P231a Planetesimal Dynamics in the Presence of a Giant Planet

Kangrou Guo and Eiichiro Kokubo, NAOJ/The University of Tokyo

The early evolution of planetesimals in the formation process of planets could be affected by strong perturbations from massive planets in the system, and thus deviate from the standard scenario. We investigate the dynamics of planetesimals under the perturbation of a giant planet in a gaseous disk. Our aim is to understand the effect of secular perturbation on the formation of planetary cores outside the orbit of the perturber. Using numerical simulation, we calculate the orbital evolution of planetesimals ranging from 10^{13} to 10^{20}g, with a Jupiter-mass planet located at 5.2 au. We find orbital alignment of planetesimals distributed in $\simeq$ 9-15 au, except for the mean motion resonance (MMR) locations. The degree of alignment increases with increasing distance from the planet and decreasing particle mass. The relative velocity decreases with increasing distance from the planet and decreasing planetesimal mass ratio. Our results show that with a giant planet embedded in the disk, the growth of another planetary core outside the orbit of the existing planet might be accelerated via the alignment of orbits. We also try to generalize our results by varying the mass and eccentricity of the perturbing planet and investigate its impact on the random encounter velocity of planetesimals. Generally speaking, the perturbation from a more massive planet leads to higher random encounter velocity of planetesimals in the disk. A more eccentric planet also leads to higher random encounter velocity, unless the timescale of gas damping becomes shorter than that of secular perturbation. These results of dependence study might help us understand the orbital architecture of some extrasolar planet systems.