Dark states of electrons in a double two-level quantum system

(4, Oral)

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Two-dimensional quantum materials with a pair of sublattices, such as graphene and black phosphorus, have been used not only to explore novel topological phases [1-3], but also to study quantum phenomena arising from correlations and disorder [4]. In the case of a double two-level quantum system consisting of two pairs of sublattices, destructive interference between sublattices may lead to a quantum state of matter that is forbidden to interact with photons and is therefore undetectable by spectroscopic means, such as angle-resolved photoemission spectroscopy (ARPES). In this talk, I will introduce such ARPES dark states in palladium diselenide as a model system that has two pairs of sublattices in the primitive cell [5]. Then, I will discuss, as this mechanism of dark states is generic to other systems with two pairs of sublattices, how the phenomena observed by ARPES in cuprates, such as Fermi arcs, can be resolved by the mechanism of dark states [5]. The message from this talk is that the sublattice degree of freedom, which has been overlooked so far, should be carefully considered in the study of correlated phenomena.

[1] J. Kim *et al., Science* **349,** 723 (2015).

[2] J. Kim *et al., Phys. Rev. Lett.* **119,** 226801 (2017).

[3] S. W. Jung *et al., Nature Mater.* **19,** 277 (2020).

[4] S. H. Ryu *et al., Nature* **596,** 68 (2021).

[5] Y. Chung *et al.,* accepted in *Nature Phys.* (2024).