Three-Way Meeting

(User Services Workshop)

SPring-8 Facility Overview

Hideo OHNO

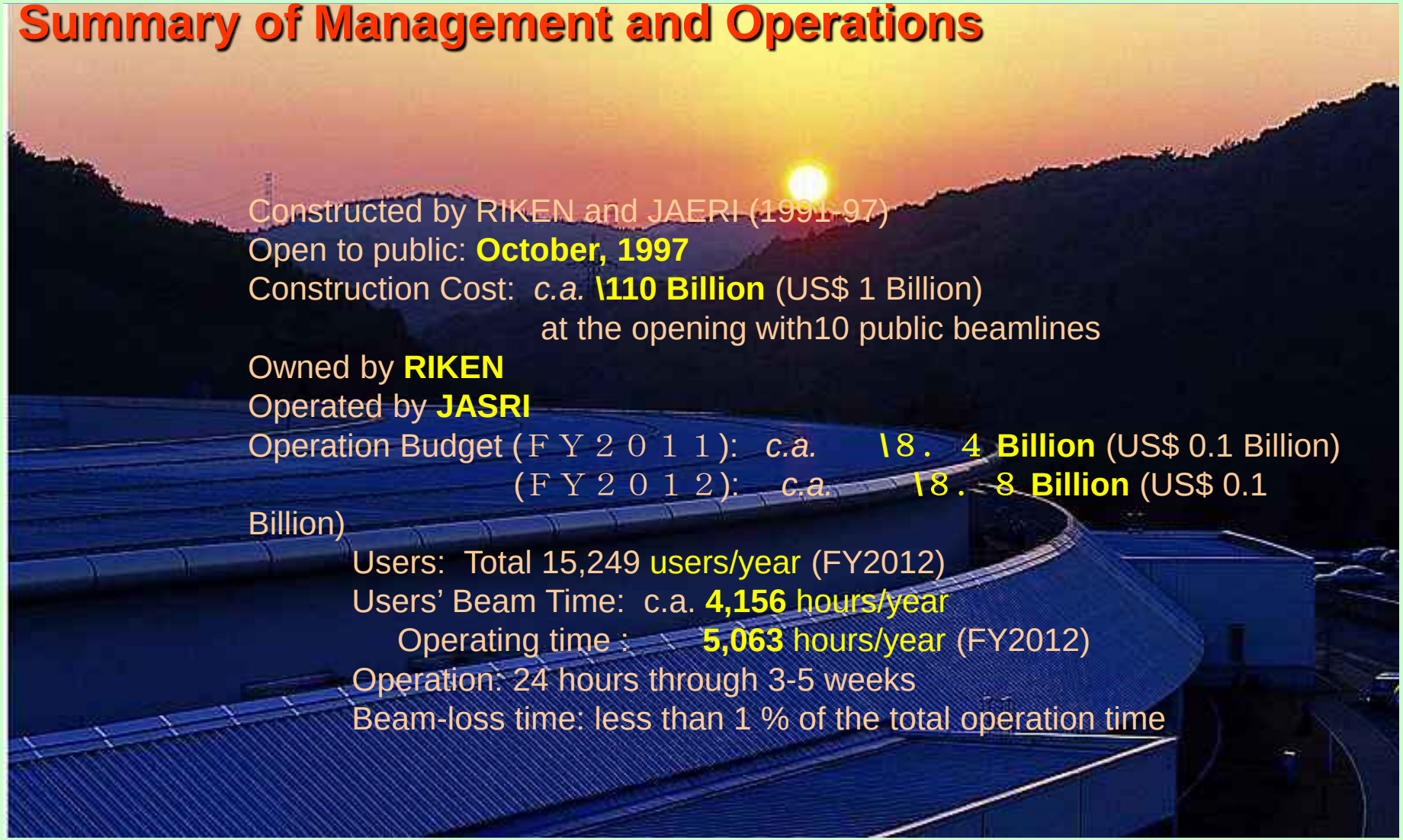
July 31 , 2013

JASRI / SPring8

Outline (by Susan-san)

- **Facility Overview**
  - Key information/dates: groundbreaking, first light, first user access,
  - Statistics: user community growth, growth in number of experiments, growth in requests for beam time vs. time available (oversubscription)
  - Number of beamlines (chart or graphic showing growth)
  - Budget, previous and current
  - Future upgrade plans as they affect the user community
  - Overview of process for user registration, beamtime requests, review, allocation, safety process, end of experiment closeout
- **Industrial User Program and Proprietary Process/Pricing**
- **User Office: Function and Staffing**
- **User Community (user organizations, workshops, meetings, etc.)**
- **Publications (history, how to collect)**
- **Education and Outreach (schools, seminars, tours, educational programs)**

Summary of Management and Operations



Constructed by RIKEN and JAERI (1991-97)
Open to public: **October, 1997**
Construction Cost: *c.a.* **\110 Billion** (US$ 1 Billion)
at the opening with10 public beamlines
Owned by **RIKEN**
Operated by **JASRI**
Operation Budget (ＦＹ２０１１): *c.a.* **\８．４ Billion** (US$ 0.1 Billion)
(ＦＹ２０１２): *c.a.* **\８．８ Billion** (US$ 0.1 Billion)

Users: Total 15,249 users/year (FY2012)
Users' Beam Time: c.a. **4,156** hours/year
Operating time : **5,063** hours/year (FY2012)
Operation: 24 hours through 3-5 weeks
Beam-loss time: less than 1 % of the total operation time


SPring-8
(1997～)
XFEL　Facility
（SACLA）
（2011～）
XFEL・SPring-8
Experimental Facility
SR
XFEL

Major Milestones（1/2）

Oct. 1988: **JAERI-RIKEN SPring-8 Project Team formed**.

Jun. 1989: Harima Science Garden City chosen as the construction site.

Dec. 1990: **JASRI founded**.

Nov. 1991: **Start of SPring-8 construction**.

Oct. 1994: The Law for the Promotion of Public Utilization of the Specific Synchrotron Radiation Facility (the Law) enforced. **JASRI designated as the Organization for Promoting Synchrotron Radiation Research.**

Mar. 1997: **First synchrotron radiation beam.**

Oct. 1997: **Start of SPring-8 user operation**.

Oct. 1999: Start of proprietary research (diversification of user program).

Mar. 2000: **SPring-8 Advisory Council (SAC).**

Apr. 2000: Start of user support by coordinators.

Sep. 2002: **The 1st Interim Review of SPring-8 Project by MEXT**

Apr. 2003: Start of priority proposal program.

Oct. 2003: RIKEN reorganized as an Independent Administrative Institution.

May 2004: Start of top-up operation.

Aug. 2004: Damage caused to storage ring roof due to typhoons.

Oct. 2005: **JAERI consolidated into JAEA (withdrawal from SPring-8 operation and management).**

Major Milestones（2/2）

Jul. 2006: **The Law revised** and renamed as Act on the Promotion of Public Utilization of the Specific Advanced Large Research Facilities .
The Organization for Promoting Synchrotron Radiation Research dissolved.

Jul. 2006: **The JASRI International Advisory Council (JIAC).**

Mar. 2007 **JASRI selected as the Registered Institution for Facilities (SPring-8) Use Promotion.**

Apr. 2007: SPring-8 operation and management assigned to JASRI by RIKEN through competitive bidding.

Jul. 2007: **The 2nd Interim Review of SPring-8 Project by MEXT.**

Oct. 2007: Ceremony held to commemorate the 10th anniversary of SPring-8 user operation.

Nov. 2008: **The SPring-8 Academic Review Committee (SPARC).**

Jun. 2009: The number of total user visits to SPring-8 reaches 100,000.

Nov. 2009: **Budget project review by the Government Revitalization Unit**.

Mar. 2011: **JASRI selected as the Registered Institution for Facilities (SPring-8 and SACLA) Use Promotion.**

Mar. 2011: **Great East Japan Earthquake. (→ Support for Disaster-Affected Quantum Beam Research Facilities)**

Mar. 2012: **Start of SACLA User Operation**

※ ***The 3rd Interim Review of SPring-8 Project by MEXT is now in progress.***

Research Complex

Research Complex

Research Facility	Operation and Management
SPring-8	
Accelerator Complex	RIKEN/JASRI
Public Beamlines	RIKEN/JASRI
RIKEN Beamlines and other RIKEN facilities	RIKEN Harima Institute
Contract Beamlines	Each Contractor
SACLA	RIKEN/JASRI
NewSUBARU	Laboratory of Advanced Science and Technology for Industry, University of Hyogo

Research Complex . . . . . cont'd

SPring-8 www.spring8.or.jp

Research Facility	Operation and Management

Contract Beamlines

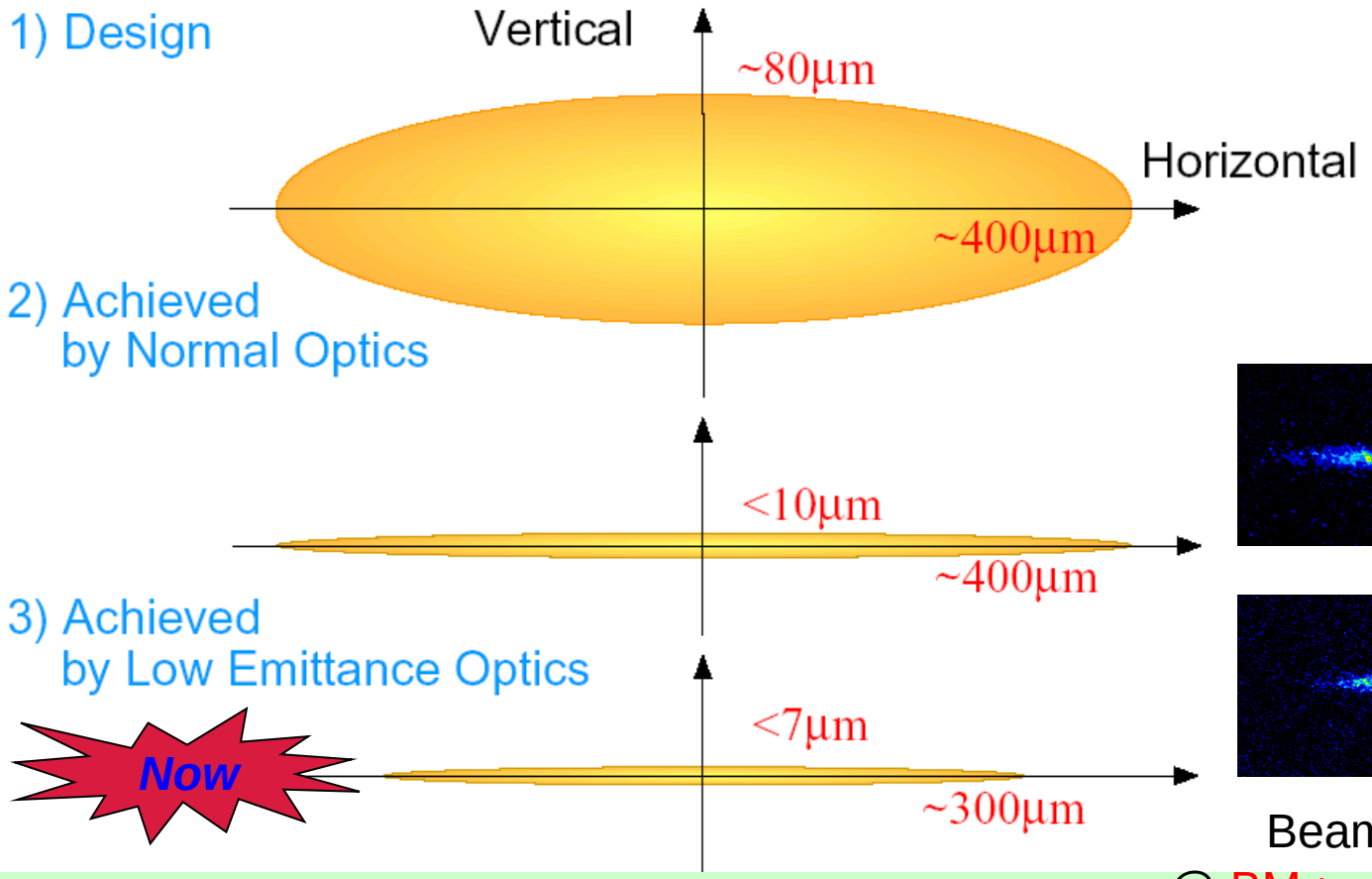
Advanced Softmaterial (BL03XU)	Advanced Softmaterial Beamline Consortium
University-of-Tokyo Synchr. Rad. Outstation (BL07LXU)	The University of Tokyo
Hyogo BM (BL08B2)	Hyogo Prefecture
Hyogo ID (BL24XU)	
JAEA Quantum Dynamics (BL11XU)	Japan Atomic Energy Agency
JAEA Materials Science (BL14B1)	
JAEA Quantum Structural Science (BL22XU)	
JAEA Actinide Science (BL23SU)	
NSRRC ID (BL12XU)	National Synchrotron Radiation Research Center, Taiwan
NSRRC BM (BL12B2)	
WEBRAM (BL15XU)	National Institute for Materials Science
SUNBEAM ID (BL16XU)	Industrial Consortium
SUNBEAM BM (BL16B2)	
RISING (BL28XU)	Kyoto University
Laser-Electron Photon II (BL31LEP)	Research Center for Nuclear Physics, Osaka University
Laser-Electron Photon (BL33LEP)	
TOYOTA (BL33XU)	TOYATA Central R&D Labs., Inc.
Catalytic Reaction Dynamics for Fuel Cells (BL36XU)	The University of Electro-Communications
Macromolecular Assemblies (BL44XU)	Institute for Protein Research, Osaka University

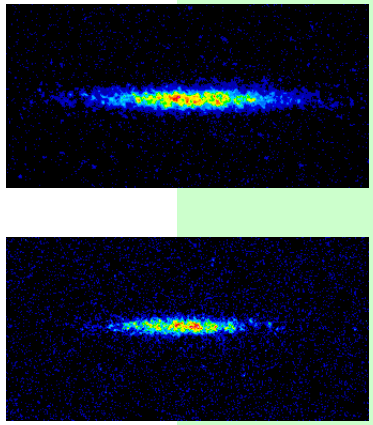
Operation Status of Storage Ring

Electron Beam

The thinner, the brighter, for the same current.

Sectional View of Electron Beam @ ID Center

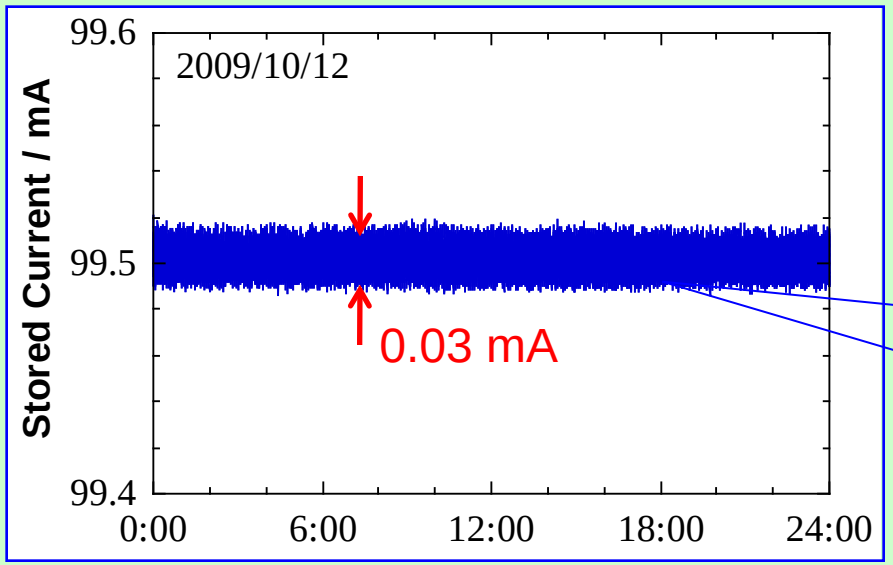




Beam Profile
@ BM (Acc.Diag.BL 38B2)

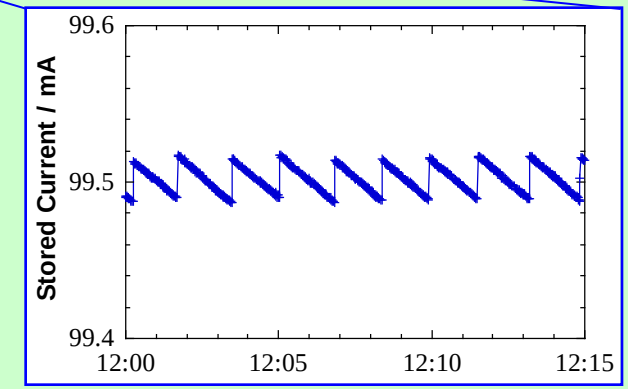
Top-up Operation (since May 2004)

- **Fixed interval (~ Oct. 2007)**
  - **Interval 1 min (several, hybrid) or 5 min (multi-bunch)**
  - **Current stability 0.1 %**
- **Variable interval (Nov. 2007 ~)**
  - **Interval depending on lifetime 20 sec ~ 2 min.**
  - **Current stability 0.03 % (30 μA/one shot)**



Stable Top-up Operation

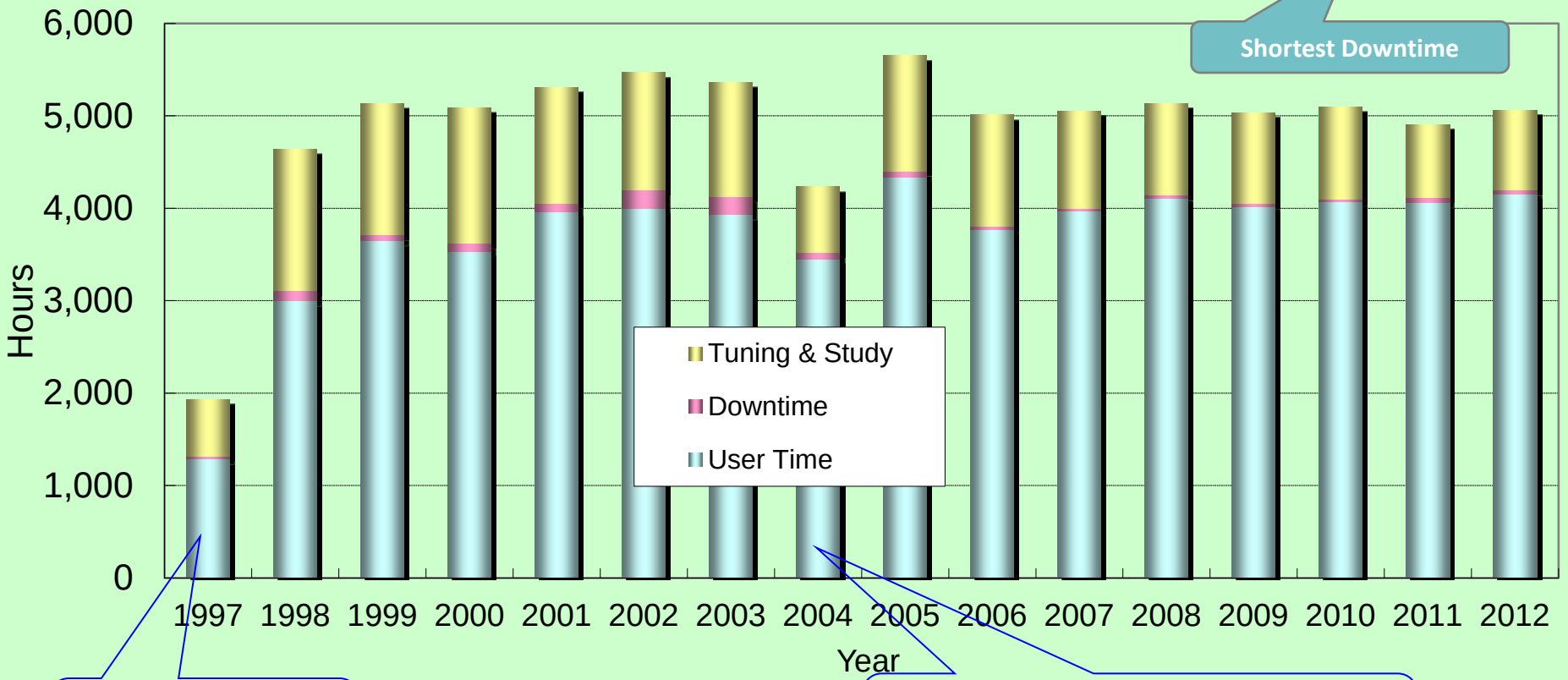
1. Stored Current Variation < 0.03 %
2. Injection Beam Loss < 10 %
3. Stored Beam Oscillation Free



Operation Hours at SPring-8

Annually, about 5,000 hours of operation has been achieved with downtime due to failure kept to a minimum.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Operation Time (hours)	1,932	4,640	5,137	5,090	5,311	5,467	5,363	4,233	5,651	5,012	5,055	5,133	5,035	5,096	4,904	5,063
Machine Study	614	1,527	1,426	1,468	1,254	1,269	1,237	711	1,246	1,204	1,056	991	986	997	789	868
User Time	1,286	2,997	3,648	3,534	3,965	4,001	3,930	3,449	4,338	3,770	3,969	4,111	4,015	4,072	4,059	4,156
Downtime	32	116	63	88	92	197	196	73	67	38	29	31	35	27	57	39

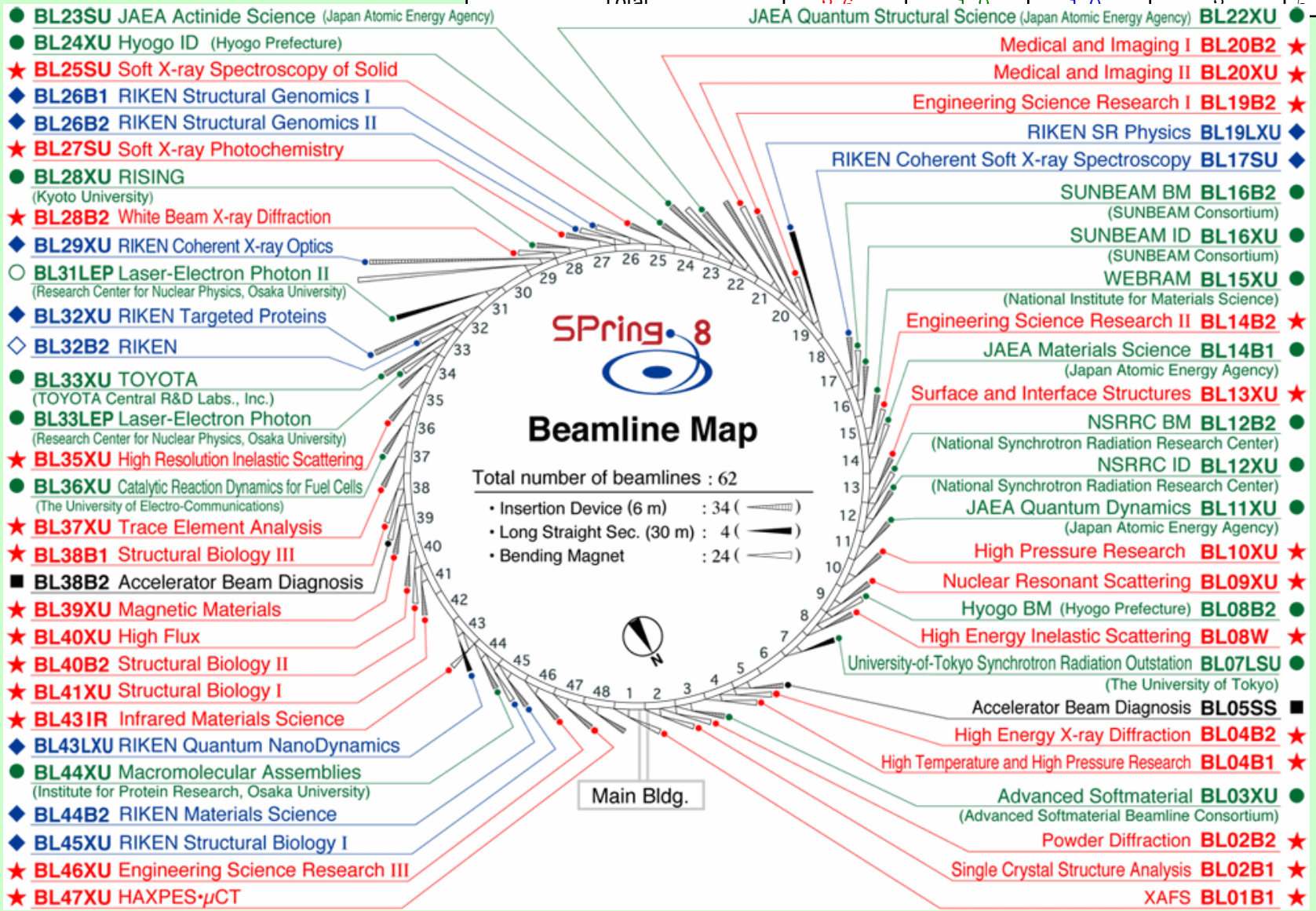


Beamline Map and New Beamlines

Beamlines

(as of January 17, 2013)

Status	Public Beamlines	Contract Beamlines	RIKEN Beamlines	Accelerator Diagnostics Beamlines	Total
Operational	★ 2 6	● 1 8	◆ 9	■ 2	5 5
Planned or Under Construction Construction		○ 1	◇ 1		2 2
Total	2 6	1 9	1 0	2	5 7



SPring-8 Beamlines

SPring-8 www.spring8.or.jp

Newly Operational FY2012

Type	BL Name/Institution
Contract Beamline	● Research & Development Initiative for Scientific Innovation of New Generation Batteries Beamline (RISING) Kyoto University
	● Catalytic Reaction Dynamics for Fuel Cells Beamline The University of Electro-Communications

Under Construction or Commissioning

Type	BL Name/Institution
Contract Beamline	○ Laser-Electron Photon II Beamline Research Center for Nuclear Physics, Osaka University
RIKEN Beamline	◇ BL32B2

Newly Operational FY2012

Type	BL Name/Institution
RIKEN Beamline	◆ RIKEN Quantum NanoDynamics Beamline

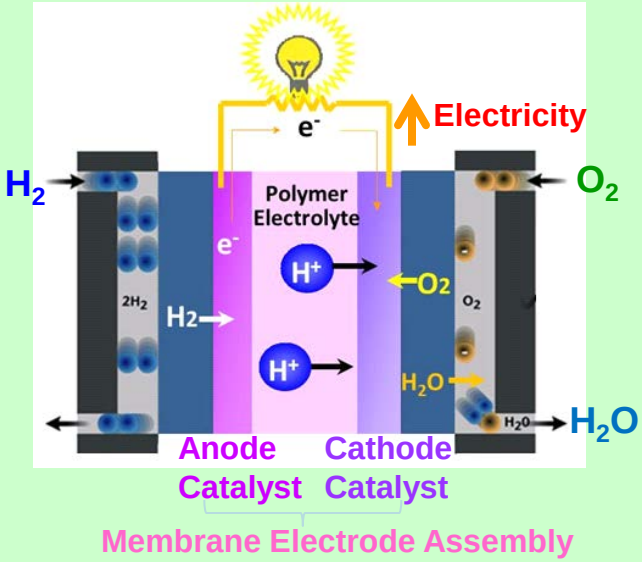
A new XAFS beamline (BL36XU) for catalytic reaction dynamics for fuel cells

- Contract beamline of the Univ. of Electro-Communications (UEC)
  Supported by New Energy and Industrial Technology Development Organization (NEDO), Japan

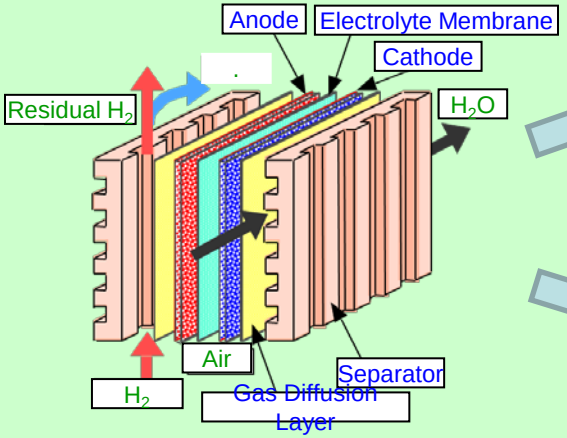
- Target of the project
  Development of catalysts for the next generation polymer electrolyte fuel cells (PEFCs)

- Target of BL36XU
  Clarification of reaction and degradation process of electrode catalysts of PEFCs under real working conditions by time- and spatially resolved XAFS method.

Schematic of PEFC



PEFC stack



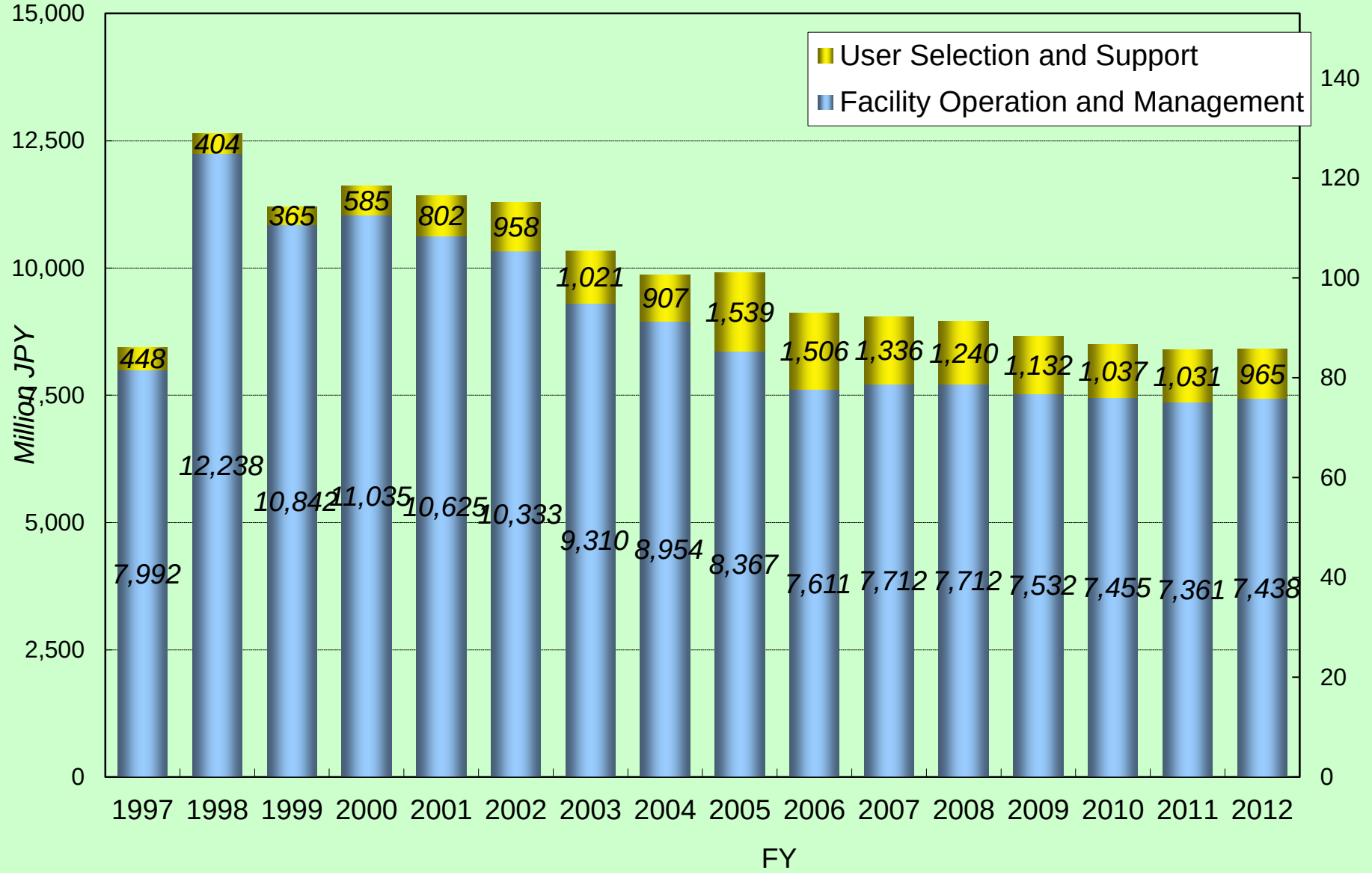
Residential co-generation system

Fuel Cell Vehicles

SPring-8 Annual Operation Cost

SPring-8 Annual Operation Cost (Government Budget)

<Million JPY>



Including Facilities : Accelerator, Public beamlines and Other equipments

Not Including Facilities : RIKEN beamlines and Contract beamlines

Overview of process for user registration and the others at SPring-8 Public BLs

Proposal Procedure at Public Beamlines

Application

Registration
- **User Registration** (all users)

Application
- **Proposal Application** (two calls/year)

Review
- **Review by Proposal Review Committee**
- **Notification of Results** (by e-mail and by post)

Arrival/Experiment

Documents
- **Required Documents** (vary on the type of proposal)
  - **Radiation Worker**
  - **Application Form**
  - **List of Samples**
  - **List of Carry-in**
- **Change of Proposal**
- **Information for Consumables**

Arrival
- **At the SPring-8 Users Office**
  - **Safety Training**
  - **Pickup** (SPring-8 user card/dosimeter with RFID/stockroom card)
  - **Receipt of documents**
- **Check-in at the SPring-8 Guest House** (2,000 yen/night)

Experiment
- **Beamline Inspection Sheet**

After Experiment

Departure
- **Check-out of the SPring-8 Guest House**
- **At the SPring-8 Users Office**
  - **Return** (SPring-8 user card/dosimeter with RFID/Beamline Notes/stockroom card)
  - **Confirmation of Consumables List**
  - **Beamtime Report**
  - **Beamline Inspection Sheet** (Required documents vary depending on the type of proposal.)

Reports
- **SPring-8 Experiment Summary Report*** (within 60 days after the end of the research term)

Publications
- **Publication & Registration of Refereed Journal Article or Equivalent** (within 3 years from the end of the research term)
- **Registration of Other Published Works**

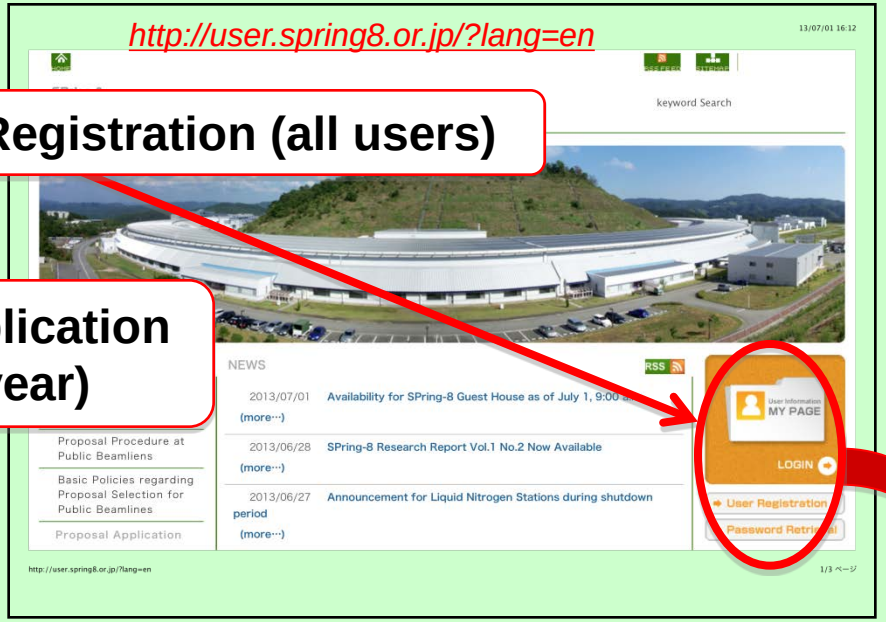
Patents
- **Report of Patent Application Publication**

*Not required if your request to change the research type from non-proprietary to proprietary has been approved.

· **User Registration (all users)**

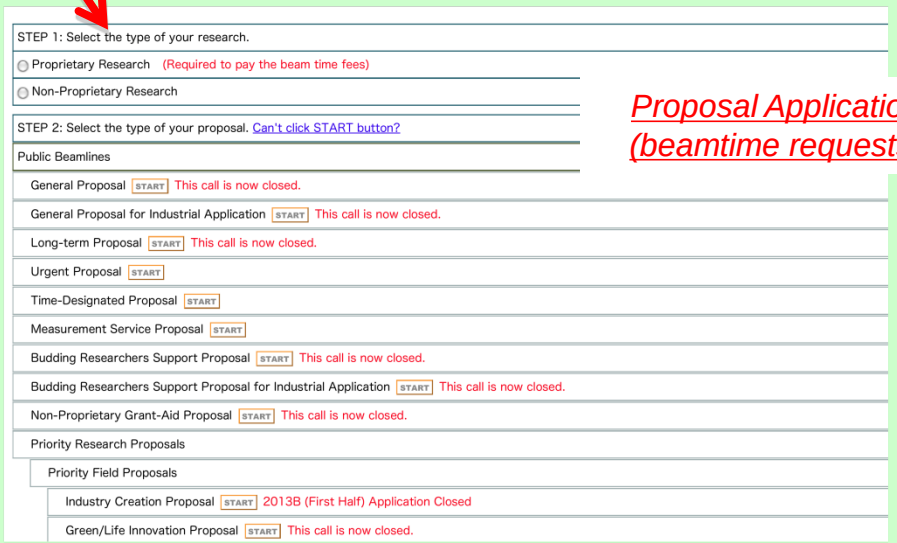
· **Proposal Application (two calls/year)**

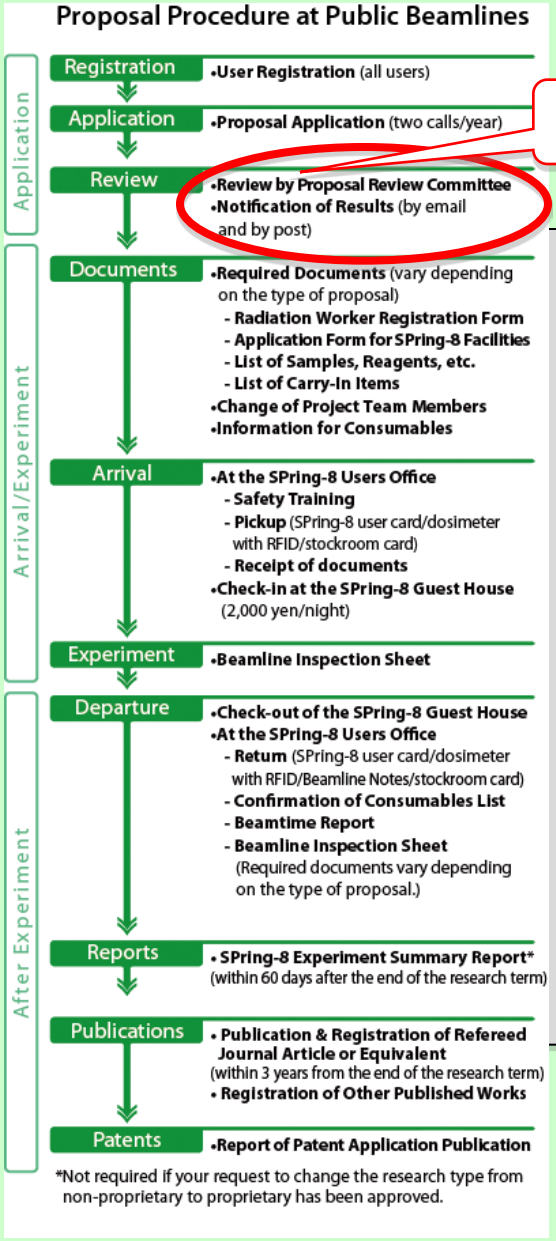
http://user.spring8.or.jp/?lang=en



Login

Proposal Application (beamtime requests)





- **Review by Proposal Review Committee**

Proposal Review

Referees

- Scientific and technical relevance
- Necessity of SPring-8 as a research tool

JASRI BL Scientists

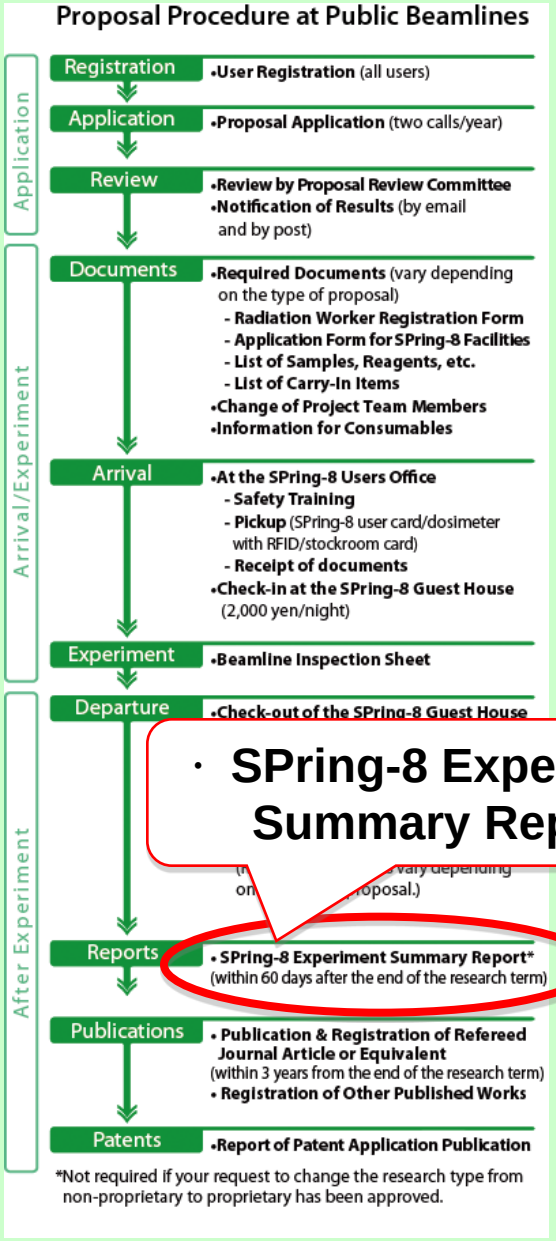
- Technical feasibility
- Estimation for suitable beamtime

JASRI Safety Office

- Safety of the experiment.

SPring-8 PRC
(Proposal Review Committee)

- Comprehensive review
- Beamtime Allocation

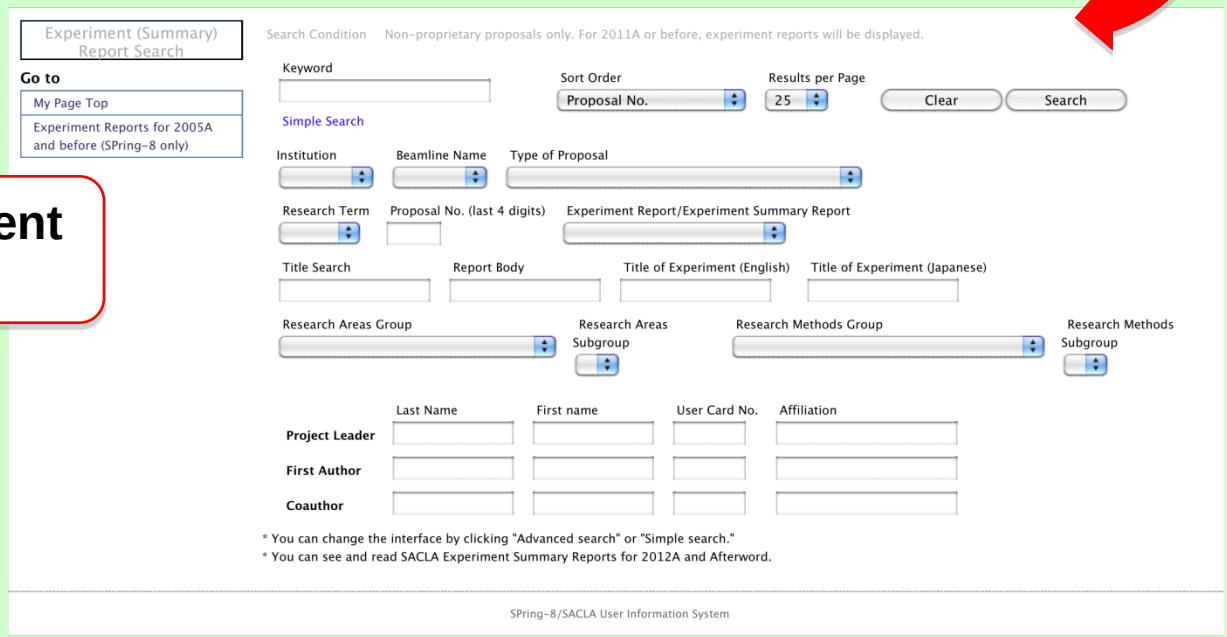


· **SPring-8 Experiment Summary Report**

Experiment Summary Report

- Project leaders of non-proprietary proposals must submit an experiment summary report online within 60 days after completion of the experiment.
- Submitted experiment summary reports will be incorporated into the experiment summary report database with search capabilities and made available on the UI site.

https://user.spring8.or.jp/uisearch/expreport/en



Proposal Procedure at Public Beamlines

Application

- **Registration** — •**User Registration** (all users)
- **Application** — •**Proposal Application** (two calls/year)
- **Review** — •**Review by Proposal Review Committee**
  •**Notification of Results** (by email and by post)

Arrival/Experiment

- **Documents** — •**Required Documents** (vary depending on the type of proposal)
  - **Radiation Worker Registration Form**
  - **Application Form for SPring-8 Facilities**
  - **List of Samples, Reagents, etc.**
  - **List of Carry-In Items**

  •**Change of Project Team Members**
  •**Information for Consumables**
- **Arrival** — •**At the SPring-8 Users Office**
  - **Safety Training**
  - **Pickup** (SPring-8 user card/dosimeter with RFID/stockroom card)
  - **Receipt of documents**

  •**Check-in at the SPring-8 Guest House** (2,000 yen/night)
- **Experiment** — •**Beamline Inspection Sheet**
- **Departure** — •**Check-out of the SPring-8 Guest House**
  •**At the SPring-8 Users Office**
  - **Return** (SPring-8 user card/dosimeter with RFID/Beamline Notes/stockroom card)
  - **Confirmation of Consumables List**

After

(within 60 days after the end of the researc

- **Publications** — • **Publication & Registration of Refereed Journal Article or Equivalent** (within 3 years from the end of the research term)
  • **Registration of Other Published Works**
- **Patents** — •**Report of Patent Application Publication**

*Not required if your request to change the research type from non-proprietary to proprietary has been approved.

Publication & Registration of Refereed Journal Article or Equivalent

Publication & Registration of Refereed Journal Article or Equivalent

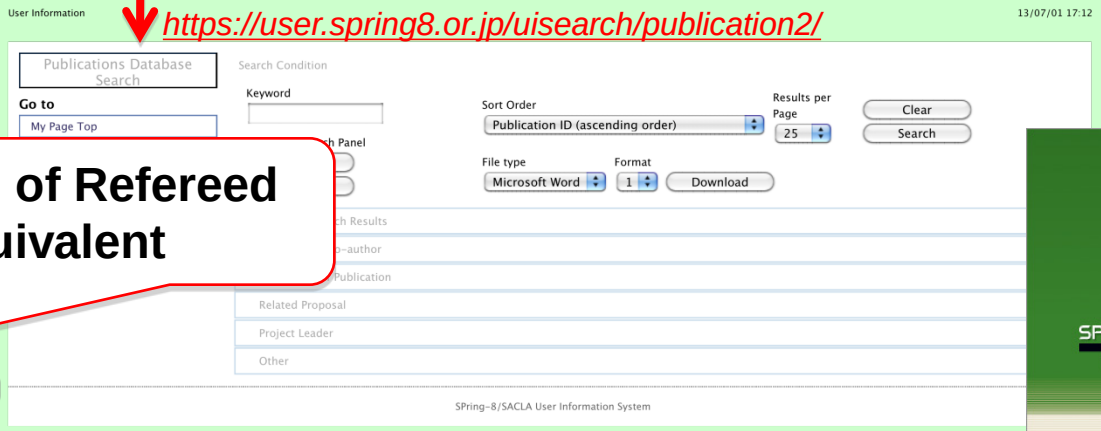
Users must publish research results in one of the following three ways and register the published work with the Publications Database within three years from the end of the research term.

① **Refereed journal paper incl. refereed proceedings and dissertation** (clearly stating the proposal number)

② **SPring-8 Research Report**

③ **Corporate technical journal article** (industrial users only)

Publication Database Search
https://user.spring8.or.jp/uisearch/publication2/

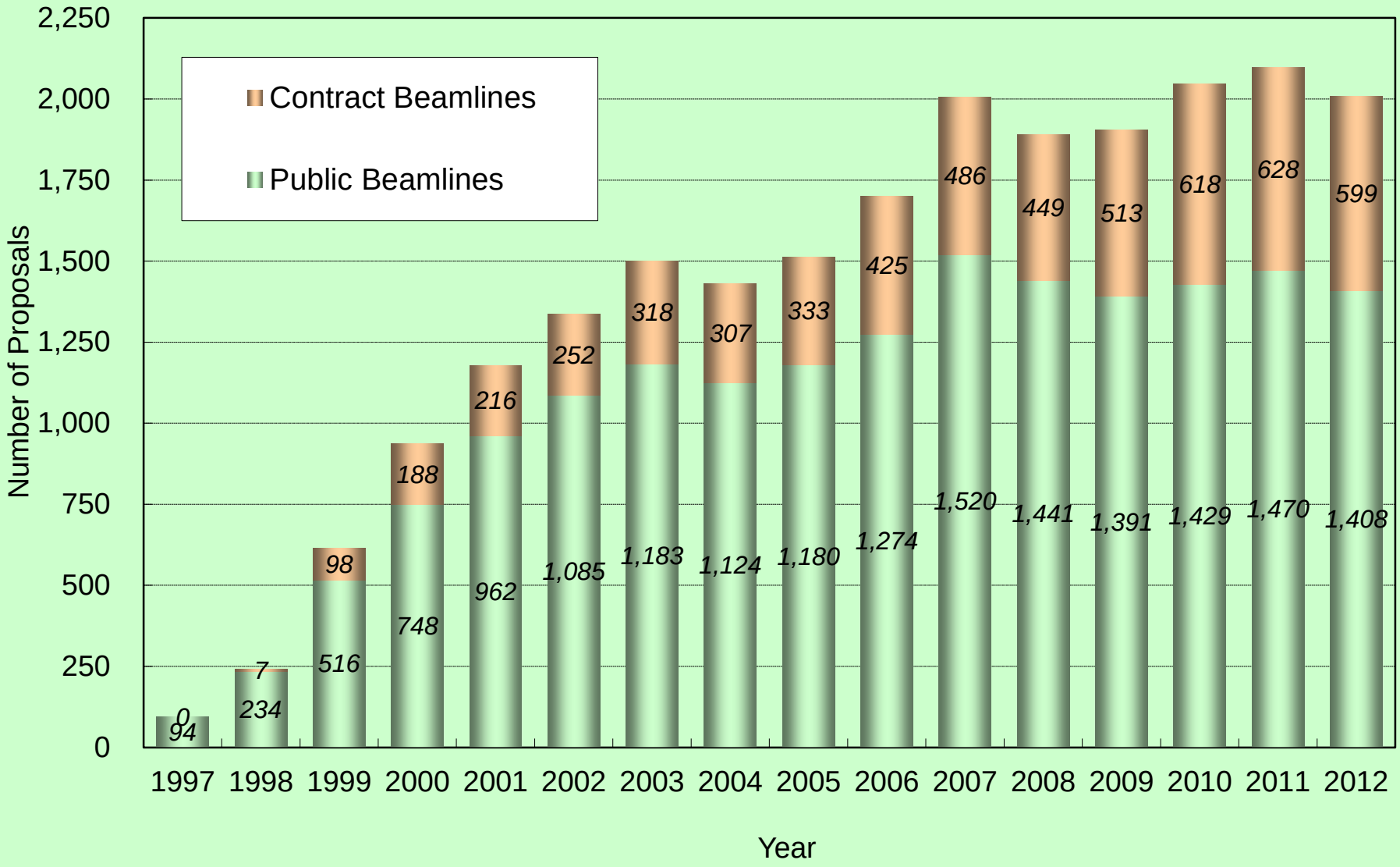


SPring-8 Research Report (Japanese text only)
http://user.spring8.or.jp/resrep/

SPring-8 Utilization Statistics

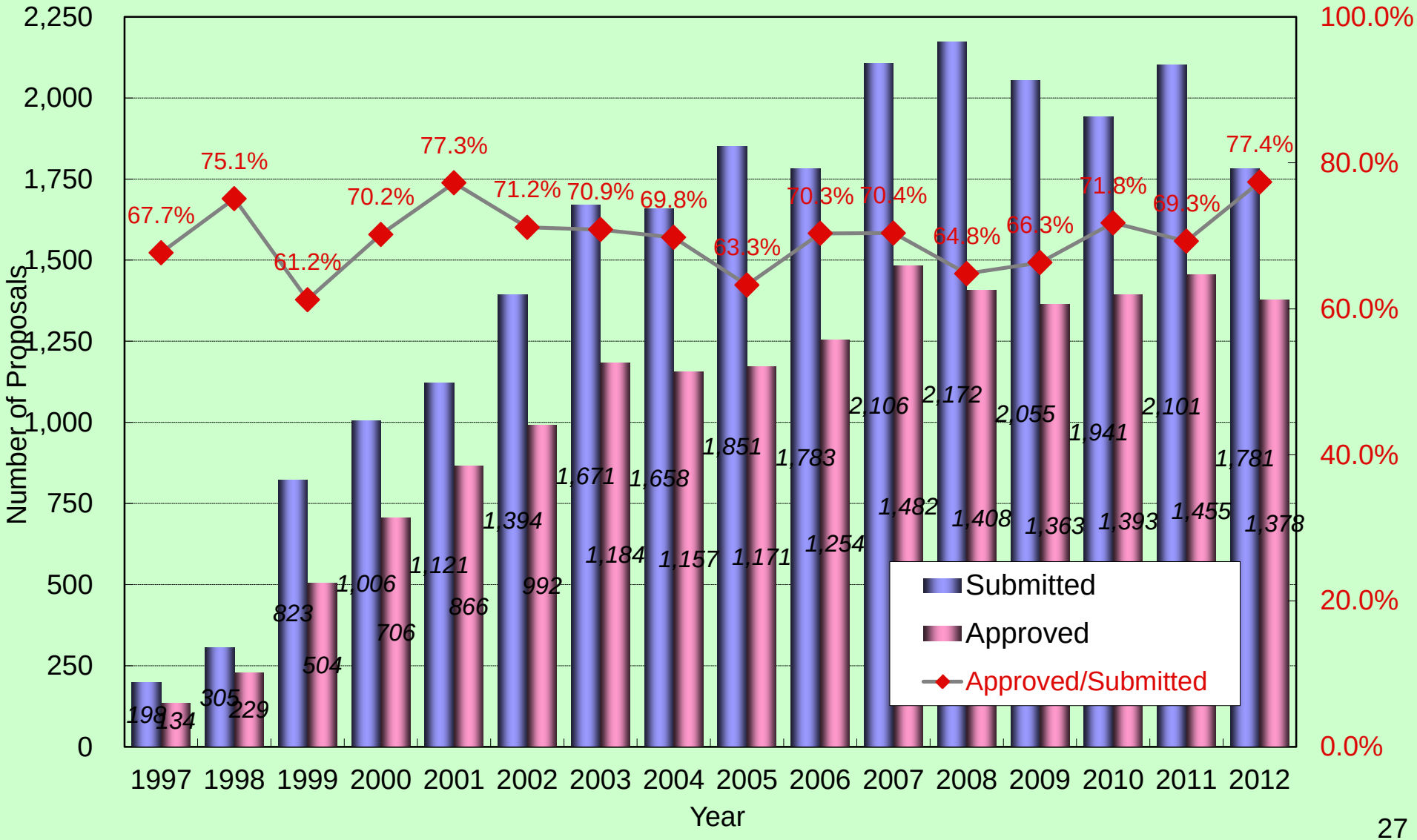
Number of Public and Contract BL Conducted Experiments

The numbers of both public and contract BL proposals have been gradually increasing.



Submitted / Approved Proposals of Public Beamlines

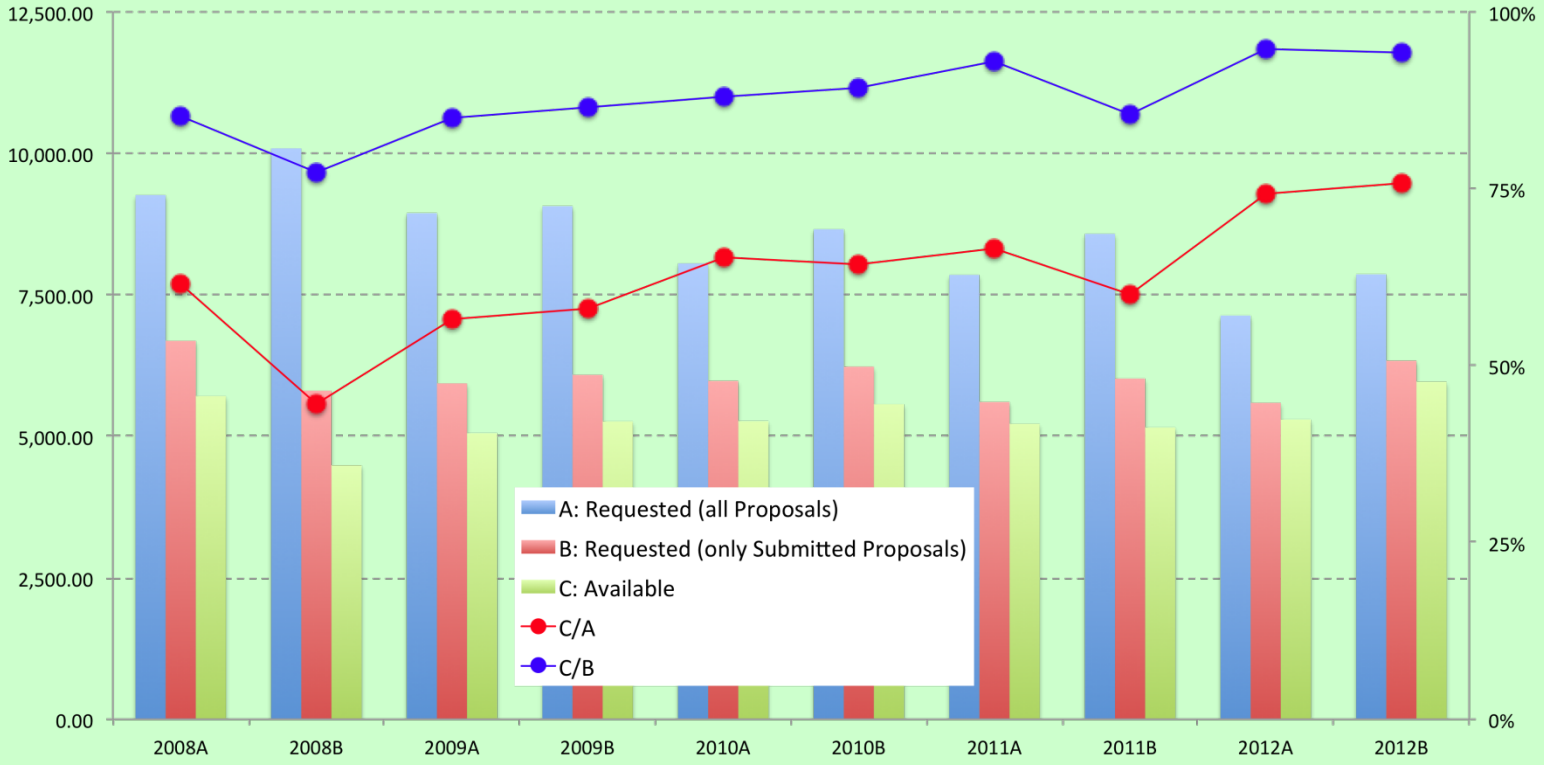
The number of proposals submitted in response to each semi annual call for proposals and the number of approved proposals



Beamtime Allocation at SPring-8 Public BLs

Unit: Shifts (1 Shift = 8 hours)

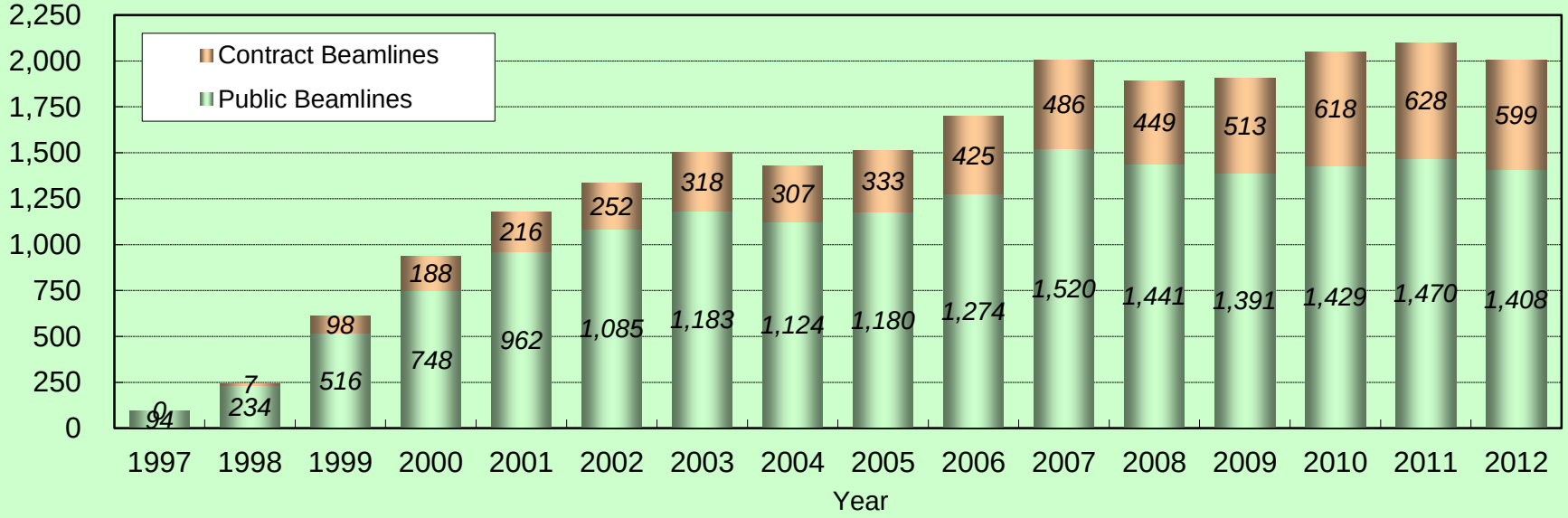
	SPring-8 Research Term									
	2008A	2008B	2009A	2009B	2010A	2010B	2011A	2011B	2012A	2012B
A: Requested (all Proposals)	9,264.50	10,089.00	8,944.25	9,067.75	8,055.75	8,659.75	7,853.25	8,578.25	7,134.25	7,862.75
B: Requested (only Submitted Proposals)	6,687.50	5,806.00	5,935.75	6,086.25	5,979.75	6,230.75	5,607.25	6,021.25	5,592.25	6,336.75
C: Available	5,711.00	4,489.50	5,054.00	5,263.75	5,267.75	5,567.00	5,220.75	5,155.75	5,296.25	5,966.25
C/A	62%	44%	57%	58%	65%	64%	66%	60%	74%	76%
C/B	85%	77%	85%	86%	88%	89%	93%	86%	95%	94%



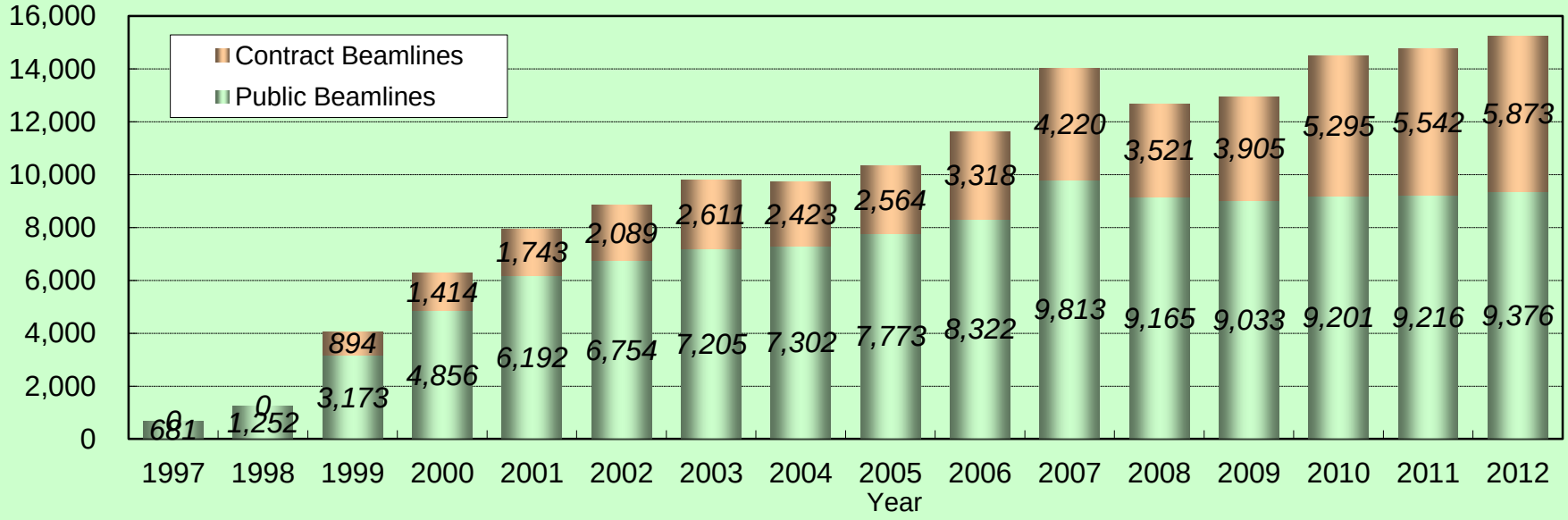
Excluding In-house Proposals by JASRI Staff

Statistics of Conducted Experiments and Users

Number of Cumulative Conducted Researches

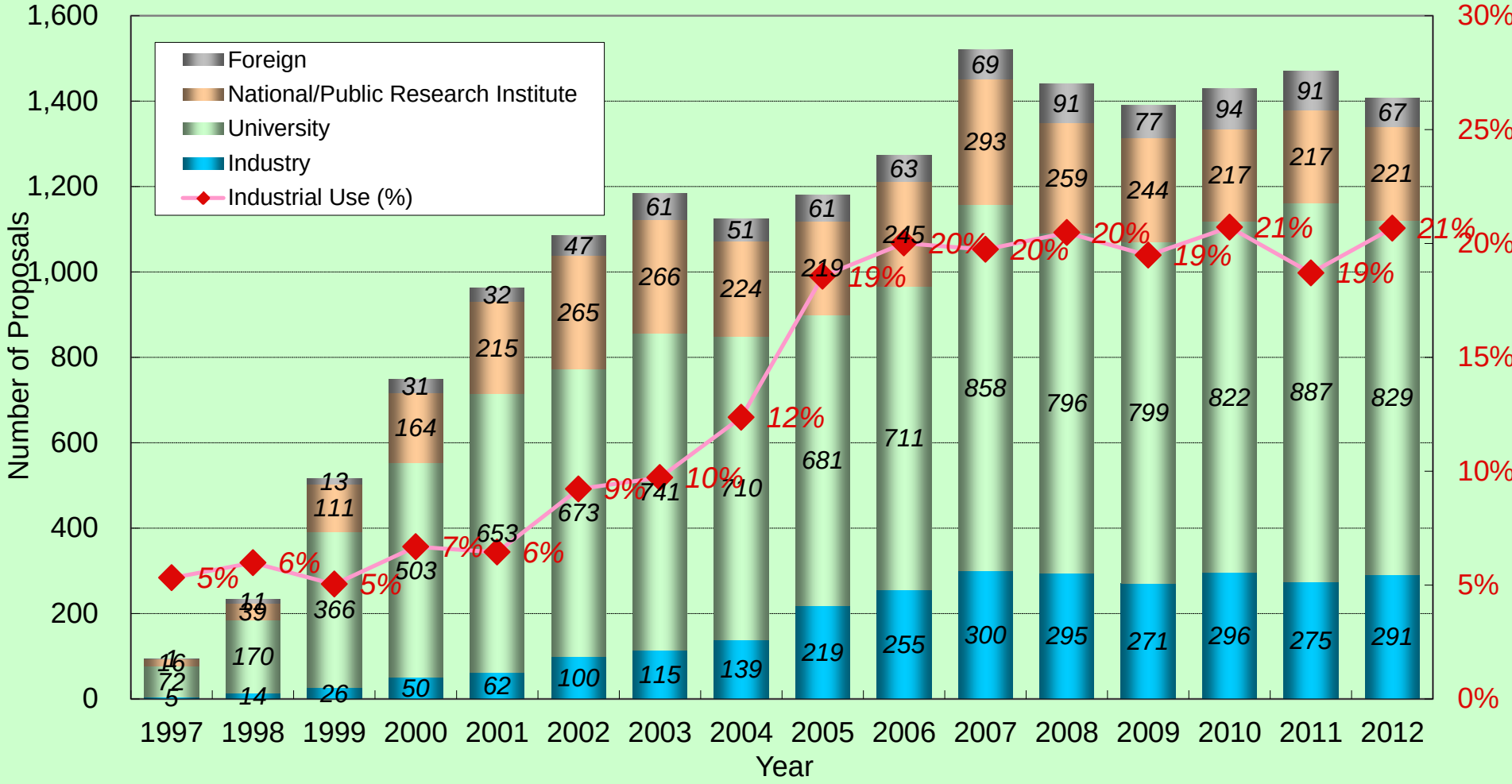


Number of cumulative Users



Number of Conducted Experiments at Public BLs by Affiliation

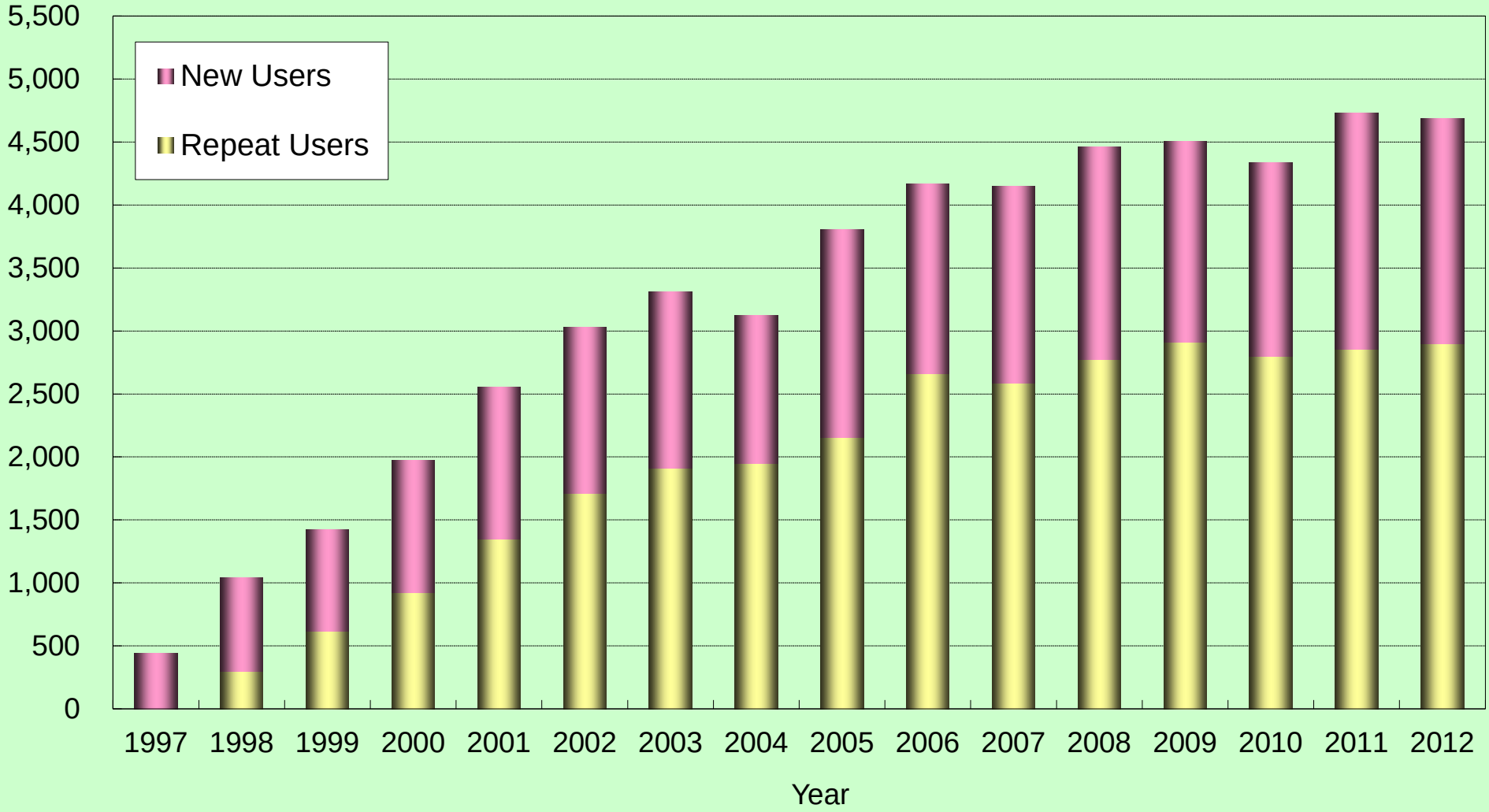
The yearly number of public BL proposal by affiliation. Industrial use has been on the rise and reached 20% in recent years.



※Affiliation Type

- Foreign: all overseas institutions and corporations
- National/Public Research Institute: independent administrative institutions, collaborative research institutes, public-interest corporations, special government-affiliated corporations
- University: national and other public universities, private universities, technical colleges
- Industry: private enterprises (incl. Japanese arms of overseas enterprises)

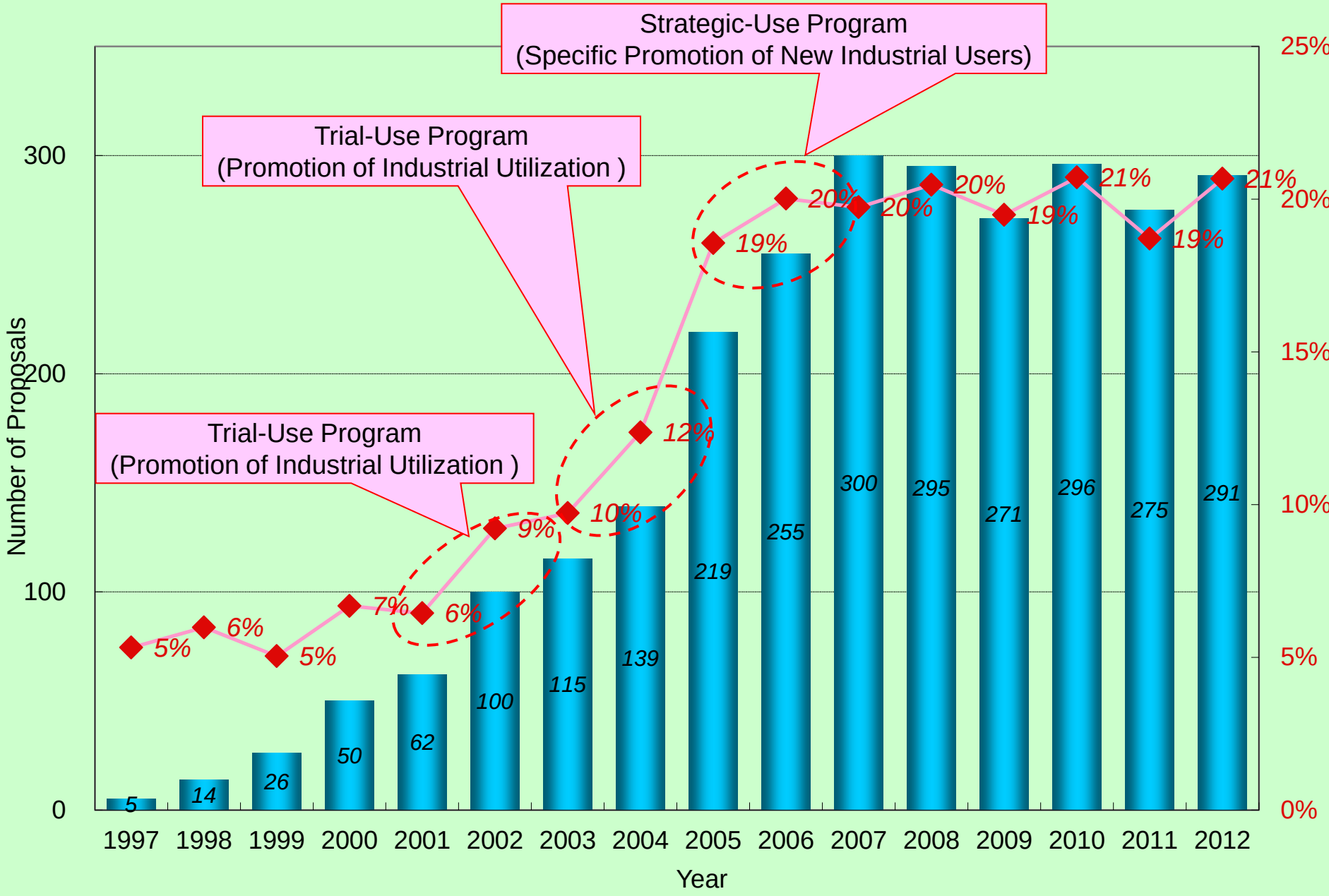
Number of Unique Users*



*An individual is counted as 1 user no matter how often the user conducts experiments.

Industrial Applications

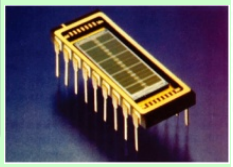
Industrial Utilization (Public Beamlines)



Industrial Applications

Electronics

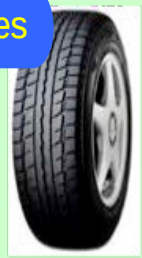
- Films for ULSI,
- Semiconductors
- HDD, DVD
- Semiconductor laser



Automobile

Metals & Soft materials

- Steel plates
- Construction materials
- Coatings
- Welding
- Tools
- Tires
- Fibers
- Functional polymer



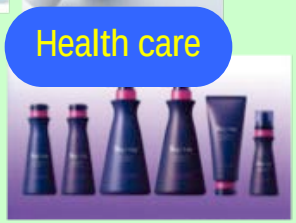
Energy & Environment

- Batteries: fuel cell & Li-ion
- Nuclear power material
- Analysis of contamination elements
- Catalysts for environment

Material Analysis

Life science

- Medicine
- Personal care
- Health care



User Administration Div.
at SPring-8/SACLA

User Administration Div. at SPring-8/SACLA

RIKEN: Research, Own ,R&D and Operation Management

JASRI: Operation (a part of SPring-8) and Public Utilization Promotion

Accelerator Div.	General Affairs Div.
Controls and Computing Div.	Research Coordination Div.
Light Source and Optics Div.	User Administration Div.
Research and Utilization Div.	Public Relations Office
Industrial Application Div.	
XFEL Utilization Div.	
Safety Office	

Function

- User Administration
- Research Proposal Administration (including Reserch Proposal Selections)
- Support for User Community
- Research Publication, User Information and User Support System

Staffing

User Administration Div.

1 Div. Director

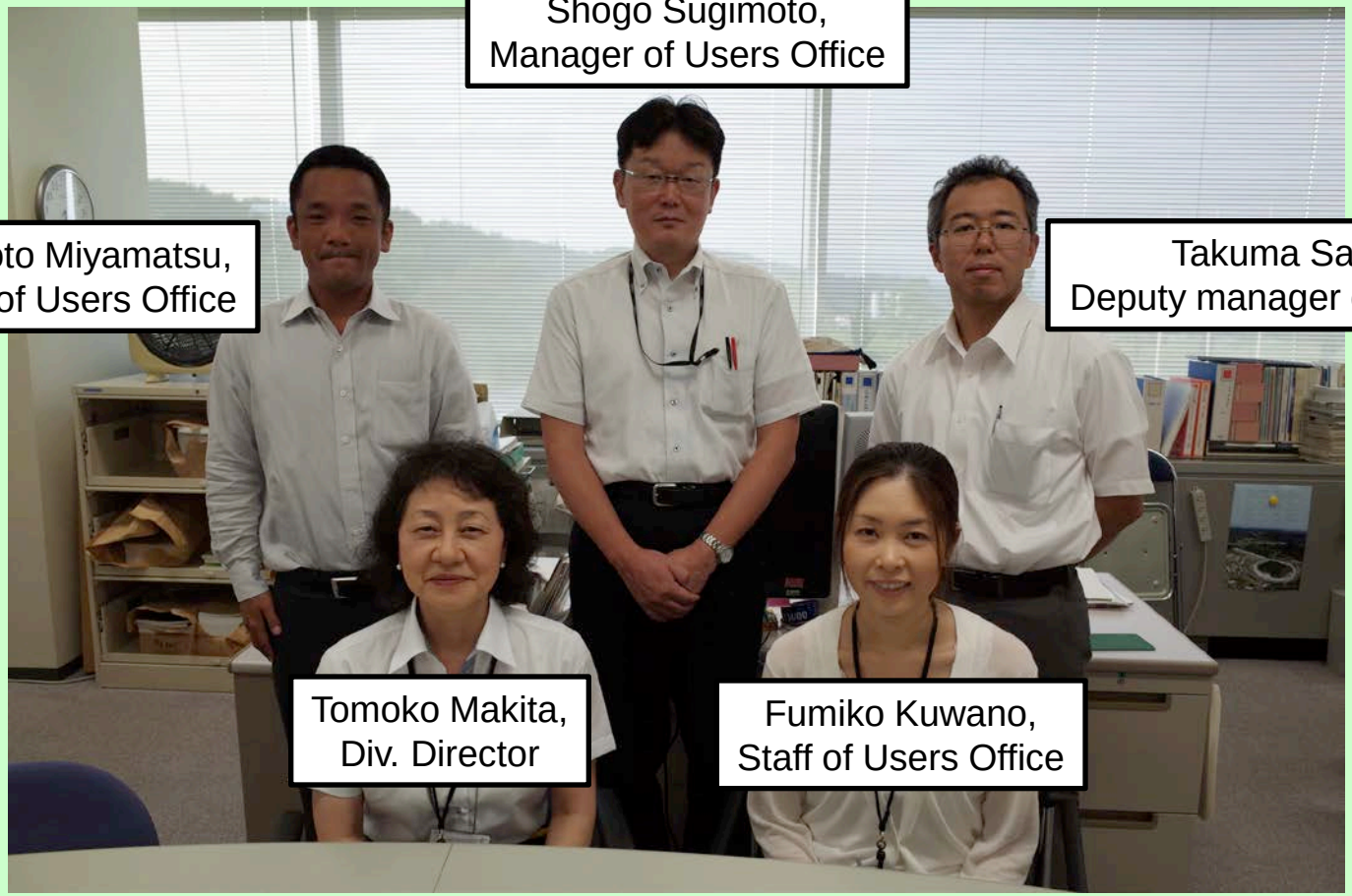
SPring-8/SACLA Users Office

1 Manager 1 Deputy manager 11 Staffs

Library and Information Sec.

1 Manager 1 Deputy manager 8 Staffs

We are very sorry that we cannot participate in this Three-Way Meeting.



Photographed on July 17, 2013


Thank you for your attention.

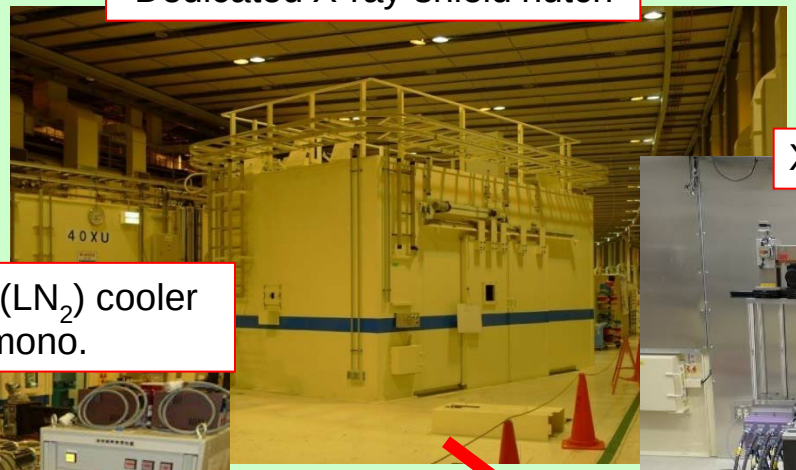
Reference

Beamlines (BL37XU, BL39XU) upgraded for nano-beam analysis

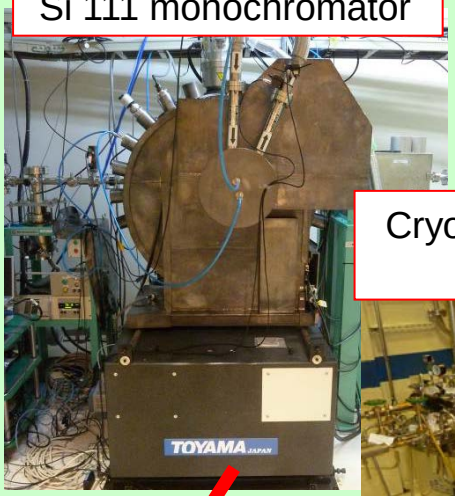
-Low-carbon Research Network JAPAN, RIKEN Harima Institue-

-High brilliant X-ray beam from SPirng-8 focused down to a nano-scale spot
-The beam stabilized in the nano-level by environments (temperature, vibration, etc.) stabilized
-Several vital equipments installed in FY2010

Dedicated X-ray-shield hutch

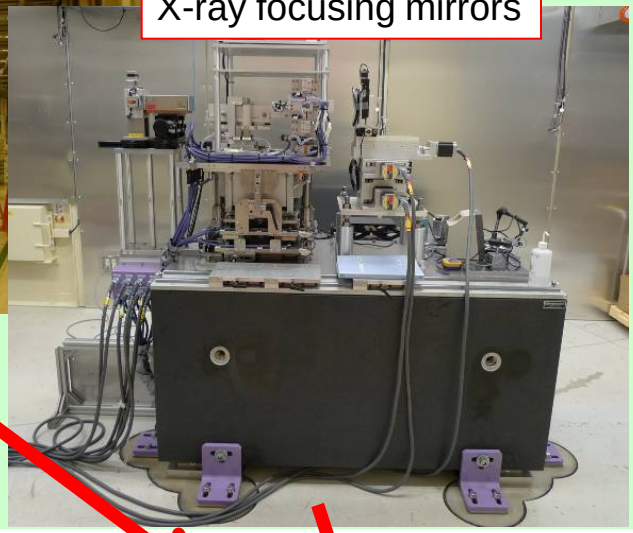


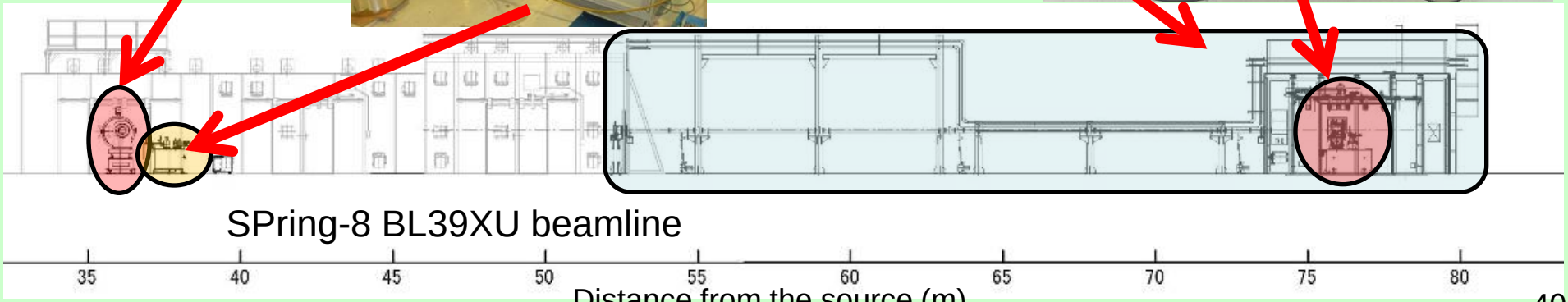
Si 111 monochromator



Cryogenic (LN_2) cooler for mono.

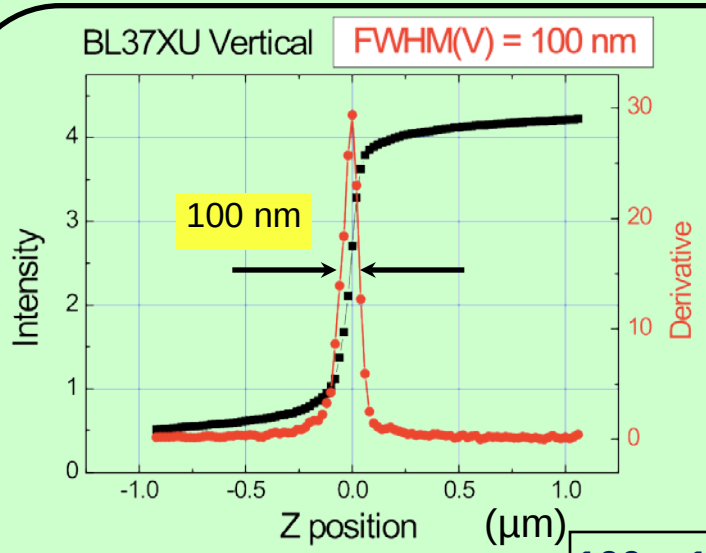
X-ray focusing mirrors

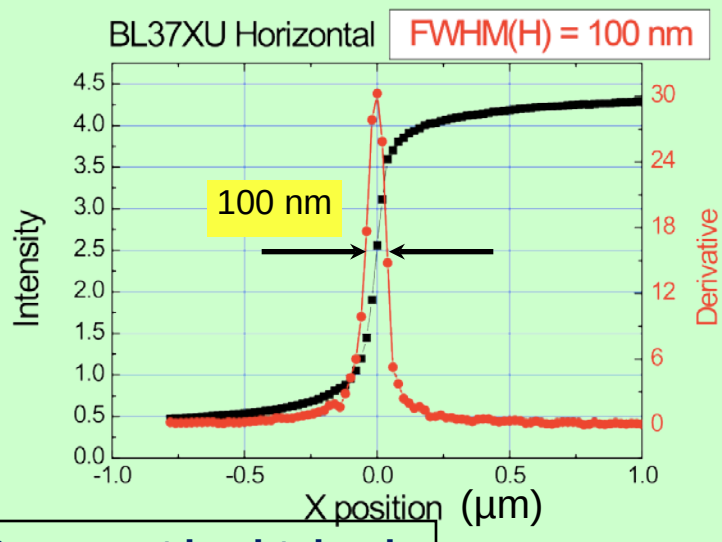




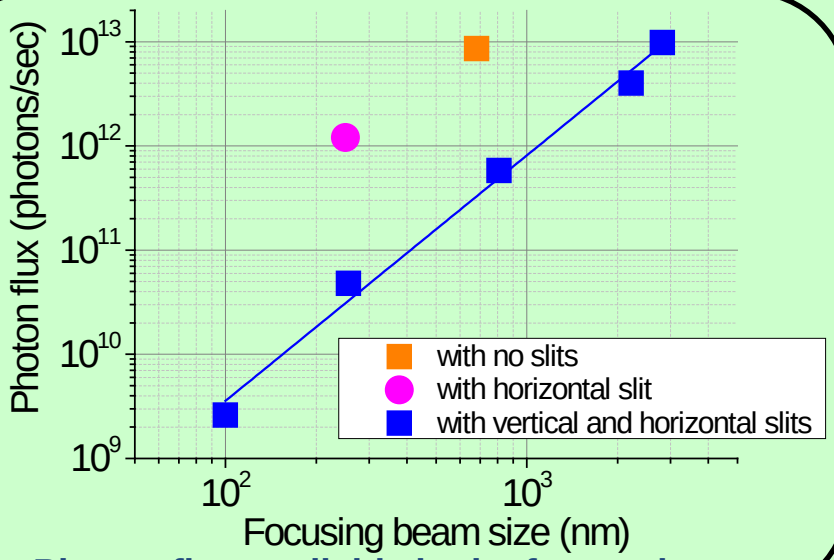
Focused X-ray beam performance

Focused beam profile at BL37XU

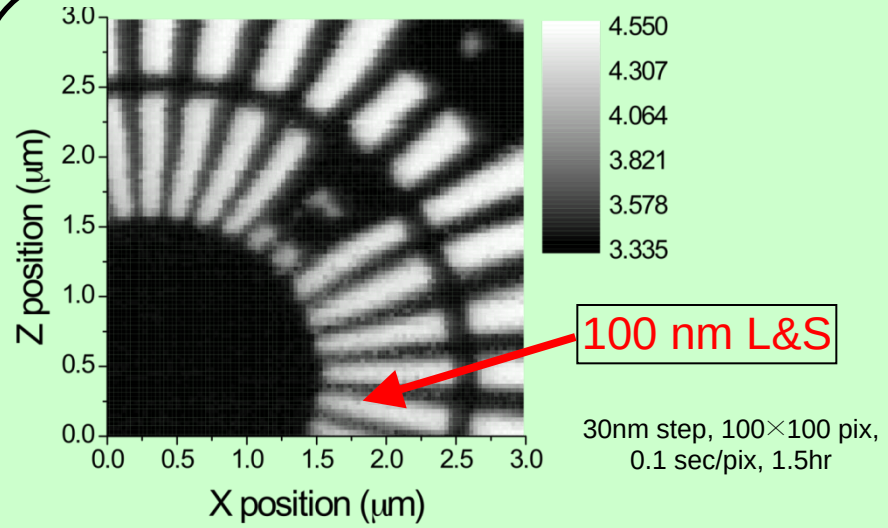




100 x 100 nm spot is obtained



Photon flux available in the focused spot



Scanning X-ray image of a Siemens test pattern

Outline of BL36XU

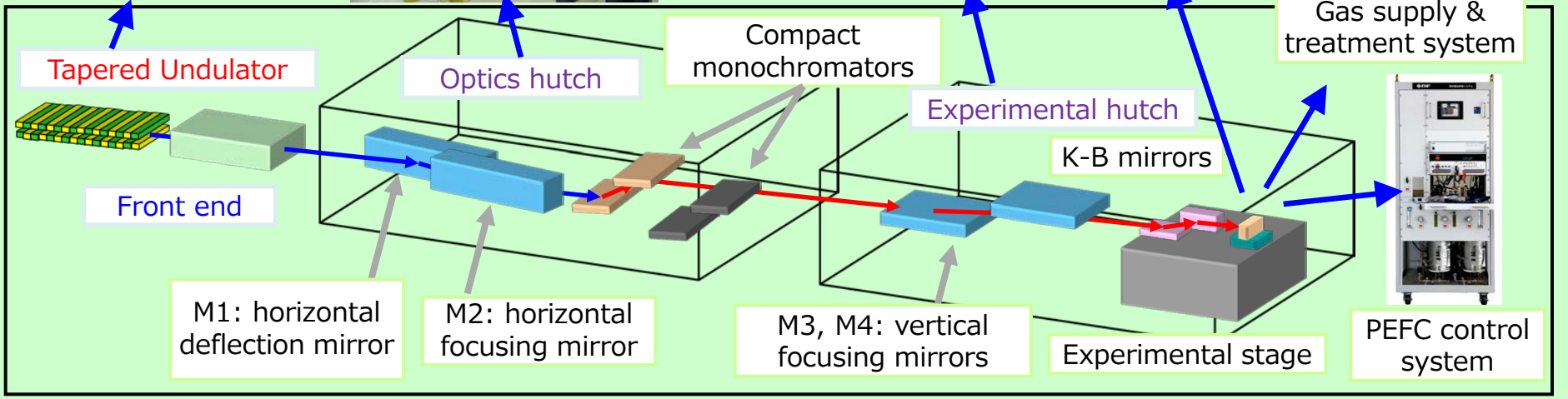
- Specifications of XAFS method at BL36XU
  - Time resolution:
    800 μs (Quick scanning XAFS)
    100 μs (Energy dispersive XAFS)
  - 2D spatial resolution: 100 nm (Fast scanning microscopic XAFS using KB mirrors)
  - 3D spatial resolution: 1 μm (Laminography XAFS)
  - Energy range: 4.5 - 35 keV





Fuel cell

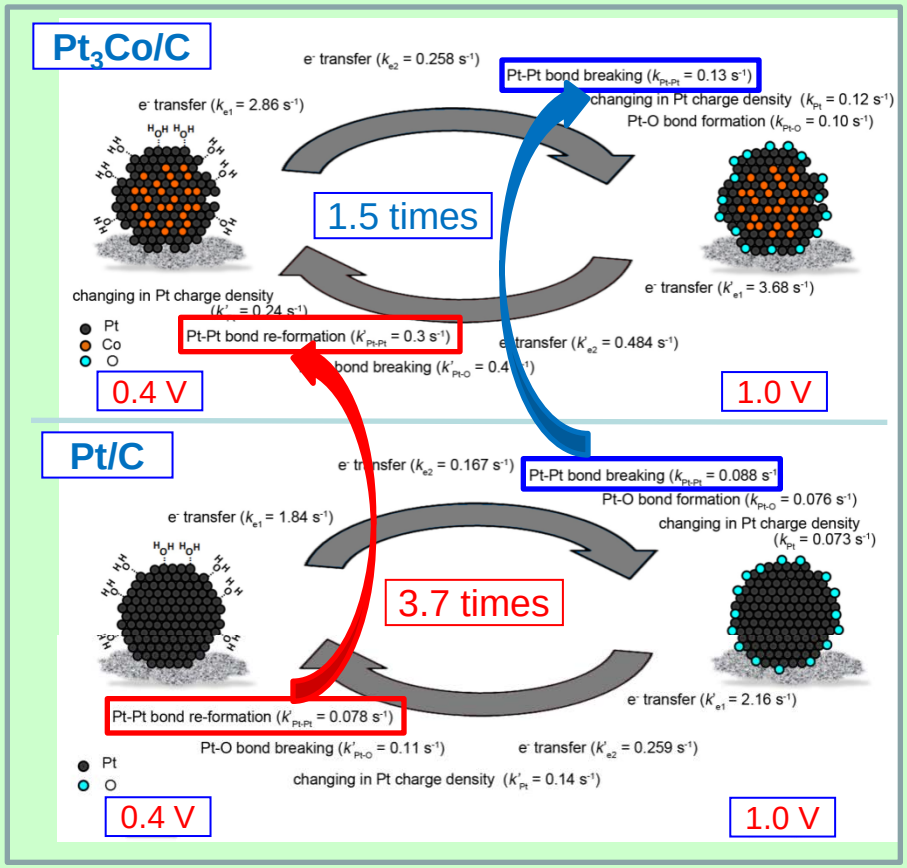
Gas supply & treatment system



O. Sekizawa et al., *J. Physics: Conf. Series*, **430**, 012020 (2013).

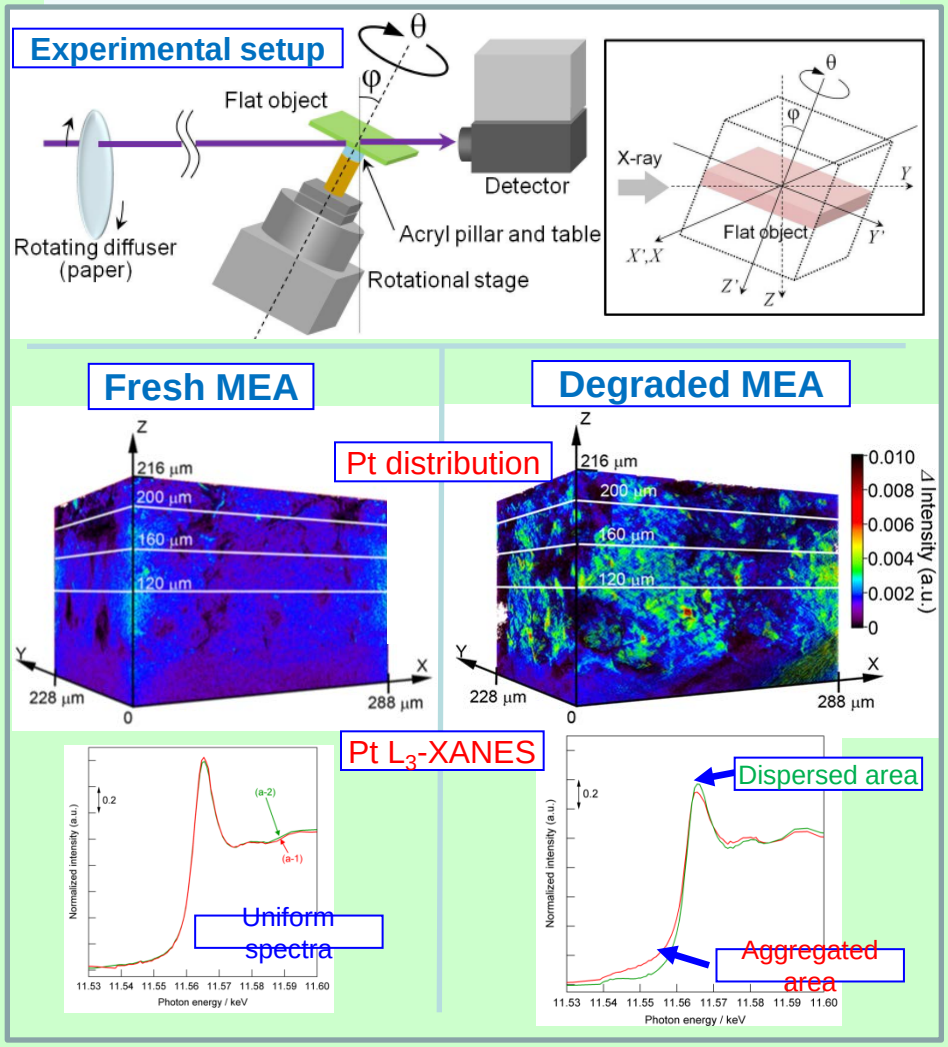
Research results

- Structural kinetics and time lags of surface events on Pt_3Co/C and Pt/C cathode catalysts in PEFC MEAs for rapid voltage-operating processes by time-resolved XAFS method



M. Tada et al., *ACS Catal.* . **2**, 1319 (2012).

- 3D-Visualization of cathode catalyst layer in MEA of PEFC by laminography XAFS



T. Saida et al., *Angew. Chem. Int. Ed.*, **51**, 10311 (2012).

Advanced Softmaterial Beamline (BL03XU)

Mission :

- **Development of tactical application of Synchrotron Radiation to the Polymer Science leading to innovative softmaterial designing**

Construction :Apr. 2008 ~, Commissioning: Nov. 2009, Opening to member's utilization: Apr. 2010

Organization Structure for BL Construction & Administration

FSBL 03XU
Advanced Softmaterial Beamline Consortium

FSBL Consortium
Representative:
Akihiko Okada (Sumitomo Chemical Co., Ltd.)
Deputy representative:
Yasunori Sugihara (Nitto Denko Corp.)

Steering Committee
Chair :
Prof. Kazuo Sakurai (The Univ. of Kitakyushu)
Dupty chairs :
Prof. Kohji Tashiro (Toyota Technological Institute)
Prof. Atsushi Takahara (Kyushu Univ.)

Supporting groups of JASRI

- Group A
  - Company A + Cooperative alliance
  - Academic researchers
- Group B
  - Company B + Cooperative alliance
  - Academic researchers
- Group C
  - Company C + Cooperative alliance
  - Academic researchers

Technical examining committee

BL-specification planning committee
Chair: Prof. Yoshiyuki Amemiya (The Univ. of Tokyo)

FSBL Consortium

(Industry-academic joint consortium)

19 Industrial Members:

Asahi Kasei Corp. ・ Kwansei Gakuin Univ. ・ Canon Inc. ・ Kuraray Co., Ltd. ・ Showa Denko K. K. ・ Sumitomo Chemical Co., Ltd. ・ Sumitomo Rubber Industries, Ltd. ・ Sumitomo Bakelite Co., Ltd. ・ Denso Corp. ・ Toyobo Co. Ltd. ・ Toray Industries, Inc. ・ Nitto Denko Corp. ・ Bridgestone Corp. ・ Mitsui Chemicals, Inc. ・ Mitsubishi Chemical Corp. ・ Mitsubishi Rayon Co., Ltd. ・ The Yokohama Rubber Co., Ltd. ・ Teijin Ltd. ・ DIC Corp.

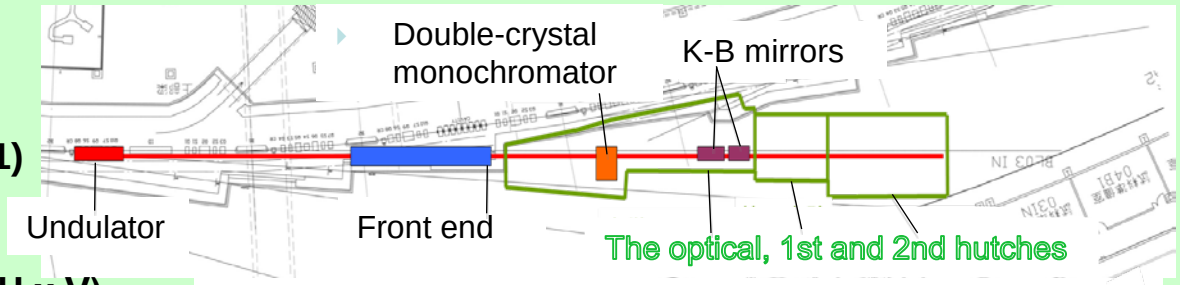
Academic Members :

Researchers of The Univ. of Tokyo, Nagoya Institute of Technology, Kyoto Univ. Kyoto Institute of Technology, The Univ. of Kitakyushu, Kyushu Univ., *etc.*

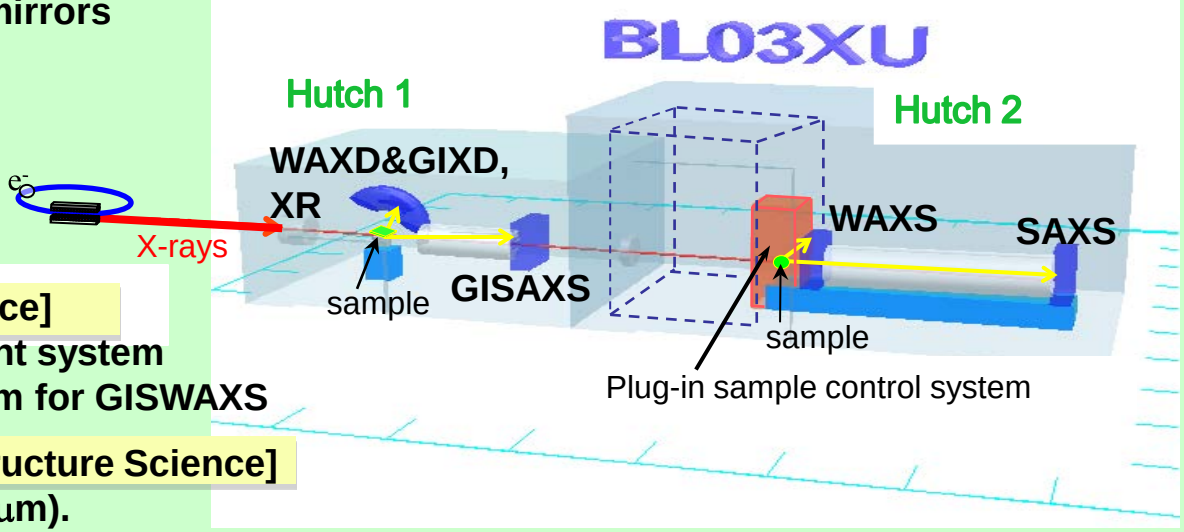
Features of Advanced Softmaterial Beamline

SOURCE AND OPTICS

- Source: Standard-type
  "in-vacuum" planar undulator
- Energy range: 6 keV ~ 35 keV
- Energy resolution (ΔE/E) : ∽10^{-4}
- Double-crystal monochromator, Si(111)
- KB mirrors



- Expected Beam Size: 240μm x 90μm (H x V)
  @ ∽75m (the 2nd hutch) without mirrors
- Expected Photon Flux: >10^{13} ph/s
  (frontend slit : full open) @ 12keV
  without mirrors



EXPERIMENTAL STATIONS

[Hutch 1, Thin-Film Structure Science]

- GIXD, GISAXS and XR measurement system
- Time-resolved measurement system for GISWAXS

[Hutch 2, Dynamic Nano・Meso-Structure Science]

- SAXS resolution: max. 0.7 μm (1.0 μm).
- Time-resolved WAXS/SAXS measurement system
- Microbeam WAXS and SAXS measurement system
- Industrial experiments with large processing or casting machines
  wide space around a sample : 3 m (l) x 3 m (w) x 4 m (h))
  plug-in sample control system

Newly constructed BL

the University-of-Tokyo Beamline （BL07LSU)

Synchrotron Radiation Research Organization in the University of Tokyo

University-of-Tokyo Synchrotron Radiation Outstation Beamline

October 9, 2009
The Opening ceremony

27m-long undulator

hv : 250 eV～2 keV

Brilliance : 10^{19} photons/s/mm^2/mrad^2/0.1b.w.

Polarization : linear (horizontal, vertical, diagonal)

helical (right, left)

High-resolution soft X-ray beamline

h ν : 250 eV ～2 keV

Energy resolution : E/ΔE: >10,000

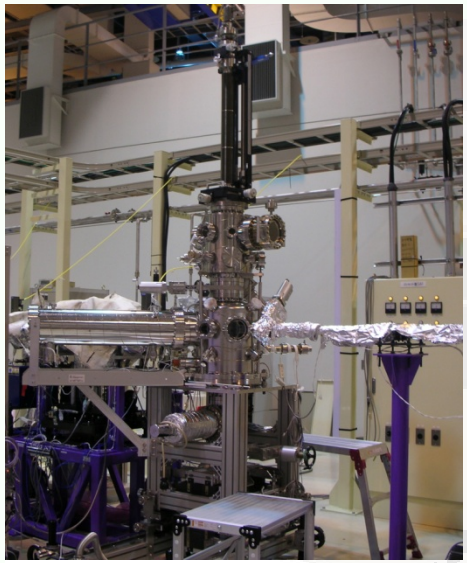
Beam size : < 10 μm,

Experiment stations of the frontier spectroscopy

Characteristics of

the University-of-Tokyo Beamline （BL07LSU)

Four experiment stations for the frontier spectroscopy

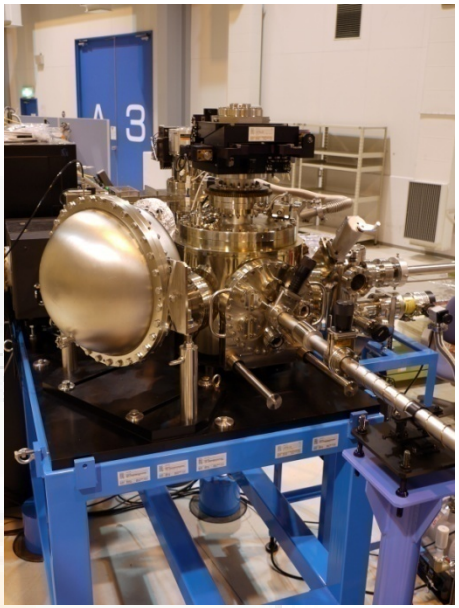


Time-resolved soft x-ray spectroscopy,
TR-SX spectroscopy

Precise time controls of soft X-ray pulse and ultrashort laser pulse
High-resolution two-dimensional angle-resolved photoemission spectroscopy at various delay time

Three-Dimensional Scanning Photoelectron Microscope Station, 3D nano-ESCA

Spatial resolution: 50 nm （x,y）
Depth resolution： 0.1 nm （z）
（Depth profile technique by MEM）



Ultra-high resolution soft X-ray emission spectroscopy station, HORNET

Energy resolution： $E/\Delta E > 10{,}000$
Experimental set-ups for gas, liquid, and solid phases

Free-Port station

for researchers worldwide to bring in their machines and to perform experiments with the high-brilliant soft x-ray beam.