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MARCO POLO SURFACE SCOUT (MASCOT) – STUDY OF AN ASTEROID LANDER FOR THE MARCO POLO MISSION

Abstract

Marco Polo is being considered as a sample return mission to a near-Earth asteroid to be jointly

developed by JAXA and ESA, with launch planned in the 2018-19 timeframe. In reponse to ESA's Declaration of Interest call in 2008, the Institute of Space Systems of the German Aerospace Center (DLR) led a proposal for a separate lander 'MASCOT' (Marco Polo Surface Scout) to be carried on the mission. The proposal was recommended for a feasibility study which was subsequently carried out from late 2008 to September 2009. The lander would augment the science capabilities of the Marco Polo mission in several ways by being a science platform in its own right for in situ analytical science and for geophysical investigations, by enhancing science and mission robustness through measurements in concert with the main spacecraft and in complementarity to the samples returned to Earth, and by serving as a 'scouting vehicle' for assessing one or possibly several candidate sampling sites for the main spacecraft prior to sampling. The present paper outlines the approach and principal results of the MASCOT study which began with a review of the science requirements, definition of a lander model payload, formulation of system requirements, and a review of key technologies. System concepts were then defined and refined in several concurrent engineering sessions of the study team. Significant heritage was provided by the Rosetta lander Philae' which is of similar complexity and scientific scope. Both the model payload and the technical concept for the lander were developed by a joint European-Japanese team. Several options of MASCOT were identified and described during the study: some with the capability to visit several locations at the surface of the asteroid, aided by the object's weak gravity field, and some with capability for exploring only a single location. MASCOT concepts range in total mass (including payload) from about 30 kg to 100 kg. Lander attitude control during ballistic descent from the main spacecraft to the surface is by 3-axis control and landing impact energy resulting from approach speeds of between about 0.2 m/s and 0.9 m/s (depending on the target asteroid) are attenuated by a legged landing gear for the lager MASCOT options. Contact instruments are placed onto the surface and samples for lander-internal instruments are acquired by way of a deployment and articulation mechanism.