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Unified Topological Field Theory for Gapped and Gapless Systems DANIEL BULMASH, PAVAN HOSUR, SHOU-CHENG ZHANG, XIAO-LIANG QI, Stanford University — We present a scheme for systematically enumerating the responses of gapped as well as gapless systems of free fermions to electromagnetic and strain fields starting from a common parent theory. Using the fact that position operators in the lowest Landau level of a quantum Hall state are canonically conjugate, we consider a massive Dirac fermion in $2n$ spatial dimensions under n mutually orthogonal magnetic fields and reinterpret physical space in the resulting zeroth Landau level as phase space in n spatial dimensions. The bulk topological responses of the parent Dirac fermion, given by a Chern-Simons theory, translate into quantized insulator responses, while its edge anomalies characterize the response of gapless systems. Moreover, various physically different responses are seen to be related by the interchange of position and momentum variables. We derive many well-known responses, and demonstrate the utility of our theory by predicting spectral flow along dislocations in Weyl semimetals.

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