ESRF	**Experiment title:** ***Where are the ORBITONS in $LaMnO_3$??***	**Experiment number**: HE1551
Beamline: ID08	**Dates of experiment**: from: 7/7/2004 to 12/7/2004	**Date of report**: 4/3/2005
Shifts: 15	**Local contact(s)**: N.B. Brookes	*Received at ESRF:*

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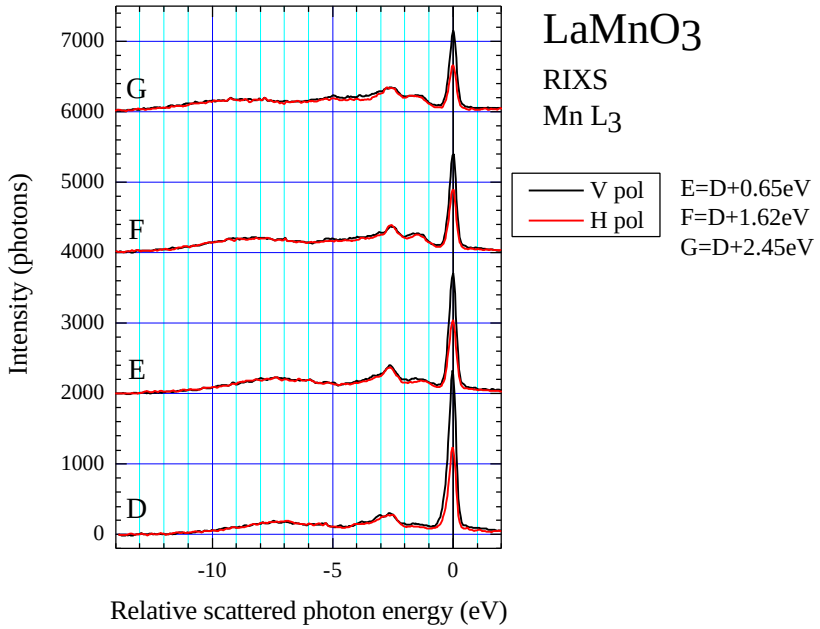
Report:

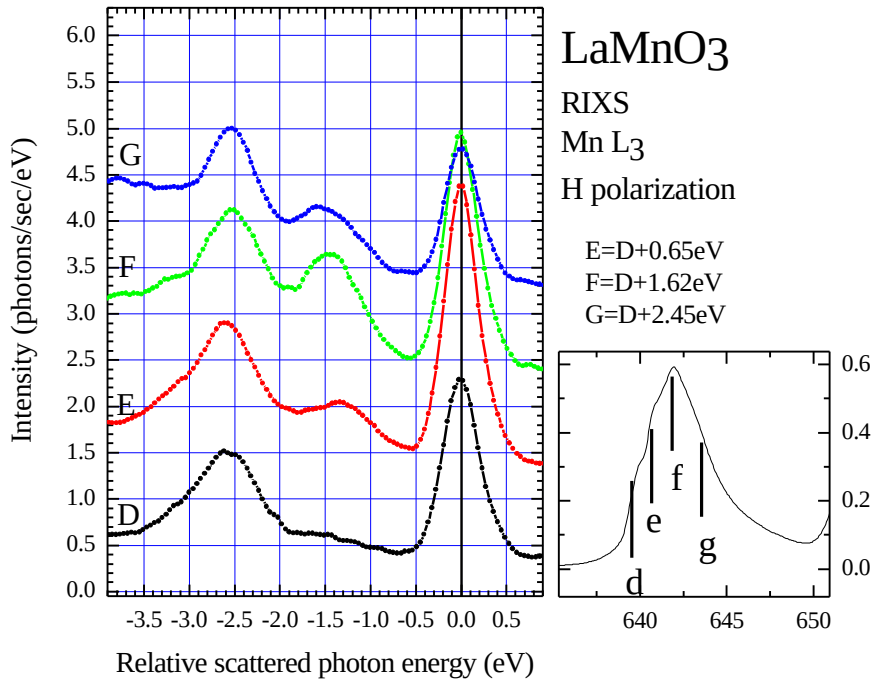
The proposed experiment was intended to explore the character of low energy excitations in $LaMnO_3$ using resonant inelastic x-ray scattering (RIXS) at the Mn L_3 edge. This technique is well suited to detect local excitations at the 3*d* transition metal sites, in particular the *dd* excitations. By playing with the polarisation of the incident photons one can often get important information not only on the energy but also on the symmetry of the excited states. The case of $LaMnO_3$ is particularly interesting because some excitations measured using optical spectroscopies (Raman scattering, optical conductivity…) around 150-200 meV are not unanimously assigned. Are we dealing with orbitons (i.e *dd* excitations) or with multi-phonon excitations? RIXS is particularly sensitive to electronic excitations (*dd* excitations) and very little to phonon excitations. On the other hand spin flip excitations are permitted in RIXS but strongly suppressed in optical spectroscopies.

We have measured RIXS spectra of $LaMnO_3$ at four excitation energies across the Mn L_3 edge, with a combined energy resolution better than 350 meV and using two orientations of the linear polarisation of the incident beam. The measurements were made using the AXES spectrometer at ID08 and its dedicated monochromator, both recently upgraded to get such a good energy resolution. The sample was a single crystal cleaved in air.

The spectra are shown in the figures. The elastic peak has a relatively symmetrical shape at all energies, indicating that no strong *dd* excitations can be detected below 500 meV. In that energy range one could expect inter-atomic exchange excitations, but at energies smaller than 150 meV and thus hardly visible with our present energy resolution. The other *dd* excitations are at energies greater than 1 eV, as expected by crystal field model calculations for Mn^{3+}. From the presented spectra the presence of orbitons of 150-200 meV seems unlikely. Cluster model calculations will be made in order to further clarify the meaning of the experimental findings.

FIGURES





Mn L_3 RIXS spectra of $LaMnO_3$.