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Extra
Photon Science Seminar

Imaging Anti-Ferromagnetic A-type domains in strongly correlated $LaSr_2Mn_2O_7$

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Abstract

Strongly correlated electron systems display a wide range of potentially useful properties. In these systems the correlation of electrons results in very rich phase diagrams with different and interesting ground states. As a consequence of the competition between different phases, very interesting properties like superconductivity and colossal magnetoresistance can occur. This competition between phases leads to electronic domains and inhomogeneities over a range of real-space length scales, from nanometers to hundreds of microns. Understanding the role that these domains play in defining the properties of strongly correlated electron systems appears as a mandatory requirement in order to achieve a full understanding of these systems. Among one of the most challenging properties to be studied in these materials is the antiferromagnetic order, one of the most ubiquitous ground states. The absence of any net magnetic moment from antiferromagnetic domains prohibits the use of most magnetic imaging techniques. Here we present results from a new imaging technique, soft x-ray resonant nano-diffraction. Reciprocal-space resolved soft x-ray diffraction, sensitive to long range electronic ordering, with a nano sized x-ray probe, focused by a Fresnel zone plate is used to study A-type antiferromagnetic (AFM) domains in $La_{0.96}Sr_{2.04}Mn_2O_7$.

The existence of two different A-type AFM regions in the sample is demonstrated. These regions have the same magnetic **Q**-vector, but differing orientations of the ordered moment, at 90 degrees to one another. The two regions have an unequal population, and when studied in retail, they are found not to be symmetry related. Further, we found that one of the regions exhibits a type of fine structure that is absent in the other region. A possible explanation for this “ripple” state will be presented based on a Dzyaloshinskii-Moriya type interaction due to the loss of inversion symmetry within each bilayer. By temperature cycling we observe that both, the domain pattern and spin directions, are quenched and the material exhibits a kind of ‘memory’.

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