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Low Energy μSR Investigation of Helimagnetism in MnGe Films

MnGe is a B20 cubic magnetic material observed to host nanoscale topological spin textures. Previous measurements by bulk μSR and small-angle neutron scattering have shown a 3-6 nm helimagnetic state below 200K and a possible 3D skyrmion lattice [1-3]. To further study this material, we have grown high quality crystalline MnGe thin films. With thickness of only a few helical wavelengths, finite size effects are expected to modify the magnetic behavior of the films. We performed zero field and weak transverse field low energy μSR (LE-μSR) measurements on three different films of 11 nm, 17 nm and 160 nm thickness while muon implantation energies are optimized by TRIM simulations and energy scan experiments (see Fig. 1(a)). We investigated the internal field distribution and spin dynamics of the films as a function of temperature between 10 K and 250 K, with example data shown in Fig. 1(b). Our results indicate a second magnetic transition at 150 K accompanied by changes to the spin dynamics, in addition to the onset of magnetism at approximately 200 K, revealing the complexity of magnetism in MnGe films.

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Figure 1: (a) TRIM simulation of 17 nm MnGe (blue, left axis) and result of energy scan (red, right axis). (b) Example wTF data at 10 K (blue) 150 K (yellow) 290 K (red).

(1) Z. Gong, PhD Thesis, Columbia University, (2018)
(2) N. Kanazawa et al., Physical Review B 86, 134425 (2012)
(3) N. Kanazawa et al., Nat. Comm. 7, 11622 (2016)

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