

# Simulated XUV spectroscopy in the laboratory with a polycapillary half lens and reflection zone plates

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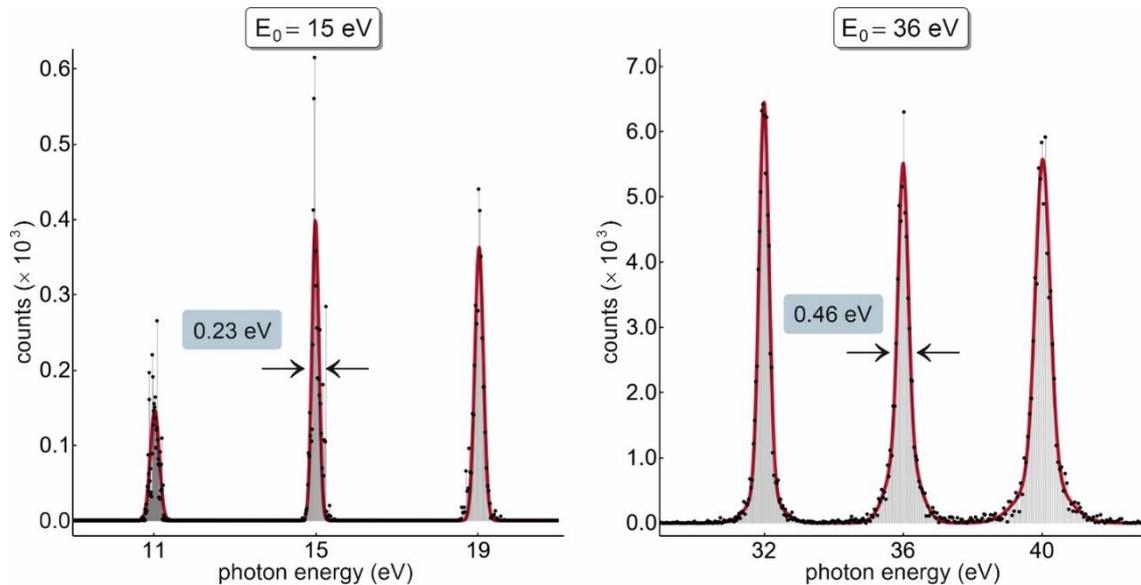
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We design a wavelength dispersive spectrometer for the extreme ultraviolet, based on a collimating polycapillary lens (PCL) and an array of reflection zone plates (RZPs). The two-channel instrument is optimized for narrow-band fluorescence or inverse photoelectron spectroscopy around 15 eV and 36 eV, respectively. The halved PCL is composed of  $\sim 10^6$  tapered borosilicate glass tubes with a mean diameter of 5  $\mu\text{m}$ . The device widens the effective, accepted solid angle for photons from the micron-sized source by about one order of magnitude and collimates the incident radiation to a quasi-parallel beam of zero divergence, which is diffracted into the (+1)<sup>st</sup> order by one of the RZPs. These holographic 2-D varied-line space gratings are fabricated with a Carbon-coated, laminar profile on a common, planar Si substrate. The spectra, recorded by an, e.g. CCD camera, feature a relatively high resolving power  $E/\Delta E \approx 70 \pm 10$ , as



**Figure 1:** Simulated spectra for the two-channels, designed at  $E_0 = 15$  eV and  $E_0 = 36$  eV, with a PCL collimator. Data (black dots) are fitted (red solid lines) using a multi-Gaussian model. Arrows indicate the averaged line width (FWHM).

shown in Fig. 1. With its short optical path length of less than 0.9 m, the spectrometer fits in typical laboratories. The spectrometer operates in the parallel, flat field mode, thus no moving parts are required.

- [1] C. Braig, A. Sokolov, R. G. Wilks, X. Kozina, T. Kunze, S. Bjeoumikhova, M. Thiel, A. Erko, and M. Bär, “[Polycapillary-boosted instrument performance in the extreme ultraviolet regime for inverse photoemission spectroscopy](#),” *Opt. Express* **25**, 31840 – 31852 (2017). [Erratum](#) in *Opt. Express* **30**, 34935 – 34937 (2022).
- [2] J. Probst, H. Löchel, M. Thiel, S. Bjeoumikhova, C. Braig, and C. Seifert, “[Collimation by a polycapillary half lens at 277 eV](#),” *Opt. Express* **31**, 30379 – 30389 (2023).
- [3] N. Langhoff, A. Sokolov, S. Bjeoumikhova, M. Thiel, C. Braig, and C. Seifert, “[Laboratory-based low-Z spectroscopy with a polycapillary optic and a curved RZP](#),” Poster, **322<sup>nd</sup>** PTB Seminar VUV and EUV Metrology, Berlin (2023).