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Superfluidity and BCS-BEC crossover of ultracold atomic Fermi gases in mixed dimensions[1] LEIFENG ZHANG, QIJIN CHEN, Zhejiang University — Atomic Fermi gases have been under active investigation in the past decade. Here we study the superfluid and pairing phenomena of a two-component ultracold atomic Fermi gas in the presence of mixed dimensionality, in which one component is confined on a 1D optical lattice whereas the other is free in the 3D continuum. We assume a short-range pairing interaction and determine the superfluid transition temperature T_c and the phase diagram for the entire BCS-BEC crossover, using a pairing fluctuation theory which includes self-consistently the contributions of finite momentum pairs. We find that, as the lattice depth increases and the lattice spacing decreases, the behavior of T_c becomes very similar to that of a population imbalance Fermi gas in a simple 3D continuum. There is no superfluidity even at $T = 0$ below certain threshold of pairing strength in the BCS regime. Nonmonotonic T_c behavior and intermediate temperature superfluidity emerge, and for deep enough lattice, the T_c curve will split into two parts. Implications for experiment will be discussed. References: 1. Q.J. Chen, Ioan Kosztin, B. Janko, and K. Levin, Phys. Rev. B 59, 7083 (1999). 2. Chih-Chun Chien, Qijin Chen, Yan He, and K. Levin, Phys. Rev. Lett. 97, 090402(2006).

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