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The search for new sources of time-reversal violation with the neutron electric dipole moment (nEDM) experiment at the Spallation Neutron Source¹

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A permanent neutron electric dipole moment (nEDM) is the textbook example of time-reversal symmetry violation, which is equivalent to CP-violation through the CPT theorem. Minimal Supersymmetric Standard Models are required to explain the matter content of our Universe today via baryogenesis, but these predict a nEDM $> 10^{-28}e.cm$ whereas the current world limit is $< 3 \times 10^{-26}e.cm$. Therefore, a two-orders-of-magnitude improvement is a promising route for finding new physics or ruling out a sector of BSM theories. The nEDM@SNS experiment will provide this improvement using a novel technique. Nuclear magnetic resonance will be performed on polarized ultracold neutrons (UCNs) and polarized 3He atoms simultaneously inside two 3 L cells filled with 0.3 K superfluid 4He in the presence of a highly homogenous magnetic field and a strong electric field. The FNPB cold neutron beam at ORNL will produce a high UCN density inside the cell. The 3He serves as a cohabiting magnetometer and a live, in-situ UCN spin analyzer. Two measurement modes will be used: free double precession and critical spin dressing. These have different systematic errors and will provide us with an important self-check. Our collaboration expects to begin taking physics data towards the end of 2023.

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