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Hayabusa 2 Mission: The Fate of Ryugu Asteroid Ejecta

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Abstract

Hayabusa 2 mission is the Japanese sample and return mission to Ryugu asteroid launched in 2014. It is the successor mission to JAXA's Hayabusa mission to Itokawa asteroid. Hayabusa2 spacecraft will encounter Ryugu asteroid in June 2018, followed by the asteroid touch-down mission phase in the first half of 2019. The challenge that Hayabusa2 spacecraft will encounter is the asteroid cratering mission phase. Hayabusa2 spacecraft is equipped with a small carry on impactor, and it is expected to create a crater of 2-3 m size to allow the sampling of substrate asteroid materials. In this talk, a preliminary analysis of the hazard posed by the asteroid ejecta dynamics to Hayabusa2 spacecraft is presented. Past studies concluded that the regions around Ryugu are expected to be cleared after two weeks from the impact event if size particles of 1 mm are considered. However, Ryugu asteroid is composed by regolith (highly porous) material with high likelihood of ejecta in 1 cm size. Natural impact phenomena on asteroids observed from Rosetta spacecraft suggest that dust particles of 1 cm size in diameter can be captured for several months in orbit around the asteroid. This condition is extremely dangerous for Hayabusa2 spacecraft as a collision with small particles can severely damage the spacecraft structure and compromise its functionality. The fate of the asteroid ejecta is here investigated through numerical modelling. A high fidelity dynamical model is used where the asteroid gravity harmonics, its ephemeris, spin rotation and inclination, the solar radiation pressure perturbation and the effect of the Sun third-body perturbation are taken into account. The equations of motion are written for a perturbed two-body problem in the Asteroid-Centred Inertial reference frame. The dust cloud is initialised following analytical empirical laws obtained from experimental data. Four sampling dust particles size of 0.1 mm, 1 mm, 1 cm, 0.1 m in diameter are selected and numerically integrated. A direct Monte Carlo simulation is carried out by taking into account of uncertainties in the impact point.

A Brief Biography of Stefania Soldini

Stefania Soldini is a JAXA Project Research Associate in the Hayabusa 2 Team. She went to Japan in March 2016 with a one year JSPS Research fellowship. She gained her PhD in October 2016 from the Astronautical research Group of the University of Southampton, UK after she graduated for both her Master and Bachelor degrees in Space and Aerospace Engineering at Politecnico di Milano, Italy. Her main interest are in astrodynamics and small bodies proximity operations.

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April, the 4th, 2017 at 12:00
Sala Consiglio, 2nd Floor, Building B12, Campus Bovisa
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