Contribution ID: **21** Type: **Contributed talk**

Free-floating planets ejected from massive self-gravitating discs

Tuesday, December 16, 2025 10:00 AM (20 minutes)

Over the past 25 years, observations have uncovered a large population of free-floating planets (FFPs), whose origins remain debated. Massive FFPs (several Jupiter masses or more) may form via gravitational collapse of molecular clouds, similar to stars. Lower-mass FFPs likely originate in planetary systems and are later ejected through dynamical interactions. We show that disc fragmentation in very young stellar binaries may be an abundant source of Jupiter-like FFPs (JFFPs). In our model, disc fragmentation at tens to 100 au from the primary star produces gas giants, while fragmentation further out forms a more massive object that will eventually evolve into the secondary star. We present 3D simulations of massive, self-gravitating discs with embedded Jupiter-mass planets and a secondary seed (5–50 M_J); chaotic migration leads to frequent planet–secondary interactions, imparting velocity kicks via to the planets that can result in planet ejections. The ejection fraction increases steeply with the secondary-to-primary mass ratio, q, reaching ~ 2/3 for $q_s \geq 0.05$. Compared to Core Accretion JFFPs, disc fragmentation JFFPs: (i) form earlier, and may be more abundant in young clusters, and (ii) are ejected at much lower velocities.

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Session Classification: Modeling

Track Classification: In-person