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Disentangling the electronic and phononic glue in a high-Tc superconductor

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The mechanism behind the formation of Cooper pairs in high-Tc superconductors is a subject of strong debate. In particular the research narrows down to two mechanisms: phonons and excitations of electronic origin are both considered the main candidates of the pairing mechanism in these compounds. Experiments performed at equilibrium conditions have the capability to reconstruct the glue spectrum. On the contrary they are insensitive to the nature of the glue and failed to separate these two contributions as they could coexist on the same energy scale (<100 meV).
Here we tackle this problem by measuring the optical response of a Bi2Sr2Ca0.92Y0.08Cu2O8+d crystal on both time and frequency domains[1]. By fitting the experimental data to the calculated variation of reflectivity at different delay times, we are able to unambiguously disentangle the electronic and phononic contribution of the glue on the basis of their different temporal dynamics[2]. We find that, on the time scale faster than electron-phonon thermalization, the quasiparticles are already thermalized with the excitations of electronic origin participating to the glue. The strength of this interaction (lambda~1.1) fully accounts for the high critical temperature of the system. These results represent an important step ahead in the understanding of the pairing mechanism in cuprates and pave the way for the investigation of the electron-boson coupling in a variety of complex materials, ranging from transition-metal oxides to iron-based superconductors.

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