ESRF	**Experiment title:** Whitebeam diffraction measurement of the magnetic form factors of ferromagnetic $La_{0.7}Sr_{0.3}MnO_3$	**Experiment number:** HE 727
Beamline: BM 28	**Date of experiment:** from: 28/10/99 to: 01/11/99	**Date of report:**
Shifts: 15	**Local contact(s):** Simon Brown	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

*Professor M Cooper
*Dr J Duffy
*Dr M Longfield
*J D Wilmshurst

Department of Physics
University of Warwick
Coventry CV4 7AL
England

*Dr S B Dugdale

Department of Physics
University of Bristol
Bristol BS8 1TL

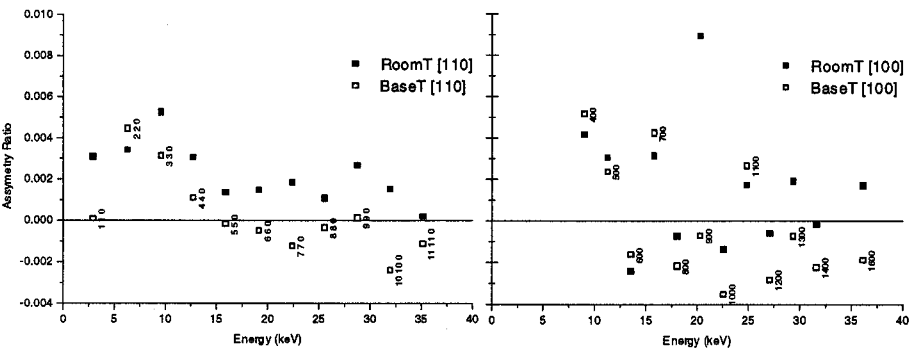
Report:

The magnetic form factors of $La_{0.7}Sr_{0.3}MnO_3$ have been successfully measured using white beam x-ray ferromagnetic diffraction. By going above/below the orbit, elliptically polarised radiation is obtained inducing an interference term in the scattering cross section. The assymetry ratio, obtained by reversing the sample magnetisation using a custom built 1T electromagnet, may then be measured. When the field configuration is along the scattered beam path, and scattering is at 90° then the assymetry ratio is proprotioanl to the projection of the total magnetisation density along the magnetisation direction ($2F_S + F_L$).

The perovskite manganites are of particular interest as they show room temperature magetoresistance associated with a paramagnetic-ferromagnetic transition, the result of a unique type of metal-insulator transition. A small moment is thought to be induced on the O 2p electrons, and whether a charge ordering effect is dominant or a double exchange mechanism between the Mn^{3+} and Mn^{4+} sites is still unclear. It has also been shown that double exchange is not sufficient to explain the magnetosresistance. Full analysis of the form factors should enable us to distinguish between the contribution from the large Mn moment and that induced on the O 2p electrons. They should also provide a better understanding of the interplay between electrical, magnetic and lattice properties in these CMR materials.

Measurements were made of the <100> and the <110> set of reflections at room temperature and at ~15K, $La_{0.7}Sr_{0.3}MnO_3$ being ferromagnetic at room temperature with T_c ~ 360K. It was possible to collect sufficient data in each of the four experimental setups to obtain statistically adequate data despite the high flourescence and the problem of multiple scattering. Full analysis of the data has not yet been made, but the initial results have been presented below. It is clear from the preliminary results that there is a definate anisotrpy between the <100> and the <110> magnetisation densities, and a temperature dependance of the magnetisation, althought this is still not well understood. Further detailed analysis and corrections for multiple scattering still have to be made. We are also performing calculations of the form factors using the LMTO perscription. It may also be noted that these data extend out much further than the earlier neutron work, which teminate with the [4 0 0] reflection (our data extending to the [16 0 0]).

Within the time period allocated successful measurements have been made. A full seperation of orbital and spin contributions in this compound will be possible following a further white beam experiment, enabling a fuller interpretation of the magnetic interactions in these mateials. Full analysis will follow, and a comparison made not only with LMTO calculations, but also with recent magnetic Compton measurements made on the same sample.



Measured form factors for $La_{0.7}Sr_{0.3}MnO_3$. Note that [9 0 0] reflection was prone to high contributions from multiple scattering.