Contribution ID: **600** Type: **not specified**

New Constraints on Axion-Like Particles from IXPE Polarization Data for Magnetars

We derive new constraints on axion-like particles (ALPs) using precision X-ray polarization studies of magnetars. Specifically, we use the first detection of polarized X-rays from the magnetars 4U 0142+61 and 1RXS J170849.0-400910 by the Imaging X-ray Polarimetry Explorer (IXPE) to place bounds on the product of the ALP-photon and ALP-nucleon couplings, $g_{a\gamma}g_{aN}$, with g_{aN} being responsible for ALP production in the core of the magnetar and $g_{a\gamma}$ controlling the ALP-photon conversion probability in the magnetosphere. These bounds are most sensitive to the magnetar core temperature, and we use two benchmark values of 1×10^8 K and 5×10^8 K to derive our constraints. For the latter choice, our bounds are competitive with the existing bounds on the coupling product coming from a combination of CAST (for $g_{a\gamma}$) and SN1987A (for g_{aN}). We advocate for more precise and extensive observational campaigns in the higher end of the 2-8˜keV spectral window, where ALP-induced polarization is the strongest. We further advocate for hard X-ray polarization studies of young, hot, near-Earth magnetars with strong magnetic fields.

Mini Symposia (Invited Talks Only)

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Session Classification: Axion

Track Classification: Axion