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**Visualizing Topological Surface States using Scanning Tunneling Microscopy and Spectroscopy**

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Topological insulators are a new class of insulators in which a bulk gap for electronic excitations is generated by strong spin-orbit coupling. These novel materials are distinguished from ordinary insulators by the presence of gapless metallic boundary states, akin to the chiral edge modes in quantum Hall systems, but with unconventional spin textures. Angle resolved photoemission experiments and theoretical efforts have provided strong evidence for bulk topological insulators and their spin-chiral surface states in several Bi-based compounds. We have performed scanning tunneling microscopy and spectroscopic studies of topological surface states on a range of different compounds. I will describe how these experiments illustrate the importance of the spin-texture of these novel states on their scattering and quantum confinement. Experiments demonstrate that these states are protected from backscattering between opposite spin states due to their chiral spin textures. [1]. More recently, our studies were extended to determine the interplay between the influence of spin symmetry on scattering and the possibility of energy level quantization due to geometric confinement for topological surface states. [2] Work was done in collaboration with P. Roushan, J. Seo, H. Beidenkopf, Y.-S. Hor, C. Parker, D. Hsieh, D. Qian, and A. Richardella, M. Z. Hasan, R. Cava. Supported by ARO, ONR, and MRSEC through PCCM.

[1] P. Roushan et al. Nature 460, 1106 (2009).
[2] J. Seo et al. submitted (2009).