Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Bosonic Mott Insulator with Pseudo-spin Meissner Currents
KARYN LE HUR, Center For Theoretical Physics (CPHT), Ecole Polytechnique and CNRS, 91128 Palaiseau France, ALEXANDRU PETRESCU, Yale University, Physics Department USA and CPHT Ecole Polytechnique France — We introduce a two-component bosonic Mott insulator that can support chiral Meissner edge currents as a result of time-reversal symmetry breaking due to the application of a uniform magnetic field. The key ingredient is the presence of two layers exhibiting both charge (total density) and pseudo-spin (relative density) degrees of freedom. This then allows for a Mott phase characterized by pseudospin edge currents of Meissner type [1]. A simple example can be built from a ladder system [2]. We determine the temperature scale for the existence of such a phase as a function of the interlayer Josephson coupling and interaction. We show that it is possible to probe this phase by introducing gauge fields parallel to the layers, and that in the low-field limit the system exhibits a Meissner effect, in which interlayer currents are suppressed, and the overall current circulation in the layers opposes the applied field. For higher field values the currents organize themselves in vortices, as a result of a commensurate-incommensurate transition.

[1] Alexandru Petrescu and Karyn Le Hur, in preparation
[2] E. Orignac and T. Giamarchi, Phys. Rev. B 64 p. 144515 (2001); F. Crepin, N. Laflorencie, G. Roux and P. Simon, Phys. Rev. B 84, 054517 (2011).

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Date submitted: 25 Nov 2012 Electronic form version 1.4