

BCS-BEC Crossover in a 2D Superconductor

March 10, 2021 (Wednesday)
5:00 p.m.

Zoom online lecture

<https://hku.zoom.us/j/91059281191?pwd=WUVuZ2ZtaTRDS0Fla2VlcldYZ2NjZz09>

Meeting ID: 910 5928 1191

Password: 2859



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Abstract:

The Bardeen-Cooper-Schrieffer (BCS) condensation and the Bose-Einstein condensation (BEC) are the two extreme limits of the ground state of the paired fermion systems, which are theoretically predicted to continuously connected through an intermediate regime [1]. We report the two-dimensional (2D) BCS-BEC realized in a gate-controlled superconductor, electron doped layered material ZrNCl. To observe this phenomenon, we utilized an ionic gating method, which is well known as a powerful tool to control the carrier density in a large scale and induced 2D superconductivity [2].

We have succeeded in controlling the carrier density by nearly two-orders of magnitude, and established an electronic phase diagram through the simultaneous experiments of resistivity and tunneling spectra on the ionic gating devices. We found T_c exhibits dome-like behavior, and more importantly, a wide pseudogap phase was discovered in the low doping regime. In the low carrier density limit, T_c scales as $T_c/T_F = 0.12$, where T_F is the Fermi temperature [3], which shows fair agreement with the theoretical prediction in the 2D limit of BEC [4].

References:

- [1] M. Randeria and E. Taylor, *Annu. Rev. Condens. Matter Phys.* **5**, 209 (2014).
- [2] Y. Saito, T. Nojima and Y. Iwasa, *Nat. Rev. Mater.* **2**, 16094 (2017).
- [3] Y. Nakagawa et al., *arXiv:2012.05707*
- [4] S. S. Botelho and C. A. R. Sá de Melo, *Phys. Rev. Lett.* **96**, 040404 (2006).

Biography:

Professor Yoshihiro Iwasa is the director of Quantum Phase Electronics Center, Department of Applied Physics, University of Tokyo and the team leader of the Emergent Device Research Team, Center for Emergent Matter Science (CEMS), RIKEN, Japan. Prof. Iwasa got his Bachelor, Master and PhD at the same department, University of Tokyo. He is an experimental condensed matter physicist working on various topics on 2D materials, superconductivity, iontronics, nonreciprocal transport and optoelectronics. His group has been pioneering in the applications of ionic liquid modulation to address fundamental questions in condensed matter physics. His achievements lead to numerous awards including the prestigious Nishina Memorial Prize, Honda Frontier Prize and Japan IBM Science Prize.

Anyone interested is welcome to attend!

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