Kinematics of the NGC1333-IRAS2A inner envelope

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The kinematics of the inner regions of Class 0 protostars is poorly known. Constraining the gas velocity in these regions is important because it can place important constraints on star formation theories. In addition, it is needed to establish if bona-fide proto-stellar disks (in Keplerian rotation) are already present in the Class 0 phase. In this contribution, we present high angular resolution (0.8-1.7") observations of two methanol lines in the NGC1333-IRAS2A Class 0 protostar . These observations have been obtained with the Plateau de Bure interferometer as part of the CALYPSO IRAM Large Program (P.I. Philippe André; see Anaëlle Maury's poster). We use these lines to measure the level of rotation of this object.

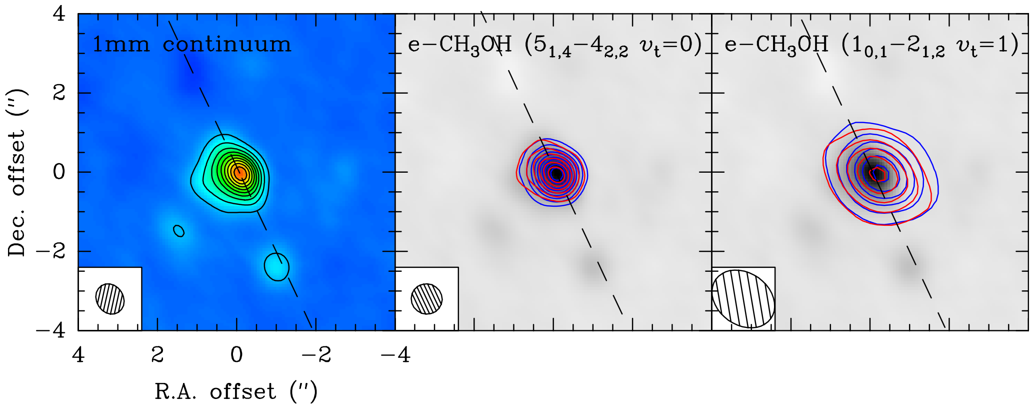
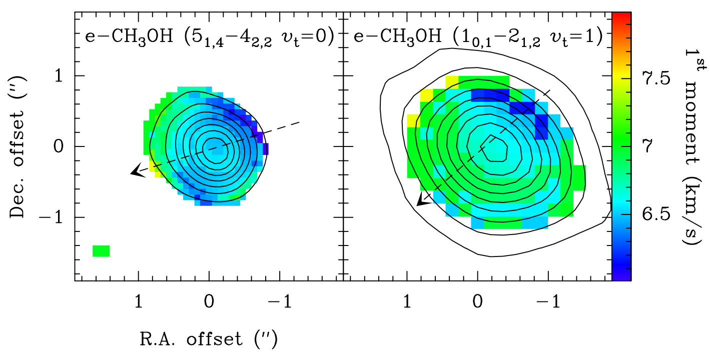


Fig 1: Continuum and line emission observed towards NGC1333-IRAS2A with the Plateau de Bure interferometer. The left panel show the 1 mm continuum emission. The other panels show the velocity integrated intensities of the e-CH_3OH $5_{1,4} - 4_{2,2}$ $v_t = 0$ and $1_{0,1} - 2_{2,1}$ $v_t = 1$ lines (blue and red contours) together with the continuum (grey-scale image). The blue and red contours correspond to velocities < 7 and > 7 km s^{-1}, respectively. The dashed line indicate the direction of the outflow.

Fig. 1 shows the continuum and methanol line emission observed in IRAS2. The methanol emission is compact (deconvolved size is 0.4" FWHM, i.e 100 AU at 250 pc) and centered on the continuum peak. Note that one of this line is from the torsionnal state, with an upper level energy ~300 K above the ground state. No elongation in the outflow direction is seen, suggesting that it originates in the inner region of the envelope *(hot-corino)*. Therefore it can be used to probe the kinematics of this region.



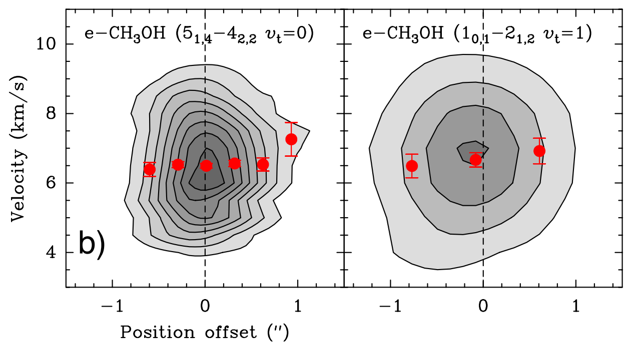


Fig 2a: First order moment maps of the e−CH3OH lines (color maps). The solid contours show the velocity integrated line intensities. The dashed arrows indicate the orientation of the velocity gradient as determined from the first order moment fit. Fig 2b: position-velocity diagrams along the direction indicated by the arrows on the left panels (grey contours). The red points with error bars show the line centroids at each position offset.

Fig. 2a shows the first moment map of the two lines. In order to determine if rotation is present, we fit the first order map with a linear gradient (as expected for solid body rotation; see Goodman et al. 1993). We tentatively detect rotation with both lines, in a direction roughly perpendicular to the outflow (see the arrows on Fig. 2a). Fig. 2b shows position velocity cuts along the direction of the gradient, together with the line centroid at each offset. A slight increase in the line centroid is seen along the cut, consistent with the presence of rotation. However, the spatial resolution of our observations do not allow to determine the precise nature of this rotation (Keplerian, solid-body, etc.). Higher angular resolution observations are needed to determine if Keplerian rotation is indeed present, and if the protostar harbors a nascent disk.

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