Project 4.29. Thermoelectric phenomena in topological materials

Supervisor: dr hab. Marcin Matusiak

Institute: IFPAN,
International Centre for Interfacing Magnetism and Superconductivity with Topological Matter "MagTop"

Unit: ON6.6

Webpage of group: http://www.MagTop.ifpan.edu.pl

Background:
Thermoelectrical coefficients quantify an electrical response of a system to the thermal stimulus. Since these phenomena can be generally understood as a measure of the entropy flow, they offer another, meaningful perspective to study properties of charge and heat carriers in topological materials.
One of the thermoelectrical effects, named after Walther Nernst, is usually small in common metals, but gains an entirely new appearance in topologically non-trivial systems. Thanks to the non-zero Berry curvature one can observe the anomalous Nernst effect (ANE), while, so called, the chiral anomaly leads to emergence of the planar Nernst effect (PNE). Both ANE and PNE exhibit unusual behaviour, which in a sense is a general characteristic of topological materials.

Aim:
The aim of the project is to better understand topological materials through investigation of the anomalous and planar Nernst effects. These studies will be performed in close collaboration with other MagTop teams.
We are going to start with measurements of ANE in topological crystalline insulators grown by molecular beam epitaxy, since films are well suitable for the measurements of thermoelectrical coefficients. Expected results are interesting not only from a point of view of basic research, but also due to potential applications in thermoelectric devices. In this regard we are also going to study thermoelectric properties of interfaces involving topological materials and metals (normal, ferromagnetic, and superconducting).
Another investigated subject will be the chiral anomaly occurring in topological semimetals. The thermal probes are mostly immune to the detrimental "current jetting" effect, which makes them well suited for such studies. The planar Nernst effect measurements will be performed on single crystals of the both Dirac and Weyl semimetals grown on-site and acquired through international collaboration.

Requirements:
MSc in physics, ability to solve technical problems, basic programming skills