Contribution ID: **189** Type: **Talk**

Three-dimensional Fermi surfaces from Diamond Light Source

Monday, 17 September 2018 15:15 (15 minutes)

In a metal the Fermi Surface is the separation –in momentum space –between occupied and unoccupied states. Here, thermal excitation are possible and rearrangements of the electronic structures such as the superconducting instability, magnetic moment formation and charge density wave-like phase transitions can be driven by the electronic states on the Fermi surface.

Angle-resolved photoelectron spectroscopy (ARPES) can map the Fermi surface of a crystalline solid thanks to conservation of momentum in the photoemission process. The method is highly surface sensitive thus inevitably the momentum component perpendicular to the surface (k_perp) is less well resolved than the fully conserved parallel momentum (k_par).

In this presentation we will demonstrate the importance of tuning the total momentum (k) and thus k_perp to precisely determine relevant questions of solid state spectroscopy, such as the precise arrangement of bands in the multi-sheet Fermi surface of FeSe, quasi-one-dimensional Tl2Mo6Se6, and the distinction between bulk-pockets and surface states in epitaxial films of Gd-doped EuO. As an outlook we will discuss the prospect of performing precise spectral function measurements, a strength of ARPES, across a wide range of photon energies.

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Session Classification: Parallel session 5

Track Classification: P5 Thin films, 2D materials and surfaces