A multi-tracer view of turbulence and triggered star-formation in the Orion B molecular cloud

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Star formation in molecular clouds is controlled by many parameters, including gravity, magnetic fields, stellar feedback... The nature of turbulence also plays a key role: compressive motions, as opposed to solenoidal motions, can trigger the collapse of cores, or mark the expansion of HII regions. The mechanisms that inject kinetic energy are often compressive (self-gravity or feedback), however star formation remains a highly inefficient process.

Our study focuses on the Orion B molecular cloud, which has been the target of an extensive hyperspectral imaging campaign in the 3mm band with the IRAM-30m telescope [1]. The detected molecular lines trace environments of various densities, temperatures, and the high spectral resolution gives us access to the motions of the gas.

Expanding on the results of a pilot study [2] which has shown the tight correlation between the fraction of solenoidal and compressive motions and the star formation activity in Orion B, we explore a 5 square degree field with three different molecular tracers. Using a statistical method [3] which allows us to retrieve 3-dimensional quantities from the projected quantities provided by the observations, we compare the fraction of solenoidal motions in media of different densities, and in region with different star-formation properties, which gives us an understanding of the way matter is accumulated into regions dense enough to harbour star formation. We also compare this with the density distribution of the gas [4], the properties of dense filaments [5] and the environment of the cloud.

The combination of these elements draws a picture where Orion B is a relatively young, mostly solenoidal cloud, in which successive generations of star formation are triggered by compressive feedback.

References

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