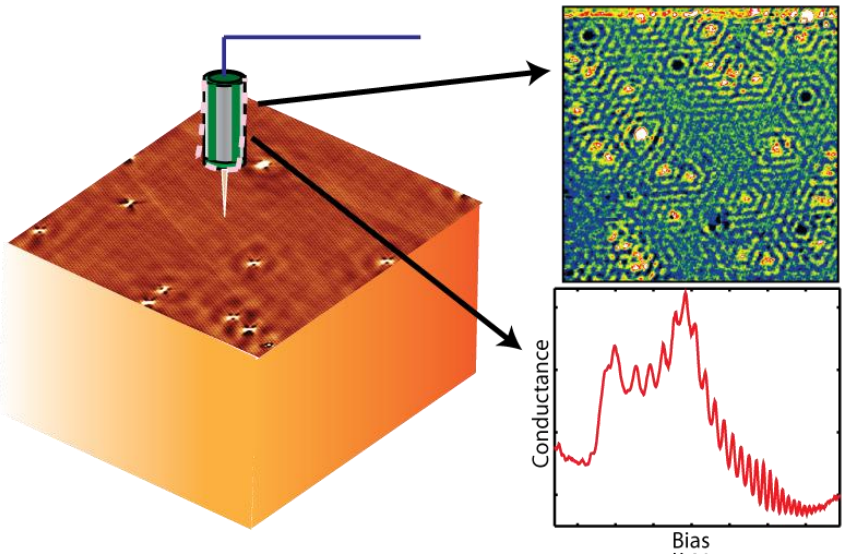
Visualizing Dirac Fermions in Topological Materials

Anjan Soumyanarayanan
Harvard University & MIT

The last four years have witnessed the emergence of a new class of electronic materials whose properties are determined by the mathematical notion of topology. These `topological materials' host surface states that mimic relativistic Dirac particles. The surface states are expected to be insensitive to material disorder, and have a range of futuristic applications – from spin-based devices to quantum computers. To develop better topological materials, it is crucial to understand their behavior on the nanoscale.

We use a scanning tunneling microscope (STM) to visualize the electronic properties of these surface state Dirac fermions on the atomic scale. Using two distinct momentum-resolved STM techniques, we study how these surface states interact with the bulk material below them and the variety of disorder around them. By better understanding their interaction with these perturbations, we look to guide the growth of new topological materials.