Diffusive modes in a two-dimensional fermionic gas with number conserving dissipative dynamics

A.A. Lyublinskaya,[1,2,*] **I.S. Burmistrov**[2,#]
[1]*Moscow Institute of Physics and Technology, Dolgoprudny, Russia*
[2]*L.D. Landau Institute for Theoretical Physics (RAS), Chernogolovka, Russia*
*email: *lyublinskaya.aa@phystech.edu*
#email: *burmi@itp.ac.ru*

Recently, there has been increasing interest in studying the behavior of many-particle systems in nonequilibrium states. The development of experimental platforms simulating such systems (for example, ultracold atoms and exciton-polariton systems) entails the need to construct an appropriate theory.

In this paper, we consider a two-band dissipative fermionic system proposed in [1]. It is a two-dimensional fermionic gas with a quadratic spectrum corresponding to a topological insulator and subject to dissipation in the framework of the Gorini-Kosakovski-Sudarshan-Lindblad (GKSL) equation. The introduced Lindblad operators preserve the number of particles and are aimed at transferring the population from the upper zone of the Hamiltonian spectrum to the lower one. The dissipation is conceived in such a way as to stabilize the ground state of the Hamiltonian, the dark state, corresponding to the complete filling of the lower zone due to the depletion of the upper one.

In the paper [2], which has not yet been published, it is shown that in the model under study there is an interval of spatial and temporal scales with diffusive dynamics of quasiparticles. We emphasize that diffusion arises due to operators of "quantum jumps" in the absence of any disorder. The aim of our work is a more complete description of the diffusive regime.

Using the approach of the Keldysh functional integral for the GKSL equation [3], we obtained an expression for the diffuson describing the dynamics of quasiparticles near the bottom of the upper band. The derived diffusion coefficient is inversely proportional to the dissipation force and coincides with the result of [2]. The self-energy of diffusons was also calculated, which is related to the diagrams beyond the ladder approximation.

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References

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