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Non-retarded pairing interaction in a high-Tc cuprate from coherent charge fluctuations spectroscopy

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Despite their obvious physical difference, from a mathematical (or purely formal) point of view, magnetism and superconductivity are closely linked phenomena. Coherent charge and pairing fluctuations can be described in terms of precession of pseudospins operators, first introduced by Anderson, and behaving as spin-1/2 operators [1].
In our experiment, a polarized ultrafast laser pulse excites the superconductor through the Impulsive Stimulated Raman Scattering (ISRS) effect [2]. The coherent oscillations of the Cooper pairs condensate are detected via delayed supercontinuum pulses and enable a new technique, Coherent Charge Fluctuation Spectroscopy (CCFS), to distinguish the electronic excitations that couple to the superconducting quasiparticles [3].
This is of pivotal importance for cuprates, as the applicability of conventional pairing theories [4], based on retarded interactions between electrons mediated by low energy glue bosons, has been doubted and a completely different framework has been proposed involving non-retarded interactions associated with high-energy electronic scales [5]. We found that the superconducting condensate oscillations resonate at the typical scale of Mott physics (2.6 eV), implying a substantial contribution of non-retarded interactions to the pairing, as in unconventional (non Migdal-Eliashberg) theories.

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