GISANS option on Super ADAM reflectometer

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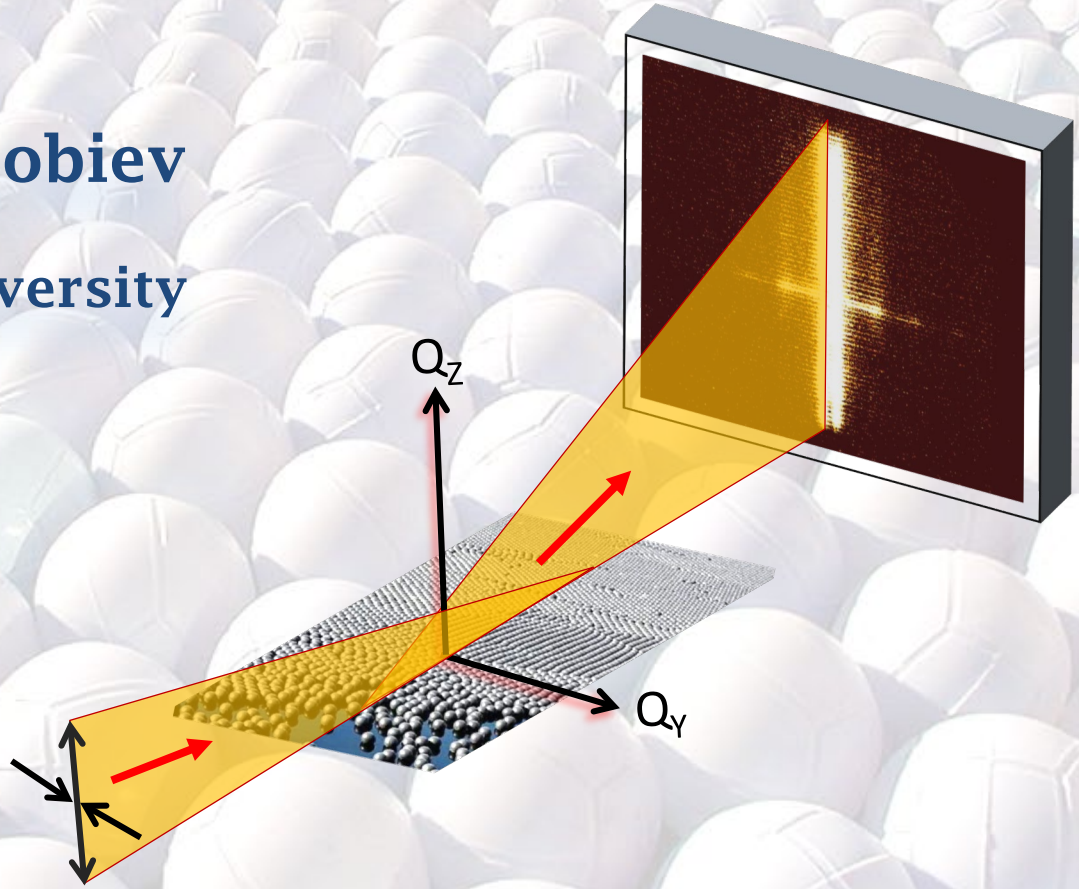
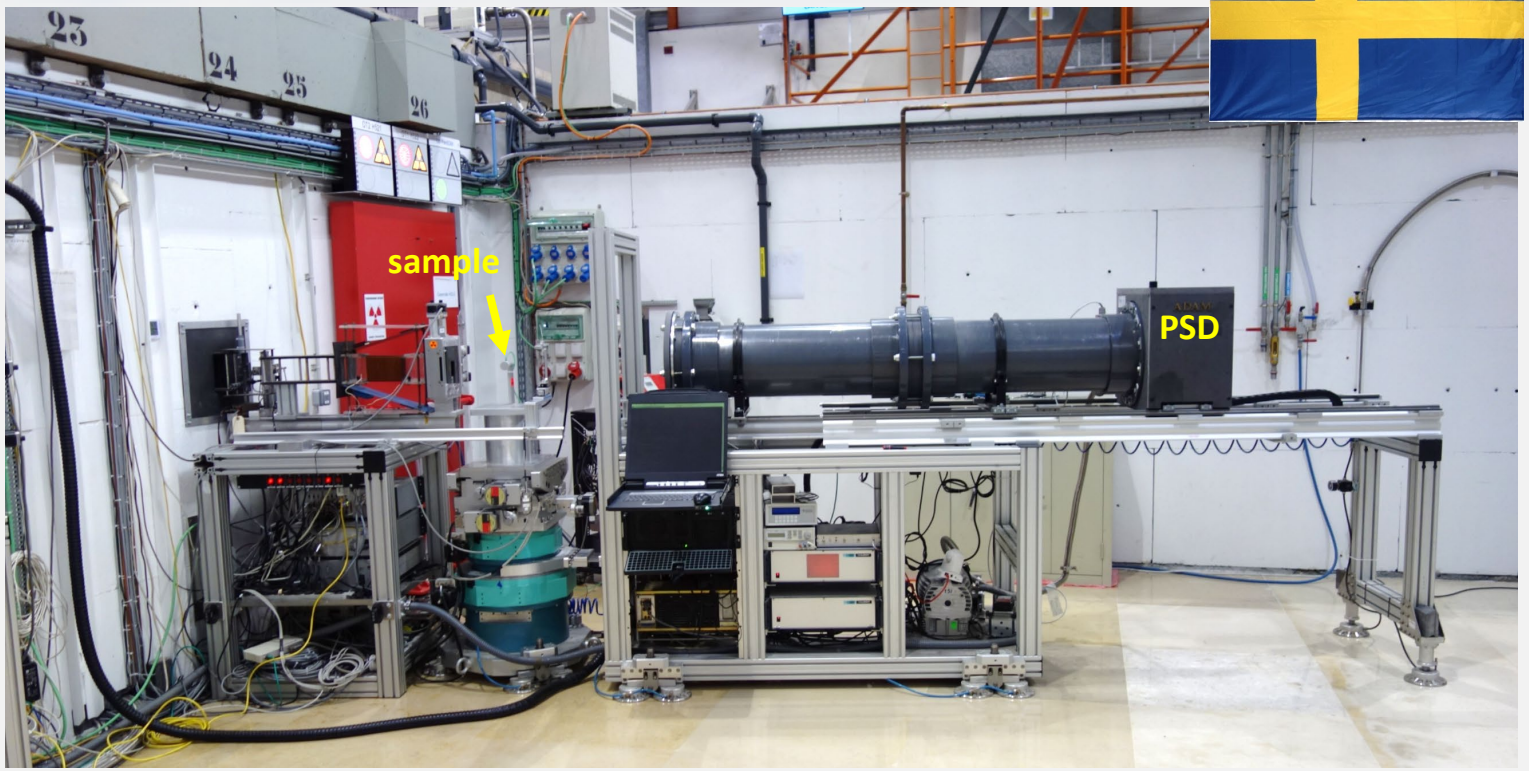
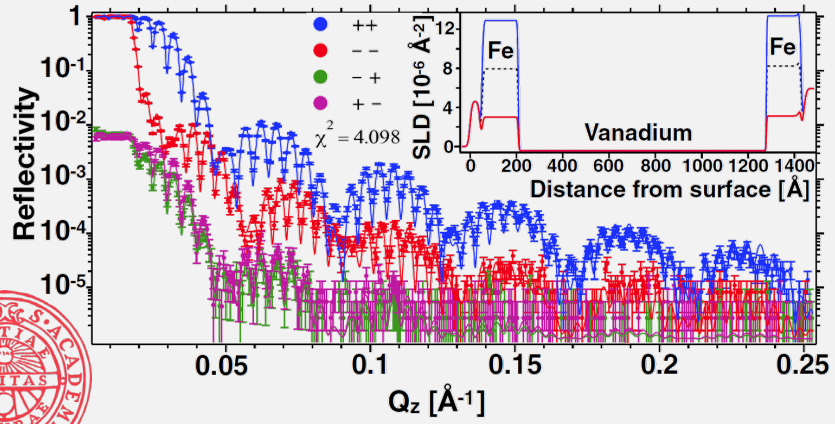


GISANS session of Swedish neutron week 2021.05.12

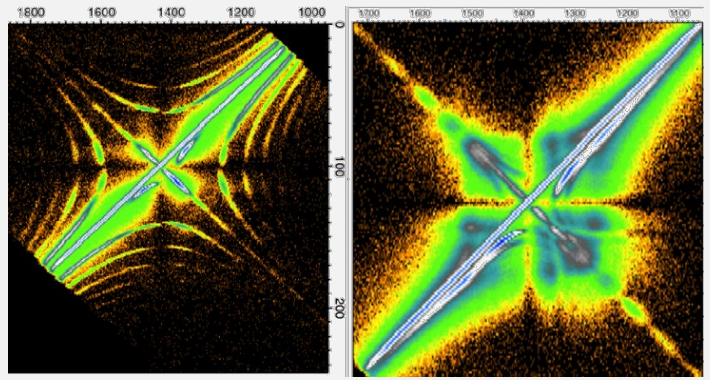
Super ADAM reflectometer



focusing HOPG monochromator (5.2Å)
variable resolution
high polarization (99.8%)
flexible construction:
sample detector distance 0.5 – 6 m
Denex PSD 300 × 300 mm
low background



M. Wolff et. al. PRL 123, 016101 (2019)

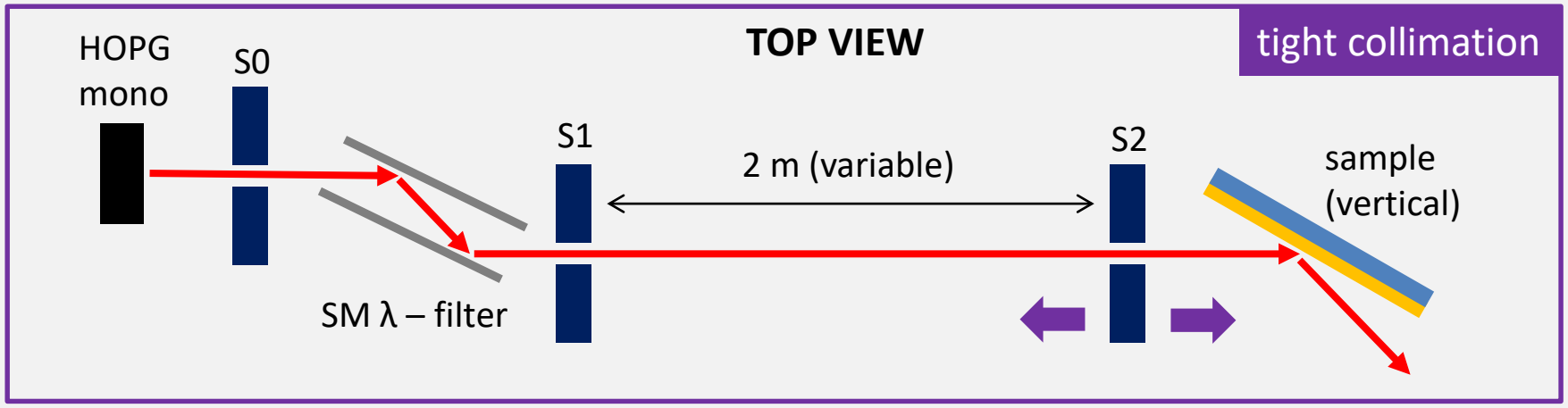


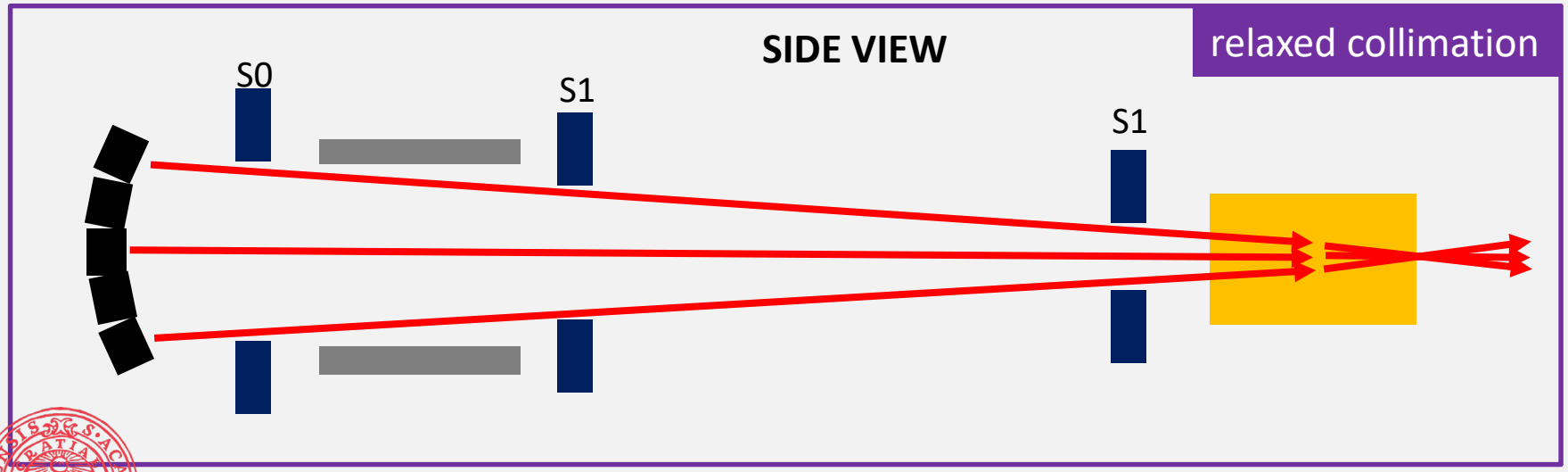
A. Devishvili, in progress

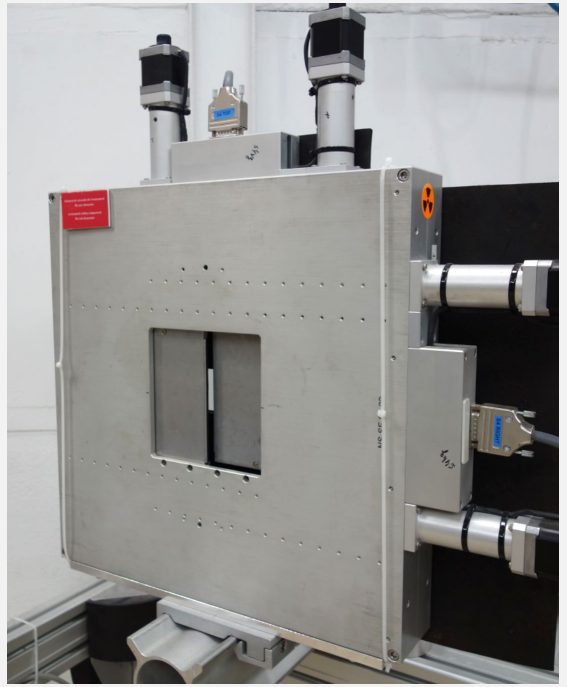
70% beamtime

especially good for
high-resolution polarized
neutron reflectivity and
off-specular scattering

How the beam is formed

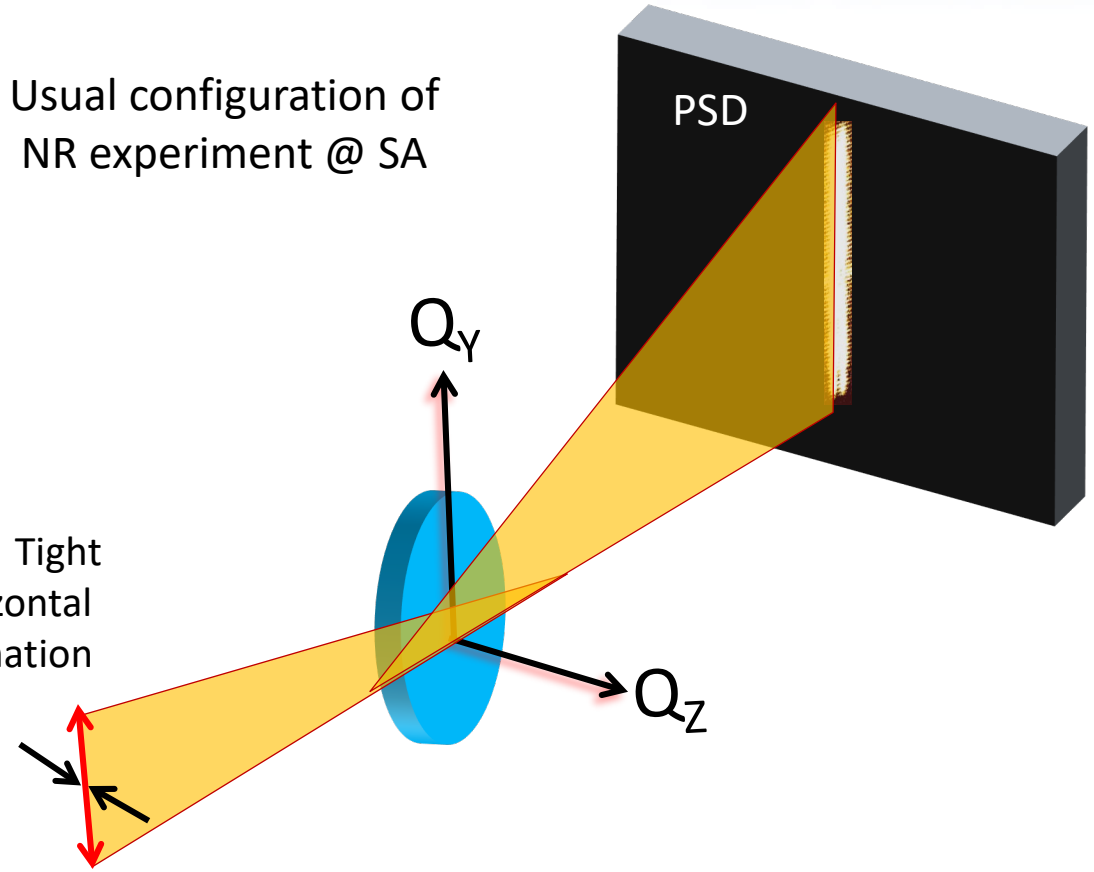






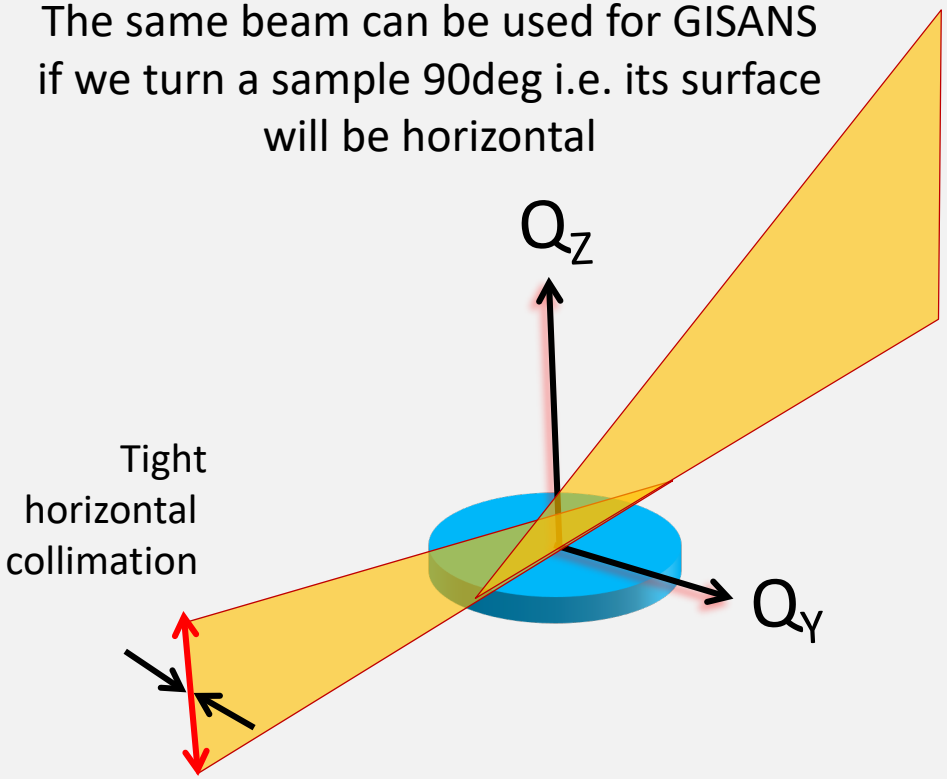
First idea about GISANS

Usual configuration of
NR experiment @ SA



Momentum transfer:
Q_Y – lateral component (in-plain structure)
Q_z – perp. component (in-depth structure)

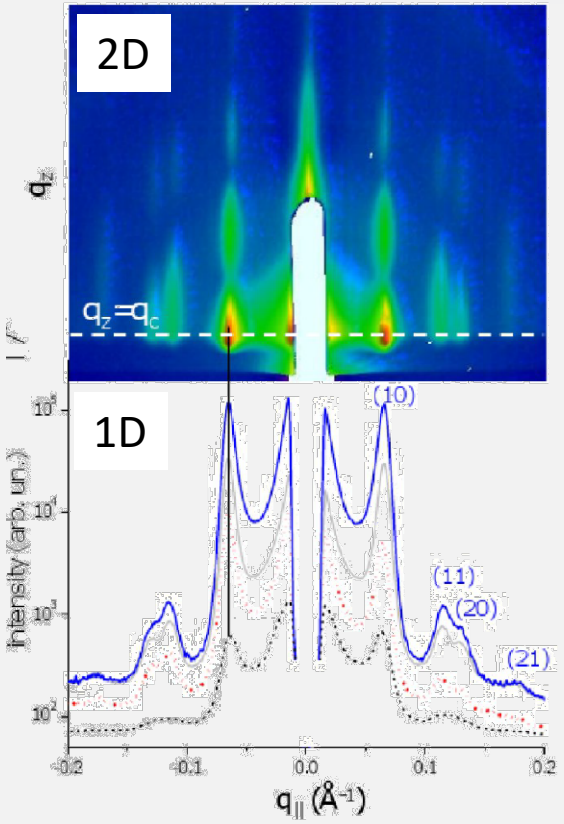
The same beam can be used for GISANS
if we turn a sample 90deg i.e. its surface
will be horizontal



Q_y and Q_z are swopped in NR and GISANS experiments

GISAXS @ ID10b ESRF

2D vs. 1D



GISAXS pattern obtained from iron oxide 10 nm particles on a water surface.

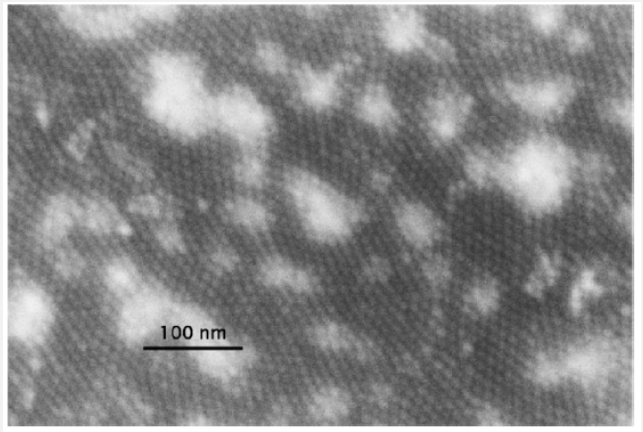


Table 1. Measured Interplanar Distances $d_{hk}^{exp} = 2\pi/q_{||}^{hk}$ Compared to Calculated Interplanar Distances $d_{hk}^{calc} = a/(4/3(h^2 + hk + k^2))^{1/2}$, Assuming a Hexagonal Lattice Constant a and Lattice Constant a^s Obtained from the SEM Data for the Samples IO-10 nm and IO-15 nm

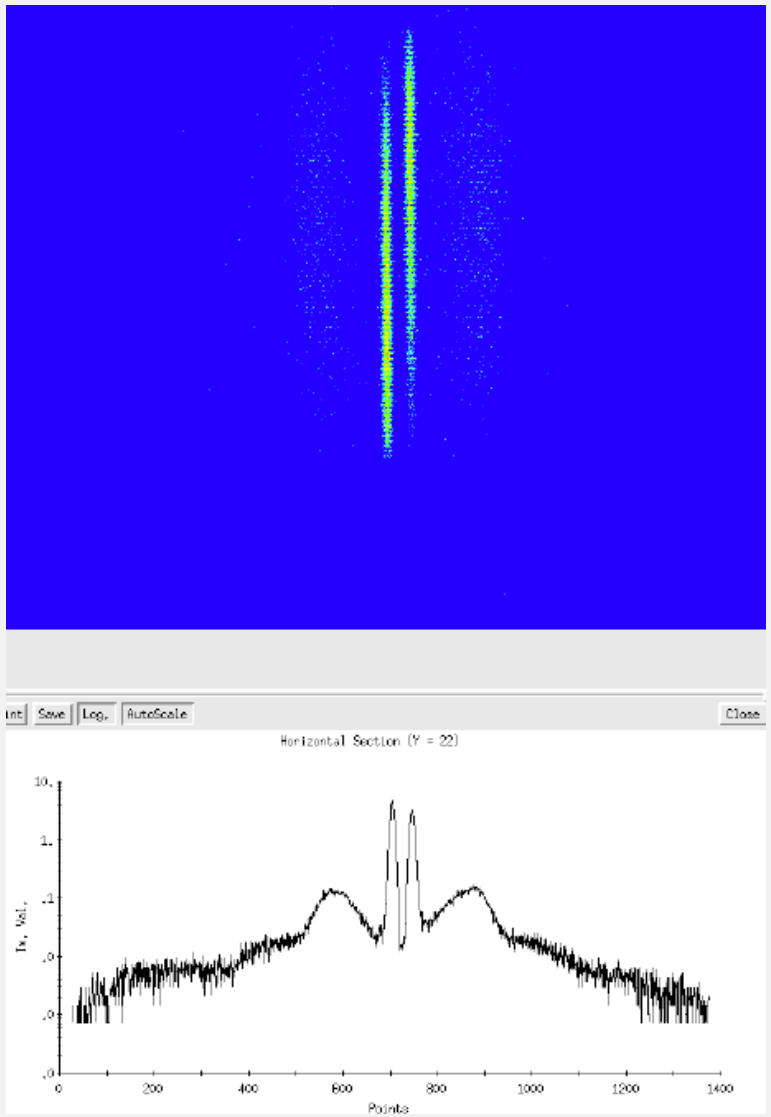
sample	(h k)	d_{hk}^{exp} (nm)	d_{hk}^{calc} (nm)	a (nm)	a^s (nm)
IO-10 nm	(1 0)	9.56	9.54	11.04	10.7
	(1 1)	5.52	5.47		
	(2 0)	4.78	4.86		
	(2 1)	3.61	3.62		

Final result is lattice constant value

A. Vorobiev et. al. Langmuir 2015, 31, 11639−11648

First GISANS pattern from Super ADAM

Drop-casted
40 nm iron oxide
nanoparticles on Si



PSD

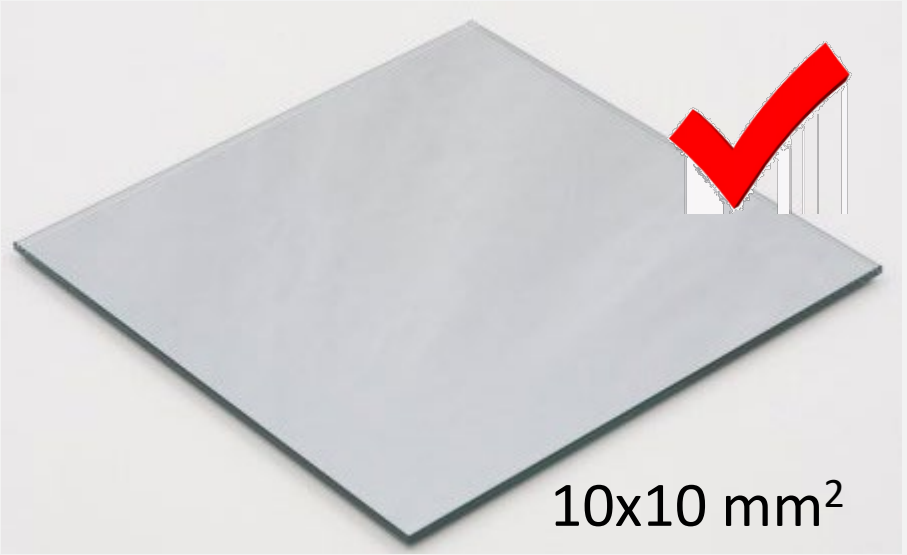
vertical
integration

Challenges in reflectometry: Sample preparation

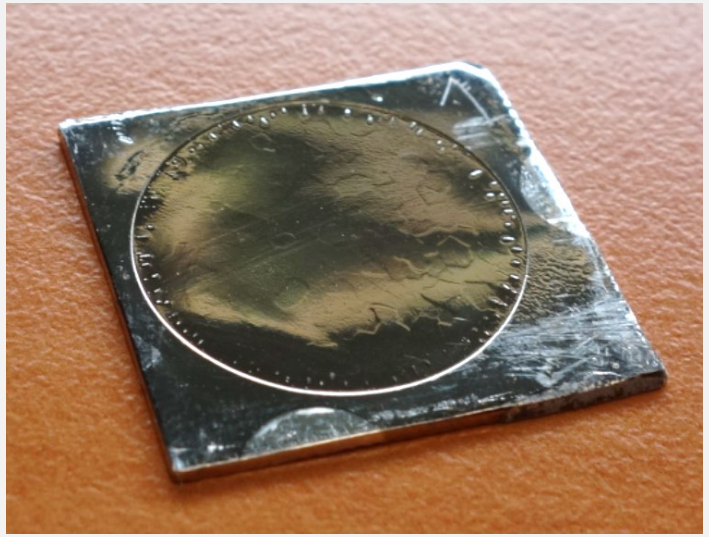
macroscopically flat

microscopically flat

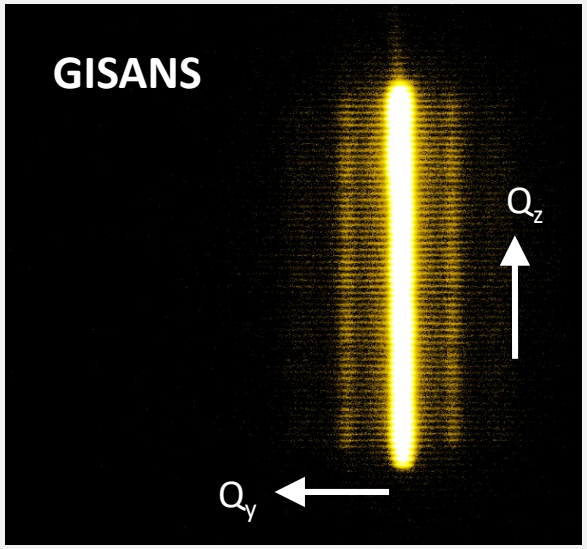
homogeneous

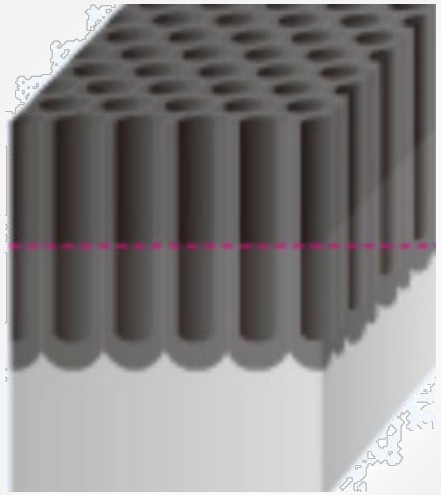


GISANS @ Super ADAM

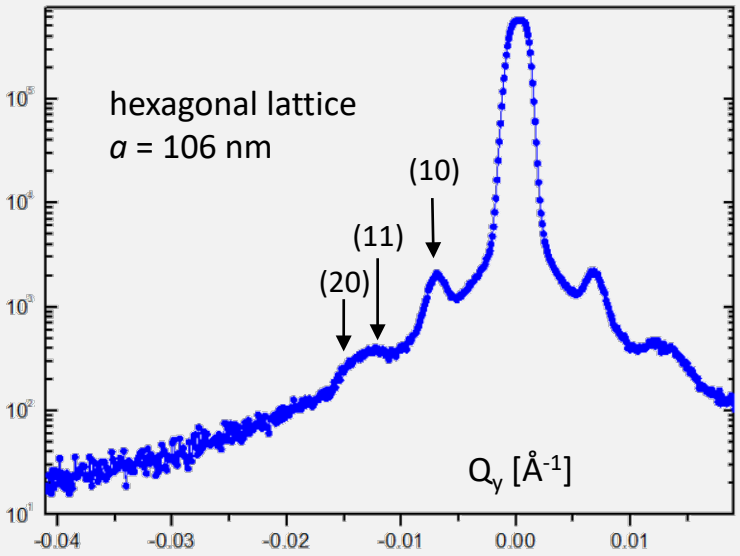


bent
rough
inhomogeneous
round
with a frame
NOT CHANCE FOR REFLECTIVITY



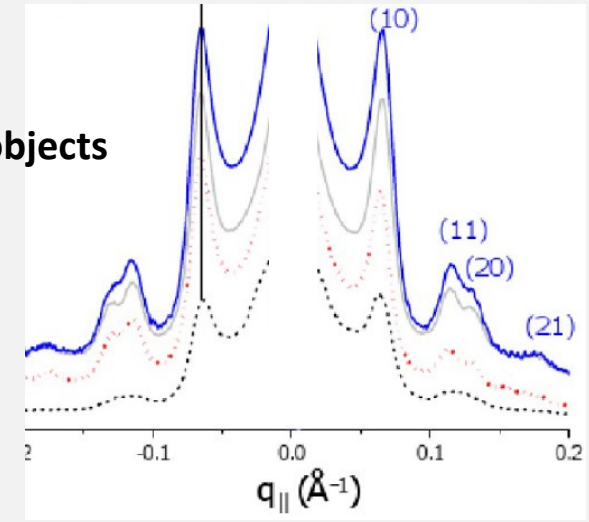


Anodized aluminum “film”
pores are filled with iron
estimated lattice constant 100 nm
capped with Ge
GISANS?

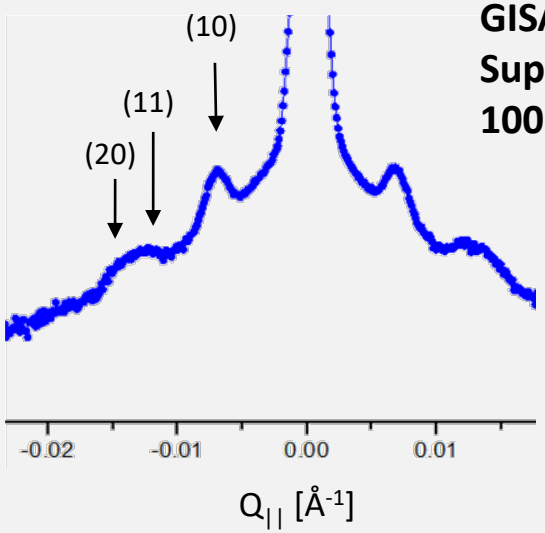


GISANS vs. GISAXS

GISAXS
ID10B
10 nm objects



$Q_{||}$
scale 10:1



GISANS
Super ADAM
100 nm objects

In both cases one can get lattice constant value

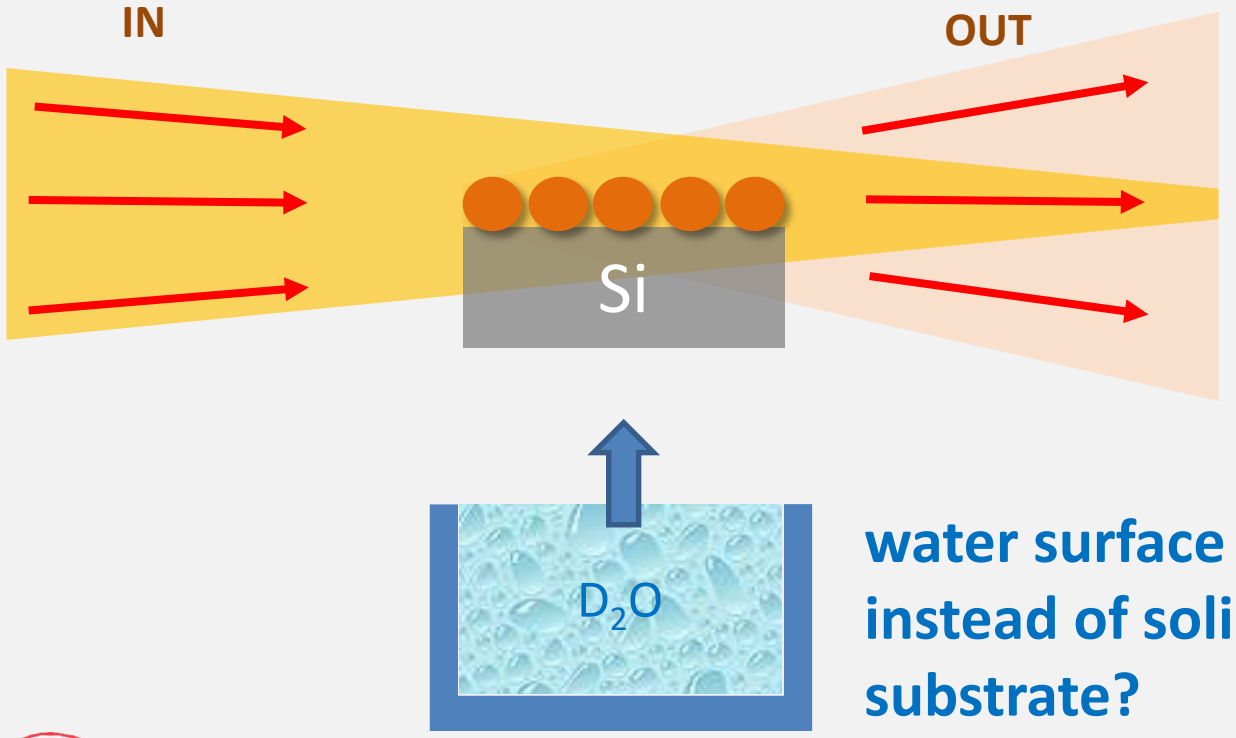
πseudo-GISANS works

π-GISANS

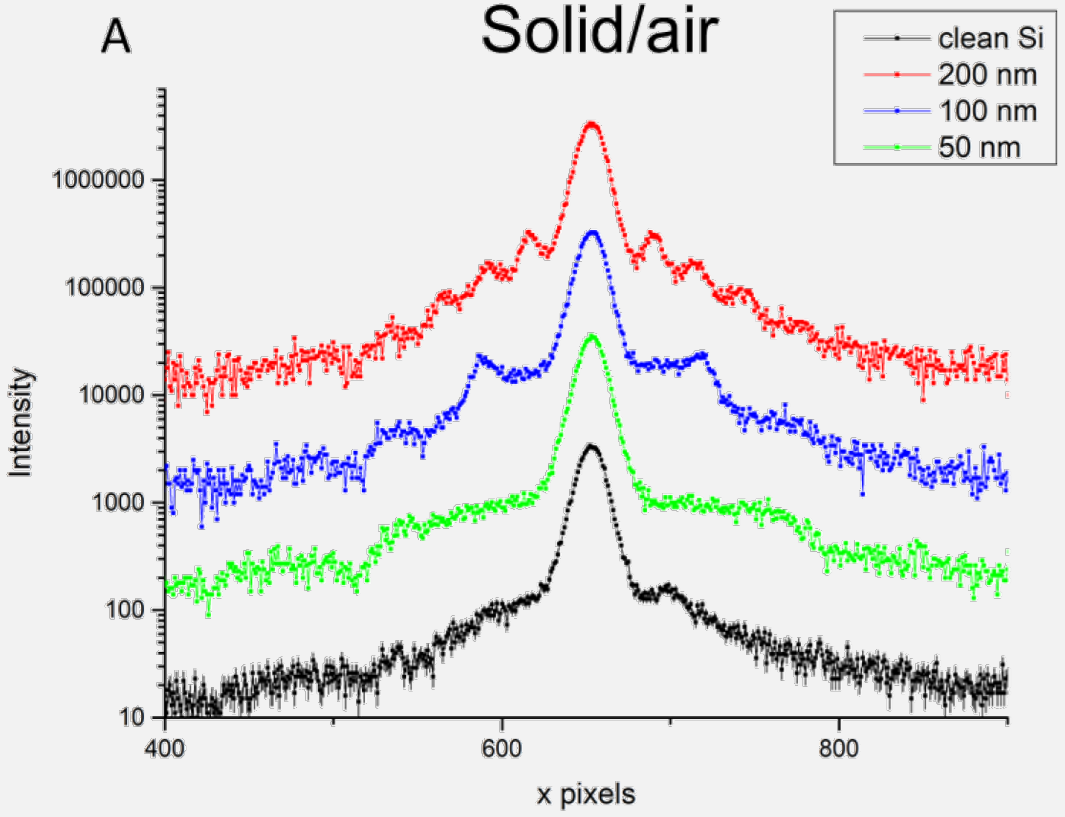
GISANS from SiO_x NP monolayers on Si surface

Nicolo Paracini
Marite Cardenas
(Malmo)

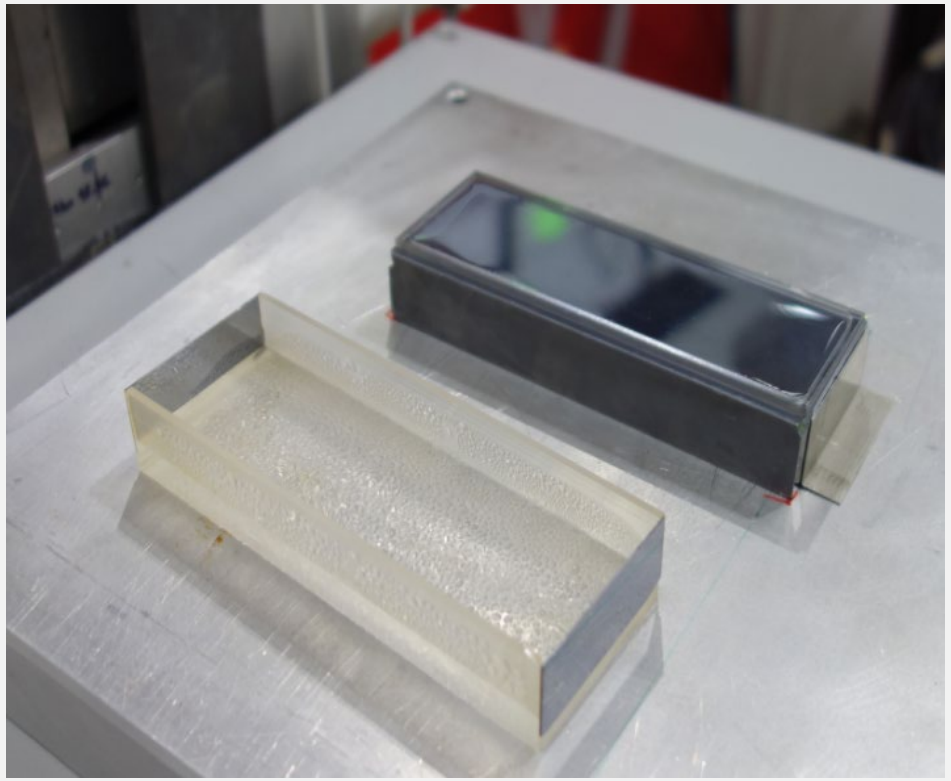
CRG-2739
2020.09.15



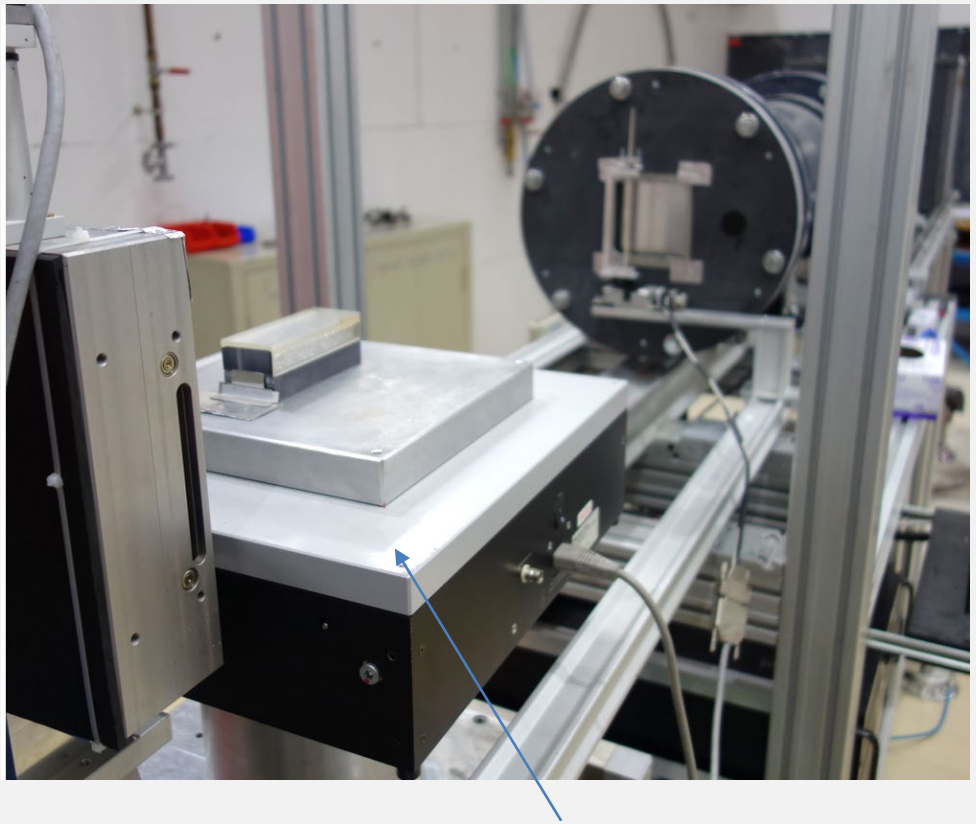
water surface instead of solid substrate?



GISANS on liquid surface



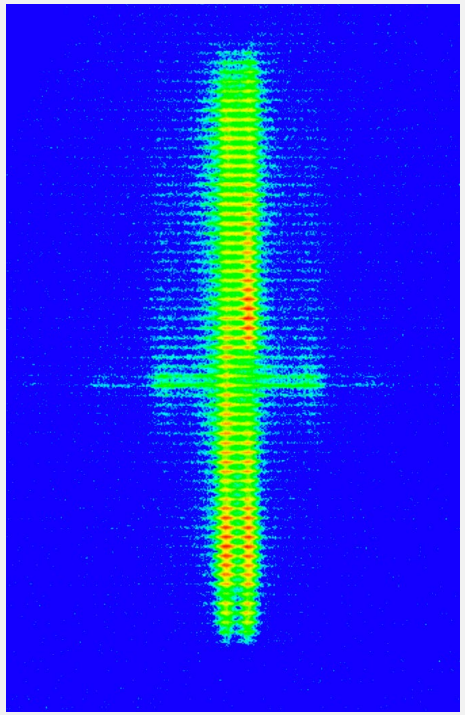
sample cell



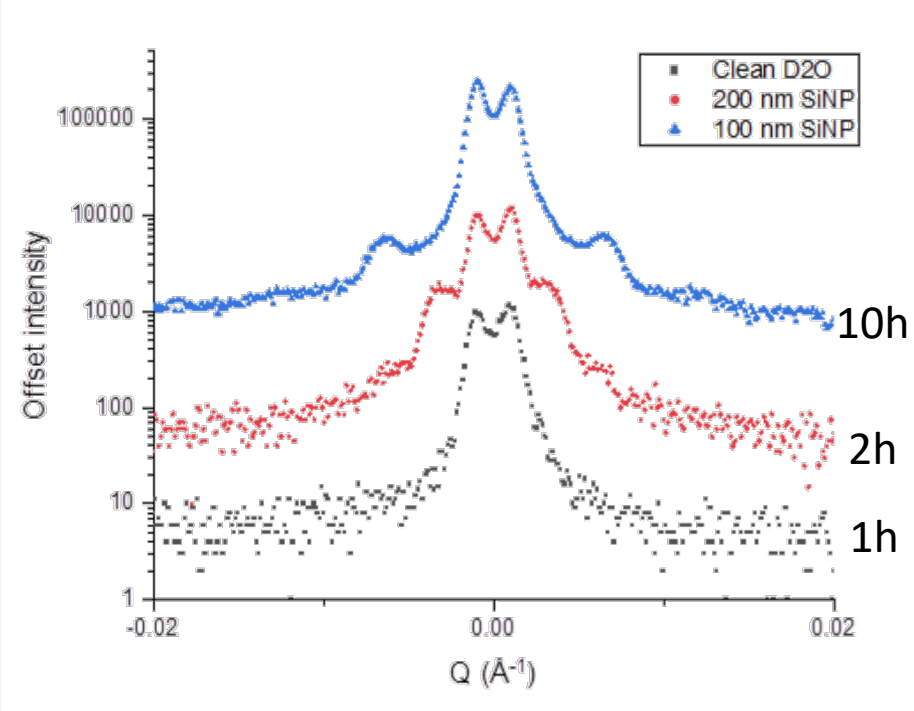
active antivibration device

Thanks Nico for the particles and instructions!

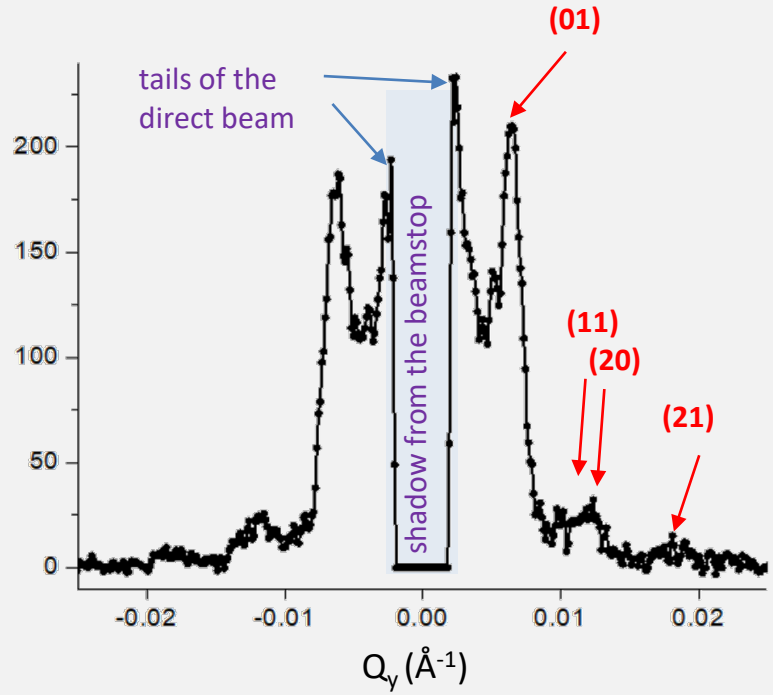
GISANS from SiO_x NP on liquid surface



raw data



integrated data



integrated and background corrected data

It works!

Acknowledgements

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Anders Olsson
Workshop:
Niklas Johansson

Super ADAM partners
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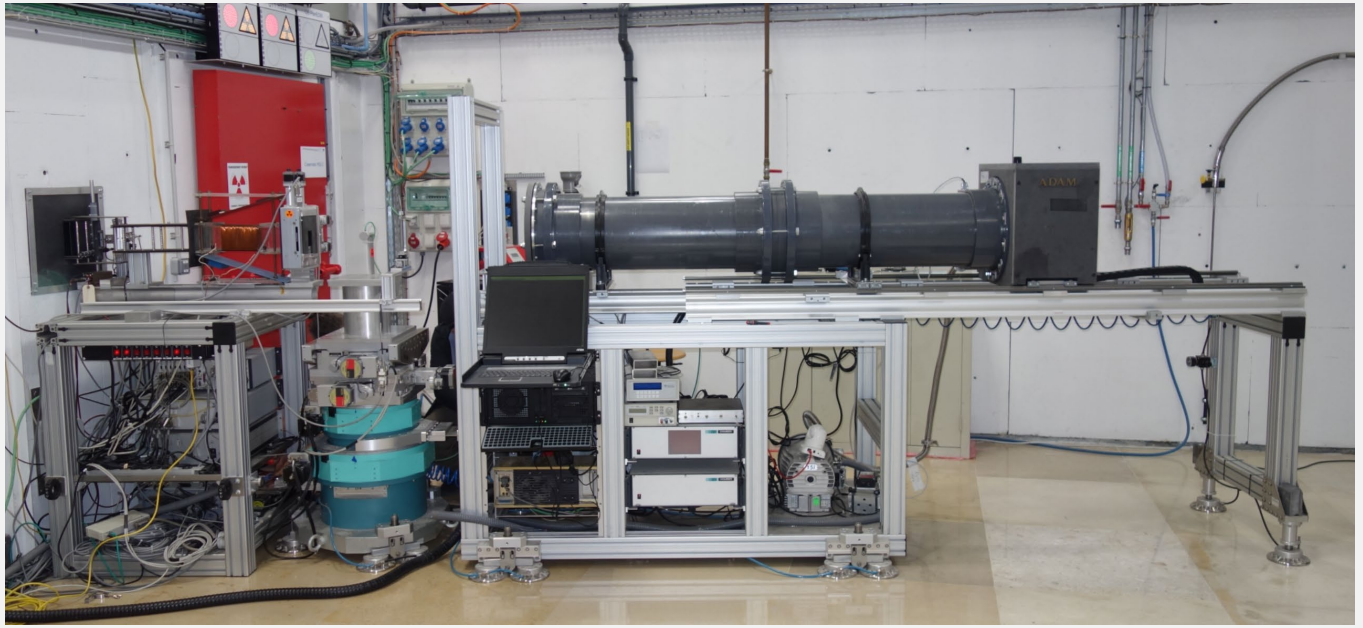
Tommy Nylander

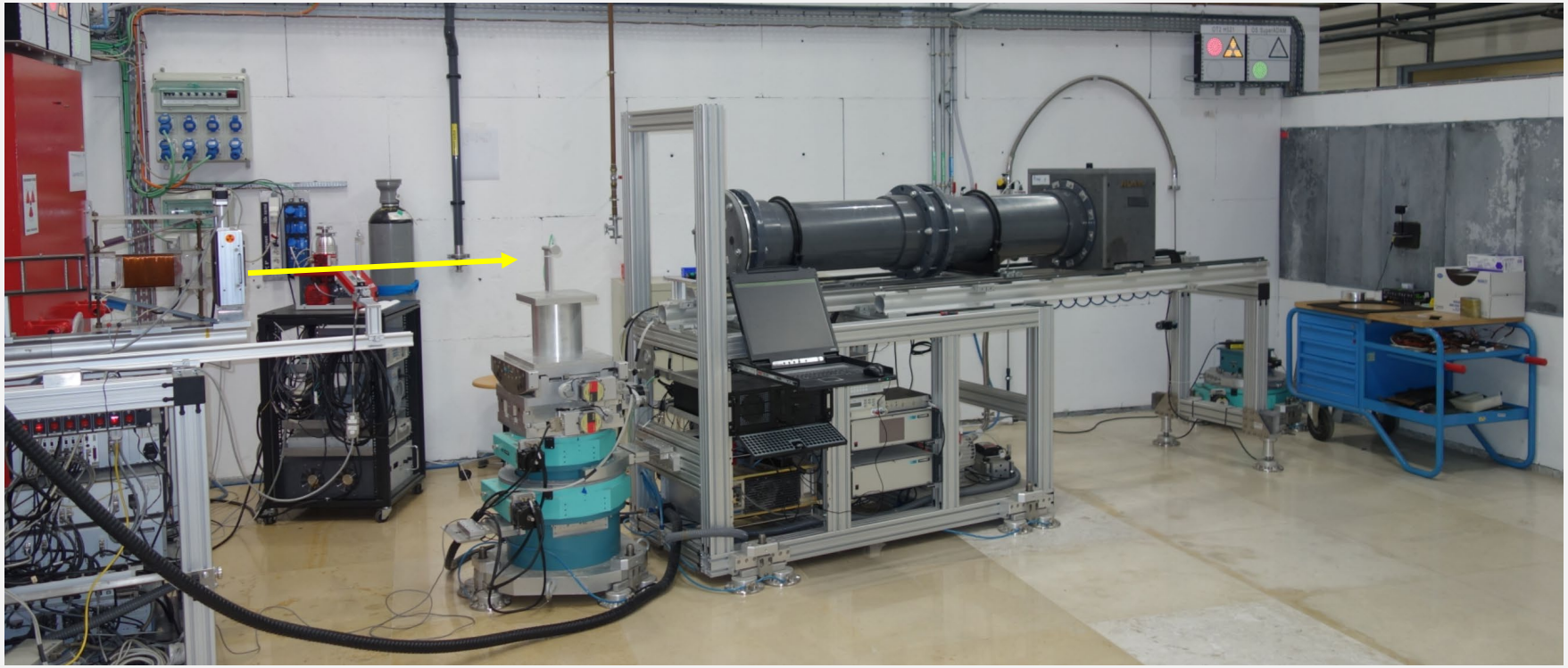
GISANS users
Nicolo Paracini
Marite Cardenas

Vetenskapsrådet

NEUTRONS FOR SOCIETY

Thank you and welcome to Super ADAM!

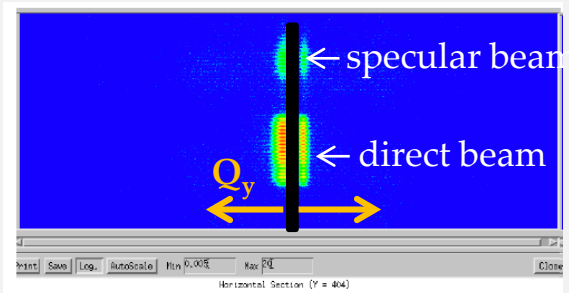




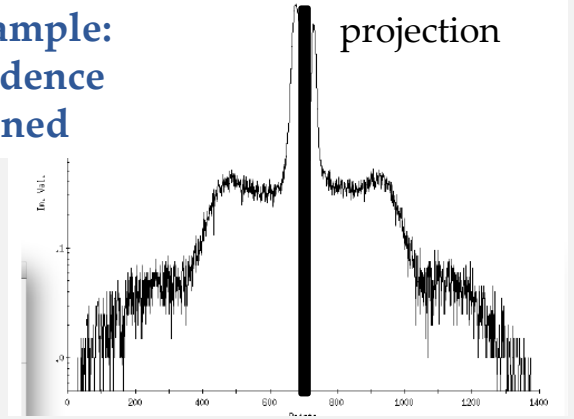
GISANS @ Super ADAM will never work for vertical sample – no resolution, no intensity, internal PSD structure

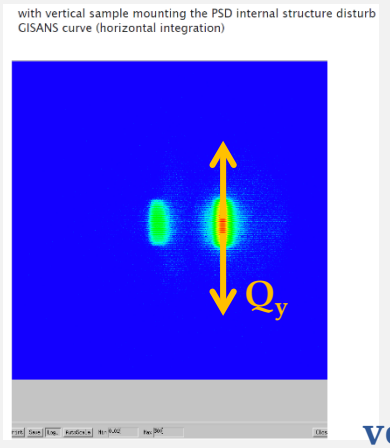
tight collimation (H) & tight collimation (V)

2D PSD image



horizontal sample: angle of incidence is badly defined





vertical sample: angle of incidence is well defined but no Q_y resolution