Spatially Resolved Dynamics of the Amplitude Schmid-Higgs Mode in Disordered Superconductors

I.S. Burmistrov
L.D. Landau Institute for Theoretical Phsyics, Chernogolovka, Russia
*email: burmi@itp.ac.ru

Key words: dirty superconductors, Higgs mode, nonlinear response

We investigate the spatially resolved dynamics of the collective amplitude Schmid-Higgs (SH) mode in disordered □-wave superconductors and fermionic superfluids. By analyzing the analytic structure of the zero-temperature SH susceptibility in the complex frequency plane, we find that, when the coherence length greatly exceeds the mean free path, (i) the SH response at fixed wave vectors exhibits late-time oscillations decaying as $1/□^2$ with frequency 2Δ, where Δ is the superconducting gap; (ii) subdiffusive oscillations with a dynamical exponent □ =4 emerge at late times and large distances; and (iii) spatial oscillations at a fixed frequency decay exponentially, with a period that diverges as the frequency approaches 2Δ from above. When the coherence length is comparable to the mean free path, additional exponentially decaying oscillations at fixed wave vectors appear with a frequency above 2Δ. Furthermore, we show that the SH mode induces an extra peak in the third-harmonic generation current at finite wave vectors. The frequency of this peak is shifted from the conventional resonance at Δ, thereby providing an unambiguous signature of order parameter amplitude dynamics. The results are published in [1].

Bibliography

[1] P. A. Nosov, E. S. Andriyakhina, I. S. Burmistrov, "Spatially-resolved dynamics of the amplitude Schmid-Higgs mode in disordered superconductors", Phys. Rev. Lett. 135, 056001 (2025)