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Emergence of Complex States in CMR Manganites and High-Tc Cuprates

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Recent developments in the context of theory and experiments for manganites and cuprates will be discussed. It will be argued that the presence of nanoscale phase separation is at the heart of the colossal magnetoresistance phenomenon [1]. Simulation results support this view, as well as experimental data. These effects are not limited to manganites, but they may appear in other compounds as well, such as the high-Tc cuprates. New results will be presented in this area, on the phenomenological competition between antiferromagnetism and d-wave superconductivity, suggesting the possibility of "colossal" effects in this context [2]. This is compatible with the recent discovery of "giant proximity effects" in Cu-oxides [3]. All this suggests that clustered or mixed-phase states could form a new paradigm for the understanding of compounds in condensed matter physics. Work in collaboration with G. Alvarez, M. Mayr, A. Moreo, C. Sen, and I. Sergienko, supported by NSF DMR. [1] A. Moreo et al., Science 283, 2034 (1999); E.D., T. Hotta and A. Moreo, Physics Reports 344,1 (2001); E.D., "Nanoscale Phase Separation and Colossal Magnetoresistance", Springer-Verlag, 2002. [2] G. Alvarez et al., cond-mat/0401474, PRB to appear. [3] I. Bozovic et al., Phys. Rev. Lett. 93, 157002 (2004)