Visualizing Electronic Structures of Topological Quantum Materials

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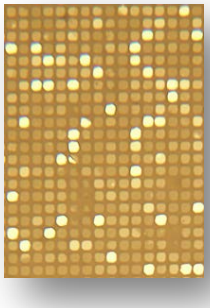
The discovery of materials with novel properties is one of the most fascinating aspects of physics, and such findings have always played important roles in the development of science and human life. Two recent examples are graphene and topological insulators. Interestingly, both materials possess 2D Dirac fermions; and topological insulators further show distinct topology in their electronic band structures. With the swift development in both fields, two questions have been naturally raised:

I. Does there exist a 3D counterpart of graphene, or a "3D graphene"?
II. Besides topological insulators, can one find other materials that have unusual topology in their electronic structures?

Remarkably, the answer to both questions can lie on a same type of novel quantum matter – the topological Dirac semi-metal - which not only processes 3D Dirac fermions in the bulk (in contrast to the 2D Dirac fermions in graphene and topological insulators), but also shows unusual topology in its electronic structures.

In this talk, I will show that by using advanced photoemission spectroscopy with high energy, momentum, and time resolution, we were able to directly visualize the non-trivial electronic structures and unusual dynamics in topological insulators and topological Dirac semi-metals recently discovered.



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