On the time dependent Ginzburg-Landau system.

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In this course we would like to discuss spectral properties of some non self-adjoint operators appearing in the analysis of the long time behavior of the solutions of the time dependent Ginzburg Landau system (due to Eliashberg-Gorkov) and then to consider the question of the global stability of the stationary normal solutions in presence of an electric current flowing through a two-dimensional wire.

We show that when the current is sufficiently strong the solution converges in the long-time limit to the normal state. We provide two types of upper bounds for the critical current where such global stability is achieved: by using the principal eigenvalue of the magnetic Laplacian associated with the normal magnetic field, and through the norm of the resolvent of the linearized steady-state operator. In the latter case we estimate the resolvent norm in large domains by the norms of approximate operators defined on the plane and the half-plane. We also obtain a lower bound, in large domains, for the above critical current by obtaining the current for which the normal state looses its local stability.

The recent results presented in the course were obtained in collaboration with Y. Almog or X. Pan. Introductory books for the time independent problems could be the monographs of Sandier-Serfaty and Fournais-Helffer (both in the series Progress in non linear analysis – Birkhäuser).
References


The time-dependent Ginzburg-Landau equations are solved numerically to obtain the electric and magnetic response of the system. It is shown that the I-V curves, for the wider strips, present a universal behaviour. The dependence of the flux-flow resistivity on the magnetic field and width allow us to propose a criterion characterizing, both, the macroscopic and mesoscopic regimes. In this work we solved the time dependent Ginzburg-Landau equations numerically finding profiles of the flux-flow resistivity for different widths of superconducting stripes. We found vortex pinning induced by the surface superconductivity. This pinning avoids the movement of the vortex lattice preventing the generation of a voltage. Time-Dependent Ginzburg-Landau Simulations of the Critical Current in Superconducting Films and Junctions in Magnetic Fields. Alexander I. Blair and Damian P. Hampshire. To this end, simulations based on the time-dependent Ginzburg-Landau (TDGL) equations have been widely applied to model vortex dynamics in superconductors, due to their relative simplicity compared to full microscopic theory. Indeed, TDGL simulations have recently also been used to predict optimal pinning landscapes in superconductors containing spherical, spheroidal and columnar pinning centers [2, 3].

1. Schematic diagram of the simulated thin film system, periodic in the x direction, containing a junction region of thickness δ. Magnetic fields are applied along the z-direction. Langevin simulations of time-dependent Ginzburg-Landau models have also been performed to study other dynamical aspects of amphiphilic systems [223,224]. An attractive alternative approach is that of the Lattice-Boltzmann models, which take proper account of the hydrodynamics of the system. They have been used recently to study quenches from a disordered phase in a lamellar phase [225,226]. [Pg.667].

3. Computer simulation results using a time-dependent Ginzburg-Landau approach, showing the microstructural evolution after a temperature jump from the lamellar phase to the hexagonal cylinder phase for a moderately asymmetric diblock copolymer. The time units are arbitrary. Title:Extended time-dependent Ginzburg-Landau theory. Authors:Konstantin V. Grigorishin. Download PDF. We study dissipative processes, which are caused by movement of the normal component of electron liquid and violate the Lorentz covariance, on the examples of the damped oscillations of the order parameter and the skin-effect for electromagnetic waves. An experimental consequence of the extended time-dependent Ginzburg-Landau theory regarding the penetration of the electromagnetic field into a superconductor is proposed. Comments: 31 pages, 8 figures,. arXiv admin note: text overlap with arXiv:cond-mat/0006070, arXiv:cond-mat/0312619 by other authors. TIME-DEPENDENT GINZBURG-LANDAU EQUATION Let us start by considering the Ginzburg-Landau (GL) functional $F(\phi, \phi^*, A)$ representing the free energy density. For our task we do not need to specify the explicit form of $F(\phi, \phi^*, A)$. This will depend on the particular dynamical model one adopts for the description of the system under study. Their values depend on the temperature $T$ and their explicit expressions depend on the system under consideration and on the adopted phenomenological model (in solid state physics $|\alpha(T)|$ is related to the chemical potential $\mu_0$, expressing, e.g. in superconductivity [31], the vacuum permeability, and $\tilde{R}(T)$ to the critical (magnetic) fields acting upon the system.