ESRF	**Experiment title:** Azimuthal and temperature dependence studies of sigma-sigma resonant scattering at the As K-edge in type-IA, antiferromagnetic uranium arsenide	**Experiment number**: HE-2057
Beamline: ID20	**Date of experiment**: from: 31 August 2005 to: 06 September 2005	**Date of report**: 15/02/06
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Report:

The aim of this ID20 experiment was to confirm a resonance observed in the σσ channel in the type-IA phase of UAs at the As Kedge [1]. After the first day of beamtime it was concluded that this signal, measured in an *XMaS* experiment [1], was a spurion as no such signal was observed at ID20. The remaining ID20 beamtime was used to perform two studies: (1) to measure the As K edge resonance lineshapes in the σπ channel in order to obtain data to compare with the previous *XMaS* study and (2) to study for the first time in UAs resonant scattering at the U M_2 edge.

(1) As K edge study

Figure 1 shows the As K edge resonance lineshapes measured at both specular and offspecular satellite positions in both antiferromagnetic (AF) phases of UAs, the type-I (k = 1 rlu) and type-IA (k = 0.5 rlu). Shown for comparison are the lineshapes measured in the *XMaS* experiment. The lineshapes are equivalent at specular and off-specular positions in both phases. It is worth noting that in the case of the type-I phase, the ID20 data is less "noisy" on the high-energy side of the resonance than the *XMaS* data.

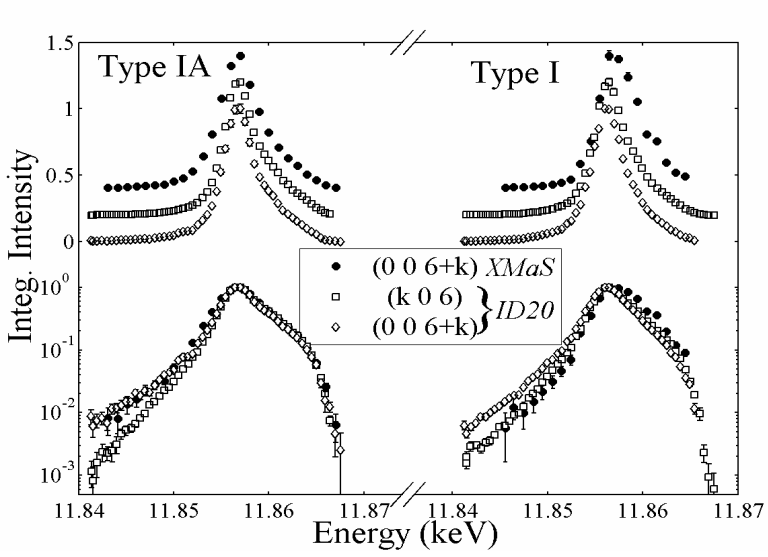

Fig. 1. Comparison of the σπ As K-edge lineshapes measured in this experiment (ID20) with those from the previous experiment (XMaS). The data is shown on both linear and log y-axes. On the linear axis the lineshapes have been offset from eachother.

(2) U M_2 edge study

Figure 2 shows the lineshapes measured at the U M_2 edge in both polarization channels and for both AF phases of UAs. The fitting curves are to the standard dipole oscillator model for resonant scattering. In the case of the σπ scattering, the lineshapes are strongly asymetric due to interference with a non-resonant magnetic scattering component. In the type-I phase, only one resonant component is required to fit both the σσ and σπ lineshapes and is attributed to a quadrupole (3p to 5f) process. However, in the type-IA phase a second resonant component is required to fit the σπ lineshapes. This is attributed to a dipole (3p to 6d) process. The attempted fit using a single resonant component is shown by the dotted lines in Figs. 2(d) and (e).

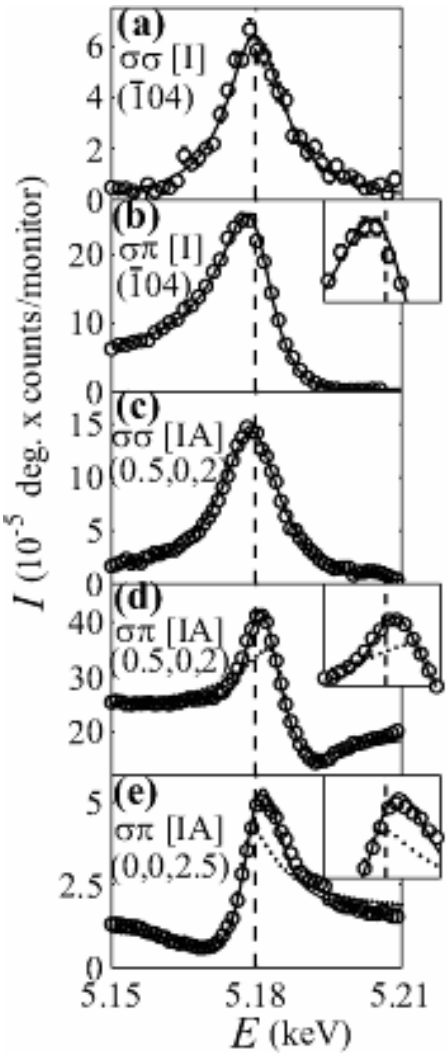

Fig. 2. Resonant lineshapes at the U M_2 edge in both polarization channels (σσ and σπ) and for both AF phases of UAs, type-I "[I]" and type-IA "[IA]". The fitted curves are described in the text.

In conclusion, our ID20 experiment has confirmed the As K edge (σπ) lineshapes measured at XMaS and has obtained new data at the U M_2 edge. It is worth noting that studies at both of these edges provide information about hybridization in UAs. An article to present the results of both of these studies is in preparation and will be submitted to Physical Review B. Theoretical calculations of the As K edge lineshapes in UAs have already been performed [2] and are not confimed by our experiment. It is hoped that these experimental results will stimulate further theoretical work, for both the As K and U M_2 edges.

References:

[1] ESRF Report for experiment HS-2450.
[2] van Veenendaal, Phys. Rev. B **67**, 134112 (2003).