	Experiment title: Collapse of magnetic order in epitaxially strained disordered FeRh films	Experiment number: HC 2761
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Report:

We have studied one disordered 57Fe-Rh thin film deposited on a tungsten layer using the new "Synchrotron Mössbauer Source" (SMS) at beamline ID18. The purpose of this experiment was to determine the magnetic structure at low temperature and in the presence of magnetic field. Due to the thin film geometry, on a thick MgO single crystal and a tengsten sublayer, it was necessary to work in reflection geometry. Generally the difficulty in this geometry is obtaining adequate smoothness in order that the outgoing beam is not spread out too much which would lead to a small count rate. We found that the counting rate in specular reflection was very good, and that the critical angle for total reflection could be observed. SMS in reflection geometry has the added difficulty (compared to the same experiment in transmission) that the resulting Doppler-energy-shifted spectrum depends sensitively on the exact scattering vector Q. Near the angle of total reflection, energy-shifting into nuclear resonance has the effect of loering the count rate: an absorbtion spectrum is measured (see figure). At higher Q, the film scatters almost no radiation except when energy-shifting into resonance: an emission spectrum is measured. At intermediate Q, these two effects combine coherently, which can be described as an interference between electronic and nuclear scattering.

Unfortunately, we were not able to find a Q value where we could work avoiding this interference effect. The upper spectrum shows a tipical result at 4.2K where the film is in the ordered magnetic state. While clearly demonstrating that the film can be measured, the interference leads to too much distortion to make a numerical exploitation possible. Shwn is an unfolded spectrum which should show a mirror symmetry around the centre. Usually such a spectrum would be folded around this centre position, eliminating any asymmetric geometry effect. The distortion is clearly neither symmetric nor antisymmetric. Due to lack of time, it was decided to discontinue the MSM experiments (see below), and concentrate on inelastic studies of the phonon density of states (see report).

One central problem with the setup used was the lack of any Kirkpatrick-Baez mirror (KBM). After the elastic (SMS) and inelastic experiments were finished, a KBM setup was installed for the next experiment (at room temperature, and in a different hutch). It was possible to test our FeRh films in this setup but only a room temperature (where they are known to be nonmagnetic). Typical results are shwon in the lower graph. Clearly the spectrum is composed of a mirror symmetric Mössbauer spectrum plus a (very very small) antisymmetric geometric effect, showing that any practical application of SMS in reflection geometry must include focusing with a KBM.