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Spin Dependent Absorption Cross Section of Neutron ^3He C.B. FU, NIST; Indiana Univ., T.R. GENTILE, NIST, T.G. WALKER, Univ. of Wisconsin Madison, F.E. WIETFELDT, M.G. HUBER, Tulane Univ. — Measurement of neutron scattering lengths for light nuclei provides a good opportunity to test theories of nucleon-nucleon and three-nucleon forces. The largest systematic uncertainty for recent measurements of the neutron-^3He incoherent scattering length originates from lack of precise knowledge of the spin dependent abosorption cross section (SDACS). To measure the SDACS to $\sim$0.1%, the primary experimental challenge is to measure the ^3He polarization to the same precision. We are developing a new approach to measure the polarization based on the free induction decay (FID) method. The ^3He gas, sealed in a special T-shape cell, is polarized with the spin exchange optical pumping method. The polarized ^3He nuclei, which are magnetic dipoles, can induce a classical magnetic field. By using the ^3He itself as a magnetometer, the Larmor frequency of the ^3He can be measured with FID method. We have chosen a special T-shape for the cell that allows for a calculable magnetic field from the ^3He gas while also permitting acceptable neutron transimission. If we flip the polarized ^3He 180°, the magnetic field will change and therefore the Larmor frequency of ^3He will change also. With this method, the polarization of ^3He, and then the SDACS of n+^3He can be measured to high precision.

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