DAMOP09-2009-000133

Abstract for an Invited Paper
for the DAMOP09 Meeting of
the American Physical Society

Pairing of Fermionic ^{6}Li Throughout the BEC-BCS Crossover[1]

GUTHRIE PARTRIDGE[2], Rice University

Studies of ultracold gases of fermionic atoms have led to discoveries that have exceeded even the high expectations that followed the creation of the first degenerate atomic Fermi gas ten years ago. One experimental tool in particular, the Feshbach resonance, has enabled much of this progress by providing an experimental means to tune interactions and facilitate pairing within gases of trapped atoms. In this talk, I will present an experiment that explores the underlying mechanisms behind such resonances as well as experiments that take advantage of their effects. First, I will describe a quantitative measurement of the closed-channel molecular state contribution to the many body state of paired ^{6}Li atoms within a broad Feshbach resonance. This measurement, based upon optical molecular spectroscopy, refines the theoretical understanding of such resonances and, moreover, provides clear evidence for pairing across the BEC-BCS crossover and into BCS regime. Next, I will describe studies of polarized Fermi gases with unequal numbers of two pairing constituents. In this system, we find that the gas phase- separates into a uniformly paired superfluid core bordered by regions of normal, unpaired atoms. At the lowest temperatures, this separation is accompanied by a spatial deformation of the core that persists to large imbalance. In this case, we find that an elongated trap geometry appears to favor superfluidity. At higher temperature, the core remains unpolarized up to a critical polarization, but does not deform. Such measurements of pairing in a polarized Fermi gas may be relevant to predictions of exotic phases of quark matter and magnetized superconductors.

[1]This work was performed at Rice University under the direction of Randall Hulet.
[2]Now at the Laboratoire Charles Fabry de l'Institut d'Optique, Palaiseau, France.