# Resonant Dichroism in the 4f-Photoionisation of Atomic Europium

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The Magnetic dichroism in photoionisation is a powerful probe instrument for magnetic properties in thin layers and surfaces. For the lanthanides the magnetic properties are determined by the 4f-electrons which are known to be well localized in the solid state. For this reason atomic models are often used for the description of dichroism in lanthanides [1]. The half filled 4f-shell makes Eu III and Gd IV in solid state and atomic Eu special, because these elements show a vanishing angular momentum in the ground state leading to a pure spin-magnetism which simplifies the theory of dichroism.

In our experiment dichroism in the photoionisation of free europium atoms is measured. The atoms are magnetically oriented by optical pumping into dark states by a cw dye laser. Fig. 1 shows the experimental set-up of the experiment. The europium is evaporated by a resistively heated oven. The circularly polarized pumping laser light is entering from the left side while the linearly polarized synchrotron radiation is entering from the right. The photoelectrons are detected by an spherical electron analyzer with an angle of $54.7^o$ in respect to the polarization vector of the synchrotron radiation.

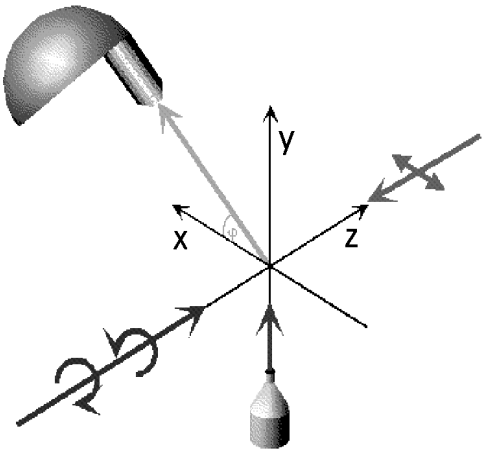


Figure 1: Experimental set-up

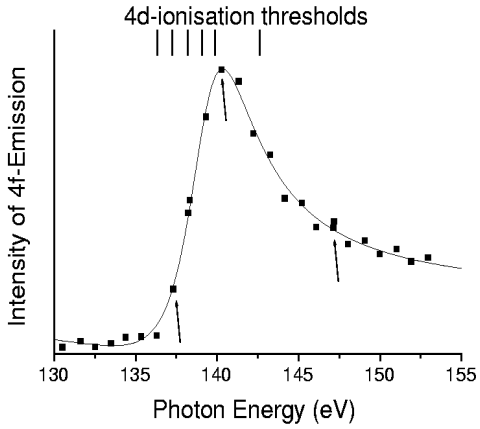


Figure 2: The 4d-4f giant resonance of Eu

The difference between the electron spectra for left and right circularly polarized laser light is called Linear Magnetic Dichroism in the Angular Distribution (LMDAD). In addition the

Linear Dichroism (LD) has been determined. For the LD measurements the atoms were aligned by pumping with linearly polarized laser light. LD and LMDAD have been theoretically studied for non-resonant photoemission. The atomic character of the magnetic dichroism of the Gd surface is borne out by the striking similarity to the LMDAD of free oriented Eu atoms [2].

In this Contribution we will present first results of our investigations on dichroism in the 4f photoemission with excitation energies in the 4d-4f giant resonance [3]. Figure 2 shows the intensity of the 4f photoemission over the giant resonance. LD and LMDAD where measured for nine excitation energies on both flanks of the resonance.

Figure 3 shows the photoionisation spectra for different magnetic orientations of the atoms as well as the LMDAD spectra for the three energies marked by arrows in fig. 2. The lineshape of the photoionisation spectra and the shape of the LMDAD are changing dramatically over the resonance. This is a clear evidence for interference between the direct photoemission on one hand and a discrete excitation followed by fast auto-ionisation on the other hand. A simple model used to explain a similar effect in solid state [4] can't explain the observed dramatic changes of the lineshapes observed. So this experiments give rise for a new detailed study of the process of resonant photoemission.

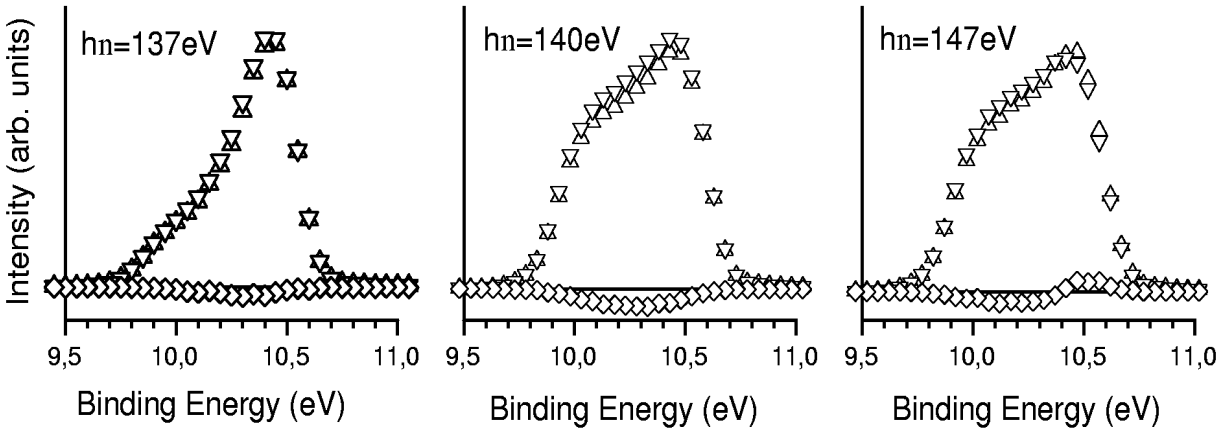


Figure 3: LMDAD of the 4f photoemission for the excitation energies marked in Fig. 2


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