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Multimethod, multimessenger approaches to models of strong correlations

The Hubbard model is *the* paradigmatic model for electronic correlations. In this talk I present a general framework for the reliable calculation of its properties, which we coined 'multi-method, multi-messenger' approach. I will illustrate the power of this approach with three recent studies: (i) an extensive synopsis of arguably all available finite-temperature methods for the half-filled Hubbard model on a simple square lattice in its weak-coupling regime [1] and (ii) a complementary subset of those applied to the Hubbard model on a triangular geometry [2]. While the former example fully clarifies the impact of spin fluctuations and tracks it footprints on the one- and two-particle level, the latter exhibits the intriguing interplay of geometric frustration (magnetism) and strong correlations (Mottness). As a last example (iii) I will show the application to a model system for the magnetic properties of an actual material, the infinite layer nickelate compound $LaNiO_2$, whose magnetic susceptibility exhibits non-Curie-Weiss behavior at low temperatures [3,4]. These examples may work as a blueprint for similar future studies of strongly correlated systems.

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[2] Alexander Wietek, Riccardo Rossi, Fedor Šimkovic IV, Marcel Klett, Philipp Hansmann, Michel Ferrero, E. Miles Stoudenmire, Thomas Schäfer, and Antoine Georges, Phys. Rev. X 11, 041013 (2021).

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[4] Marcel Klett, Philipp Hansmann, and Thomas Schäfer, Frontiers in Physics 10, 834682 (2022).