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Letter to the Editor

The dust grain alignment mechanism(s) responsible for the (sub-)millimeter dust polarization observed in protostars

Oral presentation abstract

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ABSTRACT

Class 0 protostars vigorously accrete from their collapsing envelope, such as most of the future star mass is built during this evolutionary stage. The magnetic field is thought to play a key role in the regulation of the angular momentum available for disk formation and in the infall dynamics of the inner core. However the method used to trace the magnetic field, i.e., observing the linear polarization of thermal dust emission, is subject to caveats in such environment, where the grain alignment mechanisms still remain to be fully identified, and understood. Recent ALMA observations revealed surprising polarized dust emission maps in Class 0 objects, which, compared with synthetic observations of MHD models, suggest that indeed, the grain alignment physics requires detailed analysis. In particular, the Radiative Alignment Torques (RATs) mechanism predicts that for grain alignment to be efficient enough in the dense environment of the inner envelope (< 500 au), large grains (≥ 10 μm) must already be present at these scales. In addition, the radiative feedback from the accretion onto the protostellar embryo can favor efficient grain alignment in the protostar, up to the point where dust grains get rotationally disrupted. In the context of the accretion variability of protostars, we explore the impact of the accretion on the alignment of grains responsible for the polarized dust emission detected at submillimeter wavelengths.

Key words. ISM: jets and outflows – ISM: magnetic fields – polarization – stars: formation – stars: magnetic field – stars: protostars

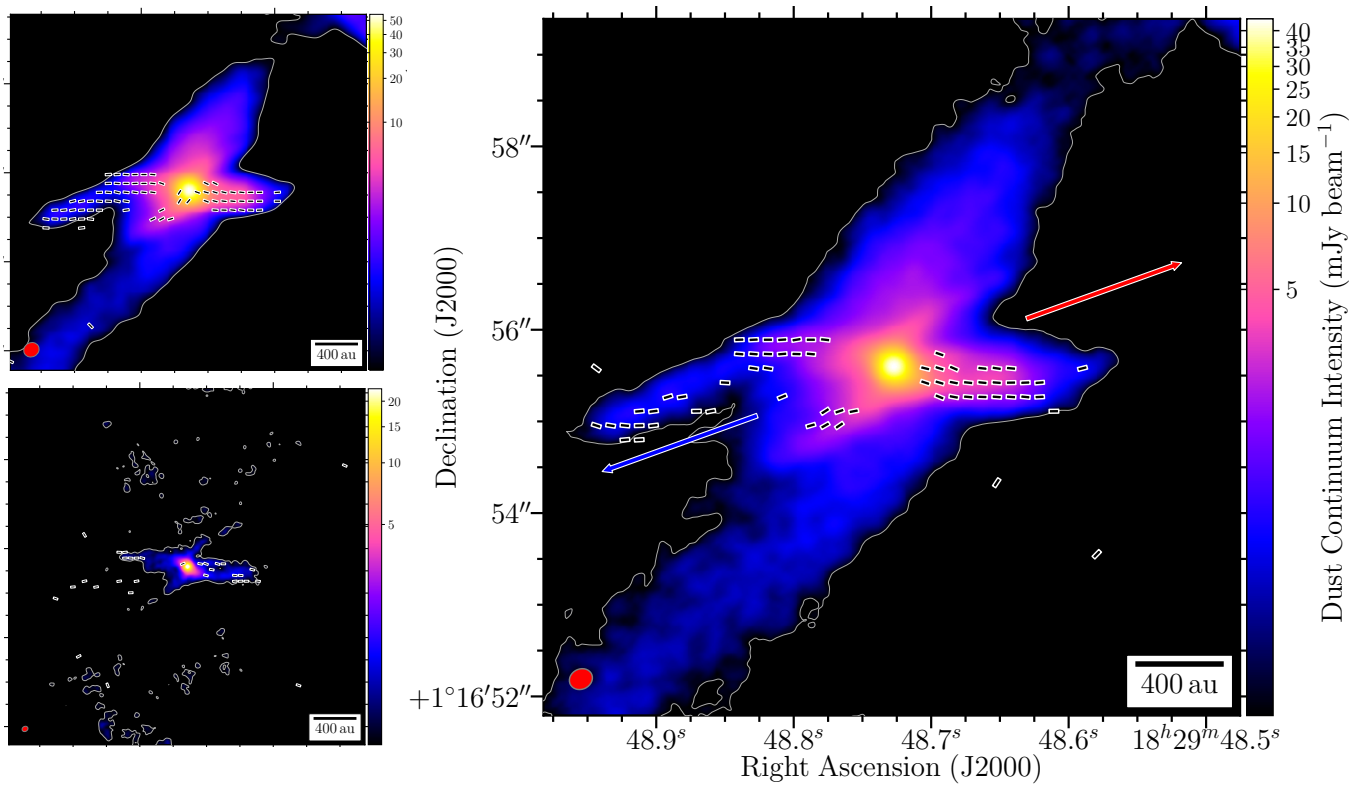

Fig. 1. Magnetic field around Serpens Emb 8(N) from Le Gouellec et al. 2020. The three panels correspond to three different angular resolution, from the lowest in the top-left panel, to the highest in the bottom-left panel. Line segments represent the magnetic field orientation. The color scale is the total intensity (Stokes I) of the thermal dust emission. The blue and red arrows represent the directions of the blueshifted and redshifted lobes of the bipolar outflow, respectively. The polarized emission is clearly enhanced along the outflow cavity walls visible in the dust thermal emission.

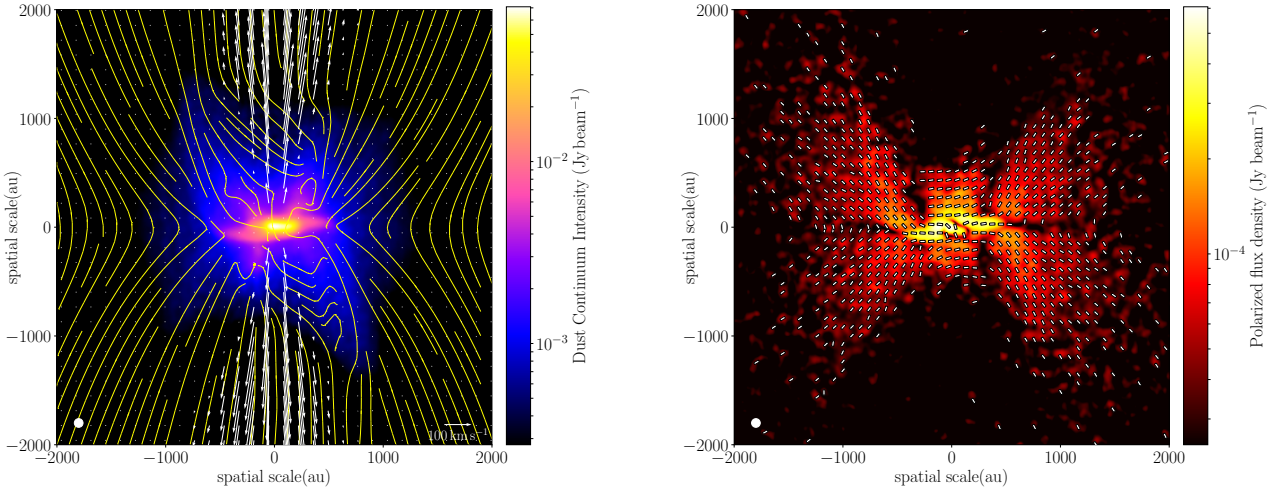

Fig. 2. Model of a protostellar core synthetically observed by POLARIS, filtered with ALMA. *Left:* Dust continuum total intensity, overlaid with the magnetic field lines and velocity field at the center of the core. *Right:* The colorscale is the polarized intensity, and segments are magnetic field lines.