ESRF	**Experiment title:** Magnetic Diffuse Scattering from $Gd_{0.67}Eu_{0.33}S$	**Experiment number:** HE300
Beamline: B112 / ID20	**Date of Experiment:** from: 08-Apr-98 to: 14Apr-98	**Date of Report:** June 24, 1998
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Report:

GdS is a metallic antiferromagnet, EuS an insulating ferromagnet. At intermediate concentrations a spin glass phase exists. The aim of this experiment was to separate the element specific spin pair correlation functions by measuring the resonant magnetic diffuse scattering at the Europium and Gadolinium L-edges in the spin glass system $Gd_{0.67}Eu_{0.33}S$.

In Figure 1 a Q-scan (3.3 0.3 0.3) $\longrightarrow$ (3.7 0.7 0.7) around the $(\frac{7}{2}\frac{1}{2}\frac{1}{2})$ position in resonance at the Gadolinium L_{II} edge is shown. The peak to background ratio is 2:3. The peak intensity is only six times higher than in our former measurements at HASYLAB in Hamburg.

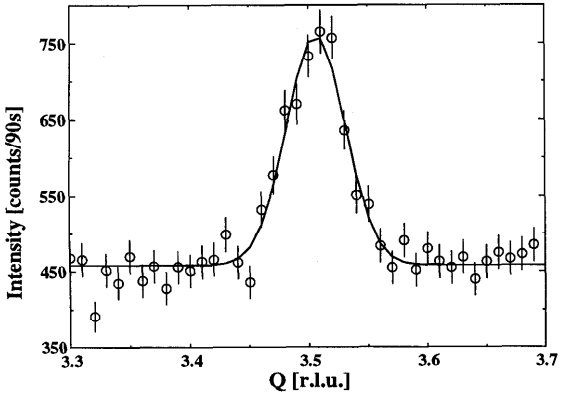

Figure 1: Q-scan (3.3 0.3 0.3) $\longrightarrow$ (3.7 0.7 0.7) around the $(\frac{7}{2}\frac{1}{2}\frac{1}{2})$ position. The sample time was 90 seconds for each datum point. The energy was tuned to the Gadolinium L_{II} edge; the temperature was 2 K. A polarisation analyser with $\sigma \longrightarrow \pi$ geometry was used. The solid line represents the fit of a Gaussian curve to determine the integrated intensity

As planned we performed energy and temperature dependent measurements. A polarisation analysis setup with a pyrolitic graphite crystal was used to suppress background due to charge scattering in $\sigma \rightarrow \pi$ scattering geometry. The residual background is probably due to Compton scattering at the analyser crystal of the fluorescence from the sample.

We measured the temperature dependence of the resonant magnetic diffuse scattering around the $(\frac{7}{2}\frac{1}{2}\frac{1}{2})$ position at the Gadolinium L_{II} edge. At each temperature a Q-scan (3.3 0.3 0.3) $\longrightarrow$ (3.7 0.7 0.7) with at least 90 seconds counting time for each datum point was performed. In figure 2 the integrated intensity of these Q-scans is shown. Because of technical problems with the temperature sensors we were not able to measure the temperature directly at the sample position. This is the reason for the differences in the temperature dependence measured at the ESRF and at HASYLAB.

The energy dependence of the magnetic diffuse scattering around the $(\frac{7}{2}\frac{1}{2}\frac{1}{2})$ position is shown in figure 3. Clearly a resonance enhancement is present. The width of the resonance of 6 eV is comparable to the resonance width of pure GdS. This resonance behaviour together with the rotation of the x-ray polarisation $(\sigma \rightarrow \pi)$ clearly proves that the observed signal is due to resonant exchange scattering.

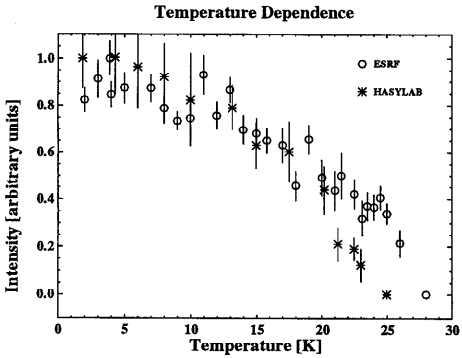

Figure 2: Temperature dependence of the magnetic diffuse scattering around the $(\frac{7}{2}\frac{1}{2}\frac{1}{2})$ position measured in resonance at the Gadolinium L_{II} edge at beamline ID 20 at ESRF ***and*** *W1* at HASYLAB.

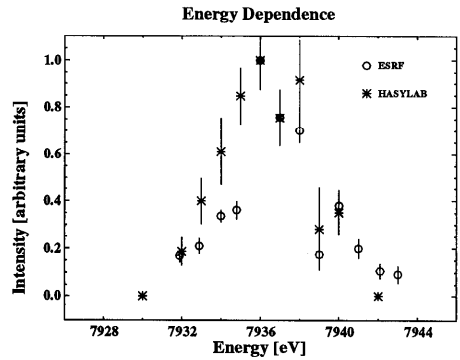

Figure 3: Energy dependence of the magnetic diffuse scattering around the $(\frac{7}{2}\frac{1}{2}\frac{1}{2})$ position. The data measured at the ESRF were shifted about $-2.5eV$ to make it comparable to the HASYLAB data.

We also searched for a magnetic signal at the Europium L_{II} edge. Since Eu^{2+} and Gd^{3+} ions have the same electronic ground state we expected from purely stoichiometric arguments a signal with an intensity in the order of one half of the intensity at the Gadolinium L_{II} edge. No such signal could be observed. We interpret this observation as an indication that in the spin glass phase the Europium ions do no longer participate in the antiferromagnetic short range order observed for the Gadolinium ions.

In conclusion we were able to observe element specific spin pair correlations in the spin glass phase of $Gd_{0.67}Eu_{0.33}S$. The Gadolinium exhibits short range antiferromagnetic order with a correlation length of about 100Å. The Europium ions do not participate in this short range antiferromagnetic order.