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Searching for Axion Dark Matter with Radio Telescopes

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The QCD axion, originally proposed to resolve the strong CP problem, is also a compelling dark matter (DM) candidate. In strong magnetic fields, such as those surrounding neutron stars, axions can convert into photons, potentially generating detectable radio signals. This axion-photon coupling offers a unique avenue for experimental searches in a well-defined mass range. In this seminar, I will present an observational study using the Green Bank Telescope (GBT) to search for transient radio signals from axion-photon conversion. Focusing on the core of Andromeda, we employ the VErsatile GBT Astronomical Spectrometer (VEGAS) and the X-band receiver (8–10 GHz) to probe axions with masses between 33 and 42 μeV , achieving a mass resolution of $3.8 \times 10^{-4} \mu\text{eV}$. We describe our observational strategy and analysis techniques, which reach an instrumental sensitivity of 2 mJy per spectral channel. While no candidate signals exceeding the 5σ threshold were detected, I will discuss future improvements, including expanding the search to additional frequency bands and refining theoretical models, to strengthen constraints on axion DM scenarios. Based on 2407.13060, 2011.05378, 2011.05377, and ongoing work.

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