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**Reentrant orbital order and the true ground state of  $\text{LaSr}_2\text{Mn}_2\text{O}_7$ .**

S. NYBORG ANCONA, S. ROSENKRANZ, R. OSBORN, K. E. GRAY, H. ZHENG, QING'AN LI, J. F. MITCHELL, Materials Sciences Division, Argonne National Laboratory, Argonne, IL 60439, U.S.A., Y. CHEN, J. LYNN, NIST Center for Neutron Research, Gaithersburg, MD 20899, U.S.A. — Strongly correlated electron systems, and colossal magnetoresistive materials in particular, exhibit a strong competition among orbital, charge and spin order. The phase diagram of the bilayer manganites,  $\text{La}_{2-2x}\text{Sr}_{1+2x}\text{Mn}_2\text{O}_7$ , display interesting features near half doping,  $x \approx 0.5$ , and it has been commonly accepted that CE order at  $x = 0.5$  is reentrant. Here, we present x-ray and neutron diffraction data of our purified  $\text{La}_{2-2x}\text{Sr}_{1+2x}\text{Mn}_2\text{O}_7$  crystals contrasting the conventional wisdom. Our crystals exhibit CE-type orbital and charge order as the low-temperature ground state for  $x = 0.5$ . For small deviations from  $x = 0.5$ , the high temperature CE phase is replaced at low temperatures by an A-type antiferromagnetic phase *without coexistence*. Larger deviations from  $x = 0.5$  result in a lack of CE-order at any temperature. Thus small compositional variations could explain why others commonly see this reentrance with coexistence.

Stine Nyborg Ancona  
Materials Science Division, Argonne National Laboratory,  
Argonne, IL 606439

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