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Stuttgarter Physikalisches Kolloquium

Max-Planck-Institut für Festkörperforschung
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Fachbereich Physik, Universität Stuttgart

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Login data will be announced by e-mail and on the colloquium webpage.

Dienstag, 20. April 2021 | **16.15 Uhr** | **Online-Vortrag**

Stuttgarter Max-Planck-Institute, Heisenbergstraße 1, 70569 Stuttgart-Büsnau

Majorana fermions and half-integer thermal quantum Hall effect in a quantum magnet

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Abstract

When topology is combined with strong electron correlations, exotic phenomena can arise. One of the most prominent example is the fractional quantum Hall effect, in which the constituent particles are electrons but the quasiparticles carry fractions of the electron charge. Recently, Kitaev quantum spin liquid (QSL) has aroused a great interest, because exotic quasiparticles, such as Majorana fermions and non-Abelian anyons, emerge as a result of fractionalization of electron spins. Kitaev model represents a spin-1/2 on a honeycomb lattice interacting through bond-dependent Ising ferromagnetic couplings.

Recently strongly spin-orbit coupled two-dimensional (2D) Mott insulator α-$RuCl_3$ has taken a center stage in investigating the Kitaev spin liquid. In this compound, the application of a parallel magnetic field destroys the long-range magnetic order, leading to a field-induced QSL ground state with massive entanglement of local spins. In the QSL state, we show that the 2D thermal Hall conductance κ_{xy}^{2D} exhibits a quantized plateau at half integer, $\kappa_{xy}^{2D}=K_0/2$, where $K_0=(\pi^2/3)(k_B^2/h)$ T is the quantum thermal conductance [1], in analogous to the quantum electronic conductance e^2/h. The topological Chern number determined by the sign of the quantized thermal Hall conductance is consistent with that expected in Kitaev QSL [2]. The angular variation of the heat capacity reveals the gap formation in the bulk, which is quantitatively consistent with the Kitaev model [3]. These results provide direct signatures of topologically protected chiral currents of charge neutral Majorana fermions at the edge and non-Abelian anyons in the bulk of the crystal.

[1] Y. Kasahara *et al.*, Nature 559, 227 (2018).
[2] T. Yokoi *et al.* arXiv:2001.01899.
[3] O. Tanaka *et al.* . arXiv:2007.06757.