Understanding Strongly-Correlated Transition-Metal Compounds

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When vast assemblies of elementary objects interact, novel and surprising phenomena take place. Classical examples are superconductivity, the Kondo effect, the Mott transition and orbital ordering. Unraveling the nature of emergent cooperative properties is the daunting task of many-body physics.

The last decades have witnessed remarkable progress in our ability of describing many-body systems. In particular, the development of dynamical mean-field theory and its combination with first-principles methods based on density-functional theory has opened new perspectives for dealing with strong electronic correlations and the associated emergent phenomena.

In this talk, after a concise introduction to this successful method, I will show how, combined with other approaches, it can be used to disentangle the mechanisms behind emergent phenomena in paradigmatic cases: Orbital-order and orbital-ordered melting in manganites and other correlated transition-metal compounds, the metal-insulator transition in ruthenates, and spin-state transitions in rare-earth cobaltates.