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Author: Prof. Othon Winter
UNESP - Univ Estadual Paulista, Brazil

Mr. Andre Amarante
UNESP - Univ Estadual Paulista, Brazil

MAPPING THE DENSITY OF PARTICLES OVER THE SURFACE OF ASTEROID (101955) BENNU

Abstract

Asteroids and comets are thought to be critical for understanding the origin and evolution of the Solar system and possibly the origin of life on Earth. Several countries and space agencies have launched missions to these small bodies. The most recent one is the OSIRIS-REX mission to Asteroid (101955) Bennu. One of its main goals is to bring back to Earth a sample of pristine carbonaceous regolith from Bennu. The analysis of such material will be important to understand the role that primitive asteroids may have played in the formation of planets and the origin of life. In the present work we study the motion of particles near the surface of Bennu. An application of the results is to give assistance for the selection of the sample site. Considering the gravitational potential given by the polyhedral model of Bennu (1348 vertices, 2692 faces), we numerically simulated many samples of 10,000 test particles initially located randomly in a cloud around the asteroid. We have investigated eccentric and inclined orbits, and we also adopted different particle sizes, from fine dust grains up to small particles. It is already know that Bennu has eight equilibrium points around it, and according to the adopted density, a couple of them might be stable. The influence of the equilibrium points is very strong on the orbital evolution of the particles. In the long term dynamics most of the particles collided with the asteroid surface. From our results we generated map diagrams indicating the amount of particles distributed over the surface of Bennu. They show the spots of very high collision rates, where are expected to be fully covered of particles, and also those where it is expected to be cleaner (sites of very low collision rates). These diagrams are made for a range of different particle sizes and also, with and without taking into account the solar radiation pressure in the dynamics of the orbital evolution. In order to make the selection for the sample site, we believe that these results might be extremely useful for the OSIRIS-REX mission.