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From Landau levels to Hofstadter physics

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We study spinless electrons in a magnetic field subject to a square periodic potential and present a method to derive a Hofstadter-like tight-binding model starting from Landau levels. We demonstrate how the Hofstadter regime emerges from a continuum Hamiltonian as the strength of the periodic potential is increased, identifying the associated topological phase transitions. Based on this, we introduce a dimensionless parameter that characterizes the Hofstadter regime. In addition, we show that the Hofstadter model requires corrections when the magnetic field is large enough that the magnetic length becomes comparable to or smaller than the lattice constant.