→ THE CHASE IS ON

Rosetta's arrival at Comet 67P/Churyumov-Gerasimenko

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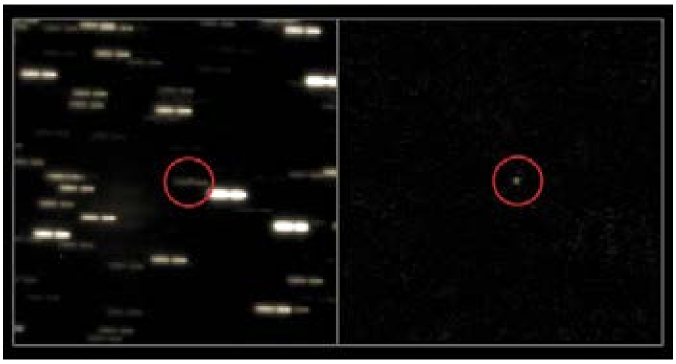
Almost six months have passed since ESA's Rosetta spacecraft woke up from deep-space hibernation, ready to complete the final leg of its 10-year comet chase. Now, with a gap of less than 200 000 km to close, the comet is firmly in Rosetta's sights.

Earlier in the spring, the 11 science instruments on board the Rosetta orbiter were reactivated and checked out, as was the Philae lander. One highlight was the much-anticipated first glimpse of Rosetta's target by the OSIRIS imaging system. The spacecraft's two navigation cameras were also in full working order and both cameras are being used to home in Comet 67P/Churyumov-Gerasimenko.

At the end of February, the comet was observed from the ground by the European Southern Observatory (ESO) Very Large Telescope in Chile. ESA and ESO are collaborating to monitor the position and brightness of the 4 km-wide comet to help refine Rosetta's navigation and to make assessments of the comet's activity before the spacecraft's arrival in August.



Comet 67P/Churyumov-Gerasimenko seen on 28 February by ESO's Very Large Telescope in Chile (ESO/C. Snodgrass (MPI)/O. Hainaut)

This image was taken on 30 April by the OSIRIS Narrow Angle Camera and the comet is already displaying a coma, which extends over 1300 km from the nucleus (ESA/MPS for OSIRIS Team)

In May, Rosetta began a critical series of manoeuvres that will steadily bring the spacecraft in line for its rendezvous with the comet. If these manoeuvres were not carried out, Rosetta would sail by the comet at a distance of around 50 000 km and at a relative velocity of 800 m/s. The aim of the manoeuvres is to reduce Rosetta's relative velocity to 1 m/s and bring it to within 100 km distance of the comet by 6 August.

The first manoeuvre was carried out on 7 May to decrease Rosetta's velocity relative to the comet by just 20 m/s. The biggest reduction in relative velocity of 290 m/s will take place on 21 May. Ten manoeuvres in total will ensure the spacecraft's arrival at the comet.

Along the way, the comet will appear to grow in Rosetta's field of view, from appearing to have a diameter of less than 1 camera pixel in May to well over 1000 pixels – equivalent to a resolution of better than a few metres per pixel – by August. During this chase phase, Rosetta's instruments will be able to make a preliminary assessment of the comet's activity, its size, shape and rotation.

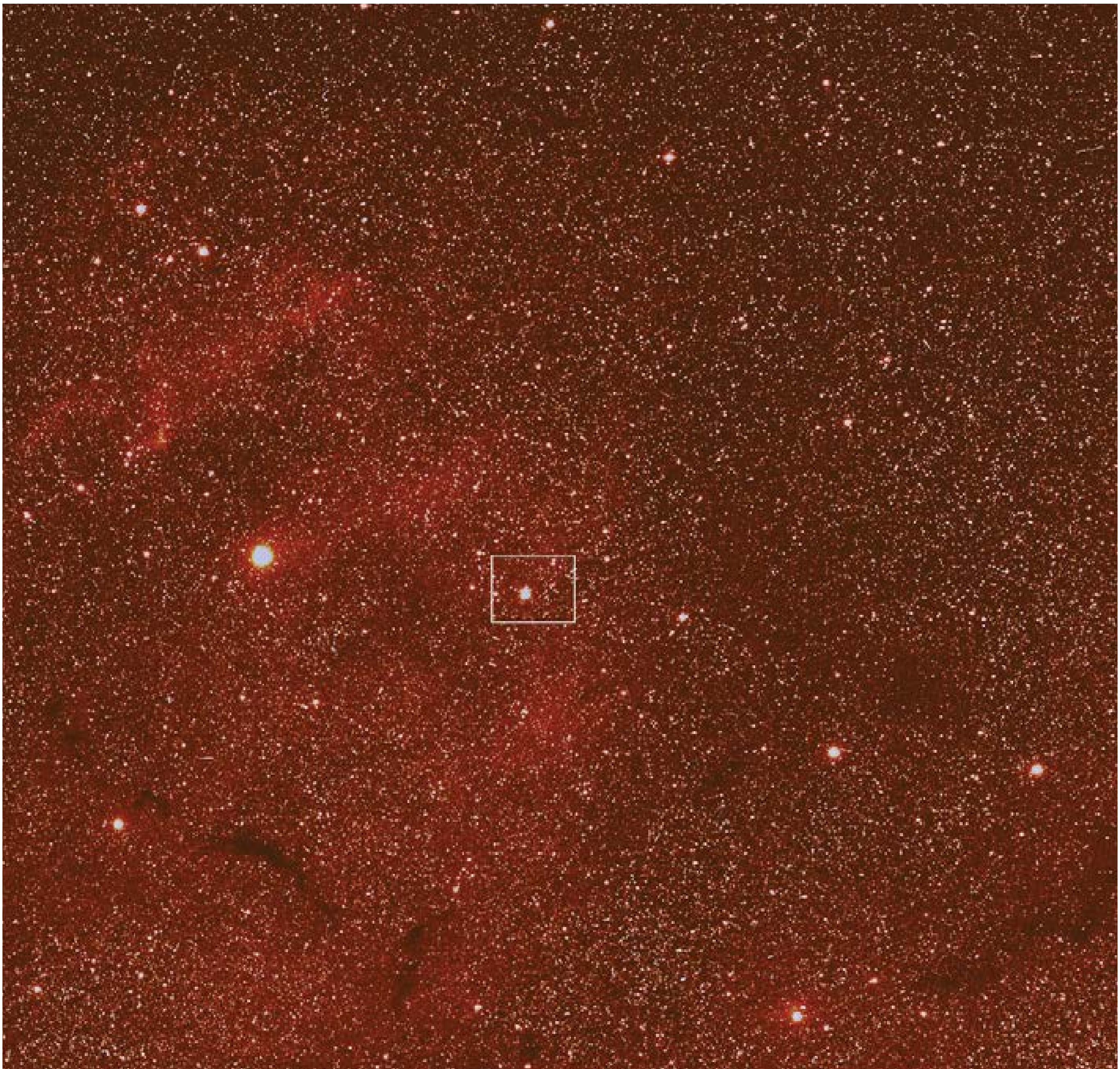
Rosetta's arrival on the 6 August will secure its place in history, as the first mission to make a slow-speed rendezvous with a comet. Then the spacecraft will follow a two-step triangular path in front of the comet to bring it from an altitude of 100 km to 50 km, manoeuvres that will take about a month to complete.

During this time, five locations of particular interest will be identified as possible landing sites for the mission's 100 kg Philae probe, which is to be deployed in November 2014. Right now, we know next to nothing about the geology and activity of the comet, both of which will play key roles in deciding where Philae can land safely.

The selection of the final landing site will likely be made at the end of September, by which time Rosetta will be orbiting at an altitude of about 30 kilometres above the surface – depending on the comet's activity – allowing detailed mapping of its nucleus at a resolution on the order of half a metre.

At the time of landing, Rosetta and the comet will still be on their approach towards the Sun, at a distance of

> **No one has ever attempted this before. In the history of spaceflight. We're very excited about the challenge!**
>
> – Matt Taylor, Rosetta project scientist



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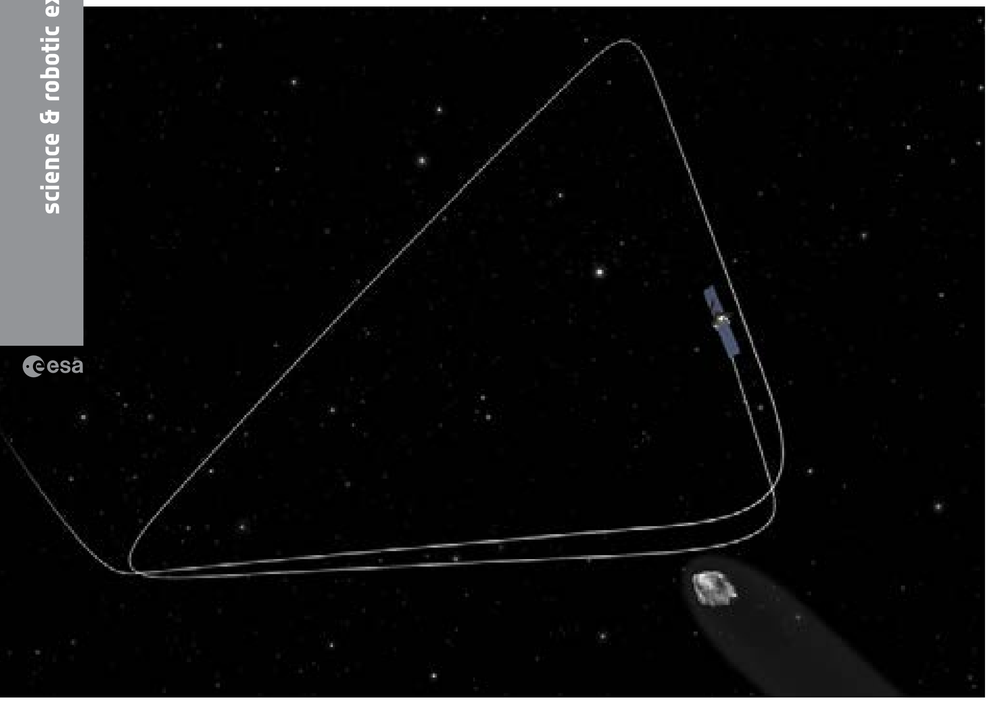
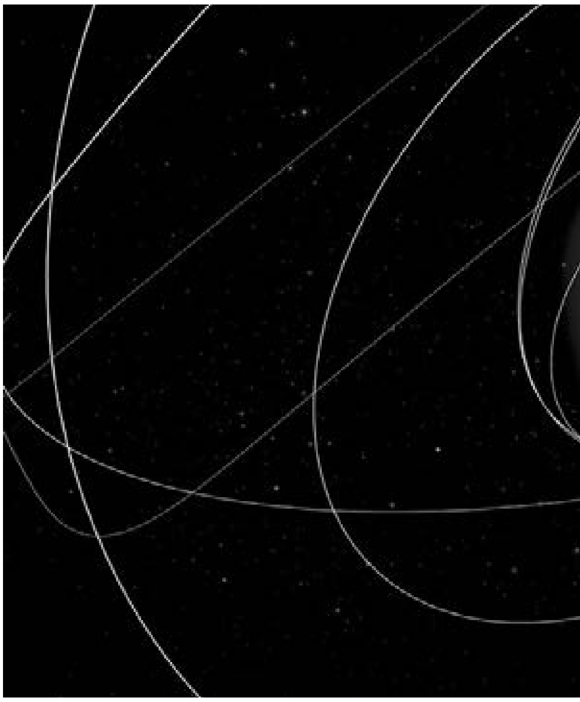
This is Rosetta's first sighting of its target, Comet 67P/Churyumov-Gerasimenko, in 2014. It was taken with the OSIRIS Wide Angle Camera on 20 March (ESA/Rosetta/MPS for OSIRIS Team MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA)

roughly 450 million km, between the orbits of Mars and Jupiter. The orbiter will come to within a few kilometres of the comet's surface to deploy the Philae lander, which will take several hours to drop slowly towards the comet's surface.

Once anchored to the nucleus, the lander will begin its primary science mission, based on an initial 64-hour initial battery lifetime. It will send back high-resolution pictures of Comet 67P/Churyumov-Gerasimenko's surface and perform on-the-spot analysis of the composition of its ices and organic material.

A drilling system will also take samples from a depth of 23 cm below the surface and will feed these to the onboard laboratory for analysis. The data will be relayed back to Earth via Rosetta during the next ground station contact period.





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After catching up with the comet, Rosetta will slightly overtake and enter orbit from the 'front' of the comet, first following a two-step triangular path in front of the comet to bring it from an altitude of 100 km to 50 km

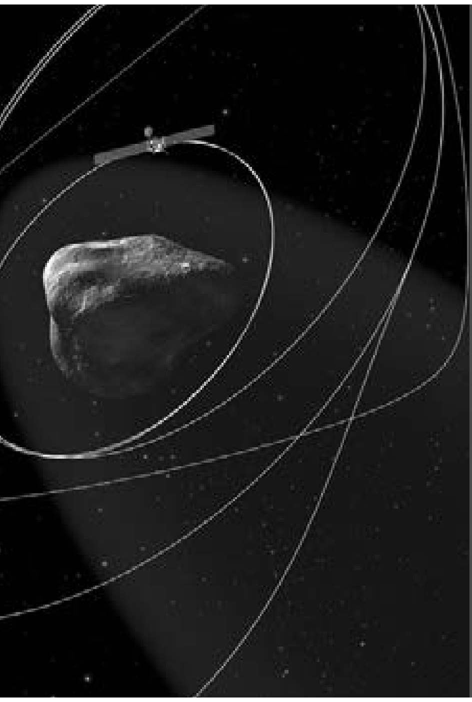
Philae also has solar panels that can be used to recharge the batteries, hopefully allowing for extended operations on the comet. But this will depend on the specific landing conditions and the accumulation of cometary dust on the cells, so this is not guaranteed.

The data collected on the surface will complement the extensive measurements made by the orbiter, which will continue following the comet on its orbit around the Sun through 2015. The closest approach to the Sun takes place at a distance of 185 million km – between the orbits of Earth and Mars – on 13 August 2015, and Rosetta will continue to return unique observations of the comet's ever-changing behaviour as it moves back towards the outer Solar System again. ■

Emily Baldwin is an EJR-Quartz writer for ESA

→ Rosetta mission milestones 2014–15

> **"Rosetta's arrival on the 6 August will secure its place in history."**



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After more complex manoeuvres, the separation between the spacecraft and comet will be reduced to around 25–30 km

→ Philae's landing

Because of the comet's extremely low gravity, Philae has a sophisticated set of systems on board to prevent it from rebounding back into space. A landing gear will absorb the forces experienced during touchdown, while a harpoon system together with ice screws in the probe's three feet will lock the probe to the surface. At the same time, a thruster on top of the lander may be used to push it down in order to counteract the impulse of the harpoons fired in the opposite direction (images ATG/medialab)

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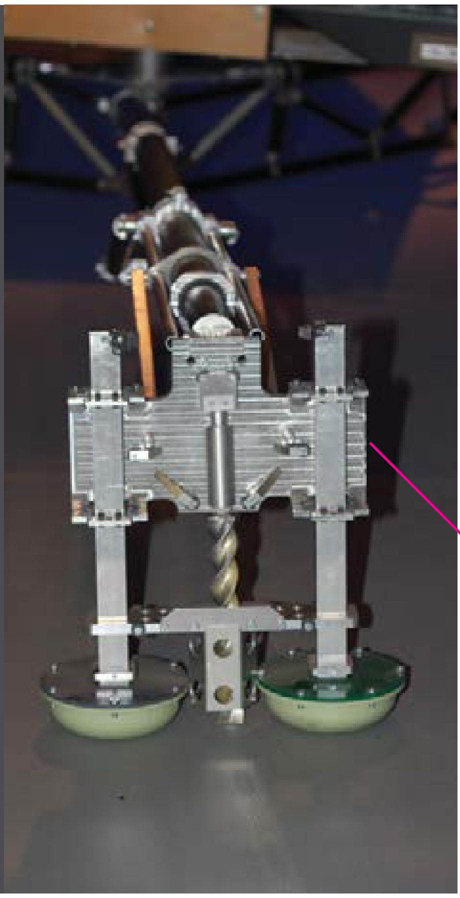
Landing pads and ice screws in on of Philae's three feet that will lock the probe to the comet surface (Neozoon)



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