PPS020-06 Room:103 Time:May 24 09:45-10:00

On the Interaction between a Protoplanetary Disk and a Planet in an Eccentric Orbit

Takayuki Muto[1]*, Taku Takeuchi[1], Shigeru Ida[1]

[1]Tokyo Institute of Technology

The number of planets discovered so far has exceeded 500, and approximately 200 of them have eccentricity more than 0.2. If such planets are born in a disk environment, it is important to study how they interact with the disk and how the orbital parameters of such eccentric planets evolve. In this talk, we present a new analytic approach to the disk-planet interaction that is especially useful for planets with eccentricity larger than the disk aspect ratio. In the study of disk-planet interaction conducted so far, the eccentricity of the planet is assumed to be small, and the planet orbit is decomposed into the power series of eccentricity. In this work, we make use of the dynamical friction formula to calculate the force exerted on the planet by the disk, and the force is averaged over the period of the planet. The advantage of this approach is that it is possible to apply this formulation to arbitrary large eccentricity. The resulting migration and eccentricity damping timescale agrees very well with the previous works when eccentricity is of the order of 0.2-0.5. If the planet eccentricity is close to the order of the unity, the orbital evolution timescale behaves very differently. Moreover, we have found that the timescale of the orbital evolution depends largely on the adopted disk model in the case of highly eccentric planets. We discuss the possible implication of our results to the theory of planet formation. We also present fitting formulae for the timescale of the eccentricity and semimajor axis evolution. These formulae can be especially useful in the study of population synthesis models.

Keywords: planet formation theory, disk-planet interaction, planetary migration