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Magnetic order and single-ion anisotropy in $Tb_3Ga_5O_{12}$

Terbium gallium garnet (TGG), $Tb_3Ga_5O_{12}$, is well known for its applications in laser optics, but also for its puzzling low-temperature physics. Its low-temperature ordered structure consists of anisotropic magnetic moments, originating from Tb^{3+} ions sitting on interpenetrating hyperkagome lattices. In this talk we revise these findings thanks to recent time-of-flight neutron powder diffraction experiments, and we contrast them to the picture of the single-ion environment measured via inelastic powder neutron scattering. From a theoretical perspective, we discuss the projection over the effective quasi-doublet ground state of the crystal-field exploiting the general relationship between the local anisotropy and the time-reversal properties of non-Kramers magnetic ions [1]. More specifically for TGG, the structure of the crystal-field states will be analysed with respect to the role they can play in hyperfine-driven phenomena of magnetic ordering [2] as well as in spin-phonon coupling for the thermal Hall effect [3,4].

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Primary authors: Mr WAWRZYNCZAK, Rafal (ILL and PSI); TOMASELLO, Bruno (ILL)

Co-authors: MANUEL, P. (STFC-ISIS); KHALYAVIN, D.; LE, M. D.; GUIDI, T. (STFC-ISIS); CERVELLINO, A.; ZIMAN, T.; BOEHM, M. (ILL); NIELSEN, G. J. (STFC-ISIS); FENNEL, T. (PSI)

Presenter: TOMASELLO, Bruno (ILL)