# Real-time oscillations of the superconducting condensate in a high-Tc superconductor

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Here, the observation of the coherent oscillations of the Cooper pairs condensate in a superconductor is presented [1]. Superconductvity is set out of equilibrium by populating selected charge fluctuations via the electronic impulsive stimulated Raman scattering mechanism. The consequent effects on the materials electronic structure are detected via ultrafast optical spectroscopy, revealing oscillations that resonate at particular energies. Unraveling the complex interplay between electronic and lattice degrees of freedom is one of the keys towards understanding the unconventional pairing mechanism in cuprates. In these expriments, we probe an optimally doped La2-xSrxCuO4 (x=0.15) single crystals. Our data reveal the temporal evolution of the pair-breaking excitations as well as the coherent oscillation of the out-of plane motion of lanthanum ions. In these experiments, the real-time observation of quantum states of matter both in amplitude and phase gives information on the coupling between high energy electronic transitions like stripes bands and charge transfers, and low-energy excitations. These coherent oscillations, detected by the transient optical properties for the first time, reveal strong resonance effects between the oscillating condensate and particular atomic motions and charge fluctuations. The resonance of these oscillations with the charge transfer energy scale suggest a contribution of high energy states to the pairing mechanism in high Tc cuprates.

[1] B. Mansart, et al. PNAS **110**, 4539 (2013).