

Plenary Talk (SAMOP) PV II Mon 9:15 HSZ 02
Pairing in Unusual Places - Stretching the Realm of Superconductivity — ●RANDALL HULET — Rice University, Houston, TX 77005, USA

Ultracold atoms are emerging as a powerful new tool for exploring fundamental physics, particularly in condensed matter. They are clean and well-characterized systems, for which the interaction strength, temperature, density, and dimensionality are readily tunable. These attributes, especially in combination with optical lattices, provide opportunities to uncover unexpected new physics.

I will discuss experiments on the pairing of ^6Li , a composite fermion, under extreme conditions. The interaction strength can be tuned to the unitary limit, where the pairing transition temperature as a fraction

of the Fermi energy is higher than any other known superconductor or superfluid. While BCS theory expects equal densities of spin-up and spin-down particles, we have investigated two-component Fermi gases where the spin populations are unequal. Such a scenario corresponds to a magnetized superconductor. In three-dimensions (3D), we find phase separation between a fully paired core and the surrounding unpaired atoms. A surprising metastable state is found in elongated trap geometries which favors pairing, even for large population imbalances. We have also determined the phase diagram of a spin-imbalanced Fermi gas in 1D, which is predicted to exhibit the elusive FFLO modulated superfluid state. The FFLO state accommodates the imbalance in spin population by forming pairs with non-zero momentum. This momentum should be directly detectable in a time-of-flight measurement.