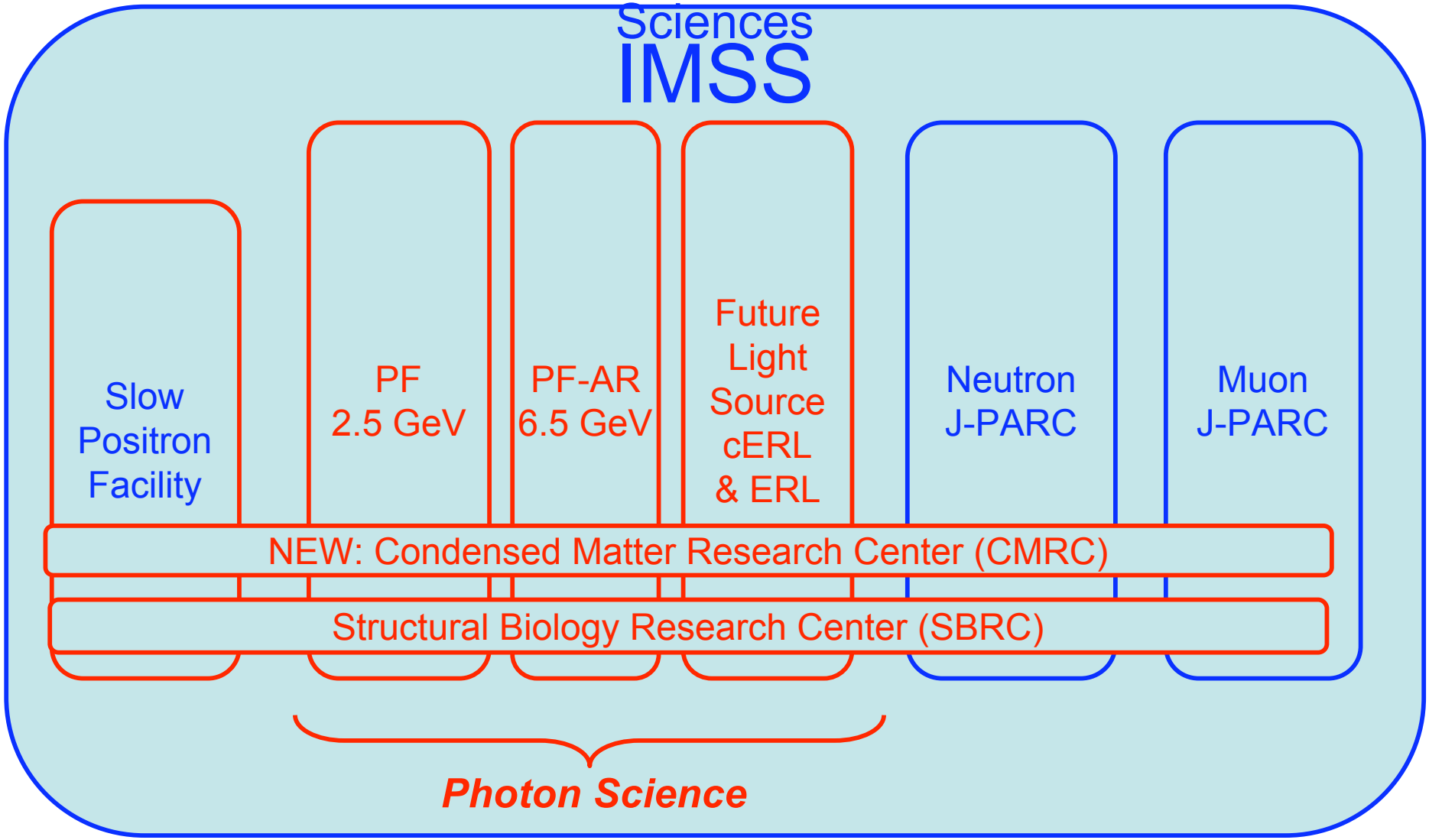
16 &17 October 2008

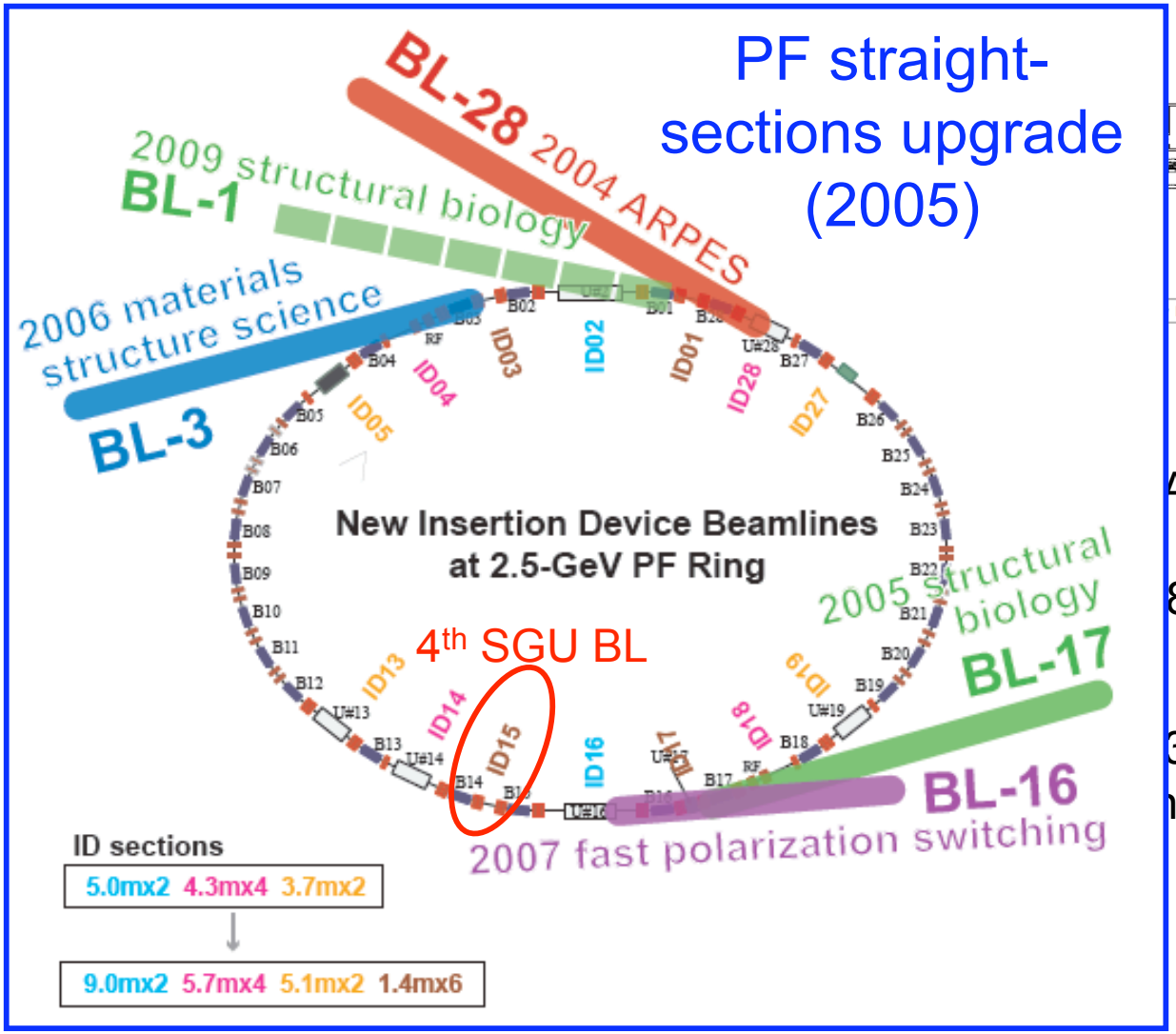
IMSS Symposium: PF and PF-AR Upgrades

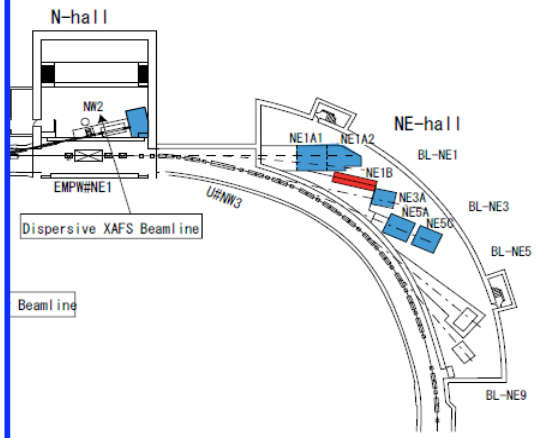
Soichi Wakatsuki
Photon Factory
Institute of Materials Structure Science
High Energy Accelerator Research Organization (KEK)

Photon Factory in the context of Institute of Molecular Structural Sciences



Plan view of experimental halls





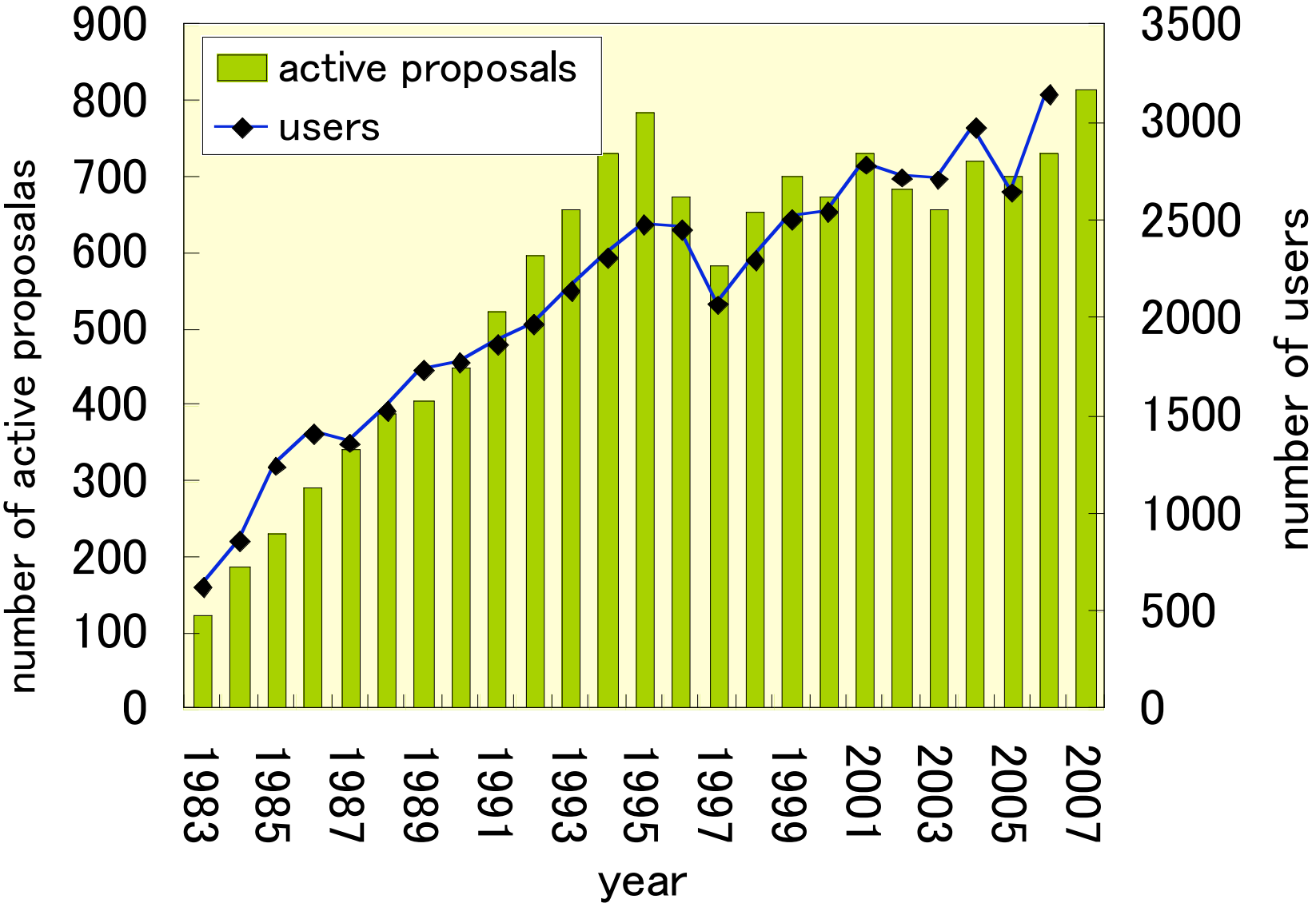
AR (6.5 GeV, 60mA,

8 independent) stations

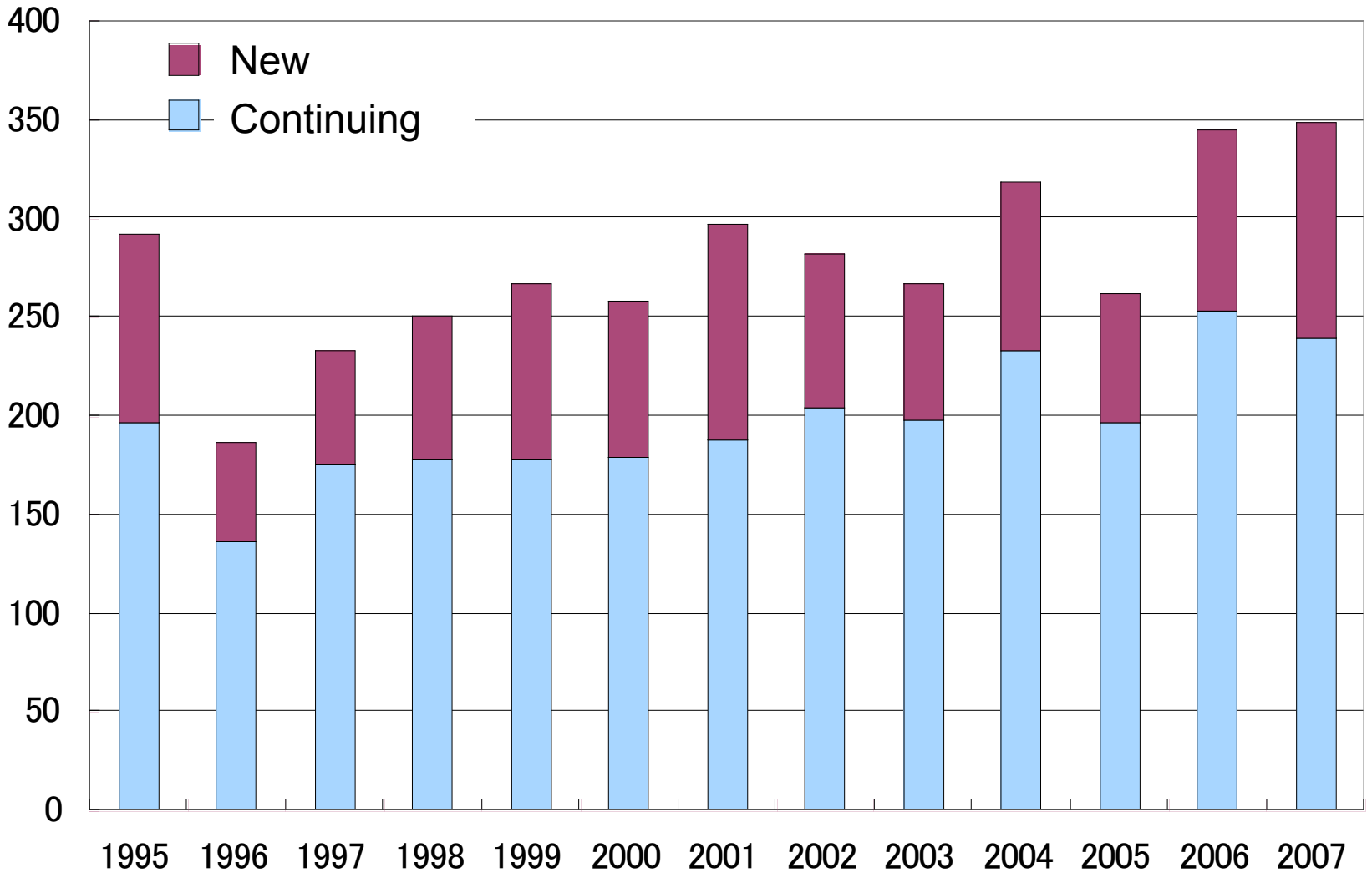
3 GeV, 450 mA, MB(SB))
ndependent) stations

February 2008

Number of active proposals and users



Trend of new spokespersons



Beam lines and staff

740 active proposals
3150 users
In FY2007

500 to 600 publications
each year since 1995

63 (53 independent) stations (including 6 PRT stations)

39 beam line scientists (total of 56 including 17 technical staff)

Photon Factory Review 2006

- There are too few scientists supporting too many beam lines. The number of beamlines needs to be reduced but against the background of a well-conceived strategic plan that focuses on a relatively small number of carefully selected areas of excellence.
- The Committee in 2006 suggested that a reasonable number of beamlines for a facility of the scale and scope of the PF might be around 30-40 and there could be around 5-10 selected areas of excellence.

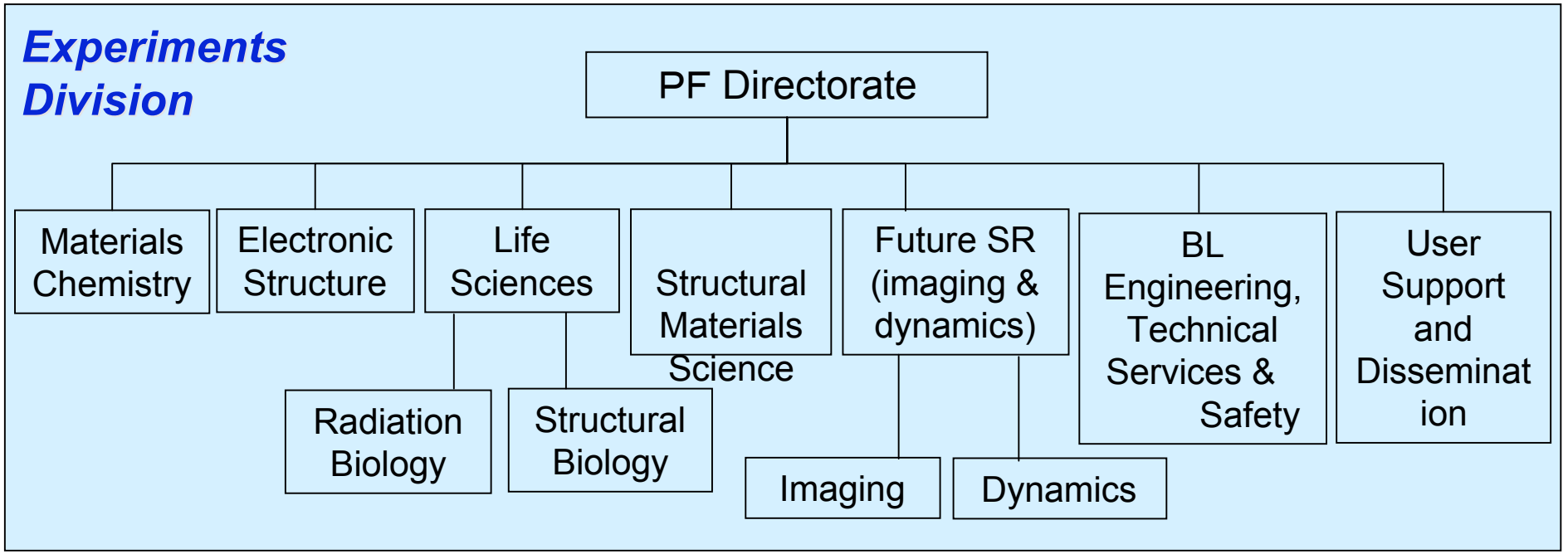
⇨ The action plan: DECREASE BY 9 stations (-27 +18)

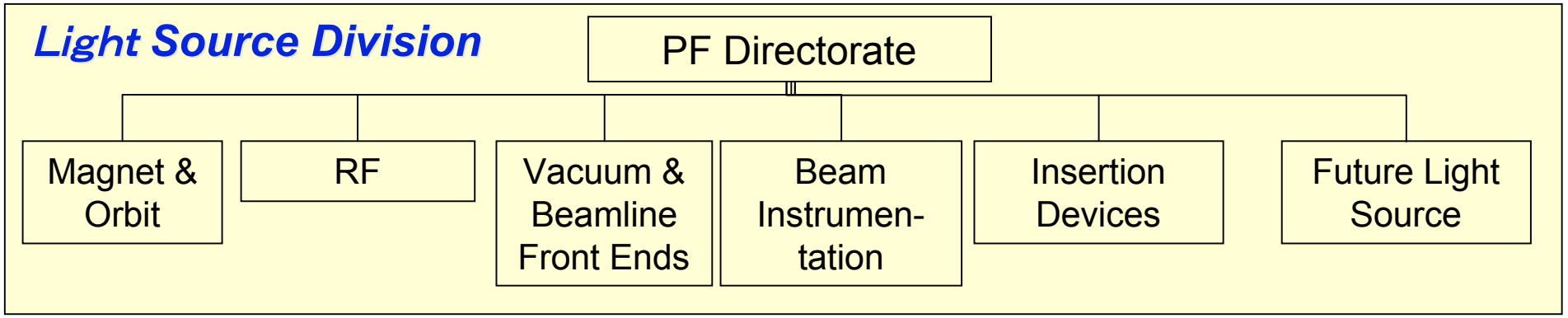
Photon Factory New Group Structure（since April 2007）

ERL Office

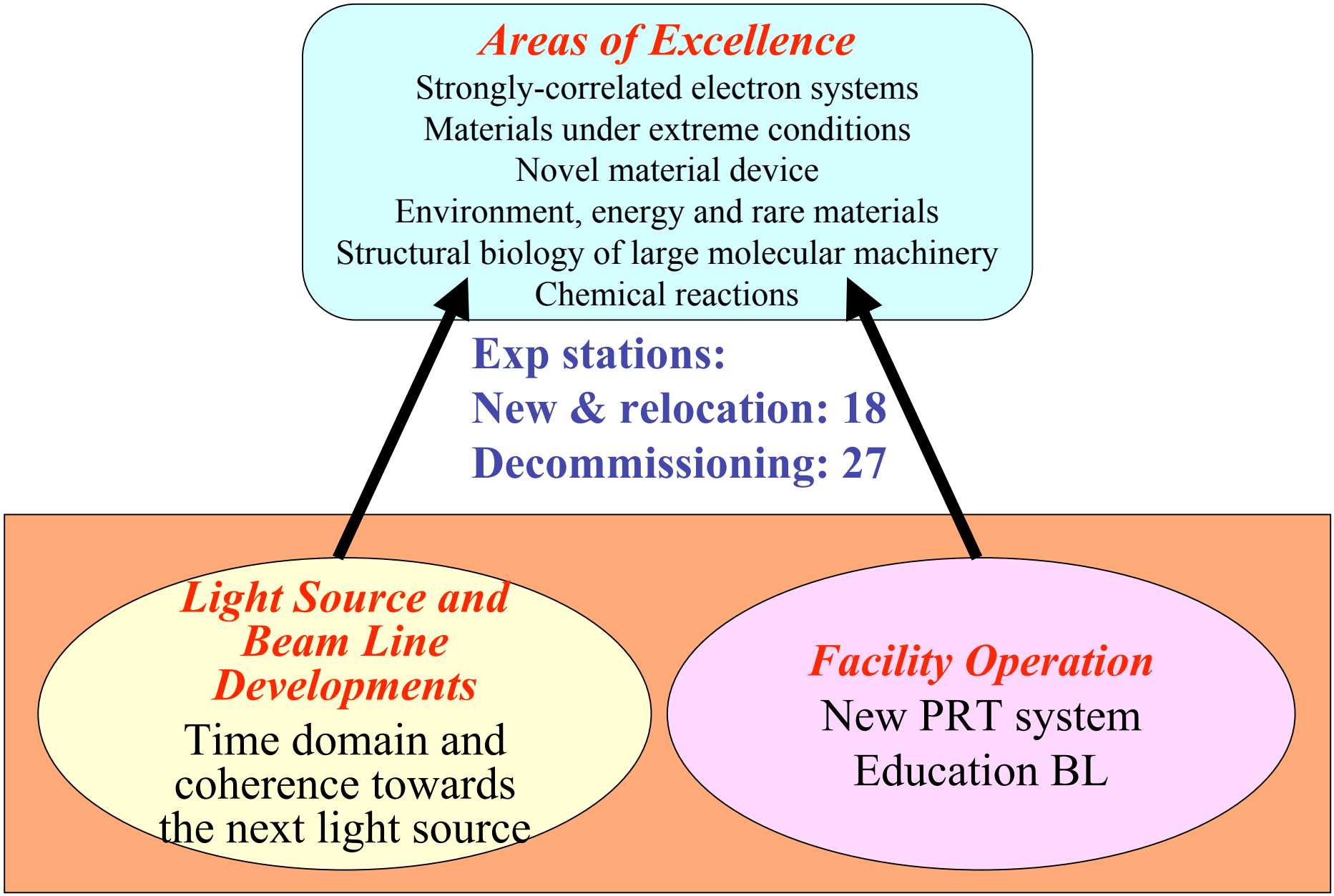
Structural Materials Science Research Center

Structural Biology Research Center





Photon Factory: three-tier system for further developments



Three-Tier System for 5-10 years (to be reevaluated in 5 years):

1. Areas of Excellence

A) Strongly-correlated electron systems

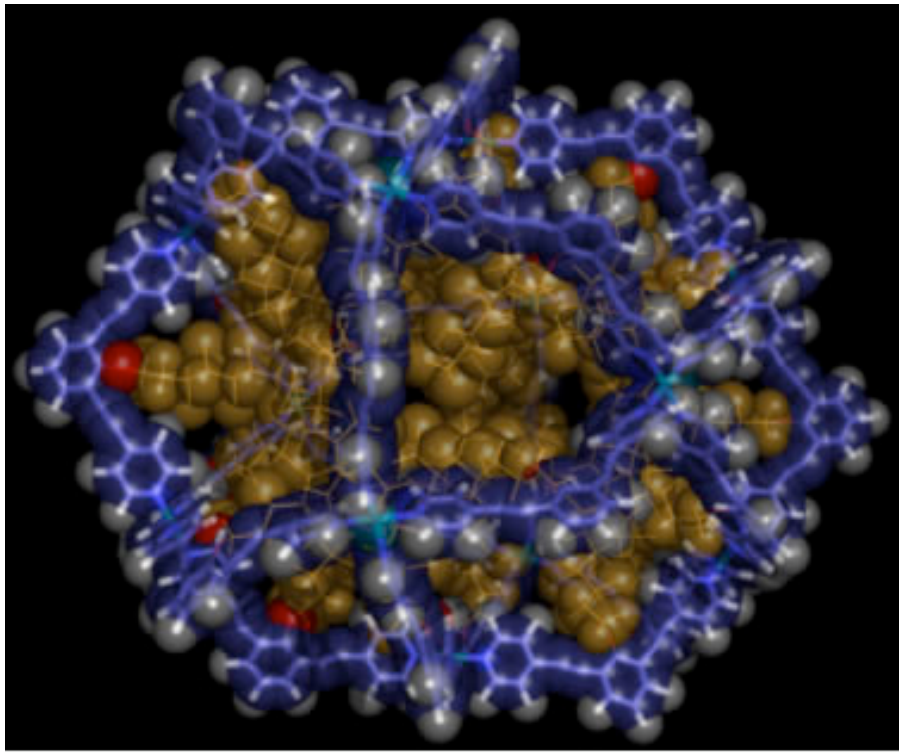
B) Materials under extreme conditions (eg., earth science)


Novel material device: polymer and functional organic materials, & nano materials


Environment, energy, and rare materials (high sensitivity chemical state analyses)


Structural biology of molecular machinery

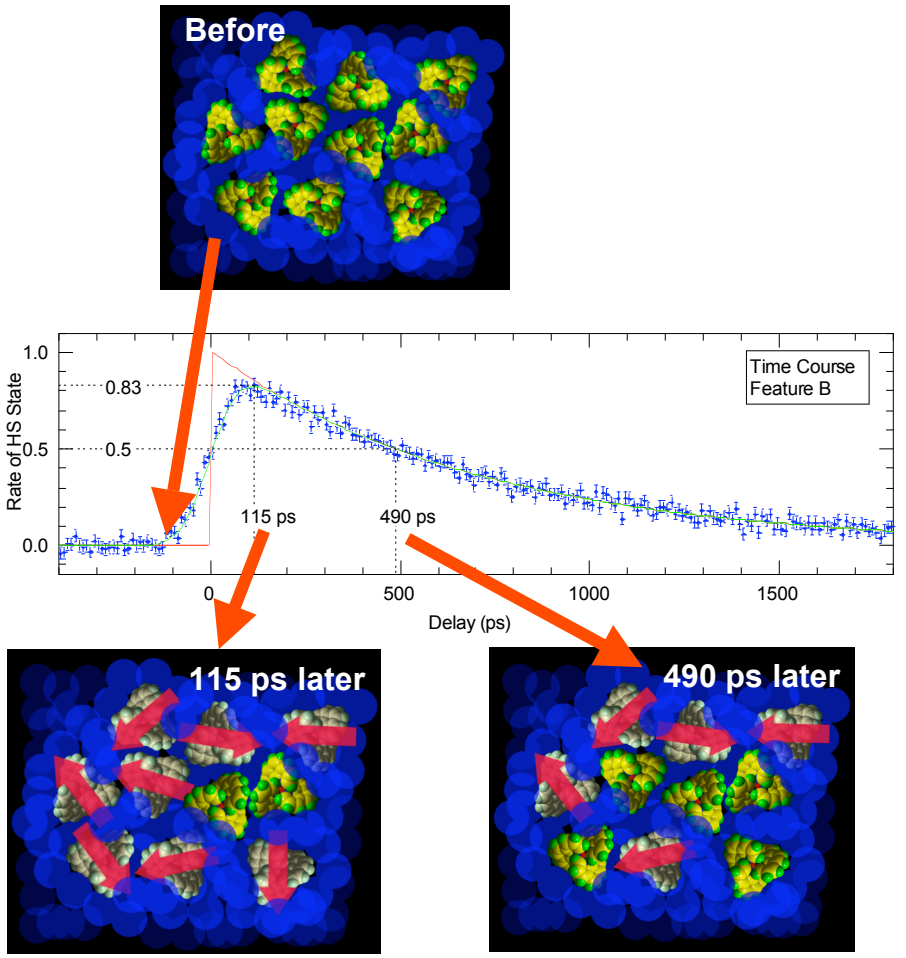

Chemical reactions: from fundamentals to applications



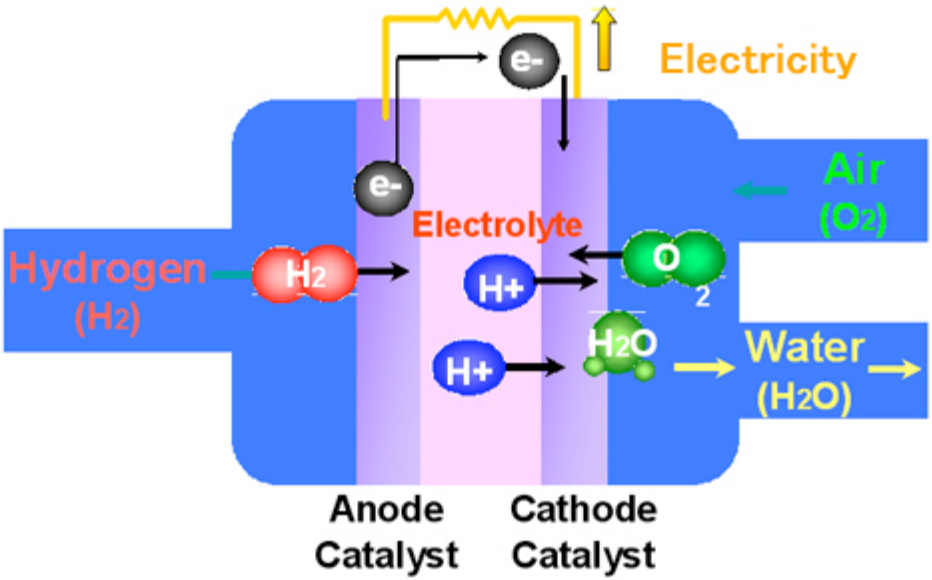
Fluorous Nanodroplets Structurally Confined in and Organopalladium Sphere., S. Sato, *et al.*, *Science*, 313, 1273-1276, Sep. 5, 2006. (AR-NW2A)

Structure of reaction intermediates within 100 ps of reaction initiation ilucidated by time-resolved XAFS (AR-NW14A)

Towards development of solar cells and novel photocatalysis mechanisms and solar cells



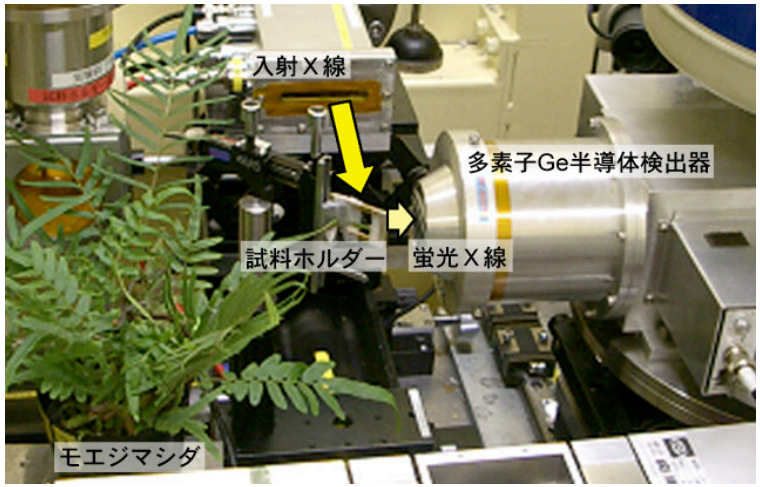
Fuel Cell Principle



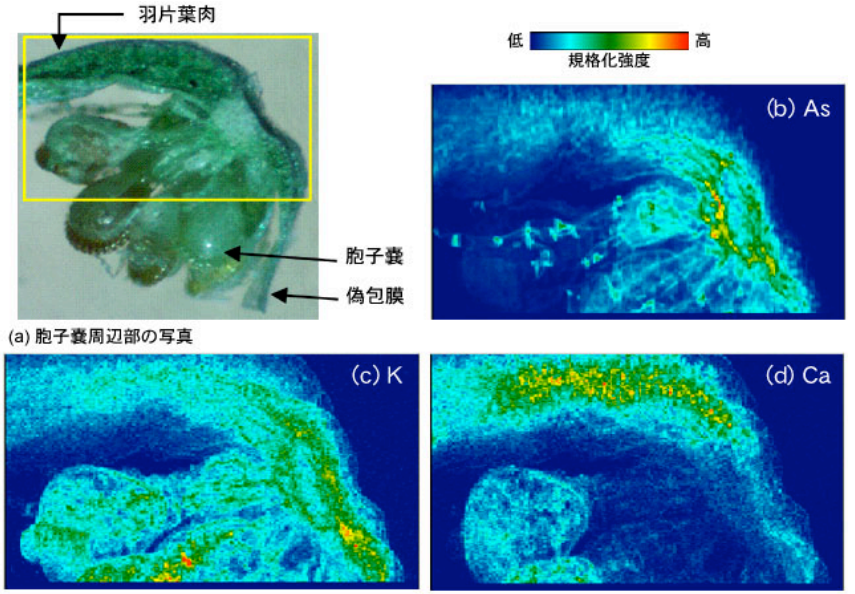
Theoretical Efficiency $\Delta G/\Delta H$ = 83%(Hydrogen)

The First In-Situ Time-Resolved Observation of the Structure and Reaction Kinetics on the Cathode Surfaces in a Pt/C Fuel Cell, Mizuki Toda, *et al*. (U of Tokyo), *Angew. Chem. Int. Ed*., Mar, 2007. Received Royal Society of Chemistry's 1st PCCP (Physical and Chemical Physics) Prize.

Phytoremediation of As by Fern Izumi et al., Tokyo Univ. of Science



Experimental setup of BL4A

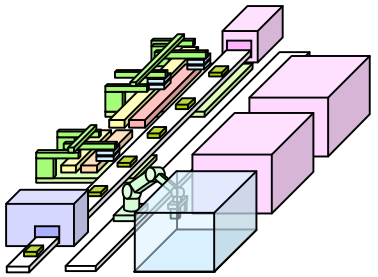


Distributions of As, K, and Ca

Structural Biology Research Center

Crystallization

200,000 trials/day

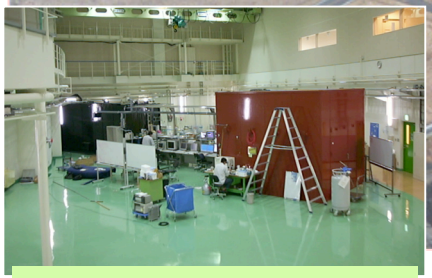


Structural Biology Research Center

Modified SSRL sample changer robot

6.5GeV PF-AR

2.5GeV PF ring



NW12A (2003)

BL-6A

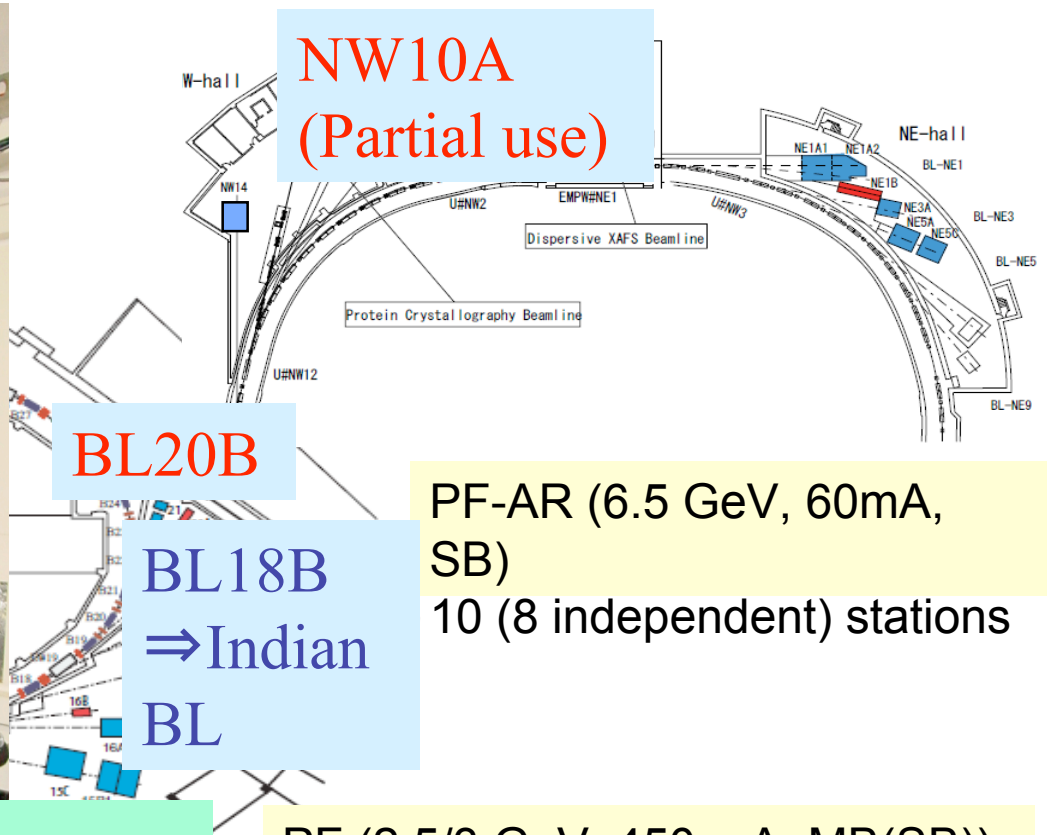
BL-5A (2004)

BL-17A (2006)

International Collaborations

Australian BL20B since 1992, one of the most productive BLs at PF

3000 registered users
500~600 papers published each year



NW10A
(Partial use)

BL20B

BL18B
⇒Indian
BL

PF-AR (6.5 GeV, 60mA, SB)
10 (8 independent) stations

PF (2.5/3 GeV, 450 mA, MB(SB))
56 (48 independent) stations

ANBF-Photon Factory
698 Experiments
~1,500 scientist visits to Japan
>> 2000 Days of beamtime
Many hundreds of publications

ons for Hard X-rays
ons for VUV and Soft X-rays

Strategic Industrial Use of the Photon Factory

- MEXT/JST Program -- Open Advanced Facilities Initiative for Innovation (Strategic use of synchrotron by industries).
  Open the doors to industrial users and open the route to creating innovative outputs.
- A system for industrial beam time was already in place at the Photon Factory, BUT historically it was used by experienced uses only because of the insufficient level of supporting staff.
  In this project, operation cost and personnel expenses are supported by the MEXT.
- Currently *11 active projects*
  Strategic Promotion of Industrial Research Activities using synchrotron radiation towards innovation in
  - Energy research
  - Production of new materials
  - Environmental science and applications

  main tools are XAFS, DXAFS, XFA, & imaging techniques
- Further reach-out efforts to find new users

Upgrade Program of the PF, PF-AR beam lines

- Increase the number of undulator beam lines.
- Solve the “hybrid” problem; X-ray & VSX.
- Exploration of new scientific fields towards ERL: imaging and time-domain sciences

Medium (~5m) and long (9m) straights

- 5 for VUV/SX, among 7
- Full use of elongated straight sections
- Solve the X-VSX hybrid problem; dedicate to U
- One single-application, one semi-specific or rather multi-pupose branch for one BL

Short (~1m) straights

- Newly created 4 straight sections.
- Dedicate them to (soft) X-ray experiments

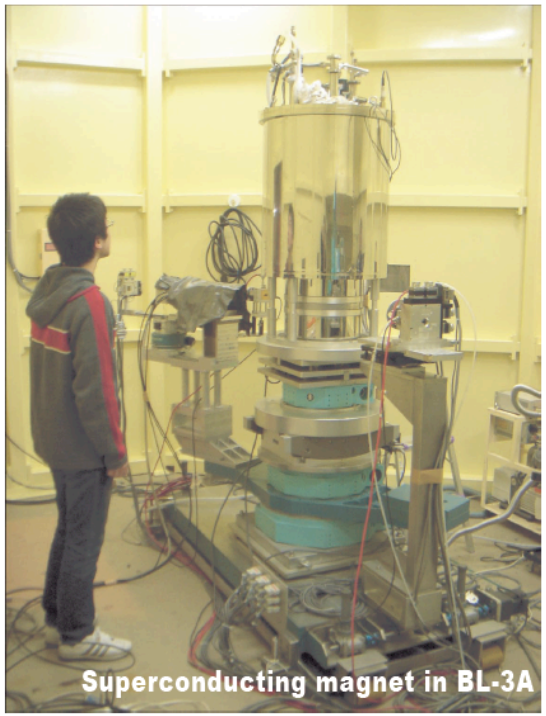
Renewal of Beamlines VSX-ID/X-ID /Bend

FY	commissioned	decommissioned
2002	NW12A	
2003	BL-5A	BL-28A, 28B
2004	BL-28A	BL-17A, 17B, 17C, 18B
2005	BL-17A, 18B, NW14A, NW10A	BL-12B, 10B, *6B, 6C*
2006	BL-28B, 3A, 6C	BL-16A, 3A, 3C1, 3C2
2007	*BL-16A*	*BL-16B*
2008	*NE3A, NE1*	*NE3A, NE1A1, NE1A2, NE1B, NE5A, NE5B*
	(BL-1A, NE7(9), BL-14C1/C2, BL-13…)	*(BL-1C, 14C1/C2, 13A, 13B1, 13B2, 13C, …)*

Underlined BL are/have been upgraded using external funds

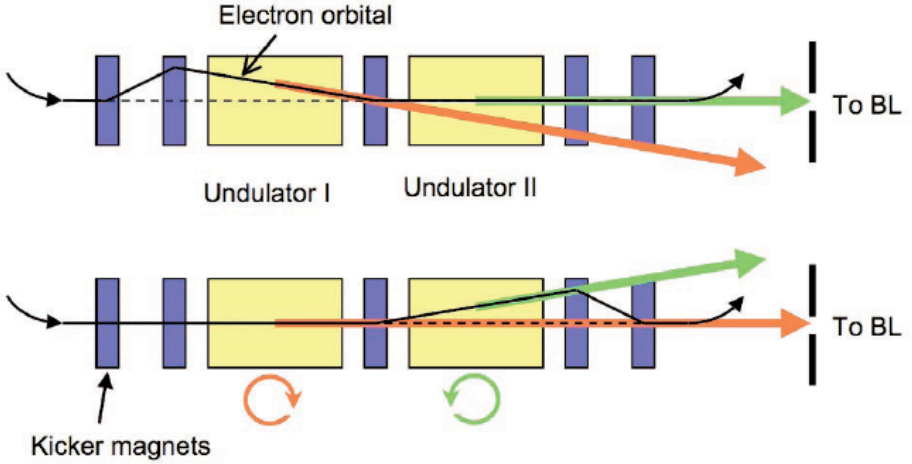
New BL3A (SGU) and BL16A (Apple-II)

BL3A: Beamline for Structural Materials Science



Two diffractometers and an 8T superconducting magnet in the experimental hutch. BL-3A is most suitable for studies on materials structures under magnetic field, eg. Magnetic chirality, giant magnetoresistance (GMR) effects, etc.

BL16A: Fast Polarization-Switching Beamline for SX Spectroscopic Studies



Second Apple-II undulator to be supported by Quantum Beam Grant of the MEXT

A R－N E　Redevelopment

BEFORE

NE1A2：Angiography

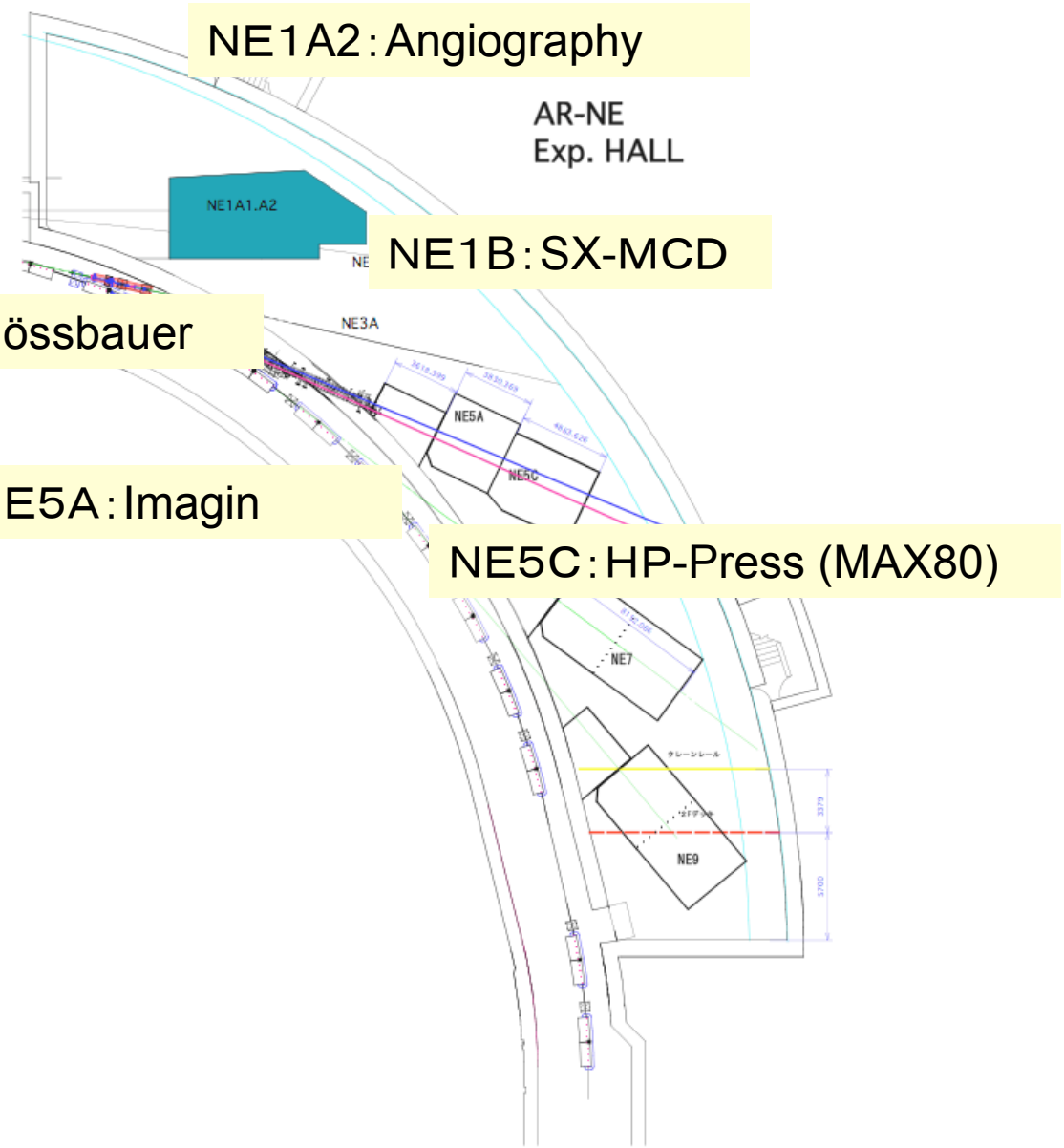
NE1A1：
Compton
Scattering

NE1B：SX-MCD

NE3：Mössbauer

NE5A：Imagin

NE5C：HP-Press (MAX80)



A R－N E　Redevelopment

TRANSITION

BL13A：High Temp, HP DAC

NE1A2：Angiography

Terminated with possibility for building a micro-angiography BL on the ground level

New NE1：HP & Mössbauer

NE1A2：Compton Scattering

NE1B：SX-MCD

New BL16A

NE3：Mössbauer

NE3：Astellas Pharma BL

To other facilities

NE5A：Imagin

NE5C：HP-Press (MAX80)

Closed but activities to be moved to NE7

New NE7：HP-Press & Imaging

BL14C2：HP-Press

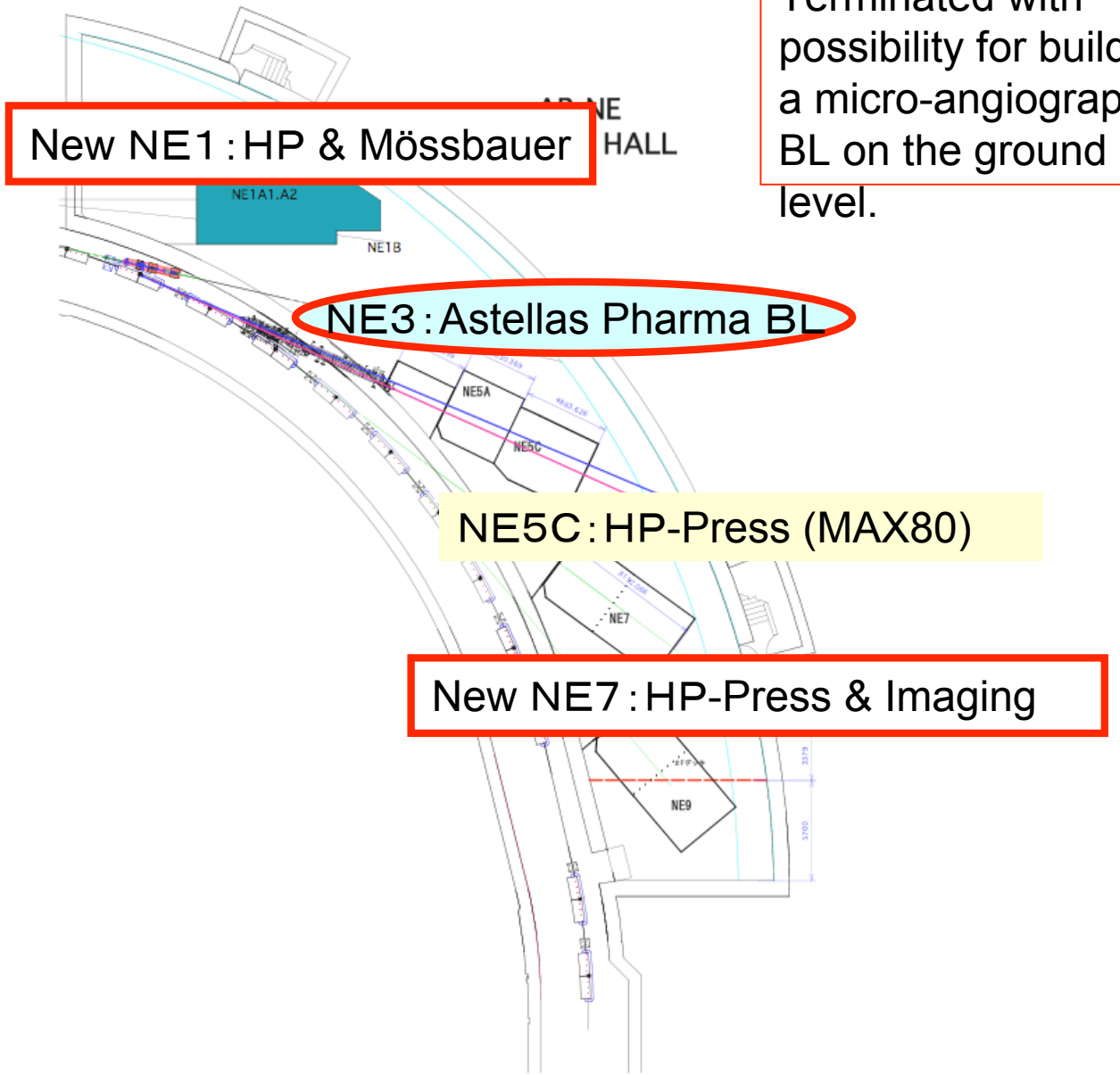
NE3：Astallas Pharma BL

IT4 ⇒ New NE7

A R－N E　Redevelopment

AFTER

Terminated with possibility for building a micro-angiography BL on the ground level.



High Energy Accelerator Research Organization (KEK)
Institute of Materials Structure Science (IMSS)
Photon Factory

International Science Advisory Committee – 2nd ISAC Meeting – March 4-5, 2008*

E. Fontes – Cornell University
H. Fukuyama – Tokyo University of Science
E. Gluskin – Advanced Photon Source
K. Hodgson – Stanford University, Chairperson
I. Lindau – Stanford University
K. Miki – Kyoto University
T. Ohta – Ritsumeikan University
M. Ree – Pohang Accelerator Laboratory
V. Saile – University of Karlsruhe
H. Suematsu – Riken Harima Institute

Subcommittes: Electronic Properties (27, 28 Feb, 2008)
Medical imaging (29 Feb, 2008),

PF, Photon Science and the KEK Roadmap

High Energy Accelerator Research Organization (KEK)
Institute of Materials Structure Science (IMSS)
Photon Factory

- ISAC recognizes that PF, SBRC, and the proposed SMRC within IMSS do forefront and pioneering research across a broad range of materials and life sciences. It is essential that the impact of this research and its importance to Japan be recognized by KEK as a key part of its mission.
- In the domain of the “nanoscale”, the properties of x-rays (including their short wavelength and penetrating ability) greatly enable and drive discovery. They provides the means to understand the basic structure and functionality of materials from the viewpoint of basic science (areas include condensed matter, biological systems, environmental and chemical sciences and many others).
- KEK can be a world leader in research that will enable solving important societal challenges of our time, including:
  - Design of new drugs to cure and control human disease and improve our health and well being
  - Understanding of man-made and natural pollution and remediation processes in our environment
  - Development of improved processes and materials underlying clean, efficient, sustainable and environmentally friendly energy production, storage and conversion
  - Understanding, tailoring and controlling the properties of atomically engineered nanoscale materials for advanced technology

KEK as a World Leading Center For Scientific Discovery using Photons, Neutrons and Muons

High Energy Accelerator Research Organization (KEK)
Institute of Materials Structure Science (IMSS)
Photon Factory

- ISAC wishes to emphasize the broad and deep impact of the research done at PF. as enabled by its accelerator-based light source and talented scientific staff.
- KEK provides a unique and world class environment for accelerator science and excellence for development of future generation of photon sources.
- The Research Centers of excellence are a key additional element in delivering world class science from the accelerator based facilities.
- ISAC urges that KEK recognize the unique role played by PF within the context of Japanese synchrotron science, especially noting that:
  - PF provides unique instruments of the highest quality for soft x ray research in Japan where there has traditionally been world leadership in this important area for condensed matter studies and AMO physics.
  - ERL promises to be a unique, x-ray source complementary to XFEL at Spring-8
  - KEK and PF have the responsibility and stewardship of a very important large National and International photon science user community. Currently PF serves about 3000 users from a broad range of scientific disciplines in academia, national laboratories and industry and this number continues to grow.

Condensed Matter Research Center (CMRC)

High Energy Accelerator Research Organization (KEK)
Institute of Materials Structure Science (IMSS)
Photon Factory

- ISAC recognizes the strategic importance of a focused center that is organized around the study of advanced materials. It is an area that is important for future growth of PF and provides strong opportunities for university/industry ties.
- ISAC believes that is important to carefully consider the organizational structure that would be most effective to achieve selected scientific goals. We encourage that the PF management broaden the discussion to the wider outside community and rapidly convene a group of experts to visit and advise on details.
- ISAC believes that the SMRC can be modeled after the very successful SBRC. Management needs to make a concerted effort to inform and engage staff and outside scientists in the concept for the proposed center. Important elements also include attracting external funding and cooperation with the user community.
- ISAC emphasizes that a critical and indeed unique opportunity exists to appoint a world-leading scientist to head the Center. This position is critical to the strategy of developing photon science as an increasingly strong component of KEK.
- The concept is very broad (photons, neutrons and muons) and this could be unique. By engaging Spring-8, it is clear that the overall strategy will be stronger.

Upcoming PF-ISAC and subcommittee meetings

Next PF-ISAC: December 16 & 17

Report and discussion on the IMSS symposium

ISAC-Machine subcommittee: 23, 24 Feb 2009

Efim Gluskin (APS, Chair)
Haruo Ohkuma (JASRI/SPring8)
Toshitada Hori (Hiroshima University HiSOR)
Joachim Pflueger (DESY)
Bob Hettel (SSRL)

ISAC-Life Sciences: Feb to March 2009

Members to be decided.

16 October 2008

Thank you for your attention.