Galilean moons origins, insights from models and observations

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Modelling the origin of Jupiter's Galilean moons remains a significant challenge. While it is widely accepted that the moons formed within a circumplanetary disk (CPD) that surrounded Jupiter during the final stages of its formation, the physical properties, evolution and composition remains unconstrained.

An approach to deduce the CPD's properties and composition is by using the bulk composition of the Galilean moons as a reference to infer compositional trends within the disk. A notable example is the gradient in water content with distance from Jupiter: from the completely dry Io to a 1:1 water-to-rock ratio on Ganymede and Callisto. This gradient strongly suggests that the CPD exhibited a corresponding water abundance gradient during its formation. With the JUICE and Europa Clipper missions currently cruising to the Jovian system, the next decade will provide an unprecedented opportunity to study Europa, Ganymede, and Callisto, providing new constraints for CPD models based on improved understanding of the moons' bulk compositions. Furthermore, with new observations of the PDS 70 system, as well as eight other tentative detections of CPDs around forming planets, exoplanetary systems could offer new constraints on the evolution of CPDs.
I will present a short review of the Galilean moons origins, from the CPD models and moon formation scenarios to the observational constrains from explorations with an outlook on potential constrains from forming exoplanetary systems.