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Emerging Functionality in Complex Oxides Driven by Spatial Confinement[1]

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The exotic properties displayed by correlated electronic materials (CEMs) such as the cuprates, manganites, ruthenates, Fe-based pnictides, and heavy-fermion compounds are intimately related to the coexistence of competing nearly degenerate states which couple simultaneously active degrees of freedom–charge, lattice, orbital, and spin states. The striking phenomenon in these materials is due in large part to spatial electronic inhomogeneities, or nanoscale phase separation. The functionality in these CEMs is almost always associated with a phase transition, metal-to-insulator, magnetic-to-nonmagnetic, normal metal to superconductor, etc. Spatial confinement on the length scale of the inherent phase separation can probe the basic physics and reveal new emergent behavior. Several examples of the manifestation of spatial confinement will be discussed [1,2], focusing on the observed fluctuations between the competing phases [2]. Work done in collaboration with Jian Shen and Zac Ward at ORNL.

[1] T. Z. Ward, S. H. Liang, K. Fuchigami, L. F. Yin, E. Daggotto, E. W. Plummer, and J. Shen, "Reemergent Metal-Insulator Transitions in Manganites Exposed with Spatial Confinement," Phys. Rev. Lett. 100, 247204 (2008)
[2] T. Z. Ward, X. G. Zhang, L. F. Yin, X. Q. Zhang, Ming Liu, P. C. Snijders, S. Jesse, E. W. Plummer, Z. H. Cheng, and J. Shen, "Time-Resolved Electronic Phase Transitions in Manganites," Phys. Rev. Letters, 102, 087201 (2009).

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