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Theory of ultrafast pump-probe phenomena in high-temperature superconductors[1]

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The physics underlying the pairing mechanism for high-temperature superconductors remains a topic of current interest. The complexity lies with the existence of competing interactions in these strongly correlated electronic materials. The ultra-fast pump-probe technique can make a stride to untangle the competing degrees of freedom (DOF). In this talk, the theoretical underpinning for this technique will be reviewed. In particular, we have developed a three-temperature model [1] to simulate the real time dependence of the electron and phonon temperatures in high-temperature superconductors. The model considers anisotropic electron-phonon coupling [2]. Based on this model, we have calculated the time-resolved spectral function, which exhibits interesting features with time delay. It has been found that the excitation of phononic DOF can provide a defining signature for the evidence of electron-vibration mode coupling [1]. In addition, the time-resolved optical conductivity and Raman spectra will also be discussed within the same model [3]

[1] Jianmin Tao and Jian-Xin Zhu, Phys. Rev. B **81**, 224506 (2010);
[2] T. P. Devereaux *et al.*, Phys. Rev. Lett. **93**, 117004 (2004); Jian-Xin Zhu *et al.*, Phys. Rev. Lett. **97**, 177001 (2006);
[3] Jianmin Tao and Jian-Xin Zhu *et al.*, unpublished (2010).

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