MAR07-2006-006992

Abstract for an Invited Paper
for the MAR07 Meeting of
the American Physical Society

Competing ferromagnetic and incommensurate order in perovskite cobaltites $\mathbf{La_{1-x}Sr_xCoO_3}$

STEPHAN ROSENKRANZ, Materials Science Division, Argonne National Laboratory

Many phenomena observed in complex oxides, and in particular their enhanced response to external fields, are intimately linked to the existence of short-range order such as formation of stripes, ladders, checkerboards or phase separation. This nanoscale disorder results from the delicate balance of spin, orbital, charge, and strain degrees of freedoms that leads to competing groundstates with incompatible order. Inhomogeneity in the form of phase separation is also believed to play a key role in the magnetoresistance of doped cobalt perovskites $La_{1-x}Sr_xCoO_3$. In this system, doping holes into the non-magnetic, insulating parent compound leads to spin-glass behavior at low doping, with nanoscale ferromagnetic clusters forming within a non-fermomagnetic matrix. Percolation of these isolated clusters then leads to the ferromagnetic and co-incident metal- insulator transition at x=0.18. Utilizing elastic and inelastic neutron scattering, we have studied in detail the evolution of the static and dynamic spin correlations in these systems. Within the cluster-glass phase, we observe the formation of static ferromagnetic droplets below the spin- glass freezing temperature. Aided by the double exchange, the ferromagnetic correlations grow rapidly with doping. At the onset of metallicity, the correlation length increases abruptly, but remains finite.[1] Concurrent, and in competition with the ferromagnetic correlations, we also observe the formation of a short- range, incommesurate (IC) spin structure below the spin-freezing or ferromagnetic transition temperature. The incommensurate wavevector increases continuosly with doping, with the intensity of the IC correlations increasing in the insulating phase with doping, but dropping in the metallic state. This IC order could result from correlations between local Co^{3+}-Co^{4+} clusters in the form of short-range stripes.

Work supported by US DOE BES-DMS DE-AC02-06CH11357 and NSF DMR-0454672.

[1] D. Phelan, D. Louca, S. Rosenkranz,S.-H. Lee, Y. Qiu, P.J. Chupas, R. Osborn, H.Zheng, J.F. Mitchell, J.R.D. Copley, J.L. Sarrao, Y. Moritomo, Phys. Rev. Lett. **96**, 027201 (2006)