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Gapped Magnetic Excitations in $^{153}\text{EuMn}_2\text{Ge}_2$

Layered RT_2X_2 compounds (R = rare-earth, T = 3d, 4d transition metal, X = Si, Ge) of tetragonal body centred ThCr_2Si_2 -type structure (I4/mmm) are among the most widely studied systems in condensed matter science [e.g. 1]. Yb- and Eu-based intermetallics are of particular interest due to their intermediate valence character and unusual physical and magnetic properties [e.g. 2, 3]. While EuMn_2Si_2 exhibits lattice behaviour at room temperature characteristic of a trivalent state, EuMn_2Ge_2 indicates a divalent state [4, 5]. Previously we established that the Mn sublattice of EuMn_2Ge_2 has an axial antiferromagnetic structure of space group I4/mmm below the Néel temperature $T_N \sim 667(9)$ K of Mn moment $\mu(0) = 3.43(4)$ μ_B [4] while Ryan et al. [5] established that the Eu sublattice orders below 9.8(1) K.

Our recent inelastic neutron scattering measurements of isotopically enriched $^{153}\text{EuMn}_2\text{Ge}_2$ (~ 1.5 –50 K; PELICAN) have confirmed magnetic order in the Eu sublattice below ~ 10 K with the associated spin waves revealing that a gap opens in the excitation spectrum. Aided by a prospective neutron diffraction measurement at ~ 1.8 K on ECHIDNA, we present an overview of the fascinating magnetic behaviour exhibited by EuMn_2Ge_2 with particular emphasis on modelling the spin wave spectrum and related gap. Such a gap could be the origin of the unusual temperature dependence reported for magnetic ordering of the Eu sublattice in EuMn_2Ge_2 [5].

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