Why USANS ?

33 % of all experiments at D11 use the longest detector distance, i.e. need low Q (statistics provided by PL)

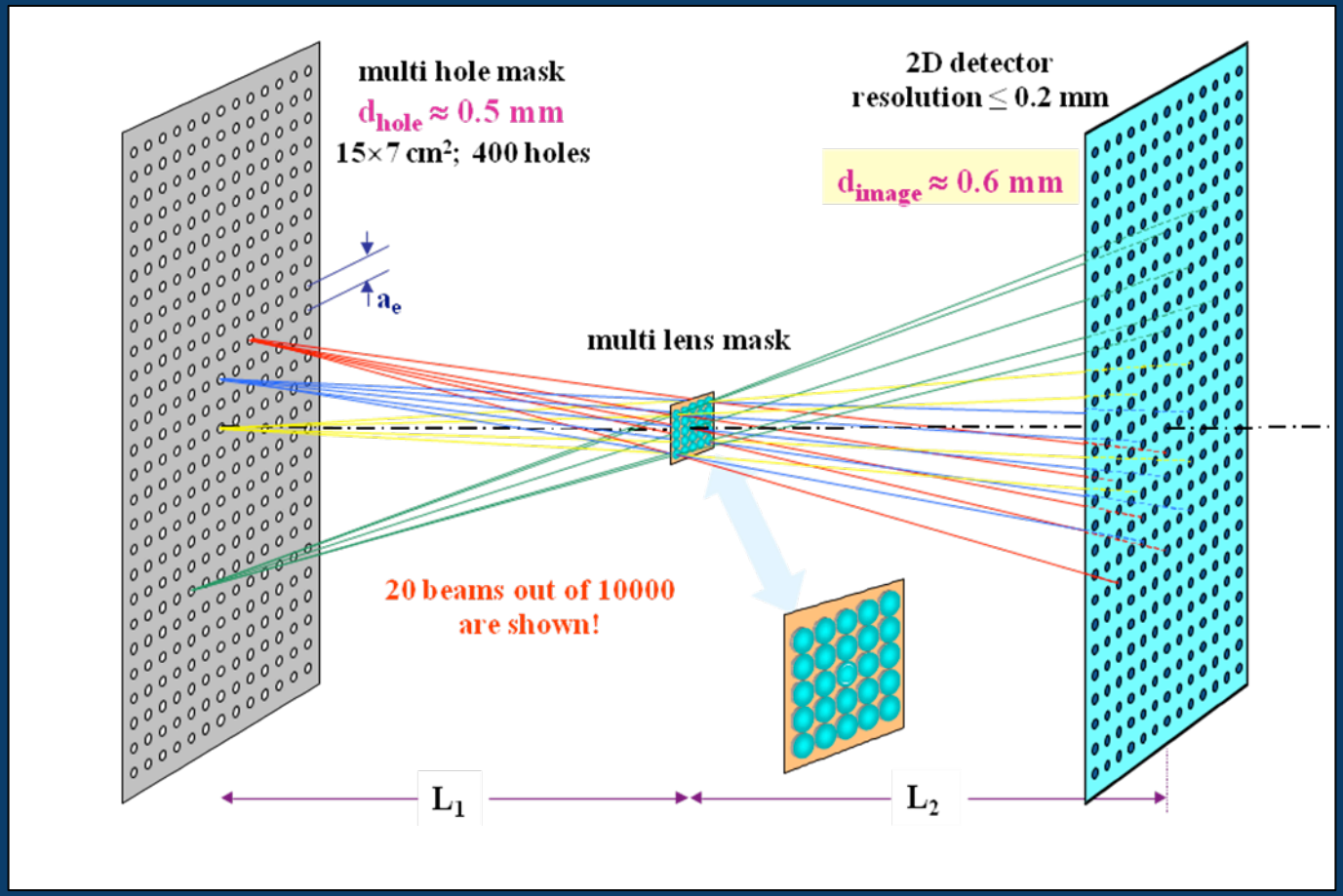
Often the Q range is not sufficient to reach a plateau / the Guinier regime (often important for fitting the data with model form factors)

On 26 April 2010 a USANS seminar was held by Roland Gähler on the technique proposed & by Peter Lindner on the scientific case

The project has been accepted and a budget line has been created

The main advantage of an option:
No need for a new, separate instrument, but an easily exchangeable option on LOKI: SANS + USANS on one instrument

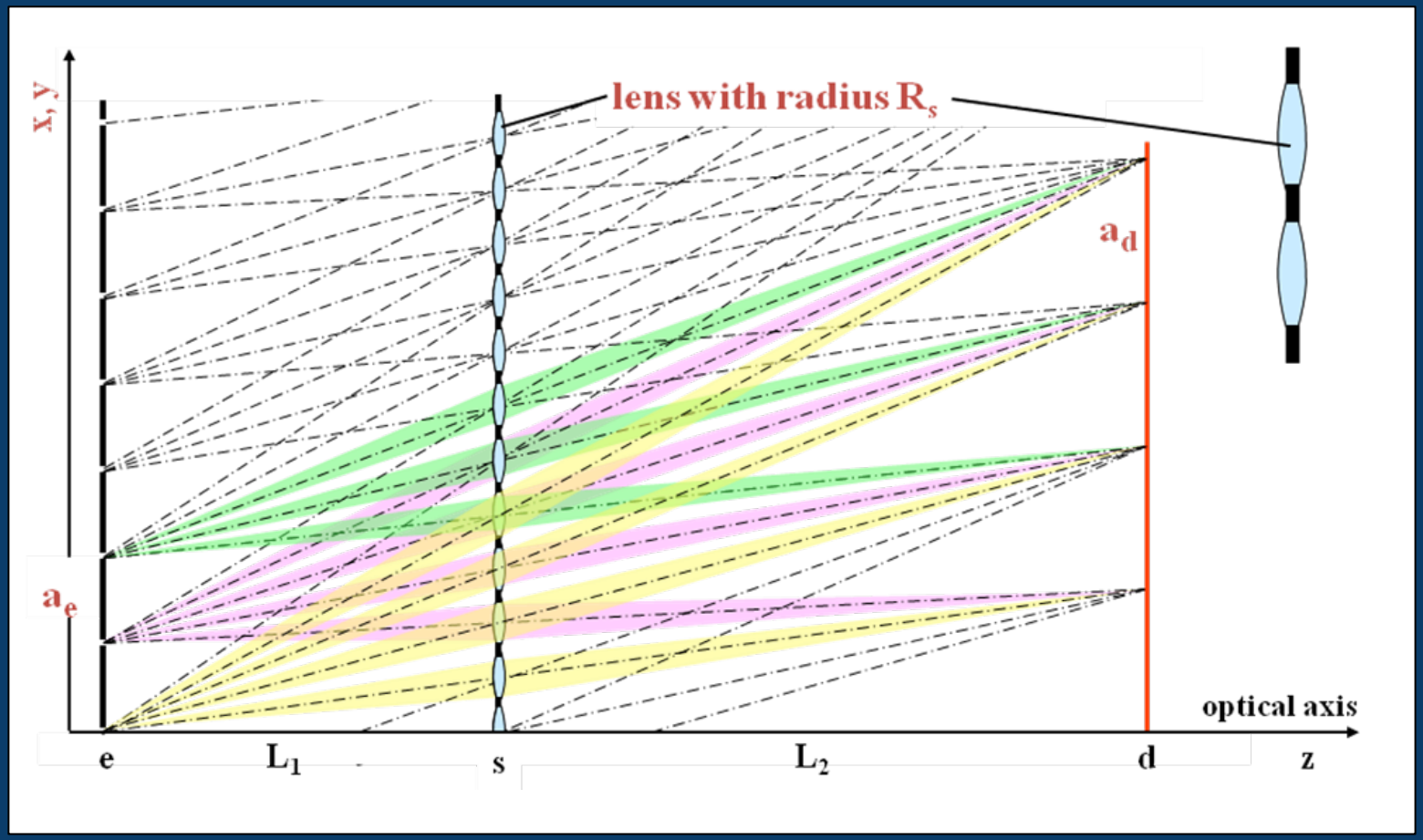
OPUS: the basic idea



The basis of our approach is the SAMBA principle proposed by Roland Gähler in 2002

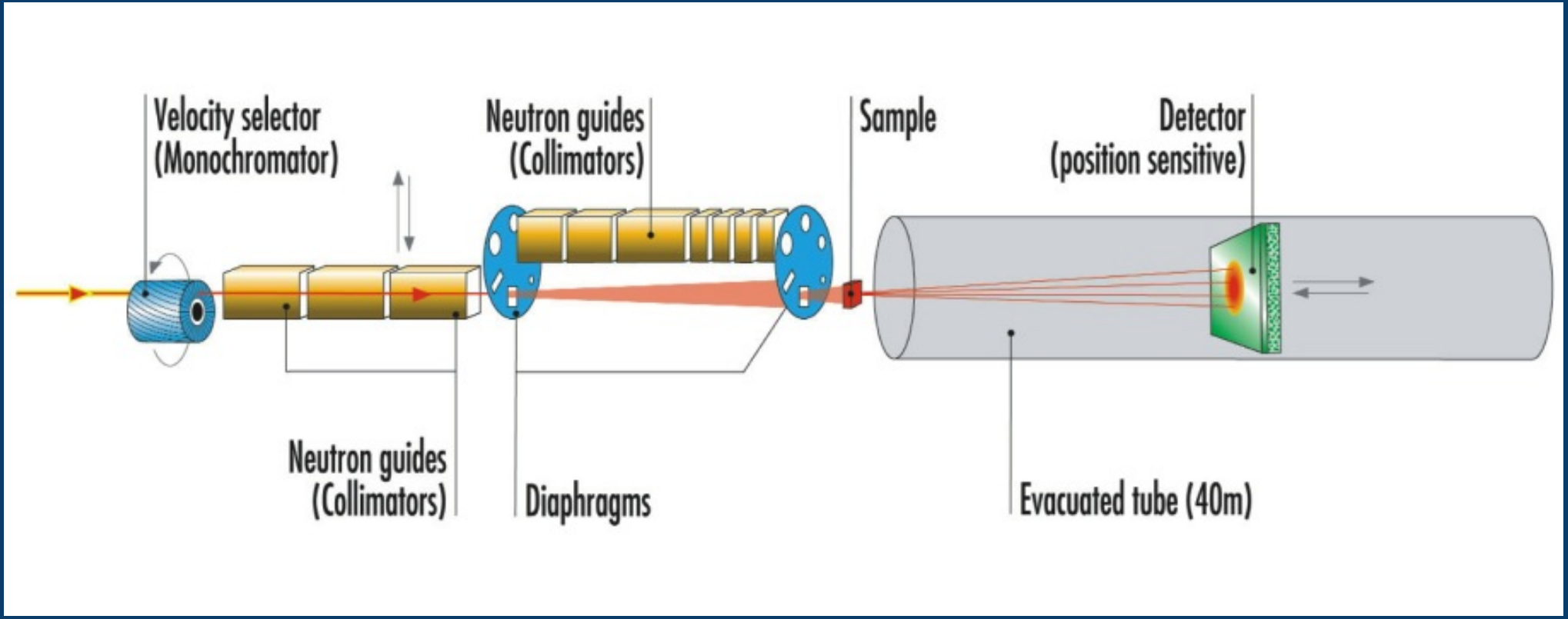
R. Gähler et al. Proceedings SPIE 4785; Advances in Neutron Scattering Instrumentation; Ed: Anderson I., Guerard B. 153-163. 2002

C. Grünzweig et al. App. Phys. Lett., 91, 203504-203504-3. 2007



Sketch of the focussing effect of the OPUS principle by using multi-lenses close to the sample.

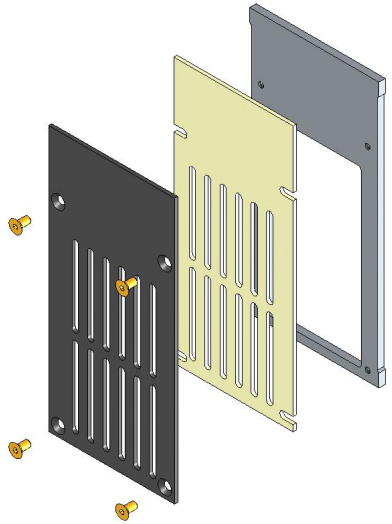
Previously Tests on D11



The D11 layout

Previously Tests on D11

Diaphragm changer disc, like at 20.5m upstream from the sample position



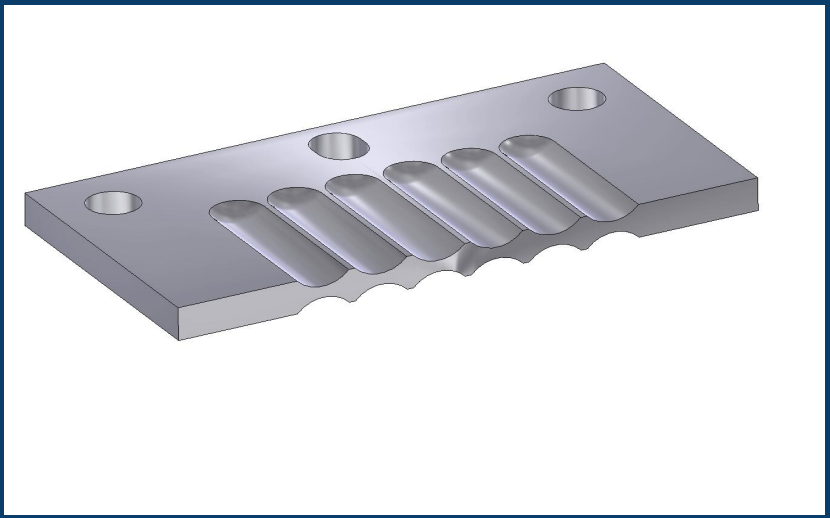
For first D11 tests: multi-slit 1D geometry

Advantages of 1D geometry
- Higher intensity;
- no prisms for g-correction

Disadvantage: not usable for anisotropic scattering

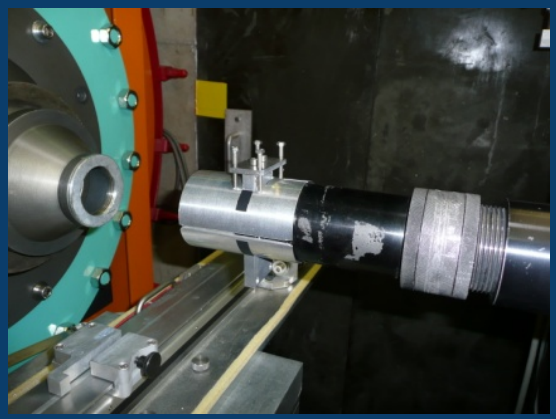
Previously Tests on D11

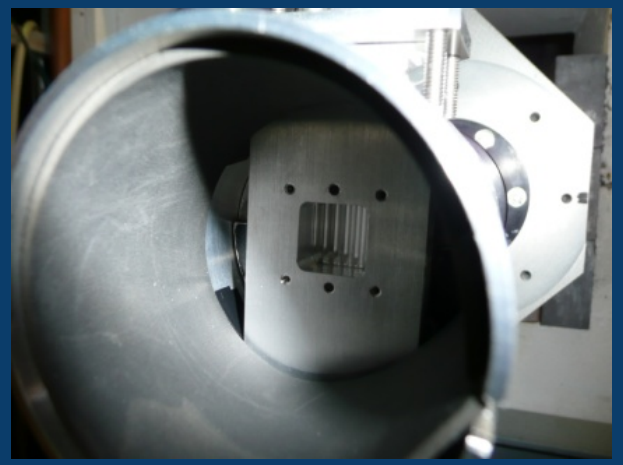
For first D11 tests: 1D geometry



Cut of the multi cylinder lens

The Cd multi lens apertures; adaptable from 0-2mm width





For the tests the lenses have been put on the black nose

in the final version they shall be put in the diaphragm changer disc at this position already available

What has been done so far?

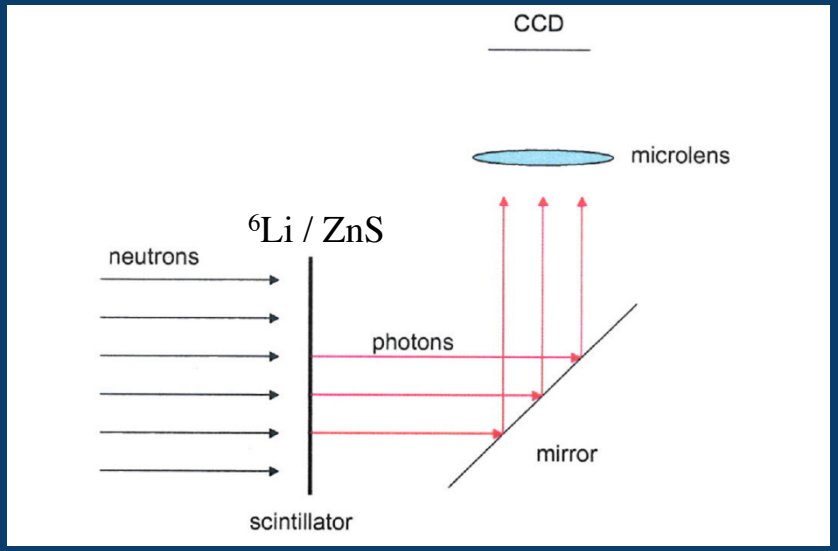
Two series of tests in August 2007 and December 2007
both with a multi-slit aperture

Tests with 2 different cameras:

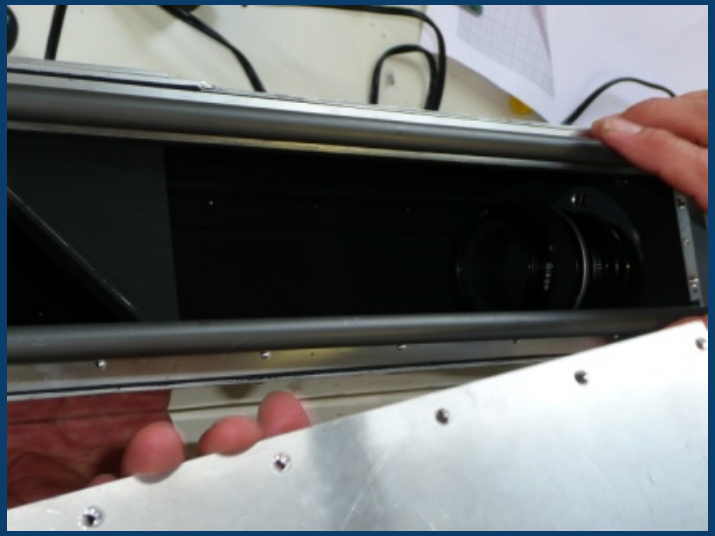
ANDOR DU 888 in August

Princeton Instruments PhotonMax 1024 in December

measurement of diverse samples (gratings, soft matter samples, cellulose fibers from S18, etc.



What has been done so far?



What has been done so far?

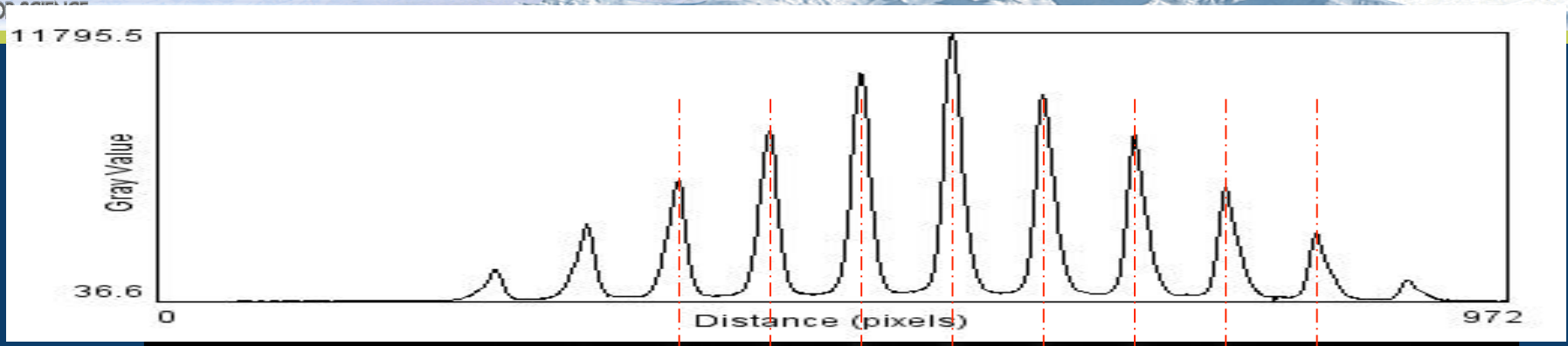
First results of the test measurements at D11 on 28-30 Aug. 2007, using the Andor EMCCD camera from Munich

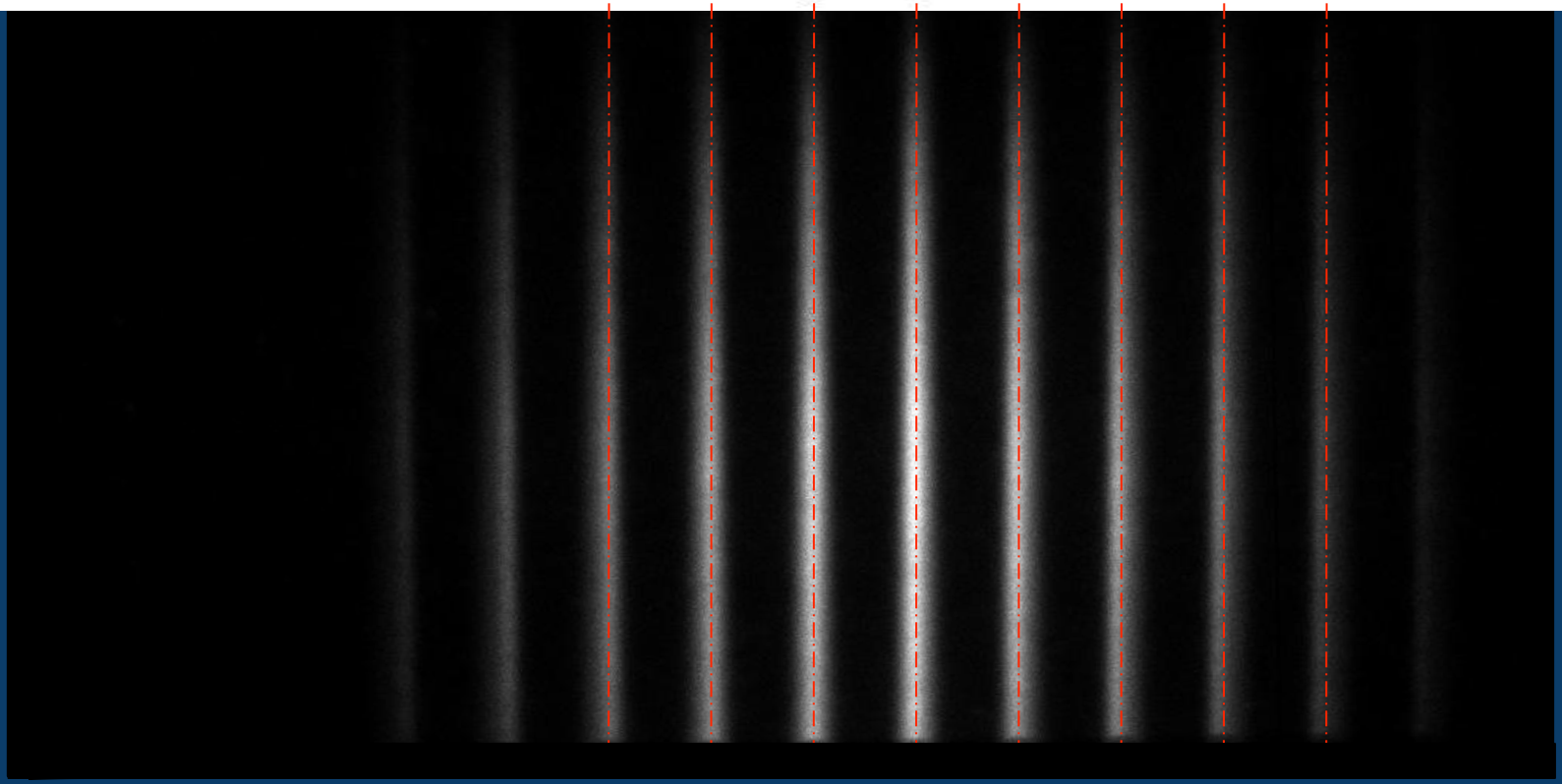
The EMCCD camera allowed for on-chip amplification up to a factor of 1000

The weak signal of just a few few hundred neutrons per pixel was enhanced to produce an image

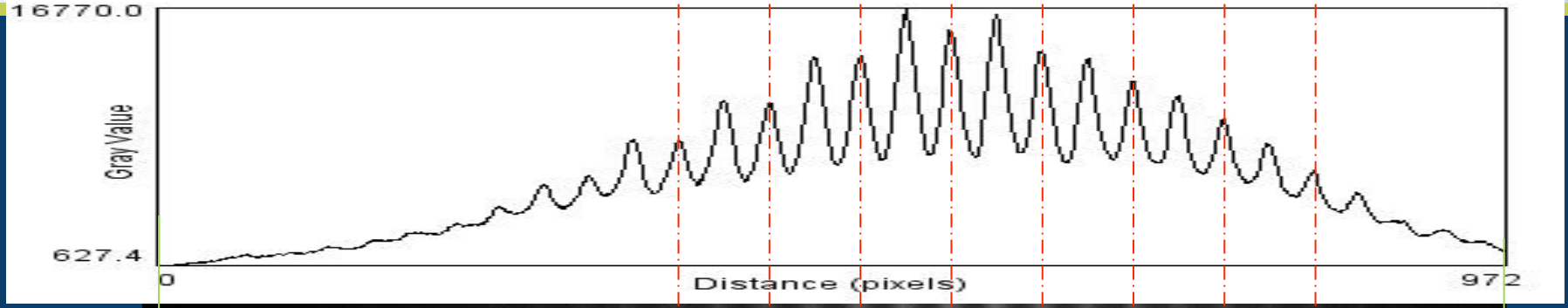
Measuring time for a sample was between 60 seconds and five minutes (Typical SANS measurement in the low Q range: 30 min …several hours)

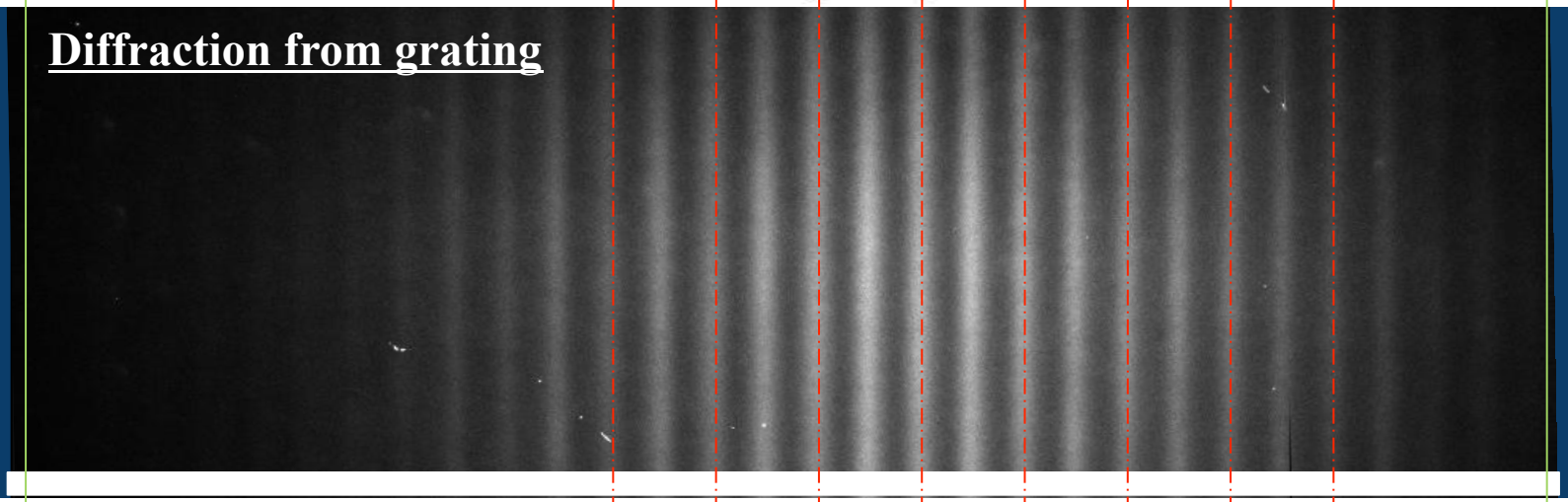
First results at D11 Aug. 2007: Image of the slits without a sample

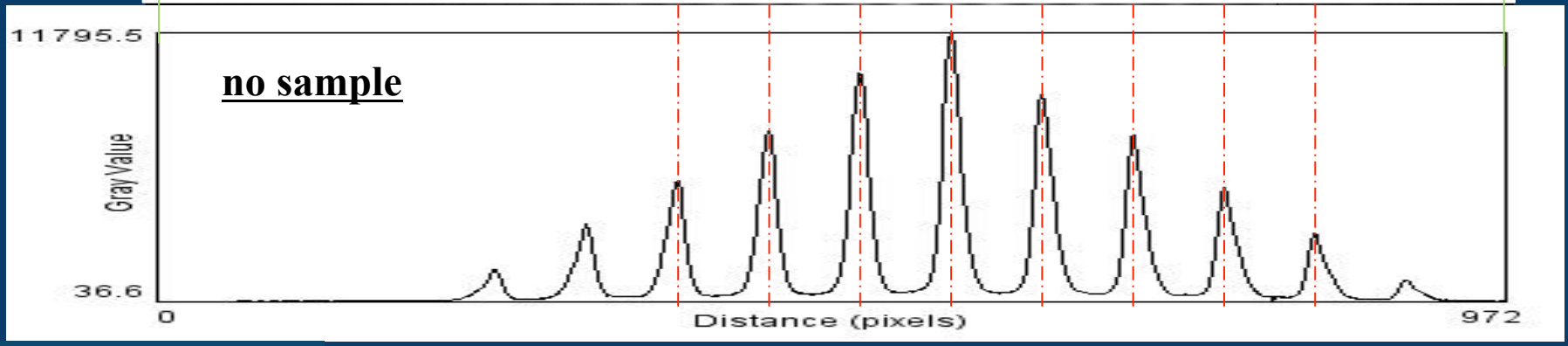




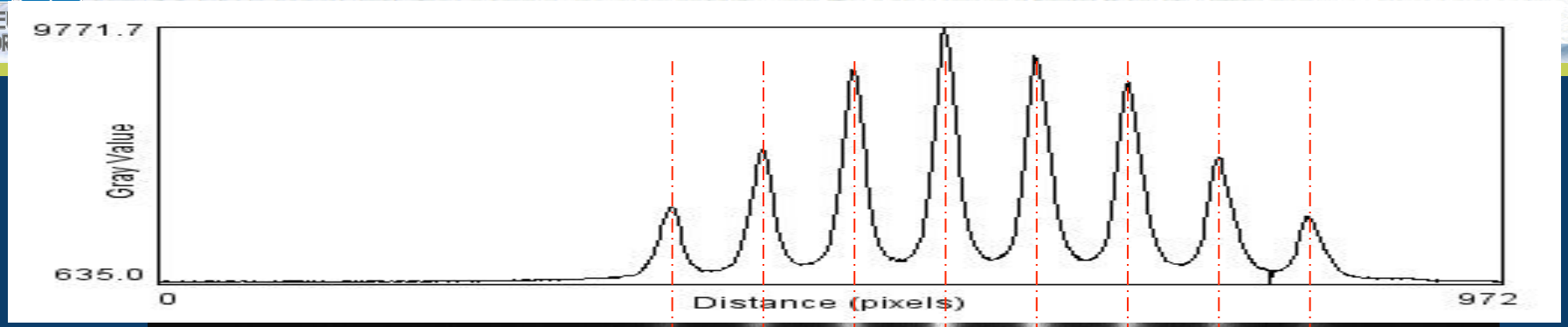
Diffraction from grating
(8.5 μm lattice constant, 1st order maxima overlap)

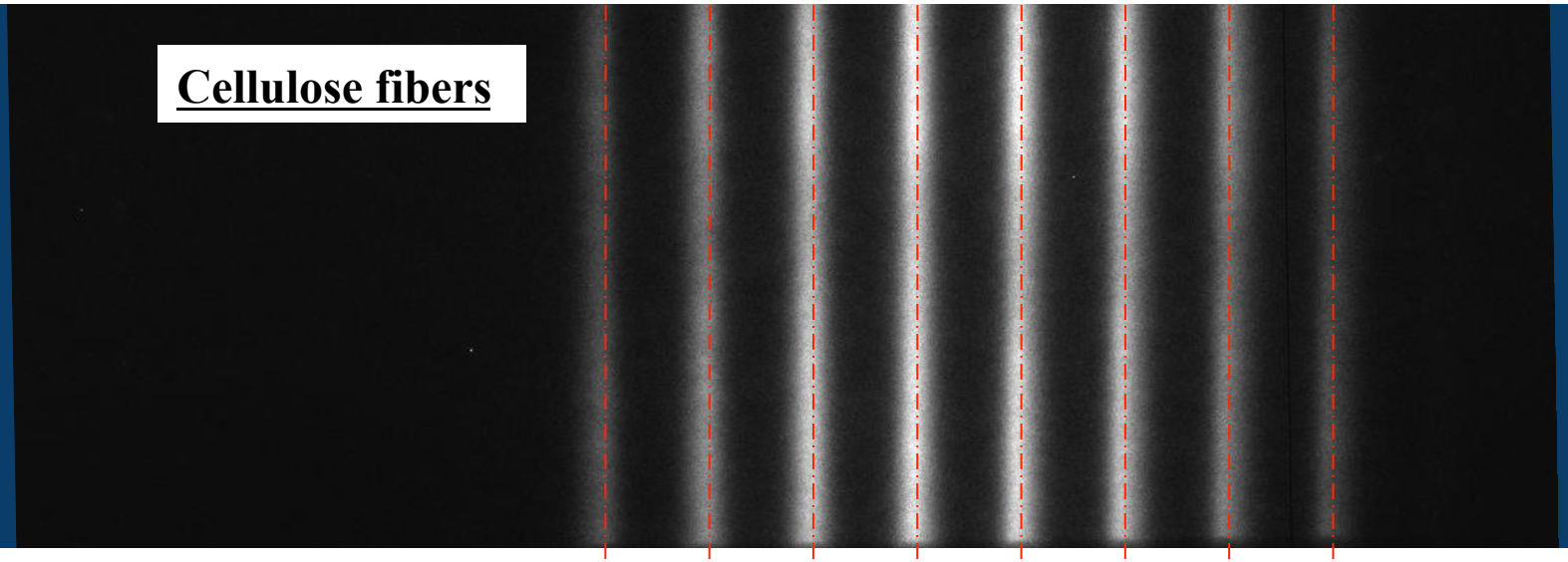


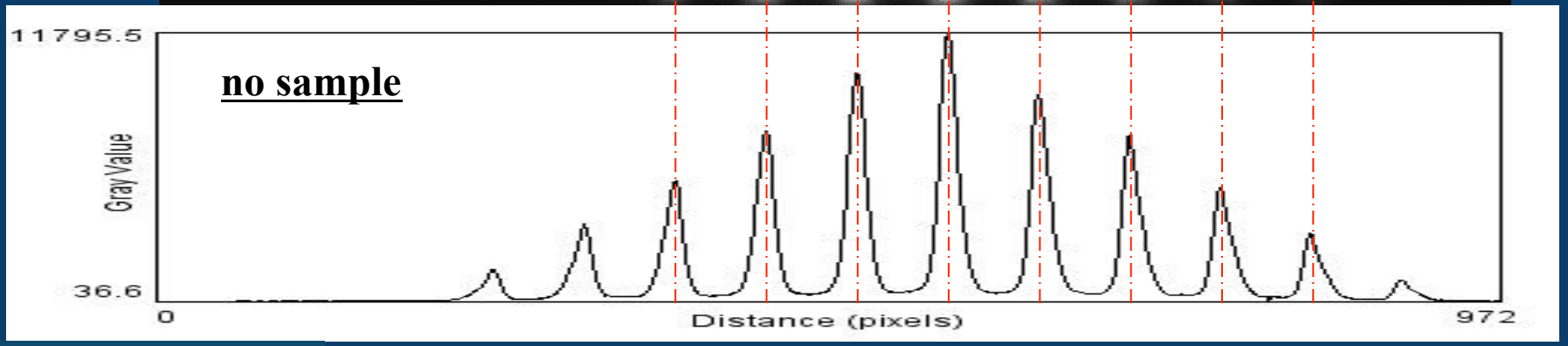




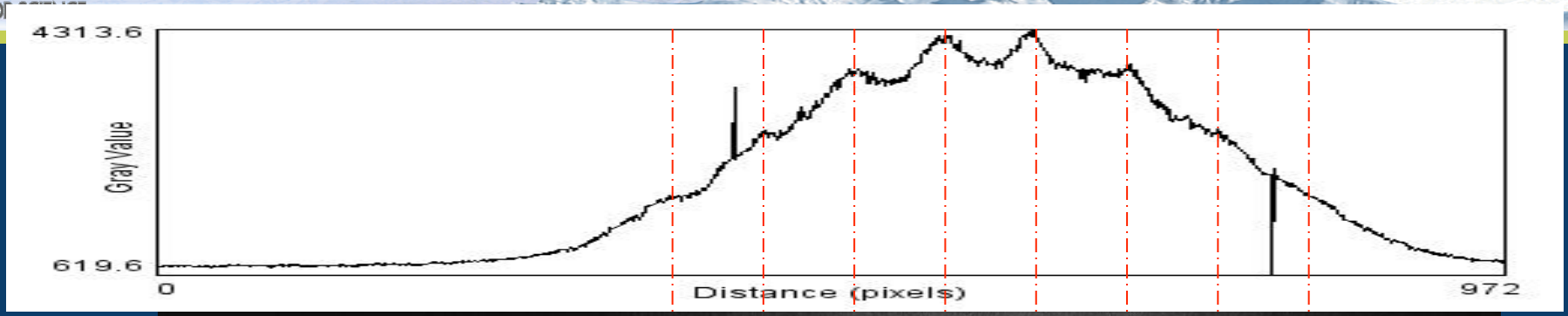
Cellulose fibers aligned horizontally, i.e. perpendicular to slits

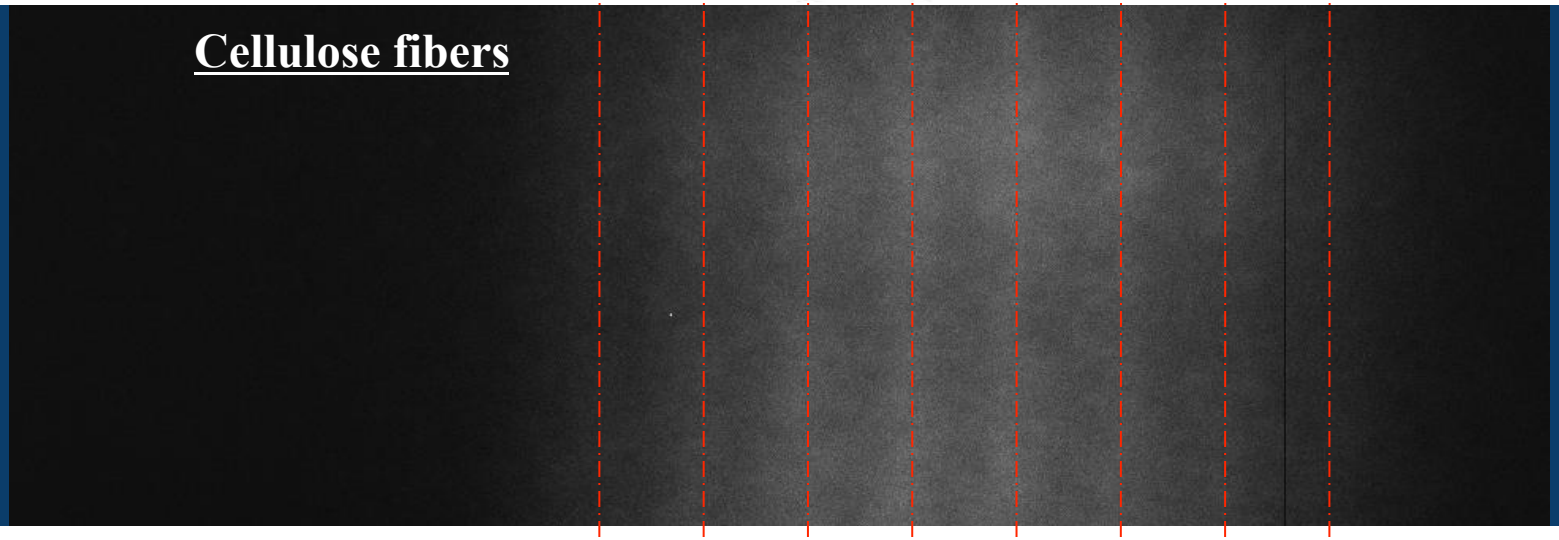


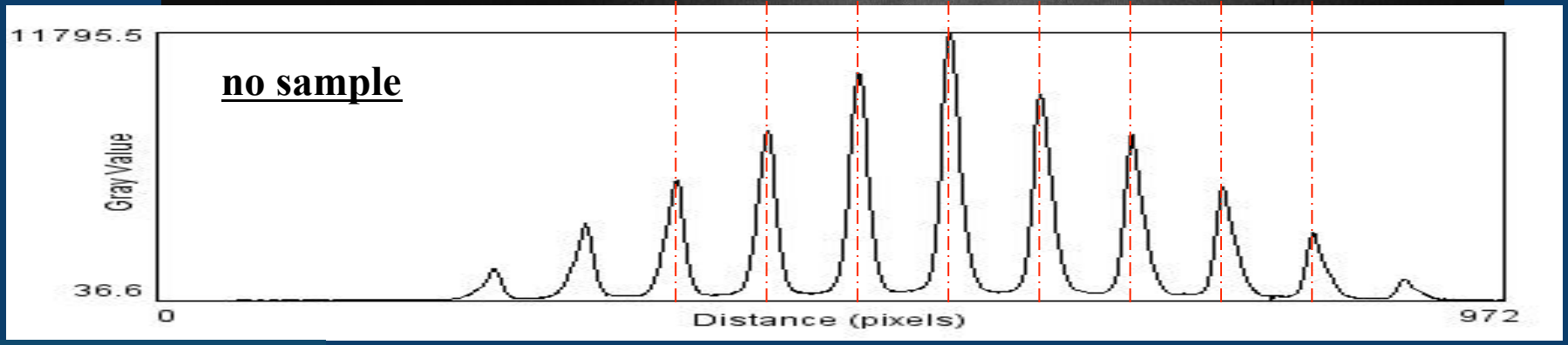




Cellulose fibers aligned vertically



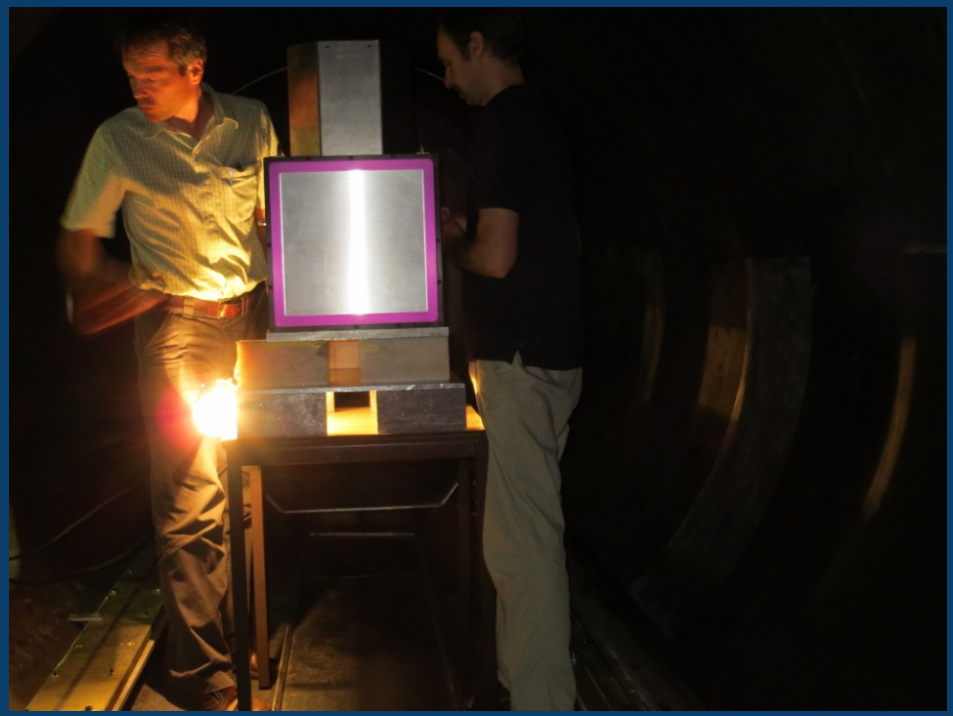




USANS / CCD update

- So far, you do a dedicated SANS experiment somewhere and if needed another dedicated USANS experiment
- This means submitting a second proposal, wait ...
- Aim: to top LOKI with an USANS option
- get at least another order of magnitude in q with decent overlap to the normal SANS curve
- Needs a high resoluion detectorSub-task on a NSE hp cell
- Then do USANS for a sample whenever you need additional q

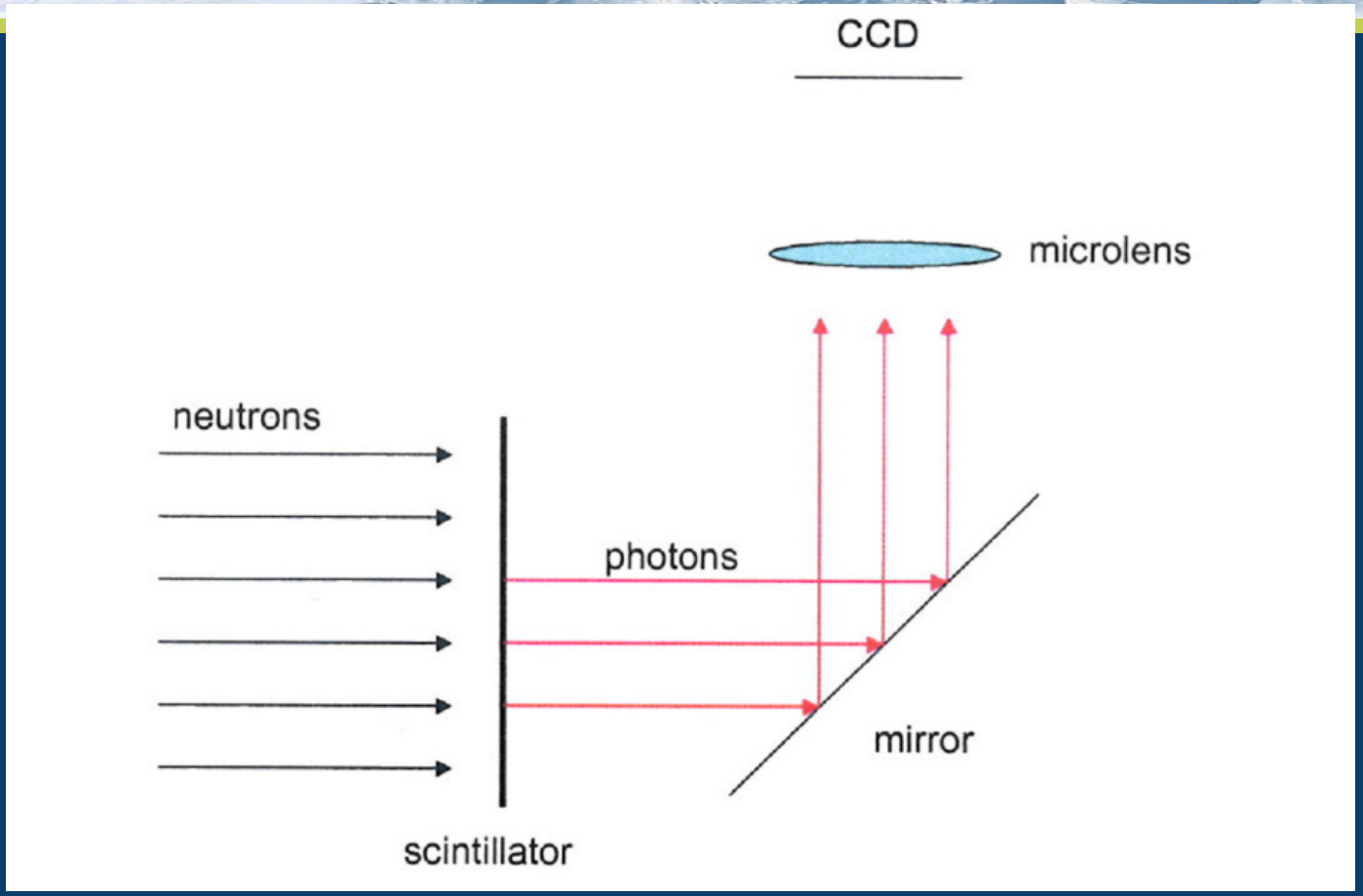
Testing of different CCD´s at D11



Setting up the Barotron Maatel / Arinax

Setting up the Photonic Science CCD

CCD´s for neutrons

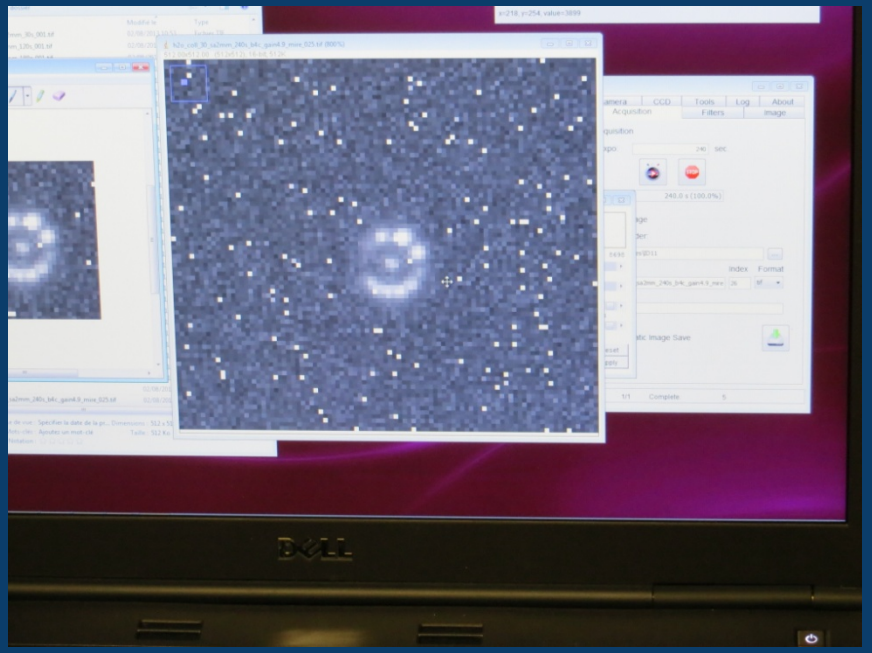


Scintillator mainly contains ...

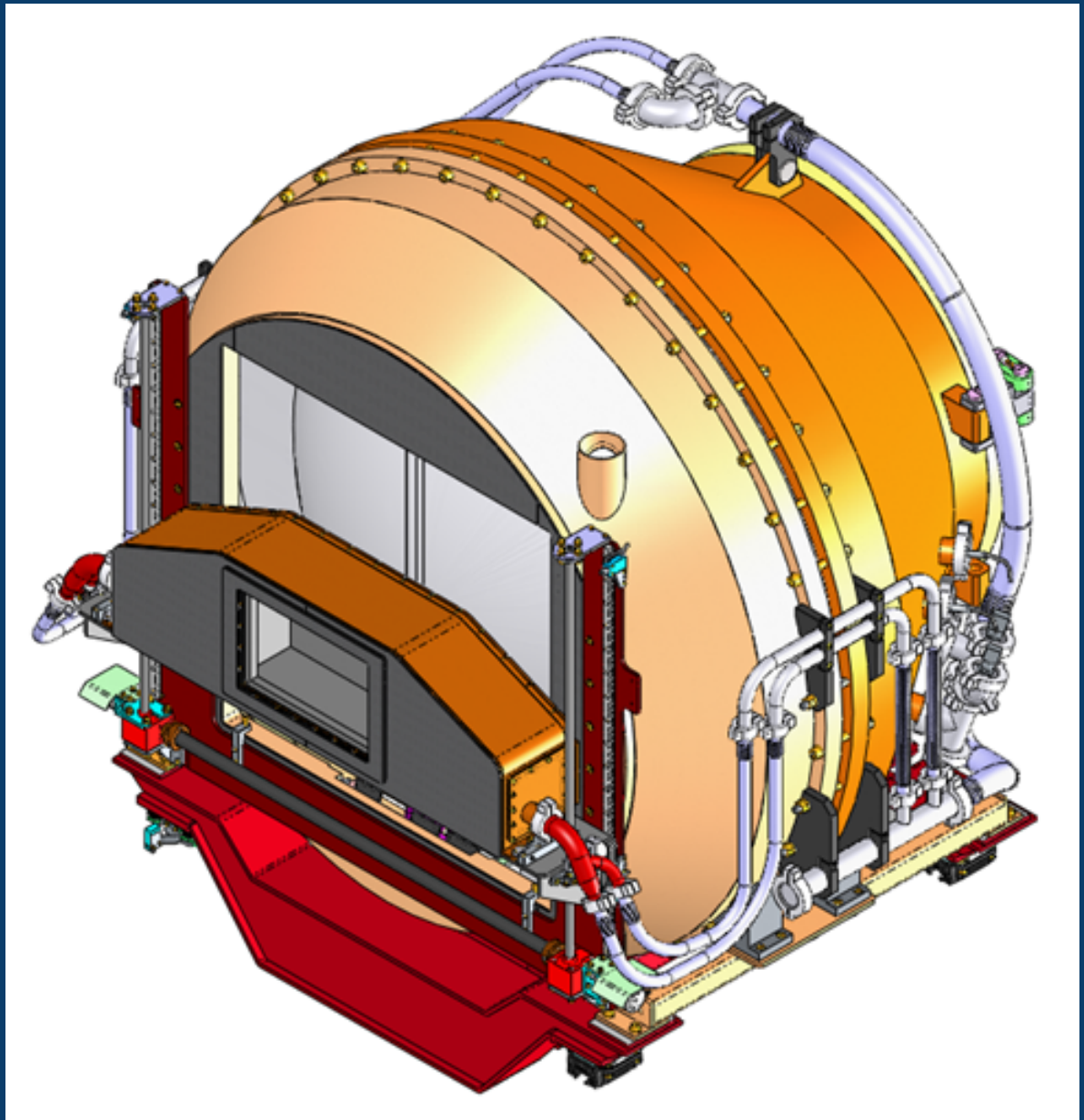
^{6}LiF: to react with neutrons and produce energy

ZnS to convert energy into light

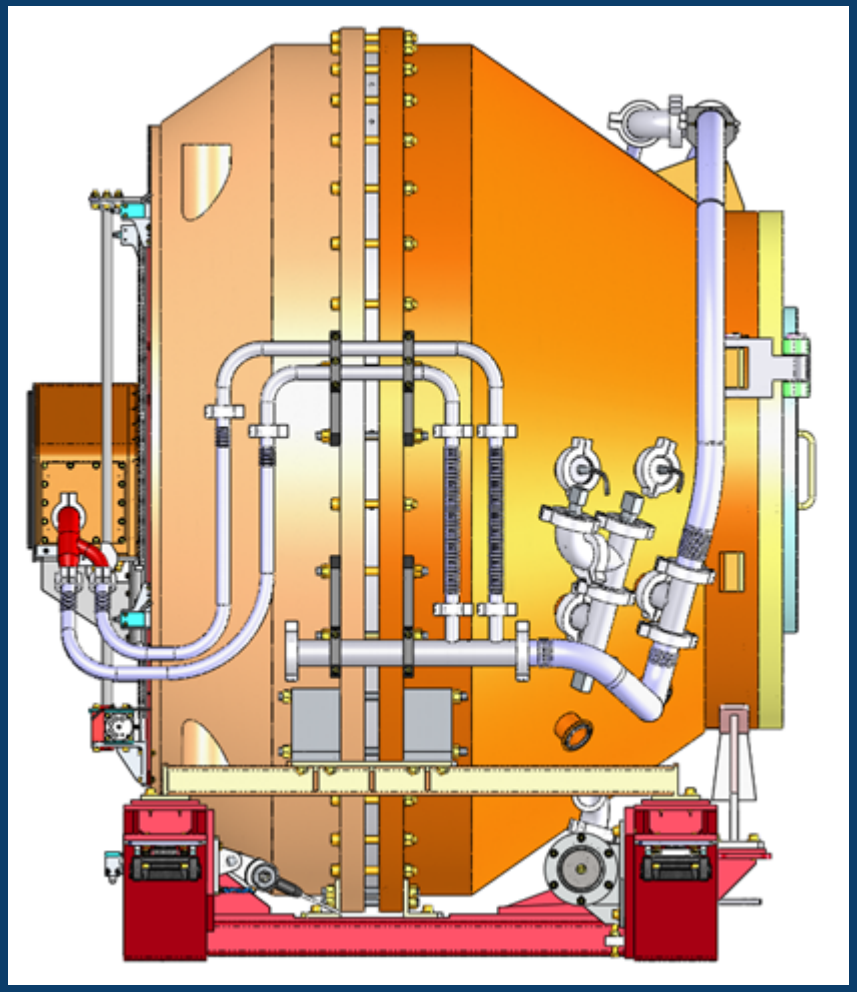
AgBehenate powder

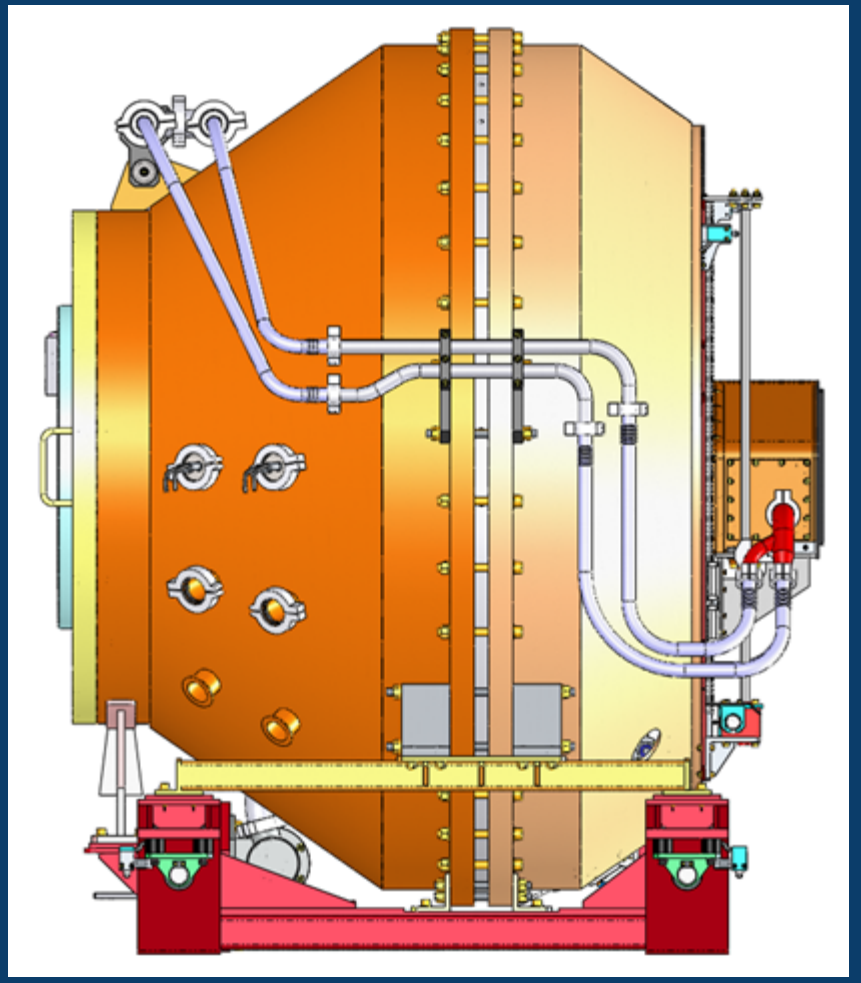


DESIGN FOR D11 PROTOTYPE



DESIGN FOR D11 PROTOTYPE

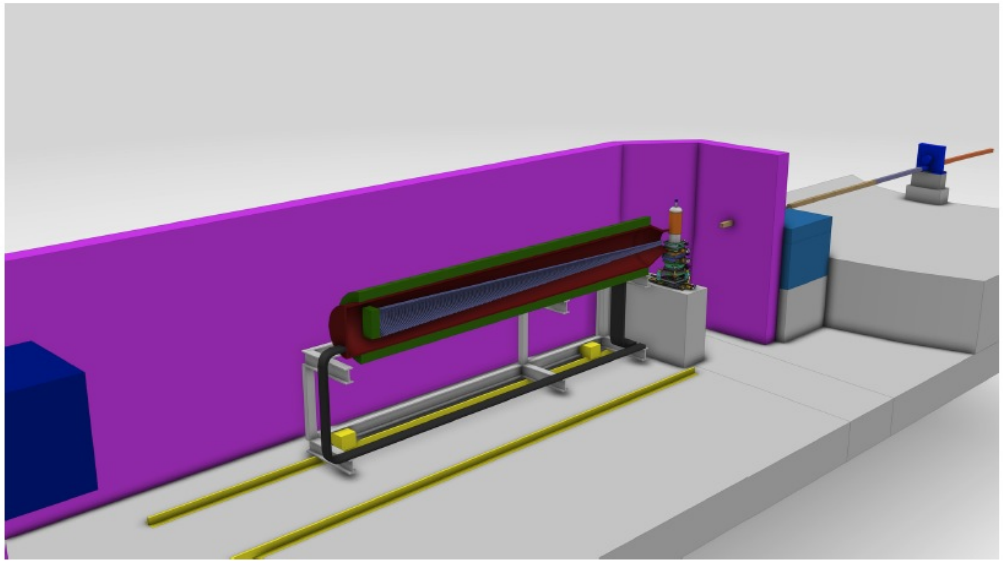




NEUTRONS FOR SCIENCE

EUROPEAN SPALLATION SOURCE

ESS Construction Proposal
LoKI - A broad-band SANS instrument



Andrew J Jackson
and
Kalliopi Kanaki

Inital Submission: 31st October 2012
Final Submission: 28th February 2013

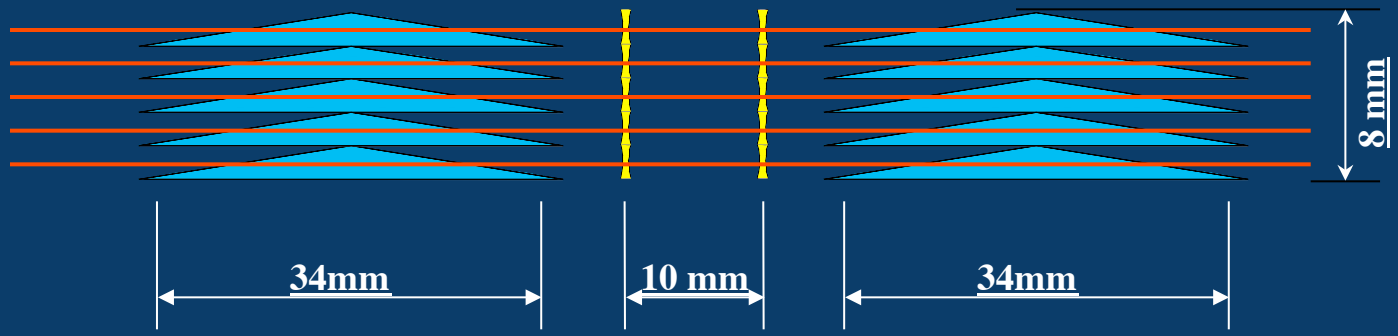
DETECTORS FOR THE PROTOTYPE

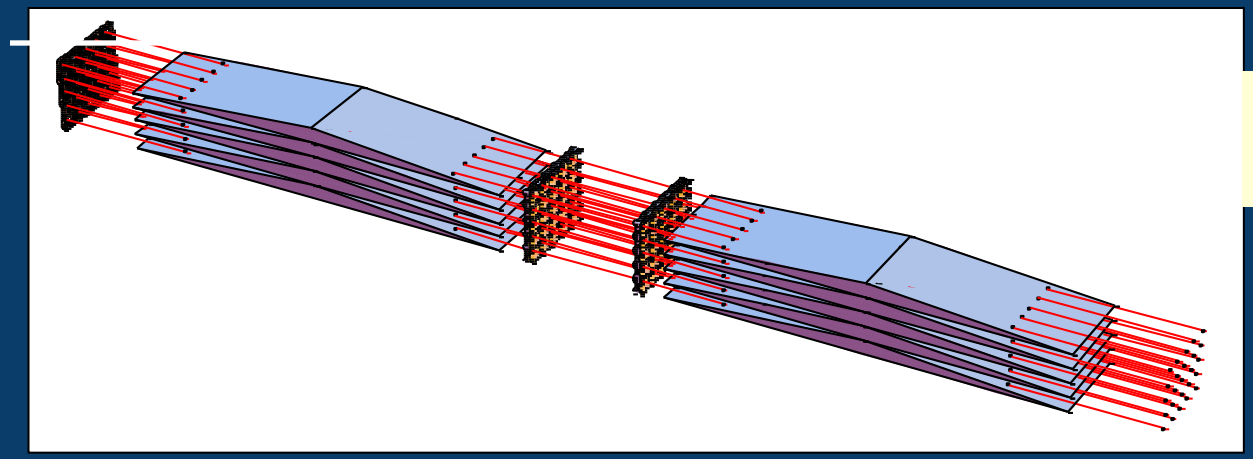
2750 (h) x 2200 (v) pixels, 4.54 μm square
Read out area of 354(w) x 221 (h) mm imaged on 2 ICCD cameras
Optical pixel size at the scintillator input of 177 μm square (no binning)
Photonic Science UK (same as OrientExpress & Cyclops)

TO BE DEFINED FOR LOKI

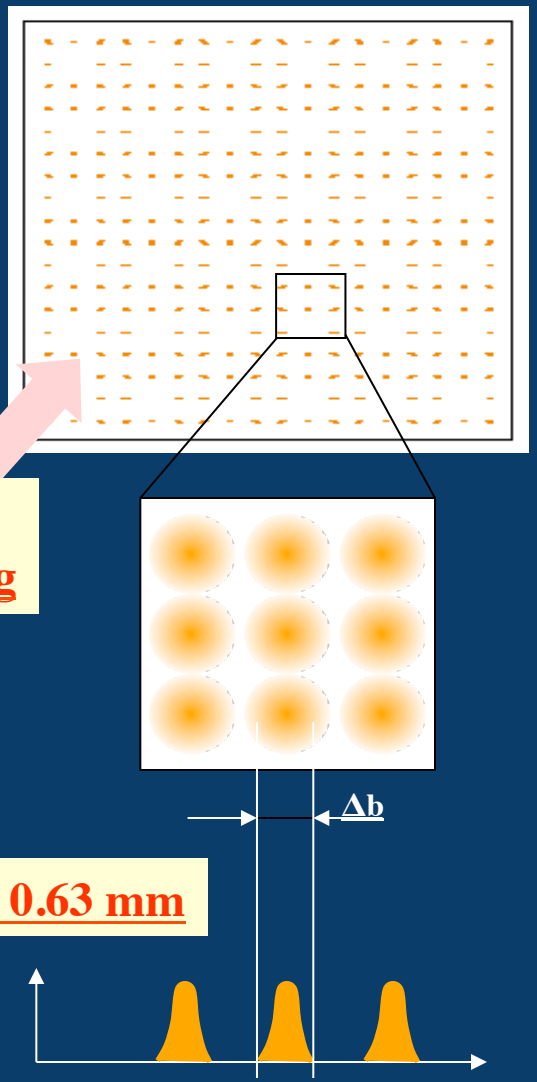
USANS CORRECTION OF THE GRAVITATIONAL DISTORTION

$L_1 = L_2 = 20m$; $\lambda = 10Å$





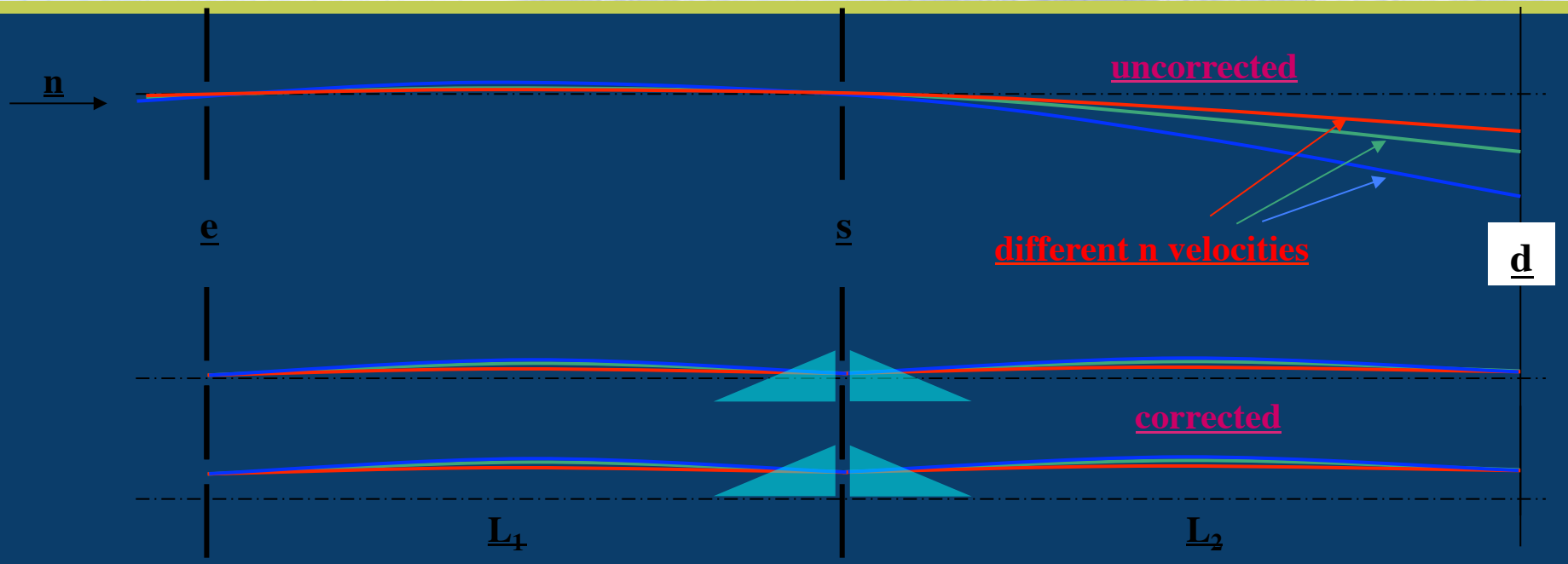
Result of ray tracing



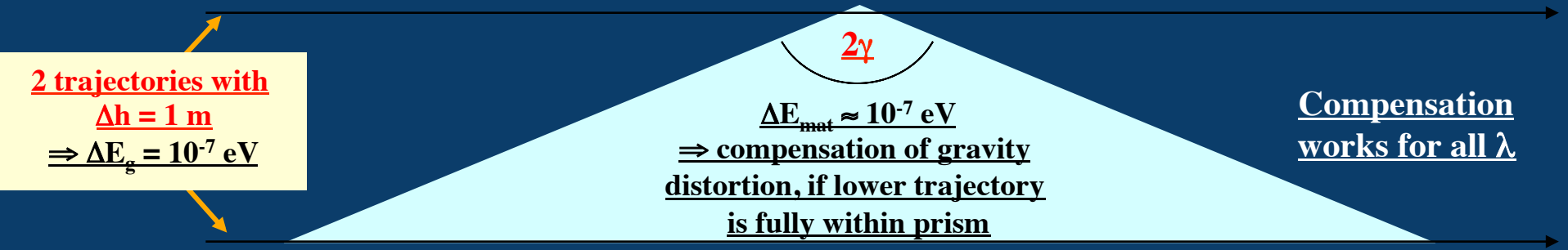
Δb ≈ 0.63 mm

Ray tracing of complete 2D setup with gravity correction based on D11 geometry;

USANS CORRECTION OF THE GRAVITATIONAL DISTORTION



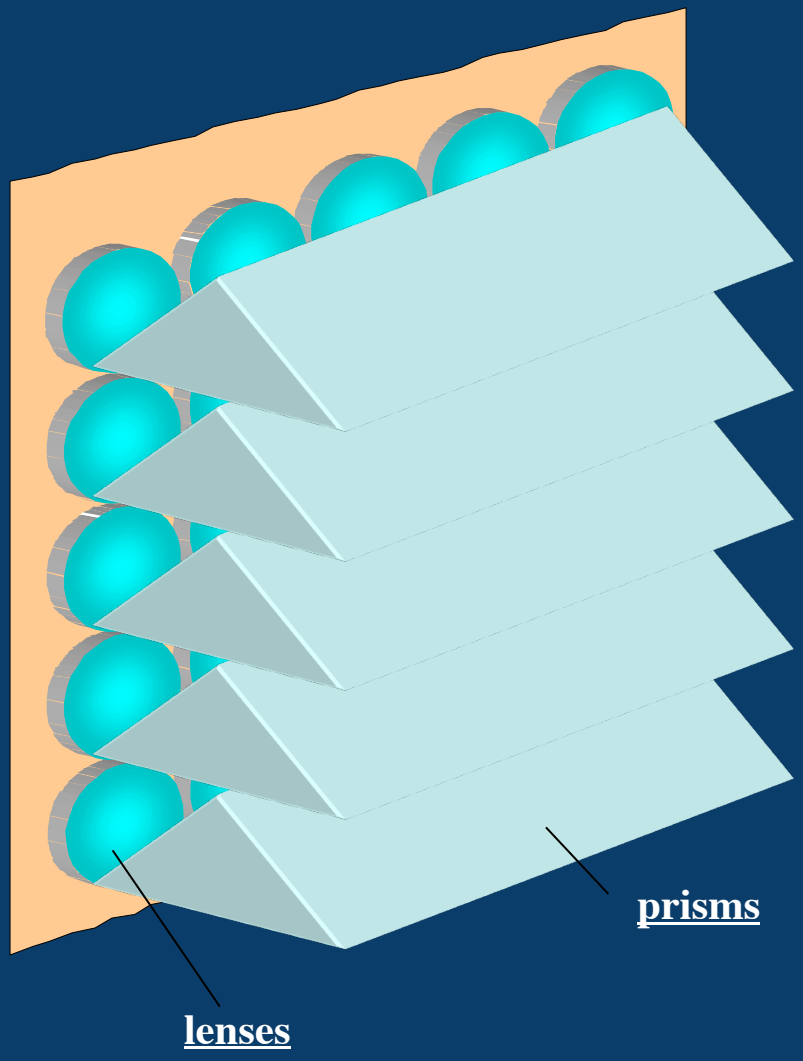
estimation of apex angle:



2 trajectories with Δh = 1 m ⇒ $\Delta E_g = 10^{-7}$ eV

For $L_1 = L_2 = 10$ m, *tan* γ = 10; γ=84°

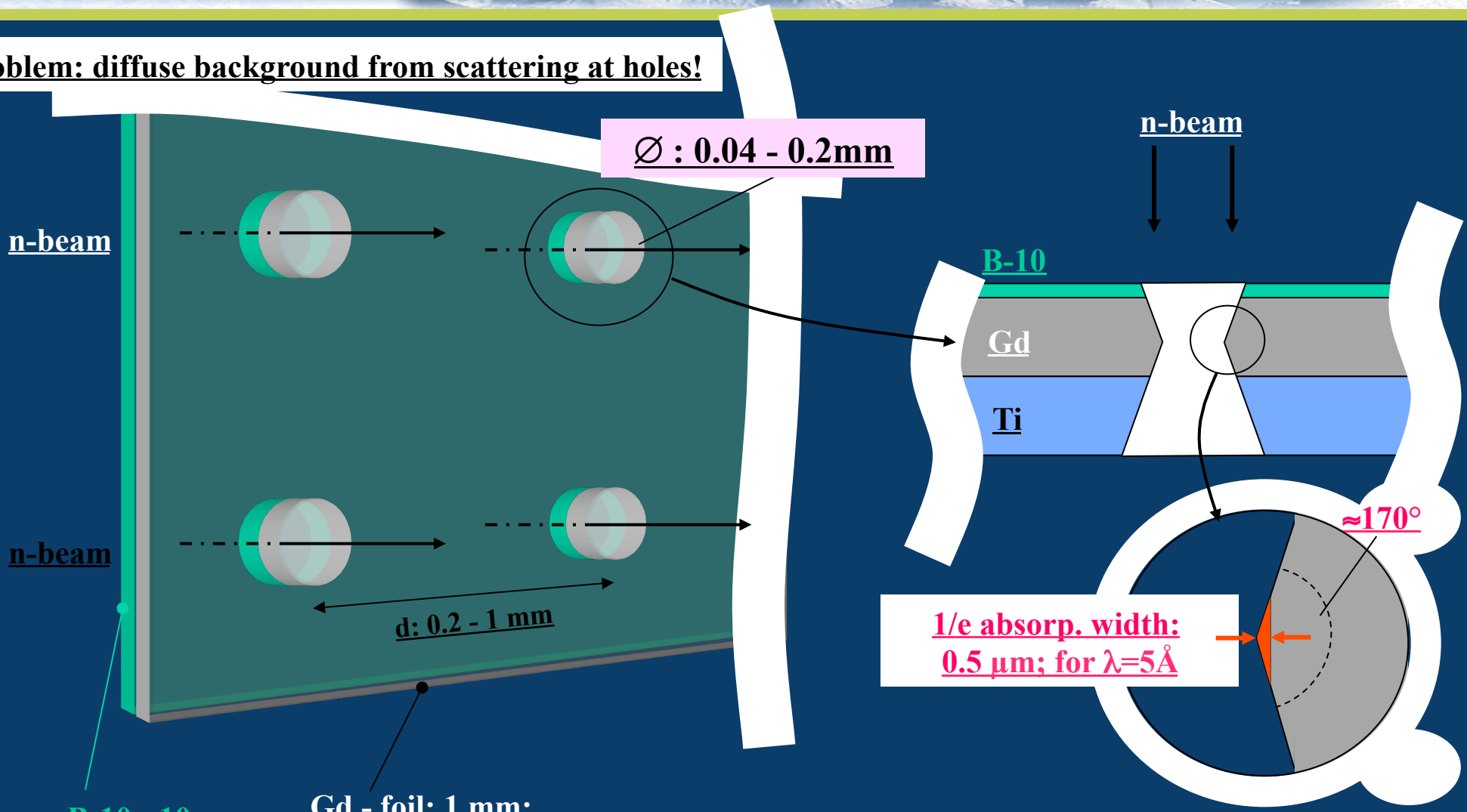
USANS: design of multi-lens and prisms near sample :



Prisms:
Height: 2.5 mm
Width: 50 mm
Length: 16 mm
Material: Quartz / Sapphire
Attenuation: ≤ 10%

Sample multi-aperture:

Problem: diffuse background from scattering at holes!



⇒ Diffraction from prism creates diffuse background;

⇒ Peak/background ratio: ≤ 10^{-4} on 2D detector