Dynamical behaviour of the time-dependent Ginzburg-Landau equation for atomic Fermi gases near the BCS-BEC crossover

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The present article studies the dynamic behaviour of the time-dependent Ginzburg-Landau equation, which describes the phenomenon of BCS-BEC crossover. First, the appropriate prior estimates are established by Gronwall's inequality and Gagliardo-Nirenberg interpolation inequality, etc. Then, we prove the existence of the global attractor in the time-dependent Ginzburg-Landau system. Finally, the evolution of the field and the influence of physical parameters on the dynamic behaviour are demonstrated by numerical experiments, thereby validating the theory in this article.

Keywords: Ginzburg-Landau theory, global attractors, Gronwall's inequality, Priori estimate, time dependent

$$i\frac{\partial \varphi_B}{\partial t} = -\frac{g}{U}u + (2\nu - 2\mu)\varphi_B = -\frac{1}{4m}\nabla^2\varphi_B \qquad (2)$$

Let Ω be a bounded domain in R^n. The fermion-pair field $u(x,t)$ and the condensed boson field $\varphi_B(x,t)$ are l-periodic, where $t \geq 0$. The chemical potential μ is a real coefficient, 2ν is a real constant that represents the threshold energy of the Feshbach resonance, and $d = d_r + id_i$ is generally complex. In the BCS limit, the real part of d vanishes, and in the BEC region, d can be considered purely real. The parameters $U > 0, a, b, c$ are real constants. The coefficient g represents a real parameter in the Feshbach resonance, and $g \neq 0$ indicates the presence of a coupling between the two condensates.

Great progress has been made based on the