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Geometry of Landau Level without Galilean or Rotational Symmetry[1] YU SHEN, F. D. M. HALDANE, Department of Physics, Princeton University, Princeton NJ 08544-0708 — The integer quantum Hall effect is usually modeled using Galilean-invariant or rotationally-invariant Landau levels. However, these are not generic symmetries of electrons moving in a crystalline background. We explicitly break both symmetries by considering a inversion-symmetric Hamiltonian with quartic terms. We carry out exact diagonalization numerically with a truncated Hilbert space, and define an emergent metric g^n_{ab} for each Landau level as the expectation value of a bilinear form in momentum. With an appropriate choice of the guiding center coherent state, the Landau level wavefunctions are holomorphic functions of z^* times a Gaussian (this is distinct from a well-known property of rotationally-invariant lowest-Landau-level wavefunctions). We show that the zeroes of the wavefunction define a "topological spin s_n", with its original definition as an "intrinsic angular momentum" no longer valid without rotational symmetry. This is now related to the number of zeroes n encircled by the classical orbit by $s_n = n + \frac{1}{2}$. Finally we introduce a mass tensor m^n_{ab} for each Landau level using a Lagrangian formalism. We conclude that topological and geometric information can be extracted without resort to Galilean or Rotational symmetries.

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