Spin Dynamics in Orbitally Degenerate Mott Insulators

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Abstract

In the past few years much attention has focused on the interplay between spin, charge and orbital degrees of freedom in the manganese oxides. Titanium and vanadium oxides (with one and two d-electrons, respectively) undergo metal-insulator transitions akin to the manganites, but their microscopic properties remain relatively unexplored. They are interesting because the d-electrons reside in t_2g orbitals whose degeneracy is larger and whose lattice coupling is weaker than in the manganites where the electrons reside in e_g orbitals. We will present neutron scattering data on insulating versions of these materials and argue that they are incompatible with standard scenarios according to which the dynamics of the spin and orbital sectors are essentially decoupled. Our data call for a new quantum many-body description of coupled spin and orbital degrees of freedom in orbitally degenerate transition metal oxides.