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Vortex lattice phases in bosonic ladders in the presence of gauge field MARIE PIRAUD, LMU, Munich, SEBASTIAN GRESCHNER, Leibniz Univ., Hannover, FABIAN KOLLEY, LMU, Munich, IAN P. MCCULLOCH, Univ. of Queensland, Australia, ULRICH SCHOLLWOECK, FABIAN HEIDRICH-MEISNER, LMU, Munich, TEMO VEKUA, Leibniz Univ., Hannover — We study vortex lattices in the interacting Bose-Hubbard model defined on two- and three-leg ladder geometries in the presence of a homogeneous flux. Our work is motivated by recent experiments using laser assisted-tunneling in optical lattices [1] and lattices in synthetic dimensions [2], which studied the regime of weak interactions. We focus on the effects arising from stronger interactions, in both the real space optical lattice and the synthetic dimension schemes.

Based on extensive density matrix renormalization group simulations and a bosonization analysis, we show that vortex lattices form at certain commensurate vortex densities [3,4]. We identify the parameter space in which they emerge, and study their properties.

Very interestingly, an enlarged unit cell forms in the vortex lattice phases, which can lead to the reversal of the current circulation-direction in both geometries [3,4]. We demonstrate this effect in weak coupling and at sufficiently low temperature, and show that it is significant for intermediate interactions [4].

[1] Atala et al., Nature Phys. 10, 588 (2014)
[2] Stuhl et al., Science 349, 1514 (2015)
[3] Kolley et al., New J. Phys. 17, 092001 (2015)
[4] Greschner et al., Phys. Rev. Lett. 115, 190402 (2015)

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