Seminar/Talk

The whole is greater than the sum of its parts â a multimethod, multimessenger perspective on quantum materials

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Quantum materials in which electrons strongly interact with each other exhibit fascinating examples of contemporary condensed matter physics. Thrilling instances include the celebrated cuprates, organic charge-transfer salts, heavy fermion compounds, moir transition metal dichalcogenides, and ultracold atomic gases. Their phase diagrams are extremely rich, hosting intriguing phenomena like unconventional superconductivity, quantum criticality, and quantum magnetism. Due to their strongly interacting constituents they pose a huge challenge to current quantum many-body theory.In my talk I will argue that a certain perspective on strongly correlated systems, which we coined multimethod, multimessenger approach, can be a very powerful and versatile tool for the description and understanding of these systems. I will first illustrate the power of the approach with two studies of the most fundamental model for electronic correlations, the Hubbard model [1], on the square [2] and triangular [3] lattice. Second, I will demonstrate how these model studies paved the way for advancing our understanding of magnetism in infinite-layer nickelates [4] and moir transition metal dichalcogenides [5], as well as the unconventional superconducting properties in organic charge-transfer salts [6]. Given their broadness in applications, these examples may serve as blueprints for future studies of strongly correlated systems.[1] M. Qin, T. Schfer, S. Andergassen, P. Corboz, E. Gull, Ann. Rev. Con. Mat. Phys. 13, 275 (2022).[2] T. Schfer et al., Phys. Rev. X 11, 011058 (2021).[3] A. Wietek, R. Rossi, F. imkovic IV, M. Klett, P. Hansmann, M. Ferrero, E. M. Stoudenmire, T. Schfer, and A. Georges, Phys. Rev. X 11, 041013 (2021).[4] R. A. Ortiz, P. Puphal, M. Klett, F. Hotz, R. K. Kremer, H. Trepka, M. Hemmida, H.-A. Krug von Nidda, M. Isobe, R. Khasanov, H. Luetkens, P. Hansmann, B. Keimer, T. Schfer, M. Hepting, Phys. Rev. Research 4, 023093 (2022).[5] P. Tscheppe, J. Zang, M. Klett, S. Karakuzu, A. Celarier, Z. Cheng, T. A. Maier, M. Ferrero, A. J. Millis, and T. Schfer, PNAS 121, 3 (2024).[6] H. Menke, M. Klett, K. Kanoda, A. Georges, M. Ferrero, and T. Schfer, Phys. Rev. Lett. 133, 136501 (2024).

Tuesday, March 4, 2025 11:00am - 12:00pm
Office Bldg West / Ground floor / Heinzel Seminar Room (I21.EG.101)

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