

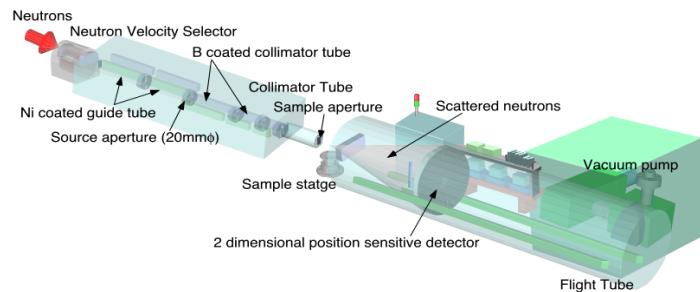
Status Report SANS-U @ JRR-3

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SANS-U HP

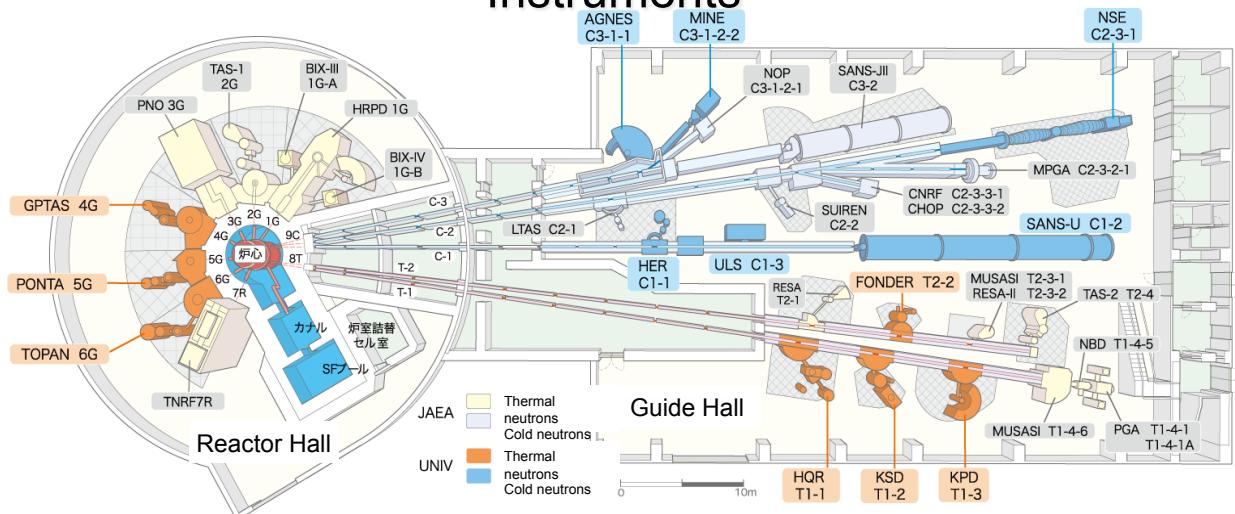
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→ <http://www.issp.u-tokyo.ac.jp/labs/neutron/inst/sans-u/index.html>



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JRR-3 Neutron Beam Lines and Instruments

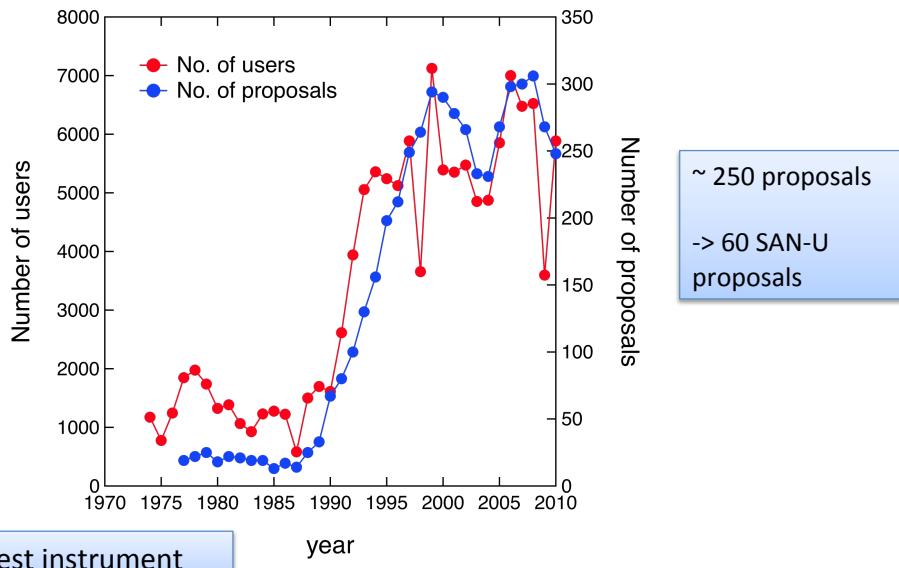


Neutron Beam Instruments

- Diffractometer and Spectrometer : 28 (Universities 13 + JAEA 15)
- Radiography : 2 (JAEA)
- Prompt gamma analysis : 2 (JAEA)



General User Program of neutron scattering for universities since 1961



SANS-U; the busiest instrument

year	No. proposal	No. accept	No. backup	No. rejected	Days of applied	Days of assigned
2011	60	48	12	0	228	106



SANS-U Home page

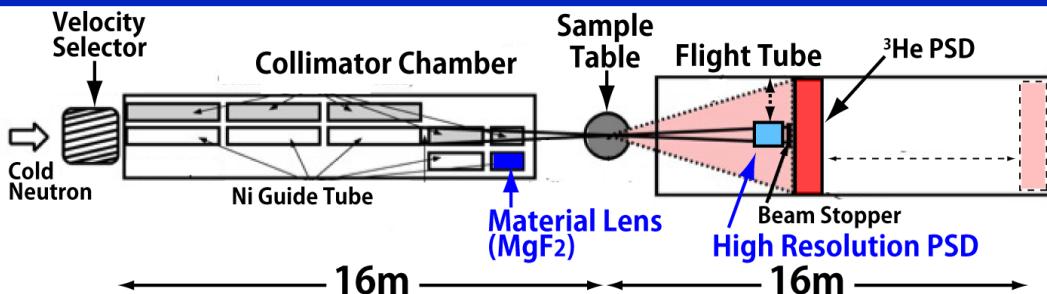
<http://www.issp.u-tokyo.ac.jp/labs/neutron/inst/sans-u/index.html>

The SANS-U Home page features several key sections:

- Link:** A red box labeled "SANS-U information" is connected to the "Link" section on the left.
- notice:** A blue box labeled "Machine time" is connected to the "notice" section at the bottom right.
- renewal:** A blue box labeled "Machine time" is connected to the "renewal" section at the bottom right.
- SANS-U information:** A red box labeled "SANS-U information" is connected to the "Link" section on the left.
- Machine time:** A blue box labeled "Machine time" is connected to the "notice" section at the bottom right.

The main content includes:

- Link:** A sidebar with links to NSL, ISSP, KEK, JAEA, J-PARC, JSNS, JPS, CSJ, SPSJ, ORNL, NIST, ILL, and ISIS.
- Contents:** A sidebar with links to Specification, Operation, Analysis, Accessories, Troubles, Access, Forms, Publications, Message, and Old Home Page (-2010).
- ニュース; News:** A news feed with the following entries:
 - 平成23年度のJRR-3運転は7月12日からですが、ガイドホールにあるSANS-U-iC3ラインのスパートナー化工事のため、第2サイクルからの運転となります。また、入射ビームの高強度化、集光化、大面積化にともない、第2サイクルからの運転では、昨年度までの3日(week day)・4日(week end)サイクルをやめ、原則として、2日(week day)・2日(week day)・3日(week end)サイクルで運用します。詳しく述べは、スケジュール表をご覧ください。
 - SANS-Uの成果には必ず謝辞を入れてください。
 - <例>This work was carried out under the Joint-use Research Program for Neutron Scattering, Institute for Solid State Physics (ISSP), the University of Tokyo, at the Research Reactor JRR-3, JAEA (Proposal No. 10xxx).
- 更新情報: Update info.** An update section with the following message:
 - 更新情報: 2011-01-18
SANS-U HPを全面変更しました。
- 重要なお知らせ: 2010.7.25 注意: Virus対策について** An important notice about virus protection.



Total Length: 32m

Monochromator: Velocity Selector (Dornier)
wave length : $5 - 12\text{\AA}$ ($\Delta\lambda/\lambda = 8 - 30\%$)

Collimation: 2, 4, 8, 12, 16 mm

(New aperture system was installed in FY2009.)

Focusing Lens: 55 MgF_2 Lenses

Sample-to-Detector Distance: 1.03 – 16m

Detector1: ^3He 2D-PSD (ORDELA)

Size: $645 \times 645 \text{ mm}^2$, Spatial resolution: 5 mm

Detector2: High resolution Scintillation PSD

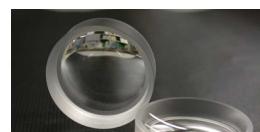
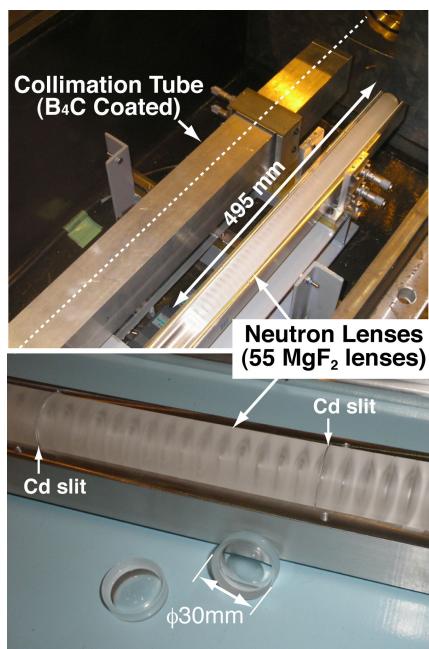
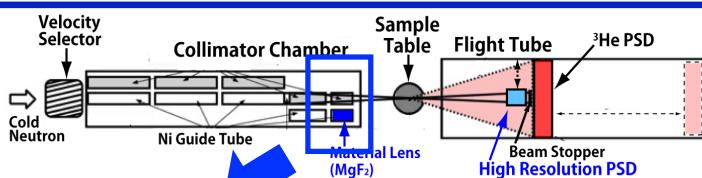
Scintillator: $\text{ZnS}/^6\text{LiF}$

Size: $\sim\phi 70\text{mm}$, Spatial resolution: 0.5 mm



Q-range: 0.0004 – 0.4 \AA^{-1}

Neutron Focusing Lens



(Eskildsen et al., Nature 1998;
Choi et al., JAC 2000)

**MgF_2 Biconcave Lens
(Ohyo Koken Kogyo, Japan)**

- Diameter: 30mm
- Effective Area: $\phi 25\text{mm}$
- Curvature Radius: 25mm
- Center Thickness: 0.7mm

○ FY2004~ : 54 MgF_2 lenses

(Okabe, Shibayama (ISSP), Adachi, Shimizu (RIKEN))

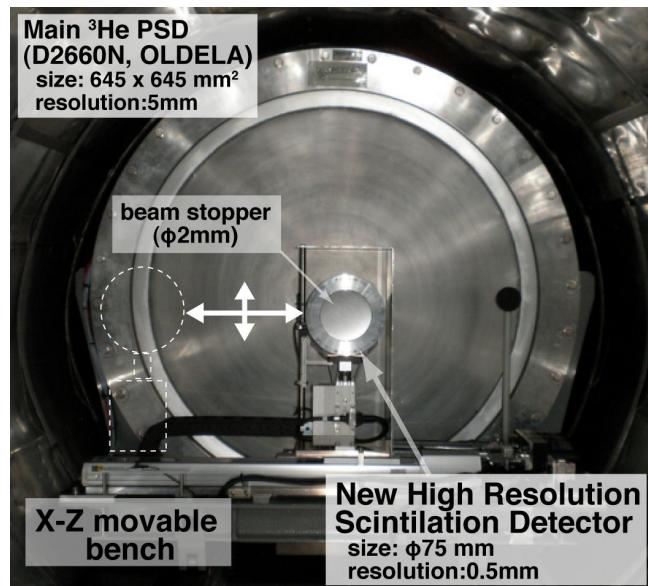
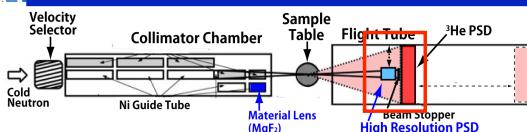
- Conditions : $\lambda = 7\text{\AA}$, $L_2 = 12\text{m}$
- Detector: ^3He main PSD

○ FY2010~ : 55 MgF_2 lenses

(Iwase, Shibayama (ISSP))

- Conditions : $\lambda = 7\text{\AA}$, $L_2 = 11.3\text{m}$
- Detector: High resolution detector

(Neutron beam is focused on the detector plane of a high resolution detector.)



High resolution scintillation detector

- ZnS/ ${}^6\text{LiF}$ Scintillator
- Cross-wired photomultiplier tube (R3239; Hamamatsu)

DAQ: KEK Original (VME)

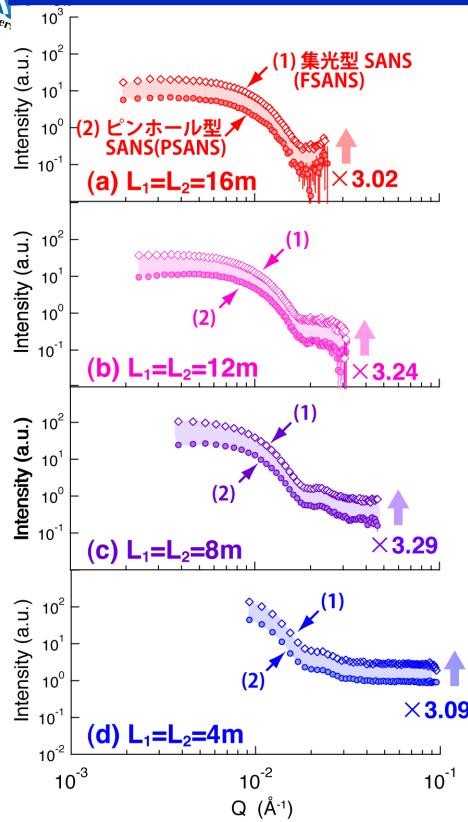
(Hirota et al., 2005)



- Effective Area: $\phi 75\text{mm}$
- Spatial Resolution: 0.5~0.7mm
- Efficiency : 30% of ${}^3\text{He}$ detector

Now, we are employing to install a home-made ZnS/ ${}^6\text{LiF}$ Scintillator developed by Katagiri (JAEA) with optimizing in SANS-U conditions.

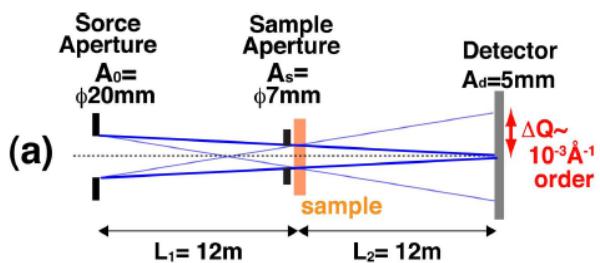
(1) high intensity focusingSANS



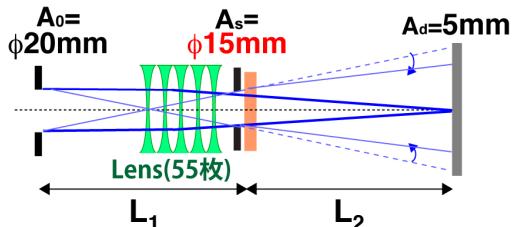
Sample : polystyrene latex
• radius : $R=250\text{\AA}$



Pin hole collimation



Focusing collimation (high intensity mode)

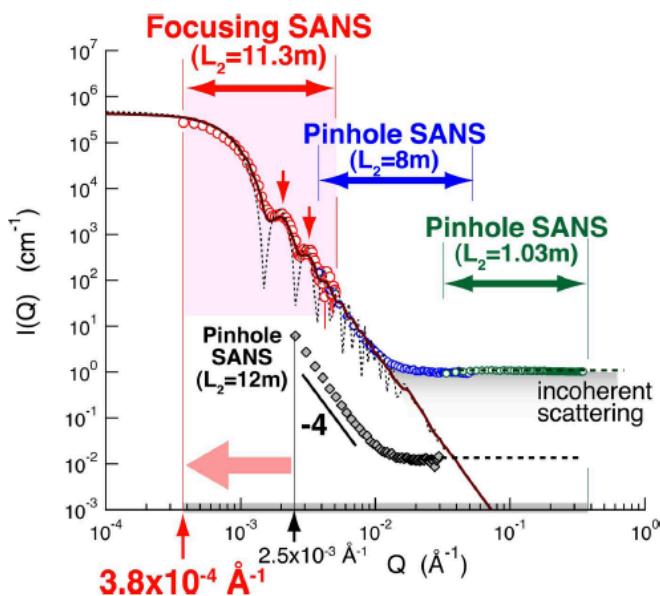


3.16x higher intensity is achieved by high intensity mode without loosing resolution.

(2) high resolution focusingSANS

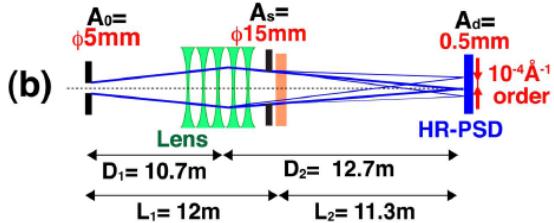
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Lower limit (Q_{\min}) : from 10^{-3}\AA^{-1} to 10^{-4}\AA^{-1} !



Sample: polystyrene latex
• radius : $R=2980\text{\AA}$

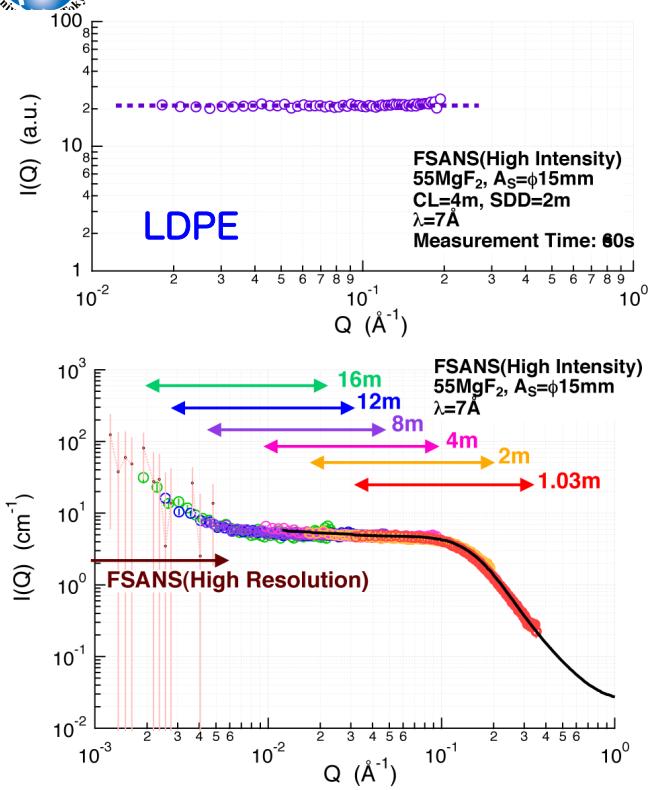
Setup:



High resolution mode allows to measure $\sim 3.8 \times 10^{-4} \text{ \AA}^{-1}$

Absolute Intensity

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SANS-U Secondary Standard:
Low density polyethylene (LDPE)
(F200-0, Sumitomo Chem.)
• 2.03mm thickness
• $\mu (= T_r(d\Sigma/d\Omega(0))t) = 0.0695$
(determined by Okabe, 2006)

SAXS Secondary standard:
glassy carbon
(provided by J. Ilavsky, APS)

• 1mm thickness

Glassy carbon is widely used as a secondary standard on many SAXS spectrometers. (APS, Spring-8, labo-SAXS, etc.)

In FY2009 and 2010, the SANS-U spectrometer was upgraded with installing a new aperture system, a high-resolution (scintillation) detector.

We discussed the two utilizations of Focusing SANS.

High-resolution Focusing SANS High-Intensity Focusing SANS

$A_1 = \phi 5\text{mm}$, $A_s = \phi 15\text{mm}$, $\lambda = 7\text{\AA}$,
 55 MgF₂ Lenses
 New High resolution PSD
 (5inch PMT with ZnS/6LiF scintillator)

$Q_{\min} : 2 \times 10^{-3} \rightarrow 4 \times 10^{-4} \text{\AA}^{-1}$

$A_1 = \phi 20\text{mm}$, $A_s = \phi 15\text{mm}$, $\lambda = 7\text{\AA}$,
 55 MgF₂ Lenses
 Conventional ³He PSD

Intensity gain :
3.2

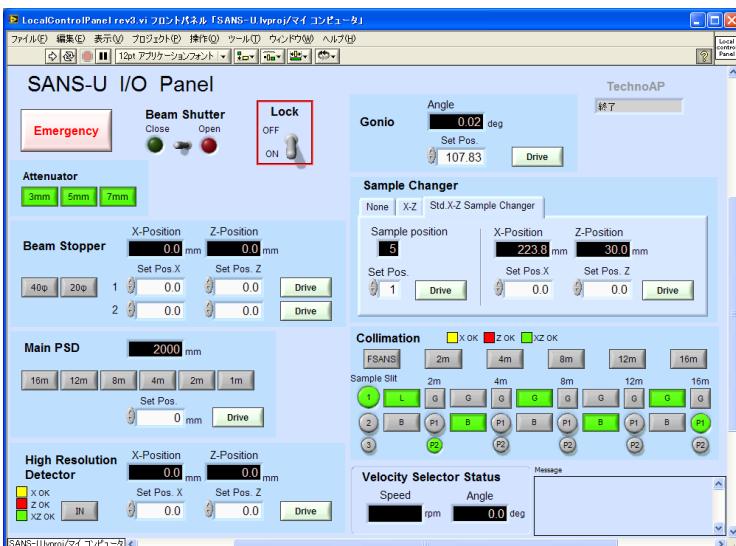
Iwase et al., J. Appl. Cryst., 2011, 44, 558-568.
Modernization of the small-angle neutron scattering spectrometer SANS-U by upgrade to a focusing SANS spectrometer

New Operating System

SANS-U User: Only 1 time Experiment (3 or 4 days) /1 year

It is very important to develop user-friendly and stable operation system !!
 in order to avoid wrong operation and unexpected loss machine time.

Improvement of operating system.



accessories



Standard sample changer



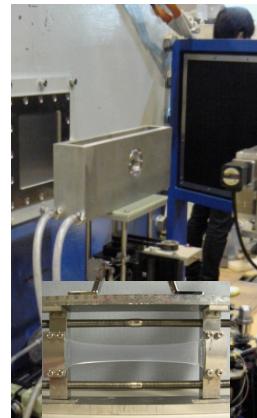
High pressure cell



Rheo-SANS



High temperature cell

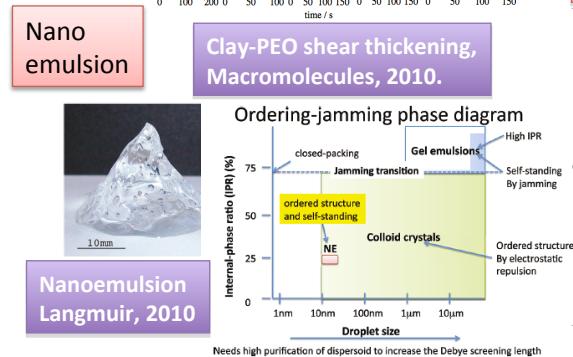
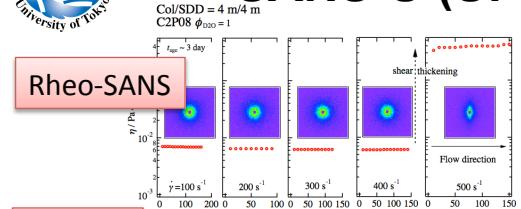


Stretching device



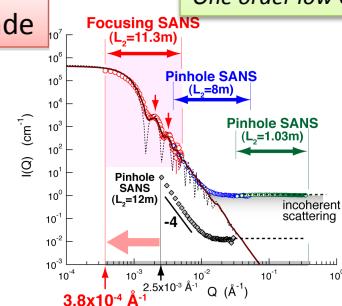
Super-critical fluid cell

SANS-U (U. Tokyo) 2010 highlight



upgrade

3x intensity
One order low Q_{\min}

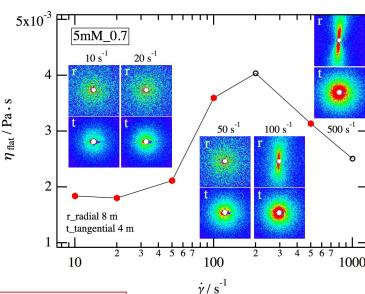


review



SANS on polymer gels
Polym. J., 2011.

SANS upgrade
J. Appl. Cryst. 2011.



Threadlike micelle
Rheo-SANS

Shear-thickening
Langmuir, 2011.