Non-thermal supports against gravitational collapse in high-mass prestellar and protostellar cores

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The formation of high-mass stars (M > 8 $M_{\odot}$) remains a complex process involving the interplay of gas dynamics (Schneider et al. 2010, Avison et al. 2021), intense UV radiation (Motte et al. 2003), and magnetic fields (Cortes et al. 2024, Sanhueza et al. 2025). The formation scenario to explain the sequence to form a high-mass star is still not well constrained, and a key open question concerns the definition of the mass reservoir available for stellar assembly. It is then crucial to identify and quantify the non-thermal supports that counteract gravity during gas assembly to properly understand the early stages of high-mass star formation.

The ALMA-IMF Large program (Motte et al. 2022) is a survey which images 15 massive protoclusters of the Milky Way and allowed the identification of 600 dense cores at a scale of 2700 au along with continuum and line data. Using ALMA-IMF, we identified 30 high-mass prestellar cores with mass ranging from 8 to 54 $\mathrm{M}_{\odot}$ (Valeille-Manet et al. 2025). To identify these prestellar cores, we developed a new systematic method to detect protostellar outflows in order to differentiate the prestellar cores (without outflows) from the protostellar cores (with outflows). We derived statistical lifetimes for this sample of high-mass prestellar cores and found that they live for more than 10 x t_ff. This first statistical sample of high-mass prestellar cores offers the opportunity to perform a turbulence analysis on an early population of high-mass star-forming sites. Using the DCN(3-2) and 13CS(5-4) lines, we studied the turbulence in the 12 most massive prestellar core candidates (M > 16 $M_{\odot}$) and found supersonic turbulence in all the cores (Valeille-Manet et al in prep). However, this supersonic turbulence is not enough for 2/3 of the cores to stabilize them against gravity and to justify their long lifetimes. As part of this effort, a magnetic field study in the W43-MM1 protocluster at the core scale using ALMA polarization observations allows us to directly measure the strength and structure of the magnetic field, and thus evaluate its role in regulating core evolution and fragmentation (Valeille-Manet et al. in prep). We will present here the results of a virial analysis combining line data and polarization data to confront all the support ingredients against gravity in high-mass prestellar and protostellar cores.