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Position-Momentum Duality, Geometrical Description and Ideal Host Lattices for Fractional Chern Insulators MARTIN CLAASSEN, Department of Applied Physics, Stanford University, CHING-HUA LEE, Department of Physics, Stanford University, RONNY THOMALE, Institute for Theoretical Physics, University of Wuerzburg, XIAO-LIANG QI, Department of Physics, Stanford University, THOMAS DEVEREAUX, SLAC National Accelerator Laboratory, Stanford Institute for Materials and Energy Sciences — The recent discovery of fractional quantum Hall (FQH) physics in flat-band Chern insulators without external magnetic field presents a profound theoretical challenge to understand the interplay of universal long-wavelength physics of the FQH effect and short-wavelength physics determined by the host lattice. Here, we present a first quantization description of fractional Chern insulators that is the dual of the anisotropic FQH problem, with the roles of position and momentum interchanged. The fundamental guiding-center geometry of the problem emerges from the interplay of lattice and interaction metrics that act as momentum-space duals of Haldane's geometrical description of the anisotropic FQH effect. We introduce a novel broad class of ideal C¿1 Chern insulator lattice models that are duals of the isotropic limit of the conventional FQH effect. These models afford a particularly elegant analytical framework and act as parent Hamiltonians for lattice FQH states with emergent guiding-center and SU(C) symmetry. Resulting microscopic insight into stabilization of FQH states on the lattice provides a foundation for future analyses of non-Abelian phases and fractional topological insulators.

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