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The PULSTAR systematic studies test apparatus for the SNS neutron electric dipole moment experiment

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In the Spallation Neutron Source based neutron Electric Dipole Moment (SNS nEDM) experiment, spins of polarized ultracold neutrons and polarized ^3He will be manipulated in a 0.3 - 0.5 K superfluid ^4He bath. Measurements will be made using two different modes: free precession and critical dressed spin. In the former, both spin species undergo a $\pi/2$ flip and then precess at their Larmor frequency in a $B_0 \sim 30$ mG field. In the latter, after a $\pi/2$ flip, a large off-resonance RF-field is used to make the two species have the same effective precession frequency. The PULSTAR test apparatus will investigate the techniques required to perform these operations experimentally using a full sized measurement cell without an electric field, and using neutrons from the NC State PULSTAR ultracold neutron source. This apparatus allows significantly shorter cooling and turn around times than the full-size SNS nEDM experiment. Other planned investigations using this apparatus include: the difference in motion between the ^3He and neutron in superfluid helium that can cause a false EDM signal, and the pseudo magnetic field caused by the spin-dependent difference of the n- ^3He scattering length. The apparatus is currently under construction with commissioning beginning towards the end of this year.

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