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How to explore an asteroid with 10 kg: the MASCOT concept

Abstract

There are manifold ways to perform in-situ investigation of a small body ranging from actively landing the complete spacecraft (s/c) such as the NEAR s/c on asteroid 433 Eros to dedicated passive landers such as Philae of the Rosetta (ESA) mission to comet 67P/Churyumov-Gerasimenko or MASCOT onboard the Hayabusa2 (JAXA) s/c towards near-Earth asteroid (NEA) 162173 Ryugu. The MASCOT concept is a surface science package with a total weight of only ~10kg and a size of 30 cm x 30 cm x 20 cm, comparable to a shoebox. It carries a suite of four scientific instruments: a wide angle camera with night-time colour illumination (MASCAM), an imaging IR spectrometer microscope (MicrOmega), a multichannel radiometer (MARA), and a magnetometer (MasMAG).

The MASCOT deployment strategy is in several aspects different to Philae. Beside the deployment altitude of just 60 m for MASCOT, the lander needs no dedicated orientation during landing. MASCOT has no anchoring mechanism and is designed to lose its kinetic energy of free fall during bouncing on Ryugu's surface till it comes to rest. Because of the unpredictable final attitude of MASCOT but with the requirement that the instruments such as MicrOmega, MASCAM and MARA need to look onto the surface, the lander is equipped with a mobility system. This enables MASCOT to upright into the correct measurement position and even to hop across Ryugu's surface allowing more than one location to be investigated scientifically.