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Gravity at Work: Energy Budget in Simulated Hub-Filament Systems

We investigate the kinetic and magnetic energy budget in a hub-filament system that arises self-consistently in an adaptive mesh refinement (AMR) simulation of a molecular cloud undergoing global hierarchical collapse (GHC). Our goal is to assess whether the energy distribution and dynamics of the formed structure are consistent with observations and to explore the role of magnetic fields along the cloud-to-core hierarchy within hub-filament systems. To quantify the energy budget, we analyze the kinetic Larson ratio, virial parameter, and their magnetic counterparts; we examine the scaling of kinetic and magnetic energies with the gravitational one across multiple spatial scales. This approach allows us to trace how energy is partitioned as substructures emerge and evolve within the collapsing cloud. Our results show that the energy distributions in the simulated clumps align well with those observed in real molecular clouds, reinforcing the hypothesis that GHC is the dominant mechanism driving the formation and evolution of substructures.

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