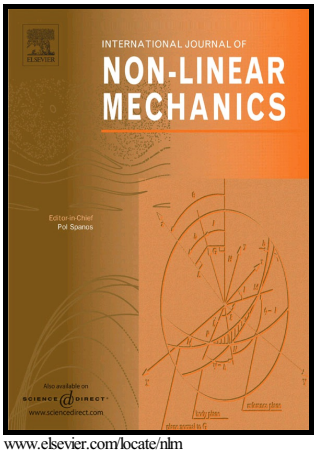

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Asteroid debris: temporary capture and escape orbits

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Abstract

We investigate the dynamical behaviour of debris ejected from the surface of an asteroid, due to a generic - natural or artificial - surface process. We make an extensive statistical study of the dynamics of particles flowing from the asteroid. We observe different behaviours: particles which fall again on the asteroid surface, or rather escape from its gravitational field or are temporary trapped in orbit around the asteroid. The tests are made by varying different parameters, like the size of the asteroid, its eccentricity, the angular velocity of the asteroid, the area-to-mass ratio of the debris.

We also extend the study to the case of a sample of binary asteroids with a mass ratio equal to 10^{-3}; we vary the distance of the moonlet from the asteroid, to see its effect on the debris dynamics.

Our simulations aim to identify regions where the debris can temporarily orbit around the asteroid or rather escape from it or fall back on the surface. These results give an important information on where a spacecraft could be safely stay after the end of the process which has produced the debris.

Keywords: Asteroid debris, Perturbed four body problem, Lyapunov exponents, temporary capture.

1. Introduction

During the last years space agencies have realized several robotic missions to asteroids. In one case (up to now), the probe *Philae* (within the ESA *Rosetta* mission) landed on the surface of the comet 67P / Churymov-Gerasimenko, thus providing the first in situ analysis of a comet. Among the future projects, space agencies started to envisage robotic, or even manned, missions to collect asteroid material and bring it back on the Earth. These projects might include a resurfacing of the asteroid, possibly due to ablation or other disruptive actions. In the light of future possible space

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