MAR09-2008-004588

Abstract for an Invited Paper
for the MAR09 Meeting of
the American Physical Society

Study of Multiferroic Manganites using Double-Exchange Models[1]

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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 $La_{1-x}Ca_xMnO_3$, 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].

[1] C. Şen *et al.*, Phys. Rev. Lett. **98**, 127202 (2007); R. Yu *et al.*, Phys. Rev. B **77**, 214434 (2008); and references therein.

[2] S. Dong, R. Yu, S. Yunoki, J.-M. Liu, and E. Dagotto, Phys. Rev. B **78**, 155121 (2008).

[3] I. A. Sergienko *et al.*, Phys. Rev. Lett. **97**, 227204 (2006); S. Picozzi *et al.*, Phys. Rev. Lett. **99**, 227201 (2007).

[1]This work was supported by the NSF grant DMR-0706020 and the Division of Materials Science and Engineering, U.S. DOE, under contract with UT-Battelle, LLC.