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progress report of the Swiss-Danish instrument initiative for the ESS WP2

focusing reflectometer

Selene

IKON 3
19.–20. 09. 2012, Lund, Sweden

aims

Selene
BOA

development and proof of concepts
for two reflectometers for the ESS,
optimised for:

ESS*Selene* small samples

- **small samples** ($< 100\,\mathrm{mm}^2$)
  - horizontal scattering geometry
  - polarisation & ∼analysis
  - voluminous sample environment
  - moderate to low resolution
  - . . .

ESS*Selene* liquid surfaces

- **liquid surfaces**
  - vertical scattering geometry
  - time-resolved studies ($\Delta t < 1\,\mathrm{s}$)
  - wide q_z-range with one (few) angular setting(s)
  - high to low resolution
  - . . .

state of work

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prototype

- on schedule
- additional beam time on Amor necessary (limitations on BOA)

ESS*Selene* small samples

- concept has to be confined to actual ESS details
- simulation delayed due to lack of manpower

ESS*Selene* liquid surfaces

- concept has to be confined to actual ESS details
- simulations in progress
- benchmarks planed for the near future

principle

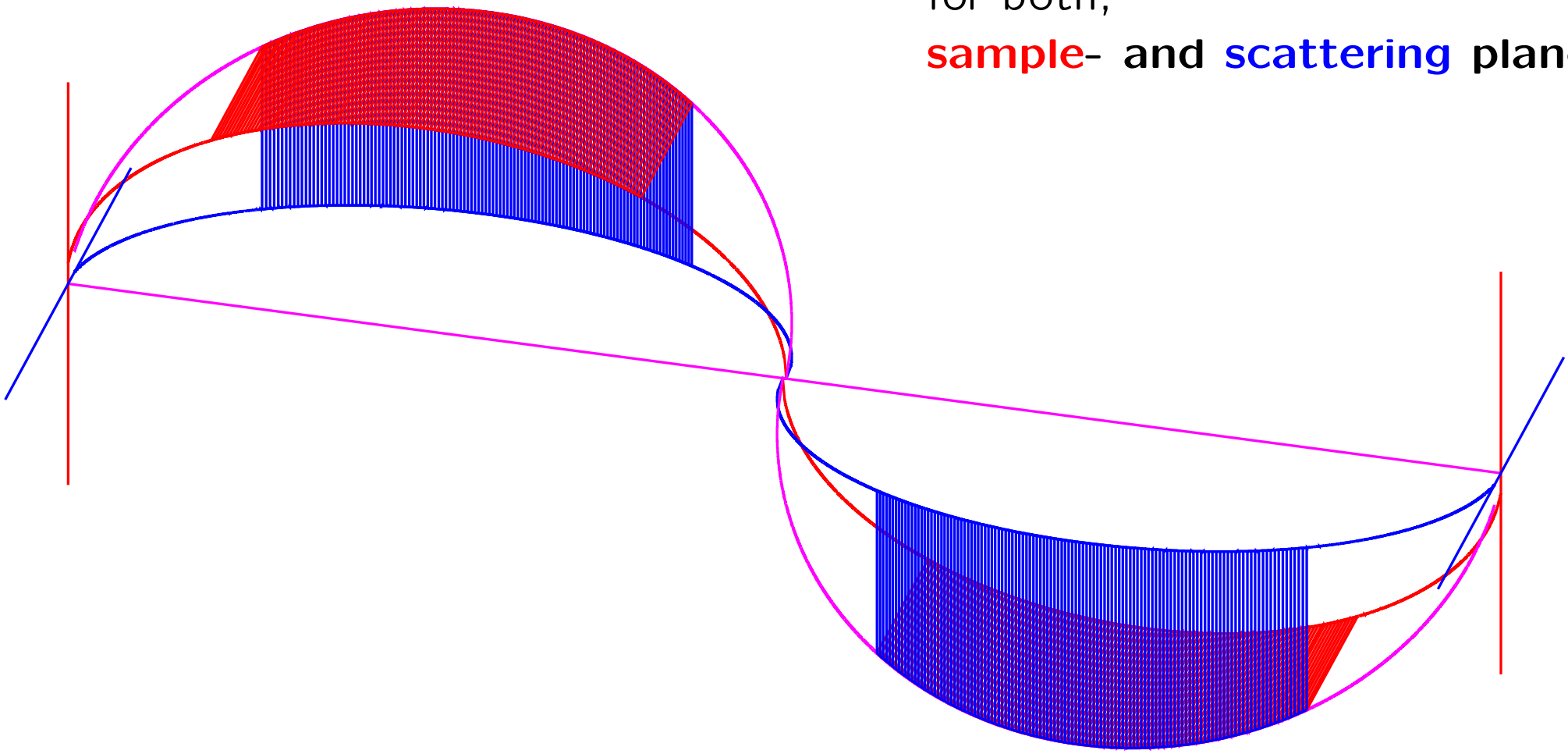
point-to-point focusing

with

2 subsequent elliptical reflectors

for both,

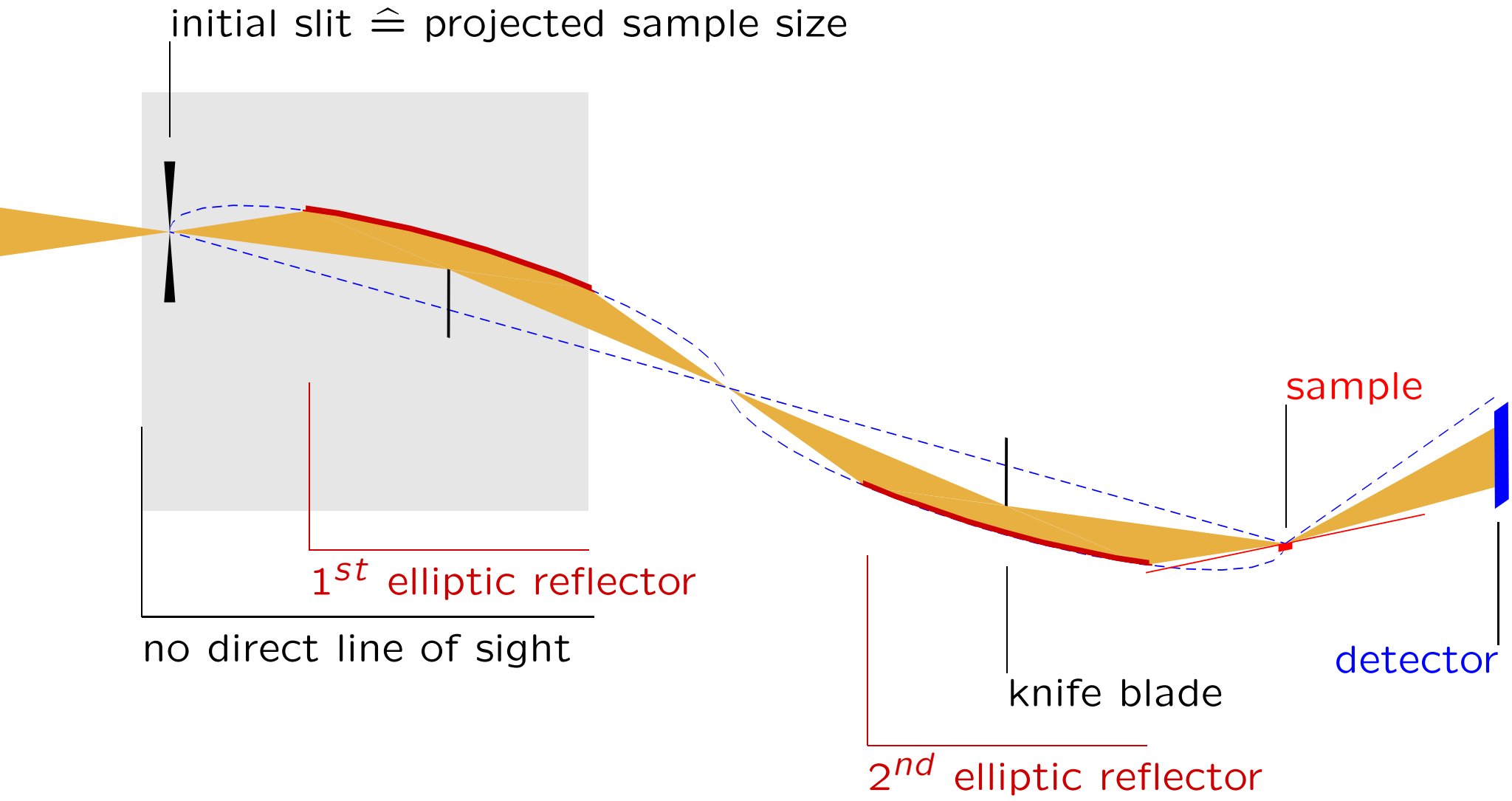
sample- and scattering plane



generic instrument layout

cut in the scattering plane

stretched by 10 normal to incident beam



prototype

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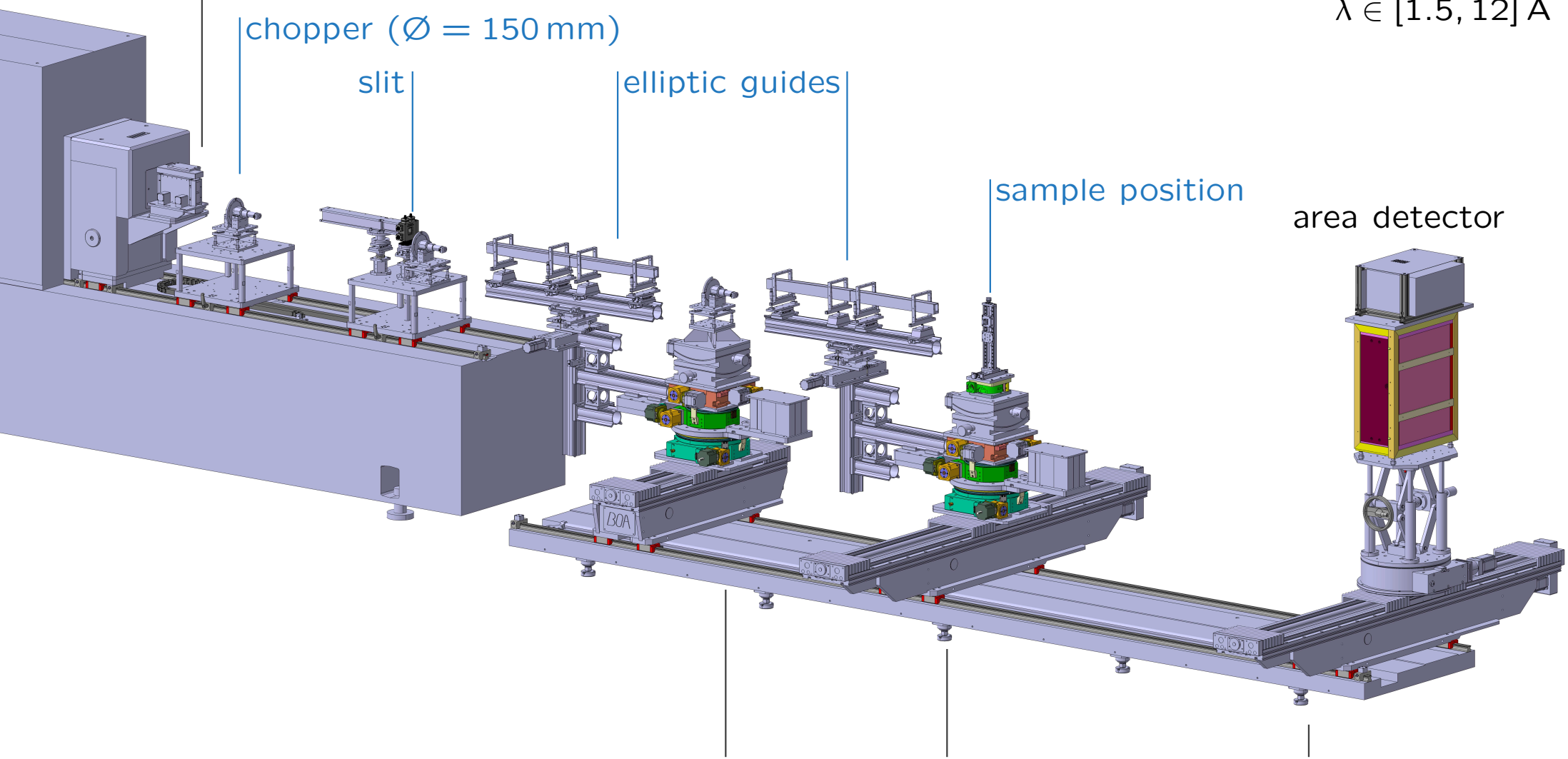
BOA is a test beam line at PSI

total length $\approx 8.6\,\mathrm{m}$

$\lambda \in [1.5, 12]\,\text{Å}$



prototype

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BOA

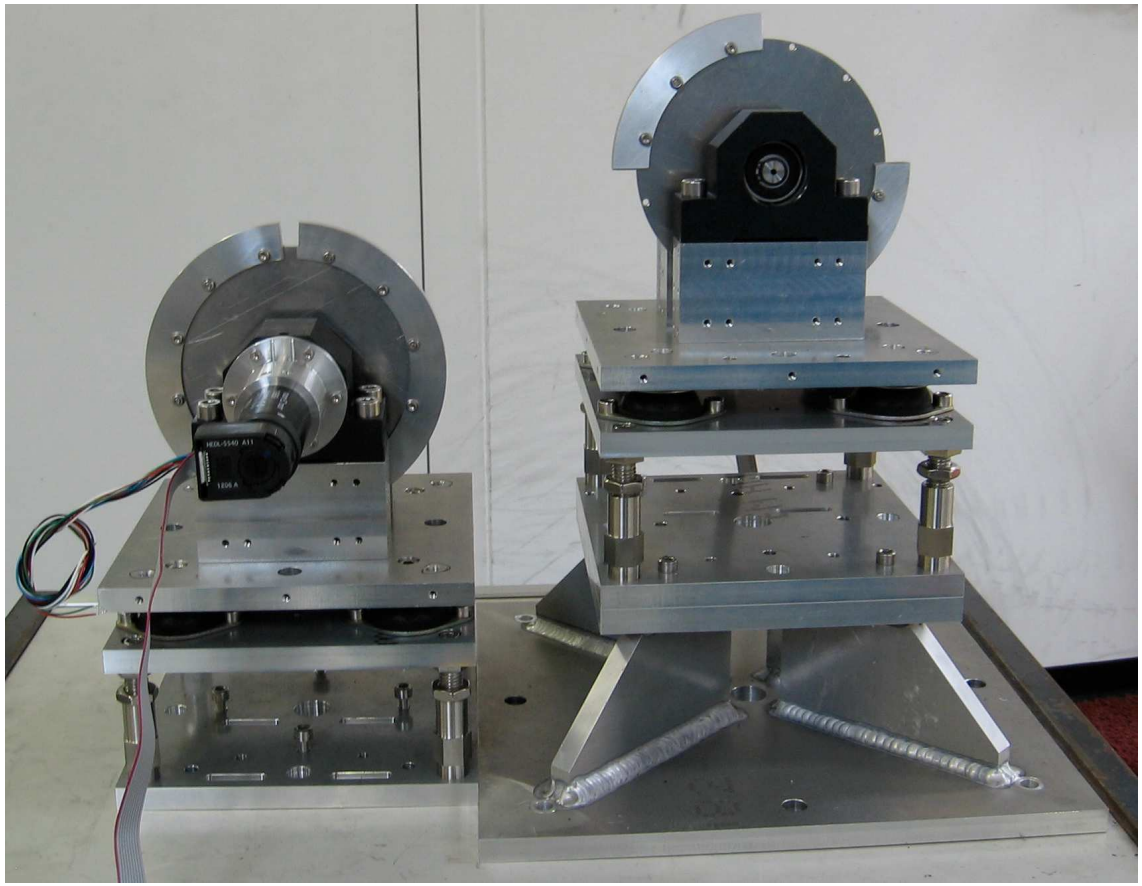
choppers

$\nu = 60\,\mathrm{s}^{-1}$
gives $\lambda = 0 \ldots 10\,\text{Å}$

$\varnothing = 150\,\mathrm{mm}$

Al:B and Cd absorber

- mimic ESS pulse
- frame-overlap filter



prototype

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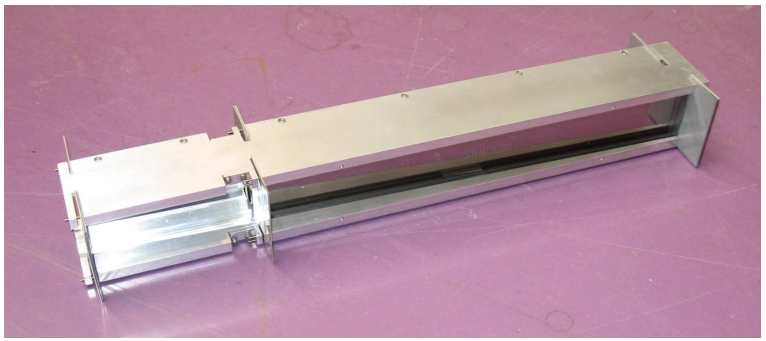
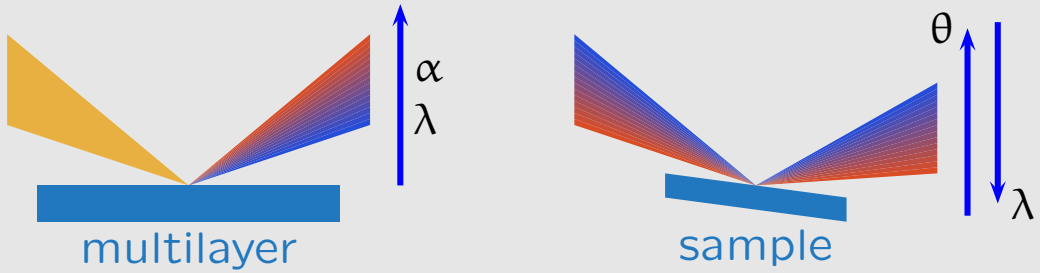
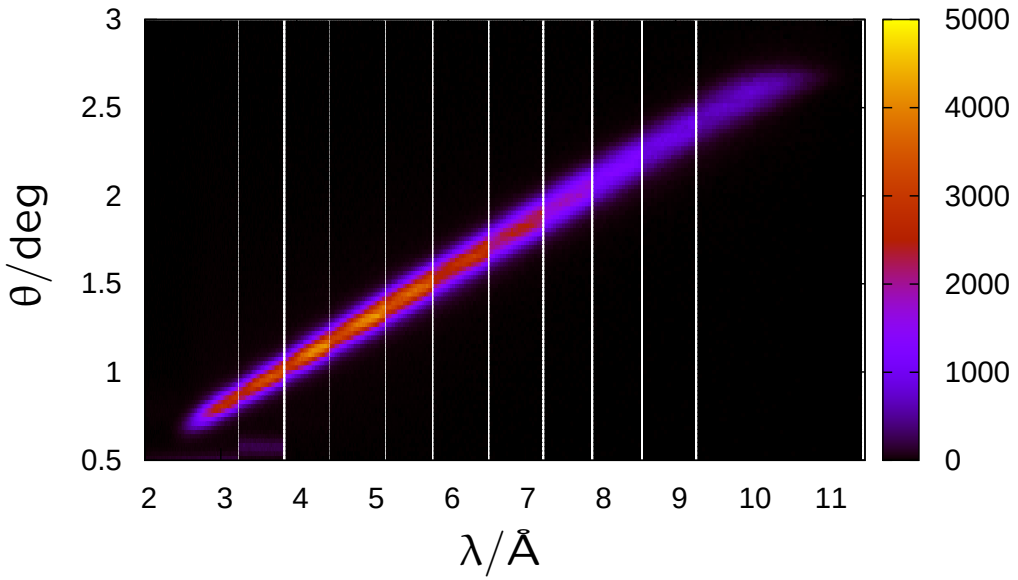
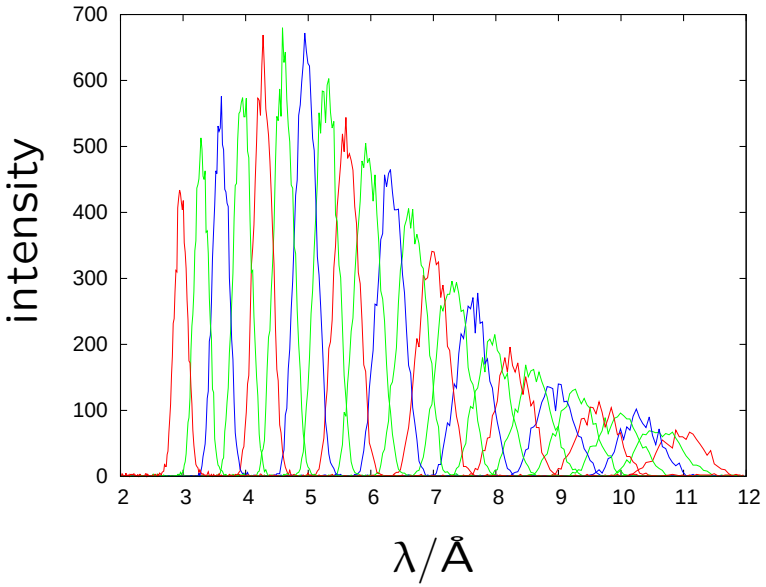
ML monochromator for λ / θ encoding









prototype

Selene
BOA

guides

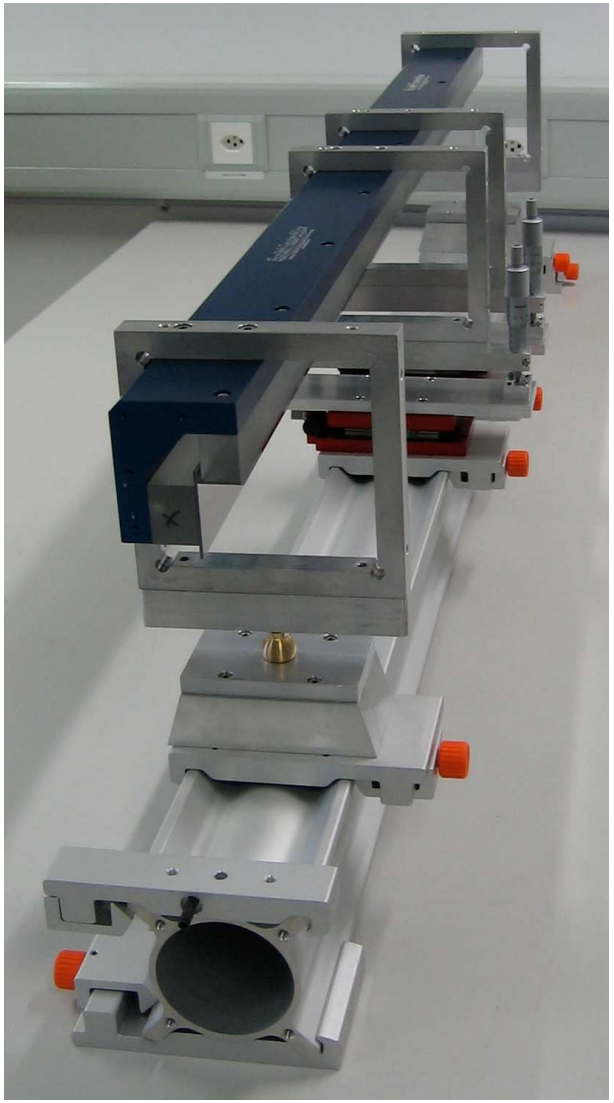
by *SwissNeutronics*

2 guides
1200 mm each

made of
2 elements

made of
2 elliptically bent reflectors
coating: Ni/Ti SM, $m = 4$

$a = 1000$ mm
$b/a = 0.0206$



prototype

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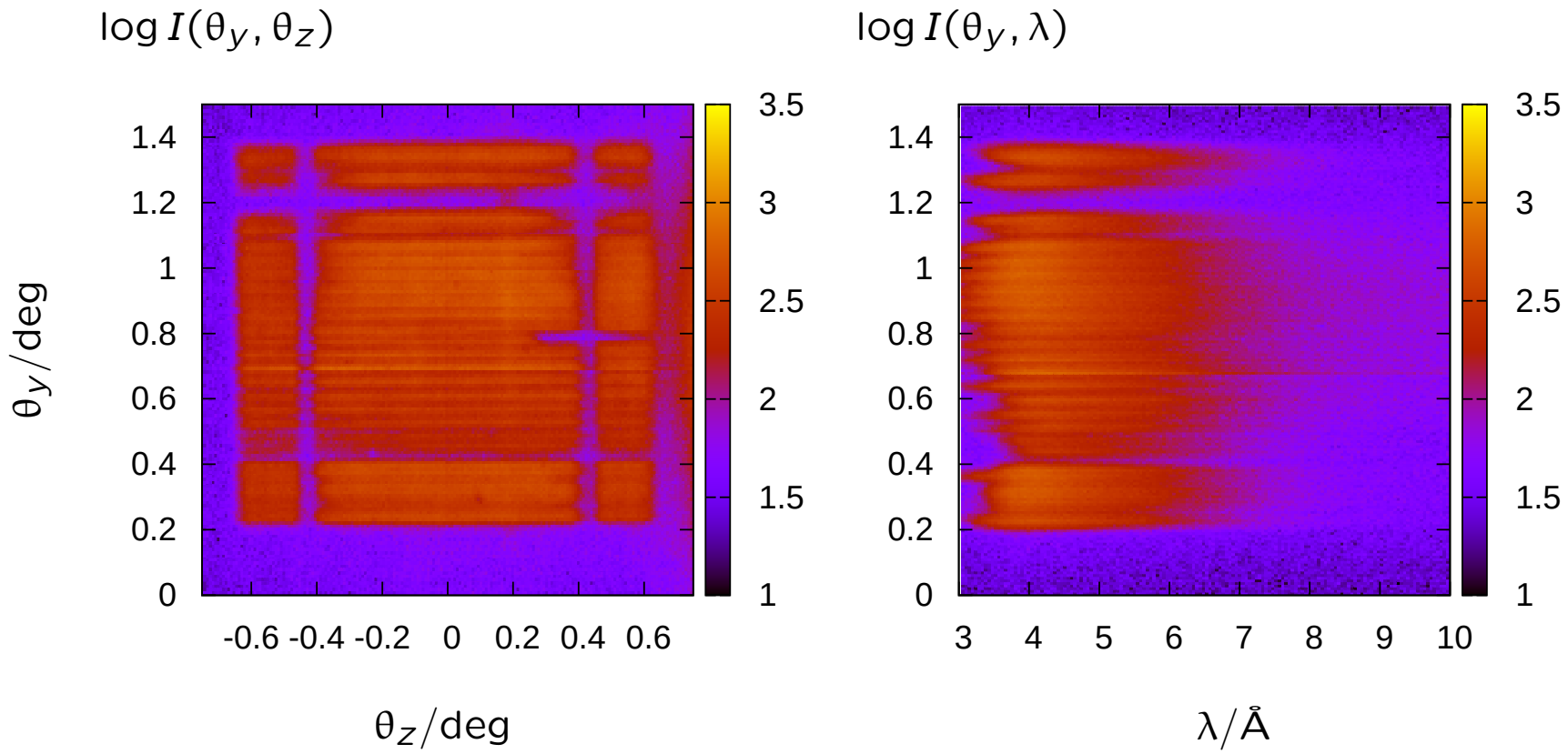
beam divergence

measured in TOF with a pin-hole

bender ⇒ stripe pattern

anti-trumped ⇒ # shadow

inhomogeneous $I(\lambda)$



prototype

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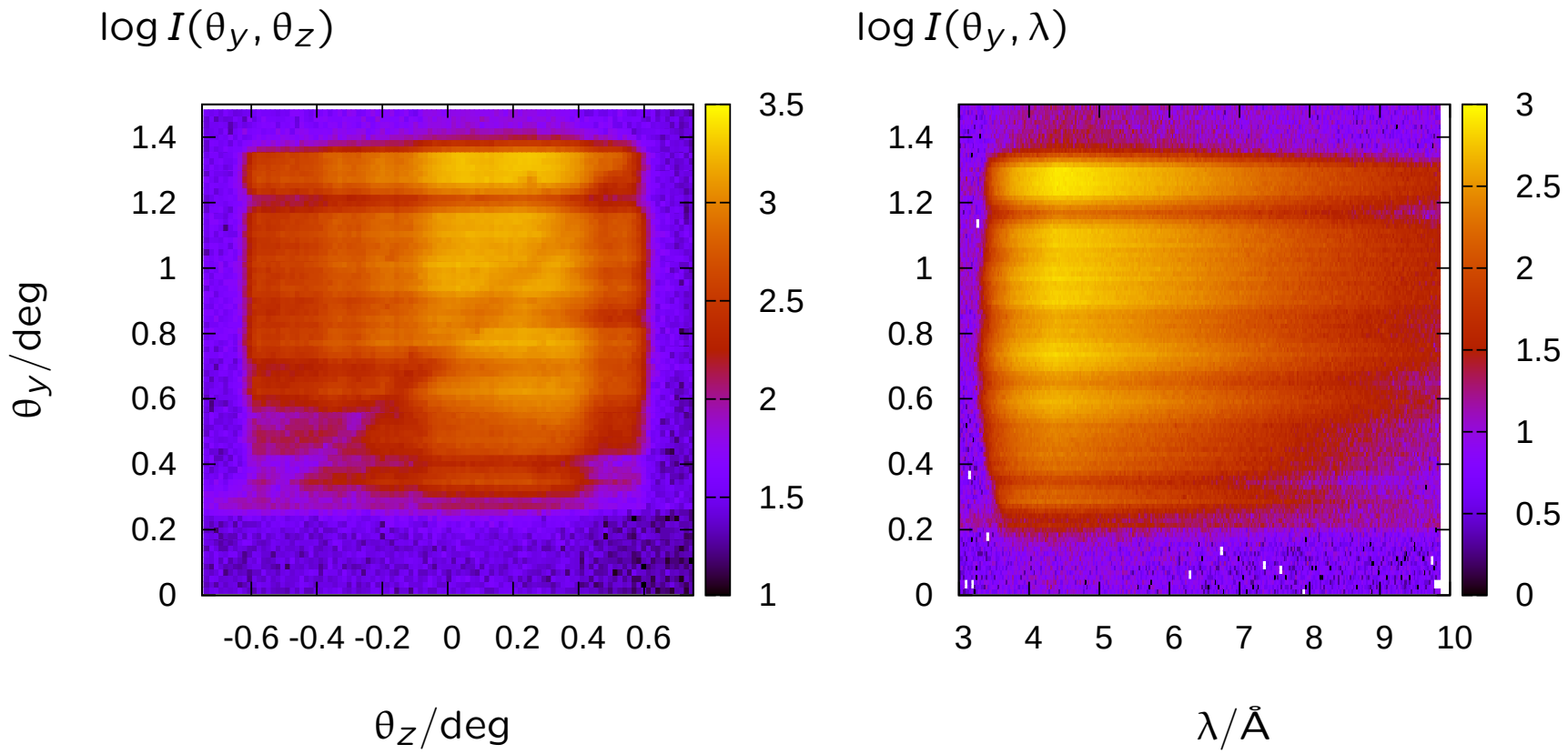
beam reflected on supermirror

Ni/Ti, $m = 5$

diagonal line in $\log I(\theta_y, \theta_z)$: joint between horizontal and vertical reflectors



prototype

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BOA

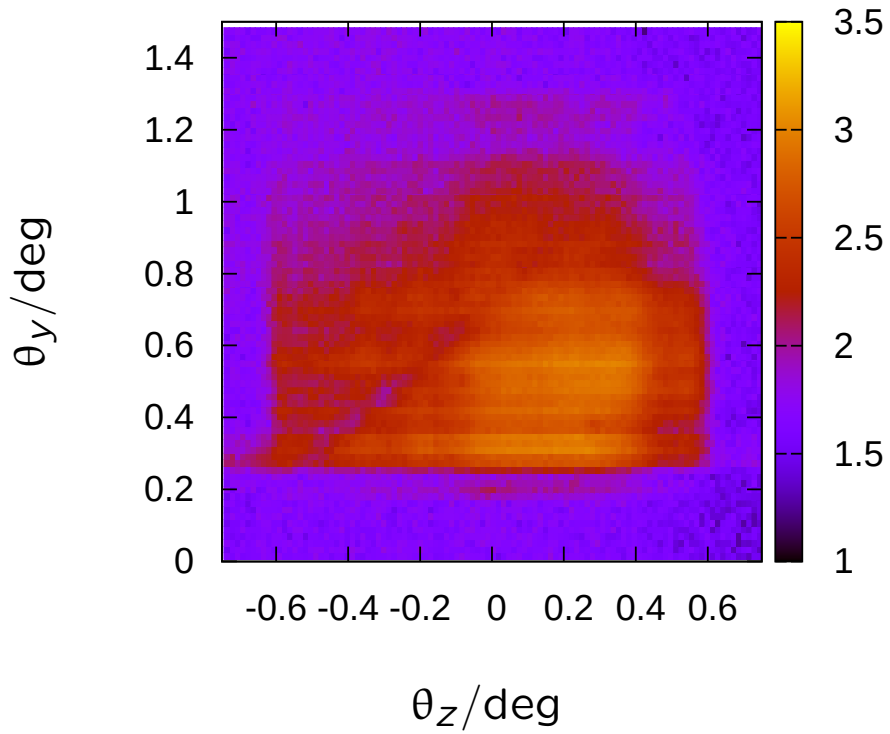
beam reflected by Ni film

1000 Å on glass

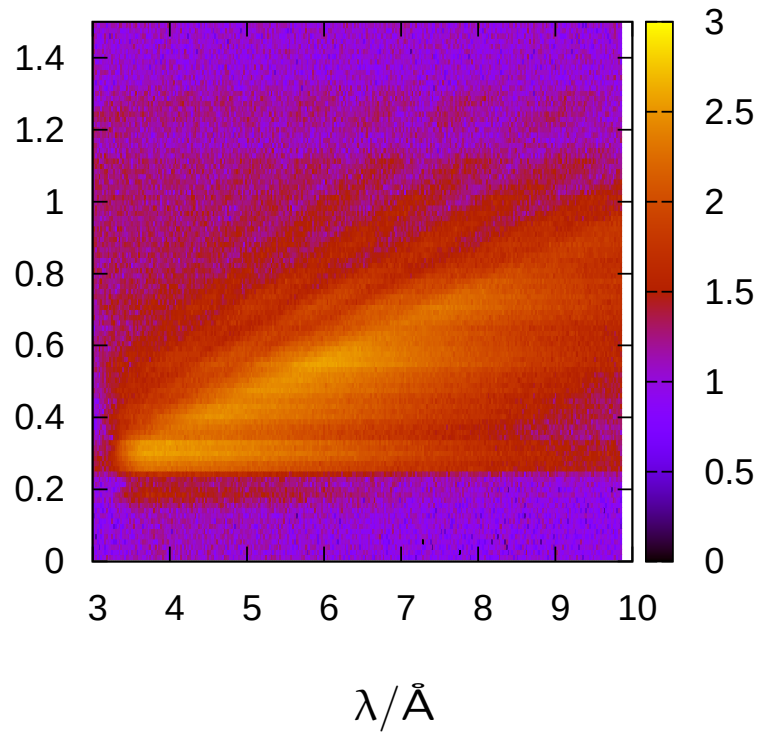
iso q_z lines:

$$q_z \propto \frac{\theta}{\lambda}$$
$$\Rightarrow \theta \propto q_z \lambda$$

$\log I(\theta_y, \theta_z)$



$\log I(\theta_y, \lambda)$



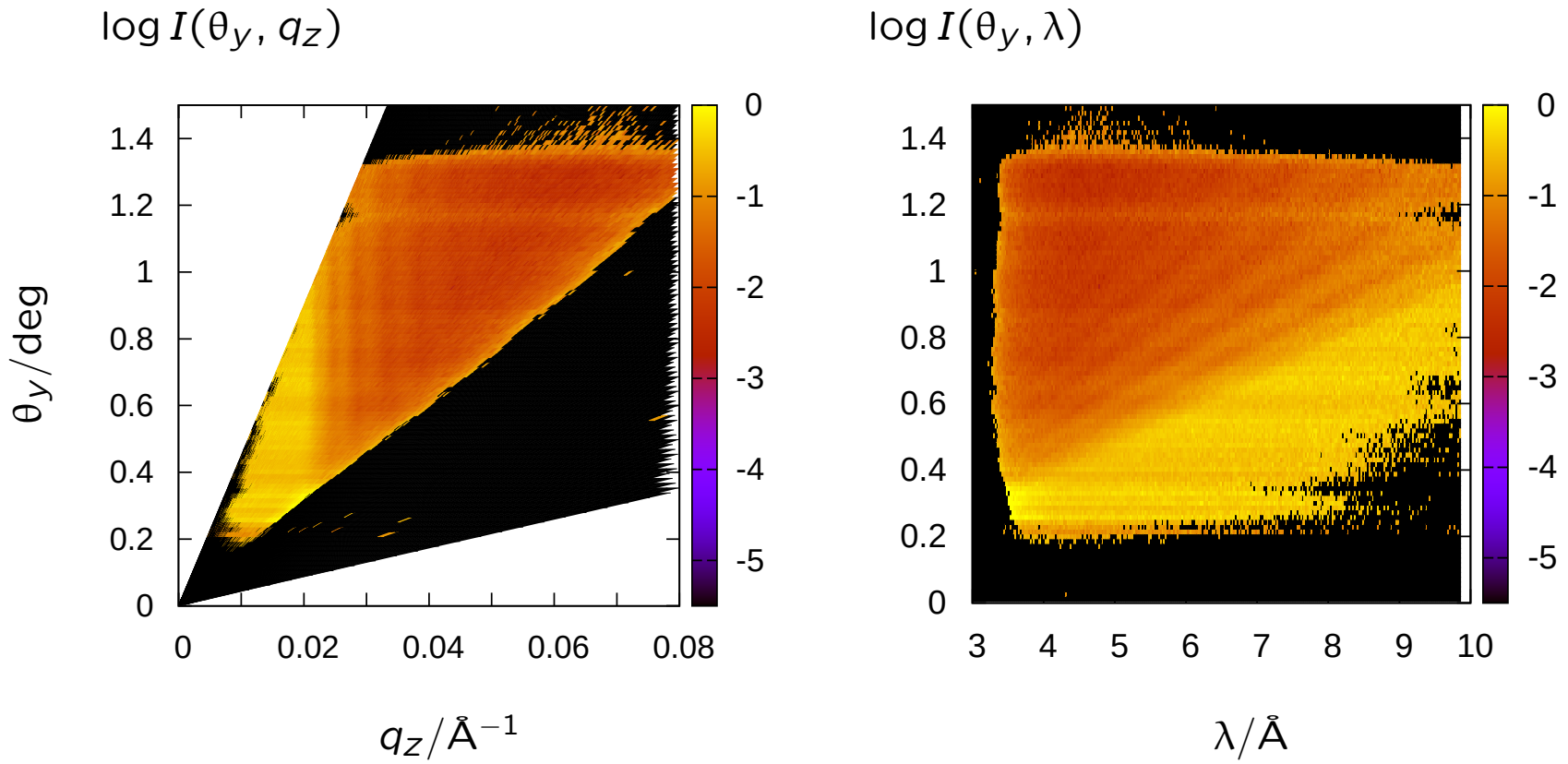
prototype

Selene
BOA

beam reflected by Ni film

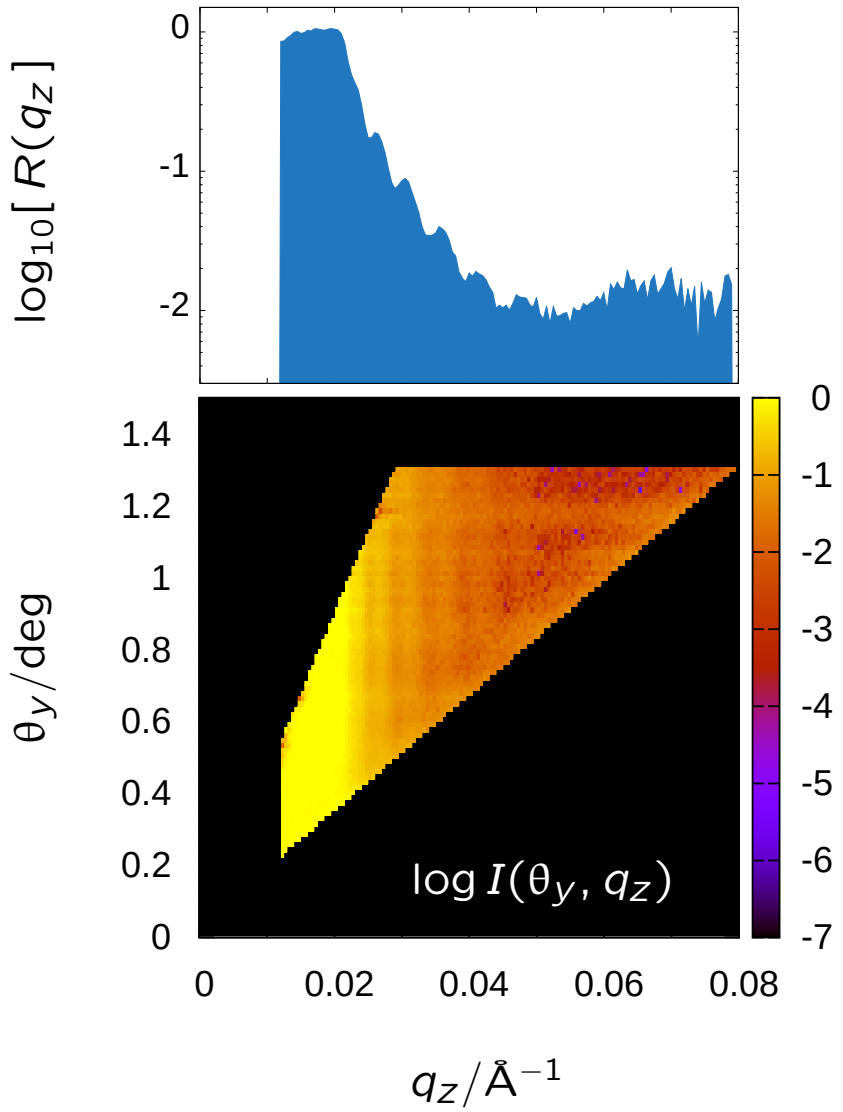
1000 Å on glass
normalised with SM

each horizontal line
corresponds to
one $R(q_z)$ curve



prototype

Selene
BOA



- proof of measurement scheme
- $\Delta\lambda =$ const.!
- source needs to be homogeneous!
- background at BOA is too high (10^{-2})
- guide accuracy has to be improved

prototype

Selene
BOA

next steps:

- remeasure with diffusor
- check set-up with ML monochromator

- testing with optical light
- TOF and ML-monochromator (on Amor, date unclear)

focusing reflectometer

ESS*Selene* small samples

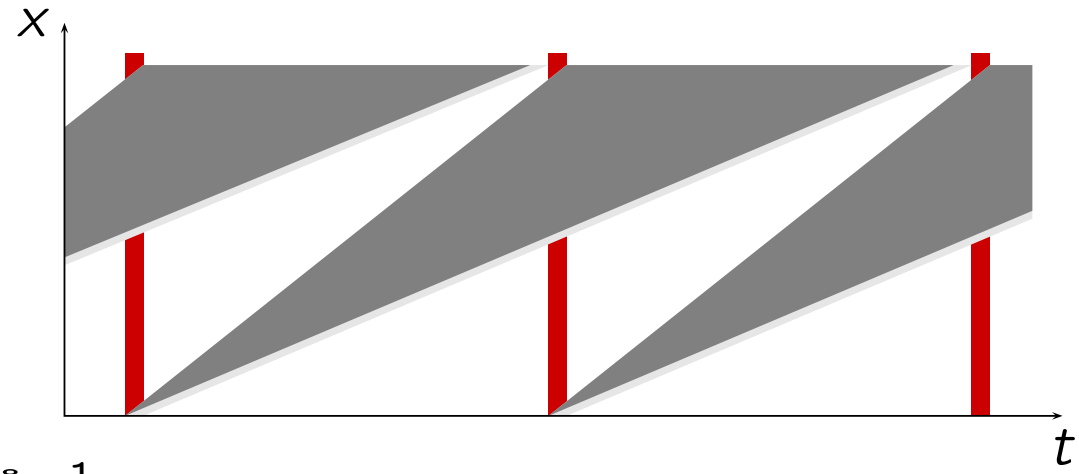
sample area 1×1 to $10 \times 10\,\mathrm{mm}^2$

polarisation & analysis

resolution $\Delta q_z/q_z = \text{const.} = 4\% \ldots 15\%$

λ-range: 5 Å . . . 9.4 Å

instrument length: 58 m



q_z-ranges:
$0.01\,\text{Å}^{-1} \rightarrow 0.08\,\text{Å}^{-1}$
$0.07\,\text{Å}^{-1} \rightarrow 0.19\,\text{Å}^{-1}$
$0.18\,\text{Å}^{-1} \rightarrow 0.38\,\text{Å}^{-1}$
$0.37\,\text{Å}^{-1} \rightarrow 0.72\,\text{Å}^{-1}$

focusing reflectometer

ESS*Selene* small samples

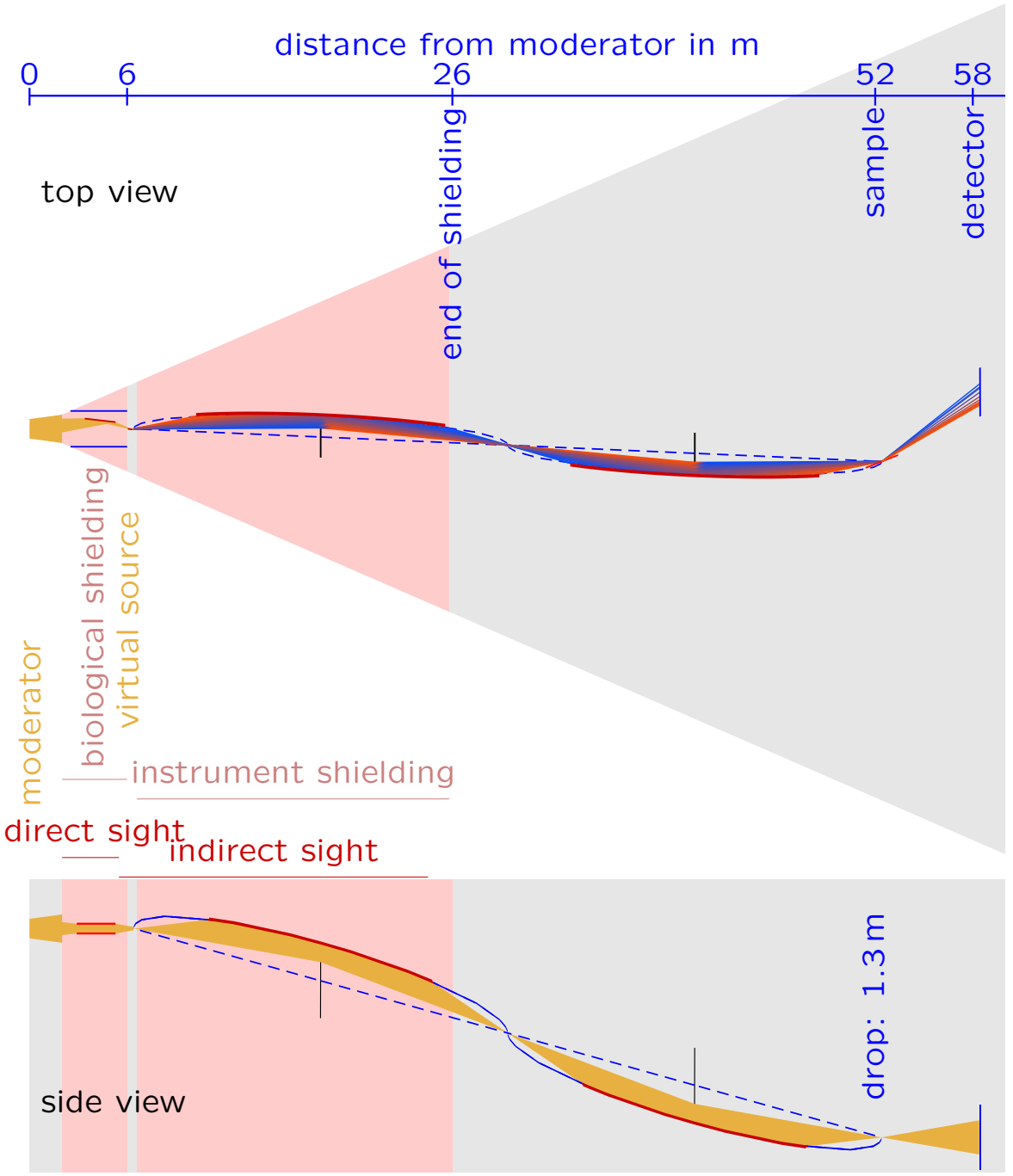
version I

one Selene guide section

λ/θ encoding
ML-monochromator at $x = 6.5\,\mathrm{m}$

$\Delta\theta_{xy} = 1^\circ$
$\Delta\theta_{xz} = 2^\circ$

problem:
radiation shielding might
be too weak



focusing reflectometer

ESS*Selene* small samples

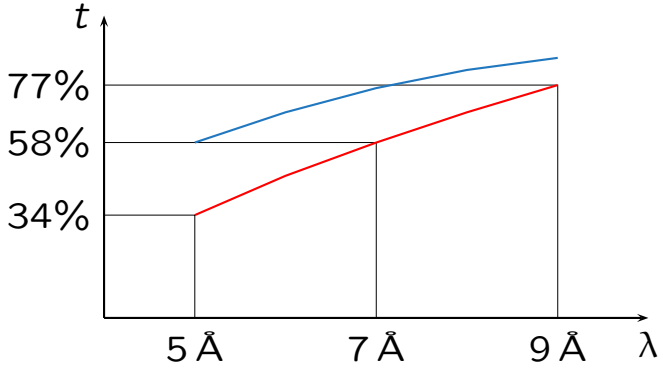
version II

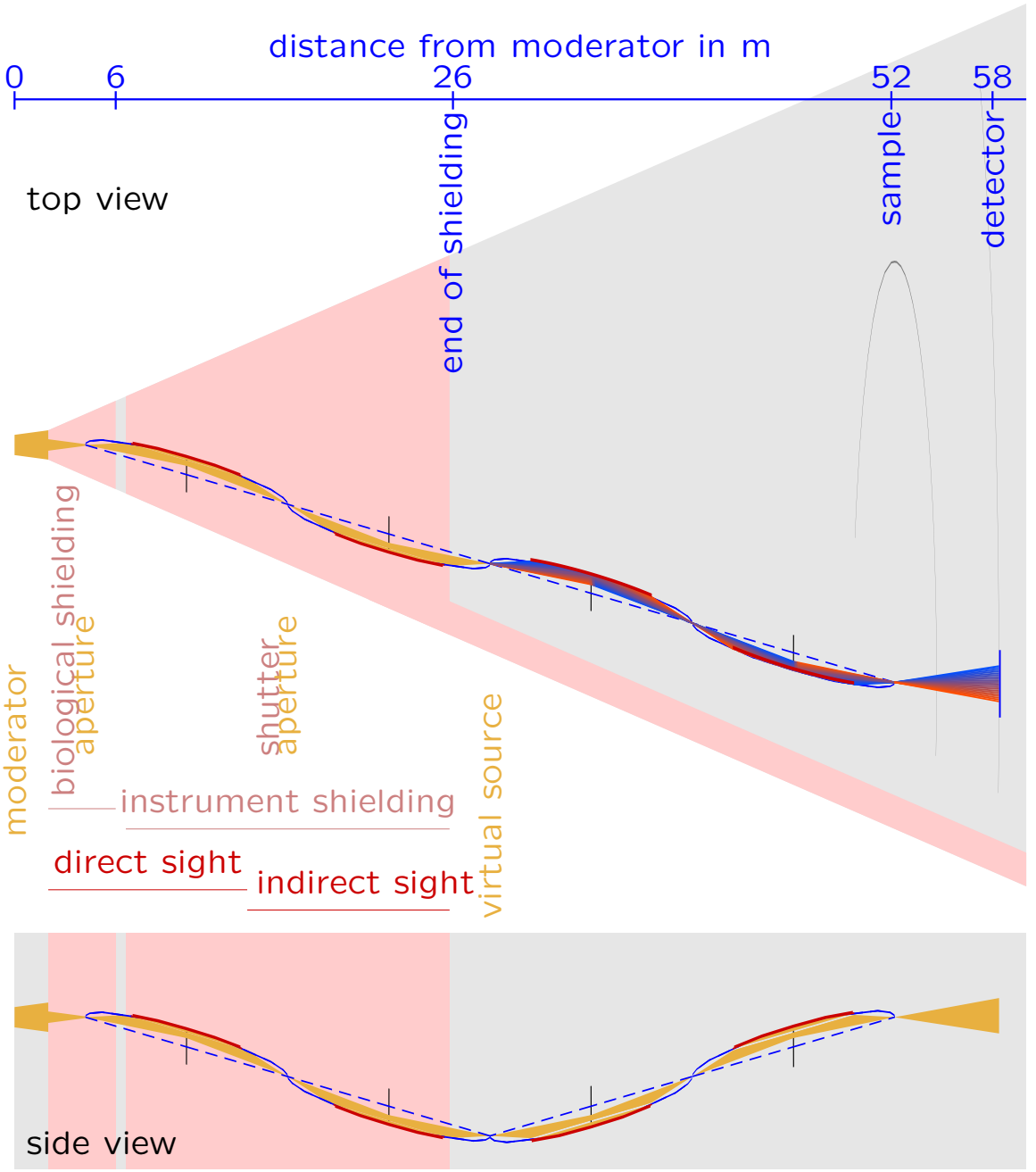
two Selene guide sections

λ/θ encoding
ML-monochromator at $x = 28\,\mathrm{m}$

$\Delta\theta_{xy} = 1.5^\circ$
$\Delta\theta_{xz} = 1.5^\circ$

problem:
lower transmission





focusing reflectometer

ESS *Selene* liquid surfaces

→ **Ursula Hansen**

questions / discussion

- constraints due to shielding — STAP recommendations
- constraints due to γ & n-burst
- spatial situation — 5° wedge

- moderator — Be-reflector moderator?
- detector / choppers — support from ESS?

- benchmarking
  - reference instrument at ESS — to be defined
  - existing instrument(s)
  - one person (at ESS / København) doing the final benchmarking