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3D and 4D Topological Insulators based SU(2) Landau Levels
YI LI, Department of Physics, University of California, San Diego, SHOU-CHENG ZHANG, Department of Physics, Stanford University, CONGJUN WU, Department of Physics, University of California, San Diego — Current studies of 3D topological insulators (TIs) based on the Bloch-wave band inversion have made great success in lattices. Independent of current routine, we propose a novel and simple mechanism achieving exactly flat topological spectra for electrons in the continuum at 3D and 4D without magnetic fields. By introducing spin-orbit couplings, helical Dirac modes or chiral Weyl modes with opposite helicities are spatially separated along an extra spatial dimension and robust at boundaries as protected by the time-reversal symmetry. Moreover, based on elegant analytic wavefunctions of high dimensional Landau levels, we construct the Laughlin type wavefunction at the fractional filling in 4d. Further, parallel to the 2D QHE, whose quantized Hall response demonstrates spatially separated (1+1)D chiral anomaly, the 4D SU(2) Landau levels explicitly show the quantized non-linear electromagnetic response, which exhibits spatially separated (3+1)D chiral anomaly with the same quantization in the unit of fundamental physical constants.

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