武汉物数所理论交叉学术交流系列报告（第一九一期）

Studying strongly correlated quantum physics based on ultracold strontium atoms

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磁共振楼10楼1016-17报告厅

About the speaker:

Dr. Xibo Zhang is an assistant professor at the International Center for Quantum Materials (ICQM), Peking University. He was selected as the China 1000-Talents Plan Young Researcher, awarded the Qiu-Shi Outstanding Young Scholar prize. He received his B.S. from Peking University in 2005 and Ph.D from the University of Chicago in 2012. He conducted post-doctoral experimental research at JILA, University of Colorado at Boulder during 2012~2015. Since 2016, he builds ultracold atom experiments at ICQM to study strongly correlated quantum manybody physics and realize novel interacting topological quantum matter.

Selected Publications:

S3. *Precision measurement and frequency metrology with ultracold atoms.* X. Zhang and J. Ye, Invited review article, National Science Review 3, 189-200 (2016).

S2. *Spectroscopic observation of SU(N)-symmetric interactions in Sr orbital magnetism.* X. Zhang, M. Bishof, S. L. Bromley, C. V. Kraus, M. S. Safronova, P. Zoller, A. M. Rey, and J. Ye, Science 345, 1467-1473 (2014). Science Express, 21 August 2014.

S1. *Observation of quantum criticality with ultracold atoms in optical lattices.* X. Zhang, C.-L. Hung, S.-K. Tung, and C. Chin, Science 335, 1070-1072 (2012). Science Express, 16 February 2012.

Abstract:

Since the creation of Bose-Einstein condensates, ultracold atoms have been driving the quantum simulation of manybody physics. However, the power of cold-atom experiments will be enhanced even further by precision measurements, allowing interaction physics and manybody physics normally probed at nK temperatures to be studied at μK temperatures. This is precisely what was recently achieved using cold strontium atoms. On the basis of ultrastable lasers with 1×10^{-16} instability, the JILA strontium (Sr) optical clock realized a powerful laboratory to study a spin system with manybody dynamics. Here, s- and p-wave inter-atomic interactions are characterized to high precision, enabling a spectroscopic observation of SU($N\leqslant10$) symmetry in ^{87}Sr and beyond-mean-field correlations at μK temperatures. This study reveals a new route for pushing the frontier of emergent many-body physics.

Going beyond experimental limitations requires combining extraordinary measurement precision with state-of-the-art techniques to cool, probe, and engineer quantum gases. High-spatial-resolution imaging is one such technique. It reveals equations of state and dynamics of a quantum gas, and allows engineering arbitrary trapping potentials for studying transport phenomena. I will discuss how degenerate Sr gases provide unique opportunities to explore strongly correlated quantum physics such as the fractional quantum Hall effect.

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