This is the first Annual Report of J-PARC.

J-PARC is a joint project between two organizations, the Japan Atomic Energy Agency (JAEA) and the High Energy Accelerator Research Organization (KEK). J-PARC stands for Japan Proton Accelerator Research Complex and it is a new and exciting accelerator research facility located in Japan. It uses MW-class high power proton beams at both 3 GeV and 50 GeV. The construction budget was allocated on April 1 of 2001. Since then, the construction has been proceeding smoothly in both the accelerators and the experimental halls. Finally, in the spring of 2009 (end of Japan fiscal year 2008) the Phase 1 project was completed after 8 years of construction.

The main purpose of J-PARC is to use various types of secondary particle beams (neutrons, muons, kaons, neutrinos, etc.) that are generated in proton-nucleus reactions. Through the use of these secondary particle beams, we will attain major scientific goals in three fields: a) nuclear-particle physics, b) materials and life sciences, and c) later, in Phase 2, research and development for nuclear transmutation. The anticipated goal of the proton current is 1 MW. From 2008 four types of beams have been obtained exactly on schedule: neutron beams (May, 2008), muon beams (September, 2008), kaon beams (February, 2009) and neutrino beams (April, 2009). Thus our facilities became fully operational and now can be used by researchers.

We expect J-PARC to become one of the most important accelerator facilities in the world for the 21st century’s sciences. Since three major regions in the world (North America, Europe and Asian/Oceanic Area) will have major scientific centers with high power proton accelerators, we would like to create a strong research center in the Asian/Oceanic region. Many non-Japanese scientists have already started to use this facility.

From Japan fiscal year 2009 we plan to strengthen the accelerator power to 1 MW. We already started Linac construction to achieve 400 MeV. Also, we plan to make special effort on creating mechanisms to provide access to J-PARC to international users, in addition to expanding the industrial use of J-PARC, the lodging capabilities, the Phase 2 projects, etc.

Shoji Nagamiya
Director of the J-PARC Center
Overview

The year of 2008 was the most important period in the J-PARC project from various aspects in terms of accelerator development, user facility completion, secondary particle production, their performance demonstration, etc. First of all, the primary goal of the facility construction was realized with a series of the beam production at each target in the four facilities, i.e., neutron at Materials and Life Science Experimental Facility (MLF), muon at MLF, K-meson at Hadron Experimental Hall and neutrino at Neutrino Facility. They were definitely co-memorable events. Here, we like to overview the most significant events in 2008.

The fiscal year 2008 started with the 3-GeV Rapid Cycling Synchrotron (RCS) beam commissioning. Linac provided stable proton beam to RCS and finally the 3 GeV proton was extracted to the MLF in beginning of May 2008.

The victory in the advanced pulse neutron source facility construction was confirmed with the first neutron beam observation at the very first proton pulse injection from RCS on May 30, 2008. The instance was celebrated the neutron team for their achievement to be memorized forever in the J-PARC history. It is worth to note that right after the event, the world record in the pulse resolution was demonstrated in the super-high resolution powder diffractometer, highlighting the high-performance of the J-PARC pulse neutron source design.

In September 26, 2008, we had a pleasant moment with the first muon beam production. It was exciting time when the muon beam was clearly identified. We had confirmed the facility’s ability in terms of beam intensity at MW power to be the world highest muon source.

On December 23, 2008, the first proton beam was accelerated from 3 GeV to 30 GeV in Main Ring (MR), the destined energy of the first phase of the project, and it was extracted to the abort beam line by a fast extraction system.

In January 2009, Hadron experimental hall, which uses a slow extraction system, was finally ready for beam. The first beam was injected on January 27, although it was very weak signal, but the real proton was injected to the Ni target. The first clear observation of K-meson was reported on February 18, 2009.
In April 23, 2009, the proton beam was injected on the neutrino production target through a fast extraction system in MR. The neutrino was identified by the muon monitor located downstream from the target. It was then, the most historical day as all of J-PARC production targets received protons, resulting in the completion of the facility construction.

Along with the facility hardware, the first user program started at the MLF on December 23, 2008. At that moment, the beam power was expected to be low as much as 20 kW at most, which was 1/50 of the goal of 1 MW. However,
we received many proposals even though the power was low. The start of first J-PARC neutron and muon user program stimulated users from academia to industrial applications.

Concerning the accelerator operation at the very beginning, we have struggled with instability of the radio frequency quadrupole (RFQ), which made limited the beam power less than 20 kW.

Nevertheless, 2008 was glorious days in J-PARC history. We could define 2008 as the commissioning year and the firm step toward the full-scale user program in 2009.
Accelerators
Overview

The J-PARC accelerators consist of a 181-MeV linac (LINAC) which will be upgraded to 400 MeV in 2012, a 3-GeV rapid cycling synchrotron (RCS) and a 50-GeV synchrotron (MR).

### Main operational goals

<table>
<thead>
<tr>
<th></th>
<th>First Step</th>
<th>Second Step</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINAC</td>
<td>0.181</td>
<td>0.4</td>
</tr>
<tr>
<td>Power (kW)</td>
<td>(30 mA)</td>
<td>(50 mA)</td>
</tr>
<tr>
<td>Repetition Rate (Hz)</td>
<td>25</td>
<td>25 (50)</td>
</tr>
<tr>
<td>RCS</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Power (kW)</td>
<td>300 (→600)</td>
<td>1000</td>
</tr>
<tr>
<td>Repetition Rate (Hz)</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>MR</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Power (kW)</td>
<td>300</td>
<td>750</td>
</tr>
<tr>
<td>Repetition Rate (Hz)</td>
<td>~ 0.3</td>
<td>~ 0.47</td>
</tr>
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</table>

The maximum energy of MR is now set at 30 GeV to obtain maximum performance for a high intensity proton source and also to mitigate the technical issues concerning stable operation due to huge excitation currents.

Since the beam commissioning of LINAC started in November 2006, we have achieved the following main milestones:

- **January 2007**: 181 MeV beam from LINAC
- **October 2007**: 3 GeV beam from RCS
- **May 2008**: 3 GeV beam stored at the injection porch in MR
- **December 2008**: Beam acceleration to 30 GeV in MR
- **January 2009**: Started the user program of MLF
- **January 2009**: Beam extraction to the hadron target at the 30 GeV flat top in MR

The progress in fiscal year 2008 is summarized in the following table and figure. The beam intensity and beam size of RCS is changed pulse-by-pulse according to the beam destination: MLF or MR.

The user program of MLF started from December with 4 kW of beam power and the planned power of 100 kW was reached in February. But the discharge problem of a radio frequency quadrupole (RFQ) in LINAC described below suspended the stable operation for user program.
Materials and Life Science Experimental Facility (MLF)

Hadron Experimental Hall

Nuclear Transmutation Experimental Facility (Phase II)

Neutrino to Kamiokande

Bird’s eye’s view of the J-PARC site.


Three Research Areas at J-PARC
Materials & Life Sciences at 3 Gev
Nuclear & Particle Physics at 50 Gev
R&D toward Transmutation at 0.6 Gev

Secondary beam produced with high-intensity proton beam.
LINAC

From RFQ to DTL and SDTL.

BL to RCS. One SDL unit is used as debuncher until ACS is installed.

Ion Source → RFQ → DTL → SDTL → ACS

(3.1m) (3.0m) (27.1m) (91.2m) (15.1m) (109.3m)

50 keV 3 MeV (324MHz) 50.1 MeV 190.8 MeV (972MHz)

Drift tube linac.
Klystron gallery.
The linac design is shown in the figure. The volume-production type of a negative hydrogen ion source is used for producing a peak current of 30 mA (which is increased to 50 mA in the second step) with a pulse length of 0.5 ms and a repetition rate of 25 Hz. The beam is extracted at 50 keV to the 324-MHz radio-frequency quadrupole (RFQ) linac and accelerated to 3 MeV. Then, the beam is accelerated through the drift tube linac (DTL) to 50 MeV, through the separated-type drift tube linac (SDTL) to 181 MeV, through the annular-ring coupled structure (ACS) linac to 400 MeV and through the super-conducting cavity (SCC) linac to 600 MeV according to the velocity increases. Here, SCC and ADS (accelerator driven transmutation system) are shifted to Phase II. RFQ, DTL and SDTL are operated with the same frequency by twenty 3-MW klystrons, which were newly developed by a klystron vendor for J-PARC in collaboration with the J-PARC accelerator team.

Currently the 181-MeV beam is injected to RCS and ACS is under construction and is expected to be in operation from 2012. The beam for RCS is chopped in order to avoid beam loss due to spilling from the RF bucket of RCS at injection.
RCS

The negative hydrogen beam is injected through the charge-exchange foil and is converted to a proton beam. This injection scheme is free from the Liouville’s theorem, that is, a new beam can be put in the region of phase space already occupied by the circulating beam. Therefore, in principle, the beam density can be increased to the space charge limit. To mitigate the space charge effect, the injection points in phase space are scanned to enlarge the beam emittance in both the transverse and the longitudinal phase space (this is the so-called “Painting Process”).

There were many issues to be resolved in the process of realizing the advantages of the RCS scheme. The most important of them were the following:

1) High accelerating voltage and wide frequency range of the RF acceleration system.
2) Ceramic vacuum chambers against large eddy current due to the fast change of the magnetic field.
3) Large aperture magnets for the beam with large emittances to mitigate the space charge effect.
4) Magnetic field tracking in rapid cycle.
5) Injection and extraction system for the high intensity beam with large emittances.

These issues have been successfully resolved to ensure the current stable operation of 100 kW.

### Present main parameters of RCS

<table>
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<tr>
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<th>Value</th>
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<tbody>
<tr>
<td>Circumference</td>
<td>348,333 m</td>
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<tr>
<td>Injection Energy</td>
<td>181 MeV</td>
</tr>
<tr>
<td>Extraction Energy</td>
<td>3 GeV</td>
</tr>
<tr>
<td>Emittance @ Injection</td>
<td>&lt; 324 π mm-mrad.</td>
</tr>
<tr>
<td>Revolution Frequency</td>
<td></td>
</tr>
<tr>
<td>at Injection</td>
<td>469.3 kHz</td>
</tr>
<tr>
<td>at Extraction</td>
<td>835.9 kHz</td>
</tr>
<tr>
<td>Repetition Rate</td>
<td>25 Hz</td>
</tr>
<tr>
<td>RF Frequency (MHz)</td>
<td>(0.938 → 1.67)</td>
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<tr>
<td>Harmonic Number</td>
<td>2</td>
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<tr>
<td>Number of RF Cavities</td>
<td>11 (→ 12)</td>
</tr>
<tr>
<td>Transition Energy (γT)</td>
<td>9.14</td>
</tr>
<tr>
<td>Number of Bending Magnet</td>
<td>24</td>
</tr>
</tbody>
</table>

Large Aperture Quadrupole.

Dipole magnet in combination process.  
Magnets in the ring.
Injection region. The beam comes from the upper-right corner. The charge exchange foil system is located in the middle. The BL to H0-dump is below to the right.

Extraction region. From left: BL to MLF, BL to MR and RCS ring.

RF acceleration stations.

Extraction kickers.

RCS building.
MR

There is transition energy in a conventional synchrotron. When the beam energy reaches this energy, the longitudinal focusing disappears in the first order and the line density of the beam blows up to infinity. That process causes instability and results in a beam loss. Therefore, the MR Lattice is designed in a way that ensures to have the imaginary transition energy in order not to arise the beam instability. The MR is the first proton synchrotron that adopted distinctive beam optics design, although there already exists as an electron storage ring for synchrotron radiation to enlarge tolerances against beam instability. The beam is accelerated to 30 GeV in 1.9 sec (2.5 sec at present) and extracted in one turn with the fast kickers to the neutrino production target, or extracted in the range of a second with the controlled resonance of betatron oscillation (the so-called Slow Extraction) to the hadron experimental facility.

The RF acceleration system is almost the same as that of RCS except for the following point. The MA (Magnetic Alloy) cores had been radially cut with a gap of 10 mm. Thus the Q value had been optimized to about 10 in order to reduce the beam loading. The small change of frequency (1.67 → 1.72 MHz) permits a larger Q-value than that of RCS, still keeping the advantage of eliminating any frequency tuning system.

Present main parameters of MR

<table>
<thead>
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<th>Parameter</th>
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<tr>
<td>Circumference</td>
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<tr>
<td>Injection Energy</td>
<td>3 GeV</td>
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<tr>
<td>Extraction Energy</td>
<td>30 GeV</td>
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<tr>
<td>Revolution Frequency</td>
<td></td>
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<tr>
<td>at Injection</td>
<td>185.7 kHz</td>
</tr>
<tr>
<td>at Extraction</td>
<td>191.2 kHz</td>
</tr>
<tr>
<td>Repetition Rate</td>
<td>~ 0.3 Hz</td>
</tr>
<tr>
<td>RF Frequency</td>
<td>(1.67 → 1.72) MHz</td>
</tr>
<tr>
<td>Harmonic Number</td>
<td>9</td>
</tr>
<tr>
<td>Number of RF Cavities</td>
<td>4 (→ 6)</td>
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<tr>
<td>Transition Energy ($\gamma_T$)</td>
<td>31.7 (imaginary)</td>
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<td>Number of BM</td>
<td>96</td>
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</table>

Fast extraction. Left: to abort dump, middle: to ring, right: to neutrino target.

Magnets aligned in MR. Blue: Dipole, Yellow: Quadrupole, Green: Sextupole, Orange: Steering.

Injection region.

Slow extraction region. Left: to hadron target.
Materials and Life Science Experimental Facility
In fiscal year 2008, the Materials and Life Science Division achieved two important milestones: it generated both the very first pulsed neutron beam at the spallation neutron system and the muon beam through the muon production target located at about 30 m upstream from the neutron source, and then advanced to the implementation of a user program.

### Key parameters of MLF

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tr>
<td>Injection energy</td>
<td>3 GeV</td>
</tr>
<tr>
<td>Repetition rate</td>
<td>25 Hz</td>
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<tr>
<td>Neutron source</td>
<td>Mercury</td>
</tr>
<tr>
<td>Number of moderators</td>
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<tr>
<td>Moderator material</td>
<td>Supercritical hydrogen</td>
</tr>
<tr>
<td>Moderator temperature/pressure</td>
<td>20K/1.5 MPa</td>
</tr>
<tr>
<td>Number of neutron beam ports</td>
<td>23</td>
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<tr>
<td>Muon production target</td>
<td>Graphite</td>
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<tr>
<td>Target material</td>
<td>4</td>
</tr>
<tr>
<td>Number of muon beam extraction ports</td>
<td>7</td>
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<tr>
<td>Neutron instruments*</td>
<td>Open for user program</td>
</tr>
<tr>
<td></td>
<td>Under commissioning/construction</td>
</tr>
<tr>
<td>Muon instruments*</td>
<td>Open for user program</td>
</tr>
<tr>
<td></td>
<td>Under commissioning</td>
</tr>
</tbody>
</table>

\* as of the beginning of the user program in fiscal year 2008.

### Beam up rate for user program since December 2008

<table>
<thead>
<tr>
<th>No. of run cycle</th>
<th>Scheduled Time (h)</th>
<th>Up rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#20</td>
<td>60</td>
<td>85.4</td>
</tr>
<tr>
<td>#21</td>
<td>297</td>
<td>54.6</td>
</tr>
<tr>
<td>#22</td>
<td>366</td>
<td>70.0</td>
</tr>
<tr>
<td>#23</td>
<td>724</td>
<td>65.1</td>
</tr>
<tr>
<td>#24-25</td>
<td>394</td>
<td>75.1</td>
</tr>
<tr>
<td>#26</td>
<td>183</td>
<td>84.3</td>
</tr>
<tr>
<td>#27</td>
<td>270</td>
<td>86.3</td>
</tr>
</tbody>
</table>

Cumulative proton beam power delivered to neutron and muon production targets at MLF since the beginning of the user program on December 2008. The operational beam power ramped to 120 kW in the run cycle #27 in 2009, while it was 20 kW in fiscal year 2008.
Neutron Source

All of the 108 magnets aligned on the approximately 300 m long tunnel of the proton beam transport line (3NBT) which transports the beam extracted from 3-GeV rapid cycling synchrotron (RCS) to the neutron production target at Materials and Life Science Experimental Facility (MLF) had been switched on. As a matter of fact, the upstream section branched to the beam-dump has been operated for accelerator studies. On the first day of the proton beam delivery to the neutron production mercury target at MLF, eventually, the 3NBT successfully transported the proton beam to the mercury target with the designed tuning parameters. The beam transport was confirmed with nine current transformers (beam intensity monitors) installed in the 3NBT line. This memorable event deserves a special praise because it was achieved through the very first beam shot extracted from RCS.

View of proton beam transport line (3NBT). 6 horizontal and 3 vertical bending magnets, 54 quadrupole and 45 steering magnets from the extraction point of RCS to the neutron production mercury target.

The neutron source system consists of the following core components for providing high intensity and quality pulsed neutron beams: a mercury circulation loop for target, three supercritical hydrogen moderators surrounded with an inner beryllium and outer steel reflector. It was ready to accept the first beam in May, 2008. It should be noted that the cryogenic hydrogen circulation system designed to circulate supercritical hydrogen with pressure of 1.5 MPa and temperature of around 20 K (-253°C) has been successfully operating with the largest flow rate of about 8 m³/h for the first time in Japan.

After the memorable event of producing the very first neutron beam, the neutronic performance data, i.e., spectrum, intensity and pulse shapes, have been measured for the three types of moderators as an important campaign to validate the neutronics design. The measured data agreed well with the design values, suggesting adequacy of neutronics design of JSNS.

In the 100 kW beam injection, the temperature of the flowing mercury in the target vessel was measured and almost coincided with the estimated value in the target design. The pressure waves were measured as well and were analyzed to understand the time responses of the target vessel. On the other hand, the bid for the second mercury target vessel was awarded to a vendor and the fabrication will be completed by the end of 2009. The next generation target vessel will be separated into two parts, a forward and a rear part, to reduce the waste volume at the target vessel. The research and development of a bubbling system is continuing consistently in order to mitigate the pressure wave on the mercury circulation system. The SNS team visited J-PARC and carried out the off-beam cavitation damage tests by using MiMTM (electro Magnetic IMpact Testing Machine) mercury loop.

During the maintenance period, the magnets and the beam monitors were re-aligned with an accuracy of ~0.1 mm through careful survey. The parameters of the beam optics were carefully tuned again throughout the on-beam commissioning. Consequently, in December 2008, successful transport of a proton beam with an intensity of 100 kW was achieved without any significant beam loss.
We encountered a couple of challenges throughout the yearly operation of the neutron source components. One was the problem with the neutron beam shutter system that occasionally was not responsive to the open signal from the shutter switch at the instrument. We finally resolved the problem by replacing the controller of the servo motor system due to malfunction caused by a bug. The other one was the failure of the rotor of a hydrogen pump. This was also repaired at the vendor’s manufacturing facility.

We completed a series of remote-handling tests of the mercury target, the moderators, the reflector plug and the proton beam window by using actual components, although the actual maintenance work is going to be conducted within the next several years.

Mercury target installed on the target trolley. The target vessel has triple-walled structure and mercury flows in the target vessel with a flow rate of 41 m³/h.

Coupled moderator.

Safety box set in the cryogenic hydrogen components room in MLF, it contains a hydrogen circulation loop, hydrogen pumps, an accumulator device and other components.
Birth of pulsed neutrons in J-PARC

At 14:25 on May 30th, 2008, the memorable event of the first neutron being generated was recorded at MLF. A shot of 3 GeV protons from RCS was injected to the mercury target at MLF. A pulsed neutron beam extracted from the de-coupled moderator was detected by the Li-glass detectors which were incorporated in the Current type Time-Of-Flight (CTOF) technique placed in the beam line of NOBORU, NeutrOn Beam-line for Observation & Research Use (an instrument for neutron source characterization).

The first memorable neutron energy spectral intensity derived from the CTOF data is shown in the photograph. The incident proton beam profile recorded by the imaging plate is also displayed. Right after the event of the first neutron production, beams were introduced to four instruments consecutively to test the system performance.

That was a very quiet but exciting achievement of an important J-PARC landmarks. The spectrum displayed on the monitor screen confirmed our achievement as a result of a 7-years long challenge. Although the power of the accelerator was still low, equal to only 4 kW, that was a calm and convincing departure forward to the J-PARC MW pulsed neutron source. The endeavors of the MLF neutron team of JAEA and KEK, were rewarded by this historical moment.

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Time of flight spectrum of the first neutron beam measured at the NeutrOn Beam-line for Observation & Research Use (BL-10), (left). Proton beam signal measured by a beam intensity monitor located at the downstream end of the 3NBT line.
Successful extraction of the first muon Beam

Four months after the memorable event of generating the first neutron beam, the muon experimental area at MLF opened as the most powerful muon beam utilization facility. The final commissioning procedures such as the vacuum connections and the installation of radiation shields for the decay muon beam line were finished the day before the first proton beam was delivered to MLF for the muon generation. In the afternoon of September 19, the muon production target was inserted into the target position of the proton beam transport line.

Eventually at 12:10 pm on September 26, 2008 (JST), the background-free muon beam was successfully delivered to the D1 experimental area after commissioning the secondary beam line components, which include the superconducting solenoid, the DC-separator, quadrupoles and bending magnets.

Positive muons with momenta of 29 MeV/c brought from Muon Science Laboratory (MSL) at KEK after refurbishment of emitted positrons were stopped in an aluminum plate placed at the heart of the μSR spectrometer and the positron events were recorded by a brand new data acquisition system designed to monitor the asymmetry. The build-up of the events and the associated sharpening of the precession signal under a weak transverse field were witnessed by an audience of about one hundred, who gathered at the experimental area, and celebrated the re-birth of the pulsed muon beam and the achievements of the J-PARC Muon Science Section.

Muon target area in the proton beam transport line (left), secondary muon beam line at experimental hall (right).
Neutron instruments

Since January, 2008, the construction of an instrument suite has been carried out intensively by many companies at the experimental halls in MLF. At the busiest period, over 10 installations were carried out simultaneously under a tight schedule to make possible the first beam operation scheduled for the end of May. The MLF staff patrolled the construction site regularly to reduce the risks of accidents. Thanks to those endeavors, the following five instruments were ready to accept the first beam on Day-1:

- IBARAKI Biological Crystal Diffractometer iBIX (BL-03),
- Neutron-Nucleus Reaction Instrument NNRI (BL-04),
- Super High Resolution Powder Diffractometer S-HRPD (BL-08),
- NeutrOn Beam-line for Observation & Research Use NOBORU (BL-10),
- IBARAKI Materials Design Diffractometer i-MATERIA (BL-20).

In September, a 4D Space Access Neutron Spectrometer 4SEASONS (BL-01), and an Engineering Materials Diffractometer TAKUMI (BL-19) joined to the commissioning stage as scheduled, and those seven instruments became available for the first user program.

The construction of the following four additional instruments was finished in December, 2008, and they advanced to the commissioning process: Neutron Optics and Fundamental Physics Beam Line NOP (BL-05), High Resolution Chopper Spectrometer HRC (BL-12), High-Performance Neutron Reflectometer with a Horizontal Sample Geometry H-REF (BL-16) and High Intensity Total Diffractometer NOVA (BL-21).

Status of neutron and muon instruments at the MLF as of December 2008.
List of neutron instruments available for user program or under commissioning in 2008.
Machine studies and trial measurements to determine the actual usage on user programs have been carried out on each instrument. As a result of that, on iBIX (BL-03), in a diffraction from a protein crystal (volume: 13 mm³) was observed for the first time. Commissioning on HRC (BL-12) and H-REF (BL-16) started with existing instruments transferred from the KENS facility, KEK, and the trial measurements were successfully carried out. Especially, on H-REF, reflection from a standard sample of Ni layer was clearly observed in the range of the reflectivity of three orders of magnitude, which is expected to be improved soon after taking countermeasures for background in the further commission work. In the case of NOVA (BL-21), we conducted performance test of a new GEM beam monitor to be used for this instrument although most of the components of the spectrometer were not yet completed.

On S-HRPD, a highest resolution of 0.037% in d-spacing was proven via the instrument-group measurement with standard sample. Moreover, the temperature dependence of the crystal structure of the multiferroic materials was measured by a group of KEK and SungKyunKwan University (Korea). On NOBORU, the Hokkaido University group carried out imaging measurements on alloys and welded materials. The user program was conducted under the beam power of about 20 kW in which frequent beam-off happened due to a problem with the accelerator. However, we are expecting a full-fledged user program activity.

The full-scale construction of the Biomolecular Dynamics Spectrometer, DNA (BL-02) and the Smaller-Angle Scattering Instrument, TAIKAN (BL-15), previously called HI-SANS, was approved. The neutron guide tubes due to be installed in the biological shields of both instruments had already been fabricated. The high-pressure neutron diffractometer was decided to be constructed at the BL-11 to use sharp pulsed neutrons provided from the decoupled moderator.

For the development and building of neutron devices, the scintillation detector development has been successfully conducted in collaboration with the ISIS detector group. The first one dimensional scintillation detector with fiber coded method for TAKUMI (BL-19) was built and tested. A prototype of a two dimensional compact detector with wavelength shifting fiber read out for iBIX (BL-03) was tested and its production already started. The fabrication of super-mirror guide tubes with $\mu = 4$ for the beam lines of chopper spectrometers started through the use of a large scale ion beam sputtering instrument at J-PARC.

Commissioning test on two dimensional compact scintillation detectors with wavelength shifting fiber read out (first and second one) for “iBIX” and one dimensional scintillation detectors with “ISIS-type” fiber coded method for “TAKUMI” (first and second one) was performed successfully.

Related workshops and meetings.
- November 11-12, 2008
  The 2nd International Advisory Committee for the project of DNA, Biomolecular Dynamics Spectrometer.
- December 8-9, 2008
  The 3rd International Workshop on Chopper Software
- January 27 2009
  The International Workshop on Nano-Structural Analysis with Wide-q.
- January 28-29, 2009
  The International Advisory Committee for the Smaller-Angle Neutron Scattering Instrument of J-PARC for reviewing the project of TAIKAN.
- January 28-29, 2009
  The 7th Neutron Technical Advisory Committee (N-TAC-7); The current status of the development of neutron instruments and devices, the management of the experimental halls, the system for user support, the international activities and collaborations, and the future plans were presented by members of MLF and then reviewed by the committee. The committee reported some valuable recommendations such as an increase of staff to be consistent with the best international practices.

![Measured d-spacing of Si single crystal with the world’s highest resolution of 0.037% at Super-HRPD.](image-url)
Muon science

The superconducting solenoid and the cryogenic system were transferred from the muon facility at KEK and installed in the secondary muon beam line at the 2nd experimental hall of MLF. The commissioning of the superconducting solenoid was started and successfully ramped to a current of 600 A and pions from the muon production target were injected into the solenoid. The pions decayed into muons in-flight, and those muons were extracted and transported into the D2 experimental area. Positive or negative muons can be obtained by reversing the polarity of the bending and focusing magnets. We were able to observe the muonic X-rays from an aluminum target. The successful application of using negative muons for nondestructive element analysis was shown by observing the Au and Ag muonic X-rays from a koban (old Japanese gold coin).

In the D1 area, a $\mu$SR experiment with a 128-segmented spectrometer was installed and tested by obtaining the spin rotation spectra of muons under a 2 mT field and muonium under a 0.5 mT field. The experimental apparatus is currently ready to run an experiment using surface muons (4 MeV positive muons).

In January, 2009, a new cabin equipped with two sets of data acquisition (DAQ) electronics systems and users’ desks was constructed for running the users’ programs. We also started several user’s programs in the end of January. The Saitama-University /JAEA group identified an antiferromagnetic state below 20 K in the (BEDT-TTF)$_2$IBrCl compound, an organic magnet which shows superconductivity under high pressure. The KEK group obtained results on Iron-Oxypnictide Superconductors and the Toyota group obtained new results on lithium diffusion.

A meeting of the Muon Science Advisory Committee (MUSAC VII) was held at TOKAI on March 6 and 7th 2009 just as the first muon beam user period was ending successfully. The main overall recommendation was that the Ultra Slow Muon beams are the future of this facility and the group should position itself to take advantage of new funding opportunities being pursued by users while maintaining a strong scientific vision.

We started the commissioning work to establish the remote handling maintenance operation in the remote handling room and in the hot cell. The procedure to exchange monitor assembly such as CT (current transformer) and PM (profile monitor) now has been successfully established, and the study of the exchange process for the muon target is underway.
Nuclear and Particle Physics Division
The Hadron Experimental Hall is one of the two facilities at the Main Ring and utilizes the various kinds of secondary particles generated by protons. "We will have the most powerful secondary particle beams of this energy," says Professor Kazuhiro Tanaka, who led the construction of the Hall. "We will explore the new frontier in nuclear and particle physics with high intensity hadron beams. Precise measurements of CP violation in K mesons, collective motions of strange quark in hypernuclei, and many other new-generation fixed target experiments are being planned."
To make plenty of secondary particles by the high intensity proton beam available for experiments, many methods of handling the high intensity beam have been developed for this facility. In particular, firm radiation shield was constructed and the magnets that were hard to be broken and easy to be replaced, in case in trouble in the high radiation area, were produced. For example, the primary proton beam line was installed with chimney magnets down to the beam dump. All the magnets were successfully tested with full excitation before their installation. The vacuum system with the beam pipes, the T1-downstream pentagon vessel and pillow-seal flanges etc. have also been commissioned successfully.

On January 27, 2009, the first beam was successfully introduced to the hall down to the beam dump after a minor adjustment of the beam line elements. On that day, both the accelerator and the hadron teams started an attempt to slow-extract a proton beam for the first time, and only after a few hours of the effort, a proton beam was successfully observed at the beam dump with a monitor at 19:35. The beam was monitored with the luminescence screens located in several places in the beam line as displayed below.

After a scheduled maintenance of the accelerator, on February 10th, the production target, T1, was inserted into the proton beam to produce secondary beams. The first secondary beam was observed by the E15/E17 experiment team, headed by Prof. Ryugo S. HAYANO (Tokyo) and Dr. Masahiko IWASAKI (RIKEN), at the K1.8BR beam line. While the beam intensity of the first beam was just 10nA and the beam power of 300W corresponding to 0.1% of the design, we were able to confirm the first production of Kaon beam at the facility. The observed ratio of particle species are consistent with our expectation and further beam tuning with the electric-separator is forthcoming.
Following the success of the first beam, the "Workshop Celebrating the First Beam at Hadron Hall" was held at the Ibaraki Quantum Beam Research Center, located just next to the J-PARC site, on March 25th and 26th. About 100 researchers attended the meeting. They discussed reports on the first beam from the accelerator team, the hadron beam line team, and the E15/E17 team, as well as the reports by the experimental groups who expect to use the beams in this fall at the K1.8 beam line and the KL beam line. In addition, they were encouraged by the talks from noted theorists, Prof. Tetsuo HATSUDA and Prof. Yasuhiro OKADA, hearing physics opportunities in the Hadron Hall. In the afternoon of March 26th, a tour to the Hadron Hall and a general assembly of the Hadron Hall Users Association (HUA) also took place.
T2K experiment

The Tokai-to Kamioka (T2K) experiment is a second-generation accelerator-based long baseline neutrino oscillation experiment. Muon neutrinos are generated at a newly built high-intensity proton synchrotron at Japan Proton Accelerator Research Complex (J-PARC), propagate 295 km across the earth, and are detected by the world’s largest neutrino detector, Super-Kamiokande. Owing to the unprecedented intensity of the neutrino beam, which is two orders of magnitude higher than that in the first-generation K2K experiment (1999–2004, KEK-to-Kamioka), groundbreaking progress in understanding the unknown properties of neutrinos is expected. The construction of the neutrino facility at J-PARC started in FY2004 and was completed in FY2008, followed by the start of the experiment as scheduled in April 2009.

The evidence of neutrino oscillation has shown that neutrinos have masses and that a lepton-flavor-violating process(es) exists. The physics of neutrino oscillations is yet to be revealed; two mixing parameters (the mixing angle of the first and the third generations, $\theta_{13}$ and the CP phase $\delta$ respectively) and the ordering of three mass eigenvalues are unknown. The primary goal of the T2K experiment is to determine the last unknown mixing angle $\theta_{13}$ by investigating muon neutrino to electron neutrino oscillation. If $\theta_{13}$ is sufficiently large to be measured in the early phase of the experiment, the possibility of discovering CP violation in the future will be enhanced.

The muon neutrinos are generated as decay products of pions that are produced from a target hit by a proton beam. One of the distinctive features of the neutrino beamline is so-called "off-axis" configuration. As shown in the layout drawing, the axes of the proton beam, and hence the neutrino beam, are inclined at an angle of a few degrees to the direction of the Super-Kamiokande. As shown in the resulting neutrino spectrum for given off-axis angles, the off-axis beam gives us the highest possible intensity of low-energy neutrinos with a small high-energy tail, which enables precise measurements with minimum background events.

The neutrino facility at J-PARC consists of the primary proton beam line, neutrino beam line, and the near neutrino detector. The purpose of the primary beam line is to transport proton beam extracted from the main ring onto the neutrino production target with designed beam direction and size. The primary beam line consists of the preparation section, arc section, and final focusing section. In the preparation section, property of the proton beam from the main ring is tuned to match the downstream arc section using 11 normal conducting magnets.

The expected spectrum of the off-axis beam for 3° (blue), 2.5° (red), and 2° (black), respectively. The $\nu_e$-to-$\nu\mu$ flux ratio is as small as 0.4% at the peak of the $\nu\mu$ spectrum.

The off-axis configuration of the neutrino beam line.

Superconducting combined function magnets in the tunnel.

Inside electrode of the electro-static beam position monitor.
Equipments in the preparation section are designed to handle possible high radiation exposure. In the arc section, the beam is bent by \( \sim \)80° to the Kamioka direction using 28 superconducting magnets, which are the world-first combined-function superconducting magnets generating both dipole and quadrupole field with single layer coil. Ten normal conducting magnets in the final focusing section are used to focus the beam onto the center of the target with designed beam size and off-axis angle. Five intensity monitors, 21 position monitors, 19 profile monitors, and 50 beam loss monitors are distributed along the beam line to guide the beam precisely. Just in front of the target, an optical transition radiation detector is placed to measure the profile of the beam.

The secondary beam line consists of three regions: the target station, which contains the target and magnetic horns, the decay volume and the beam dump. The target is a 90-cm-long graphite rod with a diameter of 26 mm. The pions generated forward from the target are focused to the Kamioka direction by a series of three electromagnets called horns. The pions are then travel in the decay volume, which is \( \sim \)110-m long, \( \sim \)3-m wide, 3–5 m high tunnel filled with helium gas, and decay into muons and muon neutrinos in flight. The decay volume is designed to accommodate the beam at a 2–2.5° off-axis angle. A beam dump, which consists of \( \sim \)3m-thick graphite blocks followed by \( \sim \)2.5m-thick iron plates, is placed at the downstream end of the decay volume to stop almost all particles other than neutrinos. High-energy muons with energies of more than 5 GeV can penetrate the beam dump. A muon monitor is placed immediately after the beam dump to monitor the intensity and the profile of such muons for each beam shot. The profile of the muons is a good indicator of the beam direction and stability.

At 280 m downstream from the target, neutrino detectors are placed to measure the neutrino beam properties. Two independent detector systems — one located on the proton beam axis and the other located off-axis (pointing toward Super-Kamiokande) — are being constructed. The main purpose of the on-axis detector is to monitor the neutrino beam direction and intensity, while the off-axis detector aims to measure energy spectrum, contamination of electron neutrinos and neutrino interaction cross sections with a similar energy spectrum at Super-Kamiokande. FY2008 was the last year of the five-years construction of the facility. Following the off-site fabrication and test, installation of the superconducting and normal-conducting magnets were carried out in 2007 and 2008. Installation and alignment of the beam monitors took place in 2008, immediately after the installation of the magnets in the relevant section. The vacuum pipes were then totally connected and evacuated to get ready for the MR operation in December 2008. Test energization of all the magnets was also successfully completed by then. The software for online data acquisition and online monitoring also got ready.
The target station building was completed and most of the beam line components inside were installed also in FY2008. The installed components are the graphite target embedded in the first magnetic horn, a baffle to protect the target, and the OTR. The second and the third magnetic horns are to be installed in summer 2009. The beam dump was successfully installed in October 2008. Two different types of muon monitors, namely, ionization chambers and silicon pad arrays, were installed and operated. They played an important role in the verification of the generation of the first neutrino beam, as described below.

After the completion of the neutrino detector hall located 280 m downstream from the target, a large magnet previously used for the UA1 experiment at CERN was successfully installed. Various detector components to measure neutrino-induced reaction are currently being installed inside of the magnet to get ready for the beam by December 2009. At the end of FY2008, the central module out of seven of the on-axis detector (INGRID) was ready for detection of the neutrino beam.

The beam operation started in April 2009 with a low-energy (30 GeV) and low-intensity \(4 \times 10^{11}\) protons/pulse) proton beam. The first neutrino beam was generated on April 23. The screen shot of the oscilloscope shows the signals from muon monitors that indicates the generation of the neutrino beam. The neutrino beamline officially passed government inspection on May 28. After the installation of the second and third horns and the completion of the INGRID detector, the beam commissioning will be resumed from October 2009. We plan to start the physics data taking with the completed off-axis detector in December 2009. Our first target is to accumulate 100kW \(\times\) 10\(^7\) equivalent data and publish physics results by the end of 2010.
Schematic view of the front near detector at located 280 m from the target.

Signals from muon monitors that verify the generation of the first neutrino beam.
Cryogenic Section
Activities

1. Construction of Neutrino Beam Line Superconducting Magnet System

The J-PARC neutrino beam line includes a superconducting beam line that bends a proton beam from the main ring by 80° with a bending radius of 100 m. The beam line uses 28 Superconducting Combined Function Magnets (SCFM). The figure to the right shows a cross section of an SCFM. The magnet uses a pair of single layer left/right asymmetric coils, which generate a dipole field of 2.6 T and a quadrupole field of 19 T/m accommodating 50 GeV beam. A helium refrigerator cools the system to 4.5 K, and its overall electricity consumption is about 500 kW, which is dramatically less than in systems made from normal conducting magnets.

The system’s installation was completed in December 2008. Its commissioning started in December 2008 with a refrigerator performance test. In January 2009, the magnet system was cooled down to the operational temperature of 4.5 K within about 10 days as shown in the figure below to the left. The excitation tests of the magnet including the magnet quench were performed successfully, and the quench recovery time was confirmed to be about two hours for the nominal quench as shown in the figure below to the right.

2. Development of Superconducting Solenoid for Muon Beam Lines

We are in the process of developing a superconducting magnet system for high intensity muon beam lines (such as the Super Omega), super slow muon beam line, or the COMET; and muon to electron conversion experiment facility, in collaboration with Muon Science Division in Institute of Materials Structure Science and Osaka University. One of our major achievements in Japan fiscal year 2008 was the fabrication of the model coils, which simulate part of the curved section of the Super Omega solenoid system. The figure below shows
the completed model coils designed and fabricated by KEK in house. Although the coil fabrication and testing were successful, we found a problem in the mechanical design that cause excessive cost. As a result of research and development, we corrected the design and changed the bending radius of the curved section from 0.75 m to 1 m to simplify the mechanical design. Based on the new bending radius, new model coils were also made by a private company at the end of Japan fiscal year 2008. The use of a new type of superconductor, MgB$_2$, is also considered and an R&D coil using MgB$_2$ was also made. Those coils will be tested in Japan fiscal year 2009.

Cool down curve of the magnet system.

Re-cool down after quench.

Model coils of the curved solenoid for a muon transport line.
Overview

The J-PARC Information System is a system of computers and networks used for researches in J-PARC. The Information System Section designs, manages and operates the system. The section provides services for the Infrastructure Network System, the Authentication System and the Data Base System. Our goal is to make each system a secure and easy-to-use Information and Communication Technology (ICT) infrastructure for the J-PARC users.

In terms of computing resources, for the moment from 2009 J-PARC will rely on the KEK central computer system for analyzing and storing data from neutrinos, nuclear physics and Materials and Life Science Experimental Facility.

History

When the construction of the new J-PARC facility began in 2001, the Center for Promotion of Computational Science and Engineering (CCSE) in JAERI (Japan Atomic Energy Research Institute, former organization of JAEA) and the Computing Research Center in KEK started to work in collaboration to design and build the J-PARC ICT infrastructure. The J-PARC network was planned and structured to provide an environment necessary for smooth collaborations between JAEA, KEK and J-PARC. While its full-scale implementation is planned to proceed gradually, an interim environment has been already introduced by JAERI (JAEA) and KEK since October 2002. In 2008, the JAEA/KEK computer center collaboration was dissolved and the KEK Information System Section was transferred to the J-PARC center. All the projects previously done through that collaboration have been taken over by the section.

J-PARC Network (JLAN: J-PARC Local Area Network)

The J-PARC network called JLAN transparently covers two sites in J-PARC, the Tokai site and Tsukuba site which are about 60 km apart. JLAN provides an environment necessary for the smooth collaboration between JAEA, KEK and J-PARC. In this way, the two sites are seamlessly connected at network Layer 2. Initially, the physical connection between the two sites and the Internet connection used by the KEK network started with a 10 Mbps wide-area Ethernet. In 2004 it was replaced with a 100 Mbps Ethernet established over the Ibaraki Broad Band Network (IBBN) operated by the local government of Ibaraki Prefecture. In 2005 JAERI and KEK successfully invited Super-SINET node to Tokai campus (Super-SINET is an ultrahigh-speed network for Japanese academic researches and is provided by National Institute of Informatics (NII). For details please refer to http://www.sinet.ad.jp.)

In 2006, JLAN was connected to the Super-SINET backbone network with a 1Gbps bandwidth. After that,
JLAN had its own unique doorway to the Internet. In the same time, J-PARC established a J-PARC information security policy independent both from JAEA and KEK.

In 2007 the SINET3 succeeded the Super-SINET. Since the Super-SINET era, NII has been greatly and continuously supporting J-PARC experiments. In 2008, the total number of hosts on JLAN exceeded 1600 and was still increasing at a rate of 150% per year.

An increasing number of public J-PARC users are expected to connect to JLAN from 2009 when J-PARC starts its operation. For the users’ convenience, a Guest Network service, which is a wireless LAN service for short-term visitors, will be available in almost all J-PARC buildings. Soon after their arrival at J-PARC, the visitors will be able to connect to the Internet without any prior registration.

Authentication system

Since J-PARC is located at the site of an atomic energy research laboratory, it requires a more secure authentication system for using online services, which at the same time is convenient for its users. The Authentication System Group researched to resolve those issues. The group listed up possible use cases of personal authentication over online services in J-PARC and mapped their required security strength to available authentication technologies. They tested the feasibility of some of them for practical use.
One Time Password authentication using Web browser. Authentication key is image pattern.

Authentication system R&D.

Database system

As an international public science facility J-PARC should be as easily accessible as possible. For that purpose, we planned a portal Web service to be used for almost all applications and registrations for J-PARC. It should be an integrated, 24h/7days non-stop, quick response remote service. To provide such services several databases and subsystems were developed. As a first step, a “Proposal Submission System” (https://gamusha1.j-parc.jp/) and a “User Support System” (https://mercury.j-parc.jp/usjparc/) were developed by the Users Office and have been in operation since May and December 2008, respectively. The proposal submission system displays public announcements about the J-PARC experiments and accepts corresponding proposal submissions. In the User Support System, users can complete registrations, applications, and reservations required to stay and conduct experiments at J-PARC. As a next step, a Proposal Review System to review submitted proposals is under development. The following table shows the schedule for development of the databases and systems.

<table>
<thead>
<tr>
<th>Name</th>
<th>FY ’08</th>
<th>FY ’09</th>
<th>FY ’10</th>
</tr>
</thead>
<tbody>
<tr>
<td>One Stop Portal site</td>
<td>partially start</td>
<td>Modify</td>
<td>Operate</td>
</tr>
<tr>
<td>Personnel DB</td>
<td>for public users</td>
<td>for Staffs</td>
<td>Operate</td>
</tr>
<tr>
<td>Public user support system</td>
<td>started in Dec.</td>
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<td>Operate</td>
</tr>
<tr>
<td>Experiment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>proposal submission sys.</td>
<td>started in June</td>
<td>Operate</td>
<td></td>
</tr>
<tr>
<td>review sys.</td>
<td>Develop</td>
<td>Start</td>
<td>Operate</td>
</tr>
<tr>
<td>result report sys.</td>
<td>Develop</td>
<td>Operate</td>
<td></td>
</tr>
<tr>
<td>IT system ID DB</td>
<td>Develop</td>
<td>Operate</td>
<td></td>
</tr>
<tr>
<td>Equipment Maintenance DB</td>
<td>Modify</td>
<td>Operate</td>
<td></td>
</tr>
</tbody>
</table>

Secure IC dongle.
Transmutation Section
Check and Review for Partitioning and Transmutation Technology by JAEC

The Japan Atomic Energy Commission (JAEC) reviewed the Partitioning and Transmutation (P&T) technologies including the accelerator driven system (ADS). The JAEC issued a report entitled “Current Status and a Way Forward to Promote the Research and Development of Partitioning and Transmutation Technologies”.

The report summarized that P&T technologies will contribute to rational design of nuclear waste disposal system, and the research and development should be undertaken steadily to build up basic data for the discussion of its feasibility. As the basic policy for research and development (R&D) of P&T technologies, the report presented that the R&D of double-strata concept with ADS should be undertaken as a part of the R&D for future nuclear power generation systems considering the transitional phase from light-water reactor (LWR) cycle to FBR cycle as well as the equilibrium phase of FBR cycle. The report indicated that further R&D and the collaborations with foreign R&D activities are required for the ADS to proceed to next R&D phase where the feasibility study is to be performed from the engineering and economical viewpoints. The report also pointed out importance of the integral experiences of the transmutation systems, especially requirement of the critical experiments using minor actinides (MA), and importance to prepare the facility to perform these experiments. Moreover, the report recommended that TEF-P (Transmutation Physics Experimental Facility) planned in the second phase of J-PARC project should be investigated as a part of the preparation of facility.

Following the decision of the JAEC, JAEA has started the discussion for rational R&D strategies including utilization plans for domestic and overseas R&D facilities.

Activities

Post Irradiation Test

To evaluate mechanical properties of irradiated materials, post irradiation examination (PIE) of the STIP (SINQ target irradiation program, SINQ; Swiss spallation neutron source) specimens was carried out at Waste Safety Testing Facility (WASTEF) in Tokai Research and Development Center, JAEA. Results of the tensile tests on austenitic steel JPCA indicated that irradiation hardening occurred with increasing displacement damage level up to 10 dpa. At higher doses, irradiation hardening seemed to tend to saturate. Degradation of ductility was bottomed around 10 dpa and specimens kept its ductility until 19.5 dpa. In the present study, all the specimens fractured in ductile manner.

As for the development of the LBE spallation target, corrosion tests of 316SS-GBEM (grain boundary engineering materials) under flowing Pb-Bi condition were conducted. Results showed that corrosion rate of GBEM was smaller than that of 316SS-BM (base materials).

Development of Flow Measurement Techniques

A new technique* to measure the velocity vector in multi-dimensions on a line in the flow field has been investigated. A system to achieve this goal was developed based on ultrasonic velocity profiling by using multiple transducers. A three-dimensional system was constructed and successfully applied to an actual flow field for three-dimensional velocity vector measurements. In future, this system will be applied to measure three-directional velocity components in the liquid metal flow.

Estimation of Acceptable Beam Trip Frequencies

Frequent beam trips as experienced in existing high power proton accelerators may cause thermal fatigue problems in ADS components which may lead to degradation of their structural integrity and reduction of their lifetime. Thermal transient analyses were performed to investigate the effects of beam trips on the reactor components, with the objective of formulating ADS design that had higher engineering feasibilities and determining the requirements for accelerator reliability. These analyses were made on the thermal responses of four parts of the reactor components; the beam window, the cladding tube, the inner barrel and the reactor vessel. Our re-

*This study was supported by innovative nuclear research and development program by Japan Science and Technology agency (JST).
Results indicated that the acceptable frequency of beam trips ranged from 50 to $2 \times 10^4$ times per year depending on the beam trip duration. The former was corresponding to the beam trip duration exceeding five minutes. On the other hand, the latter was corresponding to the beam trip duration 10 seconds or less. And the plant availability was estimated to be 70 % or greater in cases where the beam trip frequency decreased to the acceptable frequency of beam trips.

In order to consider measures to reduce the frequency of beam trips on the high power accelerator for ADS, we compared the acceptable frequency of beam trips with the operation data of existing accelerators. The result of this comparison showed that for typical conditions the beam trip frequency for durations of 10 seconds or less was within the acceptable level, while that exceeding five minutes should be reduced to about 1/30 to satisfy the thermal stress conditions.

An averaged three-dimensional velocity vector profile and velocity components in a rectangular water channel measured by the developed system.
Safety Division
J-PARC is a proton accelerator complex with various experimental facilities, and is managed under the Law Concerning Prevention from Radiation Hazards Due to Radio-Isotopes, etc. in the Japanese legal system. A license for its use must be issued by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), and the related safety inspection must be conducted by the Nuclear Safety Technology Center (NUSTEC), before the accelerator and the experimental facilities begin their operations. The application process for the license started in 2007 from the first phase of construction of the accelerator LINAC. By the end of fiscal year 2007, we have already submitted three applications to MEXT and received a permission to deliver the 4-kW proton beams to Materials and Life Science Experimental Facility (MLF).

In fiscal year 2008, we were able to operate proton beams with an intensity of 100 kW, for the next year our target is to ramp the beam up to 250 kW. In order to guarantee the 100 kW beam operation, we submitted an application to MEXT on July 25, 2008 and all applied items were approved on November 4, 2008. Thanks to the licensing efforts, the preparation of the neutron and muon instruments, which will be supplied for the first user program at MLF was completed in terms of radiation safety. An application for increasing the beam power up to 250 kW was also submitted in January 2009.

The on-site inspection of the secondary beam lines in the experimental area of MLF was successfully conducted by NUSTEC on September 4 and 24, 2008, before and during the operation, respectively, after which the beam lines area was officially opened for users to conduct beam experiments. The photograph shows the safety inspection conducted by NUSTEC.

<table>
<thead>
<tr>
<th>Accelerator/Facility</th>
<th>Application items for license in fiscal year 2008.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linac</td>
<td>Application (1)*</td>
</tr>
<tr>
<td>max. accelerating particles</td>
<td>Jul. 25 2008</td>
</tr>
<tr>
<td>RCS</td>
<td>Application (2)</td>
</tr>
<tr>
<td>max. accelerating particles</td>
<td>Jan. 7 2009</td>
</tr>
<tr>
<td>MR</td>
<td>from 3.0x10^16 /h ( @4 kW)</td>
</tr>
<tr>
<td>max. acceleration energy</td>
<td>to 7.5x10^17 /h ( @100kW)</td>
</tr>
<tr>
<td>MLF</td>
<td>from 7.5x10^17 /h ( @100kW)</td>
</tr>
<tr>
<td>max. accelerating particles</td>
<td>to 1.9x10^18 /h ( @250 kW)</td>
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<tr>
<td>Neutron instruments</td>
<td></td>
</tr>
<tr>
<td>Muon instrument</td>
<td></td>
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<tr>
<td>Hadron Hall</td>
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<tr>
<td>max. acceleration energy</td>
<td>9x10^14 /h</td>
</tr>
<tr>
<td>max. acceleration energy</td>
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<tr>
<td>Neutrino</td>
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<td>9x10^14 /h</td>
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<tr>
<td>Exparimental beam line</td>
<td>30 GeV</td>
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</table>

(*) All Items applied for on July 25, 2008, were approved on November 4, 2008.
The J-PARC Users Office (UO) started its operation in fiscal year 2007. Since December 16 2008, the UO moved to a new office space located on the first floor of the “Ibaraki Quantum Beam Research Center” building. The building is located 300m to the north of the main gate of the J-PARC and has been previously used by the NTT (Nippon Telegraph and Telephone Corporation) Research Center.

The J-PARC Users Office had the following achievements in fiscal year 2008:

April 1, 2008; UO started issuing the J-PARC User ID card to users. The users are requested to take their photo at UO or to send a jpeg-file of the photo in advance.

May 19, 2008; training for general safety and radiation workers at J-PARC with video was started targeting the users at UO.

July 8, 2008; the proposal submission system for J-PARC started and first were called proposals for the MLF (Materials and Life Science Experimental Facility) user program for the second half of fiscal year 2008 (2008B) term.

March 25-26, 2009; UO provided assistance for the “First-Beam Workshop at the J-PARC Hadron Experimental Hall” held at the Ibaraki Quantum Beam Research Center.
Items handled by the Users Office

- **Procedures to use J-PARC**
  - User registration
  - Procedures to work at J-PARC
  - Accommodation booking
  - Procedures to work at radiation controlled area
  - Other applications
  - Safety Instructions
- **Procedures to enter/leave J-PARC**
  - Procedures to enter/leave J-PARC
- **How to get to J-PARC**
  - Public Transportation
  - Rental car Information
  - KEK bus
  - JAEA bus
  - (circulating inside of JAEA/commuter)
- **On site Information**
  - On site Facilities
  - AED (Automated External Defibrillator), First Aid Kit, Stretcher

- **Borrow Items**
  - Procedures to borrow items
  - Cafeteria card
  - Other services
- **Application for network use**
  - Network (JLAN) use in Tokai area
  - Network use at Tsukuba campus
- **Accommodations**
  - Accommodations at KEK (Tsukuba Campus)
  - Akogigaura Club
  - Masago International Lodging
  - Tokai bunshtsu
- **Daily Life Information**
  - Visa
Users

J-PARC Users (person-days)

- Accelerator: 156
- Neutrino: 1,902
- Hadron: 837
- MLF: 1,052

J-PARC Foreign Users (person-days)

- Accelerator: 32
- MLF: 62
- Hadron: 9
- Neutrino: 1,024

Number of users, who stayed at J-PARC in JFY2008 since the beginning of the user program at MLF in December, 2008. Total number of users at each facility (left). Total number of foreign users at each facility (right).
User Program
1. Proposal reviewing system for the J-PARC/MLF User program

The Neutron Science Proposal Review Committee and the Muon Science Proposal Review Committee were organized in 2008. The first proposals for the MLF user program for the second half of fiscal year 2008 (2008B) term were called from July 7 to the end of August, 2008. The call for the first half of fiscal year 2009 (2009A) term opened on December 1, 2008 and closed in February, 2009.

2. Program Advisory Committee (PAC) for Nuclear and Particle Physics Experiments at the J-PARC 50GeV Proton Synchrotron

The PAC was organized in 2006 to be in charge of

1) evaluation of the scientific merits, technical feasibility and recommendations about the neutrino program at J-PARC,
2) evaluation of the scientific merits and technical feasibility of proposals at the hadron hall and the prioritization of the secondary beam line (K1.8/K1.8BR/K1.1/K1.1BR/K0/Others),
3) prioritizing proposals as to which are to be Day-1 experiments.

The first PAC meeting was held on June 30- July 2, 2006. The seventh PAC meeting, which was the last for fiscal year 2008, was held on March 6 and 7, 2009.
Approval summary of the J-PARC/MLF User program.

(1) Approved summary of the 2008B user program

Number of the proposals submitted and/or approved for the 2008B user program for each instrument in MLF.

Requested and allocated beam time to each instrument for the 2008B user program.

(2) Approval summary of 2009A User program.

Number of the proposals submitted and approved for the 2009A user program for each instrument in MLF.

Requested and allocated beam time to each instrument.

Access mode for MLF use

(a) General user program

The general use provides both national and international users with an opportunity to conduct experiments with the instruments of MLF. A variety of experiments are accepted, both for academic research and for industrial applications.

(b) Project use

The project use is the access mode in which JAEA and KEK conduct their main tasks oriented programs such as inclusive scientific research projects, research programs proposed to fulfill the plans for midterm goal of JAEA, joint research programs and contract research programs with other institutes or organizations. The principal investigator of the project use may request the beamtime longer than one year in his/her proposal.

(c) Instrument group use

The instrument group use is dedicated to instrument scientists responsible for the beam-line instruments. The instrument group shall maintain and/or improve the performance of their instrument, and conduct the leading-edge research and development which will output maximal performance of the instrument so that MLF always can provide users with the most superior experimental environments.
### Approval summary of the 50 GeV- PAC after the 7-th meeting (March 7, 2009)

<table>
<thead>
<tr>
<th>Approval status (PAC recommendation)</th>
<th>Slow line priority</th>
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J-PARC organization and committees
Organization structure
Member lists of the Advisory Committees organized for J-PARC (as of March, 2009)

International Advisory Committee

Eugene W. Beier University of Pennsylvania, USA
Ja’er Chen Peking University, China
Bernard Frois CEA-Saclay, France
Hidetoshi Fukuyama Tokyo University of Science, Japan
Stuart D. Henderson Oak Ridge National Laboratory, USA
Stephen D. Holmes Fermi National Accelerator Laboratory, USA
Claude Petitjean Paul Scherrer Institute, Switzerland
Jean-Michel Poutissou TRIUMF, Canada
Yoichiro Suzuki University of Tokyo, Japan
Satoru Tanaka University of Tokyo, Japan
Andrew Taylor Rutherford Appleton Laboratory and ISIS, UK
Steve Vigdor Brookhaven National Laboratory, USA
John W. White Australian National University, Australia (chair)

Accelerator Technical Advisory Committee

Roland Garoby CERN
Ian Gardner Rutherford Appleton Laboratory, UK
David Gurd Oak Ridge National Laboratory (retired), USA
Stuart D. Henderson Oak Ridge National Laboratory, USA
Ingo Hofmann GSI, Germany
Stephen D. Holmes Fermi National Laboratory, USA (chair)
Akira Noda Kyoto University, Japan
Thomas Roser Brookhaven National Laboratory, USA
Lloyd M. Young Los Alamos National Laboratory (retired), USA
Jie Wei Brookhaven National Laboratory & Tsinghua University, China

Linac Upgrade Subpanel participants

Roland Garoby CERN
Lloyd M. Young Los Alamos National Laboratory (retired), USA
Leonid Kravchuk Institute for Nuclear Research, Russia
Peter Ostroumov Argonne National Laboratory, USA
Tsumoru Shintake Riken, Japan

Neutron Science Technical Advisory Committee

Günter Bauer Forschungs Zentrum Jülich (retired), ESS, Germany
Stephen Bennington Rutherford Appleton Laboratory, UK
Kurt Clausen Paul Scherrer Institut, Switzerland
John Haines Oak Ridge National Laboratory, USA
Toshiji Kanaya Kyoto University, Japan
Yoshiaki Kiyamaichi Hokkaido University, Japan
Dan Neumann National Institute of Standards and Technology, USA (chair)
Robert Robinson Australian National Science and Technology Organization, Australia
Kazuyoshi Yamada Tohoku University
Muon Science Advisory Committee

Jun Akimitsu Aoyama Gakuin University, Japan
Yoshihiko Hatano Japan Atomic Energy Agency, Japan
Robert H. Heffner Los Alamos National Laboratory, USA
Susumu Ikeda High Energy Accelerator Research Organization, Japan
Yujiro Ikeda Japan Atomic Energy Agency, Japan
Masahiko Iwasaki Riken, Japan
Yasuhiro Miyake High Energy Accelerator Research Organization, Japan
Nobuhiko Nishida Tokyo Institute of Technology, Japan
Kusuo Nishiyama High Energy Accelerator Research Organization, Japan
Jean-Michel Poutissou TRIUMF, Canada (chair)
Claude Petitjean Paul Scherrer Institute, Switzerland
Leonid I. Ponomarev Kurchatov Institute, Russia
Yoshinari Yamazaki High Energy Accelerator Research Organization, Japan

Radiation Safety Committee

Shuichi Ban High Energy Accelerator Research Organization, Japan
Tatsuji Hamada Japan Radioisotope Association, Japan (chair)
Hideo Hirayama High Energy Accelerator Research Organization, Japan
Makoto Inoue Kyoto University, Japan
Kazuaki Kato High Energy Accelerator Research Organization, Japan
Kenjiro Kondo High Energy Accelerator Research Organization, Japan
Takeshi Murakami National Institute of Radiological Science, Japan
Takashi Nakamura Tohoku University, Japan
Hiroshi Noguchi Japan Atomic Energy Agency, Japan
Osamu Oyamada Japan Atomic Energy Agency, Japan
Kotaro Satoh High Energy Accelerator Research Organization, Japan
Yoshitomo Uwamino RIKEN, Japan
Makoto Yoshida Japan Atomic Energy Agency, Japan

Users Consultative Committee for J-PARC

Yasuhiro Fujii Japan Atomic Energy Agency, Japan
Toshiharu Fukunaga Kyoto University, Japan
Yoshiaki Fukushima Toyota Central R&D Labs., Inc., Japan
Makoto Hayashi Ibaraki Prefecture, Japan
Tomohiko Iwasaki Tohoku University, Japan
Shinichi Kamei Mitsubishi Research Institute, Inc., Japan
Toshiji Kanaya Kyoto University, Japan
Yoshiaki Kiyanagi Hokkaido University, Japan
Sachio Komarniya University of Tokyo, Japan
Tomofumi Nagae Kyoto University, Japan
Tsuyoshi Nakaya Kyoto University, Japan
Kazuma Nakazawa Gifu University, Japan
Nobuhiko Nishida Tokyo Institute of Technology, Japan
Kazumi Nishijima Mochida Pharmaceutical Co., Ltd., Japan
Koichiro Nishikawa High Energy Accelerator Research Organization, Japan
Kusuo Nishiyama High Energy Accelerator Research Organization, Japan
Mamoru Sato Yokohama City University, Japan
Budget

Construction budget profile.

Operation budget profile.
Events
Events

March 5 – 7, 2008
The First J-PARC International Symposium, Mito, Ibaraki, Japan.

Two major symposium a) materials and life science (IPS08) and b) particle and nuclear physics (NP08 workshop), respectively, were held separately, whereas the joint session was held in the afternoon of March 5. About 250 members participated in the former symposium and 200 in the latter, with the total number within JFY2008, many plans, dreams, and future expansions were discussed at these two symposia.

The proceedings of IPS08 was issued as the journal Nuclear Instruments and Methods in Physics Research A, Vol. 600 (2009).

May 15, 2008
Ceremony for establishment of the Industrial Users Society for Neutron Application and the symposium of science and technology for industry, Tokyo

On May 15th, a ceremony for establishment of the Industrial Users Society for Neutron Application and a symposium of science and technology for industry were held in Tokyo.

Many companies (49 companies, 83 people) in area of industry, electric, steel, automobile, chemical, medicine etc., participated for the ceremony for establishment. Mr. Takashi Imai, the honorary of Nippon Steel Co., was appointed the chairman of this society. This society established committees on Industry-Academia collaboration, and provided much technical information, organized workshops, summarized the needs of industry within 2008.

A scene of the Ceremony.

Mr. Shoyama, the executive vice chairman, gave an inaugural speech on behalf of the Chairman Imai.
After the ceremony, the symposium of science and technology for industry was attended by about 350 participants of academies, organizations of research, industry. Before the start of the symposium, guests speeches made by Mr. Matsunami, Vice Minister of Education, Culture, Sports, Science and Technology, Mr. Okumura, the member of Council for Science and Technology Policy and Mr. Shoyama, chairman of Hitachi Ltd.. In the first part, Director Akimitsu of Aoyama Gakuin University and the others gave a lecture. In the second part, representatives of Industry, Academy and Government gave speeches about needs and expectations to J-PARC, after that, a panel discussion on needs and expectations of neutron in J-PARC was moderated by Mr. Ikawa of Yomiuri Shimbun editorial writer.

**August 10, 2008**

**J-PARC Open House**

On August 10th, the entire J-PARC facilities were opened to the public. Many people came from various regions and enjoyed a tour of five facilities, LINAC, 50 GeV synchrotron, Materials and Life Science Facilities, Hadron Experimental Hall, and Neutrino Experimental Facilities. The number of visitors is about 2,600 people and was more than expected.
October 19 -25, 2008

*The Asian Science Seminar on High Intensity Proton Accelerator, Beijing, China.*

The seminar was planned primary for Asian young scientists who had strong interest in scientific research to be carried out at high-intensity proton accelerators such as J-PARC and at other accelerator facilities in Asia. In the seminar, lectures were given by Asian leading scientists on science frontier related to J-PARC in nuclear/particle physics and material/life science, as well as on the accelerator and experimental facilities. The number of participants by countries is China 102, Japan 86, Korea 13, Taiwan 3, and USA 3. Many young people (about 70) attended this conference.

November 18, 2008

*Signing of a cooperation agreement among JAEA, KEK and Ibaraki Prefecture*

JAEA, KEK and Ibaraki Prefectural Government signed a cooperation agreement to promote the application of neutron in J-PARC. The three parties cooperate and support with each other in user support, Users Office operations, technical development and operation and maintenance of beam line use, and dissemination of neutron. On November 18th, agreement signing ceremony was held in Ibaraki prefectural building, and the agreement was signed by the President of JAEA, the Director General of KEK, and the Governor Ibaraki.

From left; President Okazaki of JAEA, Governor Ibaraki Mr. Hashimoto, Director Nagamiya of J-PARC center, Director General Suzuki of KEK.
December 16, 2008

*Ceremony for MLF and New Building for Users, “IQBRC”*

On December 16th, a ceremony was held in Tokai to celebrate the opening of the Materials and Life Science Experimental Facility (MLF) facilities to public users, a new building named as Ibaraki Quantum Beam Research Center (IQBRC), that is owned by Ibaraki Prefectural Government, and a new facility named as Tokai-mura study exchange plaza in IQBRC, that is owned by Tokai Village. IQBRC is located near the outside of Nuclear Science Research Institute, which J-PARC is located in. It is now accommodate Ibaraki Prefecture, Tokai Village, University of Tokyo, Ibaraki University, and the Users Office of J-PARC Center. And it is available to use by J-PARC users as a work space.

A scene of the ceremony.

Ibaraki Quantum Beam Research Center (IQBRC).

March 25-26, 2008

*The First-Beam Workshop at the J-PARC Hadron Experimental Hall, IQBRC, Tokai-mura.*

About 100 researchers attended the meeting and discussed reports on the first beam from the accelerator team, the hadron beamline team, and the E15/E17 team, as well as the reports by the experimental group who expect to use the beams in this fall at the K1.8 beamline and the KL beamline. In addition, they were encouraged by the talks from noted theorists, Prof. Tetsuo HATSUDA and Prof. Yasuhiro OKADA, hearing physics opportunities in the Hadron Hall. In the afternoon of March 26th, a tour to the Hadron Hall and a general assembly of the Hadron Hall Users Association (HUA) also took place.

Other Activities in 2008

*Activities of the Industrial Users Society for Neutron Application in 2008*

The Industrial Users Society for Neutron Application was established to promote industrial application of neutron on May 15, 2008. Membership was 49 companies at the end of March, 2009.

In 2008, the Steering Committee and Research & Development Committee were organized to operate and discuss research activities of the Society. The Society provided much information about industrial use, the operation status of J-PARC and JRR-3, the call for proposals of J-PARC and some meetings and so on. Various research meetings were planned and held in cooperation with Ibaraki Prefectural Research Society for Industrial Application of neutron Science. Further, the Society called for participa-
tions in some training courses of neutron experiments in cooperation with Nuclear Technology and Education Center and Quantum Beam Science Directorate of JAEA. Also the Seminars on Industrial Application of Neutron were held in Osaka city (December 19, 2008), Saitama city (February 3, 2009) and Hamamatsu city (February 5, 2009) for dissemination of industrial neutron use in cooperation with Ibaraki Prefecture and J-PARC Center.

Activities of J-PARC/MLF Users Society in 2008

The J-PARC/MLF Users Society was established to promote application of J-PARC through mutual exchange of users on September 7th in 2007. Membership was 259 people, and Sponsor membership was 12 parties at the end of March, 2009.

In 2008, the Secretary Committee and 9 Studying Subcommittees were organized to promote the research activities among researchers and engineers by application of neutron and muon in J-PARC/MLF. Subcommittees established the action plan in this year, and decided to hold some workshops in cooperation with the Industrial Users Society for Neutron Application and the Ibaraki committee of neutron application. This Society provided much information about the operation status and construction status of J-PARC/MLF, the call for proposals, the results of neutron and muon research and some events and so on.

Activities of the Hadron Hall Users’ Association (HUA) in 2008

The Hadron Hall Users’ Association, HUA, was founded on March 25, 2007. The purpose of HUA is, according to the Charter, to provide an organized channel for the interchange of information among those who use the Hadron Hall of the J-PARC, to make up a collective opinion among researchers from different fields with a bottom up basis, to promote better research activities, and to use the results of the research to promote the science of the Hadron Hall to a wide audience. The activities include

- Interchanging information between the members,
- Collecting opinions from the users about the current activities and the future plans of the facility, and reporting these opinions to the J-PARC Center and other related organization,
- Presenting information for the users, and promoting interchange among various researchers and organization,
- Recommending the representatives of the Hadron Hall that sit on the Users’ Committee of J-PARC,
- Hosting scientific meetings, such as a Hadron Hall symposium, and promoting interchange and cooperation with other scientific organization, and
- Other necessary activities to achieve the purpose of HUA.

The membership was 154 at the end of the Japanese Fiscal Year (JFY) 2008, including 30 from foreign institutions. Two meetings were held by HUA during JFY2008. An information meeting of HUA was held at Yamagata University during the autumn meeting of the Physical Society of Japan (JPS) on September 20. Status of the construction of the slow extraction system was reported as well as the general status of the Hadron Hall construction. The general assembly of the year, which must be held at least once a year, was held at the Ibaraki Quantum Beam Research Center on March 26, 2009, just after the “First-Beam Workshop at the J-PARC Hadron Experimental Hall” at the same place. The success of the 1st beam to the Hadron Hall was reported, and the result of the election of the members of the Executive Committee for JFY2009 was introduced, as well as general discussions including ones with the user coordinator of J-PARC.

The Hadron Hall just entered its operational era. Bottom-up activities by the researchers themselves who use the Hadron Hall are of the most importance to achieve scientific goals in this era. HUA will strengthen its activities.
Major Visitors to J-PARC in 2008

**Dr. Ferenc Mezei**, the Hungarian Academy of Sciences and **His Excellency Mr. Ernő Bohár**, the Hungarian Ambassador to Japan (September 2, 2008).

**Prof. Jiang Mianheng**, vice president of the Chinese Academy of Sciences (CAS) and 6 other members of CAS, (January 16, 2009).

**Dr. R. Chidambaram**, Principal Scientific Advisor to the Government of India and Chairman, Scientific Advisory Committee to the Cabinet, (January 20, 2009).

**Akiko Santo** (wear in light blue), the Vice President of the House of Councillors. (June 27, 2008)

**Kisaburo Tokai**, the Minister of Education, Culture, Sports, Science and Technology. (July 18, 2008)

**Koji Omi**, the member of the House of Representatives. (July 3, 2008)

From left; **Akira Gunji**, the member of the House of Councillors; **Masamitsu Naito**, the member of the House of Councillors; **Yukihisa Fujita**, the member of the House of Councillors. (July 9, 2008)

**Keichi Ishii**, the member of the House of Representatives. (July 15, 2008)

**Toshio Yamauchi**, the Senior Vice Minister of Education, Culture, Sports, Science and Technology. (September 2, 2008)
Publications
Publications in Periodical Journals

A-001
Kohara, S. et al.
Structural basis for the fast phase change of Ge\textsubscript{2}Sb\textsubscript{2}Te\textsubscript{5}: Ring statistics analogy between the crystal and amorphous states

A-002
Oigawa, H. et al.
Experiment for accelerator-driven transmutation
*Butsuri* Vol. 56, p. 749 (2001)

A-003
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A-004
Nagamiya, S. et al.
Proton collaboration is under way in Japan

A-005
Takano, H.
Transmutation of long-lived radioactive wastes

A-006
Futakawa, M. et al.
JSNS and MUSE at MLF in J-PARC

A-007
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Structure of Mg\textsubscript{2}SiO\textsubscript{4} glass made by a method for containerless supercooled-liquid-phase processing at high temperatures
*Expected materials for the future Vol.* 5, p. 28 (2005)

A-009
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Completion of J-PARC Mercury Target System -Outline and Topics-
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A-010
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A-011
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A-012
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A-014
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Present status and perspective on nuclear transmutation, C: Accelerator driven transmutation system

A-015
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A-016
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Introduction of the slow beam extraction system for J-PARC 50GeV Main Ring

A-017
Oigawa, H.
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A-018
Fuji, Y.
Utilization of intense neutron beams from basic research through industrial application

A-019
Aizawa, K.
To smaller angle

A-020
Suzuya, K.
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A-031
Toyoda, A. et al.
Development of the Optical Transition Radiation Monitor for the High Intensity Proton Beam Profile Measurement

A-032
Tanaka, K.H. et al.
Development of Radiation-Resistant Magnets for the JHF Project.

A-033
Tanaka, K.H. et al.
Development of Radiation-Resistant Magnets for the JHF/J-PARC Project.

A-034
Tanaka, K.H. et al.
Development of Radiation-Resistant Magnets for JHF/J-PARC Project.

A-035
Hirose, E. et al.
A new 3-axes magnetic field measurement system based on the Hall elements

A-036
Tanaka, K.H. et al.
Radiation Resistant Magnets for the J-PARC Project.

A-037
Hirose, E. et al.
The Beam-Handling Magnet System for the J-PARC Neutrino Beam Line

A-038
Takahashi, H. et al.
Magnet Operation in vacuum for High Radiation Environment near Production Target

A-039
Hirose, E. et al.
Shield Penetrating Water Cooled Bus Ducts for Radiation Resistant Magnets at J-PARC,

A-040
Nakamura, T. et al.
Usage of a capillary plate as a pre-gas-amplification device for a neutron microstrip gas chamber

A-041
Oyama, Y.
Construction of High Intensity Proton Accelerator Facility (J-PARC)

A-042
Futakawa, M. et al.
Erosion damage on solid boundaries in contact with liquid metals by impulsive pressure injection

A-043
Takahashi, N. et al.
Neutron spin-echo studies on polyvinyl alcohol gels during melting process

A-044
Kanaya, T. et al.
Neutron Spin-echo Studies on Crossover from Single Chain Motion to Collective Dynamics

A-045
Kiyana, Y. et al.
Nuclear science and engineering expected in high-intensity proton accelerator facility (J-PARC)

A-046
Futakawa, M.
Impact erosion by pressure wave propagation in mercury target for pulsed spallation neutron source

A-047
Shibata, T.
Utilization of radiation and its perspective:-The trend of radiation usage in industrial and medical fields-

A-048
Okamura, K. et al.
SiC-based ceramic fibers prepared via organic-to-inorganic conversion process; A Review

A-049
Hoshikawa, A. et al.
Observation of hydrogen in deuterated methane hydrate by maximum entropy method with neutron powder diffraction

A-050
Suzuya, K. et al.
Very strong hydrogen bonds in a bent chain structure of fluoroorganohydrogenacenions in liquid Cs(FH)2.3F

A-051
Teshigawra, M. et al.
Gas yield and mechanical property of super insulator (polyimide and polyester) after γ ray irradiation

A-052
Kato, T. et al.
Spallation Neutron Source at J-PARC and Its Cryogenic Hydrogen System

A-053
Kato, T. et al.
Safety Design of the Cryogenic Hydrogen System at J-PARC

A-055
Kohara, S. et al.
The Disordered 3-dimensional structure visualized by a combination of high-energy synchrotron X-rays and computer simulations

A-056
Hoshikawa, A.
Observation of hydrogen in methane hydrate by neutron powder diffraction

A-057
Suzuki, J. et al.
New development in nanostructure analysis by smaller-angle neutron scattering instrument of J-PARC

A-058
Suzuya, K. et al.
Overview of the High-Intensity Total Diffractometer at J-PARC and Structural Study


A-088
Tsujimoto, K. et al.
Neutronics design for lead-bismuth cooled accelerator-driven system for transmutation of minor actinide

A-089
Kinoshita, H. et al.
Experiments on mercury circulation system for spallation neutron target

A-090
Futakawa, M. et al.
Damage diagnostic of localized impact erosion by measuring acoustic vibration

A-091
Ohno, S. et al.
Experimental investigation of lead-bismuth evaporation behavior

A-092
Takei, H. et al.
Derivation of simple evaluation method for thermal shock damage on accelerator materials caused by out-of-control beam pulses and its application to J-PARC

A-093
Tsujimoto, K. et al.
Research and development program on accelerator driven subcritical system in JAERI

A-094
Kogawa, H. et al.
Dynamic response of mercury subjected to pressure wave

A-095
Wakui, T. et al.
Failure probability estimation of multi-walled vessels for mercury target

A-096
Kogawa, H. et al.
Microbubble Formation at a Nozzle in Liquid Mercury

A-097
Futakawa, M. et al.
Mitigation Technologies for Damage Induced by Pressure Waves in High-Power Mercury Spallation Neutron Sources (I) -Material Surface Improvement-

A-098
Futakawa, M. et al.
Mitigation technologies for damage induced by pressure waves in high-power mercury spallation neutron sources I-Bubbling effect to reduce pressure wave-

A-099
Naoe, T. et al.
Lifetime Estimation of Microbubble in Mercury

A-100
Kohara, S. et al.
Intermediate-range order in vitreous SiO2 and GeO2

A-101
Inamura, Y. et al.
Transformation in intermediate-range structure of vitreous silica under high pressure and temperature

A-102
Suzuya, K. et al.
Structural studies of disordered materials using high-energy x-ray diffraction from ambient to extreme conditions

A-103
Sawada, S.
Status and plan of J-PARC

A-104
Itoh, S. et al.
High-energy resolution inelastic neutron scattering experiment on magnetic fracton dispersion in near-percolating three-dimensional Heisenberg antiferromagnet, RbMn$_{0.75}$Mg$_{0.25}$F$_3$

A-105
Kajimoto, R. et al.
Spin wave and orbital ordering in the C-type antiferromagnetic phase of Nd$_{2}$Sr$_2$MnO$_6$

A-106
Kajimoto, R. et al.
R-dependence of spin exchange interactions in RMnO$_3$ (R = Rare-Earth Ions)

A-107
Ikeda, Y. et al.
Experiments for accelerator driven nuclear transmutation under the JAERI-KEK joint project of high intensity proton accelerator

A-108
Suzuya, K. et al.
Structural Analysis of Materials using Pulsed Neutrons at J-PARC

A-109
Futakawa, M. et al.
Hardening effect on impact erosion in interface between liquid and solid metals

A-110
Naoe, T. et al.
Pitting damage evaluation by liquid/solid interface impact analysis

A-111
Naoe, T. et al.
Fatigue strength degradation by pitting damage

A-112
Naoe, T. et al.
Pitting Damage Morphology of Surface Modified Material - Damage suppression by surface hardening treatment -

A-113
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Bending Fatigue Strength of Surface Modified Stainless Steel with Pitting Damage

A-114
Kamiya, J. et al.
Reduction of Outgassing for Suppressing Electrical Breakdown in the Kicker Magnet of J-PARC

A-115
Date, H. et al.
Impact behavior of mercury droplet

A-116
Kogawa, H. et al.
Coupled behavior between structural body and liquid under impact loading
A-117
Futakawa, M. et al.
Inverse problem on indentation load and depth curve; Identification of material constants by using a spherical indenter

A-118
Naoe, T. et al.
Mechanical property evaluation of gradient surface layer by inverse analysis using spherical-contact multi layer model

A-119
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Journal of JSEM Vol. 5, p. 64 (2005)

A-120
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Erosion damage evaluation using acoustic vibration induced by micro-bubble collapse

A-121
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A-122
Kogawa, H. et al.
Wettability Effect on Bubble Formation at Orifice Type Nozzle

A-123
Nakatsuksa, S. et al.
Development of crosslinked rubber material for high radiation field

A-124
Kikuchi, K. et al.
Lead-bismuth eutectic compatibility with materials in the concept of spallation target for ADS

A-125
Kobayashi, T. et al.
Development of digital low level rf system

A-126
Hasegawa, K.
Report on the third ACFA-HPPA mini-workshop

A-127
Meigo, S. et al.
Beam Commissioning of the J-PARC MLF

A-128
Ao, H. et al.
LINAC08 Report

A-129
Suzuya, K. et al.
Atomic-scale Structure of Polymer-route Si-C-O Fibers Observed by Synchrotron Radiation X-ray Diffraction

A-130
Nagamiya, S.
Overview of J-PARC, in “Particle and Nuclear Physics at J-PARC”

A-131
Ogino, Y. et al.
Crystallization of isotactic polypropylene under shear flow observed in a wide spatial scale

A-132
Kikuchi, K. et al.
Introduction of J-PARC
Maintenology Vol. 6, p. 49 (2008)

A-133
Mehmood, M. et al.
Electro-deposition of tantalum on tungsten and nickel in LiF-NaF-CaF$_2$ melt containing K$_2$TaF$_7$; Electrochemical study

A-134
Kikuchi, K. et al.
Study on swelling for Austenitic steel irradiated by 580 MeV proton

A-135
Kohara, S. et al.
High-energy synchrotron x-ray diffraction studies on disordered materials - from ambient condition to an extreme condition
Molten salts Vol. 50, p. 71 (2007)

A-136
Shibata, K. et al.
Lattice dynamics of the Zn-Mg-Sn icosahedral quasicrystal and its Zn-Sn periodic 1/1 approximant

A-137
Ikeda, Y.
1-MW pulse Spallation Neutron Source (JSNS) of J-PARC

A-138
Haga, K. et al.
Water flow experiments and analyses on the cross-flow type mercury target model with the flow guide plates

A-139
Sasa, T. et al.
Research and development on accelerator-driven transmutation system at JAERI

A-140
Sakaki, H. et al.
Beam energy gain fluctuation in a linac caused by RF system noise

A-141
Sakaki, H. et al.
Simulation of electron beam energy fluctuation in a linac; Filtering of the utility parameter’s information by ensemble average

A-142
Nagamiya, S.
KEK/JAERI Joint Project on high intensity proton accelerators

A-143
Matsubayashi, M. et al.
Development of a fast neutron radiography converter using wavelength-shifting fibers

A-144
Masaoka, S. et al.
Optimization of a micro-strip gas chamber as two-dimensional neutron detector using Gadolinium converter

A-145
Kai, T. et al.
Coupled hydrogen moderator optimization with ortho/para hydrogen ratio
A-146
Harada, M. et al.
Neutronic studies on decoupled hydrogen moderator for a short-pulse spallation source

A-147
Nakamura, T. et al.
Operation of a capillary plate under high-pressure ³He for neutron detection

A-148
Kai, T. et al.
Neutronic performance of rectangular and cylindrical coupled hydrogen moderators in wide-angle beam extraction of low-energy neutrons

A-149
Ooi, M. et al.
Measurements of the change of neutronic performance of a hydrogen moderator at Manuel Lujan Neutron Scattering Center due to conversion from ortho- to para-hydrogen state

A-150
Harada, M. et al.
Neutronics of a poisoned para-hydrogen moderator for a pulsed spallation neutron source

A-151
Ohkawa, T. et al.
Dispersion matching at the injection from a high-intensity linac to a circular accelerator

A-152
Kobayashi, T. et al.
RF Reference Distribution System for J-PARC Linac

A-153
Naoe, T. et al.
Cavitation damage reduction by microbubble injection

A-154
Takahashi, N. et al.
A Novel Time-Spatial-Focusing Momentum-Correction Analyzer for the Near-Backscattering Spectrometer DIANA at J-PARC

A-155
Ohkawa, T. et al.
Macro-particle simulation study on transverse halo collimator for J-PARC linac

A-156
Ohkawa, K. et al.
Design and Application of NOBORU -NeutrOn Beam-line for oBServation and Reserch Use at J-PARC

A-157
Harada, M. et al.
Pulse characteristics of epi-thermal neutrons from a spallation source

A-158
Nagamiya, S.
J-PARC project

A-159
Ieiri, M. et al.
Electrostatic separator for K1.8 beam line at J-PARC

A-160
Nagamiya, S.
Physics prospects with high intensity proton accelerator (J-PARC) at Tokai

A-161
Nagamiya, S.
Current status of the J-PARC project

A-162
Nagamiya, S.
J-PARC Project in Japan

A-163
Sawada, S.
J-PARC, Japan Proton Accelerator Research Complex

A-164
Miyake, Y. et al.
J-PARC Muon Science Facility with use of 3 GeV Proton Beam

A-165
Shimomura, K. et al.
Design Study of Muon Beam from J-PARC 3 GeV Rapid Synchrotron

A-166
Tsujimoto, K. et al.
Validation of minor actinide cross sections by studying samples irradiated for 492 days at the downreay prototype fast reactor, 2; Burnup calculations

A-167
Maekawa, F. et al.
Analysis of neutronic experiment on a simulated mercury spallation neutron target assembly bombarded by Giga-electron-Volt protons

A-168
Tsujimoto, K. et al.
Feasibility of lead-bismuth-cooled accelerator-driven system for minor-actinide transmutation

A-169
Nagamiya, S.
High Energy Accelerator Research Organization in Japan (KEK)

A-170
Shobuda, Y. et al.
Coupling Impedances of a Gap in Vacuum Chamber

A-171
Shobuda, Y. et al.
The Generalized Napoly Integral to Compute Wake Potentials in Axysymmetric Structure

A-172
Tamura, F. et al.
Dual-harmonic auto voltage control for the rapid cycling synchrotron of the Japan Proton...
Accelerator Research Complex

A-173 Miyake, Y. et al.
Status of J-PARC muon science facility at the year of 2005

A-174 Takahashi, N. et al.
Quantum Beam Studies on Polymer Crystallization under Flow

A-175 Takahashi, N. et al.
Gelation-Induced Phase Separation of Poly(vinyl alcohol) in Mixed Solvents of Dimethyl Sulfoxide and Water

A-176 Fujii, Y.
Challenging neutron industrial application

A-177 Arai, M.
Present status and future of neutron research in the world

A-178 Oyama, Y. et al.
Neutron facility at high intensity proton accelerator project
Radiation and industries Vol. 107, p. 45 (2005)

A-179 Morii, Y. et al.
Industrial application system of neutrons at J-PARC
Radiation and industries Vol. 107, p. 52 (2005)

A-180 Oyama, Y.
Development of high intensity pulsed neutron source and its application

A-181 Nakashima, H. et al.
Radiation Safety on Accelerator Facilities(I)
(Radiation safety and management at J-PARC)

A-182 Watababe, N.
Neutronics of pulsed spallation neutron sources

A-183 Nakamura, T. et al.
Cryogenic neutron detector comprising an InSb semiconductor detector and a supercritical helium-3 gas converter

A-184 Yamagishi, H. et al.
Novel instrument system for discriminating secondary particles in high-spatial-resolution neutron detection

A-185 Tanaka, H. et al.
A two-dimensional gas detector with individual readouts for neutron detection with a high spatial resolution and fast temporal response

A-186 Arai, M.
Current trend of proton accelerator development in the world

A-187 Oyama, Y.
Progress of high-intensity proton accelerator project; J-PARC, Japan Proton Accelerator Research Complex
Science and Technology in Japan Vol. 24, p. 2

A-188 Kohara, S. et al.
Glass formation at the limit of insufficient network formers

A-189 Zherebtsov, S. et al.
Erosion damage of laser alloyed stainless steel in mercury

A-190
Fujii, Y.
Neutron science and high pressure; Inelastic neutron scattering associated with pressure-induced phase transition

A-191 Ishikura, S. et al.
Micro pit formation by mercury-sphere collision

A-192 Aso, T. et al.
Experimental investigation of characteristics of impinging jet heat transfer and application to JSNS moderator design

A-193 Hayashi, K. et al.
Thermal-hydraulic experiment on beam window for developing the accelerator-driven transmutation system

A-194 Hattori, H. et al.
Direct numerical simulation of turbulent heat transfer in plane impinging jet: Effects of impingement distance on heat transfer in confined space

A-195 Soyama, H. et al.
Estimation of incubation time of cavitation erosion for various cavitating conditions

A-196 Soyama, H. et al.
A prediction method of incubation period on cavitation erosion

A-197 Futakawa, M.
MIMTM, Magnetic Impact Testing Machine
Conference Reports

C-001
Aoki, K. et al.
Development of New Cooling System Using Gm/jt Cryocoolers for the SKS Magnet

C-002
Tatsumoto, H. et al.
Thermal Stress Analysis for a Transfer Line of Hydrogen Moderator in J-PARC

C-003
Tatsumoto, H. et al.
FORCED CONVECTION HEAT TRANSFER OF SUBCOOLED LIQUID NITROGEN IN HORIZONTAL TUBE

C-004
Nagamiya, S.
J-PARC and Spin Physics

C-005
Futakawa, M. et al.
Visualization of mercury cavitation bubble collapse

C-006
Sasaki, K. et al.
Magnetic Field Measurement System in Superconducting Combined Function Magnets for the J-PARC Neutrino Beam Line

C-007
Kamiya, J. et al.
Magnetic field mapping and excitation test in vacuum for the kicker magnet in J-PARC RCS

C-008
Yoshimoto, M. et al.
Field Measurement of DC Magnets at 3GEV RCS in J-PARC

C-009
Tani, N. et al.
Design and Fabrication of an RCS Magnet Coil Using a Stranded Conductor of J-PARC 3-GeV Synchrotron

C-010
Tatsumoto, H. et al.
Numerical Analysis of Forced Convection Heat Transfer of Subcooled Liquid Nitrogen

C-011
Nakahara, K. et al.
Design of the Large Acceptance Muon Beamline at J-PARC
NEUTRINO FACTORIES, SUPERBEAMS AND BETABEAMS: 9th International Workshop on Neutrino Factories, Superbeams, and Betabeams - NuFact 07. AIP Conference Proceedings, Volume 981, p. 312

C-012
Shimomura, K. et al.
Status of Decay/Surface Muon Channel for the Muon Science in J-PARC
NEUTRINO FACTORIES, SUPERBEAMS AND BETABEAMS: 9th International Workshop on Neutrino Factories, Superbeams, and Betabeams - NuFact 07. AIP Conference Proceedings, Volume 981, p. 381

C-013
Arai, M.
J-PARC and Prospective Neutron Science

C-014
Nagamiya, S.
J-PARC Program Overview

C-015
Nakane, Y. et al.
Monte Carlo Calculations for the Shielding Design of Beam Injection and Extraction Areas at the 3-GeV Synchrotron in J-PARC

C-016
Masukawa, F. et al.
Estimation of Radioactivity Produced in Cooling Water at High-Intensity Proton Accelerator Facility

C-017
Bucheeri, A. et al.
Fabrication of a bubbler nozzle for micro-bubble injection in liquid mercury
5th International Conference on Porous Metals and Metallic Foams (MetFoam 2007), A104, Montreal, Canada, September 5-7, p. 189

C-018
Naito, F.
Present Status of J-PARC
Proc. of APAC 2007, Raja Ramanna Centre for Advanced Technology (RRCAT), Indore, India, p. 1

C-019
Nakane, Y. et al.
Monte Carlo Calculations for the Shielding Design of Beam Injection and Extraction Areas at the 3-GeV Synchrotron in J-PARC

C-020
Koseki, T. et al.
Present Status of J-PARC MR Synchrotron
Proc. of APAC 2007, Raja Ramanna Centre for Advanced Technology (RRCAT), Indore, India, p. 259

C-021
Shobuda, Y. et al.
Degradation of the Beam passing through Idle Coupled Cavities
Proc. of APAC 2007, Raja Ramanna Centre for Advanced Technology (RRCAT), Indore, India, p. 369

C-022
Shirakata, M. J. et al.
The Magnet Alignment Method For The J-PARC Main Ring
Proc. of APAC 2007, Raja Ramanna Centre for Advanced Technology (RRCAT), Indore, India, p. 752

C-023
Toyoda, A. et al.
OPTICAL TRANSITION RADIATION MONITOR FOR HIGH INTENSITY PROTON BEAM AT THE J-PARC
Proc. of DIPAC 2007, p. 30
<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Authors</th>
<th>Volume</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-024</td>
<td>ALIGNMENT OF CAVITIES AND MAGNETS AT J-PARC LINAC</td>
<td>Morishita, T. et al.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-025</td>
<td>Present Status of Materials and Life Science Experimental Facility (MLF) and Spallation Neutron Source Related Components.</td>
<td>Kaminaga, M. et al.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-026</td>
<td>Commissioning Experience and Plans for J-PARC LINAC</td>
<td>Ikekami, A. et al.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-027</td>
<td>Development of Permanent Magnet Quadrupole Lenses for Neutron Polarization and Transport</td>
<td>Muto, S. et al.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-028</td>
<td>Experimental Program at a Neutron Beam Line NOBORU in JSNS</td>
<td>Maekawa, F. et al.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-030</td>
<td>A Plan for Novel Material Science Facility integrating an All-ion Accelerator and a Small Neutron Source</td>
<td>Kawai, M. et al.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-031</td>
<td>Recent Progress in Development and Construction of High Resolution Chopper Spectrometer a J-PARC</td>
<td>Itoh, S. et al.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-034</td>
<td>Development of Neutron Shielding Concrete Containing Colemanite and Peridotite</td>
<td>Okuno, K. et al.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-035</td>
<td>Fabrication Status of Moderator-reflector in JSNS</td>
<td>Teshigawara, M. et al.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-037</td>
<td>Estimation of Pressure Change Based on Hybrid Control System in JSNS Hydrogen Loop</td>
<td>Hasegawa, S. et al.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-038</td>
<td>Thermal Shock Test of Ta-cladded W Solid Target Model</td>
<td>Kikuchi, K. et al.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-039</td>
<td>R&amp;D on Pressure-wave Mitigation Technology in Mercury Targets</td>
<td>Futakawa, M. et al.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-040</td>
<td>Development of Controlled Micro-Gas Bubble Formation in Mercury Targets</td>
<td>Haga, K. et al.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-041</td>
<td>Present Status of JSNS Mercury Target</td>
<td>Haga, K. et al.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-042</td>
<td>Construction of the JSNS Shutter System</td>
<td>Oikawa, K. et al.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-043</td>
<td>Nuclear Heating Calculation for JSNS</td>
<td>Harada, M. et al.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
C-045
Hiroki, N. et al.
MULTI-WIRE PROFILE MONITOR FOR J-PARC 3GEV RCS
Proc. of the 18th Meeting of the Int. Collaboration on Advanced Neutron Sources, Dongguan, Guangdong, China, 25-29 April, 2007, p. 1131

C-046
Ikeda, Y.
J-PARC Status Update

C-047
Futakawa, M. et al.
Development of the Hg target in the J-PARC neutron source

C-048
Miyake, Y. et al.
J-PARC muon source, MUSE

C-049
Oishi, R. et al.
Rietveld analysis software for J-PARC

C-050
Meigo, S. et al.
Beam Commissioning for Neutron and Muon Facility at J-PARC

C-051
Suzuki, S.Y. et al.
New pipelined data acquisition system for µSR experiments at J-PARC

C-052
Haga, K. et al.
Bubble flow simulations in target vessel

C-053
Maruyama, R. et al.
Development of high-reflectivity neutron supermirrors using an ion beam sputtering technique

C-054
Sakai, K. et al.

C-055
Kinoshita, H. et al.
Remote handling devices in MLF

C-056
Hasegawa, S. et al.
Effect of hydrogen loop fluctuation on cold neutron performance with hybrid control system in JSNS

C-057
Oikawa, K. et al.
Engineering Design of JSNS Shutter System

C-058
Harada, M. et al.
Settlement of Materials and Life Sciences Experimental Facility at J-PARC

C-059
Takahashi, N. et al.
Study of the analyzer crystals for use in the near-backscattering spectrometer DNA at J-PARC

C-060
Kogawa, H. et al.
Development on Mercury Pump for JSNS

C-061
Oku, T. et al.
Pulsed neutron beam control using a magnetic multiplet lens

C-062
Satoh, S. et al.
Development of a readout system employing high-speed network for J-PARC

C-063
Shinohara, T. et al.
Design and performance analyses of the new time-of-flight smaller-angle neutron scattering instrument at J-PARC

C-064
Kawamura, N. et al.
Design strategy for devices under high radiation field in J-PARC muon facility

C-065
Ooi, M. et al.
Developmental status of a server system for the MLF general control system

C-066
Suzuki, J. et al.
Object-oriented data analysis framework for neutron scattering experiments

C-067
Ebisawa, T. et al
Shield evaluation of cold neutron curved guide tubes for J-PARC neutron resonance spin echo spectrometers

C-068
Nakahara, K. et al.
The super omega muon beamline at J-PARC
C-069
Takeshita, S. et al. 
Development of positron detector for μSR based on multi-pixel photon counter 

C-070
Makimura, S. et al. 
Present status of construction for the muon target in J-PARC 

C-071
Wakui, T. et al. 
Effects of pitting damage and repeated stresses on lifetime of mercury target 

C-072
Strasser, P. et al. 
Alignment and shields in the M2 primary proton beamline at J-PARC 

C-073
Sakasai, K. et al. 
Development of neutron detector for engineering materials diffractometer at J-PARC 

C-074
Nakamura, T. et al. 
Evaluation of the performance of a fibre-coded neutron detector with a ZnS/10B2O3 ceramic scintillator 

C-075
Fujimori, H. et al. 
Radiation resistant magnets for the J-PARC muon facility 

C-076
Nakayoshi, K. et al. 
Development of a data acquisition subsystem using DAQ-Middleware 

C-077
Kai, T. et al. 
User’s Beam Interlock System at the Materials and Life Science Experimental Facility of J-PARC 

C-078
Higemoto, W. et al. 
J-PARC muon control system 

C-079
Higemoto, W. et al. 
JAEA-ASRC μSR project at J-PARC MUSE 

C-080
Kajimoto, R. et al. 
Study of the neutron guide design of the 4SEASONS spectrometer at J-PARC 

C-081
Shimomura, K. et al. 
Superconducting muon channel at J-PARC 

C-082
Ohhara, T. et al. 
Development of data processing software for a new TOF single crystal neutron diffractometer at J-PARC 

C-083
Hosoya, T. et al. 
Development of a new detector and DAQ systems for IBIX 

C-084
Shamoto, S. et al. 
Total scattering of disordered crystalline functional materials 

C-085
Wakimoto, S. et al. 
Neutron scattering study of the relaxor ferroelectric K1-xLixTaO3 

C-086
Tatsumoto, H. et al. 
Design of Hydrogen Vent Line for the Cryogenic Hydrogen System in J-PARC 

C-087
Maekawa, F. et al. 
NOBORU: J-PARC BL10 for Facility Diagnostics and Its Possible Extension to Innovative Instruments 

C-088
Ishida, T. et al. 
Neutrino Facility at J-PARC: Construction Status and Future Prospects 
Proc. of the 3rd International Workshop on a Far Detector in Korea for the J-PARC Neutrino Beam, p. 23

C-089
Takada, H. 
Accelerator based facility design in association with nuclear data 

C-090
Nakamoto, T. 
STATUS OF THE SUPERCONDUCTING MAGNET SYSTEM FOR THE J-PARC NEUTRINO BEAM LINE 

C-091
Ishida, T. et al. 

NEUTRINO AND OTHER BEAM-LINES AT J-PARC
Proceedings of 2007 Particle Accelerator Conference (PAC ’07) (Internet), p. 686

C-092
Sasa, T. et al.
Shielding analysis at the upper section of accelerator-driven system
Proceedings of 8th International Topical Meeting on Nuclear Applications and Utilization of Accelerators (AccApp ’07), p. 628

C-093
Sasa, T. et al.
Conceptual study of actinide reformer using high-power proton accelerator
Proceedings of 8th International Topical Meeting on Nuclear Applications and Utilization of Accelerators (AccApp ’07), p. 904

C-094
Sasa, T. et al.
Current plan of J-PARC transmutation experimental facility
Proceedings of 8th International Topical Meeting on Nuclear Applications and Utilization of Accelerators (AccApp ’07), p. 949

C-095
Nakashima, H. et al.
Benchmark calculation for the J-PARC shielding design
Proceedings of 8th International Topical Meeting on Nuclear Applications and Utilization of Accelerators (AccApp ’07)

C-096
Yoshikawa, H. et al.
Current Status of the Control System for J-PARC Accelerator Complex
Proceedings of ICALEPCS07, Knoxville, Tennessee, USA, p. 62

C-097
Sako, H. et al.
Beam Commissioning Software and Database for J-PARC LINAC
Proceedings of ICALEPCS07, Knoxville, Tennessee, USA, p. 698

C-098
Harada, H. et al.
Current Status of Virtual Accelerator at J-PARC 3 GeV Rapid Cycling Synchrotron
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 215

C-099
Allen, C.K. et al.
XAL Online Model Enhancements for J-PARC Commissioning and Operation
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 218

C-100
Sugai, I. et al.
Development of Hybrid Type Carbon Stripper Foils with High Durability at >1800K for RCS of J-PARC
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 242

C-101
Takagi, A. et al.
Comparative Study on Lifetime of Stripper Foil using 650keV H Ion Beam
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 245

C-102
Sako, H. et al.
Development of Commissioning Software System for J-PARC LINAC
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 257

C-103
Yamamoto, M. et al.
Longitudinal Particle Tracking of J-PARC RCS for Synchronization
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 260

C-104
Shaw, R.W. et al.
Spallation Neutron Source (SNS) Diamond Stripper Foil Development
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 620

C-105
T. Ishida for the Neutrino Beam-Line Subgroup
NEUTRINO AND OTHER BEAM-LINES AT J-PARC
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 686

C-106
T. Koseki and J-PARC MR Group
Status of J-PARC Main Ring Synchrotron
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 736

C-107
Sasaki, S. et al.
A Possibility for Using an APPLE Undulator to Generate a Photon Beam with Transverse Optical Modes
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 1142

C-108
Akiikawa, H. et al.
Profile Measurement and Transverse Matching in J-PARC Linac
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 1472

C-109
Ikegami, M. et al.
RF Amplitude and Phase Tuning of J-PARC DTL
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 1481

C-110
Tomizawa, M. et al.
Design of Dynamic Collimator for J-PARC Main Ring
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 1505

C-111
Tomizawa, M. et al.
New Beam Optics Design of Injection/Fast Extraction/Abort Lines of J-PARC Main Ring
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 1508

C-112
Yoshii, M. et al.
Present Status of J-PARC Ring RF Ring RF Systems
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 1511

C-113
Ao, H. et al.
Fabrication Status of ACS Accelerating Modules of J-PARC Linac
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 1514

C-114
Ito, T. et al.
High Power Conditioning of the DTL for J-PARC
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 1517

C-115
Morishita, T. et al.
The Precise Survey and the Alignment Results of the J-PARC Linac
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 1520

C-116
Morishita, T. et al.
The DTL/SDTL Alignment of the J-PARC Linac
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 1523

C-117
SAHA, P.K. et al.
Updated Simulation for the Nuclear Scattering Loss Estimation at the RCS
C-118
Shen, G. et al.
RF Amplitude and Phase Tuning of J-PARC SDTL
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 1529

C-119
Yamamoto, M. et al.
High Power Test of MA Cavity for J-PARC RCS
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 1532

C-120
Fang, Z. et al.
RF Feedback Control Systems of the J-PARC Linac
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 2101

C-121
Tamura, F. et al.
Development of the Beam Chopper Timing System for Multi-Turn Injection to the J-PARC RCS
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 2125

C-122
Kobayashi, T. et al.
Performance of J-PARC Linac RF System
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 2128

C-123
Schnase, A. et al.
MA Cavities for J-PARC with Controlled Q-value by External Inductor
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 2131

C-124
Kazuo Hasegawa for the J-PARC Linac commissioning team
Commissioning of the J-PARC Linac
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 2619

C-125
Chin, YH, et al.
ABCI Progresses and Plans: Parallel Computing and Transverse Napoly-Shobuda Integral
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 3306

C-126
Ohkawa, T. et al.
Comparison of Trajectory Between Modeling and Experiment for J-PARC Linac
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 3324

C-127
Shobuda, Y. et al.
Extension of Napoly Integral for Transverse Wake Potentials to General Axisymmetric Structure
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 3333

C-128
Sato, S. et al.
Beam Position Monitor and its Calibration in J-PARC LINAC
Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 4072

C-129
Hotchi, H. et al.
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Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 4078

C-130
Satou, K. et al.
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Proceedings of PAC07, Albuquerque, New Mexico, USA, p. 4084

C-131
Oguri, H. et al.
Development and operation of a Cs-free J-PARC H+ ion source

C-132
Fujii, Y.
Overview on neutron sources in Japan

C-133
Takei, H. et al.
Comparison of beam trip frequencies between estimation from current experimental data of accelerators and requirement from ADS transient analyses