The role of quasi-particle excitations in the processes of thermal phase slips

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In past years there were a lot of researches on topic of phase slips in superconducting nanowires. In one-dimensional geometry such processes have been understood in terms of a theory, developed by Langer and Ambegaokar (LA). However, in this paper properties of quasiparticle subsystem are not discussed, also applicability of time-dependent Ginzburg-Landau equation is limited. In our work, in order to cover these shortcomings, we model superconducting nanowire with a weak spot as a zero-dimensional SINIS junction (S – superconductor, N – normal metal, I – insulator). Making use of Keldysh NLσM, we find zero-dimensional solutions analogous to the instanton, described in LA, we then expand action near the saddle point up to quadratic terms in fluctuations. Then we obtain action on classical and quantum phase, which has the form of classical mechanics one. Then we find explicit form of solution for phases. After it we proceed with computations of potential barrier U_0 and effective temperature T for phase slip processes, which are related to the rate $\Gamma \sim \exp(-U_0/T)$.
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