ESRF	**Experiment title:** **The transition from intermediate to jj coupling in atoms**	**Experiment number**: HE-1018
Beamline: ID15B	**Date of experiment**: from: 3 May 2001 to: 9 May 2001	**Date of report**: 5 March 2003
Shifts: 18	**Local contact(s)**: Dr. Veijo Honkimaki	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

*Prof. Moshe DEUTSCH
*Dr. Reut DIAMANT
*Prof. Keijo HAMALAINEN
*Dr. Simo HUOTARI
Dr. Chi-Chang KAO

Report:

These measurements concentrated on the $K^h\alpha_{1,2}$ hypersatellite spectra of several elements in the medium-to-high Z range, concentrating mainly on the intensity ratio relative to the corresponding $K\alpha_{1,2}$ lines. The intensity ratio of the lines *within* the $K^h\alpha_{1,2}$ spectra provides unique information on the variations of the atomic coupling schemes with Z, while the hypersatellite/diagram intensity ratio is important for determining the relative single/double electron excitation cross-section in the same shell. The measured Kα hypersatellite and diagram spectra for Yttrium are shown in Fig. 1, with the hypersatellite lines sitting on the tails of the diagram spectrum. Being able to measure the diagram and hypersatellite lines with the same setup, allows us to measure accurately the relative cross sections of these spectra.

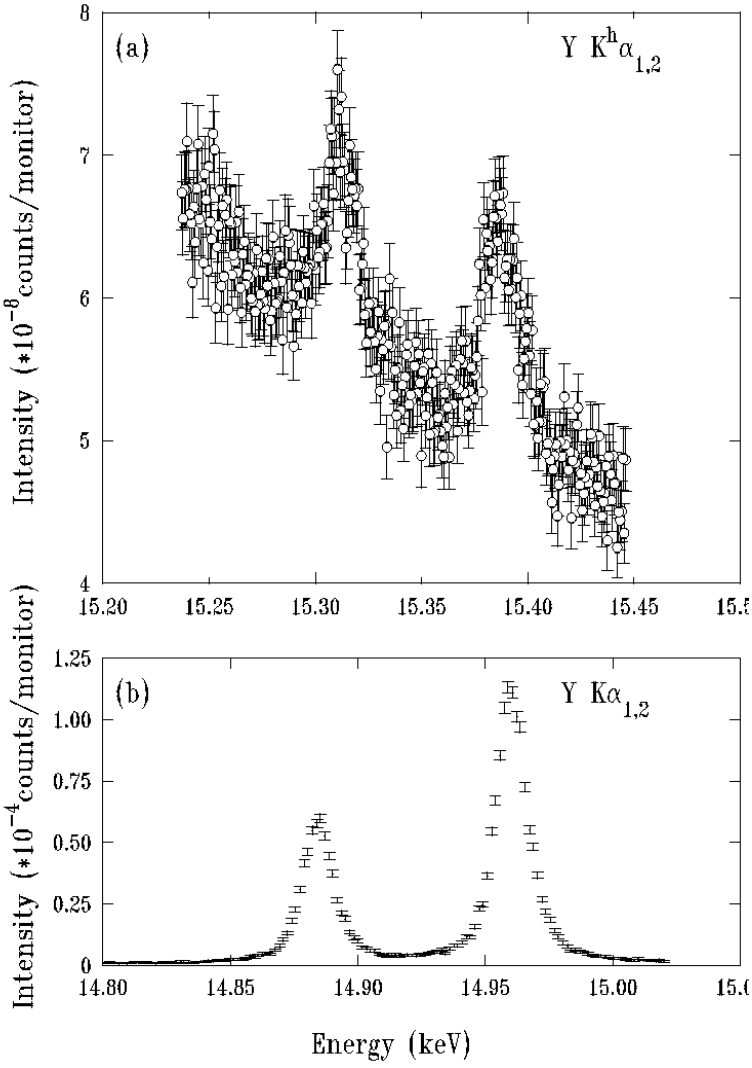

Fig. 1: The measured $K^h\alpha_{1,2}$ hypersatellite (**a**) and $K\alpha_{1,2}$ diagram (**b**) spectra of Yttrium.

Note the very low intensity of the hypersatellite lines, ~10^{-4} of that of the diagram. This cross section diminishes strongly with the atomic number, Z, roughly as Z^2. The allocated time was, therefore, insufficient to allow measuring the hypersatellite spectra for our other samples, Nd and Ce (Z=58 and 60) , with satisfactory signal/noise ratio. However, the $K\alpha_{1,2}$ and $K\beta_{1,3}$ spectra were accurately measured with the same analyzer and experimental setup, and limits can be obtained on the intensity of the hypersatellite spectra even for these high-Z elements. With the experience gained in this experiment, we plan to design and construct an analyzer with characteristics tailored to these demanding Z-range, and measure the hyperstaellite spectra in the Z=60 neighbourhood. The results obtained in this run will allow determining the behaviour of P_{KK}, the single/double excitation cross section for Y, and put limits on its value for Nd and Ce. The measurements will also allow determining accurately the intermediacy of the coupling in the vicinity of Z=40, which was not hitherto measured.