MAR15-2014-020060

Abstract for an Invited Paper
for the MAR15 Meeting of
the American Physical Society

Topological superconductivity and Majorana fermions in chains of magnetic atoms on the surface of a superconductor[1]

ALI YAZDANI, Princeton University

Chain of magnetic atoms on the surface of a BCS superconductor is a versatile platform for the realization of one-dimensional superconductors with Majorana bound states that lends itself to high-resolution scanning tunneling microscopy studies [1,2]. In this talk, I will describe experimental efforts to realize this platform using self-assembled chains of Fe atoms on the surface of Pb (110) and to directly visualize Majorana quasi-particle bound states at their edges [2]. Using spin-polarized STM studies, we show that Fe chains are ferromagnetic while tunneling into Pb's substrate demonstrates signatures of strong spin-orbit interaction at its surface. Comparison of experimental measurements of structure and normal state electronic structure with DFT calculations suggest that these are triple zigzag chains with an odd number of band-crossings at the Fermi level. The onset of superconductivity in the Pb strongly modifies the low energy density of states of the Fe chains and induces a zero energy state at their ends. I will describe how these observations are consistent with the formation of a topological superconducting phase with Majorana edge states.

[1] S. Nadj-Perge, I.K. Drozdov, B. A. Bernevig, and A. Yazdani, Physical Review B 88, 020407 (2013).
[2] S. Nadj-Perge, I. K. Drozdov, J. Li, H. Chen, S. Jeon, J. Seo, A. H. MacDonald, B. A. Bernevig, A. Yazdani, Science 346, 6209 (2014).

[1]Work supported by ONR, NSF-DMR, NSF-MRSEC, ARO-MURI, and LPS-ARO grants.