ESRF	**Experiment title:** Depth selective hyperfine analysis of ^{57}Fe/(^{57}Fe)Si multilayers by SMR (Synchrotron Mössbauer Reflectometry)	**Experiment number:** SI 236
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Report:

Magnetic coupling and order of consequtive ferromagnetic (FM) iron layers in a $[^{57}Fe(26Å)/^{56}FeSi(14Å)]_{10}$ magnetic multilayer (ML) on a Zerodur substrate was investigated by Synchrotron Mössbauer Reflectometry (SMR)[1] on the ^{57}Fe Mössbauer transition at room temperature (RT) as well as field cool cycle down to 16 K and up to RT in various transversal ($\underline{H} \perp \underline{k}$) external magnetic fields.

Results:

Considerable antiferromagnetic (AF) contribution in the consequtive layer magnetization alignment (CLMA) was observed by SMR as hyperfine Bragg-reflection (double ML period). With increasing external field full transition to FM CLMA was observed at 9.5 kG (Fig.1). Cooling the ML in an external field of 500 G to 16 K the AF Bragg peak-diminished, did not recover on warming up to RT in 500 G (Fig. 2). The metastable state survived in 2 kG at RT. By low angle conversion electron Mössbauer spectroscopy (CEMS) no sample degradation on temperature cycle (stuctural or magnetic transition in either the FM or the spacer layer) and both AF and FM components of the CLMA were observed in an in-plane magnetic field of 500 G. Whether or not the disorder is within the layer-plane (pin-hole FM coupling) or perpandicular to it (AF+bi-quadratic coupling), needs further investigations by SMR, CEMS and various magnetic methods.

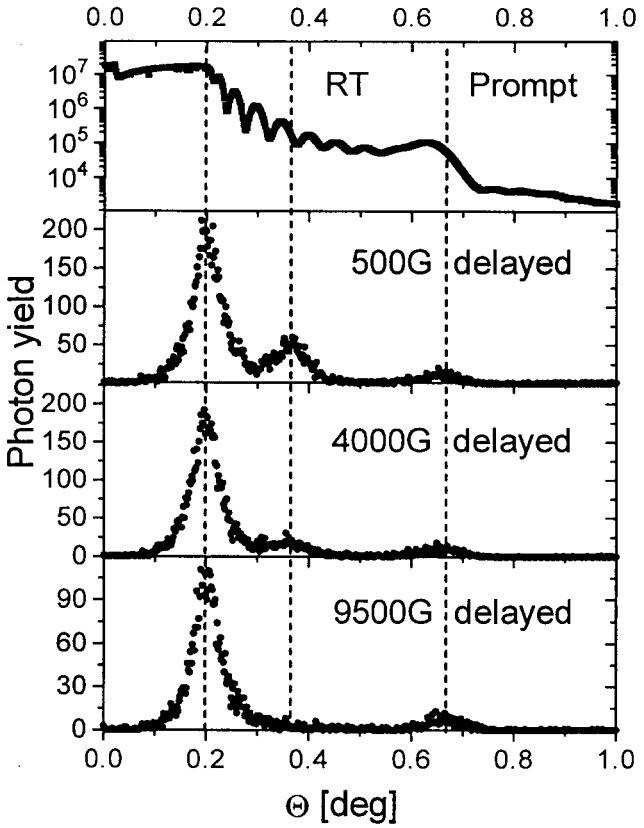

Fig. 1. Prompt (electronic) and delayed (nuclear) reflectivity curves of a $[^{57}Fe(26\acute{L})/^{56}FeSi(14\acute{L})]_{10}$ multilayer in various external magnetic fields at room temperature. Vertical dashed lines indicate the glancing angles of the total external reflection, magnetic SL Bragg- and structural ML Bragg-angles, respectively.

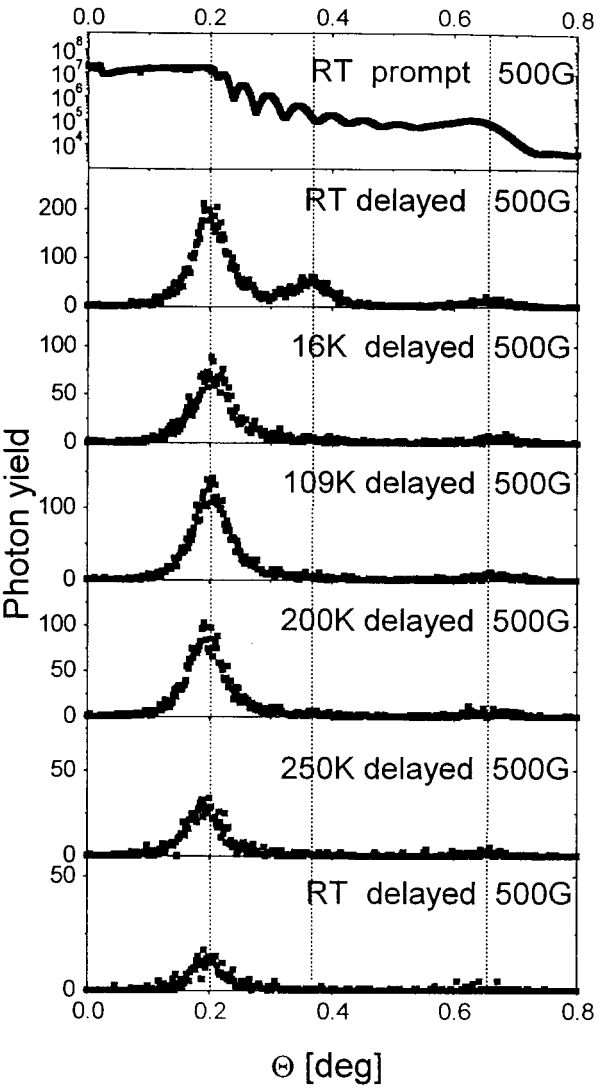

Fig. 2. Delayed reflectivity curves at various temperatures on a $[^{57}Fe(26\acute{L})/^{56}FeSi(14\acute{L})]_{10}$ multilayer in a transversal external magnetic field of 500 G. In-field temperature cycle: from top to bottom.