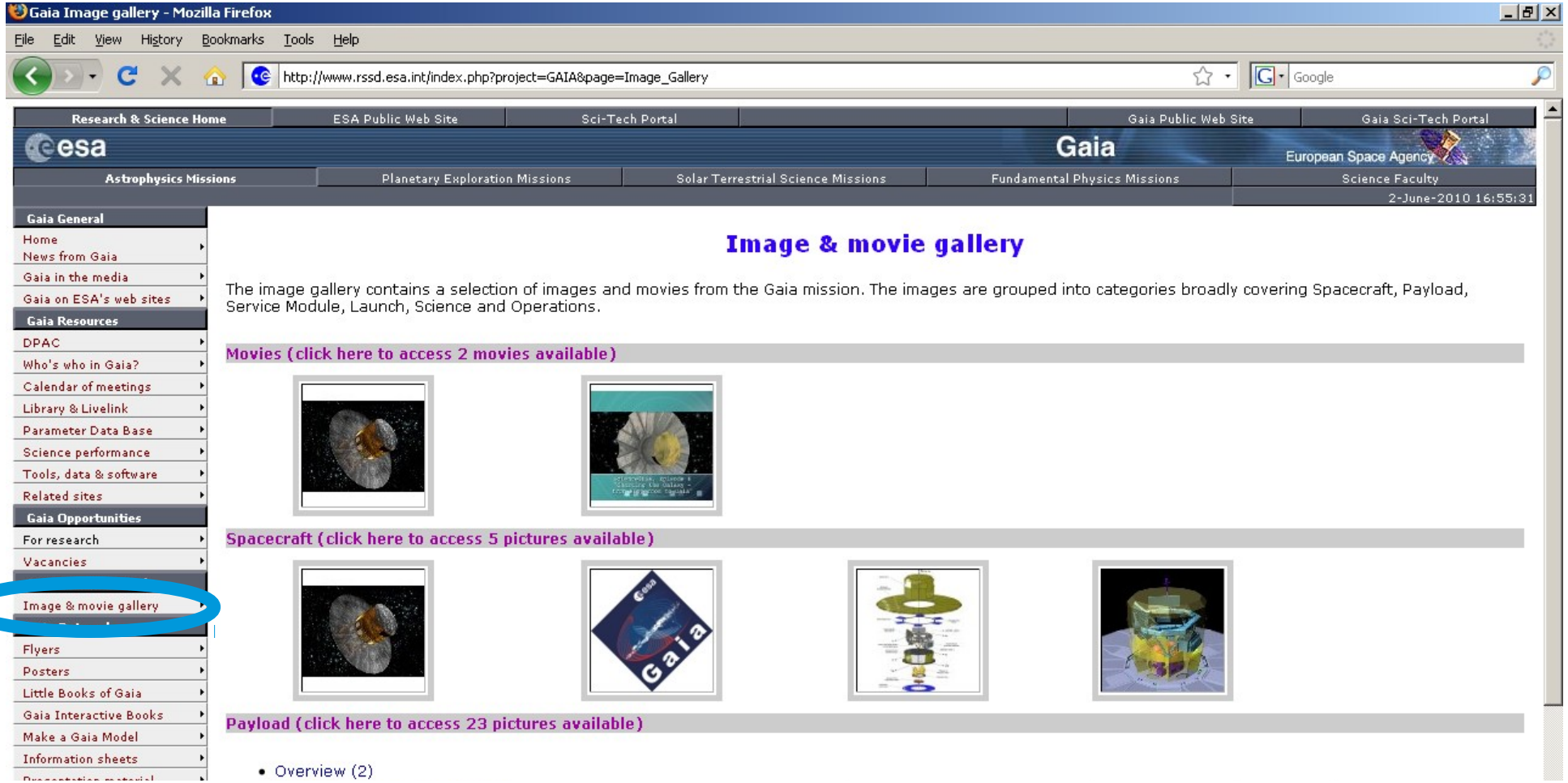
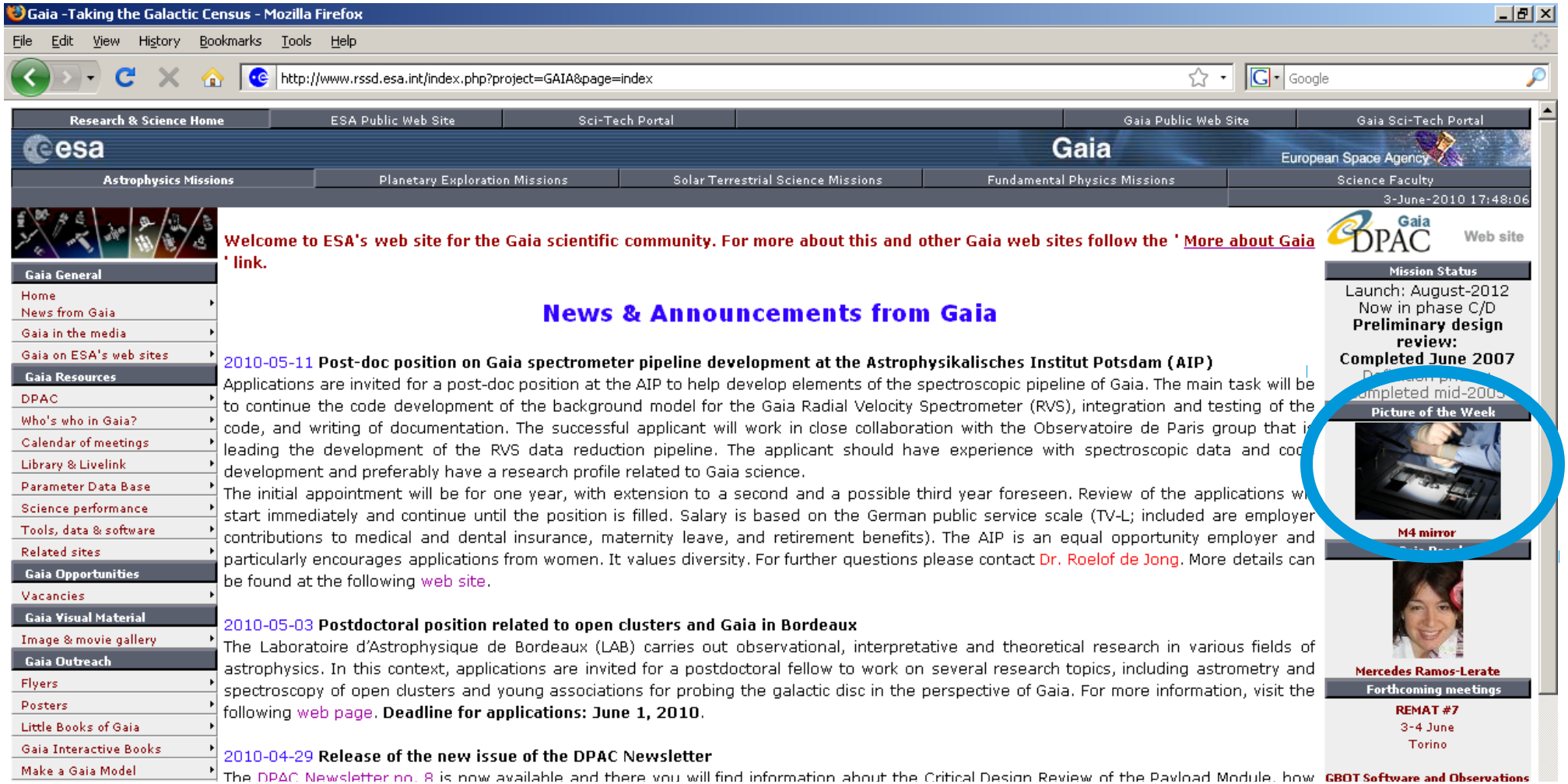


Image gallery

Image gallery



Posters

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Gaia Posters

A number of general posters have been produced about the Gaia mission. 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.

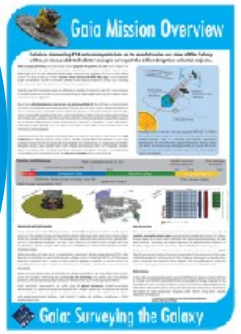
Gaia Mission Poster

Produced by: ESA Science
Available in a number of formats here

Industrial involvement in the Gaia spacecraft

Produced by: C. Blasco
ailable as pdf file (16M).

Gaia Mission Overview



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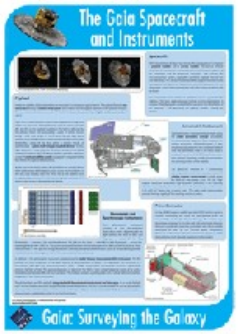
The Gaia Spacecraft and Instruments



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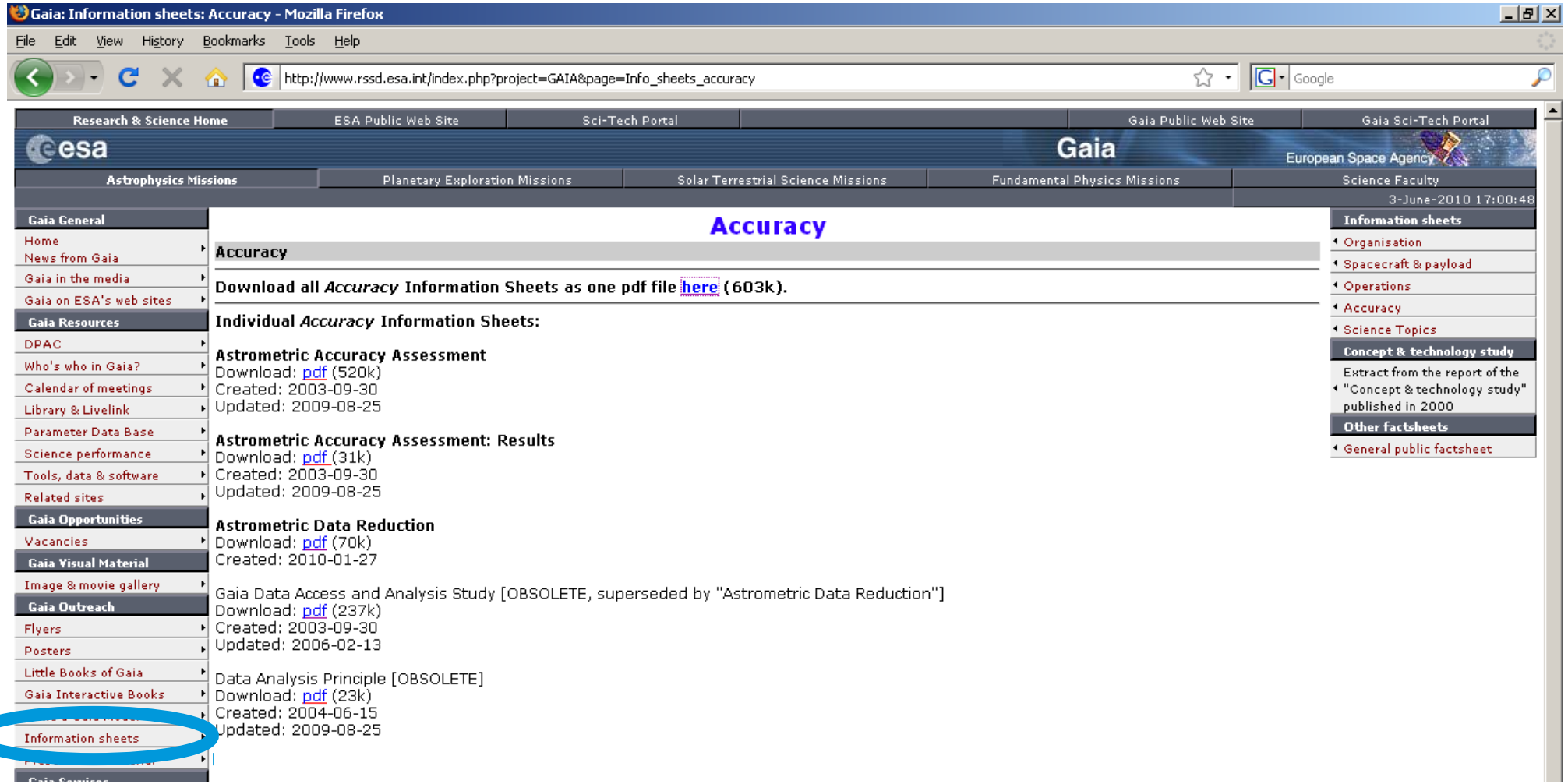
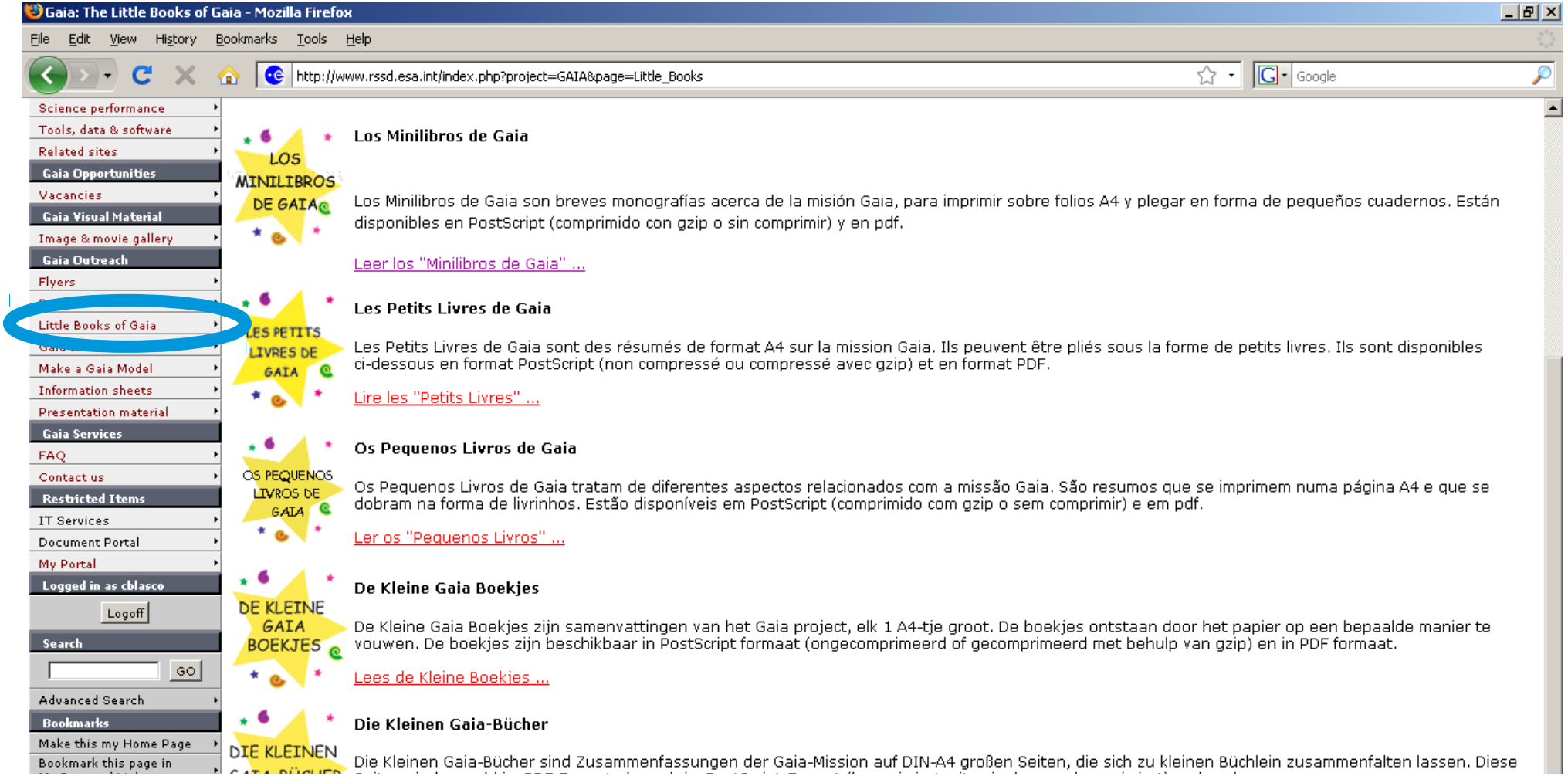
Information sheets



Little Books of Gaia



Conclusions

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