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Oliver E. Buckley Condensed Matter Prize Talk: Energy Gaps and Their Implications on the Phase Diagram of Cuprate Superconductors

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In this talk, I will survey the progress made in understanding the cuprate superconductors using angle-resolved photoemission spectroscopy. I will focus on the discovery and understanding of the anomalous energy gaps, and their implication on the pairing symmetry as well as the phase diagram of cuprate superconductors. This includes the detection of the d-wave superconducting gap structure that contributes to the current consensus of d-wave pairing symmetry, the unexpected discovery of the anisotropic normal state gap in single particle spectra (also known as pseudogap) that has become a defining feature of the cuprate phase diagram, the new progress in demonstrating that the pseudogap state is a distinct phase that breaks the particle-hole (thus translational) symmetry, and the momentum dependent information on the competition between pseudogap and superconducting gap.