



the
Swiss-Danish Instrument Initiative
presents

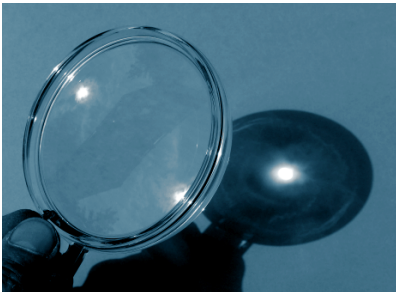
Estia
Εστία

a

focusing reflectometer for small samples

based on the

Selene guide concept



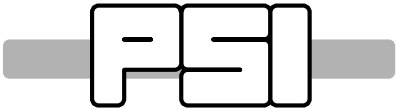
J. Stahn



the
Swiss-Danish Instrument Initiative
for reflectometry are

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Paul Scherrer Institut, Switzerland



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University of Copenhagen, Denmark

M. Cardenas

U. Bengaard Hansen



SYDDANSK UNIVERSITET
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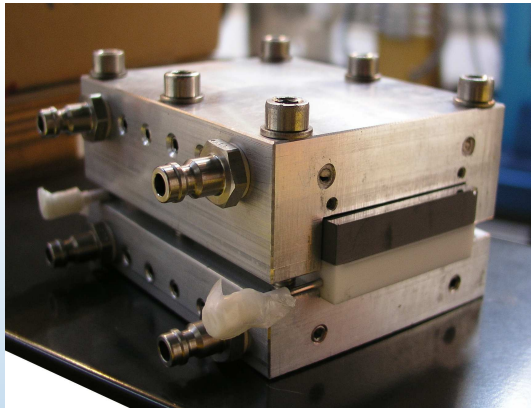
University of Southern Denmark

B. Klösger

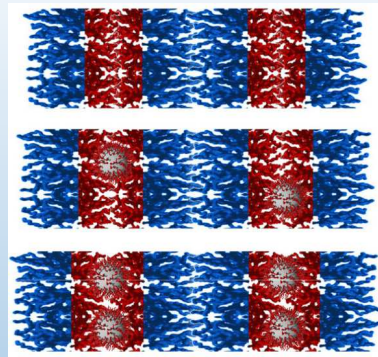
science case

depth-profiling of structural and magnetic densities

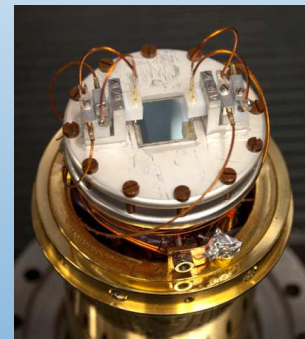
lateral structures close to surfaces



organic films at a solid liquid interface

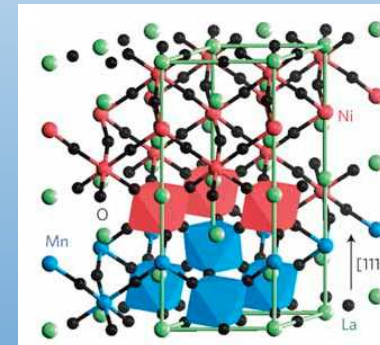


laterally structured (organic) films



functional devices

magnetic heterostructures



instrument

key parameters

sample size $1 \times 1 \text{ mm}^2$
to $10 \times 50 \text{ mm}^2$

horizontal scattering plane

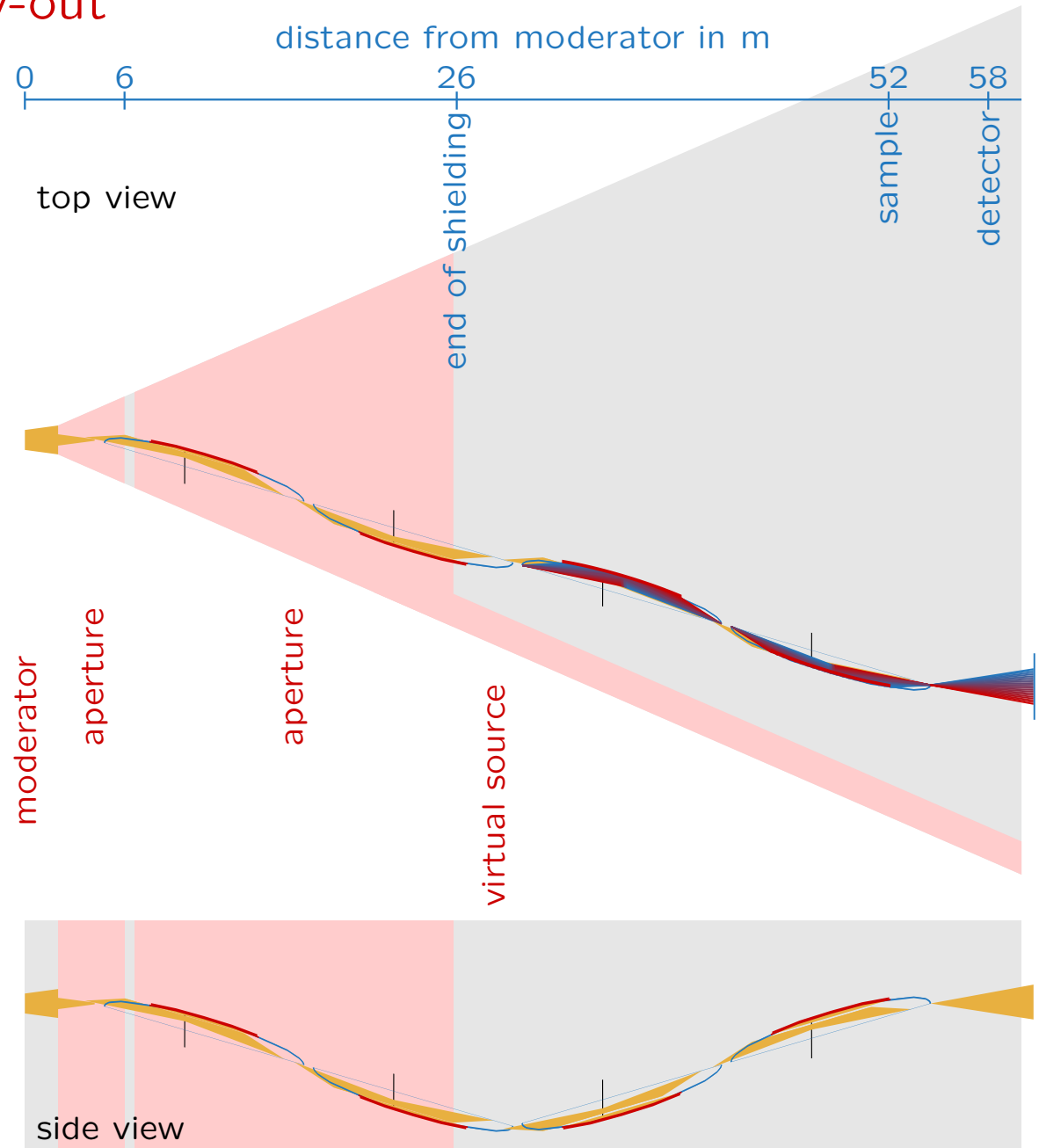
intrinsic resolution 2 to 4%

polarisation option

low background

truly focusing

lay-out



instrument

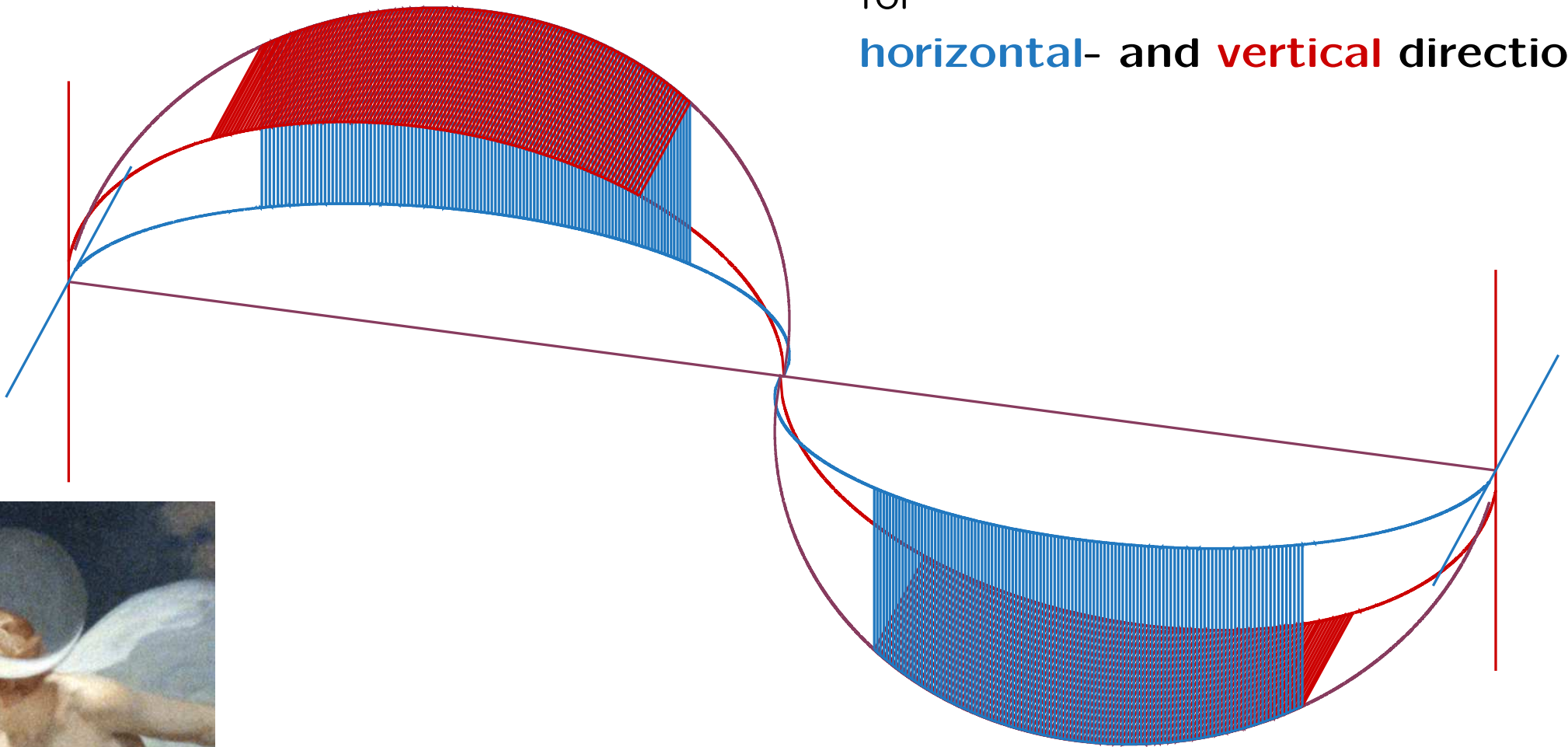
point-to-point focusing

with

2 subsequent elliptical reflectors

for

horizontal- and vertical direction



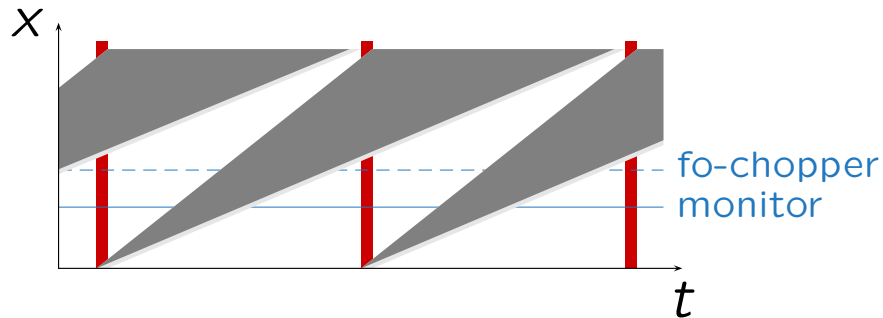
Selene guide concept

instrument

shielding concept

direct view: 14 m
indirect view: 26 m

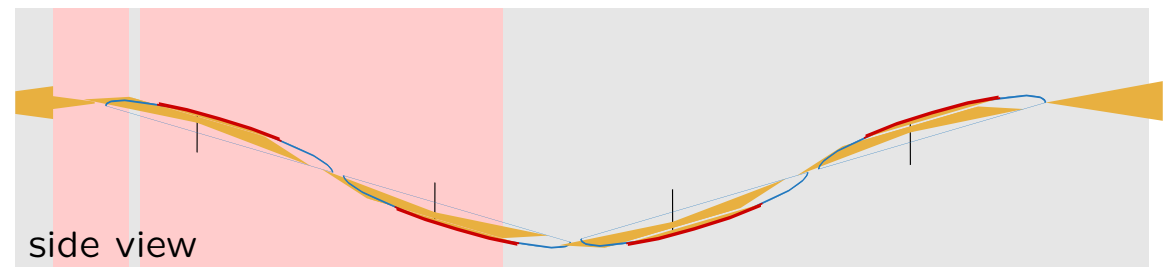
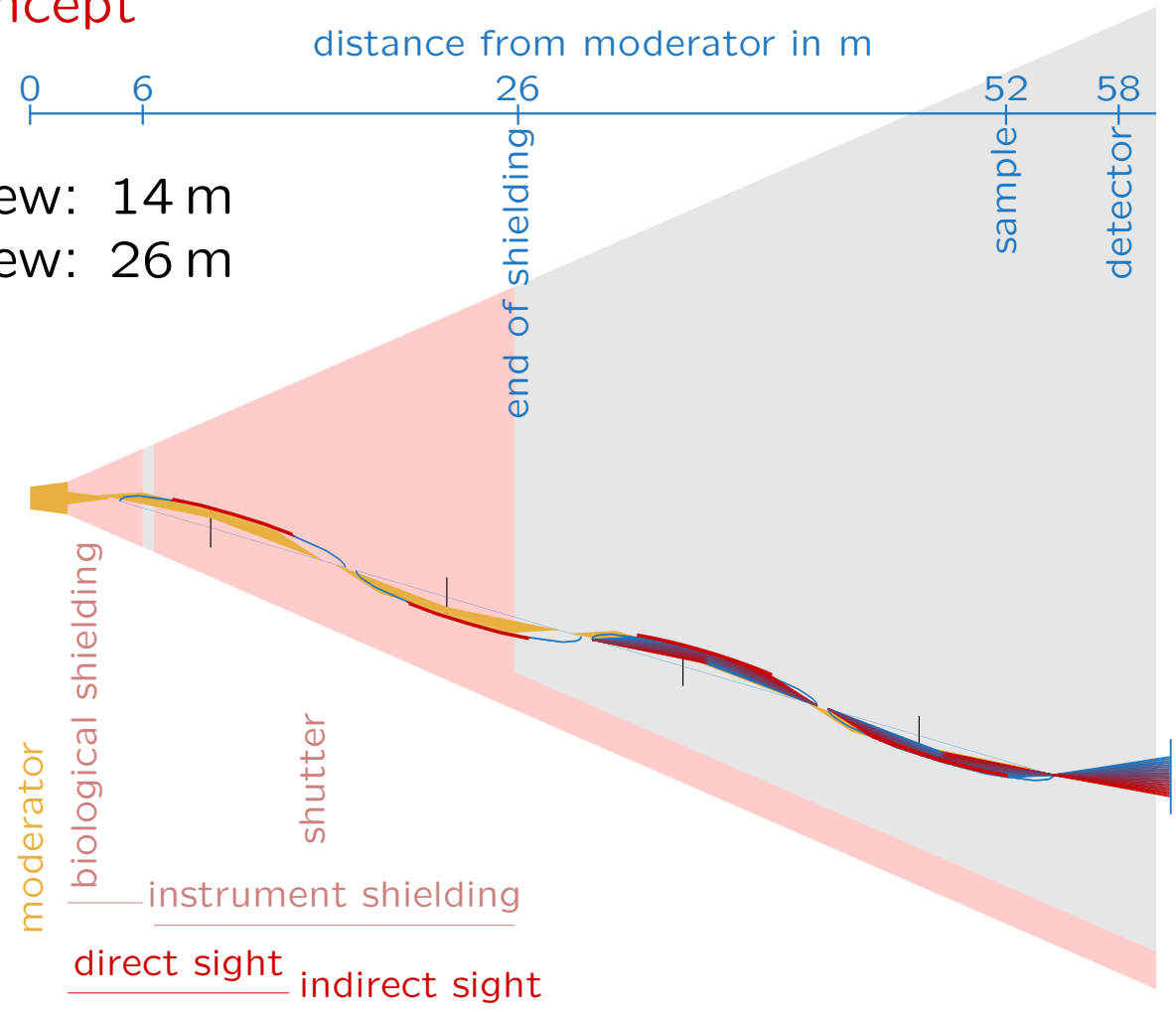
time regime



$$\lambda \in [5, 9.4] \text{ \AA}$$

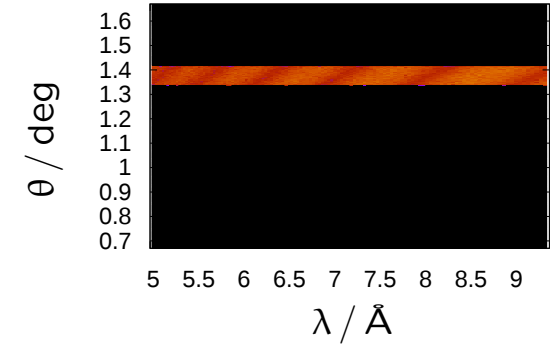
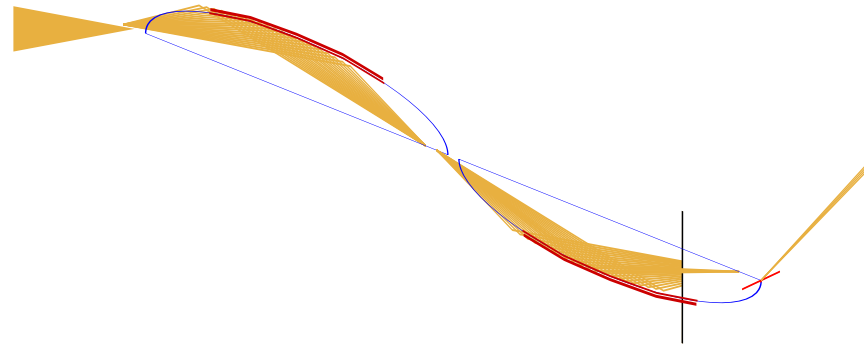
$$\Delta\theta_{xy} = 1.5^\circ$$

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



operation modes

almost conventional



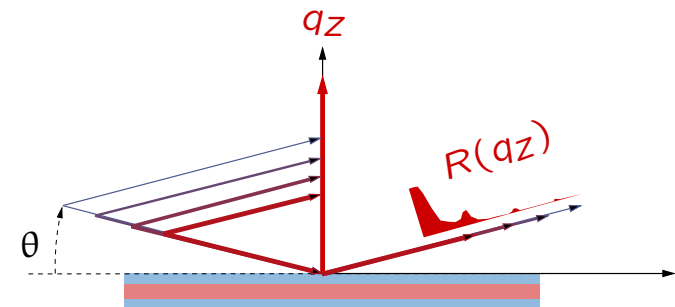
convergent beam

defined footprint

defined divergence

medium resolution ($\approx 5\%$)

specular & off-specular reflectometry



operation modes

almost conventional

convergent beam

defined footprint

defined divergence

medium resolution ($\approx 5\%$)

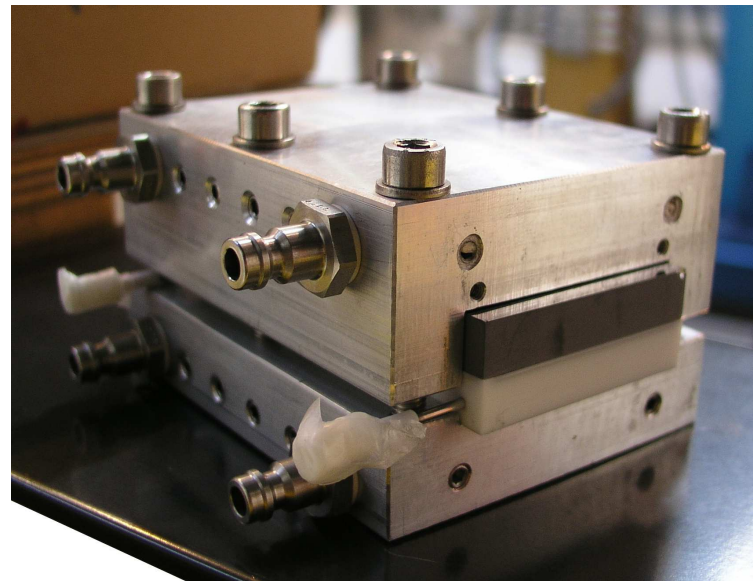
specular & off-specular reflectometry

liquid interfaces

e.g. solid-liquid cell

avoid gasket & trough walls

restrict to a homogeneous area



operation modes

almost conventional

convergent beam

defined footprint

defined divergence

medium resolution ($\approx 5\%$)

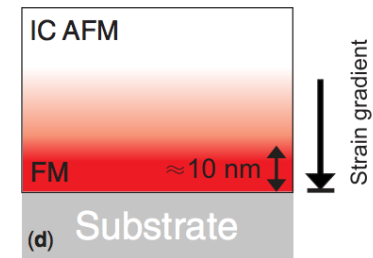
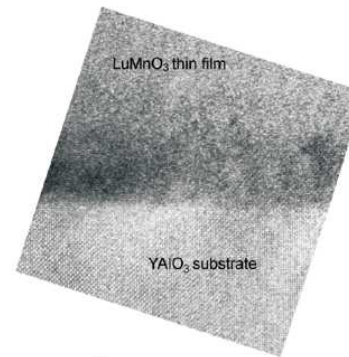
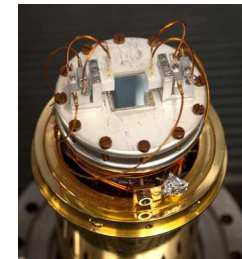
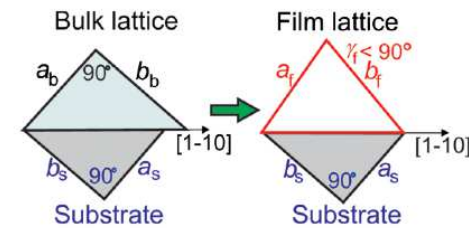
specular & off-specular reflectometry

multiferroics

strain induced FM in
multiferroic AFM LuMnO_3

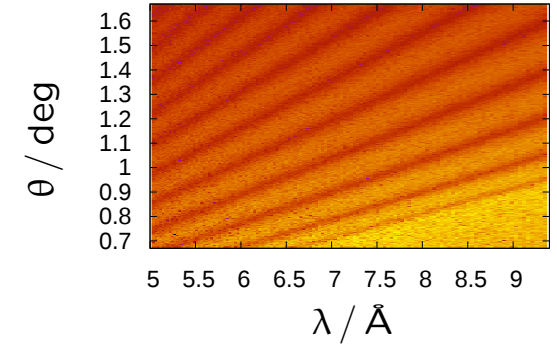
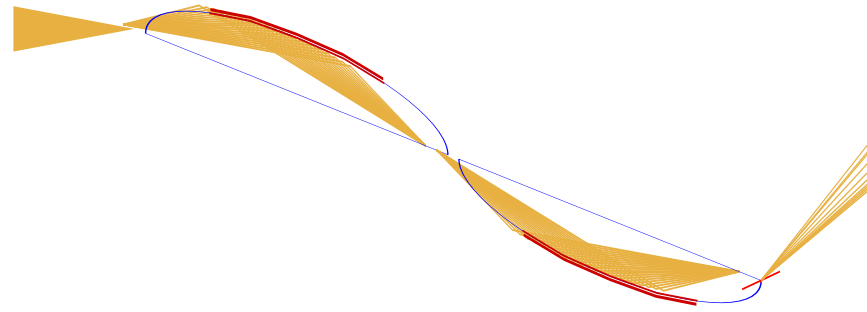
J. White et al.

PRL **111**, 037201 (2013)



operation modes

high-intensity specular reflectivity



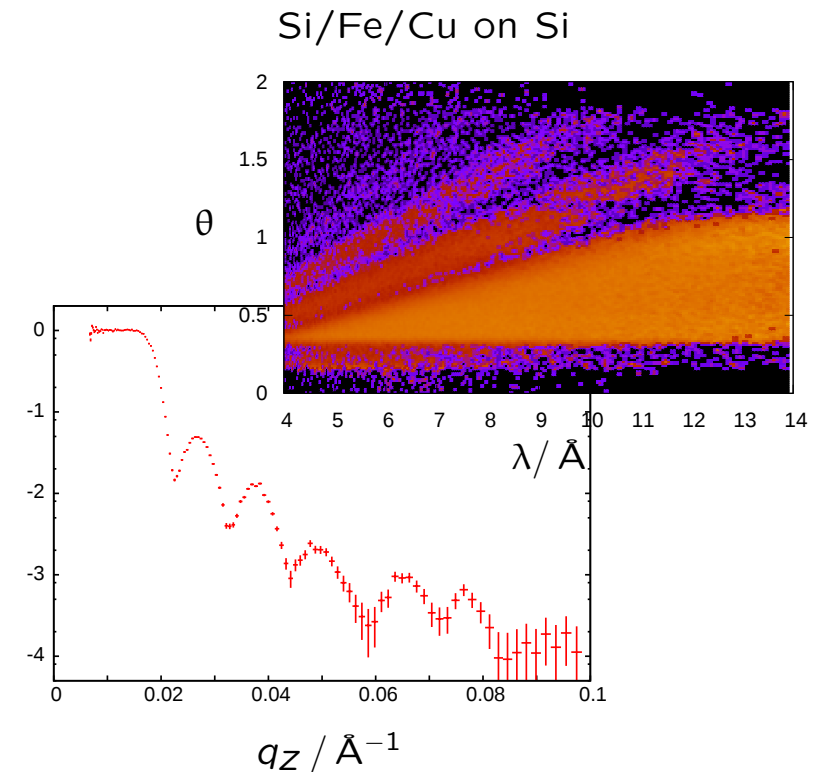
trading off-specular resolution for intensity

⇒ complex resolution function

quick & dirty way to scan a phase diagram

time-resolved studies

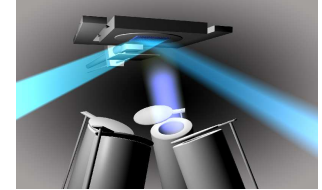
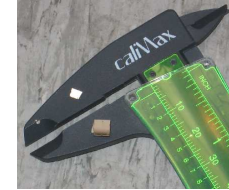
tiny samples



operation modes

high-intensity specular

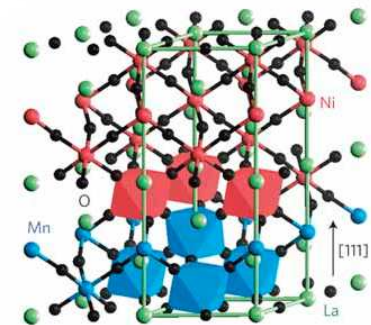
novel electronic phases
at interfaces



exchange bias in LaNiO_3 (PM) / LaMnO_3 (FM)
superlattices

M. Gibert et al.

nature materials **11**, 195198 (2012)



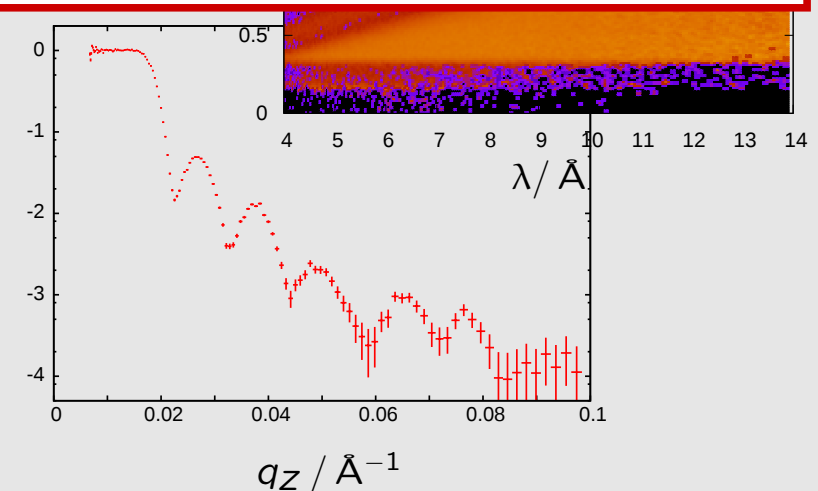
trading off-specular re

⇒ complex resolution

quick & dirty way to scan a phase diagram

time-resolved studies

tiny samples



operation modes

high-intensity specular reflect

trading off-specular resolution

⇒ complex resolution function

quick & dirty way to scan a

time-resolved studies

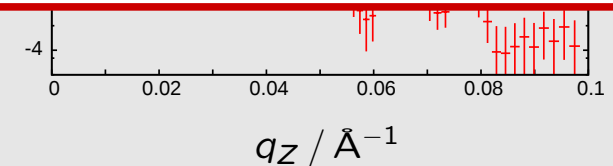
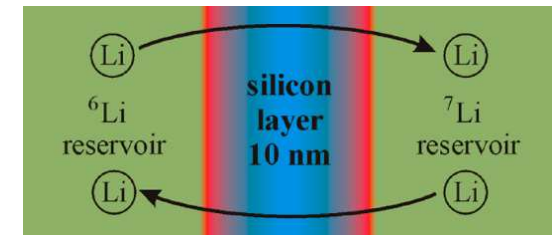
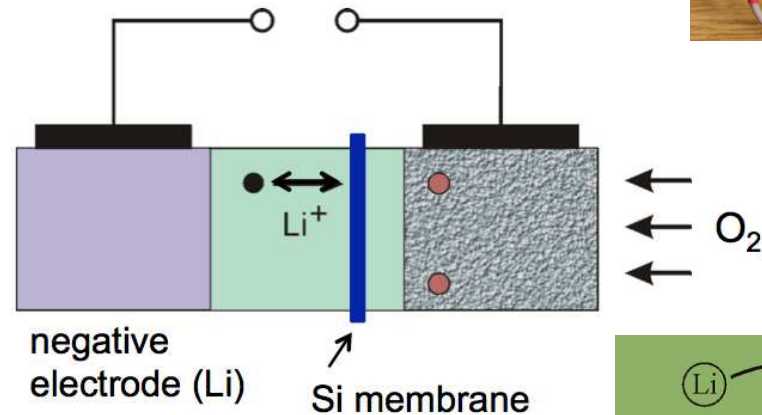
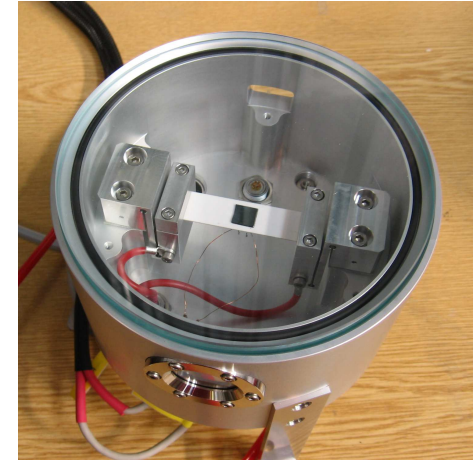
tiny samples

interdiffusion

Li diffusion through a thin Si layer

E. Huger et al.

Nano Lett. **13**, 1237 (2013)

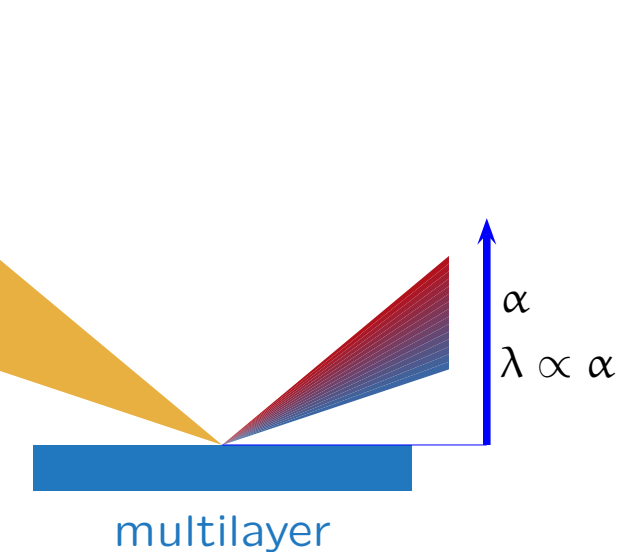


9

14

operation modes

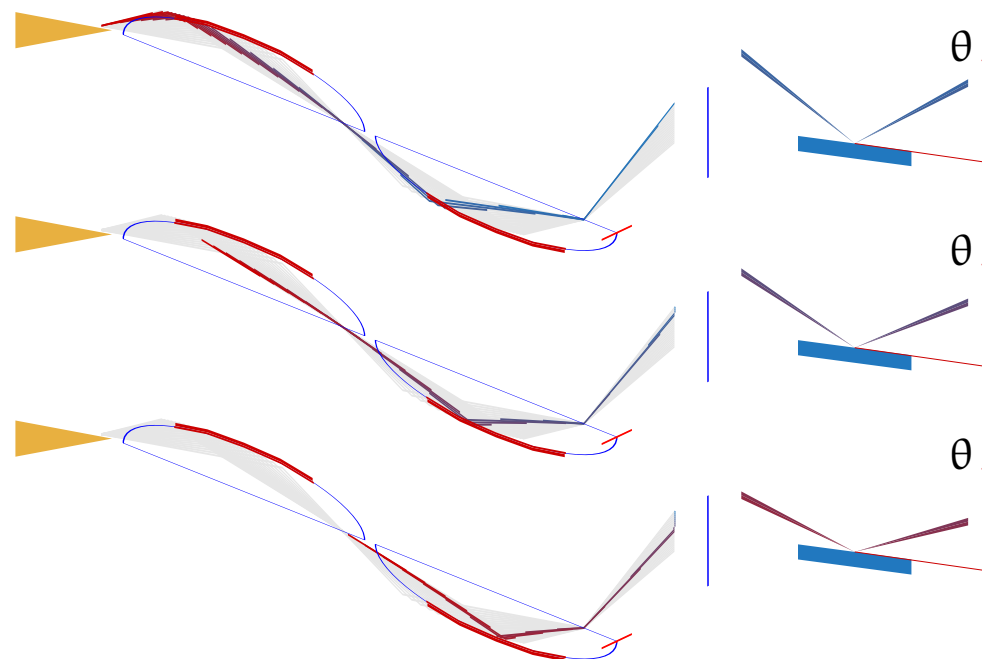
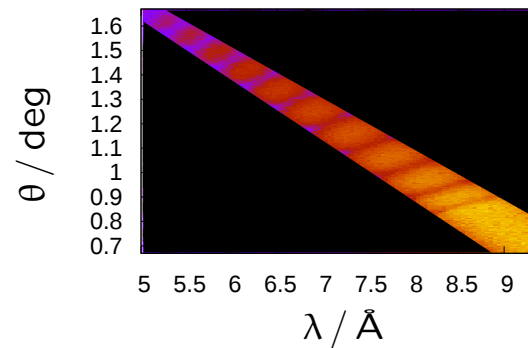
λ - θ encoding



spectral analysis of the white beam

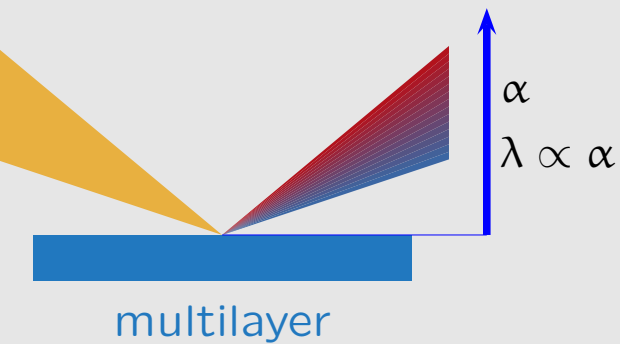
constant $\Delta q/q$

wide q_z -range



operation modes

λ - θ encoding

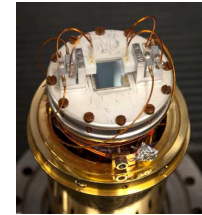


spectral analysis of the w

constant $\Delta q/q$

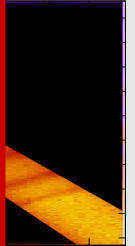
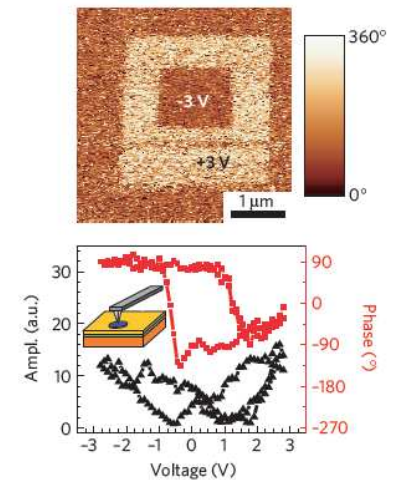
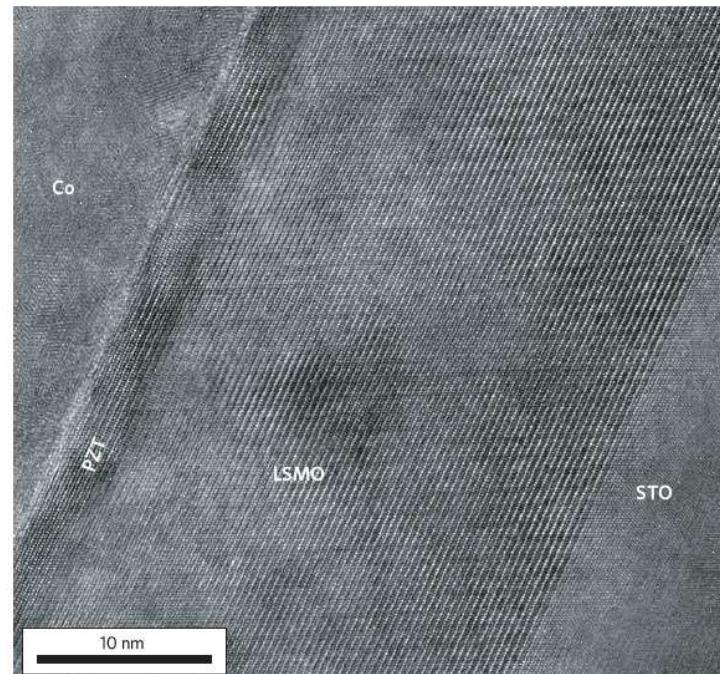
wide q_z -range

functional devices

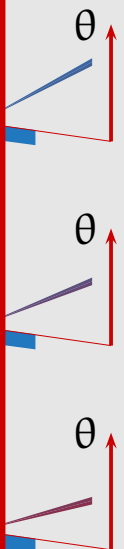


electrical switching of spin polarisation
D. Pantel et al. *nature materials* **11**, 289 (2012)

active area $< 50 \times 50 \mu\text{m}^2$



8.5 9



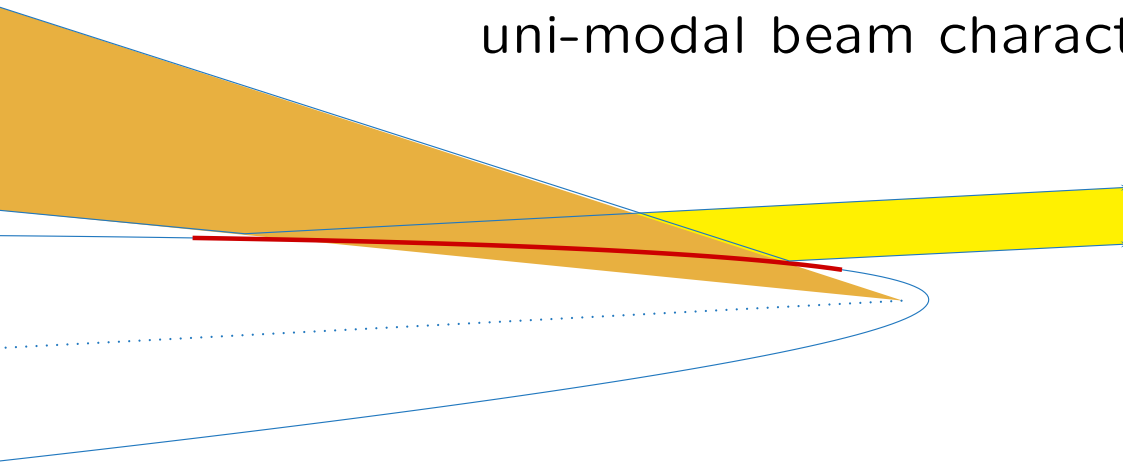
operation modes

parallel beam

by reflection on a **parabolic** mirror

tunable divergence and beam size

uni-modal beam characteristics

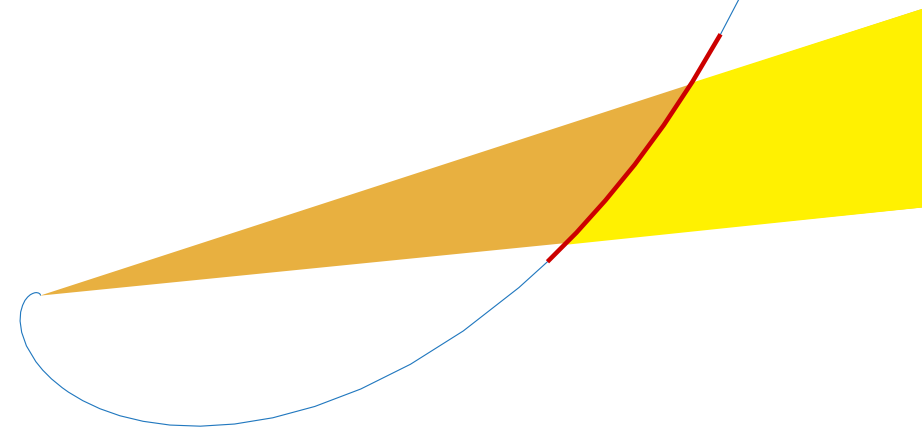


for
laterally structured samples
(GISANS)

polarisation

by selective reflection

on a **log-spiral** mirror



constant angle of incidence

low- m coating $\Rightarrow$ high P

operation modes

parallel beam

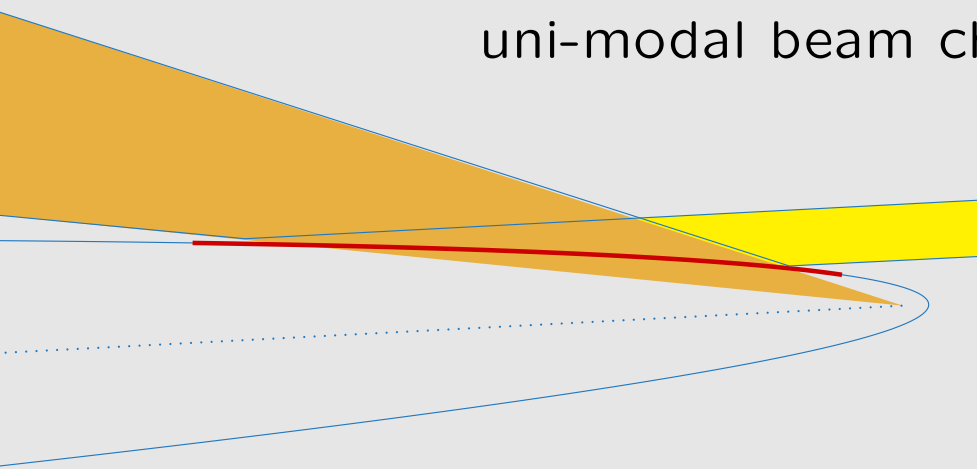
by reflection on a **parabolic** mirror

tunable divergence and

uni-modal beam ch

polarisation

by selective reflection



for

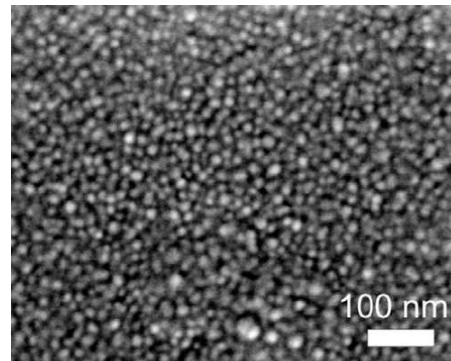
laterally structured samples

(GISANS)

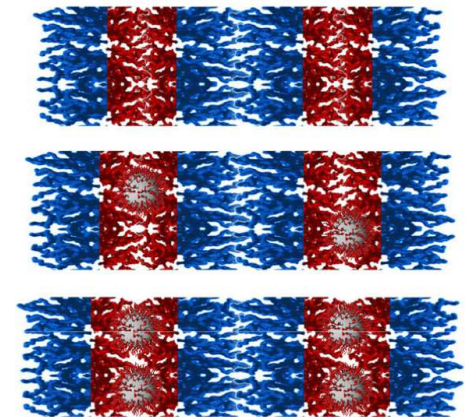
structured surfaces

nanostructured diblock copolymer
films with embedded magnetic
nanoparticles

Xin Xia et al. J. Phys. **23**, 254203 (2011)



SEM image

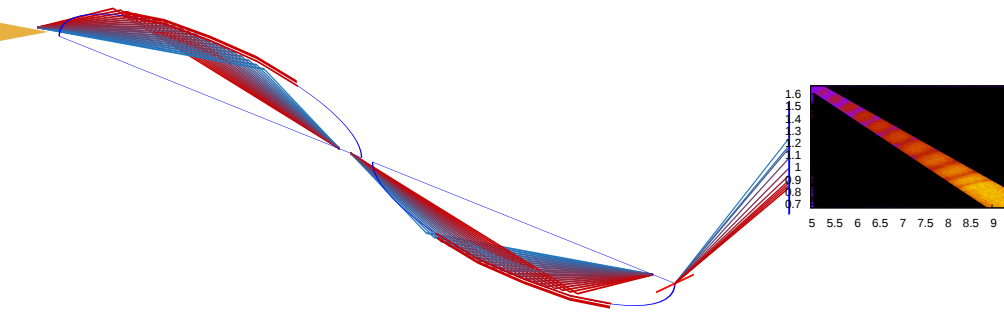


low- m coating $\Rightarrow$ high P

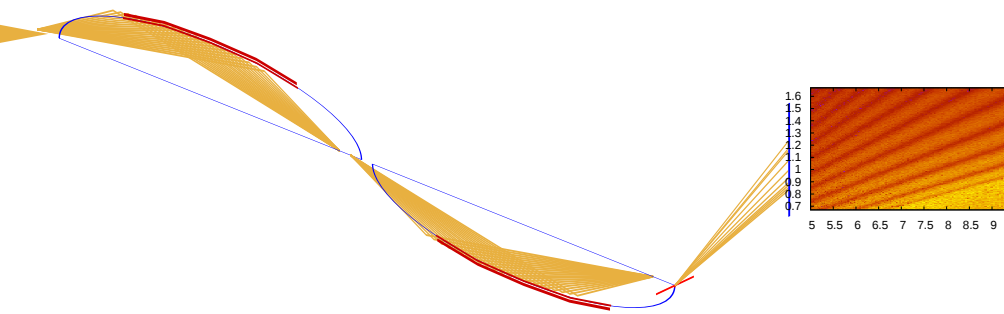
performance

obtained by McStas simulations

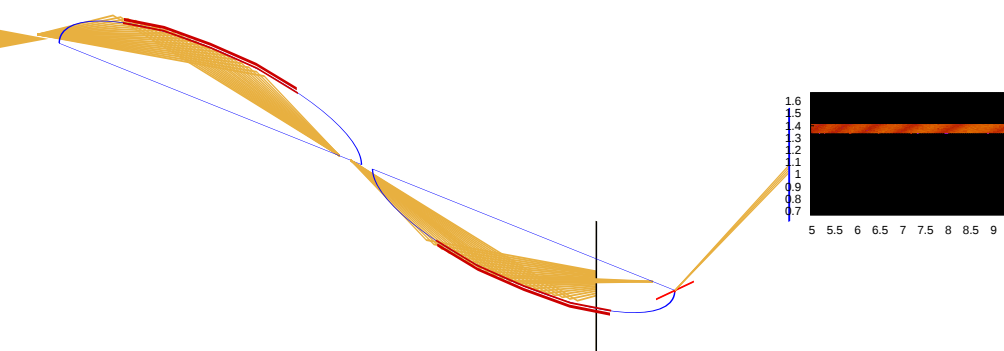
λ - θ encoding



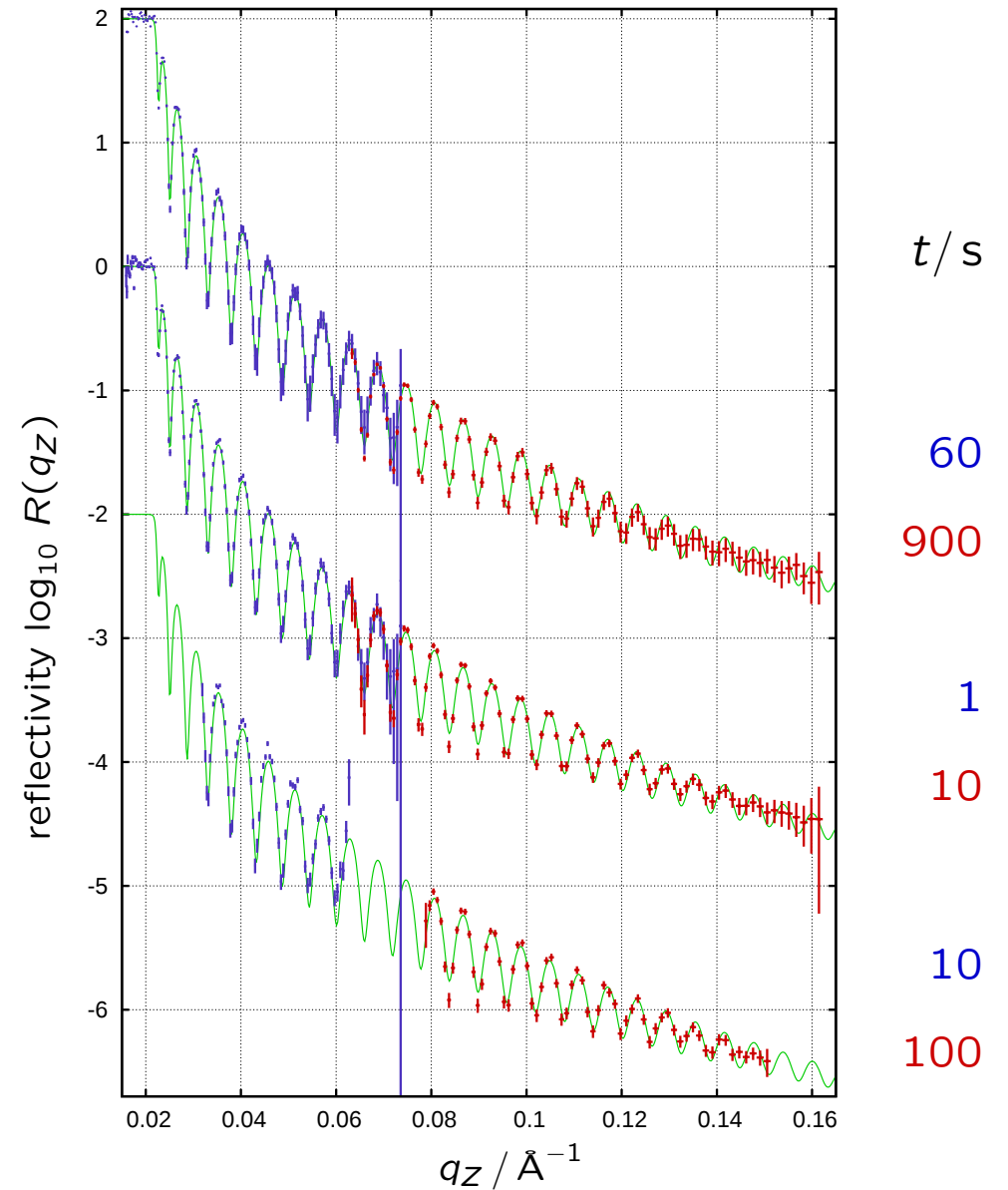
high-intensity specular reflectivity



almost conventional



1000 Å Ni on glass ($5 \times 5 \text{ mm}^2$)





Estia
Εστία

