

Selene-type reflectometer for small samples



aim:

use flux-gain and time-structure of the ESS to open access to reflectometry on surfaces in the sub-mm² range (in addition to reflectometry on cm² samples)

approach:

use a *Selene* type guide in horizonatl and vertical direction to focus the beam on a defined footprint (→ poster 1/4)

favoured applications:

- small samples (1 × 1 mm²)
- curved or bent surfaces
- spatially inhomogeneous samples
- restricted area on contacted or functional multilayers

also possible:

- moderately sized samples as on current instruments
- solid/liquid cells
- focusing GISANS (with larger sample surfaces)
- diffraction

key parameters & features:

sample area	0.3 × 0.3 mm ² to 20 × 20 mm ²
λ range	3 Å to 9 Å
q _z range	0 Å ⁻¹ to 1 Å ⁻¹ reflectometry 0 Å ⁻¹ to 4 Å ⁻¹ diffraction
q _z resolution	Δq _z /q _z = 2.5%, 5%, 10%, 20%
q _x resolution	Δq _x = Δq _x (λ) = 10% ... 3%
options	polarisation & analysis diffraction (2θ < 140°, shorter detector arm) focusing GISANS

- adjustable footprint: sub-mm to cm
- horizontal and vertical scattering geometry possible
- encoding via multilayer monochromator (or prism, fast moving slits) ⇒ operation without choppers possible (but not mendatory)
- wide divergence for high-intensity specular reflectometry
- combination of high/low θ with low/high λ enables for a wide q_z range to be measured simultaneously
- free space around the sample (also free of diaphragms!) and between the guides (≈ 4 m) allows for all kinds of sample environment, add-on options like MIEZE or SERGIS can be installed

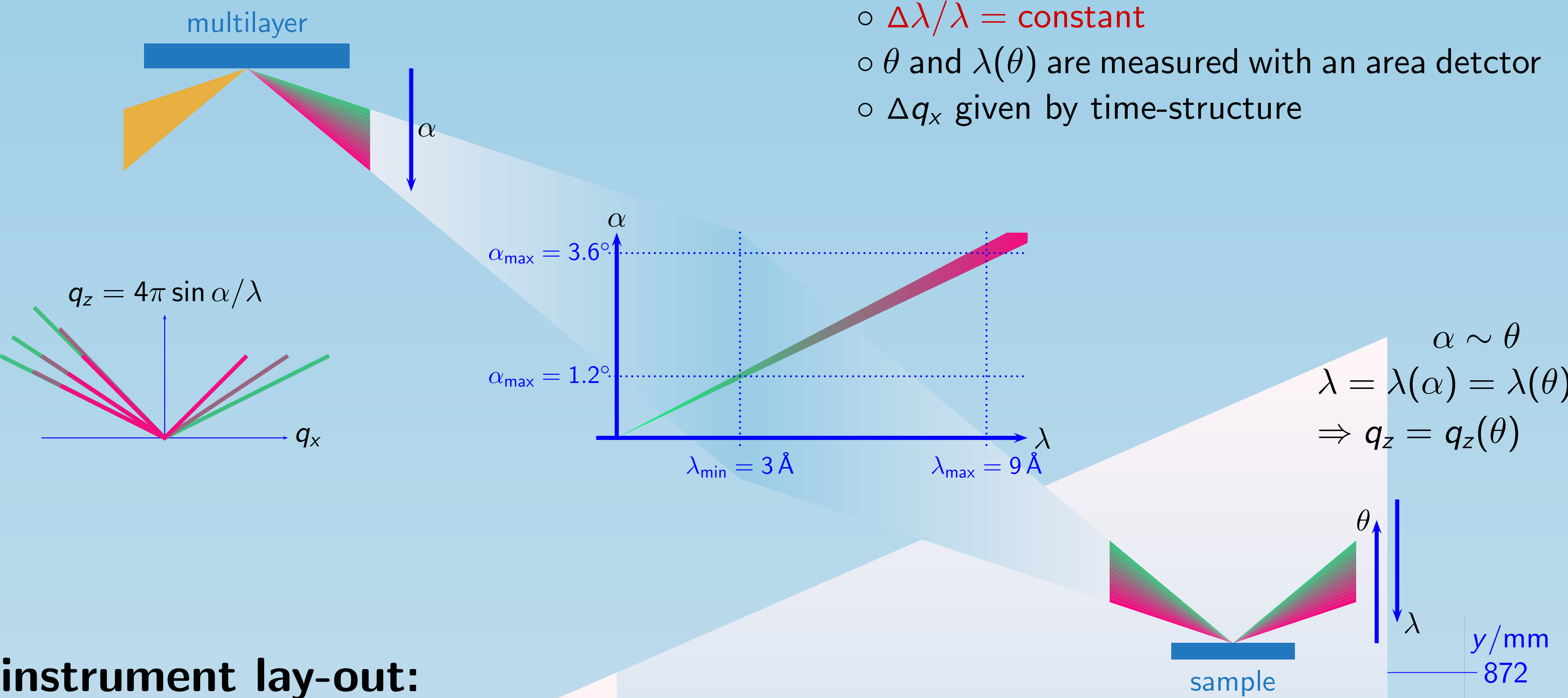
this work is part of the
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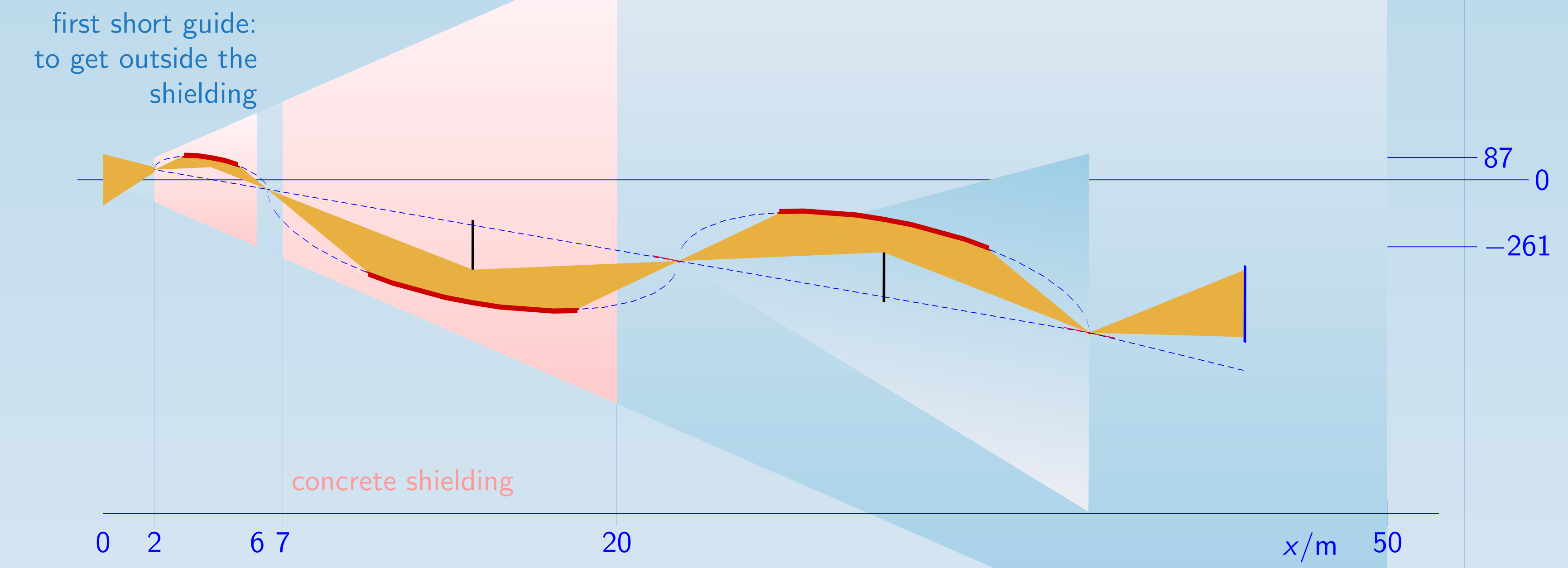
λ/θ encoding:

λ is encoded in θ via spectral analysis by am multilayer

- no chopper needed
- Δλ/λ = constant
- θ and λ(θ) are measured with an area detctor
- Δq_x given by time-structure



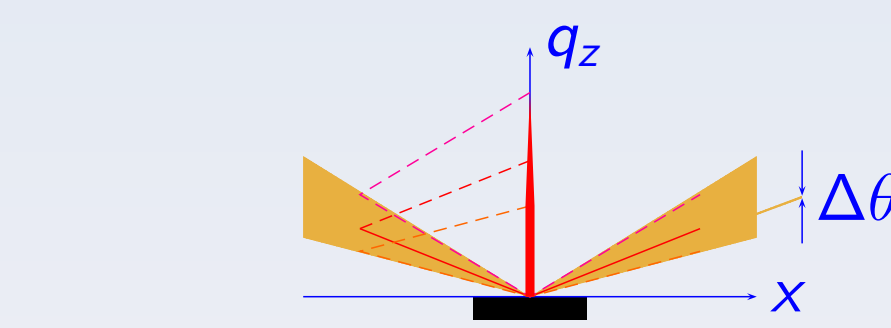
instrument lay-out:



high-intensity specular reflectometry:

full divergent beam, λ-resolution = 3% to 10% (9 Å to 3 Å)

- energy- and angle-dispersive ⇒ gain > 10
- off-specular scattering causes background
- for fast scanning of T, H, E ...
- complex data analysis

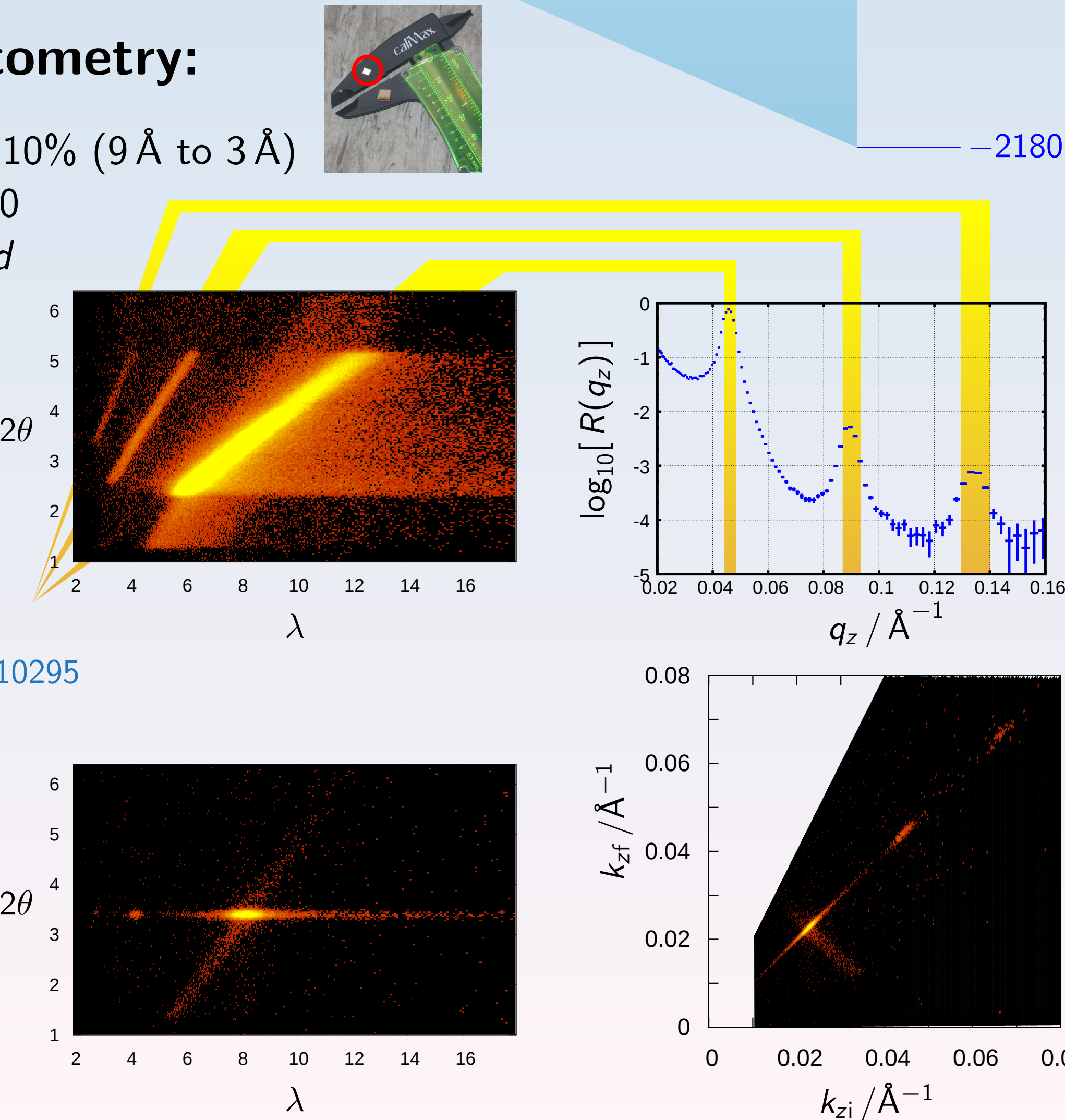
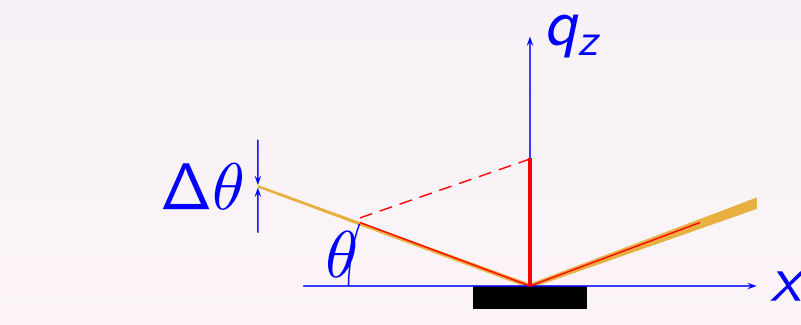


J. Stahn et al. EPJAP doi:10.1051/epjap/2012110295

fall-back to an *almost* conventional mode

by reducing the divergence

- allows for off-specular reflectometry



science case

small sample area

1 × 1 mm² ... 5 × 5 mm²

- restricted by prepaation technique
e.g. PLD produces homogeneous films for ∅ < 6 mm, only

F. Miletto, Naples, Italy
C. Schneider, PSI, Switzerland

- expensive materials (e.g. certain isotopes)

H. Schmidt, Claustal, Germany

- compatibility with other techniques (e.g. SQUID)

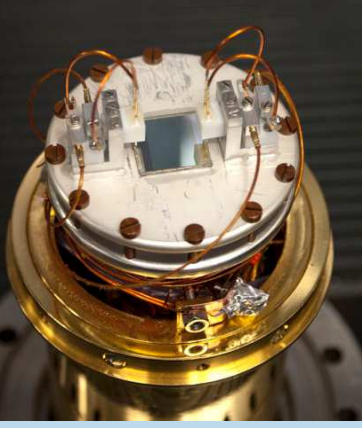


samples with perturbing sourroundings

1 × 1 mm² ... 5 × 5 mm²

- contacted devices
e.g. organic spin valve

L. Schulz, A. J. Drew et al. NMAT
doi:10.1038/nmat2912



unconventional surfaces

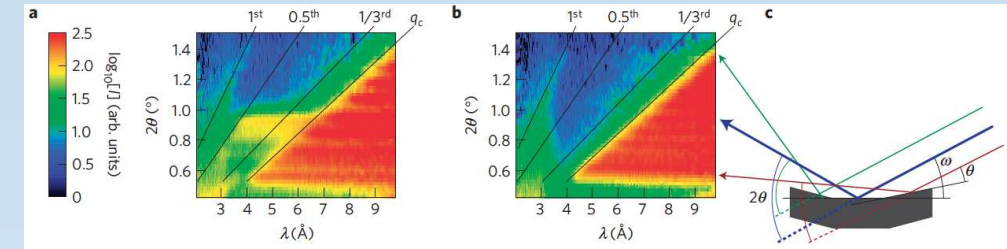
0.3 × 0.3 mm² ... 2 × 2 mm²

- unsupported films



- curved or fracmentet surfaces

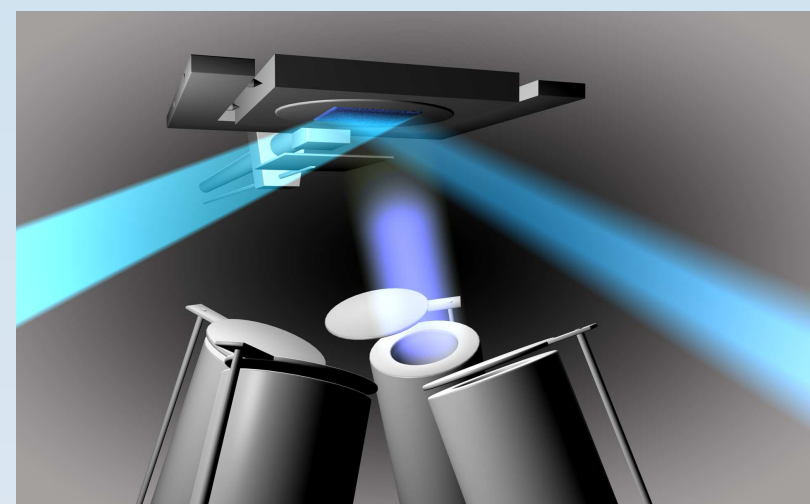
J. Hoppler et al. NMAT
doi:10.1038/nmat2383



in-situ combination

5 × 5 mm² ... 20 × 20 mm²

- MBE
moderate t resolution
no illumination of environment
→ poster W. Kreutzpaintner et al.:
In-situ polarised neutron reflectometry
on MBE-grown samples at ESS

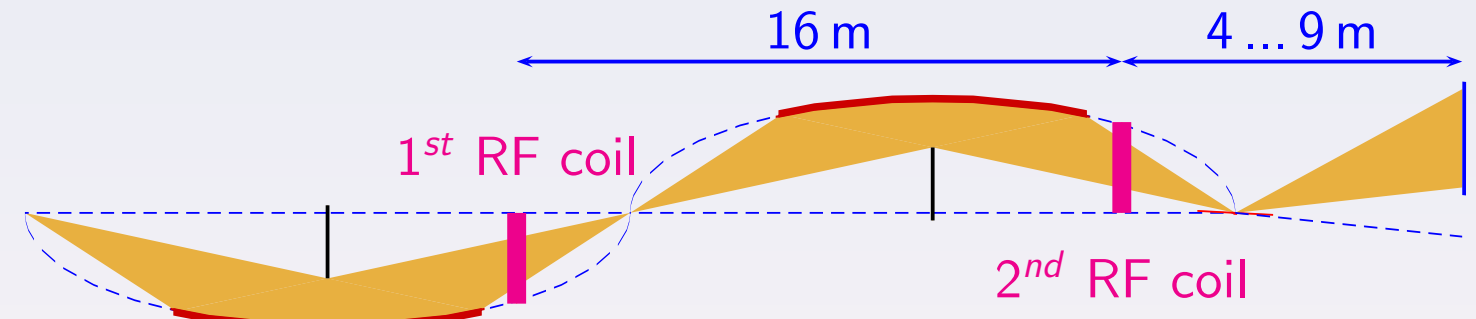


- X-ray reflectometry

combination with spin-echo techniques

1 × 1 mm² ... 5 × 5 mm²

- MIEZE
magnetic dynamics in the range 100 ps < t < 500 ns
sample size determines resolution



→ poster W. Häußler et al.: Multi angle MIEZE beam Line at ESS

→ poster R. Georgii et al.: The scientific case for a
MIEZE-NRSE-spectrometer at the ESS