Quantum Simulation in Hot Atoms

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One of the most important discoveries in condensed matter physics is the quantum Hall effect (QHE). At low temperature and with large magnetic field, the Hall conductivity of a 2D electron gas is quantized. The back-scattering-free quantum Hall currents locate at the edges of the sample and they are immune to local defects. The observation of the QHE requires low temperature and large magnetic field or in rare cases at least one of them. Quantum simulation of the edge currents has been conducted in ultra-cold atoms with synthesized magnetic field. The quantum optics group of Da-Wei Wang, Jun-Xiang Zhang and Shi-Yao Zhu from Zhejiang university (China) report the first experimental observation of chiral edge currents in atoms at room temperature, which is 8 orders of magnitude higher than the usual requirement. This work substantially lowered the threshold of observing topological physics in atoms (neither magnetic field nor low temperature is required). It also demonstrates a new way to achieve unidirectional reflectionless (invisible) mirrors, which have been an important topic in photonic structures such as the PT-symmetric materials. This work\(^1\) has been accepted in Physics Review Letters.