Towards thermoelectric transport in magnetoelectric materials

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I will begin my talk with the presentation of a microscopic expression for the surface anomalous Hall conductivity, which is directly related to the linear bulk magnetoelectric tensor, also known as axion coupling. Being able to calculate both quantities on a microscopic level, by constructing tight-binding models we explored and confirmed the connection between the two quantities [1].

By following the same idea for the traceless part of the magnetoelectric polarizability tensor, one obtains an analogous "surface theorem" yielding longitudinal surface conductivity. Longitudinal electric current parallel to the inducing electric field should be dissipating, as opposed to the dissipationless Hall current. While one might first expect a generation of a heat flow between opposite surfaces, we concluded that the induced current is bound and does not produce Joule heat.

Nevertheless, these considerations lead us towards the idea of the existence of an intrinsic heat current induced by an applied electric field in materials with broken time-reversal and inversion symmetry, thus sharing the same symmetry conditions with the magnetoelectric polarizability.

In the final part of my talk, I will summarize the recent state of the literature on the intrinsic nonlinear anomalous thermoelectric transport based on the concept of field-induced Berry curvature [2-6] and I will present our own preliminary results obtained with the WannierBerri code [7].

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