

動き出すTAIKAN

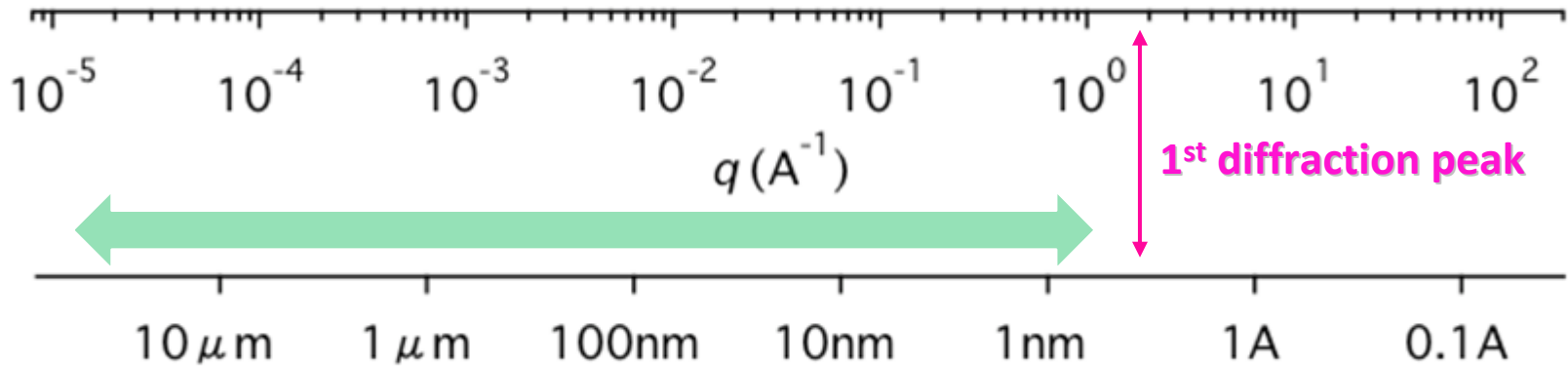
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Y.Inamura, T.Ito, K.Suzuya, K.Aizawa, M.Arai,
T.Otomo (J-PARC), M.Sugiyama (KURRI)

*CROSS



Small-Angle Neutron Scattering Method

Analysis of microstructure and nanostructure

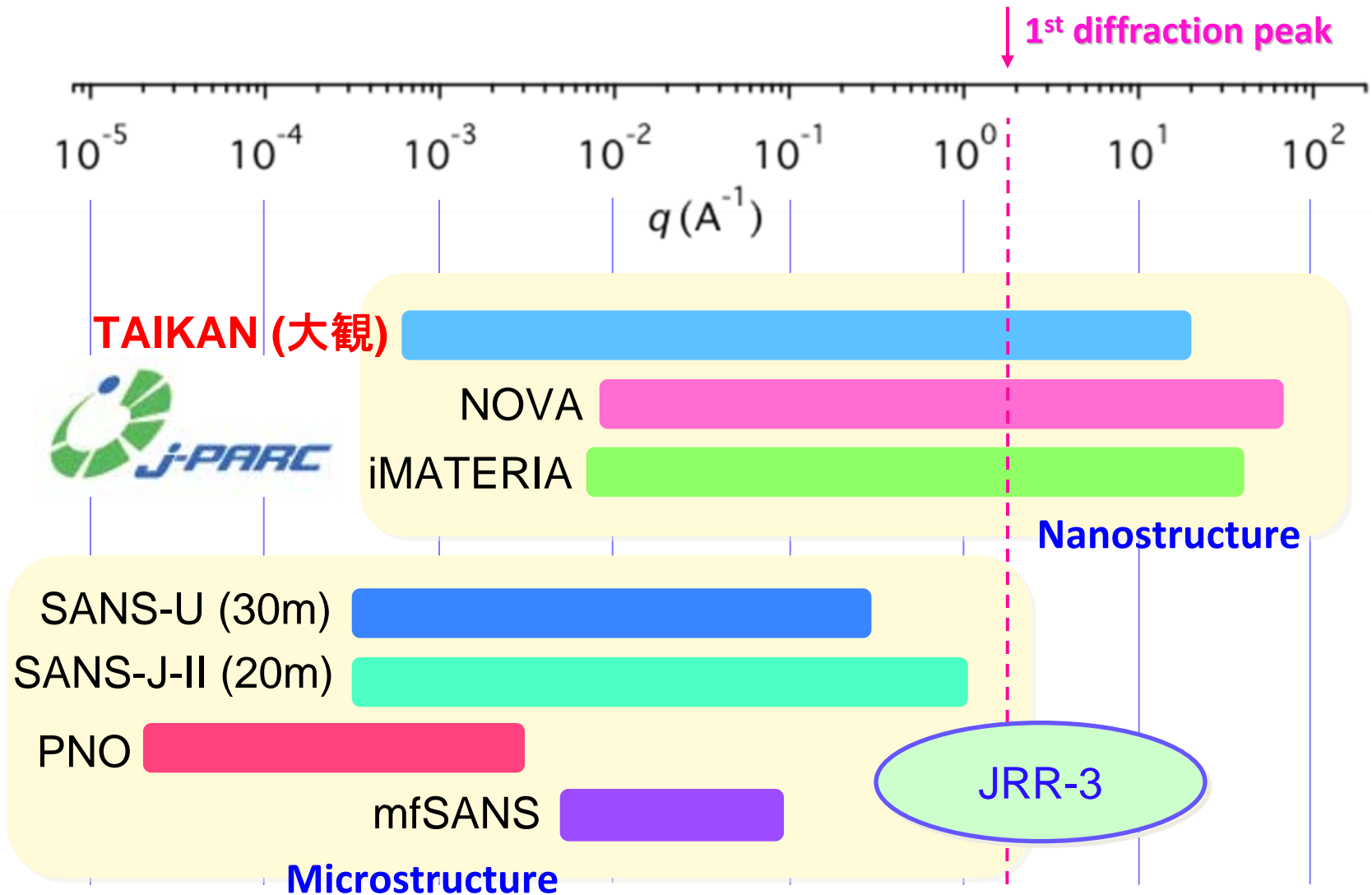


Size
large

Small

Matter in Various Scientific Fields

Instruments which can measure small-angle scattering

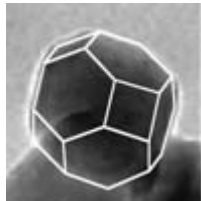


TAIKAN: SANS@J-PARC - Requirements -

- Recent progress in nano science (nano structure and electronic state) and research of multi-phase, multi-component system and nonequilibrium system
- Efficient measurement with higher spatial resolution and higher time resolution

ex1.

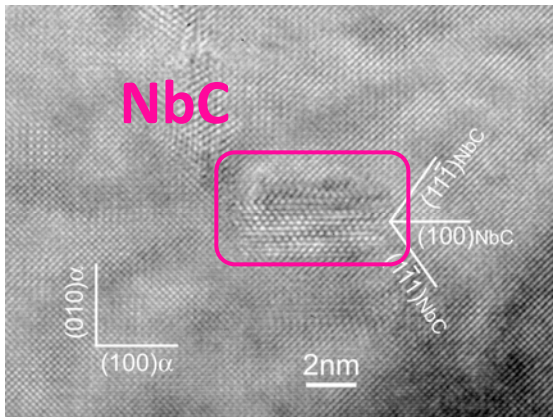
Pd



polyhedron \neq sphere
 ferromagnetism on surface
 quantum size effect, surface effect

**Properties
 of nanoparticle**

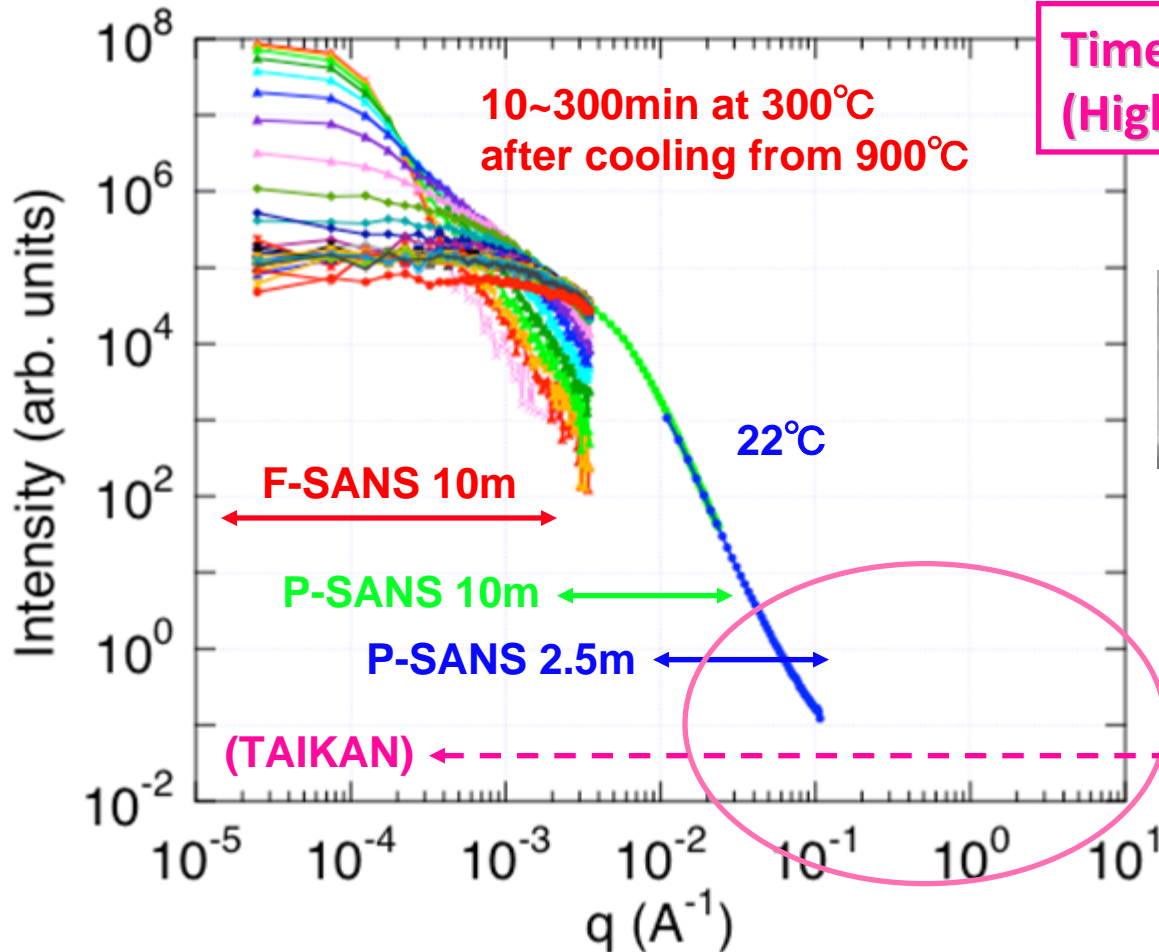
ex2.



Mechanism of hydrogen inducing
 brittlement in high-strength steels
 which posing engineering problem
 in the context of a hydrogen economy

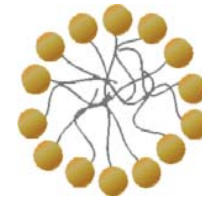
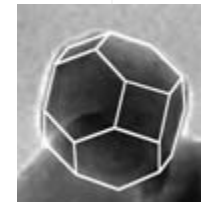
Success of upgrade, and requirements

ex. Phase Transformation of Bainite Steel



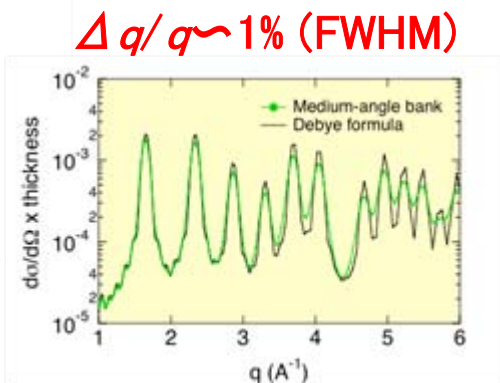
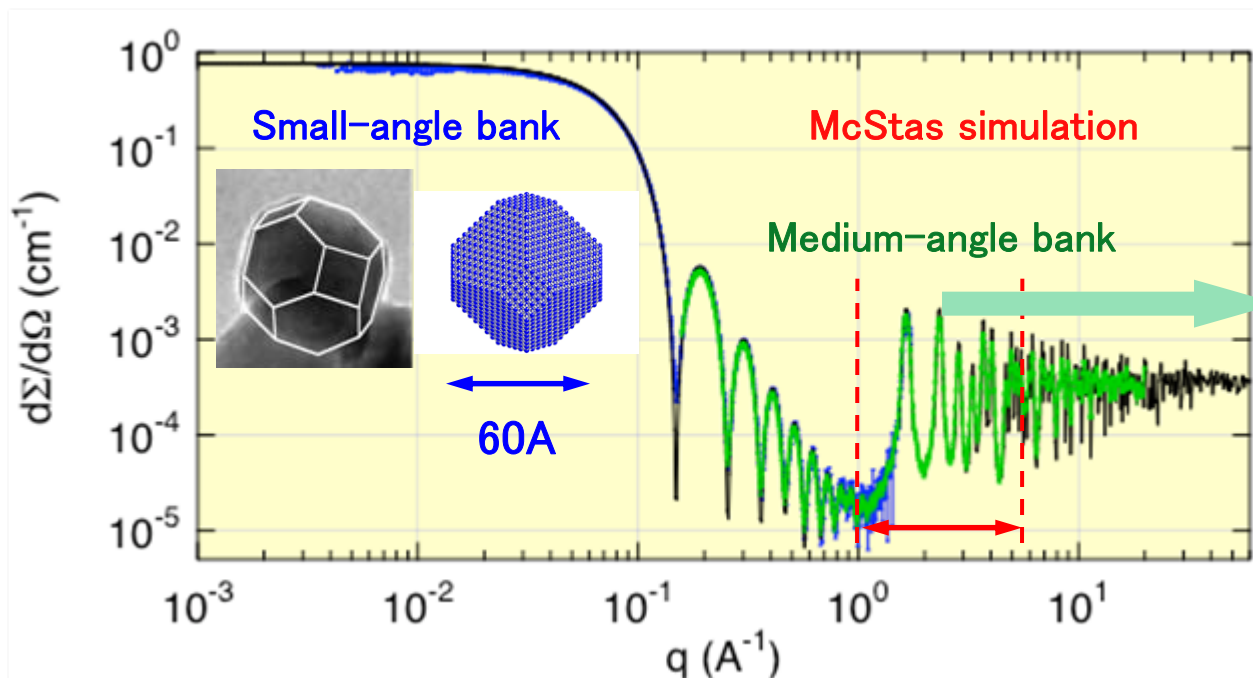
Time variation of $I(q)$ in wide- q
(High time resolution)

Nanoparticles

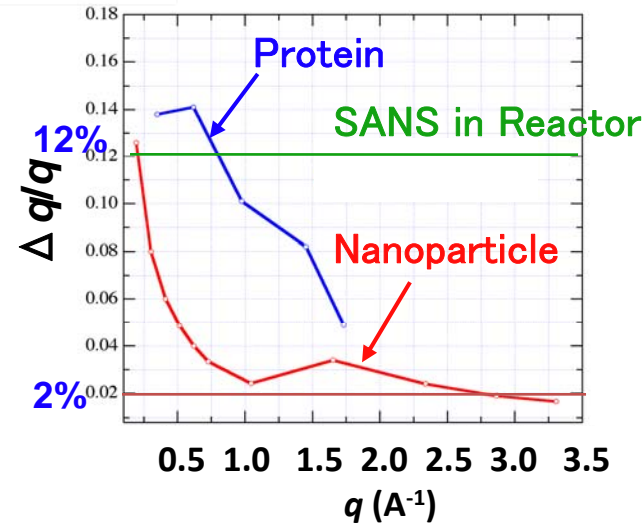
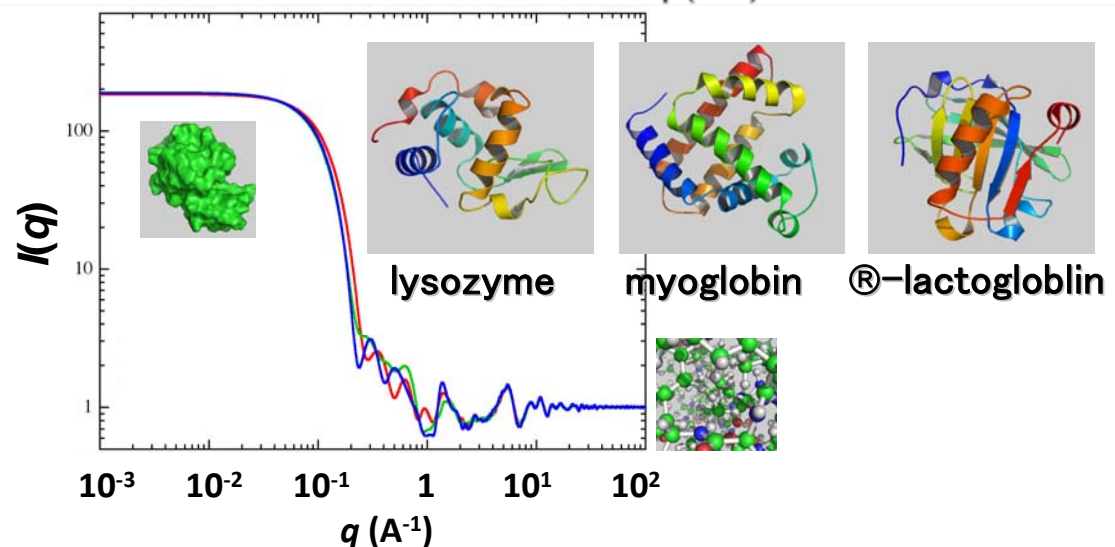


Structural analysis
with atomic resolution
(High spatial resolution)

q Range and q Resolution Required



$\Delta q/q < 2\%$ (FWHM)



$d\Sigma/d\Omega$ for various systems

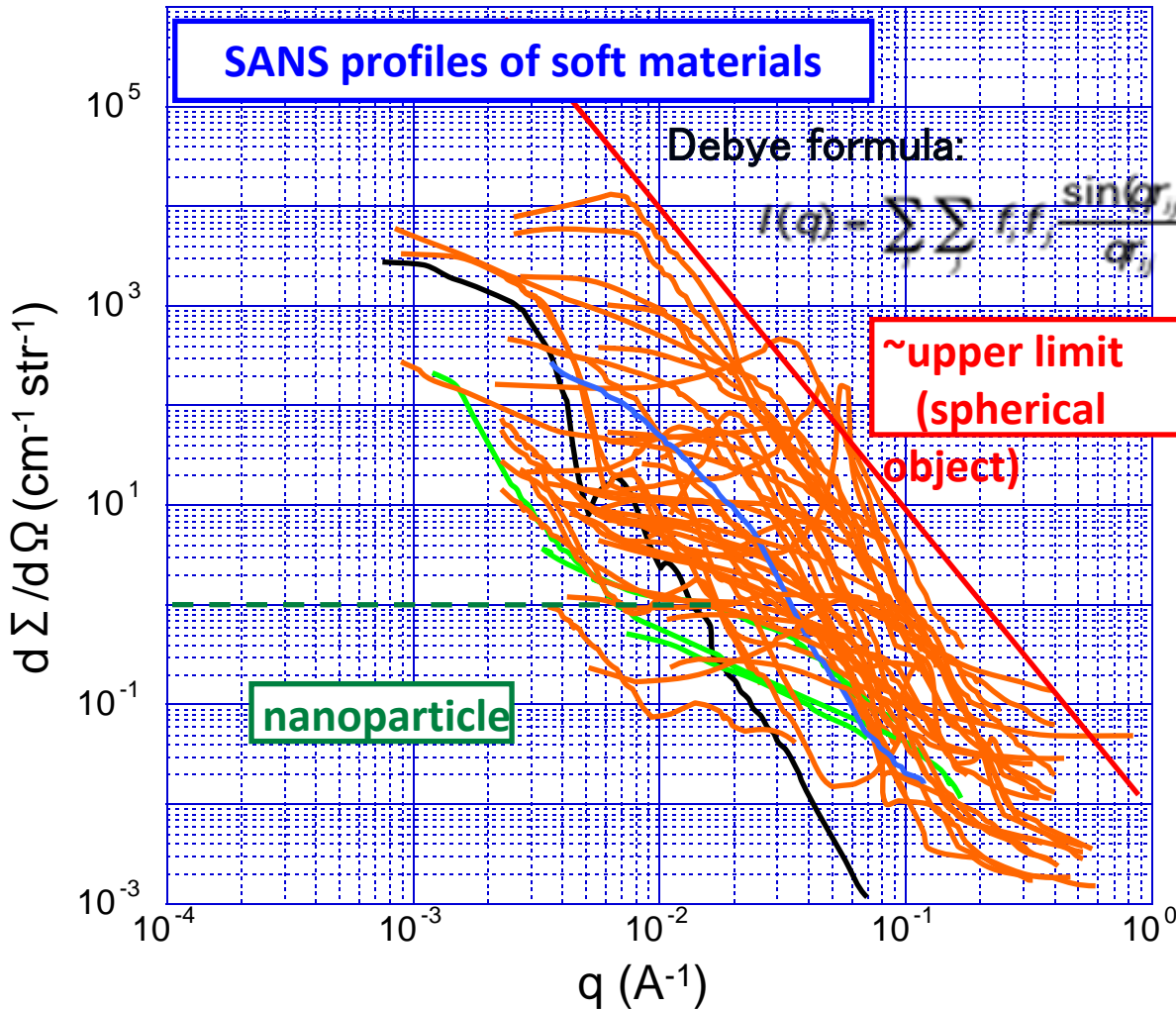
SANS profiles of soft materials

Debye formula:

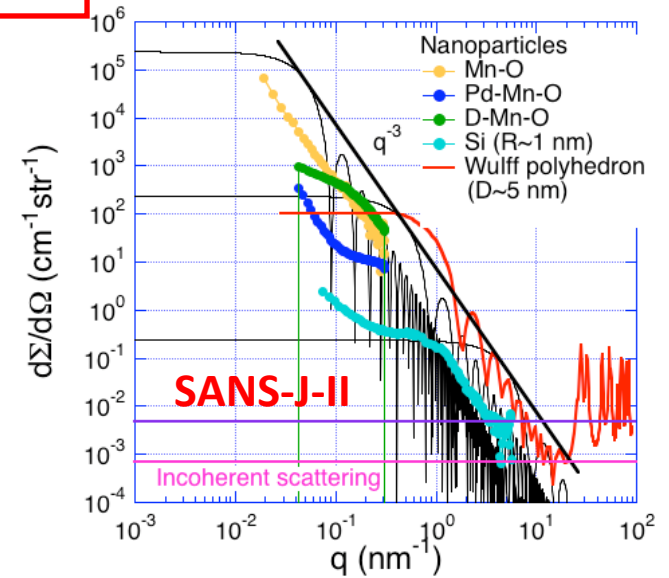
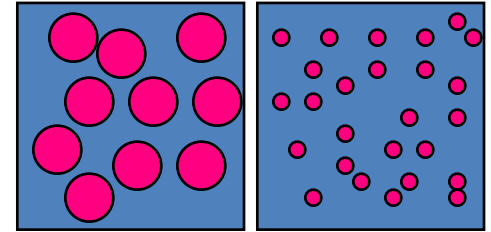
$$I(q) = \sum_j \sum_k f_j f_k \frac{\sin(qr_{jk})}{qr_{jk}}$$

~upper limit
(spherical
object)

nanoparticle

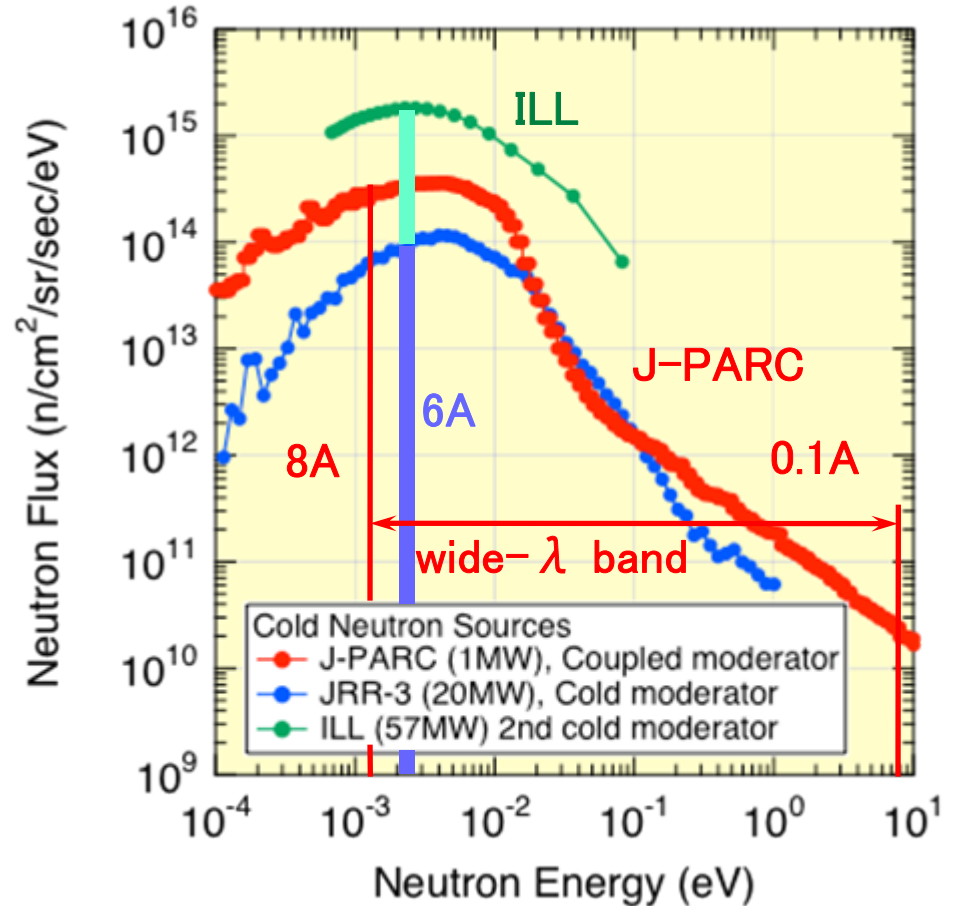
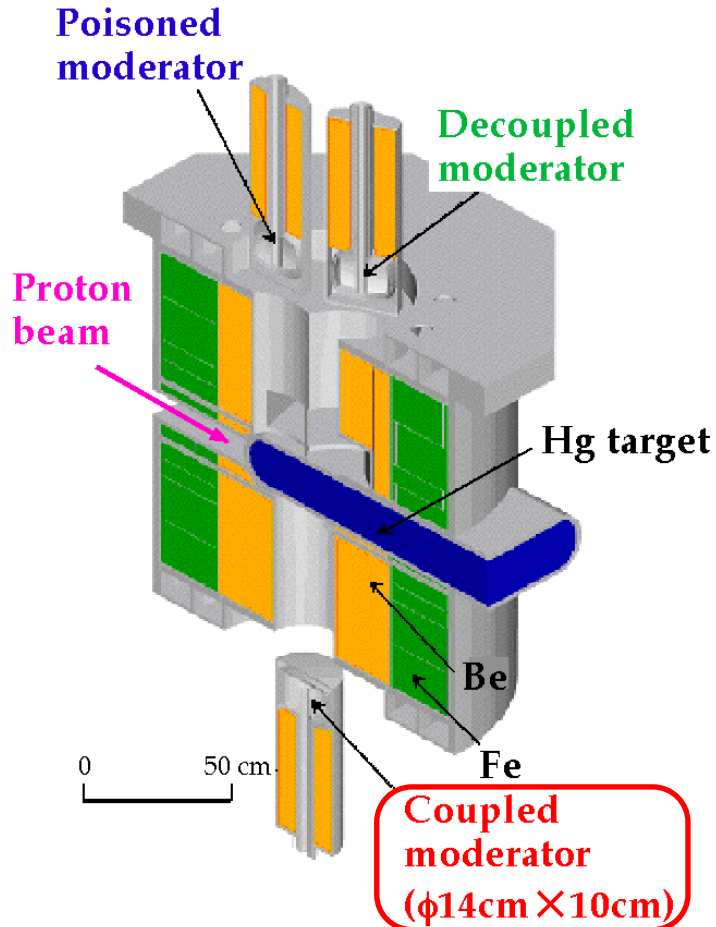


kind of nucleus: finite
→ scattering length: finite



Neutron Source

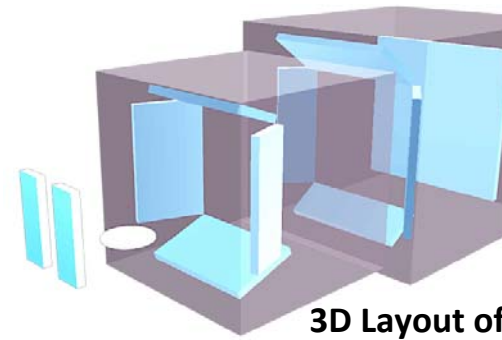
TAIKAN (BL15): Coupled Supercritical Hydrogen Moderator(+TOF method)



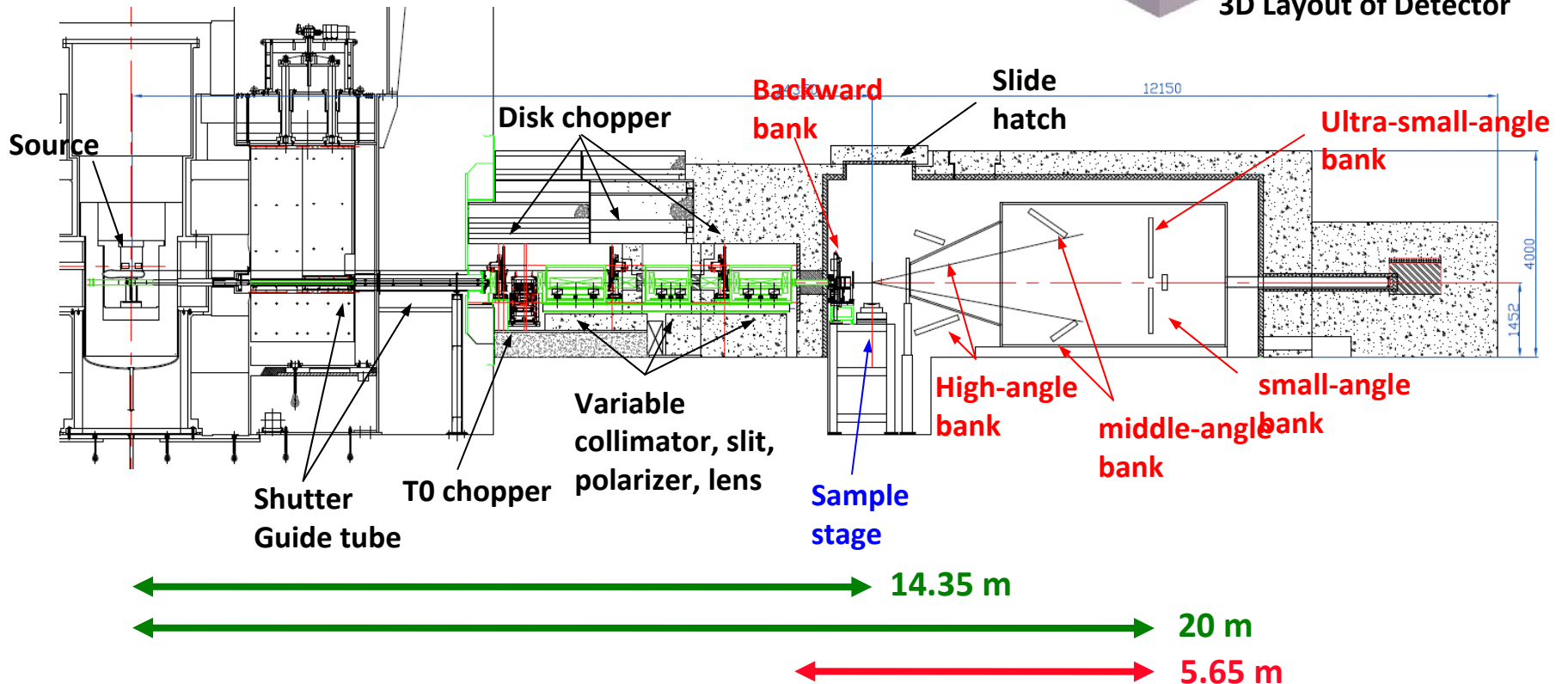
Time-averaged Intensity @ Moderator

TAIKAN

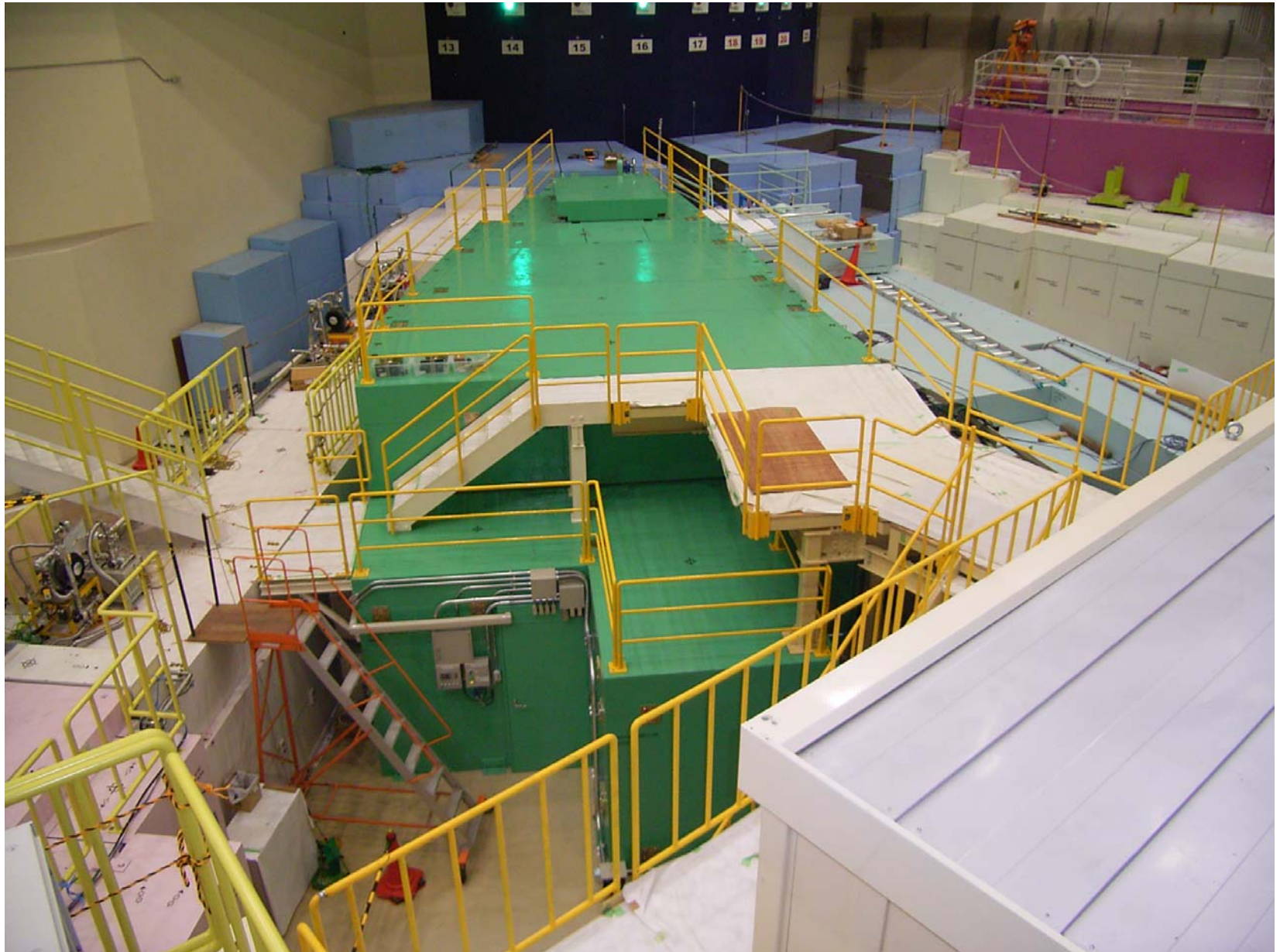
- Beam Port: BL15 (Coupled Moderator)
- Wavelength: $\lambda = 0.8(0.4) \sim 7.8\text{\AA}$
(1st frame, T0-chopper 25, 50Hz)



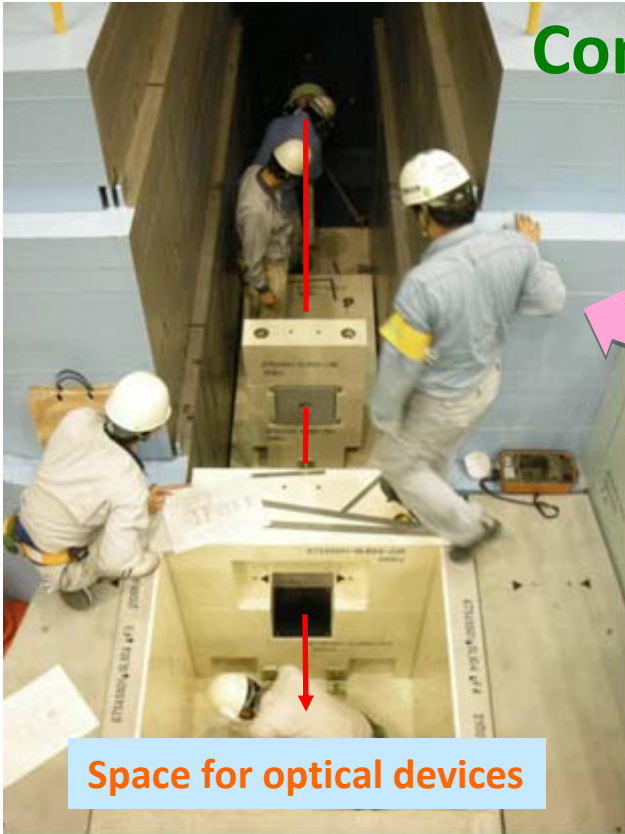
3D Layout of Detector



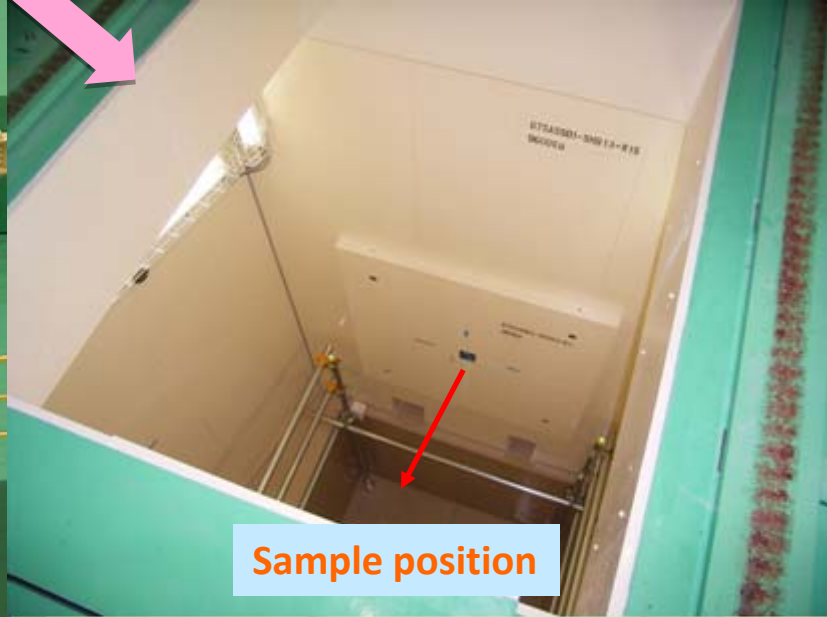
Construction of TAIKAN



Construction of TAIKAN



Space for optical devices



Sample position

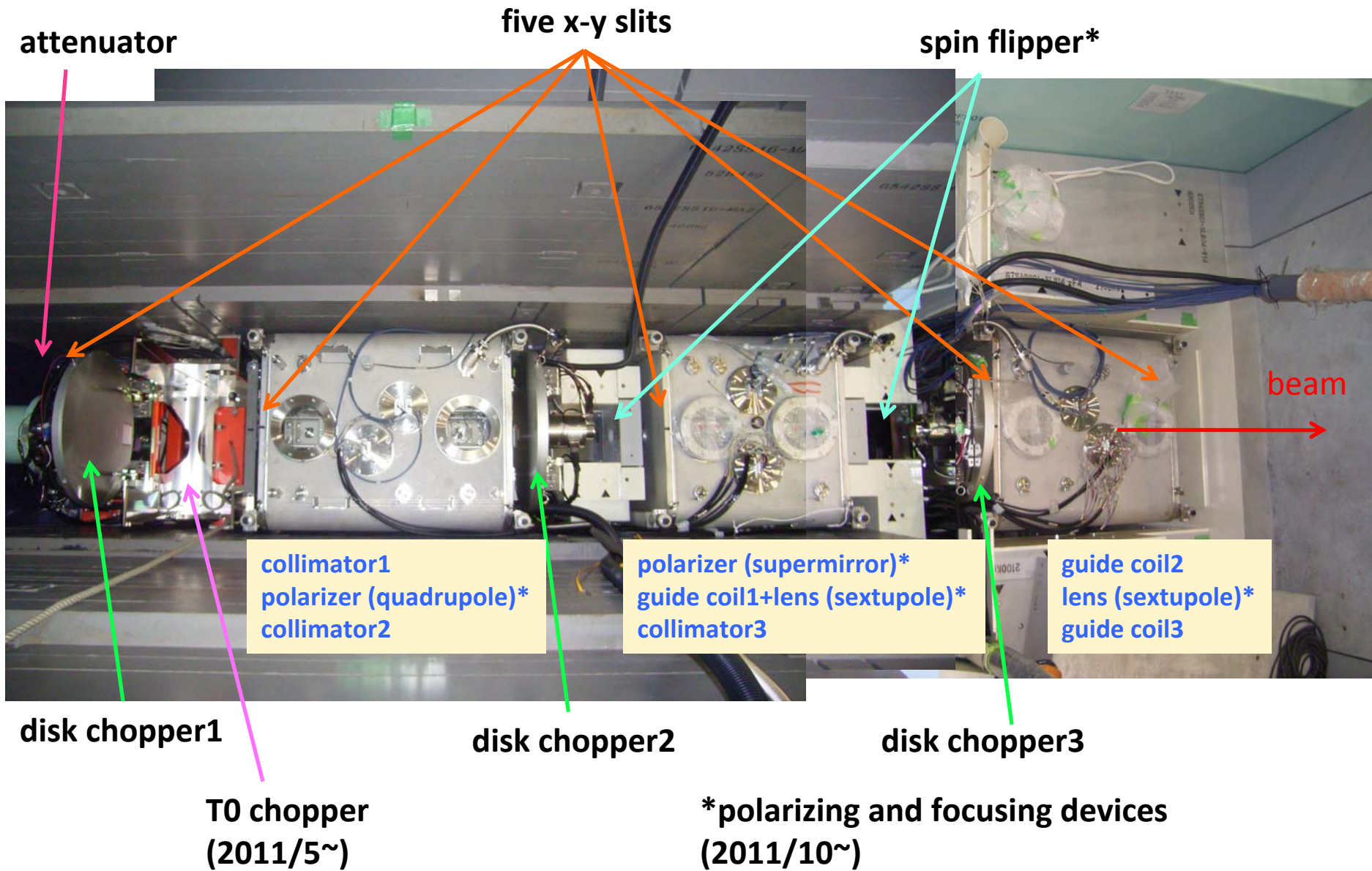


Construction of TAIKAN

Optical devices



Optical devices in the beam line

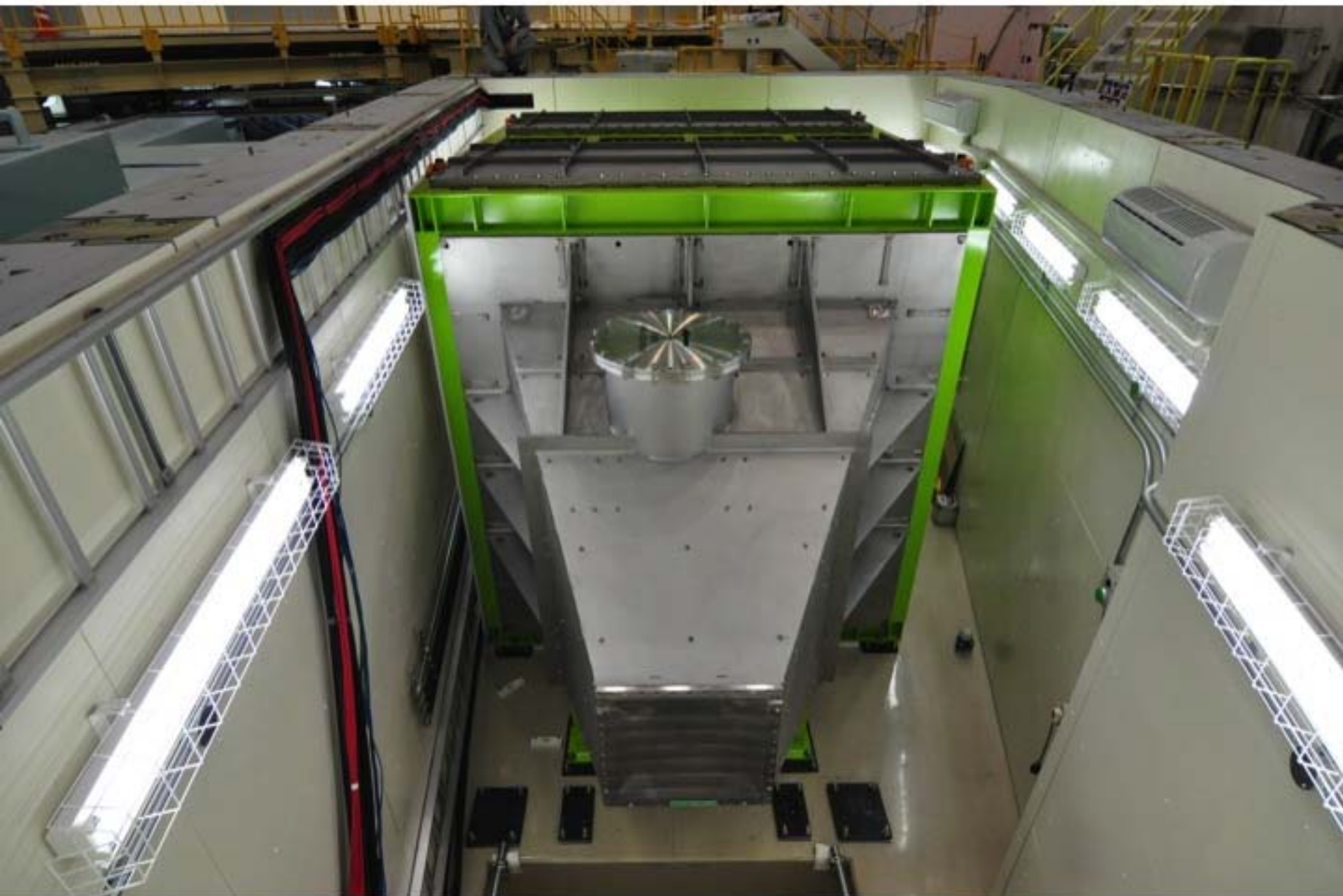


Construction of TAIKAN

Inside of the shield







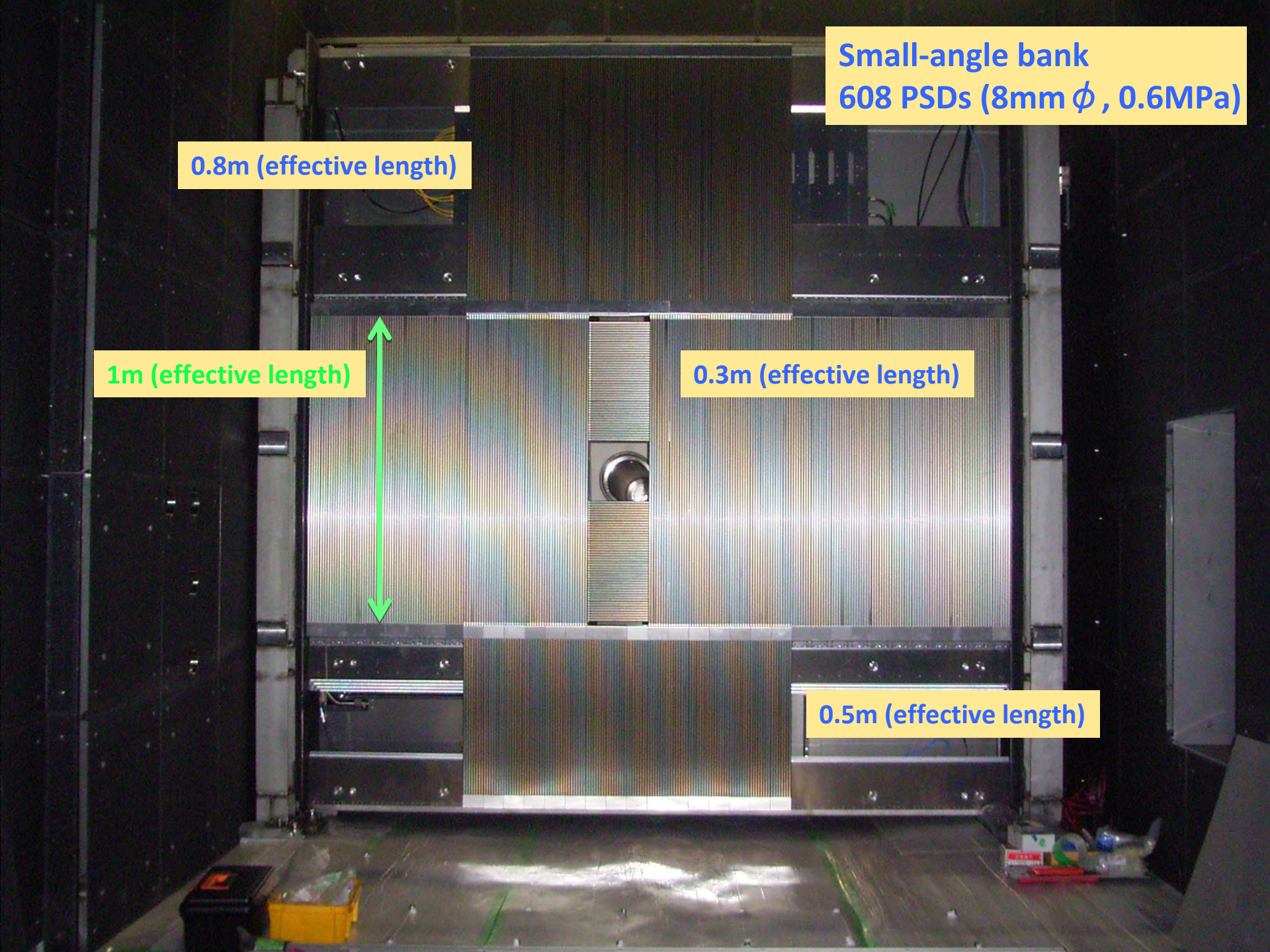
Small-angle bank
608 PSDs (8mm ϕ , 0.6MPa)

0.8m (effective length)

1m (effective length)

0.3m (effective length)

0.5m (effective length)



Utility ports



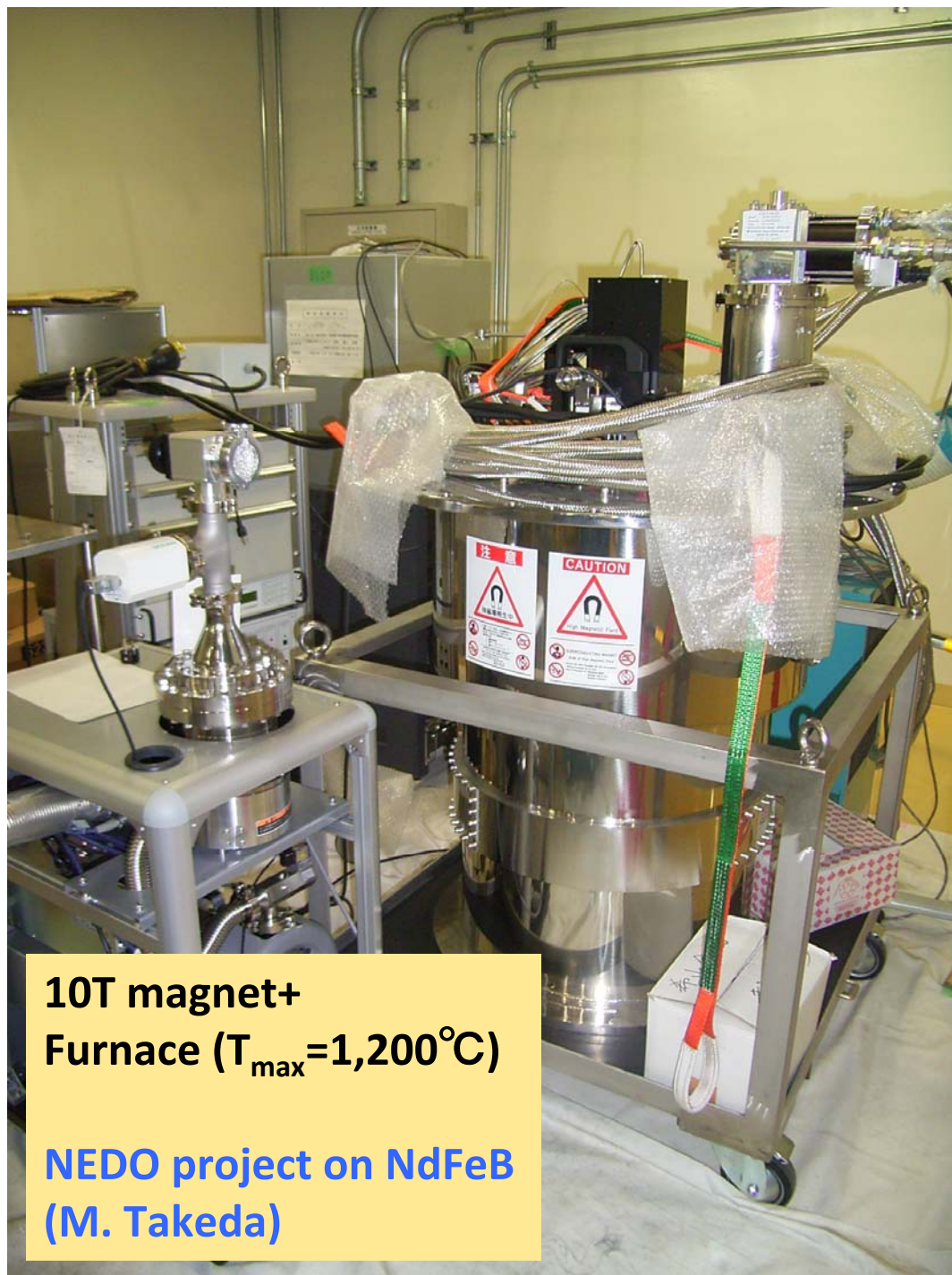
4-axes goniometer
 $x, y, R_x, R_y (= \omega)$

Protective wall



Sample environment

- Auto sample changer
10 samples,
 $T = \text{約} -40 \sim 200^{\circ}\text{C}$
- 1T magnet
- 7T magnet+DR



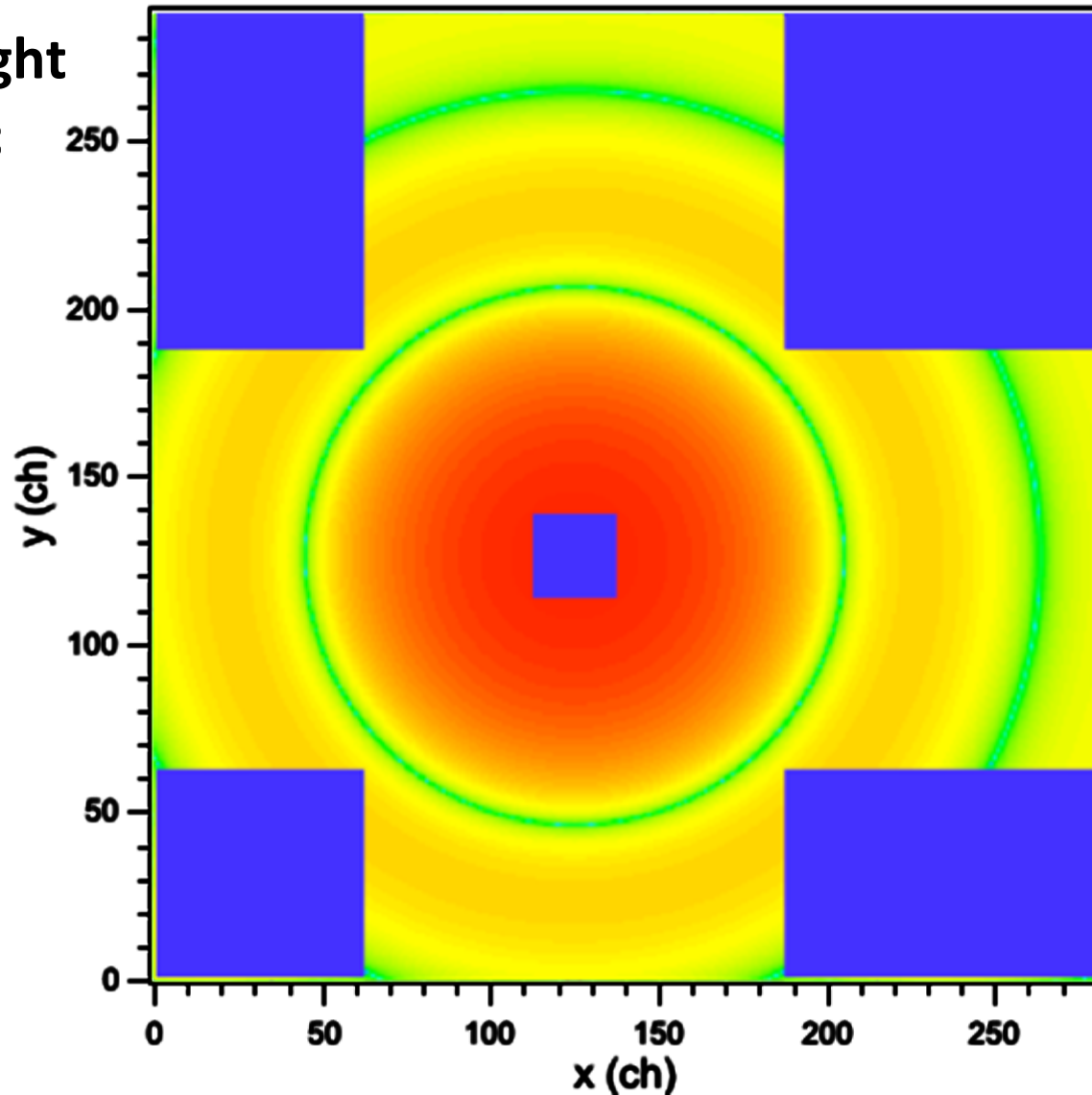
10T magnet+
Furnace ($T_{\text{max}} = 1,200^{\circ}\text{C}$)

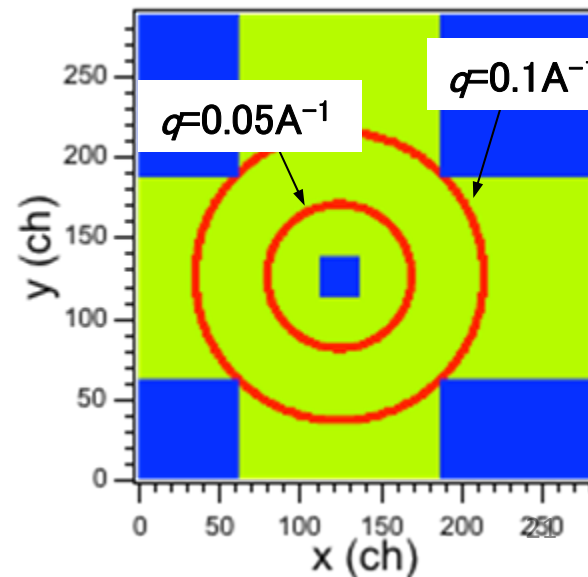
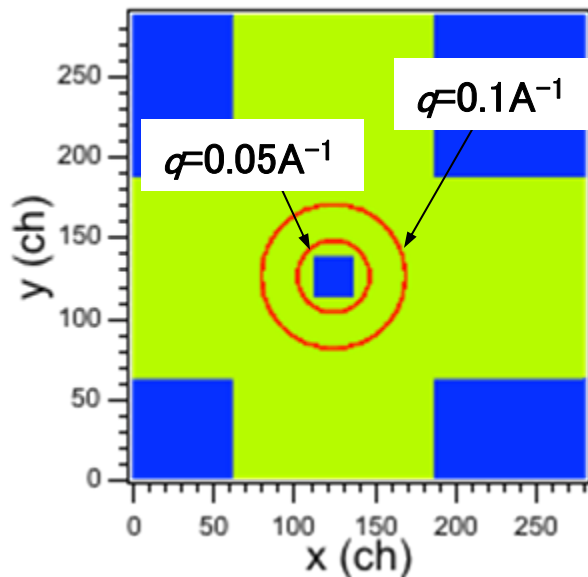
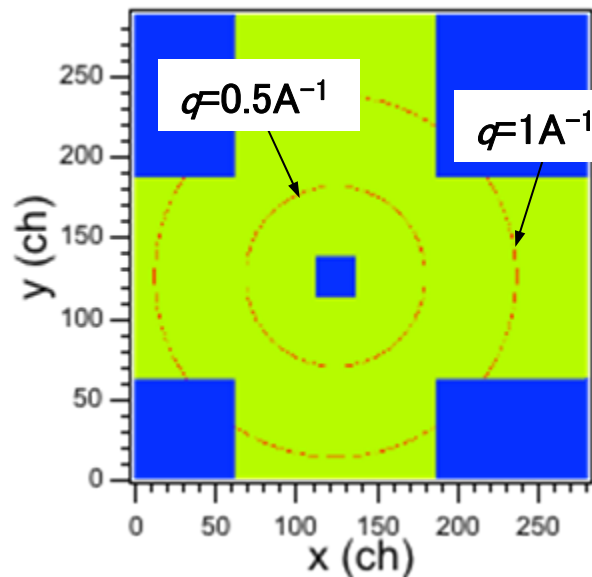
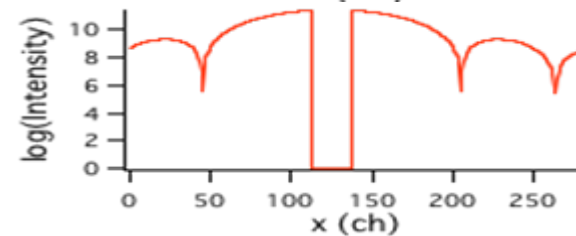
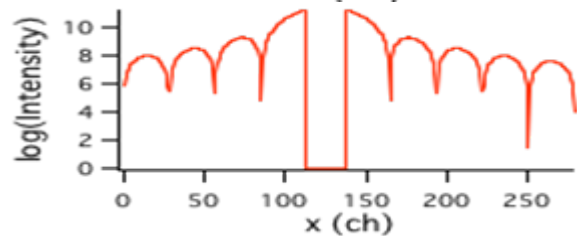
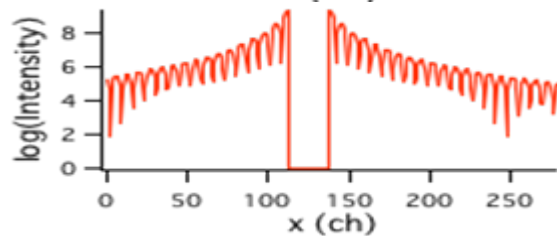
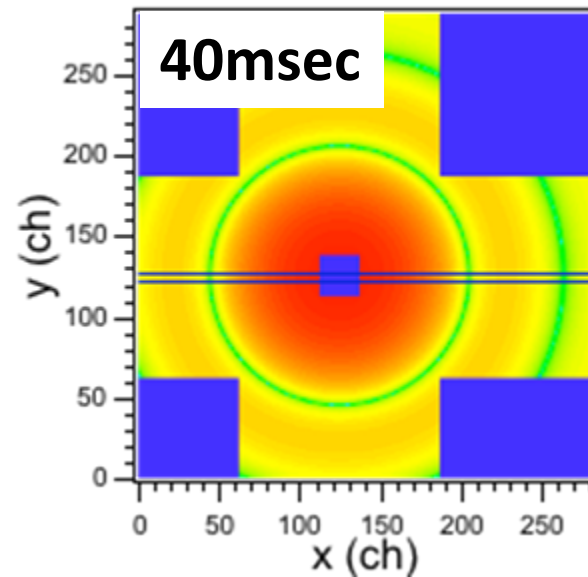
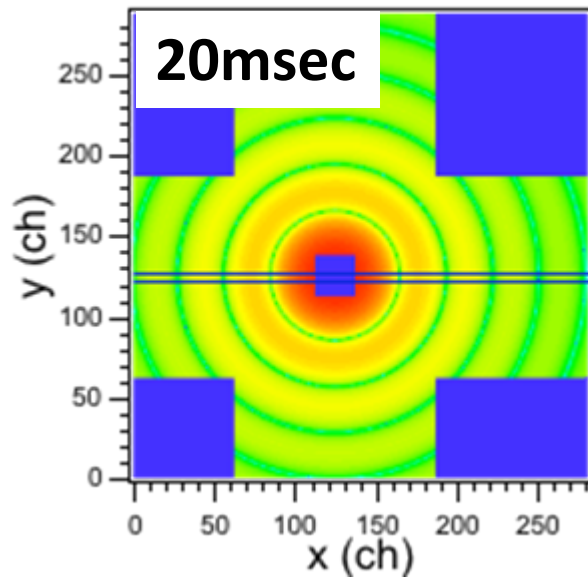
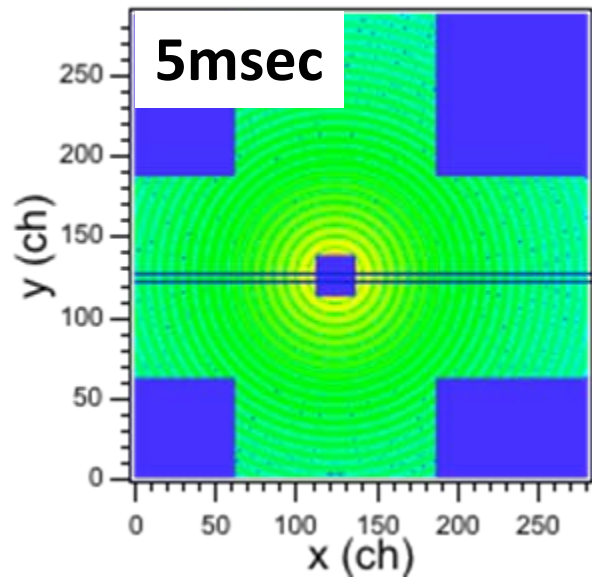
NEDO project on NdFeB
(M. Takeda)

Scattering pattern (Small-angle bank)

Nanoparticle (Radius=50A)

Time-of-flight
= 20msec

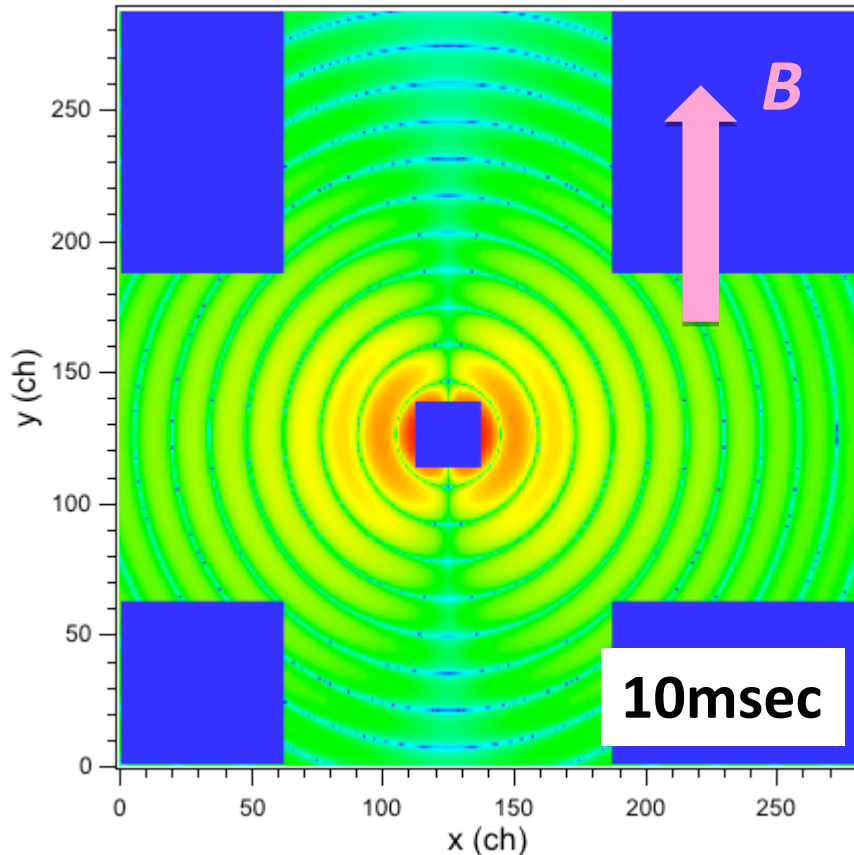




Scattering pattern (Small-angle bank)

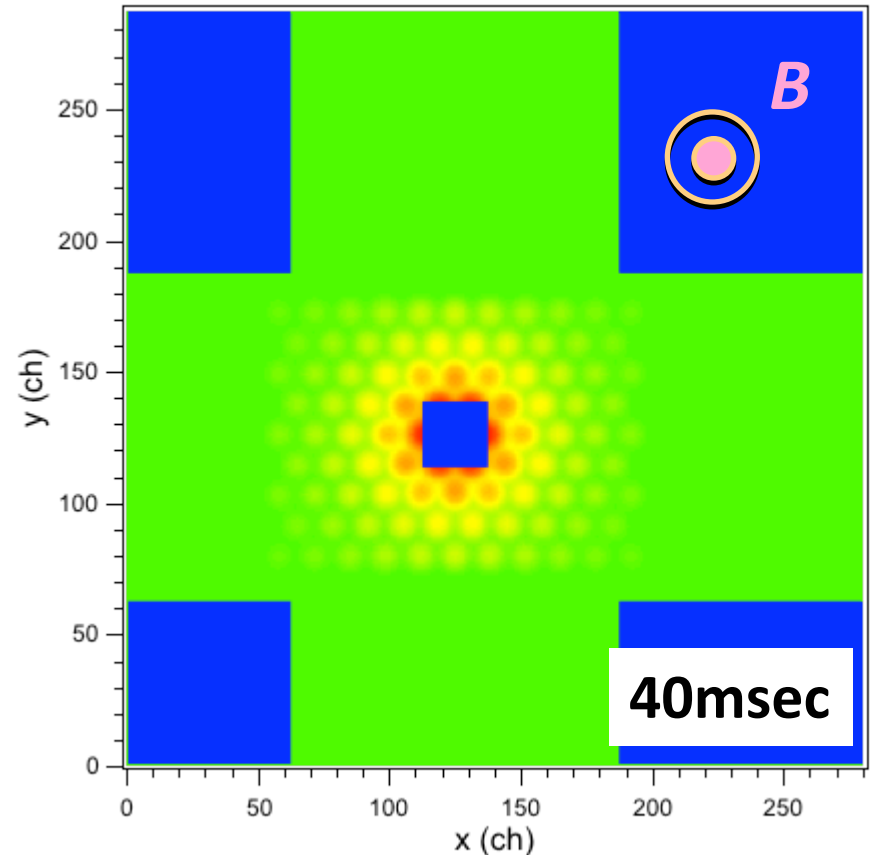
Magnetic scattering

Magnetic nanoparticle (Radius=50Å)



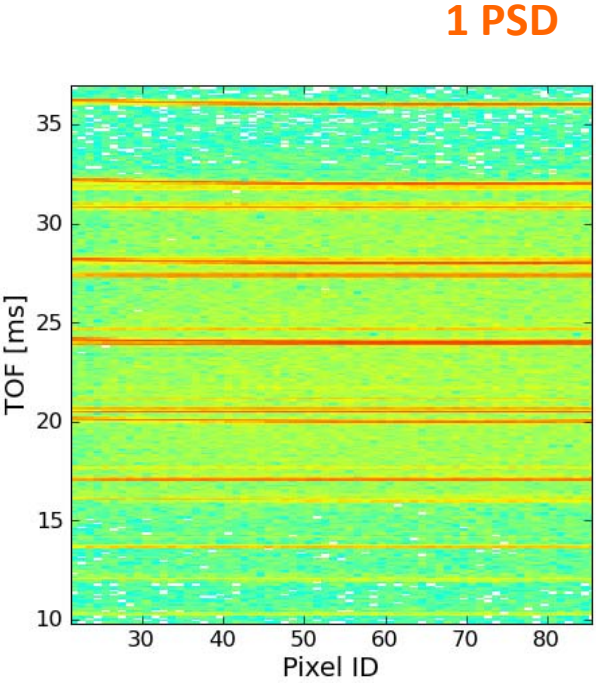
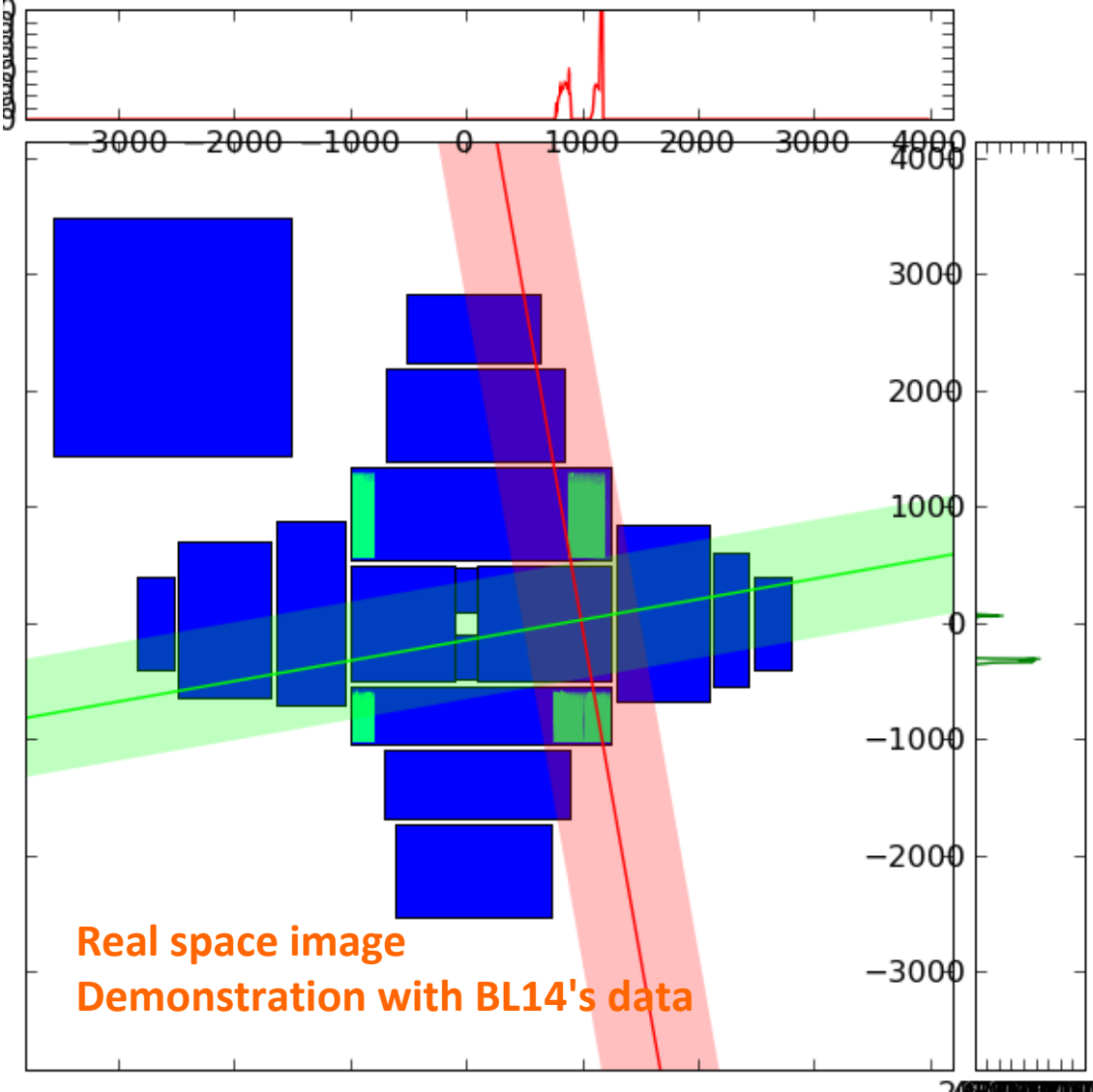
Anisotropic scattering pattern

Vortex lattice (B=1Tesla)



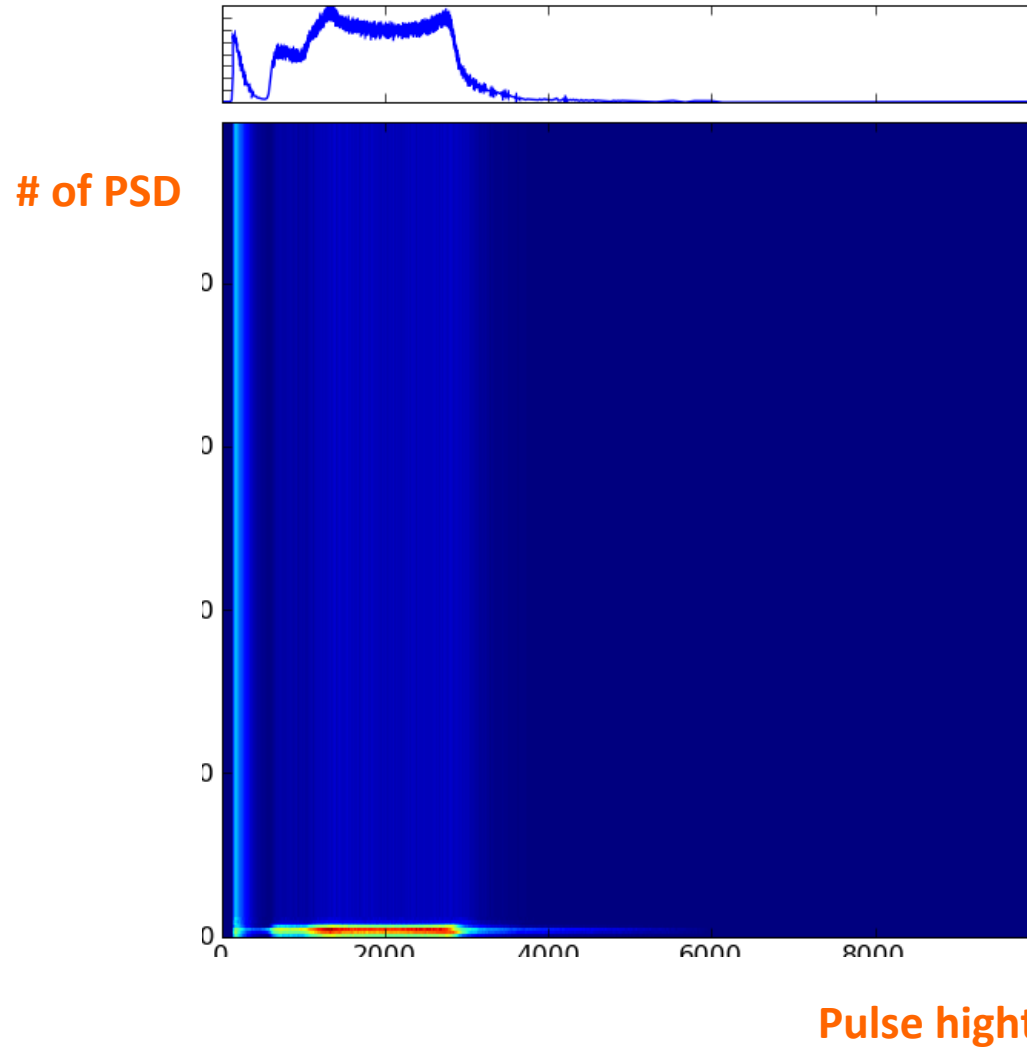
Long-range order $d [A] = \frac{480.6}{\sqrt{B [Tesla]}}$

Software for Data Analysis



異常検出器診断, LDL・UDL設定

Pulse hight distribution



まとめ, 今後の計画

1. J-PARCのパルス中性子小中角散乱装置「大観」の建設
- 小角検出器バンク → 約 $0.01 < q < 約1 \text{ \AA}^{-1}$ の測定

2. 今後の計画

2010年度内

- 初ビーム受入(3/7), コミッショニングの開始

2011年度

- 2011A コミッショニング,
他バンクの検出器据付等

- 2011B 44日程度(50%)を供用予定
コミッショニング(偏極ビームの利用)

MLF BL, JRR-3 BLとの連携(ソフト)

