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Time- and Angle-Resolved Photoemission of Quantum Materials

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The phase diagram of copper-oxides hosts intertwined phases as disparate as high-temperature superconductivity, charge order and the pseudogap. In the last decade the development of time-resolved techniques has offered a novel perspective for investigating dynamical properties of quantum phases. In this regard, we recently demonstrated that time-resolved photoemission spectroscopy can disentangle the dynamics of phase fluctuations and charge excitation, establishing the dominant role of phase coherence in the emergence of high-temperature superconductivity in Bi-based cuprates [1]. We employed this same dynamical approach to reveal unambiguously the relation of the pseudogap and short-range antiferromagnetic correlations in optimally-doped NCCO electron-doped cuprate [2], providing clear evidence of the role of short-range correlations in defining the Fermi surface topology. Finally, I will propose a way to redefine the paradigms of the TR-APRES analysis accessing the mode-projected electron-phonon matrix element in graphite in an ultrafast fashion [3].

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