PAUL SCHERRER INSTITUT

Jochen Stahn
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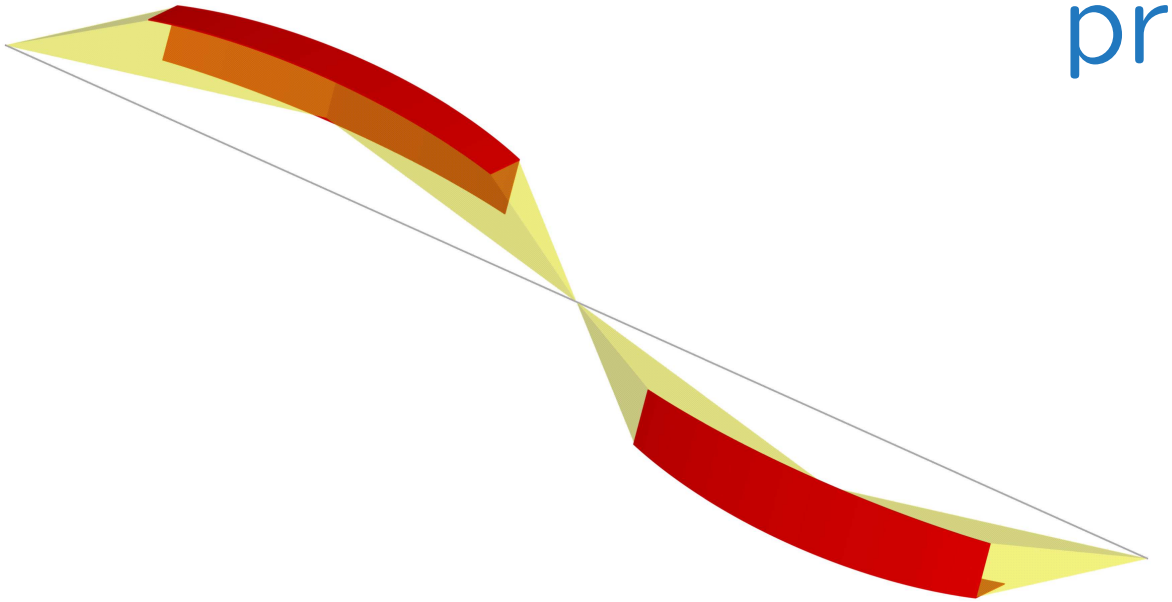
Laboratory for Neutron Scattering and Imaging

Experiences with the *Selene* guide prototype



4th International Workshop on Neutron Delivery Systems
28. - 30. 09. 2015, Grenoble, France

Selene guide

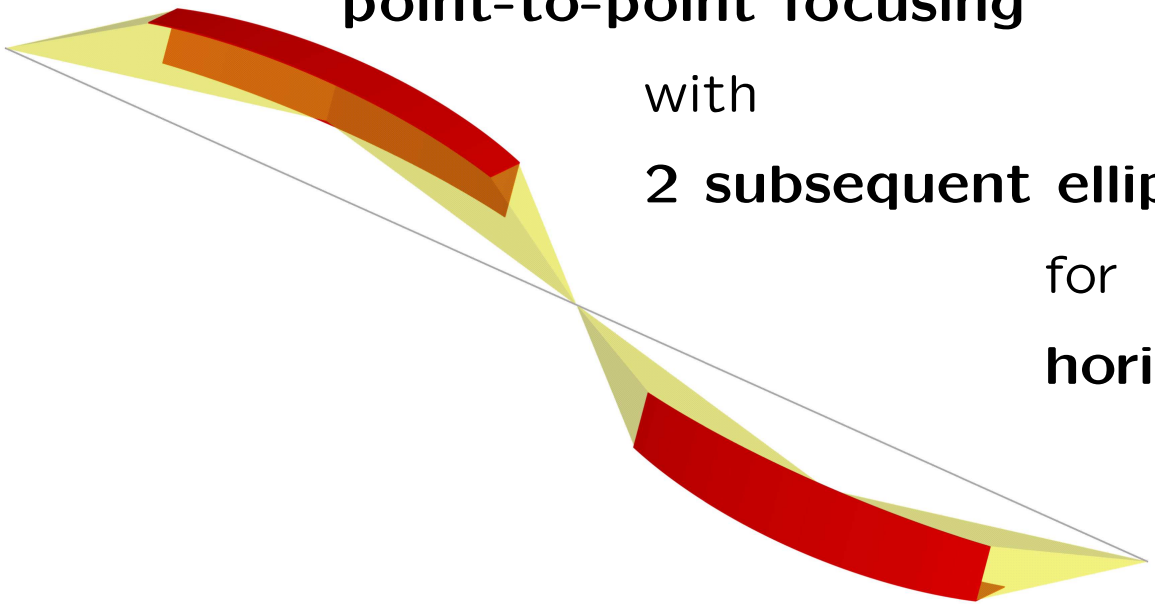
point-to-point focusing

with

2 subsequent elliptical reflectors

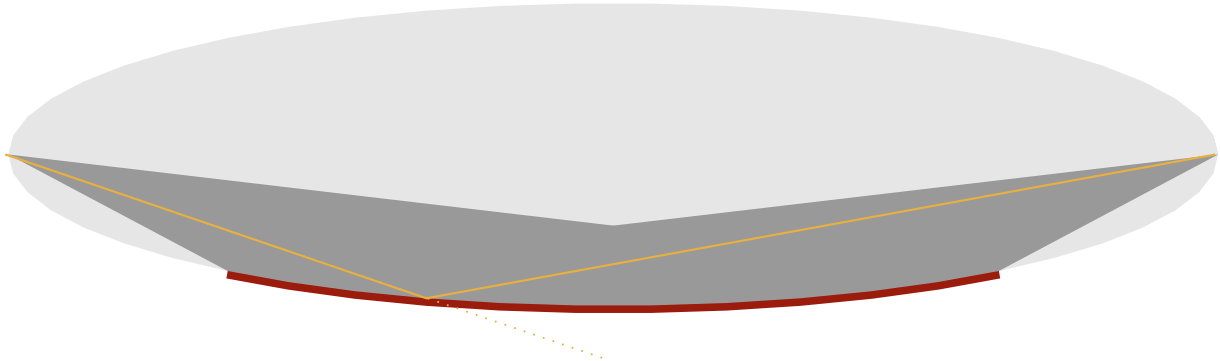
for

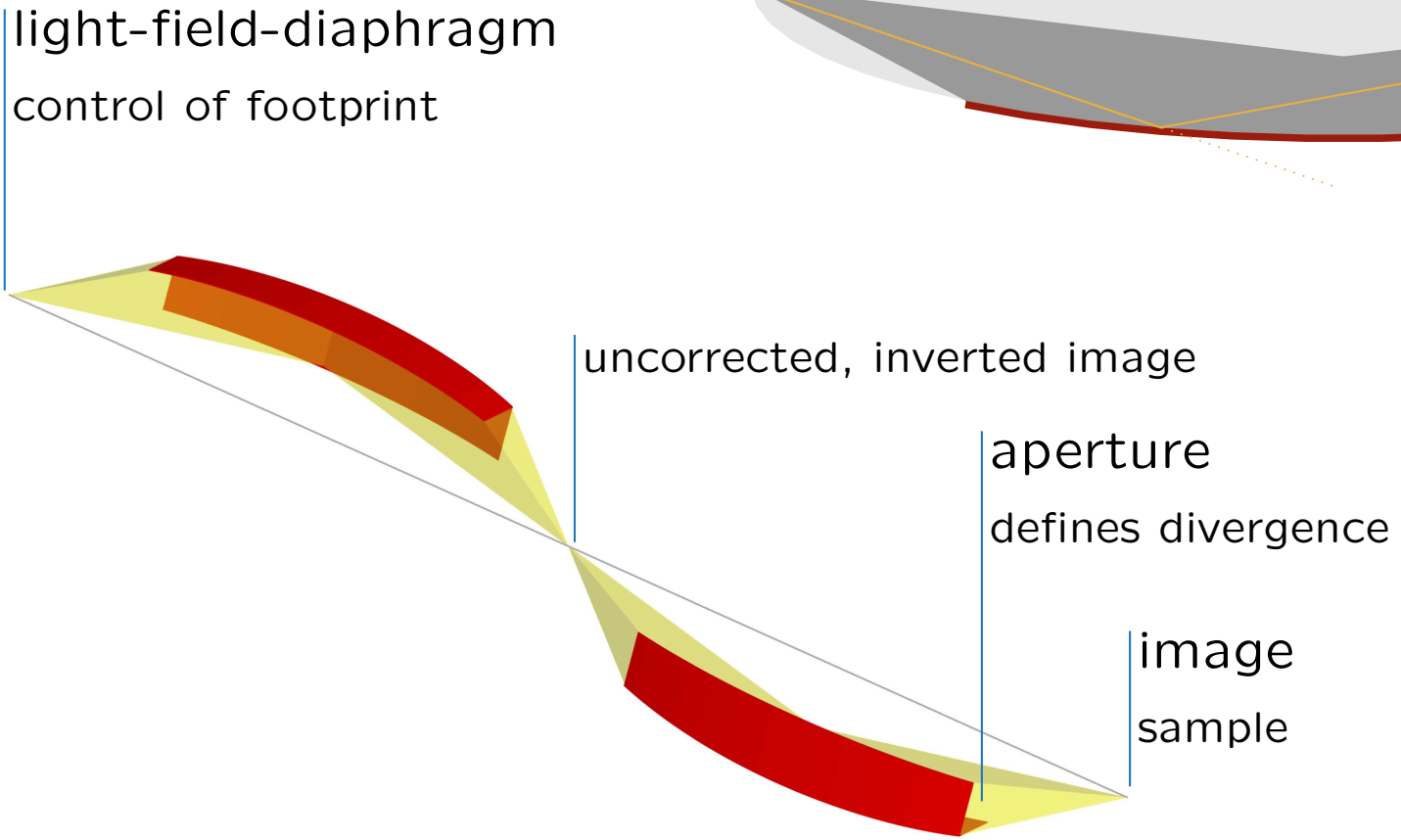
horizontal and vertical direction



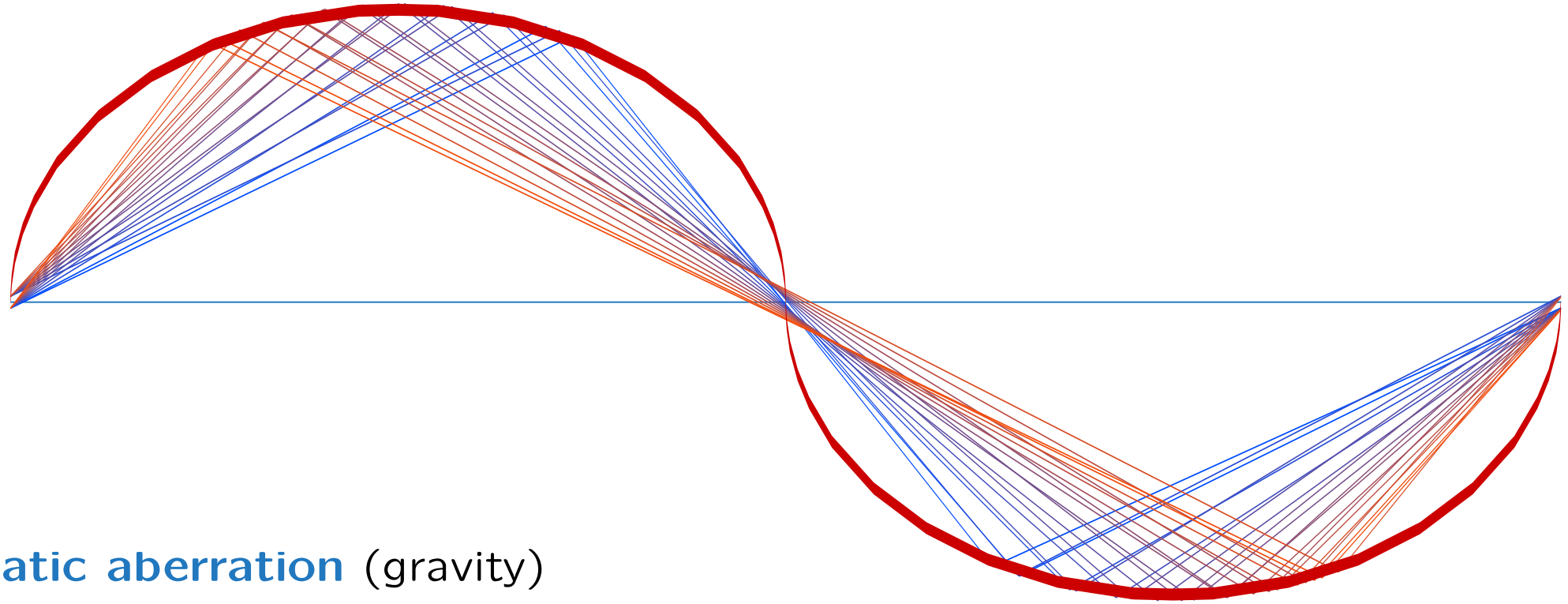
Selene picture
ceiling painting in the Ny Carlsberg Glyptotek, København

geometry




light-field-diaphragm
control of footprint
uncorrected, inverted image
aperture
defines divergence
image
sample

coma aberration



chromatic aberration (gravity)

→ limits *length* × *wavelength* to ≈ 400 m Å

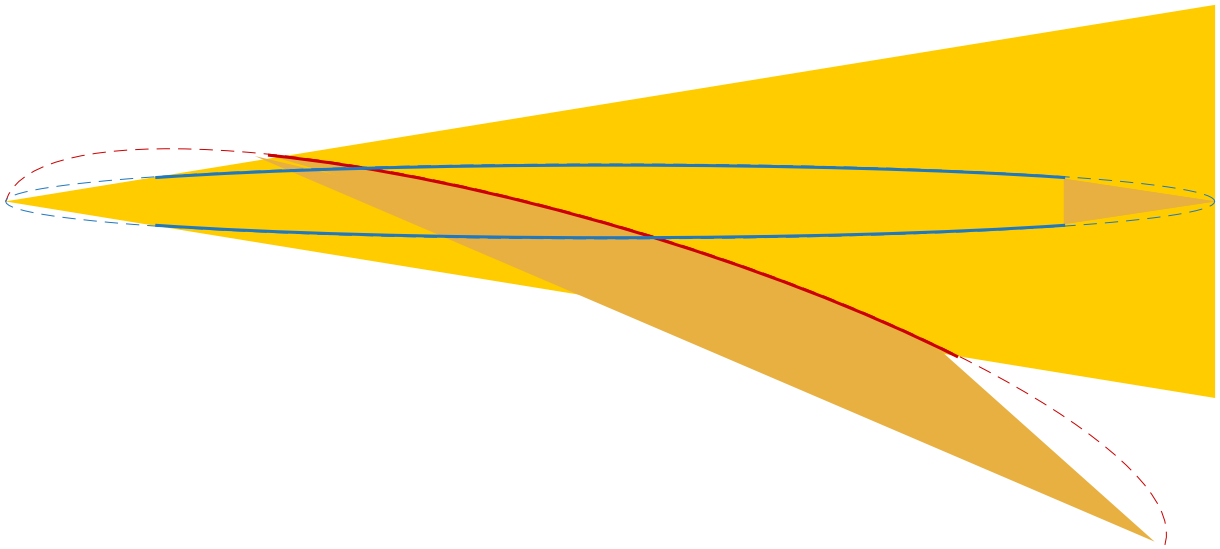
transmission

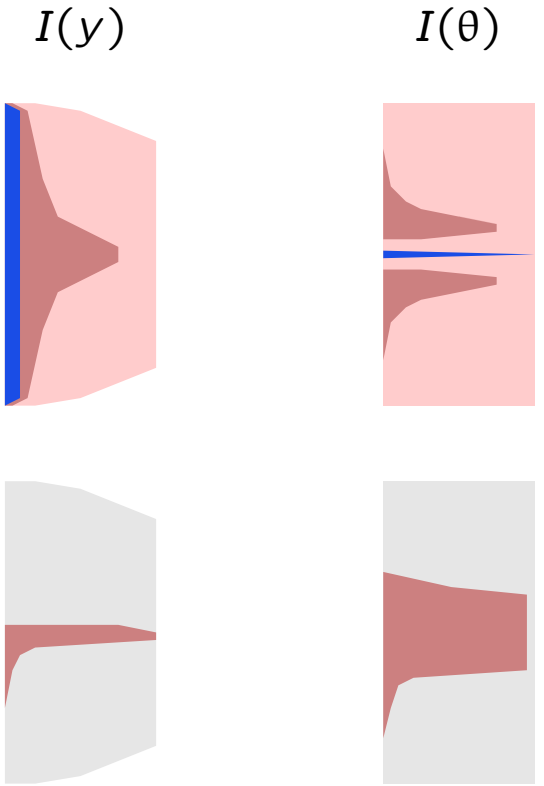
→ 4 reflections at relatively high q_z

⇒ reduced transmission

coating $m \approx 8 \frac{\Delta\theta/\mathrm{deg}}{\lambda_{\mathrm{min}}/\mathrm{Å}}$

comparison to normal elliptic guide



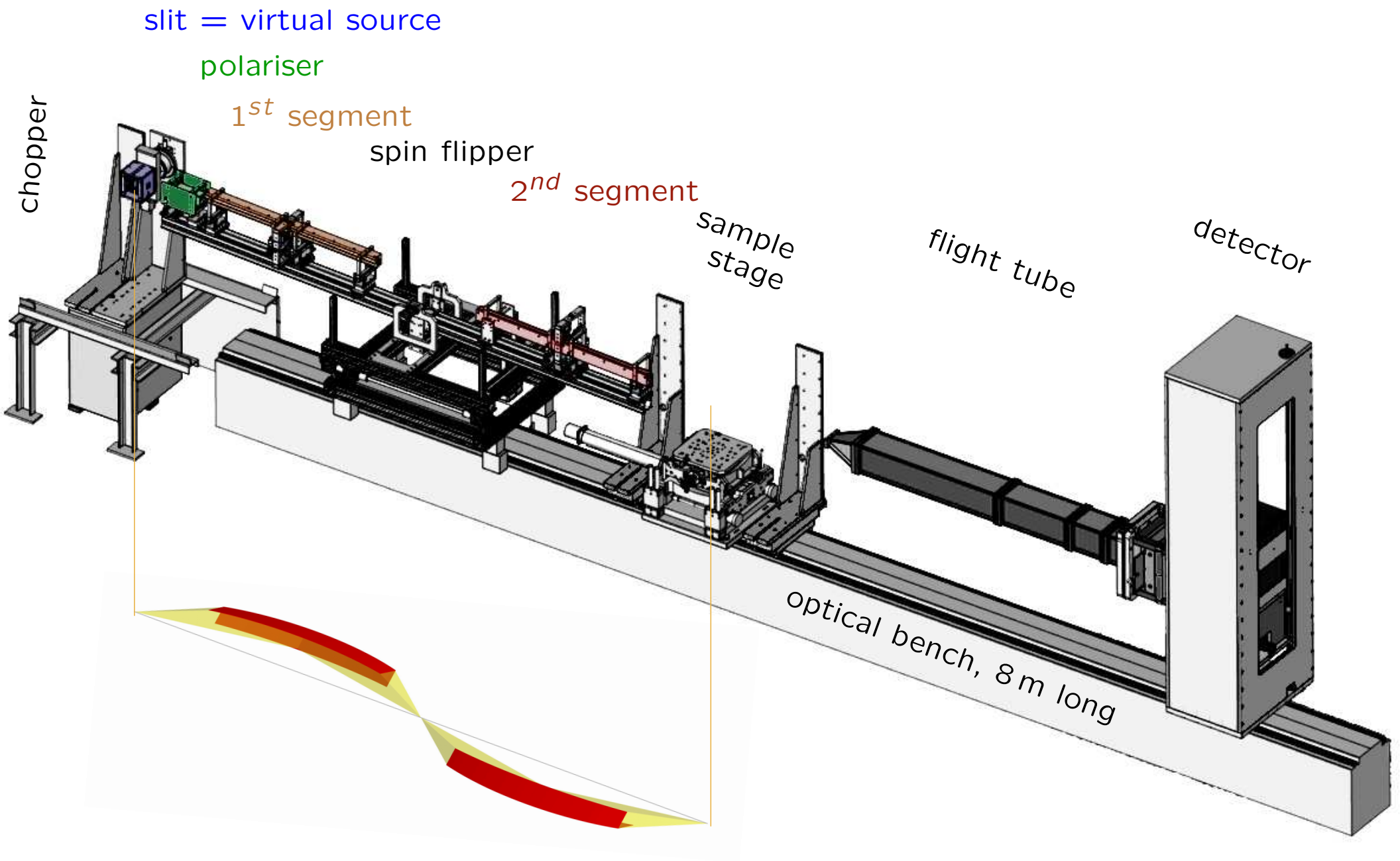


0, 1, and ≥ 2 reflections

L. Cussen et al. *N.I.M. A* **705**, 121

prototype

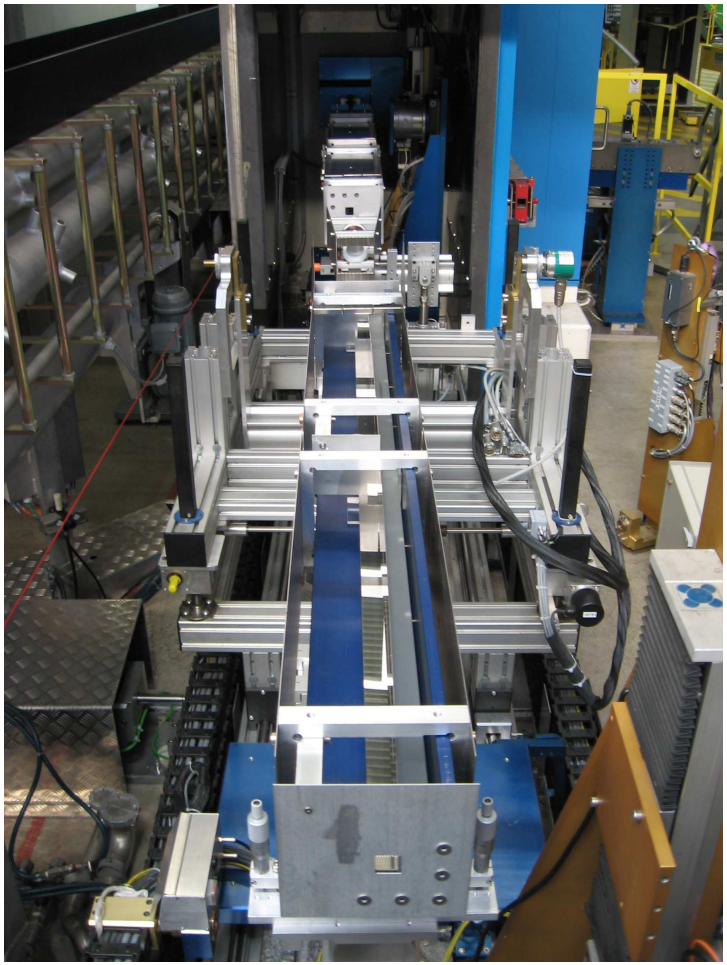
on Amor @PSI

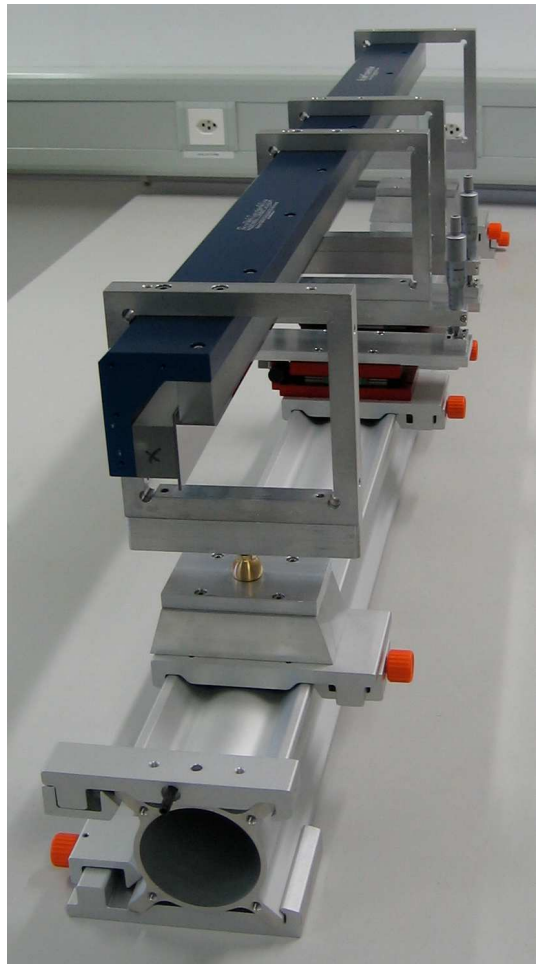


prototype

on Amor @PSI

- total length $= 4\,\mathrm{m}$
- divergence $\approx 1.8^\circ \times 1.8^\circ$
- max spot size $\approx 2 \times 2\,\mathrm{mm}^2$
- wavelength $\geq 4\,\text{Å}$

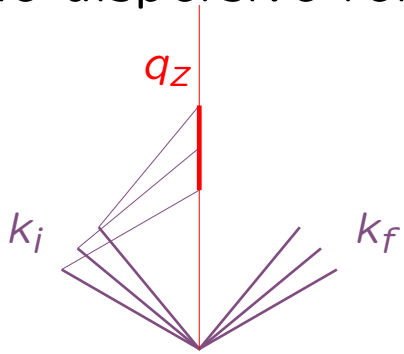


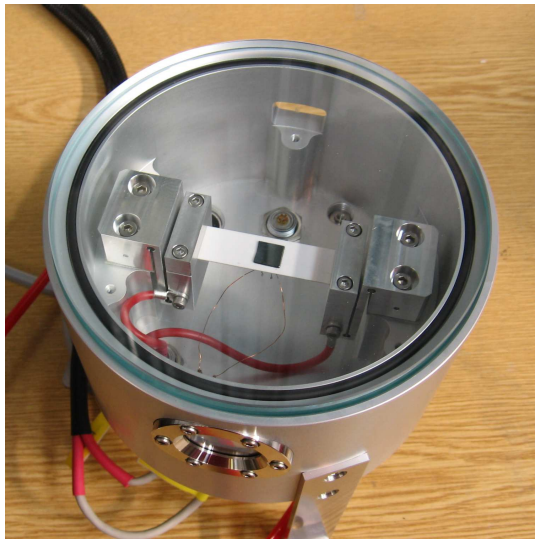


prototype — application

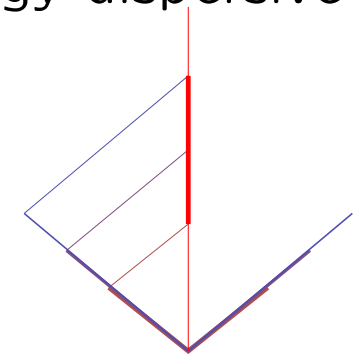
high-intensity specular reflectometry

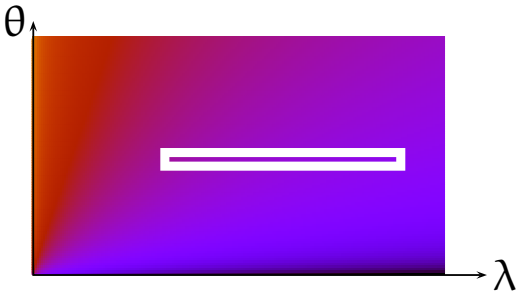
angle-dispersive reflectometry

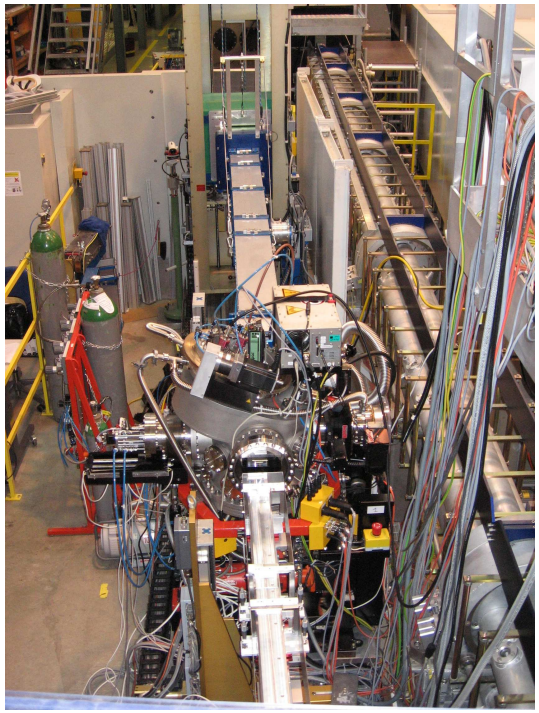




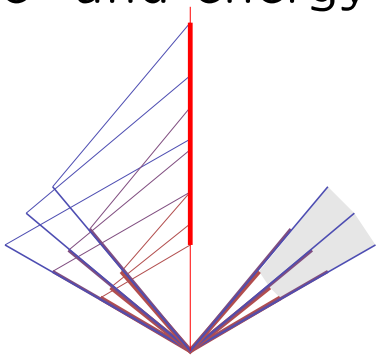
energy-dispersive reflectometry

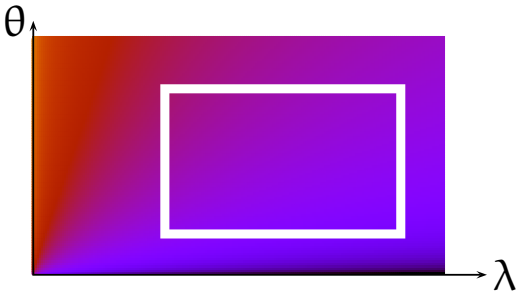






angle- and energy-dispersive reflectometry

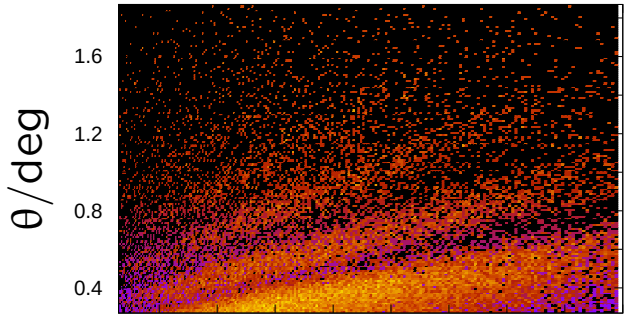




high-intensity specular reflectometry

data acquisition and reduction

raw data

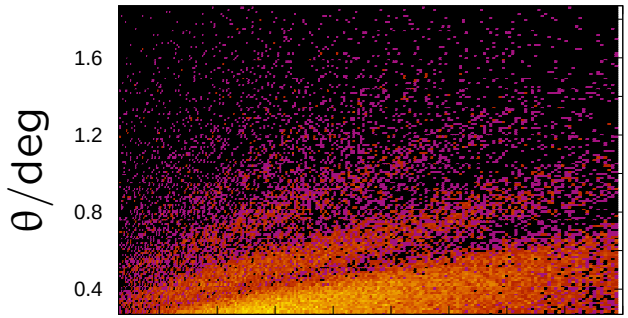


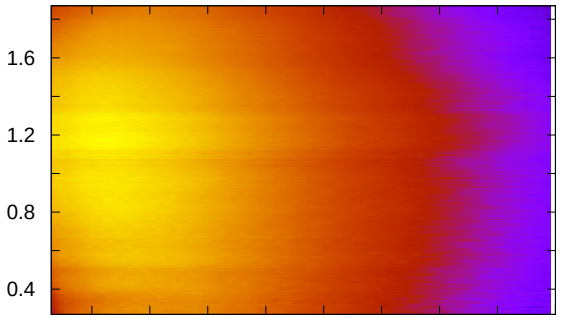
$A = 60\,\mathrm{mm}^2$

$t = 180\,\mathrm{s}$

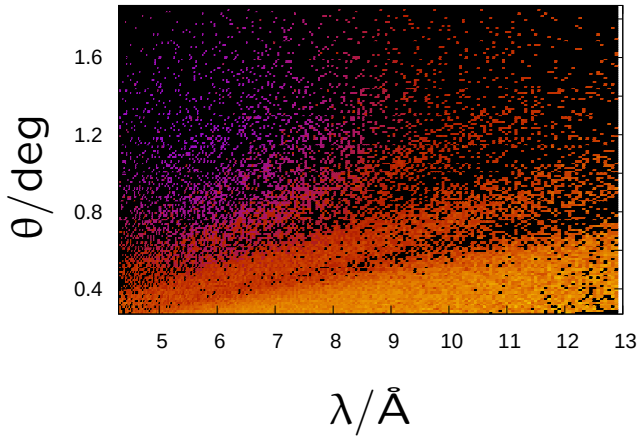
reference

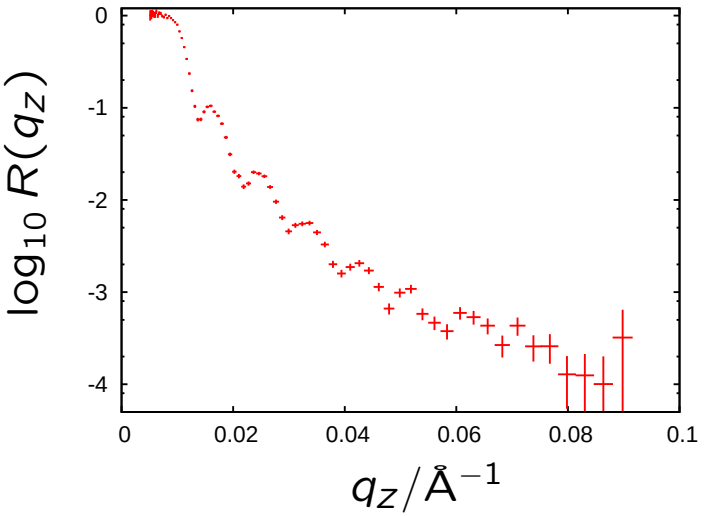
illumination corrected





normalised





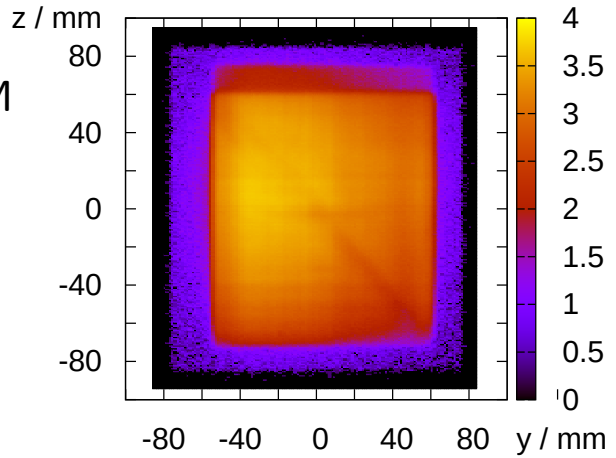
prototype

guide quality

- negligible waviness (due to glue)
- deviation of guide shape from the ellipse at the junctions (due to polishing)

$\Rightarrow$ dark lines in $I(y, z)$ and widening of focal spot

$I(y, z)$ reflected by a SM

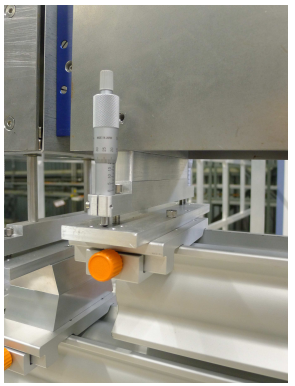


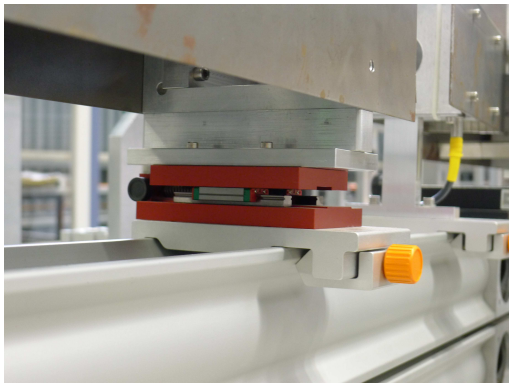
guide alignment

- using optical light & pin-hole
- criteria: small focal spot

homogeneous $I(y, z)$ map on detector

$\Rightarrow$ very accurate but time-consuming due to limited access

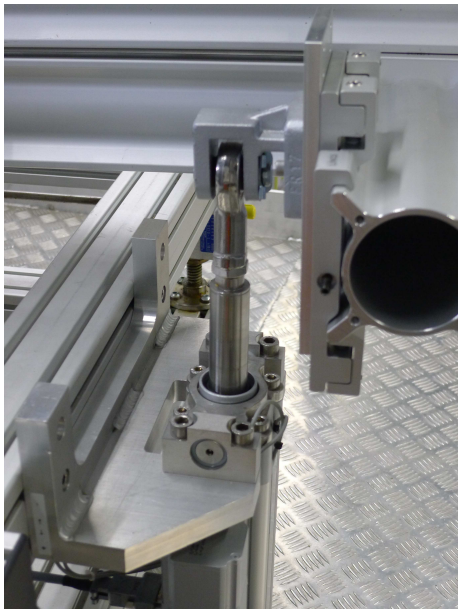




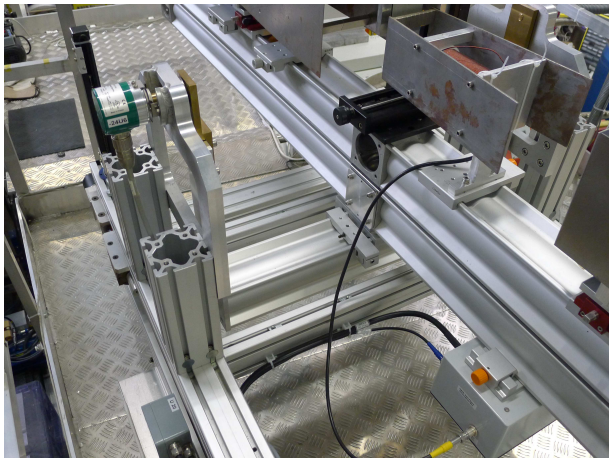
reliability

- guide on support beam is very robust
- position of guide relative to source depends on T!

thermal expansion of tilting-stage

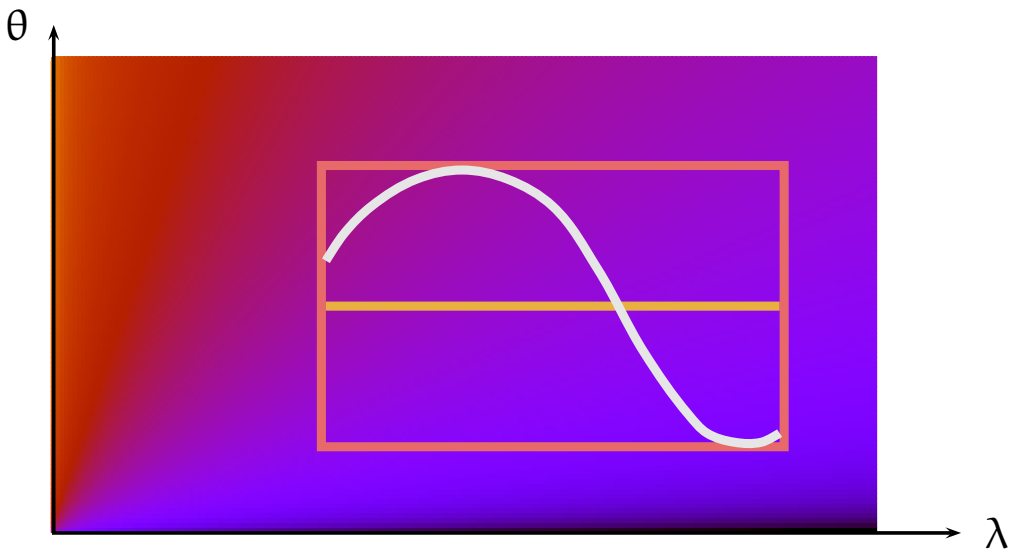


- inclination (and its encoding) are not precise enough

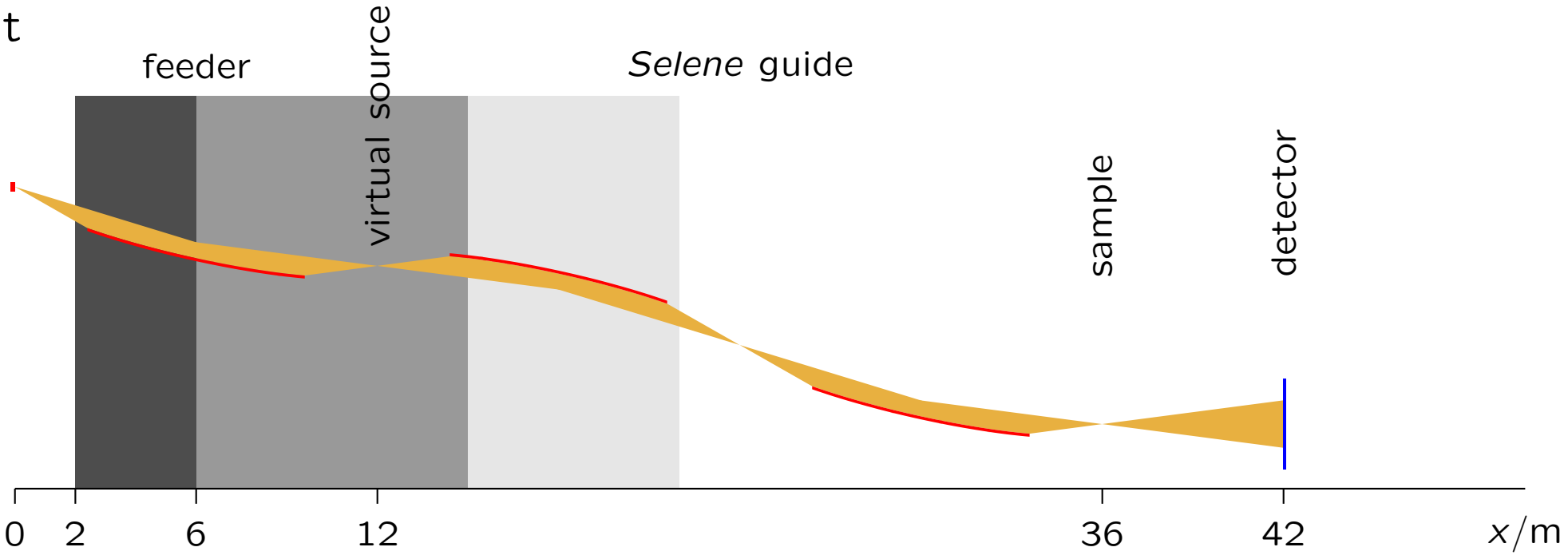


- position of sample is the main problem
  $\rightarrow$ alignment of sample (and reference) at the focal spot
  $\rightarrow$ shift in z and ω due to environment, T and H

a TOF reflectometer for the ESS

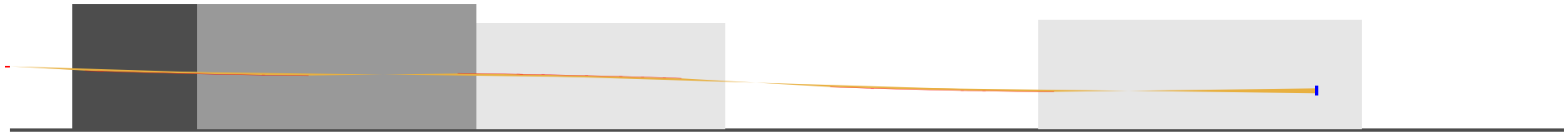


- horizontal scattering plane
- sample size $< 10 \times 50\,\mathrm{mm}^2$
- divergence $1.5^\circ \times 1.5^\circ$
- $\lambda \in [4, 10]$ Å
- principle operation modes: classical, optimised, high-intensity
- lay-out

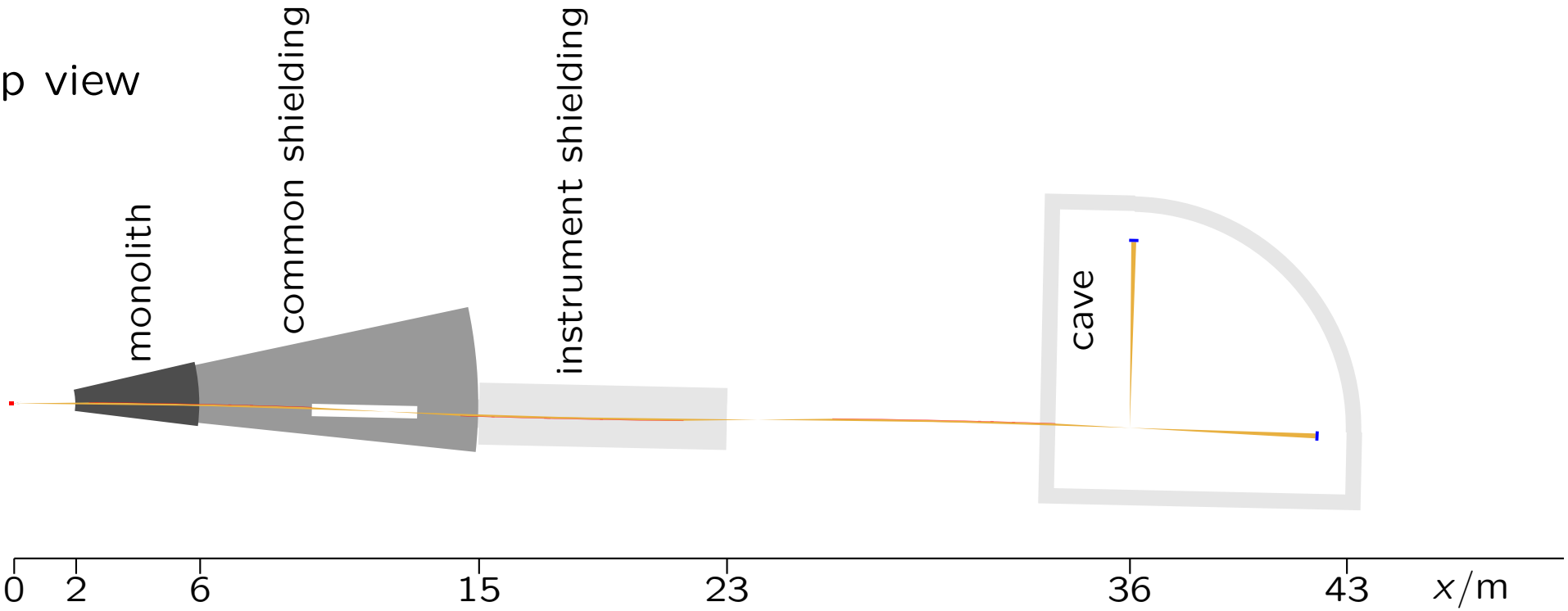


guide lay-out

side view



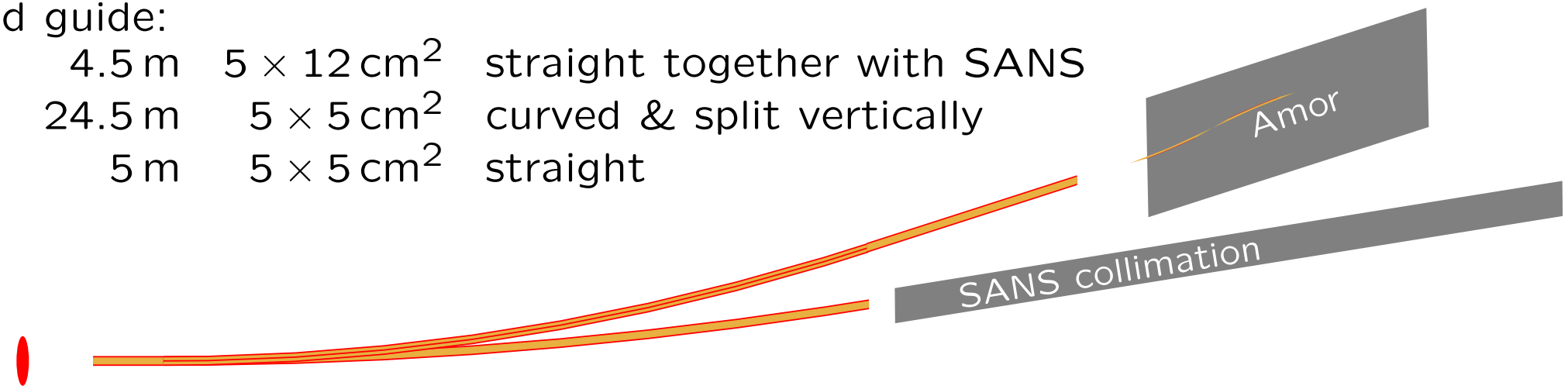
top view



replacement of beam guide

old guide:

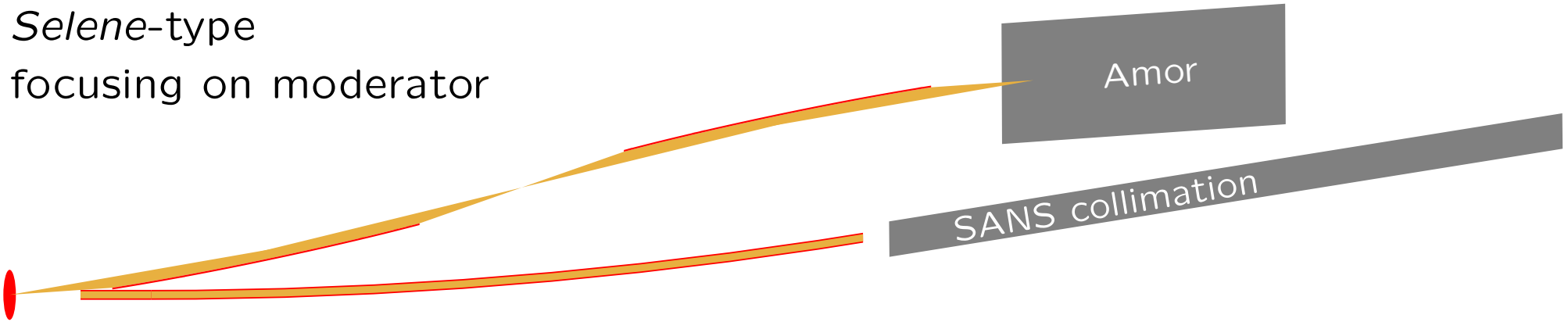
4.5 m	$5 \times 12\,\mathrm{cm}^2$	straight together with SANS
24.5 m	$5 \times 5\,\mathrm{cm}^2$	curved & split vertically
5 m	$5 \times 5\,\mathrm{cm}^2$	straight



new guide:

Selene-type

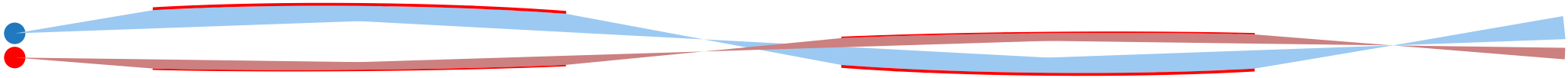
focusing on moderator



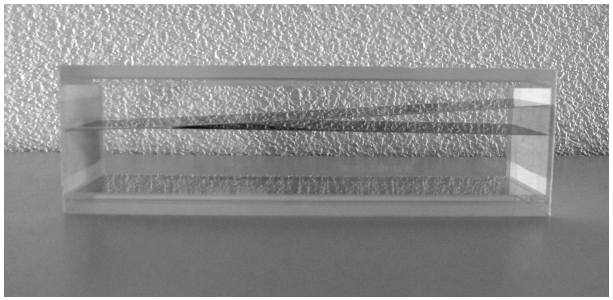
further applications

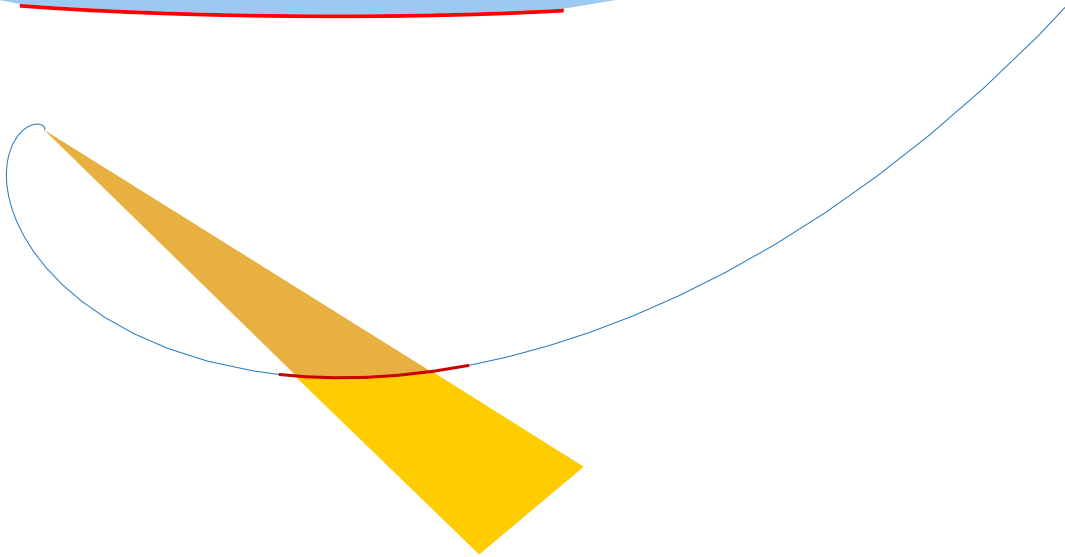
higher θ-coverage (option for *Estia*)

Werner Schweika's thermal & cold guide

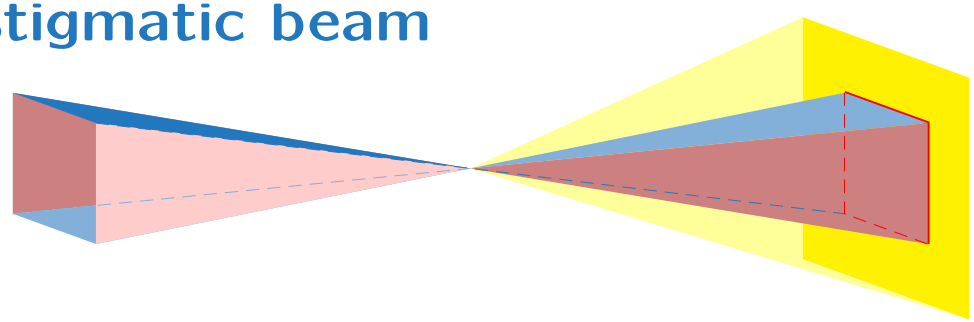


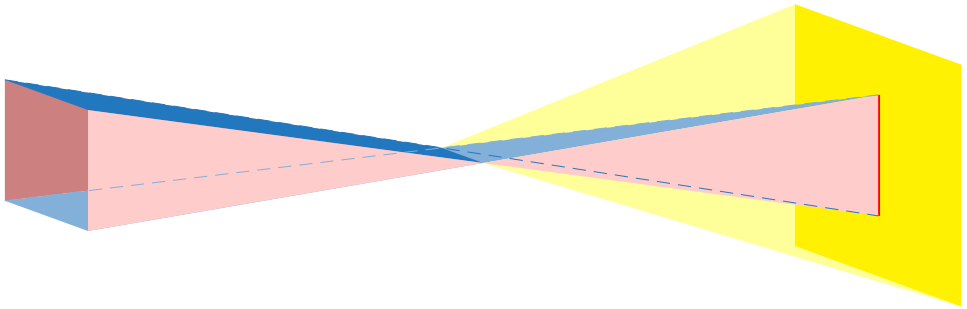
polariser / analyser (realised on *Amor*)





astigmatic beam





THANKS to YOU

and

simulations

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experiments

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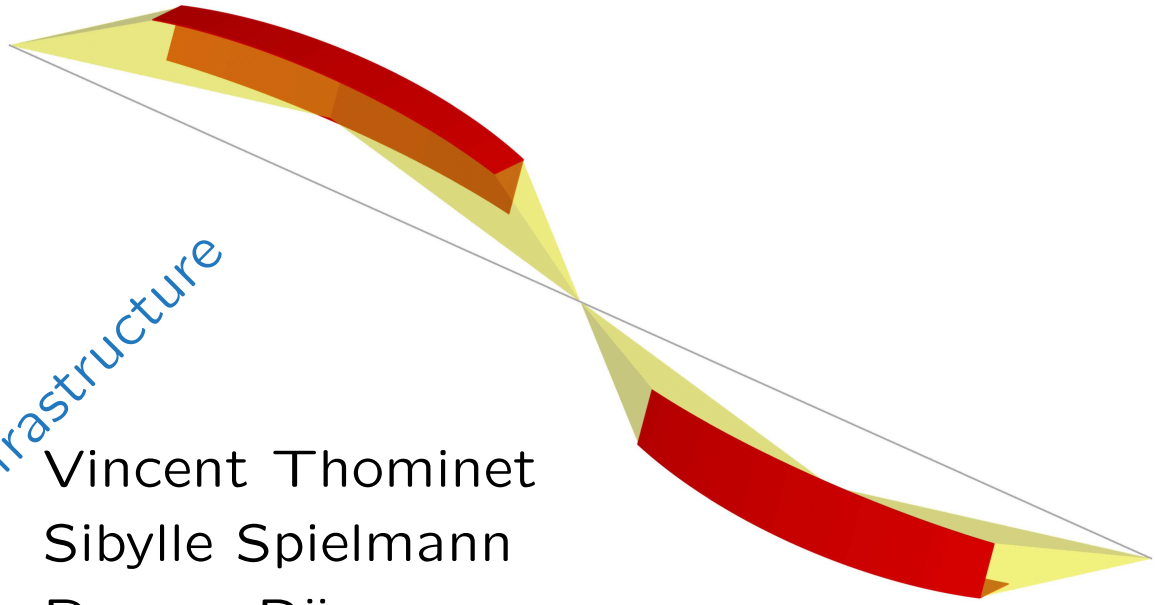
Sina Mayr



PSI infrastructure

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ideas / discussions

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Frédéric Ott
Phil Bentley
Bob Cubitt
Peter Böni
Uwe Stuhr
. . .