



复旦大学物理系 Colloquium

Time: 14:00, Tuesday, 2021.12.21

Location: Room C108, Jiangwan Physics Building

Tencent Meeting No.: 651 8715 5730 Password: 200438

Resonance from antiferromagnetic spin fluctuations for superconductivity in UTe₂

Prof. Pengcheng Dai

Department of Physics and Astronomy, Rice University

Abstract: Superconductivity originates from the formation of bound (Cooper) pairs of electrons that can move through the lattice without resistance below the superconducting transition temperature T_c . While electron Cooper pairs in most superconductors form anti-parallel spin-singlets with total spin $S=0$, they can also form parallel spin-triplet Cooper pairs with $S=1$ and an odd parity wavefunction. Spin-triplet pairing is important because it can host topological states and Majorana fermions relevant for quantum computation. Since spin-triplet pairing is usually mediated by ferromagnetic (FM) spin fluctuations, uranium based materials near a FM instability are considered ideal candidates for realizing spin-triplet superconductivity. Indeed, UTe₂, which has a $T_c \sim 1.6$ K, has been identified as a candidate for chiral spin-triplet topological superconductor near a FM instability, although it also has antiferromagnetic (AF) spin fluctuations. Here we use inelastic neutron scattering (INS) to show that superconductivity in UTe₂ is coupled with a sharp magnetic excitation, termed resonance, at the Brillouin zone (BZ) boundary near AF order. Since the resonance has only been found in spin-singlet unconventional superconductors near an AF instability, its discovery in UTe₂ suggests that AF spin fluctuations may also induce spin-triplet pairing or that electron pairing in UTe₂ has a spin-singlet component [1].

[1] Chunruo Duan et al., **Nature DOI : 10.1038/s41586-021-04151-5 (2021)** (To appear Dec. 23rd).



Biography: Pengcheng Dai obtained his B.S. in 1984 from Zhengzhou University and his Ph. D in 1993 from University of Missouri. He did 3 years postdoc at Oak Ridge National Laboratory up graduation, and became a staff member at Oak Ridge National Laboratory from 1996 till 2001. In 2001, he moved to The University of Tennessee as an associated professor, obtained Tenure in 2003, became full professor in 2006. In 2008, he was promoted to Tennessee Advanced Materials Laboratory chair professor. In 2013, he moved from The University of Tennessee to Rice University, and is currently Sam and Helen Worden Professor of Physics at Rice. His group has focused on using neutron scattering as a probe to study correlated electron materials over the past two decades. Over the past ten years, he worked on mostly iron based superconductors and correlated electron materials, after discovering magnetic order in these materials. He is a APS, AAAS, and NSSA fellow, and won sustained prize of neutron scattering society of America in 2016. He is currently a divisional associate editor of PRL. He published about 290 papers with a google citation of > 21240.