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Names and affiliations of applicants (* indicates experimentalists):

Prof. Dr. Gisela Schütz	Universität Würzburg
Dirk Ahlers	Universität Würzburg
*W. Rössl	Universität Würzburg
*R. Zeller	Universität Würzburg
*Jon Duffy	University of Warwick
*M. J. Cooper	University of Warwick

Report:

This is a preliminary report on this experiment, which we only completed three weeks ago. As yet, we have not fully analysed the data. We measured the momentum space spin density in ferromagnetic EuO, using magnetic Compton scattering. The experiment was successful. The 4f spin moment on the Eu^{2+} site is clearly visible, and there is a difference between the Eu-O-Eu and Eu-Eu projection, which may relate to an induced moment on the oxygen site.

In the experiment, two crystallographic directions were measured: [100], where the Eu and O atoms alternate, and [110], parallel to the Eu-Eu exchange direction. The two magnetic Compton profiles (MCPs) are presented in figures 1 and 2. Although these are preliminary results based on our present data analysis, a complete analysis is unlikely to change the shape of the MCPs significantly. The analysis and interpretation are presently in progress.

An intriguing feature at present is an apparent anisotropy in the spin moment. In [110] the magnetic effect was three-quarters of the [100] value. This should only occur in strongly anisotropic materials, such as cobalt, where an applied field of 1T is insufficient to saturate the magnetic moment in the “hard” direction. We are awaiting magnetisation data in order to clarify this.

Turning to the shapes of the profiles, there are two main points. Firstly, the tails, i.e. J_{mag} for p_z> 2a.u. are of the same shape, as would be expected for the localised 4f electrons which contribute here. Secondly, at low momentum, anisotropy is observed: the dip around zero momentum being twice as broad, and more pronounced in the [110] direction. This is the momentum range at which any oxygen polarisation would be expected to contribute. It is not yet clear what the net oxygen moment is, or indeed whether there is one. A comparison with the MCP from pure Gd, another 4f ferromagnet, is interesting (see report on experiment HE-269). Whilst EuO is insulating, Gd is a conductor, and a clear induced conduction electron moment, of **~0.6uB,** is observed at low momentum, indicative of the indirect exchange which is largely responsible for the ferromagnetic ordering. These electrons are not present in EuO, and consequently the low momentum part of the MCP is much flatter. Hence, in EuO, indirect exchange appears not to be significant. The nature of the magnetic ordering is clearly different from that in Gd, and is under investigation.

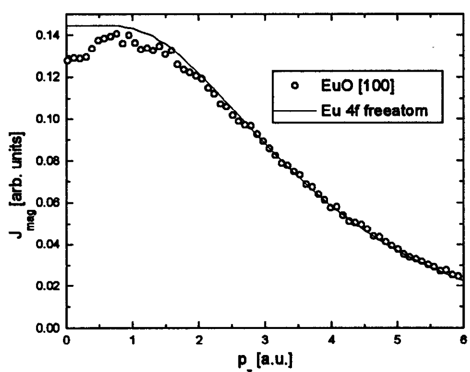

Figure 1. The experimental MCP for EuO **[100]** (symbols) and the calculated relativistic Hartree-Fock free atom profile for 4f electrons.

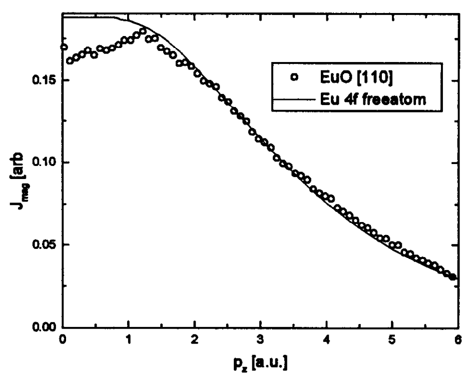

Figure 2. The experimental MCP for EuO [110] (symbols) and the calculated relativistic Hartree-Fock free atom profile for Eu 4f electrons.

A collaboration exists with band-structure theorists in **Würzburg,** and the electronic structure and MCPs will be calculated. We need these model line shapes in order to help us determine the origin of the spin density features observed in the experimental data.