

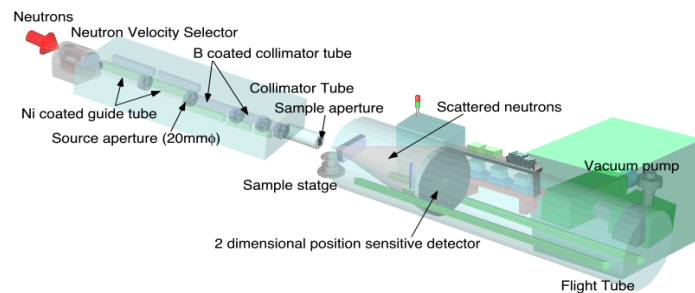
Status Report SANS-U @ JRR-3

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Tokai, Ibaraki, Japan

SANS-U HP

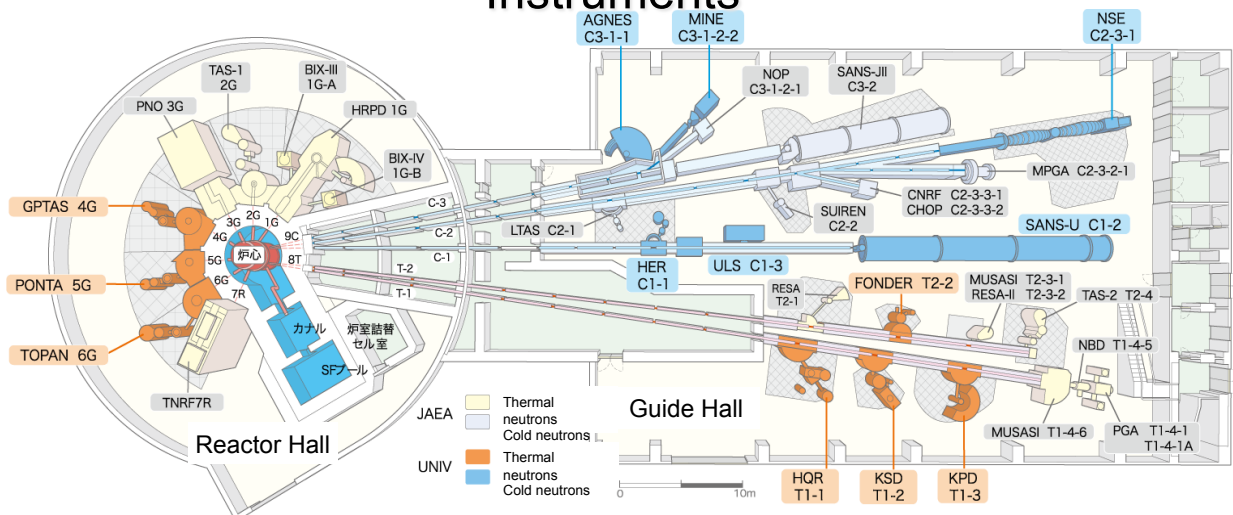
E-mail: sibayama@issp.u-tokyo.ac.jp

<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

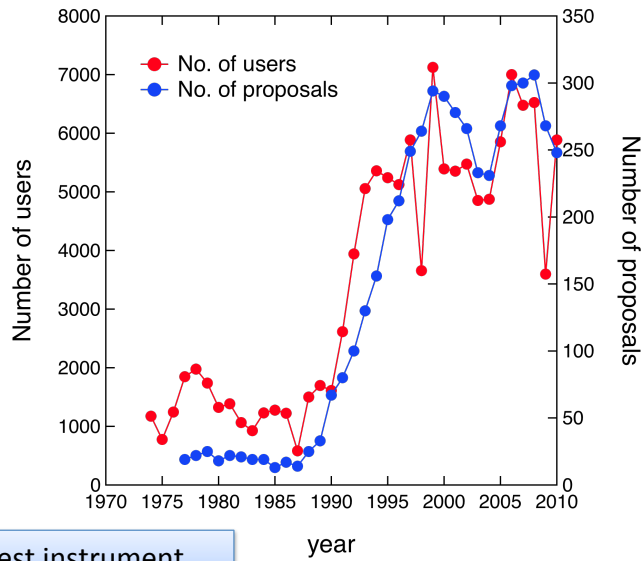


Neutron Beam Instruments

- 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



~ 250 proposals
-> 60 SAN-U proposals

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>

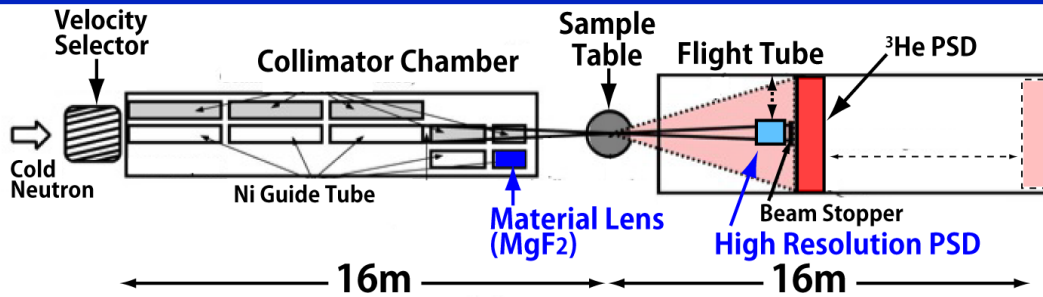


SANS-U information

Machine time

notice

renewal



Total Length: 32m

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

Collimation: 2, 4, 8, 12, 16 mm
(New aperture system was installed in FY2009.)

Focusing Lens: **55 MgF₂ Lenses**

Sample-to-Detector Distance: 1.03 - 16m

Detector1: ³He 2D-PSD (ORDELA)

Size: 645 x 645 mm², Spatial resolution: 5 mm

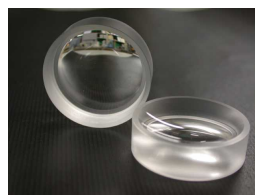
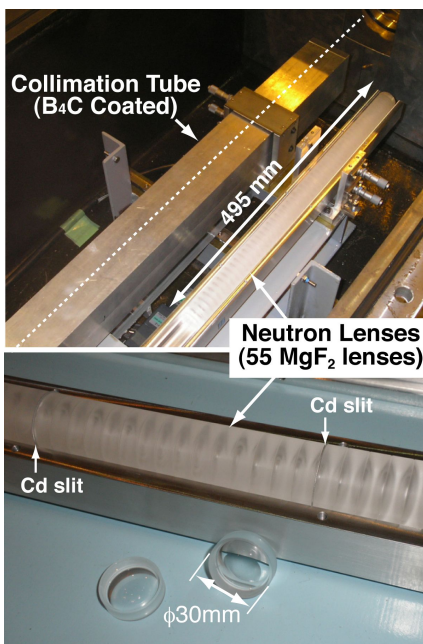
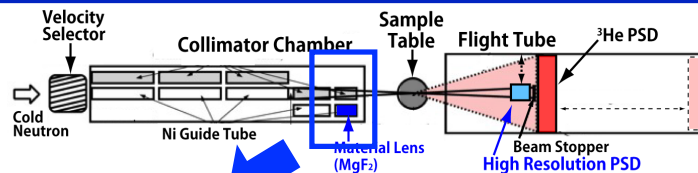
Detector2: **High resolution Scintillation PSD**

Scintillator: ZnS/⁶LiF

Size: ~Φ70mm, Spatial resolution: 0.5 mm



Q-range: 0.0004 - 0.4 Å⁻¹



MgF₂ Biconcave Lens
(Ohyo Koken Kogyo, Japan)

- Diameter: 30mm
- Effective Area: Φ25mm
- Curvature Radius: 25mm
- Center Thickness: 0.7mm

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

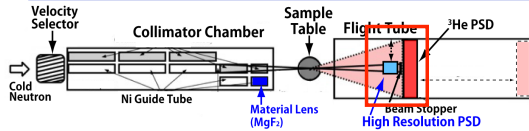
○FY2004~ : **54 MgF₂ lenses**
(Okabe, Shibayama (ISSP), Adachi, Shimizu (RIKEN))

- Conditions : λ = 7Å, L₂ = 12m
- Detector: ³He main PSD

○FY2010~ : **55 MgF₂ lenses**
(Iwase, Shibayama (ISSP))

- Conditions : λ = 7Å, L₂ = 11.3m
- Detector: **High resolution detector**

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

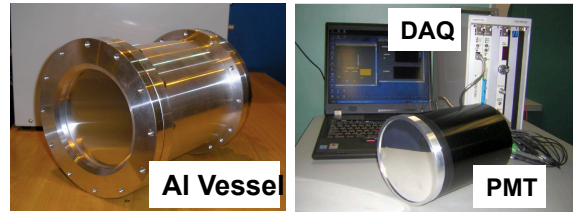
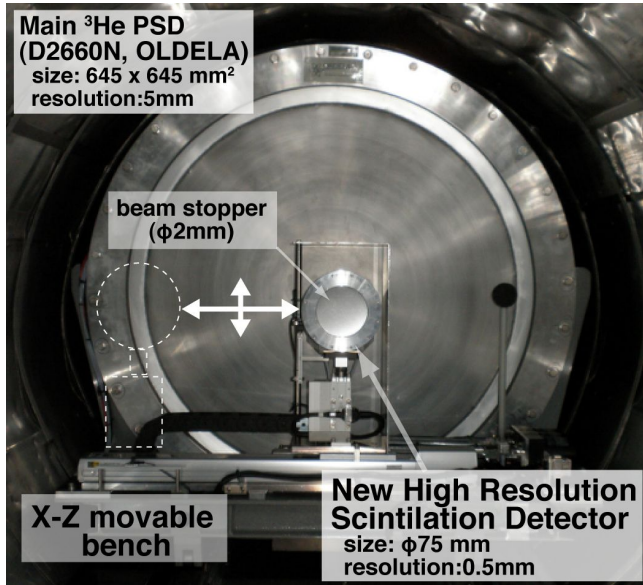


High resolution scintillation detector

- ZnS/⁶LiF Scintillator
- Cross-wired photomultiplier tube (R3239; Hamamatsu)

DAQ: KEK Original (VME)

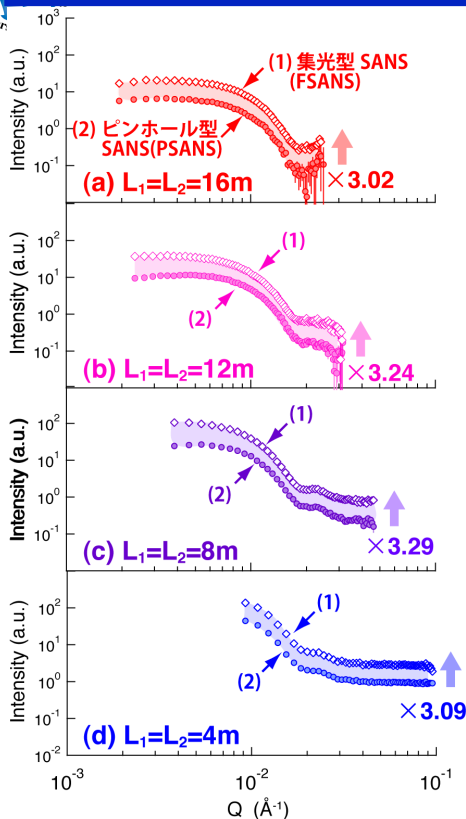
(Hirota et al., 2005)



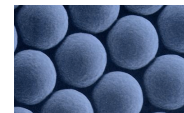
- Effective Area: ϕ 75mm
- Spatial Resolution: 0.5~0.7mm
- Efficiency : 30% of ³He detector

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

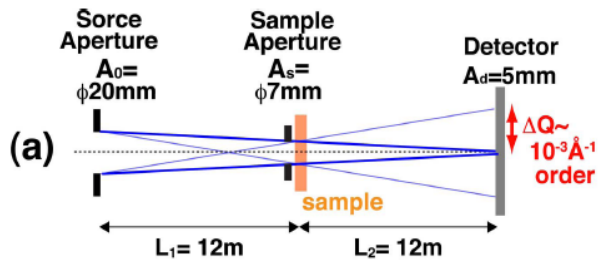
(1) high intensity focusing SANS



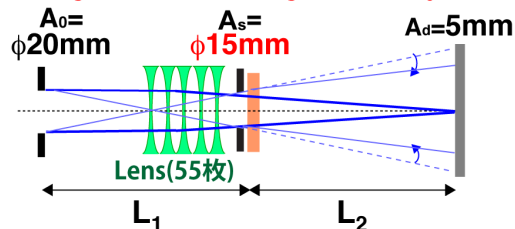
Sample : polystyrene latex
• radius : $R=250\text{\AA}$



Pin hole collimation



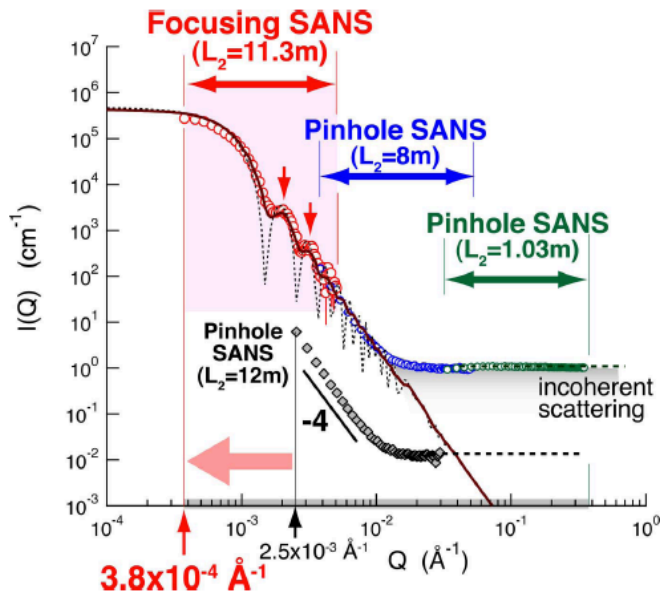
Focusing collimation (high intensity mode)



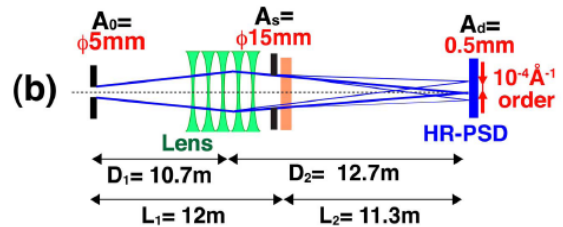
3.16x higher intensity is achieved by high intensity mode without losing resolution.

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

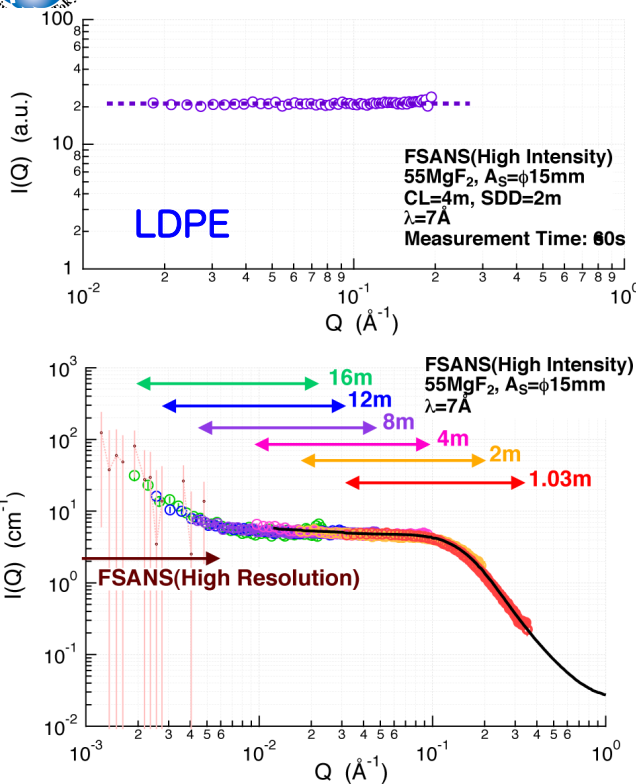
Sample: polystyrene latex
 • radius : $R=2980\text{\AA}$



Setup:



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



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

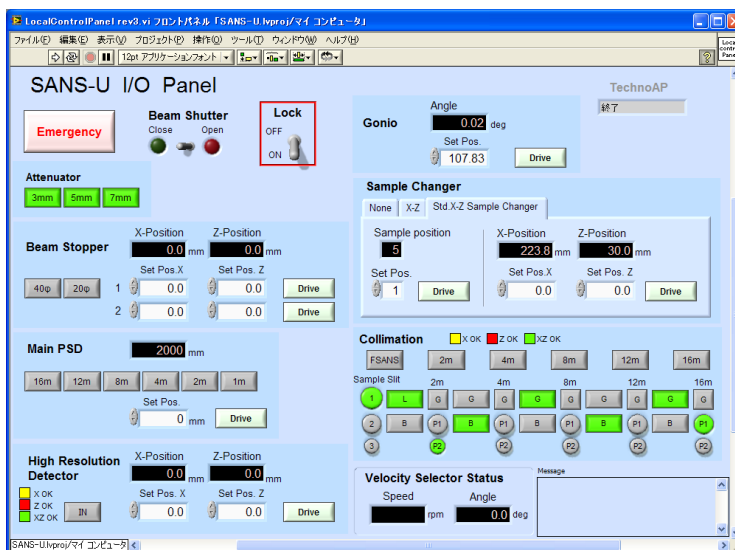
**Intensity gain :
 3.2**

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

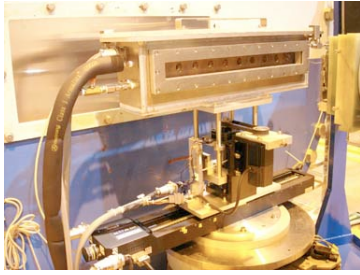
SANS-U User: **Only 1 time Experiment (3 or 4 days) / 1 year**

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

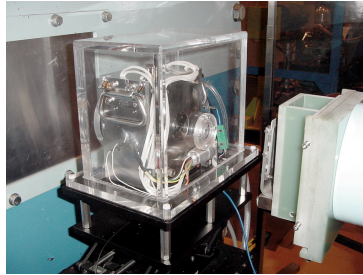
Improvement of operating system.



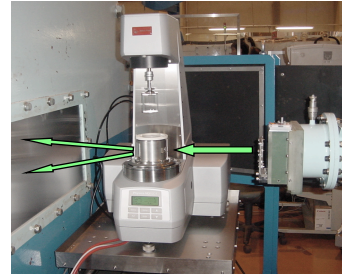
accessories



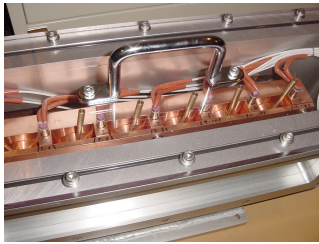
Standard sample changer



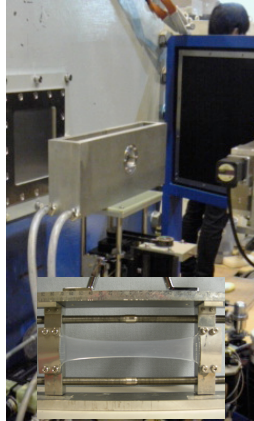
High pressure cell



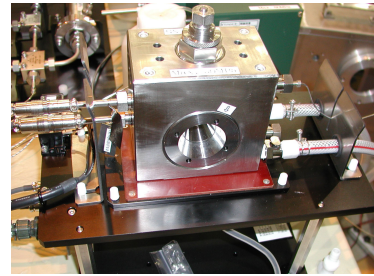
Rheo-SANS



High temperature cell



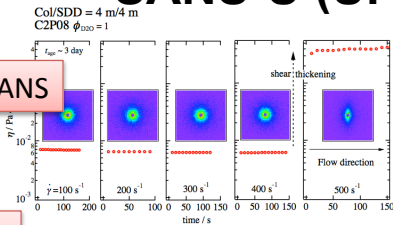
Stretching device



Super-critical fluid cell

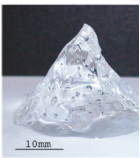
SANS-U (U. Tokyo) 2010 highlight

Rheo-SANS



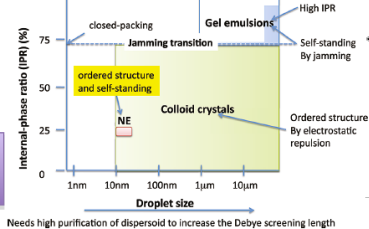
Nano emulsion

Clay-PEO shear thickening, *Macromolecules*, 2010.

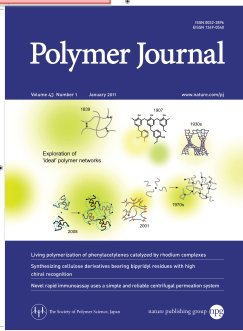


Nanoemulsion *Langmuir*, 2010

Ordering-jamming phase diagram

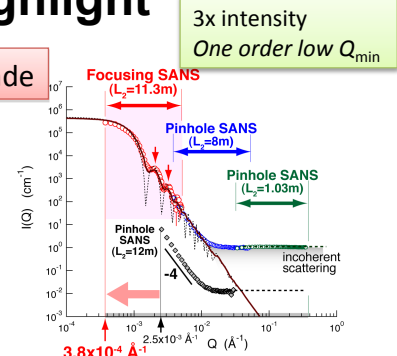


review

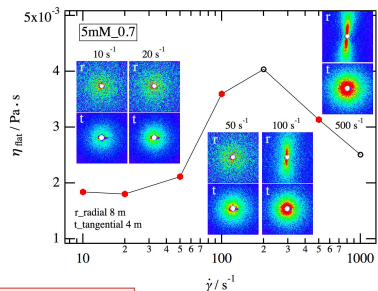


SANS on polymer gels *Polym. J.*, 2011.

upgrade



SANS upgrade *J. Appl. Cryst.* 2011.



Threadlike micelle
Rheo-SANS

Shear-thickening
Langmuir, 2011.

gel

Uniform deformation
Macromolecules, 2011.

