

Overview of the SPring-8 Project

1. Introduction

The SPring-8 joint project team was formed from the staffs of the Japan Atomic Energy Research Institute (JAERI) and the Institute of Physical and Chemical Research (RIKEN) to carry out SPring-8's planning and construction. 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's Kansai Research Establishment and RIKEN's Harima Research Establishment were founded at the SPring-8 site in 1995 and 1998, 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:

- October 1988: JAERI and RIKEN formed the SPring-8 Project Team.
- June 1989: Harima Science Garden City, Hyogo Prefecture, was selected as the SPring-8 construction site.
- December 1990: JASRI was established as a non-profit foundation.
- November 1991: Construction of the facility began.
- October 1994: The government passed legislation establishing JASRI as a national organization for promoting synchrotron radiation research.
- August 1996: Commissioning of the linac was started and the acceleration of the electron beam to 1 GeV was achieved.
- December 1996: Commissioning of the synchrotron was started and the acceleration of the electron beam to 8 GeV was achieved.
- March 1997: Commissioning of the storage ring was started and the first synchrotron radiation was observed.
- October 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.
- October 1998: Beam currents increased to 70 mA in user-service mode.

2. Accelerators

The facility is basically comprised of three accelerators: a 1 GeV injector linac, an 8 GeV booster synchrotron, and an 8 GeV storage ring.

2.1 Storage Ring

The beam commissioning of the storage ring was started in the middle of March 1996. The first synchrotron radiation from a bending magnet was observed on March 25, 1996. The first synchrotron radiation from an insertion device was observed on April 23, 1997. The user-time operation was started in October 1997 with a stored beam current of 20 mA.

In FY 1998, detailed studies on machine performance, such as orbit stability, emittance, and coupling *etc.*, as well as improvement and development of the storage ring were carried out. The beam current for user operation was increased from 20 mA to 100 mA (design value).

SPring-8 was stably operated in two- or three-week mode for one cycle. The total operation time was 4,190 hours. Users used 2,624 hours (62.6 %), and 110 hours (2.6 %) were lost due to machine and beam line failures. The remaining 1,456 hours were used for the tuning and study of accelerators and for the commissioning of new beamlines.

2.2 Linac

The beam commissioning was started on August 1, 1996, and the acceleration of the beam to the final energy of 1 GeV was achieved on August 8.

During the summer shutdown of 1998, after operation for one and a half years, the beam stability was intensively examined and improvements were carried out. The electron beam injection into the New SUBARU storage ring was started in October 1998.

2.3 Synchrotron

Beam commissioning started on December 10, 1996, and we achieved energy ramping of the electron beam in the synchrotron from 1 GeV of injection energy to 8 GeV of extraction energy on December 16.

A new rf-knockout system was installed in the synchrotron to improve the purity of the single-bunch beam in the storage ring.

Although the original computer-control programs were able to achieve beam commissioning and constant beam operation of the synchrotron, a new control program was implemented to integrate the computer-control systems of the SPring-8 accelerators.

3. Beamlines

SPring-8 has been 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 the 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 four groups according to use: public beamlines constructed by SPring-8 and opened to public use, JAERI/RIKEN beamlines constructed by JAERI/RIKEN for their exclusive use, contract beamlines constructed by proposers for their exclusive use, and R&D beamlines constructed by SPring-8.

Ten public beamlines were operated for public use: 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 Solid (BL25SU), Soft X-ray Photochemistry (BL27SU), Physicochemical Analysis (BL39XU), and Structural Biology I (BL41XU). In 1998, construction began on the following public beamlines: Powder Diffraction (BL02B2), High Energy X-ray Diffraction (BL04B2), Medical and Imaging II (BL20XU), Medical and Imaging I (BL20B2), White Beam X-ray Diffraction (BL28B2), High Resolution Inelastic Scattering (BL35XU), High Flux (BL40XU), Structural Biology II (BL40B2), and Infrared Material Science (BL43IR). Of these, the bending magnet beamlines, BL02B2, BL04B2, BL20B2, BL28B2 and BL40B2, were scheduled to be finished by the end of FY 1998 and will be available for trial use in 1999.

Six beamlines of JAERI and RIKEN were also constructed: 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 will 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.

A contract beamline, Hyogo (Hyogo Prefecture, BL24XU), was also in operation. Five more contract beamlines were under construction: WEBRAM (Nat. Inst. for Res. Inorg. Mat., BL15IN), Industrial Consortium ID (Industrial Consortium, BL16XU),

Industrial Consortium BM (Industrial Consortium, BL16B2), Laser-electron Photon (Osaka Univ., BL33LEP), and Macromolecular Assemblies (Osaka Univ., BL44XU).

An R&D beamline, BL47XU, was also completed. The second R&D beamline, BL46XU, will be completed with an experimental hutch.

4. Facility Construction

SPring-8 has completed construction of accelerators and several main buildings. Construction is continuing on the Materials Science Facility, Synchrotron Radiation Physics Facility I, and other facilities as shown in Table 1.

Table 1. Construction of Buildings

Buildings (Provisional titles)	Floor area	Completion
Gymnasium	1-storied 1,400m ²	Mar. 1999
Structural Biology Experimental Facility	2-storied 950 m ²	Mar. 1999
Hazardous Materials Storage	1-storied 120 m ²	Mar. 1999
Stockroom for Instruments	1-storied 1,400 m ²	Mar. 2000
Visitor Center	1-storied 800m ²	Mar. 2000
Experimental Facility for SPring-8 Users	3-storied 2,400m ²	Mar. 2000
Experimental Animal Facility	2-storied 630m ²	Mar. 2000
1km-long Beamline Facility	2-storied 970m ²	Mar. 2000
Materials Science Facility	4-storied 4,500m ²	May 2000
Synchrotron Radiation Physics Facility I	4-storied 4,400m ²	May 2000

5. SPring-8 Budget

SPring-8 Phase I was from 1987 to 1998. During this phase, construction of the accelerators was completed and the user-service mode operation was initiated. In accordance with the end of the first phase, the JAERI-RIKEN Project Team was dissolved. JASRI has responsibility for 1) operation, maintenance and improvement of SPring-8, 2) construction of new beamlines, and 3) R&D for new SR applications. Total budget of JASRI in fiscal year 1998 was 13,756 Million Yen. About 90 % of the total budget is for SPring-8 operation and maintenance, which comes through JAERI and RIKEN. Yearly change in budget is shown in Fig. 1.

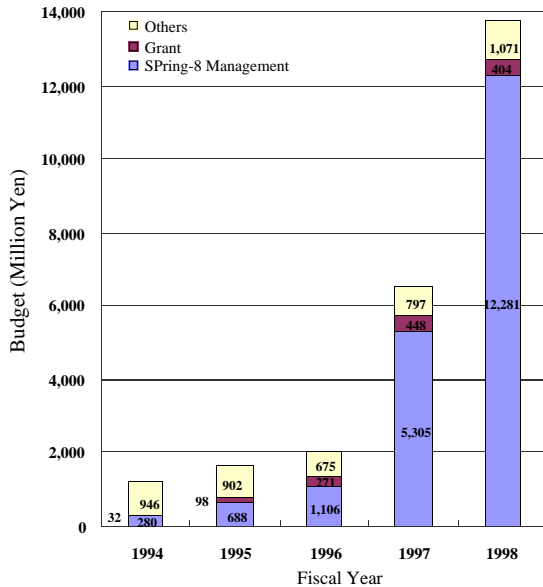


Fig. 1. Yearly Budget of JASRI.

User service mode operation was started from October 1997 and the increase of budget comes from the half year and full year operations in FY 1997 and FY1998, respectively.

6. Spring-8 Organization

6.1 Organizational Structure

The JASRI organizational structure is shown in the figure in Appendixes. In 1997, the JAERI-RIKEN SPring-8 Project Team was dissolved, and many members of the team moved to JASRI. By the end of March 1999, JASRI had a total full-time staff of 335.

6.2 Committees

6.2.1 Steering Coordination Committee

A Steering Coordination Committee was organized to promote effective cooperation among JASRI, JAERI and RIKEN. Figure 2 illustrates how SPring-8's principal committees interact with each other.

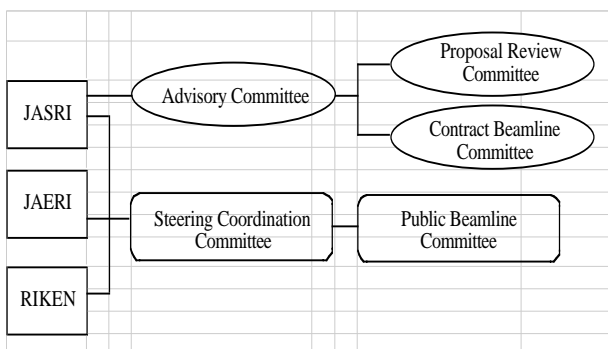


Fig. 2. SPring-8 Committees.

6.2.2 Advisory Committee

At the request of JASRI, the Advisory Committee deliberates and makes recommendations on important

matters such as solicitation and selection of proposals for conducting research with the public beamlines, as spelled out in Article 15 of the Law Regarding Promotion of Common Use of the Synchrotron Radiation Facility, SPring-8. The committee met two times in 1998 as follows:

10th Meeting on Feb. 23

- 1) Establishment of beam-time for exclusive-use beamlines (contract beamlines) provided to JASRI
- 2) Evaluation of a letter of intent to construct a contract beamline for the Asia and Pacific Council for Science and Technology (APCST)
- 3) Review and selection of proposals for research using public beamlines in the first half of 1998

11th Meeting on Sept. 8

- 1) Review and selection of proposals for research using public beamlines in the first half of 1999
- 2) Evaluation of proposal to construct the APCST beamline

6.2.3 Contract Beamline Committee

Under the Advisory Committee, the Contract Beamline Committee deliberates on planning for the contract beamlines used by owners. The committee met two times in 1998 as follows:

10th Meeting on Feb. 19

- 1) Standardization of beamtime provided to JASRI
- 2) Evaluation of a letter of intent to construct the APCST beamline

11th Meeting on July 13

Evaluation of proposal to construct the APCST beamline

6.2.4 Proposal Review Committee

Under the Advisory Committee, the Proposal Review Committee evaluates and selects proposals to use the public beamlines. The committee met four times in 1998 as follows:

12th Meeting on Feb. 6

Review of proposals for beamtime in the first half of 1998

13th Meeting on Apr. 22

- 1) Establishment of basic principles of proposal review
- 2) Report on the proposal review

14th Meeting on May 14

Establishment of evaluation method and process

15th Meeting on Aug. 28

Review of proposals for beamtime in the first half of 1999

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 Steering Coordination Committee. The committee met three times in 1997 as follows:

7th Meeting on Feb. 7

- 1) Discussion on construction plan of public beamlines
- 2) Evaluation of letters of intent for public beamlines
- 3) Construction of medical use beamlines

8th Meeting on May 13

- 1) Discussion on construction of public beamlines
- 2) ID beamlines at 30 m long-straight sections of the storage ring
- 3) Future beamline projects

9th Meeting on July 13

Discussion on important technical matters for the construction of public beamlines.

7. Applications to Use Public Beamlines

Each year SPring-8 issues two calls for proposals to use its public beamlines. Successful 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 in March 1998. The second research period ran from April 1998 until September 1998. After a somewhat longer third research period (October 1998 until June 1999), SPring-8 will divide public beamline operation between the first and second half of the calendar year, with research periods running from January through June and July through

December.

The respective proposal submission deadlines for the second and third research periods were January 6, 1998 and July 12, 1998. SPring-8 Proposal Review committee approved 229 of the 305 proposals submitted for the second period and 258 of the 392 applications for the third period. In each case, all of the proposals received were for non-proprietary research and 4 % of the successful applications were from overseas. The breakdown of successful proposals is shown in Fig. 3.

SPring-8 operational results for 1998 is shown in Table 2. In 1998, SPring-8 provided users with 2,639 hours of beam-time in 13 operating periods. Some 1,874 individuals used the facility's public beamlines in 366 separate experiments. Between the October 1997 opening of SPring-8 for research and the end of 1998, a total of 2,363 public beamline users conducted 423 experiments. The real number of users in 1998 is difficult to count. Instead, the number of individuals registered as radiation workers of SPring-8 in 1998 is written in this report (Safety Office) as 2,075.

8. Construction of Contract Beamlines

SPring-8 invites applications from Japan and overseas to construct contract beamlines. In contrast to 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, then have three years to produce detailed proposals for beamline construction and use.

Table 2. SPring-8 Operational Results for 1998

Operation Cycle		User Beam Time (hour)	Number of Experiments	Number of Users	8GeV Operation Mode
98-01	02.18.98-02.27.98	(no beamtime allocated)			Beamline commissioning
98-02	03.04.98-03.13.98	168	21	74	<20mA, full bunch, 2weeks
98-03	03.18.98-03.27.98	167	23	118	<20mA, full bunch, 2weeks
98-04	04.01.98-04.17.98	272	40	168	<20mA, full bunch, 3weeks
98-05	04.22.98-04.30.98	166	28	113	<20mA, full bunch, 2weeks
98-06	05.13.98-05.22.98	167	31	132	<20mA, 21 bunch, 2weeks
98-07	05.27.98-06.12.98	286	50	206	<20mA, 21 bunch, 3weeks
98-08	06.17.98-07.03.98	288	62	246	<20mA, 21 bunch, 3weeks
98-09	09.07.98-09.25.98	(no beamtime allocated)			Beamline commissioning
98-10	09.30.98-10.16.98	282	44	175	<70mA, 21 bunch, 3weeks
98-11	10.21.98-11.06.98	271	62	212	<70mA, 2/3 fill bunch, 3weeks
98-12	11.11.98-11.27.98	277	52	219	<70mA, 2/3 fill bunch, 3weeks
98-13	12.02.98-12.19.98	295	49	211	<70mA, 2/3 fill bunch, 3weeks
1998 total		2,639	462	1,874	

First research period: October 1997 – March 1998

Second research period: April 1998 – October 1998

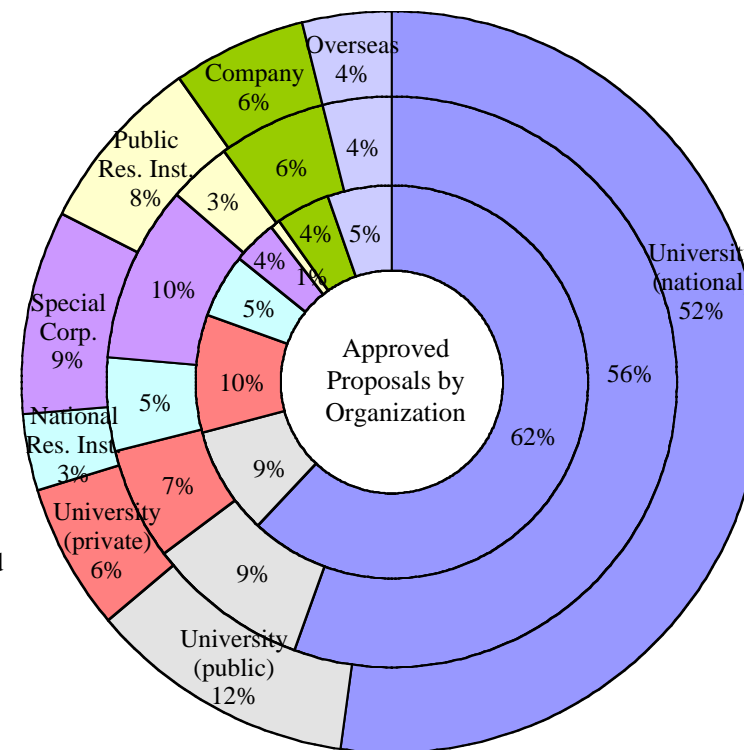
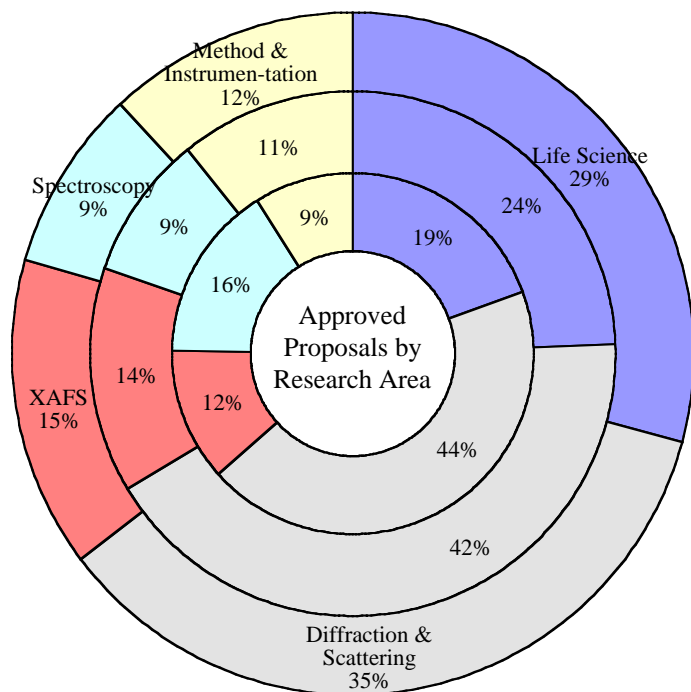
Third research period: November 1998 – June 1999

Breakdown of Approved Proposals

First research period: October 1997-March 1998, Proposed 198, Approved 134

Second research period: April 1998-October 1998, Proposed 305, Approved 229

Third research period: November 1998-June 1999, Proposed 392, Approved 258

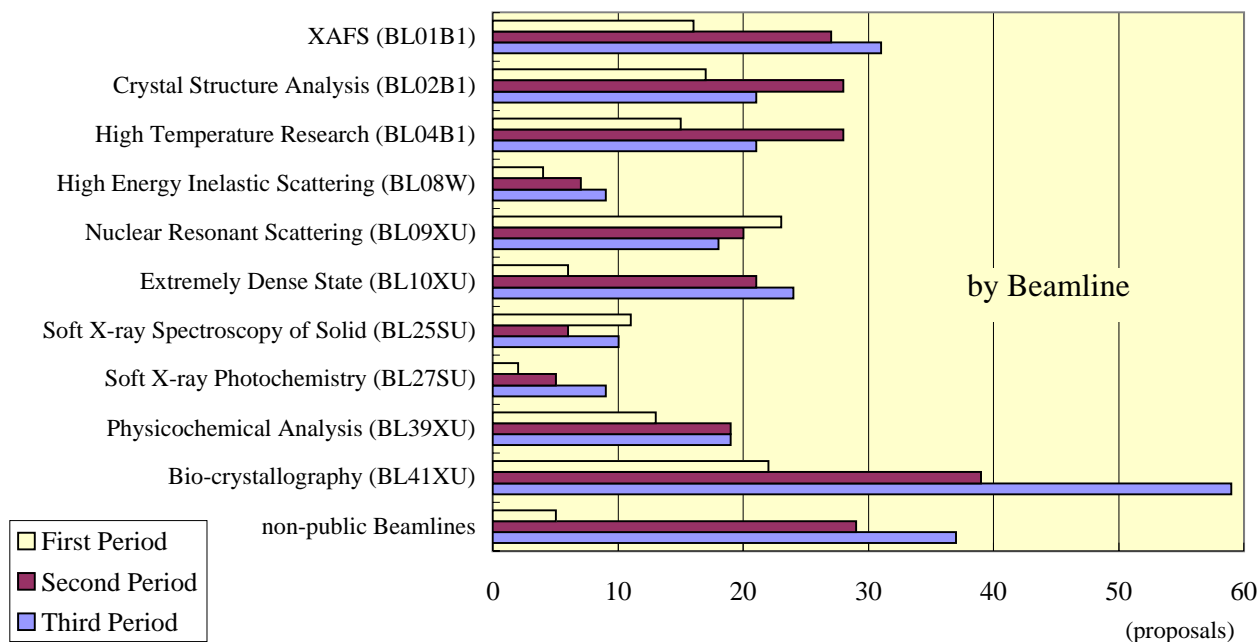
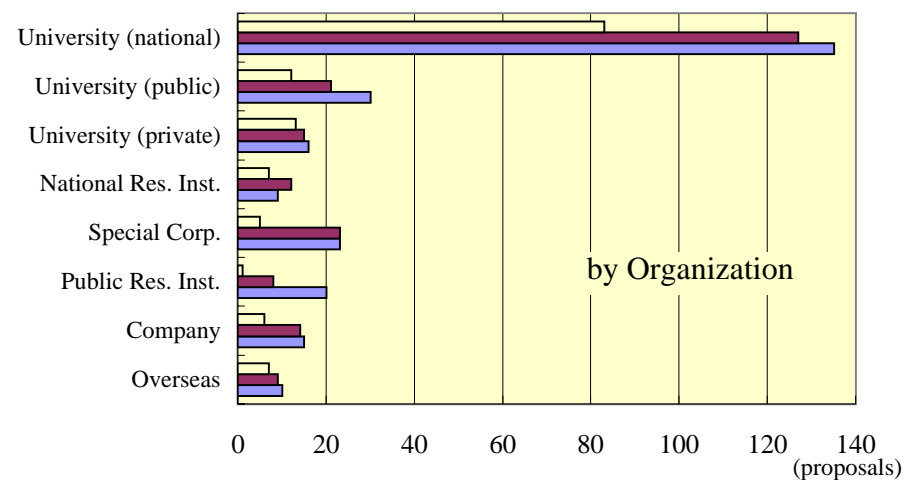
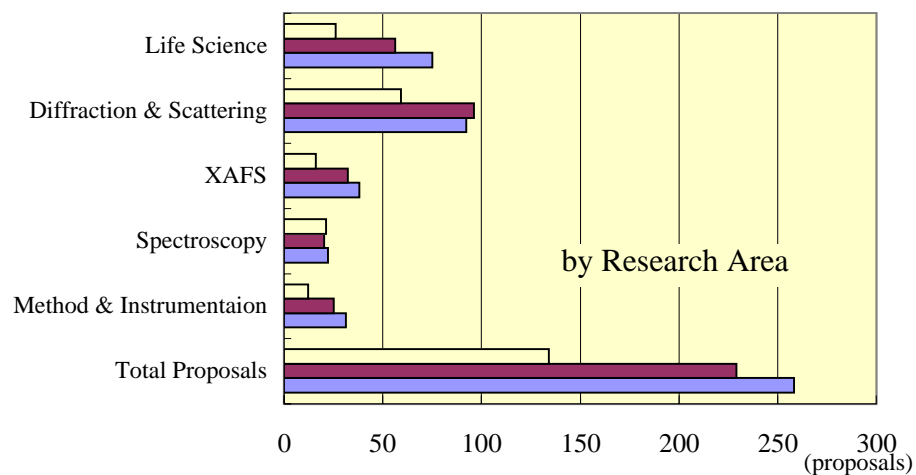


Inner Circle : first period
 Middle Circle: second period
 Outer Circle : third period

	First Period	Second Period	Third Period
Life Science	26	56	75
Diffraction & Scattering	59	96	92
XAFS	16	32	38
Spectroscopy	21	20	22
Method & Instrumentation	12	25	31

	First Period	Second Period	Third Period
University (national)	83	127	135
University (public)	12	21	30
University (private)	13	15	16
National Res. Inst.	7	12	9
Special Corp.	5	23	23
Public Res. Inst.	1	8	20
Company	6	14	15
Overseas	7	9	10

Fig. 3 - 2



	1st Period	2nd Period	3rd Period
XAFS (BL01B1)	16	27	31
Crystal Structure Analysis (BL02B1)	17	28	21
High Temperature Research (BL04B1)	15	28	21
High Energy Inelastic Scattering (BL08W)	4	7	9
Nuclear Resonant Scattering (BL09XU)	23	20	18
Extremely Dense State (BL10XU)	6	21	24
Soft X-ray Spectroscopy of Solid (BL25SU)	11	6	10
Soft X-ray Photochemistry (BL27SU)	2	5	9
Physicochemical Analysis (BL39XU)	13	19	19
Bio-crystallography (BL41XU)	22	39	59
non-public Beamlines	5	29	37

The Contract Beamline Committee has approved letters of intent from eight organizations to construct a total of 10 contract beamlines. Six organizations have also had their detailed beamline construction plans approved by the committee.

Hyogo Prefecture took the lead in contract beamline construction, and its BL24XU beamline began operation in June 1998. Two beamlines being constructed by an Industrial Consortium (BL16XU and BL16B2) are now in the final stages of installation. Progress is also being made on four other beamlines. These are being constructed by the Osaka University Protein Research Center (BL44XU), the Osaka University Nuclear Physics Research Center (BL33LEP), the National Institute for Research in Inorganic Materials (BL15IN), and the Asia and Pacific Council for Science and Technology (APCST) in Taiwan (BL12IN & BL12B2).

9. User Support

JASRI has revised the Japanese and English versions of its "SPring-8 User Guide." This provides information on user-related activities, ranging from research proposal submissions to the completion of experiments.

JASRI has published the first of its compilations of experiment reports submitted by users. The SPring-8 User Experiment Report (No. 1) presents results reported by users who conducted experiments during the first SPring-8 research period.

JASRI mails "SPring-8 User Information" to registered users. This is a bi-monthly publication in Japanese that provides the latest information on SPring-8.

The first phase of the SPring-8 guest house opened in August 1996, and since October 1998 all 240 rooms have been available to guests.

In a limited number of cases, JASRI was able to support the travel and subsistence costs of public beamline users who visited the facility to conduct non-proprietary research.

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10. SPring-8 Users Society

The SPring-8 Users Society was formally established in 1993. More than 1,200 members (68 % from universities, 17 % from national laboratories and 15% from industries) within 35 research groups have joined for the purpose of promoting scientific programs, including the detailed design of public beamlines.

11. Public Relations

The SPring-8 Public Relations Office was established on January 1, 1998. The members of the office receive and guide visitors, assist the press, organize events, prepare related materials, and provide information to the public.

The total number of visitors to SPring-8 was 22,056 in total in 1998. Six press releases were issued, such as the March 12 press conference to announce the first results of using the SPring-8 facility. Interviews with reporters from newspapers, TV, magazines and organizational newsletters were given. Nine events were held, including the "Harima Science Garden City Top Seminar in Tokyo" on July 14. The pamphlet, video and information board for visitors were also revised.

12. Symposiums and Workshops

The First SPring-8 Symposium was held March 17-19, 1998 at the Center for Advanced Science and Technology (CAST) under the auspices of JASRI and SPring-8 Users Society. The Second SPring-8 Symposium was held December 2-4, 1998.

The SPring-8 International Workshop on High Flux Detectors was held August 14-26, 1998. The Second International Conference on Synchrotron Radiation in Materials Science (SRMS-2) was held in Kobe from October 31 to November 4 under the auspices of JAERI, RIKEN and JASRI. The 290 participants were from 16 countries, and the program featured 236 presentations. The First Harima International Conference with the theme of "Frontiers of Surface Science" was held at SPring-8 December 2-6 with the support of Hyogo Prefecture and SPring-8. The Third International Conference on Industrial Applications of Synchrotron Radiation was held November 11-13, 1998 at CAST, sponsored by Hyogo Prefecture, SPring-8 and other organizations.