

Rosetta probe makes history by landing on comet



J. Mai/ESA

Scientists at the European Space Operations Centre cheered the progress of the Philae spacecraft as it moved closer to its target.

The European Space Agency's (ESA) Philae spacecraft landed [on the surface of a comet](#) on 12 November, in a first for space exploration. Scientists erupted in joy when the first signals from the craft reached the European Space Operations Centre in Darmstadt, confirming that the ESA's Rosetta mission had achieved its goal.

“We couldn’t be happier than we are now,” said Andrea Accomazzo, Rosetta’s spacecraft-operations manager. ESA scientists confirmed that Philae had not only touched down safely but was in radio contact with its parent craft, had power and was sending data. “We are sitting on the surface. Philae is talking to us,” said Stephan Ulamec, Philae lander manager at the German Aerospace Center (DLR).

But despite the jubilation and relief, the feat did not go off without a hitch. Early data suggest that Philae’s harpoons failed to fire or at least to secure the lander, and the craft may have bounced before settling on the surface of Comet Churymov-Gerasimenko, or 67p.

The troubles with Philae's landing gear came after a series of small glitches, including an overnight failure in the craft's on-board computer. That was fixed with a reboot, but Philae scientists also

confirmed that the lander's thrusters, intended to pin Philae to the comet's surface while the harpoons fired, were not working.

Details about Philae's exact situation are still hazy. But the uncertainty did little to dampen the spirit of scientists for whom the landing is the pinnacle of a decade-long mission. “Maybe today we didn’t land once, but twice,” Ulamec told a packed auditorium.

That Philae made it to the surface at all was a momentous achievement for the Rosetta team. Its namesake spacecraft has been traveling to 67p for 10 years. After it arrived in August, ESA scientists had just weeks to [choose a landing site](#) for Philae on the [irregular and difficult-to-navigate](#) comet, which is shaped like a rubber duck.

Scientists eventually picked an elliptical target with an area of just 1 square kilometre. Hitting it required the Rosetta craft to navigate with extreme accuracy around the 4-kilometre-wide 67p — all while being buffeted by gases streaming off the comet.

Bumpy landing

Before the event, Accomazzo, an experienced ESA flight manager, called Rosetta the most complex and ambitious mission he had ever undertaken. Officials from NASA, which contributed three instruments to Rosetta, praised the effort. “How audacious, how exciting, how unbelievable, to dare to take that step to land on a comet,” said Jim Green, the agency’s director of planetary science.

Now scientists will attempt to determine how the landing problems have affected Philae. Fluctuations in the radio link between Philae and Rosetta, along with a rotation in Philae's solar-power generator, hinted that the landing craft may have lifted off the surface at a very slow speed. But after two hours, this motion seemed to have stopped, suggesting to Ulamec that it may have landed again.

Mark McCaughrean, senior science advisor at ESA, called the theory "cute if true". "We won't know until we have all the data," he said.

This was not the only surprise awaiting researchers. As the first pictures rolled in showing aerial views of the landing site, Ulamec confirmed that Philae ended up on a surface that much softer than the Rosetta team had been expecting. Ulamec says Philae has sent back not just “housekeeping” data, but also scientific observations, including images and information on surface properties. Others instruments designed to test the composition of the comet are also working well, he adds.

Plans for Philae's primary science mission — which will run until the craft's main batteries run out of juice sometime in the next 2.5 days — include taking more photos and drilling 23 cm into the comet’s surface to retrieve a sample for analysis on the lander's on-board laboratory. In collaboration with Rosetta, Philae will also use radar to probe the interior of 67p.

In the dark

For now, Rosetta has dipped below the horizon of the comet, severing Philae's contact with Earth for several hours.

The first panoramic pictures from Philae's Comet nucleus Infrared and Visible Analyzer (CIVA) camera were due to be published in the hours after landing. But an early end to the lander's data link — which could be caused by a hill on the horizon or something more ominous — meant a full image could not be gathered. "Tomorrow morning we should know a lot more," Ulamec told journalists.

Nonetheless, the lander made it to 67p one piece, and remains on the comet. "It's just an astonishing day. It's a privilege to be part of it," said McCaughrean.

Philae will need to keep riding its luck if it is to extend its mission beyond the primary phase. Carrying on beyond the next few days will mean charging a second set of batteries using solar panels, which can happen only if they avoid becoming covered with dust.

If the solar panels charge successfully, Philae could continue taking data until as late as March next year, when conditions on the comet surface are expected to become too hot for the lander to operate.