High-temperature topological insulator states in strained graphene

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PESIN, University of Texas, Austin — Recently, it was realized that
the electronic properties of graphene can be manipulated via mechan-
ic deformations, which opens prospects for both studying the Dirac
fermions in new regimes and for device applications. More specifically,
non-uniform strains give rise to pseudomagnetic fields that are opposite
in the two valleys of Dirac fermions. Certain natural configurations of
strain generate large nearly uniform pseudo-magnetic field, leading to
flat spin- and valley-degenerate Landau levels (LL). Here we consider
the effect of the Coulomb interactions in strained graphene with nearly
uniform pseudo-magnetic field. We show that the spin/valley degenera-
cies of the LL get lifted, giving rise to topological insulator-like states.
We find that both anomalous quantized Hall states and quantum spin
Hall states can be realized. These many-body states are characterized
by quantized conductance and persist to high temperature scale set by
the Coulomb interactions. This work provides a new route to designing
robust topological insulator states in mesoscopic graphene and other 2D
Dirac materials.


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