Precision Galactic Magnetometry

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A large scale magnetic field permeates the interstellar medium (ISM) of our Galaxy. The ISM magnetic field strength is notoriously difficult to measure, and for this reason there is a longstanding debate about its dynamical importance in the star formation process. The magnetic field strength can be directly measured, with the Zeeman effect, only in a limited number of cases. For this reason, indirect methods have been developed for estimating the magnetic field strength. The most widely accessible methods are based on dust polarization that probes directly the plane-of-the-sky magnetic field morphology. These indirect magnetic field strength estimation methods are based on the energy balance of Alfvénic turbulence. Observations, however, indicate that turbulence in the ISM is highly compressible. We propose a novel method for estimating the magnetic field strength from dust polarization based on the energetics of compressible MHD turbulence. We assess the accuracy of the proposed method with synthetic data produced from a suite of numerical simulations. We find that with the proposed method an accuracy better than a factor of two can be achieved.