

The eccentric von Zeipel-Lidov-Kozai Mechanism in the Oort Cloud due to the Galactic Potential

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The Oort cloud is the hypothetical object which was first suggested in 1950 by Oort as a nest of comets in the outermost region of the Solar System. Comet nuclei are thought to be distributed until 10^5 times farther than the Earth from the Sun but its existence and formation history are unknown yet.

The characteristics of observed long period comets (LPCs) are thought to reflect those of the Oort Cloud.

One of the characteristic properties of the LPCs is the spherical distribution of their apocenters. Another is that almost half of their orbits are retrograde. The cause of these properties has not been understood well.

The candidates of the reason are gravitational interactions between other Planets, fly-by stars and interstellar objects (ISOs) and the force from the Galaxy. The effects from the first 2 can be estimated only stochastically and uncertainty is large.

In this study, we investigated the effect of the Galactic potential (GP) to the orbital evolution of the Oort cloud objects by using numerical simulations. Since we focused on the effect of the Galactic force, we did not include interactions with other Planets and fly-by ISOs in our numerical simulation.

In our simulation, the equations of motion of a test particle which is a model of an Oort Cloud are integrated in the Cartesian sidereal coordinates. The Galactic Potential is modeled by the Miyamoto-Nagai Potential.

We found that many retrograde orbits emerges. It is driven by one of the eccentric Kozai mechanisms.

Also we found that the effect from the Galactic potential is not enough to make the distribution of the Oort Cloud spherical. Therefore other additional mechanism will be required to explain their orbital properties.

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