

A Radio Astronomy Search for Cold Dark Matter Axions

Wednesday 17 May 2017 15:40 (20 minutes)

The search for axions has gained ground in recent years, with laboratory searches for cold dark matter (CDM) axions, relativistic solar axions and ultra-light axions the subject of extensive literature. In particular, the interest in axions as a CDM candidate has been motivated by its potential to account for all of the inferred value of $\Omega_{DM} \sim 0.26$ in the standard Λ CDM model. Indeed, the value of $\Omega_{DM} \sim 0.26$ could be set by a universal value of the CDM axion mass. We investigate the possibility of complementing existing axion search experiments with radio telescope observations in an attempt to detect axion conversion in astrophysical magnetic fields. Searching for a CDM axion signal from a large-scale astrophysical environment provides new challenges, with the magnetic field structure playing a crucial role in both the rate of interaction and the properties of the emitted photon. However, with a predicted frequency in the radio band (200MHz - 200GHz) and a distinguishable spectral profile, next generation radio telescopes may offer new opportunities for detection. If we consider observations at ~ 500 MHz using the planned SKA1-mid telescopes, the limiting sensitivity is expected to be ~ 0.04 mK. This compares with a signal temperature of ~ 0.005 mK using SKA Phase 1 telescopes and up to ~ 0.2 mK using a collecting area of $(1\text{km})^2$ as planned for Phase 2.

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Session Classification: Session 7