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Revolutionizing Our View of Protostellar Disk and Multiplicity: The VLA/ALMA Nascent Disk and Multiplicity Survey”

Contributed talk

Abstract:

“We have conducted a large survey of 328 protostars in the Orion star forming regions at ~ 40 AU ($0.1''$) resolution, using ALMA (0.87 mm) and the VLA (9 mm). This large sample was derived from Spitzer and Herschel surveys and constitutes the majority of the protostars in Orion, providing a statistical characterization of the protostellar disk and multiplicity properties. We are characterizing the size, masses, and physical density structure of disks throughout the protostellar phase, and the same data enable us to examine the distribution of companion separations both as a whole and with evolution. We find that the disks toward protostars are significantly more massive than the proto-planetary disks around more evolved young stars, having a median mass of $\sim 0.02 M_{\text{sun}}$. There is a systematic decrease in protostellar disk mass with increasing evolutionary state, but with significant scatter in each evolutionary Class.

Thus, the planet formation process may be well-underway by the end of the protostellar phase. For disk radii, we find a systematic decrease from Class 0 to Flat spectrum and a median disk radius is ~ 30 AU. The largest disks, however, are found in the Class I and Flat spectrum systems. The longer wavelength data are crucial to enabling us to further assess the planet formation dust evolution toward these systems in terms of grain growth and the radial distribution of dust grain sizes. The distribution of companion separations is found to be bi-modal. This bimodal distribution may be indicative of multiple routes of binary/multiple star formation. The longer wavelengths of the VLA enabled us to detect companions that could not be resolved by ALMA due to optical depth of dust emission at the shorter wavelengths.

Thus, the combined strength of ALMA and the VLA at have been essential to revolutionizing our understanding of protostellar disks and multiple star formation.”

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Session Classification: Circumstellar Disks