

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

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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  $1 \times 10^8$  K and  $5 \times 10^8$  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.

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