Physics 785 Assignment 1

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A Virialized Filamentary Infrared Dark Cloud

Abstract

Infrared Dark Clouds (IRDC) match the initial conditions of massive and clustered star formation, and are thus an excellent tool to probe the earliest stages of these modes of star formation. Using IRAM molecular line observations of $C^{18}O$ along with MIREX extinction maps, we measure the kinematics of a filament containing a few $10^3 M_\odot$, with a length of $\approx 4pc$. We use this data to obtain the total velocity dispersion σ along the line of sight to approximately 10% accuracy. This allows us to use a simple theoretical model of the filament geometry to perform a virial analysis on the filament probing smaller scales (and produce better mass estimates) than done in previous studies, such as Hernandez and Tan 2011. Our results show that, contrary to previous studies, IRDC filaments are in (or near) virial equilibrium. If IRDC filaments are the initial locations of star formation, this result implies that stars form from gas that is in rough pressure equilibrium, validating one of the main assumptions of McKee and Tan's core accretion model of massive star formation.