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Polarized Fermi superfluids between one and three dimensions

MEERA PARISH, Princeton University, STEFAN BAUR, ERICH MUELLER, Cornell University, DAVID HUSE, Princeton University — We theoretically explore the phase diagram of a polarized two-component Fermi gas divided into an array of tubes by a two-dimensional optical lattice. By increasing the intensity of the optical lattice one suppresses the inter-tube hopping, and one can drive a crossover from three to one-dimensional behavior. We show that the Fulde-Ferrell-Larkin-Ovchinnikov (FFLO) inhomogeneous superfluid phase is stabilized by the lattice, and we argue that the most promising parameters for observing the FFLO phase are in the intermediate lattice limit, where the anisotropy in the atomic motion enhances Fermi surface ‘nesting’, but there is still a small amount of tunneling between the tubes to provide long-range order. Finally we discuss the spatial arrangement of phases in a trap: in 3D the homogenous superfluid phase sits in the center of the trap, while in 1D it lies on the edge. We explain how this pattern evolves as one changes the lattice intensity.

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