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Chapter 7: 2,3,9,10,11
due Monday, November 28, 2016

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2 sessions: 09:00-12:00; 13:00-17:00; (this may change)

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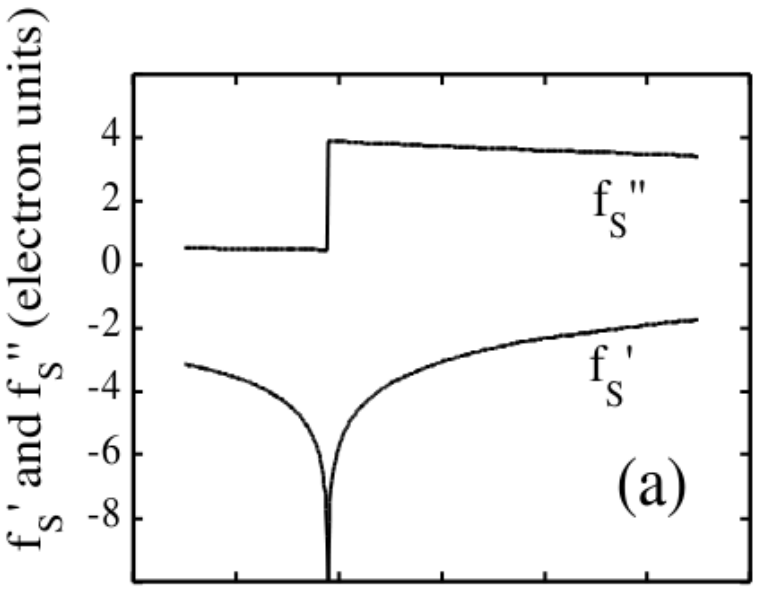

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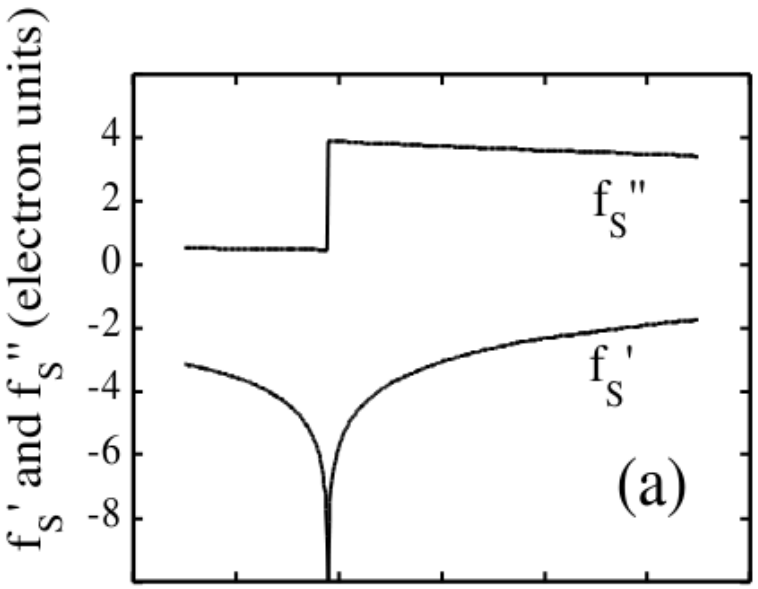

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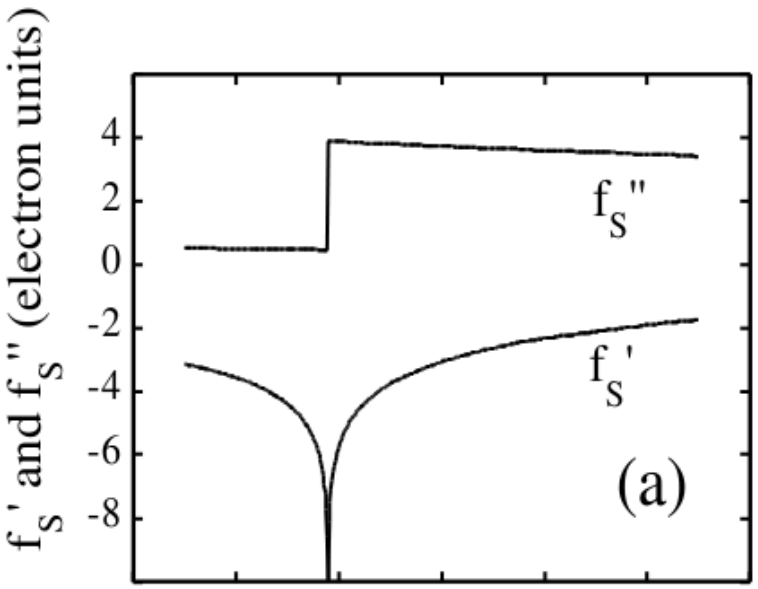

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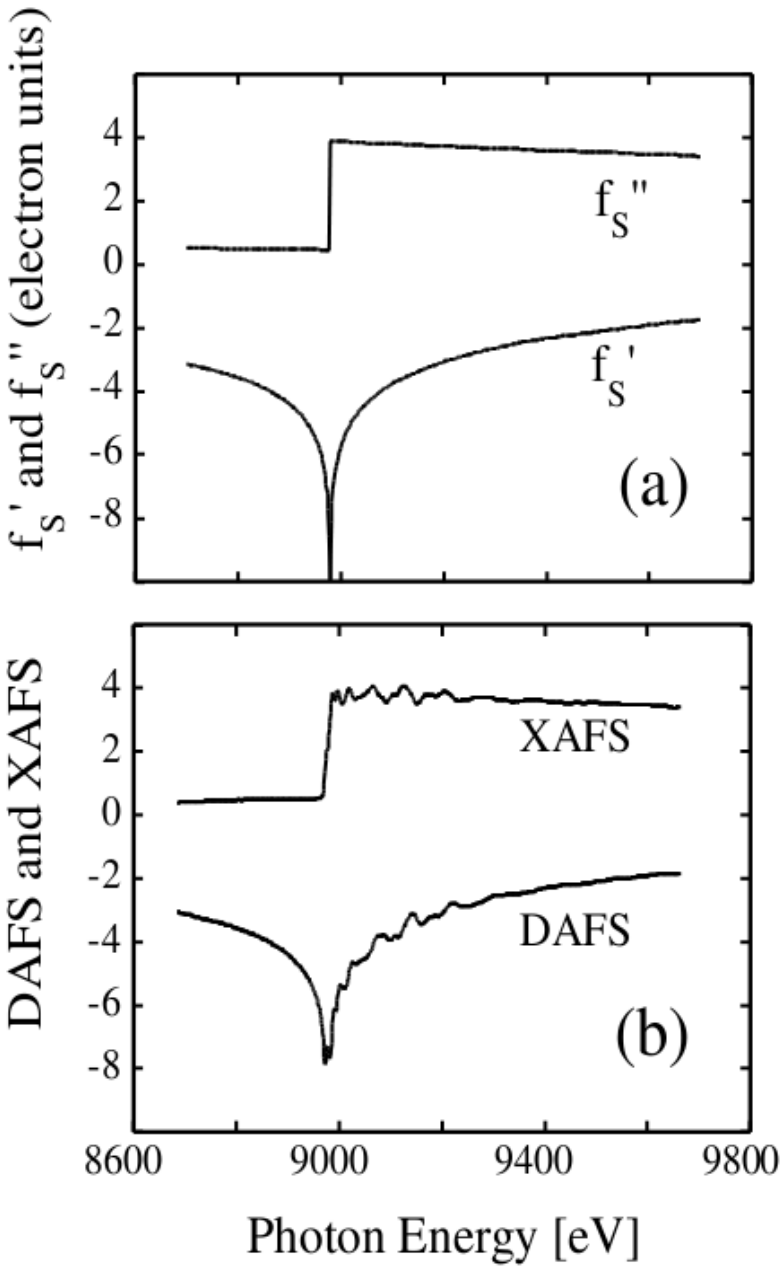

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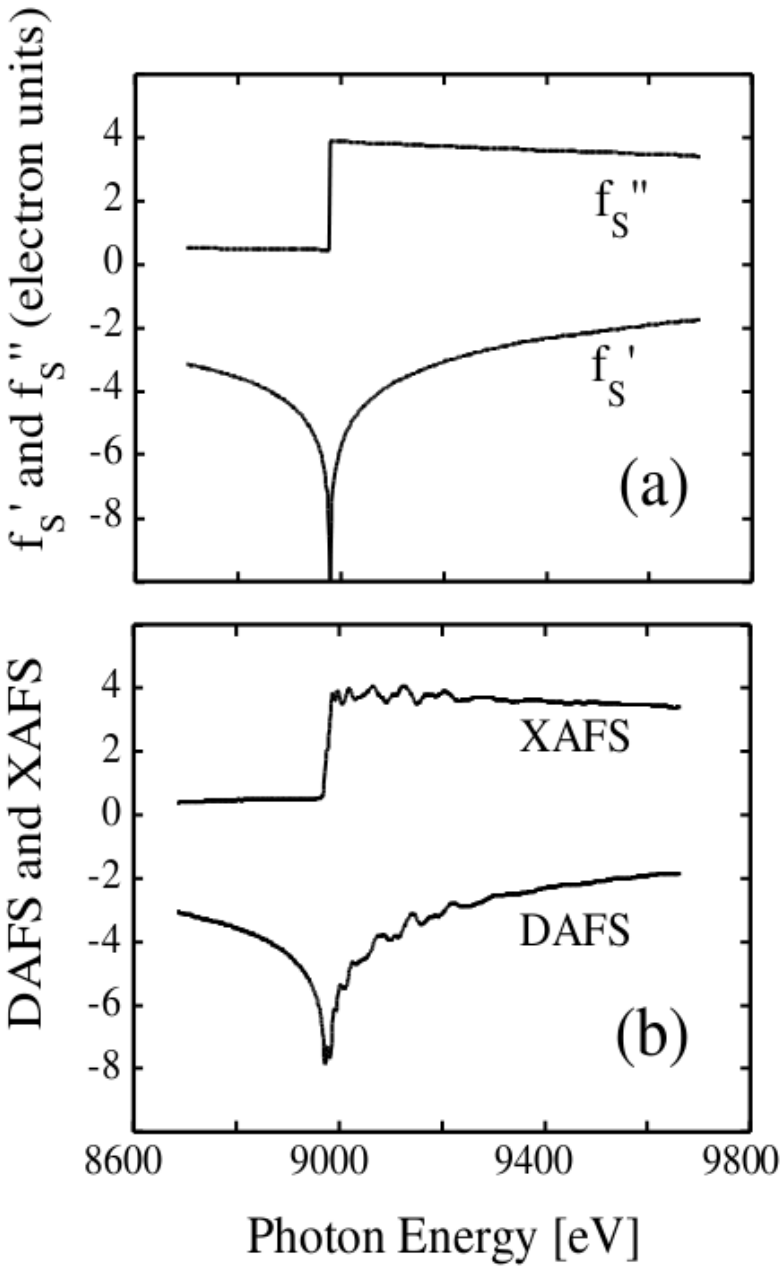

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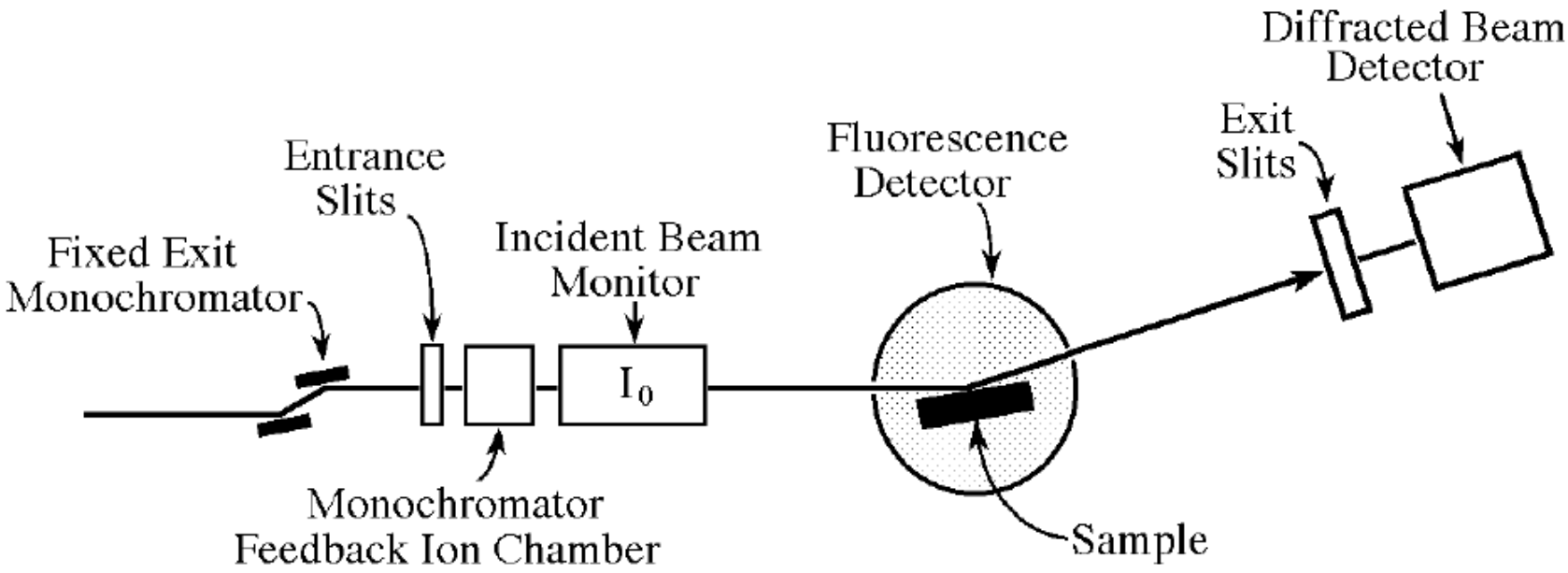
This can be measured in Bragg reflections contributed to by the atom with the absorption edge and exploited to extract site specific information

The DAFS experiment



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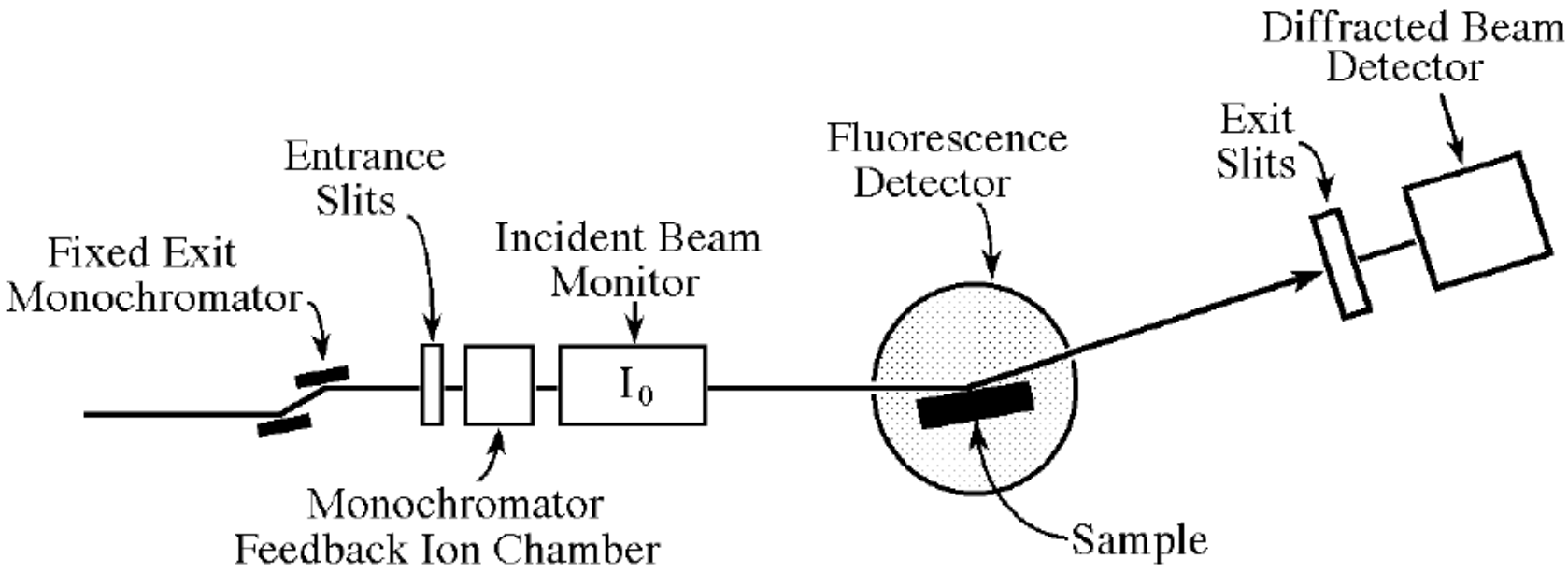

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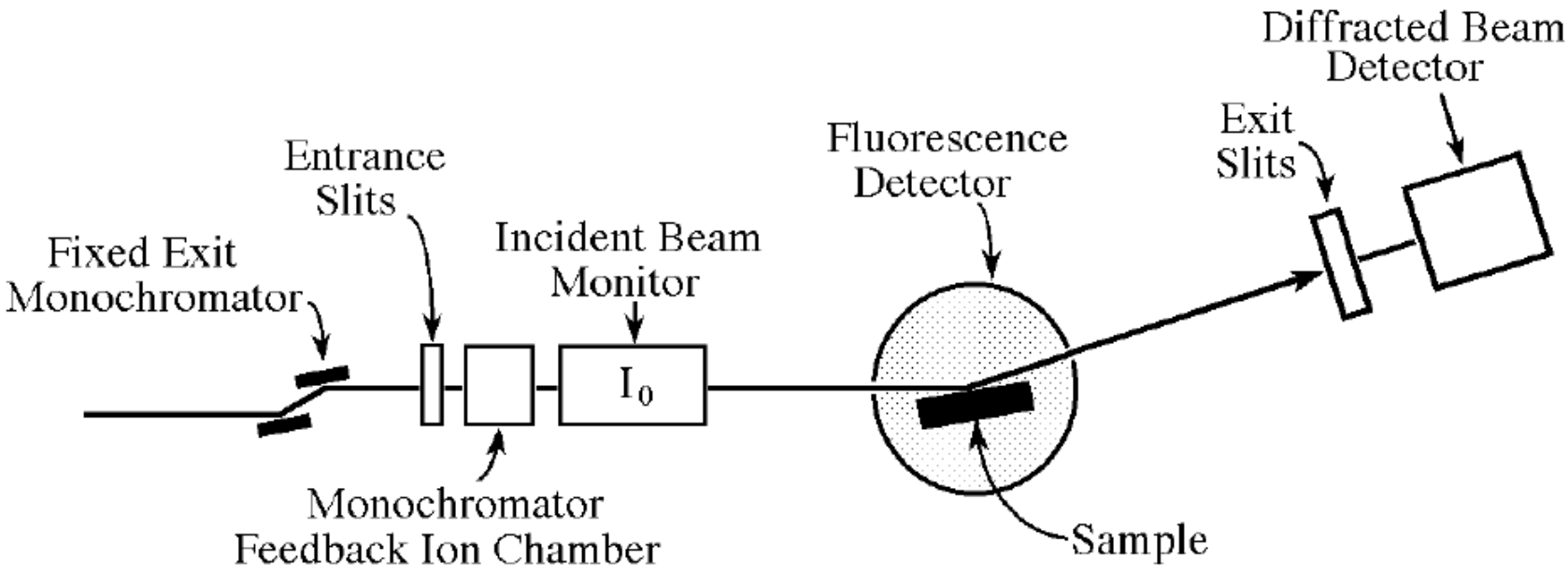

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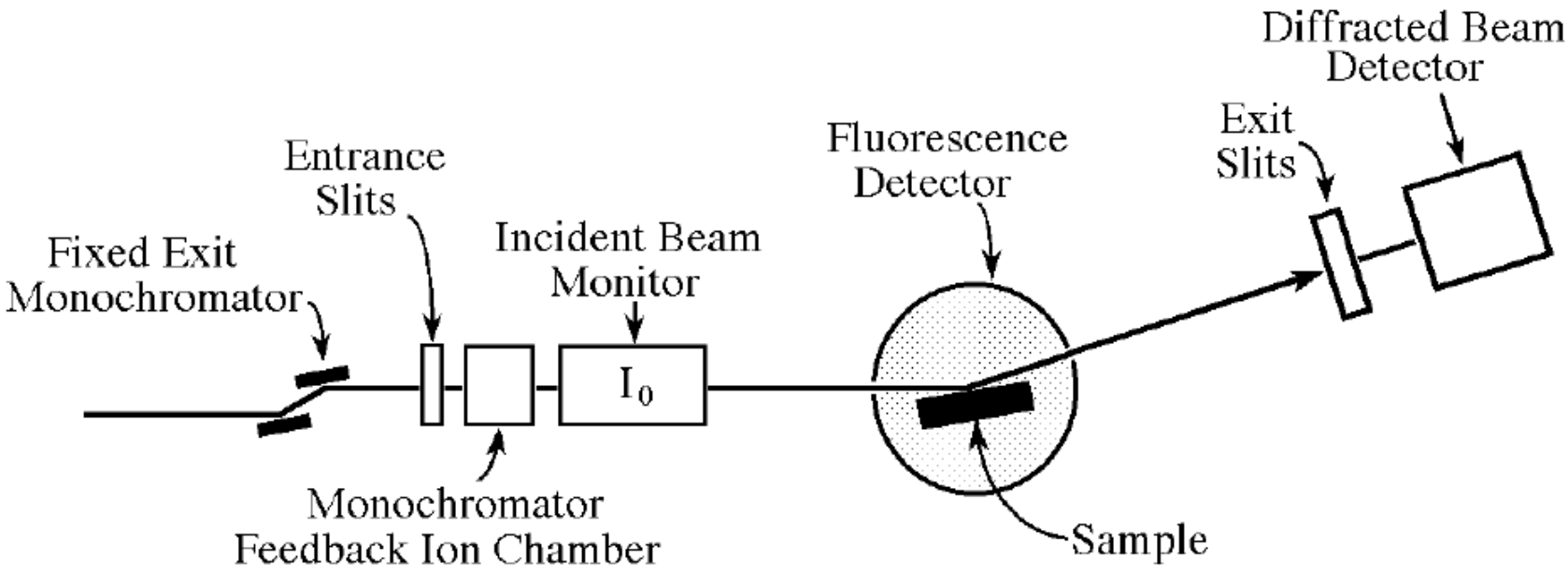

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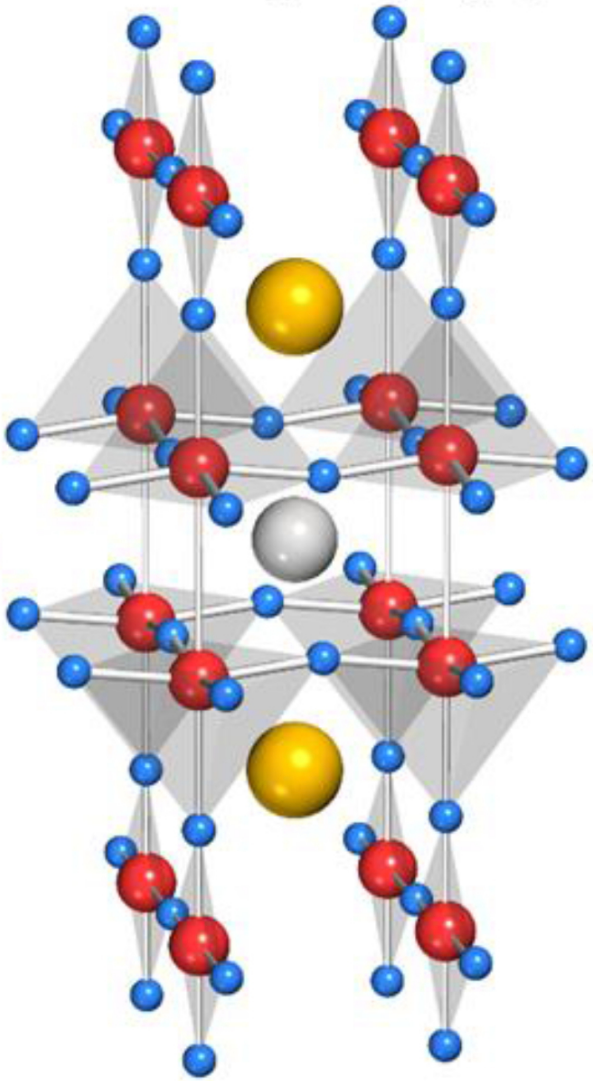
Initially experiments were done on single crystals but now DAFS on powders can be performed

DAFS of $YBa_2Cu_3O_7$



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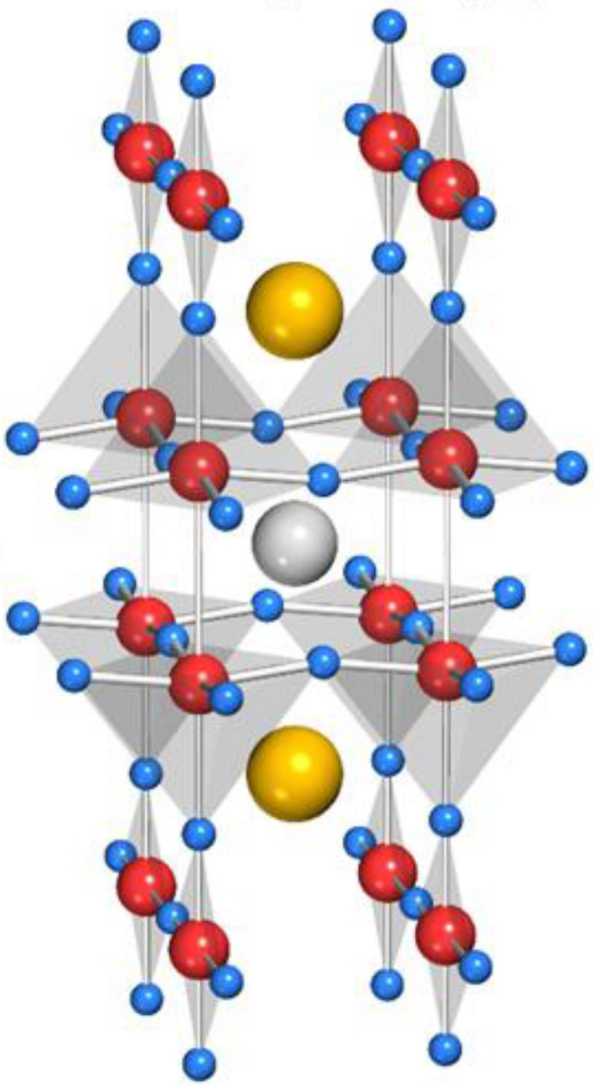

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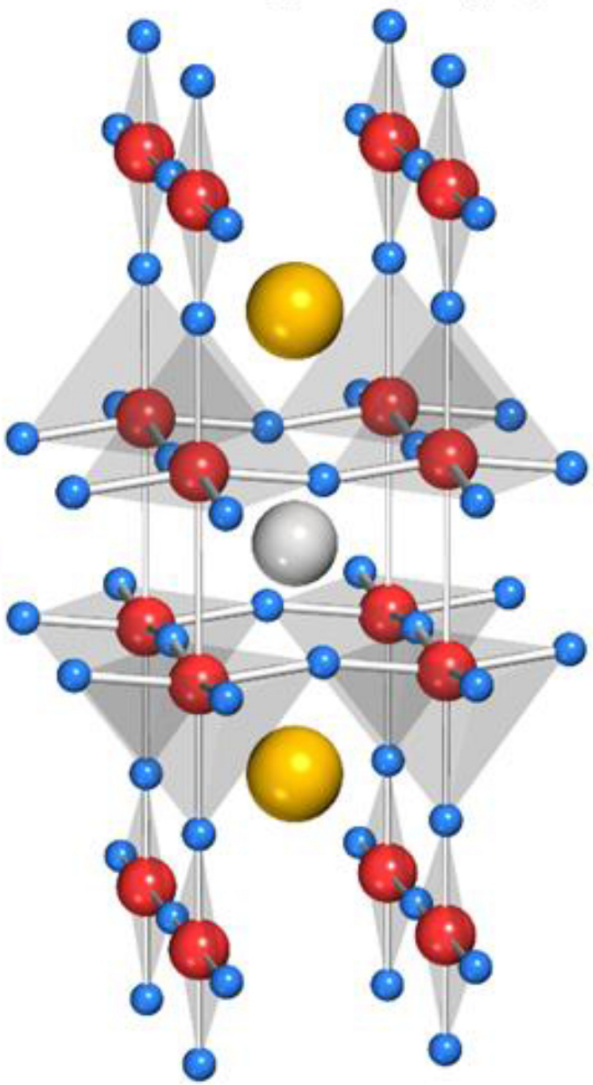

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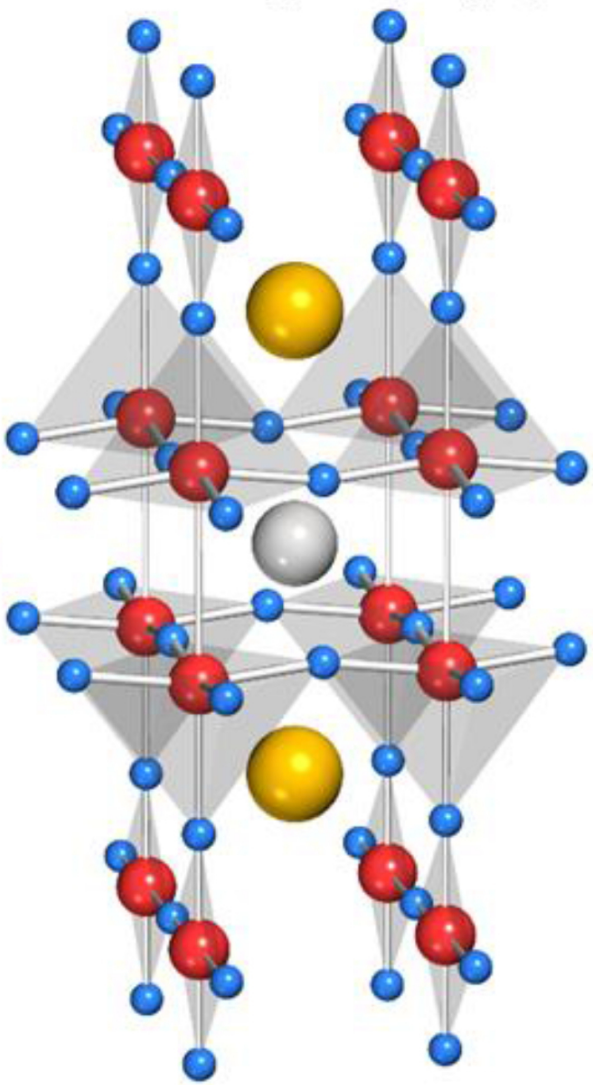

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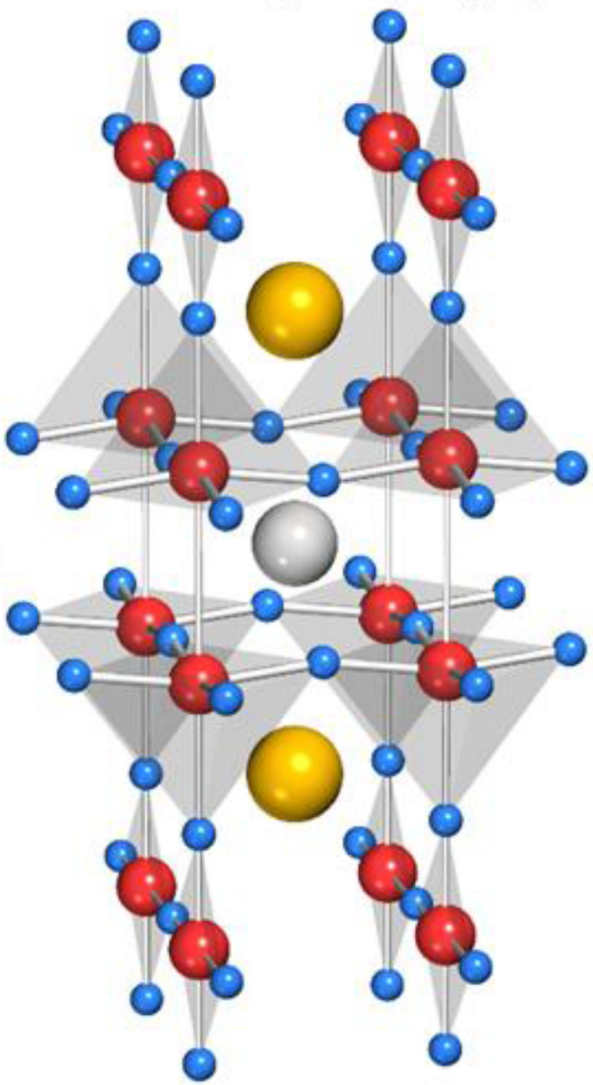

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by measuring the DAFS of multiple diffraction peaks, it is possible to separate the EXAFS of the two Cu sites

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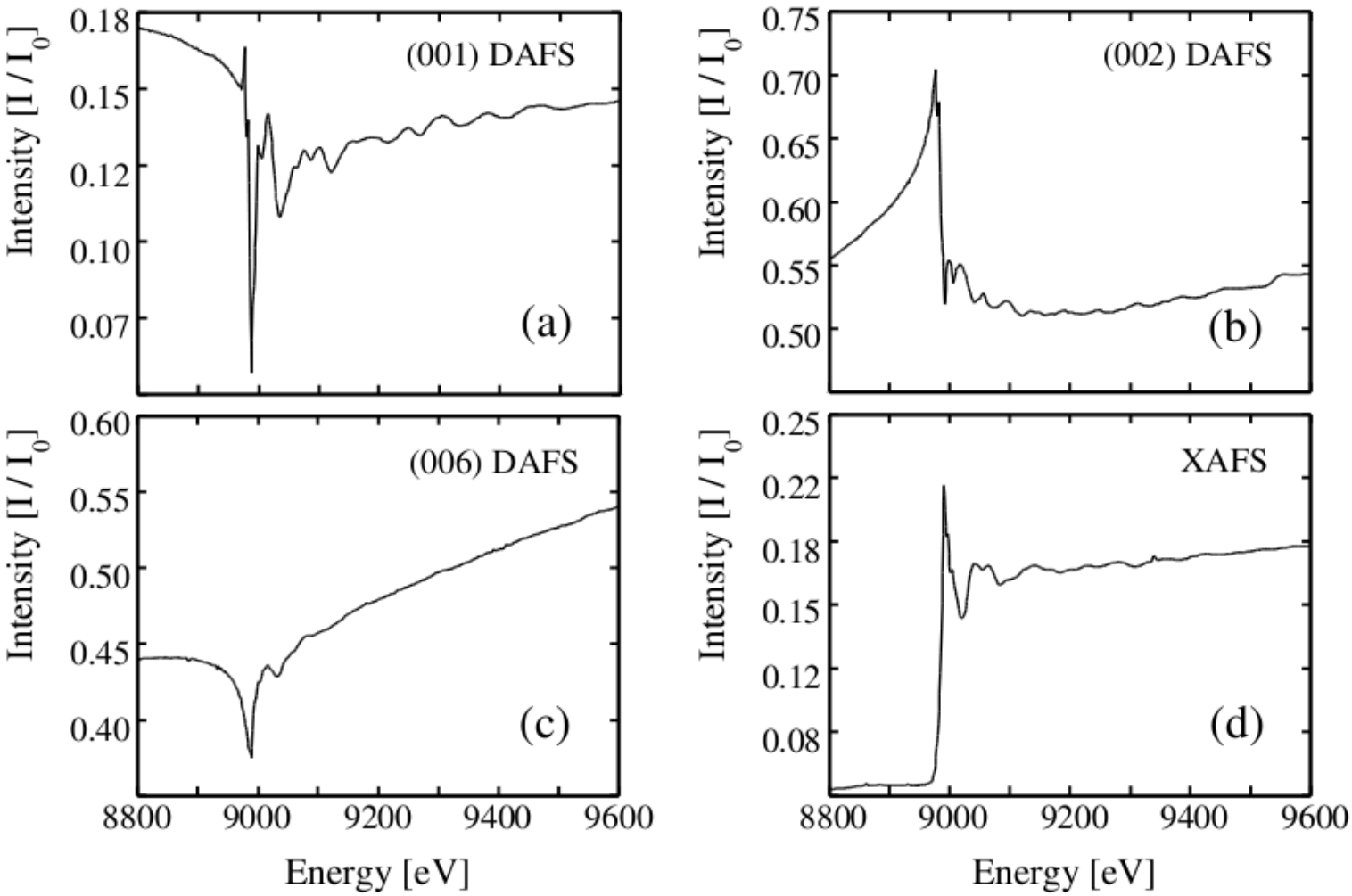

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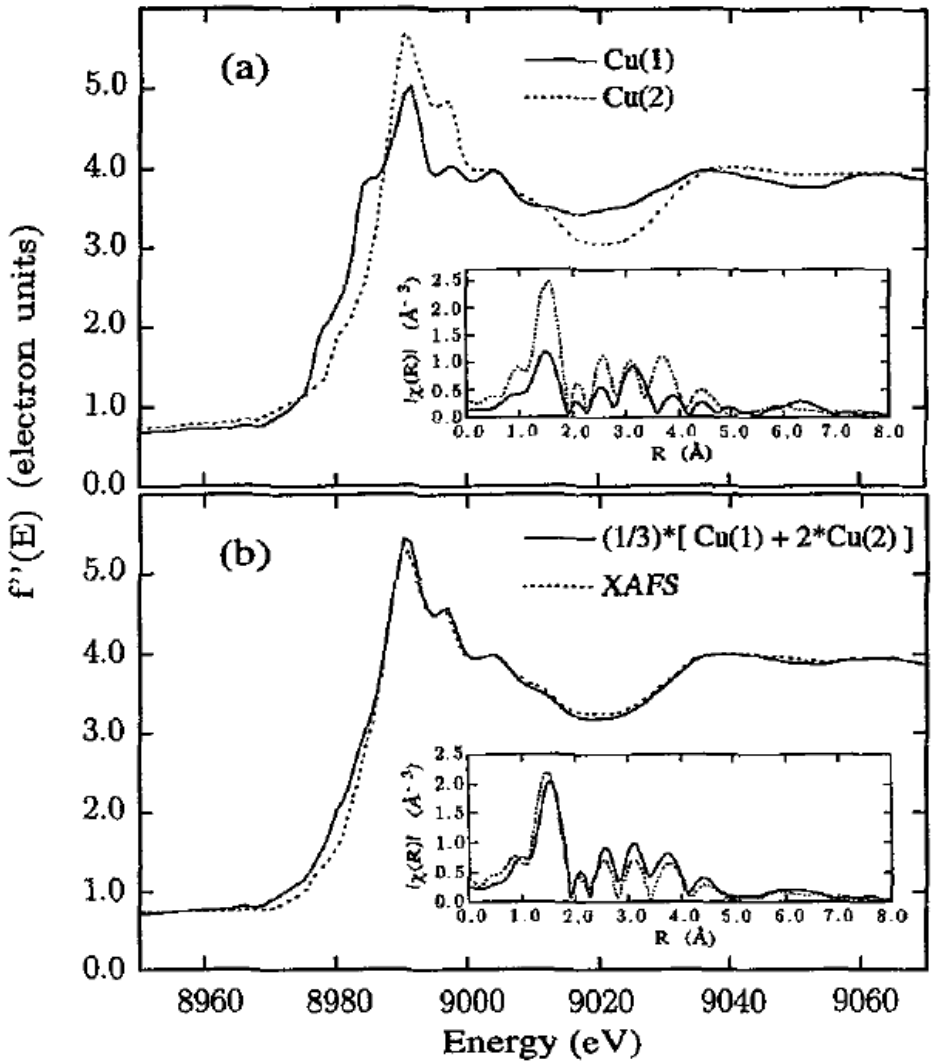

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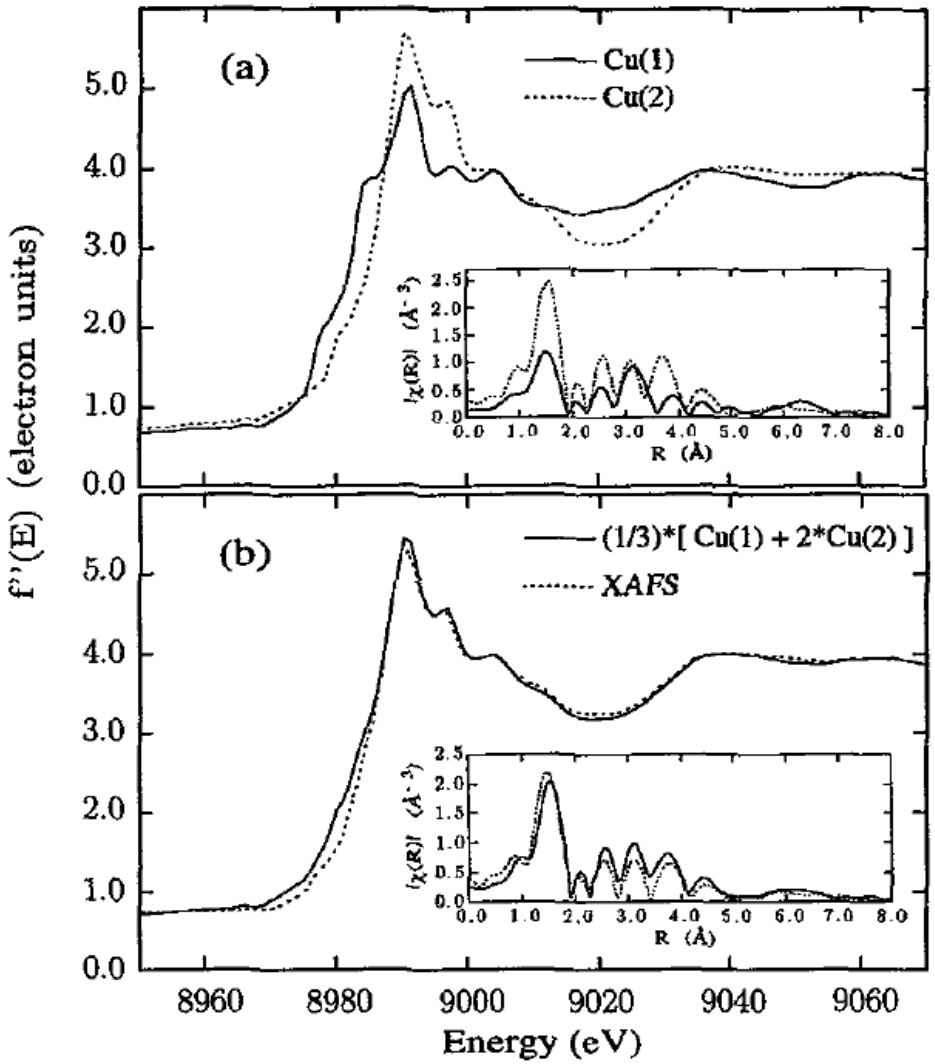

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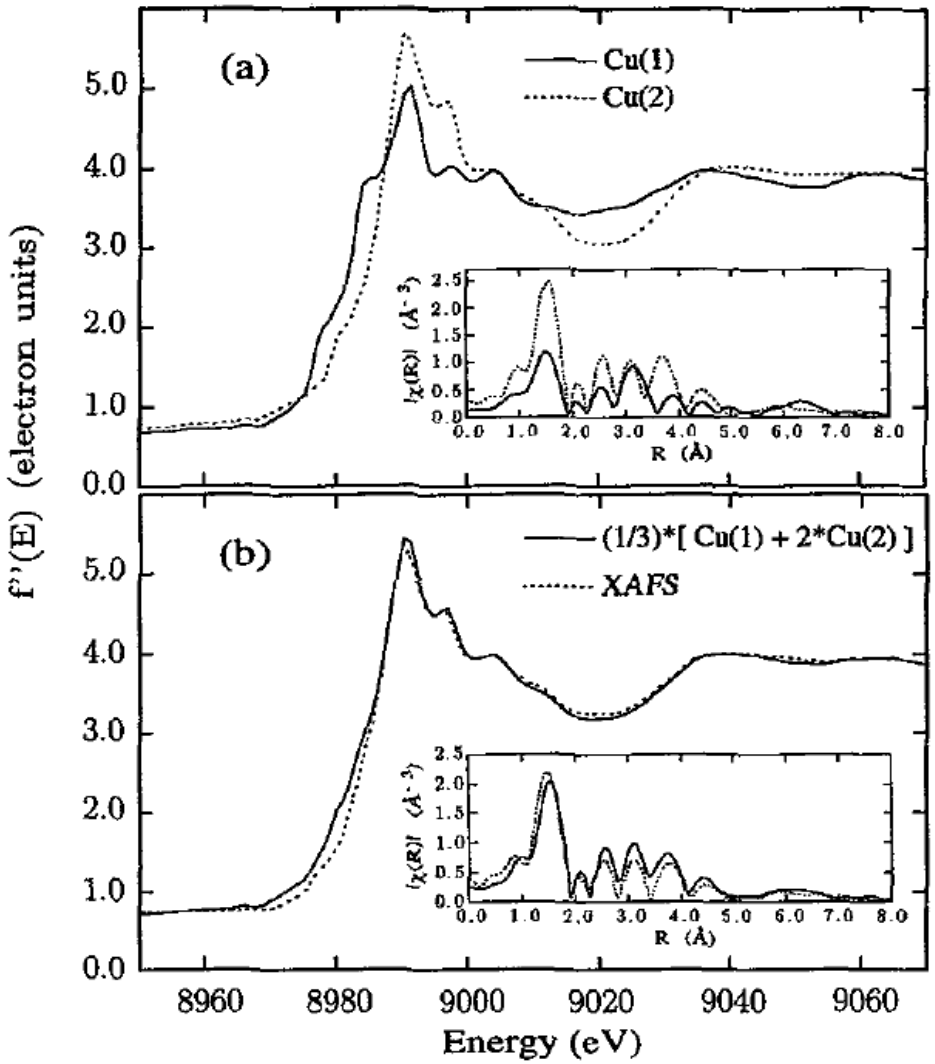

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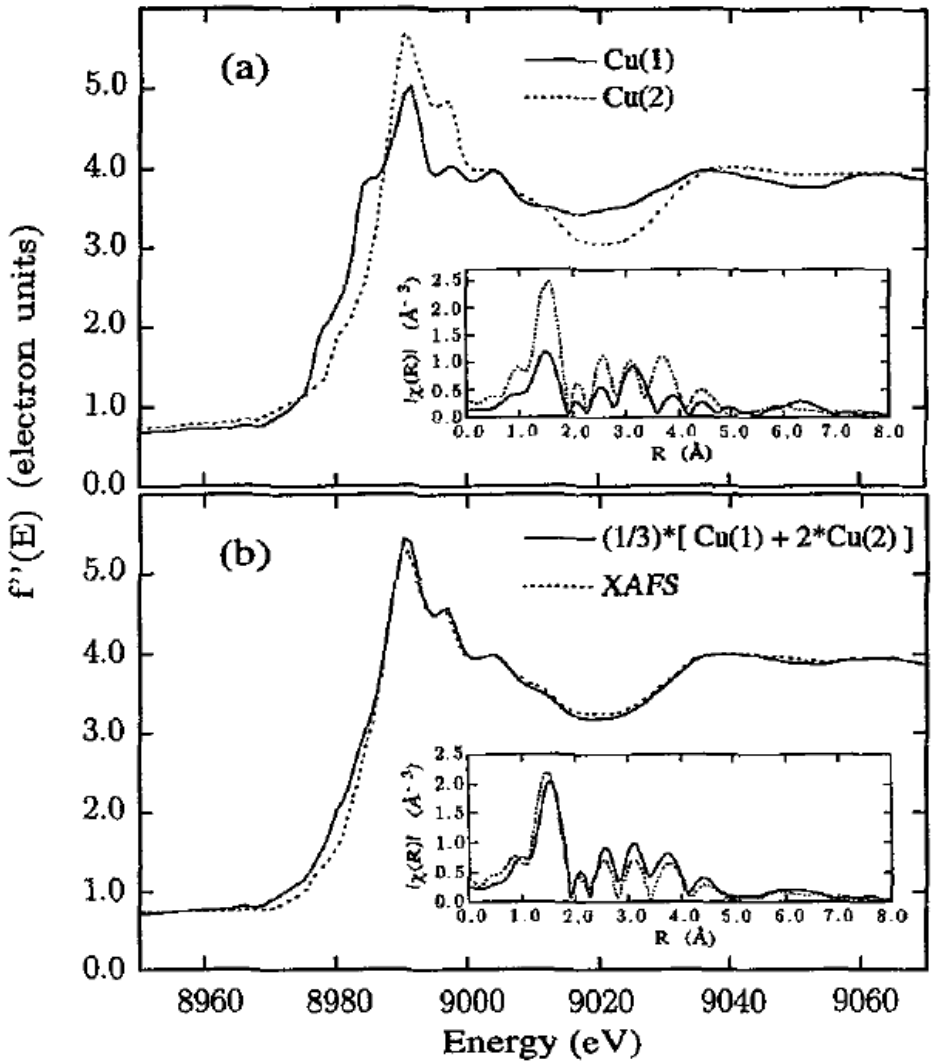

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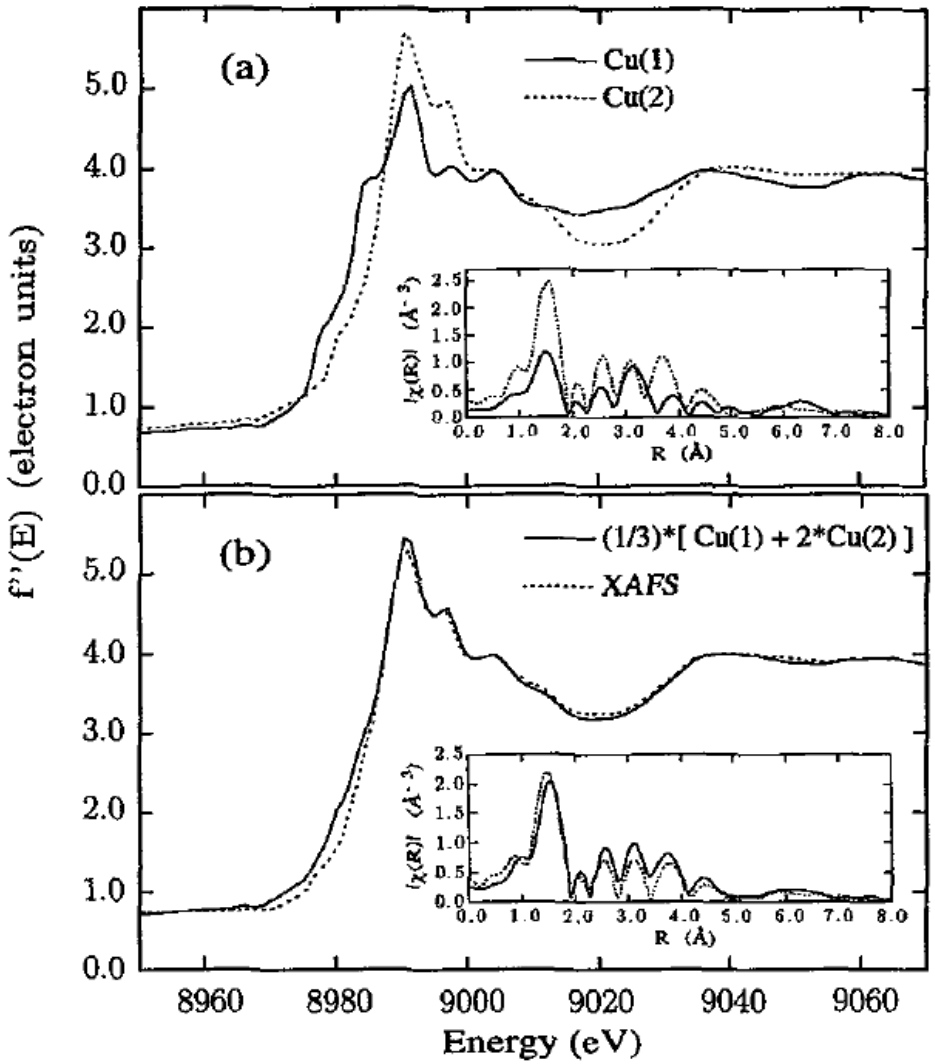

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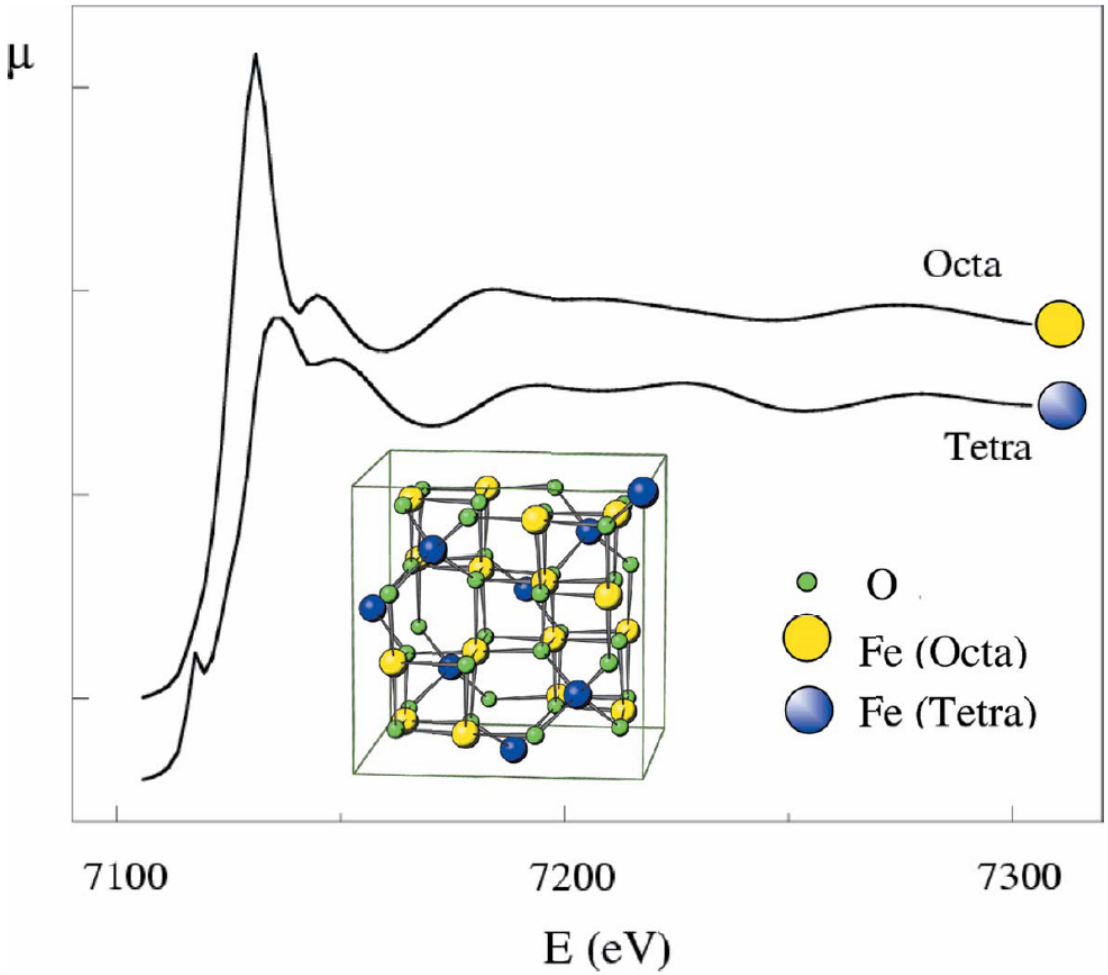

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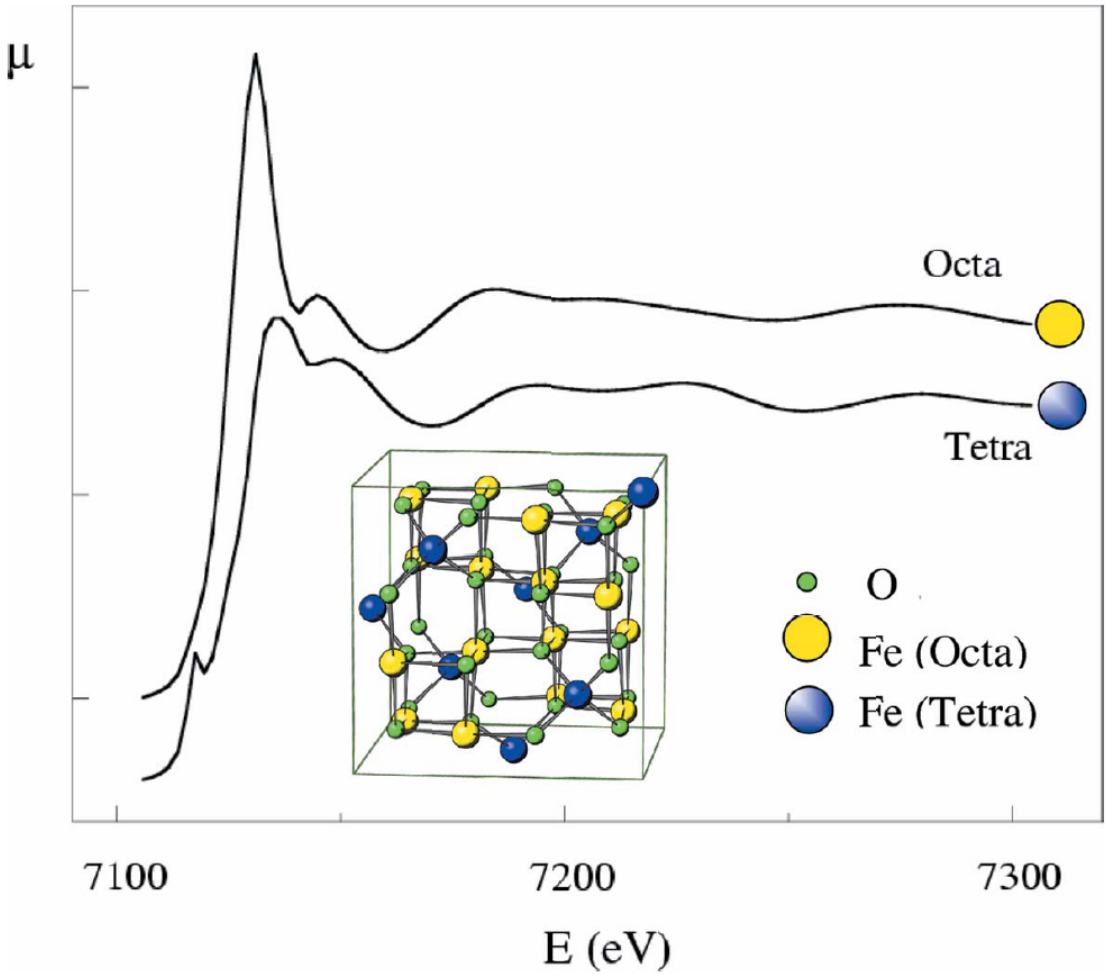

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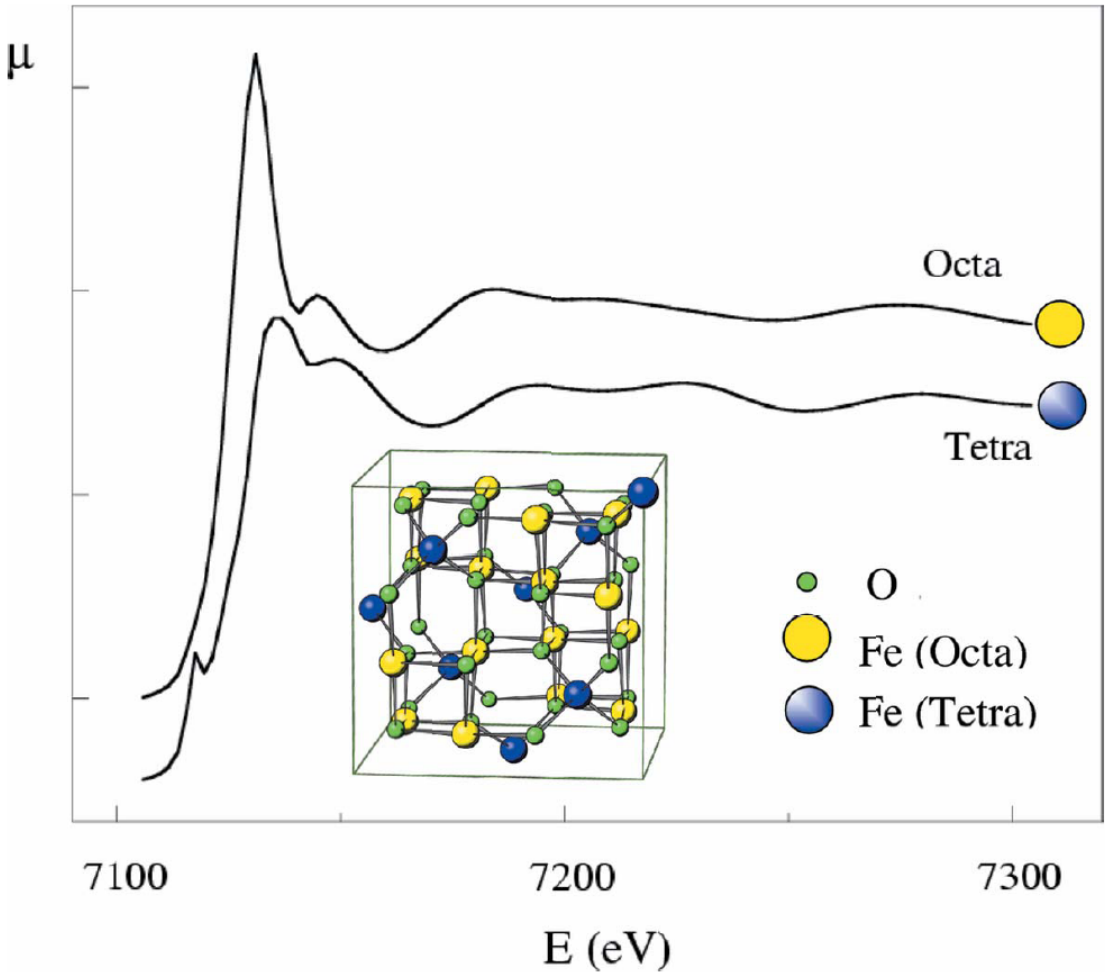
DAFS can also be used to separate different phases which contain the same element in a heterogeneous system or closely overlapping absorption edges



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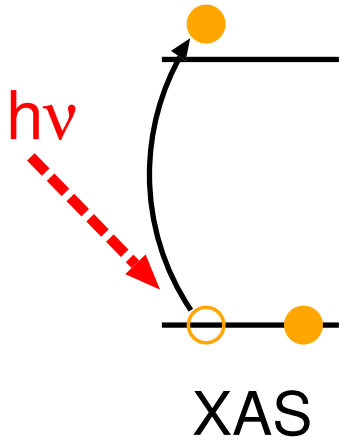

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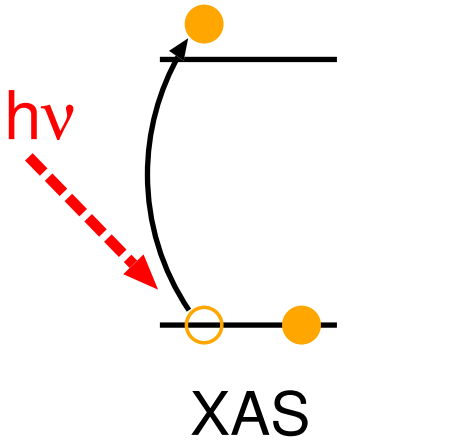

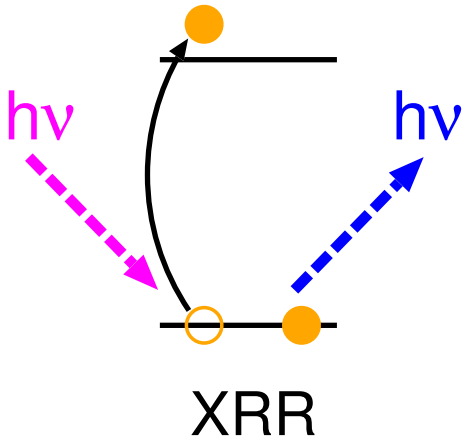

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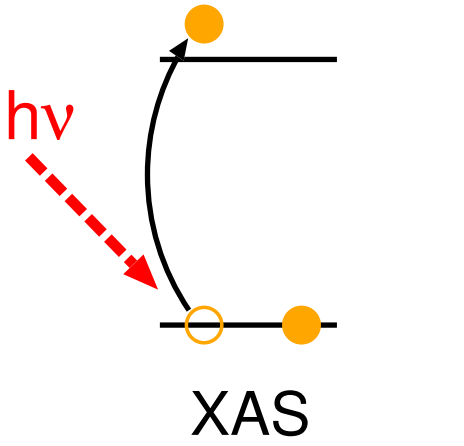

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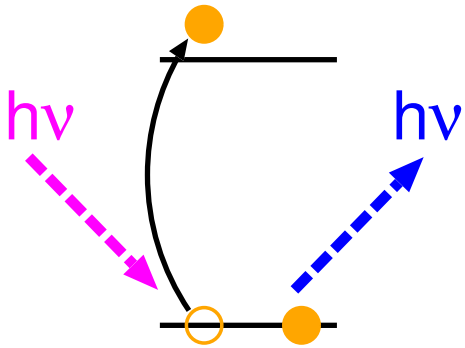

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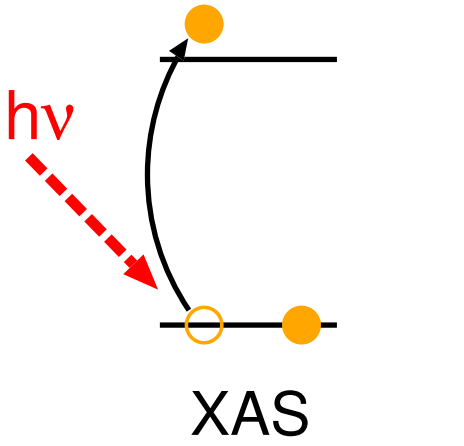

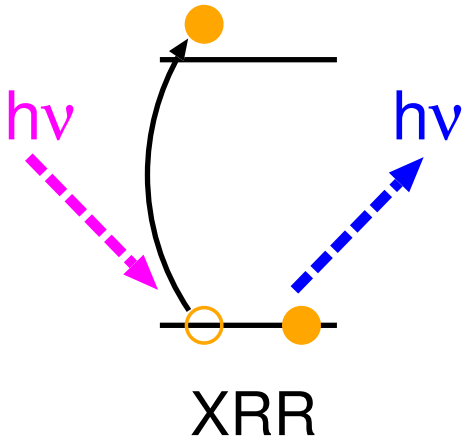

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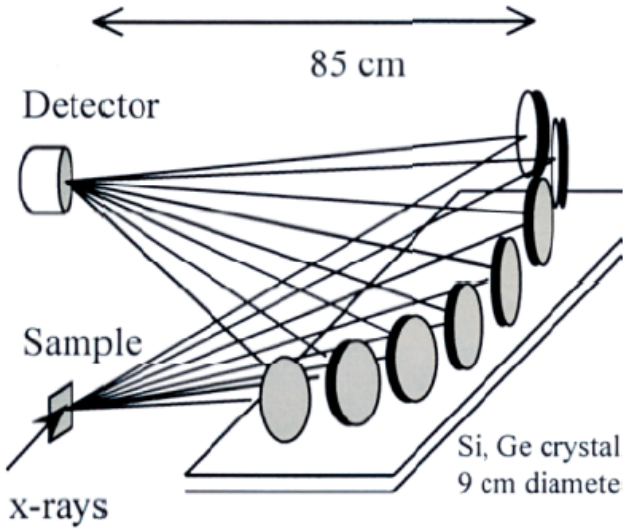
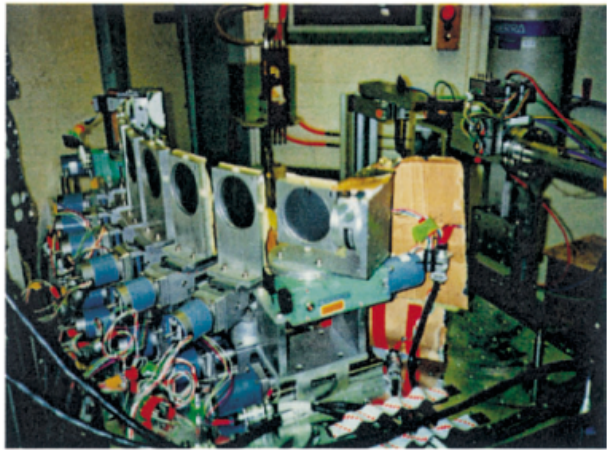
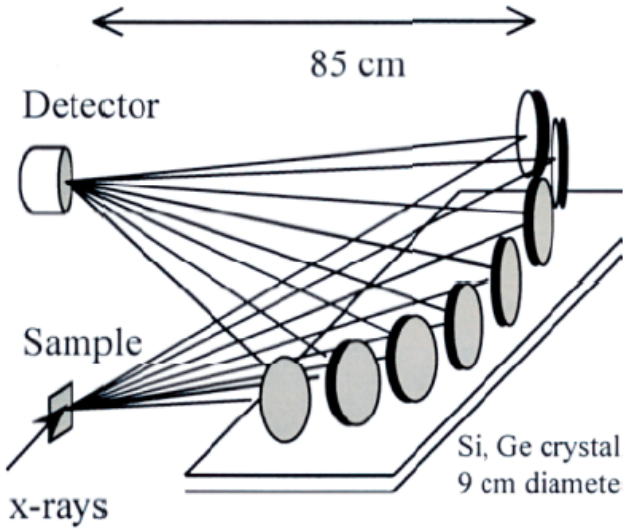
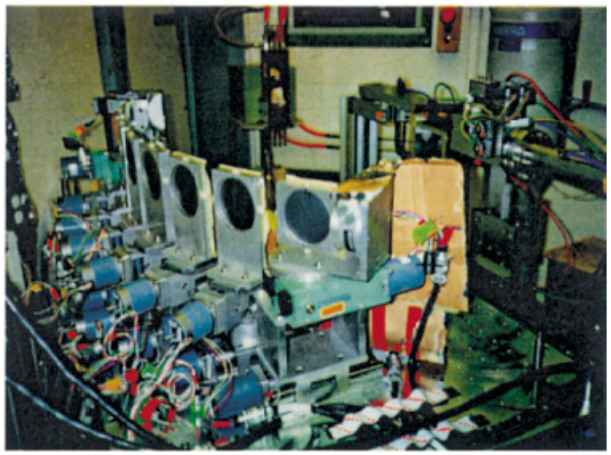


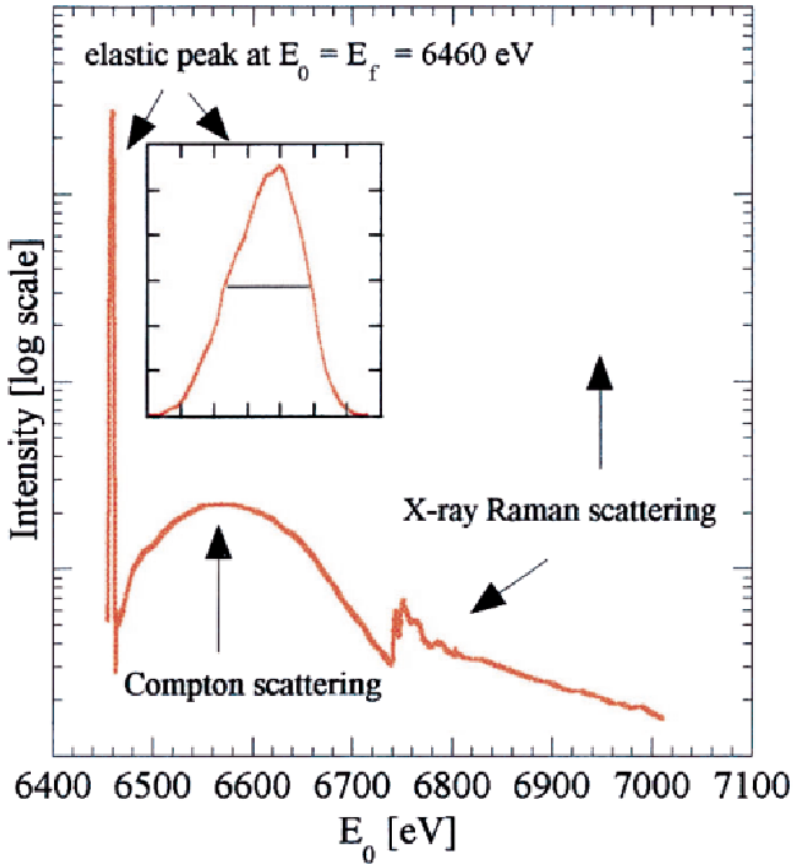


"Bulk-sensitive XAS characterization of light elements: from x-ray Raman scattering to x-ray Raman spectroscopy," U. Bergmann, P. Glatzel, and S. Cramer, *Microchem. J.* **71**, 221-230 (2002)

The XRR experiment







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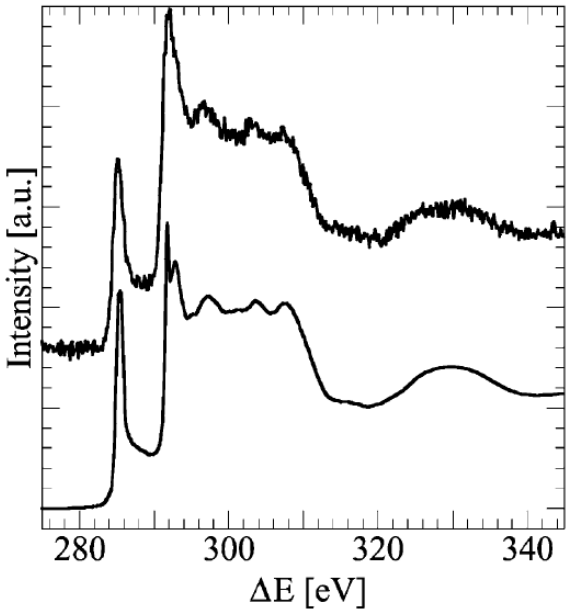
XRR spectra of light elements



Comparison of XRR and XAS on graphite

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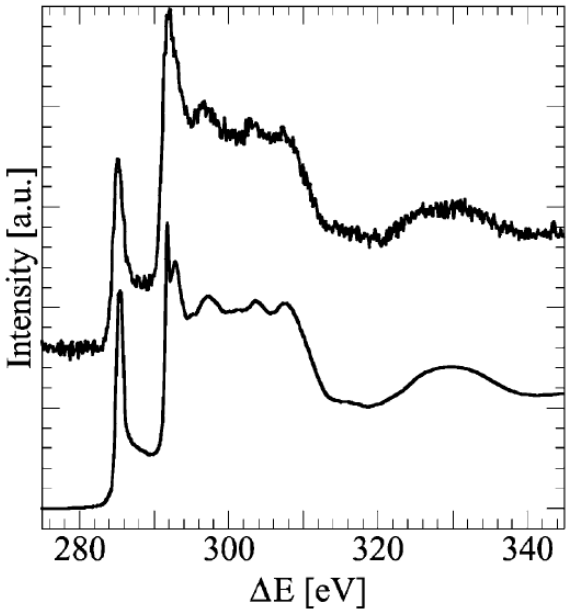

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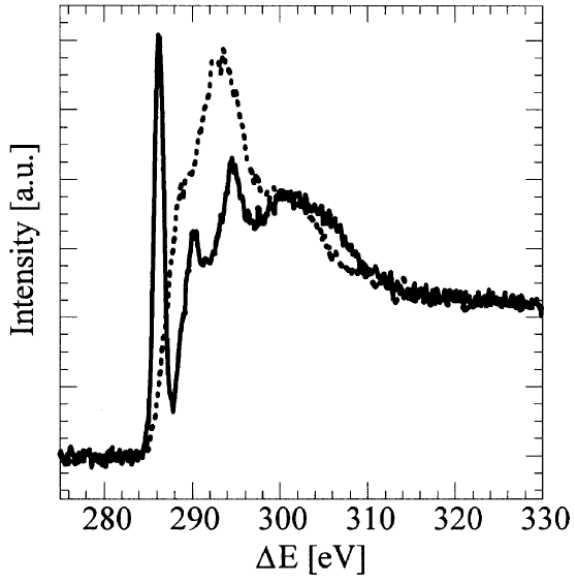

Aromatic (solid) and aliphatic (dashed) carbon K-edge x-ray Raman spectra

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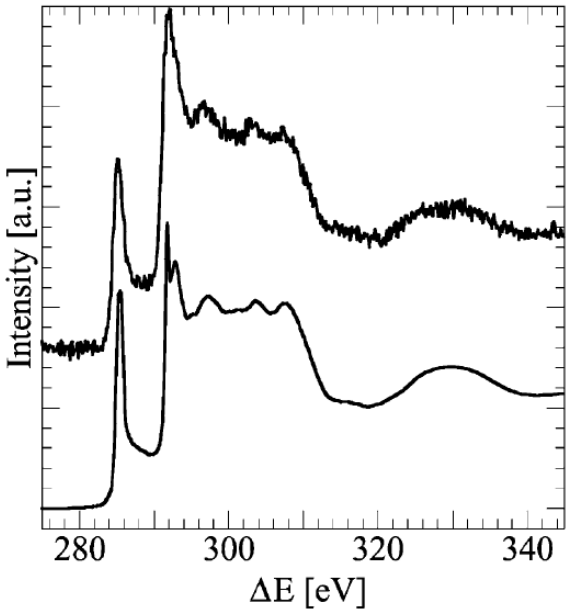

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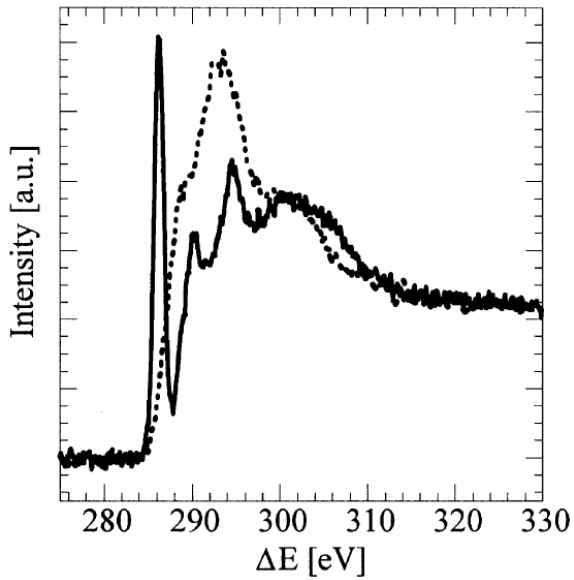

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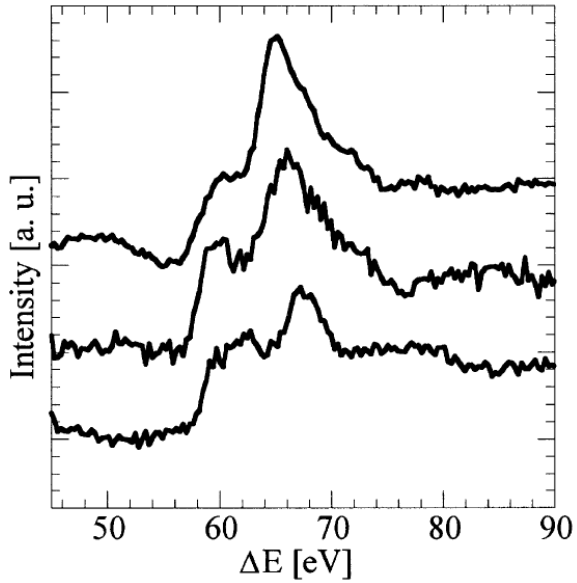

Li K-edge spectra for $LiOH \cdot H_2O$ (top), Li_2CO_3 (middle), and Li_4SiO_4 (bottom).

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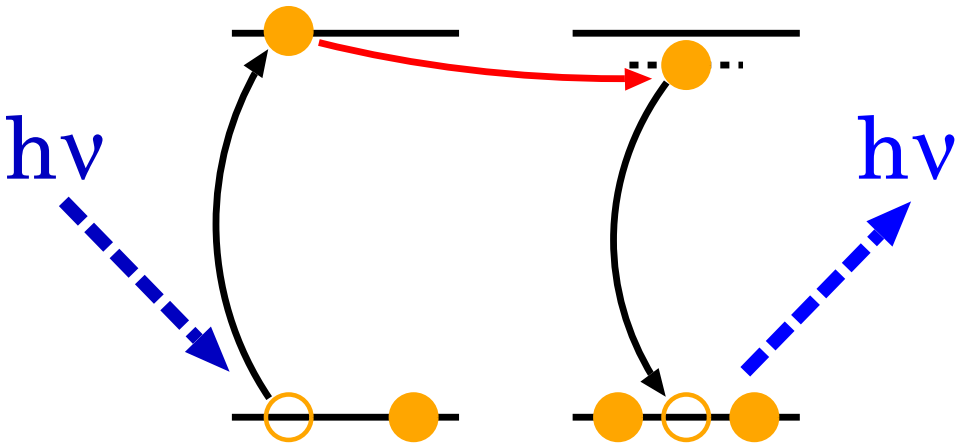
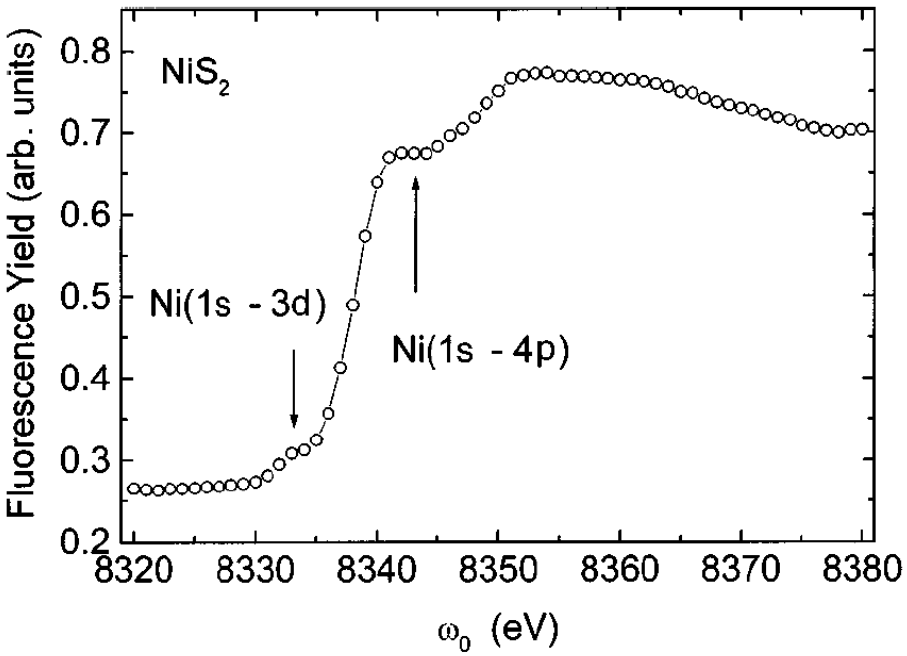
Resonant inelastic x-ray scattering (RIXS)



RIXS measures electronic excitations



"Resonant inelastic x-ray scattering," P.M. Platzman and E.D. Isaacs, *Phys. Rev. B* **57**, 11108 (1998)

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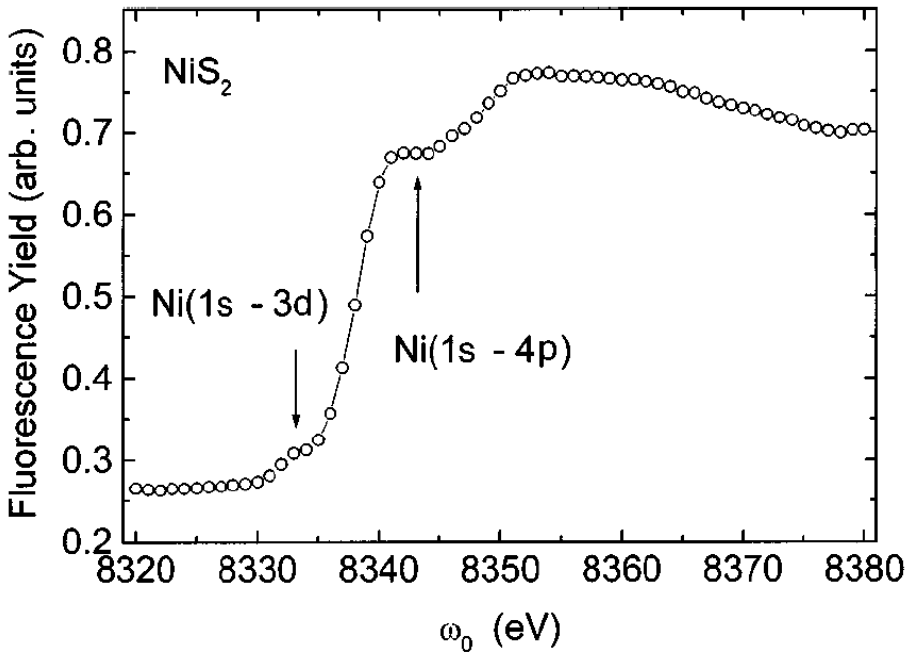

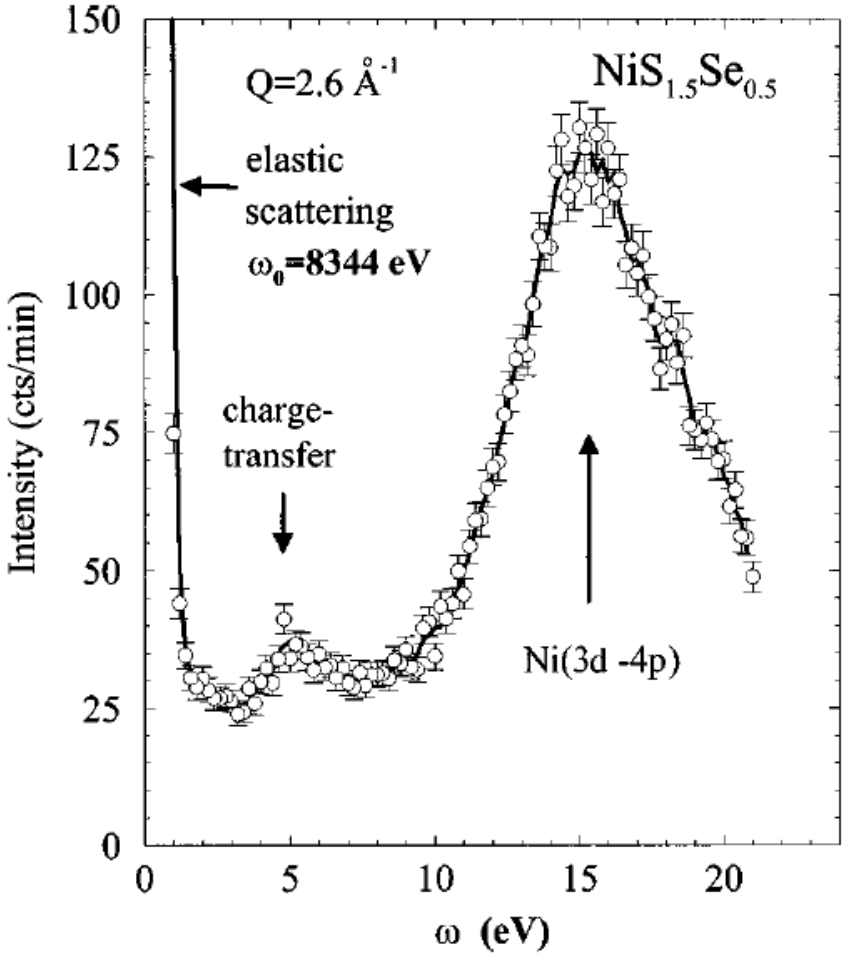

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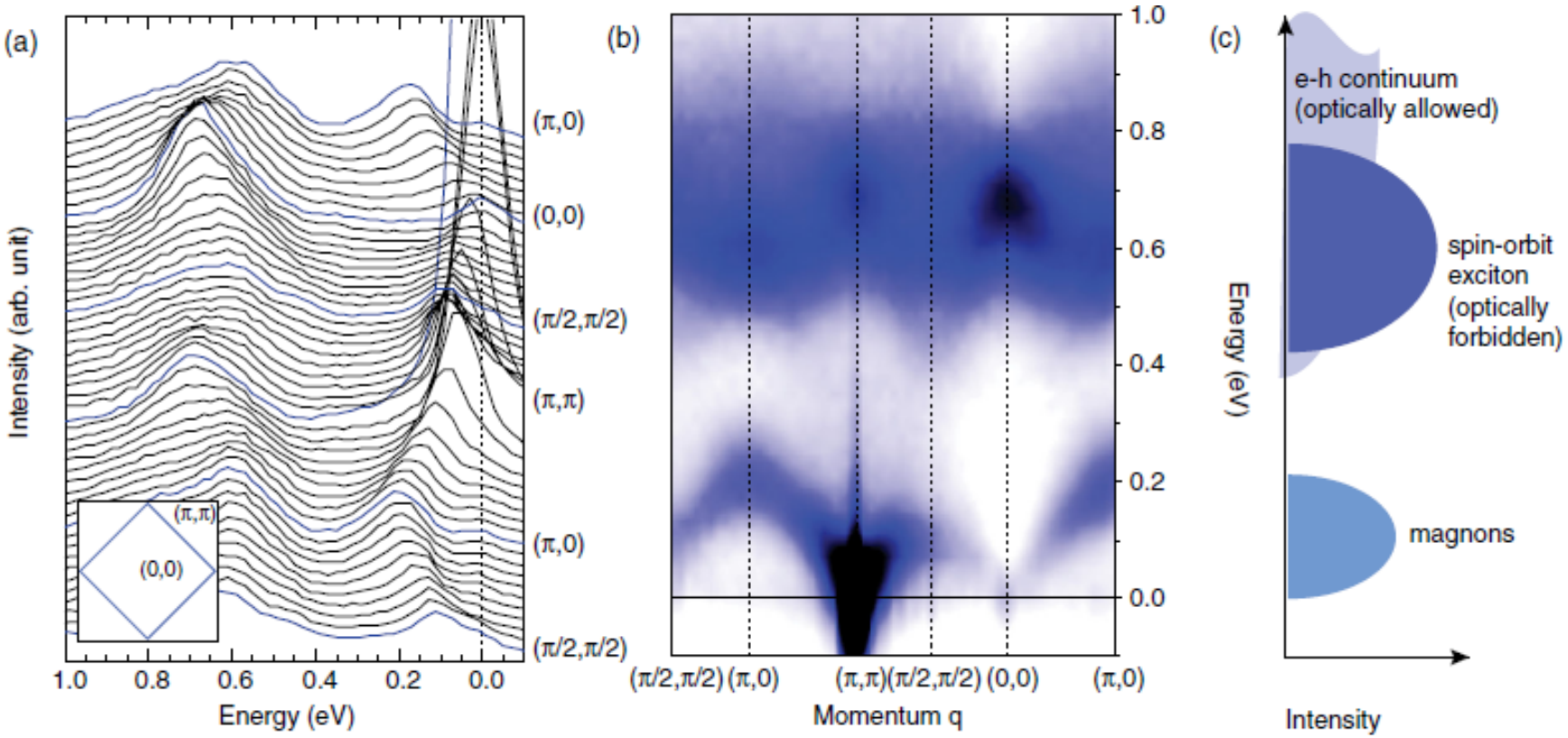
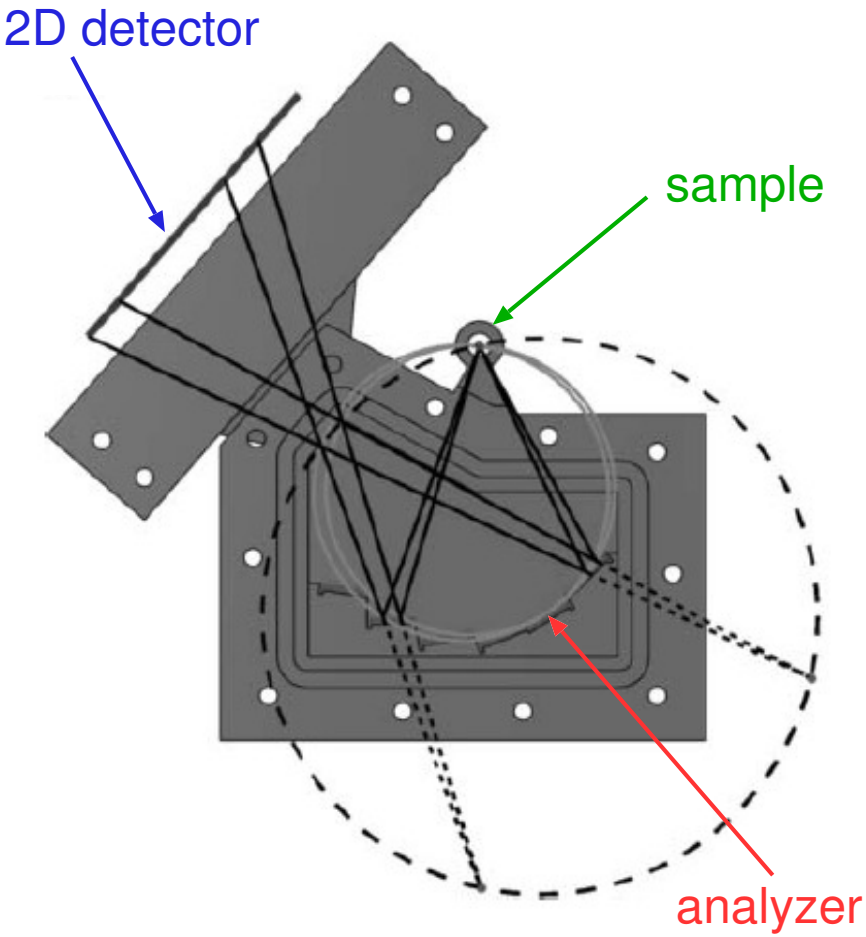
RIXS example



"Magnetic excitation spectra of Sr_2IrO_4 probed by resonant inelastic x-ray scattering: Establishing links to cuprate superconductors," J. Kim, D. Casa, M.H. Upton, T. Gog, Y.-J. Kim, J.F. Mitchell, M. van Veenendaal, M. Daghofer, J. van den Brink, G. Khaliullin, and B.J. Kim, *Phys. Rev. Lett.* **108**, 177003 (2012).

X-ray emission spectroscopy (XES)



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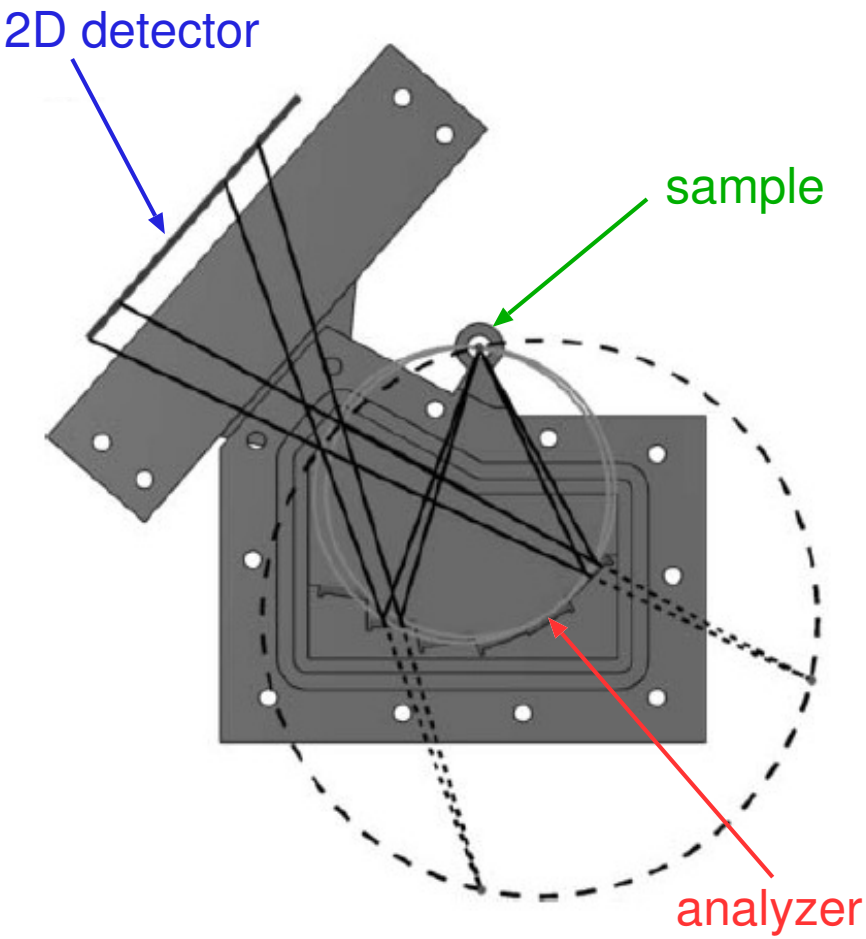

Normally a fluorescence line is measured with a detector which cannot resolve its fine structure

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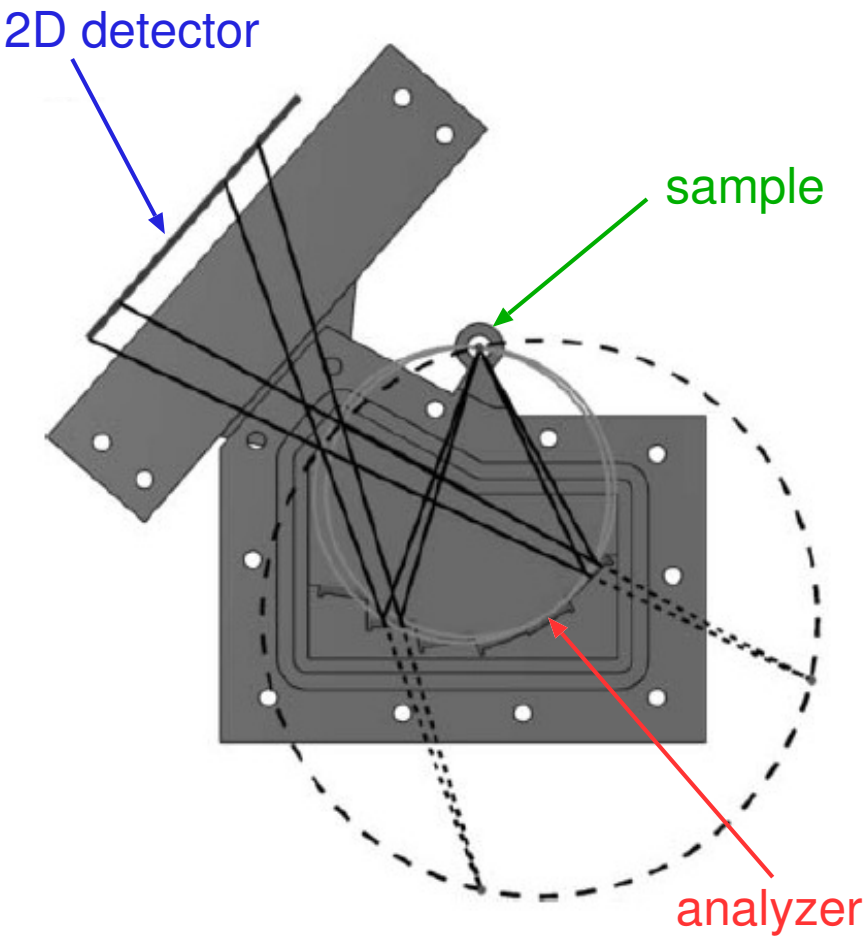

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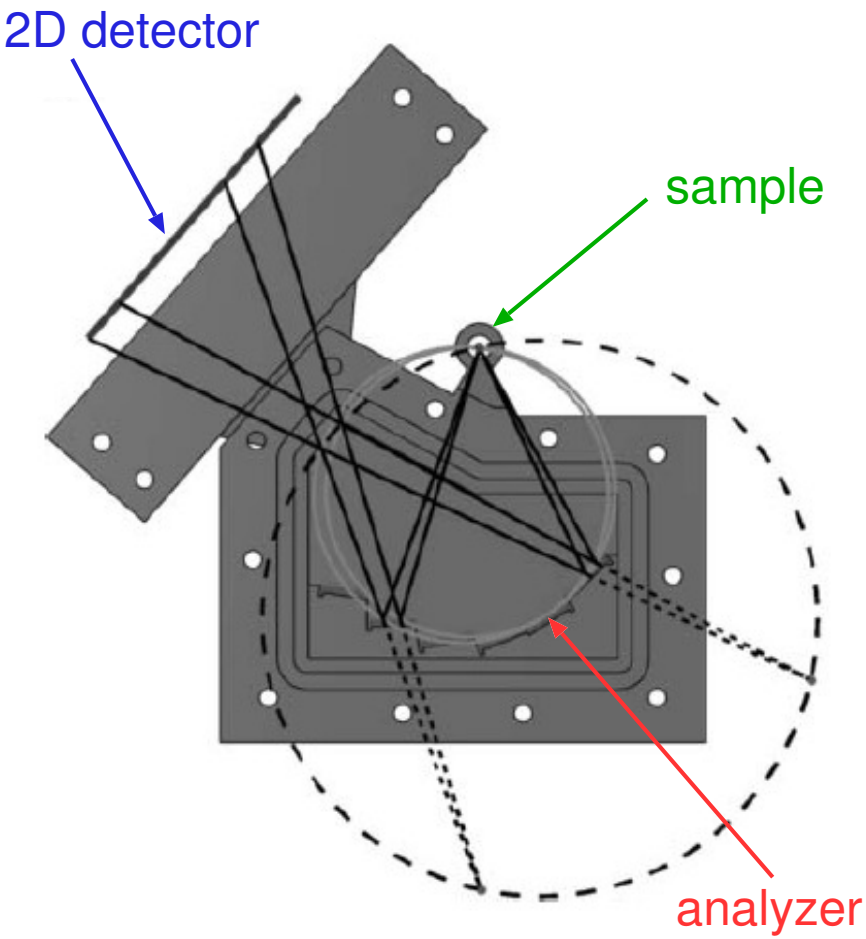

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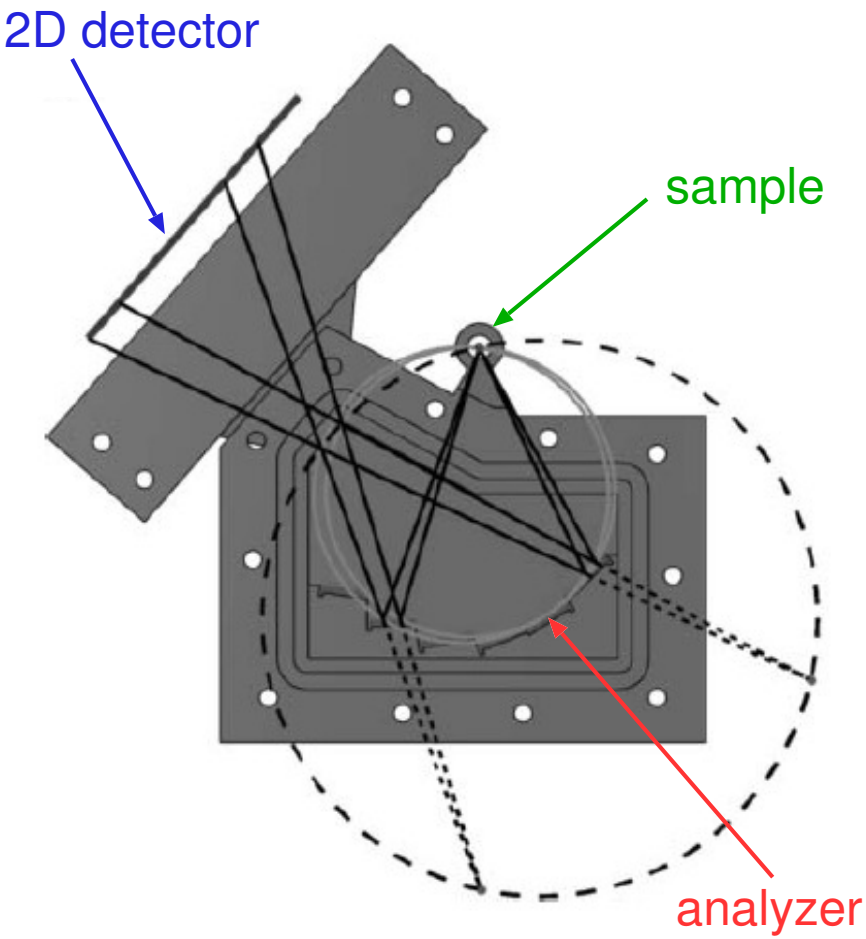

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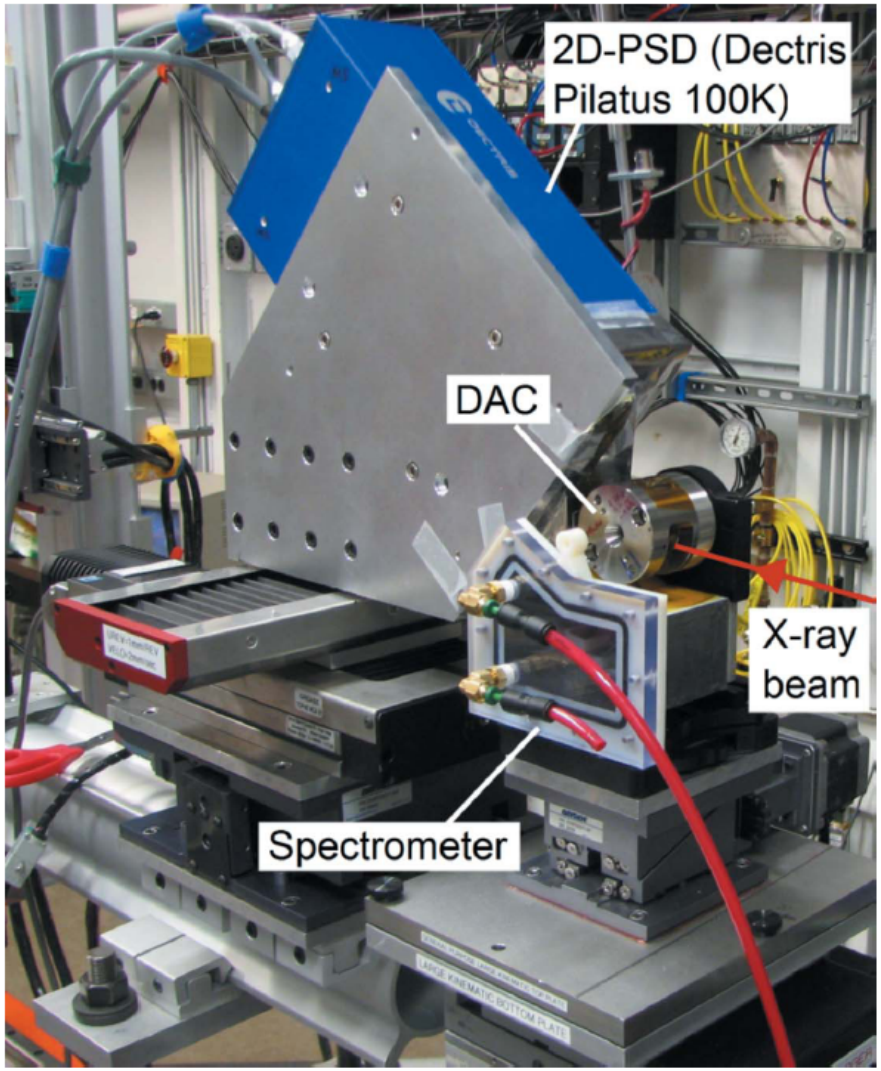

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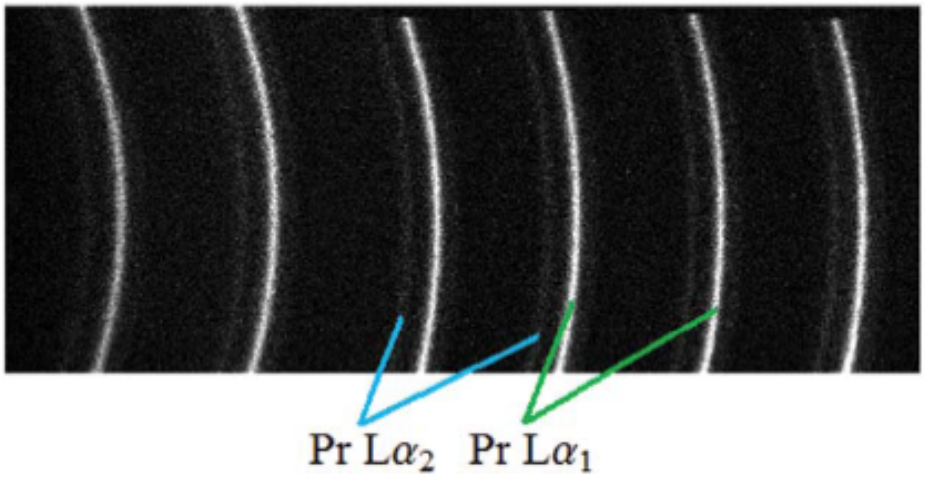
RIXS spectrometer performance



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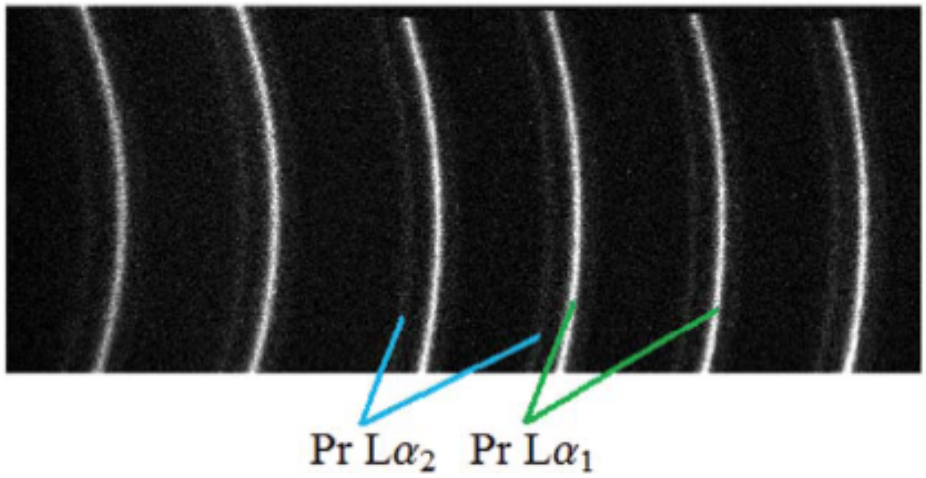

The Pr-containing sample is placed in a diamond anvil high pressure cell (DAC) and illuminated with energies near the Pr L_3 edge (5964 eV)

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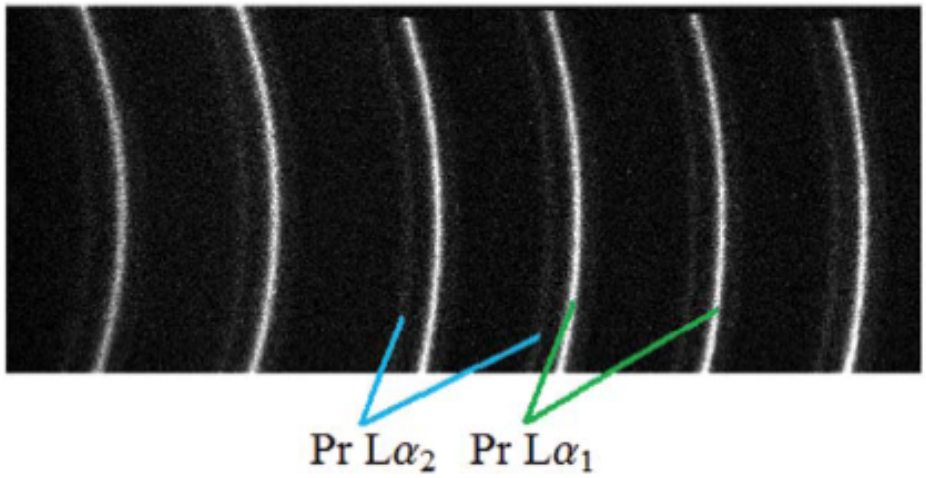

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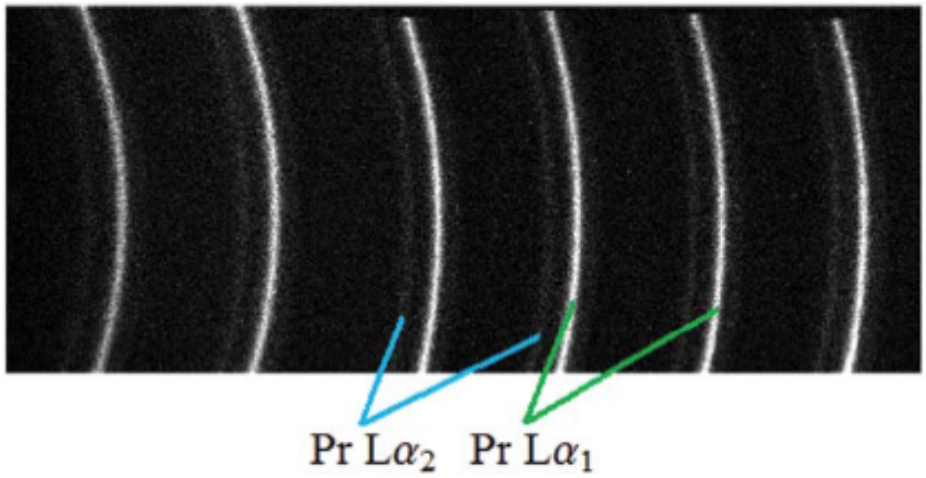

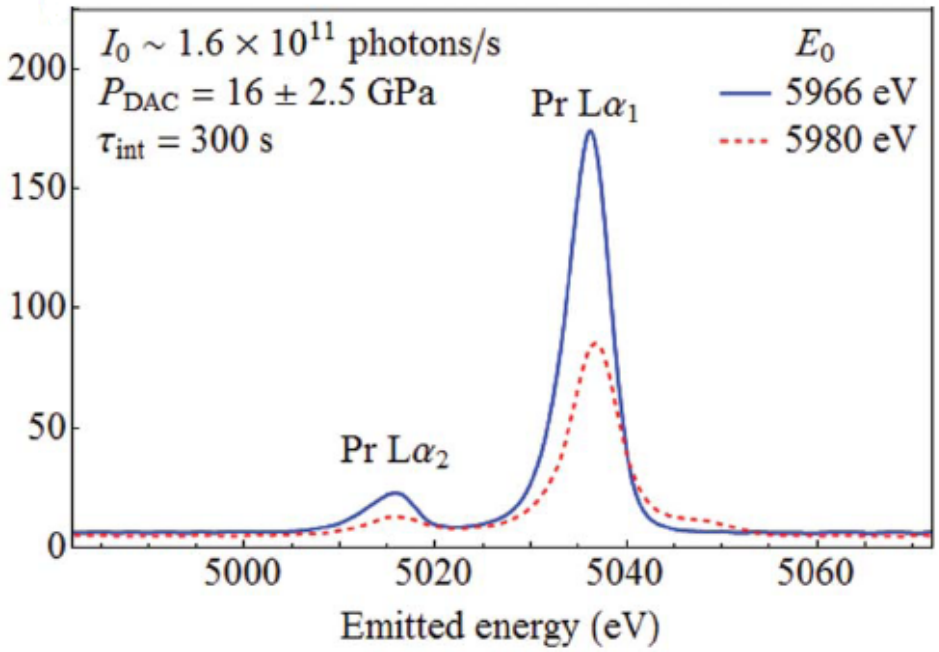

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after integration, the two peaks can be seen to change relative intensities and even position as a function of the incident energy: just at the absorption edge and 14 eV higher