

NuSTAR as an Axion Helioscope

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We present a novel approach to investigating axions and axion-like particles (ALPs) by studying their potential conversion into X-rays within the Sun's atmospheric magnetic field. Utilizing high sensitivity data from the Nuclear Spectroscopic Telescope Array (NuSTAR) collected during the 2020 solar minimum, along with advanced solar atmospheric magnetic field models, we establish a new limit on the axion-photon coupling strength $g_{a\gamma} \lesssim 6.9 \times 10^{-12} \text{ GeV}^{-1}$ at 95% confidence for axion masses $m_a \lesssim 2 \times 10^{-7} \text{ eV}$. This constraint surpasses current ground-based experimental limits, opening previously unexplored regions of the axion-photon coupling parameter space up to masses of $m_a \lesssim 5 \times 10^{-4} \text{ eV}$. These findings mark a significant advancement in our ability to probe axion properties and strengthen indirect searches for dark matter candidates.

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