Orbital structure of planetary systems formed by giant impacts: stellar mass dependence

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Recent exoplanet surveys revealed that for solar-type stars close-in super-Earths are ubiquitous and many of them are in multi-planet systems. These systems are more compact than the solar system terrestrial planets. Ongoing and future exoplanet observations will find more planets around low-mass stars. However, there are not many theoretical studies on the formation of such planets around low-mass stars. Now is the time to clarify the dependence of the stellar mass on planet formation. In the standard model, the final stage of terrestrial planet formation is the giant impact stage where protoplanets gravitationally scatter and collide with each other, to evolve into a stable planetary system. We investigate the effect of the stellar mass on the architecture of planetary systems formed by giant impacts. We perform N-body simulations of the giant impact stage around the star with masses of 0.05 - 1.0 times the solar mass. Using the isolation mass of protoplanets, which is the final mass of protoplanets we distribute the initial protoplanets in 0.05 - 0.15 au from the central star, and follow the evolution for 100 million orbital periods of the inner planet. We find that for a given protoplanet system, the mass of planets increases as the stellar mass decreases, while the number of planets decreases. The eccentricity and inclination of orbits and the orbital separation of adjacent planets increase with decreasing the stellar mass. One possible reason for this behavior is that as the stellar mass decreases the relative strength of planetary scattering becomes more effective. We also discuss the properties of planets formed in the habitable zone.

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