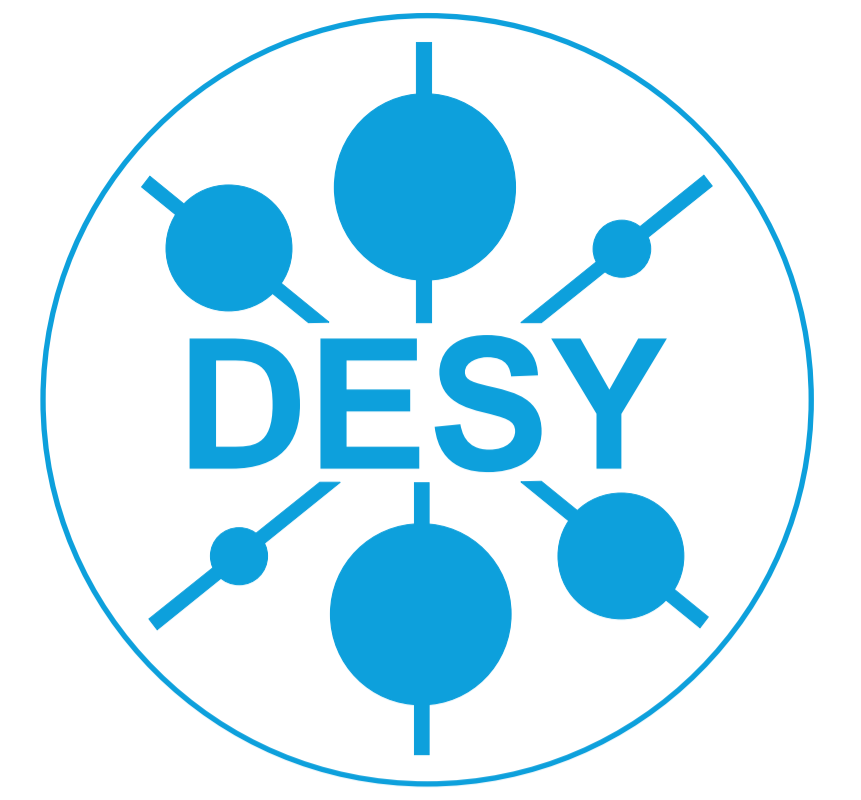


# The Variable Polarization XUV beamline P04 at PETRA III.

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## A unique XUV source

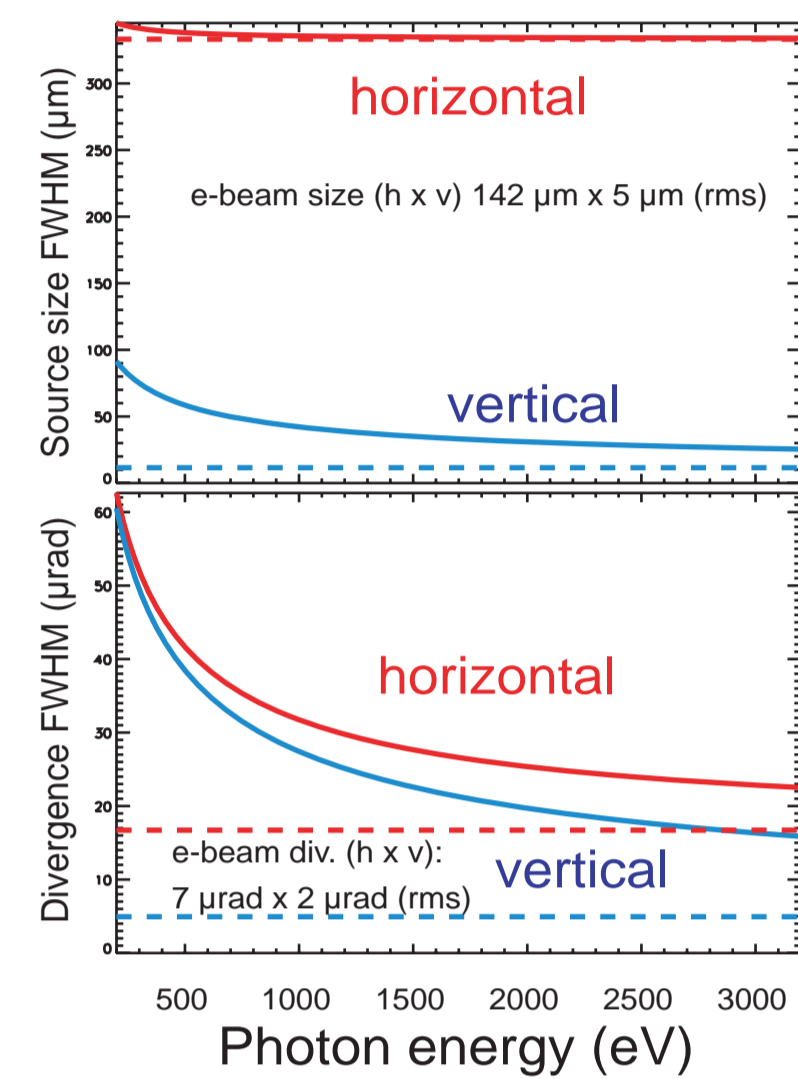


The low emittance storage ring PETRA III provides opportunities for an unique light source in the eXtreme UltraViolet (XUV). P04 - the XUV beamline - will provide highest brilliance and flux from 250 eV to 3000 eV with variable polarization in the first harmonic.

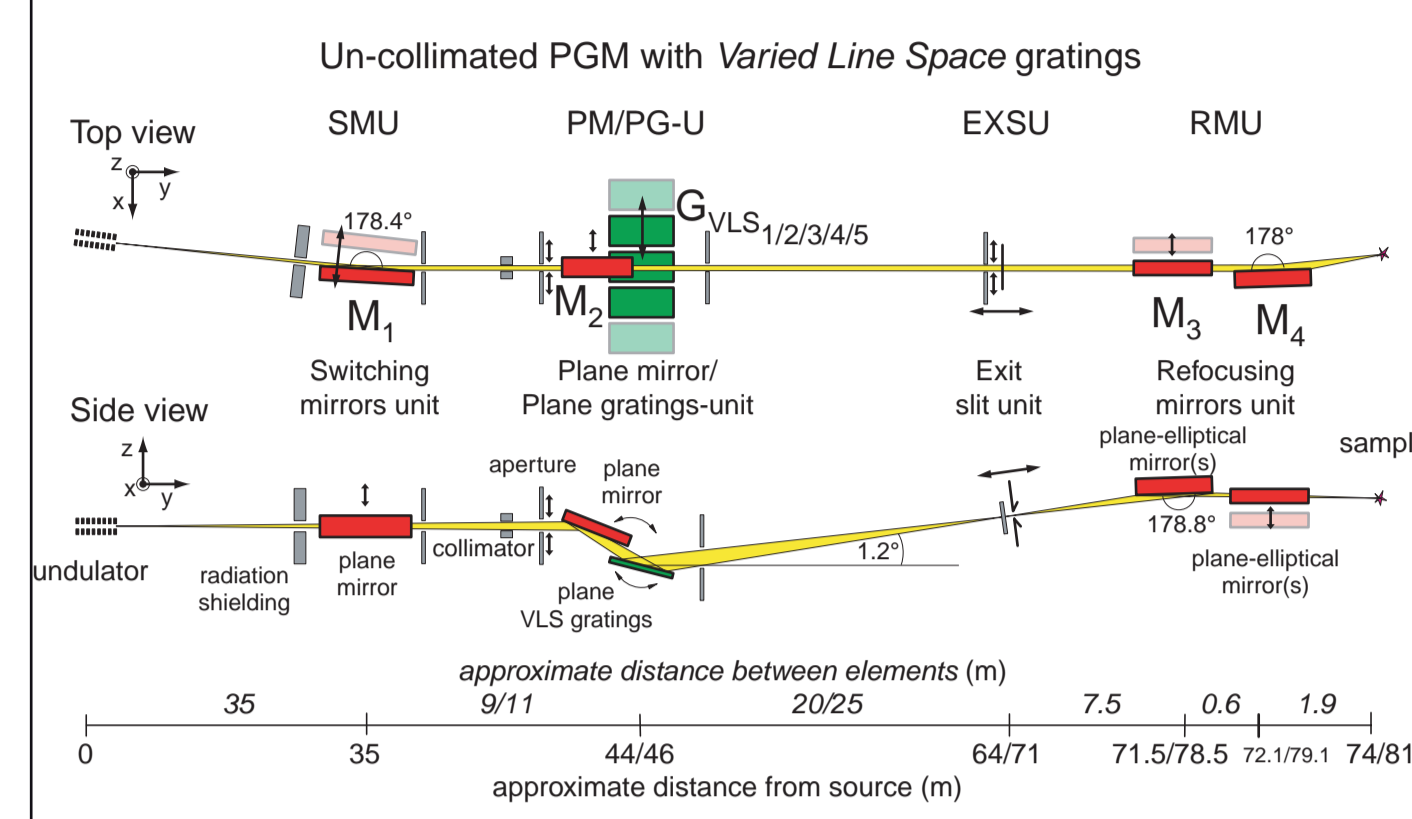
- High stability
- Low emittance, diffraction limited source
- Wide range of photon energies
- Large facility, space for user experiments

## Parameters

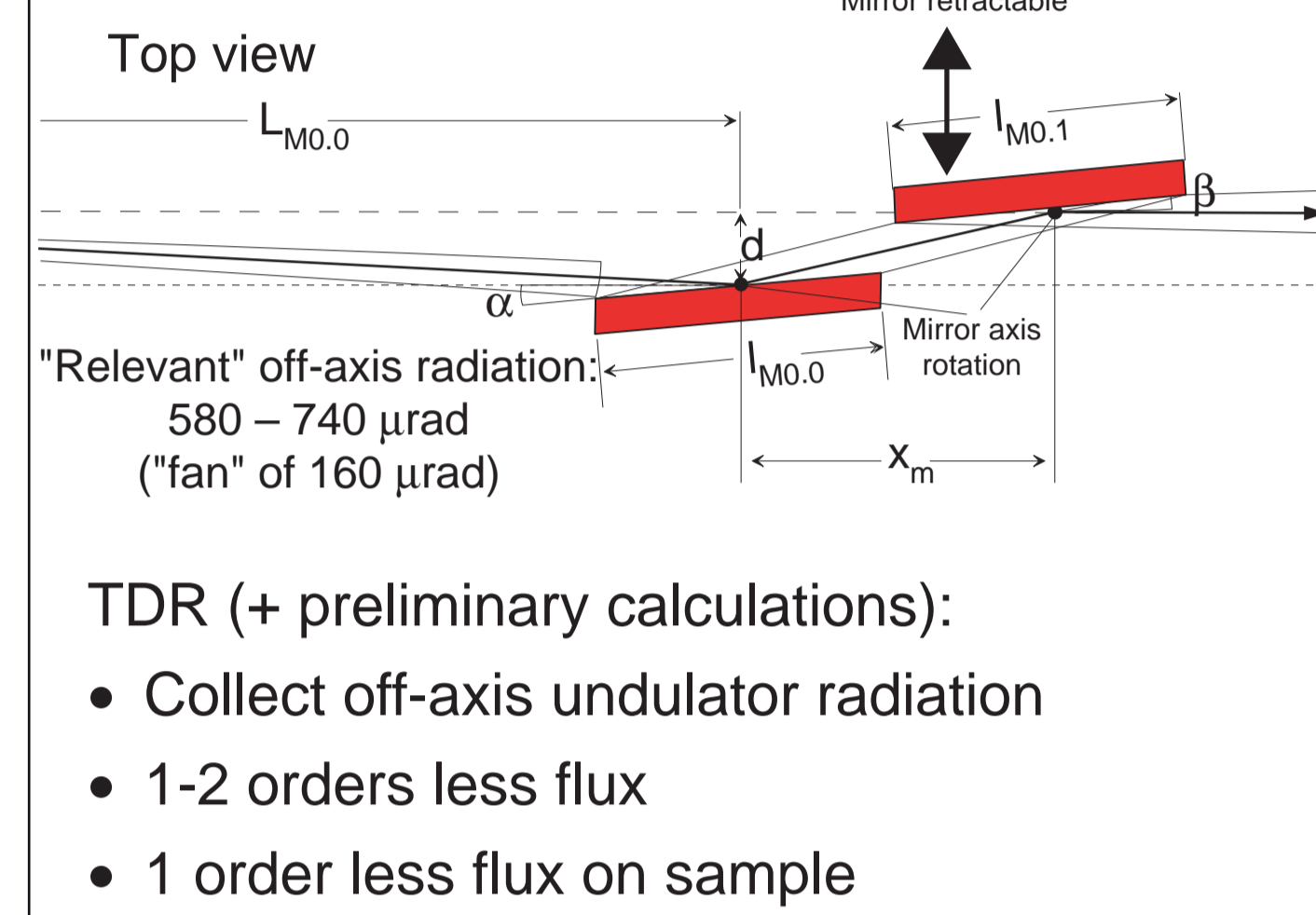
PETRA III	(design)	(2010)
Beam energy	6 GeV	ok
Beam current	100 mA	100/60 mA
Circumference	2304 m	
Revolution time	7.685 $\mu$ s	
Number of bunches	960/40	4x60/40
Beam lifetime	24/2 h	10 h
Bunch spacing	8/192 ns	128/192 ns
Bunch length (FWHM)	100 ps	95-110 ps
Filling mode	topping up	ok



## Beamline layout



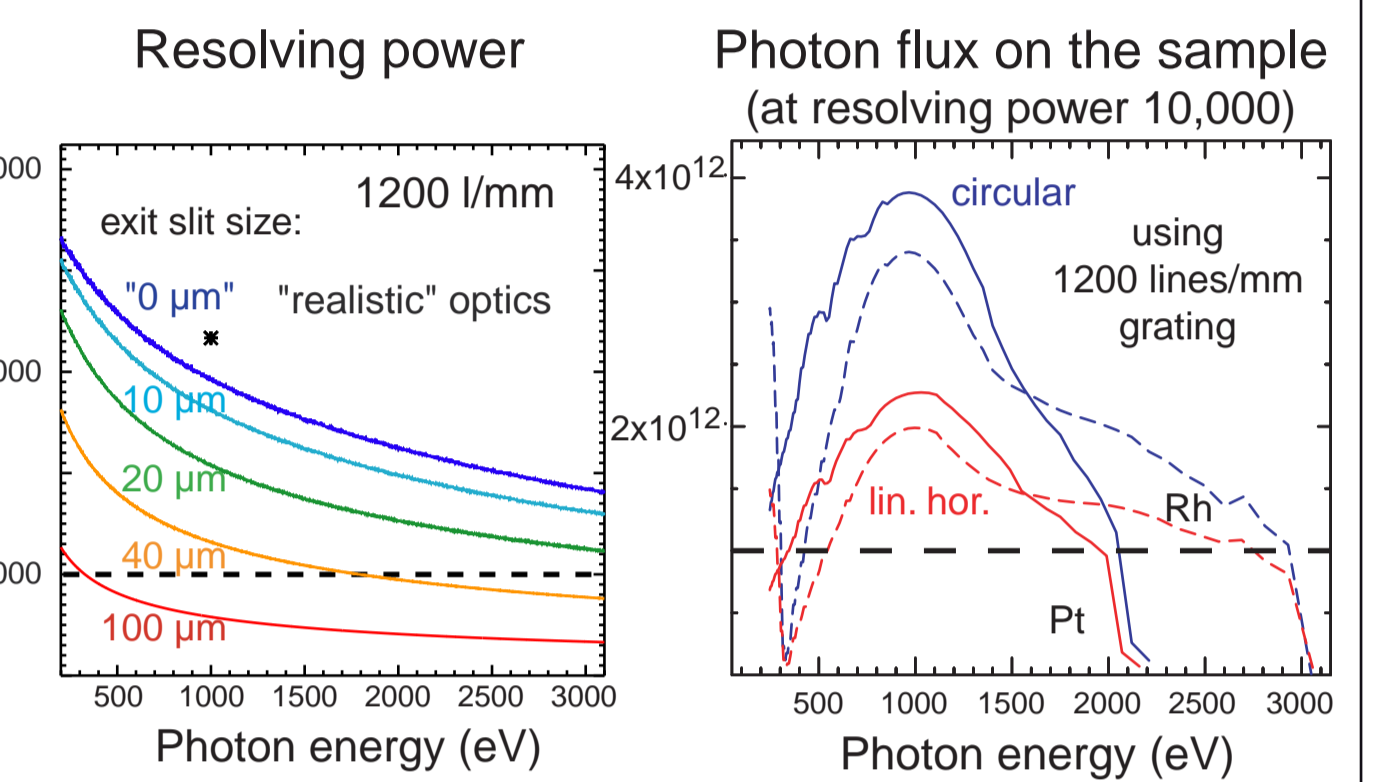
### Low energy option (already installed)



## User requirements (TDR/workshops)

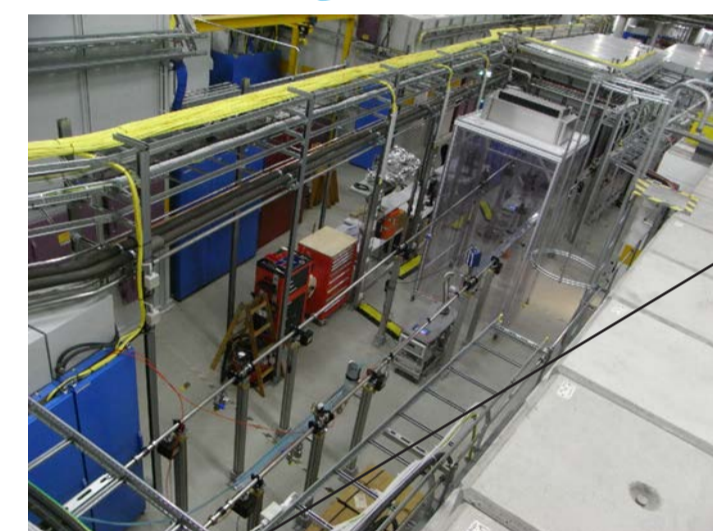
- Photon energy range: 250 - 3000 eV
- Resolving power:  $>10^4$
- Photon flux:  $>10^{12}$  photons/s
- Spot size at sample: 10 x 10  $\mu$ m<sup>2</sup>
- Polarization (switching rate): circ./lin.  $<0.1$  Hz

### Calculated P04 XUV beamline performance



## Floor layout – Status of main beamline components –

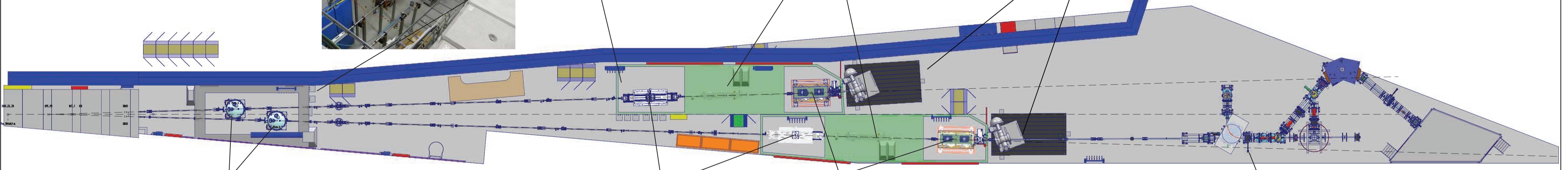
Front end incl. low energy option.  
 + SMU / XBPM / Collimators  
 • In-house development



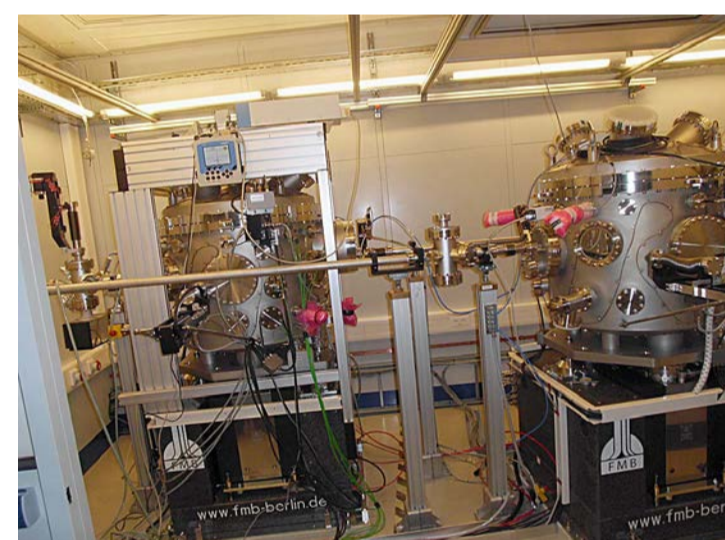
Climatization hutches  
 • In-house design

Beamline accessories  
 Filter system  
 • In-house development

Experimental platforms.  
 • In-house development (2 m by 3.6 m)



Plane Mirror/Plane Grating-Unit (PM/PG-U).



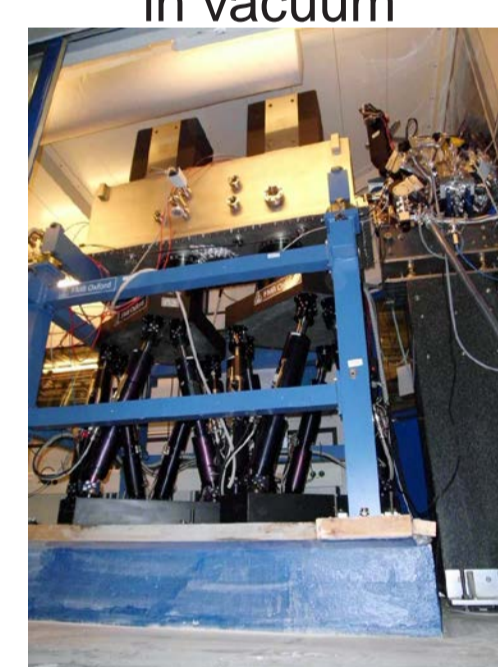
- Supplier FMB Berlin  
 Angular precision: 50 nrad ( $\pm 7^\circ$ )  
 New stepper motor design for "high speed" verified (10 eV per sec)

EXIT Slit-Unit (EXSU).



- Supplier Bestec Berlin (Subcontractor of Jenoptik)

Refocusing Mirrors Unit (RMU).



- Supplier FMB Oxford  
 2 In-air Hexapods for 2 mirrors in vacuum

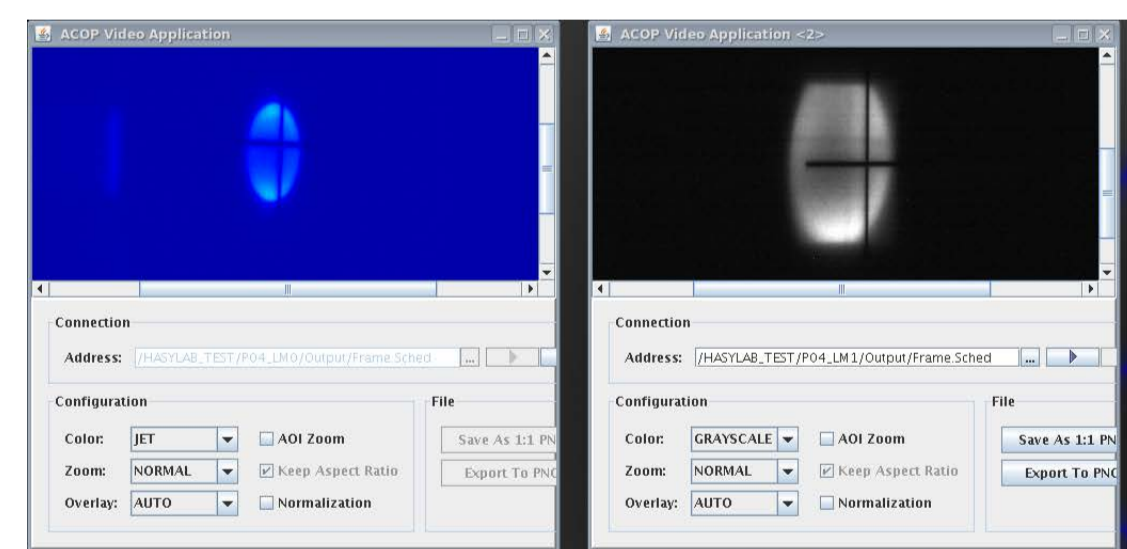
Angular resolution: 2  $\mu$ rad ( $\pm 0.3^\circ$ )  
 "fine pitch": 40 nrad (350  $\mu$ rad)  
 Translational resolution: 1  $\mu$ m ( $\pm 5/45$  mm)  
 Beam steered up to the end of the diagnostics unit in vacuum

PIPE (1 of 5 BMBF projects)

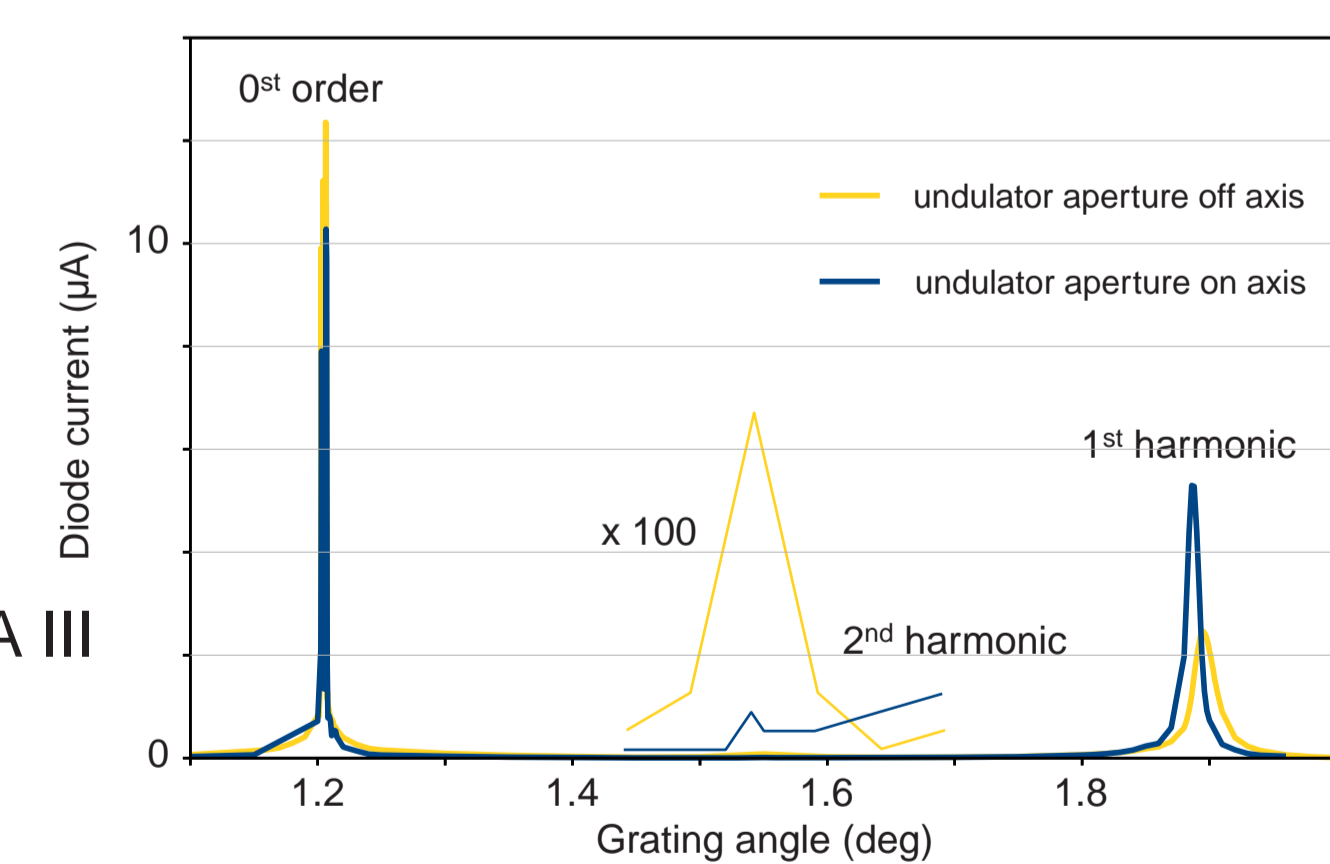


- Uni Giessen/HH/Berlin/Frankfurt

### First light in the optics hut of P04 (15-Dec-2010).



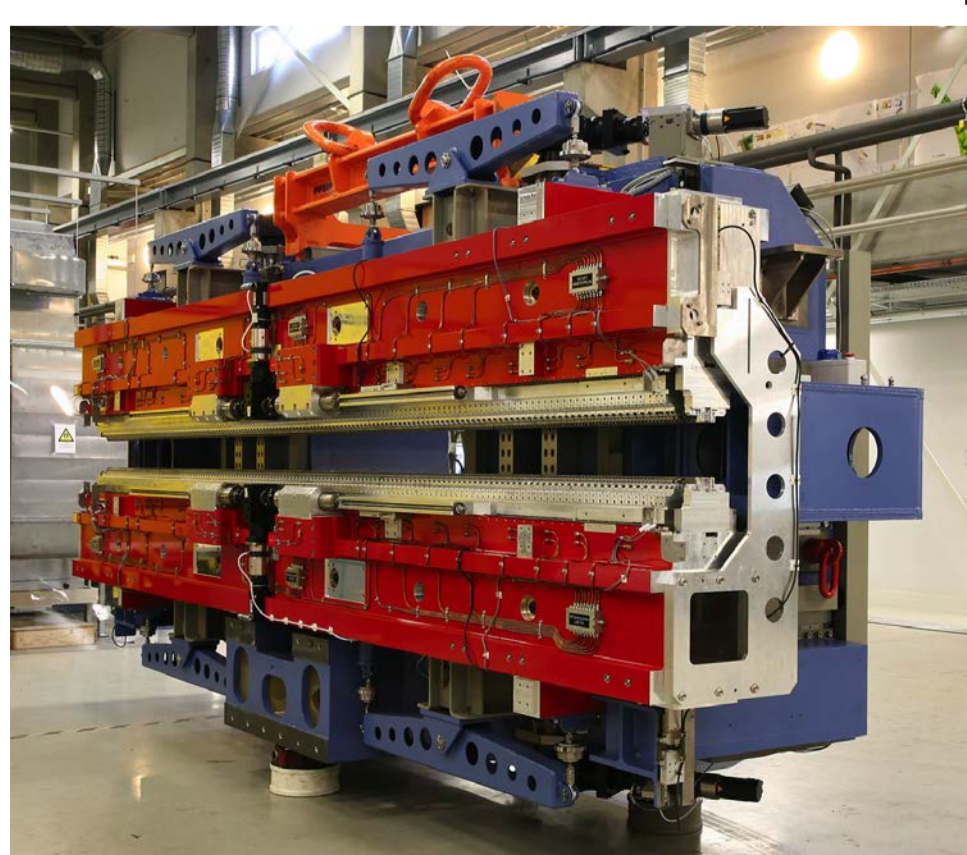
Undulator delivers circularly polarized light. Nearly "spot on".



400 l/mm grating works. We can optimize apertures. 0-order bad, due to the pre-mirror "dummy", i.e. wait for July 2012 to receive real mirror.

First light obtained in December 2010. In 2011 smooth operation of the PETRA III storage ring in all polarization modes. We gratefully acknowledge the support of the HASYLAB FS-BT Team

### APPLE-2 Undulator.



- Supplier HZB (BESSY)  
 1st (l) harmonic:  
 linear hor. ~220–3000 eV  
 circular ~240–3000 eV  
 linear ver. ~280–3000 eV  
 linear  $\pm 90^\circ$  ~470–3000 eV  
 4.9 m long  
 65.6 mm period ( $\lambda$ )  
 72 periods

### Diagnostics.

- (Offline) characterisation of:
- Focus size ("automatic" alignment)
- (Online) monitoring of:
- Photon flux ( $\leq 1\%$  abs.,  $\leq 0.1\%$  rel.)
  - Beam position ( $\leq 1$   $\mu$ m) calibration with "destructive" BPM
  - Photon energy ( $\leq \Delta E$ ,  $\leq 1/10,000$ )
  - Polarisation ( $\leq 1\%$ )

