Gaia spots possible moons around hundreds of asteroids

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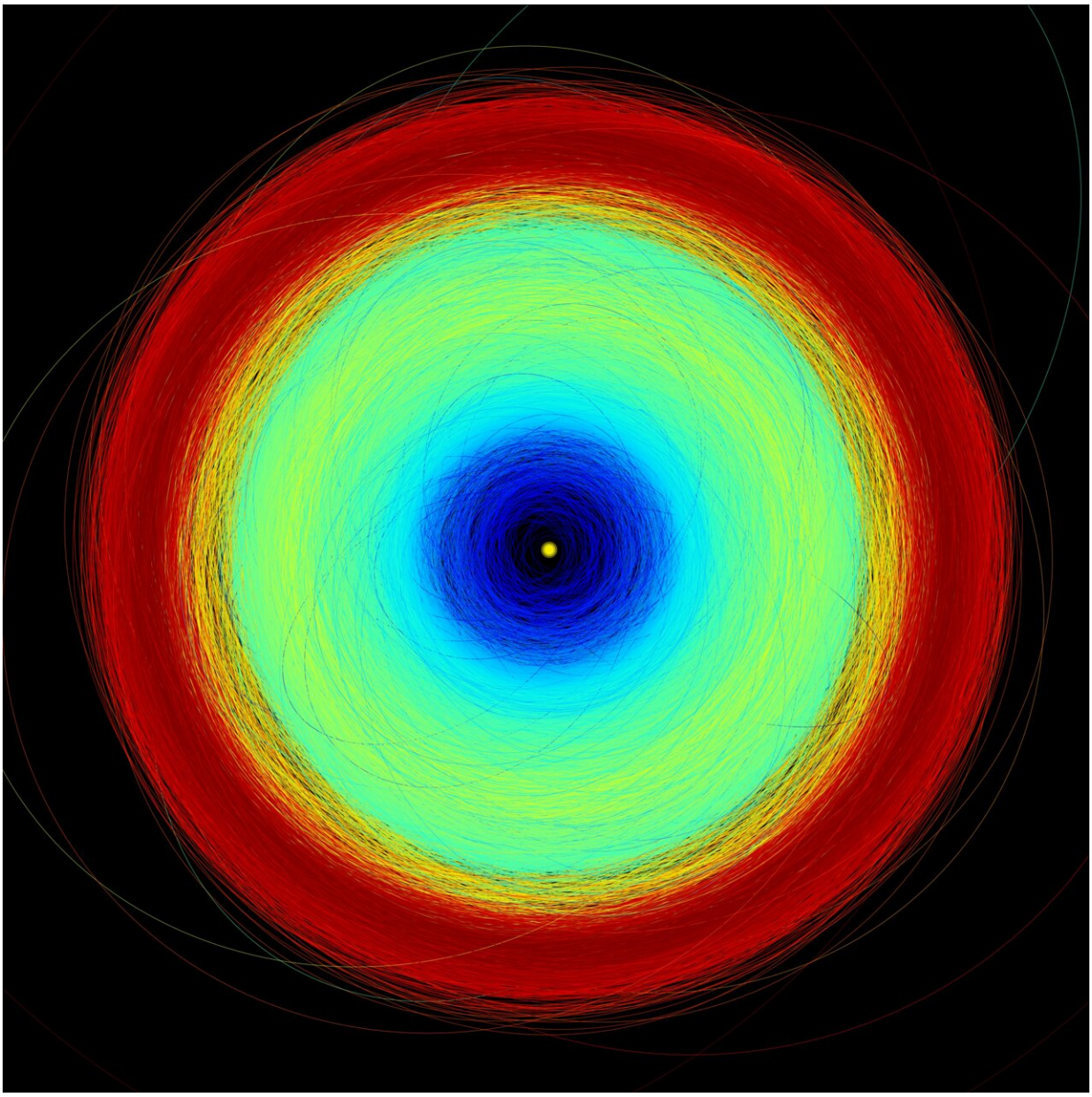

This image shows the orbits of the more than 150,000 asteroids in Gaia's data release 3, from the inner parts of the solar system to the Trojan asteroids at the distance of Jupiter, with different colour codes. The yellow circle at the centre represents the sun. Blue represents the inner part of the solar system, where the near earth asteroids, Mars crossers, and terrestrial planets are. The Main Belt, between Mars and Jupter, is green. Jupiter trojans are red. Credit: ESA/Gaia/DPAC; CC BY-SA 3.0 IGO

ESA's star-surveying Gaia mission has again proven to be a formidable asteroid explorer, spotting potential moons around more than 350 asteroids not known to have a companion.

Previously, Gaia had explored asteroids known to have moons—so-called "binary asteroids"—and confirmed that the telltale signs of these tiny moons show up in the telescope's ultra-accurate astrometric data. But this new finding proves that Gaia can conduct "blind" searches to discover completely new candidates, too.

"Binary asteroids are difficult to find as they are mostly so small and far away from us," says Luana Liberato of Observatoire de la Côte d'Azur, France, lead author of the new study published in *Astronomy & Astrophysics*.

"Despite us expecting just under one-sixth of asteroids to have a companion, so far we have only found 500 of the 1 billion known asteroids to be in binary systems. But this discovery shows that there are many asteroid moons out there just waiting to be found."

If confirmed, this new finding adds 352 more binary candidates to the tally, nearly doubling the known number of asteroids with moons.

An outstanding asteroid explorer

Asteroids are fascinating objects, and hold unique insights into the formation and evolution of the solar system. Binaries are even more exciting, enabling us to study how different bodies form, collide and interact in space.

Thanks to its unique all-sky scanning capabilities, Gaia has made a number of important asteroid discoveries since its launch in 2013.

In its data release 3, Gaia precisely pinpointed the positions and motions of 150 000+ asteroids—so precisely that scientists could dig deeper and hunt for asteroids displaying the characteristic "wobble" caused by the tug of an orbiting companion (the same mechanism as displayed here for a binary star). Gaia also gathered data on asteroid chemistry, compiling the largest ever collection of asteroid "reflectance spectra" (light curves that reveal an object's color and composition).

The 150,000+ orbits determined in Gaia's data release 3 were refined and made 20 times more precise as part of the mission's Focused Product Release last year. Even more asteroid orbits are anticipated as part of Gaia's forthcoming data release 4 (expected not before mid-2026).

"Gaia has proven to be an outstanding asteroid explorer, and is hard at work revealing the secrets of the cosmos both within and beyond the solar system," says Timo Prusti, Project Scientist for Gaia at ESA. "This finding highlights how each Gaia data release is a major step up in data quality, and demonstrates the amazing new science made possible by the mission."

Rendezvous with a binary asteroid system

ESA will further explore binary asteroids via the forthcoming Hera mission, due to launch later this year. Hera will follow up on NASA's DART mission—which collided with Dimorphos, a moonlet orbiting the asteroid Didymos, in 2022 as an asteroid deflection test—to produce a post-impact survey of Dimorphos. It will be the first probe to rendezvous with a binary asteroid system.

Gaia helped astronomers view the shadow cast by Didymos as it passed in front of more distant stars in 2022, an observing technique known as stellar occultation. The feasibility of this technique has been drastically improved by Gaia's asteroid orbits and ultra-precise star maps in recent years, proving the mission's immense value for solar system exploration.

More information: L. Liberato et al, Binary asteroid candidates in Gaia DR3 astrometry, *Astronomy & Astrophysics* (2024). DOI: 10.1051/0004-6361/202349122

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