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Marcel Schild

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first tests with a model

*Selene*-type neutron guide



*Selene*

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**IKON 4**

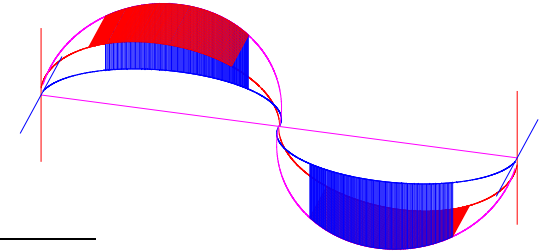
13.–14. 02. 2013, Lund, Sweden

# outline

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*Selene*

guide concept  
application: reflectometer

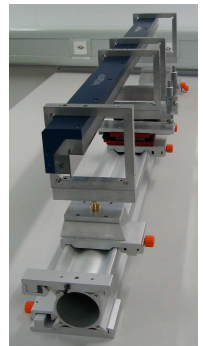


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model and tests

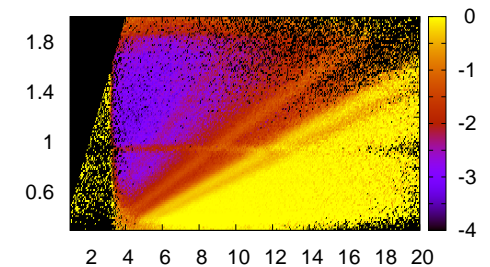
*Selene*  
**BOA**

set-up & components  
virtual point-source  
high-intensity specular reflectivity



*Selene*  
**Amor**

high-intensity specular reflectivity  
 $\lambda/\theta$  encoding



discussion

# principle

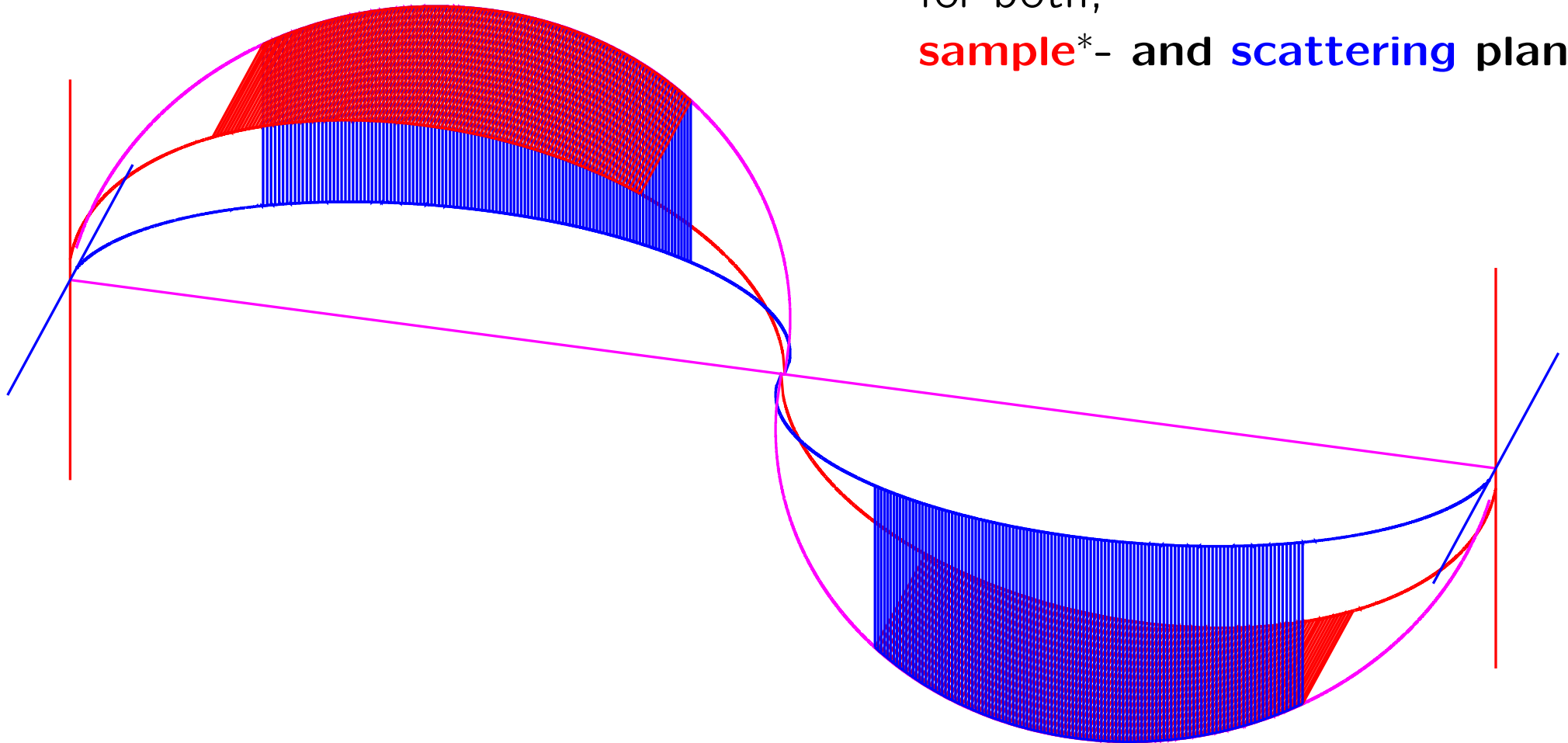
point-to-point focusing

with

2 subsequent elliptic reflectors

for both,

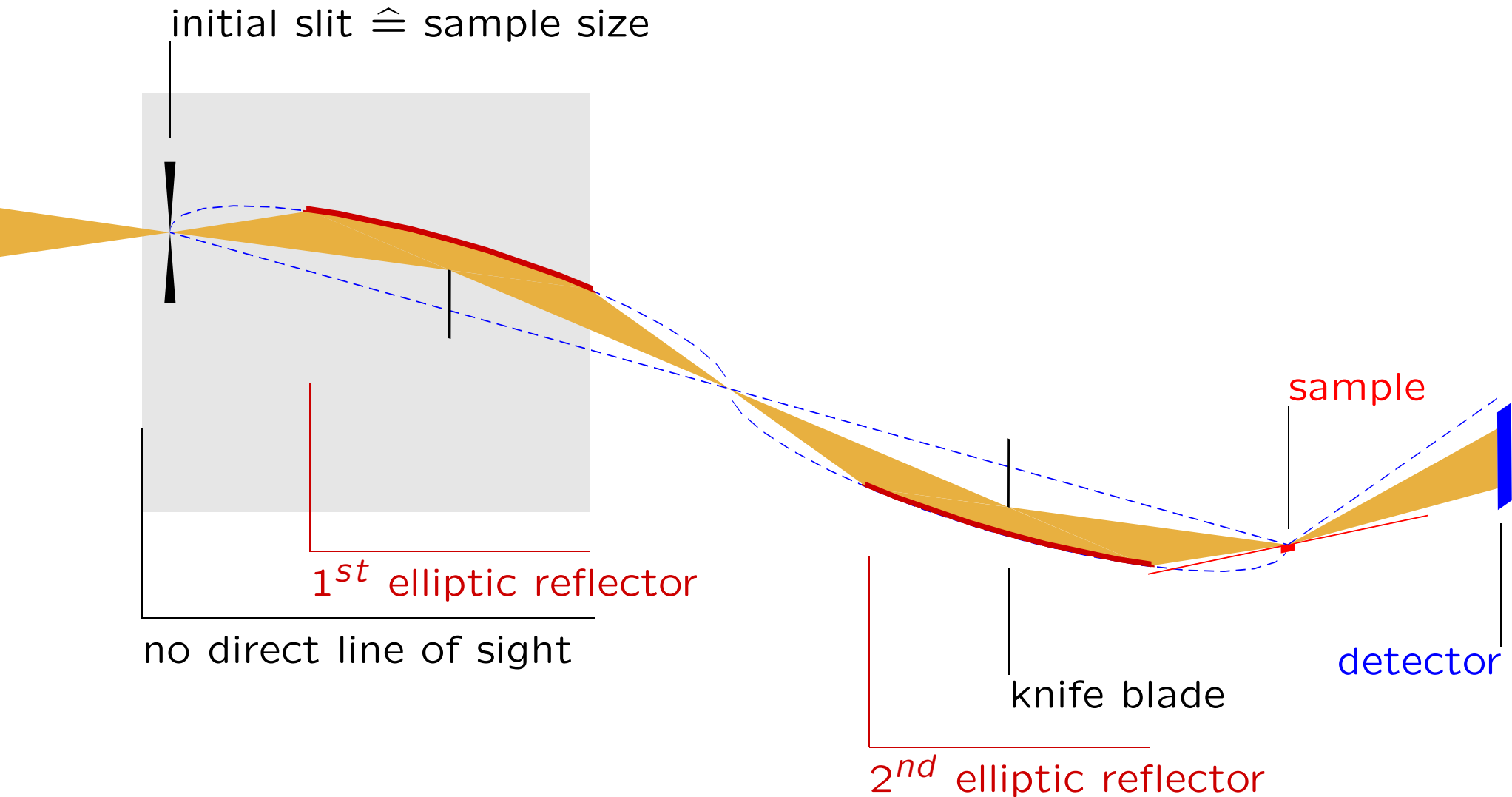
**sample\*** - and **scattering plane**



\* for reflectometry

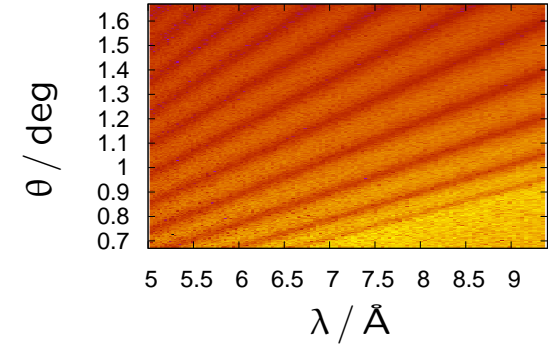
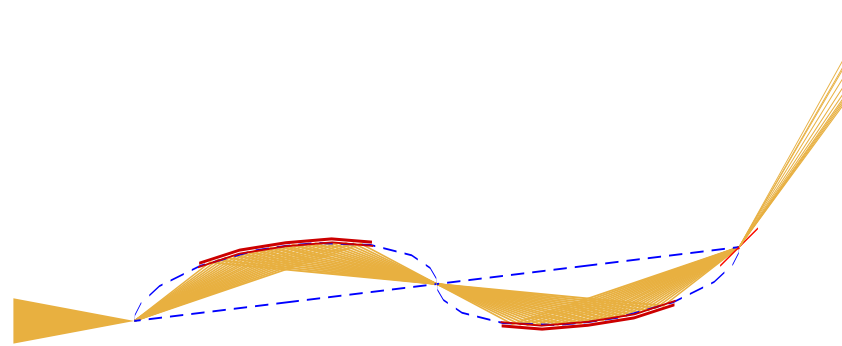
# generic instrument layout

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

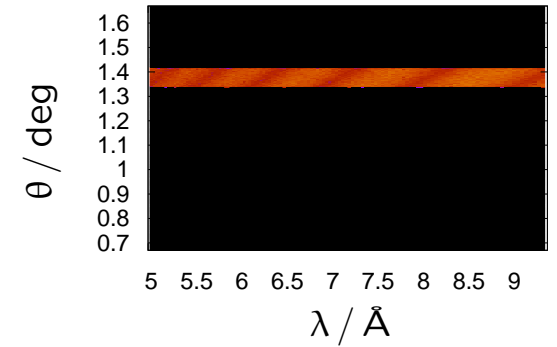
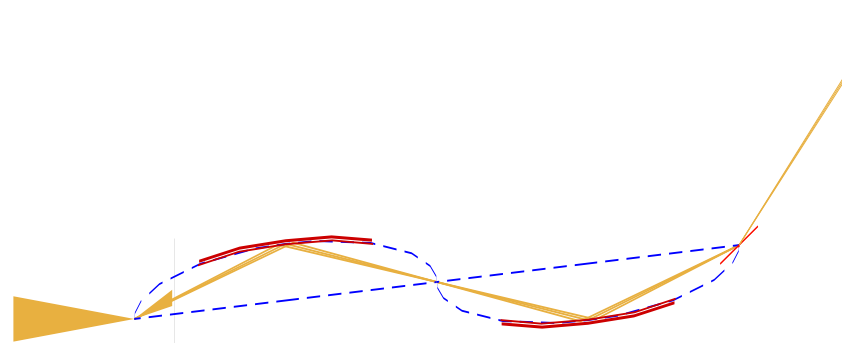


# operation modes for reflectometry

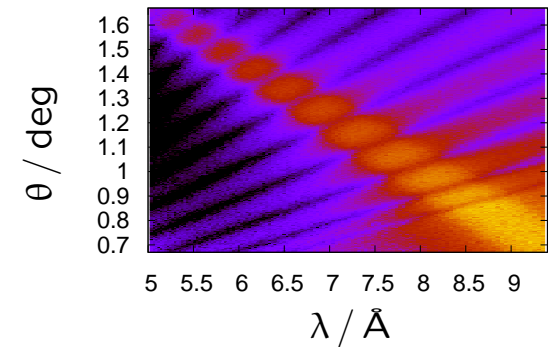
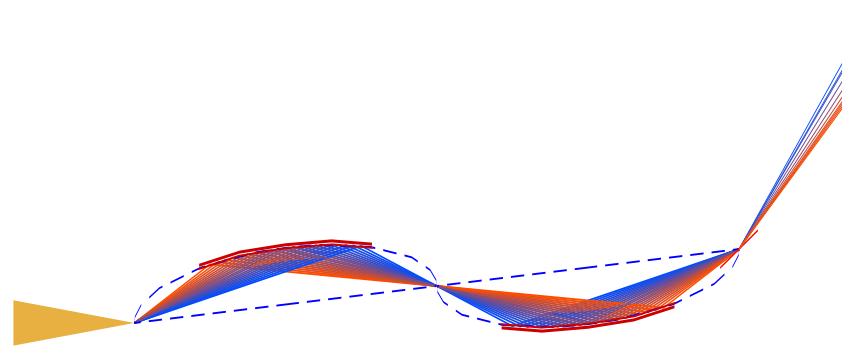
high-intensity  
specular reflectivity



almost conventional  
reflectivity



$\lambda$ - $\theta$  encoding



## prototype

### guides

by *SwissNeutronics*

2 guides

1200 mm each,

made of

2 elements,

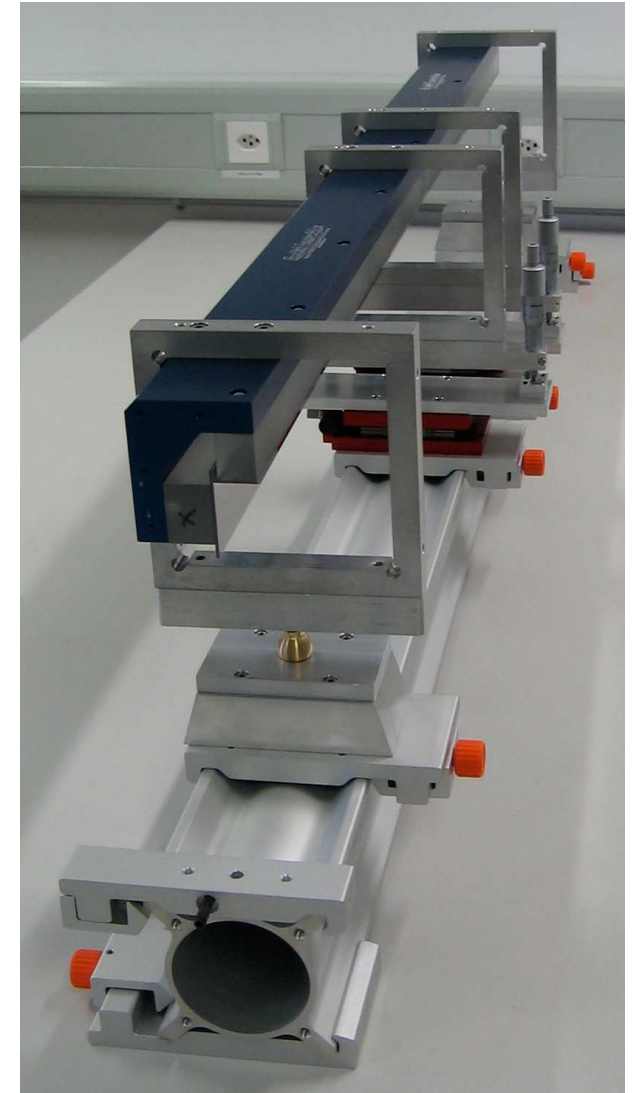
made of

2 elliptically bent reflectors.

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

$a = 1000$  mm

$b/a = 0.0206$



## prototype

### choppers

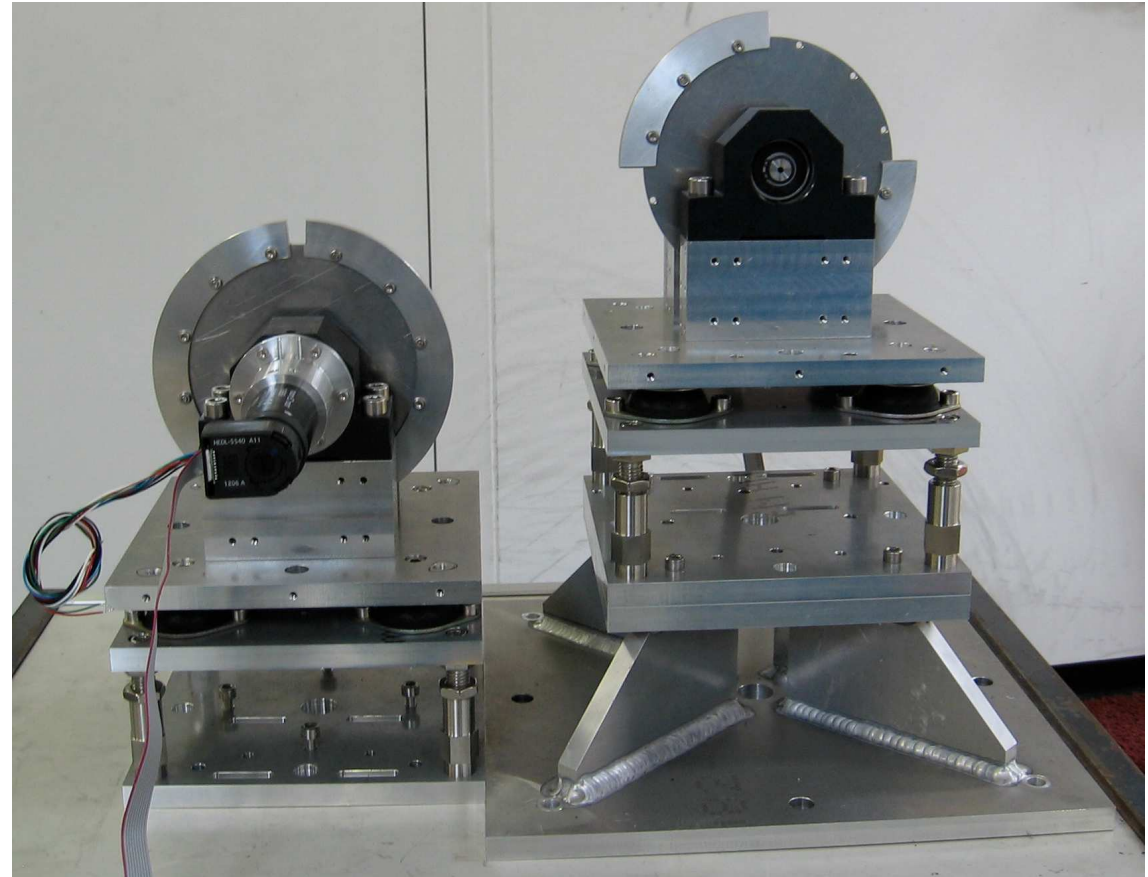
$$\nu = 60 \text{ s}^{-1}$$

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

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

Al:B and Cd absorber

- mimic ESS pulse
- frame-overlap filter



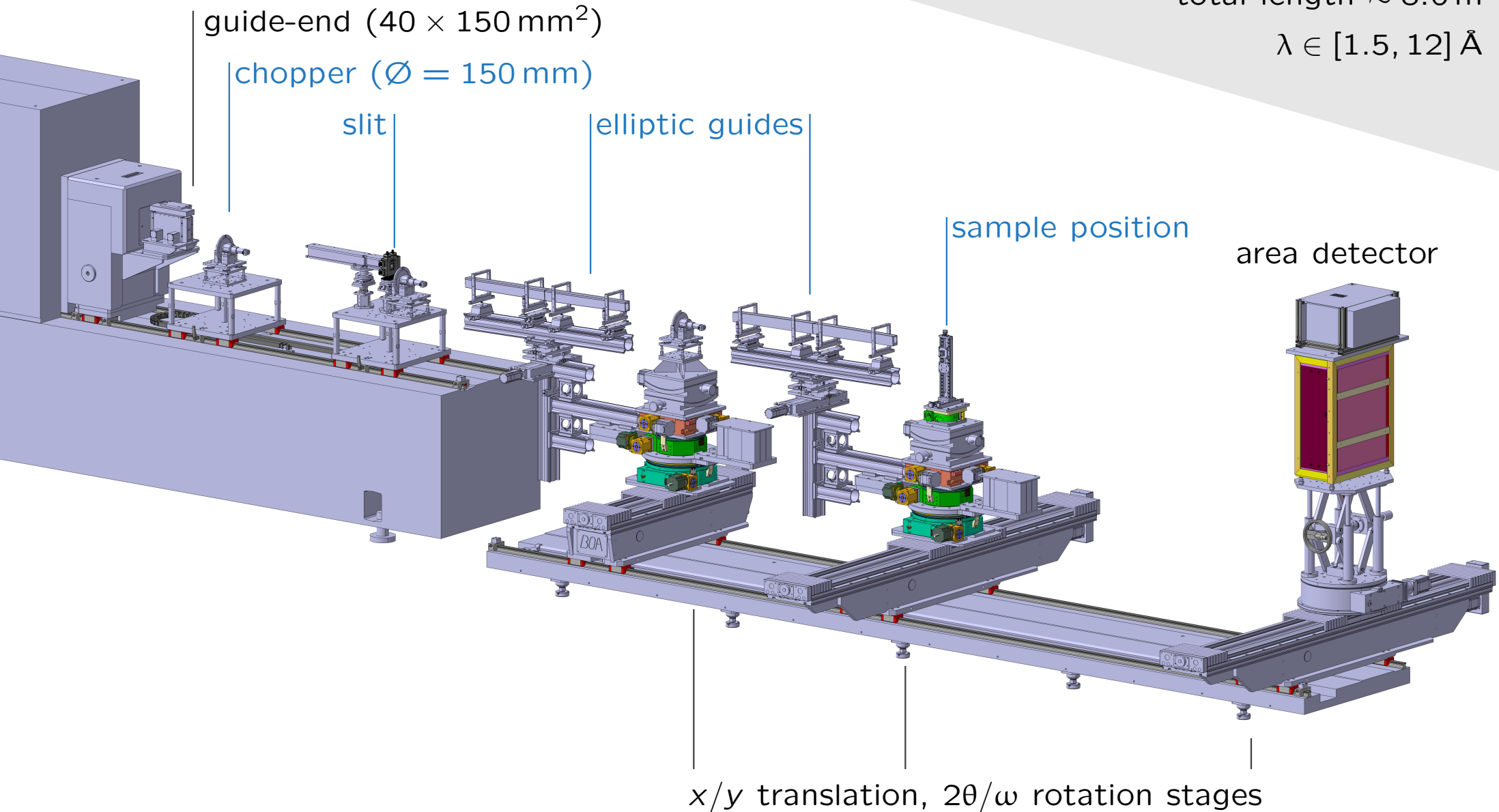
# prototype

## *Selene* BOA

BOA is a test beam line at PSI

total length  $\approx 8.6$  m

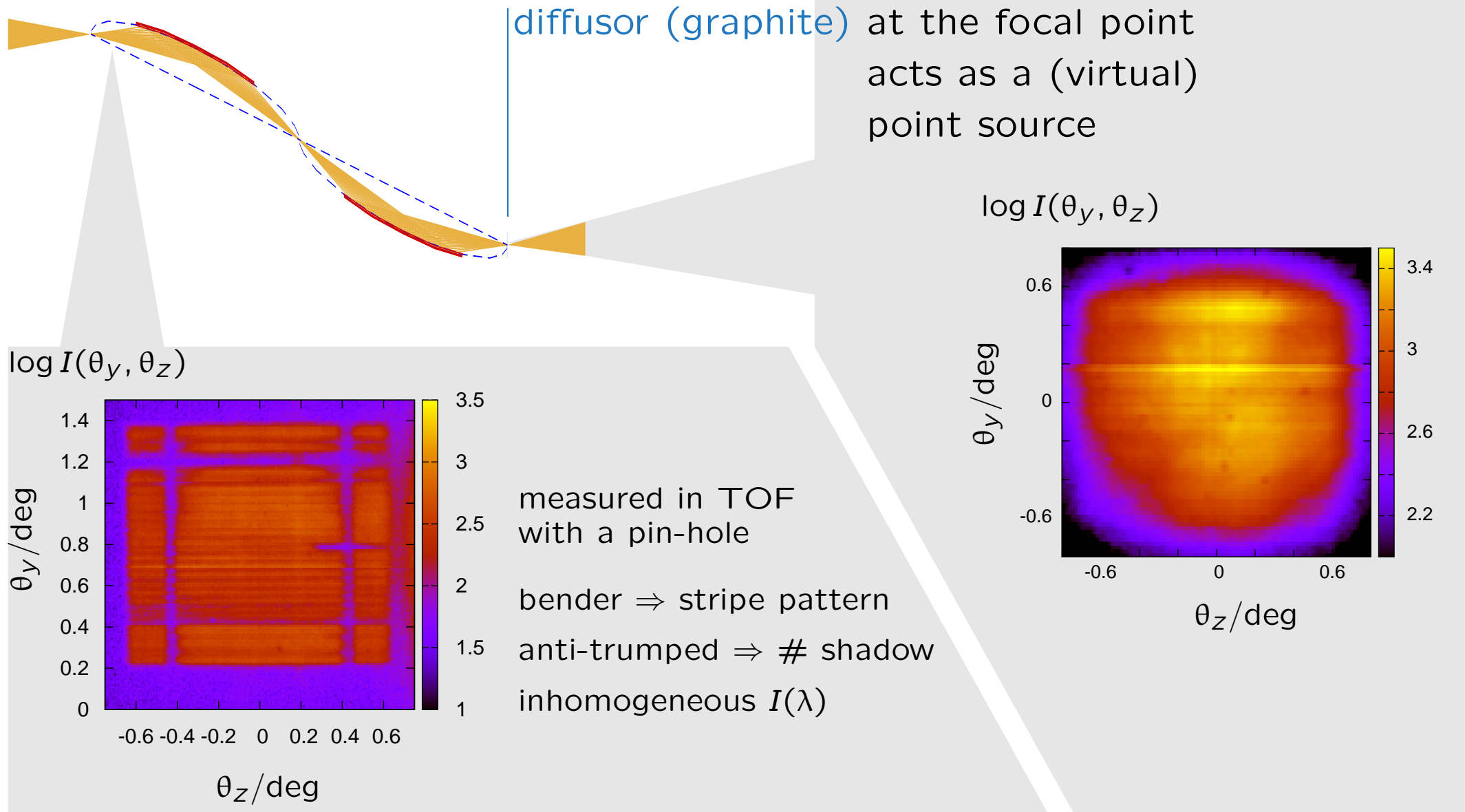
$\lambda \in [1.5, 12]$  Å





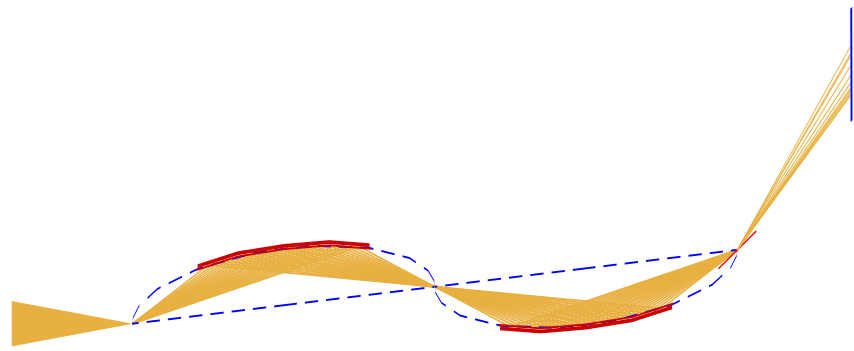
# virtual point source

*Selene*  
**BOA**



# high-intensity specular reflectometry

*Selene*  
**BOA**



Ni (1000Å)/glass  
10 × 10 mm<sup>2</sup>

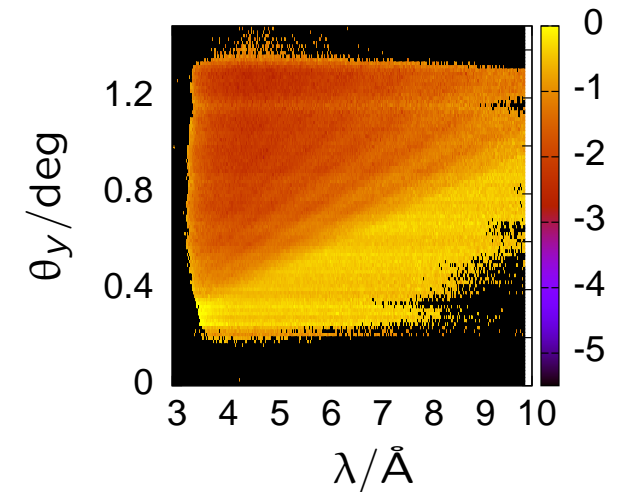
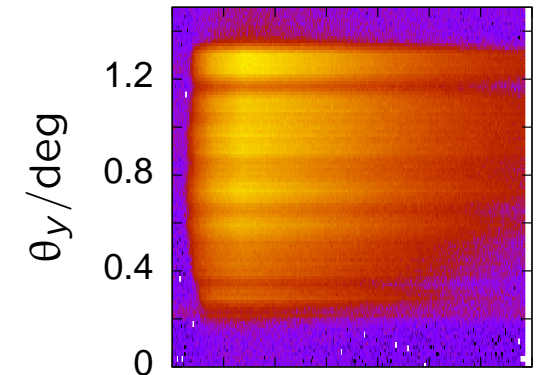
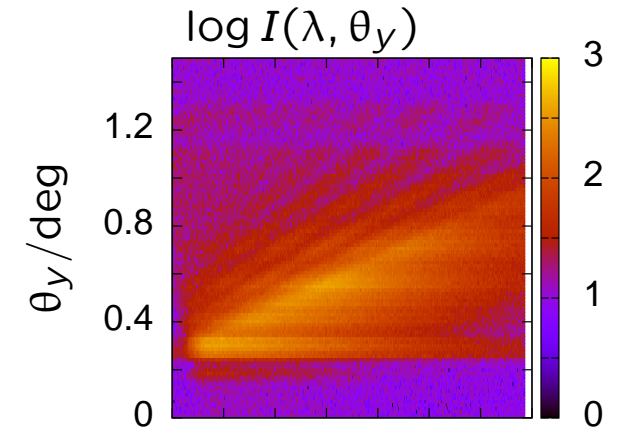
Ni/Ti supermirror  
 $m = 5$

$\lambda$ -range: 3.5 ... 10 Å

beam spot: 1 × 1 mm<sup>2</sup>

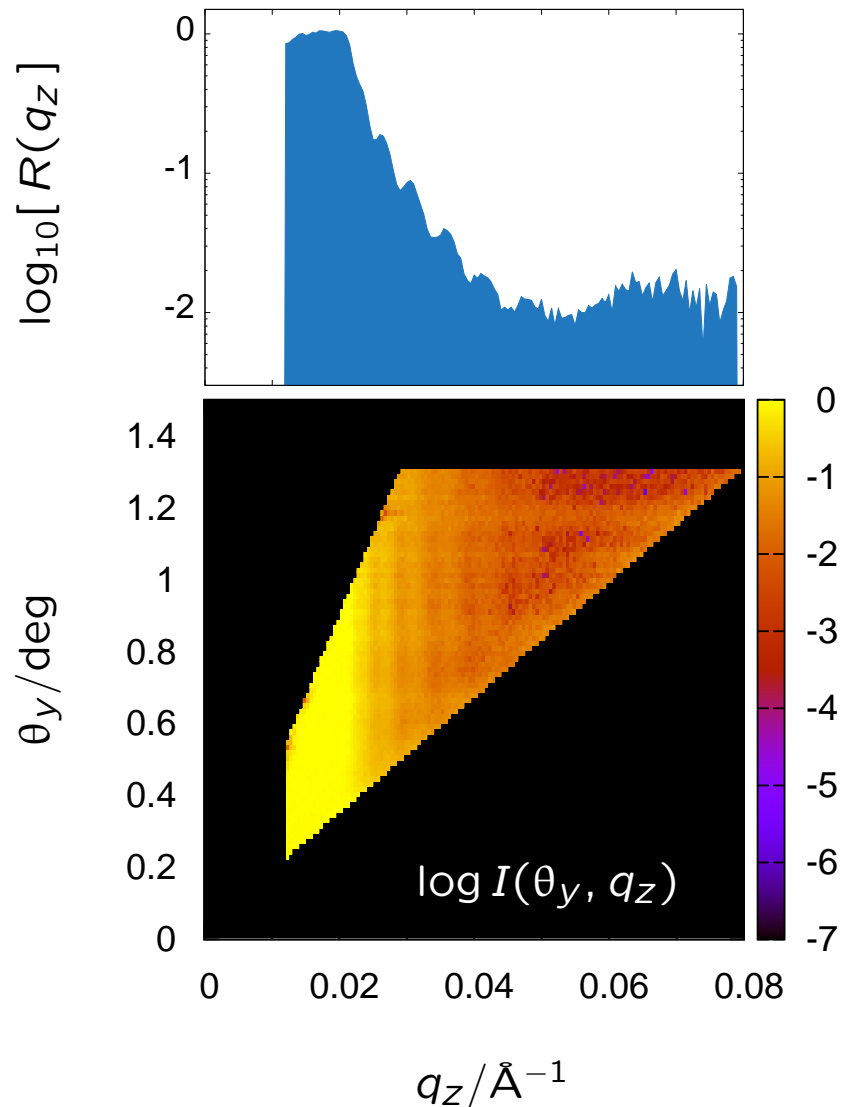
⇒ effective sample size 10 mm<sup>2</sup>

quotient



# high-intensity specular reflectometry

*Selene*  
BOA



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

# high-intensity specular reflectometry

*Selene*  
**Amor**

[LCMO(200 Å)/YBCO(400 Å)]<sub>5</sub>

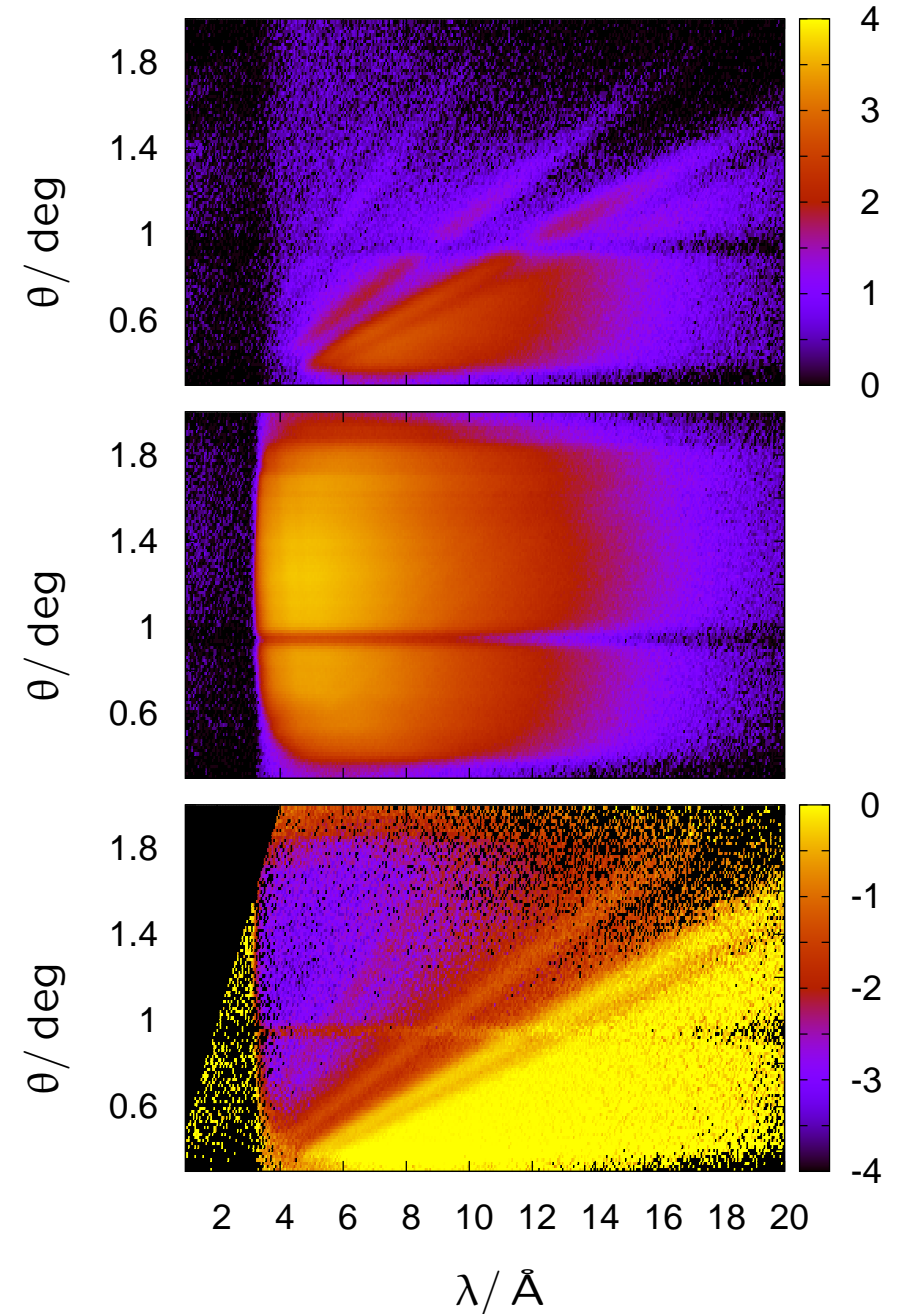
10 × 10 mm<sup>2</sup>

SM

$m = 5$

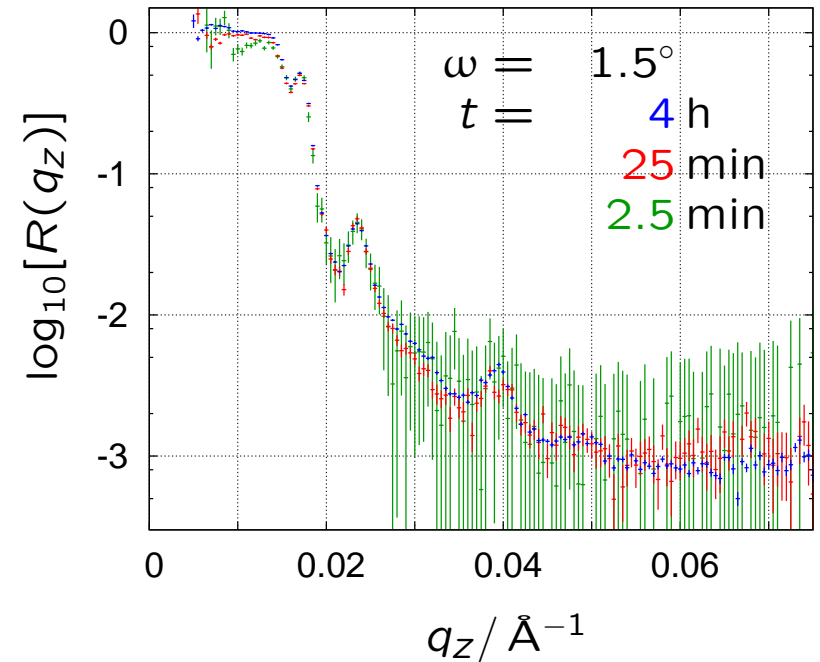
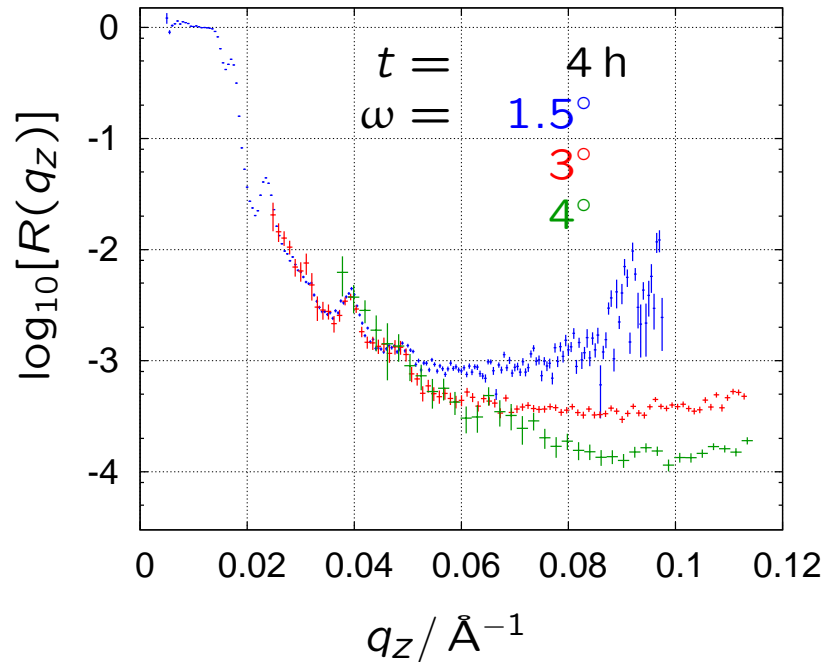
## Amor:

- + own chopper
- + low background
- shielding not adapted
- no horizontal detector offset

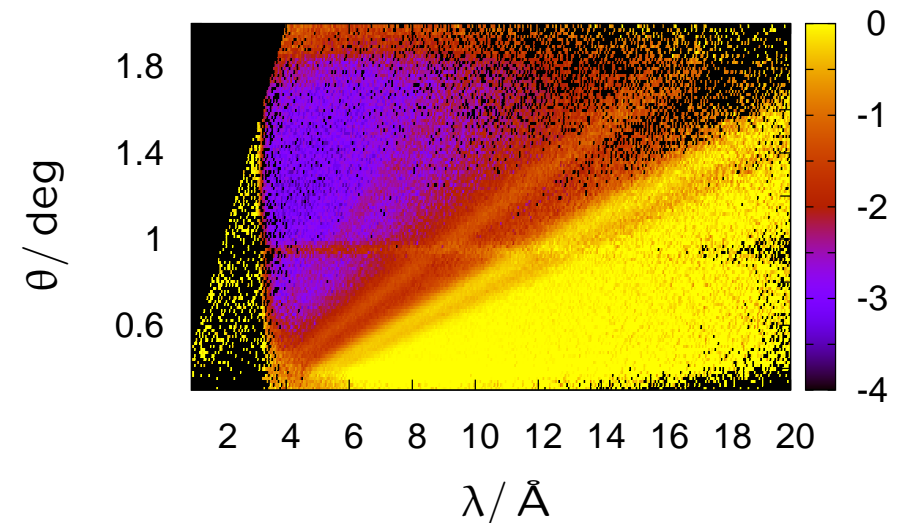


# high-intensity specular reflectometry

*Selene*  
Amor



$0.005\text{ \AA}^{-1} < q_z < 0.05\text{ \AA}^{-1}$   
in 25 min on  $10\text{ mm}^2$  area,  
limited by background  
due to open detector



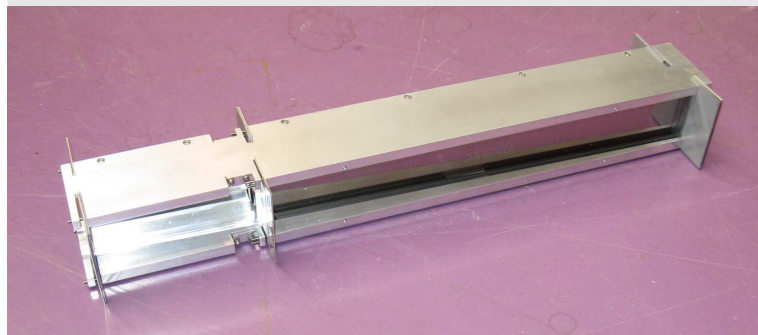
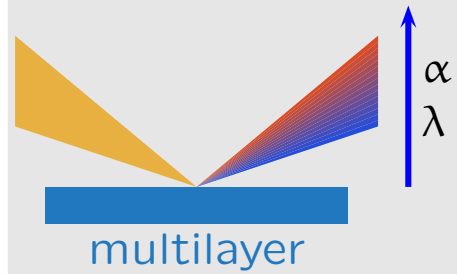
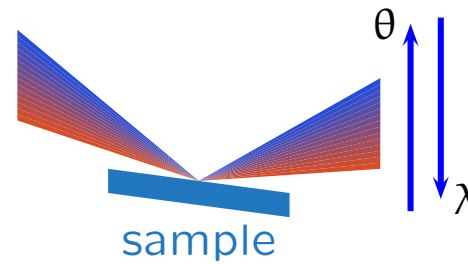
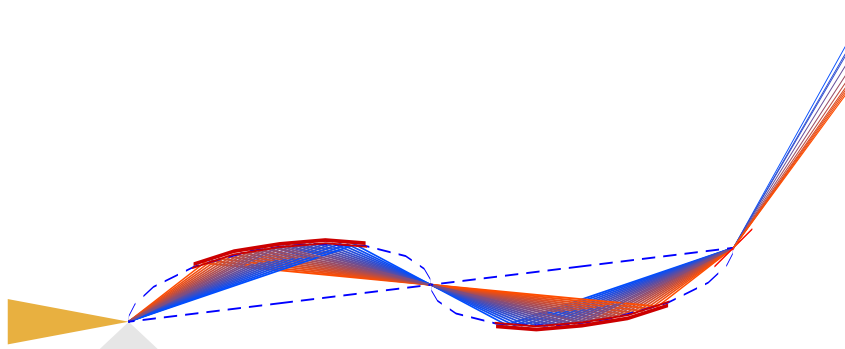
# $\lambda/\theta$ encoding

*Selene*  
**Amor**

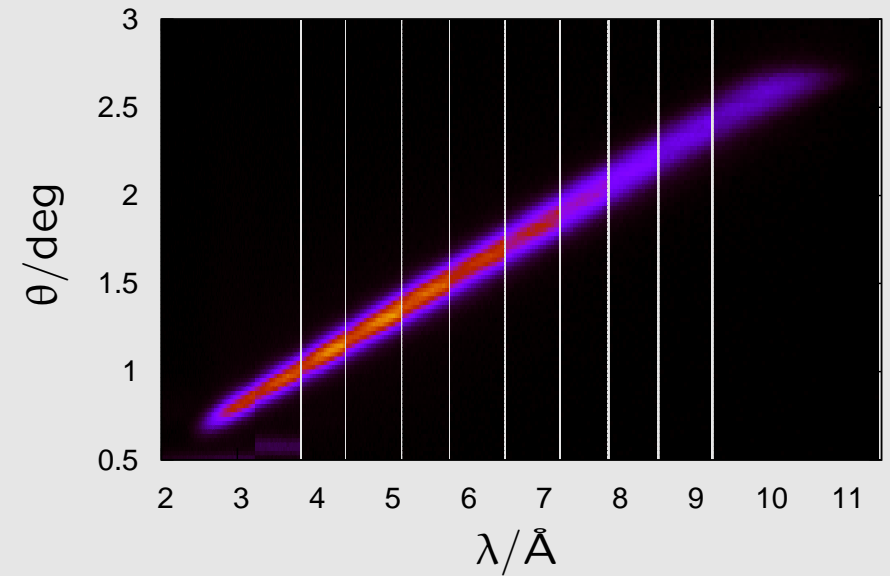
$$\alpha \sim \theta$$

$$\lambda = \lambda(\alpha) = \lambda(\theta)$$

$$\Rightarrow q_z = q_z(\theta)$$



$I(\lambda, \theta)$  measured on Amor



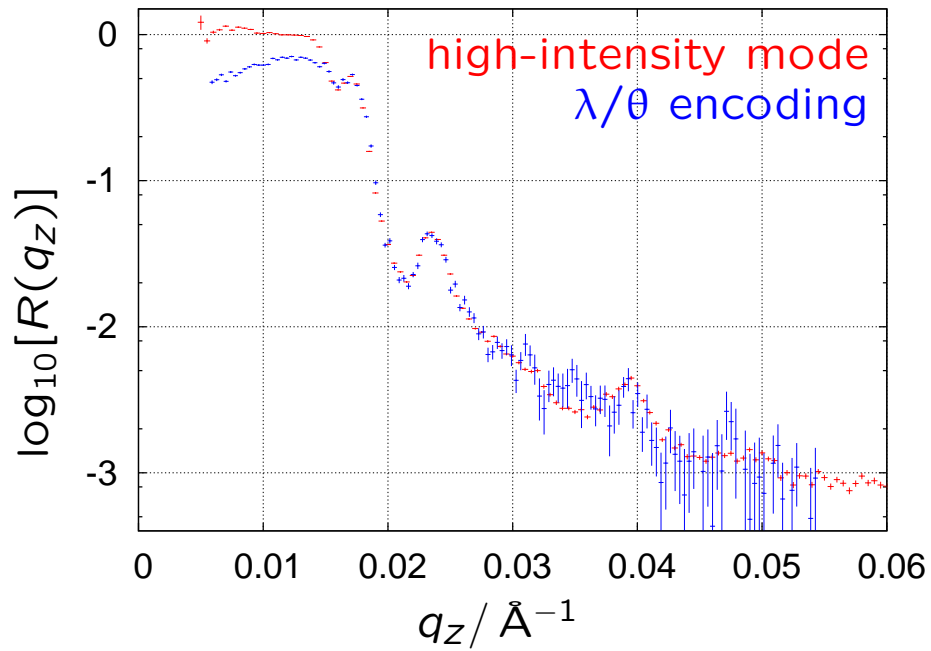
double ML monochromator

$\lambda/\theta$  encoding

*Selene*  
Amor

[LCMO(200 Å)/YBCO(400 Å)]<sub>5</sub>

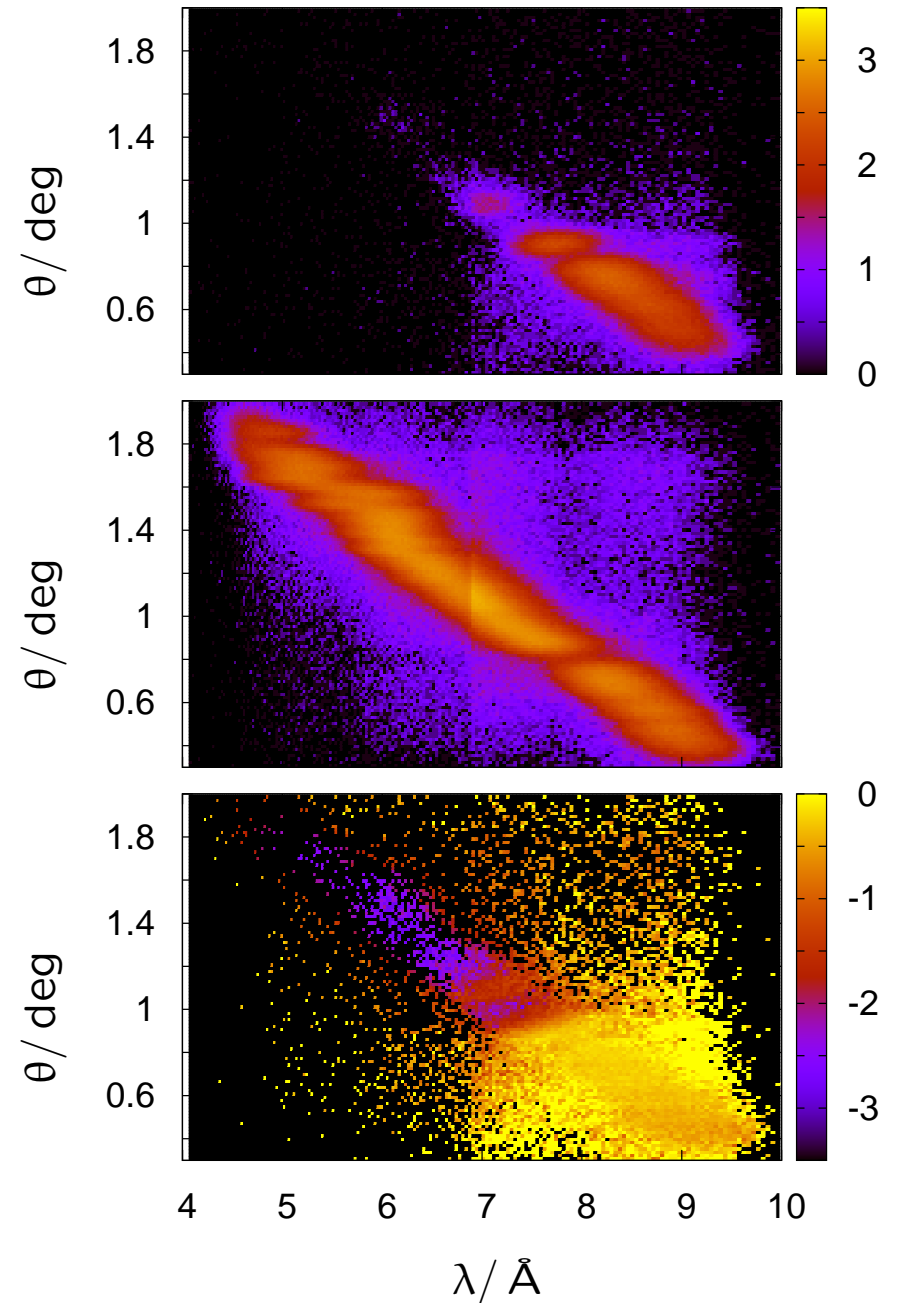
10 × 10 mm<sup>2</sup>



SM  
 $m = 5$

problems of data-analysis:

- absolute error of 0
- guide waviness



## discussion

### **general limits** of *Selene* guides

- $\lambda > 3 \text{ \AA}$
- max. spot-size / guide-length  $\approx 5 \cdot 10^{-4}$   
i.e. 1 cm / 20 m

### **technical limits** (to be pushed)

- guide waviness too high for  $\lambda/\theta$  encoding
- sample alignment has to be improved

### **successes**

- + guide quality sufficient for high-intensity reflectometry and conventional reflectometry
- + successfully applied to real samples

### **next steps**

- polarisation &  $\lambda$ -filter
- mechanical modification of Amor