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Two leg bosonic ladder in an external magnetic field at unit filling

ANTOINE STERDYNIAK, Institut für Theoretische Physik, Universität Innsbruck, MARCELLO DALMONTE, Institut für Theoretische Physik, Universität Innsbruck ; Institute for Quantum Optics and Quantum Information of the Austrian Academy of Sciences, SALVATORE MANMANA, Institute for Theoretical Physics, Georg-August-Universität Göttingen, PETER ZOLLER, Institut für Theoretische Physik, Universität Innsbruck; Institute for Quantum Optics and Quantum Information of the Austrian Academy of Sciences, ANDREAS LAUCHLI, Institut für Theoretische Physik, Universität Innsbruck — Motivated by the recent experimental realizations of artificial gauge field on optical lattices, we study the two-leg bosonic ladder in an external magnetic field, both analytically using bozonization techniques and numerically using finite size density matrix renormalization group algorithm. At unit filling, interacting bosons can exhibit a rich variety of phases on ladders. At large interaction, they form a Mott insulator phase while, at smaller interaction, they exhibit a Meissner phase and, more intriguing floating and staggered vortex phases. A weak chiral Mott insulator phase is also found for intermediate interaction strength. We determine the phase diagram and Luttinger parameters from correlations functions and entanglement spectrum. While usually thought to be second order, some of the phase transitions appear to be first order.

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