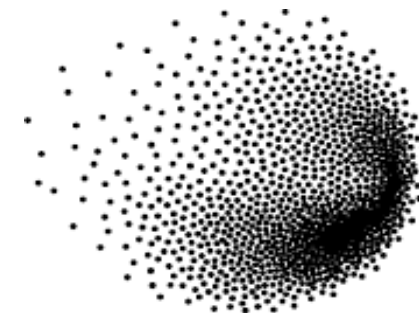




# The ESTIA beamline

PRESENTED BY JOS COOPER



**PSI**

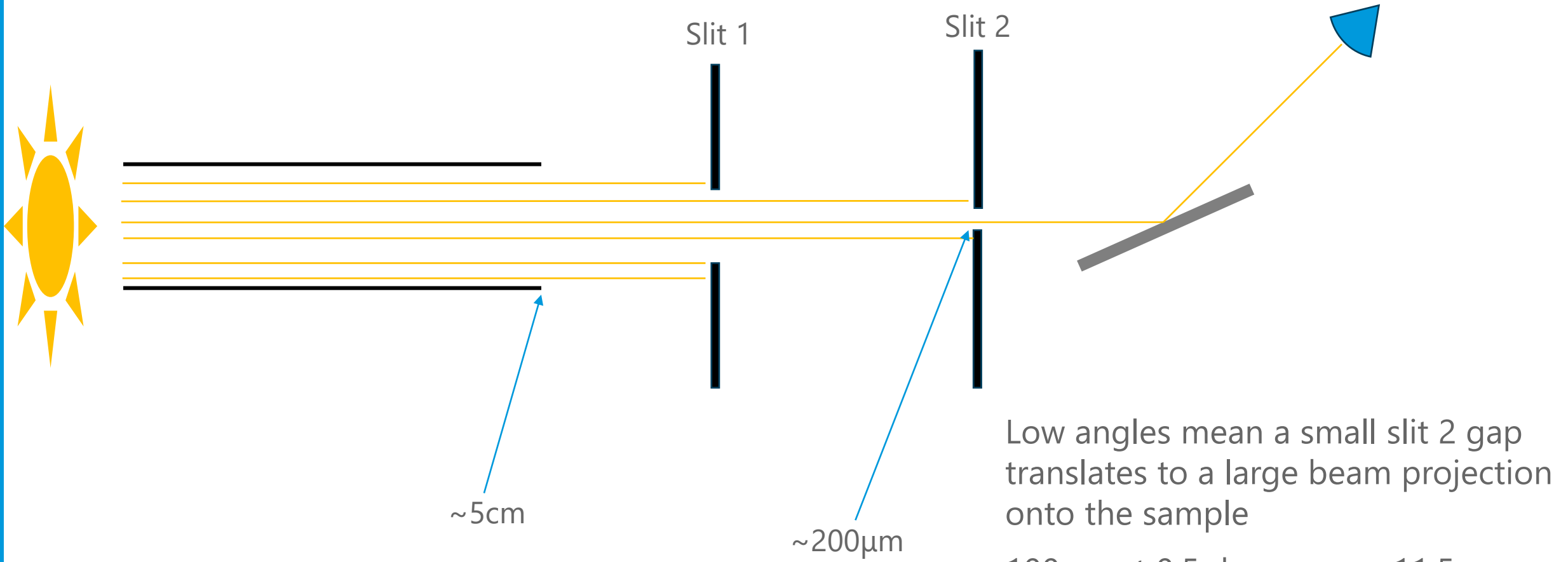


EUROPEAN  
SPALLATION  
SOURCE



# Neutron Reflectometry

## Instruments



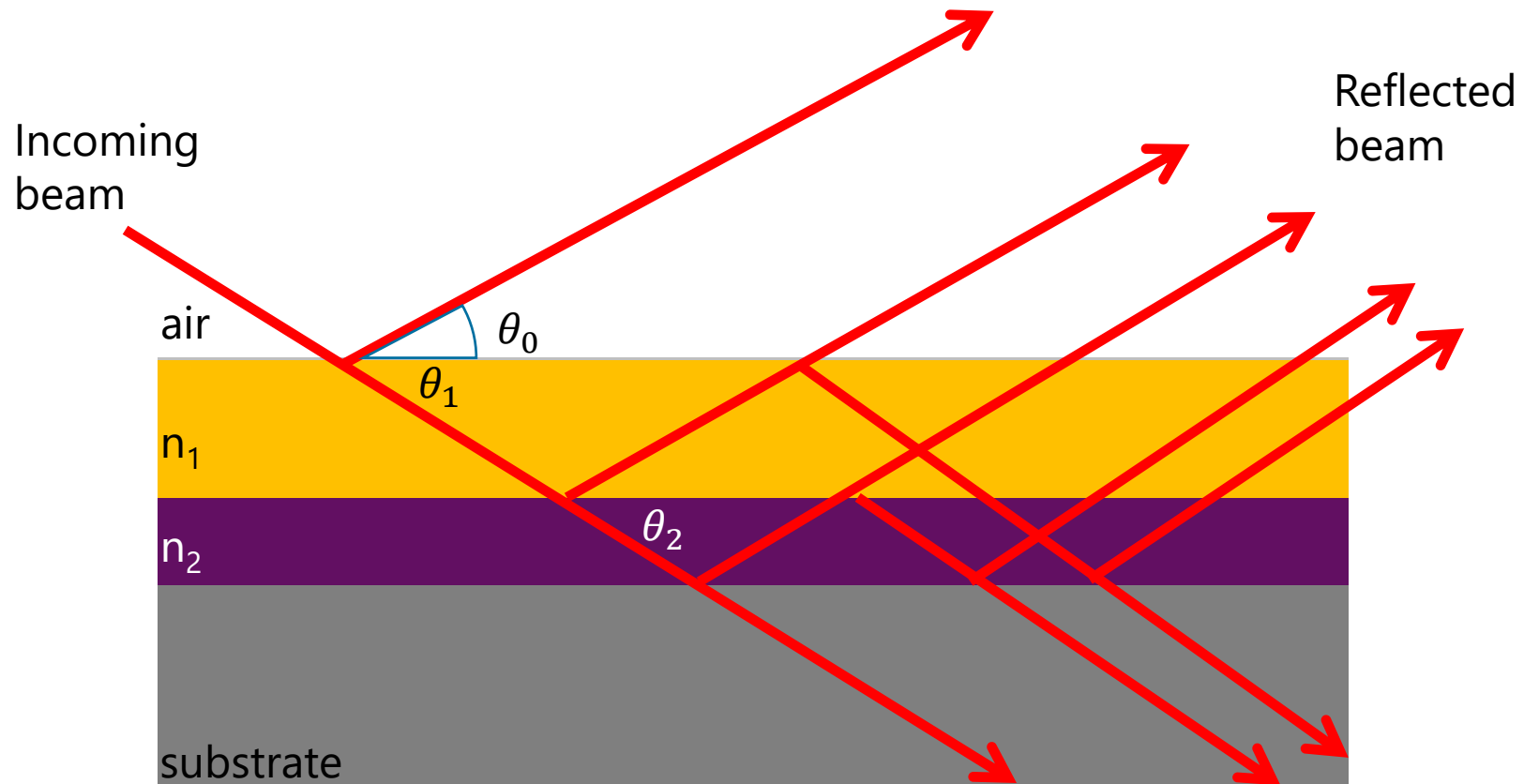
Low angles mean a small slit 2 gap translates to a large beam projection onto the sample

100µm at 0.5 degrees = >11.5 mm footprint

Lots of lost neutrons, large footprints on samples

# Neutron Reflectometry

## Basics

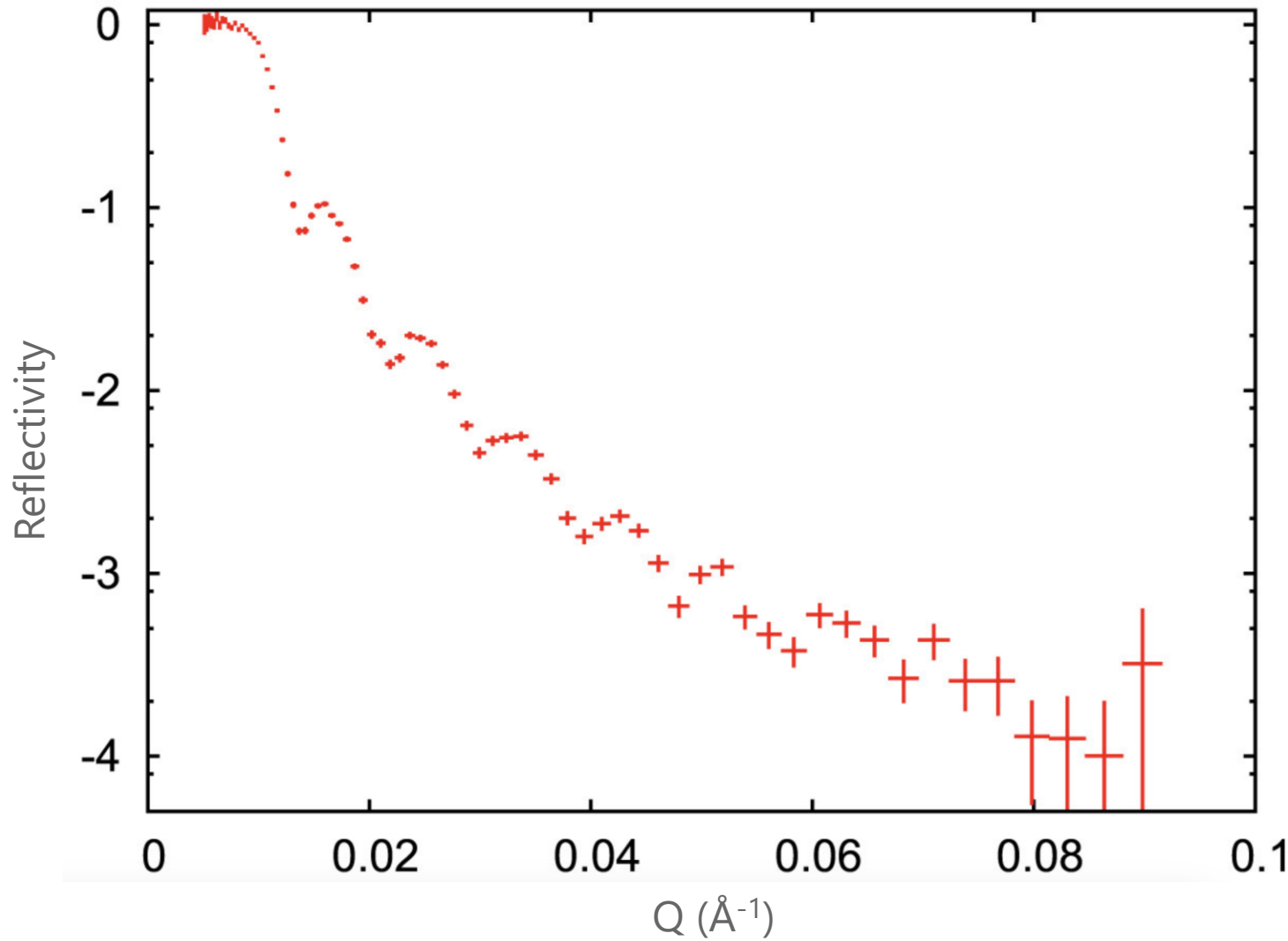


$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

$$Q = \frac{4\pi \sin\theta}{\lambda}$$

$$n\lambda \neq 2d \sin\theta$$

# Neutron Reflectometry



# Neutron Reflectometry

## Instruments

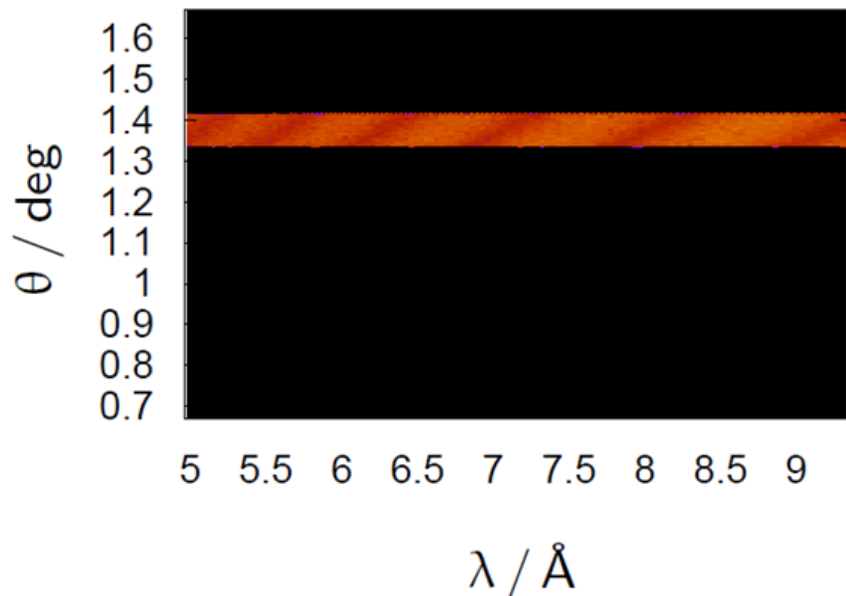
### Time of Flight

$$Q = \frac{4\pi \sin\theta}{\lambda}$$

### Monochromatic

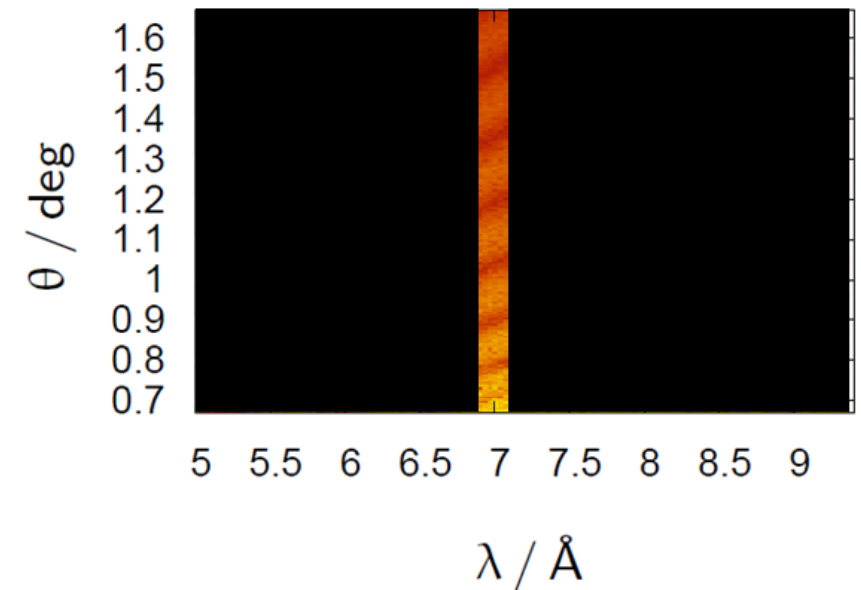
A range of wavelengths at a fixed angle:

$$[Q_{min}, Q_{max}] = \frac{4\pi \sin\theta}{[\lambda_{max}, \lambda_{min}]}$$



A range of measured angles at a fixed wavelength:

$$[Q_{min}, Q_{max}] = \frac{4\pi \sin[\theta_{min}, \theta_{max}]}{\lambda}$$



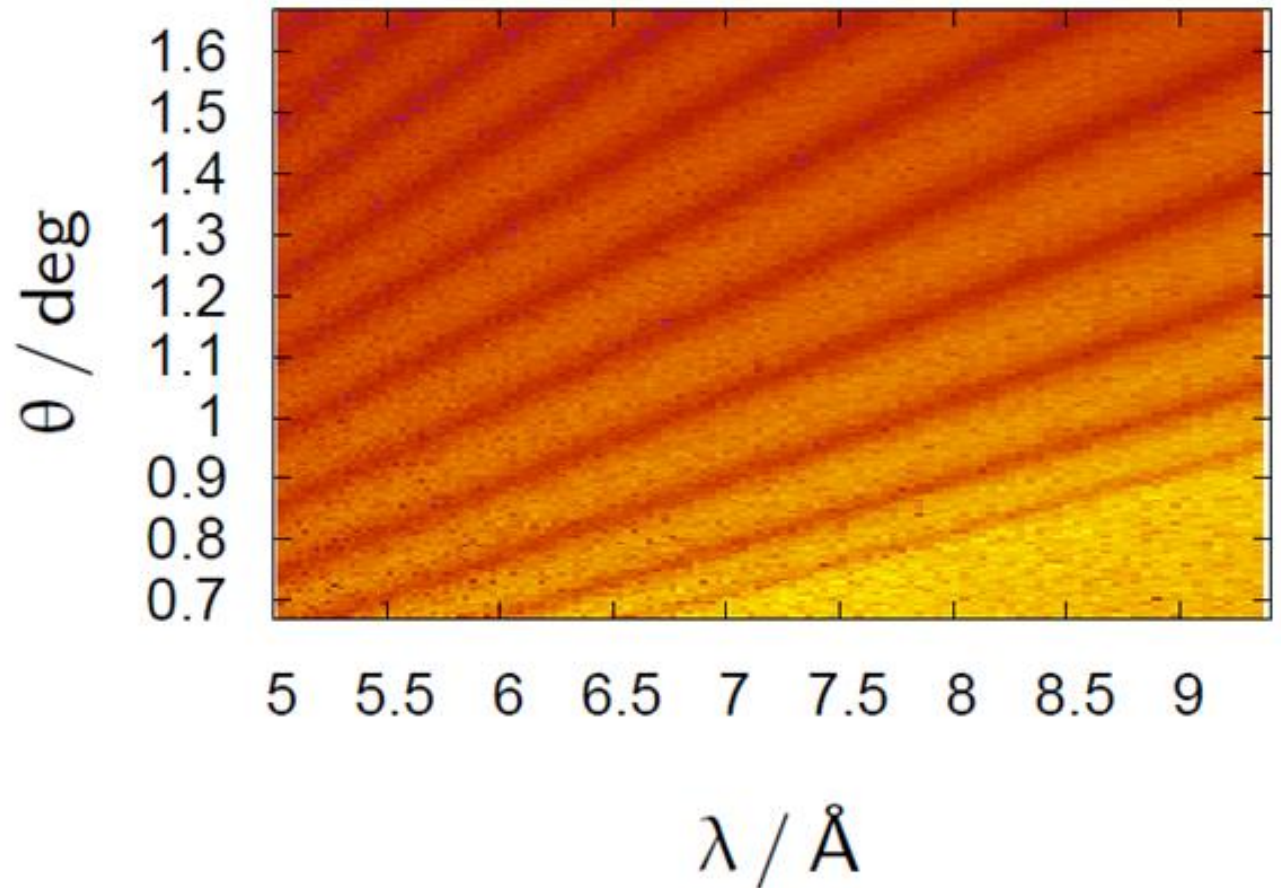
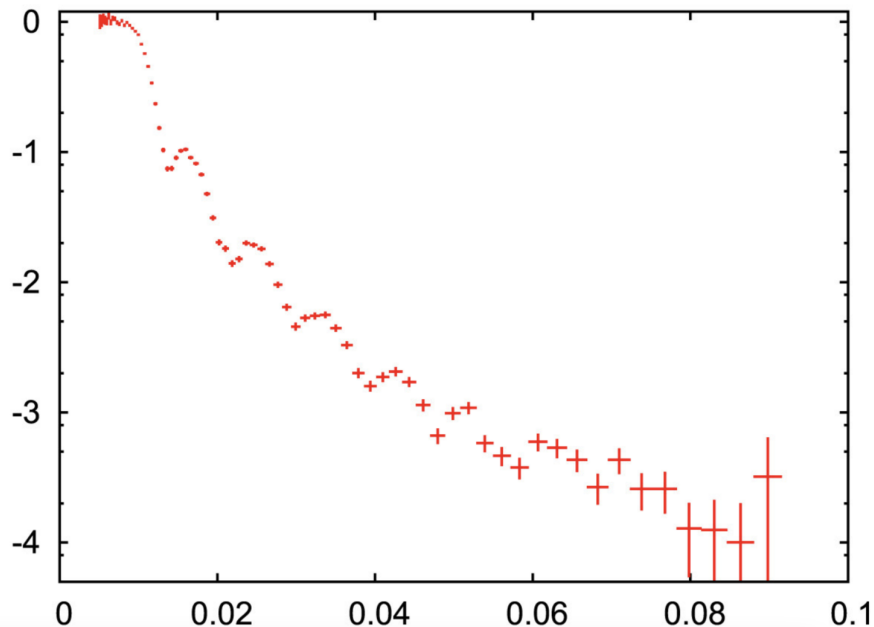
# Selene Guide Concept

## Instruments

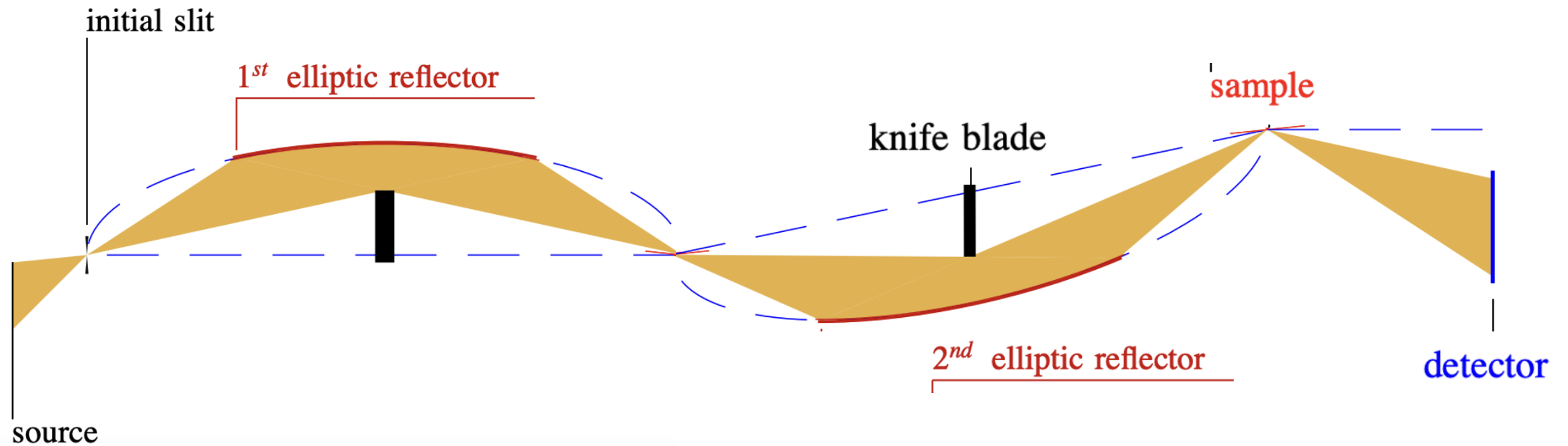
Selene guide on a ToF source:

$$Q = \frac{4\pi \sin\theta}{\lambda}$$

$$[Q_{min}, Q_{max}] = \frac{4\pi \sin[\theta_{min}, \theta_{max}]}{[\lambda_{max}, \lambda_{min}]}$$



# Selene Guide Concept



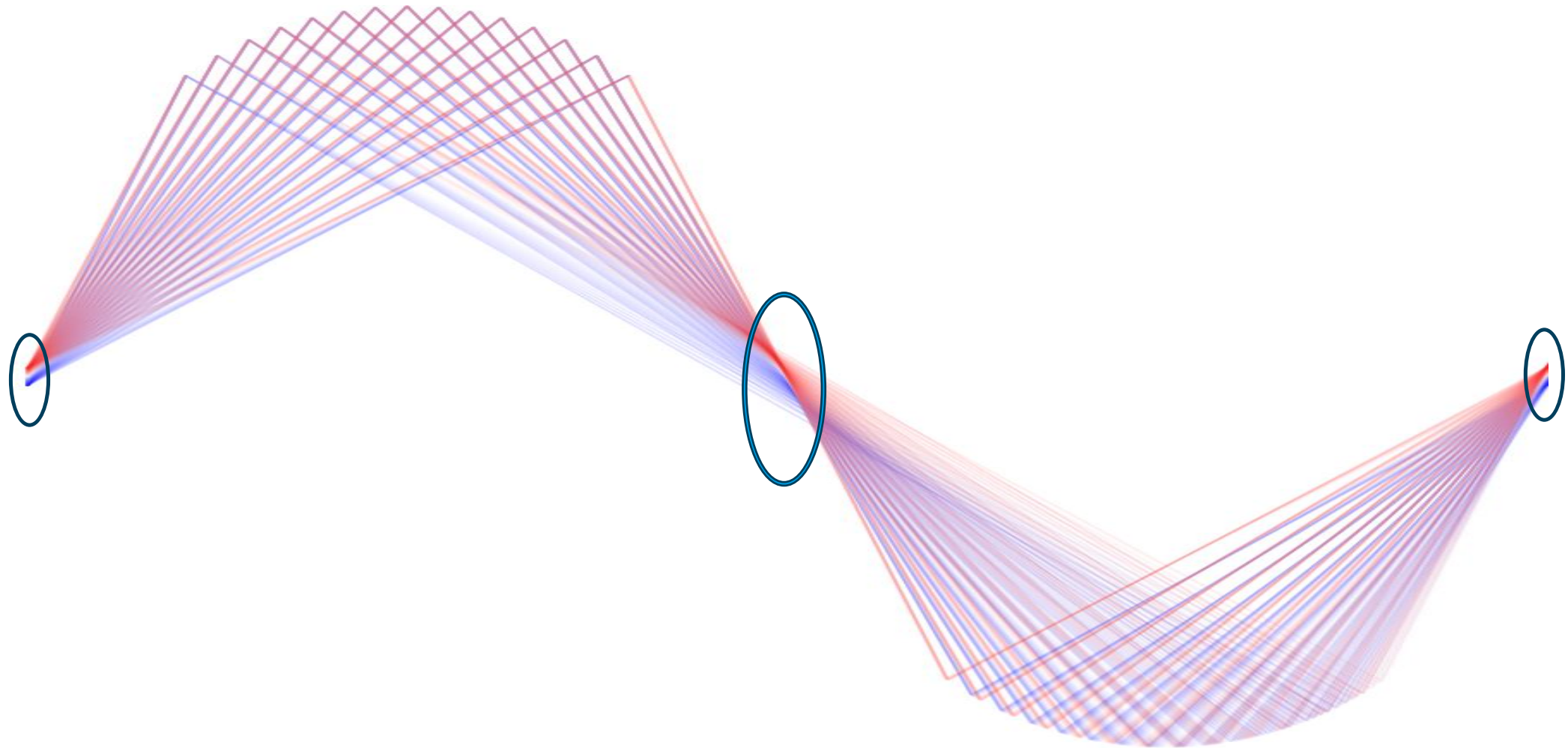
Eur. Phys. J. Appl. Phys. (2012) 58: 11001  
<https://doi.org/10.1051/epjap/2012110295>

## Focusing specular neutron reflectometry for small samples

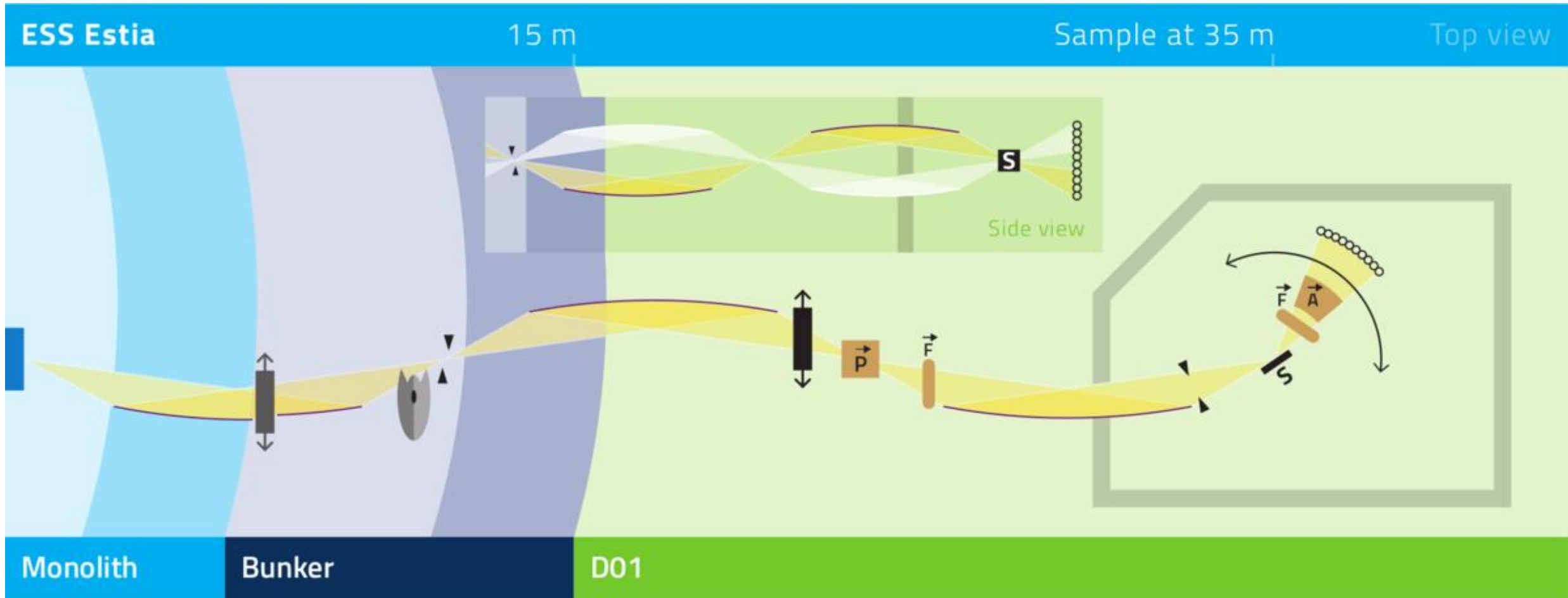
J. Stahn<sup>1a</sup>, U. Filges<sup>2</sup> and T. Panzner<sup>2</sup>

# Selene Guide Concept

## Coma Aberration



# The ESTIA Instrument



# ESTIA

## Science Case

- Magnetic systems
  - Small samples with polarisation
- *In operando* measurements
  - High flux
- High throughput measurements of e.g. biological samples
  - Low backgrounds

A reflectometer generally wants most of these features but having Selene guides and polarisation built into its heart allows ESTIA to focus on its abilities

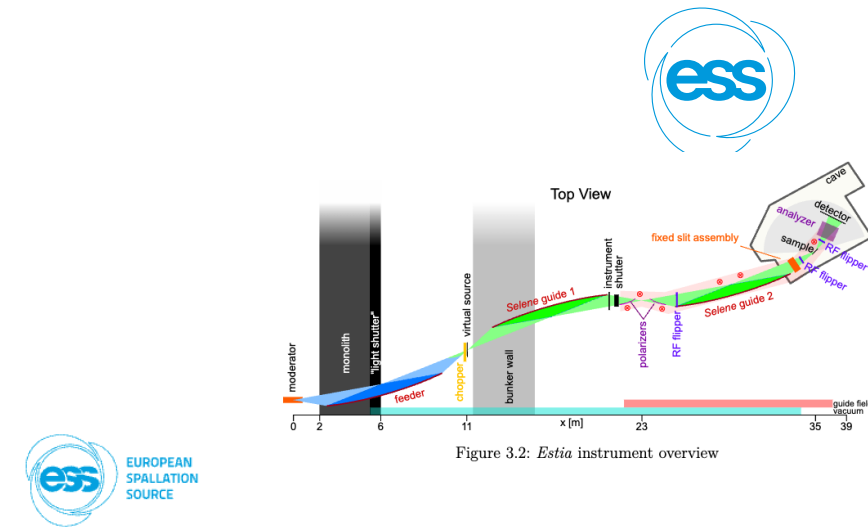


Figure 3.2: *Estia* instrument overview



### Concept of Operations for Polarized Reflectometer (*Estia*)

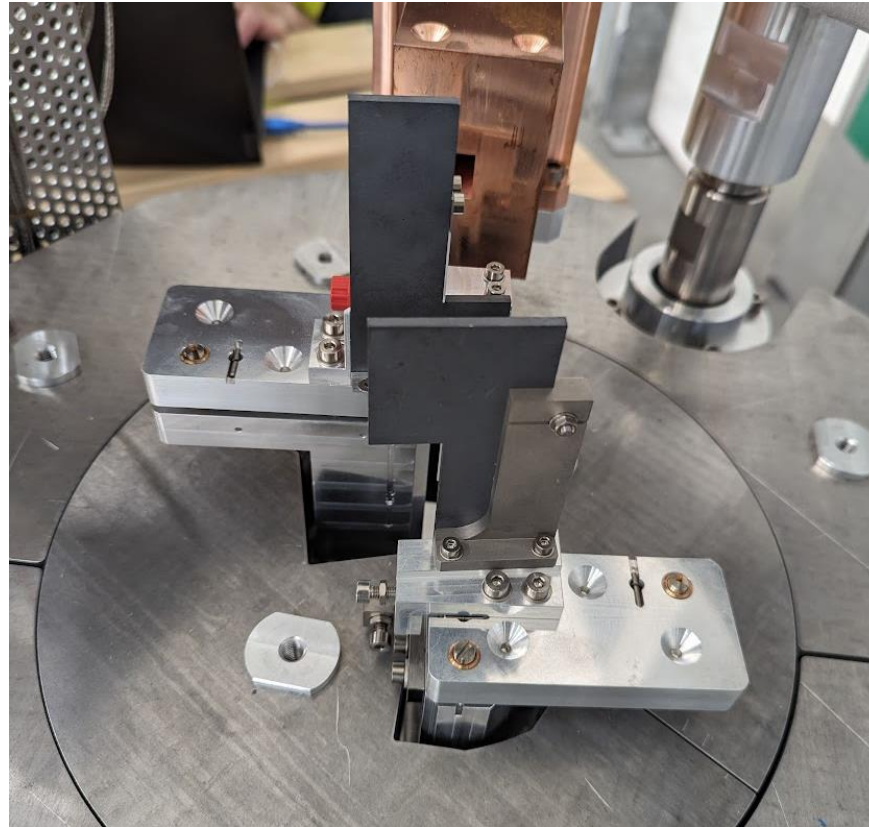
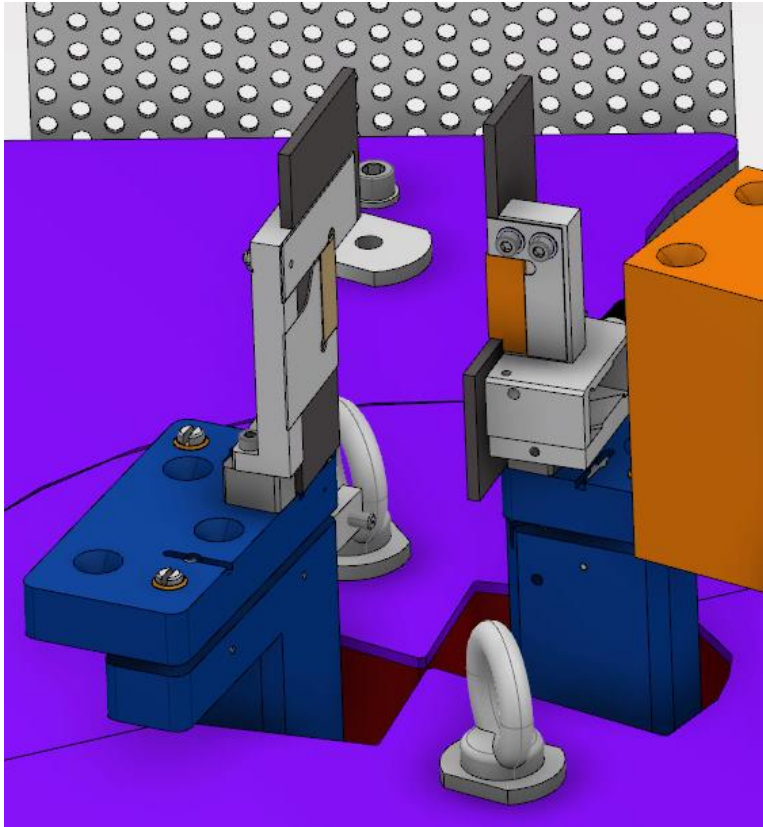
#### Version 1.3

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<b>TG2 Review Committee</b>	Shane Kennedy (Chair) Ken Andersen John Ankner Robert Cubitt Sylvain Désert Richard Hall-Wilton Arno Hiess Gábor László Iain Sutton	ESS ESS STAP STAP LLB ESS ESS ESS ESS
<b>Approver</b>	Andreas Shreyer	ESS

# ESTIA

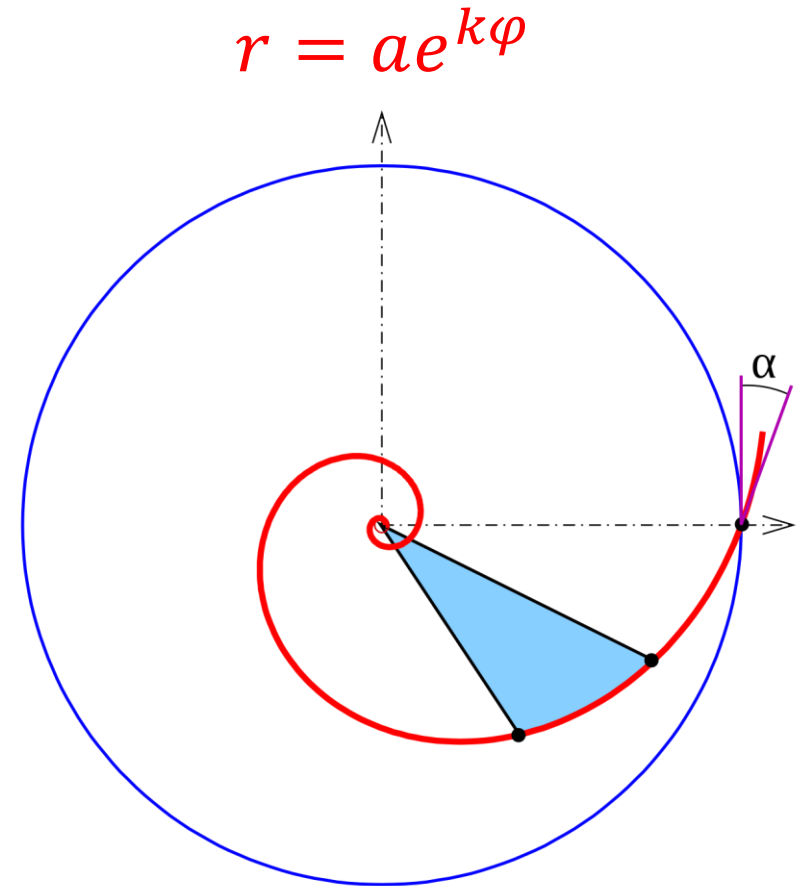
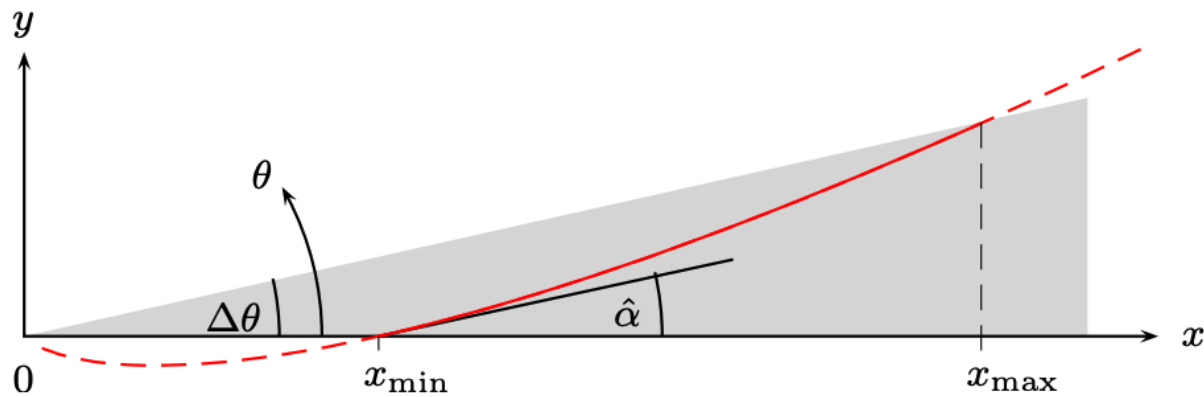
## Small Samples

- The collimation on ESTIA is done at the “virtual source” – the point where we decide what neutrons to bring to the sample point (almost 30m from detector)
- 3D slit defines focus size - mirrors beam distribution on the sample point



# ESTIA

## Polarisation



### Efficient polarization analysis for focusing neutron instruments

Jochen Stahn<sup>1</sup> and Artur Glavic<sup>1</sup>

Published under licence by IOP Publishing Ltd

[Journal of Physics: Conference Series, Volume 862, International Conference on Polarised Neutrons for Condensed Matter Investigations \(PNCMI 2016\) 4–7 July 2016, Munich \(Freising\), Germany](#)

Citation Jochen Stahn and Artur Glavic 2017 *J. Phys.: Conf. Ser.* **862** 012007

DOI 10.1088/1742-6596/862/1/012007

# ESTIA

## Polarisation

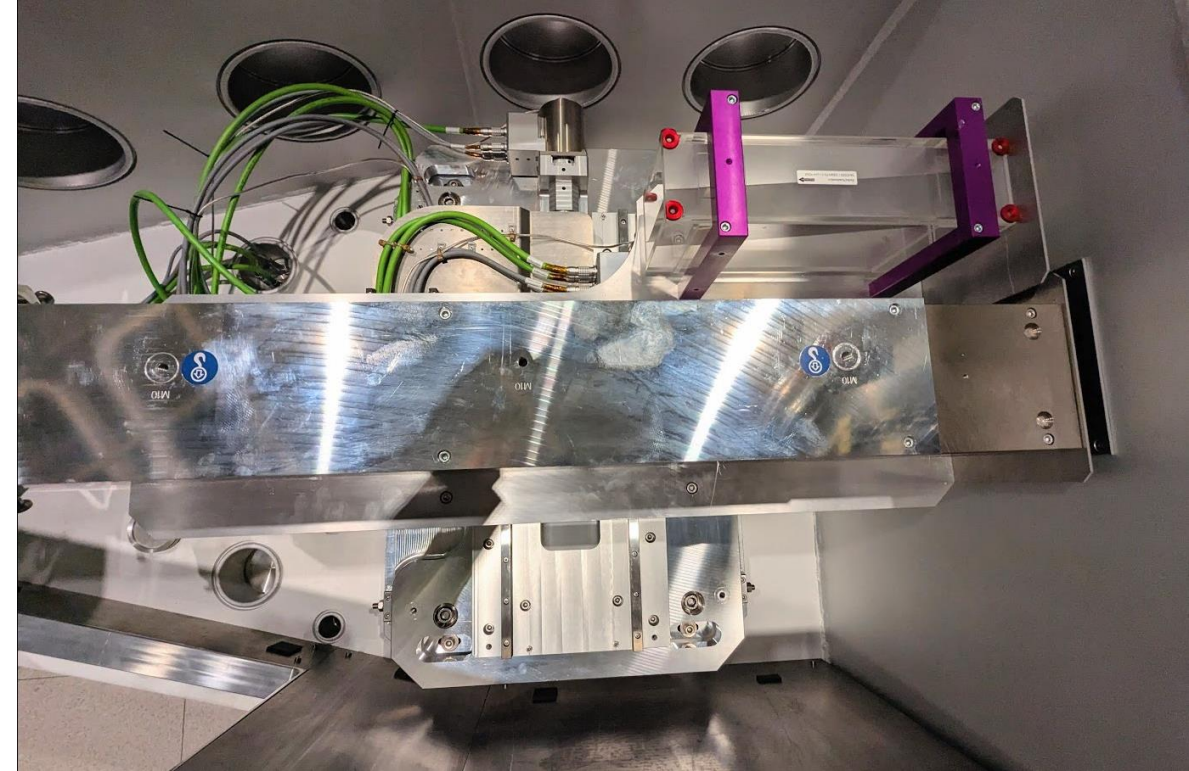
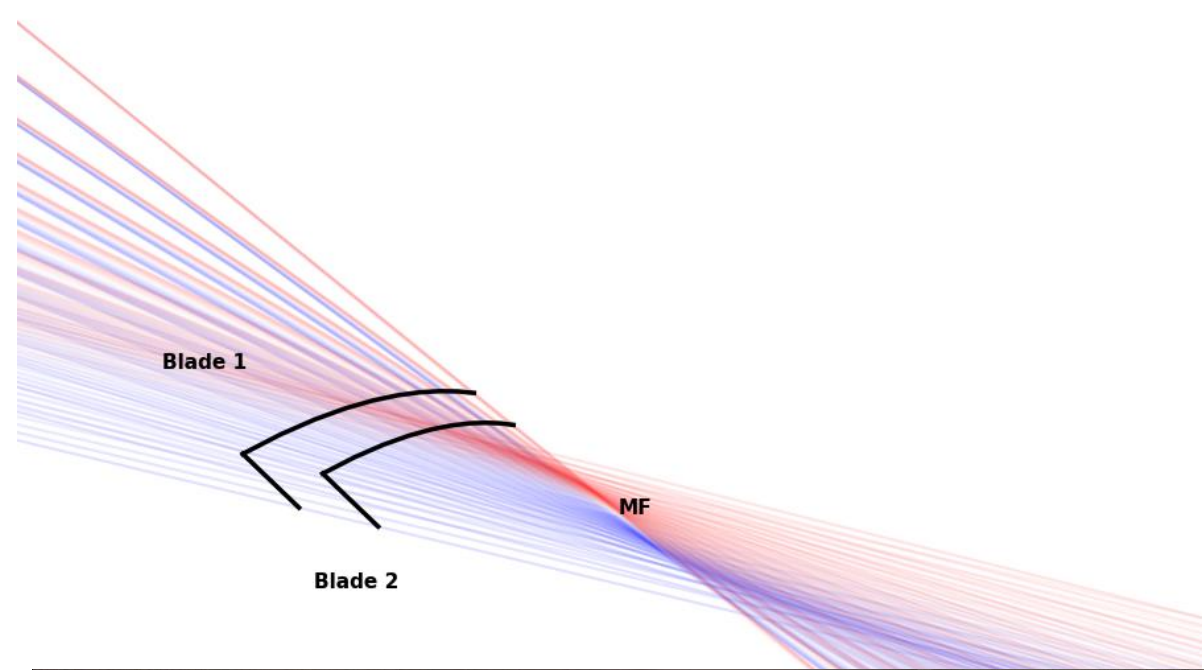
Two transmission polarisers in series

- Improved polarisation

Part logarithmic spiral and part linear

- Linear covers rays created by coma which are almost parallel
- Pointing backwards to make device shorter
- Both sides coated with  $m=5$  Fe/Si

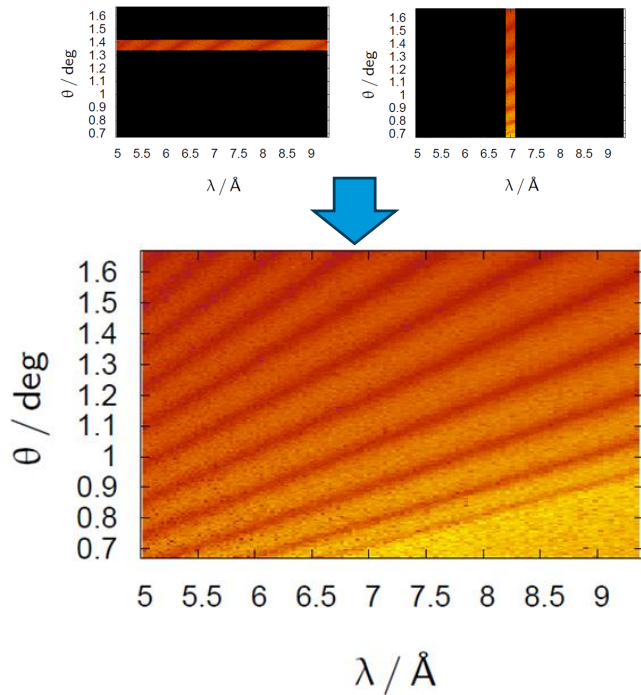
Device is almost 1m long



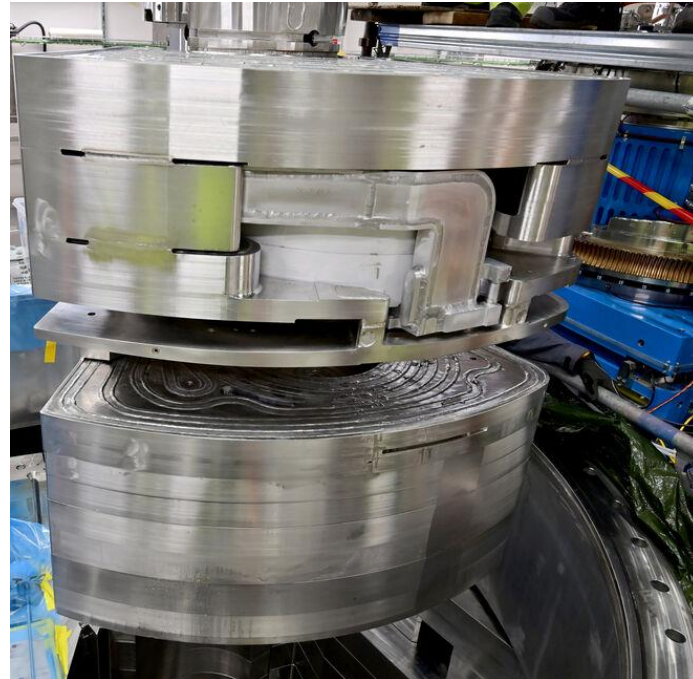
# ESTIA

## High flux

- Divergent beam covers much larger Q space resulting in equivalent flux gain
- Moderator design leads to flux gain over existing spallation sources
- Accelerator energy leads to flux gain over existing sources



~10x flux



~10x flux

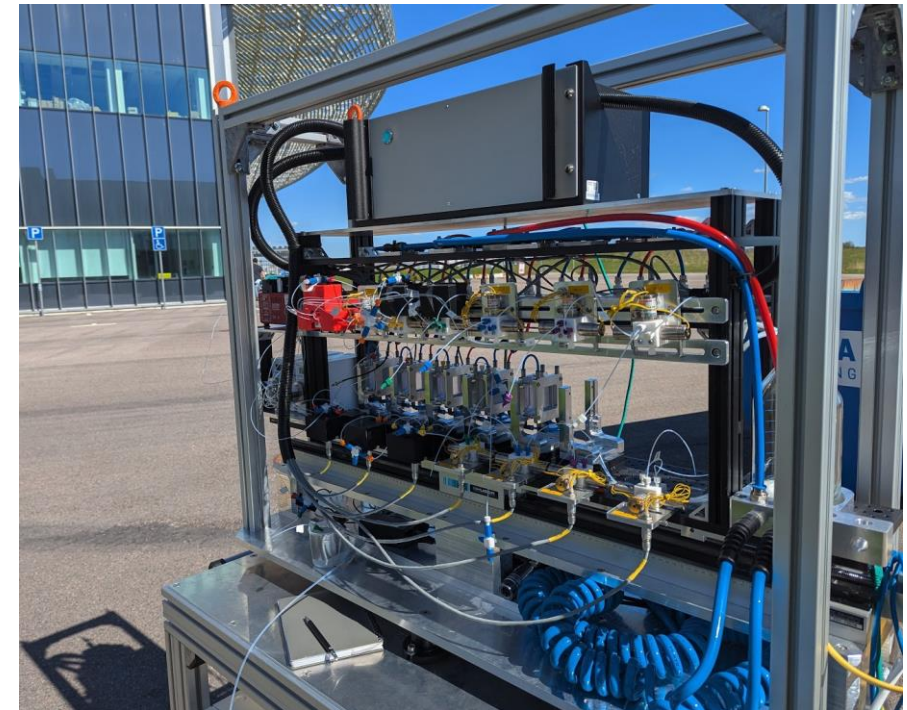
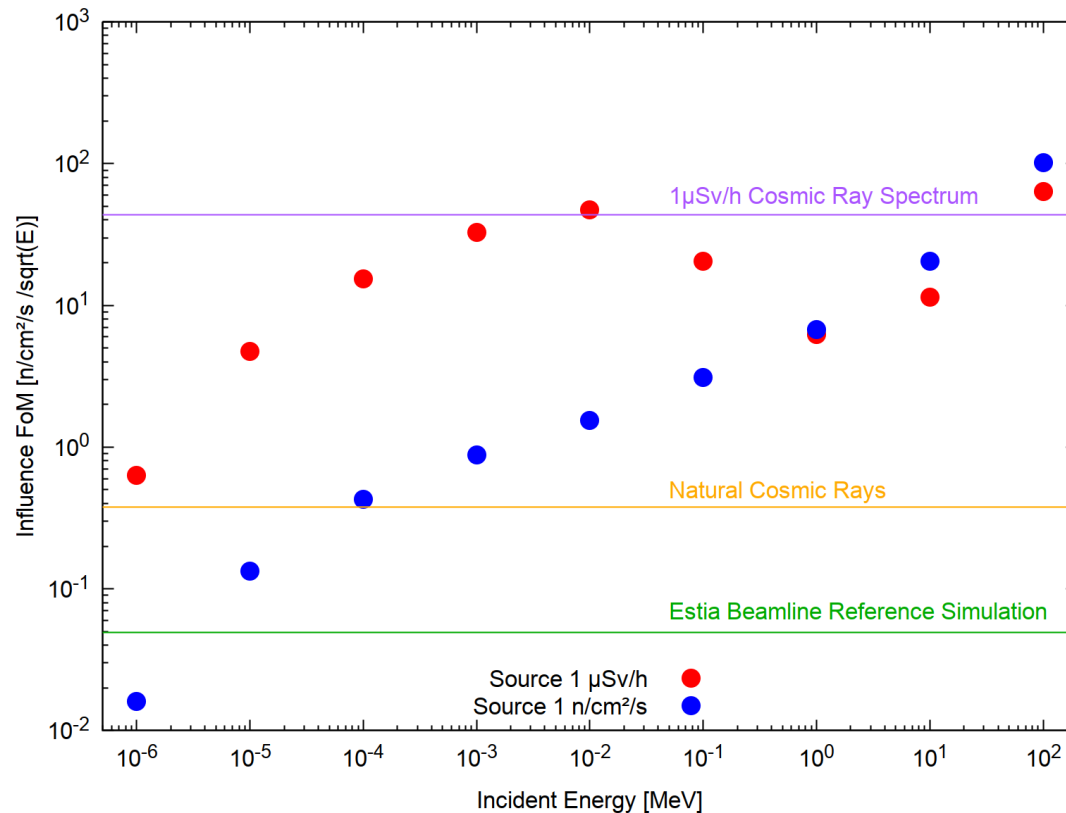


~5x flux

# ESTIA

## Low Backgrounds

- Elimination of line of sight three times from moderator/target
- Lots of shielding around the beam
- Enabling measurements solely of sample backgrounds



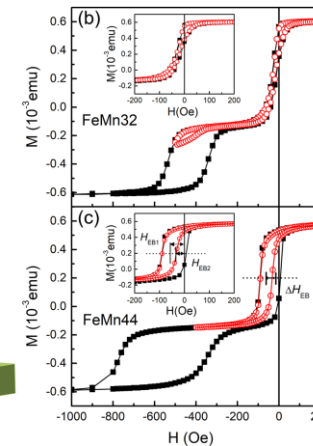
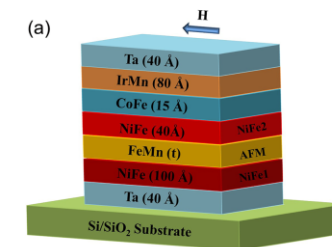
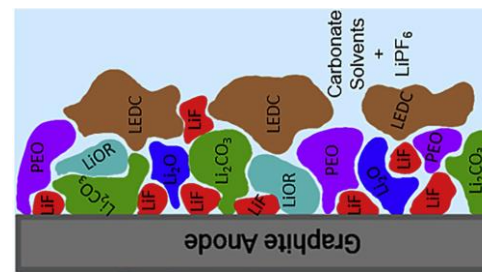
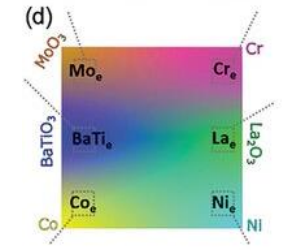
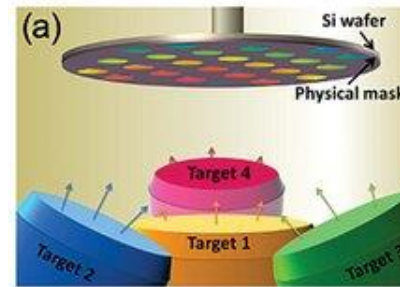
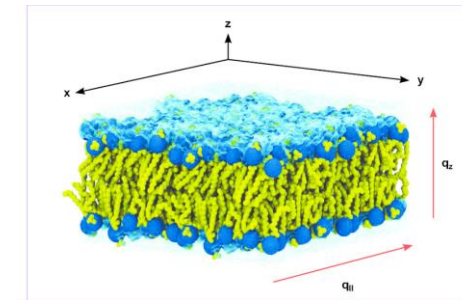
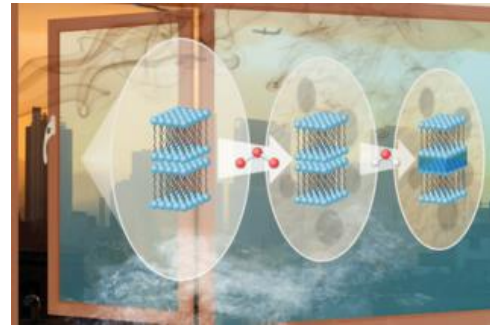
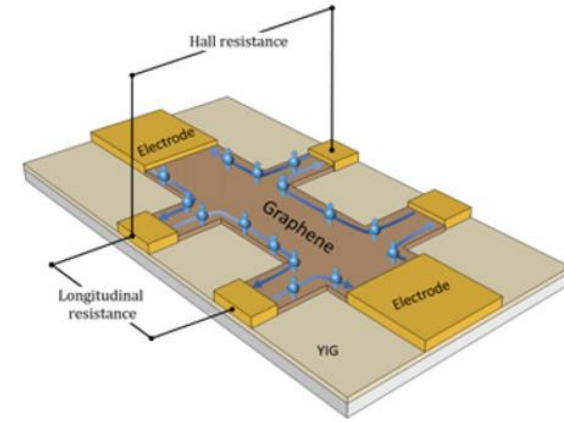
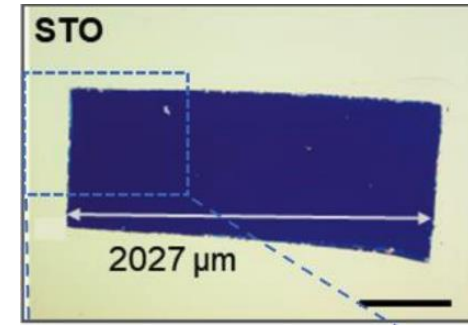
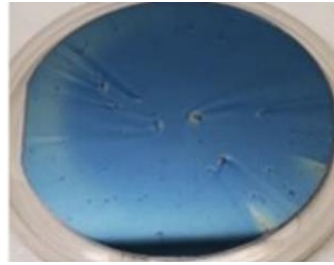
# ESTIA

## Science Case

- Magnetic systems
  - Small samples with polarisation ✓
- *In operando* measurements
  - High flux ✓
- High throughput measurements of e.g. biological samples
  - Low backgrounds ✓

# ESTIA Science

- Spin coated samples
  - Just measure the best spots!
- Freestanding oxide membranes
  - Only measure the membranes
- Working devices
- Atmospheric chemistry
- Surfactants – soaps/lubricants
- Lipid bilayers -biology
- Composition exploration studies
  - Co-sputtering or temperature gradients
- Li ion batteries
- Complex magnetic heterostructures
- Off specular and GI-SANS







**EUROPEAN  
SPALLATION  
SOURCE**