The origin of the IMF and multiplicity in small stellar groups

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ABSTRACT:

In star forming regions, most of the newborn stars are found in binary/multiple systems (Duchêne & Kraus 2013) and/or clustered within small groups (Lada & Lada 2003, Joncour et al. 2018). These stellar systems are hosted inside much larger molecular clouds that provide the mass reservoir for the star formation. The fragmentation of this large-scale gaseous environment (Vázquez-Semadeni et al. 2019) results in a coupled origin for stellar multiplicity and stellar masses.

In this presentation, I will introduce a theoretical framework that both describes the multi-scale nature of the cloud and establishes its sub-structuration as the outcome of a fragmentation process resulting from a gravo-turbulent cascade (Hennebelle & Chabrier 2008, Guszejnov & Hopkins 2015).

Turbulence generates local density fluctuations that are the seeds for local collapse to occur and eventually set the stage for future gravitational collapse at smaller scales. This hierarchical mode of fragmentation cascades along increasingly smaller gaseous sub-structures until stellar systems are formed (Thomasson et al. 2022). This process may be decisive for both the formation of stellar groups and the allocation of stellar masses.

In particular, I will show how the multiplicity within stellar groups and the associated star formation efficiency are essential to predict the slope of the stellar Initial Mass Function (IMF). By fragmenting the objects that compose the top-heavy core mass function (CMF) observed in the W43-MM2/MM3 massive region (Pouteau et al. 2022), I derive the conditions required to recover a Salpeter IMF. This work suggests that hierarchical fragmentation may seed the spatial properties of young stellar groups and the IMF of individual young stars.