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The orbit's evolution of particles ejected from the surface of Phobos

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1. Introduction

It is known that all giant planets have ring systems. Generally there are faint rings, such as "gossamer rings" of Jupiter. One of the basic theories of faint's origin of rings is their formation from the dust ejected in collisions of meteorite material with the natural satellites.
Thus, a question of possible existence of Mars's dust rings arises. Mars has two natural satellites, which are subjected to bombardment. Evidences of this are impact craters of different sizes that cover the surface of both satellites.

2. Methods

To test the theory, a calculation of the movement of simulated particles, which could be ejected from the surface of Phobos by meteorite impact, was made. The initial coordinates of 650 particles on Phobos surface were simulated using regular grid $10^{o} \times 10^{o}$. Uniform distribution of the velocity was set to the absolute value in the range of 0.5 km/s to 3 km/sec; direction of the velocity vector was assigned randomly. In this study effect of the gravitational attraction of the Sun, Earth, Mars, Jupiter, Phobos and Deimos was taken into account as an attraction of the central mass.
Using software package for orbital dynamic MERCURY6 [1] - an integration of the equations of motion of particles was performed using Everhart method with a Radau spacing of the 15th order [2].

3. Results

Motion of 650 particles was considered at the time interval of 10 000 years. As a result of calculation: 202 of the particles (31.1%) returned to Phobos; 132 of the particles (20.3%) fell to Mars; 173 particles (26.6%) had a hyperbolic orbit; 143 particles rotated on their orbits around Mars, and they represent 22.0% of the total number of simulated particles.
The orbits of the particles are elongated: eccentricity is within the range from 0.1 to 0.95; pericentric distance varies from 3 500 km to 48 100 km; respectively apocenteric distance is from 9000 to 421 400 km. In the space, orbits are inclined to the ecliptic from 1 to 73 degrees, so trajectories of the particles can form a kind of toroidal structure around Mars.

4. Conclusions

As conditions which previously discussed, a cluster of ejected particles creates a dust torus around Mars, resistant to disturbances for 10 thousand years. According to statistics, nearly a quarter of the ejected particles stay on orbit around Mars.
However, the formation of a dense ring, visible using by any optics, raises doubts. Orbits of particles take a variety of configurations. So, we cannot yet specify the location of area with increased density of particles.

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References:
1. http://www.arm.ac.uk/∼jec/home.html
2. Chambers J. E. «Manual for the MERCURY integrator», 2001.