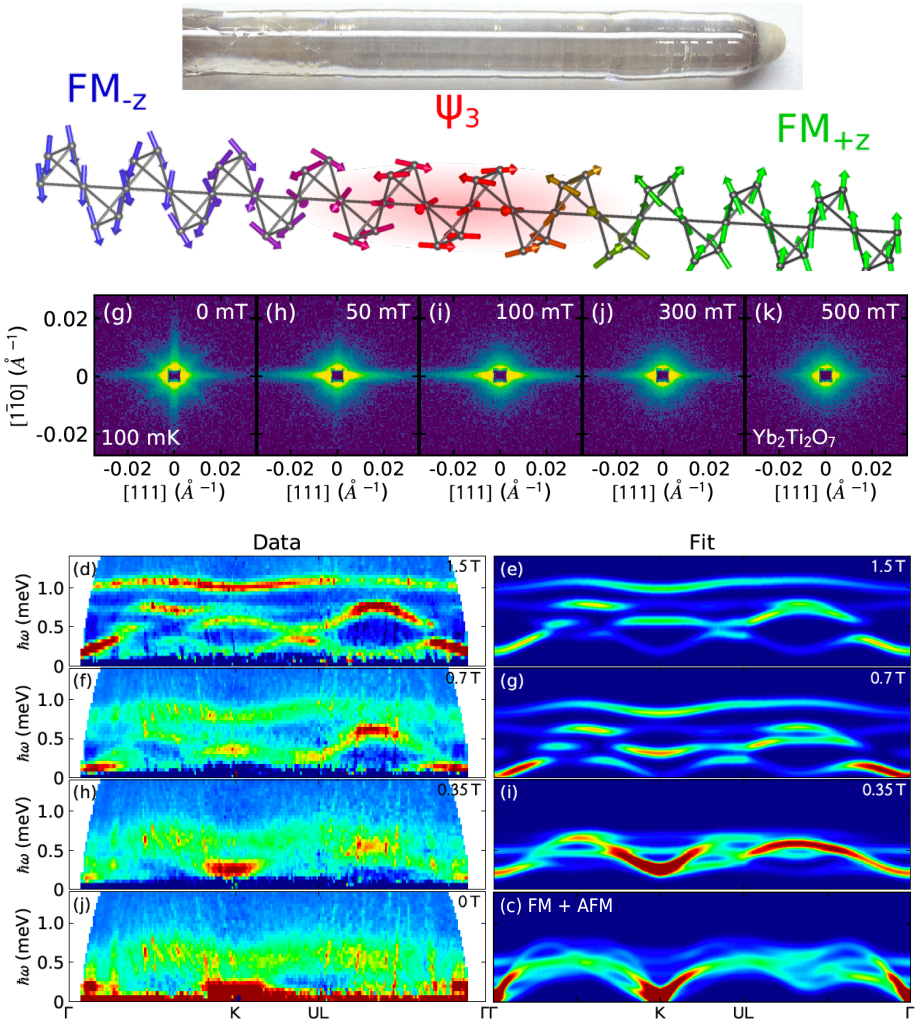
Antiferromagnetic domain walls in ferromagnetic $Yb_2Ti_2O_7$

Institute for Quantum Matter EFRC DE-SC0019331



A. Scheie, J. Kindervater, S. Zhang, G. Sala, G. Ehlers, A. Heinemann, G. Tucker, S.M. Koohpayeh, O. Tchernyshyov, and C. Broholm, preprint (2019)

Scientific Achievement

We show that ferromagnetic and antiferromagnetic states are nearly degenerate in the frustrated quantum magnet $Yb_2Ti_2O_7$. The long range nature of dipole interactions consequently induce a mixed FM/AFM state at low fields where AFM slabs serve as domain walls.

Significance and Impact

While continuum inelastic neutron scattering can signal fractionalized excitations, it can also arise from loss of translational symmetry. This appears to be the case in $Yb_2Ti_2O_7$ where the low field excitations cannot be described as coherent spin waves. Our observation of faceted FM domains and high field spin waves indicate an intrinsic mixed FM/AFM state at low fields that can account for the complex continuum scattering.

Research Details

Travelling solvent floating zone synthesis of the worlds first high quality $Yb_2Ti_2O_7$ single crystal at IQM enabled an advance in understanding this quantum spin ice candidate. High field neutron scattering provided refined anisotropic interactions. These reveal a near degeneracy between FM and AFM. Small angle neutron scattering showed faceted FM domains. The hypothesis that the AFM state forms low energy domain walls is supported by inelastic neutron scattering that can be described as a superposition of confined FM and AFM spin waves.

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