ICANS XX,
20th meeting on Collaboration of Advanced Neutron Sources
March 4 – 9, 2012
Bariloche, Argentina

Design of Next Generation Magnetic Wollaston Prisms for use in Spin Echo Scattering Angle Measurement (SESAME)

Paul Stonaha*[1,2], Roger Pynn[1,2,3]

[1] Center for the Exploration of Energy and Matter, Indiana University, Bloomington IN, 47408

[2] Physics Department, Indiana University, Bloomington IN, 47405

[3] Neutron Science Directorate, Oak Ridge National Laboratory, Oak Ridge TN, 37831

*pstonaha@indiana.edu

Abstract

Spin Echo Scattering Angle Measurement (SESAME) is an interferometric technique in which the neutron scattering angle is encoded into the final polarization of the neutron beam. This is achieved through the use of magnetic prisms, akin to Wollaston prisms used in differential interference optical microscopy, which act as pi-flippers for neutrons. The ability to retrieve useful information from the spin echo polarization is dependent on the quality of the magnetic fields provided by the Wollaston prisms. By solving numerically the Bloch equation for neutron spin evolution in magnetic fields, we identify sources of depolarization in our Wollaston prisms, most of which arise from quickly-varying fields. Using an analytical model for the magnetic fields that has been benchmarked against both experiment and detailed finite-element simulations, we also explore aberrations in the Larmor phase of neutrons passing through a series of Wollaston prisms and guide fields. These calculations allow us to optimize the disign of a new generation of Wollaston prisms that we present along with the expected and observed neutron depolarization through the device. The prisms we have constructed and have their performance has been tested on the NB-4 polarized beamline at the Low Energy Neutron Source at Indiana University.

This work was supported by the Office of Basic Energy Sciences of the U.S. DOE under grant number DE-FG02-06ER46279