Geophysical Research Abstracts
Vol. 12, EGU2010-2936, 2010
EGU General Assembly 2010

Elliptical Chandler pole motions of the Earth and Mars

Yury Barkin (1) and Jose Ferrandiz (2)

(1) Sternberg Astronomical Institute, celestial mechanics and gravimetry, Moscow, Russian Federation (barkin@inbox.ru, 07-495-9328841), (2) University of Alicante, Alicante, Spain/jm.ferrandiz@ua.es

In the work the values of the period and eccentricity of Chandler motion of poles of axes of rotation of the Earth and Mars have been determined. The research has been carried out on the basis of developed earlier by authors an intermediate rotary Chandler-Euler motion of the weakly deformable celestial bodies (Barkin, Ferrandiz and Getino, 1996; Barkin, 1998). An influence of a liquid core on Chandler motion of a pole in the given work has not considered. The periods of the specified pole motions make 447.1 d for the Earth and 218.1 d for Mars. In comparison with Euler motions of poles because of elastic properties of planets the Chandler periods are increased accordingly on 142.8 d (about 46.9 %) for the Earth and on 26.2 d (on 13.7 %) for Mars. Values of eccentricities of specified Chandler motions of pole $e = \sqrt{b^2 - a^2}/b$ (here a both b are smaller and big semi-axes of Chandler ellipse) make 0.09884 for the Earth and 0.3688 for Mars (accordingly, on 21.1 % and 6.2 % more than the appropriate values of eccentricities for models of planets as rigid non-spherical bodies).

Axes of an ellipse a also b correspond to the principal equatorial axes of inertia of a planet Ox and $Oy$for which the moments of inertia have the smallest value$A$ and middle value B. The pole of the principal axis of inertia Ox for the Earth is displaced to the west on the angle 14º9285, and the pole of the principal axis of inertia Ox for Mars is displaced to the west on the angle 105º0178 (in the appropriate basic geographical systems of coordinates of the given planets). For ellipticties of Chandler trajectories $\varepsilon = (b - a)/b$ the values 0.004897 (for the Earth) and 0.07048 (for Mars) have been obtained. The specified values surpass by Euler values of appropriate ellipticties on 46.8 % (in case of the Earth) and on 13.3 % (in the case of Mars). Love number $k_2$describing the elastic properties of planets, were accepted equal 0.30 for the Earth and 0.153 for Mars. Estimations of Chandler periods will well be coordinated to similar estimations of other authors for models of elastic planet in 200-212 d (Konopliv et al., 2006; Zharkov, Gudkova, 2009). The values of eccentricity and ellipticity of Chandler pole motion of the Earth will be coordinated to earlier estimations e=0.096-0.098 and ε=0.0046-0.0048 (Barkin, 1998; Barkin, Ferrandiz, 2004), and for Mars have been obtained for the first time. The account of influence of a liquid core on considered parameters of motion of poles of planet with elastic mantle also is discussed in report on the base of author's approach developed in the paper (Ferrandiz, Barkin, 2001).

The Barkin's work partially was finacially accepted by Spanish grants, Japanise-Russian grant N-09-02-92113-JF and by RFBR grant N 08-02-00367.

References

Barkin Yu.V., Ferrandiz J.M., J. Getino (1996) About Applications Angle-Action Variables in Rotation Dynamics of the Deformable Celestial Bodies. (Eds. S. Ferraz-Mello, B. Morrando, J.-E. Arlot) Dynamics, ephemerides and astrometry of the solar system. Proceedings. 172 nd Symposium of the International Astronomical Union, Paris (France), 3-8 Jul. 1995. 1996, pp. 243-244.

Barkin Yu.V. (1998) Unperturbed Chandler's Motion and Perturbation Theory of the Rotational Motion of the Deformable Celestial Bodies. Astronomical and Astrophysical Transactions, v. 17, N3, pp. 431-475.

Barkin Yu.V., Ferrandiz J.M. (2004) Some dynamical effects in unperturbed and perturbed Earth rotation caused by elastic properties of the mantle. Journees 2004 "Systems de reference spatio temporals" (20-22 September, 2004, Paris, France). Fundamental Astronomy: New concepts and models for high accuracy observations. Book of abstracts, Observatoire de Paris, pp. 15-16.

Ferrandiz, J.M. and Barkin, Yu.V. (2001) Dynamics of the rotational motion of the planet with the elastic mantle,

liquid core and with the changeable external shell. Proceedings of International Conference «AstroKazan-2001». Astronomy and geodesy in new millennium (24-29 September 2001), Kazan State University: Publisher «DAS», pp. 123-129.

Konopliv A.S., Yoder C.F., Standish E.M., Yuan D.-N. and Sjogren W.L. (2006) A global solution for Mars static and seasonal gravity, Mars orientation, Phobos and Deimos masses, and Mars ephemeris. Icarus, V. 182, pp. 23-50.

Zarkov V.N., Gudkova T.V. (2009) The period and Q of the Chandler wobble of Mars. Planetary and Space Science (in press).