The role of interstellar filaments in the origin of the stellar initial mass function: Insights from *Herschel* observations

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Abstract. The origin of the stellar initial mass function (IMF) is one of the most debated issues in astrophysics. Two major features of the IMF are 1) a fairly robust power-law slope at the high-mass end (Salpeter 1955), and 2) a broad peak around $\sim 0.3\,M_\odot$ corresponding to a characteristic stellar mass scale (cf. Elmegreen *et al.* 2008). In recent years, the dominant theoretical model proposed to account for these features has been the "gravo-turbulent fragmentation" picture (e.g., Hennebelle & Chabrier 2008; Hopkins 2012) whereby the properties of interstellar turbulence lead to the Salpeter power law and gravity sets the characteristic mass scale (Jeans mass). We discuss modifications to this picture based on extensive submillimeter continuum imaging observations of nearby molecular clouds with the *Herschel* Space Observatory which emphasize the importance of filamentary geometry (André *et al.* 2010; Könyves *et al.* 2015). The *Herschel* results point to the key role of the quasi-universal filamentary structure pervading the cold interstellar medium and support a scenario in which star formation occurs in two main steps (cf. André *et al.* 2014): first, the dissipation of kinetic energy in large-scale turbulent MHD flows generates ~ 0.1 pc-wide filaments (Arzoumanian *et al.* 2011) in the cold ISM; second, the densest filaments grow and fragment into prestellar cores (and ultimately protostars) by gravitational instability above a critical threshold $\sim 16\,M_\odot/$pc in mass per unit length or $\sim 160\,M_\odot/$pc^2 in gas surface density ($A_V \sim 8$). In our observationally-driven scenario, the dense cores making up the peak of the prestellar core mass function (CMF) - likely responsible for the peak of the IMF - result from gravitational fragmentation of filaments near the critical threshold for global gravitational instability. The power-law tail of the CMF/IMF arises from the growth of the Kolmogorov-like power spectrum of initial density fluctuations $[P(k) \propto k^{-1.6 \pm 0.3}]$ measured along *Herschel* filaments (Roy *et al.* 2015), in agreement with the model by Inutsuka (2001), *and* from the power-law distribution of line masses observed for supercritical filaments.

References

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