Contribution ID: **37**

Type: **Poster**

Dynamical origin of Theia, the last giant impactor on Earth

Cosmochemical studies have proposed that Earth accreted roughly 5%–10% of its mass from carbonaceous (CC) material, with a large fraction delivered late via its final impactor, Theia (the Moon-forming impactor). Here, we evaluate this idea using dynamical simulations of terrestrial planet formation, starting from a standard setup with a population of planetary embryos and planetesimals laid out in a ring centred between Venus and Earth's orbits, and also including a population of CC planetesimals and planetary embryos scattered inward by Jupiter. We find that this scenario can match a large number of constraints, including (i) the terrestrial planets' masses and orbits; (ii) the CC mass fraction of Earth; (iii) the much lower CC mass fraction of Mars, as long as Mars only accreted CC planetesimals (but no CC embryos); (iv) the timing of the last giant (Moon-forming) impact; and (v) a late accretion phase dominated by non-carbonaceous (NC) bodies. For this scenario to work, the total mass in scattered CC objects must have been ~ 0.2–0.3 $M_\oplus$, with an embryo-to-planetesimal mass ratio of at least 8, and CC embryos in the ~ 0.01–0.05 $M_\oplus$ mass range. In that case, our simulations show there are roughly 50-50 odds of Earth's last giant impactor (Theia) having been a carbonaceous object —either a pure CC embryo or an NC embryo that previously accreted a CC embryo. Our simulations thus provide dynamical validation of cosmochemical studies.

Primary author: BRANCO, Duarte (Instituto de Astrofísica e Ciências do Espaço)

Co-authors: Prof. MACHADO, Pedro (Faculdade de Ciências da Universiade de Lisboa); RAYMOND, Sean (Laboratoire d'Astrophysique de Bordeaux)

Presenter: BRANCO, Duarte (Instituto de Astrofísica e Ciências do Espaço)

Session Classification: Mish Mash

Track Classification: Poster