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Unconventional Quantum Hall Edge-Bulk Correlation in Gated Graphene Devices YONG-TAO CUI, Stanford University, BO WEN, Columbia University, ERIC MA, GEORGI DIANKOV, Stanford University, ZHENG HAN, Columbia University, FRANCOIS AMET, Stanford University, TAKASHI TANIGUCHI, KENJI WATANABE, National Institute for Materials Science, Japan, DAVID GOLDHABER-GORDON, Stanford University, CORY DEAN, Columbia University, ZHI-XUN SHEN, Stanford University — The quantum Hall effect in a two dimensional electron system (2DES) has been understood as chiral edge states circulating a highly insulating bulk when the bulk Landau levels are completely filled. We combine edge-sensitive charge transport with scanning Microwave Impedance Microscopy that probes the bulk transition through Landau levels, to directly examine such edge-state picture in gated graphene devices. Surprisingly, comparison of these measurements reveals that quantized transport typically occurs below complete filling of bulk Landau levels, different from the conventional picture in semiconductor-based 2DESs. We suggest that gate-induced charge accumulation near edges leads to a complex edge state configuration in which counter-propagating edge states could exist at the same edge. The backscattering between these states, together with an incompressible strip separating the bulk and the edge region, can explain the observed deviations.

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