Geophysical Research Abstracts, Vol. 9, 07663, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-07663

Librations and ice shell thickness of Europa

N. Rambaux, Ö. Karatekin, T. Van Hoolst
Royal Observatory of Belgium

The detection of an induced magnetic field in the vicinity of the Galilean satellite Europa by the Galileo mission suggests the existence of a subsurface ocean of liquid water. The thickness of the overlying icy shell provides important information on the thermal evolution of the satellite and the interaction between the ocean and the surface, the latter being fundamental for astrobiology. However, the thickness is not well known, and estimates range from several hundred of meters to some ten of kilometers. Here, we investigate the use of libration observations to study the ice shell thickness.

Europa is in a synchronous 1:1 spin-orbit resonance in an eccentric orbit around Jupiter. As a consequence, the satellite does not always show exactly the same face to the planet, which therefore exerts a time-variable gravitational torque on Europa that tends to modify the satellite's spin. With a subsurface ocean, the outer icy shell, the liquid ocean, and the solid interior perform differential librations with respect to each other, and the libration of the outer icy shell can be significantly different with respect to a satellite without ocean. In our dynamical model, we include gravitational coupling between the icy shell and the solid interior, which contains most of Europa's mass. We show that the presence of an ocean can increase the amplitude of libration by about 10%, depending mainly on the thickness of the icy shell. For small thickness, the amplitude of libration can even be larger due to a resonance with a normal mode.