



Contribution ID: 203

Type: **not specified**

The PULSTAR systematic studies test apparatus for the SNS nEDM experiment

Tuesday 27 September 2016 15:45 (25 minutes)

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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Session Classification: Targets

Track Classification: H. Targets