



**Frontier Science,
Cutting-edge Research
Infrastructures and
Creation of Value:
A RIKEN way**

Sofia, April 2023



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理化学研究所

Some figures about Japan and Japanese R&D

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Indicators	Population (2020)	GDP (2020)	GERD (2020)	PCT patent application (2021)
Japan	125.71 million	5315.6 billion USD	3.27	50,266
Germany	83.16 million	4560.9 billion USD	3.14	17,276
Indicators	Total number of researchers (FTE) (2020)	Government researchers (FTE) (2020)	Total number of articles, Nature Index (Apr 2021 – Mar 2022)	Global Innovation Index (2021)
Japan	689,889	30,152	4,901	#13
Germany	451,859	60,988	9,045	#10

National R&D Corporations	30
Universities	790
National	82
Public	94
Private	592
Others, not under MEXT	7
Professional	15

- ❖ **RIKEN**
- ❖ **National Institute of Advanced Industrial Science and Technology (AIST)**
- ❖ **National Institute for Materials Science (NIMS)**
 - Japan Aerospace Exploration Agency (JAXA)
 - Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
 - National Research Institute for Earth Science and Disaster Prevention (NIED)
 - National Institutes for Quantum and Radiological Science and Technology (QST)
 - National Institute of Information and Communications Technology (NICT)
 - National Agriculture and Food Research Organization (NARO)
 - National Institute for Environmental Studies (NIES)
 - ...

RIKEN is a Japanese national science institute.

- multi-disciplines: holistic approach
- platform of platforms

RIKEN is
like a small-scale
Max-Planck Society
+ Helmholtz Association
or
CNRS + CEA



1917 –

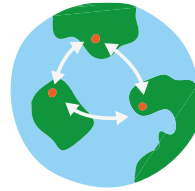
RIKEN is a comprehensive research institute



3500 Staff
(~740 non-Japanese
from 60 countries)



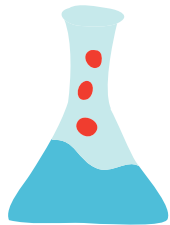
~€750M
Budget



**294 International
Collaborations**
(March 2022)



~ 2700 papers
published
annually



500+ Labs



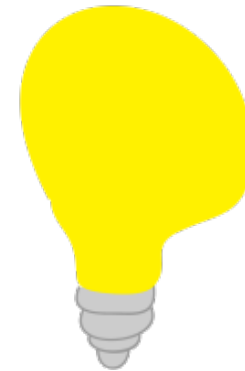
13 Centres



10 Sites
5 Overseas bases

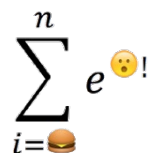
2.2%
in top 1% of cited papers
(As of July 2021)

- Innovation first
- Basic/frontier science — curiosity-driven research
- Application of research results
- Fostering talented researchers
- Tackling global challenges
- Vision and scenarios for future society



We cover a wide range of scientific fields

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Mathematics



Developmental Biology



Chemistry



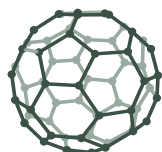
Space Science



Health and Medicine



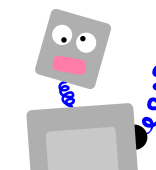
Genetics



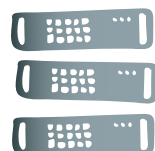
Nanoscience



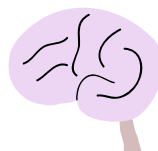
Sustainable Resources



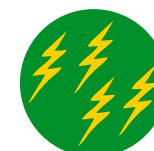
Artificial Intelligence



Computational Science



Brain Science



Energy



Nuclear Physics



Engineering



Plant Science

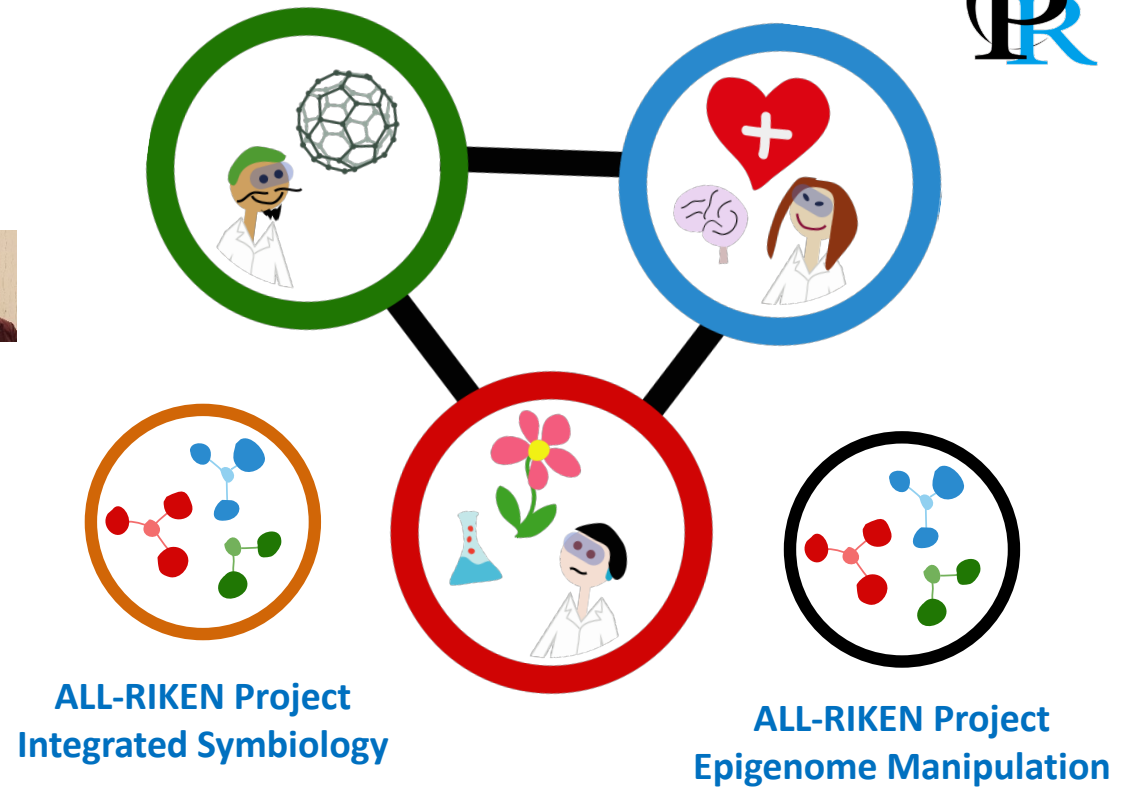
+ Social Sciences and Humanities (April 2021-)

We promote curiosity-driven research.

Chief Scientists



Cluster for Pioneering Research (CPR)



ALL-RIKEN Project
Integrated Symbiology

ALL-RIKEN Project
Epigenome Manipulation



RIKEN has 10 Strategic Research Centers

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**Integrative
Medical Sciences**



**Sustainable
Resource
Science**



**Brain
Science**

BDR

**Biosystems
Dynamics
Research**

iTHEM

**Theoretical
and
Mathematical
Science**



**Accelerator
Based
Science**



**Emergent
Matter
Science**



**Advanced
Photonics**



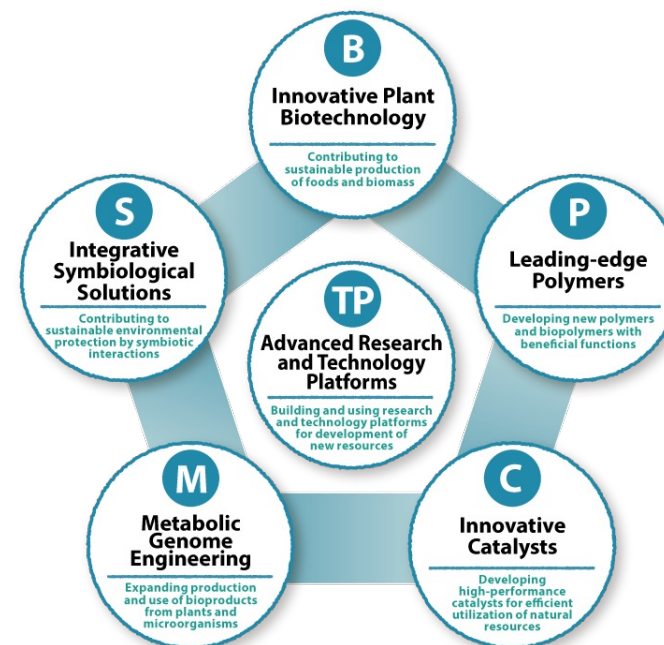
**Advanced
Intelligence
Project**



**Quantum
Technologies**

Contributing to achieving a sustainable society through transdisciplinary integration of plant science, chemical biology, and catalytic chemistry

SUSTAINABLE DEVELOPMENT GOALS
17 GOALS TO TRANSFORM OUR WORLD

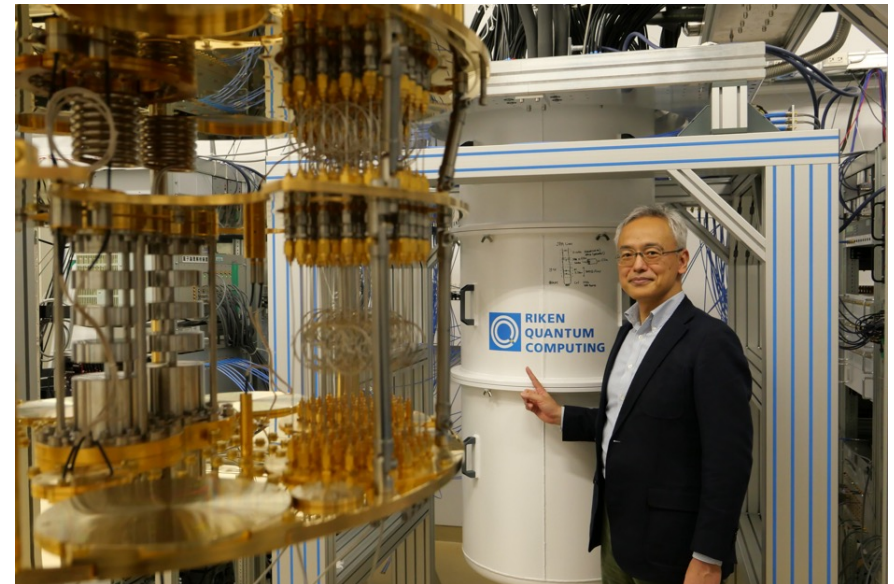


Small Molecules	Data	Genome
Compounds Metabolites Peptides	Molecule data Genome data AI	Epigenome Genome editing Synthetic genomics



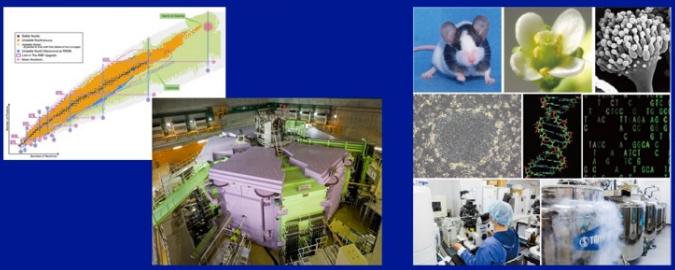
Revealing and exploiting the full potential of quantum mechanics

- ❖ Superconducting quantum computing
- ❖ Optical quantum computing
- ❖ Other quantum platforms
- ❖ Quantum computing theory
- ❑ Headquarter for Quantum Technology Innovation Hubs





The 1st Japanese quantum computer with 64 superconducting qubits now on the cloud!


RIKEN Europe symposium 2022
"Sustainable research infrastructure for a sustainable world"
Tuesday, 22 February 2022 (9:00-12:30 CET / 17:00-20:30 JST)
Free registration at <https://krs4.riken.jp/m?f=37>



Interested in world class research, facilities and services? Then join us!



2022.02.22
理研欧州シンポジウム



RIKEN has 3 Research Infrastructure Centers and also operate other facilities.



Center for
Computational Science

BRC

BioResource
Research Center



Spring-8 Center

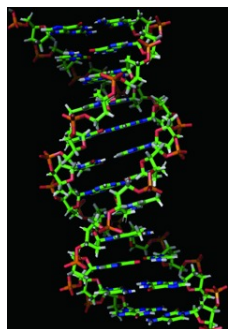
RIKEN' Research Infrastructures





Foundation for Discoveries and Access to the Future

DNA



Mice

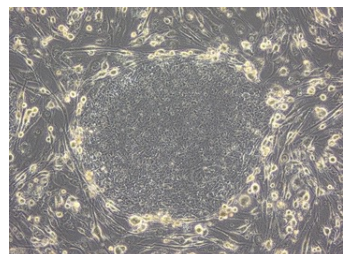


Global distribution of research materials produced in Japan

69 Countries across the world

Number of Institutions

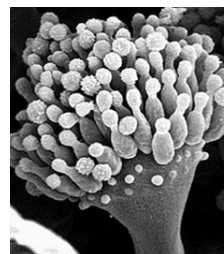
Mice	791
Plants	879
Cells	1,369
DNA	768
Microbes	1,292
Total	4,567



iPS Cells



Arabidopsis



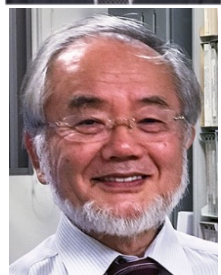
Microbes

Cutting-edge bioresources deposited by Japanese Nobel laureates



Dr. Tasuku Honjo
 “Cancer immuno-therapy by inhibition of negative immune regulation”
 (2018)

Type of bioresource	Depositions (year)	No. of distribution	Papers by users
PD-1 KO mouse strains	3 (2003)	395	10
PD-1 related mouse strains	9	13	0
Gene: mouse PD-1 cDNA	1	1	0
PD-1 related (Mouse, Gene and Cell lines)	117	770	42



Dr. Yoshinori Ohsumi
 “Mechanisms for autophagy”
 (2016)

Type of bioresource	deposition	distribution	papers
Autophagy-related mouse strains	7 (2002-)	2,891	155
Autophagy-related cell lines	8 (2007-)	396	39



Dr. Satoshi Ōmura
 “Microbes for a novel therapy against infections by roundworm parasites” (2015)

Type of bioresource	deposition	distribution	papers
Microbe strains	37 (1984-)	50	23 3 patents



Dr. Shinya Yamanaka
 “Reprogramming mature cells to become pluripotent” (2012)

Type of bioresource	deposition	distribution	papers
iPS cell lines	4,218 (2007-)	4,531	434
iPS cell-related mouse strains	6 (2007-)	494	15

Specifications

RIKEN BRC is committed to receiving deposition/donation of bioresources from the research community, confirming the authenticity of bioresources by rigorous quality control, preserving, and distributing them back to the research community. In addition, RIKEN BRC conducts research and development to accelerate active use and application of its bioresources.

RIKEN BRC handles following five bioresources:

- Experimental mouse strains
- *Arabidopsis thaliana* and other laboratory plants
- Cultured cell lines of human and animal origin
- Microorganisms
- Genetic materials (DNA clones)

Users from Europe (and around)

To date, over 2,000 institutions in Europe have used the bioresources provided by RIKEN BRC. As results, more than 1,600 scientific papers and 120 patents have been published by European researchers/organizations. Inversely, Europe has contributed to activities of RIKEN BRC by depositing over 2,200 items of bioresources developed in Europe.

Access/use by non-Japanese organizations

Please search bioresources that you wish to use in the BRC website (on-line catalogue) and/or the website of an appropriate Division.

Detailed procedures for obtaining bioresource are different among bioresources. Please read the specific instructions of an appropriate Division. RIKEN BRC provides advices and suggestions on how to use best the various bioresources.

Useful links

RIKEN BRC website:

<https://web.brc.riken.jp/en/>

Experimental Anima Division (Mouse strains):

<https://mus.brc.riken.jp/en/>

Experimental Plant Division (*Arabidopsis* seeds, DNA vectors, Plant cell culture, *Brachypodium* resource):

<https://epd.brc.riken.jp/en/>

Cell Engineering Division (CELL BANK):

<https://cell.brc.riken.jp/en/>

Gene Engineering Division (GENE BANK):

<https://dna.brc.riken.jp/en/>

Microbe Division (Jan Collection of Microorganisms, JCM):

<https://jcm.brc.riken.jp/en/>



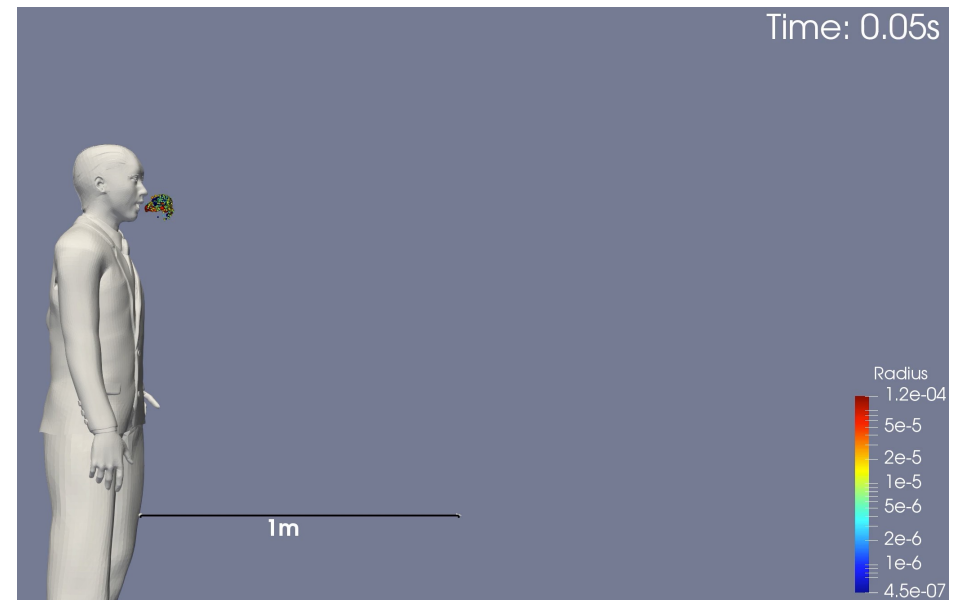
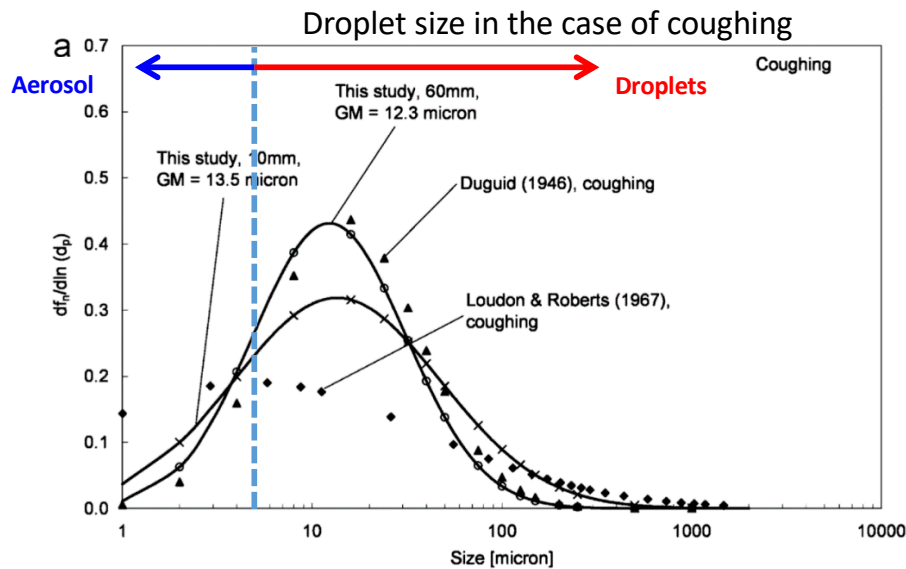
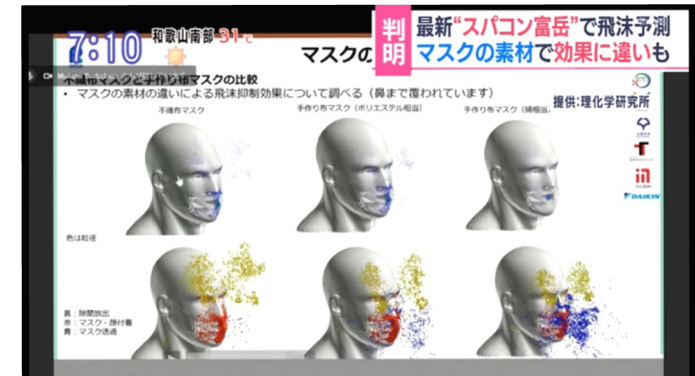
Science of Computing by Computing for Computing

Supercomputer Fugaku
- The Game Changer -
in full operation since March 2021





Fugaku resources made available a year ahead of general production. joined US-lead COVID-19 HPC Consortium. Contributed to the social awareness of understanding aerosol infection & importance of countermeasures.



Specifications

Supercomputer 'Fugaku', 158,976 nodes

- Each node 48 core A64FX Arm CPU w/SVE extensions
 - 32GB on-die HBM2 memory, 32GB, 1TB/s bandwidth
 - Tofu-D network with embedded NIC&switch on die, ~400Gbps
 - RHEL OS, integrated HPC, cloud, big data, and AI software stack
- 2.5PB NVMe + 150PB HDD storage
400GBps network connection to SINET6 & HPCI Storage

Peak performances

Floating: 537PF(FP64), 1.07EF(FP32), 2.15EF(FP16)
Integer: up to 4.3 Exaops (8bit)
Memory Bandwidth: 163 PB/s
Network Injection BW: ~5 Pbps
Storage BW: ~2 TByte/s

Major achievements

#1 in major supercomputer rankings four consecutive editions, Jun/Nov 2020-2021 --- Top500, HPCG, HPL-AI, Graph500
ACM Gordon Bell Prize winner 2021 (COVID-19 Aerosol Simulation), finalist x1, 2020 finalist x2
Numerous innovative science and industry results already 1st year including COVID-19 mitigation, incorporated into JP govt. policy

Access/use by non-Japanese organizations

Fugaku is open for use globally for open research. Non-Japanese researchers can apply equally as long as the usage is for peaceful purposes (industrial use is restricted to companies who has a major Japanese affiliation).

Users from Europe (and around)

Various research collaborations using Fugaku with top EU institutions ongoing and/or discussed
CEA, Juelich SC, BSC, CSC, CSCS, ECMWF, ...
Also US DoE, Singapore A*STAR/NSCC, ThaiSC...

Useful links

<https://www.r-ccs.riken.jp/en/> (Riken R-CCS)
https://www.hpci-office.jp/pages/e_about_hpci (HPCI Japan, including application for Fugaku usage)



Research and development for the world-leading photon facilities

SACLA

SPring-8



Specifications

SPring-8: A 3rd generation synchrotron radiation facility. 8 GeV electron energy and 100 mA ring current. 57 beamlines in operation.

SACLA: An X-ray Free-Electron Laser with 8 GeV Linac. Delivering coherent X-ray beam with 1-20 keV energy.

Peak performances

SPring-8: Extraordinary uniformity of the X-ray intensity within 0.03% during top-up operation.

SACLA: < 5fs pulse width, maximum 60 Hz repetition

Major achievements

Structural and functional analysis of PhotoSystem-II (PS-II) protein

Helped Fuel Cell Development for TOYOTA MIRAI

Access/use by non-Japanese organizations

SPring-8 and SACLA are fully open facilities for international users.

Visit <https://user.spring8.or.jp/> for beam time application.

Users from Europe (and around)

We have many European users particularly for SACLA, because many countries own synchrotron radiation facilities but do not have XFEL facilities. Some European users use HAXPES station at SPring-8.

Useful links

<https://user.spring8.or.jp/>

<http://www.spring8.or.jp/>

<http://rsc.riken.jp/>

<http://xfel.riken.jp/>



Fugaku

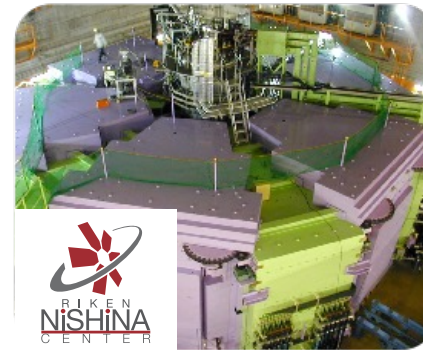
One of the fastest and most powerful supercomputer in the world

Spring-8

Third-generation large-scale synchrotron radiation

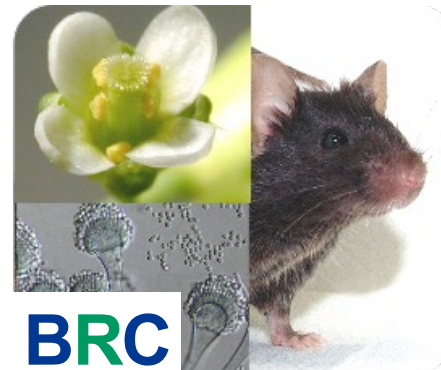
SACLA

X-ray free electron-laser (XFEL) facilities



RIBF

The Radioisotope Beam Factory houses the SRC - the world's largest superconducting ring cyclotron



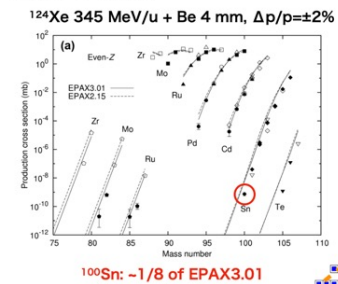
Bioresource Research Center

One of the world's largest resources for mice, plants, cells, genes, and microbes

Unraveling the mysteries of the origin of matter

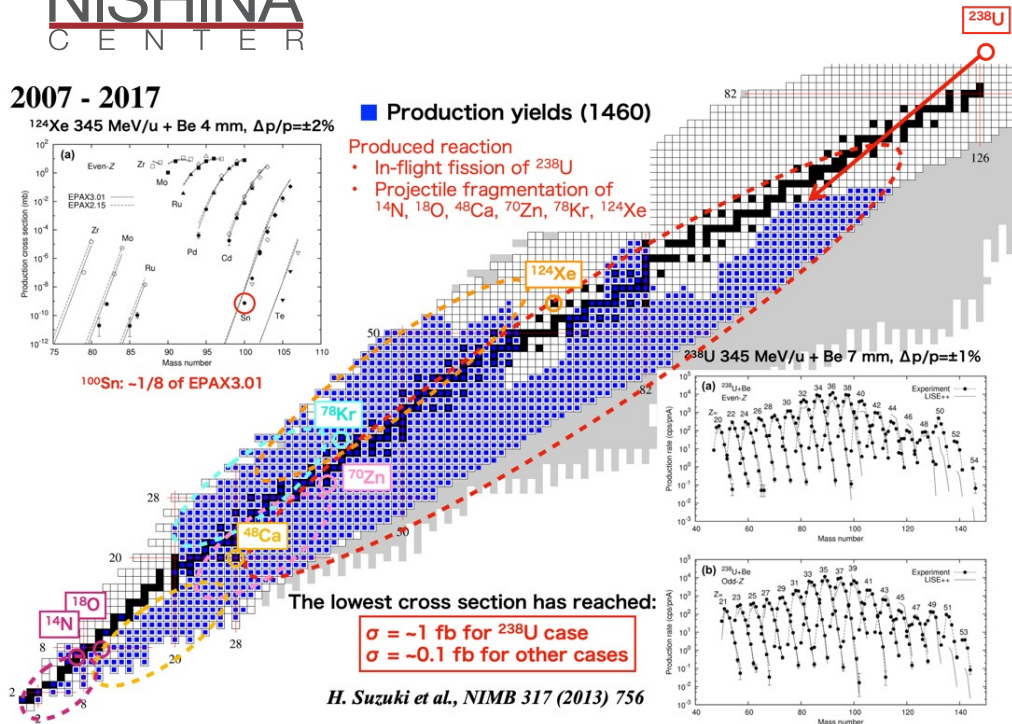


2007 - 2017



■ Production yields (1460)

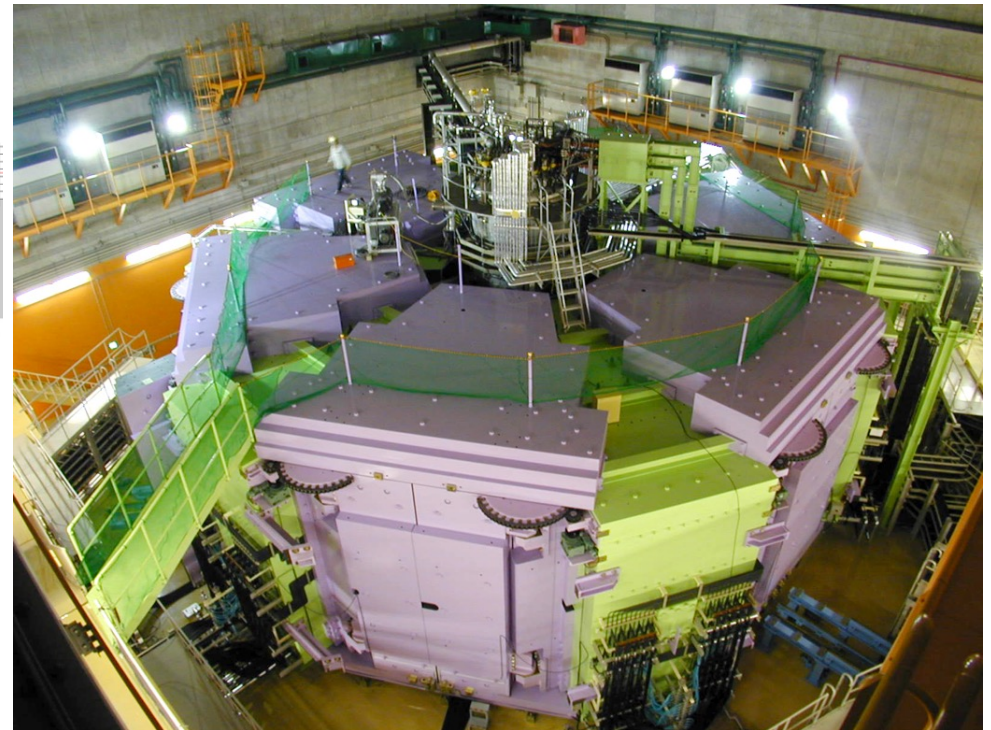
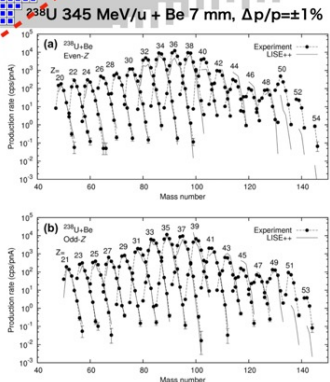
- Produced reaction
- In-flight fission of ^{238}U
- Projectile fragmentation of ^{14}N , ^{18}O , ^{48}Ca , ^{70}Zn , ^{78}Kr , ^{124}Xe



The lowest cross section has reached:

- $\sigma = -1 \text{ fb}$ for ^{238}U case
- $\sigma = -0.1 \text{ fb}$ for other cases

H. Suzuki et al., NIMB 317 (2013) 756





**Discovery of element 113
nihonium (Nh)**

Press conference after IUPAC
officially announced the name
the symbol for element 113



Specifications

One of the leading heavy-ion accelerator facilities in the world: several MeV/u to 345 MeV/u for H to U

Fast radioactive isotope beams via in-flight method

Peak performances

8kW Uranium beam from SRC

Major achievements

The naming right for the Element 113th

The top record of At-211 (for medical use) production in Japan

The highest energy of cyclotron beams since 2007
The highest intensity of fast RI beams since 2007

Access/use by non-Japanese organizations

Use for Nuclear Physics

- ✓ no country borders or no discriminations
- ✓ experimental proposals approved by program advisory committee
- ✓ an associate member of NuPECC
- ✓ an associate member of the “EURO-LABS” project

Material- and Life-Science Use

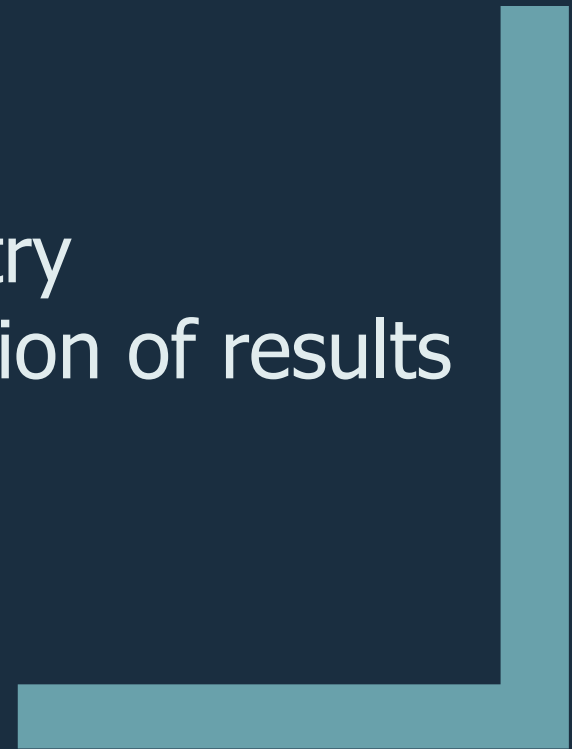
Industrial Use(so far domestic use only)

Useful links

“RIKEN Nishina Center”
https://www.nishina.riken.jp/index_e.html

“Introduction to RIBF and User’s Information”
<https://www.nishina.riken.jp/ribf/>

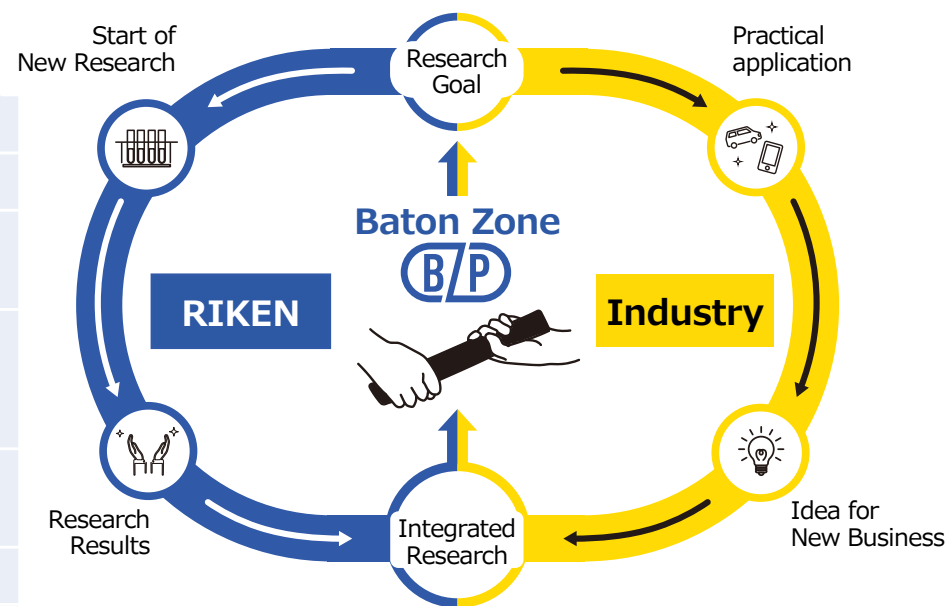
Cooperation with industry
- technology transfer and valorisation of results



Integrated collaborative research with industry (Baton Zone Program)

- Promotion of smooth technology transfer and practical application
- Term-limited collaborative research teams with projects to contribute to SDGs, industrial developments etc.

Teams	Partners
Hydrogen Energy Storage Technology Laboratory	ATSUMITEC Co., Ltd.
Microalgae Production Control Technology Laboratory	Euglena Co.,Ltd.
Mid-Infrared Laser Source Laboratory	Oxide Corp.
Vaccine Innovation Laboratory	Animal Allergy Clinical Laboratories, Inc.
Bio-monomer Production Laboratory	Zeon Corporation/ The Yokohama Rubber Co., Ltd.
Satellite Orbital State Control Laser Laboratory	SKY Perfect JSAT Corporation
Virus Inactivation LED Laboratory	Farmroid CO.,Ltd
Cell and Gene Therapy in Ophthalmology Laboratory	Vision Care Inc.



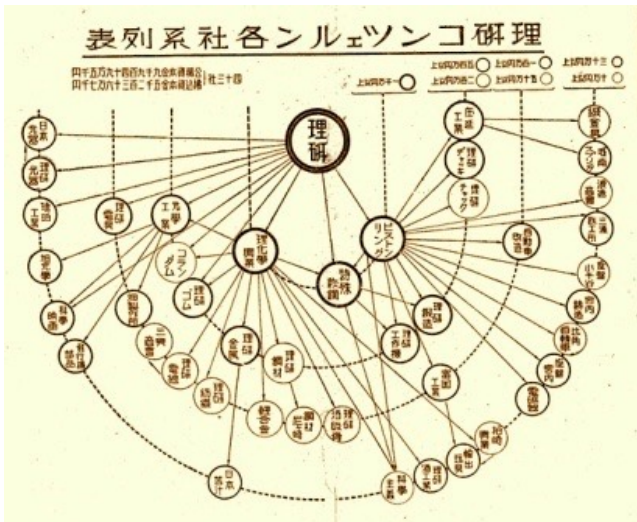
Collaboration Centers work on mid- and long-term challenges incorporating proposals from companies to create new research fields and products/services.

Center	Year of establishment
RIKEN BSI-Olympus Collaboration Center	2007
RIKEN CBS-Toyota Collaboration Center	2007
RIKEN RSC-Rigaku Collaboration Center	2010
RIKEN -JEOL Collaboration Center	2014
RIKEN BSI-KAO Collaboration Center	2016
RIKEN BDR-Otsuka Pharmaceutical Collaboration Center	2016
RIKEN-DAIKIN Wellness Life Collaboration Project	2017
RIKEN RQC-FUJITSU Collaboration Center	2021



Companies originated from the RIKEN Konzern

Ricoh Co., Ltd., Riken Vitamin Co., Ltd.,
 KAKEN Pharmaceutical Co., Ltd.,
 RIKEN Food Co., Ltd., RIKEN Perfumery Co.,
 Riken Electric Wire Co., Ltd., Riken Corp.,
 RIKEN Technos Corp., RIKEN Keiki Co., Ltd.



Commercial products based on RIKEN's research



(Suntory Flowers Ltd./JFC Ishii Farm)

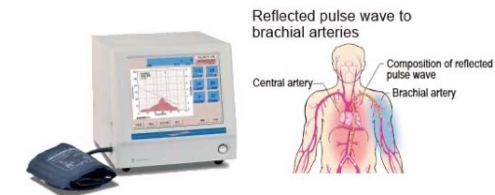
Heavy-ion treatment for garden plant breed improvement and yeast development



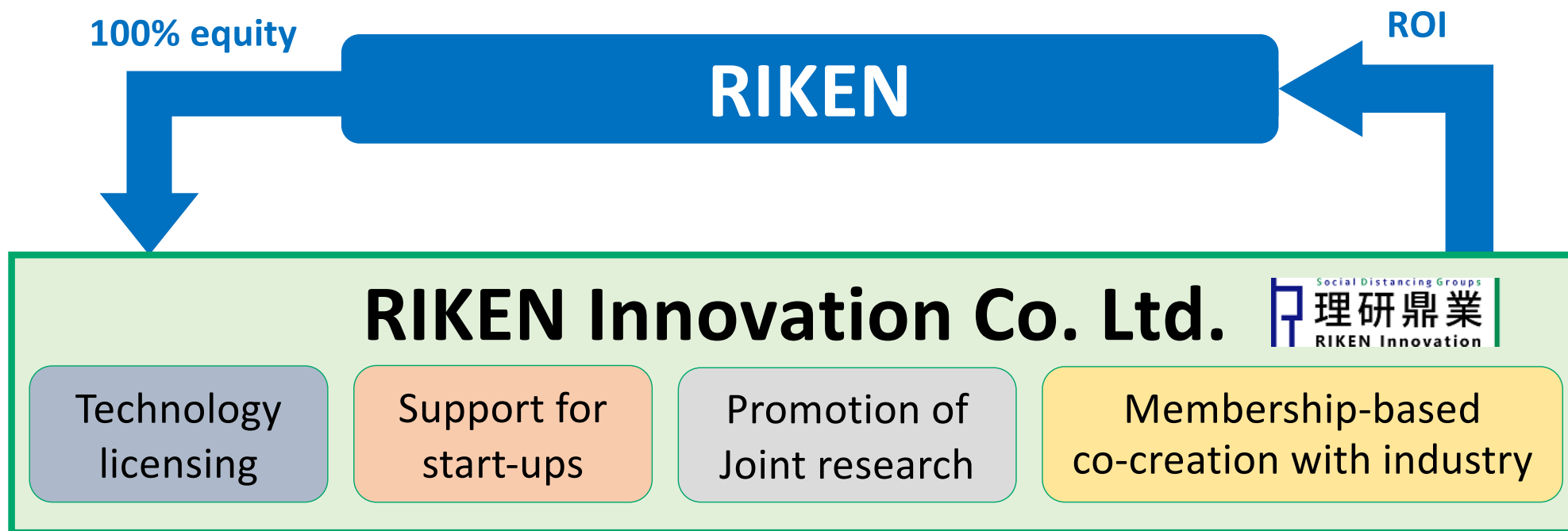
ELID honing technology
 Electrolytic In-process Dressing
 (Fuji Heavy Industries Ltd.)



『Attack』 『New beads』
 Alkaline cellulase laundry detergent
 (Kao Corporation)



PASESA
Blood Pressure Monitor
 (Shisei Datum Co.,Ltd.)



RIKEN Innovation connects you to and keeps you connected with RIKEN and its vast scientific resources.

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19th Floor, COREDO Nihonbashi, 1-4-1 Nihonbashi, Chuo-ku, Tokyo 103-0027 Japan

- Contribution to RIKEN's research capacity
- Higher visibility in Europe and around
- Access to European programmes, increased collaboration partners
- Acceleration of brain circulation
- Contribution to tackling global challenges

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**RIKEN Session “Sociability in Human-Robot Interactions”
@EJEA Annual Conference (Online, 24-25 November 2022)**

EJEA – European Japan Experts Association



Home

EUROPEAN JAPAN EXPERTS ASSOCIATION (EJEA)

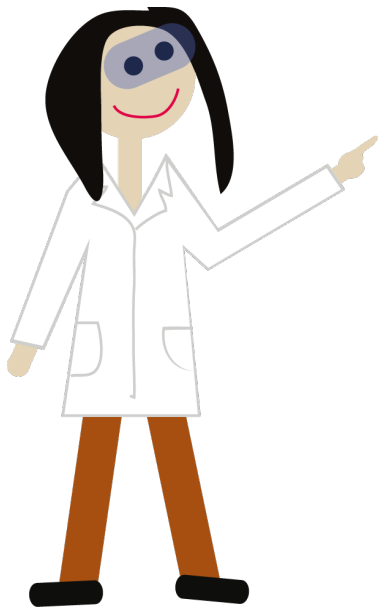
www.ejea.eu

 Search

News

- Notification: EJEA Conference 2022 is changed into online style
12 June 2022

RIKEN fosters talented young scientists and strengthens ties between RIKEN and other institutions



Interns & Student Trainees

RIKEN hosts Bachelor/Master's course students:

Special Postdoctoral Researchers (SPDR)

Fostering autonomous postdoctoral researchers

International Program Associate (IPA)

for non-Japanese PhD students

Junior Research Associate (JRA)

for Japanese PhD students

RIKEN Early Career Leaders Program (RIKEN ECL Program)

Fostering and training young PIs