Department of Physics
THE UNIVERSITY OF HONG KONG

HK Institute of Quantum Science & Technology 香港量子研究院

Physics Colloquium

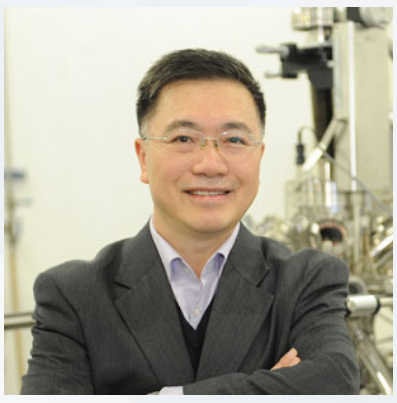
Unconventional superconductivity beyond the BCS paradigm

Date: September 27, 2023 (Wednesday)

Time: 4:00 p.m.

Venue: MB237, Main Building, HKU

Prof. Hai-Hu WEN
Nanjing University



Abstract:
High temperature superconductors and related pairing mechanism are the very basis for large scale applications of superconductors. There are two family members of unconventional high temperature superconductors: cuprates and iron based superconductors (IBS). Their parent phase seems different, but anti-ferromagnetism is a common feature. In IBS, there are multibands, thus an $S^{\pm}$ pairing manner was proposed basing on the picture by exchanging anti-ferromagnetic spin fluctuations. However, due to the distinct Fermi surface contours in different systems, it remains to know whether there is a universal pairing mechanism in all IBS. We first show the solid evidence of $S^{\pm}$ pairing by using the non-magnetic quantum impurities, then we show bosonic modes on the tunneling spectra in two types of IBS, which can also be traced back to the spin fluctuation induced pairing. In some IBS with only electron pockets, we used the phase referenced quasiparticle interference technique to reveal that the repulsive interaction, namely exchanging spin fluctuations, is still the driven pairing mechanism. We also used this technique to confirm that the *d*-wave pairing gap in a typical cuprate superconductor Bi-2212, indicating a strong magnetic coupling induced pairing. In IBS superconductors, the Fermi energies are generally quite small, which shows the strong deviation from the weak coupling BCS theory and possible crossover to the BEC scenario. We show the consequence of the small Fermi energy in IBS. Recently, superconductivity was discovered in thin films of the infinite-layer nickelate $Nd_{1-x}Sr_xNiO_2$. Here we report single particle tunneling measurements on the superconducting nickelate thin films. We find predominantly two types of tunneling spectra, one shows a *d*-wave gap function, another one exhibits a full gap. We also reveal the strong local pairing in very underdoped cuprates. Finally we give a perspective about unconventional superconductivity and possible route to explore more high temperature superconductors.

Biography:
Hai-Hu Wen is a senior professor of physics in Nanjing University, Director of Center for Superconducting Physics and Materials of Nanjing university, Yangtze River Scholarship Professor, Winner of the Outstanding Youth Foundation of China, American Physical Society Fellow. His research interests cover exploration of new superconducting materials, unconventional pairing mechanism of cuprates and iron based superconductors, mixed state properties, correlation effect and non-Fermi liquid behavior, etc. He has made several important contributions in the field of superconductivity, published more than 460 scientific papers in internationally recognized journals, received over 12000 citations with h-index 61, and delivered more than 100 speeches or invited talks at international conferences.

Anyone interested is welcome to attend!

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