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The motion of asteroids at the 5:2 resonance with Jupiter

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The present work is devoted to investigation of Near-Earth asteroids (NEAs) motion at the 5:2 resonance with Jupiter. The motion of these objects has some peculiarities such as close approaches to the inner major planets and Jupiter, large eccentricities and so on. These features render the motion of many considered asteroids unstable.

First, all NEAs at the 5:2 resonance with Jupiter have been revealed. The initial parameters of orbits were taken from Bowell catalog on January 26, 2002 (ftp://ftp.lowell.edu/pub/elgb/astorb.dat). For each investigated object a set of 100 clones has been constructed in such a way [3]. We begin from the analysis of observations and improvement of the initial parameters of every orbit by the least-squares method. In Ph.D. dissertation of Yu. D. Medvedev and paper [4] it was shown that the conditionality of the problem of orbits improvement by the least-squares method depends on the choice of initial epoch. Therefore the study of the condionality of the normal equations matrix for different initial epochs has been made. The epoch with minimal conditionality has been chosen for construction of particles ensemble. The initial set of orbits has been generated using a random number generator on the basis of the normal law and corresponding covariation matrix.

The ensemble evolution has been followed up for 6000 years. The regions of possible motion where orbital resonance continues to exist have been determined. Moreover the possibility of approaches of asteroids and clones to the inner major planets and Jupiter has been considered.

The differential equations in form suggested in [1] have been used. The asteroid motion has been considered in rectangular heliocentric coordinate frame related to ecliptic and equinox 2000.0. The equations of motion have been integrated numerically by Everhart procedure of the 19th order [2]. Perturbations from planets and the Moon have been taken into account using the planets positions given by DE406.

The asteroids falling into the vicinity of the resonance have been determined by means of numerical estimation of the resonance band $\alpha = 2n_a - 5n_J$, where n_a, n_J are the mean motions of an asteroid and Jupiter correspondingly. The objects passing through exact commensurability ($\alpha = 0$) have been revealed. The evolution of these orbits has been investigated at the several thousand years time interval. The accuracy of integration was estimated by comparing the results of toward–and–backward integration for each asteroid. Time interval has been chosen for each asteroid from the point of view of preserving the admissible accuracy.

Thus, we made a list of asteroids moving in vicinity of resonance 5:2 with Jupiter on time interval of several thousand years. For each investigated object an ensemble of 100 clones has been constructed. The results of investigation of asteroids 6178 1986 DA and 1985 WA are cited as an example.

References

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