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Exploring the Complex Chemistry of Young Solar Systems

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Abstract:

Studies of the complex organic chemistry in regions of star and planet formation have taken a tremendous step forward with data from ALMA. With its unprecedented sensitivity and angular resolution, ALMA has made it possible to zoom in on the gas surrounding deeply embedded protostars on Solar System scales. Such observations reveal the details of the rich complex organic chemistry taking place there - and, in particular, the physical and chemical evolution taking place while the young protoplanetary disks are being assembled. As part of the Protostellar Interferometric Line Survey (PILS), we have performed an unbiased spectral line survey in ALMA's Band 7 of the deeply embedded low-mass protostar IRAS 16293-2422, one of the template sources for star formation and astrochemistry. The survey has yielded a large number of new detections of molecules in the ISM, including key species in the chemical networks of prebiotic molecules. Also, the data show the presence of numerous rare isotopologues of complex organics and other species providing new constraints on their formation paths. The exact measurements of the abundances of the complex organic molecules and their isotopologues are compared to cometary measurements, i.p., from the Rosetta mission, providing the chemical link between the embedded protostellar stages and objects in our own Solar System. Finally, the PILS program outlines some of the paths forward in terms of future systematic ALMA surveys of the organic chemistry in star- and planet-forming regions.

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