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Meissner and Laughlin Phases in bosonic Ladders ALEXANDRU PETRESCU, Princeton University, Department of Electrical Engineering, MARIE PIRAUD, Department of Physics and Arnold Sommerfeld Center for Theoretical Physics, Ludwig-Maximilians-Universität München, IAN MCCULLOCH, ARC Centre for Engineered Quantum Systems, School of Mathematics and Physics, The University of Queensland, GUILLAUME ROUX, LPTMS, Univ. Paris-Sud and CNRS, UMR 8626, KARYN LE HUR, CPHT and CNRS, Ecole Polytechnique — We introduce a hard core boson model on a ladder lattice in uniform orbital magnetic flux. This model supports the Meissner effect in the presence of insulating behavior [1,2,3]. When the ratio of particle and flux densities ν is close to 1/2, the ground state is a low-dimensional equivalent of the Laughlin state of fractional quantum Hall effect [3]. Using exact analytical methods, the density matrix renormalization group method and exact diagonalization, we identify local observables that distinguish the Laughlin phase from the surrounding vortex and Meissner phases. At $\nu = 1/2$ the antisymmetric current, currently accessible in ultracold atom experiments [5,6], saturates. Thus remnants of topological order in quasi one dimensional systems can be probed using local observables. Secondly, we show how ground state degeneracy and topology can be probed with Thouless pump experiments on the ladder geometry.
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Alexandru Petrescu
Princeton University

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