Project 4.30. Heat transport by topological excitations

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Background:
Topological materials exhibit a wide range of unusual properties including unusual heat transport by itinerant topological excitations. For example, there is an ongoing debate, whether the Wiedemann-Franz law, which describes the fundamental relation between the electrical and thermal conductivity, is obeyed in topologically non-trivial materials.
Very interesting behaviour is also exhibited by a class of magnetic insulators that can host a topological quantum spin liquid. Such systems do not conduct charge, but the heat transport appears to be affected by application of the magnetic field. In result, the transverse thermal conductivity, which consists in generation of the transverse thermal gradient in response to the longitudinal heat flow, can be measured and this signal was shown to be generated by Majorana itinerant excitations. Moreover, there are reports indicating that the transverse thermal conductivity (also called the thermal Hall effect) develops the Majorana quantization.

Aim:
The aim of the project is to better understand topological materials through investigation of the longitudinal and transverse thermal conductivities. These studies will be performed in close collaboration with other MagTop teams.
Firstly, we are going to measure low temperature electrical and thermal transport properties in single crystals of topological crystalline insulators to determine validity of the Wiedemann-Franz law in these systems.
We will also attempt to measure the transverse thermal conductivity in Kitaev quantum spin liquid candidates. The single crystals for this studies will be likely acquired from foreign laboratories, which can develop into intense international collaboration.

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