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NuSTAR as an Axion Helioscope

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The nature of dark matter in the Universe is still an open question in astrophysics and cosmology. Axions and axion-like particles (ALPs) offer a compelling solution, and traditionally ground-based experiments have eagerly, but to date unsuccessfully, searched for these hypothetical low-mass particles that are expected to be produced in large quantities in the strong electromagnetic fields in the interior of stars. In this talk, I offer a fresh look at axions and ALPs by leveraging their conversion into X-rays in the magnetic field of the Sun's atmosphere rather than a laboratory magnetic field. Unique data acquired with the Nuclear Spectroscopic Telescope Array (NuSTAR) during the solar minimum in 2020 allows to set stringent limits on the coupling of axions to photons using state-of-the-art magnetic field models of the solar atmosphere. I report pioneering limits on the axion-photon coupling strength of 6.9×10^{-12} GeV^{-1} at 95% confidence level for axion masses m_a $lesssim 2 \times 10^{-7}$ eV, surpassing current ground-based searches and further probing unexplored regions of the axion-photon coupling parameter space up to axion masses of m_a $lesssim 5 \times 10^{-4}$ eV.

Primary authors: TODARELLO, Elisa (Turin University); RUZ, Jaime; VOGEL, Julia (University of Zaragoza)

Co-authors: GREFENSTETTE, Brian; KIM, Chul Soo; SMITH, David; HUDSON, Hugh; HANNAH, Iain; IRASTORZA, Igor; TRUJILLO BUENO, Javier; REGIS, Marco; TAOSO, Marco; GIANNOTTI, Maurizio; O'SHEA, Tomás

Presenter: TODARELLO, Elisa (Turin University)

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