



复旦大学物理系 Colloquium

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Location: Room C108, Jiangwan Physics Building

Direct Imaging of Orbitals in Quantum Materials using Inelastic Scattering

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Abstract: The search for new quantum materials with novel properties is often focused on materials containing transition-metal, rare-earth and/or actinide elements. The presence of the atomic-like d or f orbitals provides a fruitful playground to generate novel phenomena. The intricate interplay of band formation with the local electron correlation and atomic multiplet effects leads to phases that are nearly iso-energetic, making materials' properties highly tunable by doping, temperature, pressure or magnetic field. Understanding the behavior of the d and f electrons is essential for designing and controlling novel quantum materials. Therefore, identifying the d or f orbitals that actively participate in the formation of the ground state is crucial. Here we developed a new experimental method that circumvents the need for involved analysis and instead provides the information as measured. With this technique, we can make a direct image of the active orbital and determine what the atomic-like object looks like in a real solid. To demonstrate the strength of the technique, we imaged the ground-state $x^2-y^2/3x^2-r^2$ hole orbital of the Ni^{2+} ion in NiO single crystal and unveiled the active orbitals in complex oxides as well as in highly metallic systems.



Biography: Born on April 14, 1959 in Medan, Indonesia. Study of Physics at the University of Technology Twente in Enschede, The Netherlands (1977-1985). PhD work with Prof. Dr. G.A. Sawatzky, Solid State Physics Laboratory, University of Groningen, Groningen, The Netherlands (1986-1990). Post Doc at AT&T Bell Laboratories, Murray Hill, USA (1990-1992) and at the University of Michigan, Ann Arbor, USA (1992-1993). Royal Netherlands Academy of Sciences Researcher (1993-1998) and University Docent at the Solid State Physics Laboratory, University of Groningen, Groningen, The Netherlands. C4 Professor, Lehrstuhl für Angewandte Physik at the University of Cologne, Germany (2001-2009). Director and Scientific member at the Max Planck Institute for Chemical Physics of Solids (since 2009). Honorary Professor at the Technical University of Dresden, Germany (since 2010). Honorary Professor at the National Chiao Tung University, Hsinchu, Taiwan (since 2012). Adjunct Professor at the University of British Columbia, Vancouver, Canada (since 2020).