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A Fresh Look at Solar Axions and ALPs using the Nuclear Spectroscopic Telescope Array (NuSTAR)

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While the discovery of the Higgs boson at the LHC experimentally confirms the widely successful Standard Model (SM) of particle physics, the theory still falls short of explaining several fundamental features of our Universe. A major shortcoming is the SM's silence on the nature of Dark Matter (DM). Currently, axions and WIMPs are the leading DM candidates with axions simultaneously addressing an additional weakness of the SM, i.e. its inability to explain why strong interactions do not violate charge-parity symmetry as expected from theory. Non-QCD axions on the other hand appear naturally in extensions of the SM, e.g. string theory.

If axions exist, they will be created in great numbers in the solar core by the Primakoff effect, via the interaction of a photon from the core's radiation field with a virtual photon in a nucleus. By the inverse mechanism, one can generate an X-ray flux beyond the solar core. Extensive ground-based searches, notably the CAST experiment at CERN and the proposed next generation helioscope IAXO, use laboratory magnets for the reverse conversion. We employ a novel approach using solar observations of NASA's hard x-ray astrophysics mission NuSTAR (Nuclear Spectroscopic Telescope Array) to search for the same process via magnetic fields in the solar corona, which, although weaker than those of laboratory magnets, are much more extensive in scale. We will report on the latest results of our research.

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