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Time- and Angle-Resolved Photoemission Spectroscopy: Ultrafast Dynamics of Electronic Structure JONATHAN A. SOBOTA, PATRICK S. KIRCHMANN, SHUOLONG YANG, ZHI-XUN SHEN, Stanford University —
Angle-resolved photoemission spectroscopy (ARPES) is a powerful experimental tool for condensed matter systems as it measures the single-particle spectral function. Using femtosecond laser pulses in a pump-probe scheme, ARPES can be extended into the time domain. Here we report the construction of a time-resolved ARPES (trARPES) system. We utilize a Ti:Sapphire oscillator to produce infrared pump pulses, while ultraviolet probe pulses are generated by frequency quadrupling. A hemispherical electron analyzer measures the photoemission spectrum as a function of pump-probe delay. We present results on Gallium Arsenide, which displays hot electron dynamics on two distinct timescales in the unoccupied states. Interestingly, the signal in the occupied states has high temporal contrast, resembling a step-function with dynamics at negative delays. These properties make Gallium Arsenide a versatile tool for trARPES system characterization, allowing for calibration of pump-probe temporal and spatial overlap, as well as determination of time resolution.

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