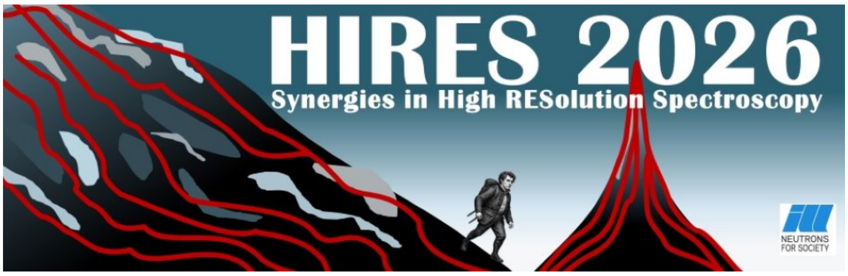

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Theory of Spin Seebeck effect and low-lying crystal field excitations in a Rare-Earth Iron Garnet

The spin Seebeck effect (SSE) is a phenomenon of thermoelectric generation that occurs within a device consisting of a bilayer of a metal and a ferromagnet. When Tb3Fe5O12(TbIG) is substituted for the ferromagnet, the effect was observed to go to zero at low temperatures, but increases to positive values with the application of a magnetic field. This is opposite to the expectation that the SSE should be suppressed by a magnetic field due to the increase in the magnon gap. We have provided a theory of this by calculating the low energy excitations, exploiting the parameters of Terbium Gallium Garnet Tb3Ga5O12(TGG) from the neutron-scattering studies and the close structural similarity between TGG and TIG. We show that when an external magnetic field is applied along the [111] direction of the crystal, the lowest Crystal Field level decreases with applied field and can carry a spin current. At low temperatures - defined by the energy of the CFE of a few mEV - this can result in an enhanced Spin Seebeck effect under applied magnetic field. While the experimental situation for low-lying magnetic excitations in TbIG is still not resolved, this makes a promising connection between the observation of low energy magnetic excitations and a low-temperature phenomenon of interest in spintronics.
This is theoretical work in collaboration with Bruno Tomasello (U. Catania) and Michiyasu Mori (JAEA, Tokai). It is closely related to more general studies with Stephan Gepraegs (Walter Meissner Institut, München), Danny Mannix (ESS, Lund) and Jack Thomas-Hunt (Aarhus)

Session

Hard Condensed Matter

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