Thermal Effects in Physics and Dynamics of Small Bodies of the Solar System

Abstract of the Ph.D. thesis

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It has been shown, that the thermal effects are very important in the dynamics of small Solar System bodies. A phenomenon which is known as *the Yarkovsky effect* is able to secularly change the semimajor axis of an orbit, while *the YORP effect* affects the rotation state of a body.

The Yarkovsky effect and the YORP effect were previously calculated with many constraining assumptions like spherical shapes of asteroids, circular orbits, small variations of the surface temperature, principal axis rotation, constant thermal parameters, etc. We developed a sophisticated numerical model of the Yarkovsky/YORP effect without such simplifications. With this model, we have been able to describe the shape, the orbit, the rotation and the thermal behaviour of an asteroid in a very precise way.

The YORP effect was studied on a sample of artificially generated shapes, roughly resembling Main Belt asteroids, and also on several shapes of real asteroids. The dependence of YORP on the obliquity and the thermal parameters of the surface were studied (Vokrouhlický and Čapek, 2002; Čapek and Vokrouhlický, 2004). A wide variety of possible YORP evolution paths of the spin state was found. The possibility of successful detection of the YORP effect via phase shift of the lightcurve was computed for several real asteroids (Vokrouhlický et al., 2004).

Our numerical model was used succesfully for the prediction and the following detection of the Yarkovsky effect on asteroid (6489) Golevka (Chesley et al., 2003). It was the first direct detection of this phenomenon effect on a natural body. We also computed the Yarkovsky effect and estimated possibilities of the detection for several other asteroids (Vokrouhlický et al., 2005a,b). (Involving the cases with highly eccentric orbits, non-principal axis rotation or binary systems.) On the basis of the detected Yarkovsky orbital drift for (6489) Golevka and our model involving the depth and the temperature dependence of the thermal parameters, we estimated the depth and the thermal conductivity of the surface regolith layer (Čapek and Vokrouhlický, 2005).