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Proliferation of Neutral Modes in Fractional Quantum Hall Regimes

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The fractional quantum Hall effect (FQHE) is a canonical example of 2D topological phases. Being incompressible in the bulk, available low-energy charged excitations are only at the edge: gapless chiral 1D edge channels. Various collective phenomena can emerge when interactions take place between coexisting multiple edge channels. Recently, there is a surge of energy transport in FQHEs besides the charge transport. A notable example is upstream neutral edge modes in so-called hole-like fractional FQHEs, arising from the interacting channels, which remained elusive despite of an early theoretical prediction. In this talk, I will describe the observation of such neutral modes revealed via our sensitive shot noise measurents. Surprisingly, they were found not only in the hole-like FQHEs, as theoretically expected, but also in particle-like FQHEs and, furthermore, in the bulk. Our result presents a new picture of energy transport in FQHEs. The presence of various neutral modes may imply their unfavorable roles as potential decoherers for fractional quasiparticles. Hence, understanding the properties of the neutral modes may allow us to control decoherence and thus to conclusively observe quantum oscillations of the fractional quasiparticles.

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