



東京理科大学

TOKYO UNIVERSITY OF SCIENCE

第35回

物理工学科セミナー

日時： 10月22日（木） 15:00 - 16:00

場所： 葛飾キャンパス研究棟8F第1セミナー室

Speaker : Prof. Yao Wang

Affiliation : Department of Chemistry, Emory University (USA)

Title : Witnessing Quantum Entanglement in Solid-State Materials

Abstract :

The rapidly developing field of quantum materials calls for increasingly precise methods to characterize and control entanglement. While foundational progress was first achieved in quantum optics and few-body quantum simulators, extending these ideas to complex many-body states in correlated materials remains a major challenge. In this talk, I will introduce the entanglement-witness framework as a practical route for characterizing entanglement through experimentally accessible solid-state measurements. I will begin with the Bell test and discuss how its underlying logic can be generalized to entanglement witnesses in material systems. Recent examples include the detection of spin entanglement in quantum magnets using neutron scattering and spin-orbital entanglement using resonant inelastic x-ray scattering. These approaches can also be extended to nonequilibrium settings, opening opportunities to manipulate entanglement with light. In the second half of the talk, I will move beyond distinguishable local degrees of freedom and consider entanglement among indistinguishable fermions. This motivates a generalized framework for multipartite electronic entanglement based on the cumulant reduced density matrix and nonlinear spectroscopic responses. With this strategy, we can further connect transport-noise measurements in cryogenic materials to an electronic entanglement metric, enabling the certification of entanglement in the fractional Chern insulating state of twisted MoTe₂.

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