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Frozen state and spin dynamics of a new kagome compound $Fe_4Si_2Sn_7O_{16}$ and a Kitaev model system Na_2IrO_3: An NMR, μSR and AC-susceptibility studies

Rajib SARKAR

Technical University of Dresden, Germany

$Fe_4Si_2Sn_7O_{16}$ is a new Fe based kagome system with a $f = \theta/T_N \approx 3.6$, which consists of alternate stacking of kagome layer formed from edge sharing FeO_6 (S = 2) and SnO_6 octahedra and stannate layer $FeSn_6$ (S = 0). $Fe_4Si_2Sn_7O_{16}$ is a classical homologue to herbertsmithite, a suitable candidate to realize quantum spin liquid phase. $^{(117/119)}$Sn NMR allows us to selectively probe the static and dynamic magnetism of different Fe-layers. While the NMR shift vs bulk susceptibility plot follows linear relation down to 10 K confirming the absence of foreign phases in the vicinity of kagome plane, the considerable line broadening below 10 K indicates the distribution of static internal field. NMR spin-lattice/spin relaxation rate $(1/T_1)/(1/T_2)$ reflect the slowing down of spin fluctuations at ~3 K associated with the static magnetism of Fe-kagome layer. Zero field (ZF)- μSR spectra shows the presence of two relaxation channels with faster and slower relaxation rates (λ_1, λ_2), respectively. A peak in both λ_1, λ_2 is observed in the temperature range of 2-3 K associated with the static magnetism. λ_1 exhibits a constant value below 1.5 K down to 270 mK indicating the presence of dynamic magnetism. In AC-susceptibility, we observe a frequency dependent broad maximum which shifts from 3.5 K to 6 K (1.1 KHz). At low temperature below 0.15 K an upturn in the AC-susceptibility is evidenced. The combination of NMR, AC-susceptibility and μSR data suggests the presence of different relevant energy scales in $Fe_4Si_2Sn_7O_{16}$.

In the second part, I present results of ^{23}Na NMR measurements on single crystalline Na_2IrO_3, a possible candidate to realize Kitaev spin model on the honeycomb lattice. The NMR shifts $^{23}K(\%)$, that is the measure of local susceptibility, have been studied in two crystallographic orientations. The NMR shifts reflect strong anisotropic behavior similar to the bulk susceptibility. However, below a temperature $T^* \sim 50$ K, the shift deviates from the bulk susceptibility. This anomalous behavior may be related to the exchange anisotropic bond interaction connected to the magnetic frustration. In contrast to the NMR shift, the spin-lattice relaxation rate $^{23}(1/T_1)$ is isotropic in the paramagnetic state, and exhibits a strong peak at T_N. Deep in the ordered state, $^{23}(T_1T)^{-1}$ approaches a constant value as a function of temperature, suggesting the presence of significant dynamics and/or the band of excitations associated with the close proximity of quantum spin liquid ground state of Na_2IrO_3.