ESRF	**Experiment title:** Resonant x-ray scattering investigation of the magnetic ordering in thin film single crystal samples of UPd_2Al_3	**Experiment number:** HE-71
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Report:

UPd_2Al_3 belongs to the class of magnetic heavy fermion superconductors. Antiferromagnetic order (T_N = 14K) of ferromagnetic (0 0 1) layers of moments coupled + - + - along the hexagonal c direction and a relatively large ordered moment of m = $0.85\mu_B$ coexists at low temperature with superconductivity (T_c = 2K) [l]. To understand the interplay of superconductivity and magnetism in this compound, an important question relates to the dimensional&y of the magnetic interactions. This was the motivation to investigate the magnetic properties of UPd_2Al_3 thin films.

Thin films of UPd_2Al_3 were epitaxially grown (in Mainz) on a, $LaAlO_3$ substrate by electron beam co-evaporation of the elements [2]. Two films with thicknesses of about z = 800Å and 1600Å and a mosaicity of ~0.3deg. were used for the resonant x-ray scattering experiment on ID20. The investigations were performed between 1.6K and 20K with the ID20 cryostat in horizontal (π incident polarization) geometry. By measuring the x-ray reflectivity at E = 8keV we confirmed experimentally the expected film thicknesses and the data show that the films are reasonable flat.

Using photons tuned to the M_4 (E = 3.73keV) and M_5 (E = 3.55keV) absorption edge of uranium we observed magnetic scattering from the (0 0 l/2) and (0 0

3/2) specular reflections for temperatures T < 12K (Fig. 1). This shows that the magnetic correlations observed in both films are the same, and similar to those observed in the bulk material [3]. Since the q width of the magnetic and charge peaks are the same in each film below 10K, this demonstrates that the magnetic long range order is defined by the film dimensions. The magnetic structure appears to be unchanged at the lowest temperatures measured (T = 1.6K), when the sample is in the superconducting state.

An other aspect of the experiment was to investigate how the magnetic order develops. The energy width of the magnetic signal depends not only on the absorption edge but also on temperature, order of Bragg reflection and the film thickness. We investigated mainly the energy width as a function of Bragg reflection and film thickness (Fig. 2) using a polarization analyzer to reduce the background noise and to increase the signal to noise ratio. The data taken at T = 4K are in excellent agreement to the theoretical prediction [4]. Due to time restriction the data taken at higher temepratures to get the temperature dependence are less precise. Nevertheless, we observed clearly a smaller energy width at higher temperatures consistent with a model that assumes the magnetic order develops initially on the surface and penetrates into the film on lowering the temperature. One possible explanation is that strains due to the misfit between film and substrate prevent an initial magnetic order throughout the film.

[l] C. Geibel et al. ; Z. Phys. B93 (1991) 305
[2] M. Huth et al.; Solid State Comm. 87 (1993)
[3] S. Langridge et al.; to be published
[4] N. Bernhoeft; to be subm. to Acta Cryst.

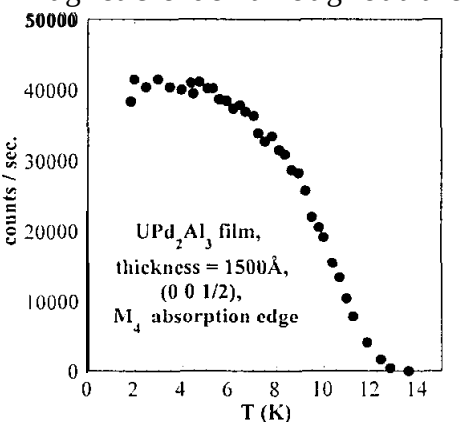

Fig. 1: Temperature dependence of the resonant magnetic intensity at the (0 0 l/2) position.

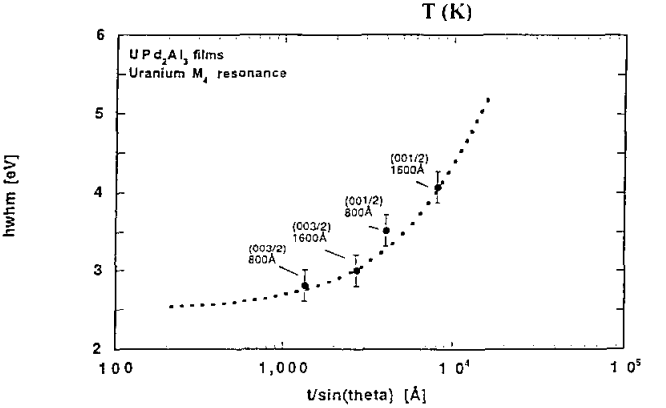

Fig. 2: Energy width of the magnetic resonance as a function of the film thickness traversed by the incident beam, with the model fit [4] shown by the dotted line.