PPS21-P06 会場:コンベンションホール 時間:5 月 25 日 18:15-19:30

原始惑星の巨大衝突に伴う軌道傾斜角の進化
The inclination evolutions of protoplanets through giant impacts

松本 侑士 [1*] ; 長沢 真樹子 [2] ; 井田 茂 [2]
MATSUMOTO, Yuji[1*] ; NAGASAWA, Makiko[2] ; IDA, Shigeru[2]

[1] 国立天文台, [2] 東京工業大学
[1]NAOJ, [2]Tokyo Institute of Technology

The Kepler mission has reported over 3500 planetary candidates (e.g., Batalha et al., 2014).
There are 899 transiting planet candidates in 365 multiple-planet systems, and 333 systems are only composed by 818 ungiant candidates, whose radii are smaller than 6 Earth radius, and which are composed by Neptunes and super-Earth.
When multiple planets are detected by the transit method, the mutual inclinations can be estimated by the ratio of transit duration times.
Fabrycky et al. (2014) suggested that the typical mutual inclination between Kepler candidates in multiple-planet systems lies in 1.0 degree - 2.2 degree.
Inclinations of protoplanets are excited by the mutual scatterings between them.
It is expected that protoplanets can excite the inclinations up to the half values given by their escape velocities.
The excited inclination is estimated as i_{esc} = 5.4 degree for a 10 Earth mass planet at 0.1 AU.
The small inclinations of observed ungiants suggest that if they are formed in-situ accretion, some inclination damping mechanism is working.
Since the eccentricities of the merged protoplanets are damped through giant impacts between protoplanets, as pointed out by our previous study, the inclinations is expected to be damped by the giant impacts.
On the other hand, for a Earth mass planet at 1 AU, i_{esc} = 8.6 degree.
The resultant planets from N-body simulations in the giant impact stage normally have i = 3 degree without any damping forces (e.g., Kokubo et al. 2006).
Ths smaller inclinations of calculated planets also suggest that inclinations are damped through the giant impact.
We investigate inclination evolutions through the collisions in the giant impact stage by N-body simulations.
We find that the inclination of the merger body is smaller than the larger inclination of the colliding two protoplanets.
The inclination after a collision is expressed as the function of the mutual inclination and the angular momenta.
Our N-body simulations suggest that the inclinations of observed ungiant planets can be reproduced by the in-situ accretion of planets in the gas-free environment.

キーワード: 惑星集積, 巨大衝突段階, 軌道傾斜角
Keywords: planetary accretion, giant impact phase, inclination