

# Basic research of planetary migration by interaction with planetesimal disk

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An outward orbital migration of Neptune in early solar system history provides an efficient mechanism for shortening the planet growth time as well as sweeping up large numbers of Trans-Neptunian objects into Neptune's mean-motion resonances. Though several works about migration of Neptune have been done, its hard to apply to other planetary system because of their restricted initial condition. We investigate the basic mechanism of orbital migration in two situation. That are one giant planet and planetesimals (restricted 3-body calculation), and two giant planets and planetesimals (restricted 4-body calculation). They revolves around the Sun within a swarm of planetesimals.

We numerically integrated the orbital evolution of planetesimals with various orbital elements and find net angular momentum exchange.

In the 3-body calculations, because of the difference of the synodic period and having eccentricity, effects from inner planetesimals and outer planetesimals are different.

In the 4-body calculations also has feature of 3-body calculations. And added planet works like 'remover'. Planetesimals around Neptune are scattered and stochastically increase their eccentricities. Some of them are finally scattered by Jupiter and remove from feeding zone of Neptune. This effect pushes the planet outward. By comparing the results of these two simulations, we can extract the effects of added planet. In our presentation, we will show these results and discuss about self gravity of planetesimal swarm.