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Selene-type reflectometer — prototype on BOA

aim:

validation of the concept of a Selene-type reflectometer
and checking the McStas simulations thereon
the prototype will be used to investigate the various operation modes

set-up:

the prototype will be setup on the instrument BOA
○ the distance between initial slit and sample is 4 m
○ the total space available is 9.1 m
○ 3 m between sample and detector to obtain a sufficient resolution
○ horizontal and vertical geometry are identical
○ the geometry allows for
− $3\,\text{Å} \leq \lambda \leq 10\,\text{Å}$
− $\Delta\theta = 1.8°$

time-line:

○ operational mid of August 2012
○ firs tests (unpolarised, RT) in August and September 2012
○ modificatios / extention of flecibility (polarisation, sample environment, vertical scattering geometry)
○ future tests
− horizontal surfaces
− in-situ sample preparation

BOA:

BOA is a multi-purpose neutron beamline at SINQ, PSI, Switzerland. The operation of BOA (**B**eamline for neutron **O**ptics and other **A**pproaches) has started successfully in May 2011. The beamline offers the following properties:
− cold source: $\lambda_{\text{peak}} = 3.2\,\text{Å}$
− mean flux (at $x = 0$): $1.1 \times 10^8\,\text{n s}^{-1}\text{cm}^{-2}\text{mA}^{-1}$
− wavelength band: $1.5\,\text{Å} - 15\,\text{Å}$
− cross section: $40\,\text{mm} \times 150\,\text{mm}$
− variable instrument length: 9.5 m (extendable to 12 m)
○ **polarization:**
− primary polarization: permanent 1.6m long bender unit (FeCoV/TiN)
− polarization analyzer: 4° bender unit (FeCoV/TiN)
− spin flipper: adiabatic spin flipper
○ **detectors:**
− single ^{3}He detector
− ^{3}He $x - y$ (EMBL wire) $172\,mm \times 190\,mm$, resolution $\approx 2mm$
− CCD camera (Andor IKON-M) 1024×1024 pixel, resolution $< 40\mu m$
○ **options:**
− time of fligth measurements
− monochromatic measurements (using a douple monochromator setup)

**more details see** http://www.psi.ch/sinq/boa/description

components:

○ 2 guides (a):
elliptic reflectors in y and in z
focal point distance: 2 m
lengths: 1.2 m
coating: NiTi, $m = 5$
manufactored by SwissNeutronics

○ multilayer monochromator (b): $\Delta\lambda/\lambda = 6\%$

○ source chopper (c): $\varnothing = 150\,\text{mm}$, $\nu < 100\,\text{Hz}$
○ frame-overlap chopper (d): $\varnothing = 150\,\text{mm}$, $\nu < 100\,\text{Hz}$

○ high-precision (X-ray) slit (e)

○ support frames (X95 profiles)
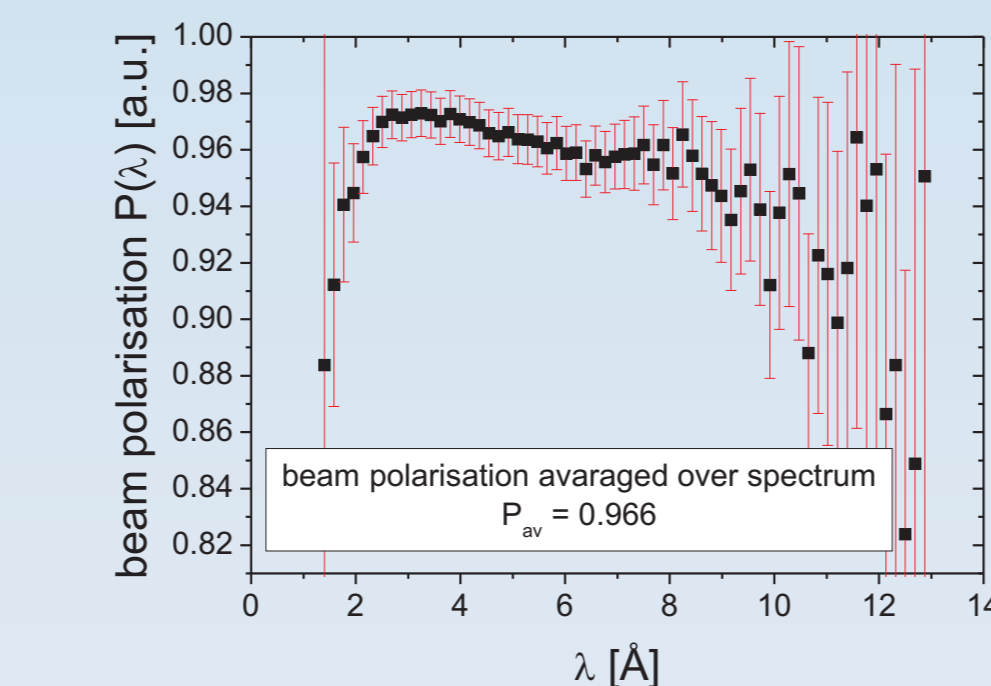○ manual and automated translation and rotation stages
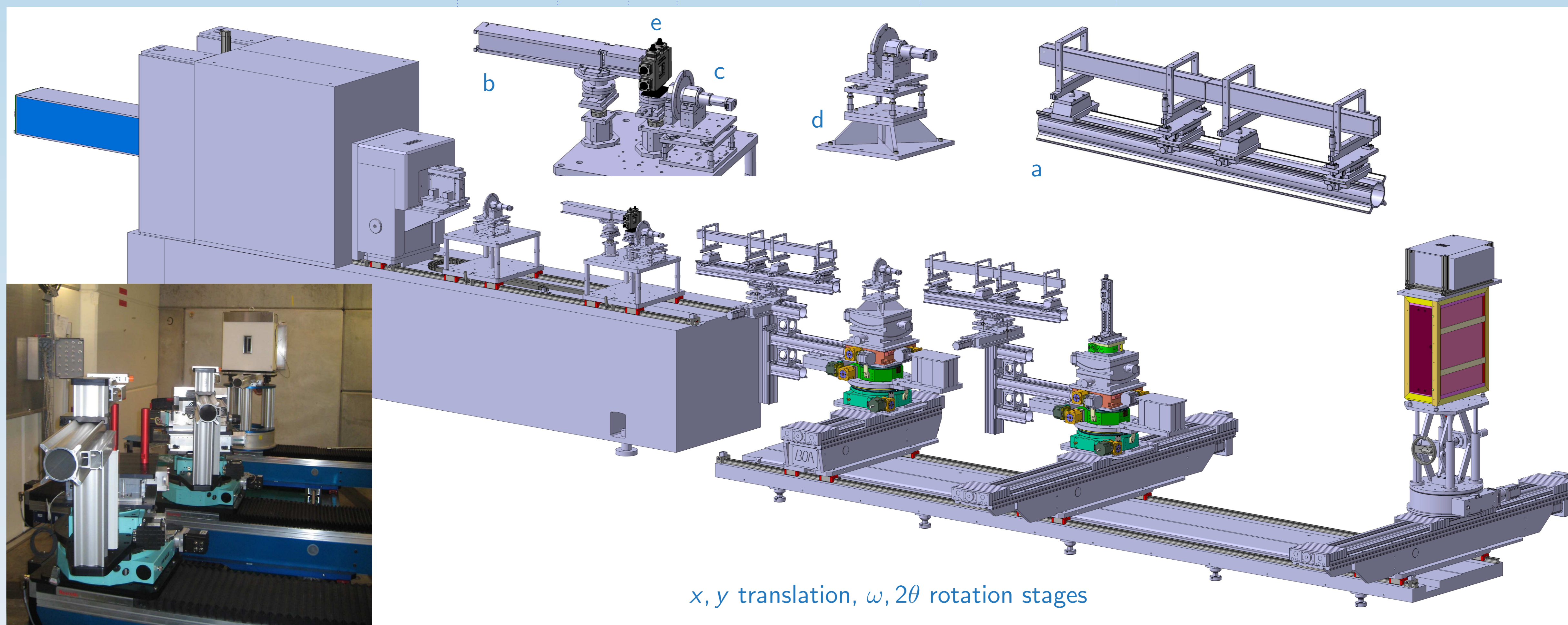
scheme of the Selene set-up:

source = guide end
ml-bandpass
initial slit
$1^s t$ reflector $2^n d$ reflector   sample
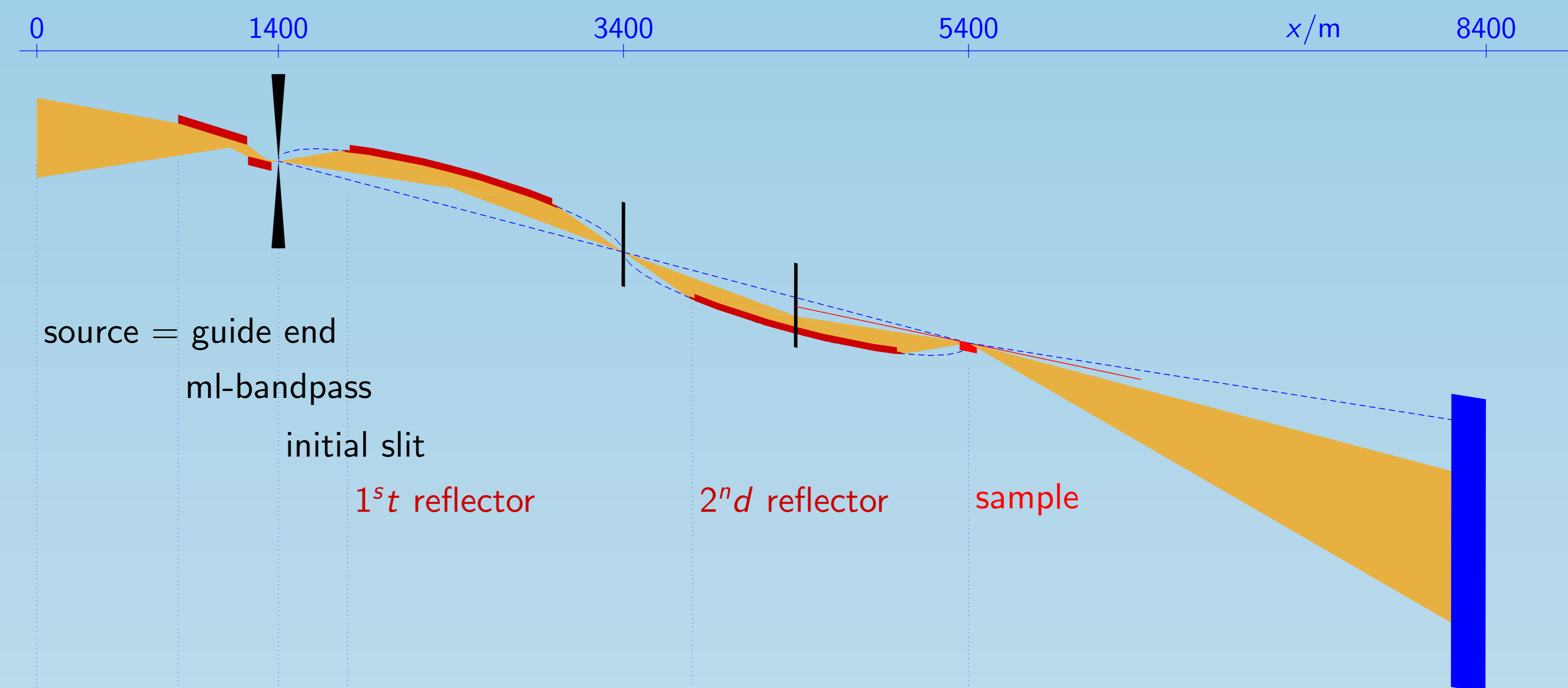
instrument lay-out:
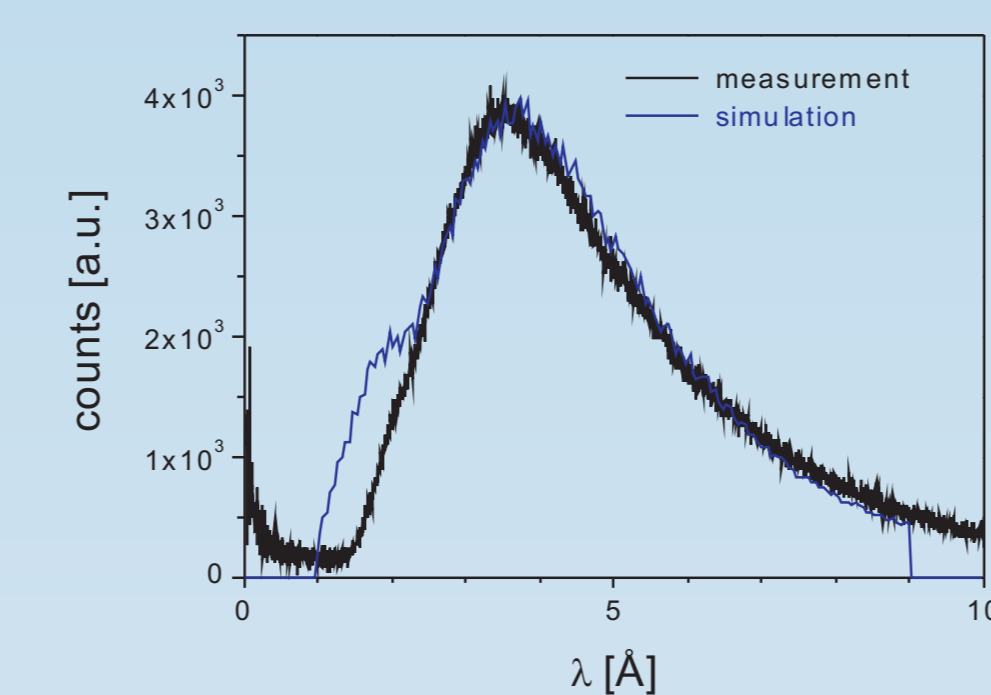
wavelength distribution at $x = 0$

polarization efficiency at $x = 0$

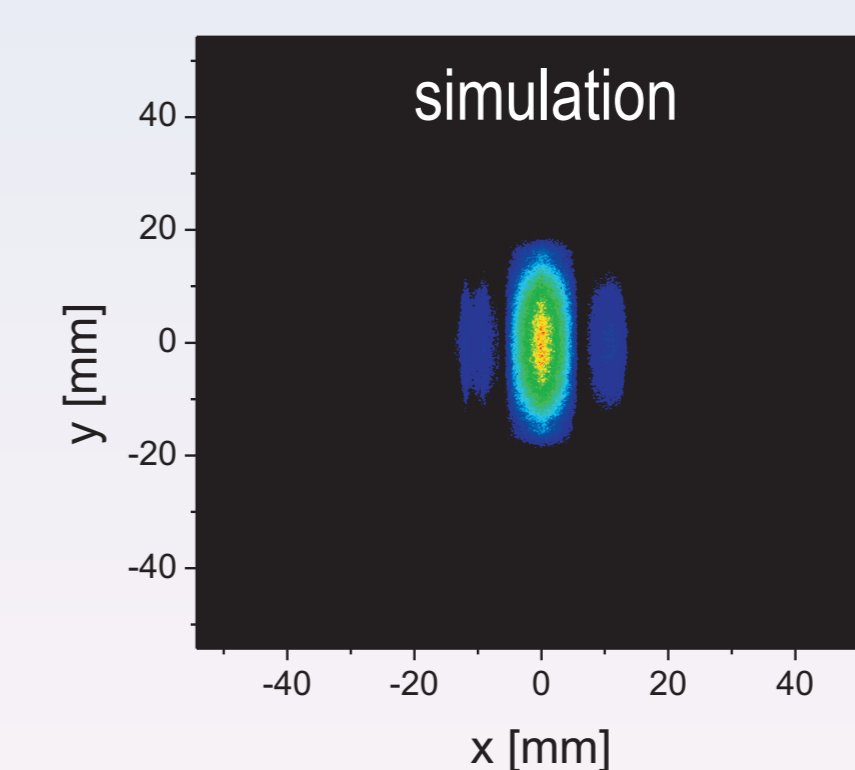x, y translation, $\omega, 2\theta$ rotation stages

BOA beam characterization

In the start-up phase the beamline was characterized:
○ The **wavelength spectrum** was measured at $x = 0$ by the time-of-flight technique.
○ The **polarization efficiency** was measured with the same TOF setup (including an adiabatic spin flipper). The result shows that BOA offers a highly polarized beam over a wide energy region.
○ The **beam profiles** have been measured at different positions along the neutron flight path (x-axis). The relevant measurement/simulation for the *Selene* setup is shown on the right.
○ The performed **McStas simulation** for this setup shows a good agreement.
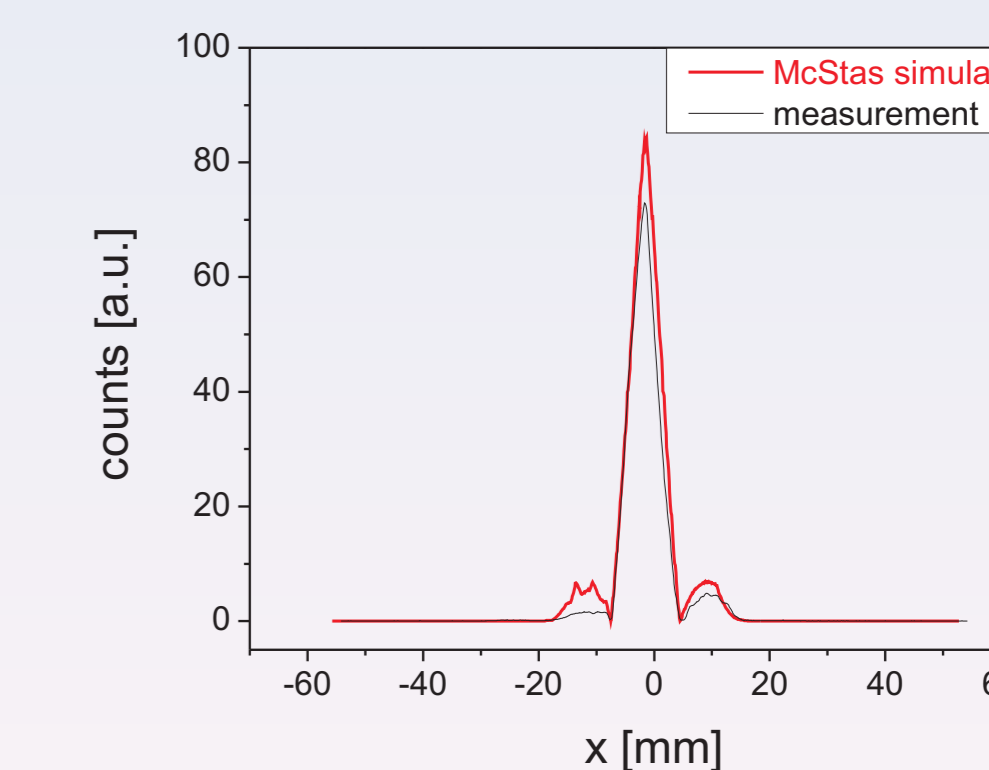
measured and simulated beam profile at $\mathbf{x = 0}$
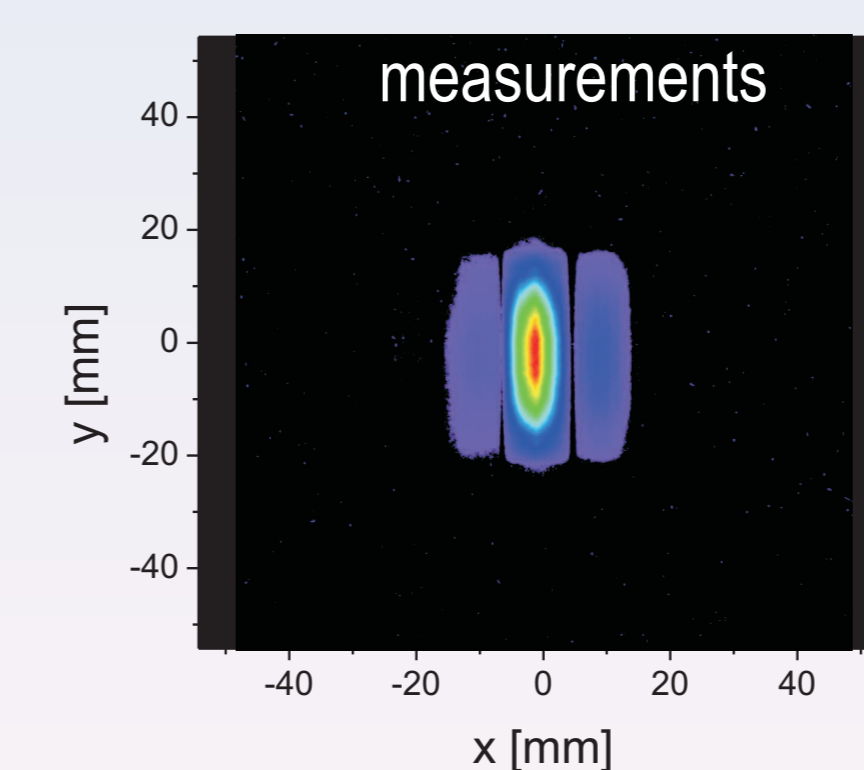
measured data taken with a CCD camera   McStas simulation   comparison of beam profiles (integrated data over y)