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Long-lived Higgs mode in a strongly interacting Fermi gas

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The amplitude mode is a fundamental phenomenon that emerges from a broken continuous symmetry. In the framework of Ginzburg-Landau theory, this corresponds to an oscillation of the complex order parameter Δ, which characterizes the long-range order of superfluids and superconductors. Typically, this mode is unstable and decays rapidly into pair-breaking excitations that exist within a continuum. Therefore, its experimental detection in strongly interacting systems has historically been challenging, and theoretical efforts have proposed mechanisms to suppress coupling to these pair-breaking excitations [1].

In my poster I will show that an ultracold quasi-2D Fermi gas exhibits a long-lived amplitude mode in the strongly interacting regime. We excite the amplitude mode via trapping modulation spectroscopy, thereby influencing the interaction energy. These measurements show a narrow resonance at 2Δ, suggesting a long lifetime. We support these results by direct measurement of the coherent oscillations of the momentum distribution.

Additionally, the spectral response features an avoided crossing between the pairing gap energy 2Δ and the second excited state of the trapping potential. The experimental evidence combined with a two-band superconductor model, suggests that the admixture of this excited state provides a route to stabilize the amplitude mode, effectively pushing it out from the pair-breaking continuum.

[1] D. Pekker, C. Varma, Annu. Rev. Condens. Matter Phys.6,269–297 (2015).

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