FLIPPER 2024
11 - 13 December Grenoble, France

Contribution ID: **43** Type: **Contributed talk**

# Exploiting Advanced Polarised neutron and X-ray synergies to reveal magnetic structure and dynamics in spin caloritronics

*Thursday, 12 December 2024 16:30 (20 minutes)*

Exploiting Advanced Polarised neutron and X-ray synergies to reveal magnetic structure and dynamics in spin caloritronics

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Spin caloritronics a currently a science highlight due to their potential exploitation in the next generation of spintronics applications. The magnetic materials and interfaces at the core of spin caloritronics of materials combine both spintronic and thermoelectric functionalities by interconversion of charge, spin, and heat currents. A prominent example is the spin Seebeck effect (SSE), where the generation of a net spin current is understood in terms of thermal excitation of chiral magnons and converted into a charge current by the inverse spin Hall effect [1]. We present new insights into the physics of the prototypal spin caloritronic compounds, i.e. the rare-earth compensated ferrimagnets Gd3Fe5O12 and Tb3Fe5O12, by exploiting the synergies of polarised neutron and photon methodologies. Polarised inelastic neutron scattering and RIXS experiments identify the chiral magnons involved in the SSE thermoelectric conversion. In addition, recent polarised neutron Lamor diffraction experiments results are presented that could eventually lead to the measurements of the Q-dependent magnon lifetimes in the vicinity of the magnetisation compensation temperatures of this class of materials. Polarised soft X-ray diffraction studies was exploited to reveal new magnetic phase transitions in thin films of Tb3Fe5O12. Finally, ultrafast pump-probe experiments, combined with polarised resonant X-ray scattering, have been used to characterise the heat, phonon and spin dynamics currents in thin films spin caloritronic heterostructures [3].
References

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[2] P. G. Evans, et al., Science Adv. 6, aba9351 (2020).
[3] D. Sri Gyan, et al., Struct. Dyn. 9, 045101 (2022)

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**Session Classification:** Smart materials

**Track Classification:** Smart materials