Current Status of the Hokkaido University Neutron Source (HUNS)

-Since 1974-

Hokkaido University
Michihiro Furusaka

2015.05.14.

Special Thanks

- Hokkaido University
  - S.Takeda, T. Ishida, H. Moriki, T. Sasaki
  - M. Ohnuma, T. Kamiyama, H. Sato
- RIKEN
  - Y. Yamagata, J. Guo, T. Hosobata, J. Kato, S. Morita, T. Kawai
- KURRI
  - M. Hino
- KEK
  - N. Yamada

2015.05.14.

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- Introduction to the HUNS facility
- HUNS upgrade on going
  - Best example of “laboratory neutron source”
  - METI advanced steel project
    - Ministry of Economy, Trade and Industry
  - Not too large, just enough for daily research activities
- New target stations
  - Cold source troubles

2015.05.14.

Status of HUNS

- New iANS, intermediate-angle neutron source.
- Focusing mirror development for focusing-SANS
  - RIKEN and Hokkaido Univ.
    (S. Takeda, Y. Yamagata, et. al.)
- Upgrade design of the
  Bragg-edge transmission instrument
  (H. Sato, et al.)
- X-ray & neutron imaging (T. Kamiyama)

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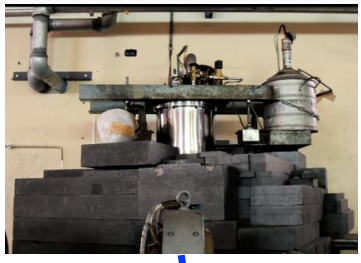
CANS,
Compact Accelerator
Driven Neutron Source

A model "Laboratory neutron source" at Hokkaido University

HUNS



Changed over

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"Pulsed" "Cold" neutron source

- Electron Linac
  - 35 MeV, 30 μA,
  - Since 1974

1kW

- Pulsed & Time of flight
  - 50 pps, 3μsec electron pulse

- Solid methane Cold Source @17K
  - "Coupled"
  - Tentatively mesitylene

Flux ≈1/2000 of that of ISIS TS2

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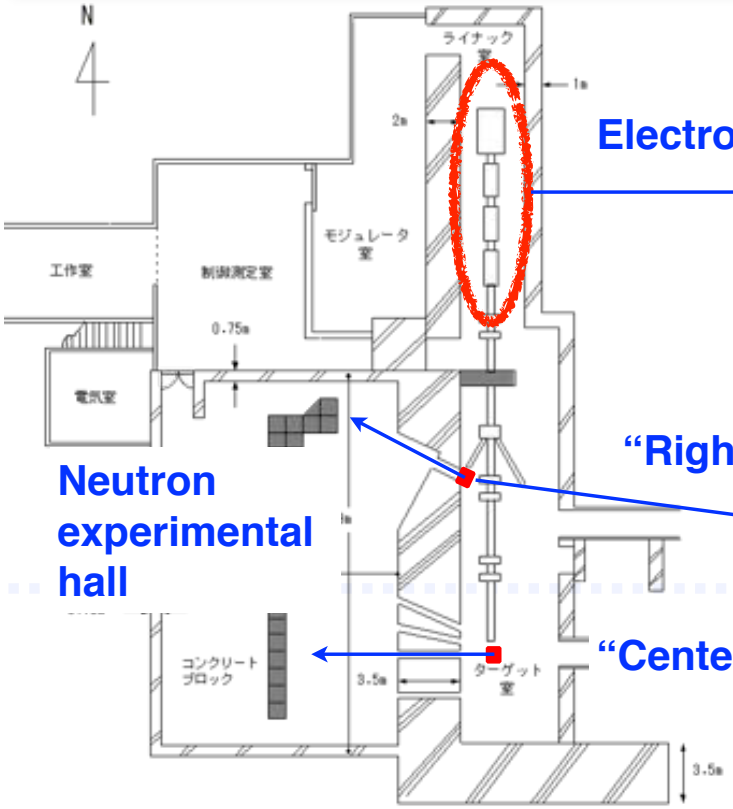
Layout of the HUNS facility



Electron linac

"Right target"

Neutron experimental hall

"Center target"

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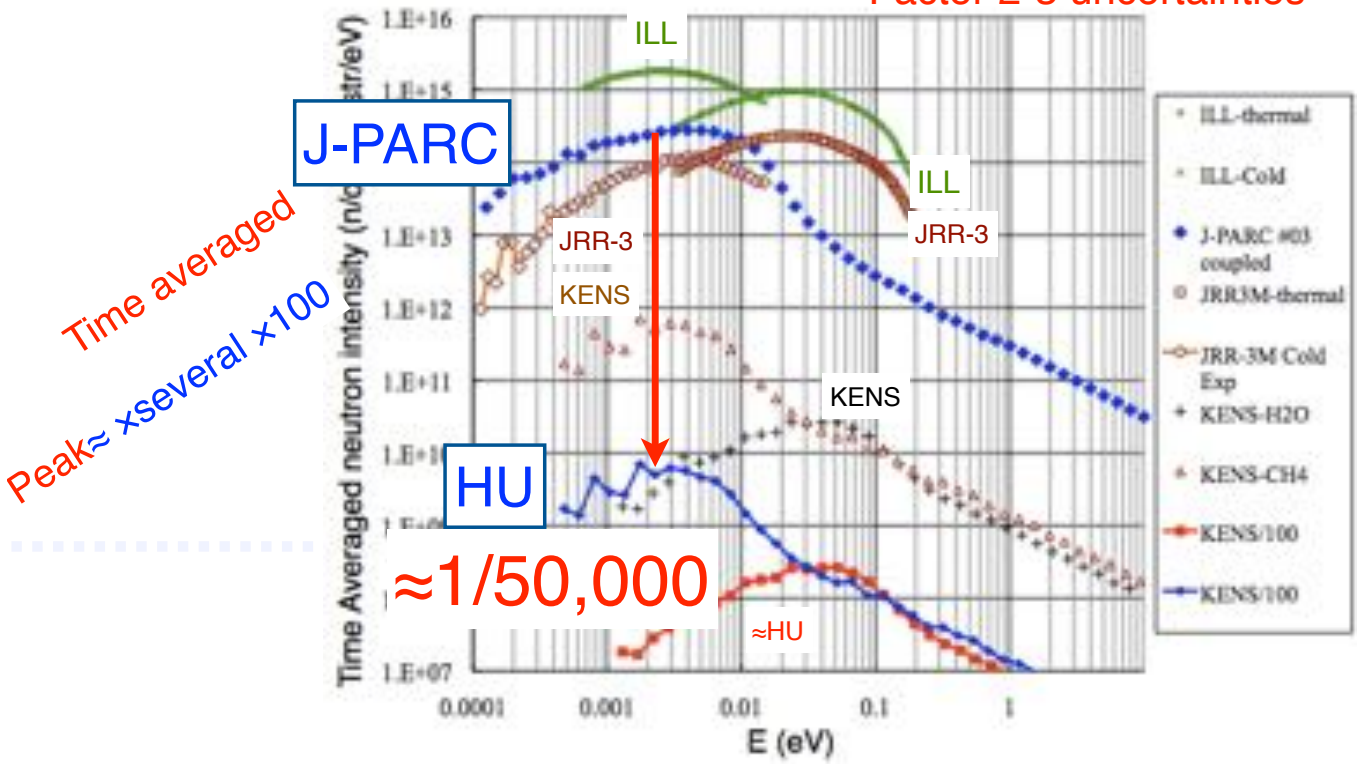
Time averaged intensity

Factor 2-3 uncertainties



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New cold source in trouble

- 4K CCR, pulsed tube type
- Tmin≈35K!

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Good news!

HUNS Upgrade

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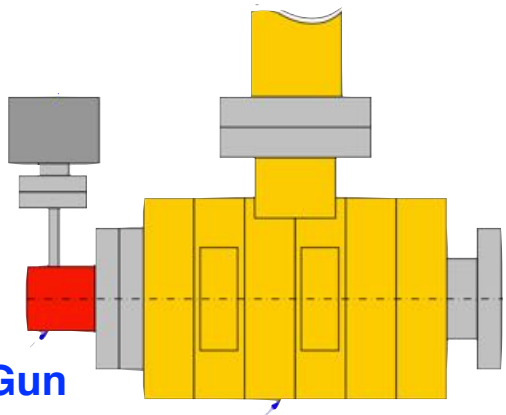
Injector option-1

- Electron linac injector budget in this fiscal year budget



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Specification goal

- energy ≈ 45. MeV
- power ≈ 3. kW
- frequency = 50. pps
  - ≥ 100 pps short pulse mode
- current≈ 67 μA
- Pulse width = 3 μs (7 μs)
  - Short pulse mode: 0.1 μsec ~ 1 μsec

×3 intensity

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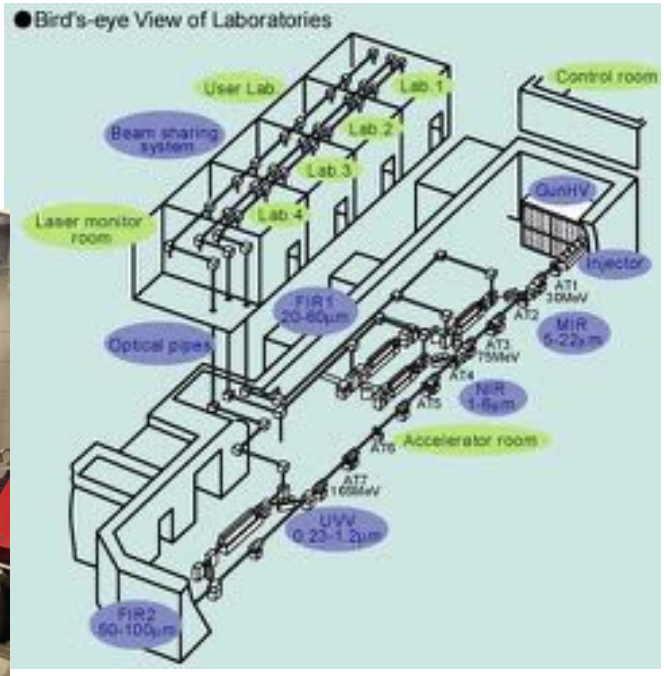
Getting a second-hand linac from iFEL

- Institute of Free Electron Laser, Osaka University
- S-band,
- 165 MeV-2.5 kW,
- 24 μsec macro-pulse at 10 Hz.
  - modifiable to 4 μsec 50Hz



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Klystron at iFEL

- Toshiba E3729, 2 in use, 2 backups
  - Frequency 2.856GHz
  - Very close to the ones used at KEK-B injector

24 μsec	24 MW	10 pps	284 kV	280 A
12.5 μsec	34 MW	50 pps	304 kV	316 A
4 μsec	70 MW	50 pps	378 kV	451 A

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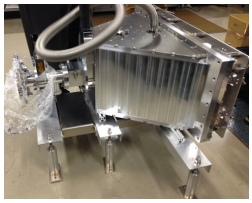
What's on?
at HUNS



intermediate-Angle Neutron Scattering

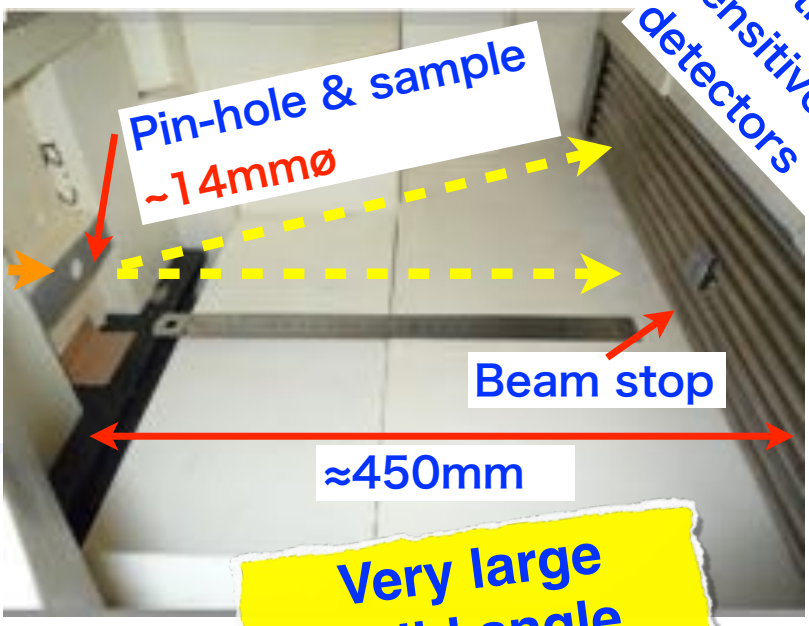
The instrument iANS using very short flight-paths

Optimized to a nanoscopic region

Intermediate-angle neutron scattering instrument

iANS (iron's)

- Very large $\Delta\theta_{inc} \approx \Delta\theta_{scatt}$
- =highly efficient at an intermediate-q range



±10mrad beam divergence

Very large solid angle

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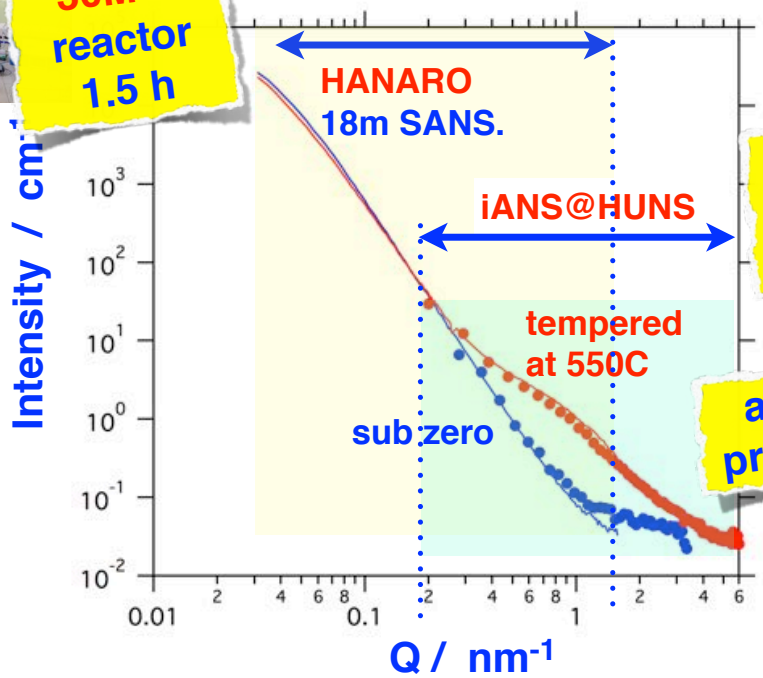
High Nitrogen Martensitic Steel

30MW reactor 1.5 h



1kW Electron Linac; 6h

a few nm precipitates

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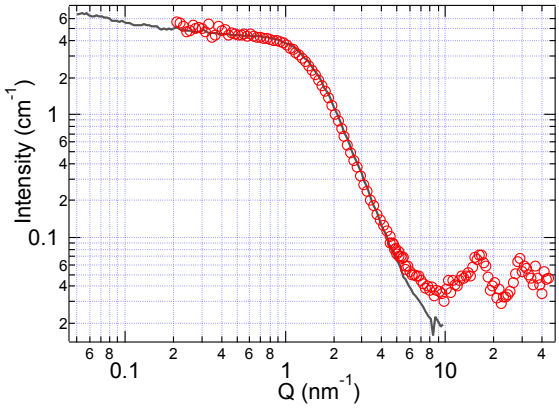
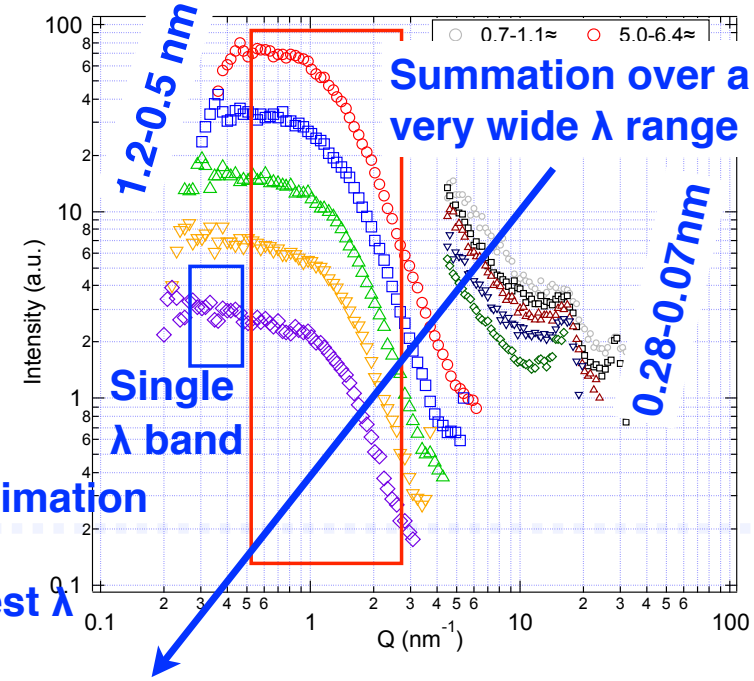
Improved data reduction code

Glassy carbon



Glassy carbon



Relaxed collimation determined by the longest λ

Intensity gain by pulsing

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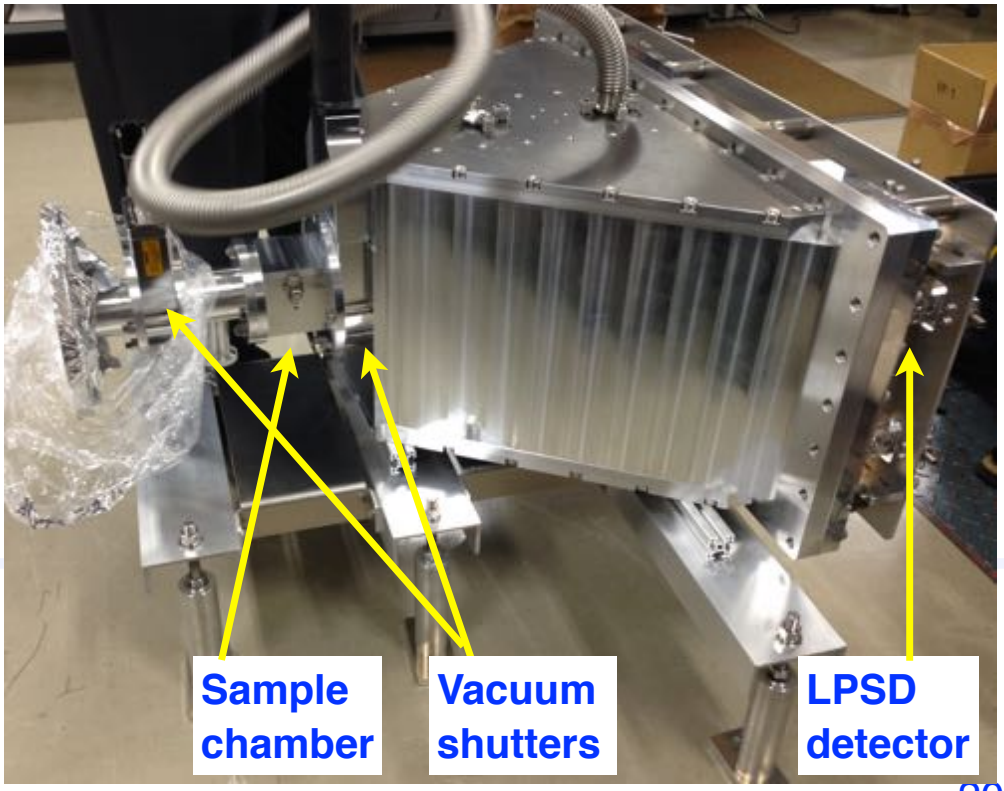
Vacuum chamber for iANS



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focusing SANS development

Under development at RIKEN/KUR/KEK

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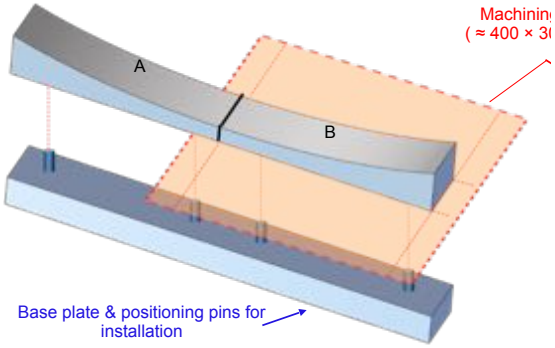
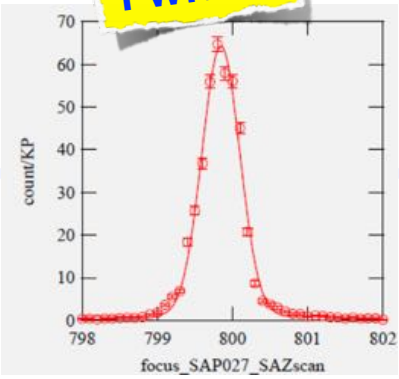
Elliptic mirror development

- 500mm in 2 mirrors
- amorphos NiP on Al base plate
- + NiC/Ti supermirror

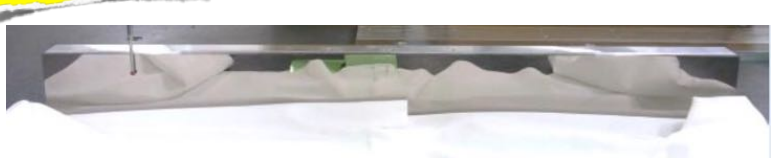
Metal!



≈0.4 mm FWHM



≤ 0.3 nm roughness



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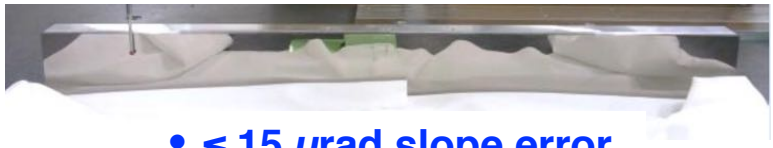
Focusing mirror development

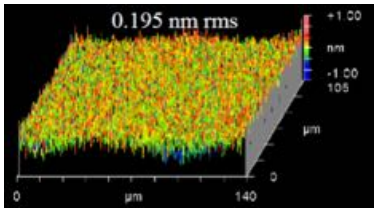
- High precision cutting + mechanical polishing
- RIKEN team
  - Shin Takeda (Hokkaido Univ.)
  - RIKEN: J. Guo, S. Morita, T Hosobata, T. Kawai, Y. Yamagata
- KUR
  - M. Hino

- Elliptic mirror



- ≤ 15 μrad slope error

≤ 0.3 nm roughness



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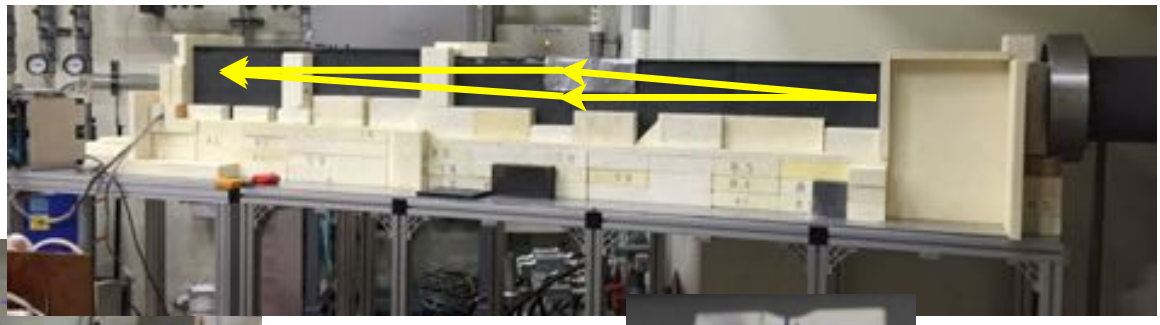
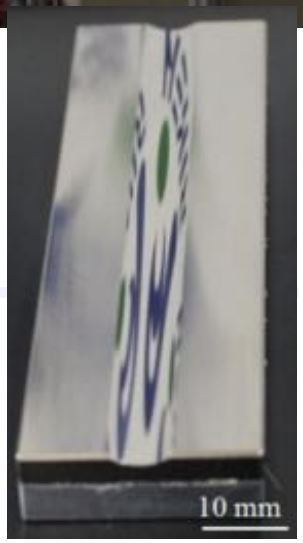
A focusing SANS instrument



Scintillation detector ZnS+RPMT

- Ellipsoidal mirror



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Bragg-edge transmission instrument@HUNS design

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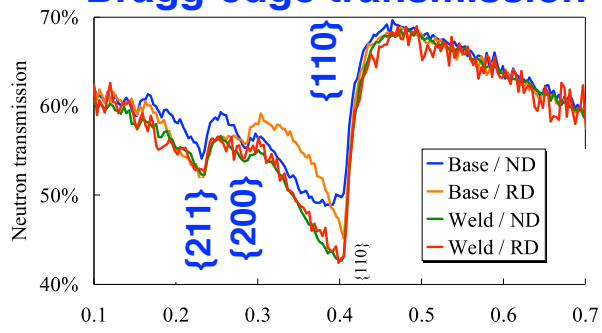
Neutron Bragg Imaging

Bragg-edge transmission

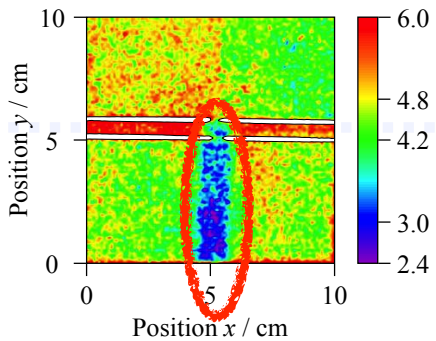


@HUNS

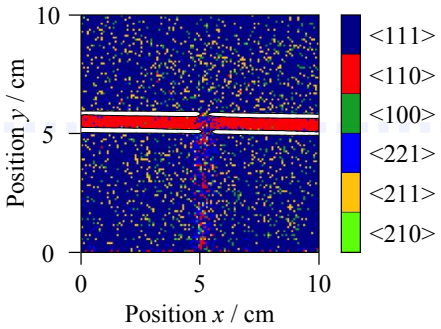
Analyzed by the RITS code

6 mm^t steel

Crystallite size (μm)



Preferred orientation

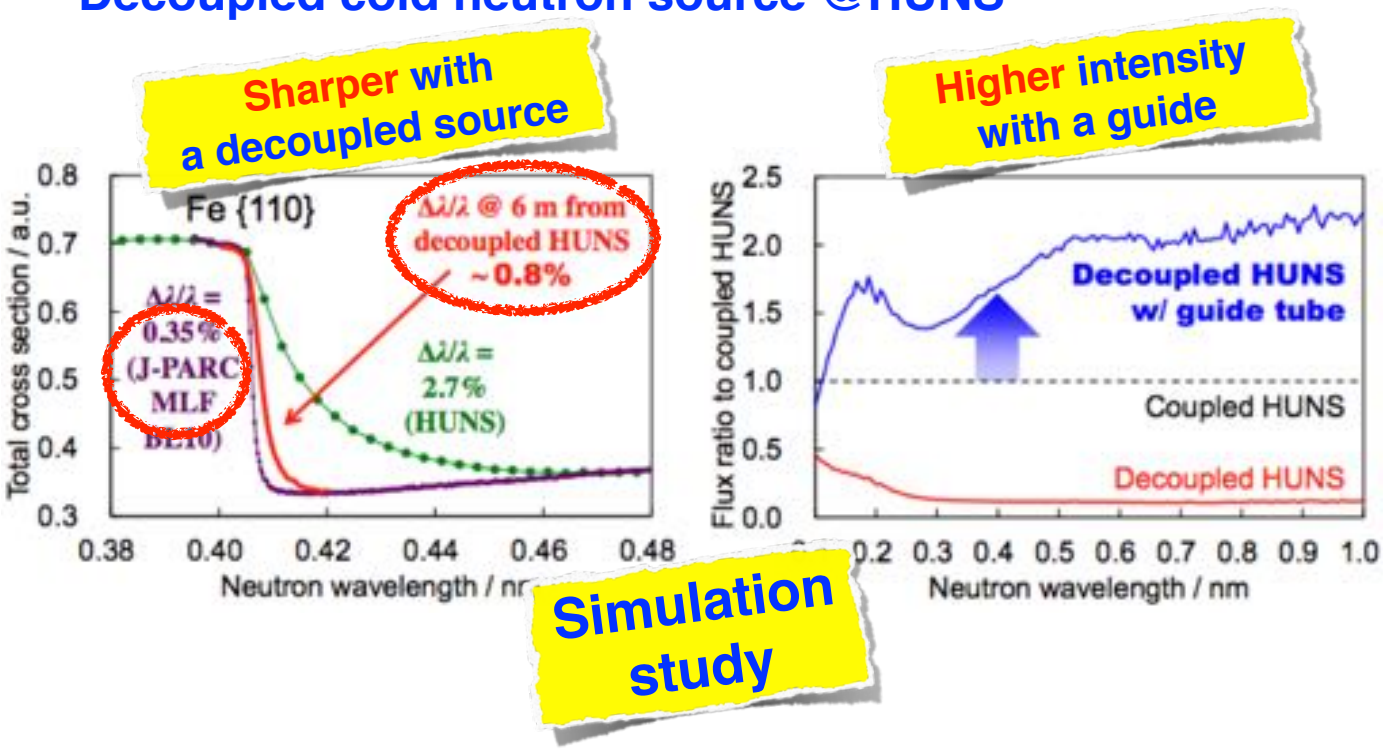


H. Sato, T. Kamiyama and Y. Kiyanagi, Mater. Trans. 52 (2011) 1294.

2015.05.14.

Bragg-edge transmission@HUNS?

- Decoupled cold neutron source @HUNS



H. Hirotaka, Hokkaido Univ. 2015.05.14.

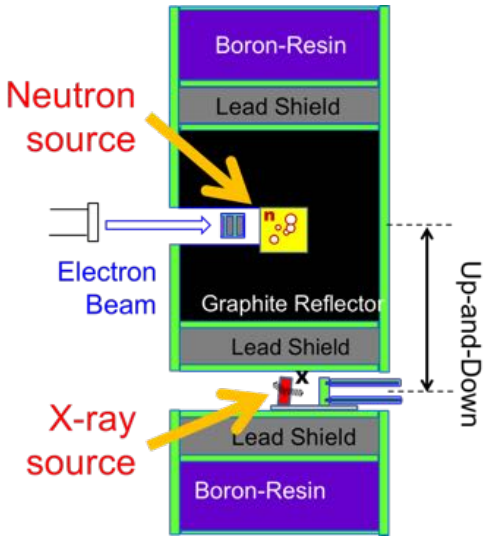
Imaging: poster by T. Kamiyama

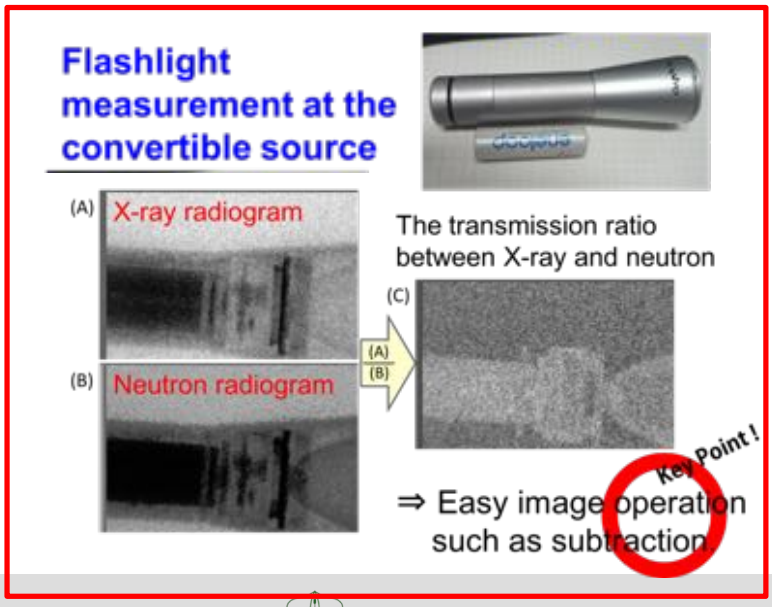
2015.05.14.

Convertible Source System of Thermal Neutron and X-ray

Advantage of the convertible source system

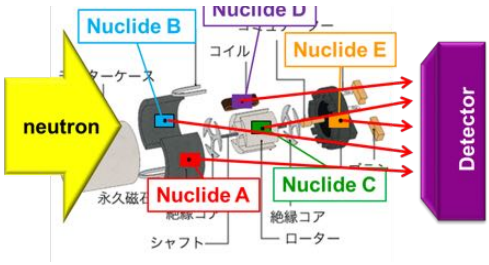
- Usage of common sample position and detector for neutron and X-ray imaging on the single beam line.



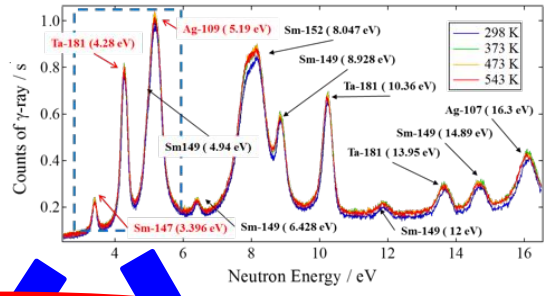


Neutron Thermometry with Multiple Nuclides

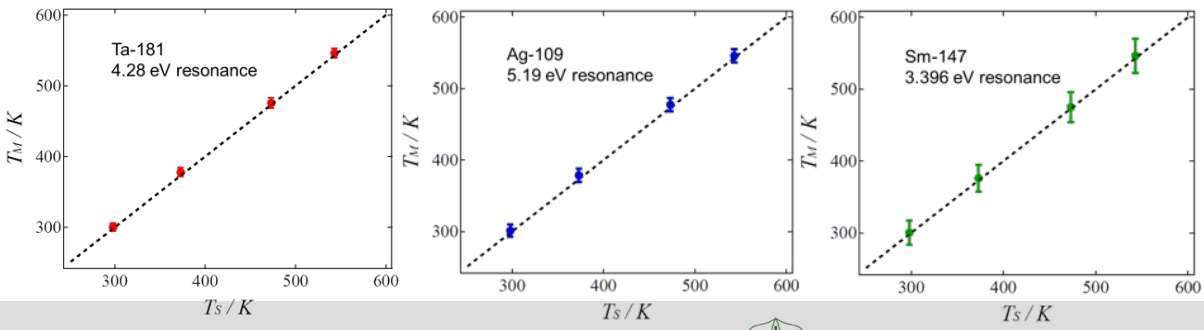
By incorporating the nuclides to the mechanical components, they work temperature sensors for each position.



Resonance Absorption Spectrum



Peak Shape Analysis

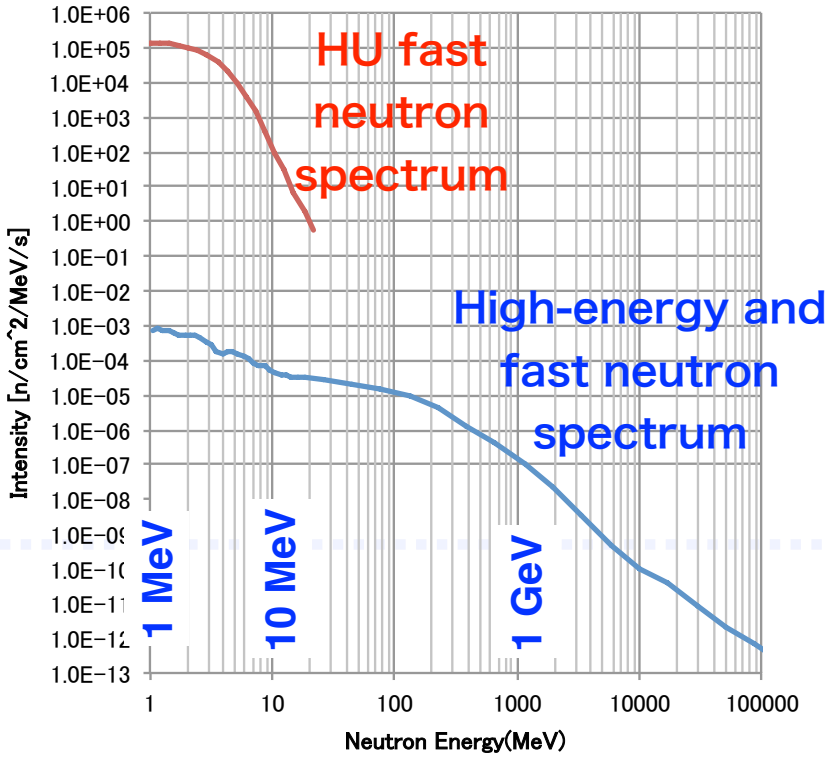


Soft-error Experiments (Single event effects) of Telecommunication Deices

Large facilities was required.

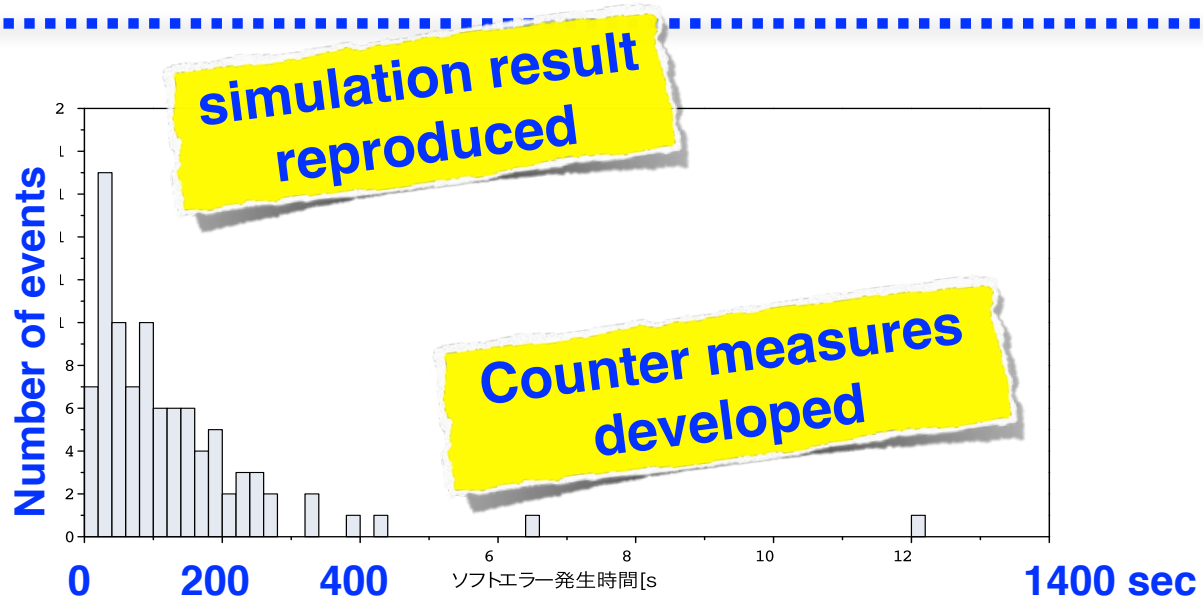
2013.9.24.

Neutron spectra for soft-error



2013.9.24.

Softerror generated



Time interval between events

2013.9.24.

Summary

2015.05.14.

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