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Early results from the VLS-PGM Beamline at the Canadian Light Source Inc.

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The VLS-PGM beamline at the CLS covers the far UV and ultrasoft X-ray energy range and overlaps with the lower range of the SGM beamline. The beamline is designed to deliver photons ranging from 5.2 to 250 eV (using three pairs of spherical mirror and VLS grating). Technical specification:

- ↓ Spectral range:
 - Low Energy Grating 5.2-38 eV
 - Medium Energy Grating 25-120 eV
 - High Energy Grating 98-250 eV

- ↓ Source: Insertion Device (1.76 m long, 185 mm period length PPM)
- ↓ Shared a straight section with the SGM
- ↓ Resolving power at least 10^4
- ↓ Spot size at the sample position less than $0.5 \times 0.5 \text{ mm}^2$
- ↓ Two easily switchable branches

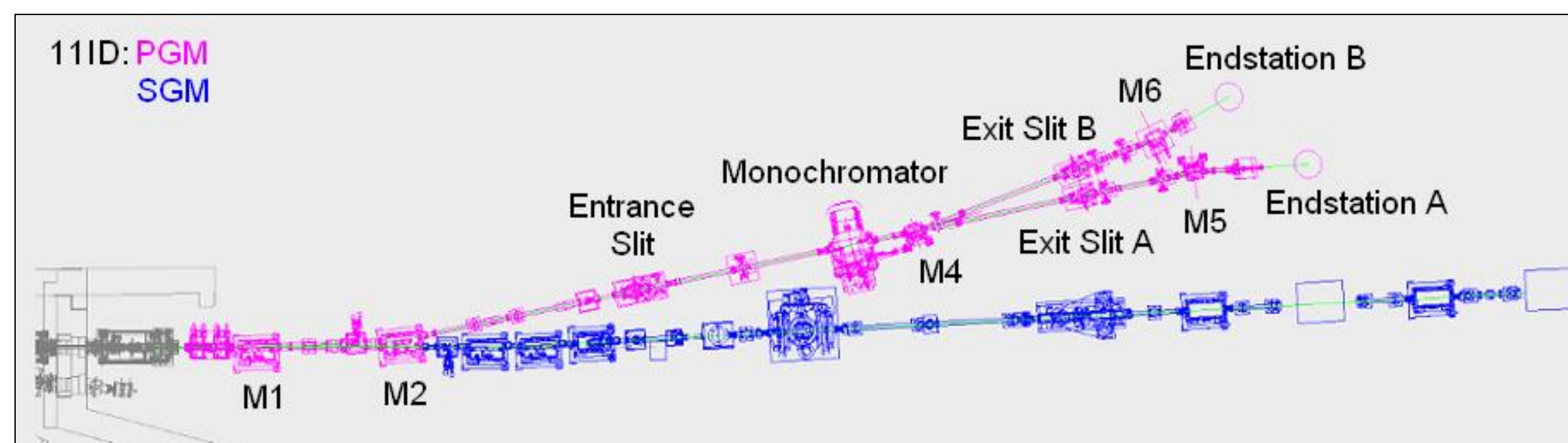


Fig. 1: Optical layout of the VLS-PGM beamline

Performance: Resolution

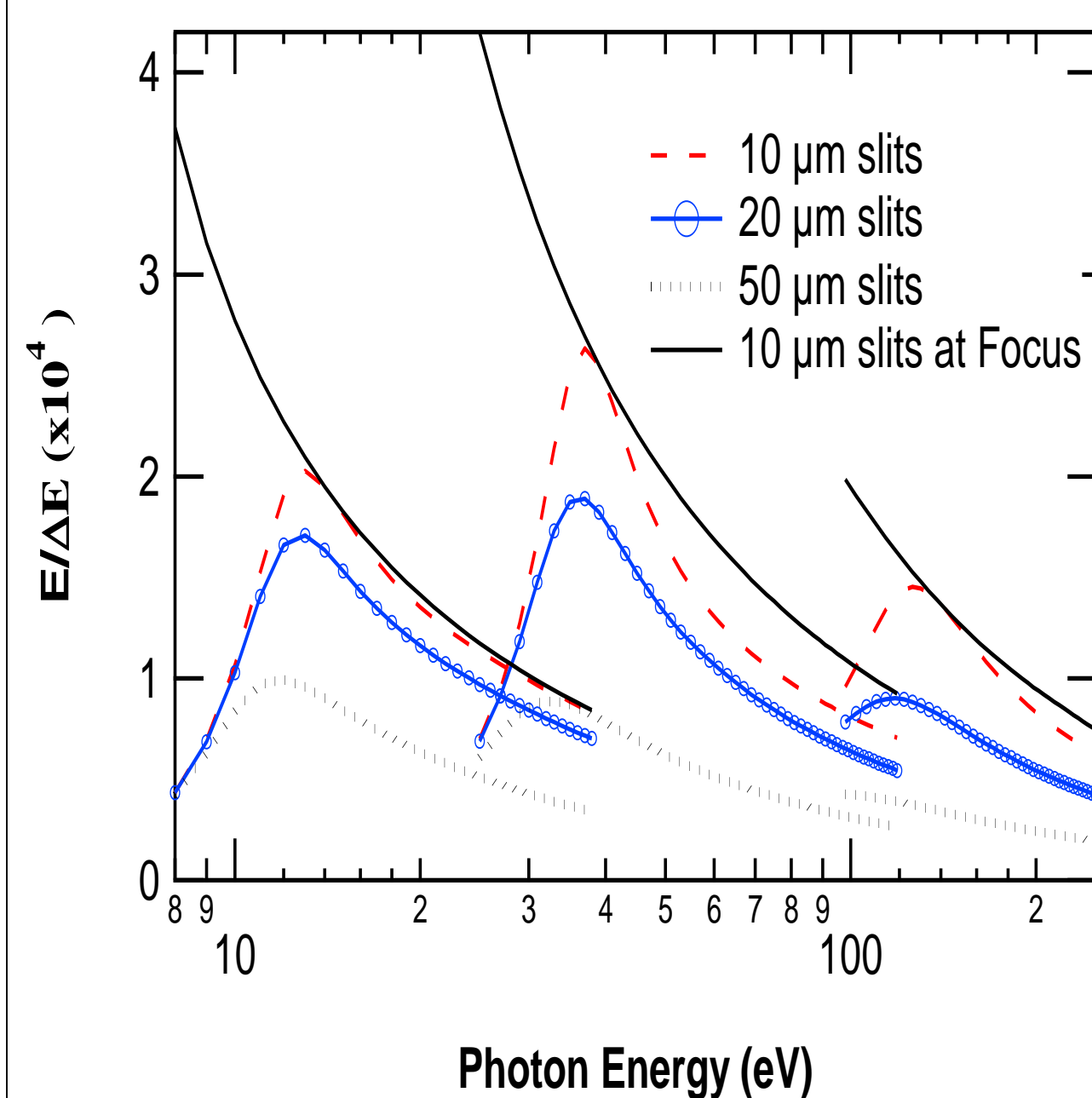


Fig. 4: Calculated resolving power with the delivered optics when both entrance and exit slits are set to 10, 20, 50 μm, respectively. The solid curves represent the "optimal" resolving power at a 10 μm slit when the exit slit focus tracks the photon energy focus. The total exit slit displacement is 6 cm.

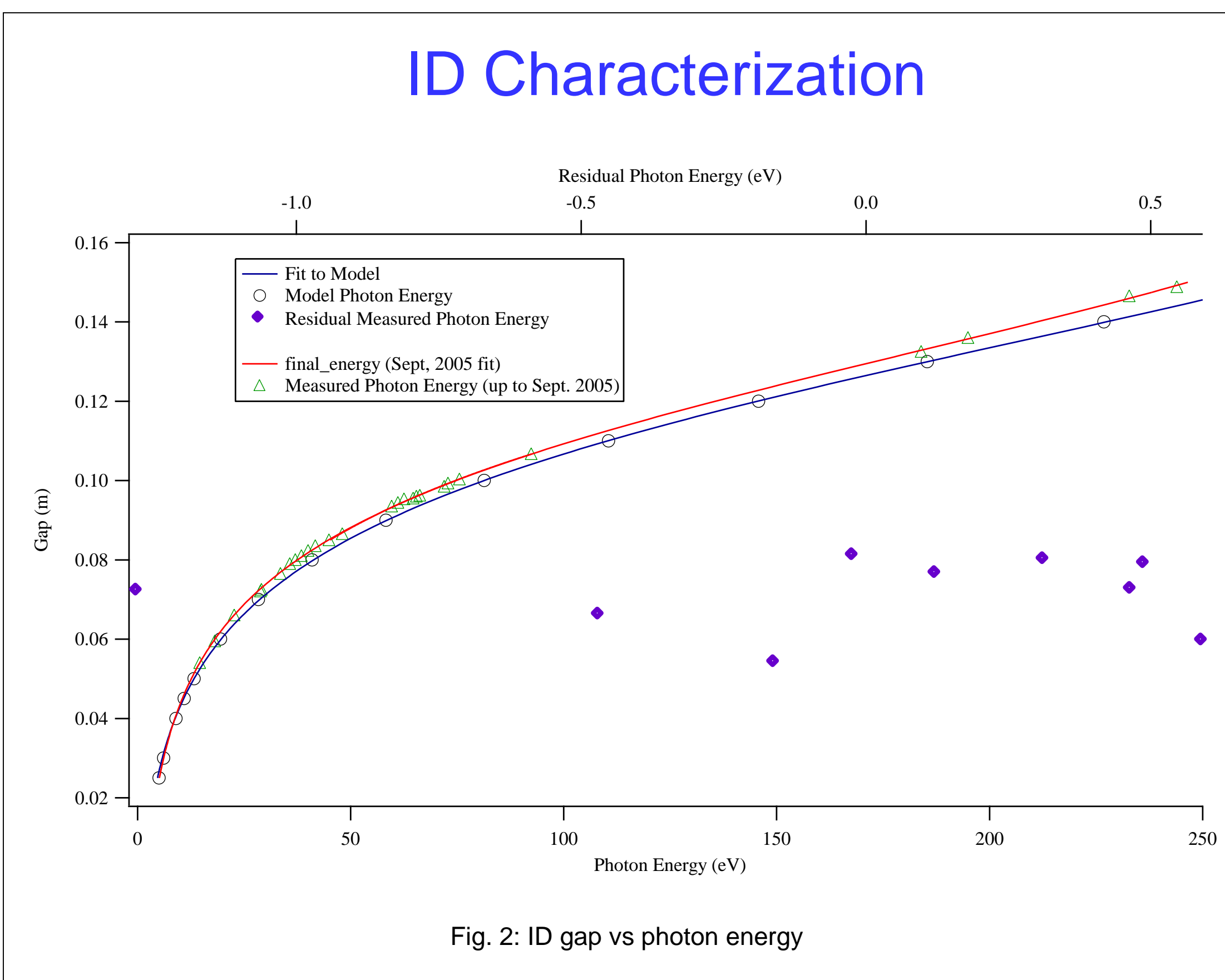


Fig. 2: ID gap vs photon energy

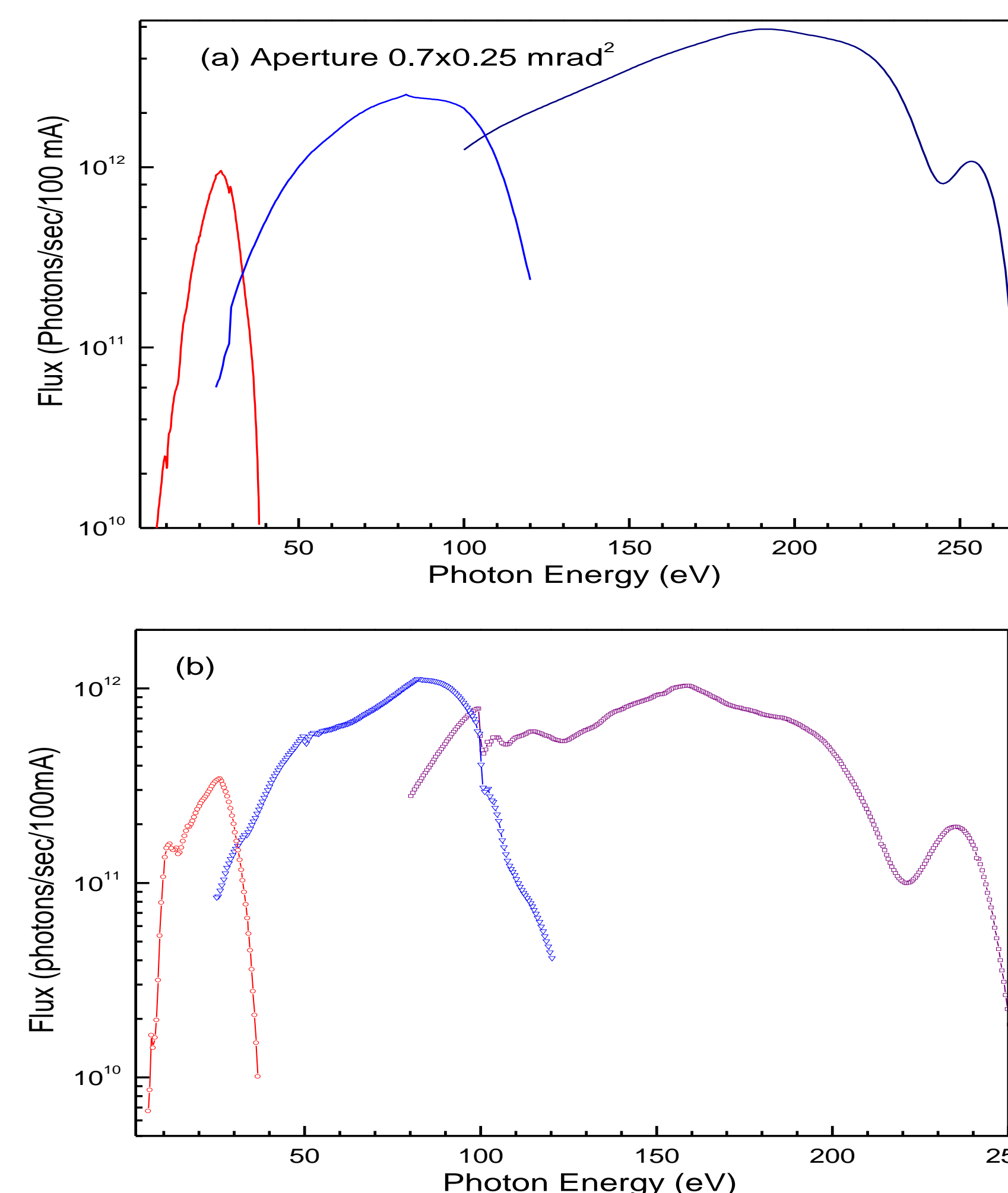


Fig. 3: Photon flux with slits setting of $50 \times 50 \text{ μm}$, normalized to 100 mA ring current (a) calculated flux with an aperture of $0.7 \times 0.25 \text{ mrad}^2$; (b) experimental flux measured with an AXUV-100 Si photodiode.

At a $50 \times 50 \text{ μm}$ slit setting and normalized to 100 mA ring current, a flux of $\sim 10^{12}$ Photons/sec has been obtained with medium and high energy gratings. The flux using low energy grating is a little lower than the calculated flux

The total resolving power is calculated by including contributions from defocus, slits, higher order aberrations and slope error. It is clear that by positioning the exit slit such as to zero the defocus term, it is possible to achieve a much higher resolving power at a slit setting of $10 \times 10 \text{ μm}$, using the low and medium energy gratings.

Exit Slit Focus Effect

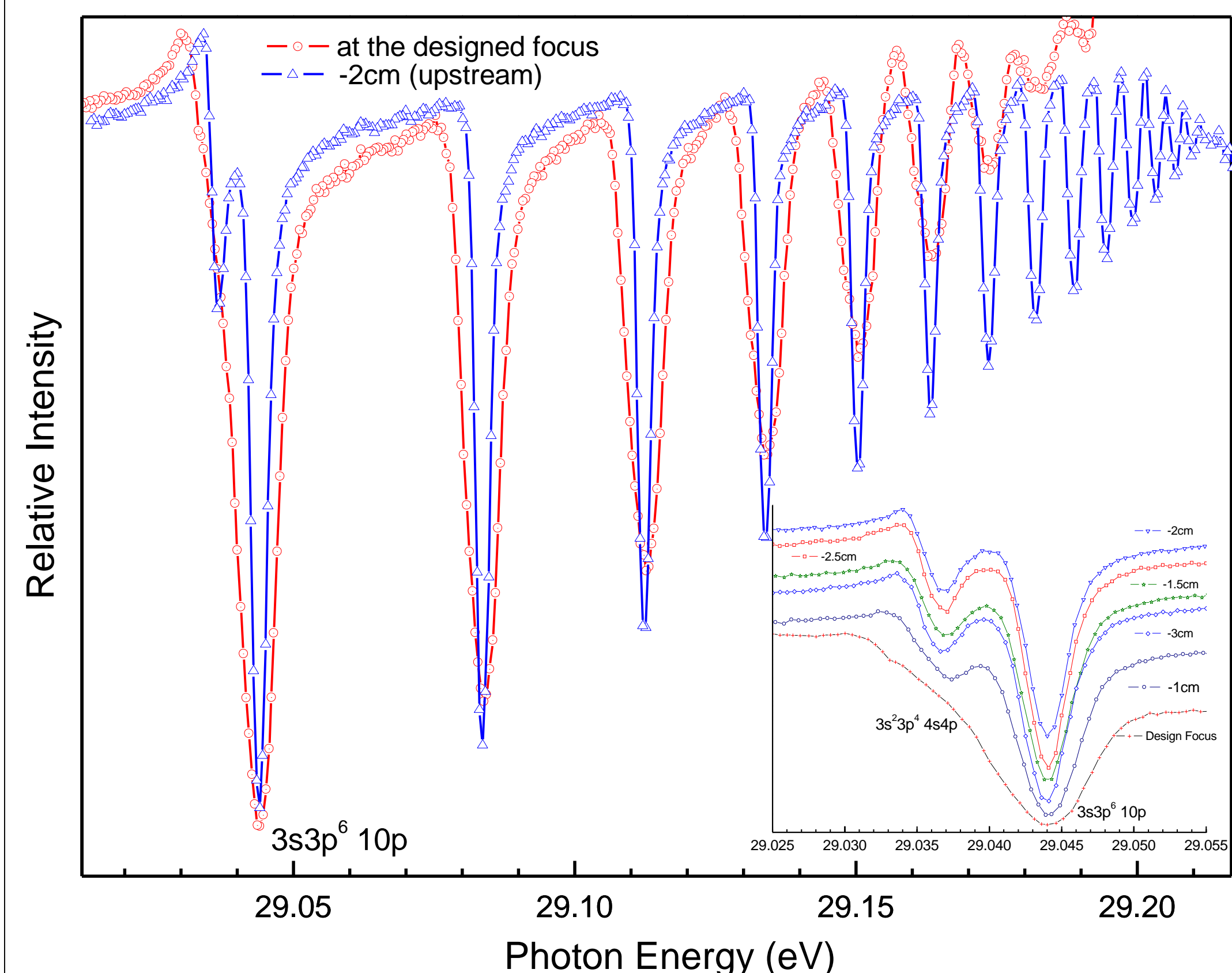


Fig. 5: Ar $3s3p^6 np$ double excitation spectra recorded at different exit slit positions ($20 \times 20 \text{ μm}$)

Gas Phase Commissioning Results

Gas-phase absorption spectra of noble gases are used to characterize the beamline (Figures 6-8). All spectra were taken at a $10 \times 10 \text{ μm}$ slits. Very high resolving power (up to 50,000) has been obtained using all three gratings.

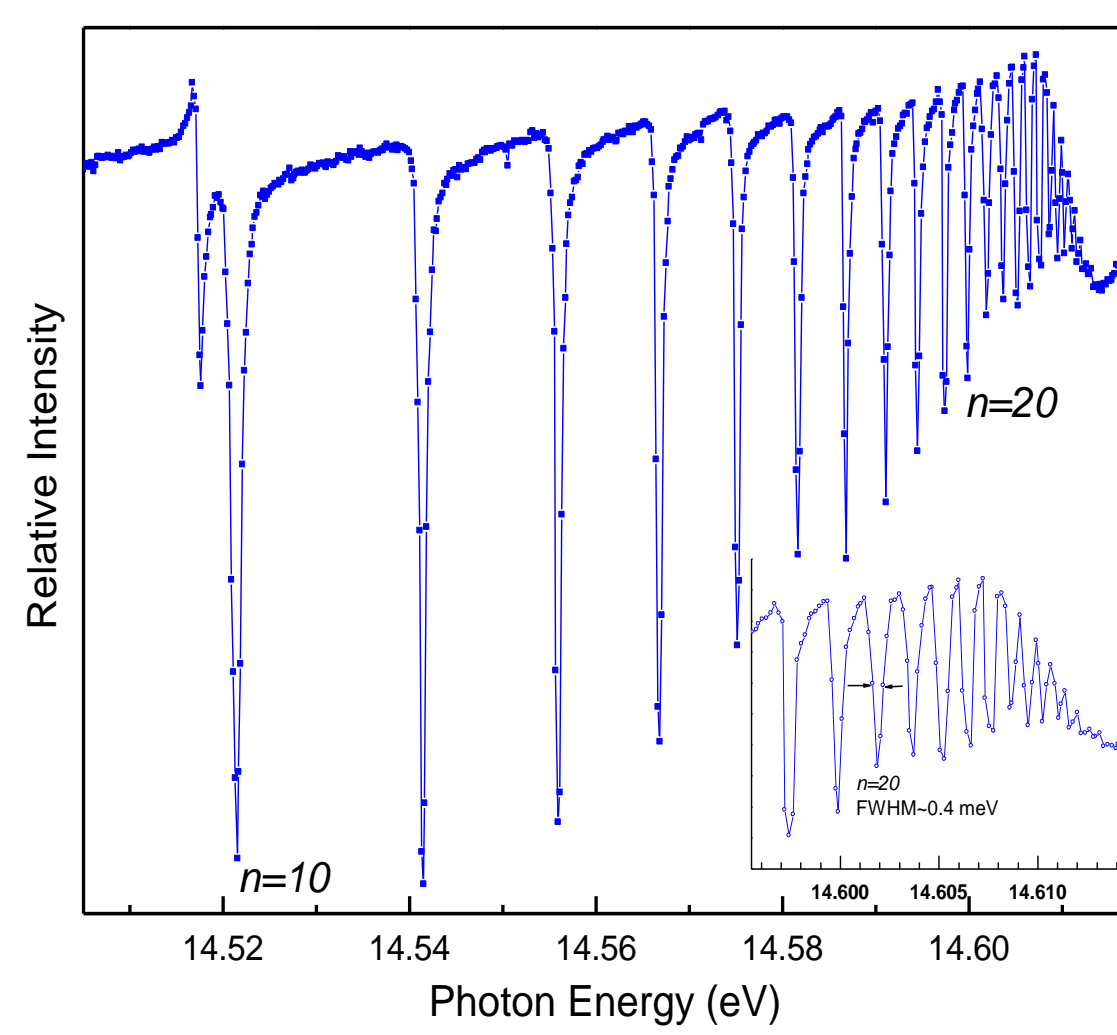


Fig. 6: Ar $3s3p^6 np$ double excitation spectra using the low energy grating recorded with the 2nd order

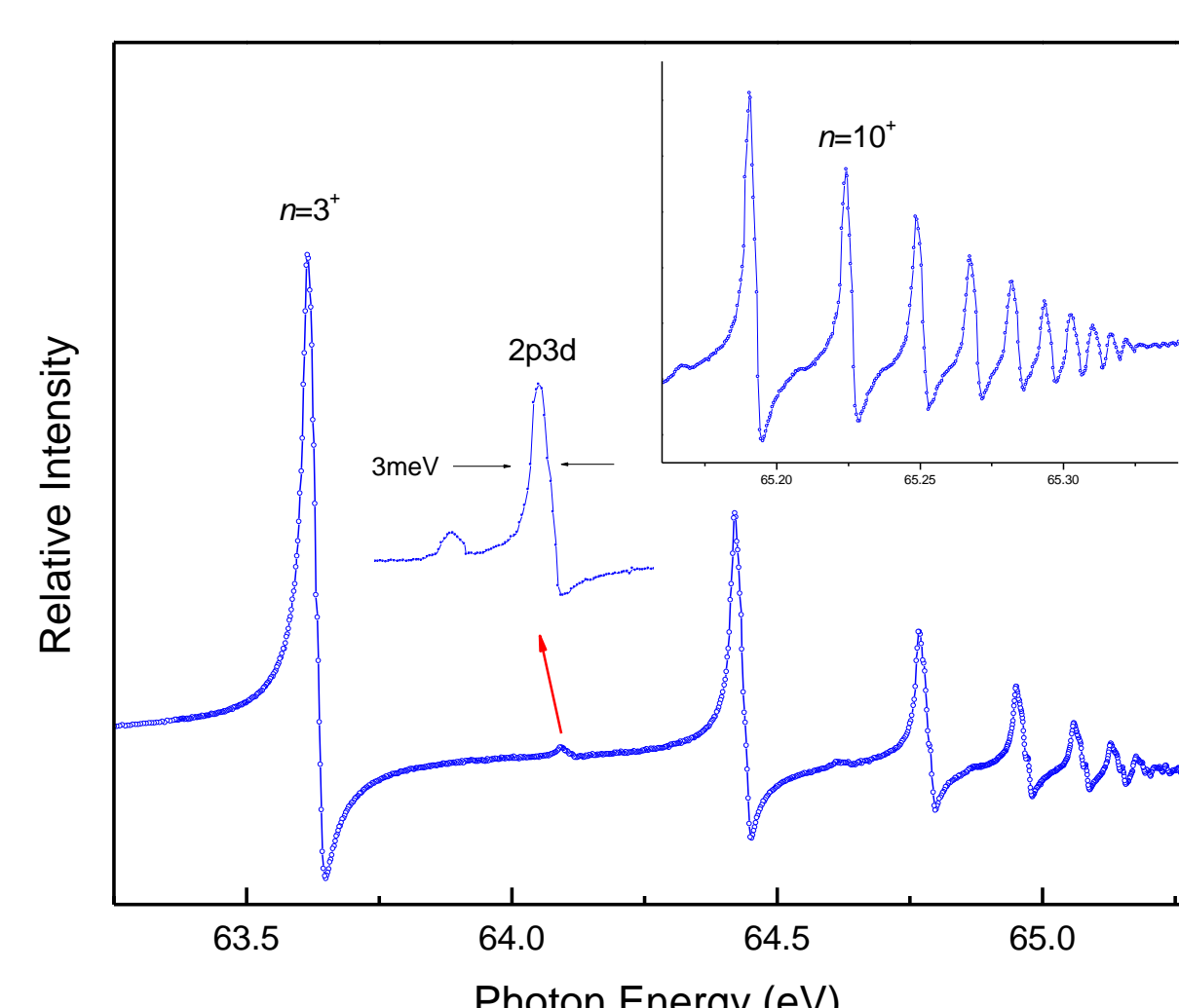


Fig. 7: He ($2snp+/-2pns$) double excitation spectrum using the medium energy grating

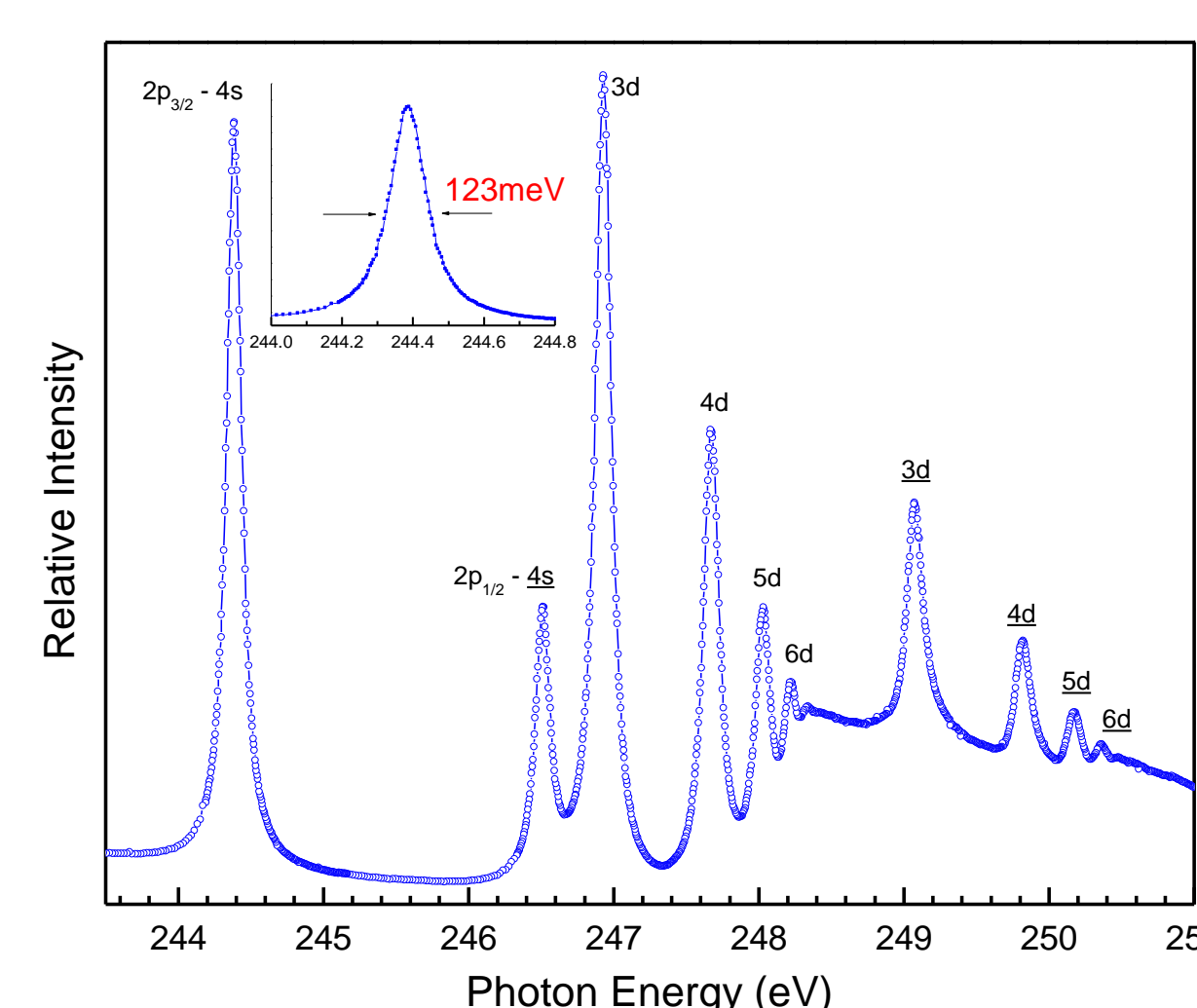
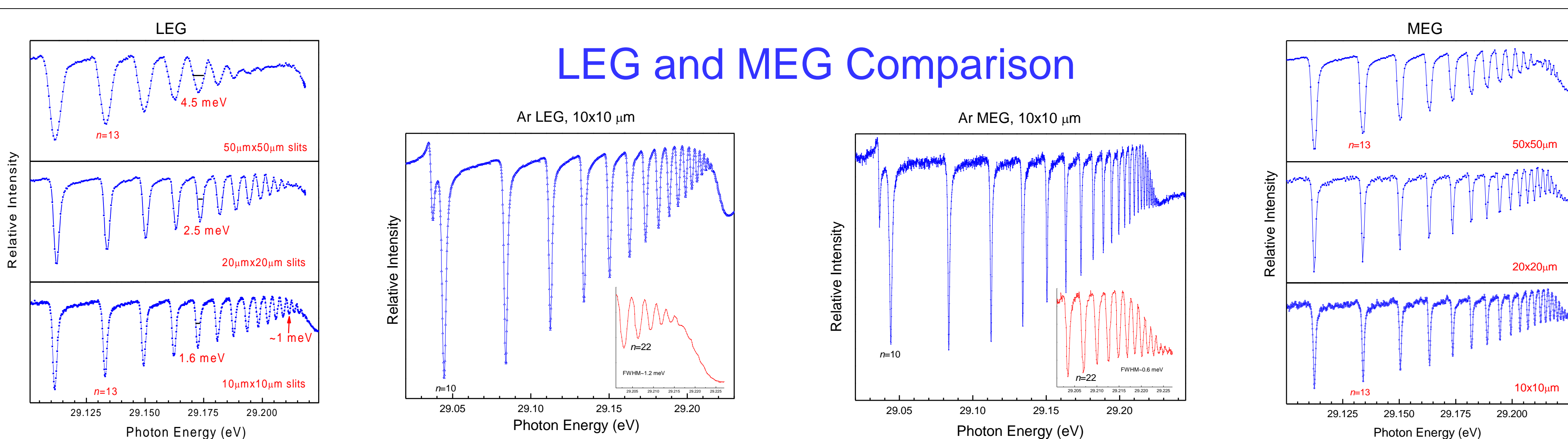


Fig. 8: Ar $L_{2,3}$ excitations spectrum using the high energy grating

LEG and MEG Comparison



Applications

Gas Phase Spectroscopy

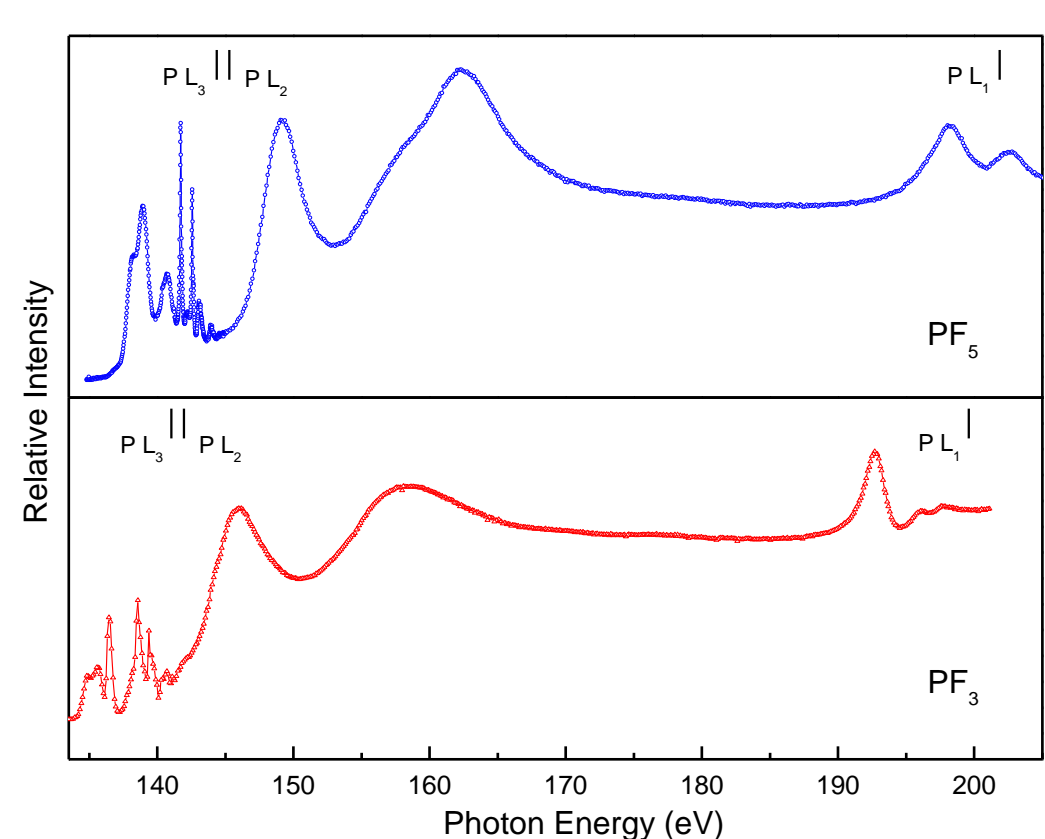


Fig. 9: Photoabsorption spectra of PF_5 and PF_3 between 130 and 205 eV. The ionization thresholds $P_{L_{1,2,3}}$ are indicated.

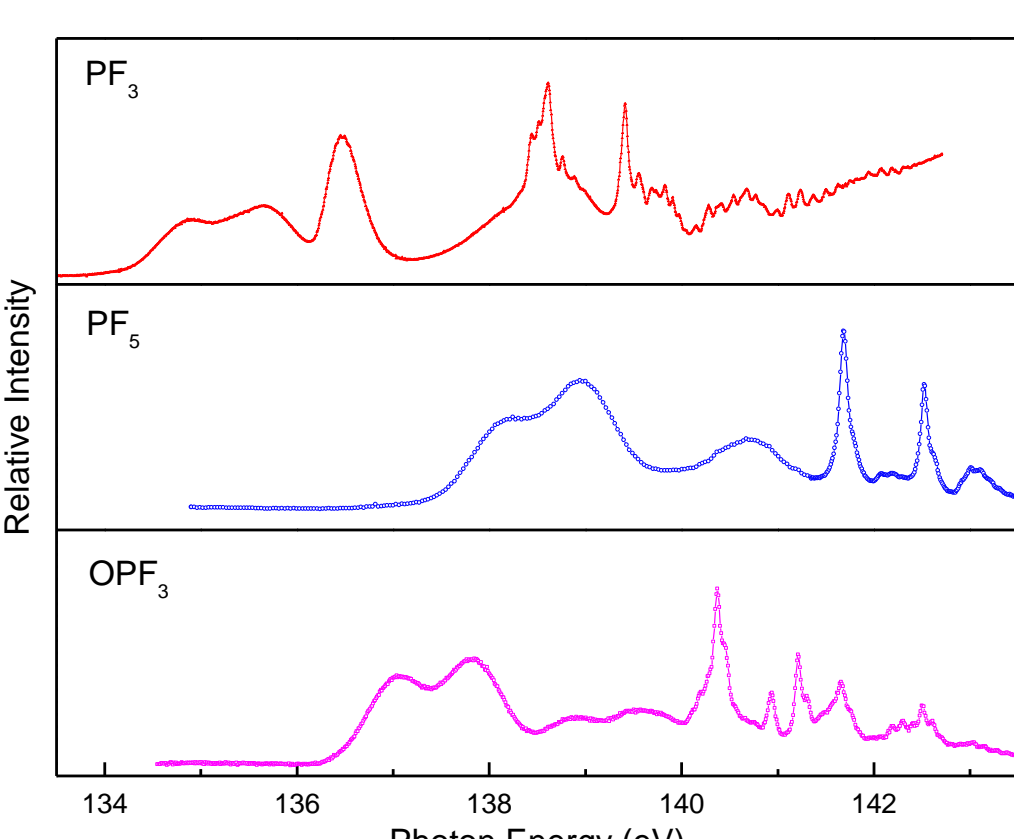


Fig. 10: High resolution photoabsorption spectra of PF_3 , PF_5 and OPF_3 near the $P_{L_{2,3}}$ ionization thresholds.

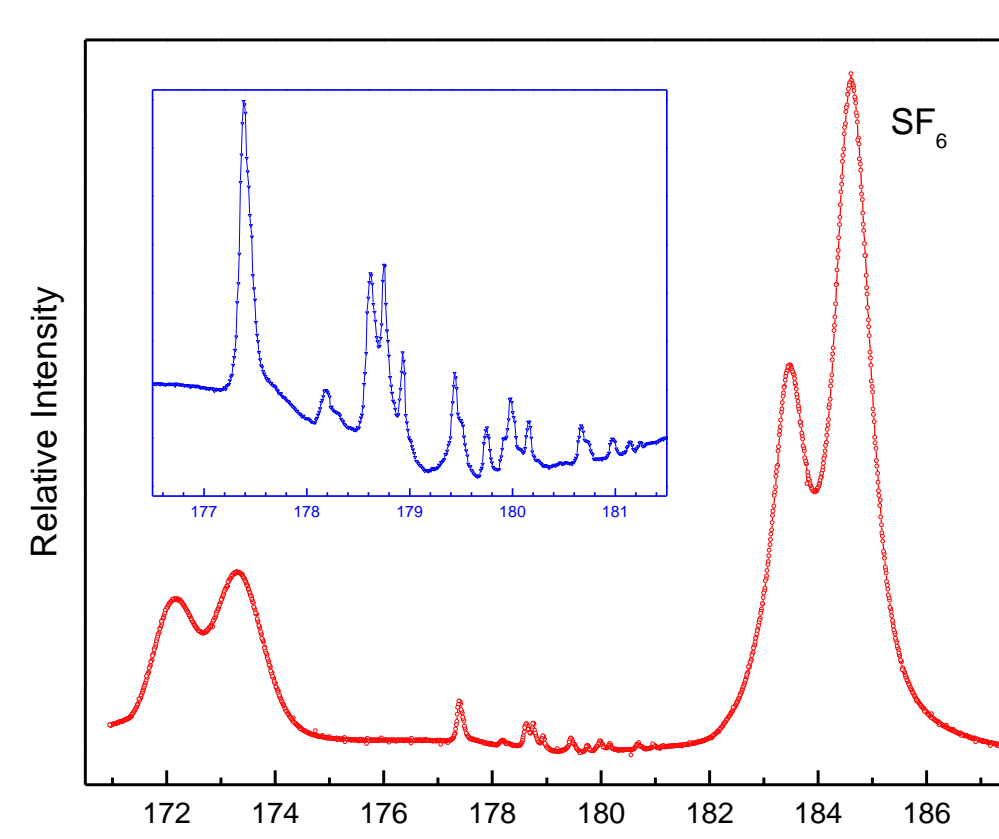


Fig. 11: High resolution photoabsorption spectrum of SF_6 near the $S_{L_{2,3}}$ ionization thresholds.

Absorption Spectroscopy of Materials

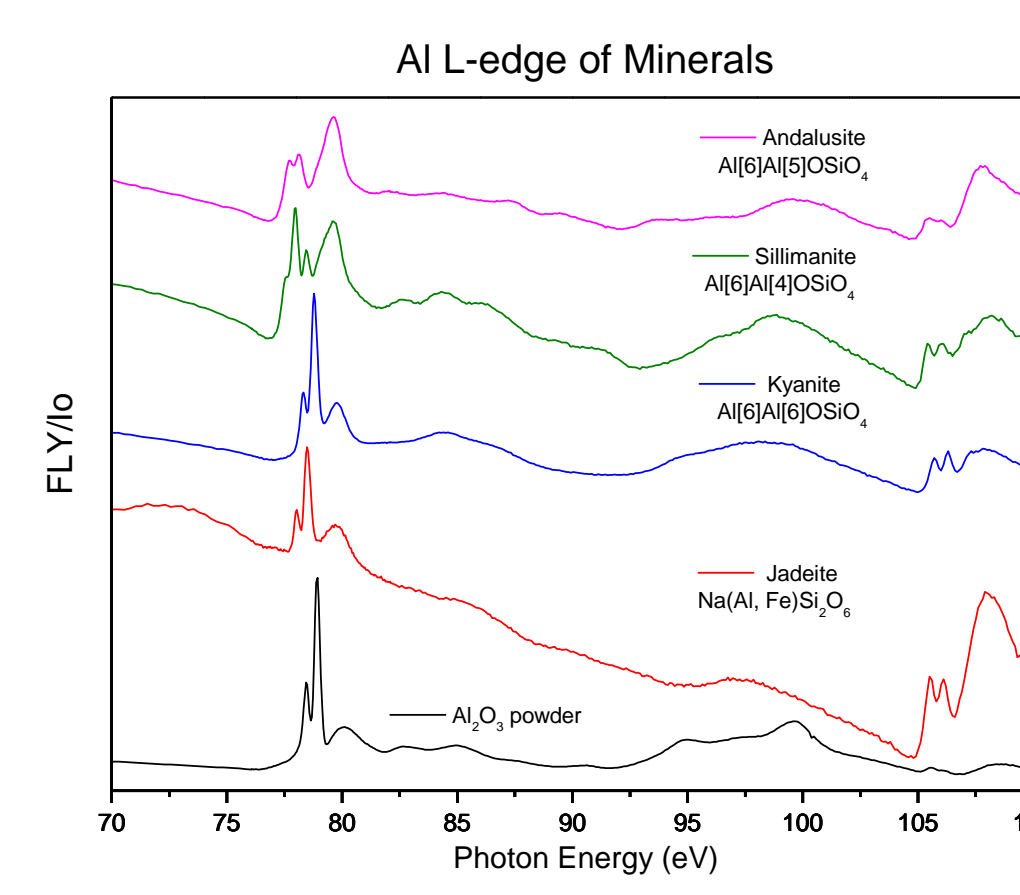


Fig. 12: Representative Al L-edge FY-XANES spectra of selected Al minerals

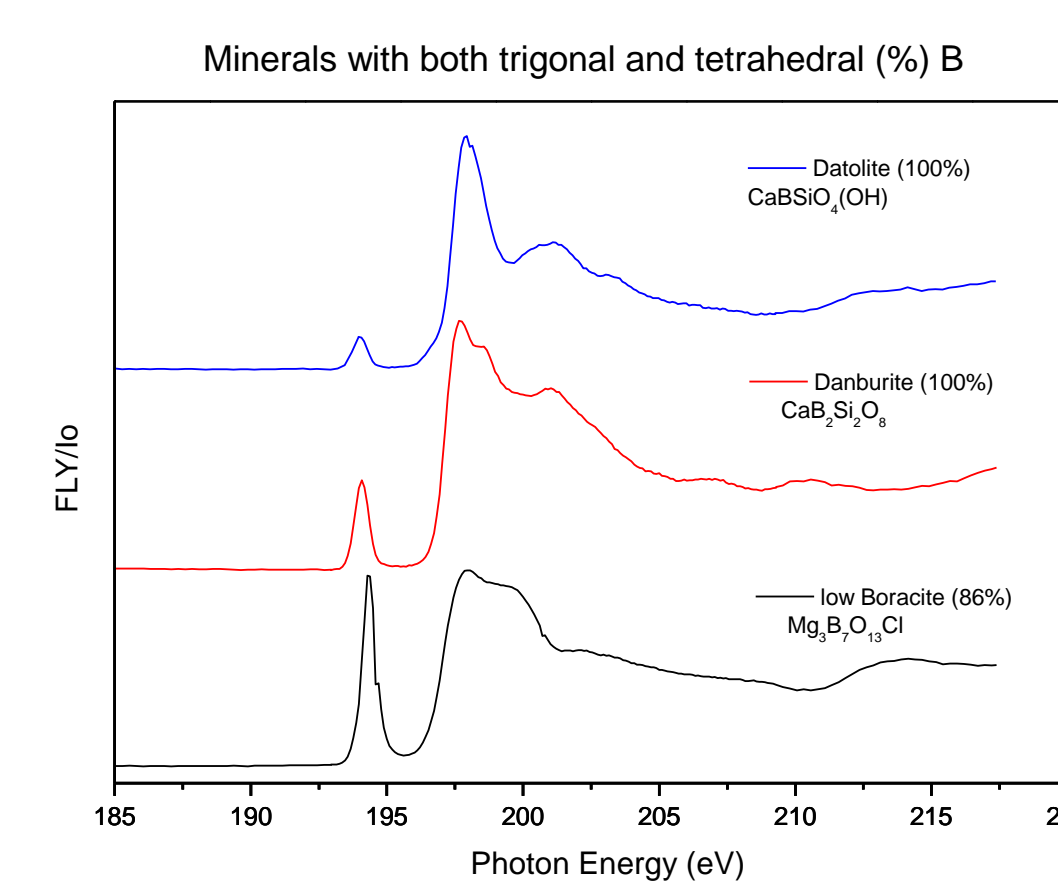


Fig. 13: Representative B K-edge FY-XANES spectra of selected B minerals with nominal contents of IV B indicated

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