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Study of Multiferroic Manganites using Double-Exchange Models

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The double exchange (DE) model, supplemented by lattice distortions and superexchange between the $t_{2g}$ spins, has been very successful in describing the physics of manganites, such as $\text{La}_{1-x}\text{Ca}_x\text{MnO}_3$, including the presence of colossal magnetoresistance in Monte Carlo simulations [1]. In this presentation, we describe the first steps toward the application of the theoretical framework previously used for CMR manganites now to the study of multiferroic manganites. An encouraging result was recently obtained when S. Dong et al. [2] showed that the addition to the DE model of a next-nearest-neighbor antiferromagnetic $t_{2g}$ coupling $J_2$ was found to produce a phase diagram that correctly predicts a transition from an A-type AF to a spiral phase and finally to an E-type AF state with increasing $J_2$, as in experiments. This result paves the way for a variety of investigations and theoretical predictions now varying both the hole doping $x$ and $J_2$. Other issues in the area of multiferroics will also be addressed in this presentation, including the prediction of ferroelectricity in the spin zigzag E-type AF state [3].


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