Superfluid transition temperature and its zero density limit extrapolation in a unitary atomic Fermi gas on a lattice\(^1\) QIJIN CHEN, Zhejiang University — The superfluid transition temperature \(T_c\) of a unitary Fermi gas has been of great interest. One way to study \(T_c\) in a 3D continuum is to study fermions on a lattice at finite densities and then extrapolate to the zero density limit, as has been done in quantum Monte Carlo (QMC) simulation studies. For this extrapolation to work, it is essential to probe the densities in the asymptotic regime. In this talk, we study fermions on a three-dimensional isotropic lattice with an attractive on-site interaction as a function of density \(n\), from half filling down to \(5.0 \times 10^{-7}\) per unit cell, using a pairing fluctuation theory. As \(n\) decreases towards \(n = 0\), \(T_c/E_F\) increases to the leading order linearly in \(n^{1/3}\), and reaches the zero density limit \(T_c/E_F = 0.256\), consistent with that calculated directly in the continuum for a contact potential. Inclusion of the particle-hole channel reduces \(T_c/E_F\) to 0.217, in agreement with experiment. However, except for very low \(n\), \(T_c/E_F\) exhibits significant higher order nonlinear dependence on \(n^{1/3}\). The densities accessed by QMC studies are still not low enough to be in the asymptotic regime.


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