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Clustered Star Formation in Magnetic Clouds: Properties of Dense Cores Formed in Outflow-Driven Turbulence

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We investigate the physical properties of dense cores formed in turbulent, magnetized, parsec-scale clumps of molecular clouds, using three-dimensional numerical simulations that include protostellar outflow feedback. The dense cores are identified in the simulated density data cube through a clumpfind algorithm. We find that the core velocity dispersion does not show any clear dependence on the core size, in contrast to Larson's linewidth-size relation, but consistent with recent observations. In the absence of a magnetic field, the majority of the cores have supersonic velocity dispersions. A moderately-strong magnetic field reduces the dispersion to a subsonic or at most transonic value typically. Most of the cores are out of virial equilibrium, with the external pressure dominating the self-gravity. The implication is that the core evolution is largely controlled by the outflow-driven turbulence. Even an initially-weak magnetic field can retard star formation significantly, because the field is amplified by the outflow-driven turbulence to an equipartition strength, with the distorted field component dominating the uniform one. In contrast, for a moderately-strong field, the uniform component remains dominant. Such a difference in the magnetic structure is evident in our simulated polarization maps of dust thermal emission; it provides a handle on the field strength. Recent polarization measurements show that the field lines in cluster-forming clumps are spatially well-ordered. It is indicative of a moderately-strong, dynamically important, field which, in combination with outflow feedback, can keep the rate of star formation in embedded clusters at the observationally-inferred, relatively-slow rate of several percent per free-fall time.

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