

Probing magnetic fields in dense molecular clouds with cosmic-ray electrons

Abstract

Measurements of the strength of the magnetic field in pre-stellar molecular cloud cores, precursors to star formation, are notoriously difficult: the only direct observational technique, the Zeeman effect, is applicable to a restricted number of chemical species, few of which are tracers of high-density gas. On the other hand, the Davis-Chandrasekhar-Fermi method generally applied to dust polarisation maps assumes a perfect coupling between the field and the gas, a questionable assumption for weakly-ionised dense cores. Because of these limitations, the role of magnetic fields in the process of star formation remain unclear. We propose a novel method to detect magnetic fields in dense cores by measuring the synchrotron emission produced by cosmic-ray electrons, of either Galactic or local origin, spiralling around the core's magnetic field lines. The proposed observations will simultaneously allow us to test models of propagation of relativistic electrons locally accelerated by expanding shocks associated to HII regions. The observations exploit the capabilities and sensitivity of MeerKAT in the U-band, and, if successful, provide an original science case for the first phase of SKA.