THE PHILAE LANDING – LESSONS LEARNED FOR FUTURE SMALL BODIES MISSIONS

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Introduction and Overview: The comet Lander Philae was part of the ESA Rosetta mission [1]. It successfully landed on comet 67P/Churyumov-Gerasimenko on November 12th, 2014 [2]. The landing followed a careful landing site selection process based on data obtained with the Rosetta orbiter instruments [3].

After several (unplanned) bounces, Philae performed a First Scientific Sequence (FSS), based on the energy stored in it's on-board batteries. The touch-down dynamics, bouncing trajectory and attitude could be reconstructed a-posteriori.

Philae has a payload of ten scientific instruments, all of which have been operated at least once [4].

Due to the fact that the final landing site was poorly illuminated, Philae went into hibernation after FSS, but signals from the Lander were received again in June and July 2015. However, attempts to re-establish reliable and stable communications links, unfortunately, failed. September 2nd, 2016, shortly before the Rosetta mission was ended with a planned impact of the main spacecraft, Philae could be clearly identified on the comet surface with the Rosetta Orbiter Camera (OSIRIS).

Rosetta is an ESA mission with contributions from its member states and NASA. Rosetta's Philae Lander is provided by a consortium led by DLR, MPS, CNES and ASI with additional contributions from Hungary, UK, Finland, Ireland and Austria.

Lessons Learned from Philae Mission: Rosetta was the first spacecraft working for an extended period of time in the vicinity of a comet and Philae was the first device to actually land on a comet nucleus. A tremendous amount of information on the nature of comets has been obtained, allowing future comet missions to be adapted to this previously poorly known environment.

Regarding the interaction with the surface, one of the surprising results of the Philae measurements (and the bouncing itself) is the high strength of the surface material [2].

There are also aspects from a programmatic point of view, where the Philae project can support the planning and designing of future missions.

Philae was a multi-lateral, long term project facing challenges regarding an appropriate management structure as well as its knowledge management strategy [5].

Small Payloads for future small bodies missions: Philae is avery complex, about 100 kg lander with a sophisticated payload, but there are options for smaller (and less expensive) devices, still capacle of providing important data from an asteroid´s or comets surface.

One example is MASCOT, a small (about 10 kg) surface package, currently aboard the JAXA Hayabusa 2 spacecraft on its way to asteroid (162173) Ryugu [6].

Other small lander designs, partly based on MASCOT are currently considered for e.g. the planned missions AIM/AIDA (asteroid mitigation demonstration) [7], MarcoPolo M5 (a proposal for the ESA science program) or MMX (planned JAXA mission to Phobos).

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