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Tensor networks for Hofstadter models

The Bose-Hofstadter model, describing mobile bosons or fermions in a magnetic field on a lattice, hosts a plethora of interesting topological ground-state phases. The magnetic field is implemented through phases in the hopping amplitudes breaking translation invariance, which makes tensor network simulations particularly challenging. First, we show what are the convenient choices of the gauge for MPS simulations on the cylinder, making the connection with both the Lieb-Schultz-Mattis theorem and the "thin-torus" limit of the FQH effect. Next, for infinite PEPS we show that the phases in the hopping amplitudes can be absorbed into the virtual bonds, allowing for PEPS representations on the infinite plane that do not break any translation invariance. We argue that the combination of cylinder-MPS and infinite-PEPS simulations provide a comprehensive tensor-network approach for Hofstadter-like models.

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