

ALS SPECTRUM

Advanced Light Source :: Facility Report :: 2009-2010

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U.S. DEPARTMENT OF
ENERGY

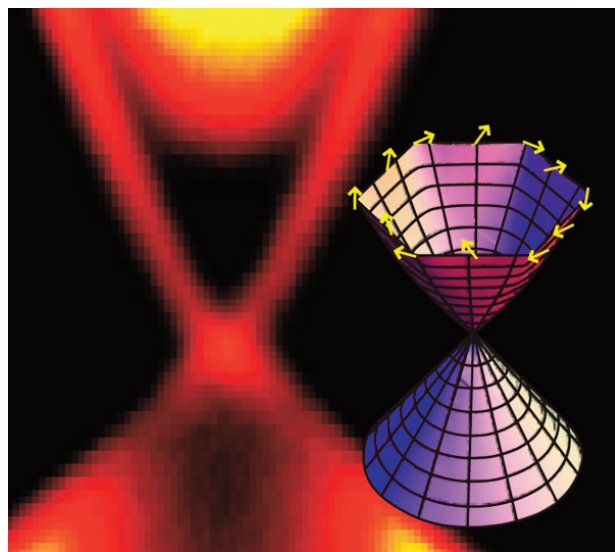
Office of Science



ALS COMMUNICATIONS

ALS Reveals New State of Matter

ALS user groups from Princeton and Stanford have been making waves this past year with several high-profile papers and extensive news coverage of their work on a new state of matter embodied by so-called "topological insulators," materials that conduct electricity only on their surfaces. First identified at the ALS in 2007 by a Princeton team led by M. Zahid Hasan, topological insulators have been the subject of intense interest, based on unusual quantum properties that manifest themselves macroscopically. The discovery of a "second generation" of topological insulators that robustly retain these properties well above room temperature has spurred a rising tide of theoretical proposals for potential applications in nanoscale spintronic devices and fault-tolerant quantum computers. In addition, it's also been suggested that



Band structure of the topological insulator, bismuth selenide (Bi_2Se_3). The red areas represent surface states. The vertical space between the yellow areas is the bulk band gap (about 0.3 eV). Because the surface states cross the band gap, this "insulator" conducts electricity on its surface. Inset: Three-dimensional schematic of the cone-shaped surface band structure. The spin states (yellow arrows) indicate that electrons on the surface won't backscatter from disorder and impurities. (Image courtesy of David Hsieh, Yuqi Xia, and Andrew Wray, Princeton University).

topological insulators may serve as a test bed for studies of never-before-seen

particles predicted by high-energy physics.

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User Support Building Opens for Business

The ALS User Support Building (USB), a facility whose need was identified in the first days of ALS operations, is now complete and open for use. The \$35 million project faced many funding challenges over the

years, but with the American Recovery and Reinvestment Act providing the final \$14.5 million needed a year ahead of schedule, the project was able to proceed ahead of plan.

The 30,000 square foot

building provides users and staff over 4000 square feet of badly needed experimental staging area with all the requisite utilities, a high bay, and a two-ton-capacity bridge crane. The staging

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