White beam monitors for the EMBL beamlines at PETRA III

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EMBL

Outline

Introduction to EMBL Beamlines.

Design of the white beam monitor.

First results.

Conclusions.

Petra III

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Energy 6 GeV

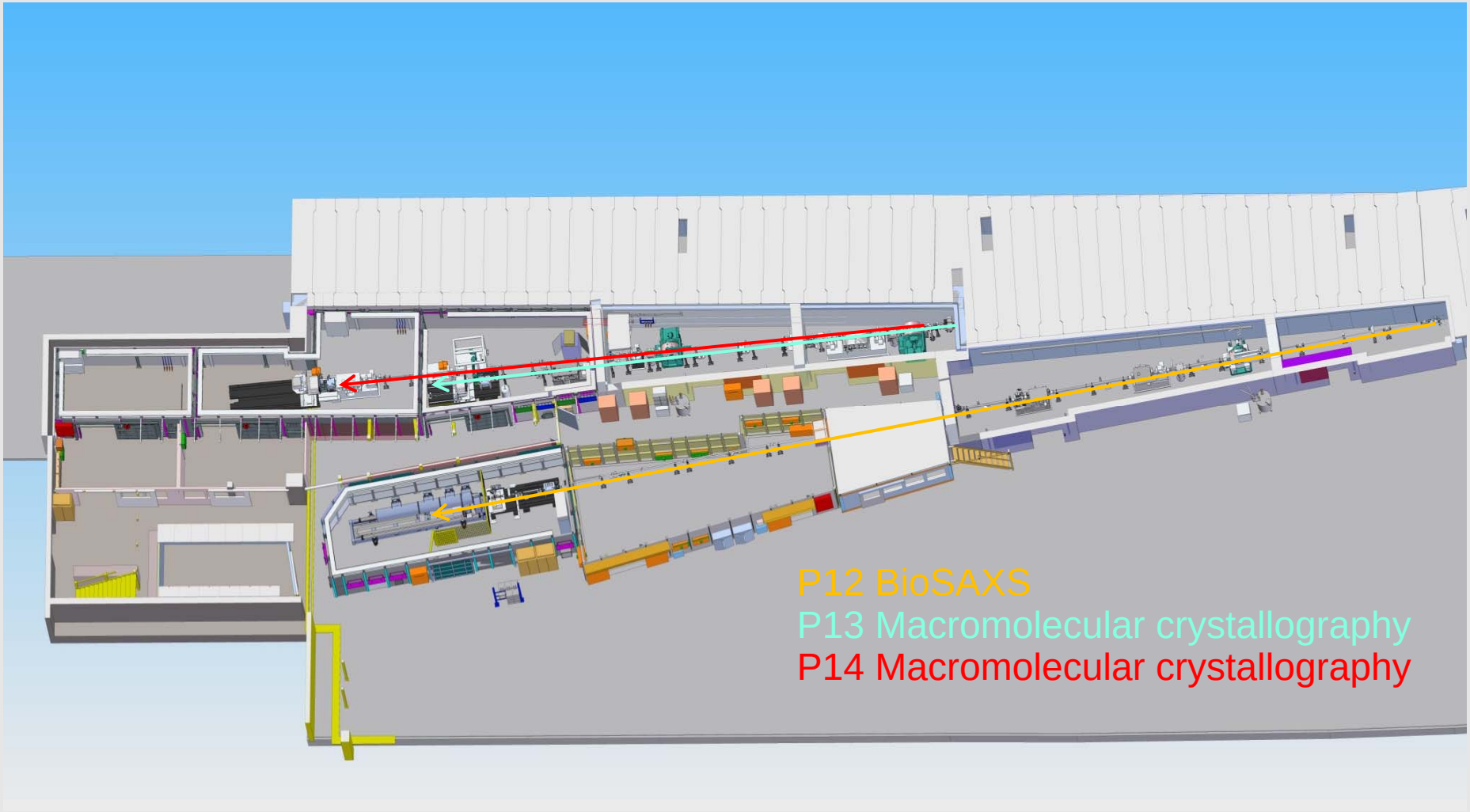
Current 100mA

Circumference 2300m

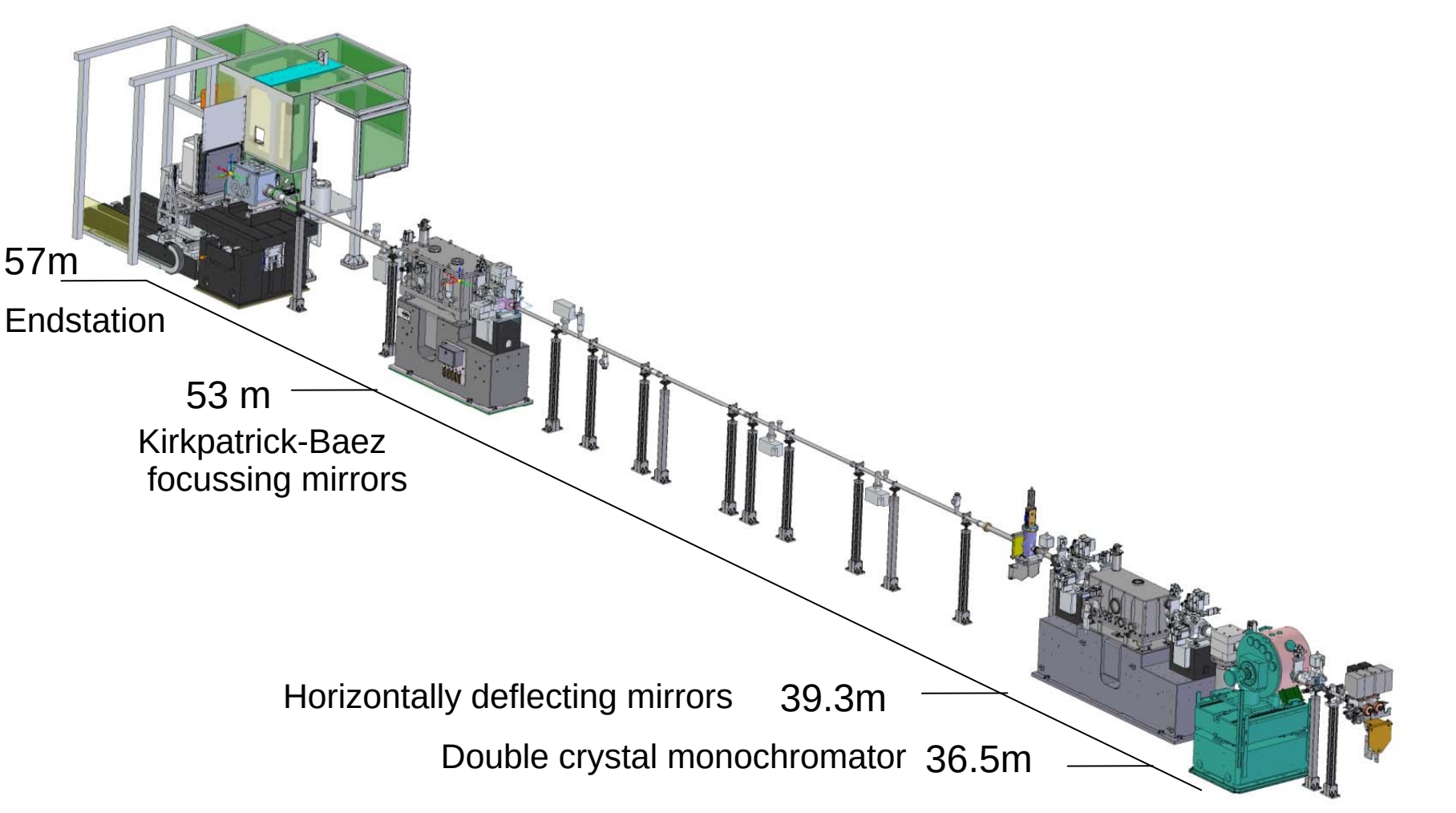
14 beamlines in 9 sectors

EMBL at Petra III

EMBL at Petra III



P13 Macromolecular crystallography



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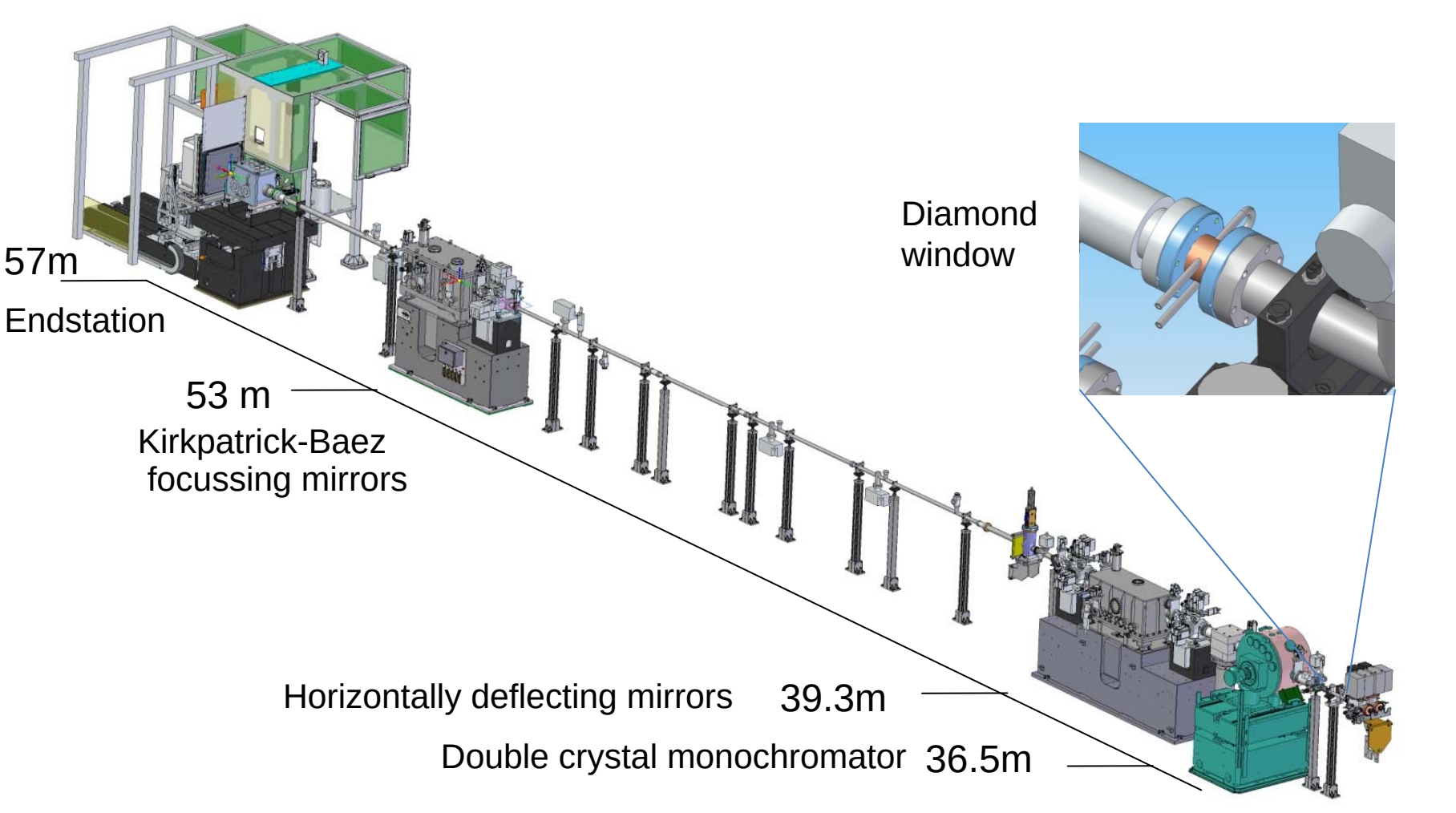
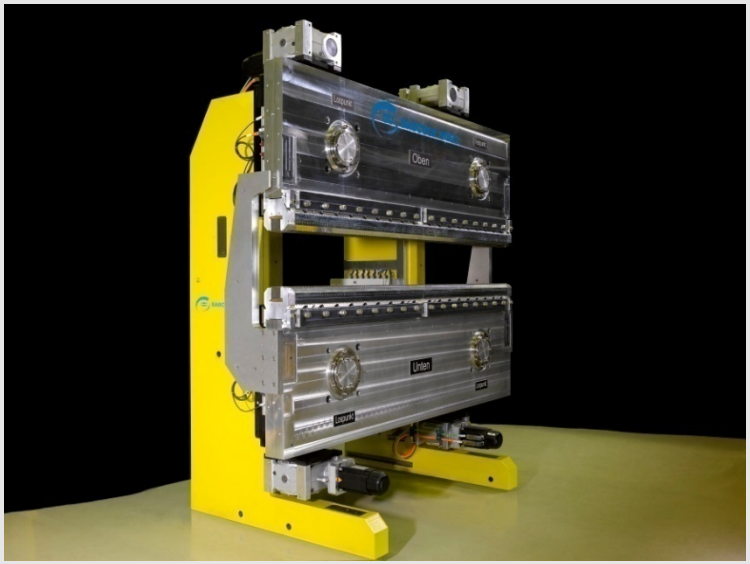


Petra generic front-end

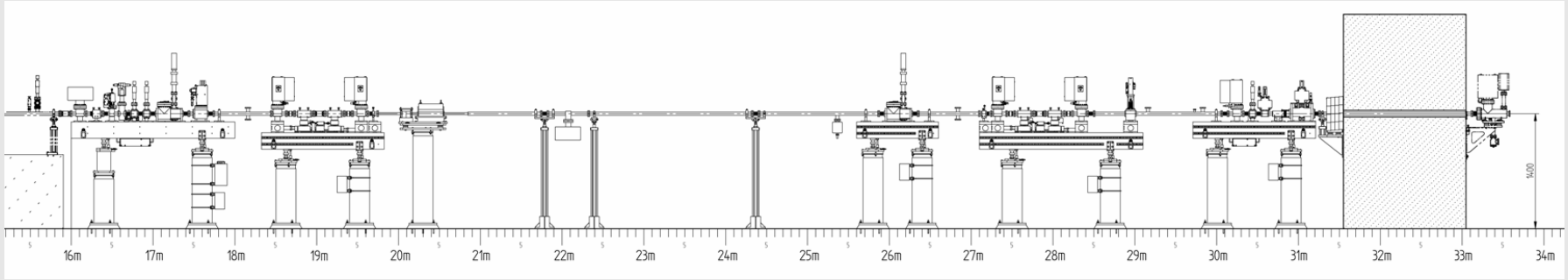
The PETRA III front-ends extend in the ring tunnel from the source, up to the optic hutch.

Designed and maintained by DESY.

- 1 Vertical slit at 19m from source.
- 1 Vert./ Hor. slits at 28m from source.
- Two white beam screens.
- Attenuators.
- Beam shutters.
- Vacuum diagnostics and safety system.



PETRA III 2m U29 UNDULATOR *© DESY 2009*



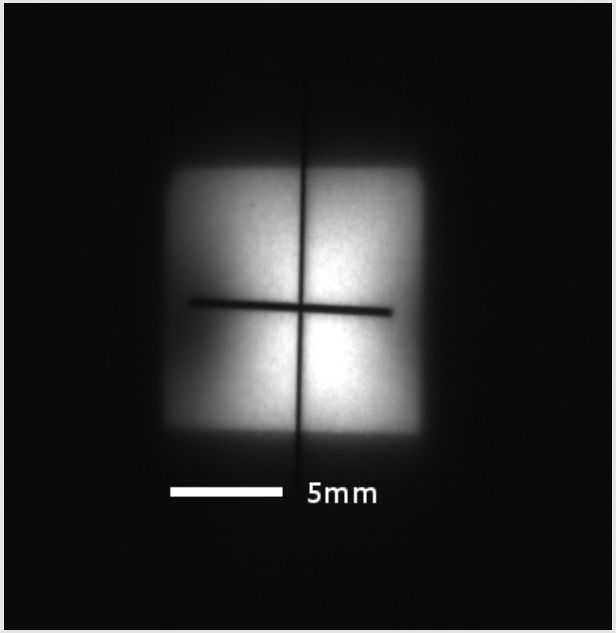
(Courtesy of DESY)

Available diagnostics

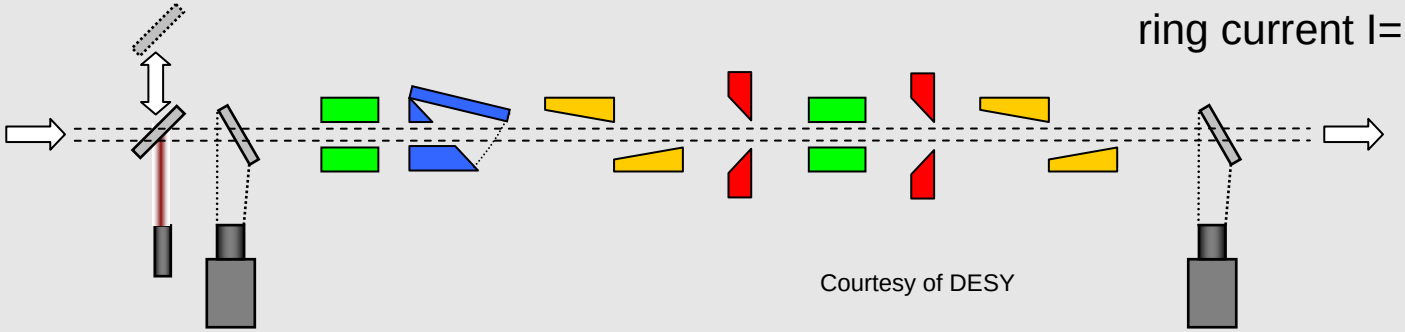
White beam viewers are available in the front-end to help aligning the photon beam to its theoretical path.

The diamond screens offer a qualitative estimate of the beam position.

The screens are not cooled and can be used only in special machine run modes at 1mA of ring current.



P12 front-end white beam viewer, ring current I=1mA



Courtesy of DESY

Motivation

Visualizing the white beam in the optic hutch would be a powerful aid for commissioning monochromators and front ends.

The diamond of the window being exposed to the white beam allows the exploitation of the fluorescence for visualizing the white beam without additional interference.

Front-end window

Together with DESY engineers we investigated the possibility of observing the fluorescence from the downstream side of the front end window.

(Courtesy of Diamond Materials)

Front-end window

Clearance: D = 5mm.

Material: Diamond

Thickness: 200 µm.

Process: Chemical vapor deposition.

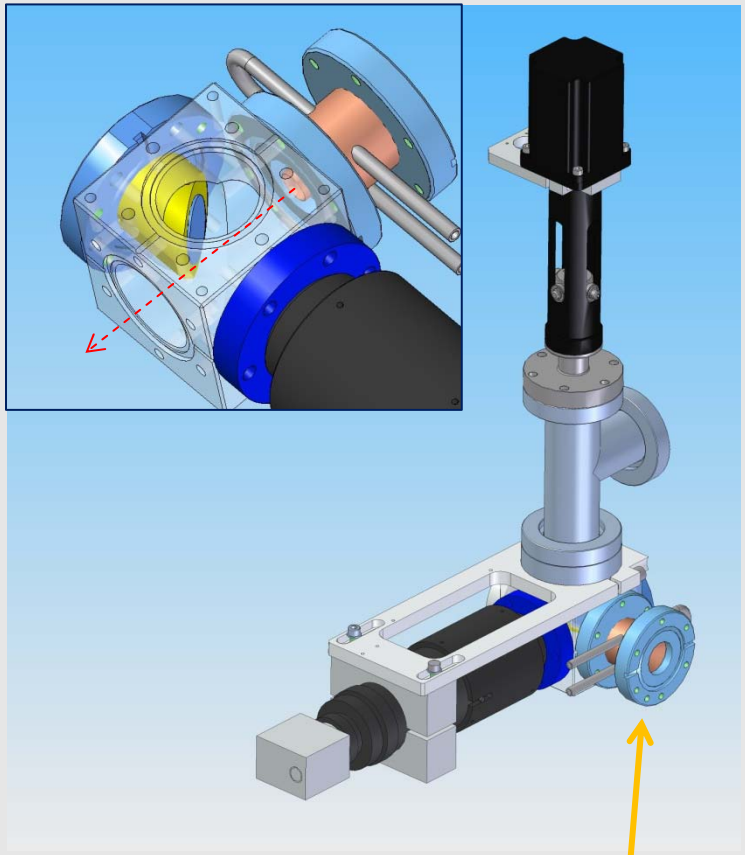
Structure: Polycrystalline.

Grade: Optical

Surface roughness : < 10nm RMS.

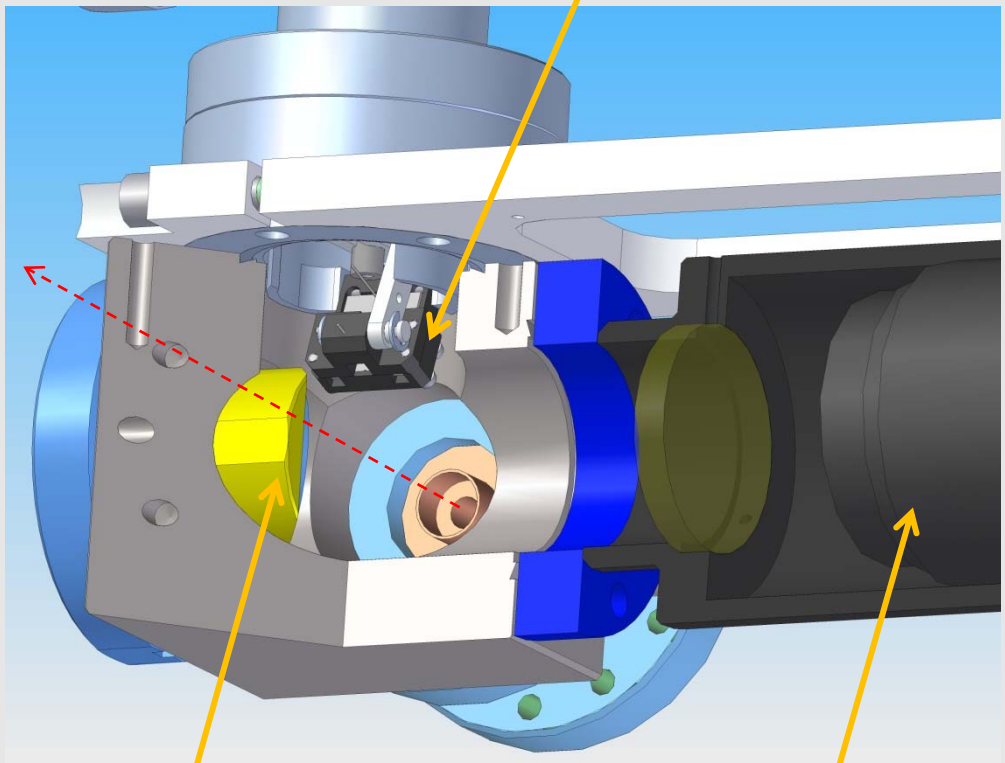
(Courtesy of Diamond Materials)

Viewer assembly



Window

Retractable PIN diode
IRD AXUV 100

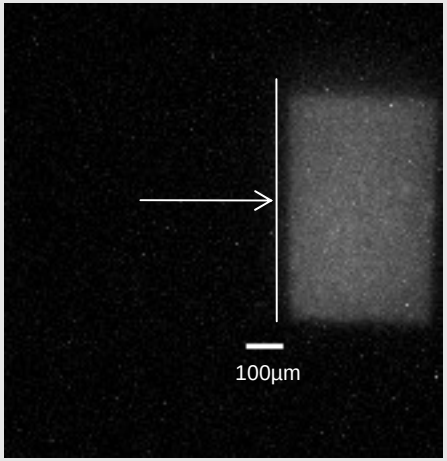


Off-axis mirror

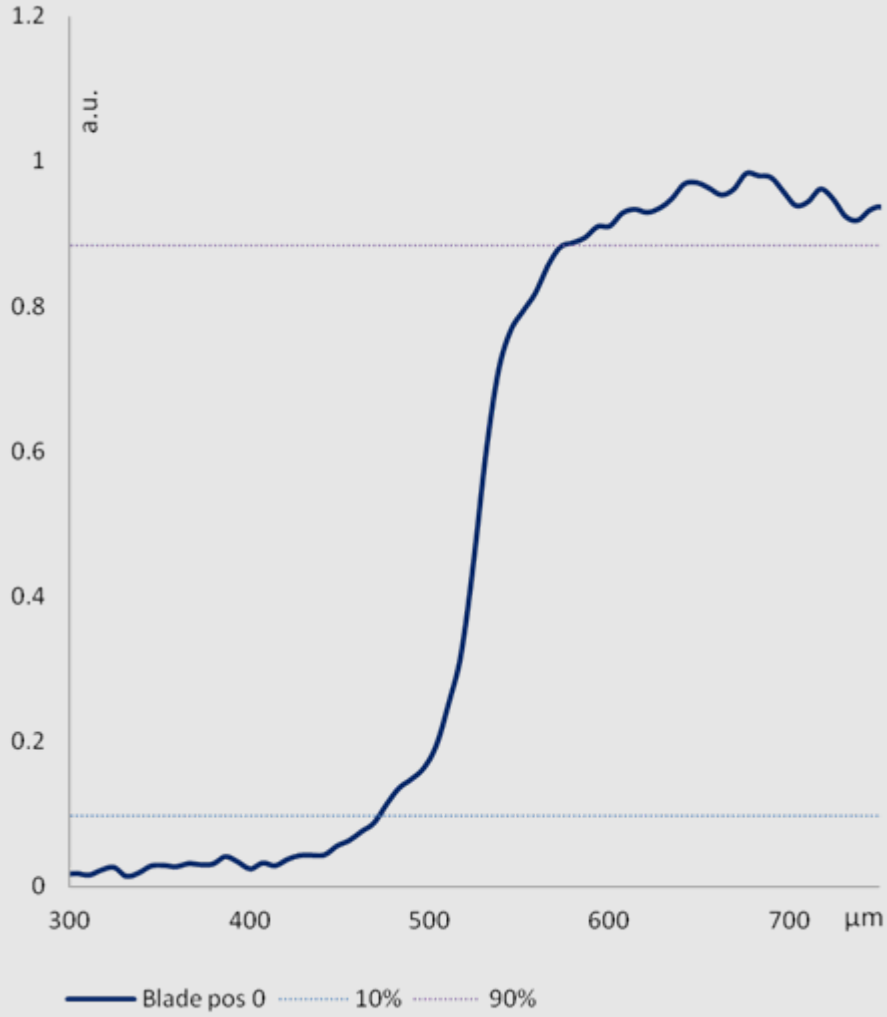
Camera and optics

Viewer assembly space resolution

Horizontal edge scan
Diamond window 60 µm
Energy 11 KeV
Camera horizontal res. 7µm / Pixel

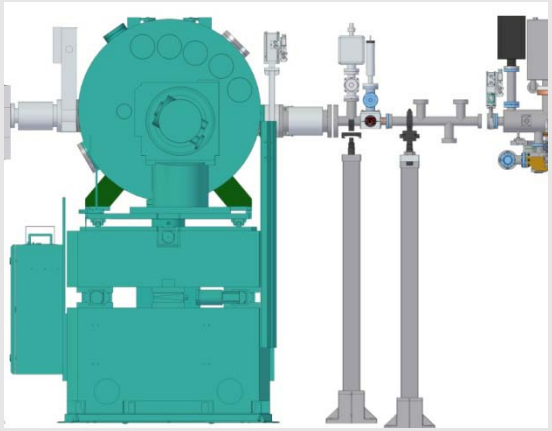


Blade pos

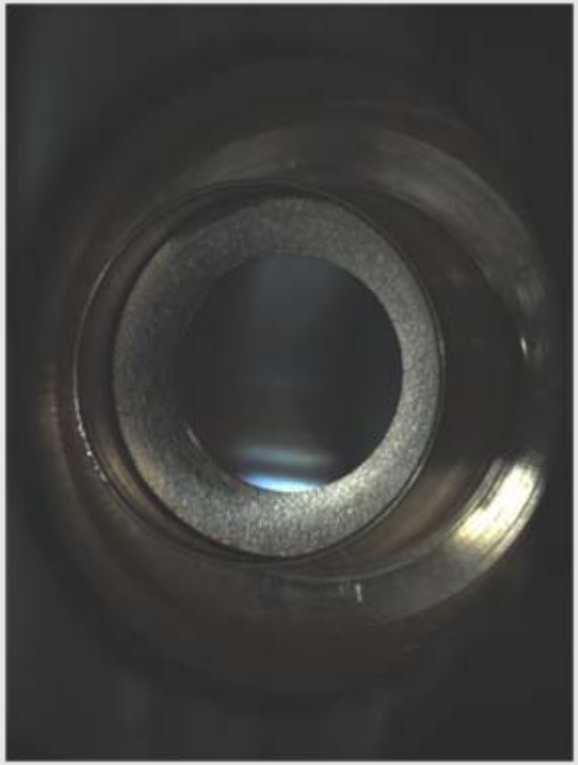


Edge response (10%-90%)
Spacial resolution= 90 µm

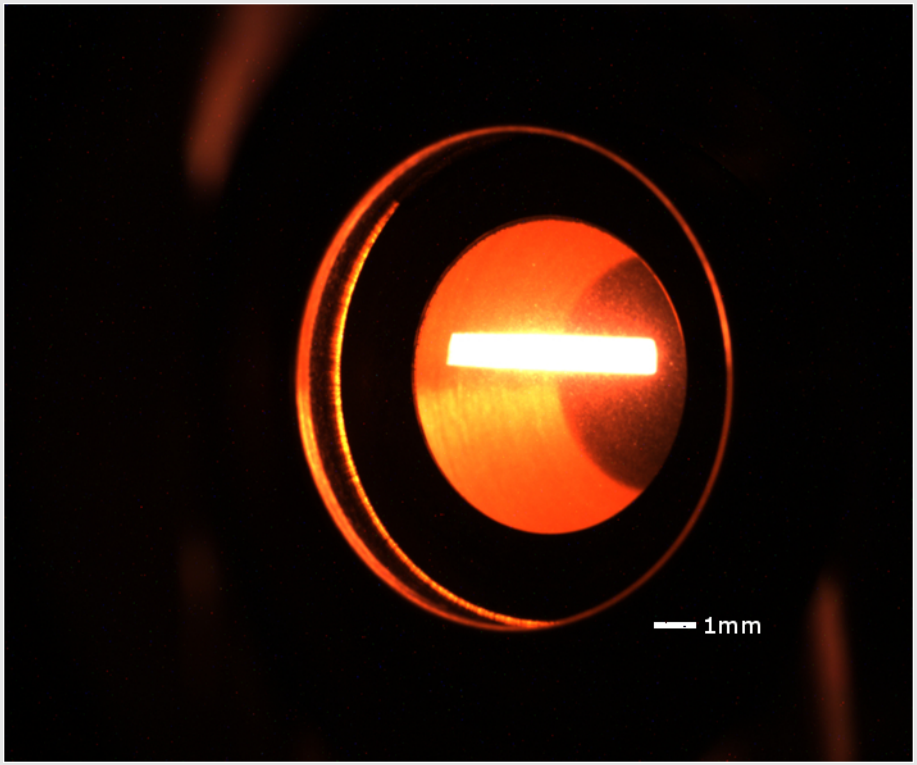
First installation at P13



Viewer



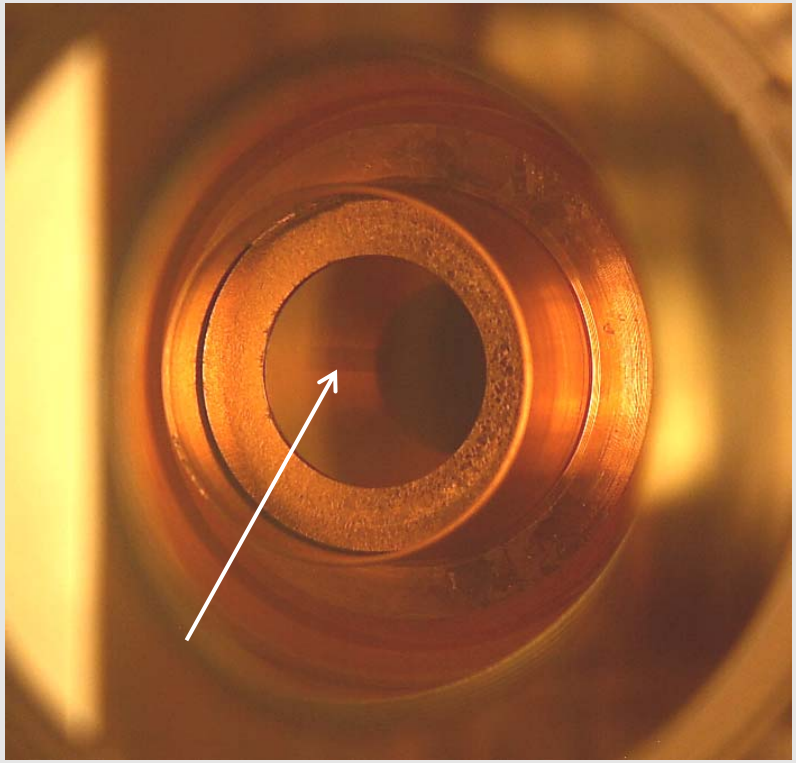
Without beam



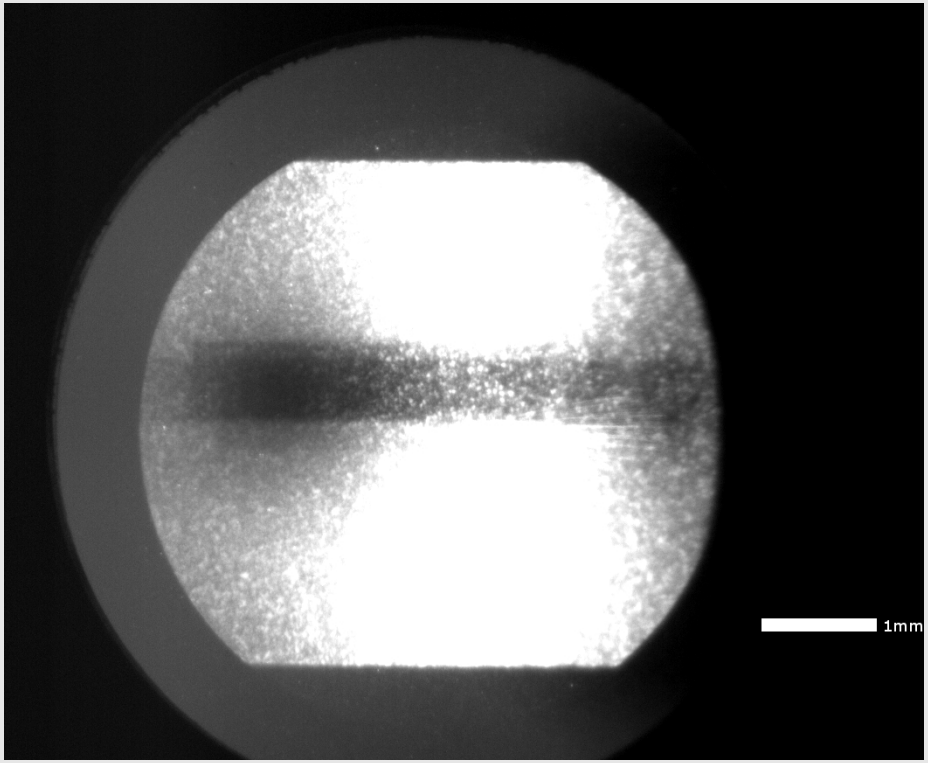
With beam

White beam at P13 Front-end slits aperture 0.5 mm x 5 mm

Signal degradation



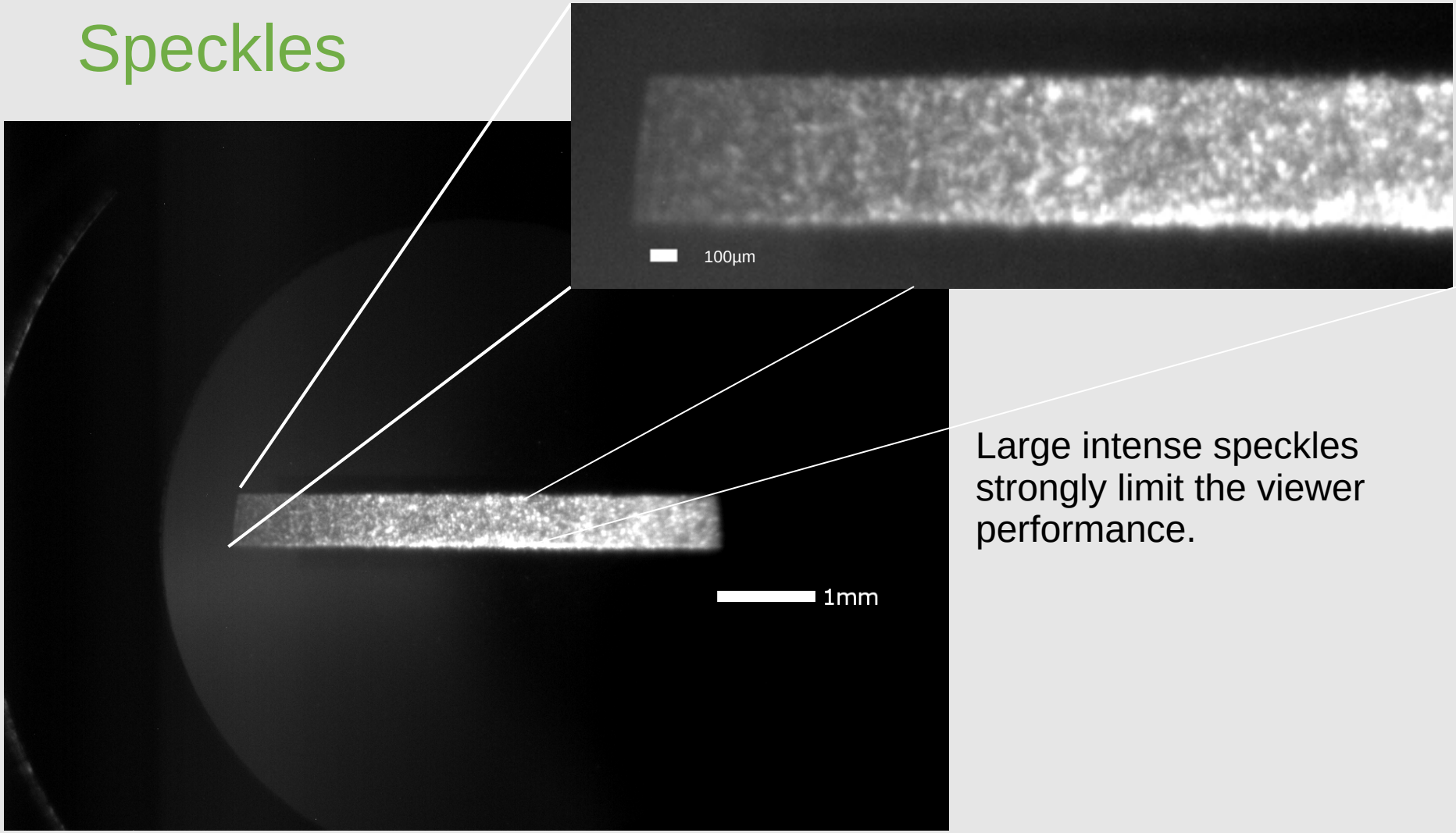
Without beam



With beam

P13 Degradation of the image after about 1 year of window exposure.

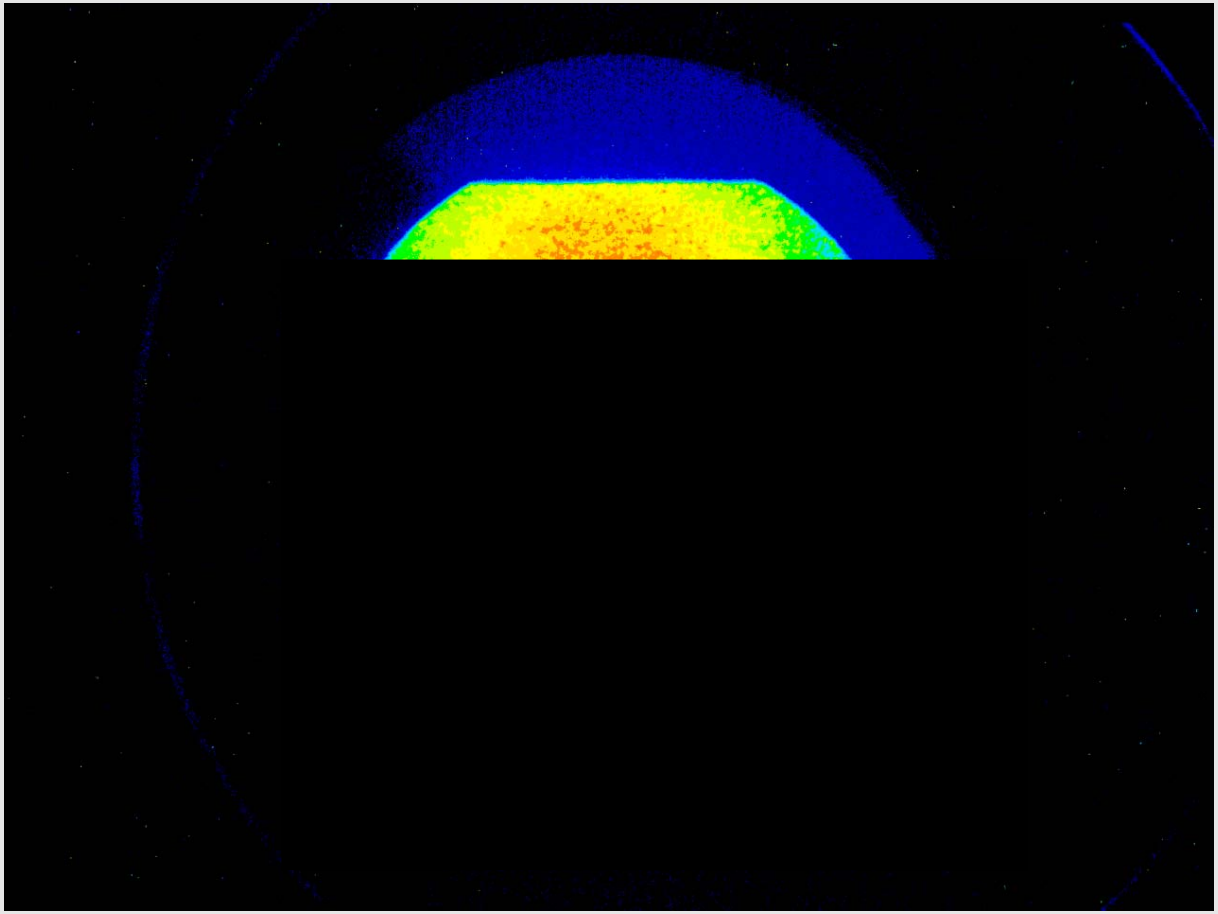
Speckles



Large intense speckles strongly limit the viewer performance.

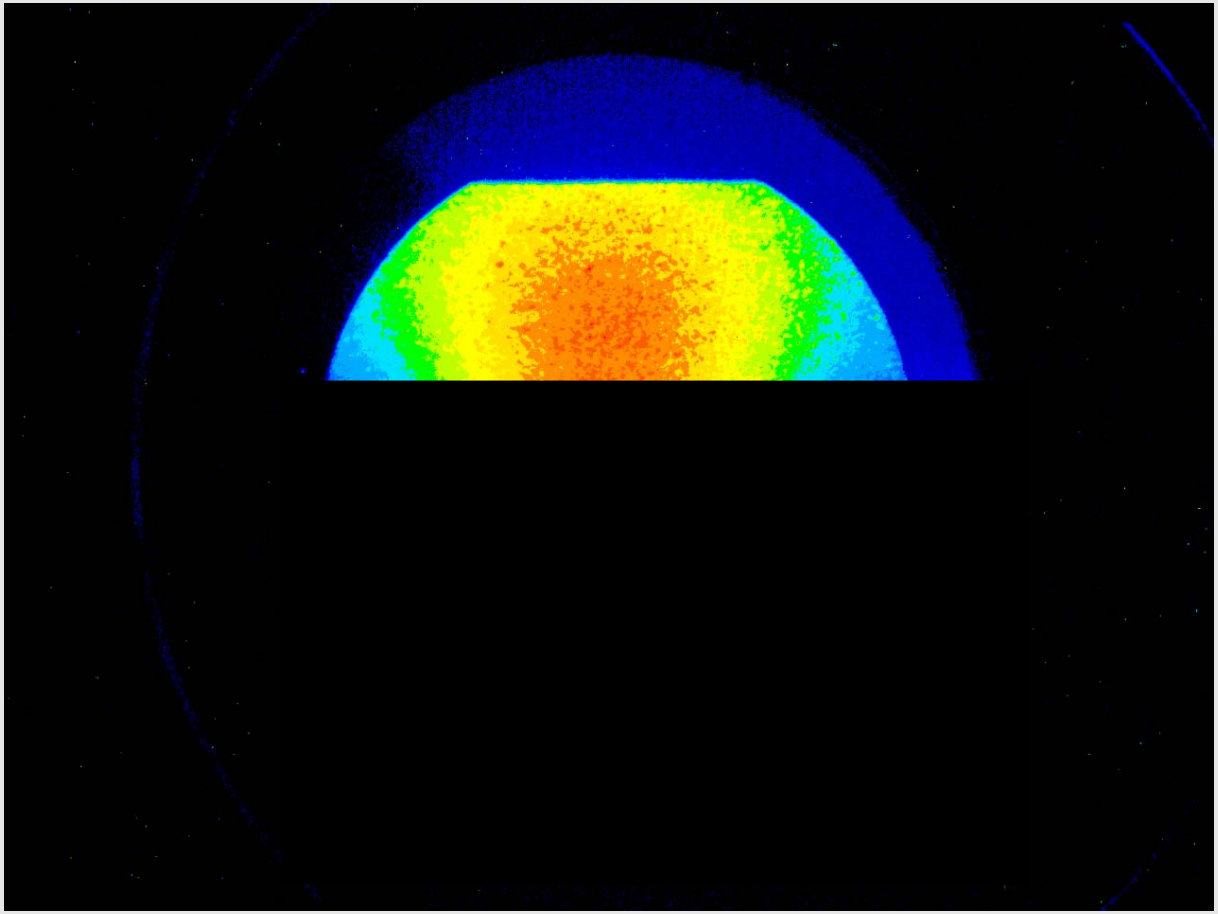
Front end slits aperture 0.5 mm x 5 mm

CVD front-end window



Overlayed images of P14 white beam at 18.3mm undulator gap

CVD front-end window



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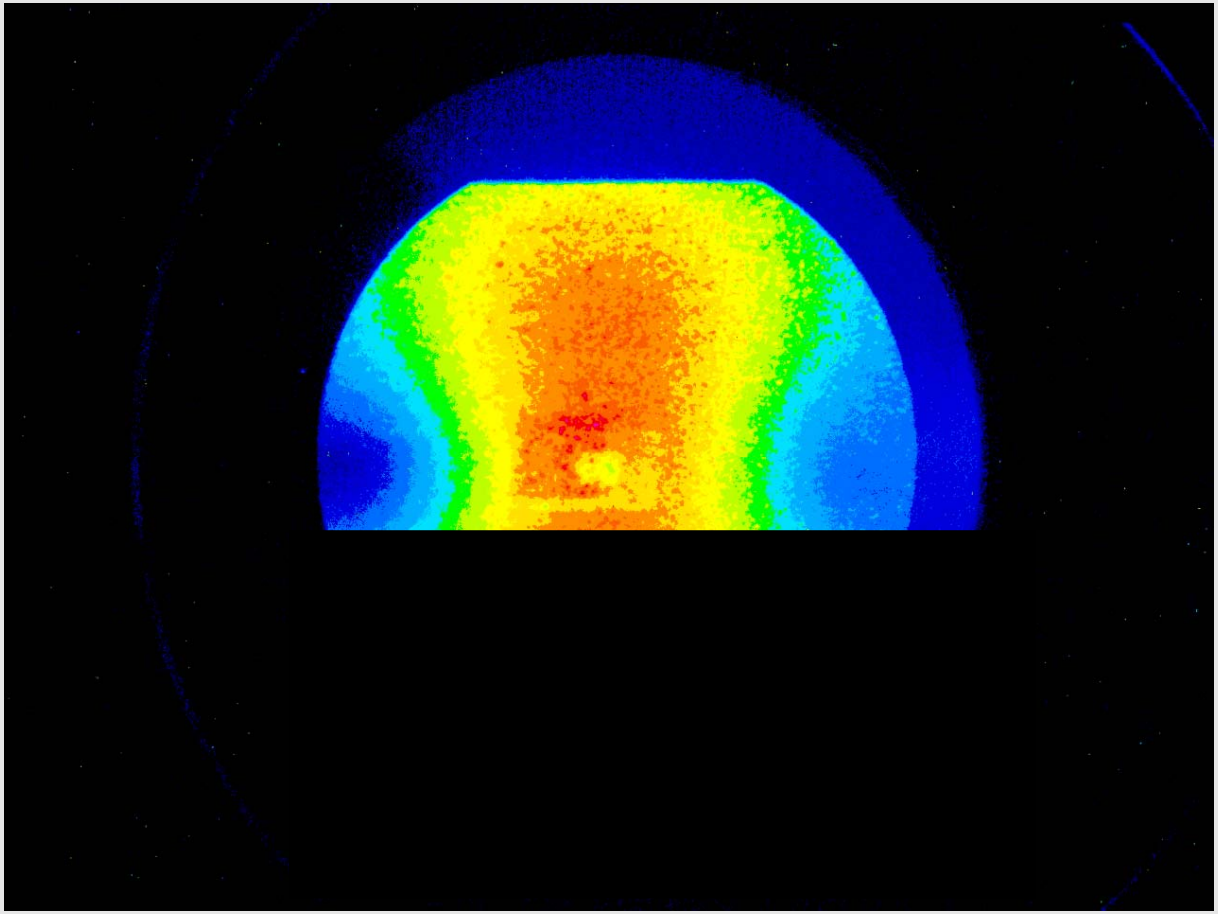

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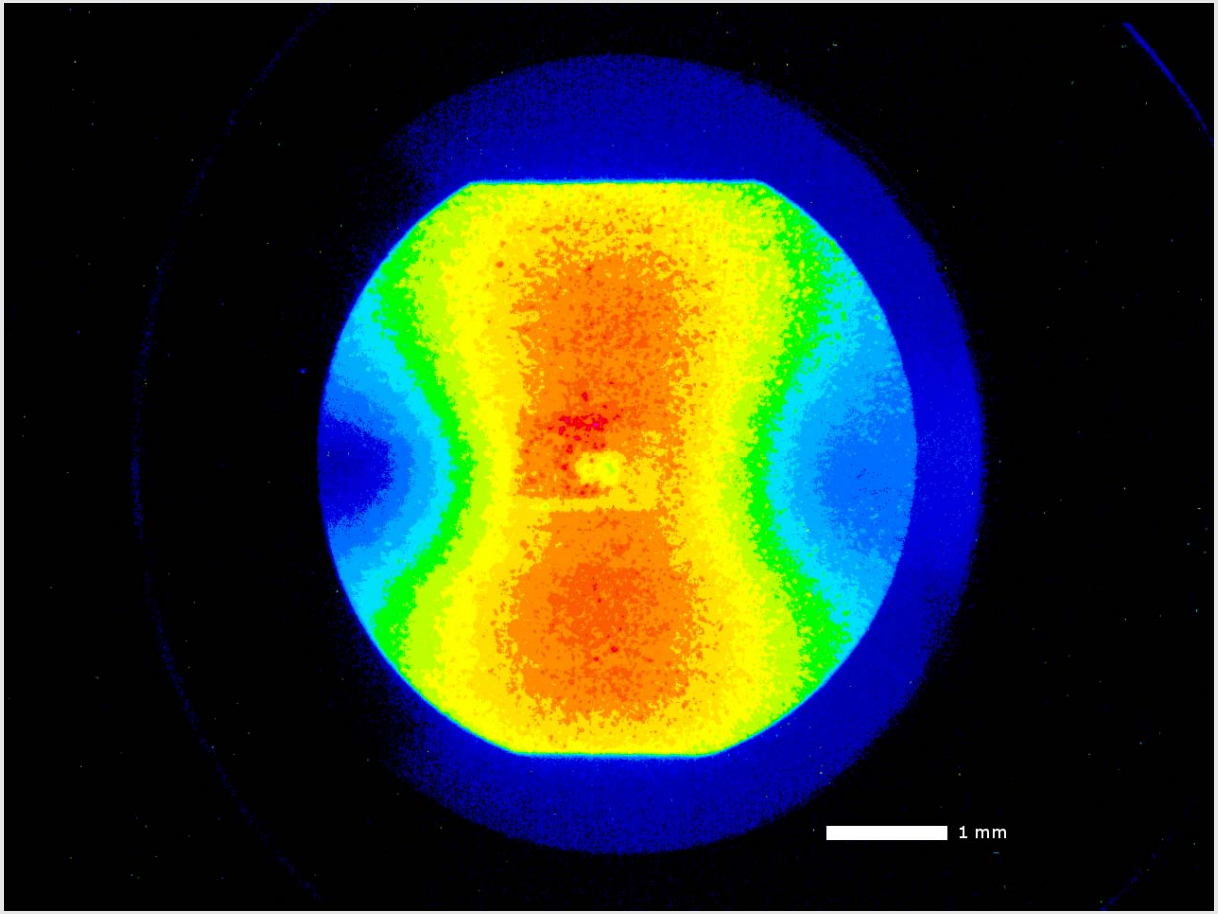

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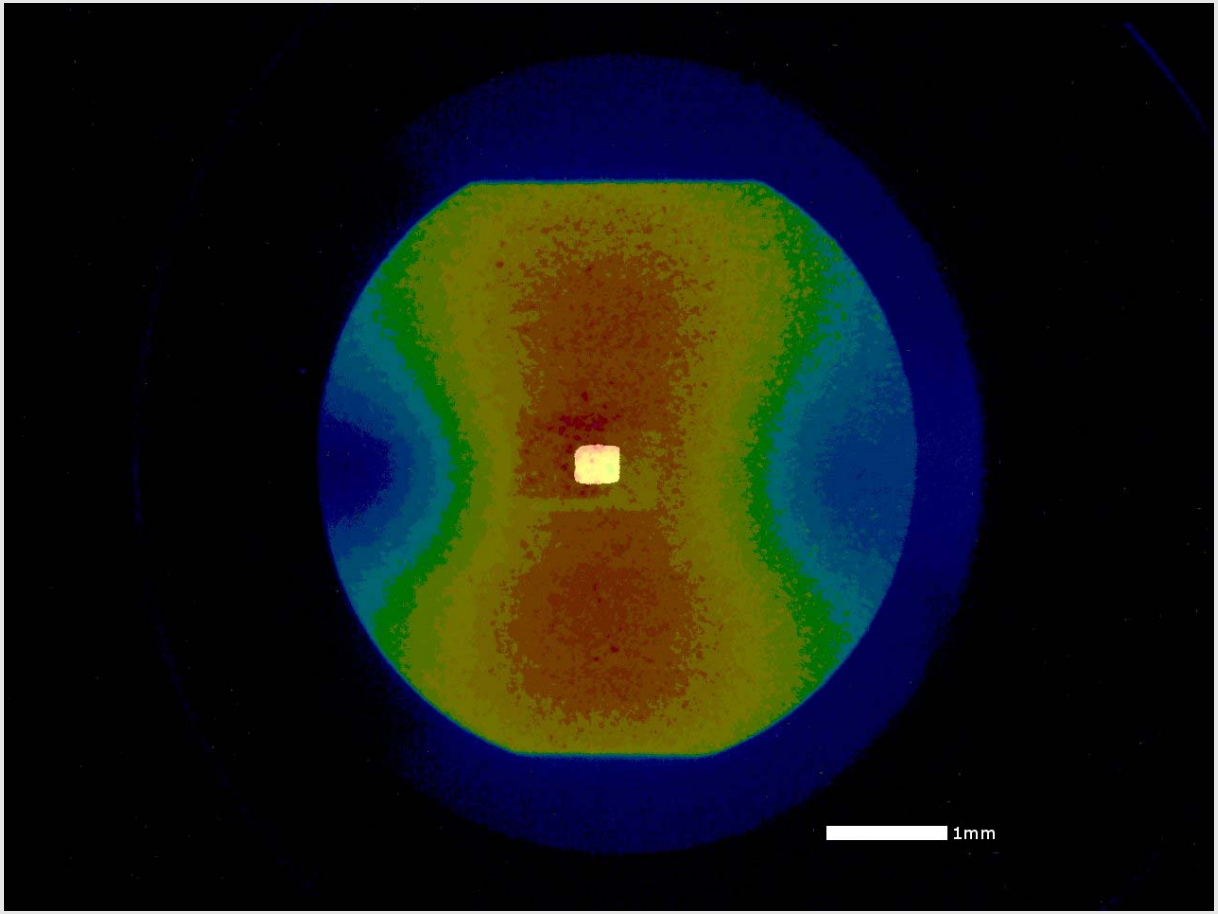
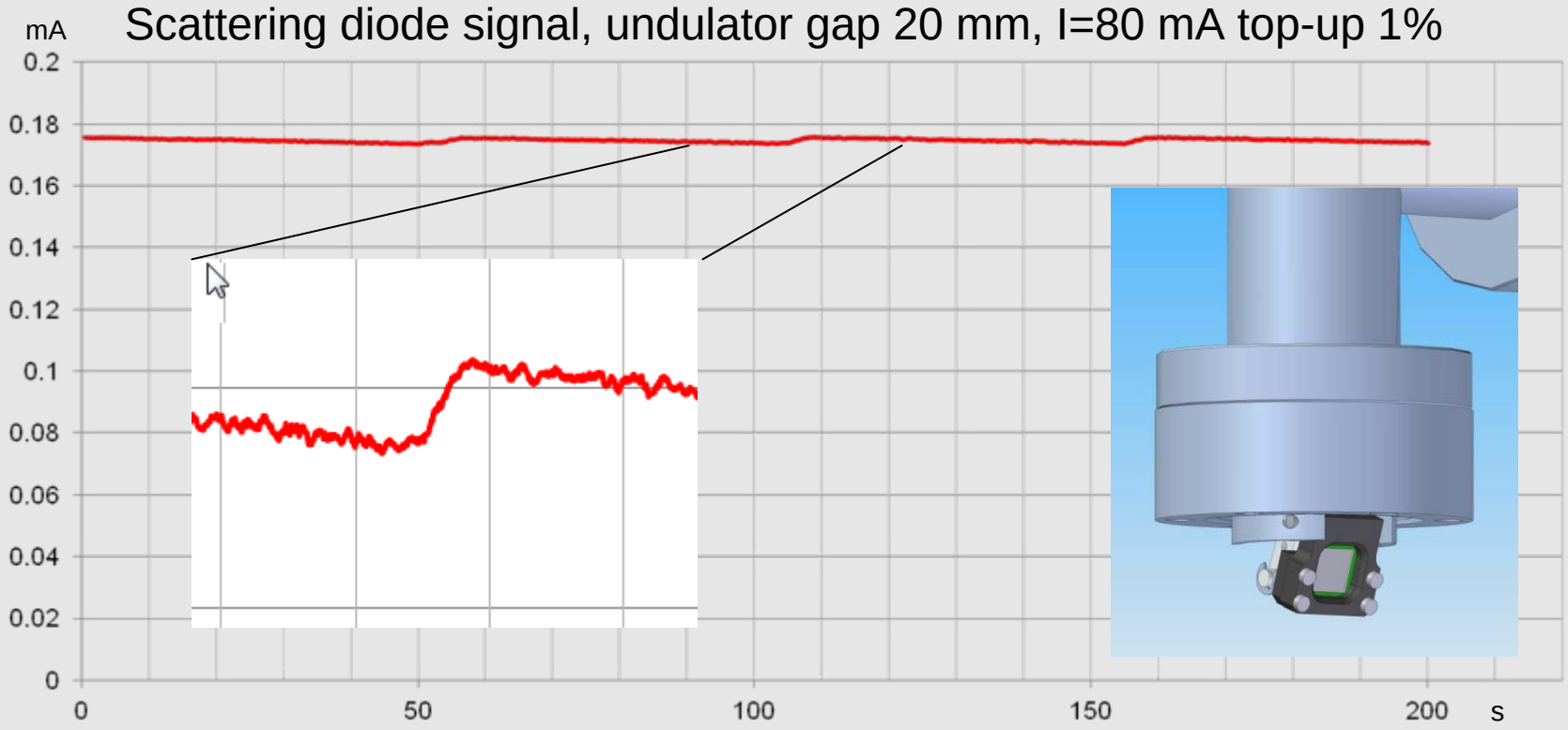
CVD front-end window



Overlayed images of P14 white beam at 18.3mm undulator gap

Pin diode

The PIN diode detects the radiation scattering at the window.
To extend the lifetime it can be retracted to shield it from direct radiation.



Conclusion

A simple diagnostic instrument was obtained by adapting existing components.

All three beamlines have been provided with the monitor.

Despite the low resolution of the images it is still possible to estimate the position of the beam axis and to check the position of the apertures.

The high sensitivity and quick response of the diode will be used to prove the stability of the front-end.

The monitor has become very popular among the beamline scientists and has proved its value while troubleshooting the beamlines.

At the moment, Desy engineers are developing cooled diamond front-end screens for white beam applications.

Acknowledgements

Stefan Fiedler	Head of instrumentation group EMBL - Hamburg
Markus Deghenhardt	FS-BT, Deutsches Elektronen-Synchrotron DESY
Horst Schulte-Schrepping	Head of FS-BT, Deutsches Elektronen-Synchrotron DESY
Michele Cianci	EMBL Beamline P13

Instrumentation group EMBL

Financial support by :

Bundesministerium für Bildung und Forschung

Thank you!