Bifurcation analyses of capture at the resonance rotation in celestial mechanics

Alexander V.Gusev and Olga A.Salangina[†]

Kazan State University, 18, Lenin str., Kazan, 420008, Russia
[†] Kazan Physical-Technical Institute, 10/7, Sibirskij str., Kazan, 420029, Russia
e-mail: gusev@astro.kazan.su olgas@open.ksu.ras.ru

The dynamical picture of distribution matter in Solar system is testified about a strongly marked tendency in a resonance structure. The motions of Moon, Mercury, Pluton, Haron, some satellites of Saturn, Jupiter, Mars are the resonances. Some rotations of artificial satellites are presented a resonance too. The discovery of resonance motion of two celestial bodies in planet system of solar type around millisecond radiopulsar PSR B1257+12 is fantastic.

At the present report for the plane motion we are completely analyzing the two differential equations systems of capture of celestial bodies at the resonance rotation with action of tidal torques only and with common action of gravitational and tidal torques by qualitative analysis and bifurcation theory of dynamical systems.

The analyses of the phase portraits of one-, two-, three-parameter dynamical systems and the bifurcation space of parameters confirm the gravitational capture. The separations of parameter spaces of dynamical system by bifurcation surfaces are obtained. The gallery 15 (with action of tidal torques) and 79 (with action of gravitational and tidal torques) phase portraits of capture confirms and extends the known scenario of global evolution celestial bodies.

Among the bifurcations being investigated we meet the typical catastrophes of Arnold-Thome from A class, which are illustrated a structural stability of the gravitational capture phenomenon at the resonance rotation.

The present results may be used for investigations the rotation of small celestial bodies and satellites.