W0447

Combination of Three-Beam Diffraction and Resonant Scattering for Study of Orbital Ordering in Microcrystal of $LaMnO_3$. Qun Shen[1], K.D. Finkelstein[2], R. Colella[3], [1]Advanced Photon Source, Argonne National Laboratory, [2]Cornell High Energy Synchrotron Source (CHESS), Cornell Univ., [3]Dept. of Physics, Purdue Univ.

The (300) reflection in $LaMnO_3$ has been observed at Mn K-edge and interpreted as the effect of orbital ordering by virtue of on-site 4p-3d Coulomb repulsion. An alternative interpretation is the effect of cooperative Jahn-Teller distortion of the oxygen octahedron surrounding Mn. Ordinarily these two effects are not distinguishable in resonant x-ray scattering experiments. However, they cause a phase difference of 180^o in the resonantly scattered beam, which can be measured by phase-sensitive three-beam diffraction. We have performed such a three-beam experiment on $LaMnO_3$. The recorded three-beam interference profiles show that the mechanism of resonant scattering is the cooperative Jahn-Teller distortion rather than 4p-3d Coulomb repulsion. It demonstrates that the resonant technique supplemented by three-beam diffraction is a very powerful tool capable of providing unique information to distinguish different electronic models responsible for the resonant scattering.

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