Title: Orbital and internal dynamics of terrestrial planets

Author: Michaela Walterová

Department: Department of Geophysics

Supervisor: RNDr. Marie Běhounková, Ph.D., Department of Geophysics

Abstract: Close–in exoplanets are subjected to intense tidal interaction with the host star and their secular evolution is strongly affected by the resulting tidal dissipation. The tidal dissipation not only provides an additional heat source for the planet's internal dynamics but it also contributes to the evolution of the planet's spin rate and orbital elements. At the same time, the tidal dissipation itself is also determined by the planet's thermal state and by the spin–orbital parameters. The evolutions of the orbit and of the interior are, therefore, intrinsically linked. In this work, we combine analytical and numerical techniques to gain insight into the interconnection between the internal properties and the orbital evolution, with special focus on the role of tides. After a general study of parametric dependencies of the tidal heating and tidal locking, we present a semi–analytical model assessing the coupled tidally–induced thermal–orbital evolution in systems consisting of a host star and one or two planets. Specifically, we study the thermal–orbital evolution in three systems inspired by existing low–mass exoplanets and in a model system with ongoing Kozai–Lidov oscillations. Two additional studies illustrate the derivation of planet—planet tidal potential and the analysis of tidal phenomena in viscoelastic bodies in a numerical approach.

Keywords: tidal evolution, thermal evolution, terrestrial exoplanets