Formation of the Oort Cloud and New Comets due to the Galactic Tide

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We have investigated the evolution of the structure of the Oort cloud and the injection of new comets from the Oort cloud due to the galactic tide. The galactic tide pulls up perihelia and randomizes inclinations of planetesimals with large aphelion distances produced by planetary scattering. We considered the effect of the vertical component of the tidal force from the galactic disk on the structure of the Oort cloud.

Due to the galactic tide, the eccentricity and inclination of some planetesimals conversely oscillate a great deal. The planetesimals that gain the perihelion distances large enough to leave the planetary region become elements of the Oort cloud. We examined the evolution of the planetesimal disk to the Oort cloud due to the galactic tide by applying the analytical solutions to the

orbital evolution of planetesimals. We found that due to the galactic tide, planetesimals with the semimajor axes ˜1,000 AU raise the perihelion distances outside the planetary region and planetesimals with the semimajor axes ˜10,000 AU obtain the inclination from 0 to 153 deg to the ecliptic plane in 4.5 Gyr.

As perihelion distances oscillate, the planetesimals come back to the planetary region as new comets. We also found that the galactic tide alone can not realize the isotropic distribution of inclination of new comets from the Oort cloud, which is expected from the observation of long-period comets.