北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Seminar

Harnessing Individual and Collective Quantum Spins on Surfaces

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Time: 4:00pm, Jan. 7, 2022 (Friday)

时间：2022年1月7日 （周五）下午4:00

腾讯会议链接：https://meeting.tencent.com/dm/ay9aPkU9nv2N

腾讯会议ID：938-988-375

Abstract

Recent years have witnessed growing interests in quantum spin systems at two frontiers. Many-body spin systems are heavily investigated for new phases of matter and exotic excitations therein, while individual quantum spins are harnessed as quantum information carriers and quantum sensors. This talk focuses on a special class of quantum spins at material surfaces that are probed and controlled by a scanning tunneling microscope (STM). In the first part of this talk, I will discuss collective quantum spin liquid (QSL) behavior in single-layer 1T-$TaSe_2$, a newly discovered 2D Mott insulator [1] predicted to host a Fermi sea of itinerant spinons [2]. Evidence for such spinon behavior in single-layer 1T-$TaSe_2$ was found from unexpected spatial modulations that are quantitatively consistent with a spinon Fermi surface instability [3] as well as an unusual spinon-induced Kondo effect in magnetic adatoms [4]. In the second part of my talk, I will introduce techniques to coherently control individual spins using an STM, as well as recent efforts towards multi-spin quantum control beyond the spin in the tunnel junction [5]. Finally, I will discuss future directions of combining quantum control with quantum materials in the form of atomic-scale quantum sensing and quantum simulation.

[1] Yi Chen et al., *Nature Physics* **16**, 218 (2020).
[2] Wen-Yu He et al., *PRL* **121**, 046401 (2018).
[3] Wei Ruan*, Yi Chen* et al. *Nature Physics* **17**, 1154 (2021)
[4] Yi Chen et al., Submitted
[5] Soo-hyun Phark*, Yi Chen* et al., arXiv: 2108.09880

About the speaker

Yi Chen received his B.S. from Peking University and Ph.D. in physics from University of California at Berkeley under the supervision of Michael Crommie. He is currently a postdoctoral fellow working with Andreas Heinrich at Center of Quantum Nanoscience. Yi's research interests lie in the quantum world, ranging from many-body-entangled quantum materials to few-body-entangled individual quantum systems, as well as their intersections.