Future operation plan of RIBF in RIKEN

August 30th, 2017

Shigeo Koyasu, Executive Director

Celebrating the naming of the new element nihonium

March 31, 2017

A ceremony to commemorate the naming of element 113 as “nihonium” was held at the Japan Academy in Tokyo on March 14, 2017, with His Imperial Highness the Crown Prince in attendance.

Natalia Tarasova, President of the International Union of Pure and Applied Chemistry (IUPAC), then formally declared nihonium as the name of element 113.

Drs. Morita and Oganessian

RIBF2 --RIBF Upgrade Plan

- The RIBF upgrade (RIBF2) was proposed to the large scale project plan of the Science Council Japan, as the collaboration of Nishina Center, Osaka University (RCNP), KEK and The University of Tokyo (CNS) .

  The project has been optimized and cost reduced to 70%.

  Two pillars
  - ➢ Expand neutron-rich heavy element productions to transuranium region.
  - ➢ Production of superheavy elements 119 and beyond.

- Nishina Center hopes to complete the construction by 2023-24, and start experiments from2025.

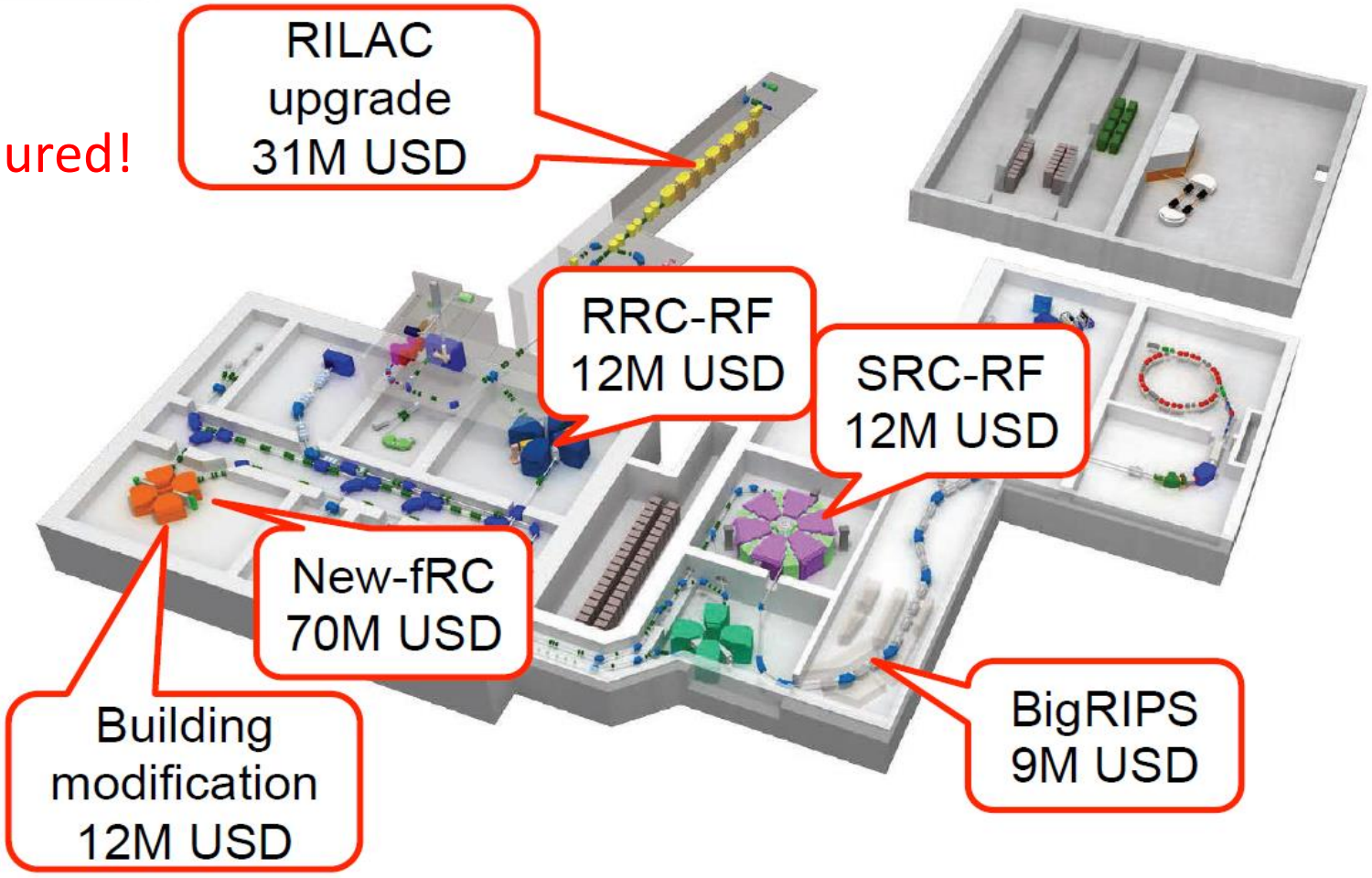
⇨ Then Nishina Center will be able to maintain the competitive edge of RIBF as the world leading.

World Race of RI facilities

Type	Facility	Beam		Target(ISOL) or Beam current(PF)		(Post) acceleration		Start
		Beam	Beam Power (kw)	Direct/ Conv/ PF	Fissions/s Beam pnA	MeV/A	^{132}Sn/s	
PF running	RIBF 2015	U86+	5	PF	58 pnA	345	$3*10^{6}$	running
PF upgrade	RIBF2	U86+	160	PF	2000pnA	345	$2*10^{8}$	plan
PF Const-ructing	FRIB	U76~80+	400	PF	8000 pnA	200	10^{8}~10^{9}	2020
	RISP	U77~81+	400	PF	8000 pnA	200	10^{8}~10^{9}	2019
	FAIR	U28+ 1500MeV	10	PF	30 pnA	1500	10^{7}~10^{8}	2018
ISOL Const-ructing	ARIEL	e 50MeV 10000mA p 500MeV 100mA	~100	Direct	$1*10^{14}$	5-11	$2*10^{9}$	2015
	HIE ISOLDE	p 1GeV 2mA	2	D&C	$4*10^{12}$	5-10	$2*10^{8}$	2015
	SPIRAL2	d 40MeV 5000mA	200	Conv	$1*10^{14}$	3-10	$2*10^{9}$	2014 2020?
	SPES	p 40MeV 200mA	8	Direct	$1*10^{13}$	10	$3*10^{8}$	2016
Super ISOL Planning	EUR ISOL	p 1GeV 5000 mA	4M	D&C	$1*10^{15}$	20-150	$4*10^{11}$	?
	CARIF	Reactor	6M	reactor	$2*10^{15}$	>100	$5*10^{10}$	?

RIBF Upgrade Plan

Secured!



Project requires 146M$ in total.

Intensity will be 5x RILAC, 30x RRC, 30x SRC.

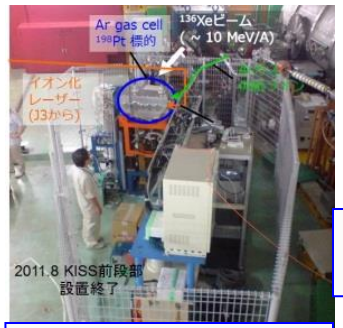
RIBF facility and International Collaboration

World best performance of RIBF and unique experimental facilities invites many users, with significant investments on their own facility at RIBF.

RIKEN fund

User Institution Fund

Major Collaborators



KEK Isotope Separation System

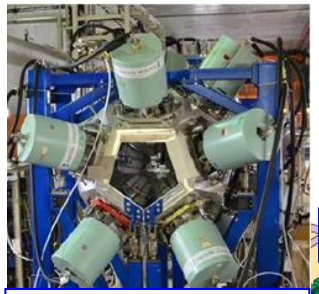
KEK

Charge State Multiplier U-Tokyo

14GHz ECR Ion Source U-Tokyo

Gamma ray spectrometer (GRAPE) U-Tokyo

Osaka, Tokyo, Michigan, LBLN, GANIL, GSI, Orsay



Euro-ball (EURICA project)

EURICA (16 countries 51 institutions from Europe)

RI・electron scattering Facility(SCRIT)

SCRIT detector Tohoku

Tohoku, Rikkyo

Multi Particle Spectrometer (SAMURAI)

Tohoku, TITech, Kyoto, GANIL, Michigan, Durmshtad, Orsay

Zero-degree spectrometer

Return BT (beam from IRC)

2M$

150 institutions For HI breading

Slow RI producer (Gas catcher)

4M$

KEK、Tohoku, Niigata, Tsukuba, Nagoya

High resolution Spectrometer (SHARAQ)

Tokyo, Kyoto, Michigan, GANIL, Osaka

50 m

13M$

Rare RI Ring

Tsukuba, Saitama, Nagaoka, IMP(China)

Particle Analyzers U-Tokyo

Compact RI beam separator (CRIB) U-Tokyo

Accelerator 397M$ Experimental Facility

RIKEN 54M$

External fund 45M$

RIKEN's research system

Cluster for Industry Partnerships Industry-academia-government partnerships

Innovation Center

Cluster for Science and Technology Hub Hub for science and technology innovation

Program for Drug Discovery and Medical Technology Platforms

Preventive Medicine and Diagnosis Innovation Program

Compass to Healthy Life Research Complex Program

Medical Sciences Innovation Hub Program

Research Infrastructure Centers
Top-level research infrastructure

- BioResource Center
- Center for Life Science Technologies
- Advanced Institute for Computational Science
- SPring-8 Center
- **Nishina Center for Accelerator-Based Science**

Strategic Research Centers
Strategic and focused research on social needs

- Center for Emergent Matter Science
- Center for Advanced Photonics
- Center for Sustainable Resource Science
- Quantitative Biology Center
- Center for Developmental Biology
- Brain Science Institute
- Center for Integrative Medical Sciences
- Center for Advanced Intelligence project

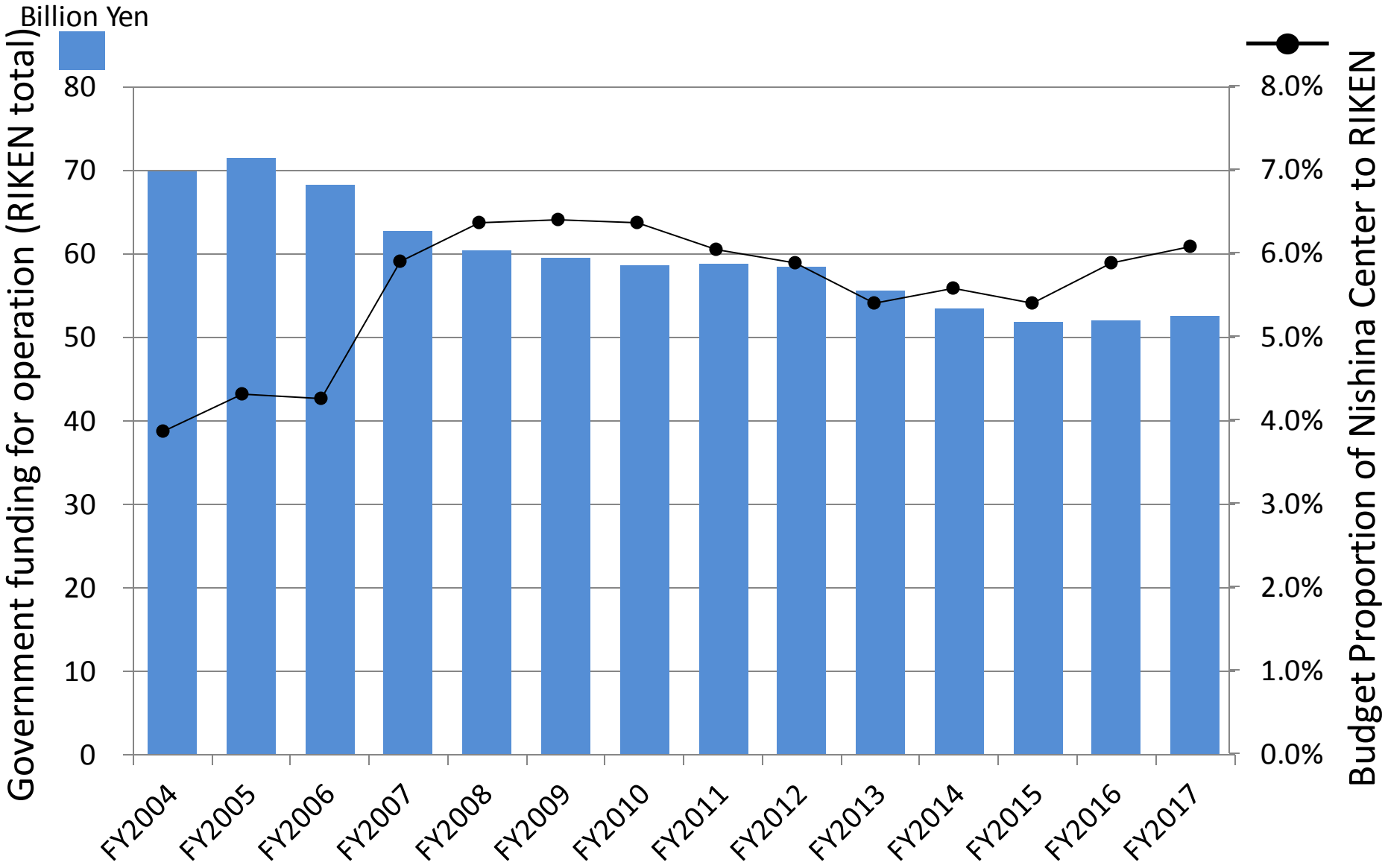
RIKEN's comprehensive strength

Chief Scientist Laboratories

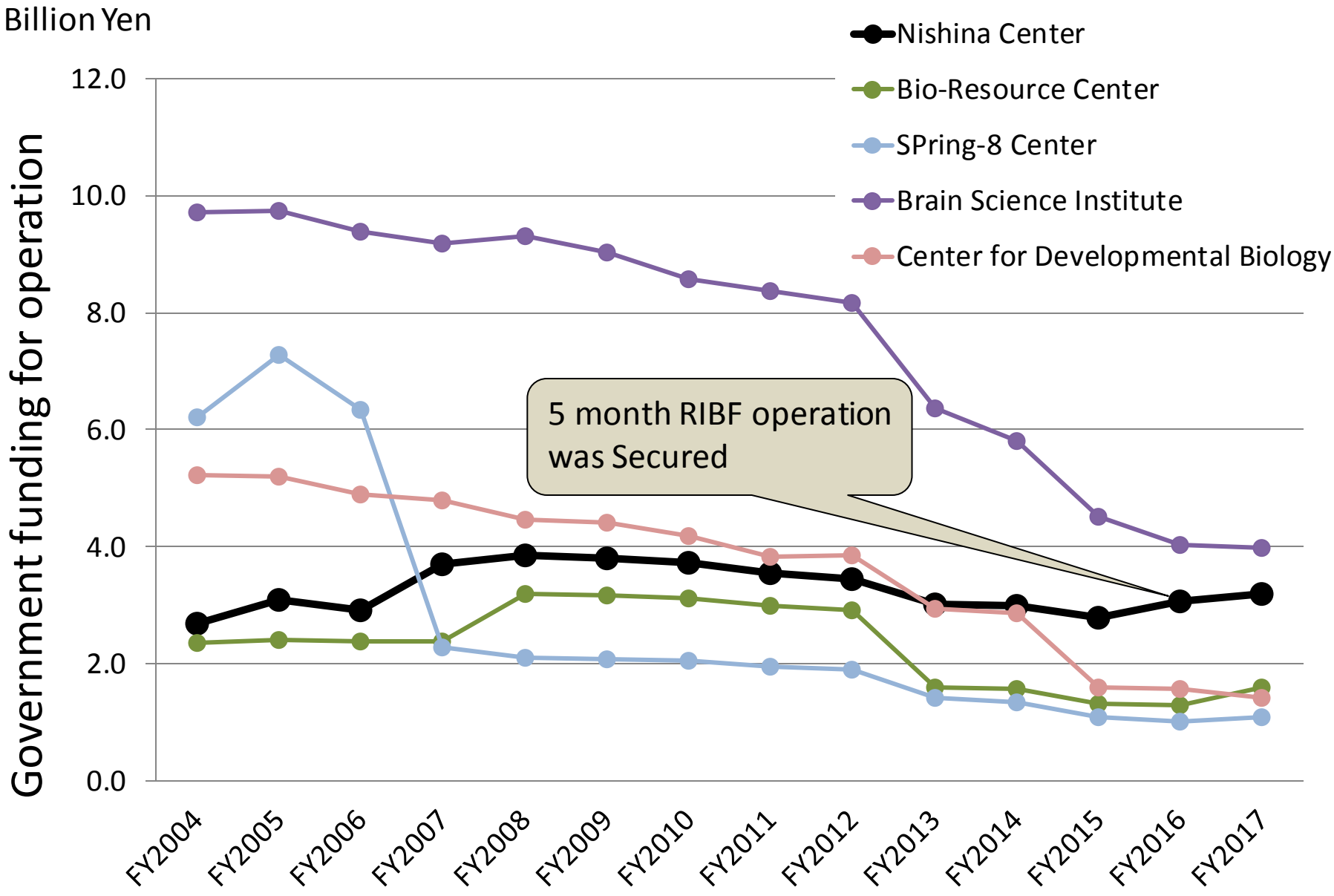
Leading-edge Interdisciplinary research

Interdisciplinary Theoretical and Mathematical Science Program

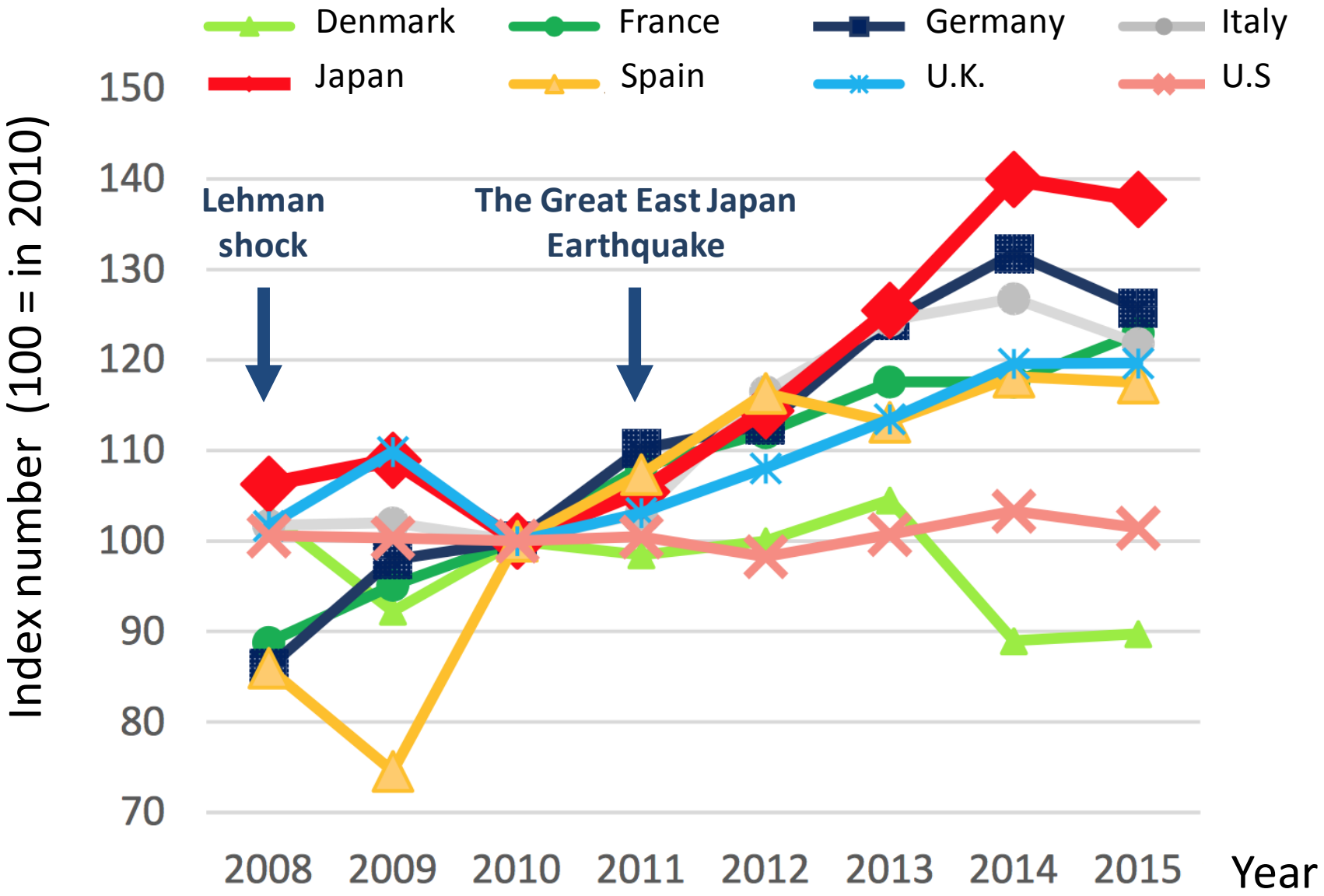
Trend of Budget Proportion of Nishina Center to RIKEN



Trend of Budget for RIKEN center



Trend of Electricity Prices for Industrial Consumers



Budget situation

- In the FY2016 budget, **5month operation** (including external fund for nuclear transmutation) was secured. This was an increase in the Nishina Center's budget by approximately 10%,

- The gap between the approved operating budget and the working budget, caused by a steep rise in electricity cost in Japan since the Great East-Japan Earthquake has been solved. (Still the electricity price is higher than most countries.)

- Nishina Center will continue to opt for longer hours of RIBF operation which very much requires additional funds.

⇨ RIKEN has been urging Nishina Center to obtain financial resources from external sources or users.

RIBF operation and budget

Nishina Advisory Committee （NCAC2013 recommended 8 month operation.）

<u>Understands that the request for additional operation hours at RIBF requires external new sources.</u> However, the successful policy of in-kind contributions should be continued. The facility should continue to adhere to the open access rules for academic research.

- ✓ The possibility of users to bear the electricity cost which is higher than most countries.
- ✓ Internationally acceptable framework in introducing collaboration fee.

As for how the collaboration fee should be collected, RIBF may follow suit of CERN-ISOLDE, i.e., collect annual fee from countries or institutions having a long-term commitment.

Collaboration Fee plan for RIBF users

How the common funds can be collected at RIBF, how they are actually being collected by other facilities.

	ISOLDE	ALICE	BELLE2	**RIBF(plan)**
Total Amount	0.8M$	6M$	1M$ (1/2 is covered by KEK)	**1M$**
Target	Collaborations (scaled by #nations)	PhD researchers	PhD researchers	**PhD researchers**
#Target	16	600	300~350	**200**
Price/ Target	10k$ to 60k$	10k$	3k$	**5k$**
Usage	Maintenance for the experiments (Technical staff, student support, 1/3 of HIE upgrade)	Running cost for the experiment (office power, secretary, materials, engineers)	Running cost for the experiment (electricity, secretary, gas, DAQ, meeting)	**Cost to operate equipment after BigRIPS (Technicians, gas, electricity, expendables)**
Memo	Trials are free			

No facility asks the cost of accelerator operation.
RIBF also would not do so.

Nishina Center's Plan and Voices so far

Of the entire external funds, the amount collected through **collaboration fee** would be in the range of **1million $ at maximum (only), the equivalent of 0.5~1.0 month of operation**.

- Not big compared to the in-kind contributions so far.
- To achieve 8 month operation, another option needed.
- First come (fee??), first served???? (currently waiting time is typically 2 years)!

VOICES

- Do not correct fee in the year when the beam is not delivered.
- In-kind contributions should substitute such fund.

Operation of the Specific Advanced Large Research Facilities

Act on the Promotion of Public Utilization of the Specific Advanced Large Research Facilities

SPring-8 The world's largest third-generation synchrotron radiation facility

X-ray Free Electron Laser SACLA

Specified Synchrotron Radiation Facilities

(i) Construct, maintain and manage the Shared Facilities for Synchrotron Radiation, and make the same available for shared use by the Researchers, etc.

(ii) Establish the Dedicated Facilities for Synchrotron Radiation and provide the persons engaged in the Researches, etc. utilizing such facilities with the Synchrotron Radiation and other convenience necessary for such Researches, etc.

(iii) Perform business incidental to the business set forth in the preceding two items.

HPCI High Performance Computing Infrastructure

Specified High-speed Computer Facilities

(i) Develop the Ultra High-speed Computers, construct, maintain and manage the Specified High-speed Computer Facilities and make the same available for shared use by the Researchers, etc.

(ii) Perform business incidental to the business set forth in the preceding item.

SPring-8 The world's largest third-generation synchrotron radiation facility

Research Type	Type of Proposal		Beamtime Fee*	Program Fee*	User Fees*
Proprietary	General Proposal		480,000 yen/shift, 60,000yen/hour	none	Fixed Fee: 10,560 yen/shift, 1,320 yen/hour — Variable Fee: calculated based on the amount actually used — Project leaders affiliated with organizations outside Japan are exempt from paying the fees.
	Time-Designated Proposal / SPring-8 Measurement Service		720,000 yen/shift, 90,000yen/hour (regular fee + 50% premium)		
Non-Proprietary	General Proposal		Users are exempt from paying the fee.	none	
	Long-term Proposal				
	Budding Researchers Support Proposal				
	Urgent Proposal				
	Non-Proprietary Grant-Aided Proposal			131,000 yen/shift, 16,375 yen/hour	
	Priority Research	New Industrial Proposal [from 2014A]		none	
		Social Interest Proposal [from 2015A]			
		Partner UserProposal [from 2014A]			
	Epoch-Making Initiatives Proposal [from 2015B]				

User Fee System

Public beamline users are required to pay the fees to cover the costs of beamline maintenance / operation and consumables actually used (user fees). User fees are composed of a fixed fee charged for wear and tear on the facility and a variable fee charged for coolants, gases, and the stockroom reagents, parts, and stationeries.

Fixed fee: 15,840 yen/shift*, 1,320yen/hour*

*Incl.tax

Variable Fee: calculated based on the amount actually used

Stockroom Price List

Safety Data Sheet (SDS): Acetone, Ethanol

[Important Notes]

JASRI will cover the user fees for the non-proprietary research submitted by foreign users within the limit of the budget. Please note that the variable fee is not always covered when it exceeds the limit of the budget.

Our Scenario for longer beam time

It will be difficult to secure the RIBF longer beam time.

RIKEN requests the Nishina Center to obtain extra financial resources. Thus Nishina Center has sought and will seek for external funds, such as competitive funds from various agency including ImPACT (Impulsing Paradigm Change through Disruptive Technologies) fund for Nuclear Transmutation at the present.

RIKEN would like to ask the users to bear the cost (collaboration fee) , not for the electricity, but for the miscellaneous cost for the common fund for experiments.

The total cost to the user would be in the order of 0.5 to 1M$, which is equivalent to one month run of RIBF.