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WORKSHOP
"PLANETARY MOTIONS, SATELLITE DYNAMICS, AND SPACESHIP ORBITS"
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Quasi-satellite regime of motion of small celestial bodies : formation and destruction

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The investigations on long-term evolution of asteroid's orbits are crucial to understanding the route through which the present configuration of the Solar system came to be. The so-called coorbiting asteroids (which share their orbits with major planets) attract the special attention in this connection : are they the primordial remnants of the building blocks of the corresponding major planet or they are "emigrants" from the other parts of the Solar system. The most well known examples of co-orbits in natural objects are provided by Trojan groups of asteroids and by asteroids moving in horseshoe orbits. These asteroids are precluded from having relatively close encounters with their host planets. However, there exists another class of coorbiting objects in which the opposite is true : they remain very near to the host planet eternally or, at least, for long enough time. Since typically they never enter the planet‚Äôs Hill sphere, they cannot be considered as satellites in the usual sense of the word. In order to emphasize this specific they are called quasi-satellites (QS).

We explore the properties of QS-orbits under the scope of the restricted spatial circular three-body problem. Via double numerical averaging, we construct evolutionary equations which describe the long-term behaviour of the orbital elements of an asteroid. Special attention is paid at possible transitions between the motion in a QS-orbit and that in another type of orbit available in the $1 : 1$ mean motion resonance. A rough classification of the corresponding evolutionary paths is given for asteroid's motion with a sufficiently small eccentricity and inclination.

To illustrate the typical rates of the orbital elements's secular evolution, the dynamics of the near-Earth asteroid 2004GU9 was studied. This asteroid will keep describing a QS-orbit for the next several hundreds of years.

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