Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Quantum phase-manipulation of a two-leg ladder in mixed dimensional Fermonic cold atoms WEN-MIN HUANG, KYLE IRWIN, SHAN-WEN TSAI, Department of Physics and Astronomy, University of California, Riverside, CA 92521, USA — The recent realization of mixed dimensional cold atoms has attracted intense attentions from both experimentalists and theoreticians. Exotic phases arise due to correlation effects, and the systems can be engineered with quantum phase-tunable parameters. We investigate a two-species Fermi gas: one is confined in a two-leg ladder with on-site interactions, and the other is free in a two dimensional square lattice. By integrating out the two-dimensional gas, a long-range mediated interaction in the ladder is generated due to the on-site interspecies interactions. Using the renormalization group method, we show that the mediated interactions enhance the instability of charge density waves, and can be controlled by the filling in the two-dimensional gas. Parameterizing the phase diagrams with different quantities, we discuss the possible quantum phase-manipulation of a two-leg ladder in mixed dimensional Fermionic cold atoms.

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Date submitted: 26 Nov 2012 Electronic form version 1.4