Abstract Submitted
for the MAR07 Meeting of
The American Physical Society

The universal phase diagram of fermionic quantum liquids near the unitarity limit PREDRAG NIKOLIC, SUBIR SACHDEV, Harvard University — We consider several models of particles with short-range attractive interactions whose universal properties are controlled by an unstable renormalization-group fixed point at zero density and temperature. The fixed point corresponds to the Feshbach resonance, and relevant perturbations are the detuning of the resonance, and parameters that control the particle densities. Some critical exponents are determined exactly as expansions about two and four spatial dimensions. The existence of a renormalization-group fixed point implies a universal phase diagram as a function of density, temperature, population imbalance, and detuning. We study this phase diagram in the context of BEC-BCS crossover of s-wave paired fermions. We develop a 1/N expansion, based upon models with Sp(2N) symmetry, and use it to systematically analyze the universal properties of interacting fermions near the unitarity limit. This approach overcomes several limitations of the expansions about two and four dimensions, and allows a well controlled exploration of the full phase diagram of imbalanced fermion populations in the experimentally relevant three-dimensional space.

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Date submitted: 20 Nov 2006 Electronic form version 1.4