SAGA
An initiative for a GISANS instrument at the ESS

A concerted Swedish initiative based on the close collaboration and joint efforts of all the main Swedish research institutions with neutron activities and funded by the Swedish research council.

Goal: Competitive instrument proposal to ESS

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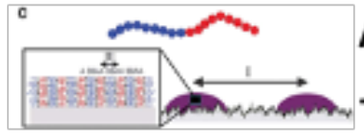
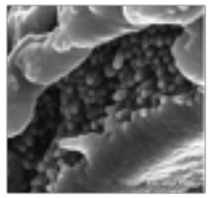
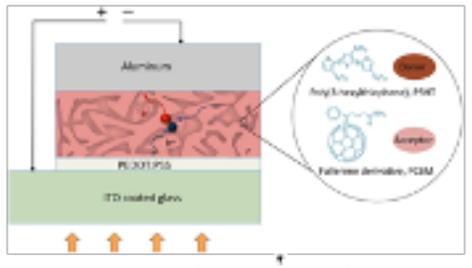
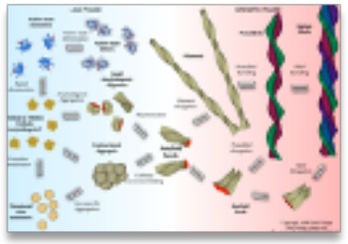
Surface science with neutrons

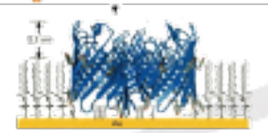


A Wide Range of Science involves
- gas, liquid, solid interfaces









Cell membranes

Organic Photovoltaics

Sustainable Biomaterials

Biosensors

Lubrication Tribology

Ionic liquids

Surfactants & Polymers

Batteries and hydrogen storage

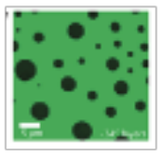
Drug delivery

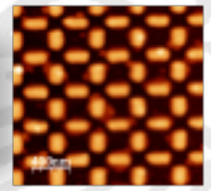
Magnetism & superconductivity

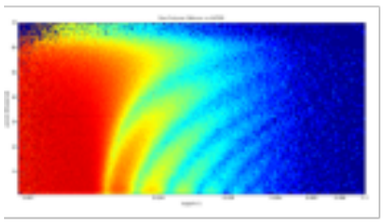
Inorganic templating

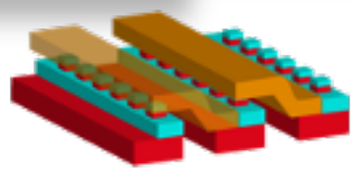
Electrochemistry

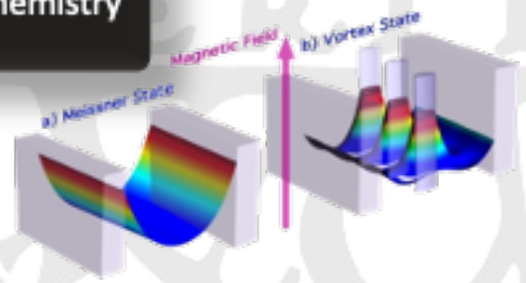
X-ray and neutron surface science





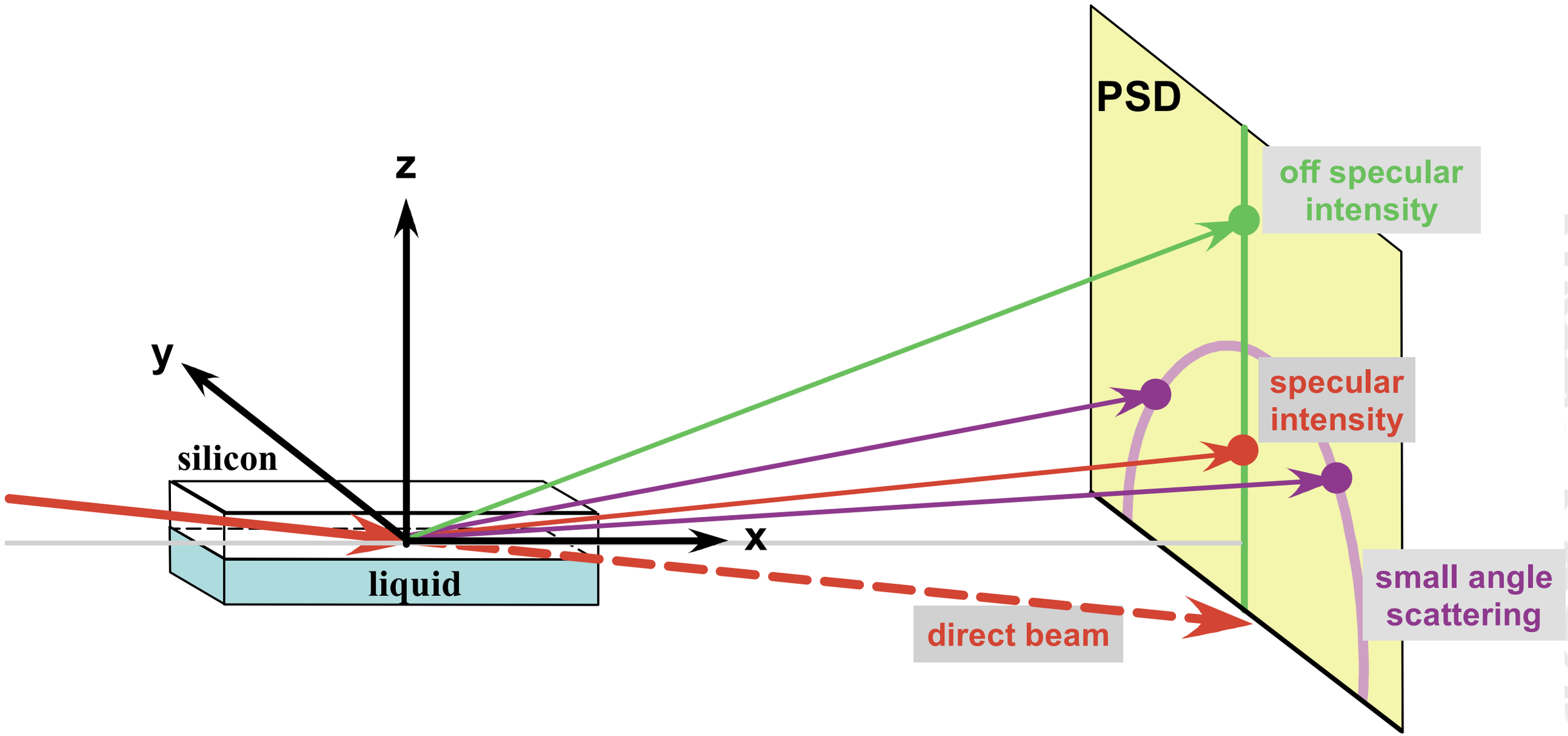






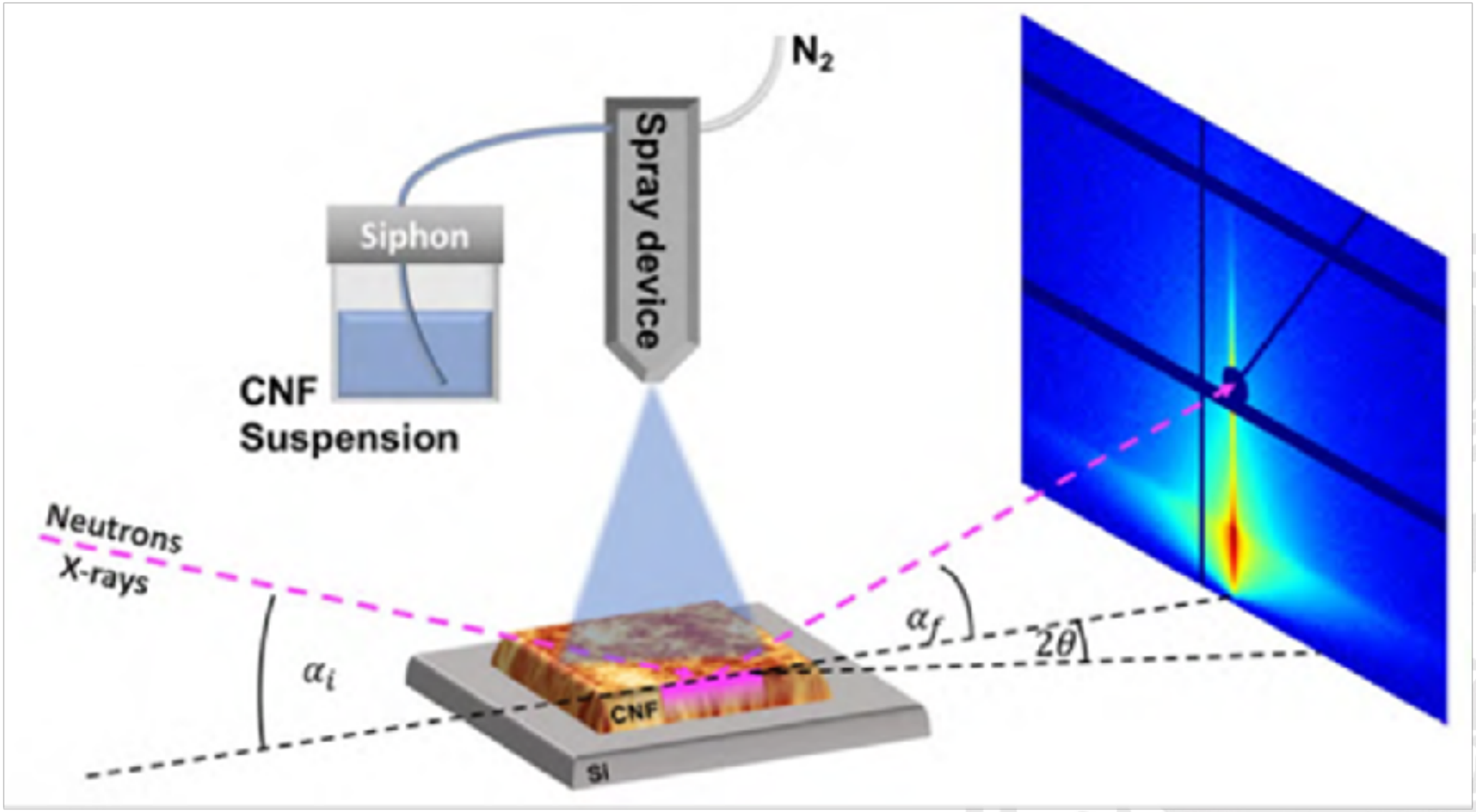
Provided by Hanna Wacklin Knecht, ESS

Scattering geometry



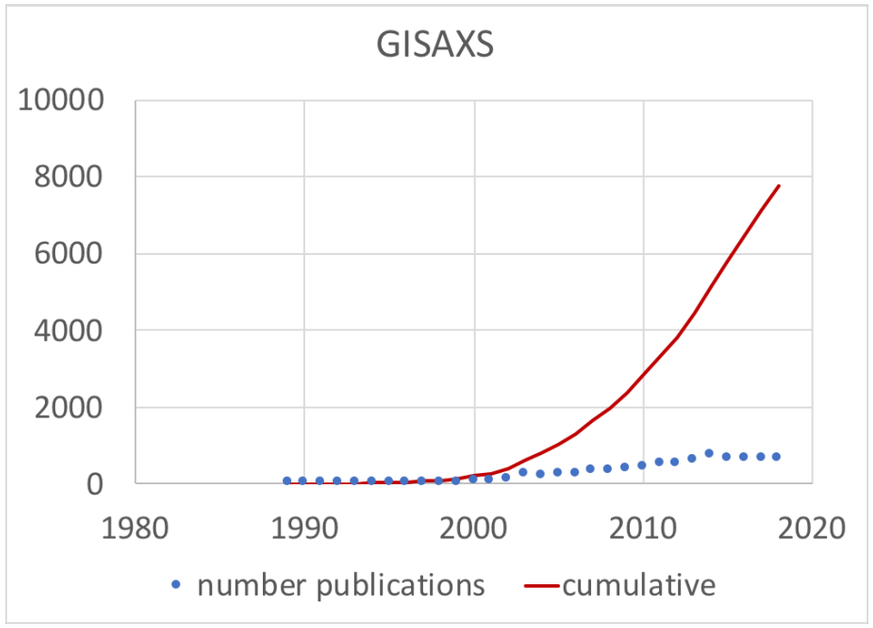
Grazing incidence scattering,
in: French-Swedish winterschool on neutron scattering: Applications to soft matter Eds.: M. Wolff, F. Cousin
EPJ Web of Conferences **188**, 04002 (2018).

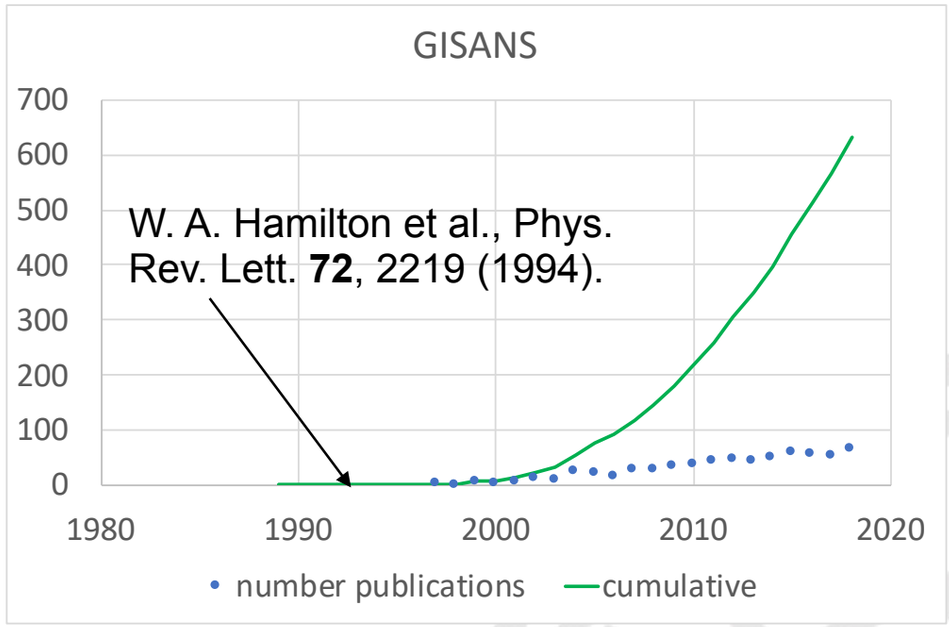
Drying of cellulose coatings



C. J. Brett et al.,
Water-Induced Structural Rearrangements on the Nanoscale in Ultrathin Nanocellulose Films
Macromolecules 52, 12, 4721-4728 (2019)

Background - GISANS





Instrument	Facility	Type	Detector dist.	Comment
D22	ILL	SANS	up to 18m	Monochromatic SANS
SANS2D	ISIS	SANS		ToF SANS
KWS2	FRM2	SANS	up to 20m	Pinhole SANS
Figaro	ILL	Reflectometer	3m	Horizontal
REFSANS	FRM2	Reflectometer	up to 12m	Horizontal*, Focusing
PA20	LLB	SANS		Facility closing 2019
MARIA	FRM2	Reflectometer	4m	Polarised
SuperADAM	ILL	Reflectometer	8m	Polarized, Swedish CRG

The only dedicated GISANS beamline REFSANS faces design challenges

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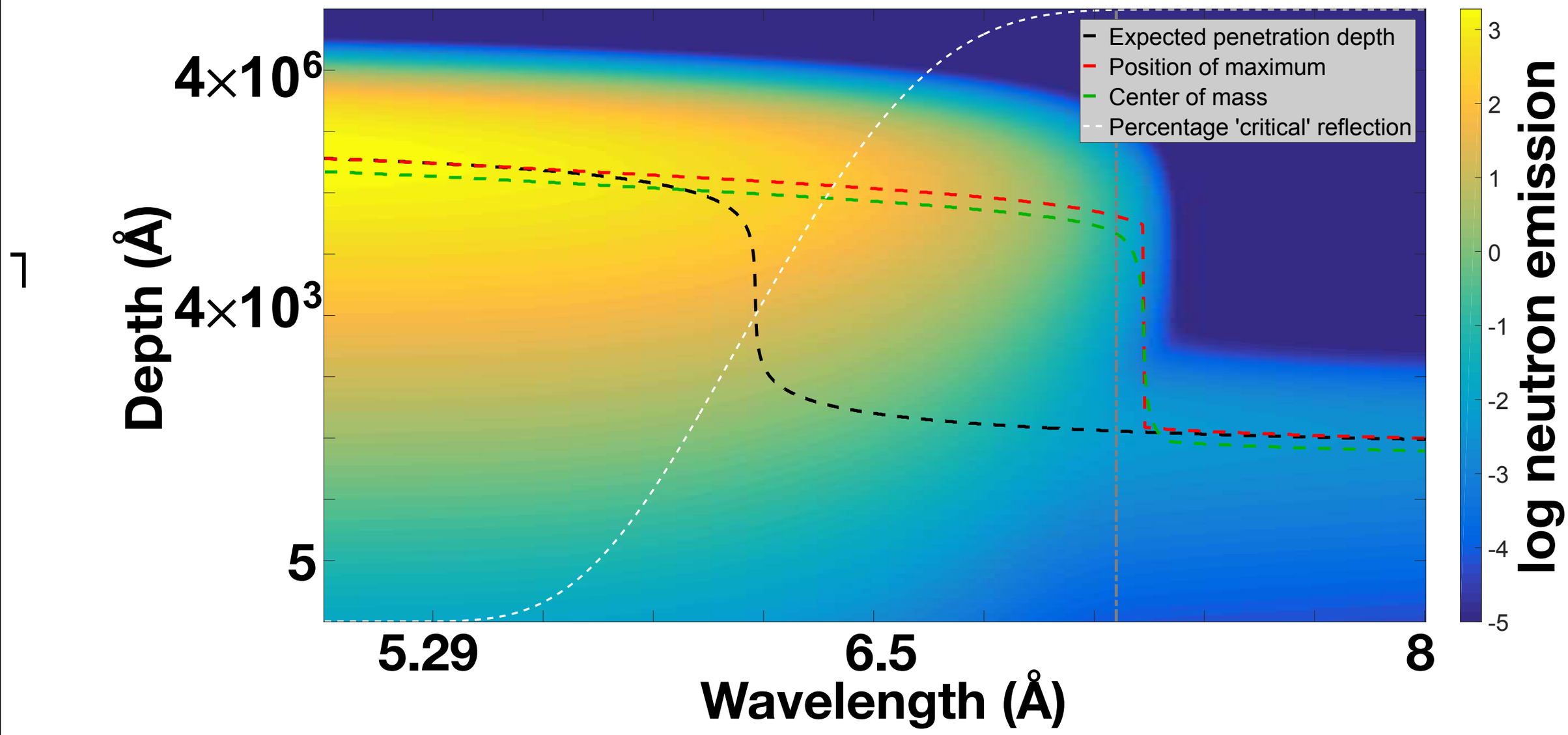
Effect of resolution

Scattering from beyond a semi-infinite interface



For GISANS high resolution is required (ideally 1 %)

For reflectometry and SANS the resolution may be relaxed (typically 10 %)

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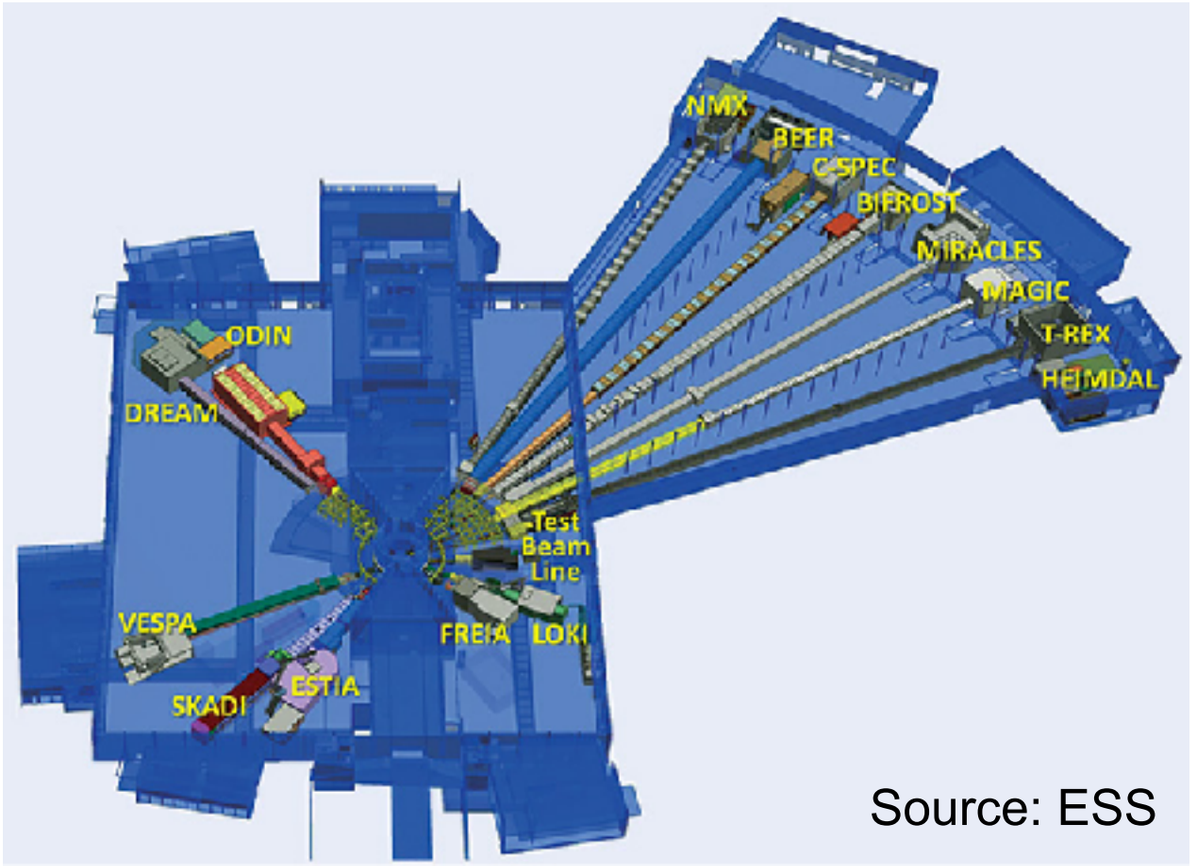
Instrumentation at ESS



Source: ESS

15 instruments under construction:

Diffraction: DREAM, HEiMDAL, MAGIG, NMX

Engineering and diffraction: BEER, ODIN

Large Scale Structures: ESTIA, FREIA, LoKI, SKADI

Spectroscopy: BIFROST, CSPEC, MIRACLES, T-REX, VESPA

Plan and space for instruments 16-22

Possible future expansion to 35 instruments

ESS capability gaps:

Priority 1 (good existing proposals / no funding): Fundamental physics, High resolution NSE

Priority 2: High-pressure diffraction, Very fast spectroscopy, Wide bandwidth spectroscopy, High magnetic fields, **Grazing incidence SANS**

Priority 3: Bio-SANS, Hydrogenous sample diffraction, Wide angle spin echo

[1]ESS Technical Design Report, Chapter 2, ESS, Lund (2013).

International and national collaboration

Within Sweden:

Strong collaborative network including almost all Swedish Universities and institutions, e.g. KTH, LU, UU, RiSE, LiU, Chalmers, MaU, SU, GU, MiU, LTU and UMU

Industrial interest from e.g. AstraZeneca, Sandvik, ABB, AlfaLaval, Tetra Pak and many small companies like Epiluvac

Educational and community efforts by SwedNess and SNSS

Connection to the international GISANS community:

Experts from neutron laboratories (PSI, MLZ, JCNS, STFC-ISIS, LLB, ESS) participate in meetings to define the instrument scope and design criteria.

Competence building at ISIS, NCNR (NIST) and ESS.

Collaborative projects, e.g., ILL (Super ADAM) and MLZ (Port-GISANS and surface dynamics)

Project organisation

Coordination with team members, the science and industry community and the funding bodies: T. Nylander (LU)

Conceptual and technical design + evaluate alternative and innovative instrument concepts: M. Wolff (UU)

Interface to the ESS and ensure integration into the ESS instruments suite and development: T. Arnold (ESS)

Working groups:

Technical developments: J. Birch (LiU)

International experts group: S. Rogers (ISIS), S. Roth (Desy)

Swedish user community: M. Månsson (KTH), M. Cárdenas (MaU)

International user community: Adrian Rennie (UU)

PostDoc1 (Design), Sebastian Köhler recruited and stationed at LINXS
PostDoc2 (Technical developments, one year)
Engineer (Drawings, 30 % over three years)

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Timeline

	Q4-21	Q1-22	Q2-22	Q3-22	Q4-22	Q1-23	Q2-23	Q3-23	Q4-23	Q1-24	Q2-24	Q3-24	Q4-24
Recruitment													
Preparatory work													
Conceptual design (WP1)		D1.1	D1.2	D1.3									
Task 1.1 Update Science Case													
Task 1.2 Define Technical Spec.													
Task 1.3 Define Concept													
Task 1.4 Feasibility studies													
Technical design (WP2)					D2.1			D2.1				D2.1	
Task 2.1 Detailed simulations													
Task 2.2 Prototyping													
Task 2.3 Performance tests													
Task 2.4 Technical details													
Proposal writing (WP3)											D3.1	D3.2	D3.3
Task 3.1 Science case & overview													
Task 3.2 Budget													
Task 3.3 Project planning													
Coordination & Engagement (WP4)	D4.1			D4.2				D4.3			D4.4		
Kick-off meeting													
Regular SAGA partner meetings													
SAGA GISANS Workshops													

Requirements of a GISANS instrument

A GISANS instrument:

- will require **high flux**
- should be able to **measure reflectivity** up to about Q_z = 0.35 Å^{-1}
- should be capable of accessing samples with **horizontal surfaces** or in **magnetic fields**
- have variable resolution (from around **7% to 1-2%**)
- have a **low background**
- have a flexible and spacious sample area for complex sample environments
- should allow for wide-angle detectors for GIWANS

Current/initial idea:

Optimise for high resolution/brilliance (long instrument) GISANS on the expense of band width

Provide second beam of lower resolution larger bandwidth for reflectometry.

The Swedish Instrument Project for Interface Science at ESS

28 October 2021

The

SAGA

She who sees everything

begins...

www.gisans.se