Fingerprints of the Jahn-Teller and superexchange physics in manganites and titanates

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The physics of magnetic materials with Jahn-Teller (JT) ions possessing orbitally-degenerate electronic states is governed by the JT electron-lattice interaction [1-5] complemented by the entirely electronic superexchange (SE) interaction [6,7]. As a rule, the former interaction results in the high-temperature JT phase transitions accompanied by removal of orbital degeneracy and structural symmetry breaking, while the latter paves the way for the long-range magnetic ordering and facilitates magnetic phase transitions, usually at much lower temperatures.

On one hand, the electron in the ground state of JT compounds, governed by the vibronic electron-lattice coupling effects, should manifest JT orbital-like excitations and quantum lattice effects. On the other hand, the electron in the ground state must have also fingerprints of the electronic SE interactions due to the intersite charge excitations, including both spin and orbital degrees of freedom. Here we discuss the fingerprints of the JT and SE physics for e_g and t_{2g} electrons in the ground state of manganites and titanates, on an example of their typical representatives, such as $LaMnO_3$ and $YTiO_3$, based on our experimental optical studies of the temperature-dependent dielectric function spectra, first- and multi-order Raman scattering and theoretical lattice-dynamics calculations.

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