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Observing the 1D-3D Crossover in a Spin-Imbalanced Fermi Gas[1] MELISSA C. REVELLE, JACOB A. FRY, BEN A. OLSEN, RANDALL G. HULET, Department of Physics and Astronomy and Rice Quantum Institute, Rice University, Houston, TX 77005 — Trapped two-component Fermi gases phase separate into superfluid and normal phases when their spin populations are imbalanced. In 3D, a balanced superfluid core is surrounded by shells of partially polarized and normal phases[2], while in 1D, the balanced superfluid occupies the low density wings[3]. We explored the crossover from 3D to 1D using a two-spin component ultracold atomic gas of ^{6}Li prepared in the lowest two hyperfine sublevels, where the interactions are tuned by a Feshbach resonance. The atoms are confined to 1D tubes where the tunneling rate t between tubes is varied by changing the depth of a 2D optical lattice. We observe the transition from 1D to 3D-like phase separation by varying t and interaction strength which changes the pair binding energy ϵ_B. We find a universal scaling of the dimensional crossover with t/ϵ_B, in agreement with previous theory[4]. The crossover region is believed to be the most promising to find the exotic FFLO superfluid phase.

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[2]B. A. Olsen et al., Phys. Rev. A. 92, 063616 (2015).
[3]Y.A. Liao et al., Nature 467, 567 (2010).
[4]M. Parish et al., PRL 99, 250403 (2007).

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