Challenges in probing turbulent and magnetic support in cores: the W43-MM1 protocluster case study

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Estimating the level of non-thermal support in cores is both challenging but crucial for constraining the earliest stages of star formation and improving our understanding of the underlying physical processes. Using ALMA 12m molecular line and dust-polarization observations of the massive protocluster W43-MM1 (see figure), we estimated the kinetic support in 45 dense cores with masses ranging from 1 to 115 Msol, among which 21 cores also have magnetic field estimates. At the core scale, we measure velocity dispersions spanning 0.35–4.48 km/s and POS magnetic field strengths, derived using the DCF method, ranging from 1 to 53 mG (Valeille-Manet+ 2026, subm).

Within the framework of a simple virial analysis, we find that approximately 70% of the cores with kinetic estimates alone and about 85% of those with both kinetic and magnetic estimates appear supported against gravity. This result is unexpected, particularly for protostellar cores, which are expected to have partially collapsing envelopes and thus to exhibit virial values below unity.

We show that contributions from organized motions (infall, convergent flows, and rotation) at velocities of a few km/s, together with the omission of surface terms in the observational virial theorem, can significantly broaden the observed linewidths and lead to an overestimation of the non-thermal support. This highlights that any simplified framework of a virial analysis can introduce biases when assessing the physical support mechanisms within cores.