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Magnetic fields and massive star formation

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Abstract. Massive stars (M $> 8\ M_{\odot}$) often form in parsec-scale molecular clumps that collapse and fragment, leading to the birth of a cluster of stellar objects. The role of magnetic fields during the formation of massive dense cores is still not clear. The steady improvement in sensitivity of (sub)millimeter interferometers over the past decade enabled observations of dust polarization of large samples of massive star formation regions. We carried out a polarimetric survey with the Submillimeter Array of 14 massive star forming clumps in continuum emission at a wavelength of 0.89 mm. This unprecedentedly large sample of massive star forming regions observed by a submillimeter interferometer before the advent of ALMA revealed compelling evidence of strong magnetic influence on the gas dynamics from 1 pc to 0.1 pc scales. We found that the magnetic fields in dense cores tend to be either parallel or perpendicular to the mean magnetic fields in their parental molecular clumps. Furthermore, the main axis of protostellar outflows does not appear to be aligned with the mean magnetic fields in the dense core where outflows are launched. These findings suggest that from 1 pc to 0.1 pc scales, magnetic fields are dynamically important in the collapse of clumps and the formation of dense cores. From the dense core scale to the accretion disk scale of $\sim 10^2$ au, however, gravity and angular momentum appear to be more dominant relative to the magnetic field.

Reference

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