

# Time dependent Ginzburg-Landau formalism for two-bandgap Fermi systems

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Two-bandgap superconductors, such as magnesium diboride, exhibit interesting vortex structures such as stripe formation. These are seen to arise from a nonmonotonic intervortex interaction potential. Attempts have been made to describe these systems using a two-component time-dependent Ginzburg-Landau (GL) equation describing two phenomenologically coupled order parameters. Whereas for a single-bandgap system, the single-component GL equation is microscopically validated (through the Gorkov formalism), this is not the case for the two-component system. After reviewing briefly the two-bandgap superconductors, we focus in this talk on a realization of the two-bandgap system through ultracold fermionic atoms, i.e. two-band superfluidity. Here, starting from the microscopic action functional of a four-component Fermi system, we use a path integral treatment to derive an effective action functional from which we can extract an extended time-dependent GL equation and corresponding free energy functional, valid over the entire temperature regime instead of a small region near the phase transition. The GL coefficients obtained are analytical and easily tractable expressions based on the microscopic theory. The two-band nature of the superfluid is exhibited through a hidden criticality of the susceptibility near the temperature corresponding to the smallest gap.

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