中央大學物理學系

Department of Physics, National Central University

Colloquium

Simultaneous Capturing of the Effective Mass and Fermi Velocity of Carriers in Quantum Matters by *q*-EELS

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Abstract :

Quantum matters boast relativistic fermions by the iconic conical spectrum of $\hbar$v_F q near the Fermi level ($\hbar$, reduced Planck's constant; v_F, Fermi velocity; q, momentum). A plethora of exotic phenomena that have no classical counterparts emerge in the matters and their profound understanding is tied to the capturing of the fundamental parameters of the effective mass (m*) and v_F of these fermions. Customarily, m* is to be resolved using low-temperature, high-field quantum magneto-oscillations and v_F is to be derived by Landau or angle-resolved photoemission spectroscopy. The methodology for a simultaneous gauge of the two parameters has not been reported, while highly demanded. Here, we demonstrate that q-dependent electron energy loss spectroscopy (q-EELS) is a robust probe for m* and simultaneously v_F using the plasmon dispersion of designated fermions near the Fermi level. The plasmon dispersion of free carriers quadratically scales with v_F and the plasmon excitation energy is a function of m*. The thorough investigation of plasmon dispersions can readily devise characteristic m* and v_F. The grand detail of our q-EELS methodology and its applications in quantum materials are to be discussed in this talk.