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Ultra-fast pump-probe determination of electron-phonon coupling in cuprate superconductors

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Fresh femtosecond spectroscopy experiments show the electron-phonon interaction strength λ to be 0.7 and 1.4 for YBCO and LSCO respectively and not around 0.2 as previously reported [1]. The revised estimates arise primarily from improved time-resolution, and also partly from improved modeling. Comparison with classical superconductors and pnictides shows non-monotonic correlation of λ with T_c. Systematic new measurements of the condensate vaporization energy (U_v) in cuprates [2] and pnictides reveals a power-law dependence on T_c with exponent 2. However, U_c is 16-18 times greater than the BCS condensation energy U_c, implying that a significant heat capacity of the "bosonic glue." In contrast, charge-density wave systems with electronically driven ordering transitions have $U_v \simeq U_c$. The data suggest BCS and Eliashberg-based models to be inappropriate for describing the physics of high-temperature superconductors, and point towards polaron models which consider strong or intermediate λ.

[1] C.Gadermeier et al., arXiv:0902.1636
[2] P.Kusar et al., Phys. Rev. Lett. 101, 227001 (2008)