Topological Thermal Hall Conductance of Even Denominator Fractional States

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The even denominator fractional quantum Hall (FQH) states ν=5/2 and ν=7/2 have been long predicted to host non-abelian quasiparticles (QPs). Their present energy-carrying neutral modes are hidden from customary conductance measurements and thus motivate thermal transport measurements, which are sensitive to all energy-carrying modes. While past 'two-terminal' thermal conductance measurements ($K_{2t}T$) already proved the non-Abelian nature of the ν=5/2 FQH state, they might have been prone to a lack of complete thermal equilibration among the counter-propagating edge modes. Consequently, we developed a novel thermal Hall conductance measurement of $K_{xy}T$, which is insensitive to equilibration among edge modes and thus determines the 'topological order' of the ν=5/2 and ν=7/2 states. This new method re-verified the nature of ν=5/2 and ν=7/2 states, being non-Abelian. Moreover, the order of these states was found to be Particle-Hole Pfaffian (PH-Pf), supporting (in addition to the charges modes) a single upstream (counter-propagating) Majorana edge mode. While current numerical works predict a different topological order (Anti-Pf), our repeated findings of PH-Pf order should, by now, motivate more theoretical works.

M. Banerjee, Nature (2017, 2018); Dutta, Science (2022, 2022); Melcer, Nat. Phys. (2023); Melcer, Nature (2024); Paul (to be published in PRL)