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An empirical microphysical determination of cosmic ray transport in the Gould's Belt

Cosmic rays (CRs) influence the ionization, heating, and astrochemistry of interstellar molecular clouds. Their propagation through the complex structure of these clouds remains unsettled but appears to transition from diffusion in magnetized turbulent regions to ballistic streaming in dense cores. Efforts to characterize CR diffusion under varying physical conditions have produced a wide range of results. These studies typically rely on large-scale observable signatures to estimate an effective diffusion coefficient, but are not derived from the gyro-scale microphysics that fundamentally governs CR transport. As a result, it is difficult to disentangle CR propagation effects from other environmental factors that may influence the observed signatures. In this talk, we present a new method to empirically construct a diffusion coefficient for molecular clouds based on small-scale magnetic field properties. We use the angular dispersion function of 850 μm dust continuum linear polarization data to estimate the magnetic field strength, and apply a Fourier transform to extract the magnetic power spectrum. Together, these measurements provide sufficient information to characterize the propagaiton of CRs, grounded in the underlying microphysics. As a demonstration, we apply our method to JCMT observations of molecular clouds in the Gould's Belt, enabling an estimate of the CR diffusion coefficient at tens of TeV. This work provides a first validation of the method and lays the foundation for future extensions to lower CR energies with higher-resolution ALMA data.

Section

High Energy

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