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Title: *"The orbital evolution of the four-planetary system Sun–Jupiter–Saturn–Uranus–Neptune on long-time scales"*

Abstract. The study of planetary systems orbital evolution is one of important problems of celestial mechanics. We present averaged semi-analytical motion theory for a planetary system with four planets. The Hamiltonian of the four-planetary problem is written in Jacobi coordinates and it is expanded into the Poisson series in orbital elements of the Poincaré second system. This system has only one angular element, that is mean longitude. It allows simplifying angular part of the series expansion. The expansion is constructed up to the second degree of the small parameter, which is the ratio of the sum of planetary masses to the mass of the star.

The averaged Hamiltonian of the four-planetary problem is constructed by means of the Hori-Deprit method. We obtain the generating function for the transformation between osculating and averaged elements, the functions for the change of variables and right-hand sides of the motion equations in averaged elements. Analytical transformations are implemented by means of the Piranha echeloned Poisson series processor.

We have applied our averaged motion theory to the investigation of orbital evolution of Solar system's giant planets. The results of numerical integration of the averaged motion equations for Sun–Jupiter–Saturn -Uranus–Neptune's system on a time interval of 10 billion years is considered. The integration is performed by Everhart method of the 15th order. The planetary motion has an almost periodic character. Eccentricities and inclinations of the planetary orbits save small values. Also, resonant properties of planetary motion are considered. The accuracy of numerical integration is given.

Joint work with Eduard Kuznetsov.