



Paul Scherrer Institut

Tobias Panzner, Uwe Filges, Panos Korelis

Københavns Universitet

Syddansk Universitet

Jochen Stahn

Marité Cardenas

Ursula Hansen

Beate Klösgen



**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** ($< 100 \text{ mm}^2$)
 - horizontal scattering geometry
 - polarisation & \sim analysis
 - voluminous sample environment
 - moderate to low resolution
 - ...

ESS Selene 
liquid surfaces

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

state of work

Selene **BOA**

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 planned for the near future

principle

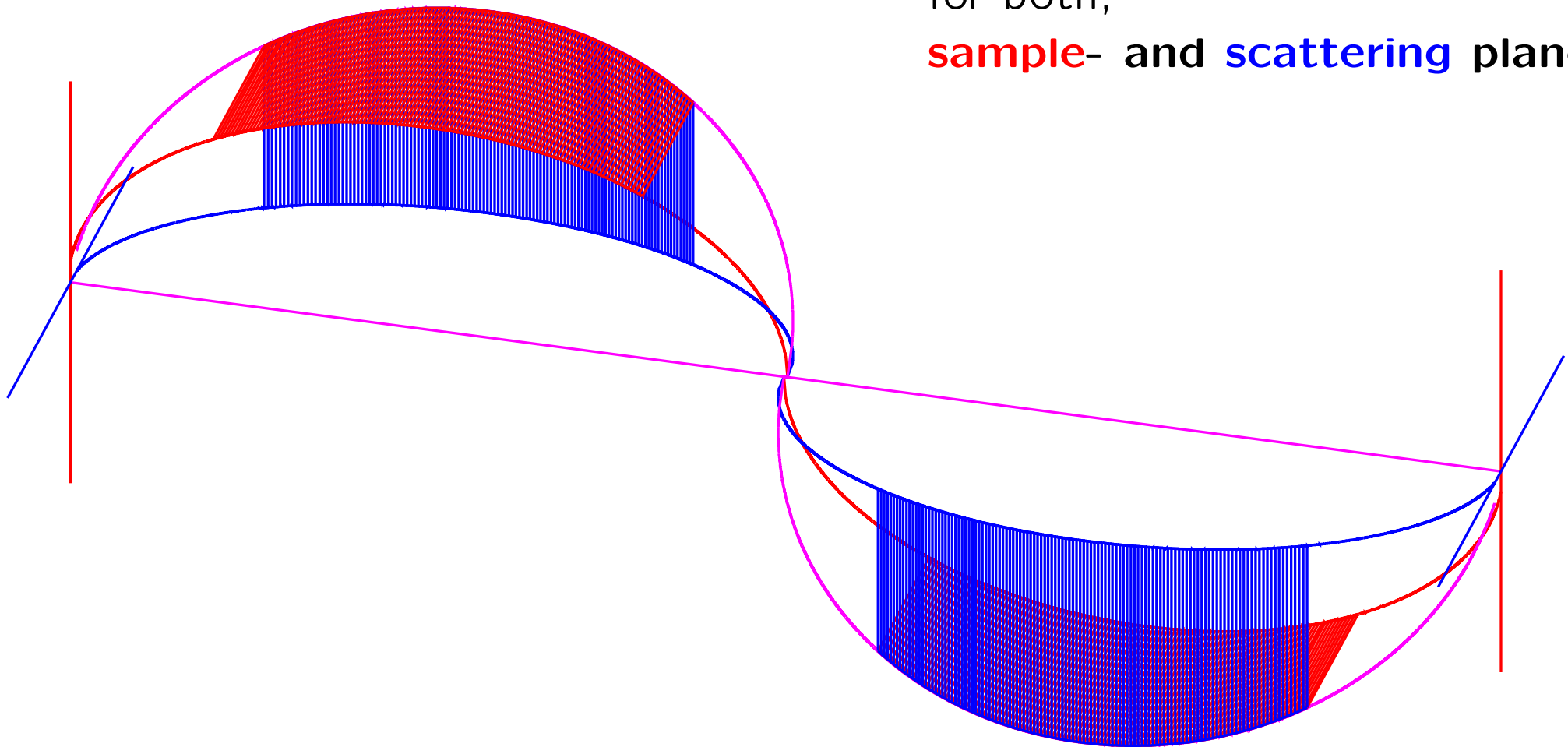
point-to-point focusing

with

2 subsequent elliptical reflectors

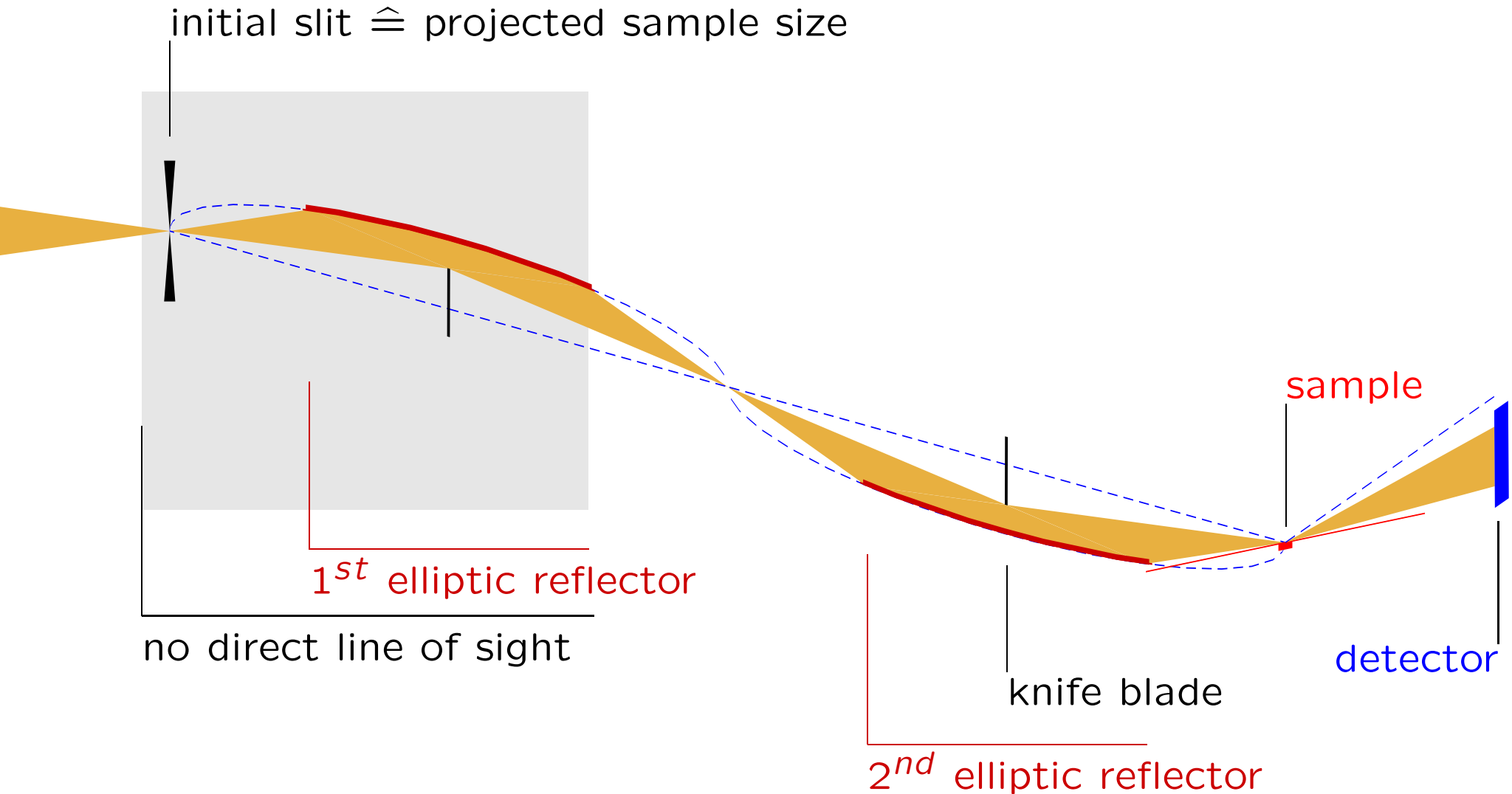
for both,

sample- and **scattering** plane



generic instrument layout

cut in the scattering plane
stretched by 10 normal to incident beam



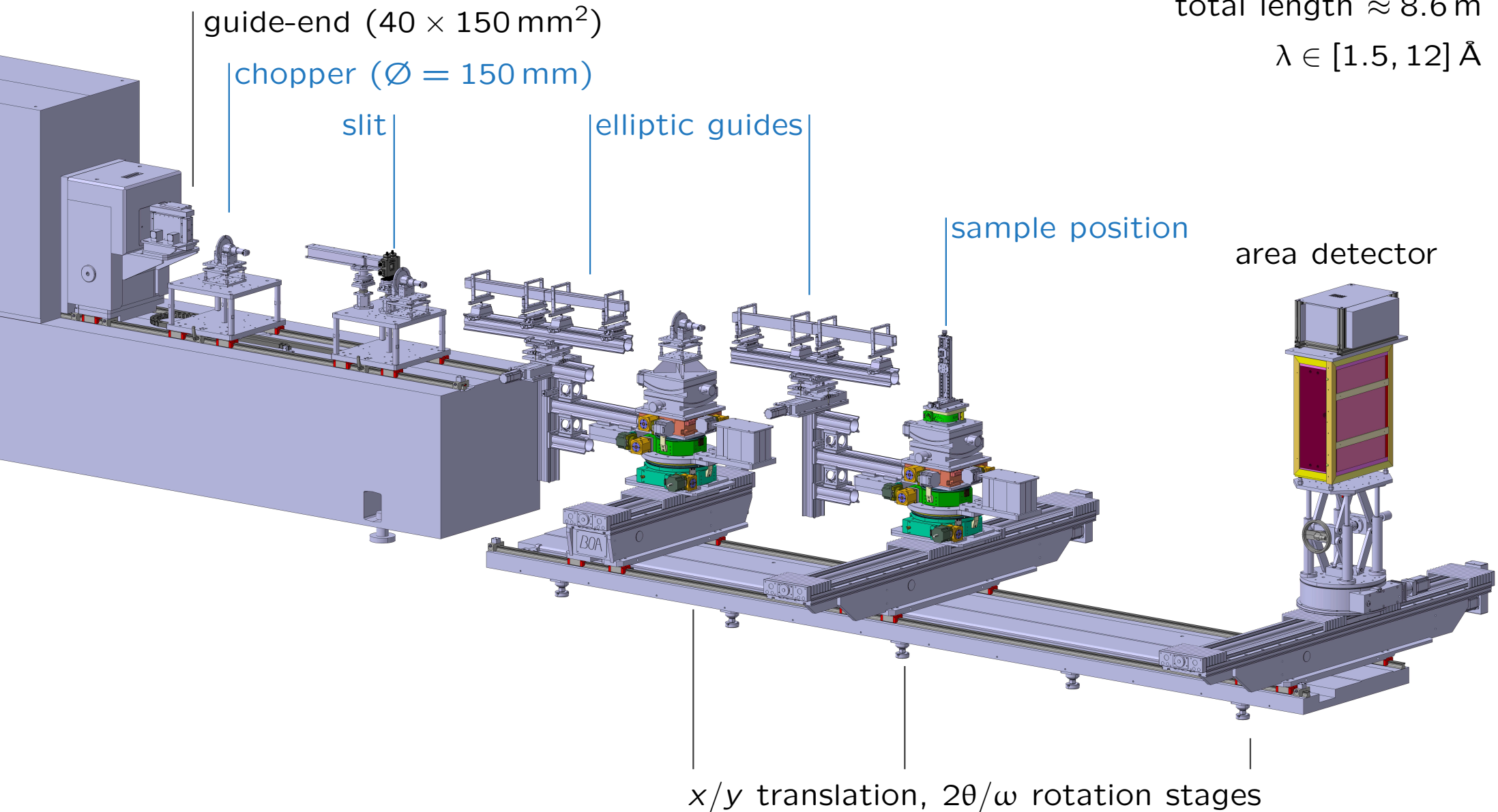
prototype

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BOA

BOA is a test beam line at PSI

total length ≈ 8.6 m

$\lambda \in [1.5, 12]$ Å



prototype

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BOA

choppers

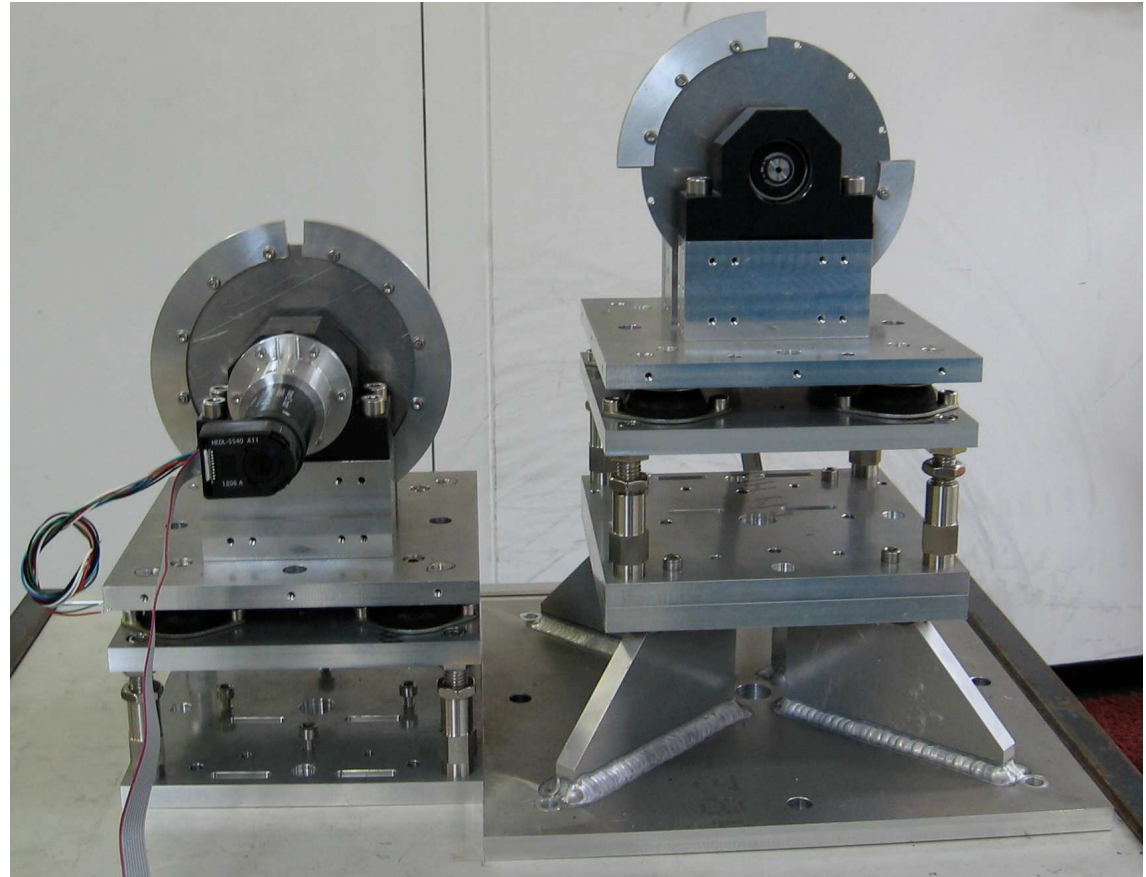
$$\nu = 60 \text{ s}^{-1}$$

gives $\lambda = 0 \dots 10 \text{ \AA}$

$$\varnothing = 150 \text{ mm}$$

Al:B and Cd absorber

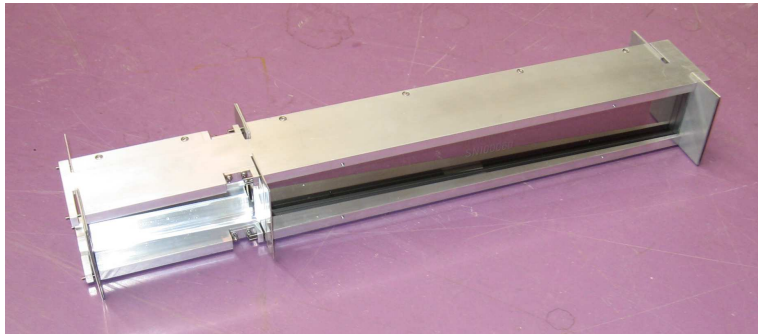
- mimic ESS pulse
- frame-overlap filter



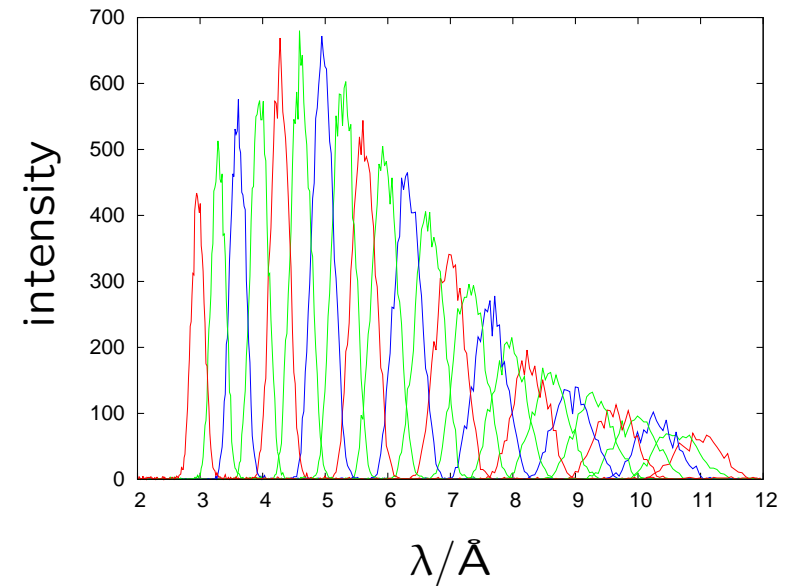
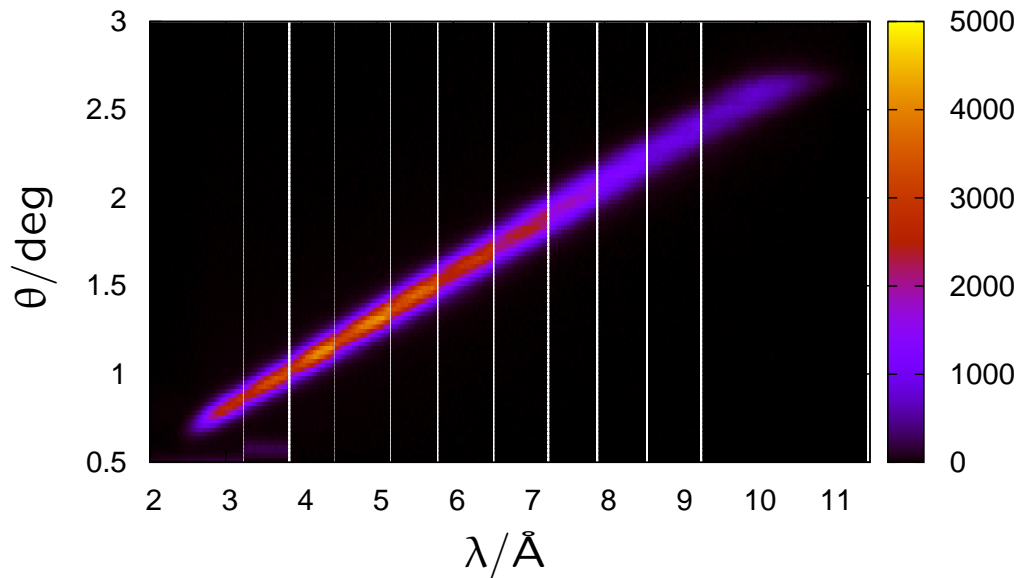
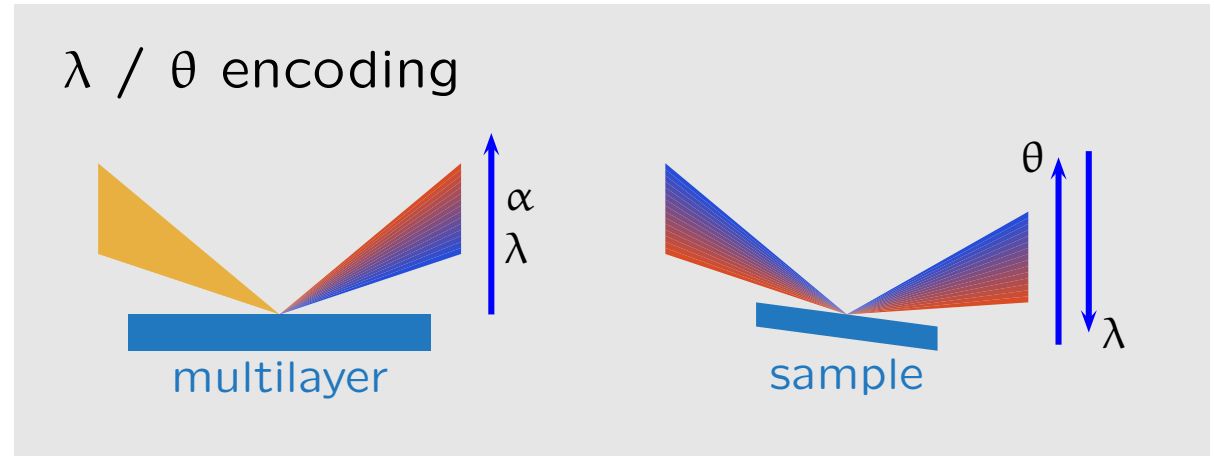
prototype

Selene
BOA

ML monochromator



for



prototype

Selene
BOA

guides

by *SwissNeutronics*

2 guides

1200 mm each

made of

2 elements

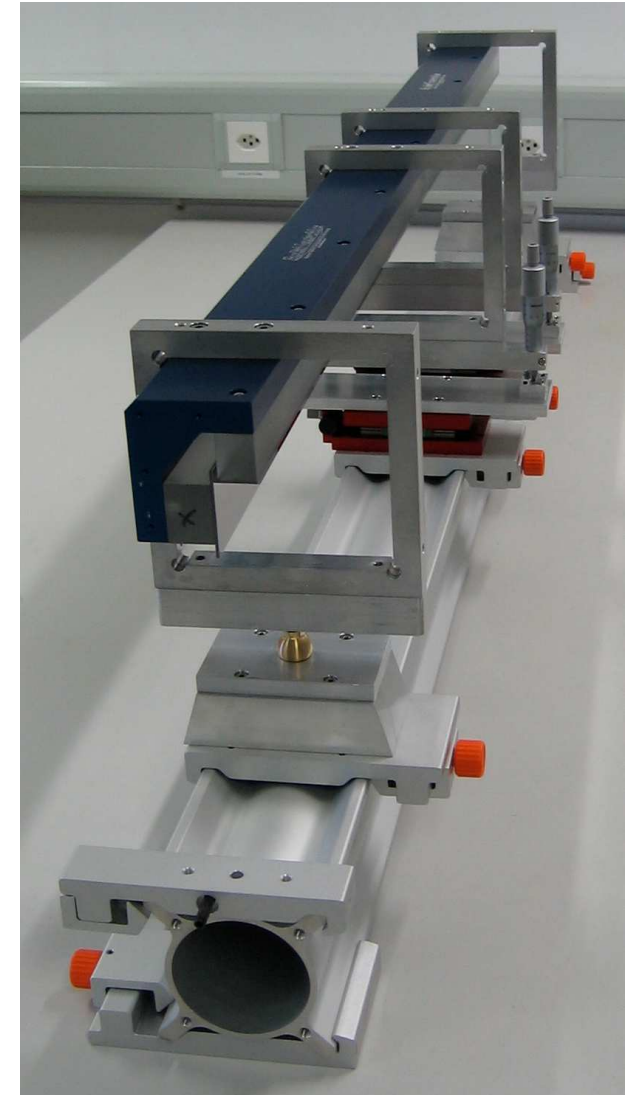
made of

2 elliptically bent reflectors

coating: Ni/Ti SM, $m = 4$

$a = 1000$ mm

$b/a = 0.0206$



prototype

Selene
BOA

beam divergence

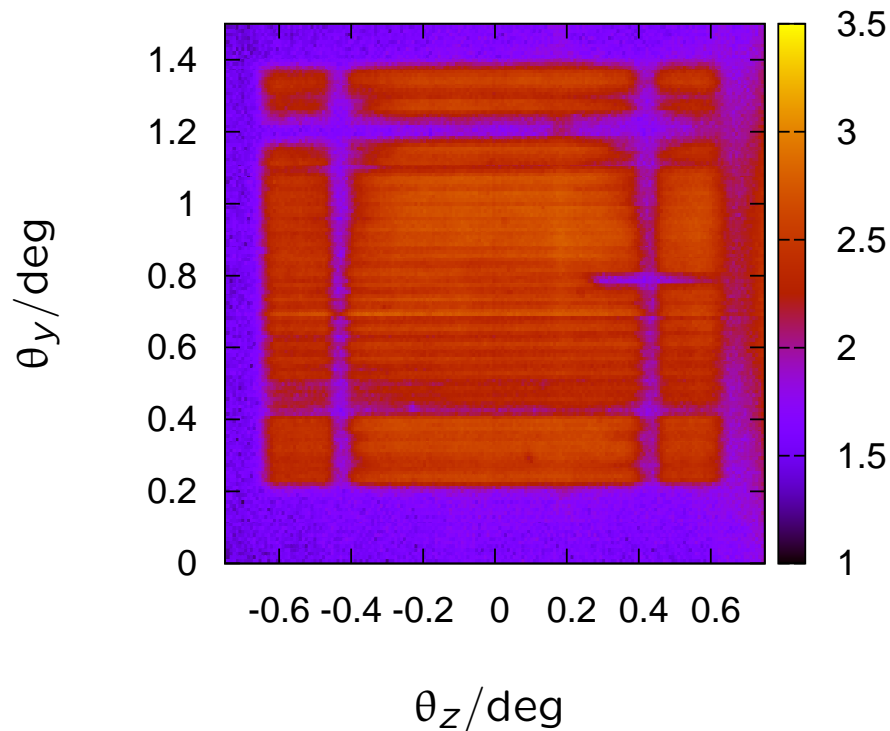
measured in TOF with a pin-hole

bender \Rightarrow stripe pattern

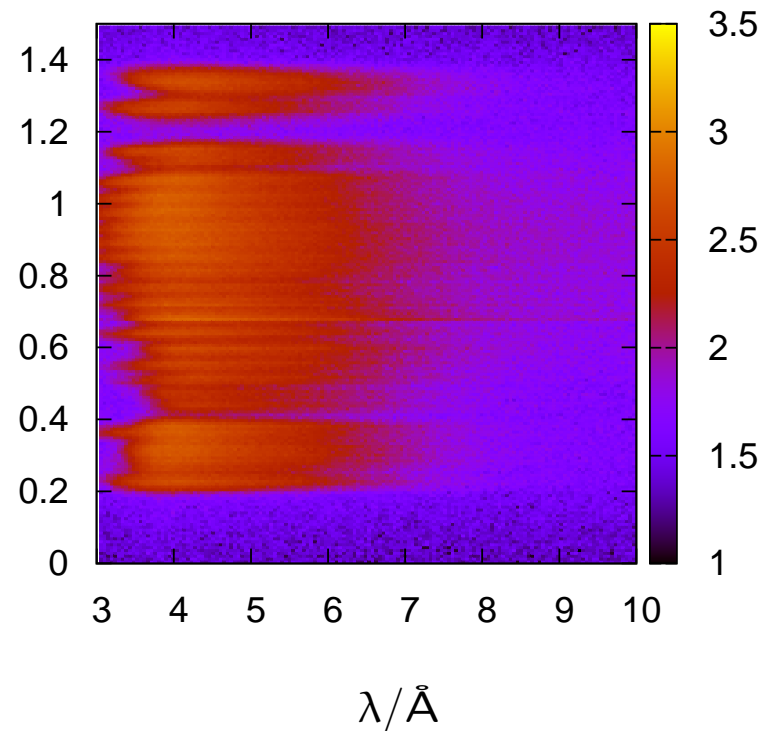
anti-trumped \Rightarrow # shadow

inhomogeneous $I(\lambda)$

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



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



prototype

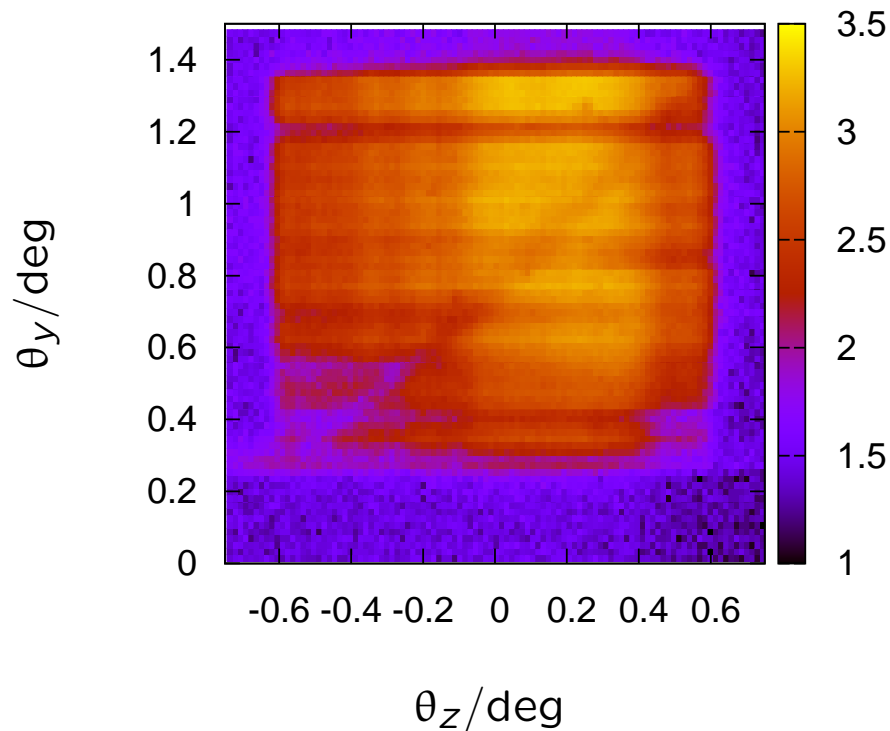
Selene
BOA

beam reflected on supermirror

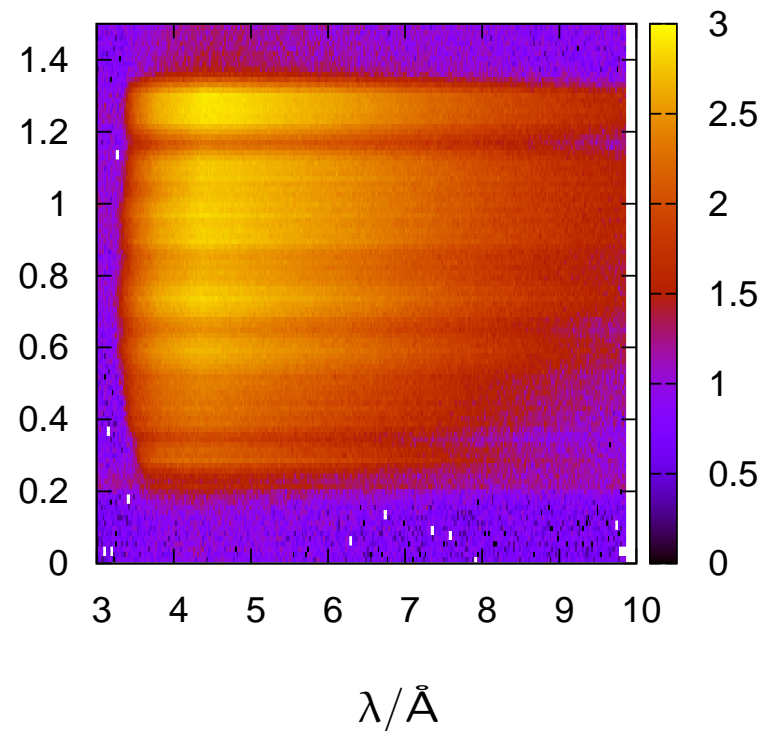
Ni/Ti, $m = 5$

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

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



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



prototype

Selene
BOA

beam reflected by Ni film

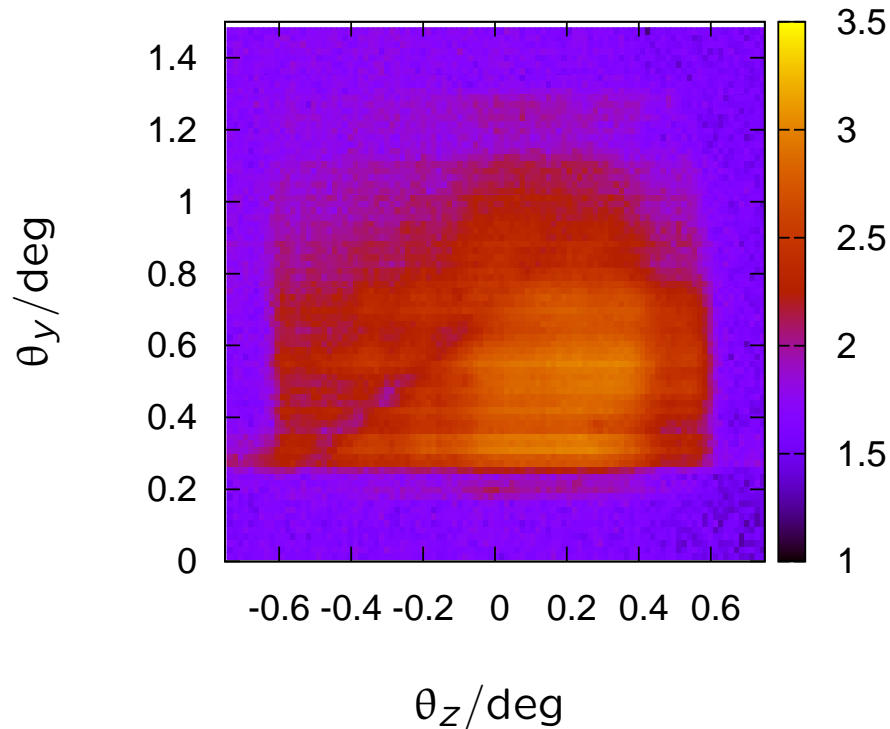
1000 Å on glass

iso q_z lines:

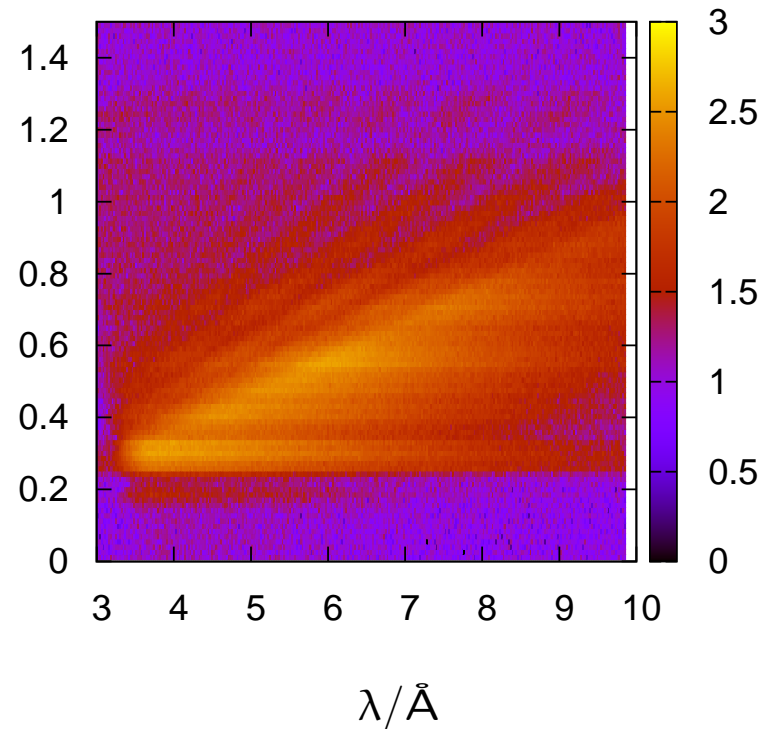
$$q_z \propto \frac{\theta}{\lambda}$$

$$\Rightarrow \theta \propto q_z \lambda$$

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



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



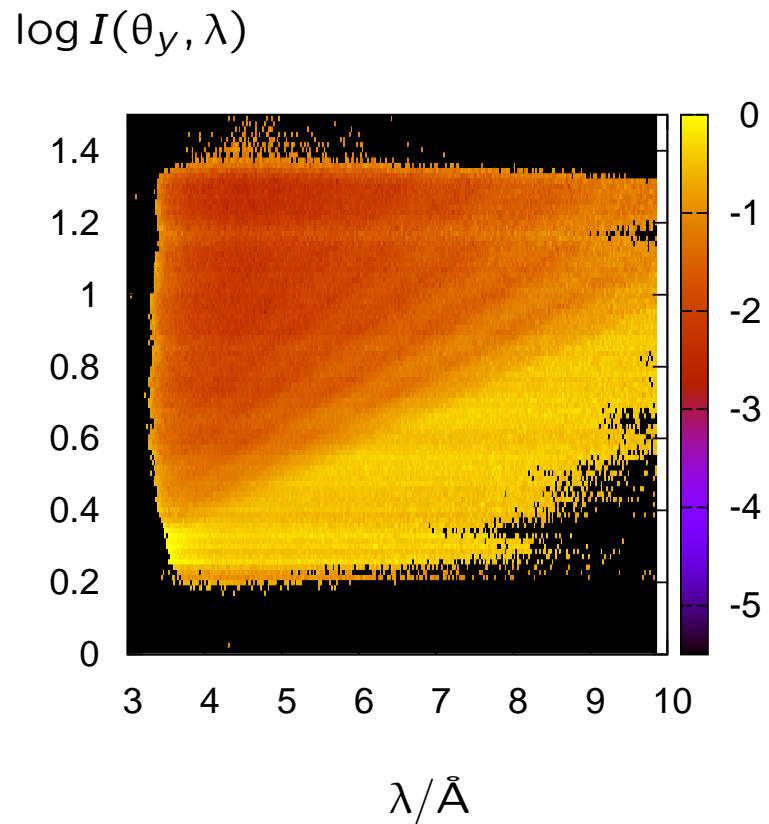
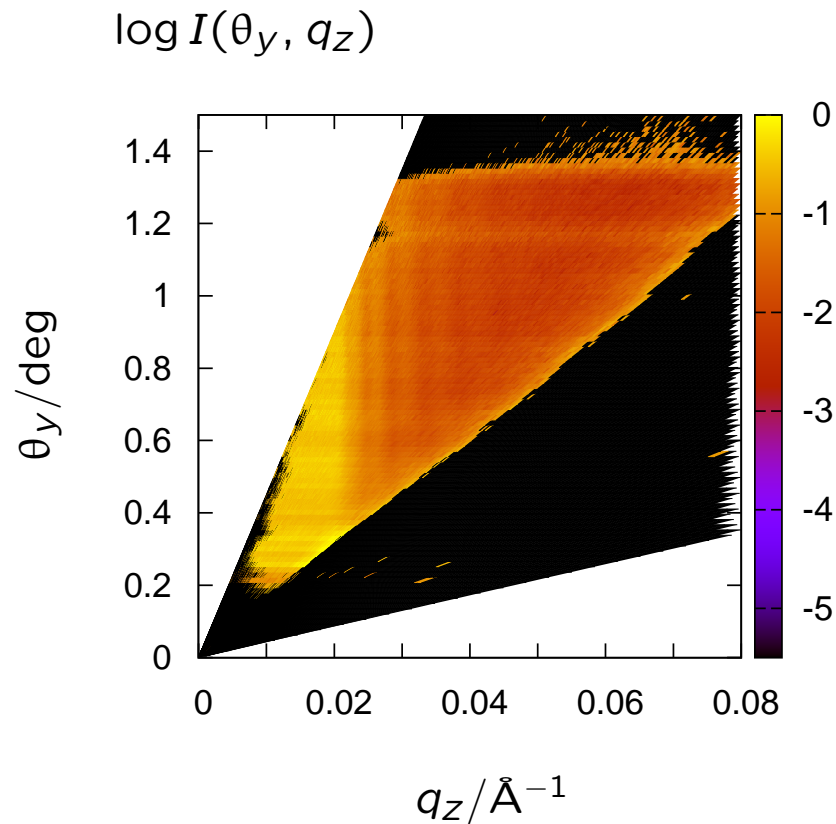
prototype

Selene
BOA

beam reflected by Ni film

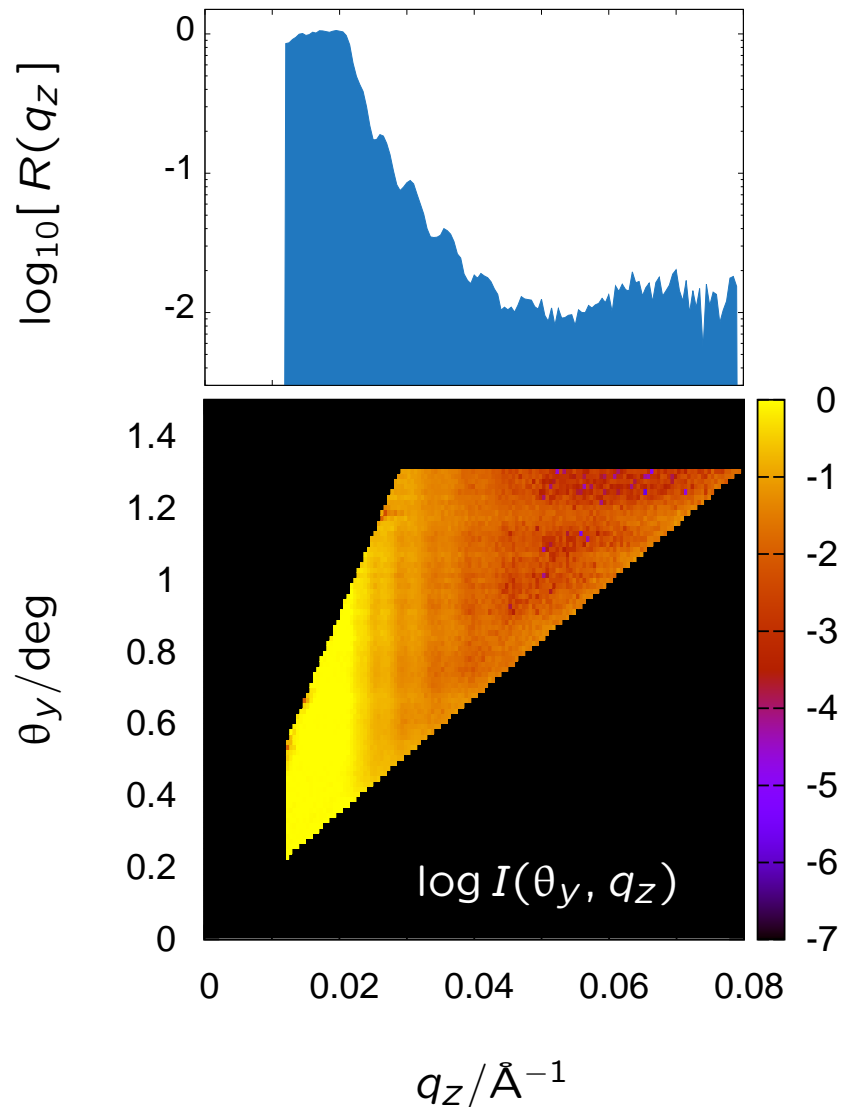
1000 Å on glass
normalised with SM

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



prototype

Selene
BOA



- proof of measurement scheme
- $\Delta\lambda = \text{const.}!$
- 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

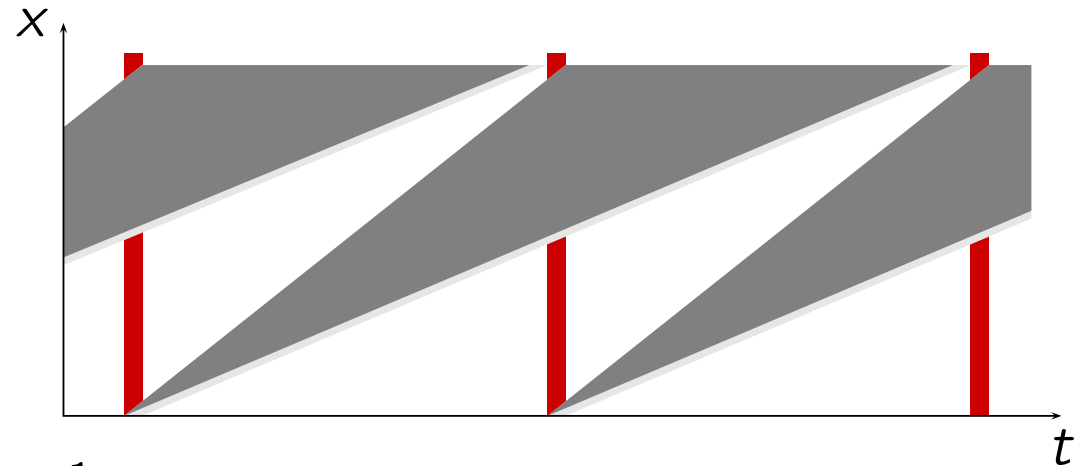
sample area 1×1 to $10 \times 10 \text{ mm}^2$

polarisation & analysis

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

λ -range: $5 \text{ \AA} \dots 9.4 \text{ \AA}$

instrument length: 58 m



q_z -ranges:

0.01 \AA^{-1}	\rightarrow	0.08 \AA^{-1}
0.07 \AA^{-1}	\rightarrow	0.19 \AA^{-1}
0.18 \AA^{-1}	\rightarrow	0.38 \AA^{-1}
0.37 \AA^{-1}	\rightarrow	0.72 \AA^{-1}

focusing reflectometer

ESS *Selene*  small samples

version I

one Selene guide section

λ/θ encoding

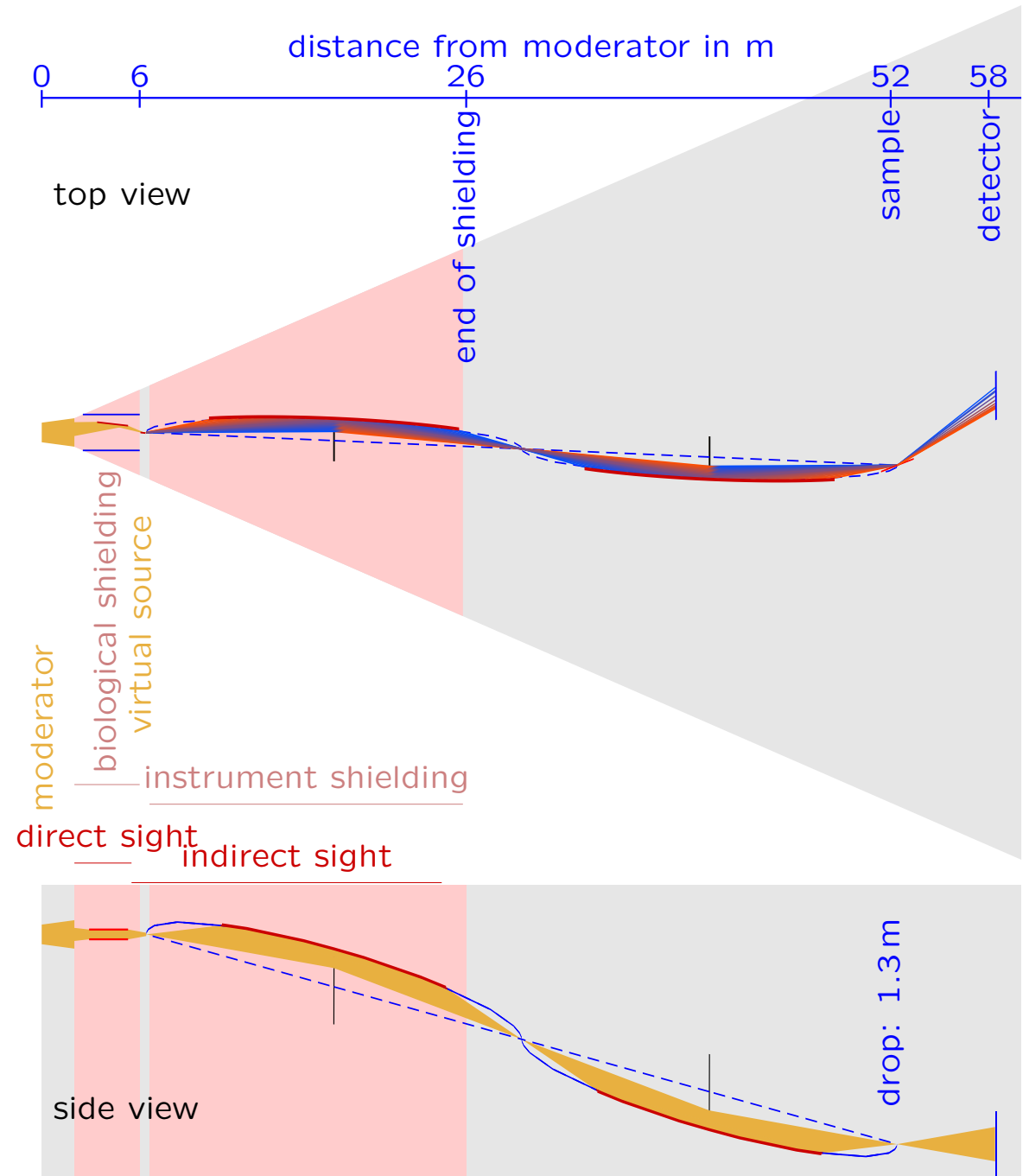
ML-monochromator at $x = 6.5$ m

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

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

problem:

radiation shielding might be too weak



focusing reflectometer

ESS *Selene*  small samples

version II

two Selene guide sections

λ/θ encoding

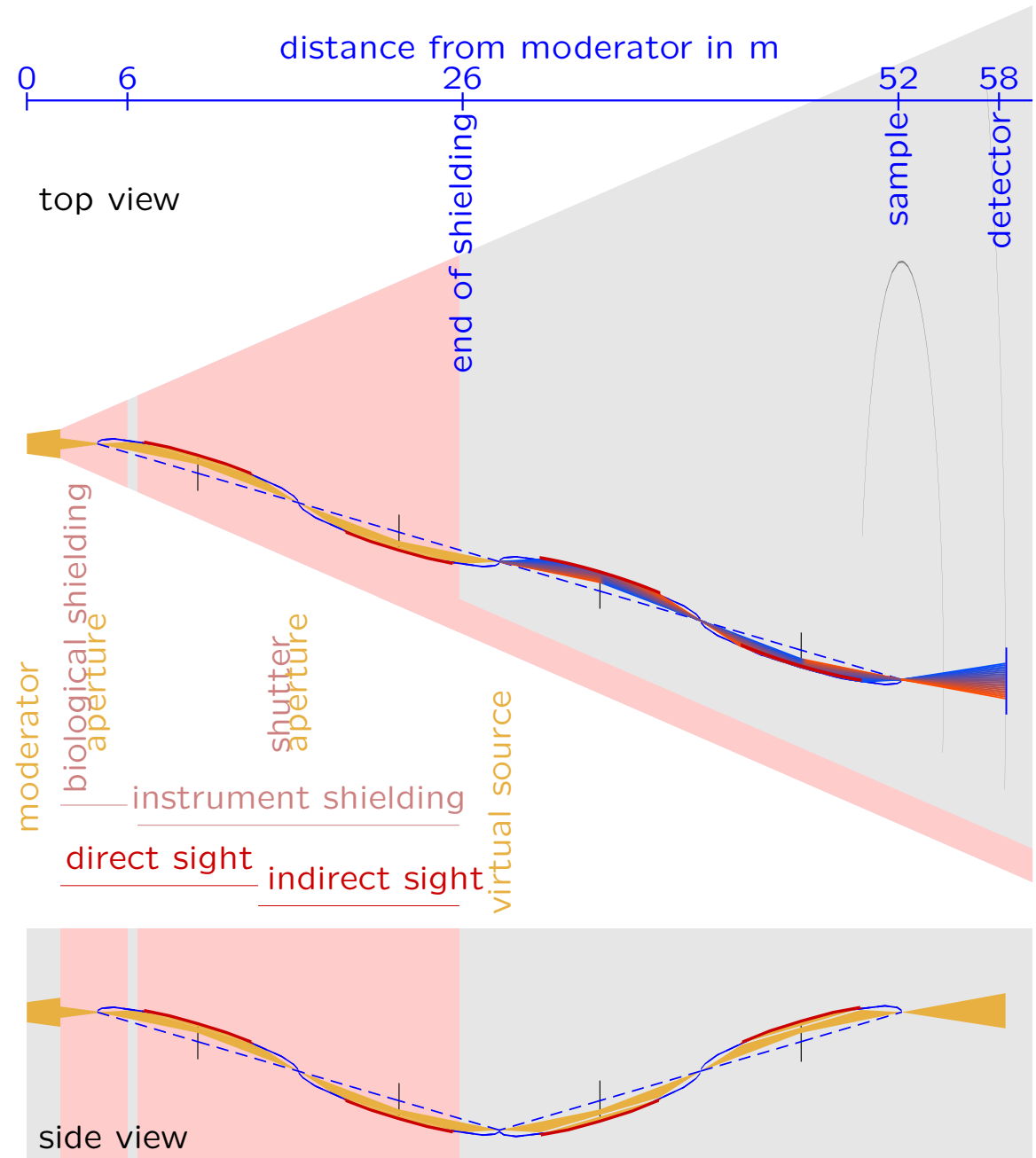
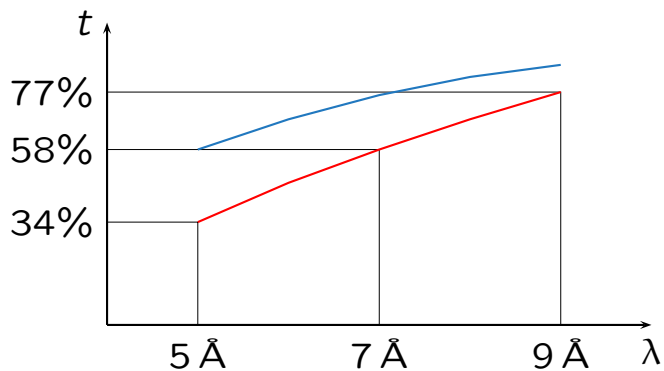
ML-monochromator at $x = 28$ m

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

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

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