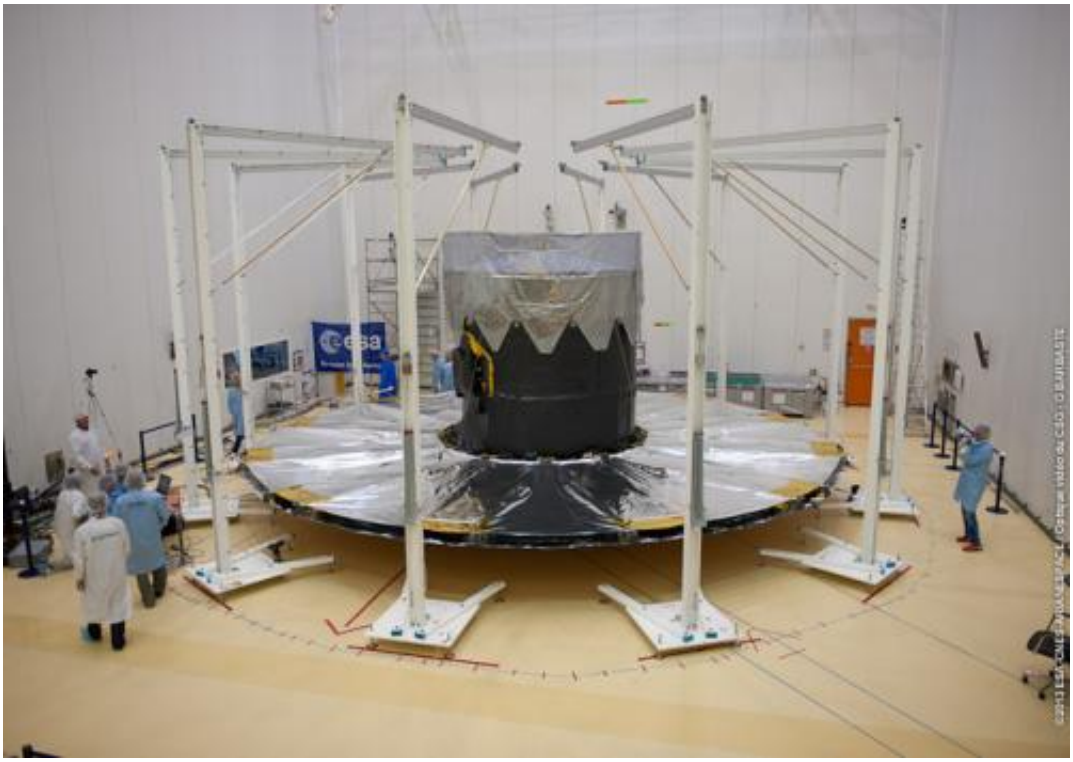
Largest ever space camera is ready to map a billion stars

February 26 2014, by Ben Dryer



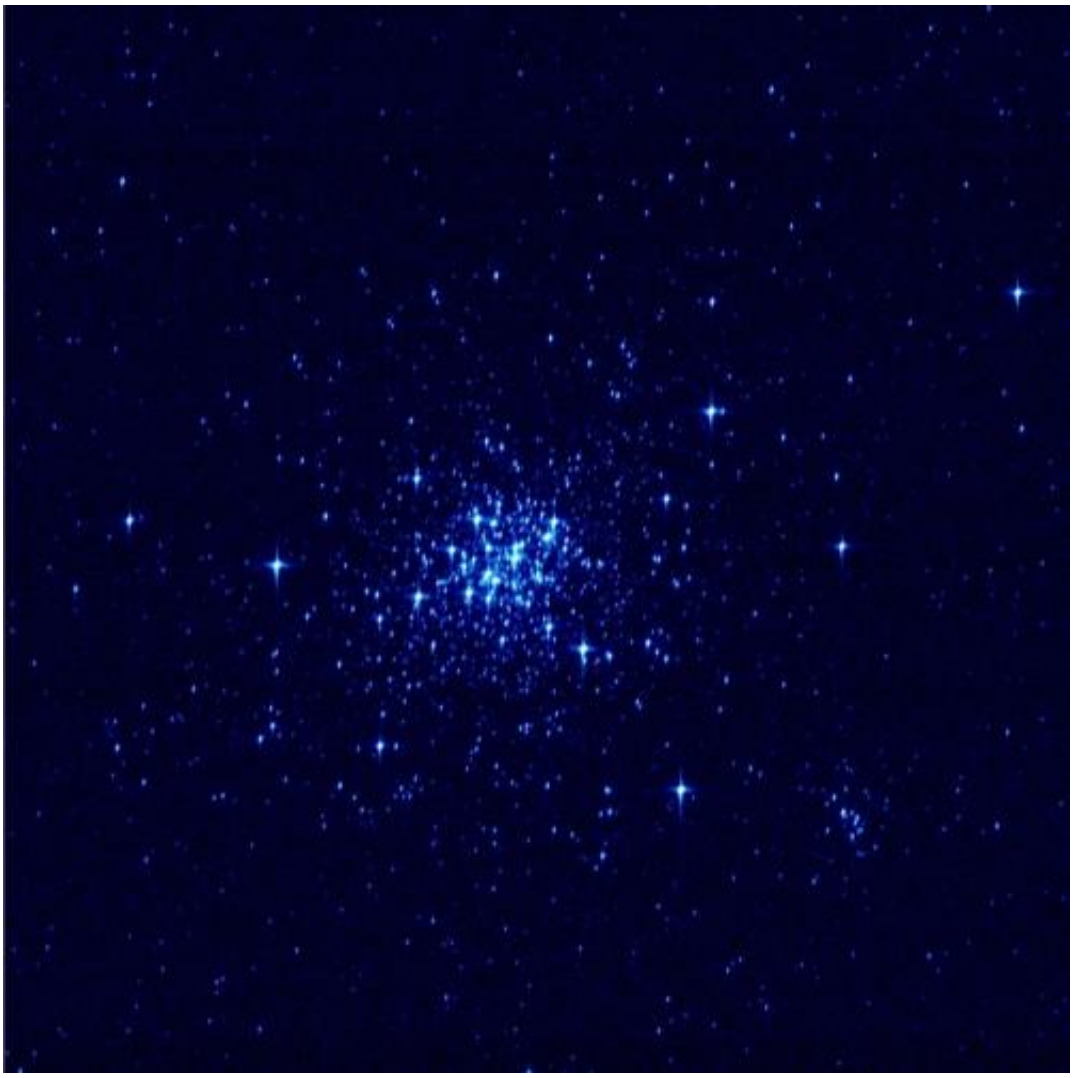
Now whizzing through space, 1.5 million km from Earth. Credit: ESA-CNES-Arianespace / Optique Vidéo du CSG - G. Barbaste

After its successful launch in December, European Space Agency's (ESA) Gaia has now taken up its position in space and is ready to survey the skies. With the help of two onboard telescopes focused onto the largest ever space camera, Gaia is estimated to catalogue nearly one billion stars in its 5-year mission.

Like Hipparcos before it, ESA's Gaia will map stars in the Milky Way. It will do this by measuring the brightest billion objects and determine their three-dimensional distribution and velocities. It also has the ability to measure the temperature, mass, and chemical composition of these billion objects.

Gaia will be able to discern objects up to 400,000 times dimmer than those visible to the naked eye. The positional accuracy of its measurements are akin to measuring the width of a human hair at a distance of 500 km.

The process will involve scanning each part of the sky an average of 70 times over its five-year mission lifetime, which means scanning the entire sky twice every 63 days, once through each of the two telescopes, making it a powerful tool for spotting time-evolving phenomena such as binary systems, supernovae, and exoplanets. Compared to Hipparcos, Gaia will be able to measure 500 times the number of stars, extending to objects 1000 times dimmer than the dimmest that Hipparcos could catalogue.



Test image from Gaia: Slightly shaky to start with, but it'll get there. Credit: ESA/DPAC/Airbus DS

The technology that makes this possible is the largest camera ever launched into space – 940 million pixels. That is why a lot of effort before launch was on figuring out exactly how to get the huge amount of data Gaia will produce back down to Earth.

When a picture is taken a number of charged-coupled devices (CCDs) – the stuff most digital camera sensors are made off – are dedicated to

spotting objects before they fall onto the main focal plane. This allows the instrument to track the objects as they pass and only retain small regions around the object, reducing the file-size needed to be sent to Earth. In five years it will send only 100 TB of data (1 TB is 1000 GB). Once the data arrives to Earth, there is a system in place to analyse the data and distribute alerts to ground-based observatories if anything quickly evolving and potentially interesting is spotted, such as supernovae.

The catalogue produced by Gaia is expected to contribute to many areas of astrophysics, multiply our database of exotic objects such as exoplanets, white and brown dwarfs, and supernovae many-fold, contribute to more precise measurements of General Relativity, help to constrain the measurements of the presence and location of dark matter, and give us more accurate information about our galactic neighbourhood and its evolution.

Gaia was successfully launched on December 19. After a month's transit, it is now in orbit at about 1.5 million km away from Earth. By virtue of its position opposite the Sun from the Earth and its large sunshield, it will be able to see objects as close as 45^0 from the Sun, allowing it to spot asteroids with orbits that lie between the Earth and the Sun, which are candidates for Earth collision, and very difficult to observe from the ground.

Staff on the ground are conducting in-orbit testing, during which the exact orbital parameters are determined, and all systems are tested for performance. Calibration images have been obtained, and the ground team is working on procedures to resolve a few remaining issues, such as reducing contamination on the CCDs and dealing with sunlight diffracted around the sun-shield.

Beyond the alert system allowing quick ground-based follow up, the first

proper Gaia catalogue will take two years to complete and will be made available to the wider scientific community. Following this, new iterations will be issued about once a year, which will add more precisely determined characteristics of these objects. It is expected that Gaia's database will have many new discoveries waiting to be mined from it, fuelling astronomers for decades to come.

Provided by The Conversation

Citation: Largest ever space camera is ready to map a billion stars (2014, February 26) retrieved 24 May 2024 from https://phys.org/news/2014-02-largest-space-camera-ready-billion.html