Kinematic structure of the low mass protostellar core IRAS 15398-3359

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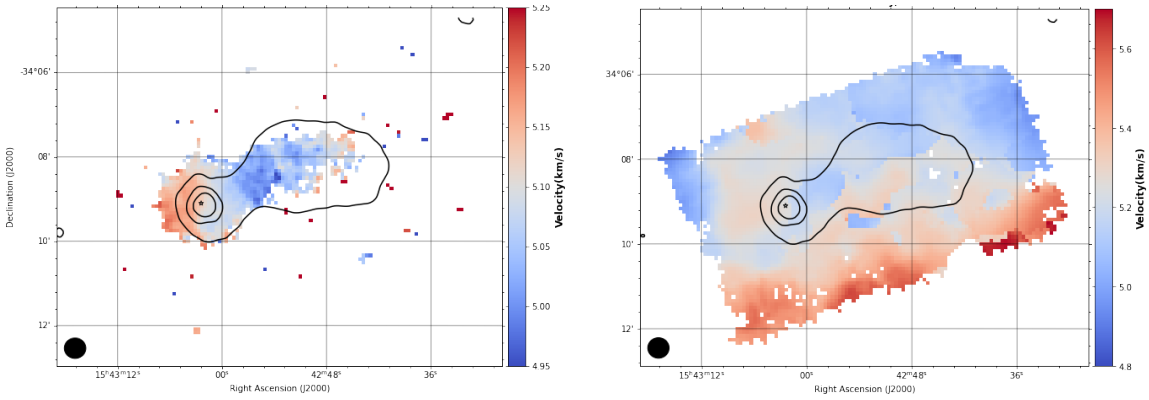
We investigate the kinematic properties of a young class 0 object, IRAS 15398-3359, a low-mass protostar located in the Lupus I molecular cloud. Lupus I appears the least evolved component of the Lupus complex [1]. It is an ideal place to study the early stages of low-mass star formation, and the core is known as the magnetized core [2],[3]. We observed the transitions of two abundant molecules, $C^{18}O$ (2-1) and DCO^+(3-2). Due to the different critical densities, higher for DCO^+ than for $C^{18}O$, DCO^+ traces the denser component closer to the central protostar, while $C^{18}O$ traces the more extended and tenuous gas in the filamentary structure. The observations were performed with the Atacama Pathfinder EXperiment (APEX) single-dish antenna with a size of 28″ at 216 GHz. These data will help us study the kinematics of IRAS15398 at different scales.

To reach our goal we perform a Gaussian fitting on the molecular data, obtaining maps of linewidth, centroid velocity, and column density for each species. Along the filament, a small velocity gradient can be seen, which could be linked to ongoing accretion towards the central object. We find a small velocity gradient toward the center in the east-west direction which could be due to the rotation of the core. Then the rotation axis would lay in the north-south direction, close to the direction of the detected bipolar outflows found by [3]. The mean velocity dispersion of the gas in the filament is 0.13 km s^{-1} based on DCO^+ analysis and becomes broader toward the center: 0.18 km s^{-1}. This increase is linked to the protostellar activity, heating the surrounding material. We also calculate the protostellar mass: M~0.4M⊙. We plan to compare the kinematic structure obtained from the spectroscopic data to the magnetic field morphology unveiled by [3], in order to study the relation between magnetic fields and gas motions.



The centroid velocity map obtained fitting the observed DCO^+ (left) and $C^{18}O$ (right) data, the star represents the position of the protostellar. The contours represent $N(H_2)$ column density as derived from *Herschel* data levels:[1.2,2.2,3.2]×$10^{22}$$cm^{-2}$.

References

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