EVOLUTION OF ASTEROIDAL METEOROID STREAMS RELEASED BY THE EARTH'S TIDES. J. Tóth[1], L. Kornoš[1] and P. Vereš[1], [1]Department of Astronomy, Physics of the Earth and Meteorology, Faculty of Mathematics, Physics and Informatics, Comenius University in Bratislava, Mlynska dolina, 842 48 Bratislava, Slovak Republic. toth@fmph.uniba.sk.

Motivation: The fall of Neuschwanstein meteorite in 2001 with practically identical orbit as Příbram meteorite [1] was the inspiration for this work. We have shown [2] similar orbital evolution of both meteorite at least for 5000 years, which indicate possible existence of meteoroid stream in the same orbit. The origin of such stream is a question. One of possible answers could be the release of meteoroids from asteroidal surfaces by the Earth's tides during close NEA approaches.

Introduction: Near Earth Asteroids larger than H(1,0) > 22 mag., which approached the Earth within 10 LD (lunar distance) for the last 100 years were investigated as a possible source of released meteoroids by the Earth tides. This mechanism was described by authors and other collaborators in our previous paper [3]. Now we focused on the following evolution of asteroidal meteoroid streams from the dynamical point of view.

Particle release due to tidal force of the Earth: The case of particle lift-off was investigated only in 3 body system – Earth, asteroid and particle on the equator of spherically shaped asteroid with the rotation and spin axis perpendicular to the plane of motion. As a testing asteroid we chose 2007 TU_{24}, H=20.3, fly-by distance 1.4 LD on 01/29/2008. According to its slow rotation of 26 hours [4] and semi-major axis we assumed a rubble-pile S-type asteroid with the same boulder surface density as we found on Itokawa [5].

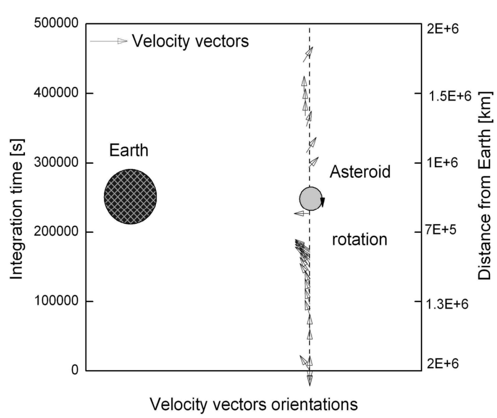

Figure 1: Schematic chart of velocity vectors (with regard to the center of asteroid) of particles leaving asteroid at different geocentric distances and positions on its equator.

36 particles were initially distributed evenly around equator, additional 7 particles were placed on the surface after close fly-by. The position and velocity vectors of test particles released during parent asteroid approach were investigated. Result is shown on Figure 1. Maximal values of differential escape velocities imply 2D spread ($\Delta Vx=4,\ \Delta Vy=15$ [cm/s]) of particle trail. The particle release due to tidal force depends on asteroid's mass, fly-by distance, velocity and spin rate. Extension of affected asteroid surface (Figure 2) allowed to calculate total amount of matter lifted on spherical 3D asteroid model (latitude=$\pm$acos(F_{min}/F)).

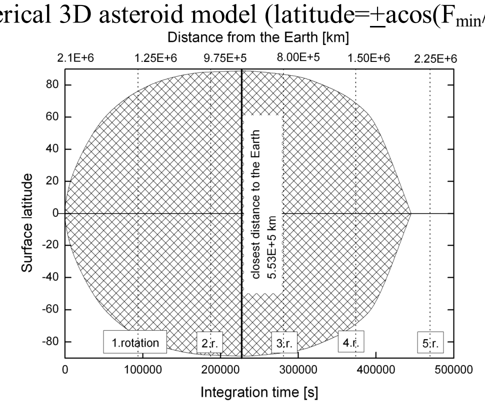

Figure 2: Asteroid 2007 TU_{24} surface area (spherical model) affected by particle lift-off during close Earth fly-by. The particle release occurred during 5 rotations of the asteroid.

Orbital evolution: The original positions and velocity vectores of escaped particles are used for orbital evolution analysis. The resulted spread of particles along the orbit and the width of the stream after several revolutions are studied. Derived characteristics of possible meteor shower of asteroidal origin are presented.

Acknowledgments: This work was supported by the Scientific Grant Agency VEGA, grant No. 1/3067/06.

References:

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