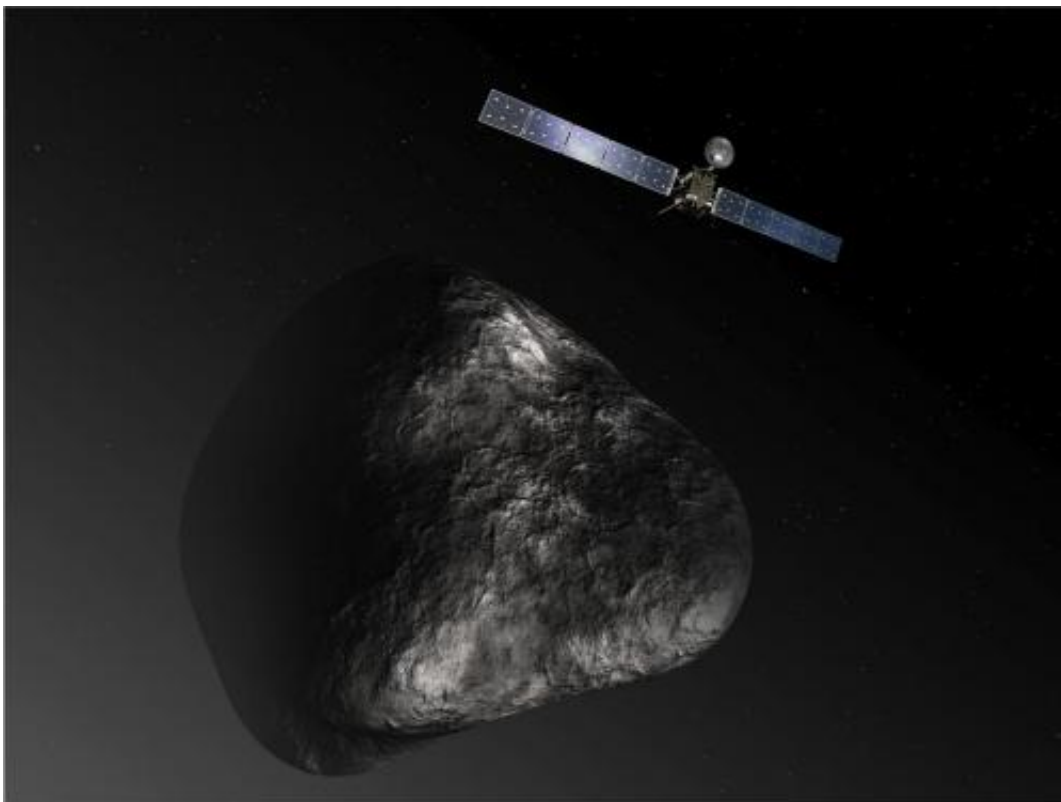


# Comet-chaser nears prey after crossing billions of miles

August 3 2014, by Veronique Martinache

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This artist's impression shows the Rosetta orbiter at comet 67P/Churyumov-Gerasimenko. The image is not to scale. Credit: ESA/ATG Medialab

After a decade-long quest spanning six billion kilometres (3.75 billion miles), a European probe will come face to face Wednesday with a comet, one of the Solar System's enigmatic wanderers.

The moment will mark a key phase of the most ambitious project ever undertaken by the European Space Agency (ESA)—a 1.3 billion euro (\$1.76 billion) bid to get to know these timeless space rovers.

More than 400 million km from where it was launched in March 2004, the spacecraft Rosetta will finally meet up with its prey, Comet 67P/Churyumov-Gerasimenko.

To get there, Rosetta has had to make four flybys of Mars and Earth, using their gravitational force as a slingshot to build up speed, and then entering a 31-month hibernation as light from the distant Sun became too weak for its solar panels.

It was awakened in January.

After braking manoeuvres, the three-tonne craft should on Wednesday be about 100 km from the comet—a navigational feat that, if all goes well, will be followed by glittering scientific rewards.

"It's taken more than 10 years to get here," said Sylvain Lodiot, spacecraft operations manager.

"Now we have to learn how to dock with the comet, and stay with it for the months ahead."

Blazing across the sky as they loop around the Sun, comets have long been considered portents of wonderful or terrible events—the birth and death of kings, bountiful harvests or famines, floods or earthquakes.

Astrophysicists, though, see them rather differently.

Comets, they believe, are clusters of the oldest dust and ice in the Solar System—the rubble left from the formation of the planets 4.6 billion

years ago.

These so-called dirty snowballs could be the key to understanding how the planets coalesced after the Sun flared into life, say some.

Indeed, one theory—the "pan-spermia" hypothesis—is that comets, by bombarding the fledgling Earth, helped kickstart life here by bringing water and organic molecules.

Until now, though, explorations of comets have been rare and mainly entailed flybys by probes on unrelated missions snatching pictures from thousands of kilometres away.

Exceptions were the US probe Stardust, which brought home dust snatched from a comet's wake, while Europe's Giotto ventured to within 200 km of a comet's surface.

On November 11, the plan is for Rosetta to inch to within a few kilometres of the comet to send down a 100-kilogramme (220-pound) refrigerator-sized robot laboratory, Philae.

Anchored to the surface, Philae will carry out experiments in cometary chemistry and texture for up to six months. After the lander expires, Rosetta will accompany "C-G" as it passes around the Sun and heads out towards the orbit of Jupiter.

## **'Duck' in space**

Before November's landing, though, Rosetta's operators have a mountain of work to do.

The first few weeks will be a get-to-know-you exercise, as the spacecraft gingerly carries out elongated loops around the comet, scanning its

surface.

The probe will have to avoid ice crystals and dust particles that are stripped from the comet's outer layers as it nears the Sun—a trail that is reflected in solar rays as its wake.

And it will have to look for a suitable [landing site](#) for Philae.

Last month, as Rosetta came ever closer to the comet, its cameras revealed that the target body, far from being shaped like a potato as many had expected, rather resembled a duck—two lobes, one big and the other small, connected by a "neck".

"That was a bit of a surprise," said Philippe Lamy of the Astrophysics Laboratory of Marseille, southern France.

"Several theories have already been aired to explain this shape, but the likeliest in my book is that it came from two bodies which fused while the Solar System was being formed."

The unexpected shape will limit the choice of a landing site, Lamy said. "You can reasonably argue that it will impose additional constraints."

## **Comets: Frozen wanderers**

- Comets are bodies of ancient ice and dust that orbit the Sun and are believed to be almost pristine material left over from the Solar System's formation some 4.6 billion years ago. One theory is that they hold complex carbon molecules that helped seed life on an infant Earth.

- As a comet nears the Sun, some of the ice is melted and transformed into gusts of gas, the bright "coma" around its head. The gassy wake, and dust loosened by the melting ice, creates a spectacular tail that is

reflected in the Sun's rays and may stretch across millions of kilometres (miles) in space. The word for comet comes from "stella cometa," Latin for "long-haired star".

- Like solar eclipses, comets have been associated with great events of history, good and bad. The birth of Jesus and Napoleon, the eruption of Vesuvius in 79 AD that destroyed Pompeii, and the Great Plague of 1665 that ravaged London have been linked to comets. "The celestial phenomena called comets (excite) wars, heated and turbulent dispositions in the atmosphere, and in the constitutions of men, with all their evil consequences," warned the first-century Egyptian astronomer and astrologer Ptolemy.

- Approximately 2,000 comets have been observed and recorded over the past 2,500 years. They follow elliptical orbits, with a return taking anything from a few years to as many as 40,000 years. Some scientists estimate there could be billions of comets, only a tiny fraction of which have ever been seen.

- The most famous comet is named after British astronomer Edmond Halley, who was the first to prove that comets orbit the Sun and return regularly. He showed that a comet of 1682, now called Halley's Comet, was identical with two that had appeared in 1607 and 1531, and he successfully predicted the comet's next return, which occurred in 1758, 16 years after his death. Halley's Comet last swung by Earth in 1986.

- Comet 67P/Churyumov-Gerasimenko, the target for Europe's Rosetta space probe, orbits the Sun once every 6.6 years. In July, images from the spacecraft as it neared the comet showed the target to be shaped rather like a duck, with a large body and a head connected by a neck. The comet is named after two Soviet astronomers, Klim Churyumov and Svetlana Gerasimenko, who first identified it, separately, in 1969.

- The head of a comet can be bigger than a planet, but most are just a few cubic kilometres (miles) in size. For all its celestial splendour, Halley's Comet is only about 15 kilometres long by four kilometers wide (nine by 2.5 miles). Churyumov-Gerasimenko is believed to measure about four kms across.
- Astronomers once believed that comets were born in interstellar space, but the consensus now is that they are created at two locations on the fringes of the Solar System. So-called long-period comets—ones which take at least 200 years to return—are believed to originate in the Oort Cloud, an accumulation of gas and debris beyond the orbit of Pluto. Short-period comets like Churyumov-Gerasimenko are believed to come from a ring of debris beyond Neptune's orbit called the Kuiper Belt.
- Comets pose a risk, albeit a very small one, to life on Earth. A collision by a comet or large asteroid 65 million years ago inflicted climate change that probably ended the reign of the dinosaurs. In 1992, the [comet](#) Shoemaker-Levy 9 was torn into 21 large fragments as it entered Jupiter's gravitational field. In July 1994, the fragments smashed into Jupiter at speeds of about 210,000 kph (130,000 mph), releasing energy that triggered fireballs larger than the Earth.

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