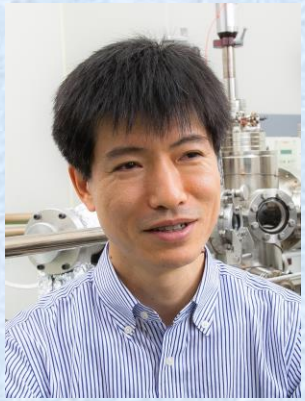
Physics Colloquium

Monday, October 7, 2019 / Pupin Hall Theory Center, 8th Floor / 12:30 PM

Lunch will be available for attendees

"Search for Majorana zero mode in Fe(Se,Te) using an ultra-low temperature STM"

Tetsuo Hanaguri, RIKEN Center for Emergent Matter Science



Vortex core of topological superconductors is one of the promising platforms that can host the Majorana zero mode. Recently, topological superconductivity has been suggested at the surface of Fe(Se,Te) [1] and STM have been utilized to search for the zero-energy vortex bound state (ZVBS) associated with the Majorana zero mode [2,3]. However, it has been difficult to clearly distinguish the ZVBS from the lowest trivial vortex bound state that may appear at ~100 μeV. We have developed an ultra-low temperature (~ 85 mK) STM that enables us to perform local spectroscopy with high energy resolution of ~20 μeV [4]. We systematically investigated many vortices in Fe(Se,Te) and revealed that there are two kinds of vortices with and without the ZVBS. We found that chemical and electronic quenched disorders are apparently unrelated to the ZVBS formation, whereas increasing magnetic field suppresses the fraction of vortices with the ZVBS [5]. These results are well reproduced by a simulation that takes Majorana-Majorana interaction and disorder in the vortex-lattice structure into account [6].

This work has been done in collaboration with T. Machida, Y. Sun, S. Pyon, S. Takeda, Y. Kohsaka, T. Sasagawa, T. Tamegai, and C. -K. Chiu.

[1] P. Zhang et al., Science **360**, 182 (2018).
[2] D. Wang et al., Science **362**, 333 (2018).
[3] M. Chen et al., Nature Commun. **9**, 970 (2018).
[4] T. Machida et al., Rev. Sci. Instrum. **89**, 093707 (2018).
[5] T, Machida et al., Nature Materials **18**, 811 (2019).
[6] C. -K. Chiu et al., arXiv:1904.13374v2.

CUPhysics