ESRF	**Experiment title:** Magnetic susceptibility and magnetic moments as a function of temperature and magnetic field and anisotropy of the orbital moment in Fe/V superlattices on MgO(001)	**Experiment number**: HE-660
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Report:

In this beamtime we recorded element-specific spectra at the Fe and V $L_{3,2}$ edges for Fe/V superlattices grown on MgO(001). Our results provided information on three separate topics (i) the Fe and induced V magnetic moments (ii) the orbital magnetism of Fe to be compared with previous Ferromagnetic Resonance (FMR) experiments [1] and (iii) the large increase of the magnetic moment at high fields and low temperatures in a Fe/V sample with very thin Fe layers, as described in our proposal. We structure our report respectively:

(i) Fe XMCD spectra are shown in Fig. 1 for 40 nm thick Fe (indicated as bulk), and Fe_4/V_2, Fe_4/V_4 and Fe_2/V_5 superlattices. The indices are numbers of atomic planes in each superlattice period. One sees that the Fe signal at the Fe_4/V_2 sample is bulk-like. When the V spacer becomes thicker the Fe XMCD decreases and this decrease is even more pronounced for the sample with the 2 at. layers of Fe. These results elucidate the behavior of Fe at the interface with V. The decrease of the Fe XMCD signal and, consequently, Fe moment is understood as a change of coordination number in a ligand field model, in agreement with theoretical predictions [2]. In Fig. 2 we show XMCD spectra from V in Fe_4/V_2. First of all, we note that the spectra quality is much higher than of previous ones recorded for V [3] due to the high photon flux and degree of circular polarization at the ID12B. The sample of Fig. 2 shows the largest degree of V polarization. Since the V L-edges overlap and the standard XMCD analysis can not be applied, we measured the total magnetization of the sample by Vibrating Sample Magnetometry and subtract the Fe magnetization. A magnetic moment of $-1.3\mu_B$/atom was deduced for V. The negative sign indicates an antiferromagnetic alignment between Fe and V, in agreement with theory and previous experiments, see e.g. [2,3].

(ii) In Fig. 3 we present the ratio of the orbital-to-spin magnetic moments (m_L/m_S) for the Fe-bulk and four superlattices, two with 4 and two with about 2 at. layers of Fe, as indicated. One may notice that the m_L/m_S ratio does not change considerably from the bulk to the 4 at. layers. However, a large increase (by more than 200% compared to bulk) occurs by going to the samples with 2 Fe layers. This is in fair agreement

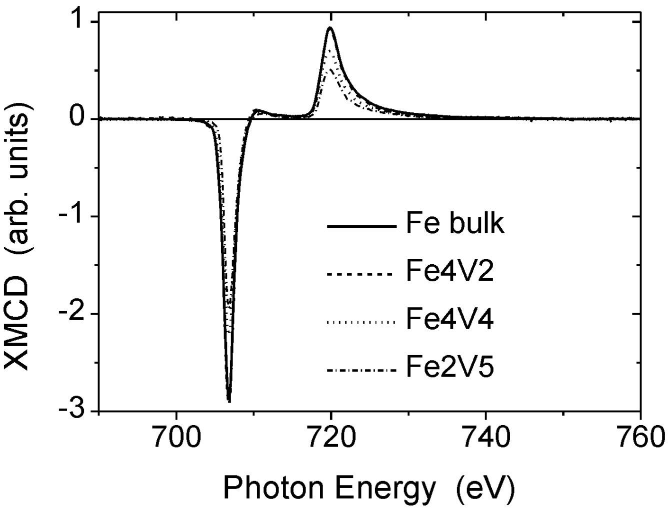

Fig. 1: Normalized XMCD spectra at the $L_{3,2}$ edges of Fe for four samples as indicated at T=10 K and H=6 T.

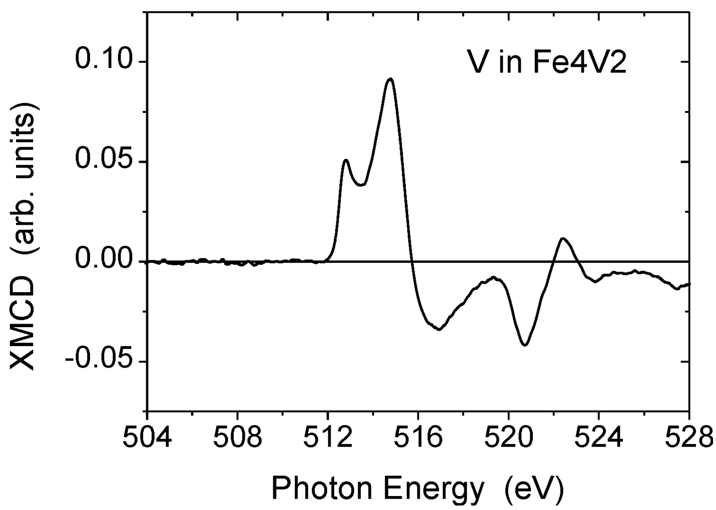

Fig. 2: Normalized XMCD spectra at the $L_{3,2}$ edges of V for a Fe_4V_2 superlattice.

with our previous publication based on FMR data [1]. This is the first time in the thin film literature that results from the two techniques that may provide the m_L/m_S ratio, i.e. XMCD and FMR, are compared and satisfactory agreement between them is found.

(iii) In Fig. 4 we see field- and temperature-dependent magnetization data deduced by analysis of the corresponding XMCD spectra for an $Fe_{1.6}/V_5$ superlattice on MgO(001). Previous non-element specific measurements by SQUID and FMR revealed a large increase of the total signal the origin of which could not be identified. It is only with the current element-specific measurements that an unambiguous input to this problem could be given. As shown in Fig. 4 a large field-induced increase of the Fe magnetization is recorded. The effect occurs at both 10 and 120 K. On the other, hand, the V polarization was very weak and therefore, we conclude that the effect is located at the Fe sites. The ultrathin and non-integer Fe layers of the sample could suggest a mixed ferro- and superferromagnetic type of behavior, see for example [4].

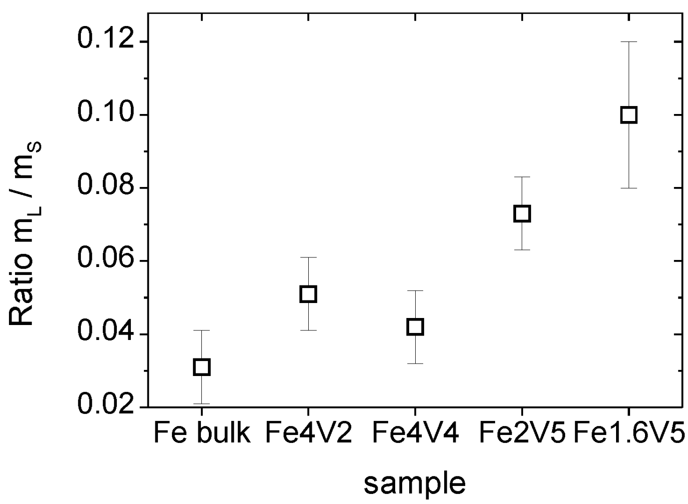

Fig. 3: The ratio m_L / m_S for Fe in bulk and four superlattices as indicated. The ratio increases by decreasing the Fe thickness.

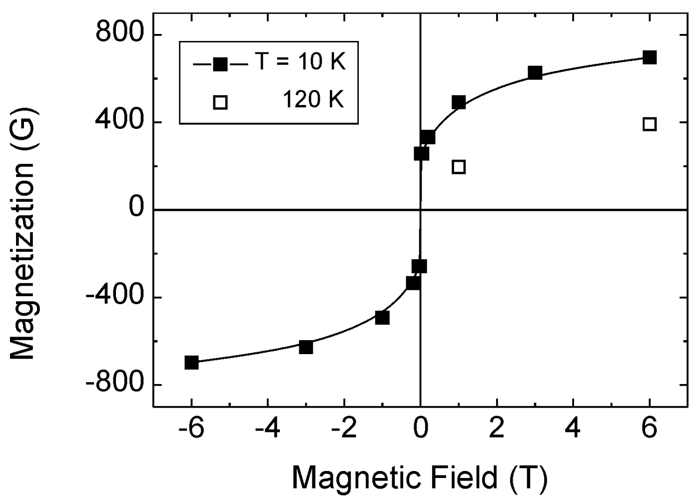

Fig. 4: Magnetization of Fe in a $Fe_{1.6}V_5$ superlattice. An unusual approach to magnetic saturation is revealed.

Finally, the ac-susceptibility part of the proposal could not be realized due to non-perfect compensation of the stray remanent field of the 7 T magnet.

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[2] S. Mirbt et al., Phys. Rev. B**55**, 67 (1997).
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[4] J. Hauschild et al., Phys. Rev. B**57**, R677 (1998).