Fragments in Protostellar Cores: Initial State for Star and Disk Fen-nation

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We present new evidence of the fragmentary structure of protostellar cores using ultra-high resolution spectral observations of the carbon chain molecule CCS at 22.344 GHz made at 0.008 km/s resolution. The observations utilize NASA's 70-m antenna and the Wide Band Spectrum Analyzer at Goldstone. The 'ultra-high resolution observations fully resolve the spectra into multiple velocity components, each with intrinsic width of 0.15 km/s, only slightly larger than the thermal broadening. These numerous fragments have masses of order 0.005 to 0.02 $M_\odot$. They can be interpreted in terms of quasi-stable clumps that form a bound orbital system at the heart of the protostellar core. We suggest they represent the initial state of protostar and protostellar disk forming cores. The ultra-high resolution and intrinsic narrow widths of the CCS emission also make it possible to determine the orbital velocity field of these fragments. Such observations are critical to specifying the initial state for understanding and modeling the formation of protostars and disks.

This research was performed at JPL, California Institute of Technology, under contract with the National Aeronautics and Space Administration.