Low-Energy and Bulk μSR Studies of Skyrmion Systems MnSi, $Mn_{0.9}Fe_{0.1}Si$ and Cu_2OSeO_3

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Recently, magnetic Skyrmion systems have attracted much attention due to interesting physics and potential for spintronics applications. A small pocket in the phase diagram at intermediate magnetic field and temperature slightly below transition has been identified as the Skyrmion Lattice (SkX) phase. Thin films tend to stabilize the Skyrmion phase, showing promise of heterostructure fabrication. We report here the first comprehensive μSR study of the H-T phase diagram of Skyrmion systems: bulk Cu_2OSeO_3, MnSi and $Mn_{0.9}Fe_{0.1}Si$, as well as a low-energy μSR study of a 50nm MnSi MBE thin film. In bulk MnSi, we observed the persistence of spin-lattice relaxation ($\frac{1}{T_1}$) in the SkX phase and suppression by field above it (Fig.1 (a) and (b)). In stark contrast, the MBE film sample in the ordered phase shows an increase of $\frac{1}{T_1}$ with field raised into the Skyrmion phase (Fig.1 (c) and (d)). In the paramagnetic phase, pure systems such as Cu_2OSeO_3 and MnSi follow a simple exponential relaxation, whereas doped $Mn_{0.9}Fe_{0.1}Si$ and MnSi MBE film show a stretched exponential relaxation whose exponent decreases approaching transition, signifying a broad distribution of fluctuation rates. These results strongly suggest an abundance of low-energy excitations in the Skyrmion phase and demonstrate the important roles that disorder and dimensionality play in changing the dynamic behavior of different systems.

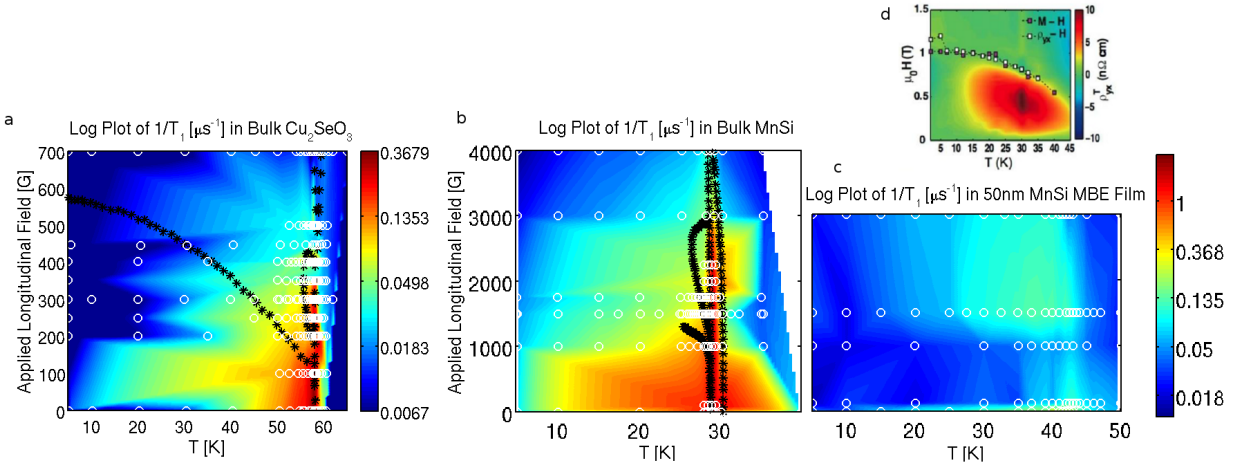

FIG. 1: Color plot of the logarithm of $1/T_1$ in (a) bulk Cu_2OSeO_3 (b) bulk MnSi (c) 50nm MnSi MBE film. Black stars show phase boundaries and white circles show μSR data points. (d) Magnetic phase diagram of 50nm MnSi MBE film.