LANDING ON SMALL BODIES: FROM THE ROSETTA LANDER TO MASCOT AND BEYOND.

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Introduction: Recent planning for science and exploration missions has emphasized the high interest in the close investigation of small bodies in the Solar System. In particular in-situ observations of asteroids and comets play an important role in this field and will contribute substantially to our understanding of the formation and history of the Solar System.

Philae

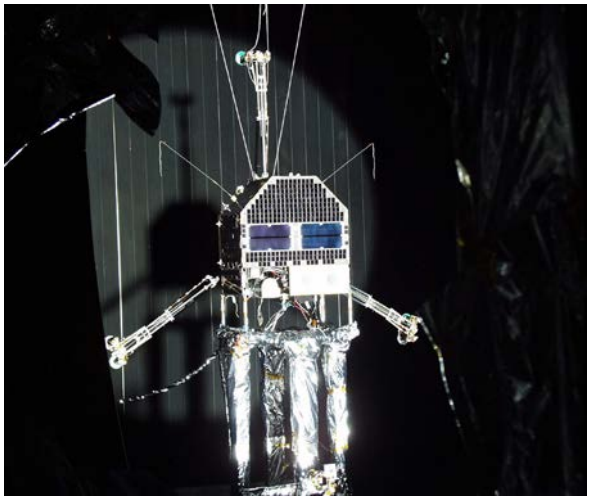

Figure 1: Lander FM (in Thermal-Vacuum Test at IABG,October 2001)

The first dedicated comet Lander is Philae, an element of ESA´s Rosetta mission to comet 67/P Churyumov-Gerasimenko. Rosetta was launched in 2004. After about 6 years of cruise (including three Earth and one Mars swing-by as well as two asteroid flybys) the spacecraft went into a deep space hibernation in June 2011. After approaching the target comet in early 2014, Rosetta was re-activated. The cometary nucleus was characterized remotely to prepare Lander delivery on 12 Nov 2014. The actual landing and first results will be discussed, with an emphasis on technology and sampling.

The Rosetta Lander was developed and manufactured, similar to a scientific instrument, by a consortium, consisting of international partners. Project management is located at DLR in Cologne/Germany, with co-project managers at CNES (France) and ASI (Italy). Mainly scientific institutes provided the subsystems, instruments and the complete, qualified lander system. Operations is performed in two dedicated centers, the Lander Control Center (LCC) at DLR-MUSC and the Science Operations and Navigation Center (SONC) at CNES. This concept was adopted to reduce overall cost of the project and is foreseen also to be applied for development and operations of future small bodies landers.

MASCOT

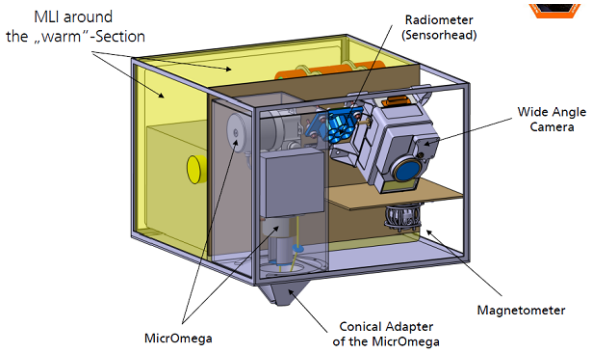

Figure 2: MASCOT design; overall dimensions are 295x275x195 mm³

A mission profiting from experience gained during Philae development and operations is MASCOT, a proposed surface package for the Japanese Hayabusa 2 mission. MASCOT is a small (~10 kg) mobile device, delivered to the surface of asteroid 1999JU3 that will operate there for about 16 hours. During this time a camera, a magnetometer and an analytical instrument will be operated to provide ground truth and even support the selection of possible sampling sites for the main spacecraft. MASCOT is a flexible design that can be adapted to a wide range of missions and possible target bodies. Also the payload is flexible to some extent (with an overall mass in the 3 kg range). The first MASCOT was launched aboard JAXA's Hayabusa-2, on 30 November 2014 and is currently on its way to asteroid 1999 JU3. Landing is in the 2018/2019 timeframe.

Sampling:

Currently we study advanced sampling landers for small bodies in the ~100 kg mass based on the Philae and MASCOT heritage and experience. A few concepts will be presented.