Synthetic observations of the early stages of star formation

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Résumé

Most stars form in multiple systems even though the multiplicity in the early phases of the star formation process is poorly constrained. This indicates a fragmentation process during star formation, which can be explained by several mechanisms (intital fragmentation, late disk fragmentation). The fragmentation process remains a matter of intense debate; in particular, disk formation and early fragmentation (i.e., during the early phase of the collapse) appear to be critical for better constraining the star formation mechanism. We seek to provide predictions for spectral energy distributions and for ALMA dust continuum emission maps from low-mass and massive collapsing dense cores. We show to what extent ALMA will be able to to probe the fragmentation scale in these objects. For that purpose, we post-processed three state-of-the-art radiation-magneto-hydrodynamic 3D adaptive mesh refinement calculations to compute the emanating dust emission. We show that observing dust continuum emission with ALMA will help in identifying the physical processes occurring within collapsing dense cores. If the magnetic field is playing a role, the emission pattern will show evidence of a pseudo-disk and even of a magnetically driven outflow, which pure hydrodynamical calculations cannot reproduce. The capabilities of ALMA will enable us to make significant progress towards understanding the fragmentation at the early Class 0 stage and discovering first hydrostatic cores.

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