



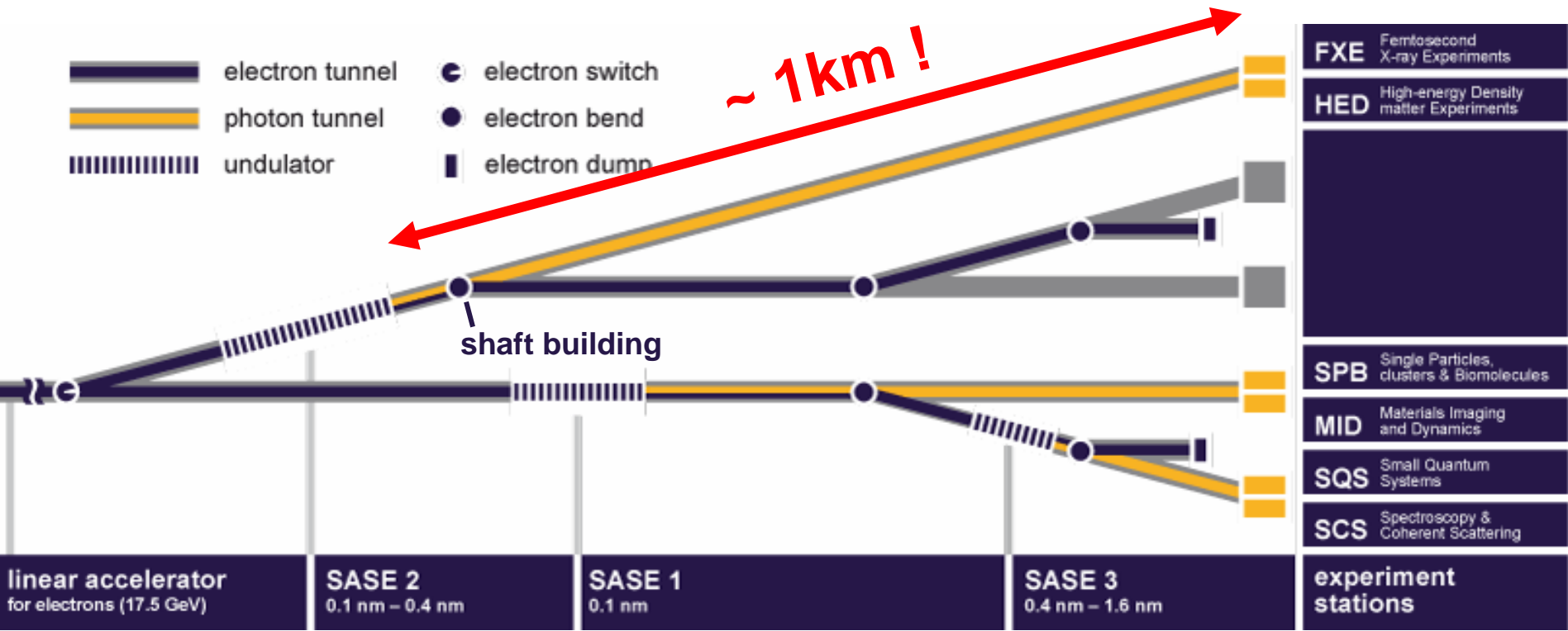
X-ray beam transport

Harald Sinn

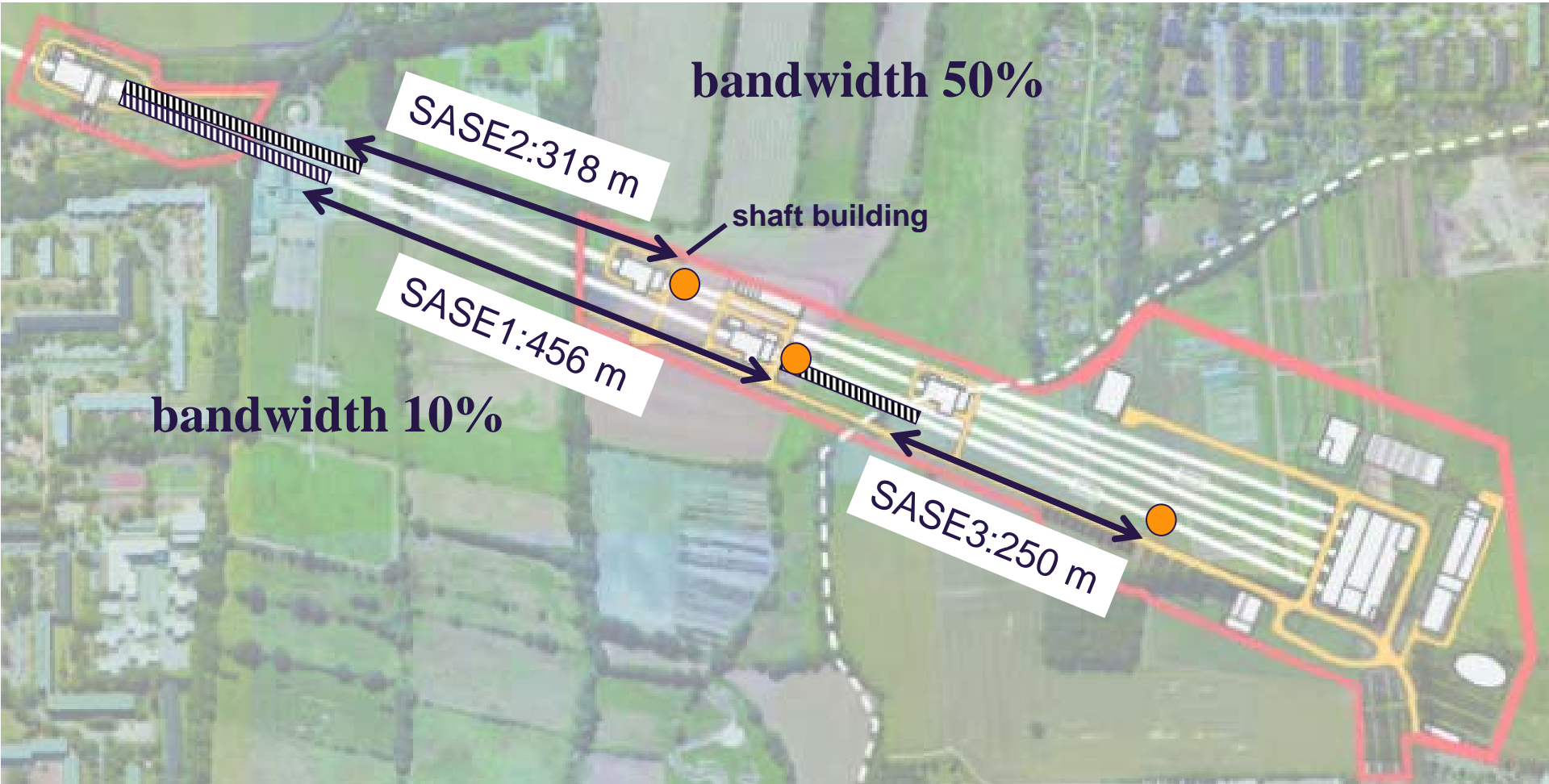
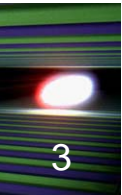
European XFEL

Users' Meeting January 26, 2011

Photon beam transport at European XFEL

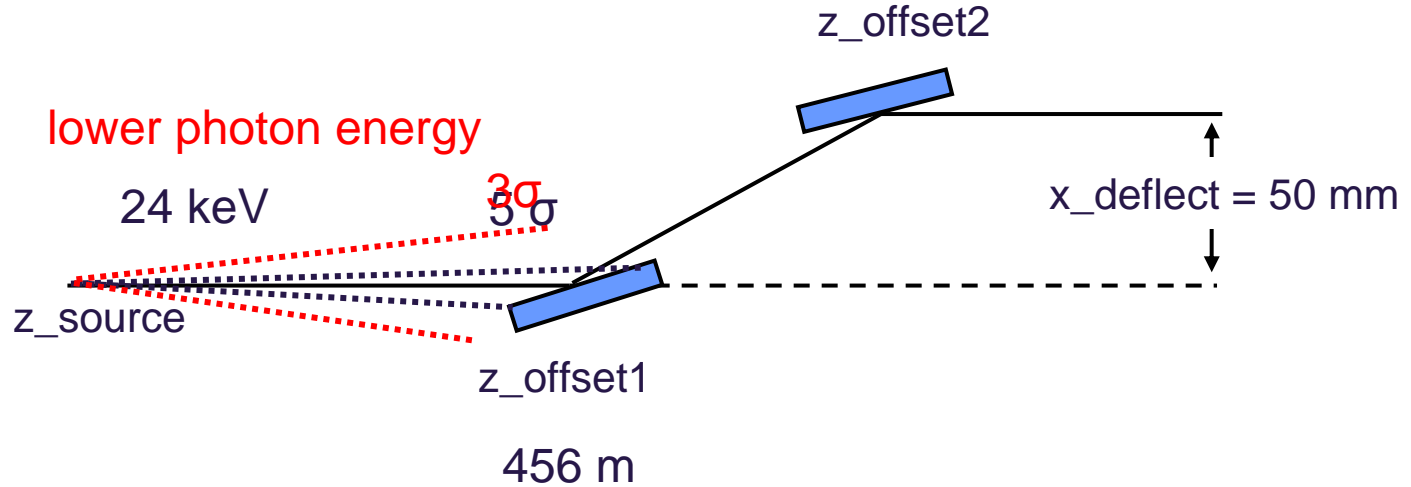


Problem: Large source to optics distance

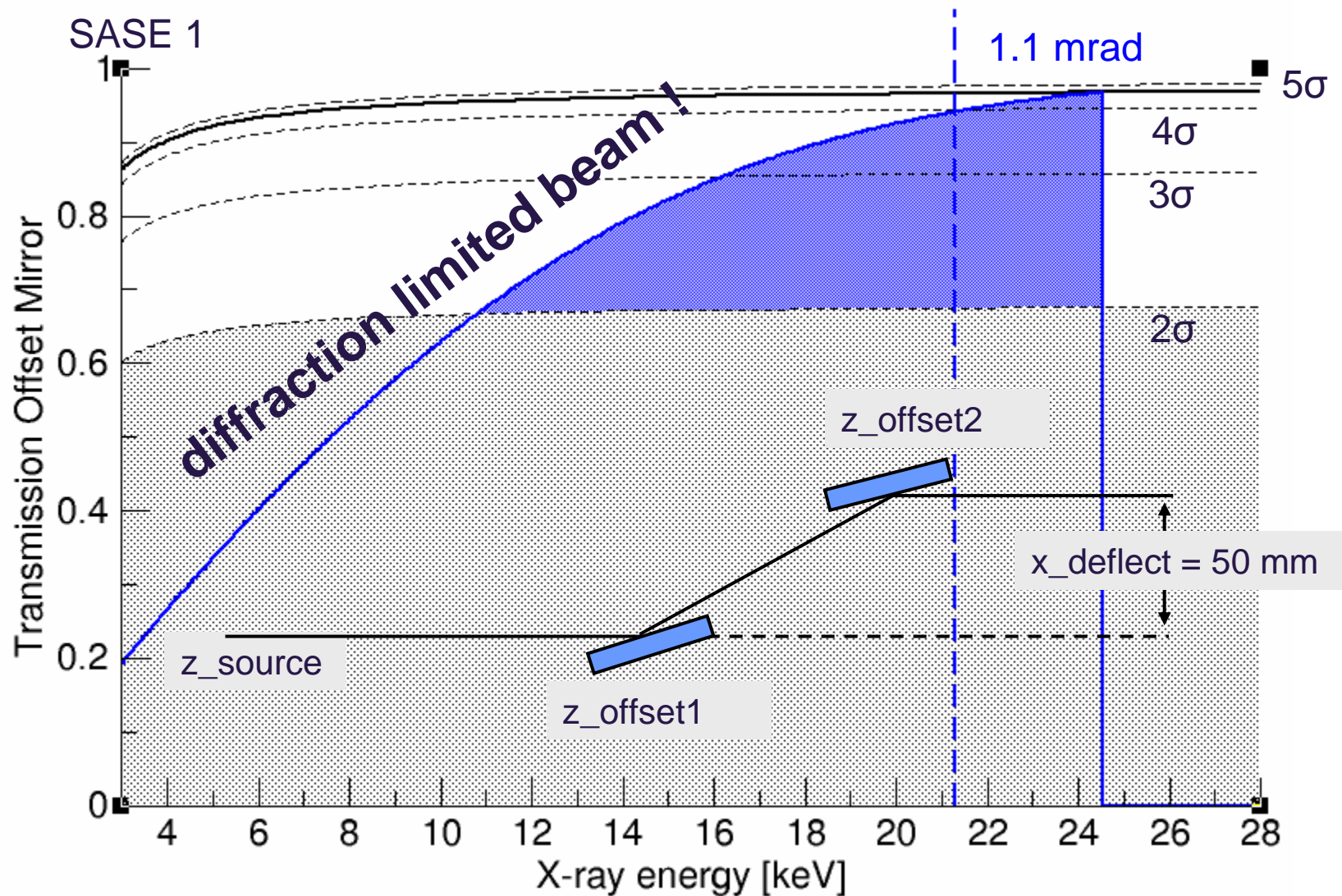




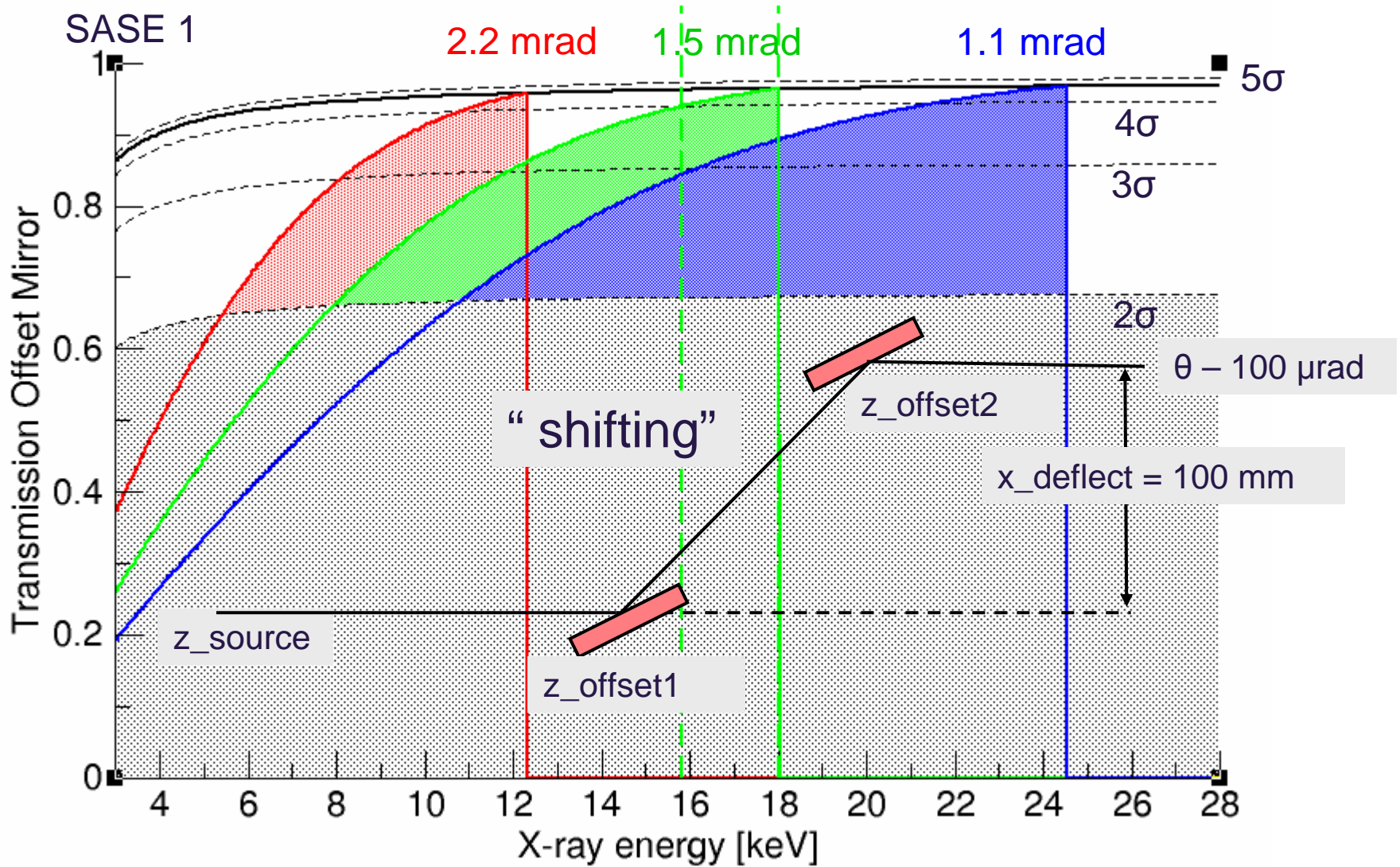
Diffraction limited source:
Beam divergence $\sim \lambda / \text{source size}$



Offset mirror bandwidth (SASE 1)



Offset mirror bandwidth (SASE 1)



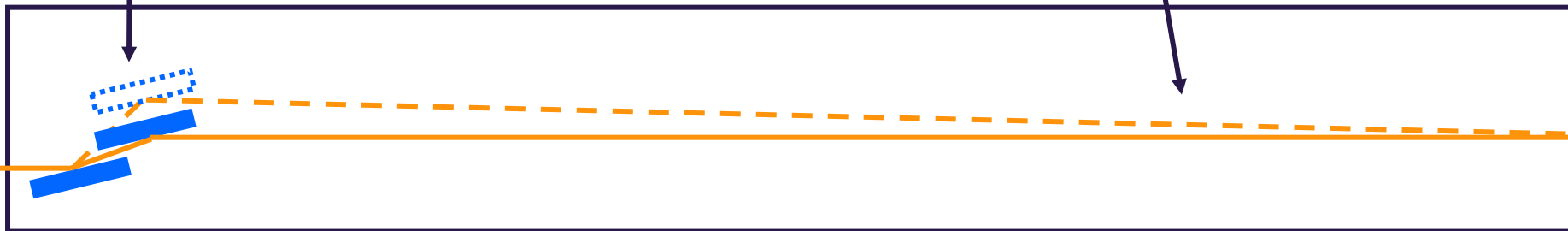
'Shifting' of offset mirrors



angle adjustment needed
to adjust to divergence

XTD 9

steers back to same
sample position



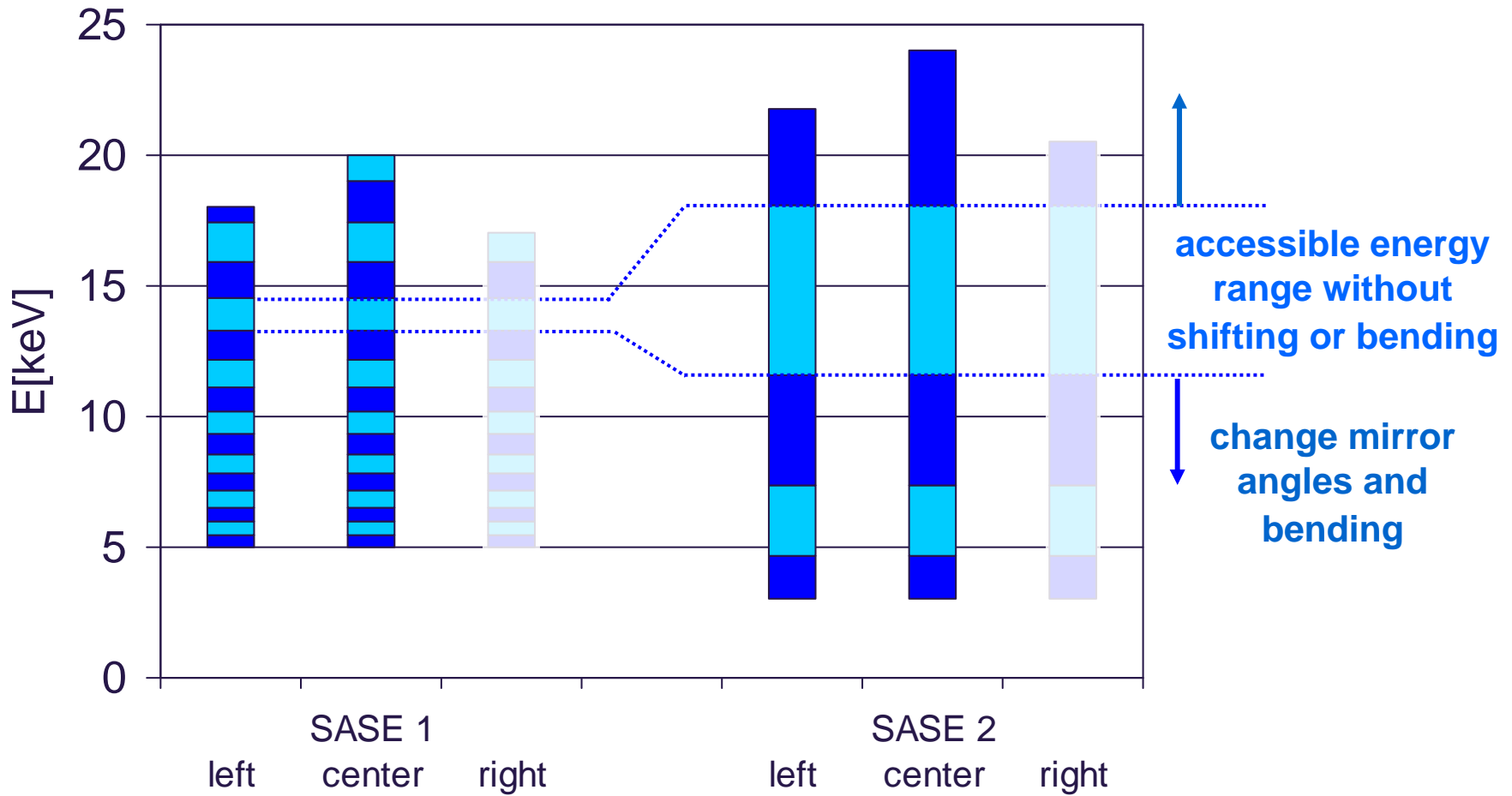
456 m

960 m

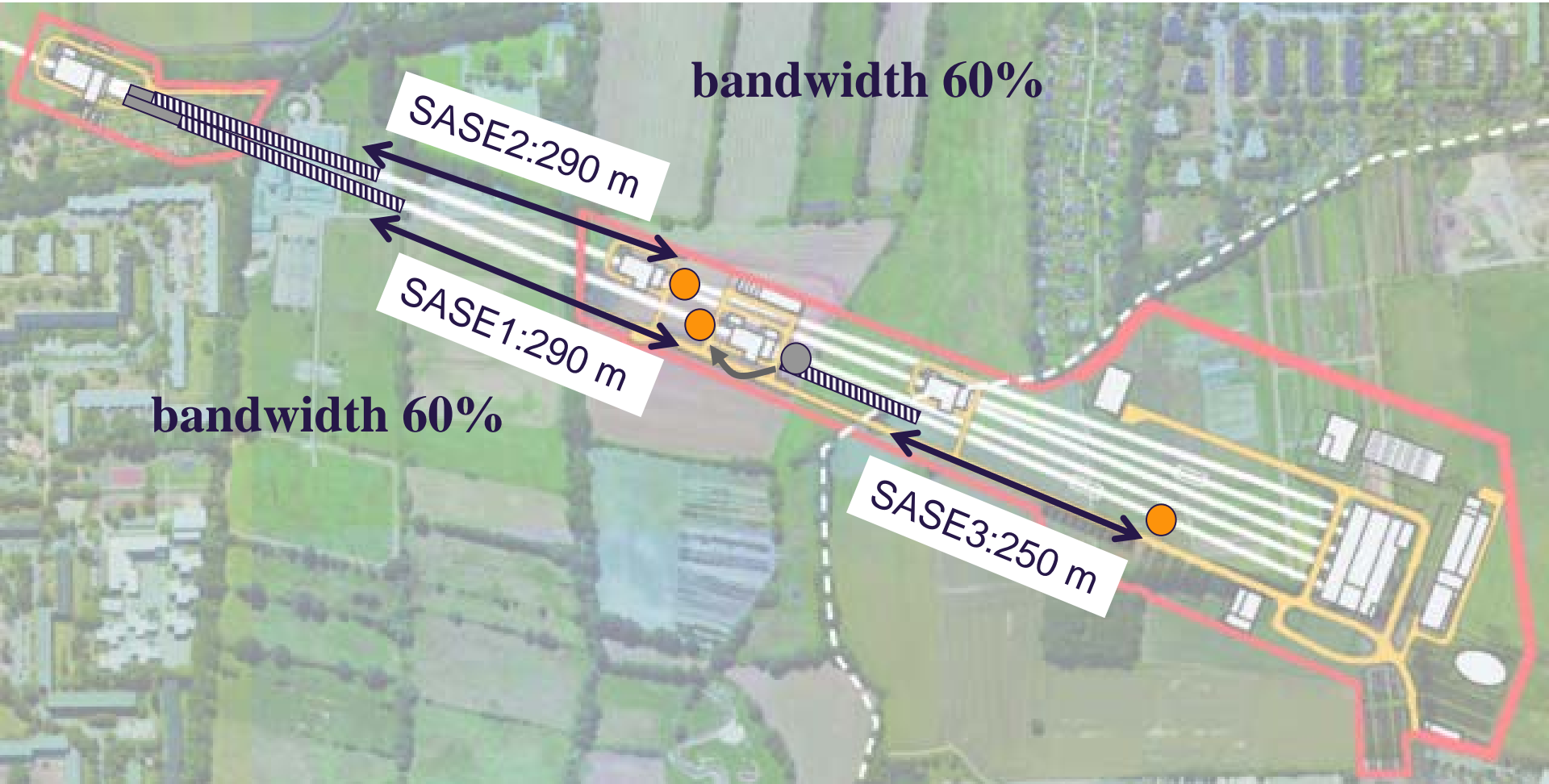
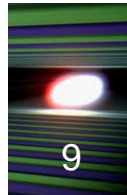
Beam Transport Systems Transmission



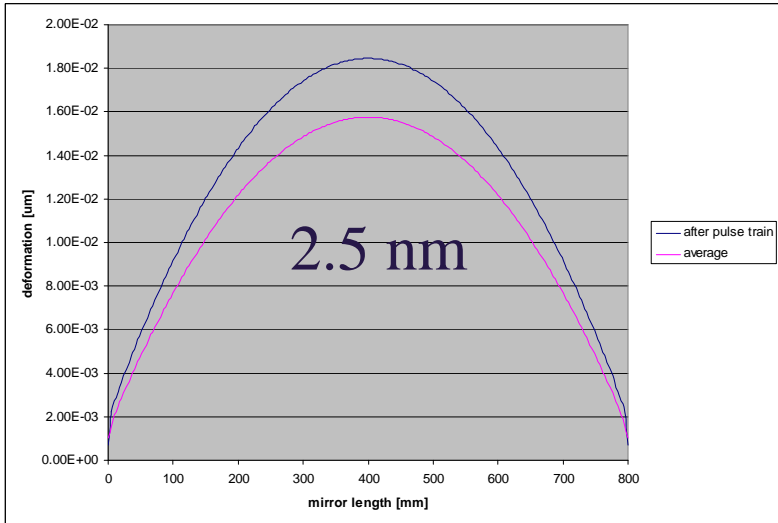
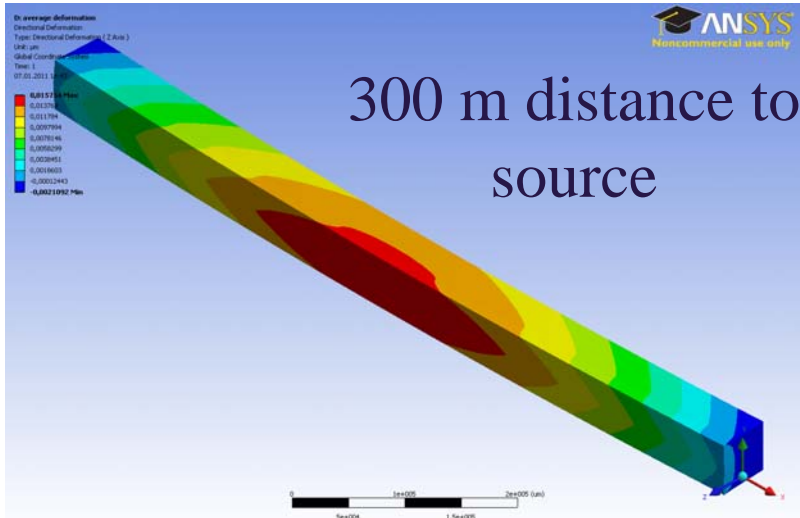
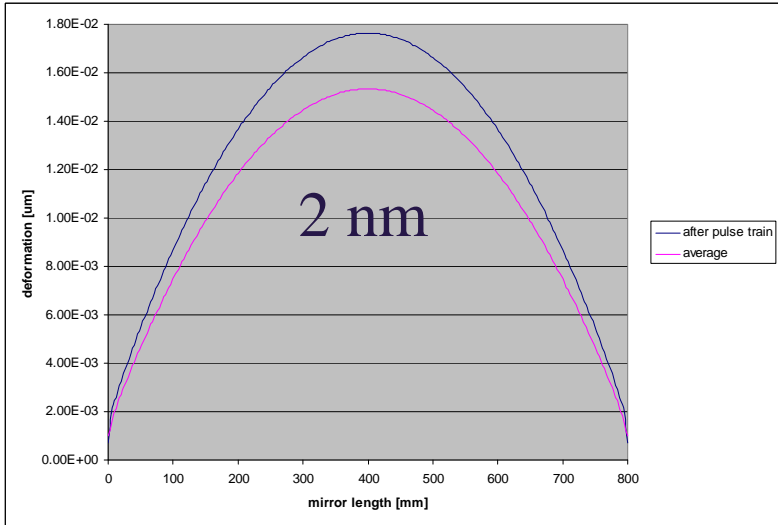
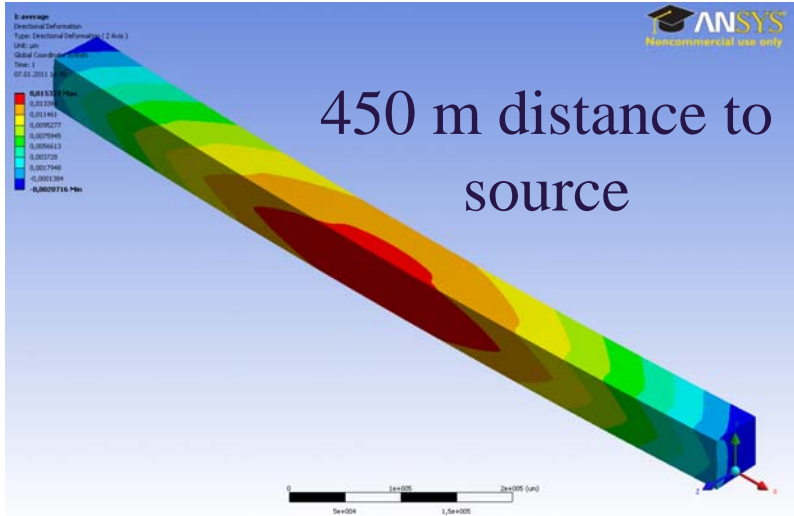
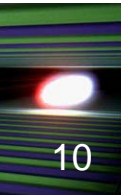
800 mm (optical length) mirrors, 1.5x divergence, min. 4 σ acceptance, branch beamlines 1.45 m apart, 20 km min. mirror bending radius



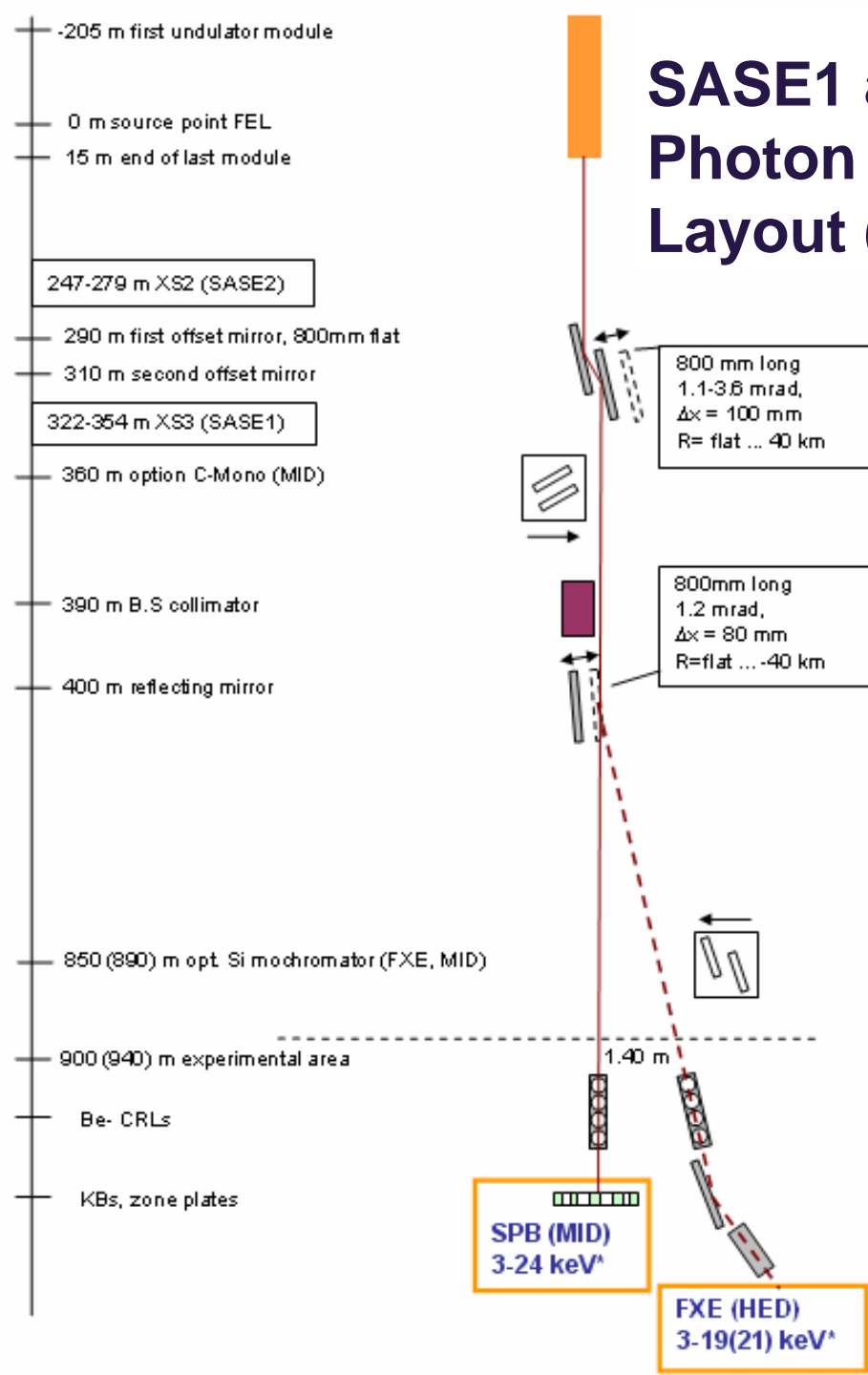
Proposal: Shift Undulators and Mirrors

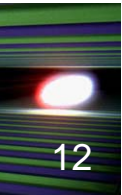


SASE 1: dynamic deformation during pulse train



SASE1 and SASE 2 Photon Beam Transport Layout (Jan2011)

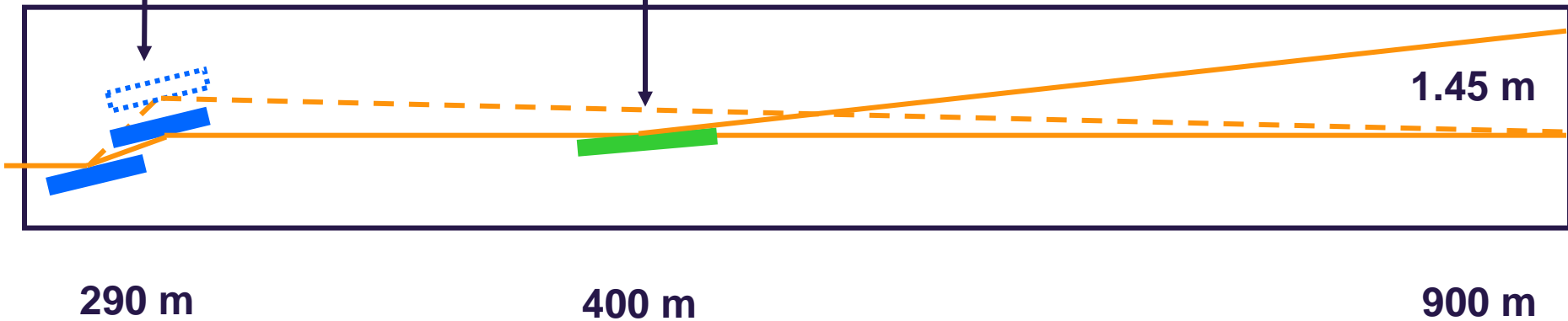




angle adjustment needed
to adjust to divergence

Problem: incident angle
cannot be adjusted

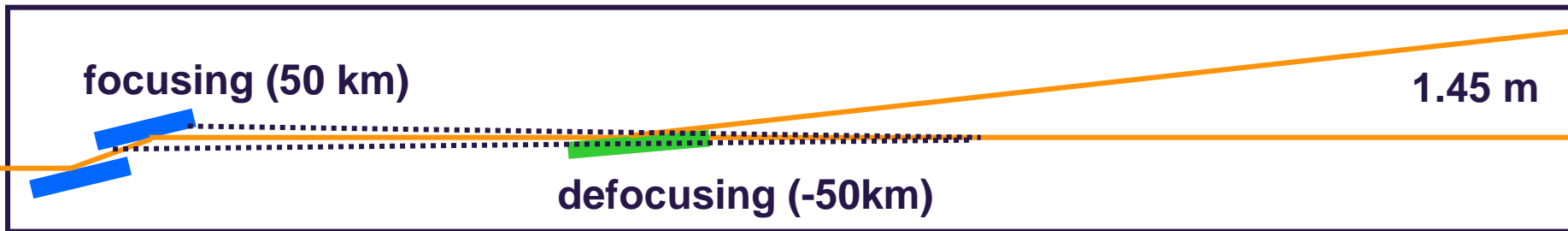
XTD 9





XTD 9

beam quality ???



focusing (50 km)

1.45 m

defocusing (-50km)

290 m

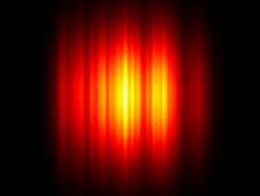
400 m

960 m

**Solution: focus behind
distribution mirror**

SASE 1&2 beam in Experimental Hall

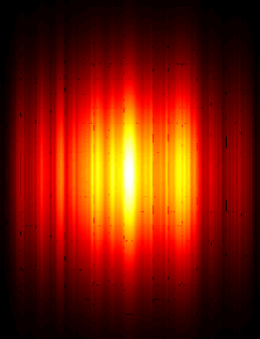
central
beamline



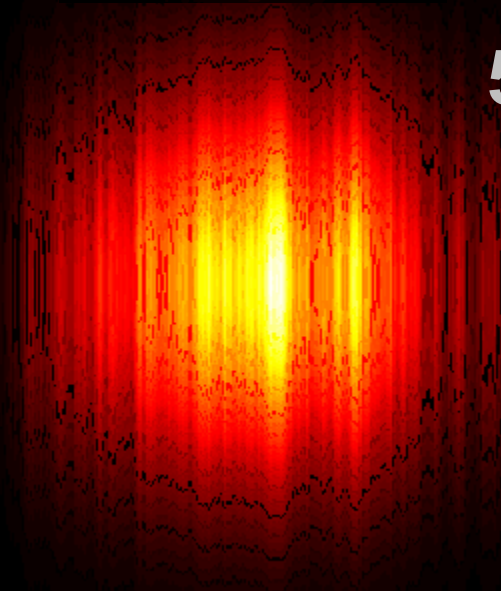
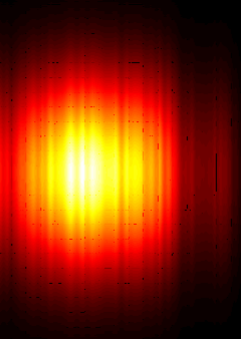
15 keV



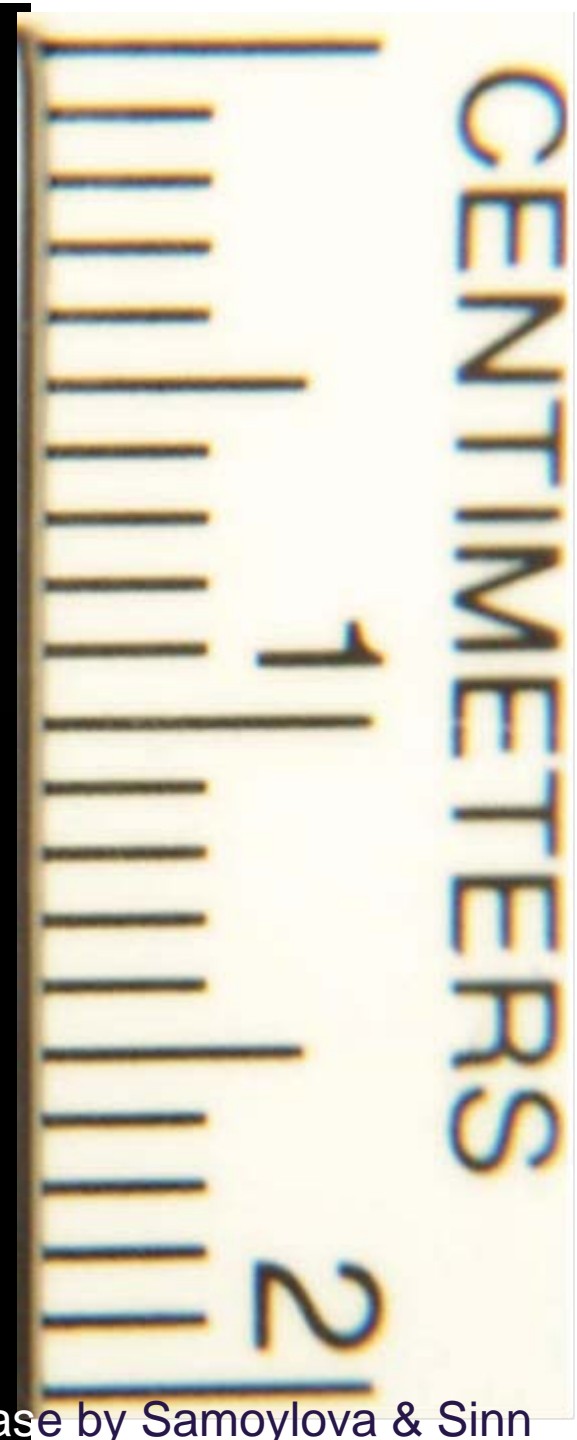
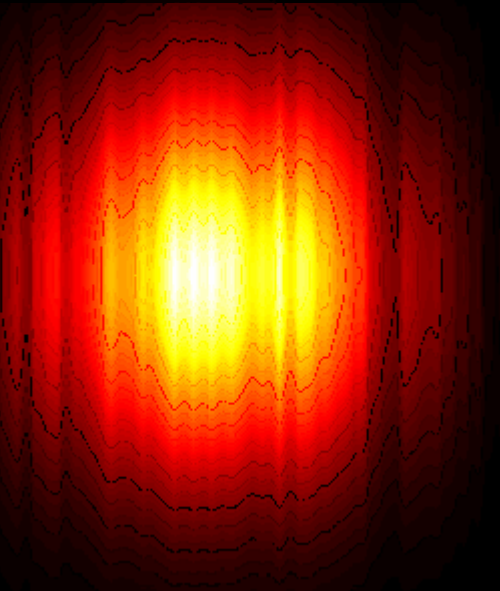
side
beamline



10 keV

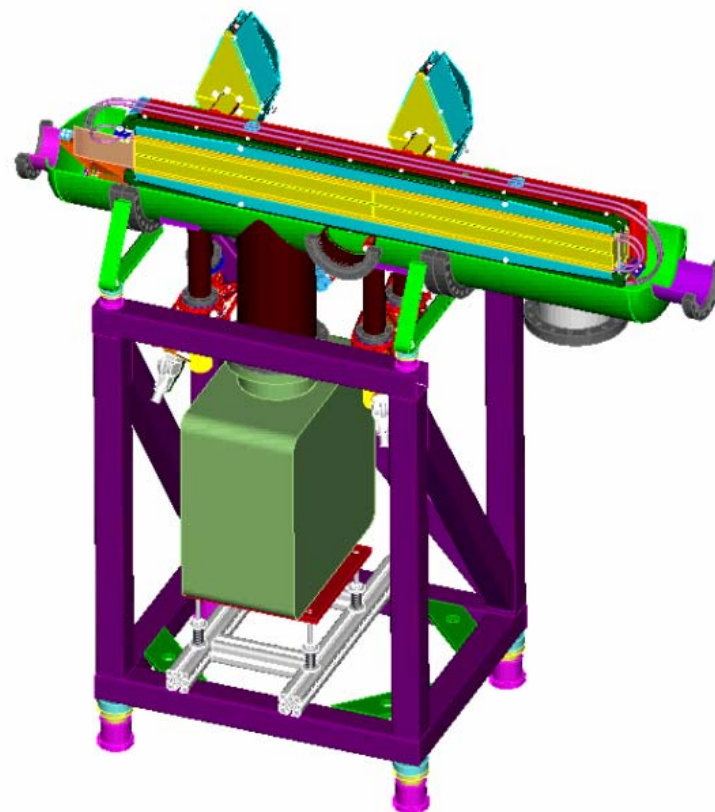
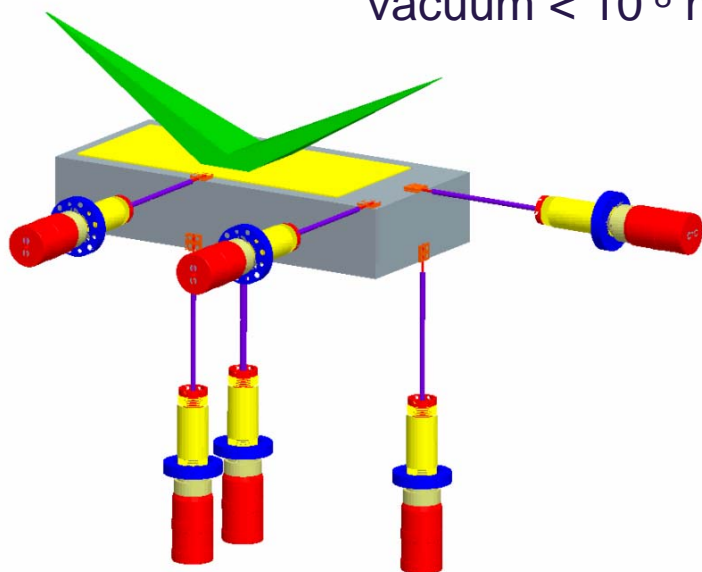


5 keV



Ultra precise motion control for mirrors

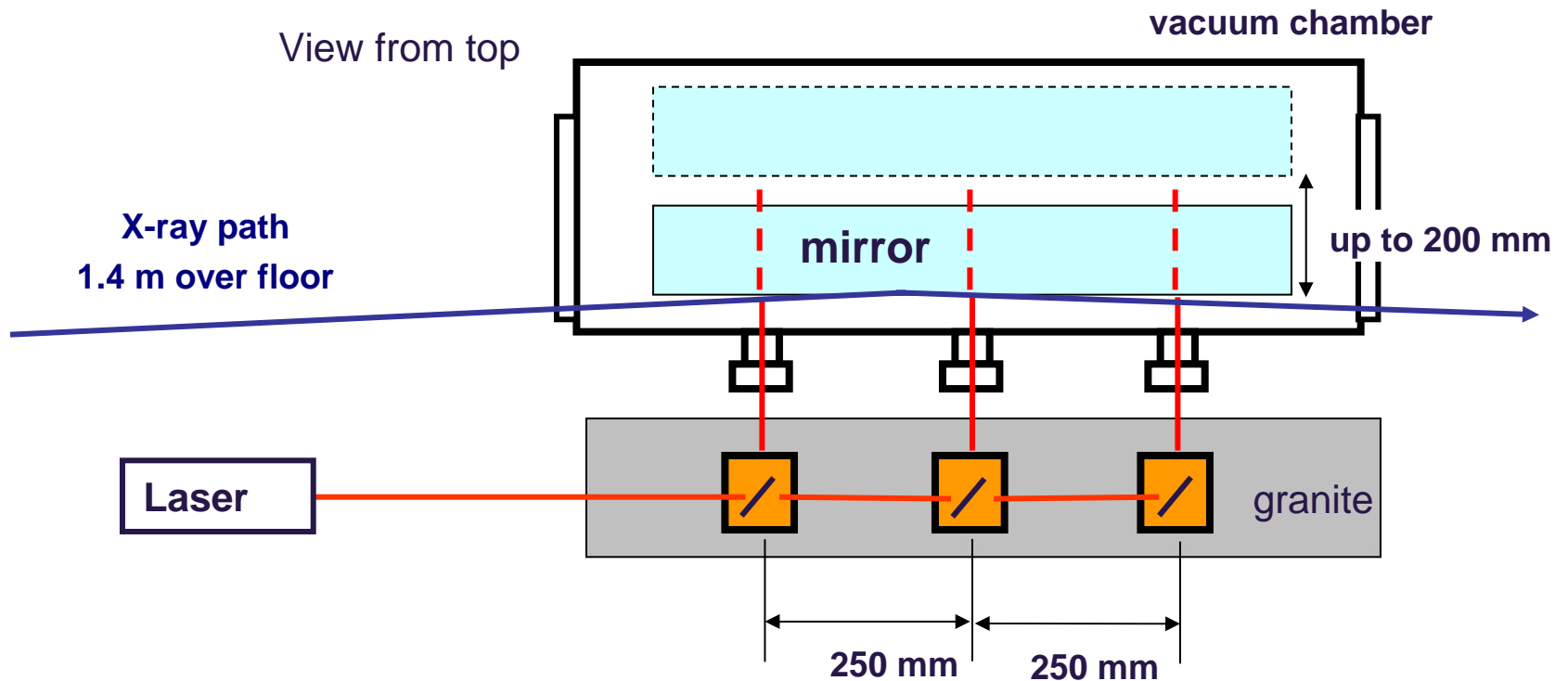
Requirements:
move up 200 mm horizontally with 10 nm resolution,
angular vibrations < 10 nrad
vacuum < 10^{-8} mbar



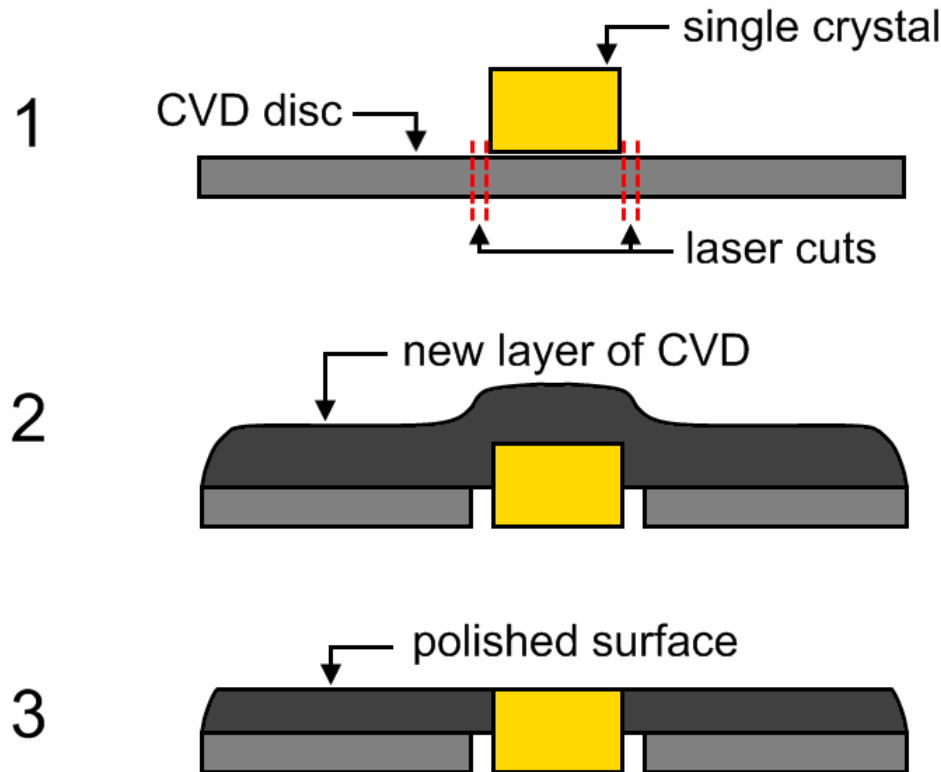
by Tino Noll, HZB
(collaboration on mirror chambers)

Measurements of vibrations and bending

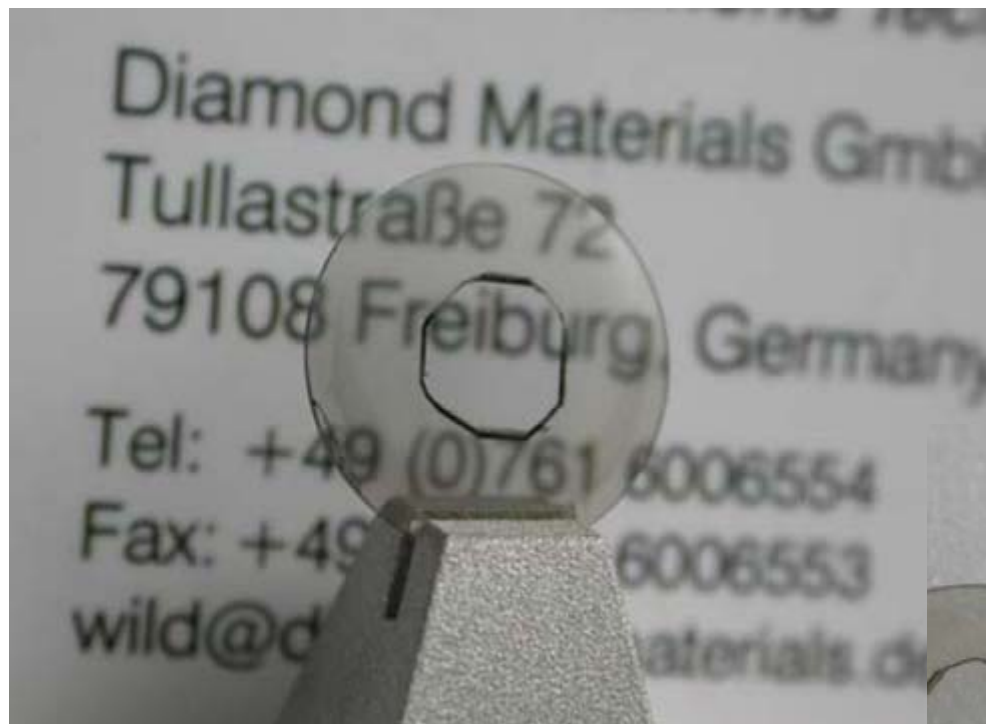
- Measure angular vibrations to 10 nrad levels (difference to measurement bench)
- Cross-calibration with two seismometers
- Interferometer also used as monitor for position and bending



Diamond optics: Single Crystal grown into CVD

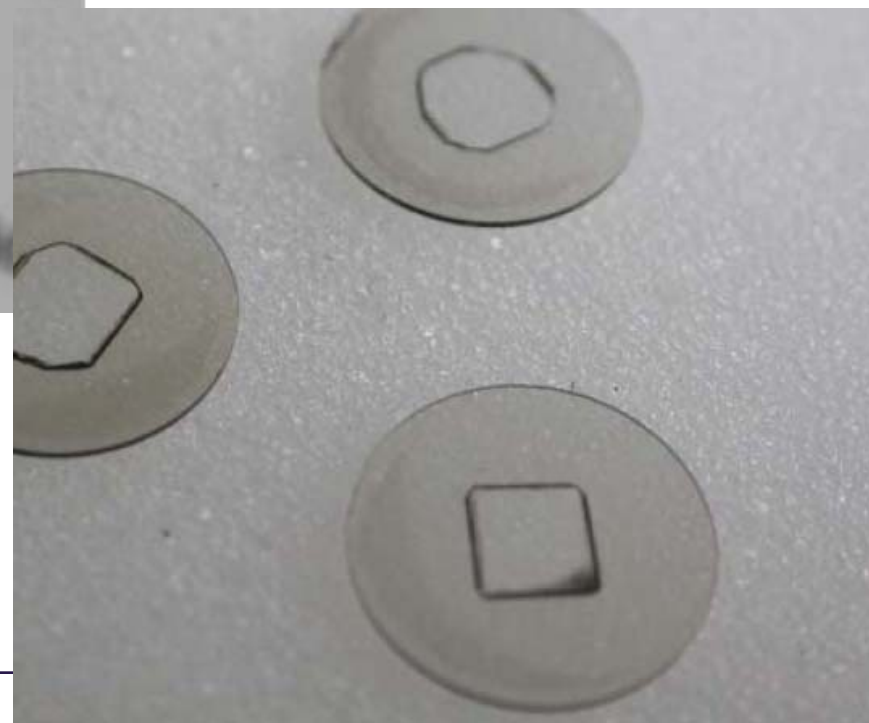


Grown-in Single Crystals

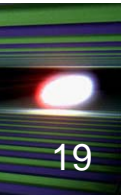


collaboration with:

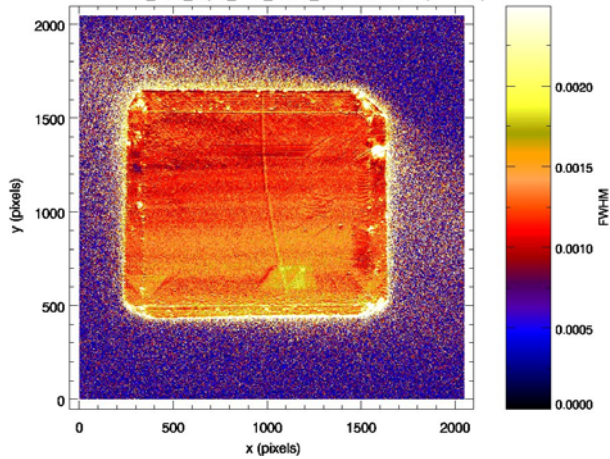
Diamond Materials,
Fraunhofer Institut Freiburg
and Element6



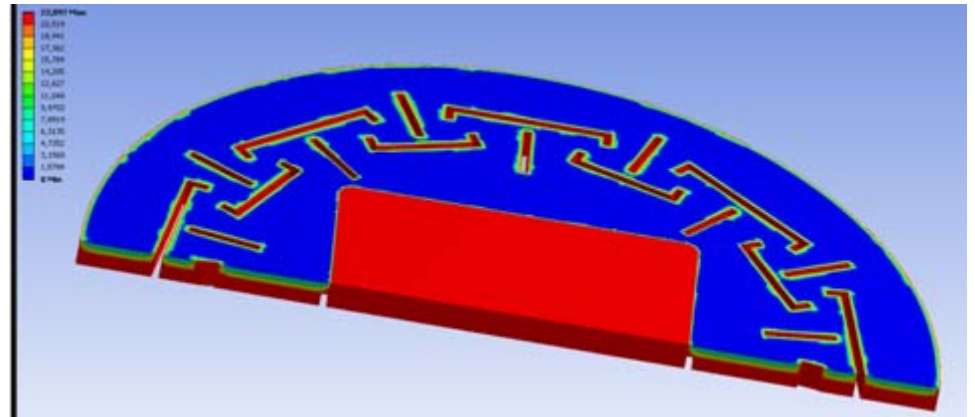
Stress in diamonds



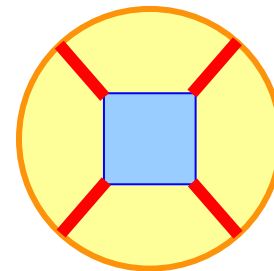
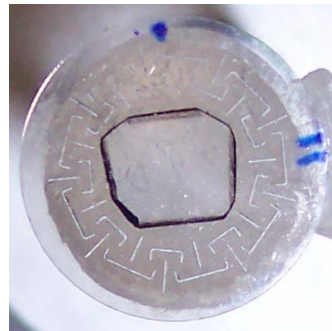
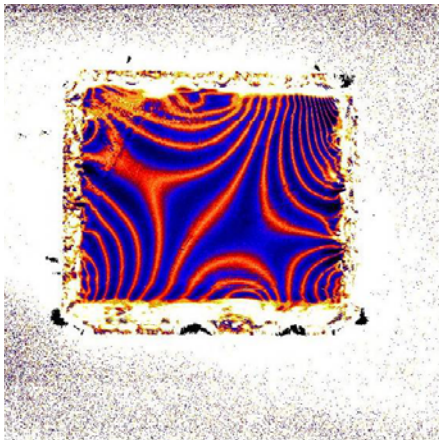
before bonding:



simulation to place strain relief cuts (Fan Yang + summer student Michal Borovsky):



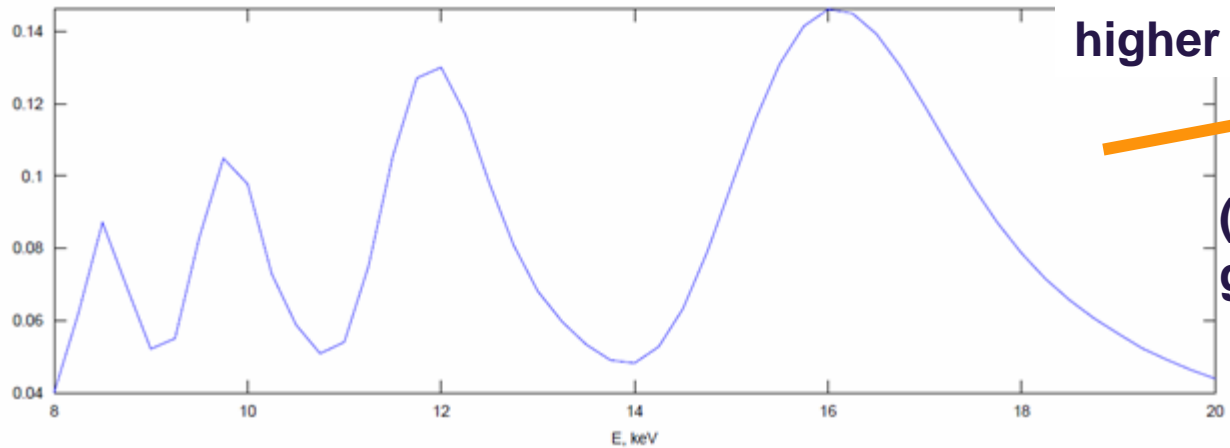
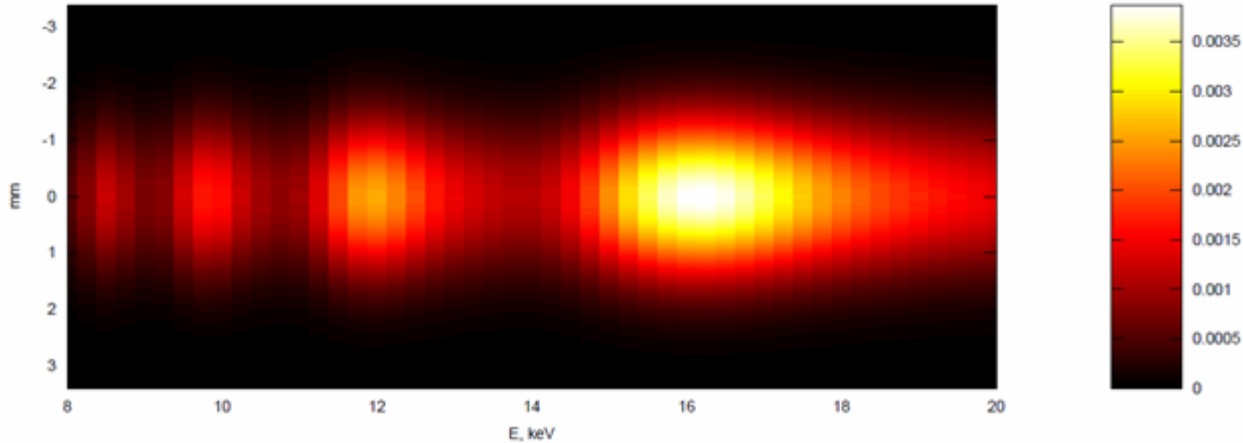
after bonding:



laser cutting
by Diamond
Materials

Liubov Samoylova, Idoia Freijo et al. , ESRF May 2010

Transmission through (perfect) double Laue mono



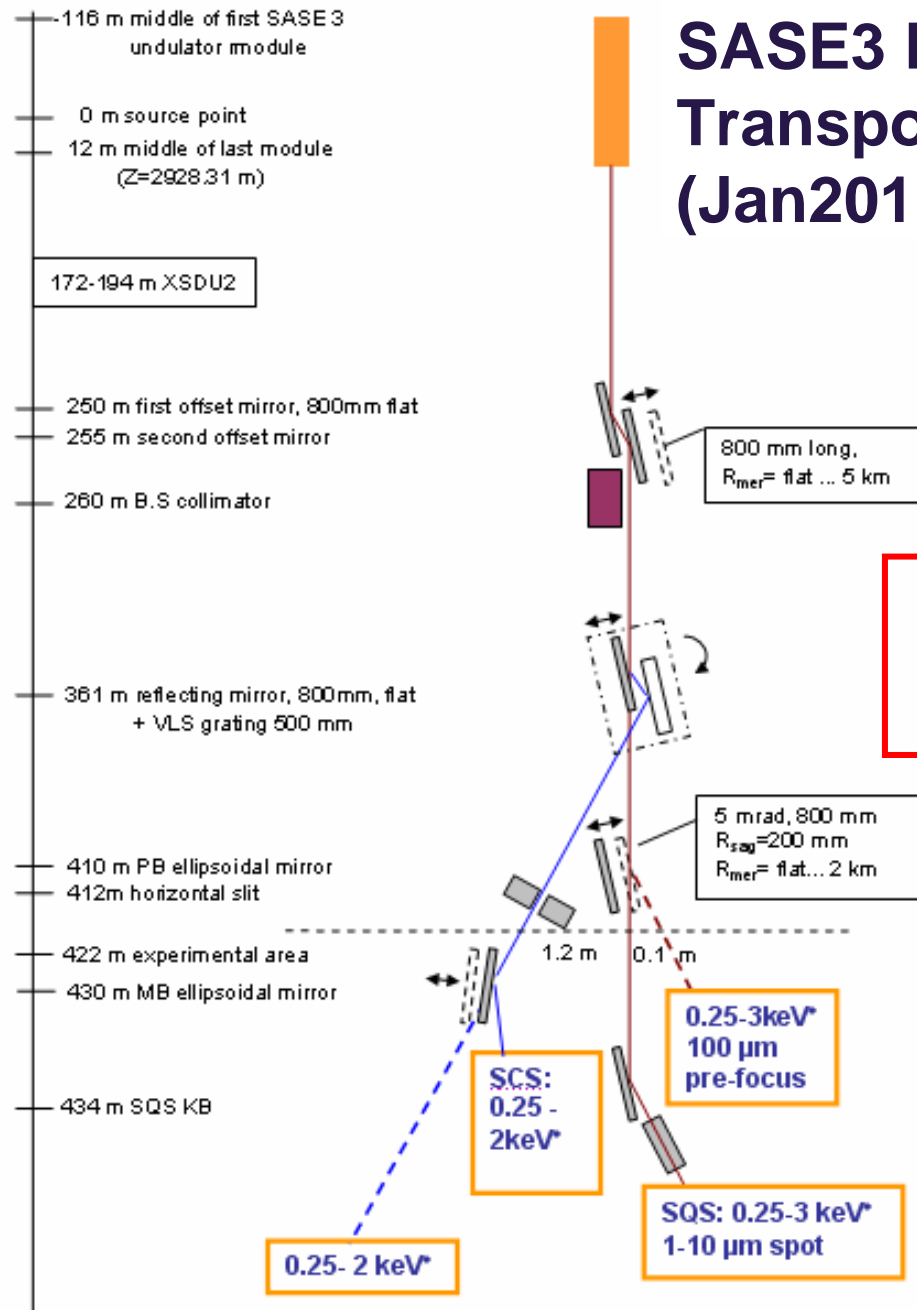
much better for
higher energies



(or use Bragg
geometry)

calculation by Mark Khenkin, see poster

SASE3 Photon Beam Transport Layout (Jan2011)



Conceptual review of beam transport in April 2011

Thank you for your attention!



Acknowledgements: Shafagh Dastjani-Farahani, Martin Dommach, Nicole Kohlstrunk, Idoia Freijo-Martin, Germano Galasso, Jérôme Gaudin, Mark Khenkin, Liubov Samoylova, Antje Trapp, Fan Yang and Tino Noll (HZB).