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Magnetically regulated collapse in the B335 protostar ?

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Abstract. The role of the magnetic field during protostellar collapse is still poorly constrained from an observational point of view, and only few constraints exist that shed light on the magnetic braking efficiency during the main accretion phase. I presented our ALMA polarimetric observations of the thermal dust continuum emission at 1.3 mm, towards the B335 Class 0 protostar (Maury *et al.* 2018a). Linearly polarized dust emission is detected at all scales probed by our observations (50 to 1000 au). The magnetic field structure has a very ordered topology in the inner envelope, with a transition from a large-scale poloidal magnetic field, in the outflow direction, to strongly pinched in the equatorial direction. We compared our data to a family of magnetized protostellar collapse models. We show that only models with an initial core mass-to-flux ratio $\mu \sim 5-6$ are able to reproduce the observed properties of B335, especially the upper-limits on its disk size, its large-scale envelope rotation β and the pronounced magnetic field lines pinching observed in our ALMA data. In these MHD models, the magnetic field is dynamically relevant to regulate the typical outcome of protostellar collapse, suggesting a magnetically-regulated disk formation scenarios is at work in B335.

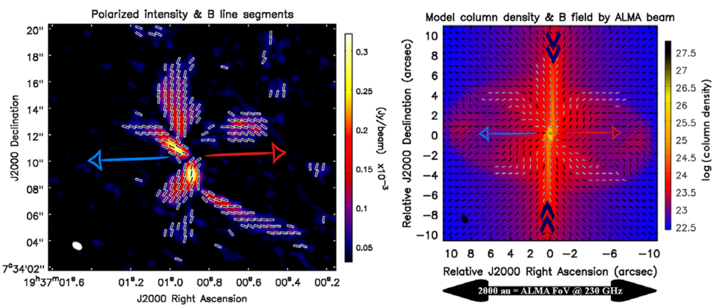

Figure 1. Left: the background image shows the ALMA polarized dust continuum emission, and the superimposed line segments show the B-field (polarization angle rotated by 90°) where the polarized dust continuum emission is detected at $> 3\sigma$. Right: Column density from a non-ideal MHD model of the protostellar collapse. The magnetic field topology in the core at scales 2000 au, integrated along the line-of-sight and convolved by the ALMA synthesized beam, are shown as black line segments, while the white line segments highlight the general areas where they are detected in our ALMA map of B335.

Reference

Maury, A.J., Girart, J.M., Zhang, Q., Hennebelle, P., Keto, E., Rao, R., Lai, S.P., Ohashi, N., & Galametz, M., *MNRAS*, 477, 2, 2760 (2018a)