

Overview of SPring-8

1. Introduction

The Japan Atomic Energy Research Institute (JAERI) and RIKEN (the Institute of Physical and Chemical Research) jointly formed the SPring-8 Project Team in 1988. Construction of the SPring-8 facility started in 1991. The facility produced its first synchrotron radiation in March 1997 and became operational in October 1997. Regular user mode operation began in 1998.

The Japan Synchrotron Radiation Research Institute (JASRI) was established as a non-profit foundation in 1990 and, in 1994, became a government-designated national organization for promoting synchrotron radiation research. The Department of Synchrotron Radiation Research of JAERI Kansai Research Establishment and RIKEN Harima Institute were founded at the SPring-8 site in 1995 and 1997, respectively.

When SPring-8 began operation in October 1997, JAERI and RIKEN entrusted JASRI with the management, operation and development of SPring-8 according to a tripartite agreement among JASRI, JAERI and RIKEN.

Historical landmarks of the SPring-8 project are as follows:

- Oct. 1988: JAERI and RIKEN formed the SPring-8 Joint Project Team.
- June 1989: Harima Science Garden City, Hyogo Prefecture, was selected for the SPring-8 construction site.
- Dec. 1990: JASRI was established as a non-profit foundation.
- Nov. 1991: Construction of the facility began.
- May 1993: The SPring-8 Users Society was established.
- Oct. 1994: The government passed legislation establishing JASRI as a national organization for promoting synchrotron radiation research.
- Aug. 1996: Commissioning of the linac was started and acceleration of the electron beam to 1 GeV was achieved.
- Dec. 1996: Commissioning of the synchrotron was started and acceleration of the electron beam to 8 GeV was achieved.
- Mar. 1997: Commissioning of the storage ring was started and the first synchrotron radiation was observed.
- Oct. 1997: SPring-8 was opened for research with a beam current of 20 mA.
- May 1998: The storage ring stored a beam current of 100 mA.

Oct. 1998: Beam currents increased to 70 mA in user-service mode.

June 1999: Beam currents increased to 100 mA (designed value) in user-service mode.

2. Accelerators

In the third year 1999 elapsed from the first beam injection in the SPring-8 storage ring, the ring was operated with a high beam stability and a long beam lifetime at a beam current of 100 mA. The total operation time of the ring was 4,864 hours in the year, among which 3,364 hours were devoted to user time.

Before the summer shut down, the ring was operated in a 2/3 or 24/29 partial filling mode to avoid beam expansion due to ion trapping in the electron beam. Later, a hybrid filling mode which consisted of a partial filling and isolating several bunch modes was introduced to serve the requirements of the various kinds of users utilizing the ring in the same time run. In addition, the storage ring optics was changed from the original hybrid optics with an alternatively varying horizontal beta function to a new optics named HHLV optics, where the variation in the horizontal and vertical beta functions is the same in all the normal cells. The new optics can provide a high radiation brilliance in all the beam lines for insertion devices, and the beam lifetime has also been extended to 140 hours from the 70 hours of the old optics. The electron beam orbit was stabilized to less than 1 μm by an orbit correction performed every minute. The coupling constant between the horizontal and vertical betatron oscillations was reduced to 0.04 %.

Intensive work on the hard and software was performed to prepare for the installation of a new optics named "Phase II lattice", in which four straight sections about 30 m long for long undulators are introduced equidistantly around the ring by rearranging the quadrupole and sextupole magnets in the ring.

The injector linac was operated with a beam bunch length of 1 ns and 40 ns. The 40 ns bunch operation was served for a fast beam injection for the partial filling mode. The 1 ns bunch operation was synchronized to the RF frequency of the injector synchrotron and the storage ring. The beam bunch was purified to a single bunch by the RF-knock out method in the synchrotron then injected and accumulated in the several RF target buckets in the storage ring. The 1 ns bunch operation also served for an efficient beam injection into the 1 GeV storage ring, New SUBARU.

3. Beamlines

SPring-8 is able to accommodate 62 beamlines, one more than the 61 initially planned, since an additional beamline proposal for infrared studies was accepted.

The beamlines are divided into four groups according to source types and source points: beamlines from insertion devices (IDs) installed in low beta sections, those from IDs in high beta sections, those from IDs in the long straight sections, and those from the bending magnets.

The beamlines are also classified into three groups according to use: public beamlines, JAERI/RIKEN beamlines and contract beamlines.

3.1 Public Beamline

The public beamlines have been constructed by SPring-8 and are open for public use.

At the end of 1998, ten public beamlines were being operated for public use. These are: XAFS (BL01B1), Crystal Structure Analysis (BL02B1), High Temperature Research (BL04B1), High Energy Inelastic Scattering (BL08W), Nuclear Resonant Scattering (BL09XU), Extremely Dense State Research (BL10XU), Soft X-ray Spectroscopy of Solids (BL25SU), Soft X-ray Photochemistry (BL27SU), Physicochemical Analysis (BL39XU), and Structural Biology I (BL41XU).

In 1999, five public beamlines were commissioned and available for trial use: Powder Diffraction (BL02B2), High Energy X-ray Diffraction (BL04B2), Medical and Imaging I (BL20B2), White Beam X-ray Diffraction (BL28B2), Structural Biology II (BL40B2).

At this time, four public beamlines were under construction: Medical and Imaging II (BL20XU), High Resolution Inelastic Scattering (BL35XU), High Flux (BL40XU) and Infrared Materials Science (BL43IR).

The R&D beamlines constructed by SPring-8 are included in the public beamline category. R&D(1) (BL47XU) had been completed. In 1999, R&D(3) (BL38B1) and R&D(2) (BL46XU) were under construction.

3.2 JAERI / RIKEN Beamline

JAERI / RIKEN beamlines have been constructed by JAERI / RIKEN for their exclusive use.

Six beamlines were operational: Material Science I (JAERI, BL11XU), Material Science I (JAERI, BL14B1), Actinide Science (JAERI, BL23SU), Coherent X-ray Optics (RIKEN, BL29XU), Structural Biology II (RIKEN, BL44B2), and Structural Biology I (RIKEN, BL45XU). Of these, the BL29XU undulator beamline is to be extended to an experimental station 1 km from the source.

Construction of a 30 m-long straight section beamline, BL19LXU (RIKEN) is scheduled to be completed in FY 2000.

3.3 Contract Beamline

The contract beamlines are being constructed by their proposers for their exclusive usage.

SPring-8 invites applications from Japan and overseas to construct contract beamlines. In contrast to the public beamlines, these are constructed and owned by their users. Applicants first submit a letter of intent to construct a beamline. They can do this at any time and, subject to approval, they then have three years to produce detailed proposals for beamline construction and use.

The Contract Beamline Committee has approved letters of intent from eight organizations to construct a total of ten contract beamlines. Six organizations have also had their detailed beamline construction plans approved by the committee.

Hyogo Prefecture took the lead in the contract beamline construction, and its BL24XU beamline began operation in May 1998. In 1999 the Industrial Consortium for material research composed of 13 companies completed two beamlines BL16XU and BL16B2, and the Institute for Protein Research, Osaka University completed BL44XU.

The Research Center for Nuclear Physics, Osaka University, the National Institute for Research in Inorganic Materials, Science and Technology Agency and the Asian and Pacific Council for Science and Technology (APCST) in Taiwan were constructing BL33LEP, BL15XU and BL12B2, respectively and will be completed in 2000. Another beamline of APCST, BL12XU, will be completed in 2001.

4. Facility Construction

SPring-8 workers have completed work on the construction of the accelerators and several main buildings. Additional construction is continuing on the Experimental Facility W attached to the Storage Ring Experimental Hall (floor area: 1-storied, 800 m², completion: Oct. 2000).

5. SPring-8 Budget

The first construction phase was from 1987 to 1997. During this phase, construction of the accelerators was completed. As the end of the first phase had been reached, the JAERI-RIKEN Project Team was dissolved. JASRI has been entrusted with the responsibility for; 1) the operation, maintenance and improvements to SPring-8, 2) technical support for the new beamline construction, and 3) R&D for new SR applications. The total budget for JASRI for fiscal year 1999 was 11,927 million yen. About 90 % of the total budget is for SPring-8 operation and maintenance, which comes through JAERI and RIKEN. The yearly change in the budget for the period from 1994 to 1999 is shown in Fig. 1. It can be

clearly seen that JASRI's budgetary situation has become steady with the transit from the first phase to the second utilization phase in 1998. Since the construction of new beamlines is still the mission of either JAERI or RIKEN, there is no cost appropriation for it.

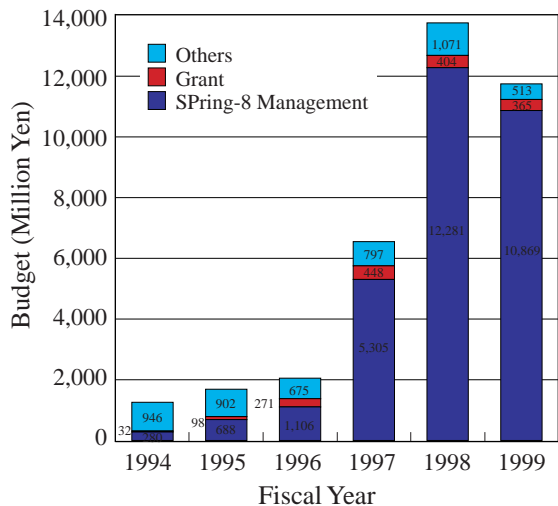


Fig. 1. Yearly Budget of JASRI.

6. SPing-8 Organization and Committee

6.1 Organizational Structure

The JASRI organizational structure is shown in the figure in the Appendix. In 1997, the JAERI-RIKEN Project Team was dissolved, and many members of the team moved to JASRI. By the end of March 2000, JASRI had a total full-time staff of 322.

6.2 Committees

Figure 2 illustrates how SPing-8's principal committees interact.

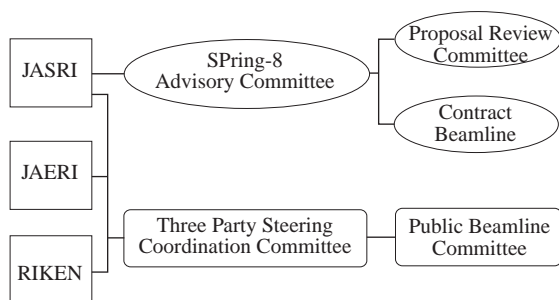


Fig. 2. SPing-8 Committees.

6.2.1 SPing-8 Advisory Committee

At the request of JASRI, the SPing-8 Advisory Committee deliberates and makes recommendations on important matters such as the solicitation and selection of proposals for conducting research with the

public beamlines, as spelled out in the "Law regarding Promotion of Common Use of the Synchrotron Radiation Facility (SPing-8)". The committee met three times in 1999 as follows:

12th Meeting on February 23

- 1) Implementation plan for management of common use in FY 1999
- 2) Acceptance of proprietary research proposals
- 3) Reelection of members of the Proposal Review Committee and the Contract Beamline Committee
- 4) Public announcement of approved proposal subjects; Selection method of urgent proposals

13th Meeting on July 26

- 1) Conclusion of the Memorandum of Understanding for promoting cooperative research between JASRI and the Paul Scherrer Institute in Switzerland
- 2) Determination of the charge for the beam time in proprietary researches
- 3) Review and selection of proposals for research using public beamlines
- 4) Introduction of the system for long term use of the beamline
- 5) Promotion of advanced R&D by in-house staff
- 6) Activities of the Public Beamline Committee

14th Meeting on December 6

- 1) Fifth selection of proposal for research using public beamlines
- 2) Introduction of the system for long term use of the beamline
- 3) Amendment to managing guidelines of the SPing-8 Advisory Committee
- 4) Effective use of beamtime
- 5) Transaction of urgent proposals

6.2.2 Three Party Steering Coordination Committee

The Three Party Steering Coordination Committee promotes effective cooperation among JASRI, JAERI and RIKEN. The committee met five times in 1999 as follows:

1st Meeting on February 25

- 1) Implementation plan for SPing-8 management in FY 1999
- 2) Results of deliberation in the Public Beamline Committee
- 3) Members of the Public Beamline Committee in FY 1999
- 4) Preparation of the COE project by SPing-8 in-house staff

2nd Meeting on March 17

- 1) Results of deliberation in the Public Beamline Committee
- 2) Implementation plan for SPing-8 management in FY 1999

- 3) Application for approval of the business plan in FY 1999

3rd Meeting on July 2

- 1) Present status and construction of R&D beamlines
- 2) Future activity of the Public Beamline Committee
- 3) System for long term use of the beamline
- 4) Start of operating the storage ring with a beam current of 100mA

4th Meeting on September 28

- 1) Report from the Public Beamline Committee
- 2) Promotion of the COE project on advanced technology and applications at SPring-8
- 3) Establishment of the SPring-8 Advisory Council

5th Meeting on December 16

- 1) Acceptance of the report from the Public Beamline Committee
- 2) Preparation of the COE project on advanced technology and applications by SPring-8 in-house staff

6.2.3 Proposal Review Committee

Under the Advisory Committee, the Proposal Review Committee evaluates and selects proposals to use the public beamlines. The committee met five times in 1999 as follows:

16th Meeting on March 23

Next call for proposals

17th Meeting on April 15

- 1) Method of review of proposals
- 2) Schedule for review of proposals in FY 1999

18th Meeting on May 26

Method of review of proposals

19th Meeting on July 22

- 1) Review of proposals for beam time in the second half of 1999(1999B)
- 2) Report on the urgent proposal review
- 3) Review of proposals in the forthcoming periods

20th Meeting on November 22

- 1) Review of proposals for beam time in the first half of 2000 (2000A)
- 2) Report on the urgent proposal review
- 3) Review of proposals in the forthcoming periods

6.2.4 Contract Beamline Committee

Under the SPring-8 Advisory Committee, the Contract Beamline Committee deliberates on planning for the contract beamlines used by owners.

6.2.5 Public Beamline Committee

The Public Beamline Committee has responsibility for the entire process of solicitation and evaluation of proposals for public beamline construction projects. The committee reports the evaluations of proposals to the Three Party Steering Coordination Committee.

The committee met five times in 1999 as follows:

10th Meeting on February 18

- 1) Report submitted to the Three Party Steering Coordination Committee and new consultation
- 2) Present status of beamline construction
- 3) Construction plan of JAERI and RIKEN beamlines
- 4) Policy of future beamline construction

11th Meeting on March 10

- 1) Evaluation of letters of intent for use of public beamline
- 2) Policy of future beamline construction

12th Meeting on June 22

- 1) Selection of proposals for public beamline construction
- 2) Status of R&D beamlines
- 3) Construction plan for Engineering Science Research Beamline
- 4) Outline of the report to the Three Party Steering Coordination Committee

13th Meeting on July 21

- 1) Present construction plan of JAERI and RIKEN beamlines
- 2) Report to the Three Party Steering Coordination Committee
- 3) Issues for the report to be submitted to the Three Party Steering Coordination Committee

14th Meeting on December 9

- 1) Present status and future plan of beamline construction
- 2) Outline of the Engineering Science Research Beamline
- 3) Prospects of reported 6 beamline construction plan
- 4) Future activities of the Public Beamline Committee

7. Applications to Use Public Beamlines

Each year SPring-8 issues two calls for proposals to use its public beamlines. Approved applicants are allocated beam time in the forthcoming SPring-8 research period. The first such period ran from October 1997 (when the facility opened) until the end of Japan's financial year, March 1998. The second research period ran from April 1998 until October 1998. After a somewhat longer third research period (November 1998 until June 1999), SPring-8 divided public beamline operation between the first and second half of the calendar year, with research periods running from January through June and from July through December.

The respective proposal submission deadlines for the fourth and fifth research periods were June 19, 1999 and October 16, 1999. SPring-8 Proposal Review Committee approved 246 out of the 431 proposals submitted for the fourth period and 326 out of the 424

Table 1. SPring-8 Operational Results for 1999

Operation Cycle		User Beam Time (hour)	Number of Experiments	Number of Users	8GeV Operation Mode	
99-01	01.28.99-02.12.99	96	16	78	<70mA, 2/3 full bunch,	3weeks
99-02	02.17.99-03.05.99	304	49	170	<70mA, single bunch,	3weeks
99-03	03.10.99-03.26.99	307	54	188	<70mA, single bunch,	3weeks
99-04	03.31.99-04.16.99	310	39	146	<70mA, single bunch,	3weeks
99-05	04.21.99-04.30.99	187	30	107	<70mA, single bunch,	2weeks
99-06	05.12.99-05.28.99	306	41	160	<70mA, single bunch,	3weeks
99-07	06.02.99-06.18.99	339	46	171	<100mA, fill bunch,	3weeks
99-08	06.23.99-07.02.99	144	22	92	<100mA, fill bunch,	3weeks
99-09	09.28.99-10.15.99	310	52	270	<100mA, fill bunch,	3weeks
99-10	10.20.99-11.05.99	304	73	313	<100mA, fill bunch,	3weeks
99-11	11.10.99-11.26.99	308	88	431	<100mA, single / fill bunch,	3weeks
99-12	12.02.99-12.24.99	449	119	617	<100mA, single bunch,	3weeks
Total		3,364	629	3,993		

Third research period: November 1998 - June 1999

Fourth research period: September 1999 - December 1999

for the fifth period. Of the approved proposals for the fourth period, the number of applications for proprietary research was five and 1% was from overseas. In the fifth period, the equivalent figures were four for proprietary research and 4% from overseas. The breakdown of approved proposals is shown in Fig. 3.

SPring-8 operational results in 1999 is shown in Table 1. In 1999, SPring-8 provided users with 3,364 hours of beam time in 12 operation cycles. Some 3,993 individuals used the facility's public beamlines in 629 separate experiments. Between the October 1997 opening of SPring-8 for research and the end of 1999, a total of 6,356 public beamline users conducted 885 experiments. It is difficult to calculate the actual number of users in 1999. Instead, the number of individuals registered as radiation workers of SPring-8 in 1999 is reported in this report (Safety Office) as 3,442.

8. User Support

The User Office is responsible for user support services such as providing SPring-8 users with information and assisting necessary procedures for conducting experiments. In a limited number of cases, JASRI is able to support the travel and subsistence costs of public beamline users who visit the facility to conduct non-proprietary research.

The Safety Office takes care of user support of safety control.

The Experimental Facilities Division is responsible for providing users with technical support. A beamline

scientist / engineer is assigned for each public beamline to give users technical advice and support for experiments.

JASRI also electronically provides users with up-to-date information on the SPring-8 Home Page at <http://www.spring8.or.jp/>.

As information services the following booklets and a periodical are published.

"SPring-8 Beamline Handbook" summarizes technical information on beamlines, including their specifications, performance characteristics and technical details.

"SPring-8 User Guide" provides information on the use of the SPring-8 facility, covering from the research proposal submission to the completion of experiment.

"SPring-8 User Information" is a bimonthly publication in Japanese, which provides the latest information on the SPring-8 facility.

SPring-8 activities are reported in the following periodicals.

"SPring-8 Annual Report"

"SPring-8 User Experiment Report": A compilation of experimental reports submitted to JASRI by users who conducted experiments during each research period.

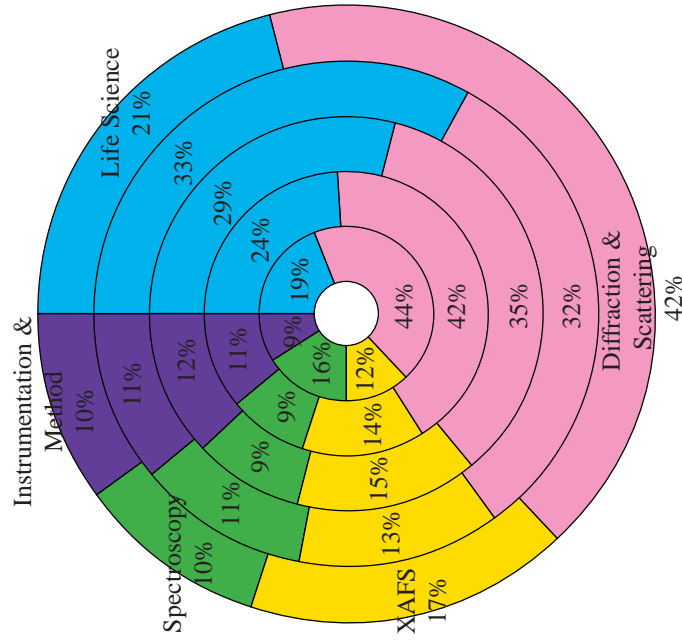
"SPring-8 Research Frontiers": Annual publication, which describes the remarkable scientific achievements made at SPring-8.

Breakdown of Approved Proposals

Fig. 3-1

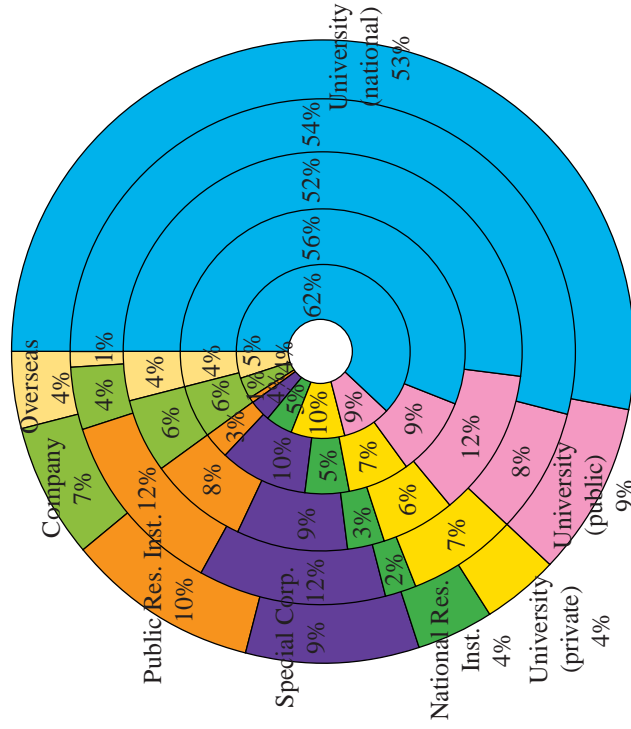
1st research period: October 1997-March 1998, Proposed 198, Approved 134
 2nd research period: April 1998-October 1998, Proposed 305, Approved 229
 3rd research period: November 1998-June 1999, Proposed 392, Approved 258
 4th research period: September 1999-December 1999, Proposed 431, Approved 246
 5th research period: February 2000-June 2000, Proposed 424, Approved 326

Approved Proposals
by Research Area



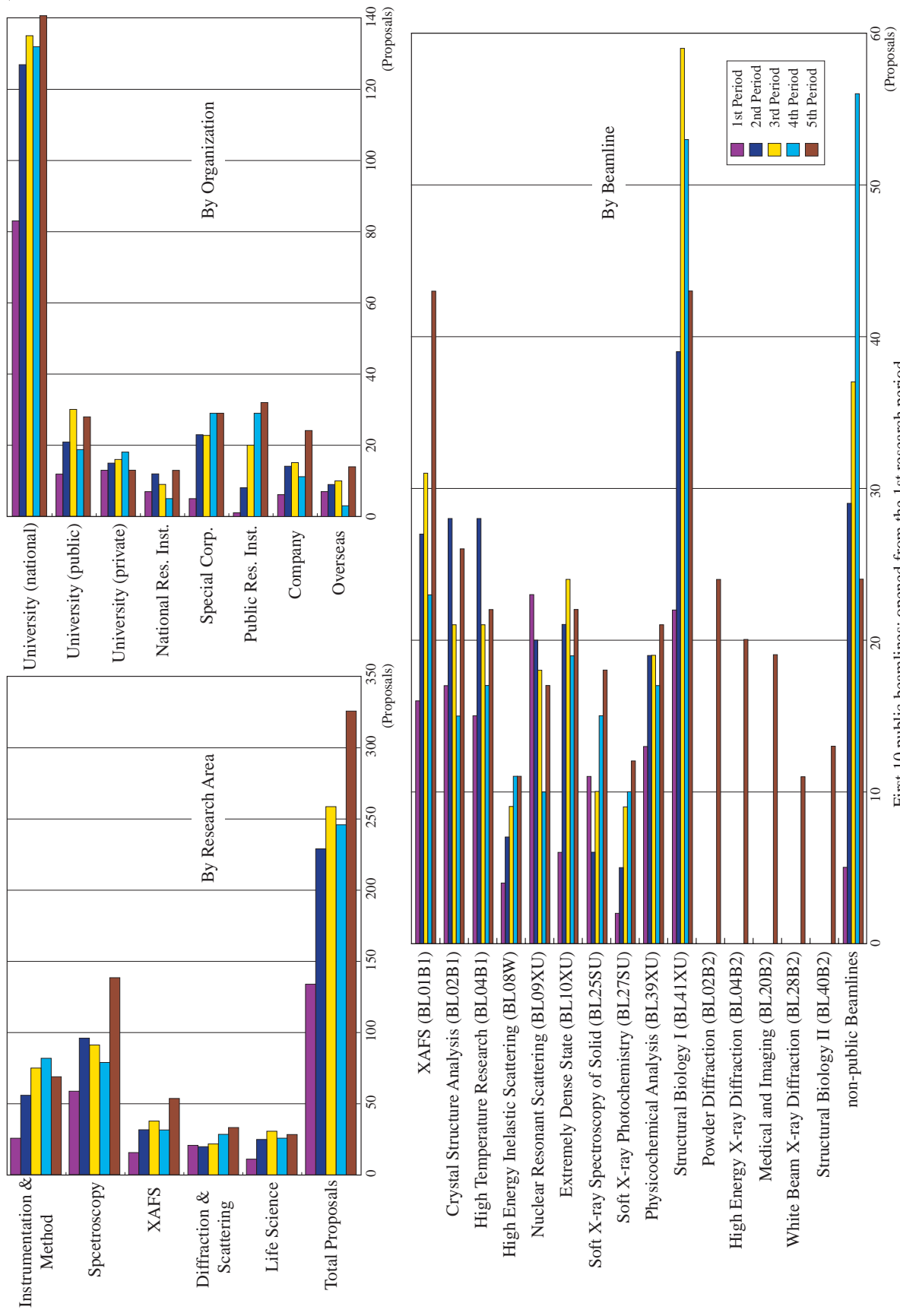
	1st	2nd	3rd	4th	5th
Life Science	26	56	75	82	68
Diffraction & Scattering	59	96	92	78	138
XAFS	16	32	38	32	54
Spectroscopy	21	20	22	28	33
Instrumentation & Method	12	25	31	26	33

Approved Proposals
by Organization



	1st	2nd	3rd	4th	5th
University (national)	83	127	135	132	173
University (public)	12	21	30	19	28
University (private)	13	15	16	18	13
National Res. Inst.	7	12	9	5	13
Special Corp.	5	23	23	29	29
Public Res. Inst.	1	8	20	29	32
Company	6	14	15	11	24
Overseas	7	9	10	3	14

Fig. 3-2



First 10 public beamlines: opened from the 1st research period
 Next 5 public beamlines: opened from the 5th research period

9. SPring-8 Users Society

The SPring-8 Users Society was formally established in 1993 aiming at promoting scientific programs to be conducted at SPring-8. At the end of 1999, the total membership of the Users Society was 1,310 (69% from universities, 17% from national laboratories and 13% from industry). In the Users Society there are 41 research sub-groups. Their roles are to make scientific programs on their specific subjects, to propose construction of public beamline, and to cooperate on the construction and upgradeing of experimental stations.

10. Public Relations

Public Relations Office was established on January 1, 1998 and reorganized Public Relations Division on May 1999. The role of the division is to disseminate news of SPring-8 activities to the public. Our activities include holding press conferences to report the results of SPring-8 research, editing pamphlets and videos to introduce SPring-8, organizing events, attending exhibitions, receiving and guiding visitors around the facilities, preparing related materials, and providing information to the public.

The total number of visitors to SPring-8 was 23,581 in 1999. Thirteen press releases were carried out such as press conference for the "First Observation of World Highest Energy Inverse Compton Scattering Gamma Rays in SPring-8" on July 16. A total of 82 interviews were given for television, newspapers, magazines and in-house journals. Several events were carried out in 1999. They were as follows:

1. Open house on April 18.
2. Education program in elementary school (Science Adventure School) was held six times a year.
3. Educational program receiving several pupils from junior high school was held (May 31 to June 4).
4. Exciting Scientific Event by Harima Doctors (on Saturdays and Sundays from July 31 to August 15).
5. Science Summer Camp in SPring-8 for high school students (August 9 – 11).
6. Science Summer Seminar for high school students (August 18, 19).
7. "Harima Science Garden City Top Seminar in Tokyo" on September 17.
8. Harima International Forum was held in November 3 to 6.

The pamphlets, newsletters, research reports, videos and panels for visitors were prepared and renewed. The designs for the layout and the interior of the public relation building have been finished and completion is slated for March 2000.

11. Symposiums and Workshops

The SPring-8 workshops on the utilization of SPring-8, high-resolution compton scattering and magnetism were held March 4-5, September 17 and October 13, 1999 respectively, at SPring-8.

The Third SPring-8 symposium was held October 14-15, 1999 at SPring-8 under the auspices of JASRI and the SPring-8 Users Society.

The Second Harima International Conference with the theme of "Structure and Function of Ion Channels" was held November 3-6, 1999 at SPring-8 with the support of Hyogo Prefecture and SPring-8.

The first SLS-SPring-8 Joint Workshop was held November 29-30, 1999 at SPring-8.