

Orbital instabilities in small number N-body system

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In the latter stage of planetary formation stage, proto planets with martian mass are formed. They distribute around the sun with almost same orbital distance. In the region between Venus and Mars a few tens proto planets are formed. Present planets are formed from these proto planets through many giant impacts. This is very important process for planetary sciences. For example the Moon was born in a giant impact event.

Proto planets interact to each other gravitationally. As a result, the eccentricities of planets are increased and finally a pair of planets among them took orbital crossing event. The time needed to have this orbital crossing event is very important to evaluate the accumulation time of planets in proto planetary system.

About orbital crossing time Chambers et al.(1996) is a pioneer work. They studied orbital evolution of five proto planets and find that the orbital crossing time depends on orbital separation of proto planets exponentially.

After Chambers et al. many studies were carried out to evaluate the orbital crossing time under different conditions. Though the exponential relation between orbital separation and orbital crossing time is not yet explained theoretically. We have no model to represent the relation. So if we need to get the orbital crossing time, we have to do almost same orbital calculation again and again.

It is needed to make a theoretical model to explain the exponential relation. It makes us possible to predict the orbital crossing time under various conditions, which might be imposed on the complex planetary formation processes.

As a first work to build a theoretical model for orbital crossing time we make the distribution of orbital crossing time around average one. From Chambers et al. we can find that even for the same orbital separation the orbital crossing time has possibly one order of magnitude fluctuation.

We confirmed that the orbital crossing time distributes around a average value with logarithmic Gaussian distribution.