Constraining the Formation of Mars with N-body simulations of Terrestrial Planet Formation

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Reproducing the orbits and masses of the terrestrial planets Mercury, Venus, Earth, and Mars remains elusive. To address that question, we investigated terrestrial planet formation by performing extensive N-body simulations of primordial protoplanetary disks representative of typical models in the literature. Those disks consisted of embryos and planetesimals placed up to ~1-4 au (depending on the disk model).

First, we employed our classification algorithm to identify the systems that formed planet analogs of the Venus-Earth pair (in terms of orbit and mass) plus Mercury or/and Mars in the same system. From the analysis of the terrestrial planets formed in such 3- or 4-planet system analogs, we obtained detailed properties regarding the formation and evolution of a vast number of identified Mars analogs. These properties include a-e-i-mass distributions, delivery of water/volatiles, number of giant impacts, accretion histories, and many others.

In this presentation, we also discuss the dependence of the results on the initial conditions (models considered), which allowed us to discuss the conditions that a protoplanetary disk must satisfy in order to satisfy the main properties of Mars and to form simultaneously the four terrestrial planets.

Keywords: Solar System, Terrestrial Planets, Planet Formation, Mars

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