Symposium on Solving Problems in Research Reactors
5 Dec. 2025, Mito Station South Satellite, Ibaraki University

Neutron Science Research at Ibaraki University:

Collaborations & Education Activities in Research and Education Center for Atomic Sciences (RECAS)

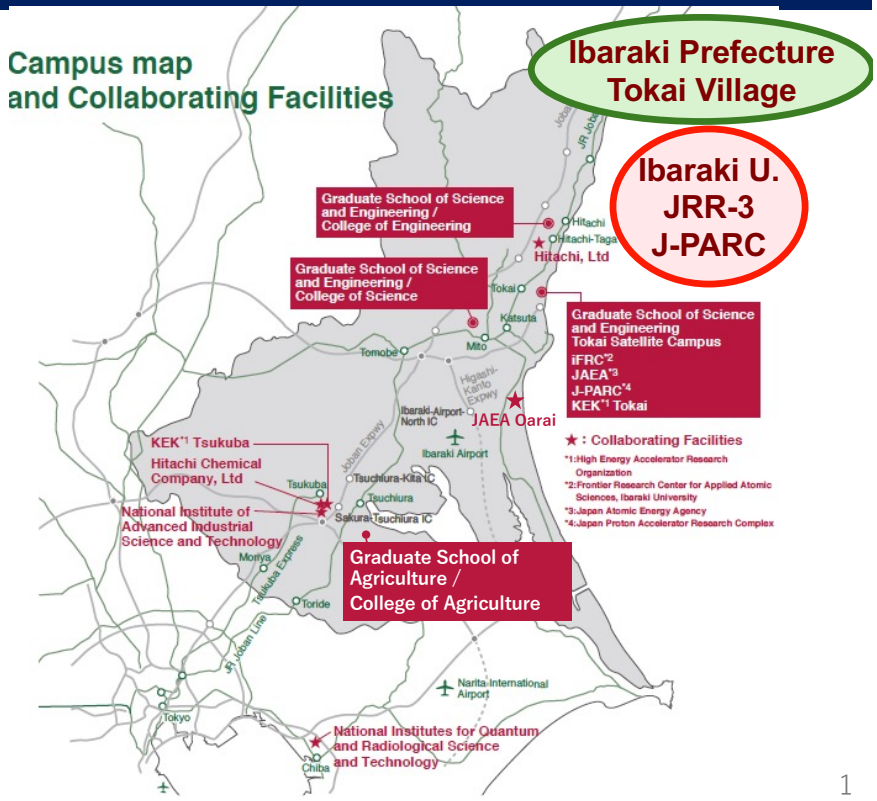
Kazuaki Iwasa, Director of RECAS

茨城大学
Ibaraki University

RECAS
Research and Education Center for Atomic Sciences

(Mito campus)

(Tokai Satellite Campus)



Atomic Science

Comprehensive Investigation of Energy, Materials
Function, and Radiations from Atoms

“Integrated Climate Change Science” in Ibaraki University

茨城大学
Ibaraki University

2003
Scientific Frontier 21
Project in Ibaraki Prefecture

2006
Institute for global Change Adaptation Science (ICAS)

2006
Frontier Research Center for Applied Atomic Science (iFRC)

Major in Quantum Beam Science (2016)

2017
Tokai Satellite Campus established

2019
Ibaraki Local Climate Change Adaptation Center (iLCCAC)

2020
Global and Local Environment Co-creation Institute (GLEC)

Climate Change Adaptation and Mitigation Research Field

Research activities with the same directional vector toward the improvement of well-being

Atomic Science Research Field

Collaboration

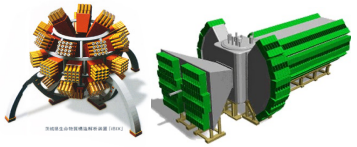
Mitigation measure

2023
Carbon Recycling Energy Research Center (CRERC)

Research and Education Center for Atomic Sciences

RECAS
Research and Education Center for Atomic Sciences

2024～2028
MEXT Budget “Establishing an education and research base for safe and secure innovative atomic sciences”

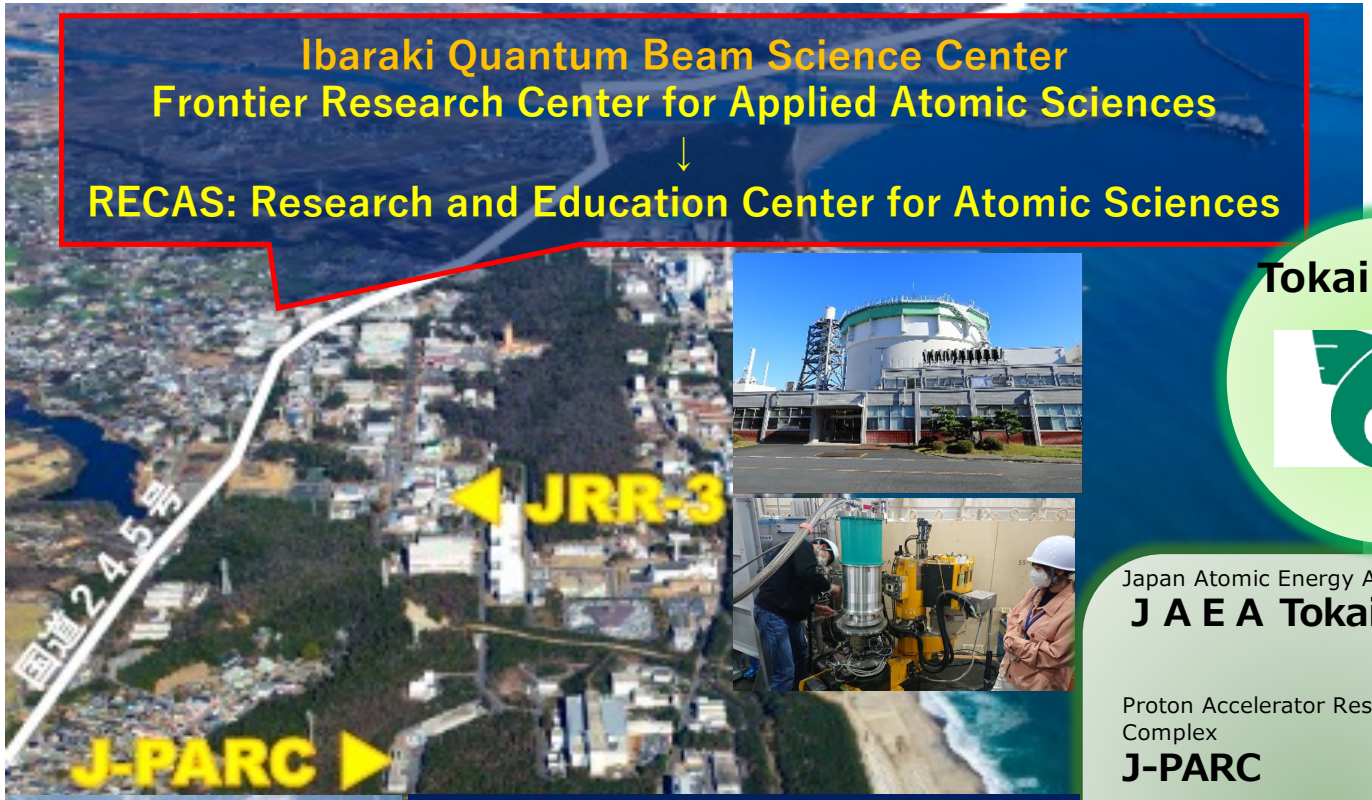


Neutron beam use at J-PARC MLF and JRR-3
iBIX: Bioscience
iMATERIA: Materials
T1-1: Physics
+
Activity in iQBS

"Atomic Science Research Field" in Ibaraki University

RECAS
Research and Education Center for Atomic Sciences

Ibaraki Quantum Beam Science Center
Frontier Research Center for Applied Atomic Sciences
↓
RECAS: Research and Education Center for Atomic Sciences



- ISSP Univ. of Tokyo: Cooperation for the JRR-3 spectrometer
- ANSTO (Sydney, Australia)
- KAERI (Neutron Science Division): Cooperation for the exchange professorship and the neutron science. [Director: Dr. Young-Soo Han]

Collaborations at accelerators and research reactors with the institutes located nearby.

Tokai Village

Ibaraki Prefecture

Ibaraki U.

Tokai Satellite Campus

Japan Atomic Energy Agency
J A E A Tokai & Oarai

Proton Accelerator Research Complex
J-PARC

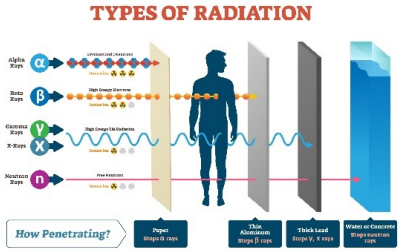
High-Energy Accelerator Research
KEK

Institute of Solid State Phys.
ISSP, U. of Tokyo

National Institutes for Quantum Science and Technology
QST

JAEA Oarai
HTTR ▶

Organization of RECAS

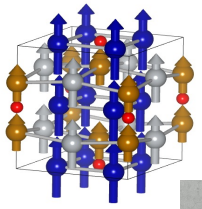


Educational activities to train students who have sufficient knowledge of radiation and its effect (to let them get national License for radiation protection supervisor).

Applied Atomic Science Division

- *Functional materials for devices*
- *Infrastructure materials*
- *Neutron and X-ray scattering ・ Muon science*

Tokai Area



Radiation Safety Division

Relationship between Radiation and Life・Environment

Knowledge of atomic science application to life and environment

Radiation effect on life and environment (Radiation Safety, Biology, Life Science & Medicine)

Innovative Atomic Sciences for Safety

Radiation

Radiation

Radiation

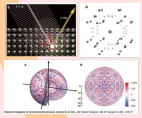
Materials Science using Quantum Beams

Energy harvest using high-density Atomic energy

Atomic Science

Division for Collaborative Solution of Social/Regional Issues

Materials Analysis (Research reactor, Synchrotron radiation, Muon Beam)

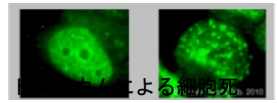


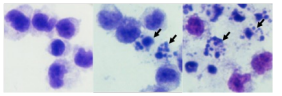
New material development for energy technique etc.

Next generation reactors (HTGR, Nuclear fusion etc.) Radiation control for energy source

Reactor Safety & Energy production efficiency

RECAS
Research and Education Center for Atomic Sciences





Effect of tritium on cells

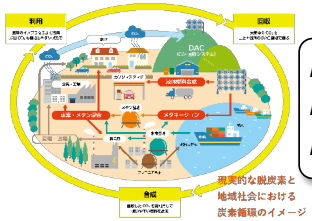
Advanced Reactor Research Division

From AEA

JAEA: High-Temperature Gas-cooled Reactor & Decommissioning of reactor

Collaboration

CRERC: Carbon recycling/neutrality

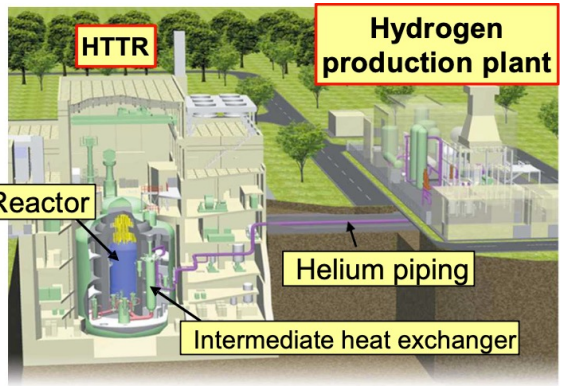


Design for Regional Energy Resources

“Establishing an education and research base for safe and secure innovative atomic sciences” Advanced Reactor Research: Advancement and succession of nuclear-related technologies

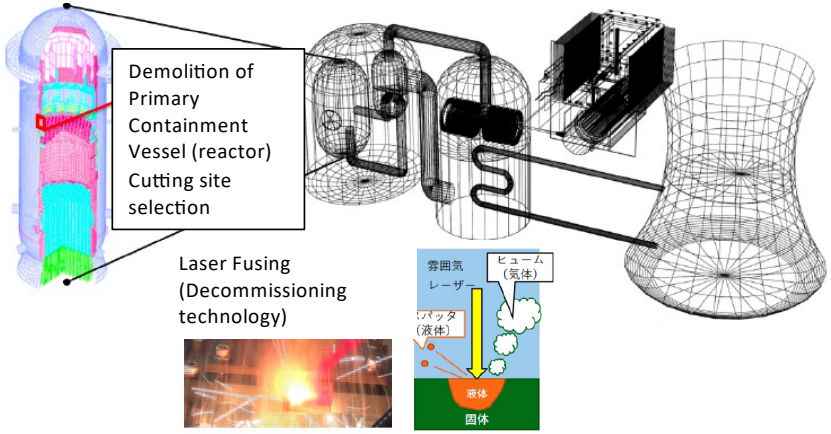
Contribution to next-generation nuclear reactor

Collaboration with JAEA for High Temperature Gas Reactor with Hydrogen Mass Production



Digital twin technology to achieve safe, fast and efficient decommissioning of reactors

Supported by GTIE GAP Fund (JST)



Research Fields

- Development of systems with improved efficiency and safety for next-generation innovative reactors, safety technologies for them, and new materials that can be used in high-temperature environments
- Energy source technology that uses hydrogen, as planned for next-generation innovative reactors
- Application of efficient thermal energy recovery technology through thermoelectric conversion
- Application of lightweight and composite materials that achieve energy savings and low environmental impact
- Research and development and commercialization start-up of decommissioning technology for conventional light water reactors using digital technology

Human Resource Development

Developing highly skilled practitioners who have knowledge of conventional nuclear reactors and can contribute to research and development of next-generation nuclear reactors

“Establishing an education and research base for safe and secure innovative atomic sciences”
Radiation Safety: Contribution to radiation safety technology

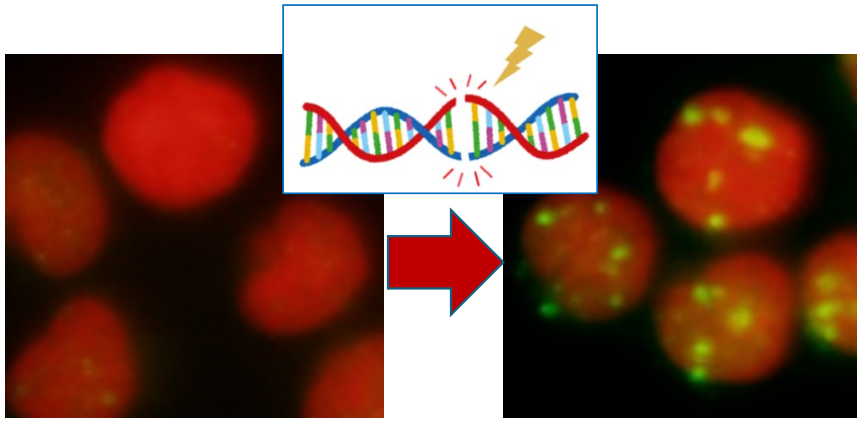
Development of a simple and rapid method for investigating tritium levels in marine products

Contribution to society through disease risk assessment from radiation damage to DNA

Nuclear regulation human resource development based on mastering knowledge of radiation and tritium (2023～2027)

- Supplying human resources who engage nuclear reactors and rebuild Fukushima region
- Supporting retail industry groups by voluntary tritium testing

University-based venture “Dinow”



Research Fields

- Effects of radiation on the human body and living organisms, such as DNA damage
- Understanding the contamination mechanism by radionuclides and developing decontamination technology
- Developing a rapid measurement method for environmental tritium
- Understanding the mechanism of cell and DNA damage, by applying the method with unsealed radionuclides including tritium

Human Resource Development

- Atomic science researchers and engineers with the potential to develop new technologies based on advanced knowledge and understanding of biological effects of radiation

“Establishing an education and research base for safe and secure innovative atomic sciences”
Applied Atomic Science: Quantum Beam Science (Neutron, Synchrotron Ray, and Muon)

Contribution to advanced quantum beam measurements, functional material developments, and basic science

Research Fields

【Development of imaging and analysis methods】

Elucidation of hierarchy in material structures

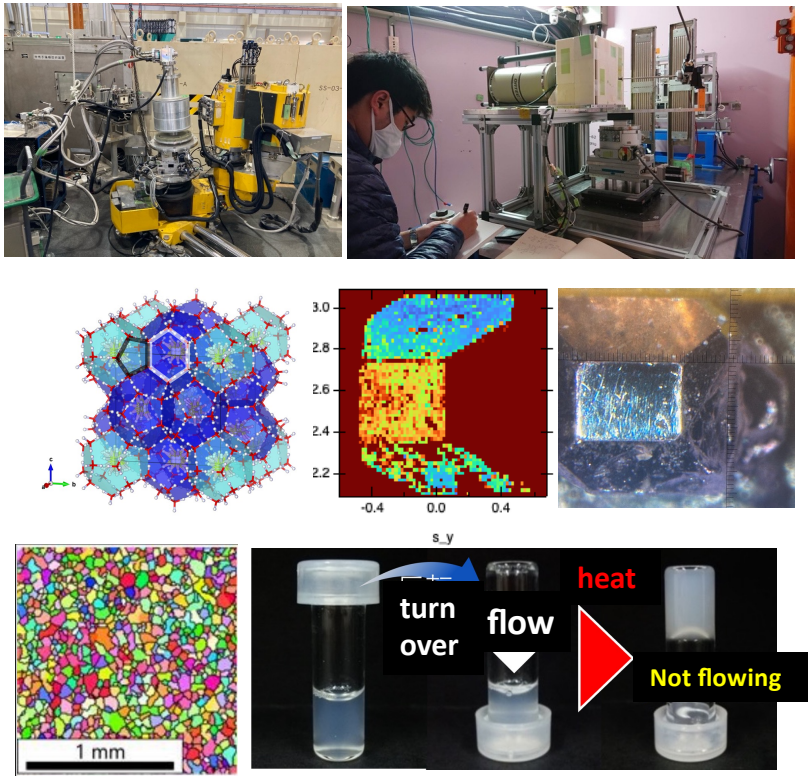
- Crystal structure analysis : Material science and Biology
- Atomic resolution holography
- Visualization of material domains and surface cracks
- Muon: Basic physics and Transparent technique

【Heat and hydrogen use in next-generation nuclear reactors】

- Elemental techniques based on new materials applicable for the next-generation nuclear reactors
- Domestic energy systems by combining developed functional materials

【Industrial use of quantum beams : infrastructures】

Texture analysis of steels, Energy storage materials, High-strength composites, Nano-polymers solidifying by heating

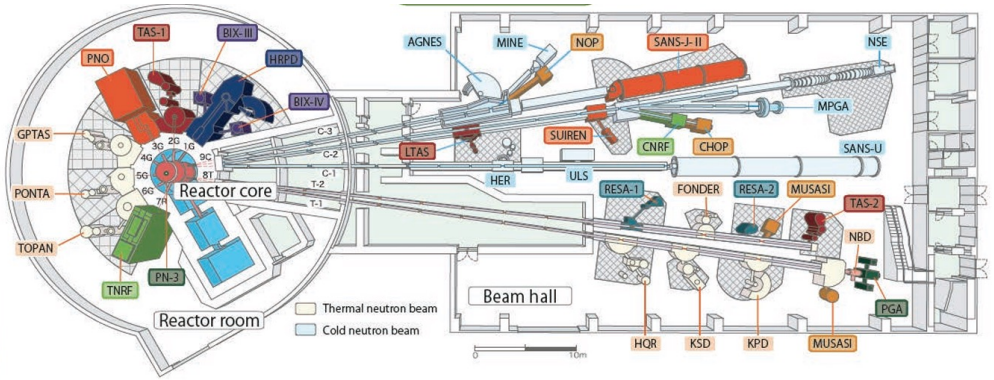


Human Resource Development

Engineers and researchers with knowledge of advanced material measurement methods using high-performance quantum beams (in cooperation with the Institute of Quantum Beam Science)

“Establishing an education and research base for safe and secure innovative atomic sciences”
Applied Atomic Science: neutron Beam Science at JRR-3

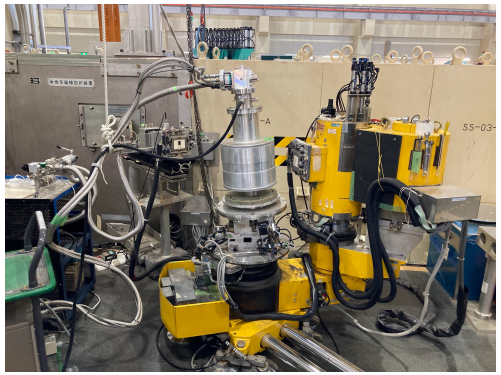
T1-1 (HQR) at restart [July 21, 2021]



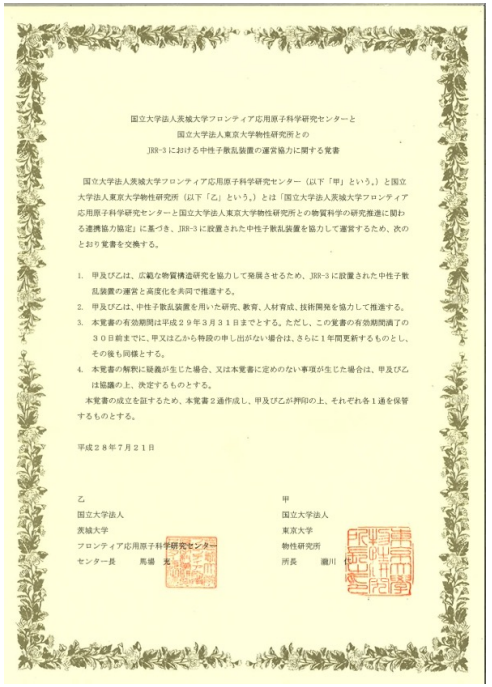
For student education (exercise, training),

- Easy to access the JRR-3 beam hall.
- Operate the spectrometer by themselves, and see what happens.
- No need to hurry up, enough time to understand.
- Combined with research experiments for master’s/doctor's degrees.

“Establishing an education and research base for safe and secure innovative atomic sciences”
Applied Atomic Science: neutron Beam Science at JRR-3



- 2016: The Department of Quantum Beam Science was established at the Graduate School of Science and Engineering, Ibaraki University.
- 2016: The "Memorandum of Understanding on Cooperation in the Operation of Neutron Spectrometers at JRR-3" was signed between the Institute for Solid State Physics, The University of Tokyo, and the Frontier Research Center for Applied Atomic Sciences, Ibaraki University.
- From July 2021 (restart of JRR-3), Ibaraki University has operated the HQR (High-Resolution Triple-Axis Spectrometer) installed at T1-1, owned by the Institute for Solid State Physics, The University of Tokyo.
- Furthermore, research and education by complementary use of quantum beam facilities have been conducted based on collaboration agreements with J-PARC, JAEA, KEK, and SPring-8.



国立大学法人茨城大学フロンティア応用原子科学研究センターと
国立大学法人東京大学物性研究所との
JRR-3における中性子散乱装置の運営協力に関する覚書

国立大学法人茨城大学フロンティア応用原子科学研究センター（以下「甲」という。）と国立大学法人東京大学物性研究所（以下「乙」という。）とは「国立大学法人茨城大学フロンティア応用原子科学研究センターと国立大学法人東京大学物性研究所との物質科学の研究推進に関わる連携協力協定」に基づき、JRR-3に設置された中性子散乱装置を協力して運営するため、次のとおり覚書を交換する。

1. 甲及び乙は、広範な物質構造研究を協力して発展させるため、JRR-3に設置された中性子散乱装置の運営と高度化を共同で推進する。
2. 甲及び乙は、中性子散乱装置を用いた研究、教育、人材育成、技術開発を協力して推進する。
3. 本覚書の有効期間は平成２９年３月３１日までとする。ただし、この覚書の有効期間満了の３０日前までに、甲又は乙から特段の申し出がない場合は、さらに１年間更新するものとし、その後も同様とする。
4. 本覚書の解釈に疑義が生じた場合、又は本覚書に定めのない事項が生じた場合は、甲及び乙は協議の上、決定するものとする。

本覚書の成立を証するため、本覚書２通作成し、甲及び乙が押印の上、それぞれ各１通を保管するものとする。

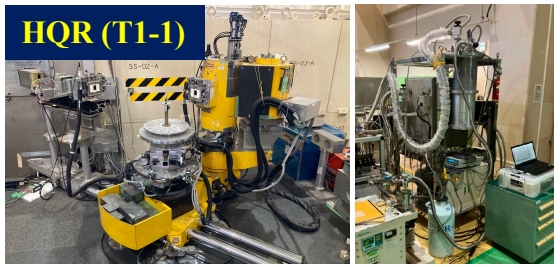
平成２８年７月２１日

乙
国立大学法人
茨城大学
フロンティア応用原子科学研究センター
センター長　馬場　嘉

甲
国立大学法人
東京大学
物性研究所
所長　瀧川

Activities at HQR (T1-1) of JRR-3: Collaboration between Ibaraki Univ. and ISSP

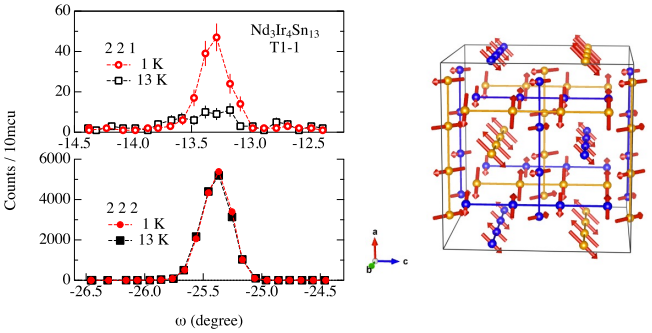
- *Research and education activities under collaboration between Ibaraki Univ. and ISSP*
- *Every year, approximately 25 students of Ibaraki Univ. experienced neutron scattering experiments.*



Installing a ^{3}He (1 K) cryostat

Students at T1-1, JRR=3

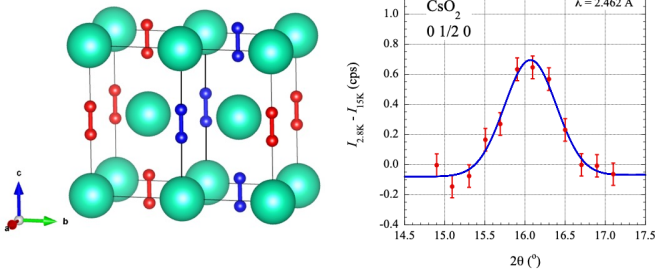
Magnetic orderings in chiral structure systems



The AFM ordered phases and chiral symmetry

A. Shimoda et al., Phys. Rev. B 109, 134425 (2024).

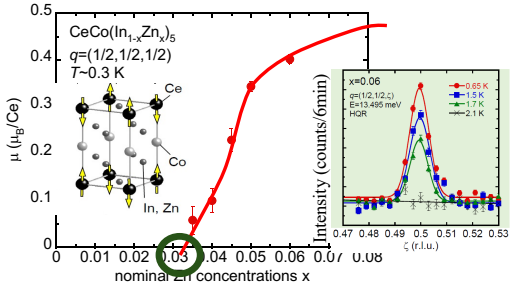
Antiferromagnetic structure of p electrons in CsO_2



The oxygen small magnetic moments are detected.

T. Nakano et al., J. Phys.: Condens. Matter 35, 435801 (2023).

Superconductivity and antiferromagnetization of $CeCo(In_{1-x}Zn_x)_5$

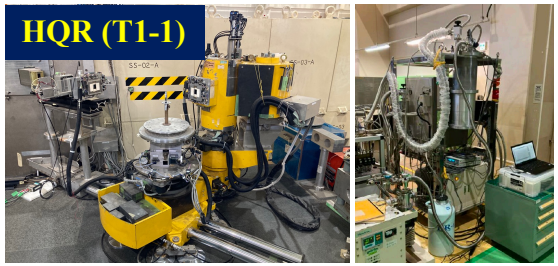


The AFM order emerges in the heavy-fermion superconducting phase.

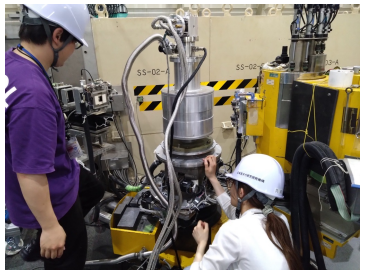
K. Inoh et al., Phys. Rev. B 111, 104510 (2025).

Activities at HQR (T1-1) of JRR-3: Education in Ibaraki Univ.

- ***Research and Education** activities under collaboration between **Ibaraki Univ. and ISSP***
- ***Every year, approximately **25 students** of Ibaraki Univ. experienced neutron scattering experiments.***
- ***Regular practical lectures of Graduate School of Ibaraki Univ. on T1-1***



Installing a ^{3}He (1 K) cryostat



Students at T1-1, JRR-3

- ***Relating activities at neutron facilities for students***

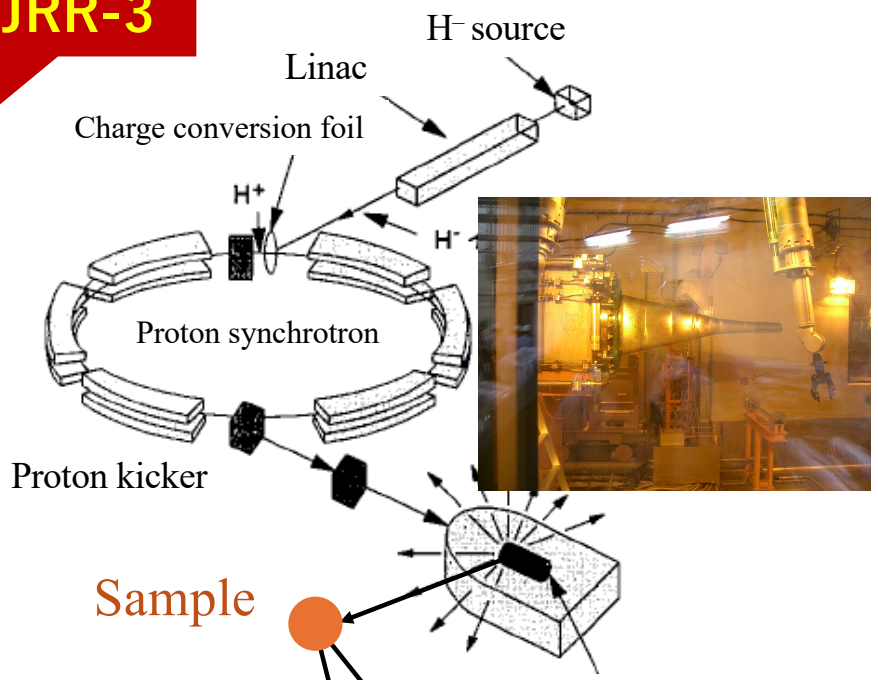
■HANARO Symposium 2025 at Daejeon.

■Visiting the Tokai nuclear plant and attending workshops for reginal safety against nuclear accident.

■Sweden–Japan Ph.D Day for neutron science

J-PARC : Japan Proton Accelerator Research Complex

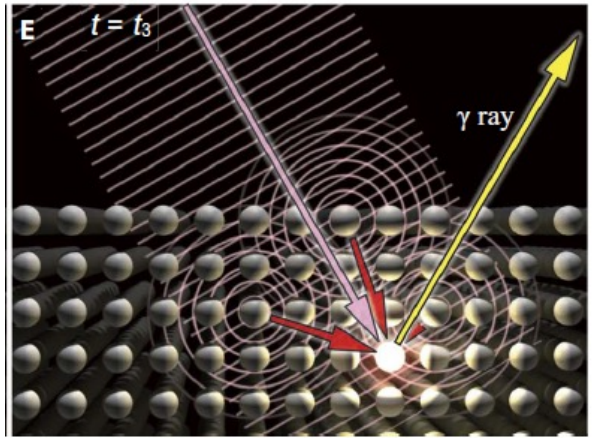
(http://j-parc.jp/)

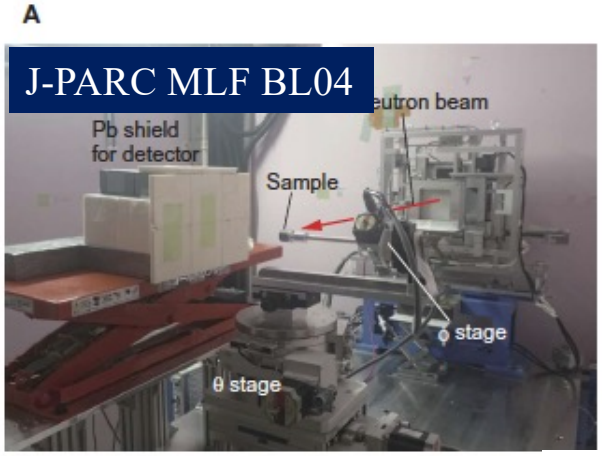


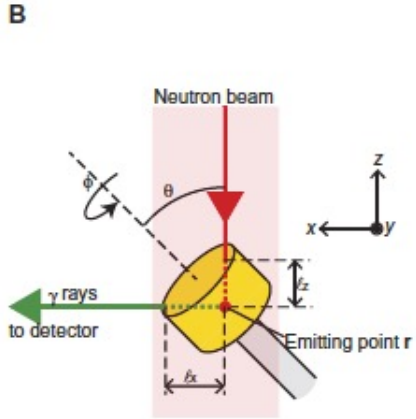
Neutron holography using accelerator-based pulsed neutron

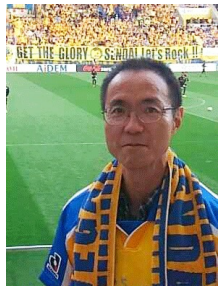
(K. Hayashi, K. Ohoyama et al., Science Advances, 3 (2017) e1700294-1-7.)

γ-ray emission intensity depending on interference of neutron scattered by surrounding nuclei.



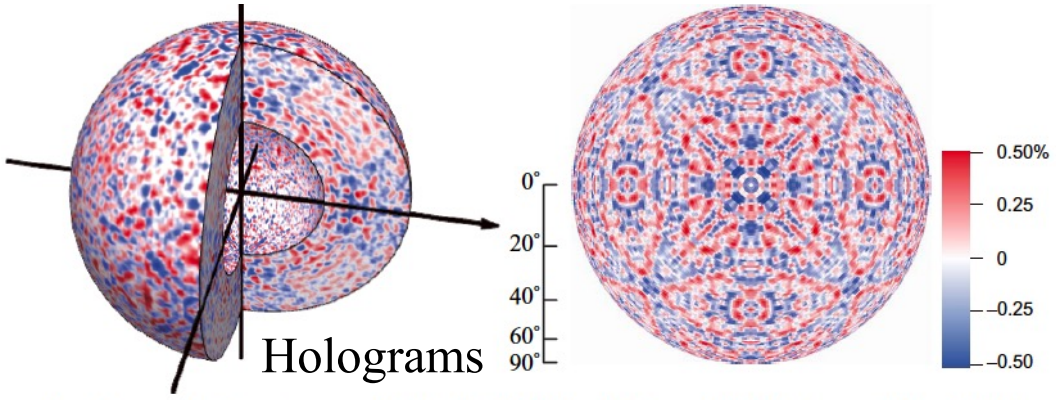




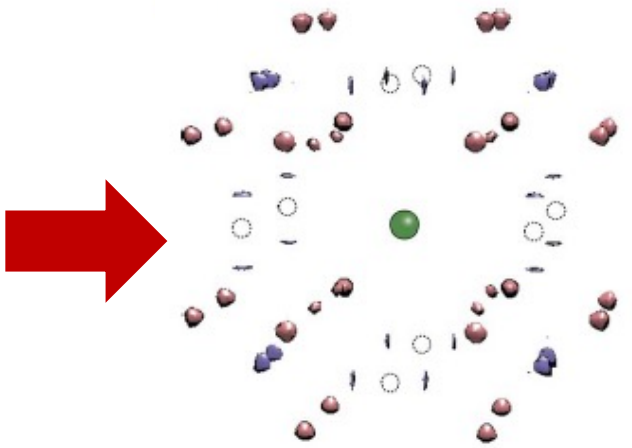


Prof. K. Ohoyama
Materials Science and Engineering
Institute of Quantum Beam Science

Structural changes induced by Eu doping to CaF_2.



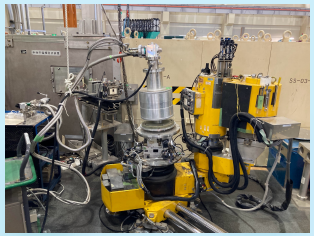
lograms of environmental structure around Eu in CaF_2. (**A**) Volume hologram. (**B**) 2D hologram at $|\mathbf{k}| = 4.05$ Å^{-1}.



Extracted local structure around doped Eu (green)

Summary: RECAS with Atomic Sciences and Reactors

RECAS
Research and Education Center for Atomic Sciences



Japan Atomic Energy Agency
J A E A Tokai & Oarai

Proton Accelerator Research Complex
J-PARC

High-Energy Accelerator Research
KEK

Institute of Solid State Phys.
ISSP, U. of Tokyo

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