ESRF	**Experiment title:** Magnetisation profile study in Ce/Fe and CeH_2/Fe multilayer by x-ray resonant magnetic scattering at $M_{4,5}$ Ce and L_2 Fe edge	**Experiment number:** HE526
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Report :

In highly correlated Ce/Fe multilayers, Cerium adopts an α-like electronic structure within 20 Å from the Fe interface. XMCD experiments at the Ce L and M edges [1], have shown that, at room temperature, the 5d and 4f states of Ce carry a net weak magnetic moment. It has been ascribed to the hybridization of the Ce 5d and 4f states with the 3d states of the Fe at the interface. XMCD results reveal a fundamental difference between the 4f polarisation which is restricted at the Fe interface, and the 5d one which extends over 20 Å in the Ce layer, though it decreases with Ce thickness. In order to better understand the complex behavior of the magnetisation of the Ce atoms when they are strained in thin film on Fe, we have performed a resonant scattering experiment at the Ce $M_{4,5}$, and Fe $L_{2,3}$, edges on Ce(22Å)/Fe(30Å). Measurement on CeH_2(19Å)/Fe(30Å) have been performed to investigate the effect of a partial relaxation through the insertion of H. The aim of this work is to describe the arrangement of the 4f magnetic moment throughout the Ce thin film. In a previous work we have found an oscillatory profile of the 5d states in Ce(10Å)/Fe(30Å) and Ce(22Å)/Fe(30Å) [3].

The diffraction pattern, for both samples, shows several Bragg peaks related to the multilayer periodicity at small q values. In order to probe the distribution of the magnetic moment of the 4f Ce states within a layer, with a reasonable spatial resolution, we collect the energy dependance of the asymmetry ratios on as many Bragg peaks as possible. The asymmetry ratio is defined as $R=(I^+-I^-)/(I^++I^-)$, where I^+ and I^- are the diffracted intensities for the two opposite direction of the applied magnetic field. Measurements have been performed on the ID12B beamline using the **Daresbury two-circle diffractometer**, wich was operating at 10^{-5} mbar. The diffractometer was working in the vertical plane and we use circular polarised beam. The external magnetic field was applied in the surface of the sample along the beam direction. A selective magnetic hysterisis loops measured at the Fe L_3 edge insured that the Fe layers were saturated. The huge resonance at the Ce $M_{4,5}$ edges entail variation, in the range of 1°, outside of the Bragg law. In order to stay at the top of the Bragg peak during the energy scans, we

divided the energy range [860-930eV] in several sectors.

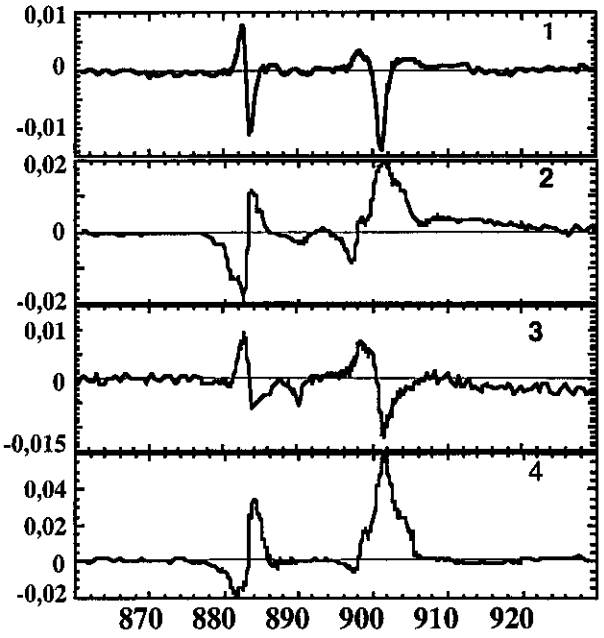
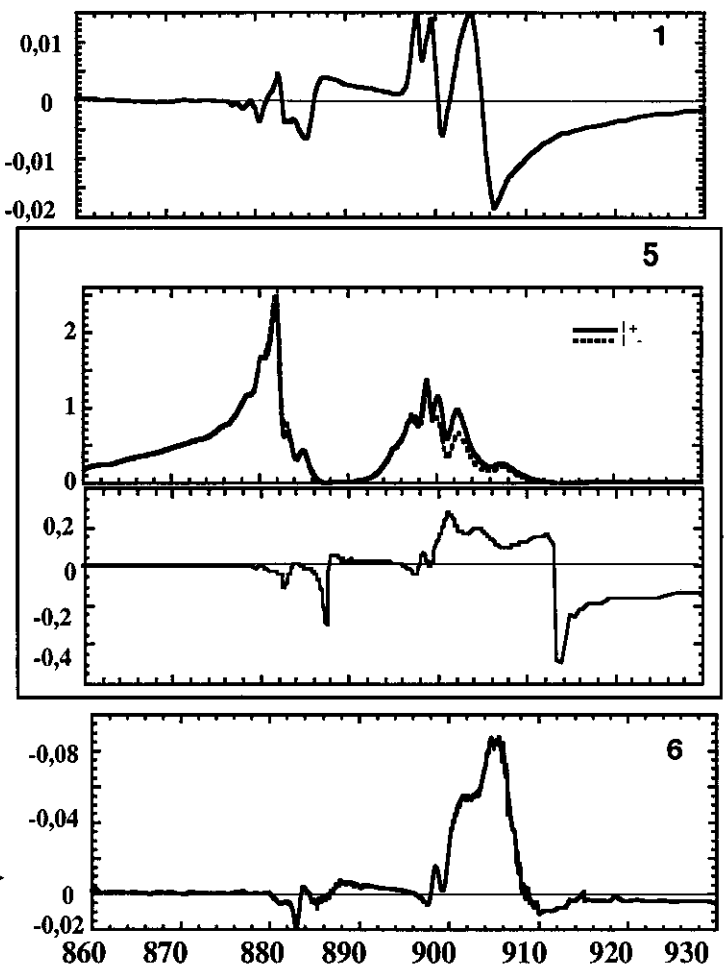


Fig 1 : Energy dependance over the Ce $M_{4,5}$ edges of the asymmetry ratio measured on top of the Bragg peak for a Ce/Fe multilayer.

Fig 2 : Energy dependance over theCe $M_{4,5}$ edges of the asymmetry ratio measured on top of the Bragg peak for a CeH_2/Fe. Second graph is an exemple of Signal measured.



. In **Fig 1** we observe asymmetry ratios, at the $M_{4,5}$ edges, with values ranging from 1.75 10^{-2} to 6 10^{-2} for the Ce/Fe system. **Fig 2** shows results in the case of the hydride sample with values from 2.9 10^{-2} to 5 10^{-1} (one order of magnitude larger than the XMCd signal [2]). We presents also signal measured for the two opposite directions of the applied magnetic field for the fifth Bragg peak.

. For the same sample, depending on the order of the Bragg peak, we observe strong changes in the shape of the energy dependence of R as well as in its amplitude.

. From one sample to the other, the results looks very different, in amplitude as well as in form.

At first glance, all these features indicate that the magnetic moment in both sample are not constant. The important difference in the shape of the signals obtained between the Ce/Fe multilayer and the CeH_2/Fe multilayer is certainly related to the difference in electronic structutre of Ce. The more surprising result is the strong signal obtained on the third and fifth order (**Fig 2**) order on CeH_2/Fe. Work is in progress to analyze the data and we are confident that a detailed information on the magnetic profile will be obtained. We like to point out that we have obtained an asymmetry ratio up to the first 6 Bragg peak, in the case of the hydride multilayer, with a very good signal to noise ratio and resolution for such XRMS experiment.

References :

1) M. Arend et al., Phys. Rev. B **57**, 2174 (1998)
2) M. Arend et al., Phys. Rev. B **59**, 3707 (1999)
3) L. Sève et al., ESRF Highlights, 1997; Phys. Rev. B 60 (1999), 9662.