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Cryogenic Design for the nEDM Experiment[1]
DAVID KENDELLEN, DAVID HAASE, PAUL HUFFMAN, North Carolina State University — The neutron electric dipole moment (nEDM) measurement proposed for the Spallation Neutron Source (SNS) will provide a precision test of time reversal symmetry. Lowering the upper limit on the nEDM, currently $\sim 10^{-26}$ e·cm, by a factor of 100 would test proposed extensions to the Standard Model. Thermal neutrons from the SNS will be trapped as ultracold neutrons in two ~ 2.2 liter cells filled with superfluid ^{4}He at 0.45 K. Polarized ^{3}He atoms dissolved into the ^{4}He will serve as co-magnetometers. A large dilution refrigerator (DR) will cool the cells and a surrounding 1000 liter volume of liquid helium. Transporting the ^{3}He to and from the cells via heat flush, and the large diameter tubes that connect volumes of superfluid liquid helium at $T \leq 0.5$ K to 4.2 K and above cause significant heat loads on the DR. We have developed thermal models to estimate these heat loads and guide the design of the DR heat exchangers. Previous theoretical and experimental results indicate that large heat flows occur due to superfluid film creep up the tubes and reflux of evaporated gas at higher temperatures. We have prepared an experiment to measure this effect at temperatures relevant to the nEDM experiment.

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