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Clumpy Star Clusters: Rethinking IMF Limits

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Star clusters (SCs) are not born in spherical symmetry, contrary to the idealized initial conditions used in the vast majority of N-body simulations performed so far. Observations suggest that the initial conditions for star formation are highly structured and clumpy, both in the distribution of molecular gas from which stars form (Williams 1999 and references therein) and in the distribution of newly-formed stars (Bate et al. 1998; Gladwin et al. 1999, Goodwin & Whitworth 2003).

Additionally, in most studies involving simulations of SCs and isolated binaries, the assumed upper limit of the Initial Mass Function (IMF) has gradually increased up to ~150 $\mathrm{M}_{\odot}$, primarily to account for the massive Black Holes detected by the Ligo-Virgo collaboration. However, while we observe massive stars up to ~300 $\mathrm{M}_{\odot}$ in young SCs and in star-forming regions such as R136 (Crowther et al. 2010), it remains uncertain whether stars can form with such high mass or if they are the product of collisions.

In this talk, I will present the results of a suite of direct N-body simulations of clumpy SCs with varying upper limits of the IMF. Our simulations demonstrate that it is not necessary to assume an IMF upper limit as large as 150 $\mathrm{M}_{\odot}$ to form the observed massive stars. Instead, these massive stars form from stellar collisions in the very early evolutionary stages of the SC, facilitated by the initial high density of the clumps.

Finally, we discuss the implications of a reduced upper limit of the IMF on the mass spectrum of compact objects in different environments and its impact on the formation of gravitational wave sources.

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