P136-016 Room: 304 Time: May 28 10:58-11:11

Evolution of the comet cloud by stellar encounters

Arika Higuchi[1]; Eiichiro Kokubo[2]

[1] NAOJ, DTA; [2] NAOJ

We have investigated the evolution of the structure of the Oort cloud by stellar encounters. Oort cloud comets are believed to be planetesimals, which are remnants of planet formation. The external forces such as the galactic tide and perturbations from passing stars and/or giant molecular clouds pulls up perihelia and randomizes inclinations of planetesimals with large aphelion distances produced by planet scattering. These processes play important roles in forming the spherical Oort cloud, which is predicted by observations of long-period comets.

We considered the effect of the passing stars on the formation of the Oort cloud. The initial planetesimal disk is flat and the perihelion distances of the planetesimals are near the planetary region. Passing stars give the velocity changes to the planetesimals and the planetesimals gain or lose their energies and/or angular momentum. These changes induce the diffusion of the planetesimal disk i.e., the perihelion distances and inclinations of the planetesimals are redistributed, and finally the planetesimals attain the isotropic distributions. When the velocity change is large, some planetesimals escape from the Solar system to the interstellar space. Effects of the stellar encounter depend on the mass, velocity, and impact parameter of the star and positions and orbital velocities of the planetesimals.

We simulated the evolution of the planetesimal disk due to the successive stellar encounters. The number of stars that pass within 1 pc from the Sun in million years is about 10 in typical cases. We us the simplified stellar sets which consist of stars with equal masses and velocity deviations, and the realistic one made from the observational data of the solar neighborhood. We used the impulse approximation to calculate the velocity change of planetesimals.

We found that the spherical Oort cloud can be formed in 5 billion years by stellar encounters with the parameters derived from the observation of the solar neighbourhood. However, the isotropic distributions of eccentricity and inclination are not produced. We also found that, in typical parameter ranges, the evolution rate of the planetesimal disk is scaled by the masses, velocities, and total number of the stars.

We will apply the results to the other planetary systems and discuss the comet clouds around them.