



Condensed Matter Seminar

物性論セミナー

Supported by Variety and universality of bulk-edge correspondence in topological phases: From solid state physics to transdisciplinary concepts
Grant-in-Aid for Scientific Research (S) Project No.17H06138

2018年12月14日 (金), Dec. 14 (Fri), 2018, 13:30-14:30

自然系学系棟B棟6階: 602号室, B602, Univ. Tsukuba

[\[Map\]](#)

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

Yuji Matsuda

Department of Physics, Kyoto University

The quantum Hall effect (QHE) is one of the most remarkable phenomena in contemporary condensed matter physics, which rivals superconductivity in its fundamental significance as a manifestation of quantum mechanics on a macroscopic scale. The quantum Hall state is a topological property of quantum matter. There are two classes of the QHE, where integer and fractional electrical conductance are measured in units of e^2/h . Here we report a novel type of quantization of the Hall effect caused by charge neutral quasiparticles, i.e. Majorana fermions due to the fractionalization of quantum spins, in an insulating two-dimensional (2D) quantum magnet, α - RuCl_3 with a dominant Kitaev interaction (a bond-dependent Ising-type interaction) on a two-dimensional honeycomb lattice[1][2]. This material has been suggested to be a candidate of Kitaev quantum spin liquid (QSL), where significant entanglement of quantum spins is expected. In the low-temperature regime of the QSL state, the 2D thermal Hall conductance reaches a quantum plateau as a function of applied magnetic field. Moreover, the plateau attains a quantization value, which is exactly half of that in the integer QHE. This half-integer thermal Hall conductance is a direct signature of topologically protected chiral edge currents of emergent Majorana fermions, whose degrees of freedom are half of those of electrons, and non-Abelian anyons in the bulk.

[1]Y. Kasahara et al. Phys. Rev. Lett. 120, 217205 (2018).

[2]Y. Kasahara et al. Nature 559, 227 (2018).

Contact : Y. Hatsugai 初貝安弘 Tel:029-853-4204 Email: hatsugai@rhodia.ph.tsukuba.ac.jp