German
Aerospace Center

A long-awaited touchdown: Interview with Stephan Ulamec

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Philae will be the first spacecraft to touch down on a comet and acquire images of its surface, examine ground samples, analyse organic substances and more. The lander is controlled and operated from the DLR Lander Control Center in Cologne. In this interview, Stephan Ulamec, project manager for Philae, explains what lies ahead for the lander and the risks involved with a mission that has never been attempted.

This interview, by Manuela Braun, was adapted from the German original to reflect changes in the status of the mission.

This is the first attempt to land on a comet following a 10-year journey through space. What can the lander expect when it touches down on Comet 67P/Churyumov-Gerasimenko in November?

The final decision on the landing site for Philae will be made in October. By then, we will have a high-resolution, threedimensional elevation model of the comet, and even higher resolution maps, derived from data acquired by the navigation camera and the OSIRIS imaging system on the Rosetta orbiter. OSIRIS and NAVCAM have already started to provide data regarding the rotational axis and the shape of the comet. Five candidates for landing sites were selected at the end of August. What we will not be able to see until later on is what the surface of the comet looks like on a small scale. For example, is it rocky? Are there holes like in a sponge or maybe even ice spikes? Is there a boulder field? We will only be able to assess all that relatively late on, in September or October - in more and more detail as Rosetta's orbit gets closer to the comet. What we probably will not be able to determine prior to the landing is the strength of the surface. We may be able to deduce, from the angle of repose of the surface materials or the slope of the crater rims, whether the surface is dusty or icy. We will certainly find this out at the moment of touchdown, when we will discover whether Philae sinks into the surface.

What kinds of surface can Philae withstand?

The lander is designed for a wide range of surface types. During the design phase, we were somewhat concerned that the surface would be hard - perhaps porous ice with dust inclusions. Now, with the images acquired by OSIRIS, we are thinking more in terms of a loose regolith - a dusty, softer surface.

From what altitude will Philae be released, and how will the landing proceed?

That will be determined once the landing site has been chosen. The landing will be triggered from an altitude of a few kilometres. Philae will be pushed away from the orbiter and will descend ballistically towards the comet. Depending on the mass and the conditions, it will take a few hours until touchdown. When it touches down, two harpoons will immediately be fired into the comet's surface - almost simultaneously. The lander feet are equipped with ice screws that will be pushed into the surface. During the landing, a cold gas thruster will fire from the top of the lander and push Philae down onto the comet surface. A damping mechanism has been incorporated into the central tube of the landing mechanism to dissipate most of the descent kinetic energy, rather than having it stored in the legs as an elastic force - that way, we will prevent any rebound.

What are the challenges for a safe landing?

We will not be able to land at an exact spot, as the landing ellipse is quite large, and the terrain throughout the area needs to be relatively flat. Even if Philae rebounds at a very low speed - here, we are talking about a few centimetres per second - this will turn into a gigantic ‘bounce’. After such a bounce, the risk that Philae does not get back on its legs is unacceptably high. However, it can tolerate a gradient of up to 45 degrees.

What is the role of the team in the DLR Lander Control Center?

To prepare for the landing, at LCC the team will program the command sequence. What is the ejection speed from the orbiter? When will each experiment be switched on during the descent? When will the harpoons be prepared for firing? We will also receive the telemetry data and the first images from the ROLIS and CIVA cameras directly in the control room - with a signal delay of half an hour. Then, the initial part of the First Science phase will begin, involving experiments that do not require any mechanical activation. The landing will be possible, even if things do get a little bit ‘bumpy’. But the parameters can still be changed over the following hours and days; for example, we can rotate the lander so it gets more sunlight. We can change the exposure time of the camera; we can determine where MUPUS, the penetrator that hammers into the ground, will be deployed. This is all controlled from the LCC using the telemetry received from Philae.

During the preparations for the landing, will the comet already be active and outgassing on its journey towards the Sun? What consequences will this have for the landing?

Our uncertainty about the exact density of the coma means that the exact trajectory is quite hard to predict. The orbiter position at the exact moment of Philae ejection cannot be foreseen with very high accuracy due to the uncertainty of the gas drag within the coma.

What could go wrong during the landing?

There are two kinds of problems. On the one hand, technical failures - for example, a motor that does not work, or a component that gets jammed. However, almost everything on Philae is redundant. And there is also the uncertainty in the comet environment that might cause problems. The lander might touch down at a crevasse, or a large rock and might tip over. Also, a jet - an outflow of gas - might divert it from its original landing site during the descent. There is not much we can do if any of these potential problems arise. However, we have conducted multiple tests and prepared the lander for any of the problems that could occur.

How quickly will it become clear in the control room how Philae has fared during the landing?

The last moment prior to landing at which we can still intervene directly from Earth is seven hours 15 minutes prior to separation from the orbiter. From then on, everything will run completely autonomously, following the sequence that we will have uploaded to Philae. However, we will receive initial telemetry data during the descent, sent to us from the lander via the orbiter. When we see the horizon from Philae’s panoramic cameras, we will know that we have arrived and Philae is operational.

How long will Philae and its instruments work on 67P/Churyumov-Gerasimenko?

Hopefully several months! Philae is designed to be able to work throughout the approach to the Sun, until the comet reaches a heliocentric distance of two Astronomical Units, which will coincide with the end of March. What is hard to estimate is how much dust will be deposited on the solar cells and when they will stop generating sufficient power. But at some point during the mission, on the journey towards the Sun, Philae will get so hot that the batteries and the electronics will stop working. From then on, the lander will travel on the comet as a historical entity.

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Stephan Ulamec, Project Manager for the Philae lander

Stephan Ulamec, seen here in Lander Control Center at DLR in Cologne has been involved in the mission since the beginning.

Landing of Philae on the comet

In mid-November 2014, the Philae lander will descend onto the target comet, 67P/Churyumov-Gerasimenko. (Frame from 'Chasing A Comet – The Rosetta Mission'.)
