

Higgs mode in conventional and unconventional superconductors

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The study of collective modes is a fascinating issue as it provides deep insight into the properties of quantum fluids. In superconductors, two collective modes are expected to emerge associated with the spontaneous breaking of U(1) symmetry: the phase mode and the amplitude mode. The later one is recently referred to as the Higgs mode from its close relation to the Higgs boson in particle physics, where the particle-hole symmetry effectively plays a role of Lorentz invariance in the high energy physics. Although Higgs mode has long evaded the experimental observation because it does not couple to electromagnetic field, recently we have observed the Higgs mode-oscillation in a s-wave superconductor, NbN, by using the ultrafast terahertz spectroscopy technique.^{1,2} The experiments are extended to a multiband superconductor, MgB₂, and unconventional d-wave high-T_c cuprate superconductors.³ The comprehensive studies of the Higgs mode will be reported in those conventional and unconventional superconductors.

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