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Polarised neutron inelastic scattering on Tb₃Fe₅O₁₂: Investigating the role of chiral magnons in a spin Seebeck prototype.

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Spin caloritronic materials are currently in the spotlight due to their potential exploitation in the next generation of spintronics applications. Composite systems, consisting of magnetic-insulator (MI) and heavy-metal (HM) bilayers, combine both spintronic and thermoelectric functionalities by interconversion of charge-, spin-, and heat-currents. A prominent example are devices exploiting the spin Seebeck effect (SSE), where thermoelectric generation is achieved by a thermally induced spin-current, which is then converted into an electric charge current by the inverse spin Hall effect within the HM layer. At low temperatures the generation of a net spin current in the MI can be understood in terms of thermal excitation of chiral magnons. The development of emerging technologies based on spin caloritronic phenomena therefore requires a microscopic understanding of their magnetic structure and dynamics. To this end, polarised neutrons can provide direct measurement of the magnon chirality of the MI layer. In this presentation, we discuss recent polarised neutron inelastic scattering results on the prototype compound Tb₃Fe₅O₁₂. Our analysis, based on microscopic description of the rare-earth's magnetic moments, unveils the origin of their anisotropies and accounts for the hybridisation between crystal-field and magnon modes [1], with the chiral effects crucial for the SSE signal generation in this class of compounds.

[1] Origin and dynamics of double umbrella states in rare-earth iron Garnets

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