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Spin-Imbalance in a One-Dimensional Fermi Gas[1]

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Ultracold atomic gases are versatile, highly-controllable systems that are well-suited for explorations of complex many-body phenomena. Physical parameters such as interaction strength, temperature, density, and dimensionality are readily tunable. I will discuss experiments on the pairing of ^{6}Li, a composite fermion, where tunable interactions enable the realization of the BEC-BCS crossover. We have performed experiments with spin-1/2 fermions with unequal spin populations in both 3D and in 1D geometries. In 3D, we find phase separation between a fully paired core and the surrounding unpaired atoms. A two-dimensional optical lattice is imposed on the atoms in order to confine them in an array of effectively one-dimensional tubes. Phase separation also occurs in 1D, but in contrast to 3D the central core is always partially polarized, while the outer wings are either fully paired or fully polarized, depending on the overall degree of spin polarization. We find good agreement between the experimentally observed densities and those calculated by Bethe ansatz. Theory predicts that the partially polarized phase is the elusive Fulde-Ferrell-Larkin-Ovchinnikov (FFLO) modulated superfluid state, where the pairs have non-zero momentum. I will discuss our progress in directly detecting the pair momentum.

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