Determination of mass of Jupiter and that of some minor planets from observations of minor planets moving in 2:1 commensurability with Jupiter.

Kochetova O.M.

[1]*Institute of Applied astronomy of RAS,*
Zhdanovskaya st. 8, St. Petersburg 197110, Russia, e-mail: 1136@ita.spb.su

Great number of observations of minor planets accumulated by now gives possibility to estimate once again the value of the Jupiter' mass from the minor planets being in 2:1 commensurability with Jupiter as proposed by Hill (1873). In so doing the perturbations from 9 major planets and 5 asteroids in accordance with coordinates/masses from DE200/LE200 ephemeris were taken into account. The relativistic terms due to the Sun and Jupiter were included in equations of motion. The observations were corrected for gravitational deflection of light and for phase effect by Lommel–Zeeliger law of scattering. 5896 observations of 13 minor planets were used in general solution for orbital elements of minor planets and mass of Jupiter. The comparison of obtained results with those of other investigations is given in the following Table.

Object of study	Sun-Jupiter mass ratio	Author
Pioneer & Voyager tracking data	1047.3486 $\pm$0.0008	Campbell and Synnott (1985)
Martian landers	1047.34830 0.00017	Pitjeva (1997)
Minor planets	1047.3482 0.0008	This paper

In the second part of present work the masses of some minor planets have been found from their gravitational perturbations on a number of smaller planets. The corresponding pairs of minor planets were chosen from those being in 2:1 commensurability with Jupiter. Sampling of the pairs was governed by criterion: minimal distance between planets is less or equal to 0.1 a.u. Usage of less stringent requirement than usually used 0.05 a.u. is here warrantable as the approaches of planets are regularly repeated due to commensurability and mutual velocities of the bodies are rather small. The obtained results are given below.

Perturbing minor planet	Mass (10^{-11} M$_{Sun}$)	Perturbed minor planets	Number of observations
10 Hygiea	5.7$\pm$1.4	48,120,357,767,1974,2330,2846	1390
52 Europa	2.9 1.6	92,401,489,491,595,635,1015, 1489,1571,1674,2197,2405,2582	1803
65 Cybele	0.79 0.40	526,979,1082,1261,3036,3150,1815	1025

Thus, the approach proposed in this paper gives possibility to increase the number of minor planets whose masses can be determined with sufficient precision.

References

Hill, G.W. 1873. Collected Mathematical Works, Vol.I, p.105.

Campbell, J.K. and Synnott, S.P. 1985. Astron.J., 90, 364-372.

Pitjeva E.V. 1997. In: Proceedings of IAU Colloquium 165, 251-256.