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CDW in cuprates: insights from inelastic photon scattering

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In the search for the mechanism of HTSC, intense research has been focused on the evolution of the spin excitation spectrum on doping from the AF insulating to the superconducting state of the cuprates. We used RIXS to show that a large family of superconductors (YBa2Cu3O6+x) exhibits damped spin excitations with dispersions and spectral weights closely similar to those of magnons in undoped cuprates [1,2]. In addition to magnetic excitations, RIXS is also sensitive to charge. The greatly enhanced sensitivity of the scattering signal to the valence electron system led us to the discovery of a fluctuating charge density wave competing with the superconducting order at low doping levels [3-5]. Using high resolution inelastic x-ray scattering, we observe a central peak analogous to those observed in conventional CDW systems and attributed to pining of CDW nano-domains on defects. The study of low energy phonons with wavevectors near the CDW ordering vector, also revealed extremely large superconductivity induced lineshape renormalizations as well as anomalous normal state broadening. This provides important insights regarding the long-standing debate of the role of the electron-phonon interaction, a major factor influencing the competition between collective instabilities in correlated-electron materials [6]. Finally I will show how unambiguous signatures of the CDW can be detected using more conventional inelastic scattering of visible light (Raman scattering) [7].

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