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Dynamical Mean-Field Equations for Strongly Interacting Fermi Gas in a Trap WEI YI, LUMING DUAN, University of Michigan, FOCUS TEAM

— We derive the time evolution equations at zero temperature for the wavefunctions of the molecular bosons and the fermion pairs in a trapped Fermi gas near a wide Feshbach resonance. The derivation of the equations is based on the variational principle and the BCS-like ansatz state: $|\Phi\rangle = \mathcal{N}\rceil^{\int \phi_\lfloor(\mathbf{r})\mathbf{\Psi}_\mathbf{b}^\dagger(\mathbf{r})\mathbf{d^3r}}\rceil^{\int \rho(\mathbf{r},\mathbf{r}')\mathbf{\Psi}_\uparrow^\dagger(\mathbf{r})\mathbf{\Psi}_\downarrow^\dagger(\mathbf{r}')\mathbf{d^3rd^3r'}}|/\rangle$. In deriving the equations, we have assumed that the external trapping potential and the wavefunction of the molecular bosons are spatially slow-varying on the length scale of the size of the fermionic atom pairs, which should be valid over a wide range on the BEC side of resonance, including the resonance point. In the bosonic region ($\mu \leq 0$, where μ is the chemical potential), the equations will reduce to one that resembles a Gross- Pitaevskii (GP) equation. We solve the the stationary ground state of the system at different detunings near the crossover region and self-consistently checked our assumptions. The time evolution equations provide macroscopic description for the wavefunctions of the molecular bosons and of the fermion pairs near the interesting BCS-BEC crossover region. In future studies, these equations can be used to analyze the interesting physics of vortices or the excitation spectrum in the Fermi condensate.

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