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Investigation of the magnetic topological insulator family $(\text{MnBi}_2\text{Te}_4)(\text{Bi}_2\text{Te}_3)_n$ by μSR and NMR

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[Fig. 1 $(\text{MnBi}_2\text{Te}_4)(\text{Bi}_2\text{Te}_3)_n$ Zero Field μSR asymmetries vs. time at different temperatures
Time-reversal symmetry breaking in a topological insulator (TI) opens a surface gap and distinguishes chiral quantum states that could eventually be exploited in electrically controlled spintronic devices. The new approach to this state in a TI is with the intrinsic magnetic proximity of a magnetic insulator that can be achieved with layered van der Waals materials.

$(\text{MnBi}_2\text{Te}_4)(\text{Bi}_2\text{Te}_3)_n$ are one of the first such examples, where the increasing number n of TI layers controls the magnetic properties and dimensionality of the material. These compounds do display the quantum anomalous Hall effect, a hallmark of a magnetic TI, where spontaneous magnetization and spin-orbit coupling lead to a topologically non-trivial electronic structure. Magnetic order critical temperatures detected by macroscopic magnetization are $T_N=25,13\text{K}$ for $n=0,1$ and $T_C=12\text{K}$ for $n=2$ with a lower metamagnetic transition at $T_M=6\text{K}$ for $n=1$ [1,2,3].

Zero-field μSR (see Fig. 1) shows more than one internal field at the muon site with the majority one decreasing in value when n is increased. The muon spin precessions display very fast relaxations of static inhomogeneous nature, and the longitudinal asymmetry component displays critical slowing down of fluctuations at T_C . Remarkably the high field site disappears above T_M . NMR additionally shows the presence of a small anti-site component (likely Mn in the Bi site) in the $n=1$ sample. This local information is crucial to correctly interpret macroscopic magnetization data.

[1] M. M. Otrokov et. al, Nature 576, 416 (2019)

[2] Raphael C. Vidal et.al, Physical Review X 9, 041065 (2019)

[3] M. Z. Shi et.al, Physical Review B 100, 155144 (2019)

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