北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Weekly Seminar

Mott transitions: transition orders, unstable heavy Fermi liquid, and quantum criticality

Seung-Sup Lee

Seoul National University

Time: 3:00 pm, Dec.24, 2025 (Wednesday)

时间：2025年12月24日（周三）下午3:00

Venue: Room W563, Physics building, Peking University

地点：北京大学物理楼，西563会议室

Abstract

Dynamical mean-field theory (DMFT) has revealed that the quasiparticle weight of a metal gets suppressed upon increasing interaction strength and vanishes at a Mott metal-to-insulator transition. Despite the success since the early 2000s, fundamental questions remain open about the DMFT scenario of Mott transitions. In this work, we answer these questions using the numerical renormalization group (NRG)—a tensor network method specialized in quantum impurity problems—as the DMFT impurity solver with direct access to real-frequency spectral functions and zero temperature. First, we find that the local ground-state degeneracy of a lattice site determines whether the quasiparticle weight undergoes either a first- or second-order metal-to-insulator transition at zero temperature. Second, we demonstrate that the unstable solution, located in the coexistence region of two stable solutions (metal and insulator), is a heavy Fermi liquid with peculiar interaction and temperature dependencies. The unstable solution is a potential origin of the quantum critical scaling of the resistivity, which was first proposed using DMFT and then confirmed in the experiment on quasi-2D organic salts.

About the speaker

Seung-Sup Lee is an Assistant Professor in the Department of Physics & Astronomy at Seoul National University, a position he has held since 2022. He received his B.S. and Ph.D. in Physics from the Korea Advanced Institute of Science and Technology (KAIST) in 2006 and 2013, respectively. Prior to his current appointment, he was a postdoctoral researcher and an Alexander von Humboldt Fellow at Ludwig Maximilian University of Munich (LMU) in Germany. His research focuses on computational quantum many-body theory, utilizing tensor network methods (such as NRG and DMRG) and dynamical mean-field theory (DMFT) to investigate strongly correlated electrons, quantum devices, and ultracold atoms.