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Magnetism of $N_{1/3}NbS_2$ (N =Fe, V): Insight into the Intercalated Transition-Metal Dichalcogenides Using μSR

The intercalated transition-metal dichalcogenides (TMDCs) are formed through the insertion of transition-metal ions between weakly bonded hexagonal layers. The low dimensionality of these systems leads to the realisation of a wide range of magnetic phenomena, which is further enhanced by varying the species and stoichiometry of the intercalate [1]. The sensitivity of muons to local magnetism makes them an ideal tool for investigating intercalated TMDCs, where they have previously identified long-range magnetic order (LRO) and low-energy magnetic dynamics [2].

Here we examine $Fe_{1/3}NbS2$, which hosts both antiferromagnetic (AFM) stripe and AFM zig-zag phases [3]. Changes in the volume fractions of these phases with temperature reveals a mixed region with phase coexistence, along with an intermediate temperature stripe-only region. The muSR relaxation in $Fe_{1/3}NbS2$ is anisotropic with oscillations due to LRO only present in the a-b plane, which can be understood through muon site analysis. We also present results on $V_{1/3}NbS_2$, where the dynamic response of implanted muons peaks at a low temperature (10 K) transition. This corresponds to a region of non-Fermi liquid behaviour that is possibly due to the formation of topological magnetic objects [4].

[1] B. Edwards et al., Chem. Mater., 36, 7117 (2024).
[2] T. J. Hicken et al., Phys. Rev. B 105, L060407 (2022).
[3] S. Wu et al., Phys. Rev. X 12, 021003 (2022).
[4] M. K. Ray et al., Nat. Commun. 16, 3532 (2025).

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