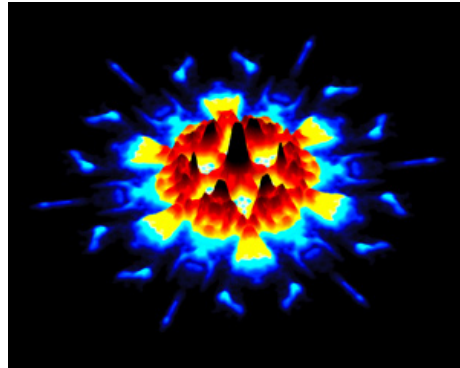
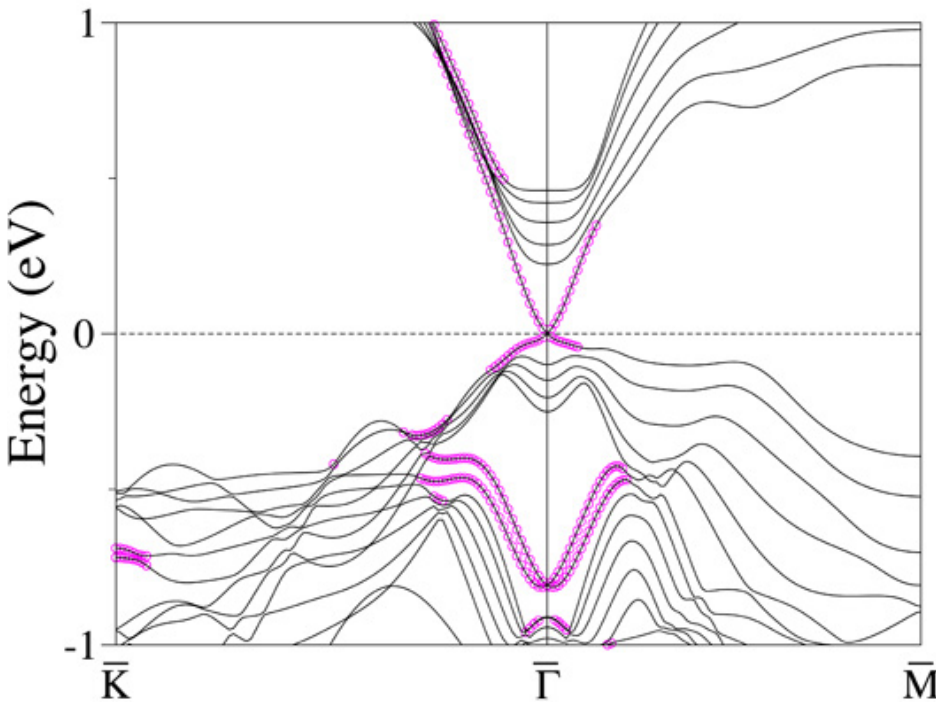


# A Scatter-Free Surface

Researchers perform simulations of “topological insulators” as another route to low-power computing



A visualization of the gapless surface states in the three-dimensional topological insulator Bi<sub>1-x</sub>Sb<sub>x</sub>. [Courtesy of Yazdani Lab, Princeton University.]



The behavior of surface electron states in momentum space for a topological insulator Bi<sub>2</sub>Se<sub>3</sub> film of thickness 6 nm. The linear dispersion at zero energy and at the Gamma point is clearly seen. This dispersion is much like that in graphene with an

Graphene’s “heavy” cousins are also moving into the spotlight. Known as three-dimensional topological insulators, these new forms of atomically heavy materials are comprised of combinations of bismuth, selenium and tellurium, and can be peeled off, like graphene, using scotch-tape.

Unlike graphene, however, these materials appear to have an intriguing ability to allow electrons to move along their surface without scattering. Scattering is the bane of transistor designers. When electrons don’t go where they’re supposed to go, information can’t be processed properly or efficiently.

The scattering-free properties arise from the symmetry of the electronic states guaranteed by a particular type of quantum mechanical interactions and the crystal structure of the topological insulators. The electronic states behave more or less like those in graphene. This makes the insulators a promising candidate for the Semiconductor Research Corporation's device search. However, other aspects, like presence of magnetic impurities might make it less suitable, as these variables can disturb the very symmetries of the electronic states that protect it from scattering in the first place.

Dr. Sahu and his team have performed interesting simulations of these material systems as another route to low-power computing.

"If you're doing simulations on new materials with new physics, you need to do them on the atomistic level where you literally build the material up atom by atom with all of the base physics that go along with that to see what happens," Dr. Welser said, "and that can only be done at an HPC center like TACC."

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