Recent activity of Japan Collaboration of Accelerator driven Neutron Sources (JCANS)

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[1]Research Laboratory of Accelerator-based BNCT system, Faculty of Engineering, Nagoya University

UCANS-V – 5th International Meeting of Union for Compact Accelerator-driven Neutron Sources
May 12-15, 2015 - Laboratori Nazionali di Legnaro (Padova), Italy

Outline

- What kinds of experiments we can do at CANS.
- Why JCANS (Japan Collaboration of Compact Accelerator driven Neutron Sources) was organized?
- Present status of JCANS
- Summary

Difference in 'CANS' between 'UCANS' and 'JCANS'

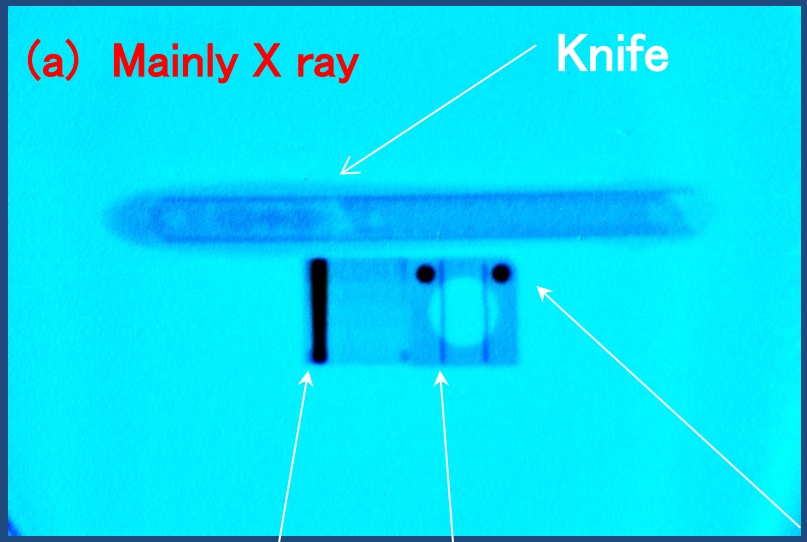
Union for Compact Accelerator driven Neutron Sources (UCANS)
Japan Collaboration of Accelerator driven Neutron Sources (JCANS)
'Collaboration' is only for JCANS
So, JCANS can include large facilities

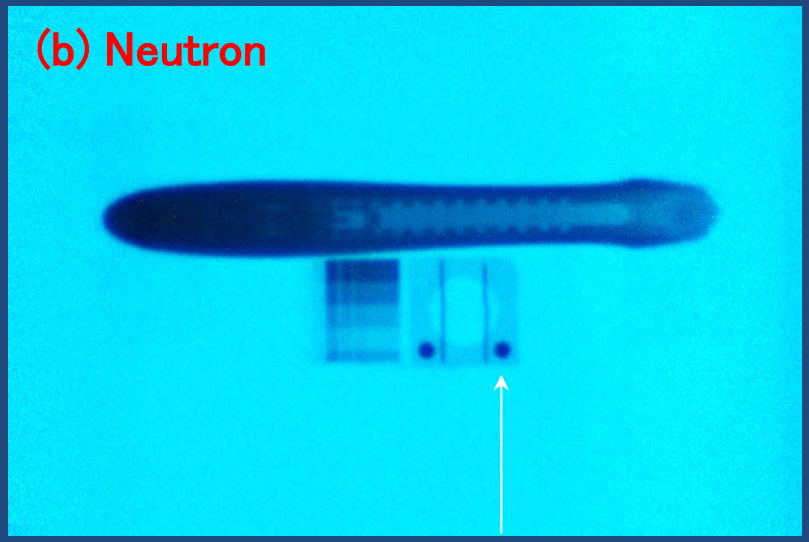
What kinds of experiments we can do at CANS?

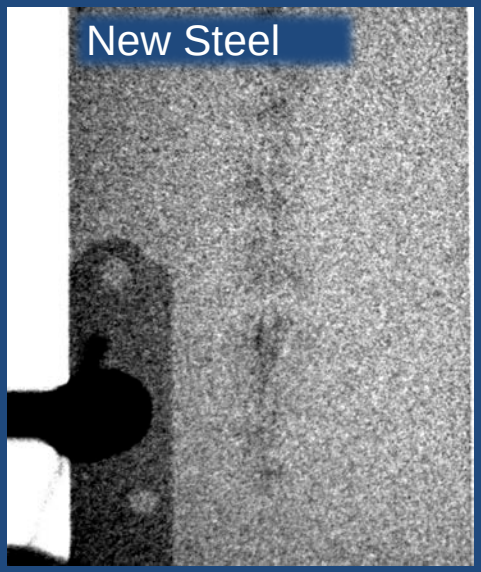
Very brief introduction!

Traditional Imaging

T. Kamiyama et al.@HUNS







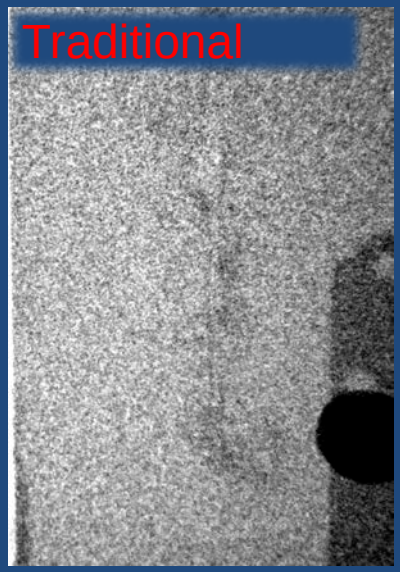
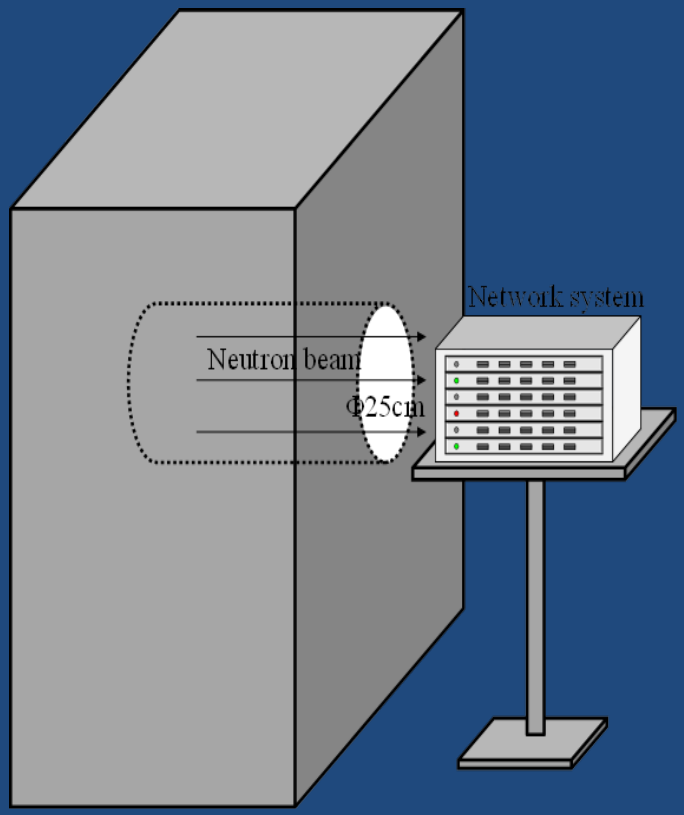


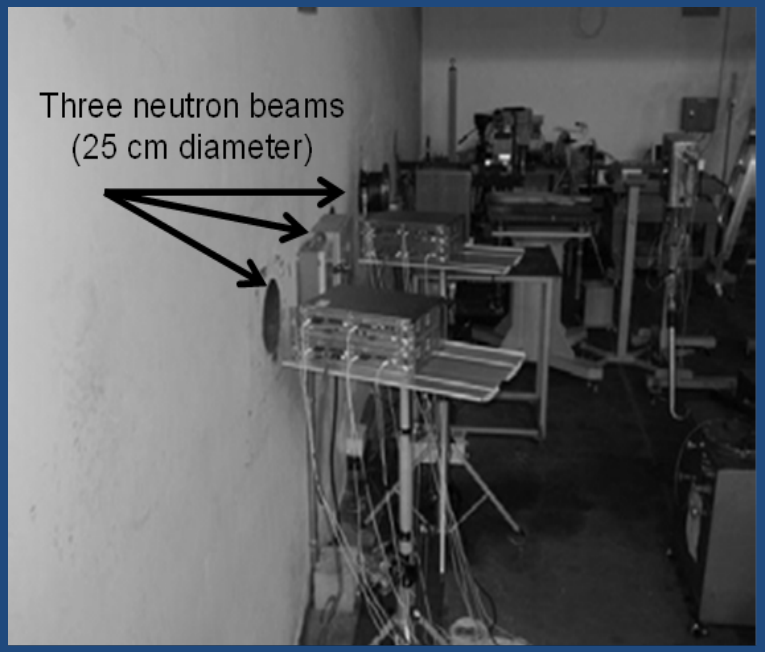
Image of rust @RANS
A. TAKETANI, M. Yamada,
Y. Otake (RIKEN)
T. Nakayama (KOBELCO)

New neutron color I.I. system that has TOF measurement function.

Soft error test

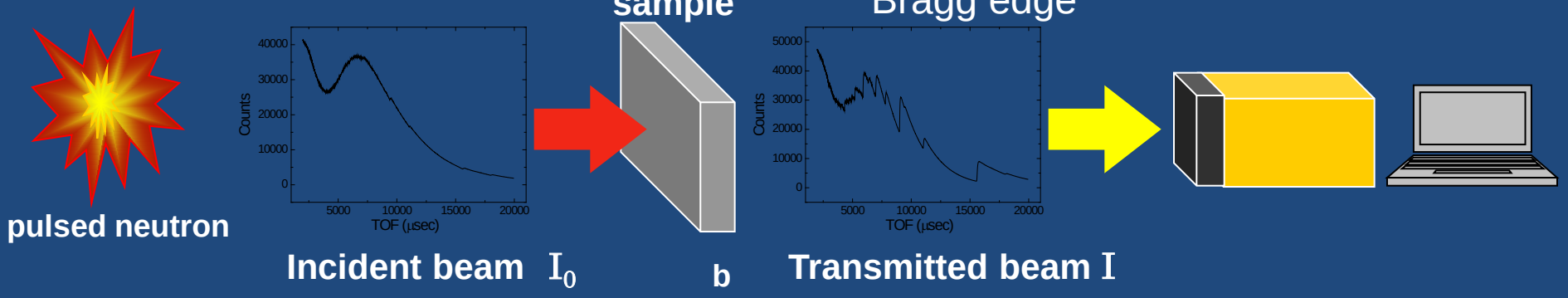


H. Iwashita, H. Sato, M. Furusaka et al.@HUNS



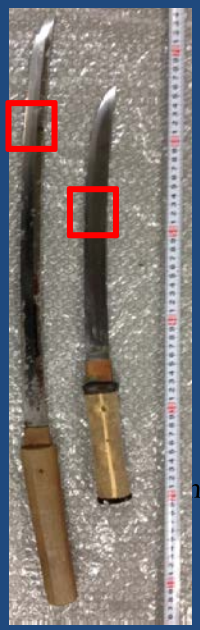
Soft errors are also performed at
THUANS : Tohoku University Cyclotron RI Center
OUANS : RCNP at Osaka University

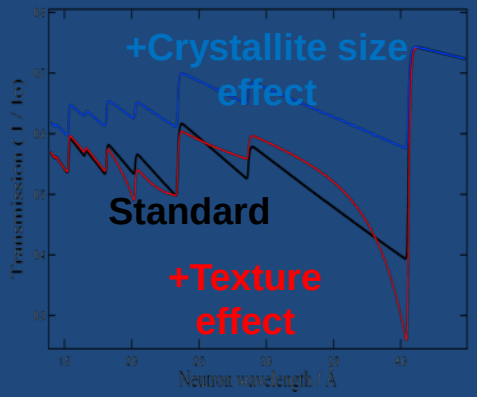
Pulsed neutron imaging@HUNS

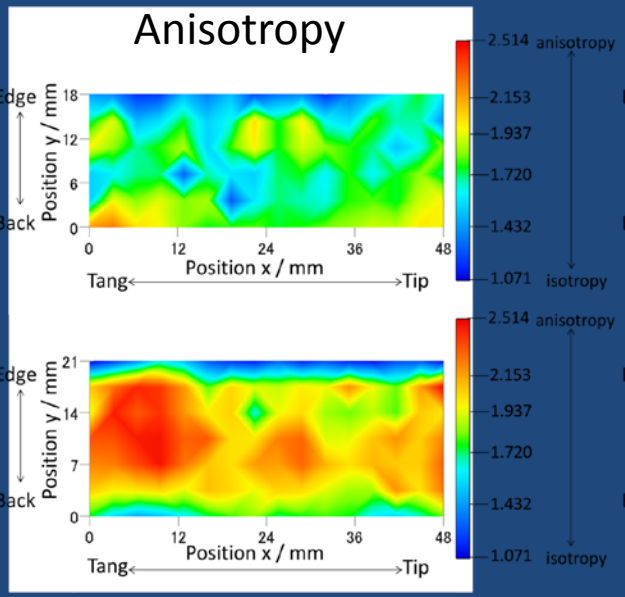


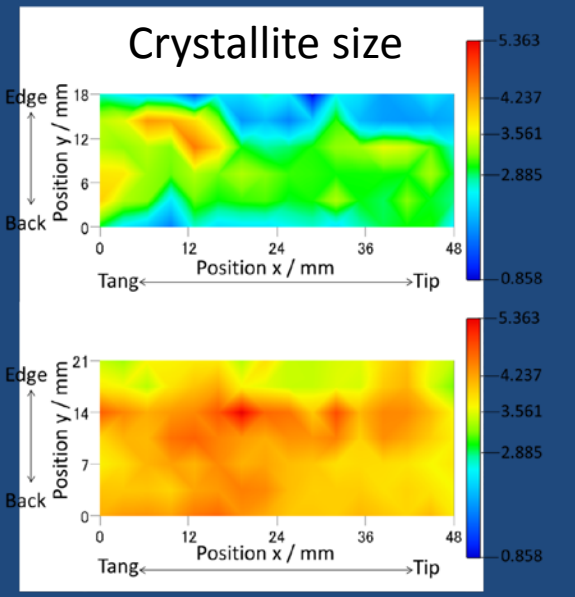
(1) Bragg edge imaging

Nagashima et al.

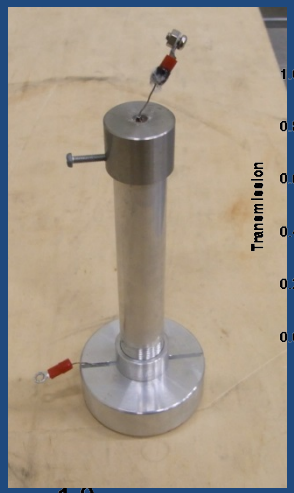


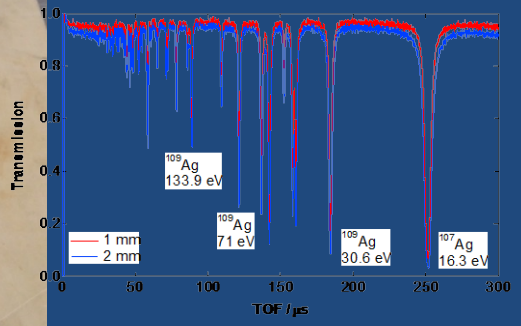


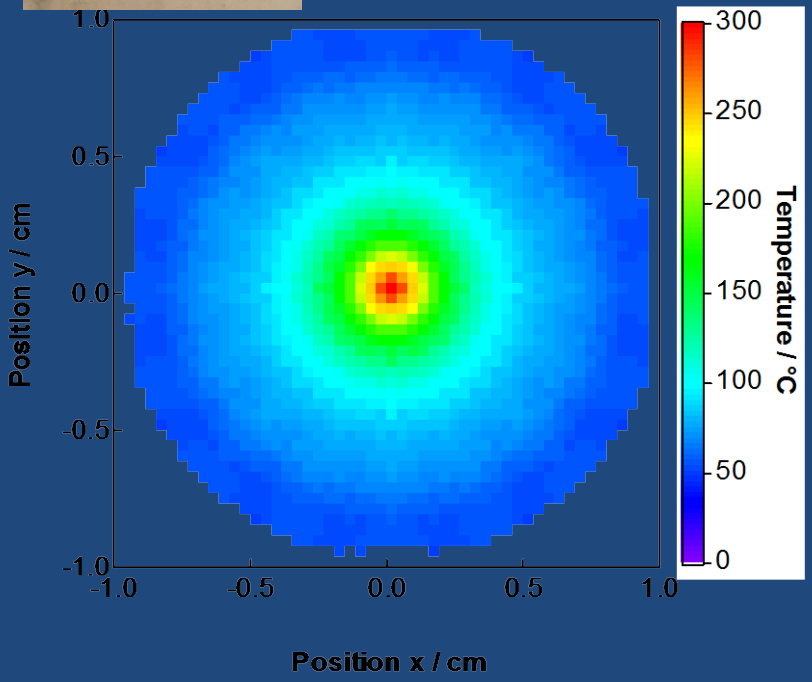




Temperature measurement by using resonance broadening @ HUNS

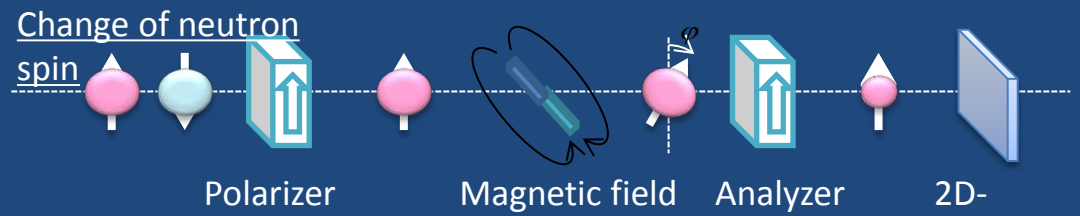






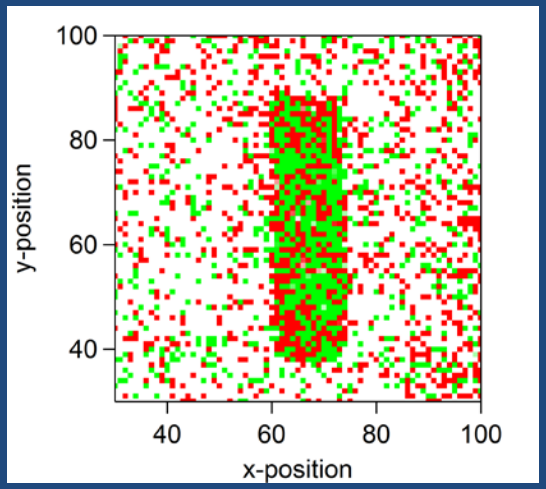
H. Hasemi, T. Kamiyama, et al.

Magnetic field imaging @ HUNS



Spin rotation is analyzed as polarization P

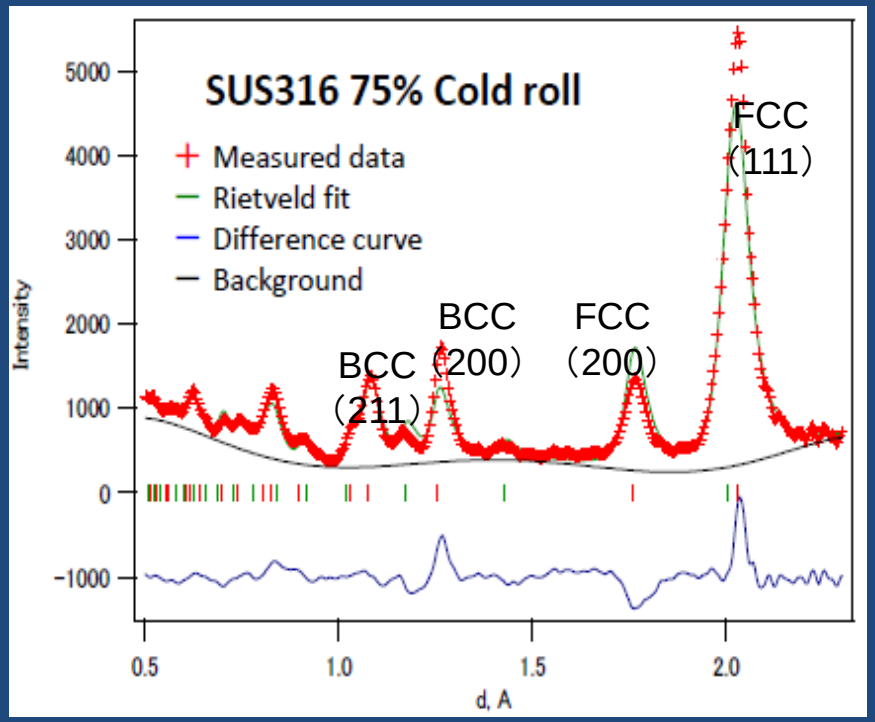
λ=4.55Å



T. Negishi, T. Shinohara et al.

Diffraction and medium angle scattering

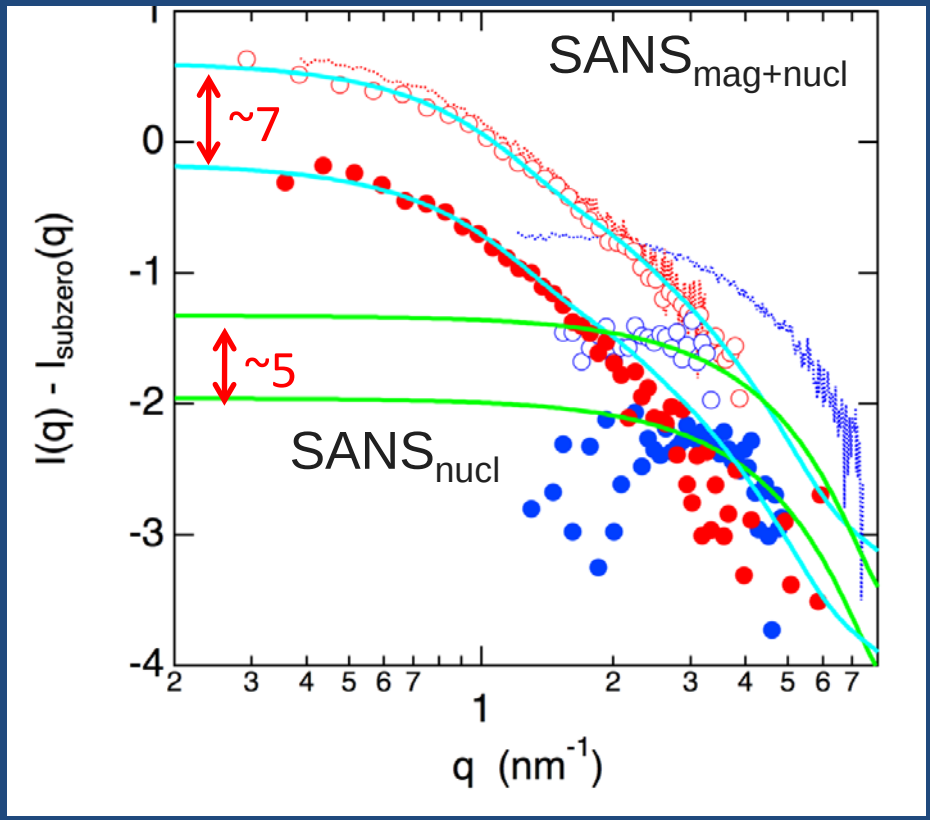
Diffraction @RANS



Y. Otake et al.

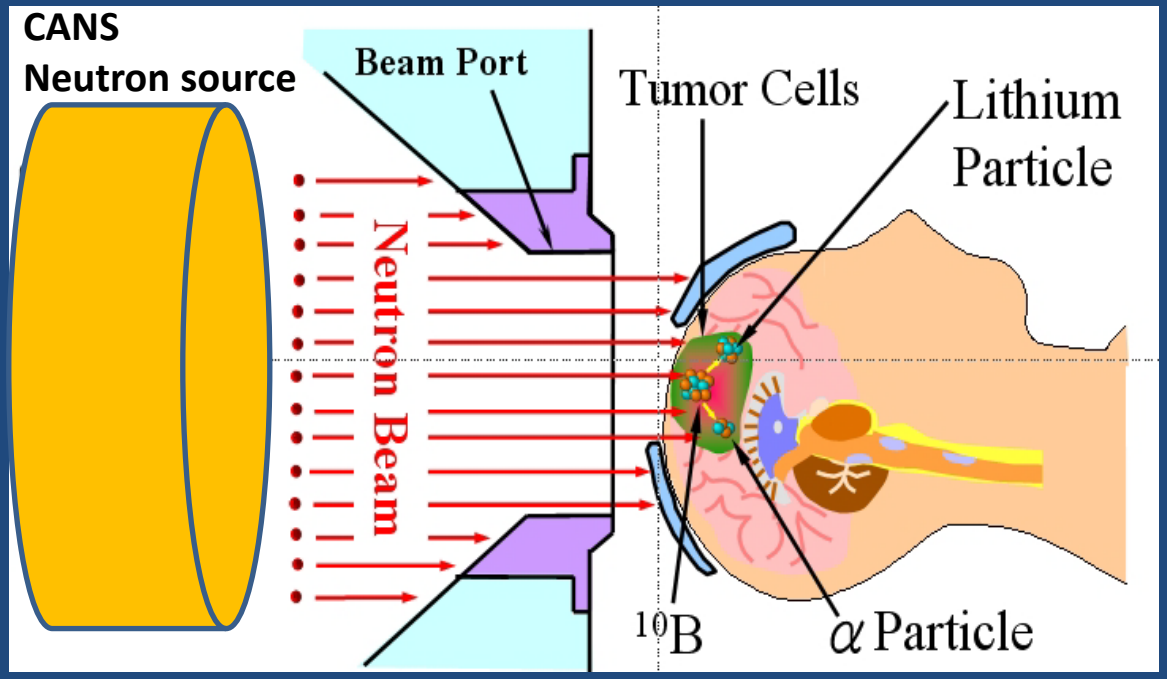
Medium angle scattering @HUNS

nuclear + magnetic scattering
(chemical + magnetization distribution)



M. Ohnuma & M. Furusaka

Boron Neutron Capture Therapy



Moderator test, device development, cross section measurement and so on are also important applications at CANS.

Why JCANS was organized?

Why compact neutron sources are required?

What kinds of things required for the neutron science.

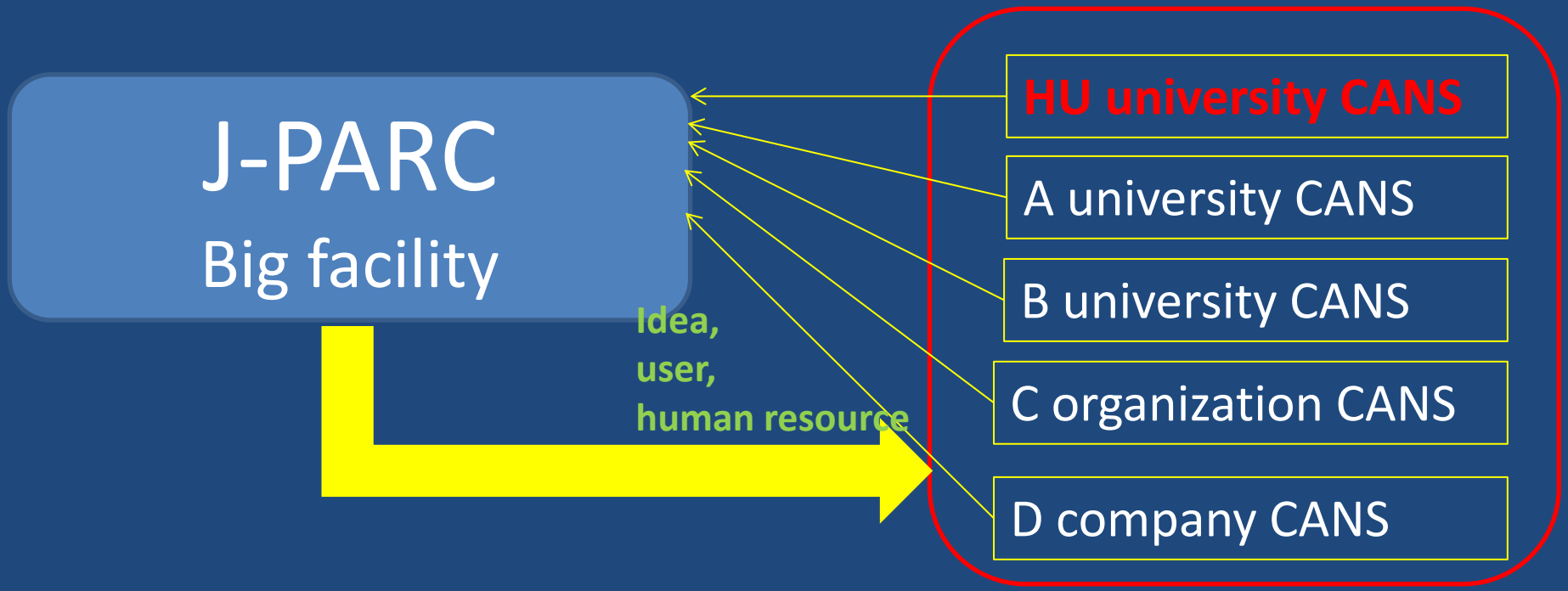
1. Trial or idea stage studies are required for new developments.
2. Easy access is important to increase the neutron users.
3. On demand or quick experiments are indispensable for many of industrial applications.
4. Flexibility in experiments are sometimes required.
5. Education for young people should be sustainable.

etc.

CANS is very useful for such requirements.

Usefulness of CANS for the neutron science

J-PARC JSNS intensity is 300 times higher than KENS.
We insisted for a long time that compact neutron sources should be constructed in Japan to enhance the activity of neutron science and J-PARC.
Big facility should not or cannot stand alone for effective use of it



There were plans to construct Kyoto University CANS and RIKEN CANS.
We started collaborative work for their construction.

Original JCANS

Japan Collaboration on Compact Accelerator-driven Neutron Sources

HUNS
Hokkaido University
Neutron Source

RANS
RIKEN Accelerator
driven Neutron Source

JCANS
Japan Collaboration on Accelerator-driven Neutron Sources

KUANS
Kyoto University
Accelerator driven Neutron
Source

Collaboration work for the design of RANS and KUANS moderator systems was performed.

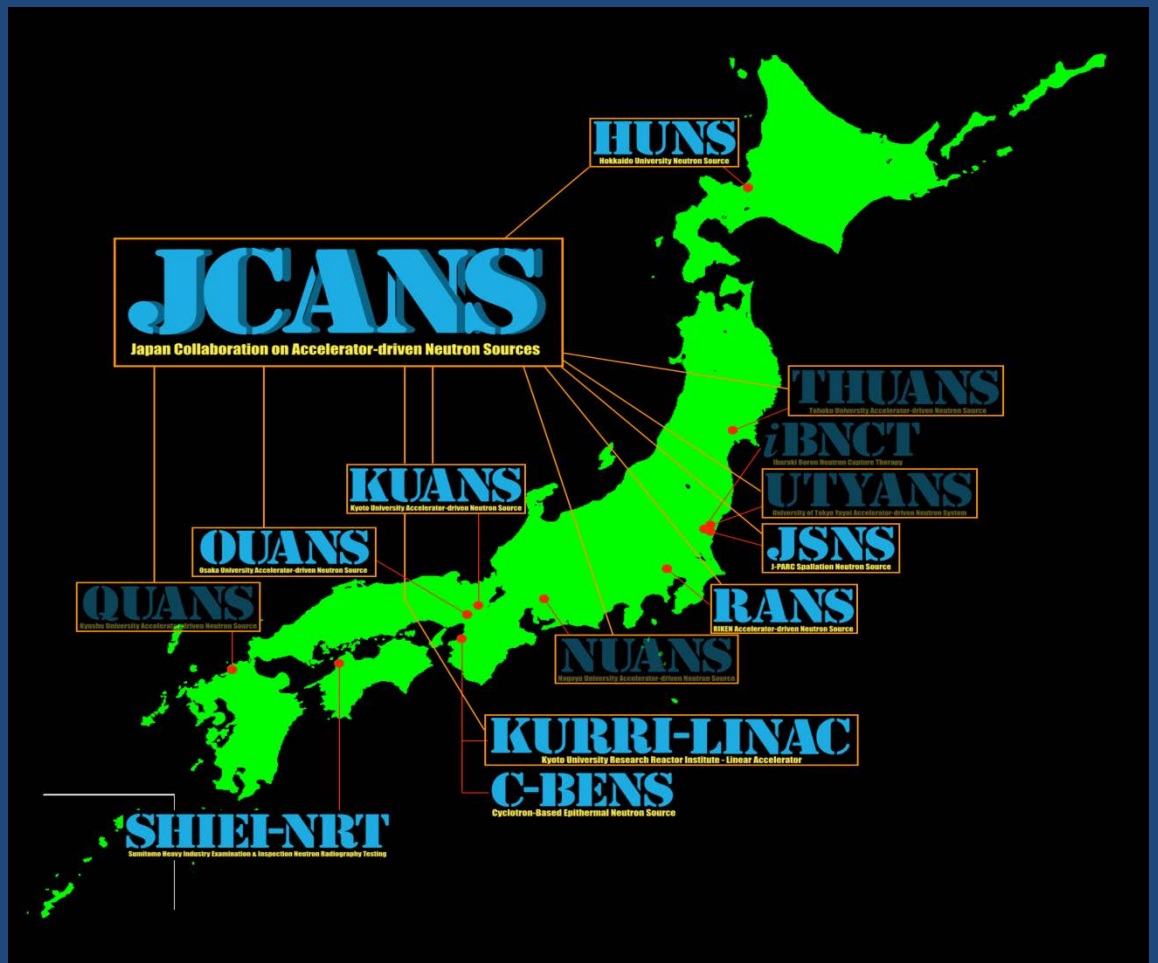
NUANS
Nagoya University Accelerator
driven Neutron Source
(under construction)

JCANS expanded

Japan Collaboration on Accelerator-driven Neutron Sources

The JCANS was consolidated on Oct. 20, 2011 at KEK with the starting members: Yoshiaki KIYANAGI and Michihiro FURUSAKA from Hokkaido University, Susumu IKEDA and Hirohiko M. SHIMIZU from KEK, Yoshihisa IWASHITA and Tomofumi NAGAE from Kyoto University, Yutaka YAMAGATA and Katsuya HIROTA from RIKEN, to activate a nation-wide network of individual research activity on neutron source and moderators.

Opaque logotypes indicate facilities already in operation for neutron production, and semitransparent ones those under construction, discussion and consideration.



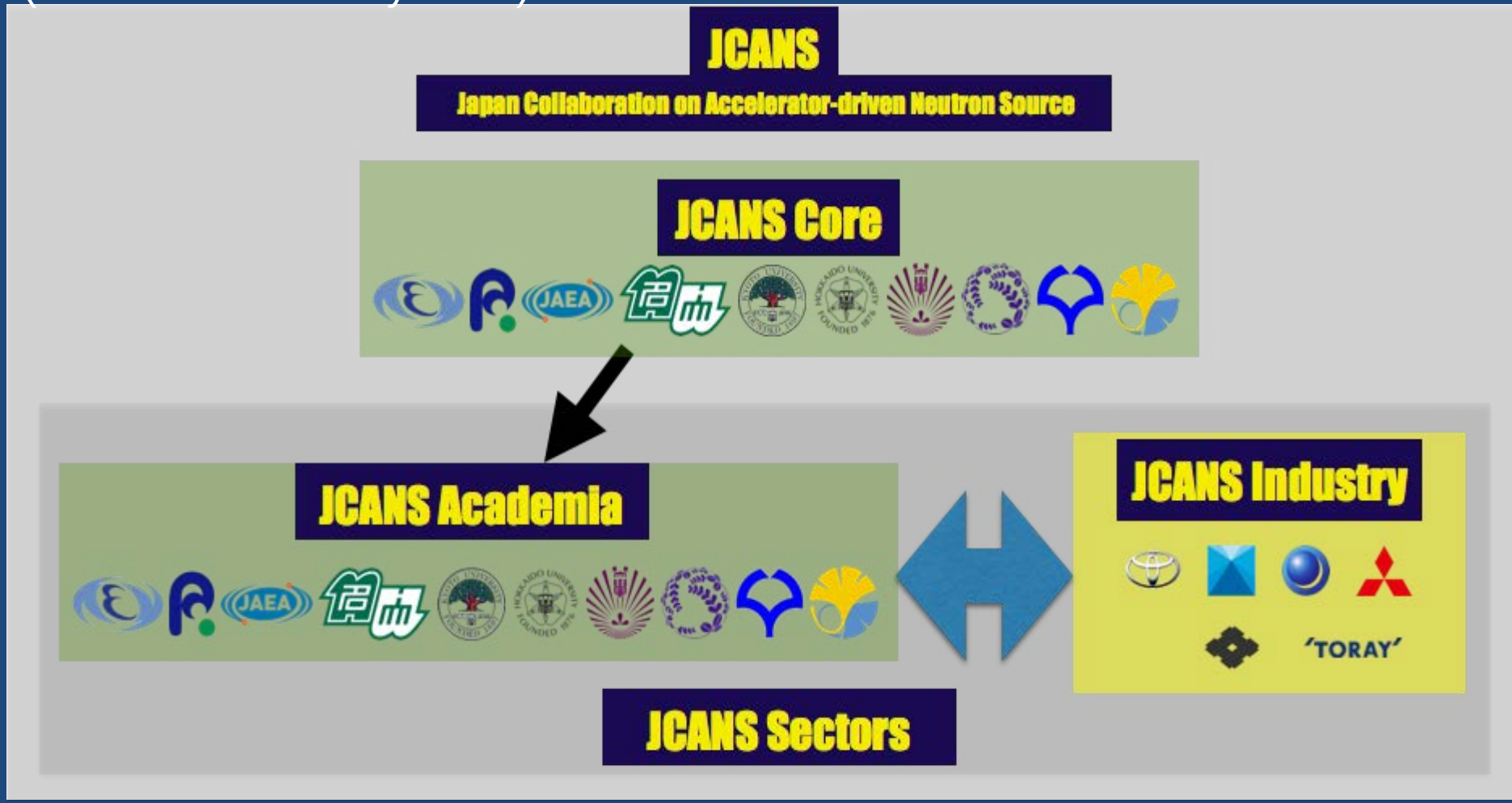
Present status of JCANS

Renovation of JCANS

- Two new facilities came into operation.
- New members have joined JCANS.
- Development of application becomes important.
- Industrial applications have been promoted at CANS.
- Industry people have been very interested in NEUTRON.

Change of JCANS

Original members are left as core member
Industrial members are added to know and discuss requests from industry.
(Decided on 16 May 2015)



JCANS

Japan Collaboration on Accelerator-driven Neutron Sources

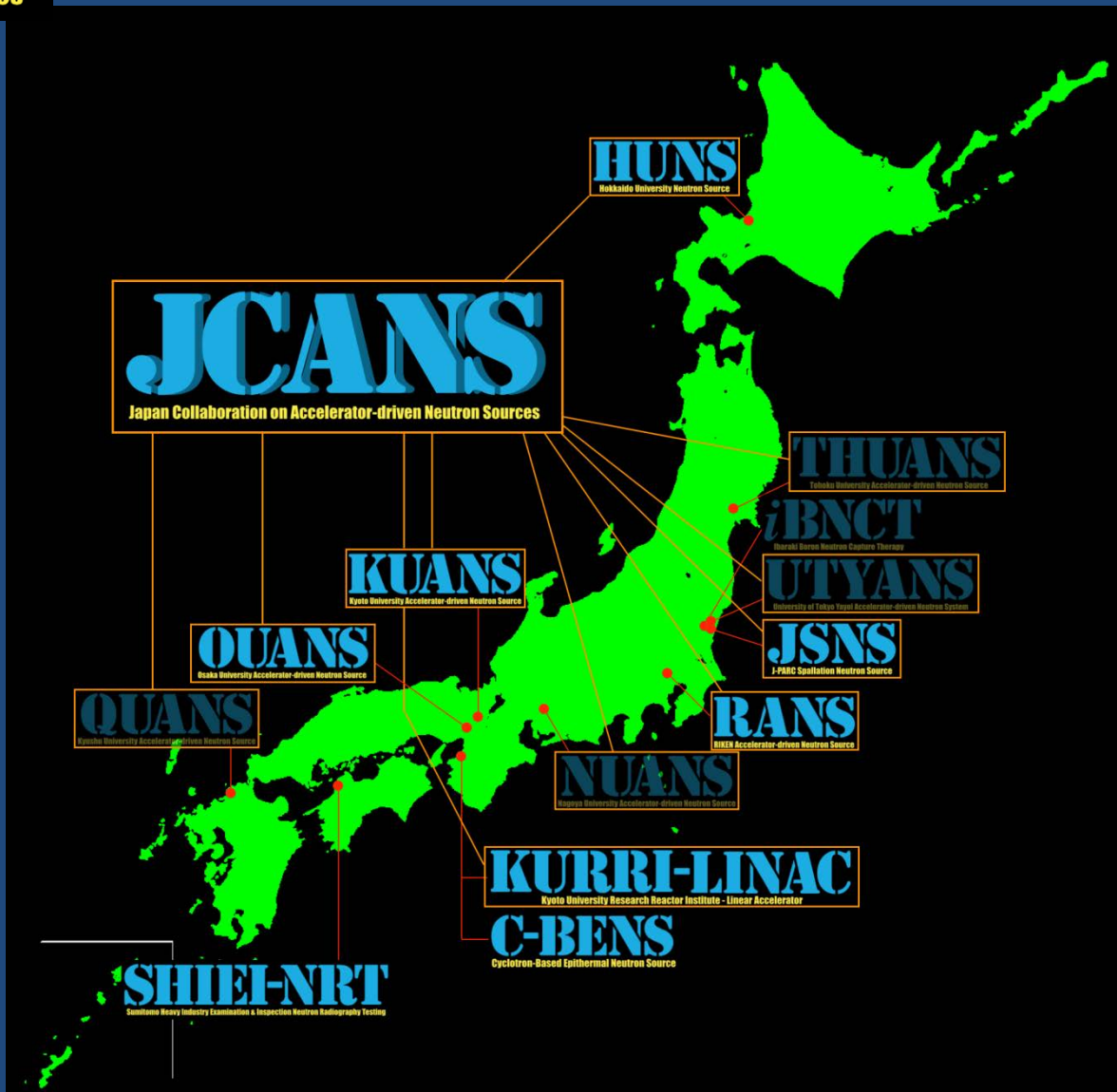
New JCANS

includes industrial groups

JCANS is the collaboration on accelerator-driven neutron soruces in Japan over scientific researches and practical applications to science and industries.

The JCANS was consolidated on Oct. 20, 2011 at KEK with the starting members: Yoshiaki KIYANAGI and Michihiro FURUSAKA from Hokkaido University, Susumu IKEDA and Hirohiko M. SHIMIZU from KEK, Yoshihisa IWASHITA and Tomofumi NAGAE from Kyoto University, Yutaka YAMAGATA and Katsuya HIROTA from RIKEN,

to activate a nation-wide network of individual research activity on neutron source and moderators and practical neutron beam technologies for the applications in science and industry.



Organization

Chair	Yoshiaki KIYANAGI	(Nagoya Univ.)
Vice Chair	Hirohiko Shimizu	(Nagoya Univ.) Academia
Vice Chair	Yasuhko Miwata	(Toyota Co. Ltd) Industrial
Secretary	Takashi INO	(KEK)
Office	Katsuya HIROTA	(Nagoya Univ.)
	Go ICHIKAWA	(Nagoya Univ.)

Members

ACADEMIA

Hokkaido University
High Energy Accelerator Research Organization (KEK)
Japan Atomic Energy Agency (JAEA)
RIKEN
Nagoya University
Kyoto University
Kyushu University
Tohoku University
University of Tokyo
Osaka University
AIST

INDUSTRY

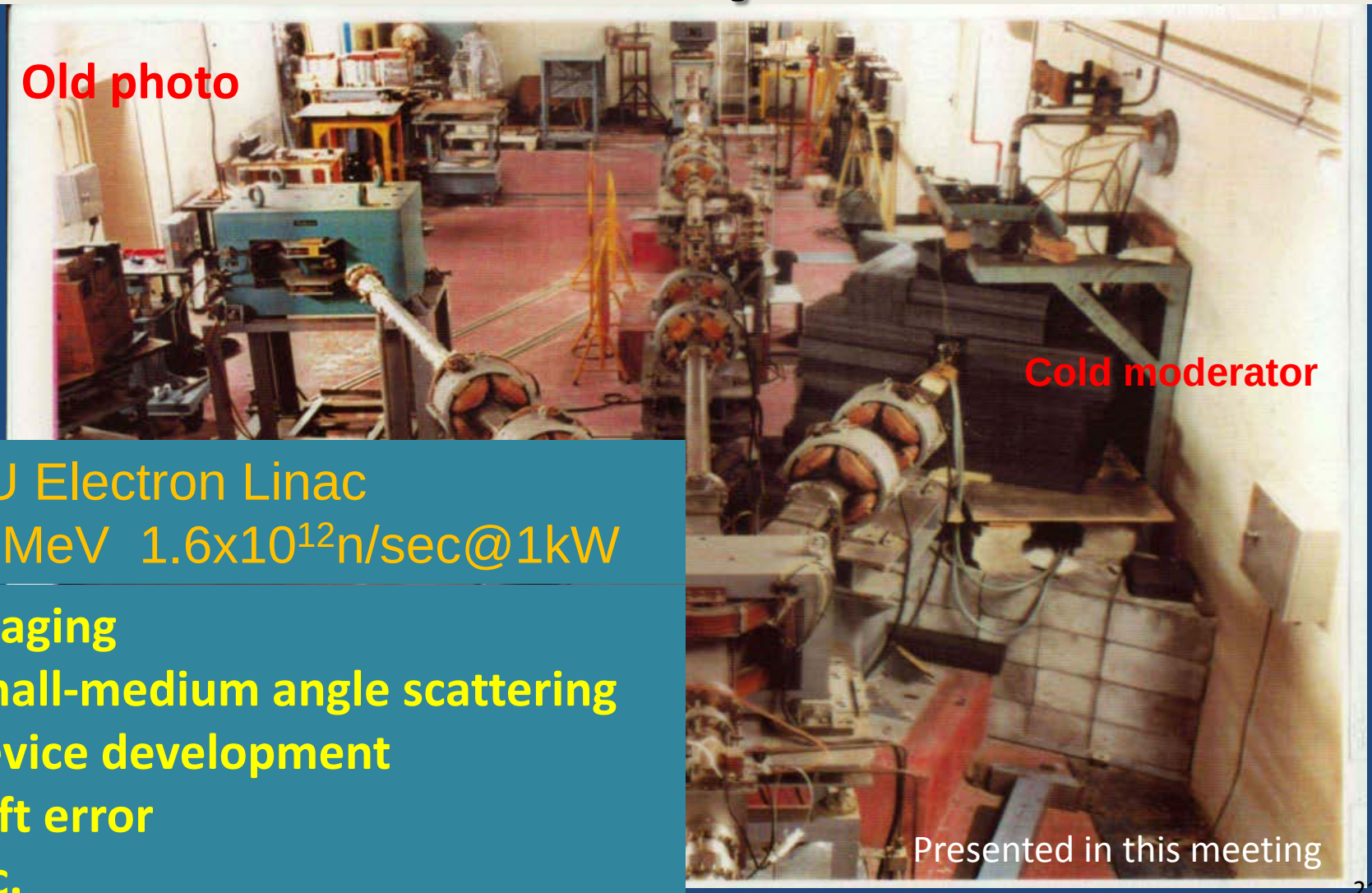
Toyota Motor Corporation
Toyota Central R&D Labs., Inc,
JTEKT Corporation

Accepting applications

Meetings of JCANS

2015/03/16-17	11th JCANS meeting @ Nagoya Univ.
2014/11/13	10th JCANS meeting @ Hokkaido Univ. Tokyo Office
2014/09/03-04	9th JCANS meeting @ Hokkaido Univ.
2014/06/26	8th JCANS meeting@Nagoya Univ.
2014/02/05	7th JCANS meeting@Nagoya Univ.
2014/01/23	"Networking of Application Oriented Neutron Sources"@Tsukuba / 6th JCANS meeting
2012/07/19	5th JCANS meeting @kyoto Univ.
2012/07/19	4th JCANS meeting
2012/06/29	3rd JCANS meeting@RIKEN Tokyo Office
2012/05/11	2nd JCANS meeting@Kyoto Univ.
2011/11/20	1st JCANS meeting@KEK

HUNS
(Hokkaido University Neutron Source)

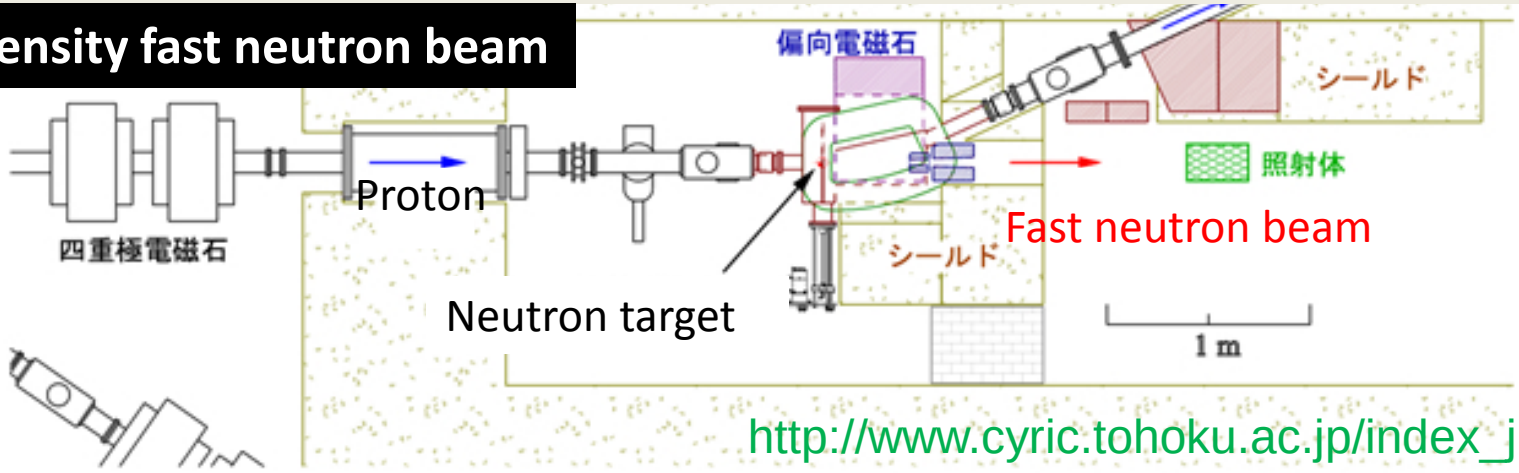


HU Electron Linac
35MeV 1.6x10^{12}n/sec@1kW

Imaging
Small-medium angle scattering
Device development
Soft error
etc.

THUANS：Tohoku University Cyclotron RI Center

High intensity fast neutron beam



http://www.cyric.tohoku.ac.jp/index_j.html

$^{7}Li(p,n)^{7}Be$

：20～80 MeV

$10^{6}n/cm^{2}/\mu A$ ， >10μA

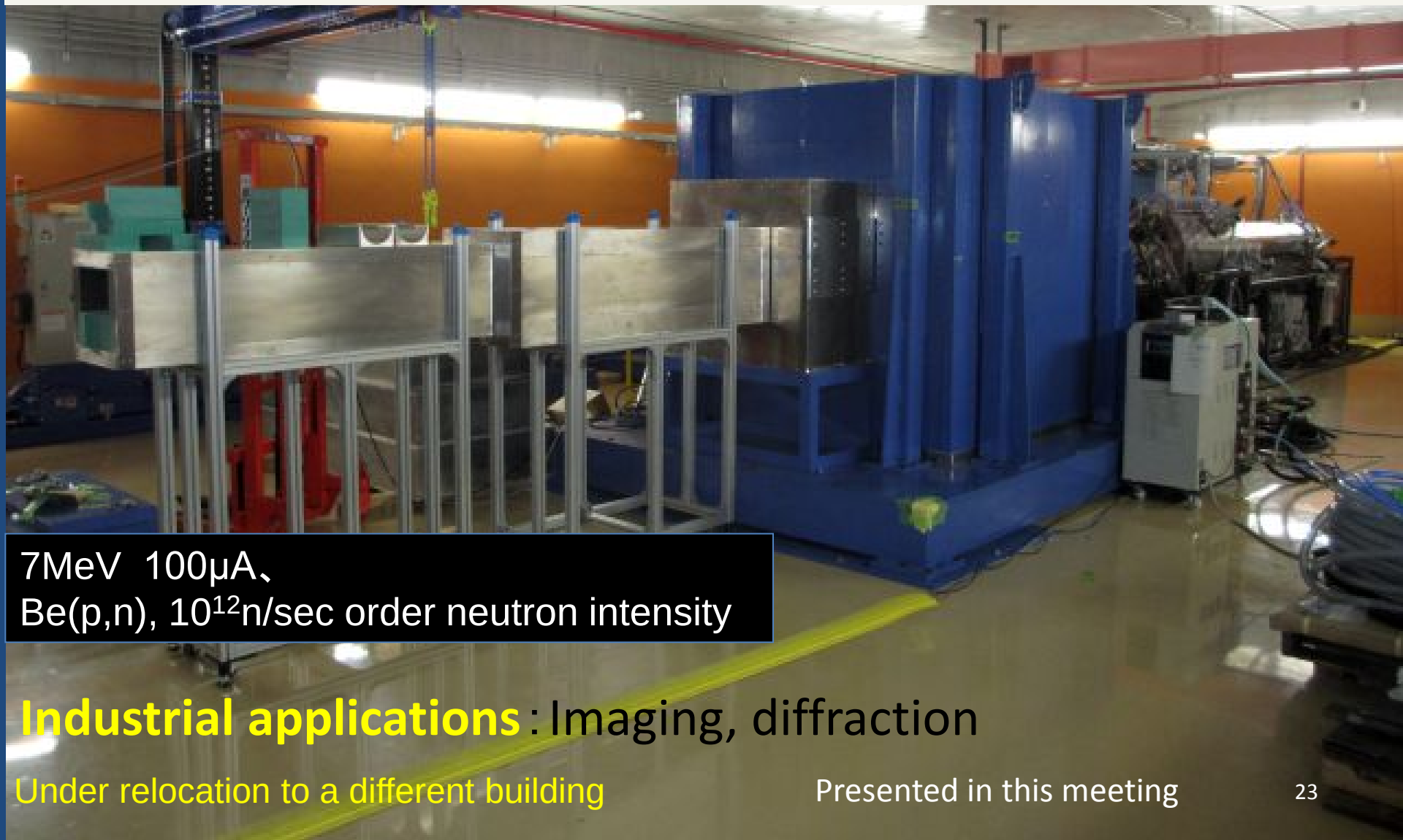
Fast neutron physics

Soft error

Future plan:
BNCT, Neutron scattering

シールド壁で覆われる前のビームライン全景

RANS
(Riken Accelerator driven Neutron Source)



7MeV 100μA、
Be(p,n), 10^{12}n/sec order neutron intensity

Industrial applications : Imaging, diffraction

Under relocation to a different building

Presented in this meeting

KUANS
(Kyoto University Accelerator-driven Neutron Source)

Performance

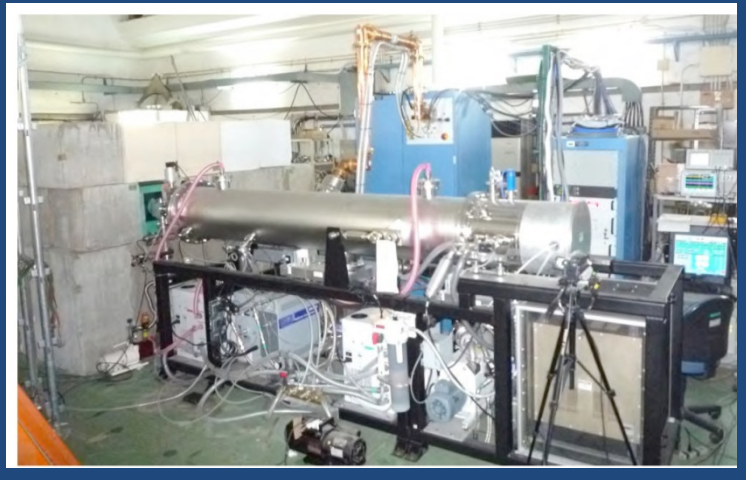
3.5MeV 100μA

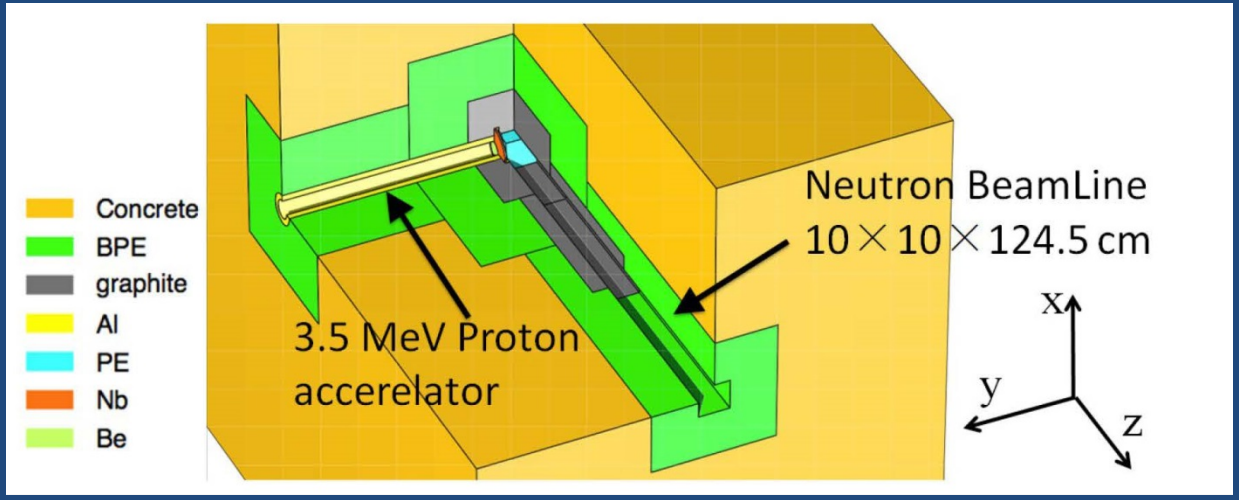
~10^{11}n/sec

Application

- Imaging
- Device
- Reflectometer
- Education
- etc.

Tasaki et al.





KURRI-LINAC

L-band linear accelerator

Electron energy : Max 46 MeV
Beam power: Max 6 kW
Pulse width: 2 ns ～ 4 μs
Frequency:
1-100 Hz (Long pulse)
1-300 Hz (Short pulse)
Neutron target:
water cooled Ta target

Two TOF beam lines
Flight path : 10 and 22 m (90 deg.)
12 m (135 deg.)

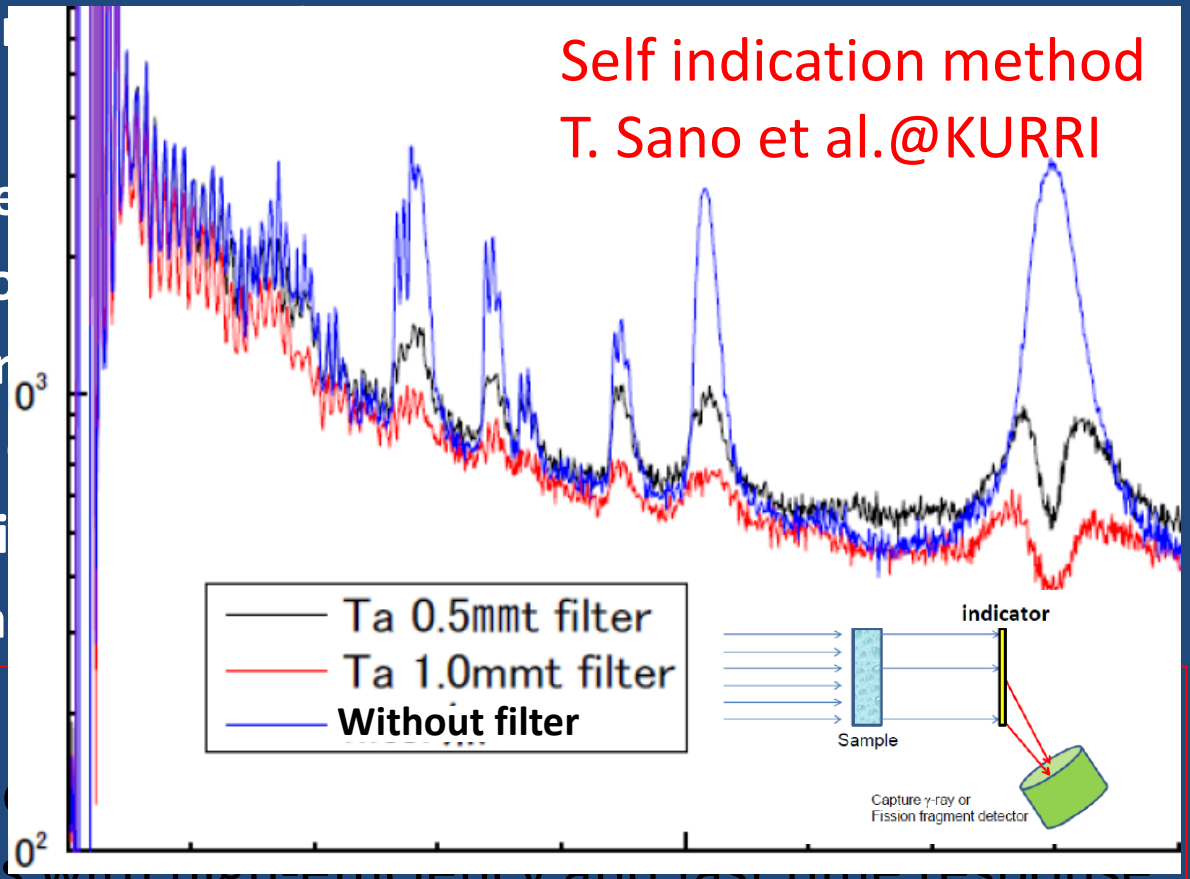
KURRI-LINAC is a unique TOF facility in Japan where we can use nuclear material.

Neutron target, moderator and beam line will be reconstructed
for integrity test of nuclear materials.
Optimization for time resolution will be checked by using REFIT code.

New project of CANS in Japan

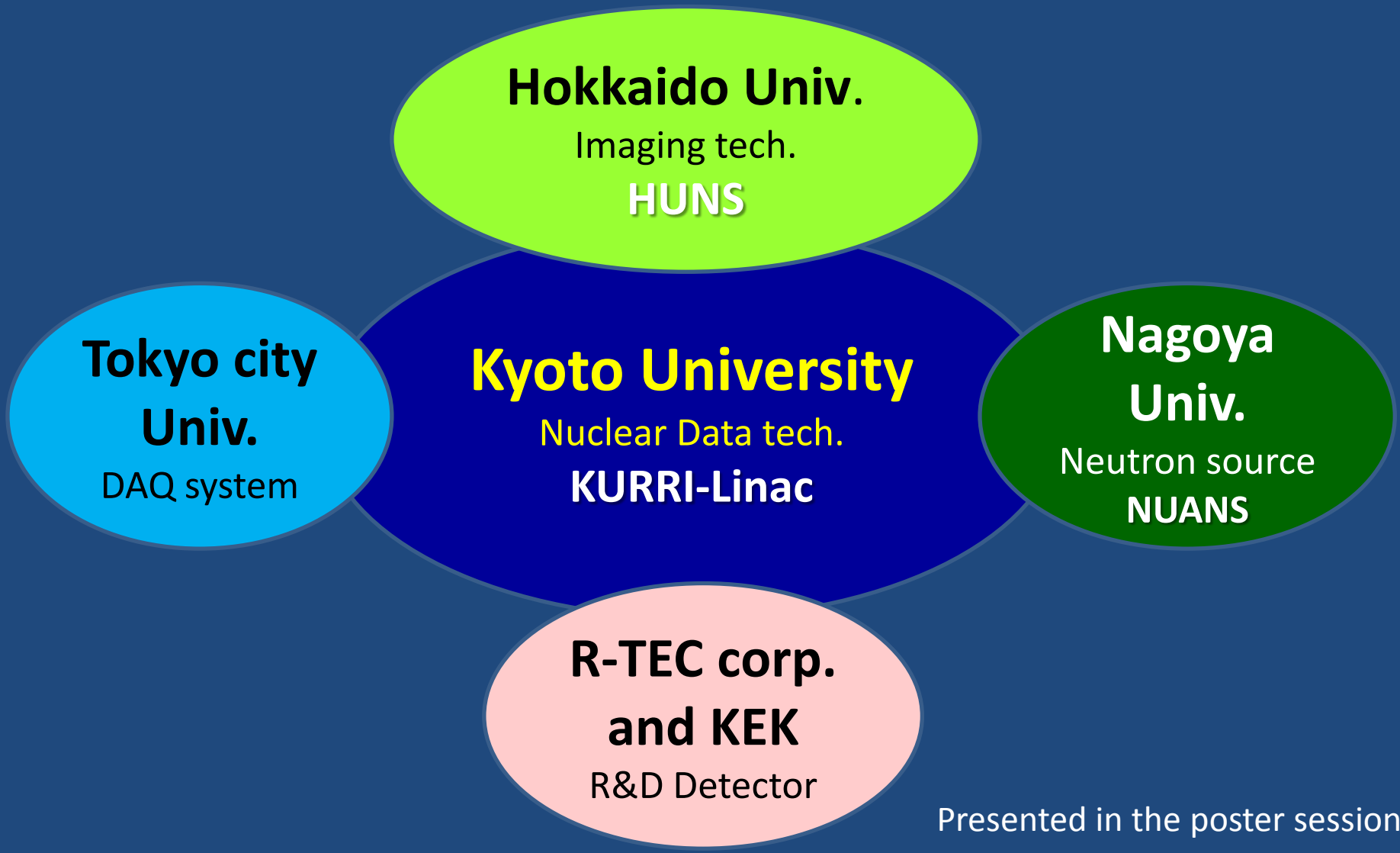
N-DeMAIN project
(Development of Non-Destructive Methods Adapted for Integrity test of Next generation nuclear fuels)
October 2014 – March 2018

- Target: Nuclear mate
- Objective:
  1. Nuclear densitome
     ← NRTA (Neutro
  2. Spatial distributio
     ← Neutron and
  3. Temperature distri
     ← Doppler Broa



(R&D)
Improvement of pulsed n
Development of detectors with high-efficiency and fast time response

N-DeMAIN Collaboration



Presented in the poster session

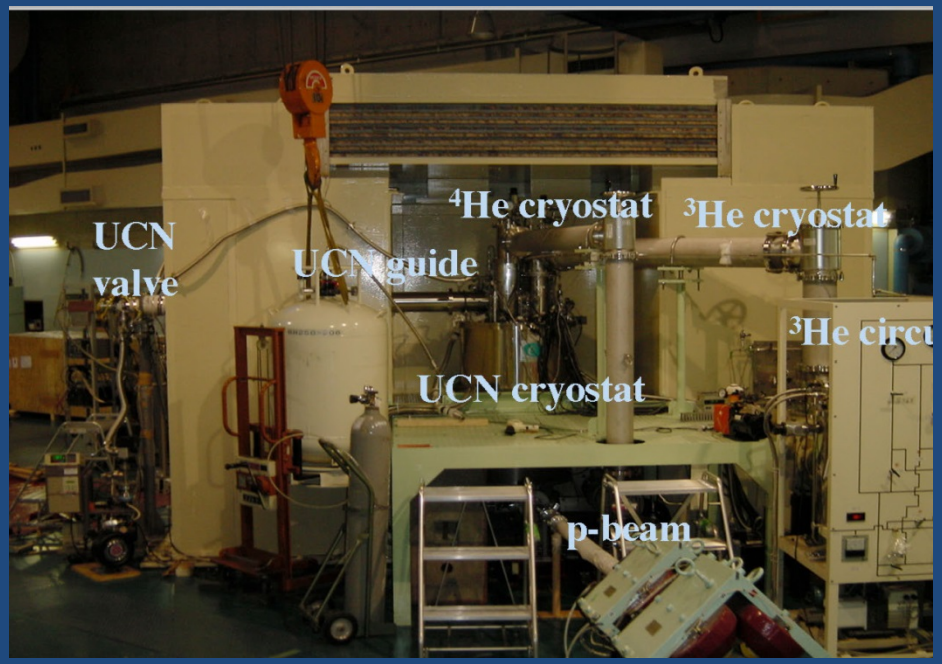
OUANS : RCNP at Osaka University

RCNP web

Y. Masuda, T. Kitagaki, K. Hatanaka, M. Higuchi, S. Ishimoto, Y. Kiyanagi, K. Morimoto, S. Muto, and M. Yoshimura, Physical Review Letters, Vol.89, No.28, pp.284801.1-4, (2002)

Neutron soft error

UCN source



400MeV

NUANS

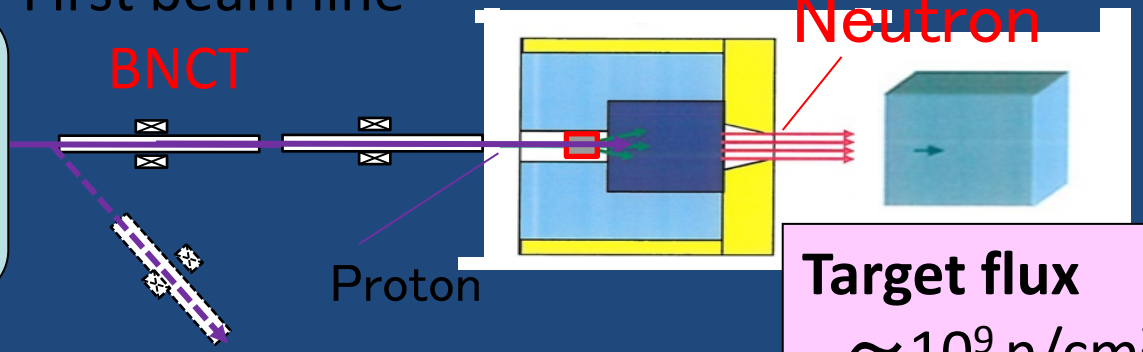
(Nagoya University Accelerator driven Neutron Source)

BNCT engineering development, Science and engineering application (Fundamental physics, Imaging etc.)
The Dynamitron accelerator has been commissioned in the USA.

(a) Accelerator | **(b) Neutron moderator** | **(c) Irradiation area**

2.8MeVx15mA＝42kW

（Dynamitron (IBA)）



Target flux
～10^9 n/cm^{2}s

Second beam line（2nd stage）

Science and engineering applications

Presented in the poster session

The measurements required for CANS

（Expected items for CANS）

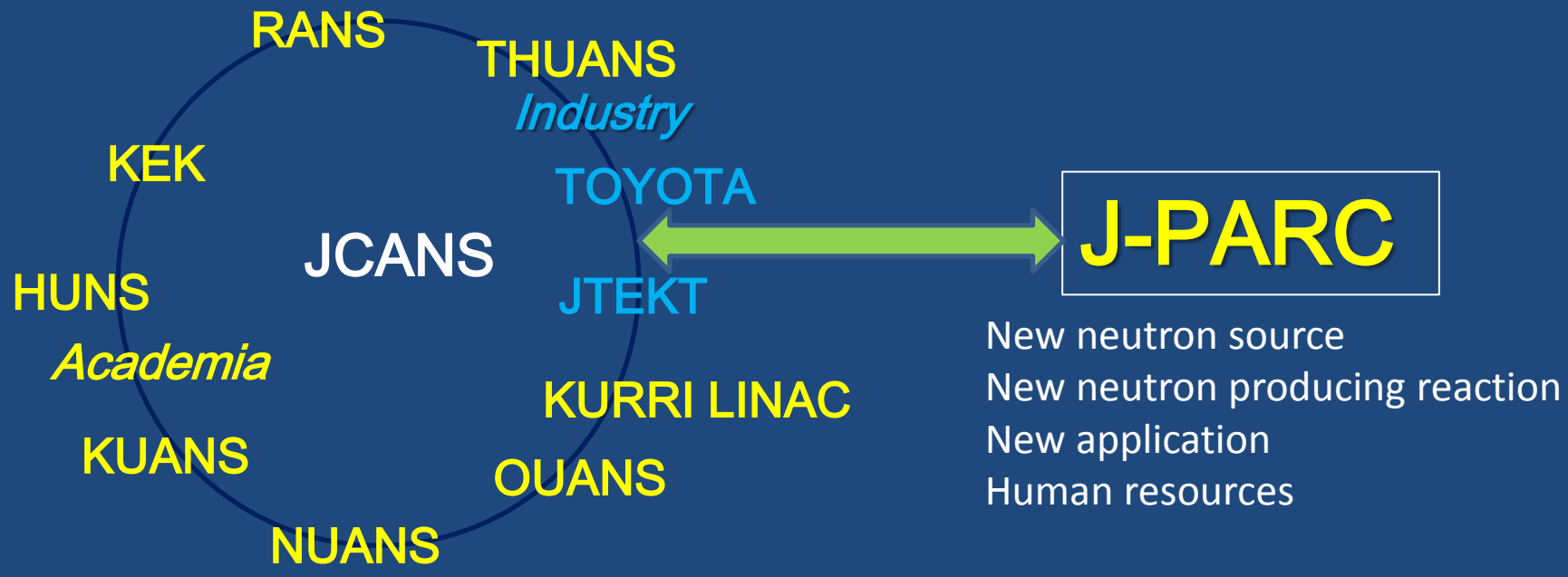
***Sustainable education**
***Effective use of neutron resources by complementary use of the big facility and CANS**
***Development of research field based on new ideas**
***Expansion of neutron field and neutron user**

Imaging：Industrial application
Structural analysis：Various fields
Others: Soft error, etc.

Inelastic：More specialized, Material science

Summary

- JCANS has changed to include industry members to promote application (and also accelerator design)
- CompactANS itself has been proved to be very useful even though it cannot cover all area of the large facility.
- Close correlation with the large facility is important for the effective use of neutron resources.



THANK YOU FOR YOUR ATTENTION!

Acknowledgement

Present study partially includes the result of “Development of Non-Destructive Methods Adapted for Integrity test of Next generation nuclear fuels” entrusted to the Kyoto University by the Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT).