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Theory of unconventional quantum Hall effect in strained graphene[1] ZI-XIANG HU, ChongQing University, China and Princeton University, USA, BITAN ROY, KUN YANG, National High Magnetic Field Laboratory, Florida State University, USA — We show graphene discerns an unconventional sequence of quantized Hall conductivity, when subject to both magnetic fields (B) and strain through both theoretical arguments and numerical calculations. The strain produces time-reversal symmetric pseudo/axial magnetic fields (b). The single electron spectrum is composed of two inter-penetrating sets of Landau levels (LLs), located at $\pm\sqrt{2n|b \pm B|}$, n = 0, 1, 2,.... For $b > B$, these two sets of LLs have opposite chiralities, resulting in oscillating Hall conductivity between 0 and $\mp 2e^2/h$ in electron and hole doped system, respectively, as the chemical potential deviates from the neutrality point, but remains in its vicinity. The electron electron interactions stabilizes various correlated ground states, e.g., spin-polarized, quantum spin-Hall insulators at and near the neutrality point, and possibly anomalous Hall insulating phase at incommensurate filling. Such broken symmetry ground states have similarities as well as significant differences from there counterparts in the absence of strain. For realistic strength of magnetic fields and interactions, we present scaling of interaction induced gap for various Hall states within the zeroth Landau level.

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Zi-Xiang Hu
ChongQing University, China and Princeton University, USA

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