Before the historic comet landing, Philae faces many dangers

September 26 2014, by Monica Grady

Landing in progress. Credit: ESA–J. Huart, 2014, CC BY

"Are we nearly there yet?" is a plaintive query that most parents learn to dread, especially if uttered while halted in a traffic jam in the baking hot sun. At least the Rosetta spacecraft has not had to deal with interplanetary traffic on its way to its destination of Comet 67P Churyumov-Gerasimenko. It is also well-protected against solar

radiation. But the scientists working on the Philae lander might be forgiven for feeling as if their journey is never going to end, as Rosetta makes increasingly delicate manoeuvres towards its final orbit.

Over the past few weeks we have been captivated by detailed images of the comet: progressing from an out-of-focus blob that became a poorly focused duck, to the beautiful pictures of craters and rubble-strewn regions distributed across what must be one of the oddest-shaped bodies ever to have been photographed by a spacecraft.

Riding the duck

Images of the two unequally sized lobes, joined in the centre by a narrower bridge of material, have already led to a whole series of questions that have to be answered before the mission can progress successfully. Is Comet 67P two bodies that have come together during an impact? Or is it a single body that has been eroded by impacts? Are the two lobes of the same density?

Instruments on board Rosetta are mapping the composition of the surface and scientists now have a good idea of how the composition varies across the cometary nucleus. On September 26, Rosetta starts a series of measurements on the "night side" of 67P. This doesn't mean that Rosetta is operating in the dark, but that its instruments are pointing towards the part of the comet's surface which isn't illuminated. This is so that we can learn more about the thermal properties of the surface, which has already been found to be hotter than expected by some 50 degrees.

The comet’s tail starts to appear. Credit: ESA/Rosetta/NAVCAM, CC BY

A safe landing for Philae depends upon very accurate knowledge of the physical and thermal properties of 67P. To carry out such measurements, Rosetta will need drop into an orbit around 20km above the comet's surface. Eventually however, Rosetta should be orbiting only about 1km above the surface, a position at which the Philae lander will be released from the mother-ship to make its descent to its destination.

While the detailed images of the comet's surface have been fascinating, they have also revealed that Philae faces more dangers that we had considered. Much thought has been given to exactly where on the comet Philae will land. The best site will be a trade-off between its flatness, its

slope, the amount of boulders scattered across the surface and how the site is illuminated.

Danger ahead

These parameters are all important. If the landing site is too bumpy or has too great a slope, it is likely that the lander will fall over rather than stay upright. If that happens, there is no way for it prop itself back up. Similarly, if there are too many boulders on the surface and one of the three legs hits a boulder, then again the lander will be unstable.

Illumination is also important: too much and the instruments will fry, too little and the battery will drain and not recharge.

Considering all those factors, two weeks ago, ESA announced the preferred landing site to be "site J", on the top of the smaller of the two lobes which make up the comet. So now we know the proposed place on the comet where Philae will land, preparations are moving towards finalising the actual landing date.

November 11 is widely spoken of as when the landing will take place, and this should be confirmed by ESA very soon. The schedule of events on that day, however, will be unclear until mid-October. This is because Rosetta will continue mapping the surface of the comet, observing any changes, for example the emission of volatiles. If site J suddenly becomes active, such that it is no longer safe to land there, then the back-up landing site – "site C" – will be studied. Site C is on the other lobe of the comet, so a new set of launch trajectories and site characterisation would be required, possibly delaying the landing by up to a month.

Whenever the landing does happen, though, it is going to be nail-biting for the mission operators. The low gravity of 67P means that there is a real possibility that Philae could bounce straight back into space once it

hits the surface. To prevent this, as it approaches, Philae will fire a harpoon into the comet, anchoring the spacecraft to its target. As Philae settles, its legs will take hold, and scientists on Earth will be hoping that all systems are now "go" for the next stage of the mission.

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