

2011/11/20 Tsukuba

# Ultra-Small-Angle Neutron Scattering at JRR3

## *SANS-J-II & PNO Spectrometers*

S. Koizumi Ibaraki Univ. (2011/10 ~)

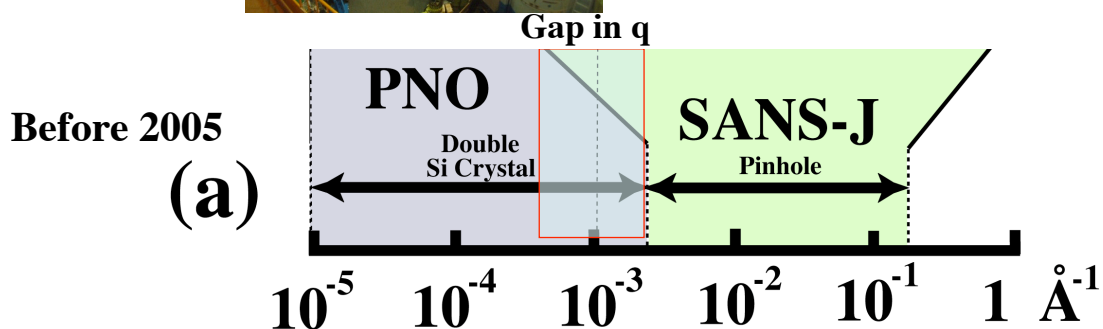
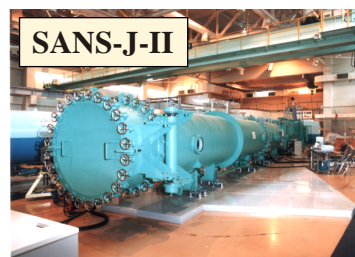
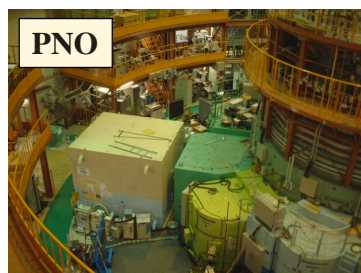


Y. Noda, Z. Yue, R. Kikuchi and D. Yamaguchi  
Japan Atomic Energy Agency



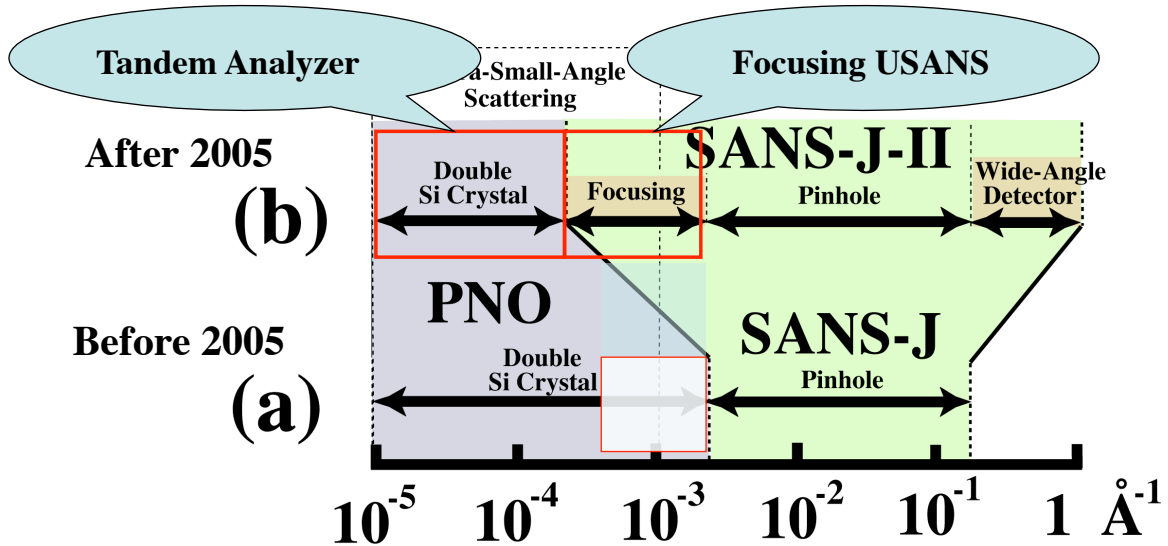
Current Status of Ultra-Small-Angle Neutron Scattering  
at JRR-3, Tokai, Japan

Complimentary Use of  
Double Crystal Type (PNO) & Pinhole Type (SANS-J-II)



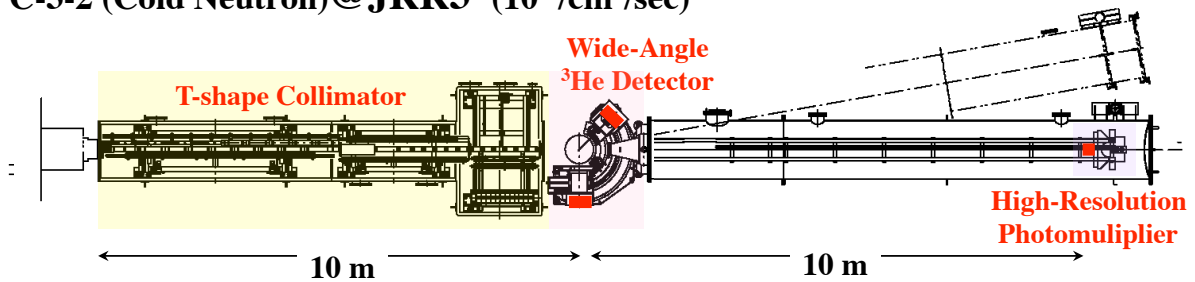
Current Status of Ultra-Small-Angle Neutron Scattering  
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Complimentary Use of  
Pinhole Type (SANS-J-II) & Double Crystal Type (PNO)



**SANS-J-II since 2005** 1991

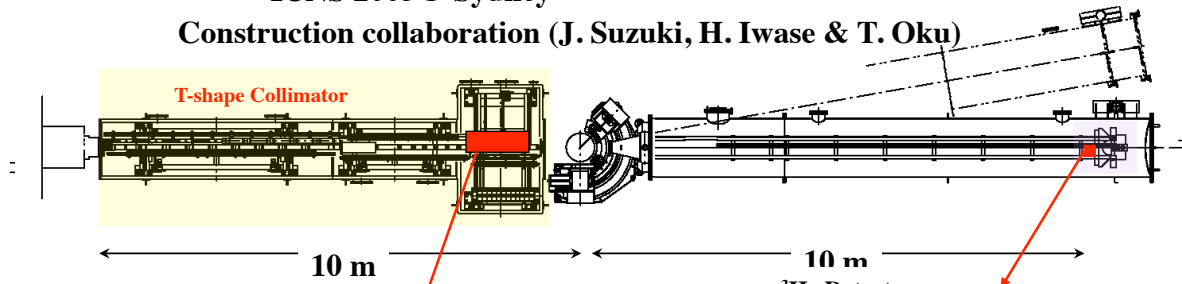
C-3-2 (Cold Neutron)@JRR3 ( $10^8$  /cm<sup>2</sup>/sec)



- Monochromator: ● Velocity Selector (Hungary)  
 $\lambda=6.0\text{\AA}$  (4000 rpm),  $\Delta\lambda/\lambda=8\sim 13\%$
- Collimation:  $S_1=20$  &  $S_2=8$  mm $\phi$  ( $10^6$  /cm<sup>2</sup>/sec @sample)
- Detector : ● <sup>3</sup>He Position Sensitive Detector (RISO, Denmark)  
60cm Diameter & 5 mm resolution  
Beam Stopper 40mm $\phi$
- Camera Length: ● 1.3m ~10m

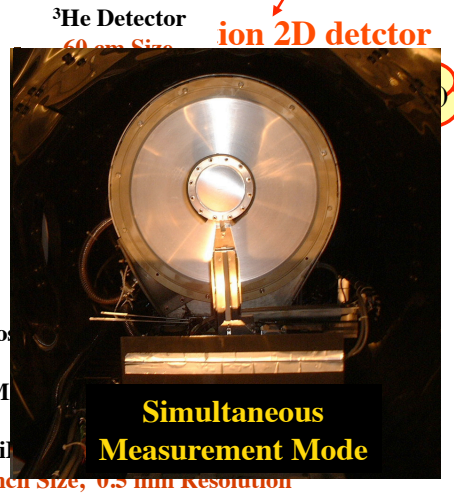
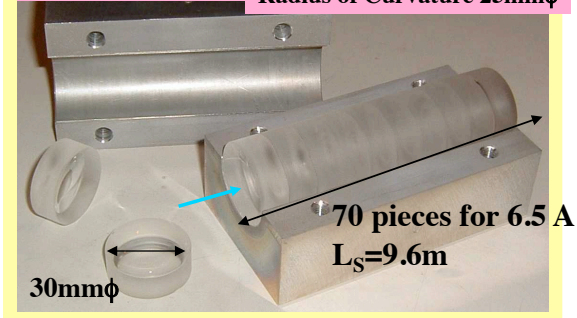
Available  $q$  is  $0.003 > q > 0.2$  (0.4) $\text{\AA}^{-1}$

ICNS 2005@ Sydney  
Construction collaboration (J. Suzuki, H. Iwase & T. Oku)

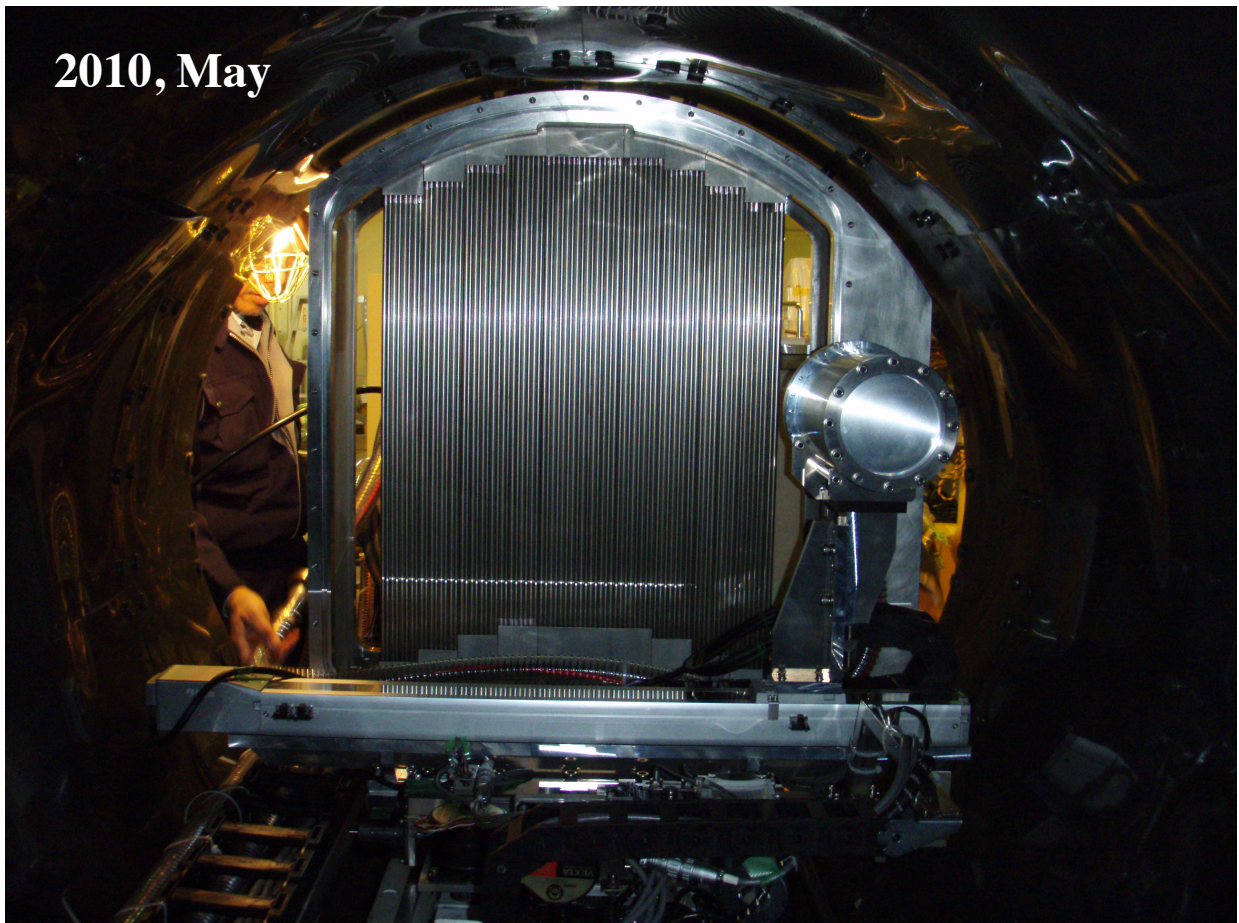


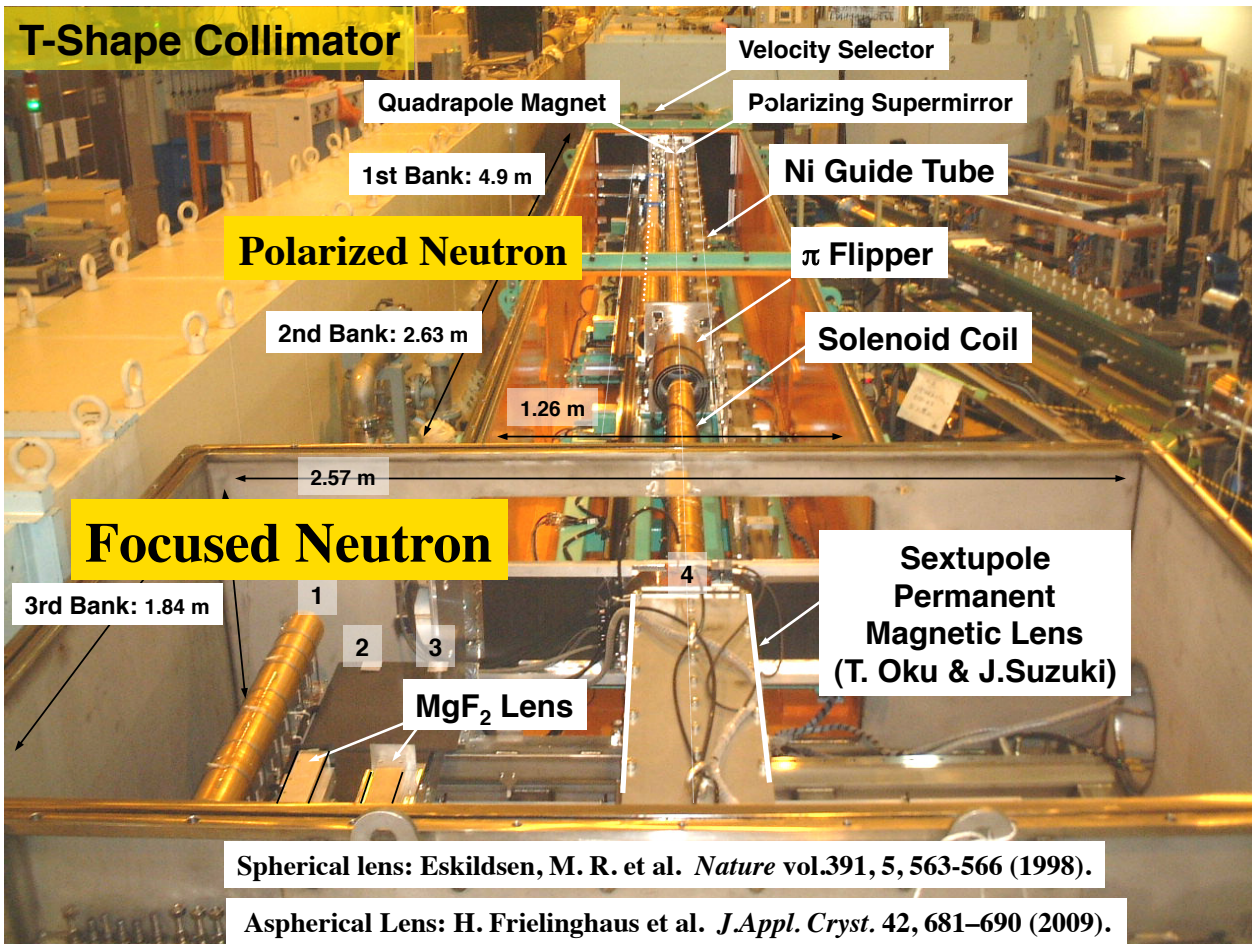
**Neutron lens**

**Biconcave & Spherical ( MgF<sub>2</sub> )**  
designed by RISO Radius of Curvature 25mm $\phi$



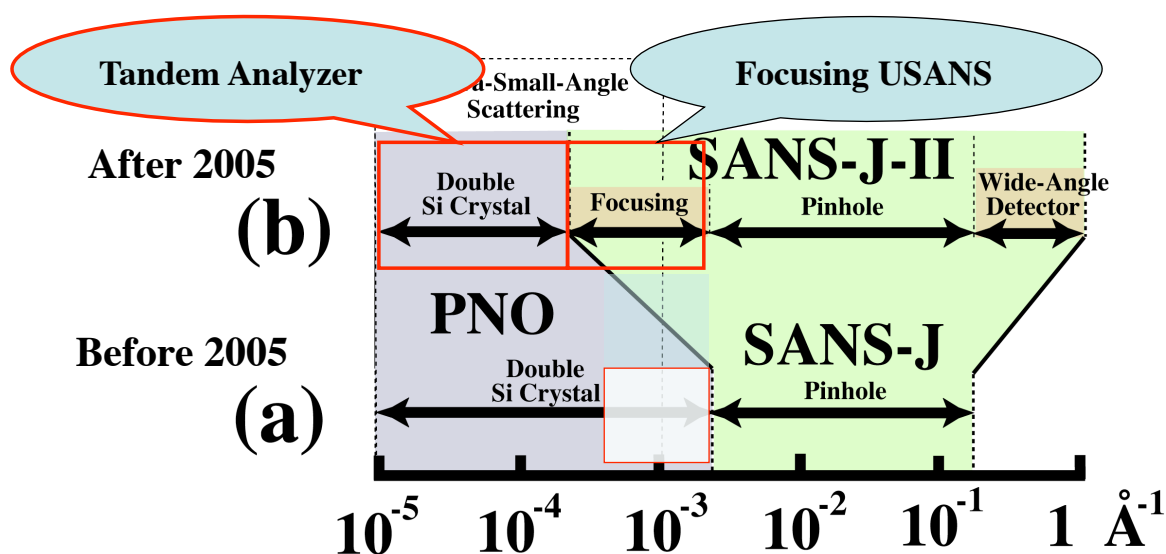
2010, May





Current Status of Ultra-Small-Angle Neutron Scattering  
at JRR-3, Tokai, Japan

Complimentary Use of  
Pinhole Type (SANS-J-II) & Double Crystal Type (PNO)

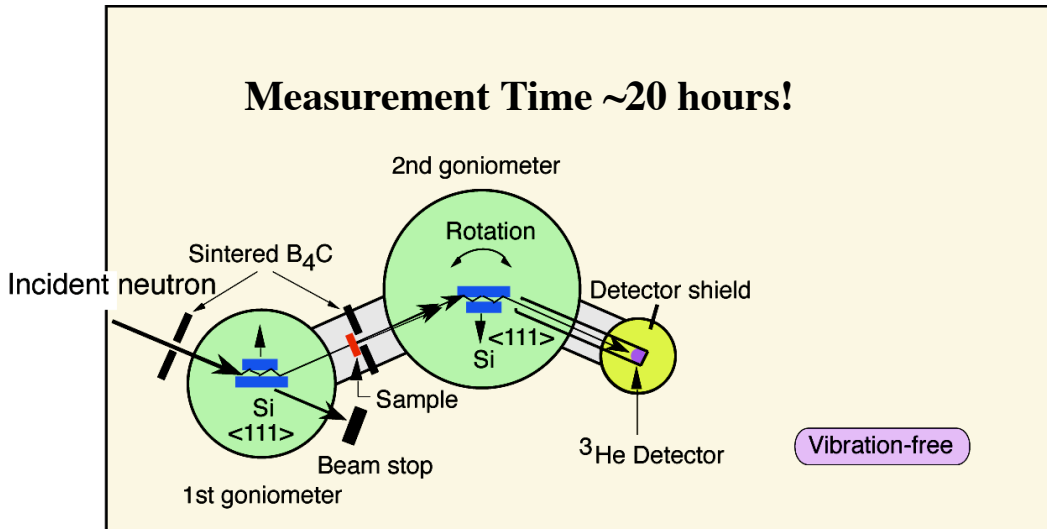


# Tandem Analyser Bense-Hart USANS Spectrometer

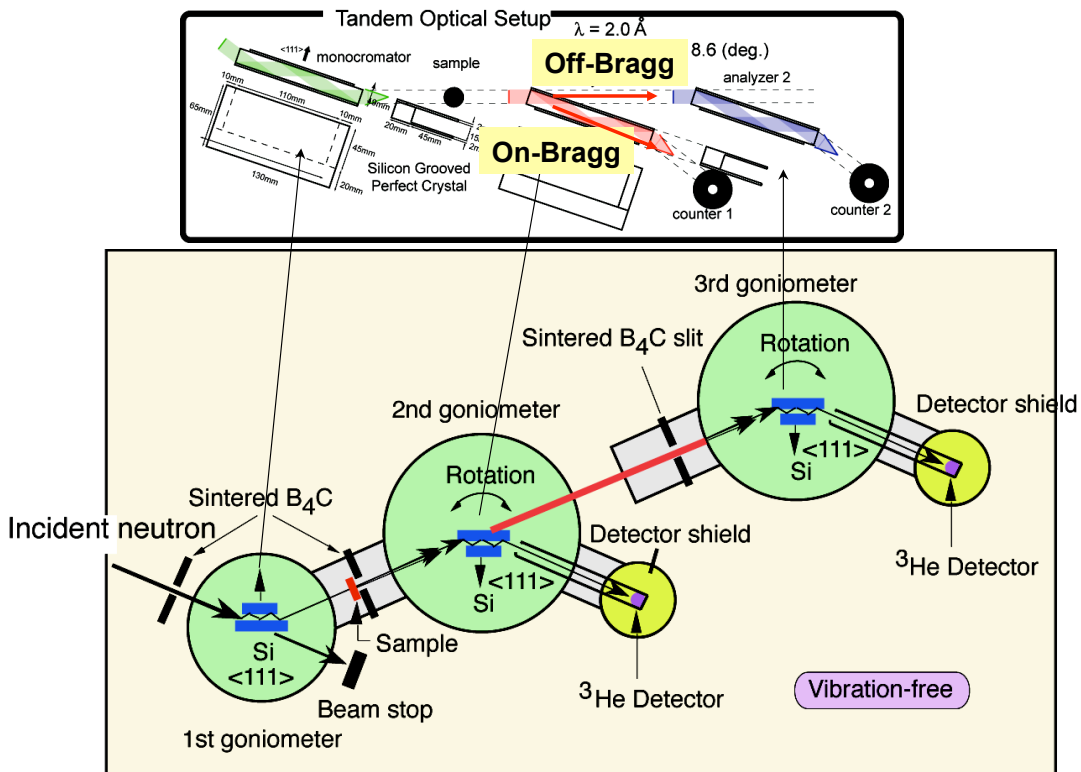
PNO @JRR3 3G

ICNS2005 Sydney  
 D. Yamaguchi and S.Koizumi  
*Phys. B, 385-386, 1190 (2006)*

Perfect silicon is transparent for neutron!



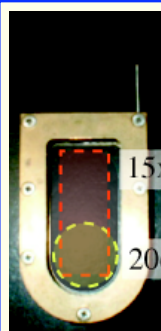
Perfect silicon is transparent for neutron!



**Measurement Efficiency: Double !**

Standard measurement time  
**5~6 hours**

## Two Spectrometers Share Same Sample Environments !



### Common Sample Holders

15x40 mm<sup>2</sup> (PNO)

$\lambda=2\text{\AA}$

20 $\phi$  (SANS-J-II)

$\lambda=6\text{\AA}$

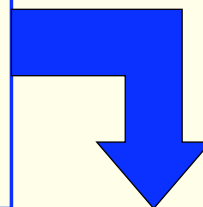
Sample thickness: 0.5 ~ 10 mm

Standard measurement time

5~6 hours

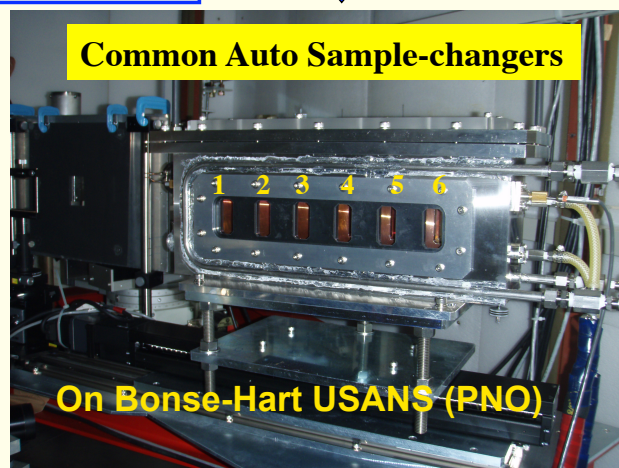
3~4 hours for focusing USANS

0.1~2 hours for pinhole SANS



**User Request**  
**Better to be in a same beam hole!**

### Common Auto Sample-changers



**On Bense-Hart USANS (PNO)**

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## Hierarchical Structure in Biology

### II. USANS on Living Cells (Invivo)

#### *Acetobactor Xylinium*

*Synthesizing extra cellular Cellulose*

**Collaboration with**

**T. Kondo, Y. Tomita.**

**Agriculture Center, Kyusyu Univ.**

**H. Iwase (Cross)**

# *Acetobactor Xylinum*, producing Cellulose

Growth Rate: 2.6 $\mu\text{m}/\text{min}$  (at 28C)

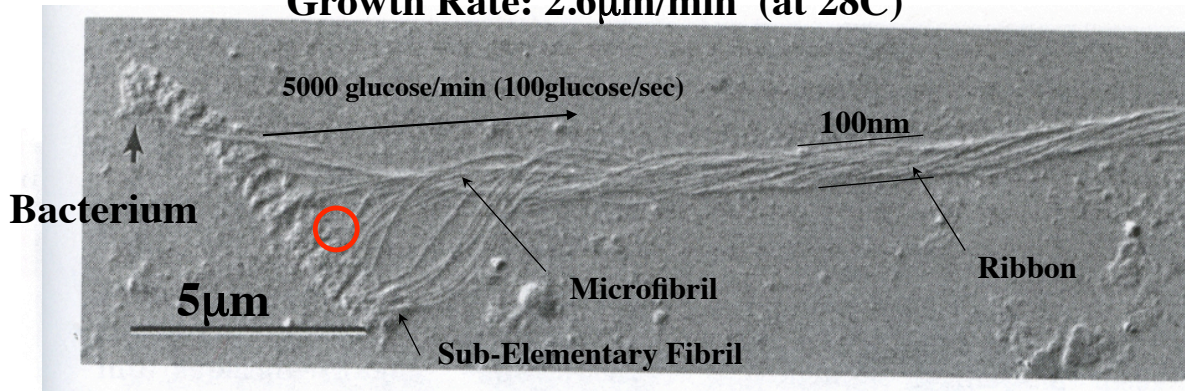


FIGURE 9 Platinum/carbon shadowed subunits of one ribbon that have been separated by CMC. Note that the subunits originate from separated groups of disorganized material (arrow). This form of disorganized material (called native band) is sometimes synthesized without addition of altering agents just before normal fibril assembly begins. Bar = 1  $\mu\text{m}$ . cited from Chapter 5, "Biosynthesis and Biodegradation of Cellulose" Edited by C. H. Haigler and P. J. Weimer. (1991)

## Polymerization-induced Self-assembly

USANS Study on Hierarchical Structure of Microbial Cellulose:

*Eur. Phys. J. E* 26, 137–142 (2008).

