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Press release

Rosetta reaches comet Churyumov-Gerasimenko after a 10-year odyssey

After a 10-year interplanetary cruise, the Rosetta spacecraft is now in orbit around comet Churyumov-Gerasimenko. This record-breaking mission marks the first time in history that a spacecraft has rendezvoused with a comet, onto which it will be dropping the Philae lander.

For CNES President Jean-Yves Le Gall, “This historic rendezvous is a world first for science eagerly awaited by the global space community for 10 years: today, Rosetta went into orbit around comet Churyumov-Gerasimenko. The science phase of the mission can now begin, with the high point in November when the Philae lander touches down on the comet’s nucleus. CNES is especially proud to have been involved from the outset more than 20 years ago in this exceptional adventure made possible by the European Space Agency. France is contributing to the mission in many ways, with several instruments involving more than 80 scientists at CNES and from 17 research laboratories at the French national scientific research centre CNRS, the Paris Observatory and universities, notably those in Grenoble and Orsay. The Philae lander, designed in partnership with our German counterparts, is set to play the starring operational role in November and is a fine example of French excellence. In total, France has invested nearly €250 million over the last two decades in this unprecedented programme from which we can expect a significant science return.”

Since its launch atop an Ariane 5 on 2 March 2004 from Europe’s spaceport in Kourou, Rosetta has travelled more than 6 billion kilometres. During its voyage, it has orbited the Sun four times and received four ‘slingshot’ gravity assists—three from Earth and one from Mars—to speed it on its course to comet Churyumov-Gerasimenko. It has also encountered two asteroids, Steins and Lutetia. Reaching the point in its journey furthest from the Sun on its way to the orbit of Jupiter, Rosetta was put into hibernation for 31 months. It was woken by its internal clock on 20 January as it continued its pursuit of the comet toward the Sun.

Today, Rosetta is almost there, in a **quasi-stationary position 100 kilometres from the comet’s nucleus**. It will now gradually close in on its target before being pulled into orbit by the gravity of the comet’s nucleus in mid-September, approaching to within just 60 kilometres. **From mid-September to mid-November, it plans to descend even lower for a global mapping phase at an altitude of 30 kilometres, followed by a close observation phase designed to map landing areas and identify any rocks on the surface**. This close observation phase will only be possible if the comet’s shape is not too irregular and if outgassing from the nucleus is not too active. Once Rosetta has released Philae, the orbiter will escort the comet on its path around the Sun, following it beyond perihelion—the closest point of approach—which will be reached in mid-August 2015. The end of the nominal mission is scheduled for December 2015, but could be extended if the spacecraft is in good shape. Philae will touch down on the comet’s nucleus around 11 November 2014.

Philae's mission: to land on the nucleus of Churyumov-Gerasimenko

Since July, teams have been working flat out to map the comet's nucleus in order to **select the landing site** and define the lander release procedure, which is likely to prove very tricky as the comet's shape and relief are unknown and the degree of outgassing hard to predict. That is why Philae's landing is undoubtedly the most critical element of the Rosetta mission.

Carrying a payload of **10 science instruments**, Philae will have a vital role to play when it lands on the nucleus. It will be the first probe ever to **analyse a comet's surface in situ**, **in particular the extremely complex organic components** collected by its drill. The aim is to analyse the most complex organic components on the surface before they are outgassed and destroyed by the Sun's ultraviolet rays. Peering into the comet's interior to gain insights into how it formed is another important challenge. **The crunch for Philae comes in the two and a half days following its separation from Rosetta**, a relatively short timeframe during which it will **run on primary battery power**. This is when it will perform the first sequence of science operations, followed once the primary battery has been drained by a **long-term science phase** relying only on the **secondary battery** charged by the solar panels. Meanwhile, the Rosetta orbiter will continue studying the comet and ultimately perform a series of flybys of the nucleus.

Strong French contribution

Rosetta is an international mission led by ESA with a high level of French participation. From early conceptual studies through to the supply of components and execution of operations, CNES is providing its valuable space expertise to some 300 French scientists and engineers, as well as to its international partners. France is the biggest contributor to the mission with Germany. **CNES has provided technical support and funding for the French space science laboratories involved in the project** (**IAS, IPAG, IRAP, LAM, LATMOS, LESIA and LPC2E**) and guaranteed the supply of a lot of science equipment. For Philae, DLR, the German space agency, is responsible for the Lander Control Centre (LCC), in Cologne, while CNES is responsible for the Science Operations and Navigation Centre (SONC), in Toulouse. The SONC is tasked with planning science operations for the 10 instruments, calculating descent trajectories to identify landing sites for Philae, sunlight illumination and transmissions with Rosetta, and determining the precise location of the landing site once Philae is secured to the surface. Lastly, CNES was also responsible for developing two subsystems on the platform (the lithium/ion primary and secondary batteries and the orbiter/lander communication system).

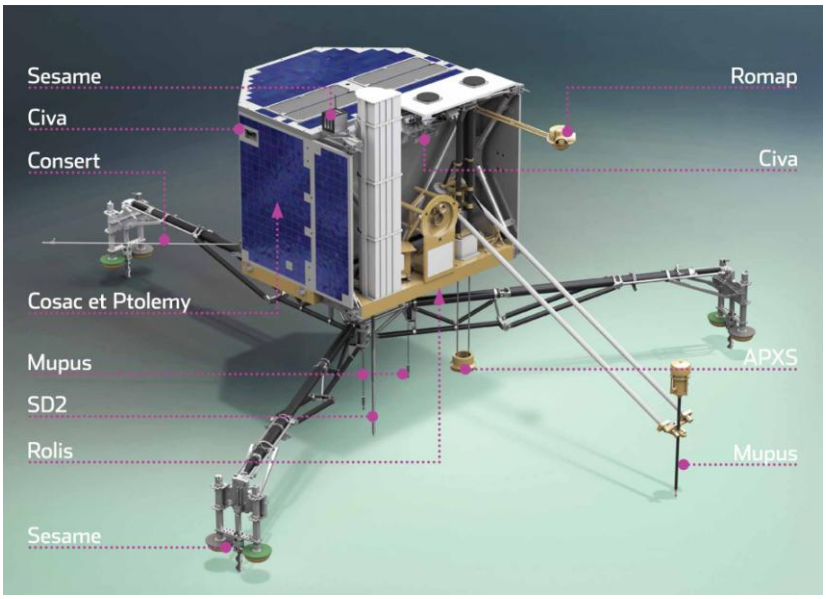
Project in partnership with Germany

Philae is managed by a consortium of institutes and space agencies led by DLR and CNES. Two French scientists are the principal investigators for two instruments, CIVA and CONSERT, and others are the PIs on the COSAC, SESAME and APXS instruments.

Philae's complex instruments mostly combine several sensors capable of operating in different modes. Each has its own flight software or shares it with another instrument. The instruments are designed to conduct three types of investigation: to study the structure of the nucleus, to analyse the composition of the comet's surface, and to probe the physical properties of the nucleus. The lander is also equipped with a drilling system to collect samples down to a depth of 25 centimetres and convey them to the microscopes and sample-analysis systems.

SONC in control of Philae's science instruments

Housed in the Descartes building at the heart of the Toulouse Space Centre, the Science Operations and Navigation Centre (SONC) is tasked with planning and tracking Philae's science operations. Its mission is to **calculate safe landing trajectories**, to plan and track **science operations** (determining in which order instruments operate), and to process and archive the resulting data. Three teams—a spaceflight dynamics team for trajectory calculations, an 'onboard' team for operations and a team managing operational data—complement one another, forming a group of **20 people working full time**. Processing resources are managed by CNES's Information Systems Directorate, which hosts and administers the computers that crunch numbers for spaceflight dynamics and science operations planning, using a tool called MOST developed specifically for Rosetta. CNES was also responsible for mission analysis and all preliminary spaceflight dynamics studies for Philae. **The software will generate descent trajectories** for the first level of landing site selection on the comet's summer hemisphere.



2014 - Rosetta's year

21 May	First manoeuvre to rendezvous with and image comet Churyumov-Gerasimenko (1 pixel)
June 2014	Series of main rendezvous braking manoeuvres
July 2014	First "resolved" pictures of comet Churyumov-Gerasimenko
6 August	Rosetta goes into orbit around the comet's nucleus
25 August	Down-selection of 5 landing sites
15 September	Primary and back-up landing sites selected
14 October	Final choice of landing site on basis of data supplied by SONC; planning of science operations during descent and 2 days following landing
11 November	Philae lands on comet
11 to 14 November 2014	Primary science mission (60 hrs. with instruments operating off primary battery power)
14 November to March 2015	Long-term science (instruments operating for a few hours every two days off secondary rechargeable batteries)
2014 - 2015	Orbiter science mission as comet activity increases the closer it gets to the Sun

Industry partners

Saft: development of Philae's primary battery.

Syrlinks: proximity links between the orbiter and lander.

Atos: engineering for planning and tracking of Philae operations.

GFI: development of SONC software.

Cisi: development of spaceflight dynamics software.

Cap Gemini: development of MOST (Mission Operation Scheduling Tool).

Laboratory partners

IAS space astrophysics institute, Paris Sud University.

IPAG planetology and astrophysics institute, Grenoble, Joseph Fourier University.

IRAP astrophysics and planetology research institute, Toulouse, Midi-Pyrenees Observatory.

LAM astrophysics laboratory, Marseille, Aix-Marseille University.

LATMOS atmospheres, environments and space observations laboratory, Versailles Saint-Quentin-en-Yvelines University, Pierre and Marie Curie University (Paris 6).

LESIA space and astrophysics instrumentation research laboratory, Paris Observatory, Pierre and Marie Curie University (Paris 6) and Paris-Diderot University (Paris 7).

LPC2E environmental and space physics and chemistry laboratory, University of Orléans.

All about Rosetta and Philae at
www.cnes.fr/rosetta-blog and http://www.cnes.fr/rosetta

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