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From the dense core edge to the disk scales

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Contributed talk

Abstract:
"Dense cores are the places where stars are formed within the supersonic Molecular Clouds. These dense regions (n~10^5 cc) are cold (T~10 K) and display subsonic levels of turbulence (Mach ~ 0.5), and represent the initial conditions for both star and disk formation. Therefore, it is crucial to study dense cores to better understand the star and disk formation process. However, there are several important open questions regarding dense cores: Do they have an edge? How is the angular momentum distributed which controls disk formation? And, is the infalling envelope into the disk uniform or does it show strong asymmetries?
We present observations with ALMA, VLA, and NOEMA that focus on these questions. The ALMA observations (12m+ACA+Total Power) of a dense core reveal a surprising detection of SO and Methanol around the dense core, which highlights the material in the transition region between dense core and molecular cloud. This reveals a new window to study the edge of dense cores.
The VLA observations of 3 young Class 0 with NH3 enabled us to determine the specific angular momentum radial profile for the first time. We find that it is significantly different from solid body rotation (the typical initial condition for numerical simulations), and which does not present a region of conserved specific angular momentum down to 750 au scales.
This shows that the specific angular momentum in the early stages of protostellar evolution (Class 0) is dissipated efficiently and it places upper limits to the maximum possible disk size of ~60 au. This shows the power of studying the dense core kinematics to constrain the disk formation process.
Finally, we present NOEMA observations of a Class 0 object, which has been suggested to present a disk under gravitational instability (GI) (asymmetrical features in ALMA high resolution dust continuum emission). The new data reveal new large scale (~10,000 au) streamers of fresh gas from the surrounding dene core down to the disk scales. This streamer is perpendicular to the outflow, and it suggests that disk asymmetries could also be driven by large scale asymmetric flows instead of GI.
These results show the power and importance of studying dense cores with interferometers to provide a complete and proper picture of star and disk formation."

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