Contribution ID: **10** Type: **not specified**

Amplification of neutron spin rotation due to the spin-orbit interaction in silicon

Wednesday, 25 September 2019 09:40 (20 minutes)

As a neutron scatters from a target nucleus, there is a small but measurable effect caused by the interaction of the neutron's magnetic dipole moment with that of the partially screened electric field of the nucleus. This spin-orbit interaction is typically referred to as Schwinger scattering [1] and induces a small rotation of the neutron's spin on the order of 10^{-4} rad for Bragg diffraction from silicon [2]. In our experiment, neutrons undergo greater than 100 successive Bragg reflections from the walls of a slotted, perfect-silicon crystal to amplify the total spin rotation. A magnetic field is employed to insure constructive addition as the neutron undergoes this series of reflections. The strength of the spin-orbit interaction, which is directly proportional to the electric field, was determined by measuring the rotation of the neutron's spin-polarization vector. Two approaches were employed for the polarizing and analyzing the monochromatic cold neutron beam: supermirrors [3] and remotely polarized ^{3}He-based neutron spin filters [4]. Whereas better statistics were obtained with supermirrors, this approach presented a systematic effect associated with a small transverse polarization component due to the need for adiabatic rotation of the neutron spin. At the expense of statistics, this systematic effect was eliminated with spin filters. Our measurements show good agreement with the expected variation of this rotation with the applied magnetic field, whereas the magnitude of the rotation is ≈40\% larger than expected.

[1] J. Schwinger. Phys. Rev. **73**, 407 (1948).
[2] C.G. Shull. Phys. Rev. Lett. **10**, 297 (1963).
[3] F. Mezei, Commun. Phys. **1**, 81–85 (1976).
[4] W.C. Chen et al, Journal of Physics: Conf. Series **294**, 012003 (2011).

Summary

Primary authors: Dr GENTILE, Thomas (NIST); Dr HUBER, M.G. (NIST); Dr KOETKE, D.D. (Valparaiso University); Dr PESHKIN , M. (Argonne National Laboratory); Dr ARIF, M. (NIST); Dr DOMBECK, T. (University of Hawaii); Dr HUSSEY, D.S. (NIST); Dr JACOBSON, D.L. (NIST); NORD, P. (Valparaiso University); Dr PUSHIN, D.A. (University of Waterloo); Dr SMITHER, R. (Argonne National Laboratory)

Presenter: Dr GENTILE, Thomas (NIST)

Session Classification: Polarized Neutrons

Track Classification: Polarized Neutrons