MIP: PARADIM at Cornell University, DMR-1539918

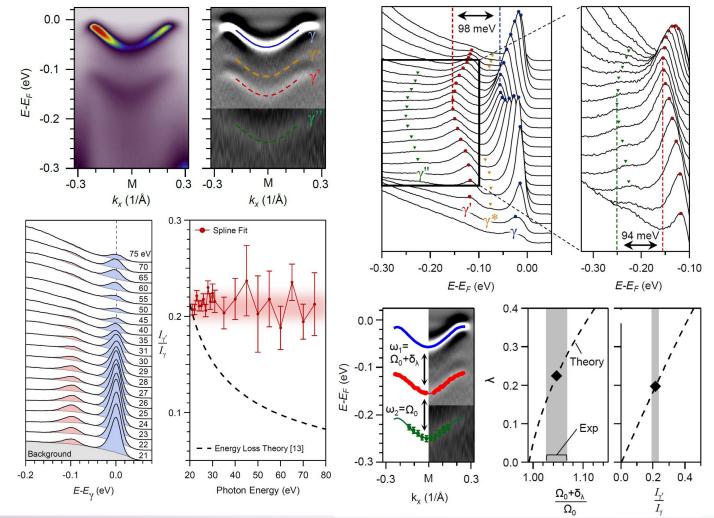
Quantification of Interfacial Electron-Phonon Coupling from Photoemission Replica Bands in a High-T_c Superconductor

The observation of replica bands by angle-resolved photoemission spectroscopy enables the study of electron-phonon coupling at low carrier densities, particularly in monolayer FeSe/SrTiO₃. Theoretical work suggests that the electrons in the ultra-thin FeSe layer couple to optical phonons in the SrTiO₃ substrate that thereby contributes to the enhanced superconducting pairing temperature. So far, the inherent fragility of such single-layer thick materials and the weak intensity of replica features has limited the quantitative evaluation of their nature.

To overcome this challenge, the **PARADIM in-house research team** developed a system to transfer the sensitive samples from ultrahigh vacuum directly into an inert environment glovebox for transport to the Advance Light Source for beamline ARPES measurements. Using this approach, PARADIM scientists were able to observe interfacial replica bands in far greater quantitative detail than had previously been possible. A detailed analysis of the energy splittings and relative peak intensities between the higher-order replicas, as well as other self-energy effects, allowed them to determine that the interfacial electron-phonon coupling in the system corresponds to a value of $\lambda = 0.19 \pm 0.02$, providing valuable insights into the enhancement of superconductivity in monolayer FeSe/SrTiO₃. Furthermore, the methodology employed in this work can also serve as a new and general approach for making more rigorous and quantitative comparisons to theoretical calculations of electronphonon interactions and coupling constants.

B.D. Faeth et al. Phys. Rev. Lett. 127, 016803 (2021).

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