Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Exotic paired states with anisotropic spin-dependent Fermi surfaces[1] ADRIAN FEIGUIN, University of Wyoming, M. P. A. FISHER, California Institute of Technology — We propose a model for realizing exotic paired states in cold atomic Fermi gases. By using a *spin dependent* optical lattice it is possible to engineer spatially anisotropic Fermi surfaces for each hyperfine species, that are rotated 90 degrees with respect to one another. We consider a balanced population of the fermions with an attractive interaction. We explore the BCS mean field phase diagram as a function of the anisotropy, density, and interaction strength, and find the existence of an unusual paired superfluid state with coexisting pockets of gapless unpaired carriers. This state is a relative of the Sarma or breached pair states in polarized mixtures, but in our case the Fermi gas is unpolarized. We also propose the possible existence of an exotic paired "Cooper-pair Bose-Metal" (CPBM) phase, which has a gap for single fermion excitations but gapless and uncondensed "Cooper pair" excitations residing on a "Bose-surface" in momentum space. We extend our study of the model to a ladder geometry by using the density matrix renormalization group method, and we unveil a phase diagram with paired states that reveal a striking resemblance to the physics of hard-core bosons with a frustrating ring-exchange term.

[1]Supported in part by Microsoft Station Q

Adrian Feiguin
University of Wyoming

Date submitted: 20 Nov 2009 Electronic form version 1.4