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Dense core formation by fragmentation of velocity-coherent filaments in L1517

A. Hacar, M. Tafalla (Observatorio Astronomico Nacional - IGN - Spain)

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Context. Low-mass star-forming cores differ from their surrounding molecular cloud in turbulence, shape, and density structure. Aims. We aim to understand how dense cores form out of the less dense cloud material by studying the connection between these two regimes. Methods. We observed the L1517 dark cloud in C18O(1-0), N2H+(1-0), and SO(JN=32-21) with the FCRAO 14m telescope, and in the 1.2mm dust continuum with the IRAM 30m telescope. Results. Most of the gas in the cloud lies in four filaments that have typical lengths of 0.5 pc. Five starless cores are embedded in these filaments and have chemical compositions indicative of different evolutionary stages. The filaments have radial profiles of C18O(1-0) emission with a central flattened region and a power-law tail, and can be fitted approximately as isothermal, pressure-supported cylinders. The filaments, in addition, are extremely quiescent. They have subsonic internal motions and are coherent in velocity over their whole length. The large-scale motions in the filaments can be used to predict the velocity inside the cores, indicating that core formation has not decoupled the dense gas kinematically from its parental material. In two filaments, these large-scale motions consist of oscillations in the velocity centroid, and a simple kinematic model suggests that they may be related to core-forming flows. Conclusions. Core formation in L1517 seems to have occurred in two steps. First, the subsonic, velocity-coherent filaments have condensed out of the more turbulent ambient cloud. Then, the cores fragmented quasi-statically and inherited the kinematics of the filaments. Turbulence dissipation has therefore occurred mostly on scales on the order of 0.5 pc or larger, and seems to have played a small role in the formation of the individual cores.

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