Science & Technology Facilities Council

gaia

→ THE BILLION STAR SURVEYOR

Gaia facts

Status: Science phase underway

Launch date: 19 December 2013

Launch location: European Spaceport, Kourou, French Guiana

Launch vehicle: Soyuz-STB/Fregat-MT

Orbit: 1.5 million km from the Earth in an orbit around a point (called the second Lagrange point, L2) where gravity of the Earth and the Sun balance.

Nominal mission duration: Five years

Objectives: To create an extremely accurate 3D map of around one billion stars.

In orbit, Gaia scans the sky, spinning around its axis. The fields of view of its two telescopes move across the sky. Gaia completes a full revolution every six hours. This allows Gaia to cover the entire sky every six months. Each star will be 'seen' by Gaia, on average, 80 times during the five year lifetime of the mission.

Further information

For more about Gaia science and the involvement of UK scientists and engineers in the mission:

* Gaia satellite UK
  http://gaia.ac.uk
* Gaia satellite European Space Agency
  www.esa.int/Our_Activities/Space_Science/Gaia
  http://blogs.esa.int/gaia/

For schools

Schools have access to several mountain-top robotic telescopes that they can use remotely from the classroom to observe Gaia Alerts:

* Faulkes Telescope Project
  www.faulkes-telescope.com
* National Schools Observatory
  www.schoolsobservatory.org.uk
* Bradford Telescope
  www.telescope.org
* PIRATE Telescope (Universities)
  pirate.open.ac.uk

Liftoff of Soyuz VS06 with Gaia.
ESA/S. Corvaja, 2013

Front cover: Gaia mapping the stars of the Milky Way. *ESA*

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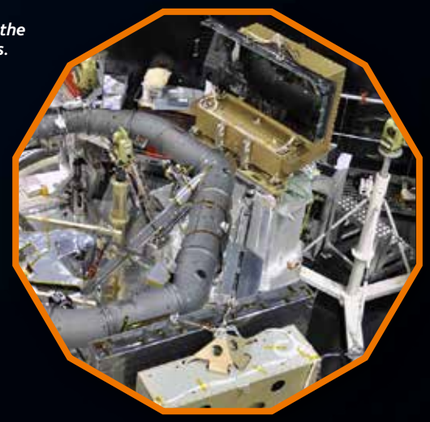
WHO'S INVOLVED

Gaia has been created with a major role for UK industry in design and construction. Additionally, six university groups have a lead role in processing the Gaia data and in discovering new transients.



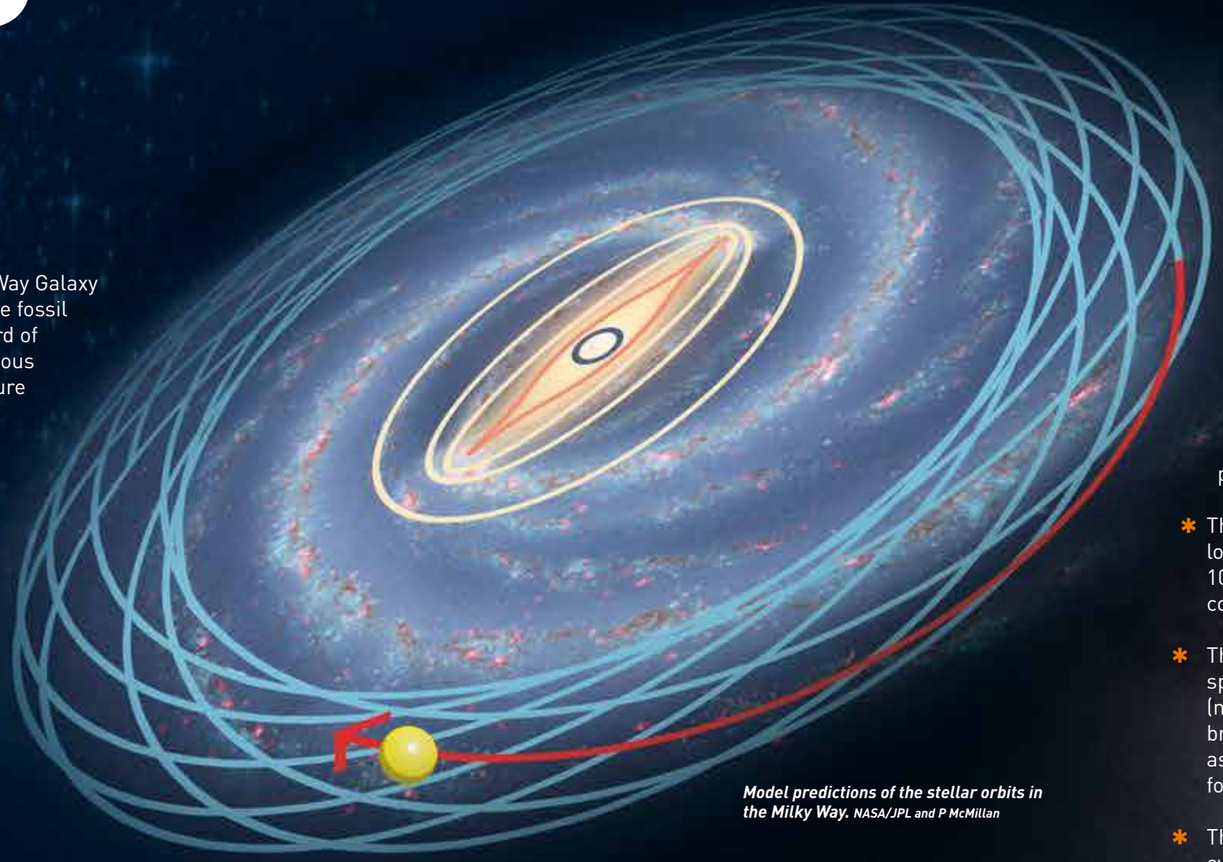
The mirrors of the two telescopes.

Galactic structure

We understand the history and the present structure of our Milky Way Galaxy using its fossils – the stars. The chemical elements in a star are the fossil record of its time of formation. The orbit of a star is the fossil record of assembly of the Milky Way itself and the distribution of the mysterious dark matter which holds the Milky Way together. How do we measure this?

We need Gaia to do this!

Gaia will create an accurate three-dimensional map of the positions – and motions – of one billion stars in the Milky Way and determine their chemical compositions.



Model predictions of the stellar orbits in the Milky Way. NASA/JPL and P McMillan

We can do lots of exciting things with a billion precise measurements

- Existing measurements tell us there must be some other material which we cannot see – dark matter. Gaia will provide the most precise measurements yet of our Galaxy's dark matter distribution, by measuring the positions and motions of stars in exquisite detail.
- Gaia will provide new tests of general relativity and perhaps detect hints of the next theory of gravity.
- A star cluster is a group of stars which formed at the same time from the same cloud of gas and dust. Gaia photometry and astrometry of star clusters will advance our knowledge of the physical structure of stars and how they evolve.
- Gaia's unique place in space (at L2) will allow it to look back towards the sun and see near-Earth objects (or 'killer asteroids') previously invisible to us.
- Among the billions of objects Gaia will observe will be one million galaxies; 500,000 quasars; 10,000 Supernovae – in real-time; 250,000 asteroids; 15,000 extra-solar planets; 200,000 white dwarfs; 50,000 brown dwarfs, and who knows how many exotic new objects.
- The night sky is constantly flickering with transient events (objects that change rapidly or in an unusual way), but most of them are too faint to see with the naked eye. Gaia will provide us with a unique way to discover and measure these transient events – Gaia Alerts – across the whole sky.

How can you get involved?

Many of the Gaia Alerts – about one per week – will be bright enough to be seen by amateur astronomers and schools with access to public world-class robotic telescopes controllable from the classroom (e.g. the Faulkes telescope). Therefore, school children can become the first to discover a supernova (or something we've never seen before) and contribute to real scientific research.

See gaia.ac.uk for details on how to get involved.

Our Gaia Alerts cat is using his telescope to follow up some of the Gaia Alerts, we hope you will too. Angel Eye Media

Gaia's payload

Gaia's payload consists of:

- Two 1.45 x 0.5m **telescope mirrors**, made from silicon carbide.
- The **astrometric instrument** measures star positions, from which proper motions (at right angles to us) and parallaxes (angular measurements of distance) are derived.
- The **photometric instrument** is used to measure red and blue low resolution spectra (wavelength ranges 320-660 and 650-1000 nm) for each object. These give colours and broad stellar compositions for all one billion stars.
- The **radial velocity spectrometer** produces a high resolution spectrum (wavelength range 847-874nm) for radial velocity (motions away/towards us) measurements for each of the brightest 100 million objects. These measurements allow astronomers to determine accurate atmospheric parameters for a smaller number of stars.
- The **camera**, the largest ever to be flown in space, is just over 104 cm long and 42 cm wide and contains one billion pixels. The camera has been designed and built by Airbus Defence and Space and contains a mosaic of 106 large area, high performance charge-coupled devices (CCD91-72) image sensors, which were custom designed, manufactured and tested by e2V.

Engineers fitting CCDs to Gaia's camera. Airbus D&S

Early Gaia data taken during testing.