Geophysical Research Abstracts, Vol. 8, 00706, 2006
SRef-ID: 1607-7962/gra/EGU06-A-00706

Mercury libration determination and the link with the interior of the planet

G. Pfyffer, V. Dehant, N. Rambaux, A. Rivoldini, T. Van Hoolst
Royal Observatory of Belgium, Brussels, Belgium (g.pfyffer@oma.be)

Mercury's internal structure is the most puzzling among the terrestrial planets. The space missions MESSENGER and BepiColombo will play an important role in constraining the structure, formation, and evolution of Mercury. Our work aims at understanding the structure of Mercury's interior from observations of the 88-day forced libration, the obliquity, and the degree-two coefficients of the gravity field of Mercury. Of those quantities, the libration is the most difficult to measure and will hence be the limiting factor. For a correct interpretation of the observations, the impact of the core on the librations must be precisely modeled.

We report here on aspects of the observational strategy to determine the libration amplitude as well as on the theoretical libration modelling. Repeated photographic measurements of selected target positions on the surface of Mercury are central to the strategy to determine the libration, in the frame of the BepiColombo mission. We simulated these measurements which enabled us to reconstruct the rotational motion of the planet, with an accuracy depending on the quantity of measurements made, the number of different targets considered and their locations on the surface of the planet. From this study, we determine criteria for the distribution and number of target positions, to maximize the accuracy on the rotation determination, from which the libration is extracted. The objective of this work is to see if we can infer knowledge of the interior structure by inverting the libration data.

To reach this goal we determined the rotational motion of Mercury, considering either a solid core or a partially liquid core, with the numerical model SONYR . The liquid core and the mantle are assumed to be coupled through an inertial torque on the ellipsoidal core-mantle boundary. We determined Mercury's rotation for a large set of possible interior structure models, using the percentage of light elements in the core

and the inner and outer core radii as parameters.

To analyze the impact of a possible solid inner core on the libration, we also developed an analytical model of the rotation of Mercury consisting of three layers. The result of the two approaches is compared.