

# Gaia: Most accurate data ever for nearly two billion stars

December 3 2020

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A diagram of the two most important companion galaxies to the Milky Way, the Large Magellanic Cloud or LMC (left) and the Small Magellanic Cloud (SMC) made using data from the European Space Agency Gaia satellite. The two galaxies are connected by a 75,000 light-years long bridge of stars, some of which is seen extending from the left of the SMC. Credit: ESA/Gaia/DPAC

Today (3 December), an international team of astronomers announced the most detailed ever catalogue of the stars in a huge swathe of our Milky Way galaxy. The measurements of stellar positions, movement, brightness and colours are in the third early data release from the European Space Agency's Gaia space observatory, now publicly available. Initial findings include the first optical measurement of the acceleration of the Solar system. The data set, and early scientific discoveries, were presented at a special briefing hosted by the Royal Astronomical Society.

Launched in 2013, Gaia operates in an orbit around the so-called Lagrange 2 (L2) point, located 1.5 million kilometres behind the Earth in the direction away from the Sun. At L2 the [gravitational forces](#) between the Earth and Sun are balanced, so the spacecraft stays in a stable [position](#), allowing long-term essentially unobstructed views of the sky.

The primary objective of Gaia is measure stellar distances using the parallax method. In this case astronomers use the observatory to continuously scan the sky, measuring the apparent change in the positions of stars over time, resulting from the Earth's movement around the Sun.

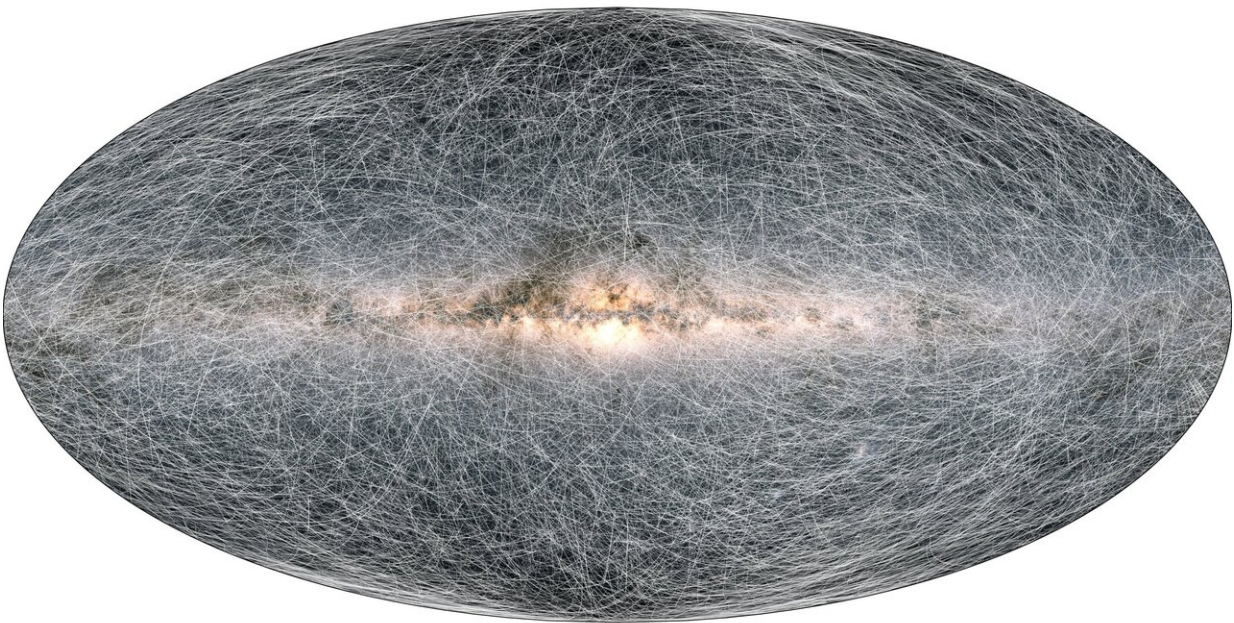
Knowing that tiny shift in the positions of stars allows their distances to be calculated. On Earth this is made more difficult by the blurring of the Earth's atmosphere, but in space the measurements are only limited by the optics of the telescope.

Two previous releases included the positions of 1.6 billion stars. This release brings the total to just under 2 billion stars, whose positions are significantly more accurate than in the earlier data. Gaia also tracks the changing brightness and positions of the stars over time across the line of sight (their so-called proper motion), and by splitting their light into spectra, measures how fast they are moving towards or away from the

Sun and assesses their chemical composition.

The new data include exceptionally [accurate measurements](#) of the 300,000 stars within the closest 326 light years to the Sun. The researchers use these data to predict how the star background will change in the next 1.6 million years. They also confirm that the Solar system is accelerating in its orbit around the Galaxy.

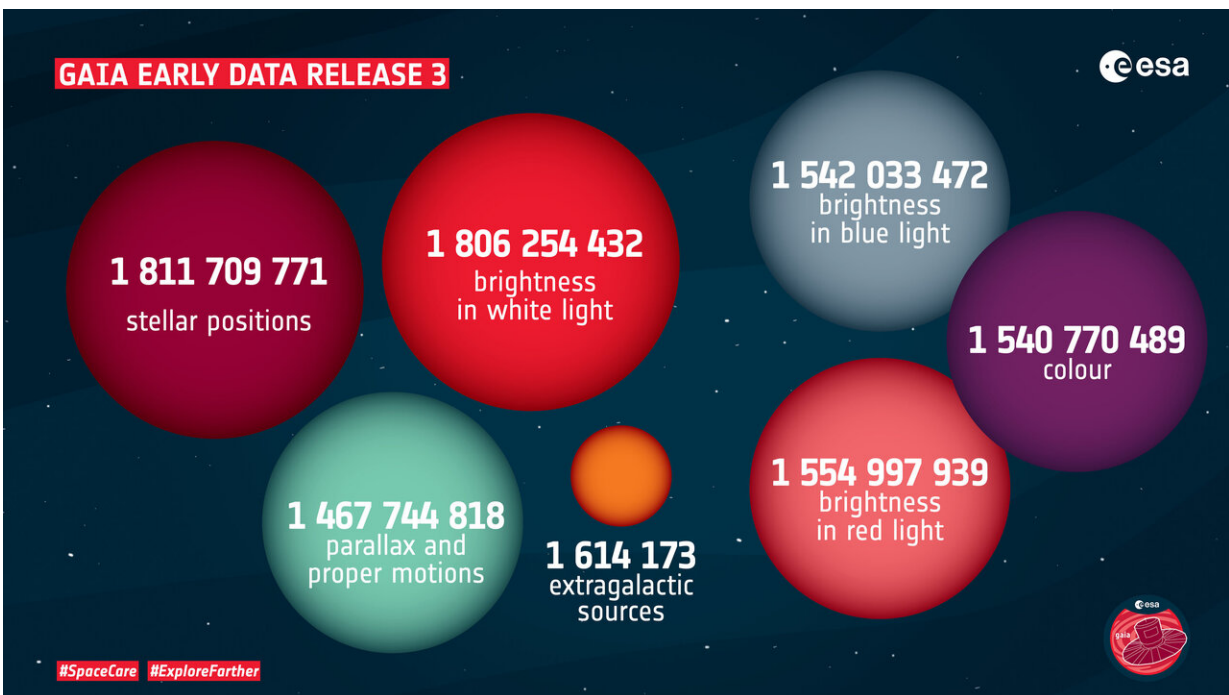
This acceleration is gentle, and is what would be expected from a system in a circular orbit. Over a year the Sun accelerates towards the centre of the Galaxy by 7 mm per second, compared with its speed along its orbit of about 230 kilometres a second.



The stars are in constant motion. To the human eye this movement – known as proper motion – is imperceptible, but Gaia is measuring it with more and more precision. The trails on this image show how 40 000 stars, all located within 100 parsecs (326 light years) of the solar system, will move across the sky in the next

400 thousand years. These proper motions are released as part of the Gaia Early Data Release 3 (Gaia EDR3). They are twice as precise as the proper motions released in the previous Gaia DR2. The increase in precision is because Gaia has now measured the stars more times and over a longer interval of time. This represents a major improvement in Gaia EDR3 with respect to Gaia DR2.

Credit: ESA/Gaia/DPAC; CC BY-SA 3.0 IGO. Acknowledgement: A. Brown, S. Jordan, T. Roegiers, X. Luri, E. Masana, T. Prusti and A. Moitinho



Gaia's Early Data Release 3 in numbers. Credit: ESA; CC BY-SA 3.0 IGO

Gaia data additionally deconstruct the two largest companion galaxies to the Milky Way, the Small and Large Magellanic Clouds, allowing researchers to see their different stellar populations. A dramatic visualisation shows these subsets, and the bridge of [stars](#) between the two systems.

Dr. Floor van Leeuwen of the Institute of Astronomy at the University of Cambridge, and UK Gaia DPAC Project Manager, comments: "Gaia is measuring the distances of hundreds of millions of objects that are many thousands of [light years](#) away, at an accuracy equivalent to measuring the thickness of hair at a distance of more than 2000 kilometres. These data are one of the backbones of astrophysics, allowing us to forensically analyse our stellar neighbourhood, and tackle crucial questions about the origin and future of our Galaxy."

Gaia will continue gathering data until at least 2022, with a possible mission extension until 2025. The final data releases are expected to yield stellar positions 1.9 times as accurate as those released so far, and proper motions more than 7 times more accurate, in a catalogue of more than 2 billion objects.

**More information:** The new results will be presented in a special online briefing hosted by the Royal Astronomical Society, at 0915 GMT on Thursday 3 December.

Provided by Royal Astronomical Society

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