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Polarized neutron studies of a Kitaev candidate spin liquid

Thursday, 12 December 2024 09:00 (30 minutes)

Samarium (Sm, element 62) is a singular element to study with neutron scattering. It has a very large neutron absorption, a magnetic form factor that peaks at high Q, and often a low magneto-crystalline anisotropy due to the limited basis of single-ion states. We use polarization techniques to study the ground state of Kitaev candidate SmI_3, a 2D honeycomb material that is similar to other rare earth tri-halides where dipole-dipole interactions can become involved. Our experiments were carried out at D3 using a hybrid setup with a Heusler monochromator and the "liquids" area detector, and using very short wavelengths in order to minimize the absorption and access high Q. The large $\Delta\lambda/\lambda$ at these wavelengths allows us to calibrate the polarization by measuring the peak shape. Using this approach, we find that the ground state of SmI_3 contains quantum fluctuations that depolarize the beam, and we characterize their time and length scales at 50 mK by comparing these results to muon spin rotation studies. We also show that the single-ion wavefunctions of SmI_3 contain ingredients for Kitaev-type interactions, by characterizing the crystal field scheme and magnetic form factor with D3 and Panther.

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