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Crossover from Polaronic to Magnetically Phase-Separated Behavior in $La_{1-x}Sr_xCoO_3$ D. PHELAN, CEMS, University of Minnesota (UMN), S. EL KHATIB, Physics, AUS, S. WANG, CEMS, UMN, J. BARKER, NCNR, NIST, J. ZHAO, H. ZHENG, J.F. MITCHELL, MSD, ANL, C. LEIGHTON, CEMS, UMN
— Dilute hole-doping in $La_{1-x}Sr_xCoO_3$ leads to the formation of "spin-state polarons" where a non-zero spin-state is stabilized on the nearest Co3+ ions surrounding a hole [1]. Here, we discuss the development of electronic/magnetic properties of this system from non-magnetic x=0, through the regime of spin-state polarons, and into the region where longer-range spin correlations and phase separation develop. We present magnetometry, transport, heat capacity, and small-angle neutron scattering (SANS) on single crystals. Magnetometry indicates a crossover with x from Langevin-like behavior (polaronic) to a state with a freezing temperature and finite coercivity. Fascinating correlations with this behavior are seen in transport measurements, the evolution from polaronic to clustered states being accompanied by a crossover from Mott variable range hopping to intercluster hopping. SANS data shows Lorentzian scattering from short-range ferromagnetic clusters first emerging around x = 0.03 with correlation lengths of order two unit cells. We argue that this system provides a unique opportunity to understand in detail the crossover from polaronic to truly phase-separated states.

[1] A. Podlesnyak et al., Phys. Rev. Lett. 101, 247603.

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