P103a　Deciphering the Origin of Dense Cores in Molecular Clouds

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Stars form from dense cores in turbulent molecular clouds, which form as a result of cloud fragmentation. However, the physical mechanisms behind this process remain poorly understood. We here investigate cloud fragmentation in nearby molecular clouds, focusing on the roles of self-gravity and turbulence. Using astrodendro on Herschel data, we identified dense cores and measured their masses and separations across 14 clouds. These were grouped by star-forming capability: quiescent, low-mass, and intermediate-mass clouds.

We compared core properties with predictions from gravitational and turbulent fragmentation. In total, 8416 cores were identified. We found that core mass and separation are significantly smaller than predictions from gravitational fragmentation, but agree with the predictions of turbulent fragmentation. The characteristic core mass and separation appear set by the sonic scale (L_S), below which thermal pressure dominates over turbulence. For nearby clouds, L_S is $\sim$0.1 pc, matching the observed peak separation. also matches observed values. These results suggest turbulent fragmentation dominates core formation (Ishihara et al. 2025a, A&A, 695, L25; Ishihara et al. 2025b, submitted to A&A).

This conclusion also applies to high-mass star-forming clumps, where gravitational fragmentation was previously favored (Ishihara et al. 2024). In these clumps, core separations peak at 0.02–0.04 pc, which is comparable to the clump sonic scale, $L_{S,\rm clump}$. $L_{S,\rm clump}$ already exceeds the Jeans threshold due to high densities. Thus, **turbulent fragmentation likely governs core formation across various cloud environments.**