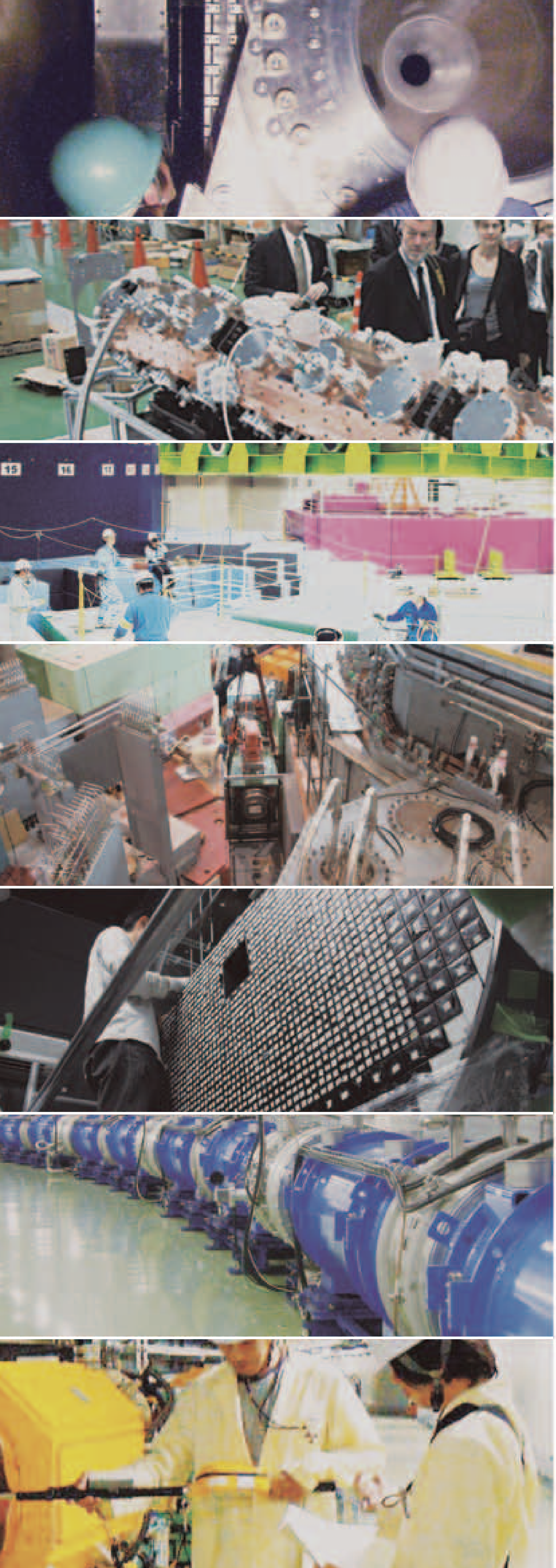


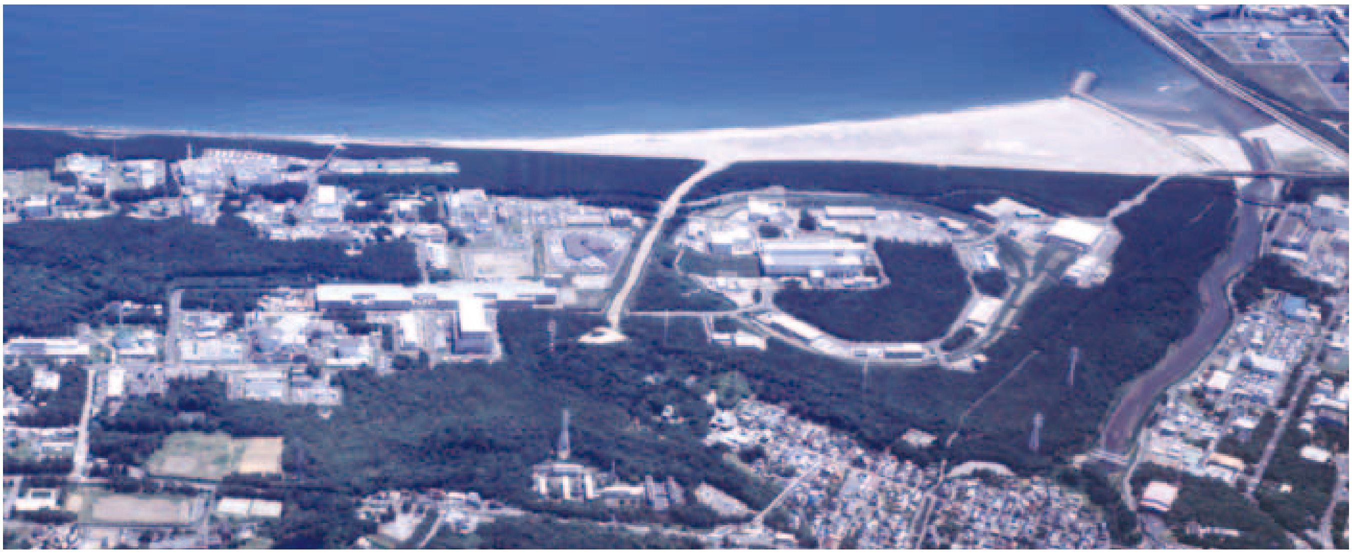
J-PARC

ANNUAL REPORT 2010

Japan Proton Accelerator Research Complex

J-PARC Annual Report 2010

Contents



Preface

During the 2010 fiscal year covered by this third Annual Report of the Japan Proton Accelerator Research Complex (J-PARC), the proton beam power was successfully ramped up to 200 kW and 145 kW at 3 GeV (RCS) and 50 GeV (MR), respectively. The neutron, muon, hadron and neutrino experimental facilities all operated very smoothly and with many contented users until the 11th of March 2011 at the very end of FY 2010.

On this day, northeastern Japan, where J-PARC is situated, was struck by a massive (M 9.0) earthquake and a devastating tsunami. J-PARC sustained no damage from the tsunami but was severely impacted by the earthquake, being shut down immediately. Fortunately, no J-PARC users or staff were injured. However, the damage to the facilities and infrastructure was very serious and spread across the entire site (See the main text). It was clear immediately that very extensive work and time would be required to make a full recovery and to resume user programs.

In the face of daunting challenges, J-PARC responded rapidly and an ambitious recovery plan was developed and implemented. The recovery work proceeded at an exhaustive pace, very often around the clock, over the ensuing months. Thanks to the tremendous effort of work teams from all sections of J-PARC, the three proton accelerators were re-started for commissioning work one by one and beam extracted to the neutron and neutrino experimental facilities on schedule in December 2011 – just 9 months after the earthquake. Full details of the recovery work will appear in the next Annual Report.

Before the shutdown of the facility due to the earthquake, experimental programs were proceeding very well. Examples include the exciting observation of electron neutrinos derived from J-PARC muon neutrinos as reported by the neutrino group. Similarly, results deriving from data collected at the J-PARC neutron beamlines contributed to some high-profile discoveries such as the reported novel battery materials.

The facilitation and production of world's best scientific outcomes remain as the core mission of J-PARC. It is our commitment and goal to continue to strive in this endeavor.

Shoji Nagamiya
Director of the J-PARC Center

Effect of The Great East Japan Earthquake

1. Linac

A big earthquake hit northeastern Japan on March 11, 2011. J-PARC is located about 200 km from the center of earthquake, and suffered significant damages. As shown in Photo 1, a road in front of the Linac was severely cracked, and a certain area in front of the Linac sank by 1.5 m, as shown in Photo 2. The damage inside the accelerator tunnel was fortunately minimal, since the main building had been built with many underpins to support it. But the earthquake effect at Linac was the most serious among all other buildings. Immediately after the earthquake, 100 tons of water was spilled out from underground, as shown in Photo 3. Since the water was highly alkaline, we had to use many tons of acids to neutralize it. It took over one week to pump out the water. The next big issue was the problem of the ground sinking along the Linac tunnel. It appeared that a water creek ran under the Linac area many decades ago. The middle of the building sank about 4 cm drop even with the many underpins installed to support it (Photo 4). For the moment, we plan to tune beams 4 cm toward the downhill and then to move them up to the normal height at the end of the Linac.

Photo 1. Cracks in front of the Linac.

Photo 2. A small place in front of Linac sank by 1.5 m (left). Repair works are under progress (right).

Photo 3. The Linac tunnel immediately after the earthquake.

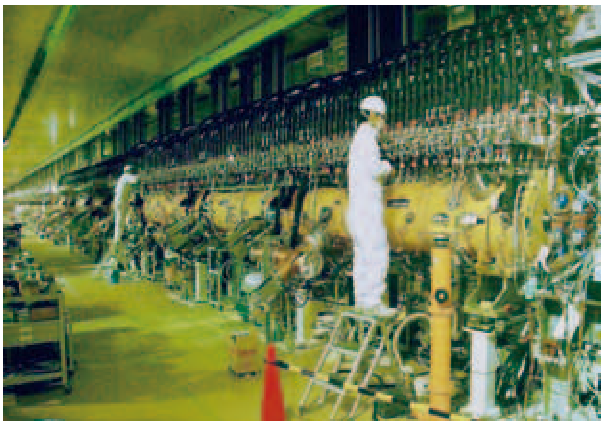


Photo 4. Linac repairs. Around the place where one person is working, a drop of 4 cm was observed.

2. 3 GeV Rapid Cycling Synchrotron and 50 GeV Main Ring

The damage around the 3 GeV Rapid Cycling Synchrotron (RCS) building was also serious. The surrounding road was waving, as shown in the left top picture in Photo 5. The repair of the road was done as the first priority for the 3 GeV RCS facility, otherwise it would have been impossible to proceed with any further repair work. For example, as shown in the right top picture of Photo 5, the power generator was tilted to the right hand side. With modern technology able to jack up the entire floor, the repair work has been completed.

Around the 3 GeV RCS building, many areas have severe problems. An example is shown in Photo 6. The condenser bank was severely bent due to the drop of the land level. We repaired it by adding a concrete shield, as shown in the lower part of Photo 6. A significant amount of concrete support was added.

On the other hand, inside the building we had no significant problems, again due to the presence of many underpins. Shown in Photo 7 are the healthy components of the 3 GeV RCS . In the 50 GeV Main Ring (MR), many magnets were forced to move by the earthquake. Figure 1 show the results. Magnets moved by 2-3 cm at the maximum. A total of 400 magnets had to be carefully realigned to the original positions and the work has been very time consuming. Within 1 cm displacement, the adjustment was rather easy but beyond 2 cm the entire magnet stand had to be replaced.

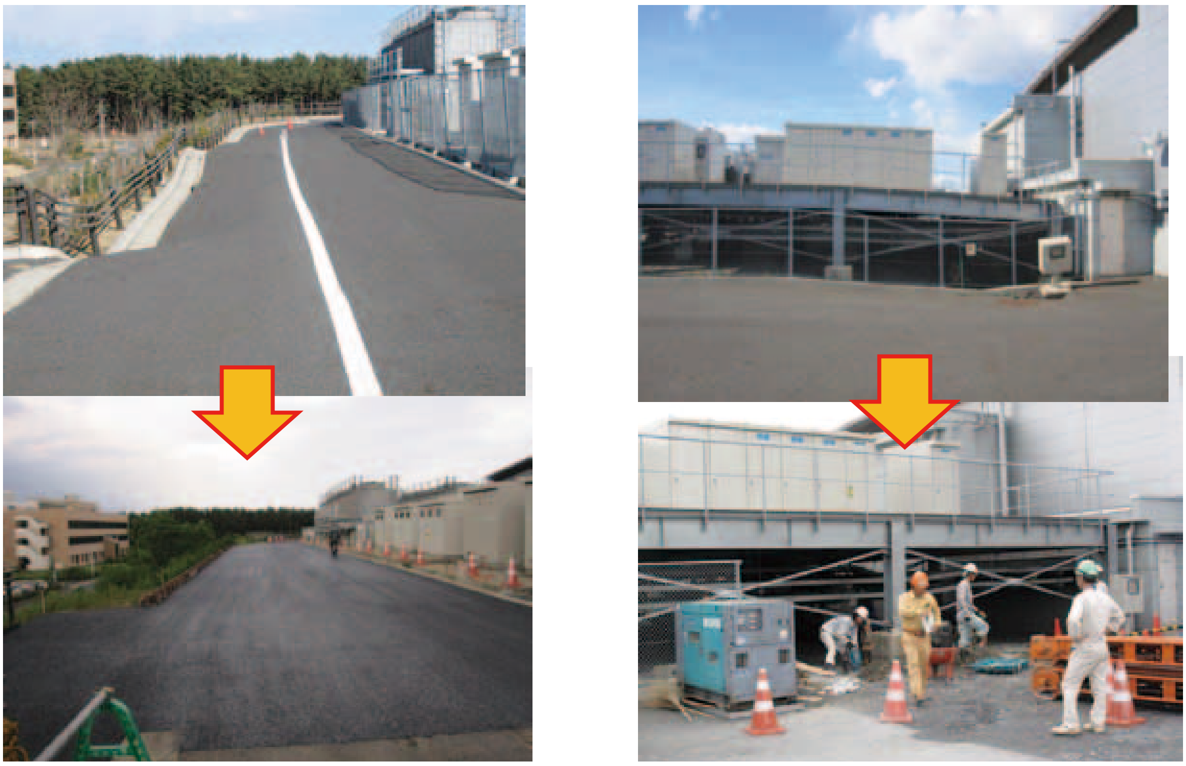


Photo 5. Damage around the 3 GeV RCS building.

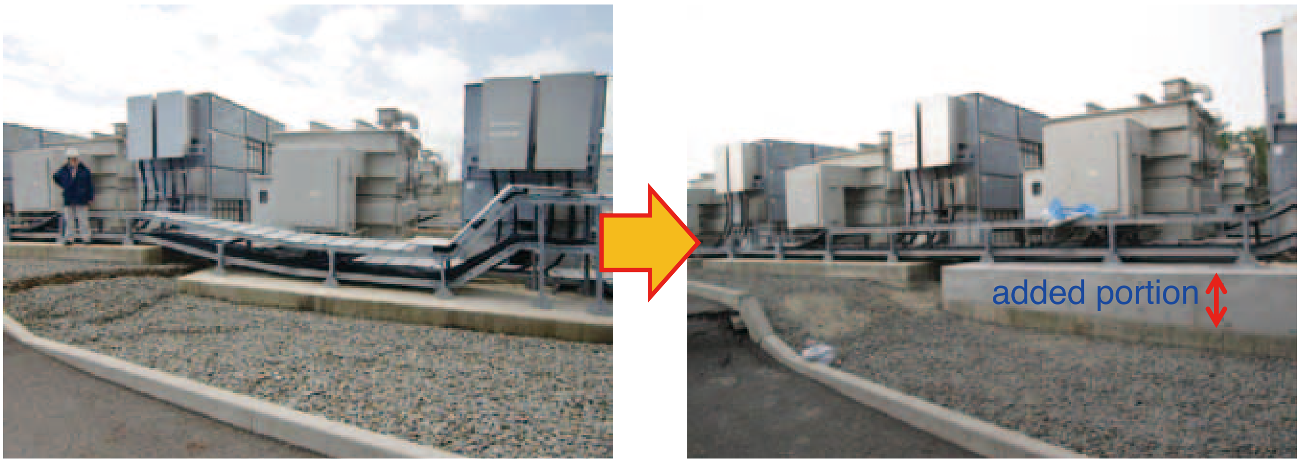


Photo 6. Around the 3 GeV RCS building, a significant amount of concrete had to be added to bring it back to the normal level.

Photo 7. 3 GeV RCS components in the tunnel. No significant damage was observed.

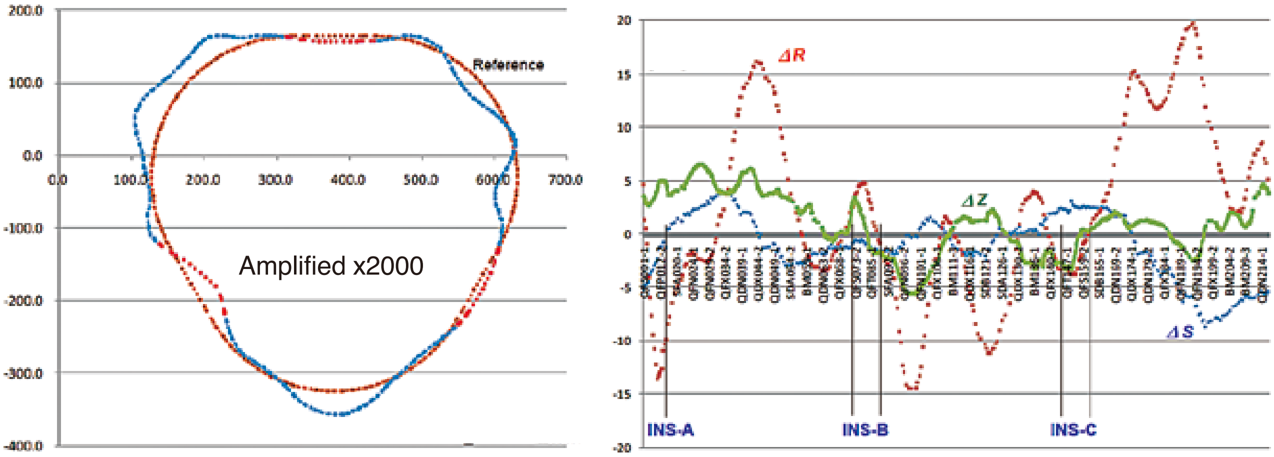


Fig.1 Movement of magnets at the 50 GeV Main Ring.

3. Materials and Life Science Experimental Facility

The Materials and Life Science Experimental Facility (MLF) was, relatively speaking, in a better condition. The outside area suffered significant damage, as shown in Photo 8. On the other hand, the inner major experimental hall had almost no damages. The problem here was a significant displacement of the shielding blocks. For example, 4,000 tons of iron shields near the neutron target area had to be moved out and, then, restacked again piece by piece, as shown in Photo 9.

Other significant repair works had to be done on the surrounding buildings. On both sides of the main hall, neutron lines were extended for some of the equipment into the outside of the main building. For those beam lines we added buildings without many underpins. These buildings sank by 30 cm, so we had to jack them up to the same level as the main building.

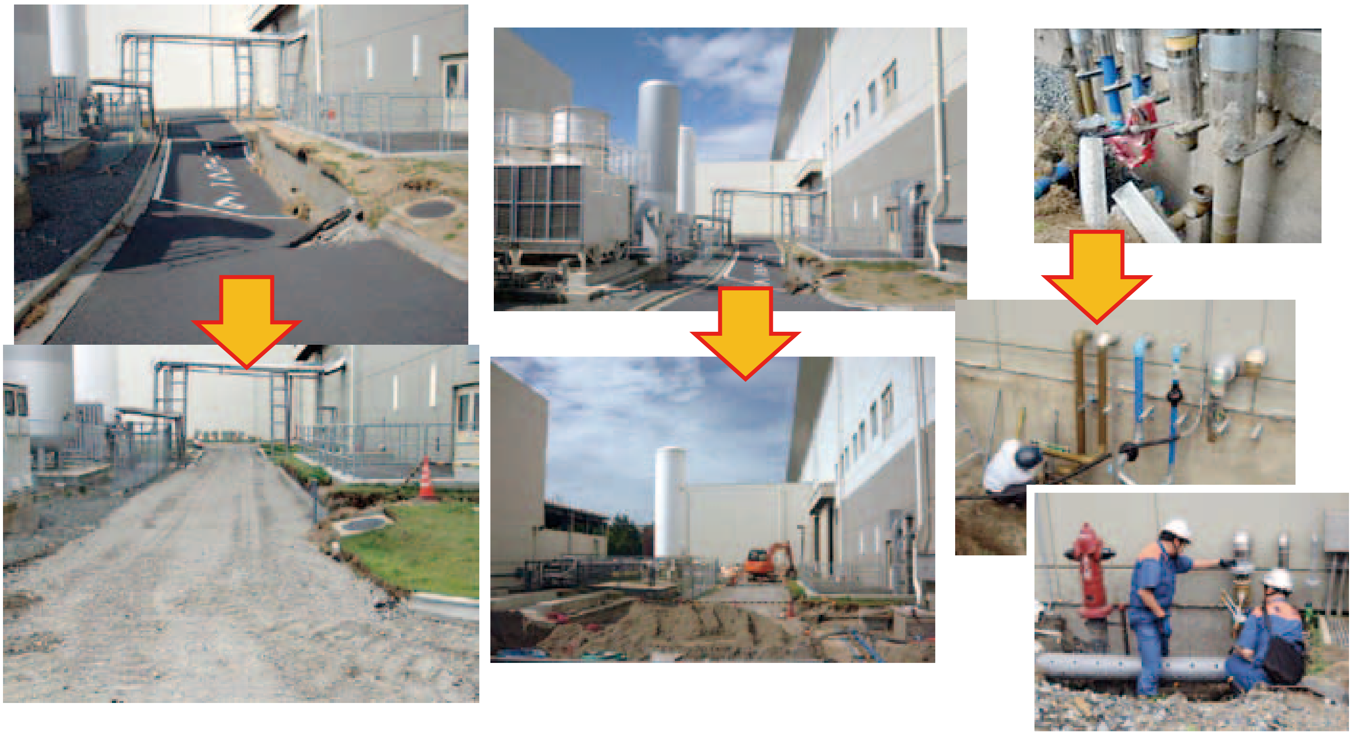


Photo 8. Outside area of the Materials and Life Science Experimental Facility (MLF).

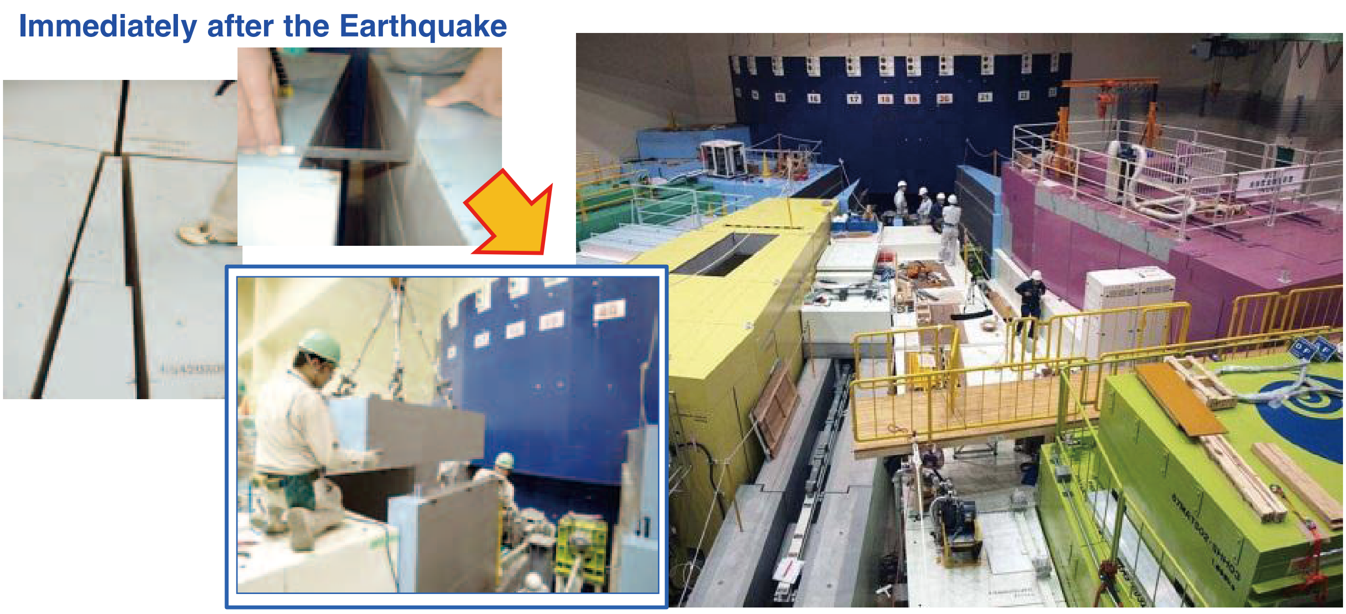


Photo 9. Displacement of the ion shields built in the most upstream area of the neutron instruments in MLF. 4000 tons of iron shields had to be removed and re-built again.

4. Neutrino and Hadron Experimental Facilities

The Neutrino and the Hadron Experimental facilities have been also damaged, but the damage level was minimal. In the neutrino area an air condition unit fell down as shown in the left part of Photo 10. There is a unit called "electric horn" designed to focus pion beams toward Super Kamiokande. The right part of Photo 10 shows the third horn which was pulled out for the inspection. Due to the possibility of high radiation level, this element was carefully examined, but no damages were detected.

As of the Hadron facility, the outside area sank significantly, as shown in Photo 11. Inside the experimental hall, many shield blocks had to be adjusted, so that over 3,000 tons of concrete shield blocks had to be removed and be restacked. This work was time consuming. On the other hand, no significant damages have been observed in the main experimental hall.

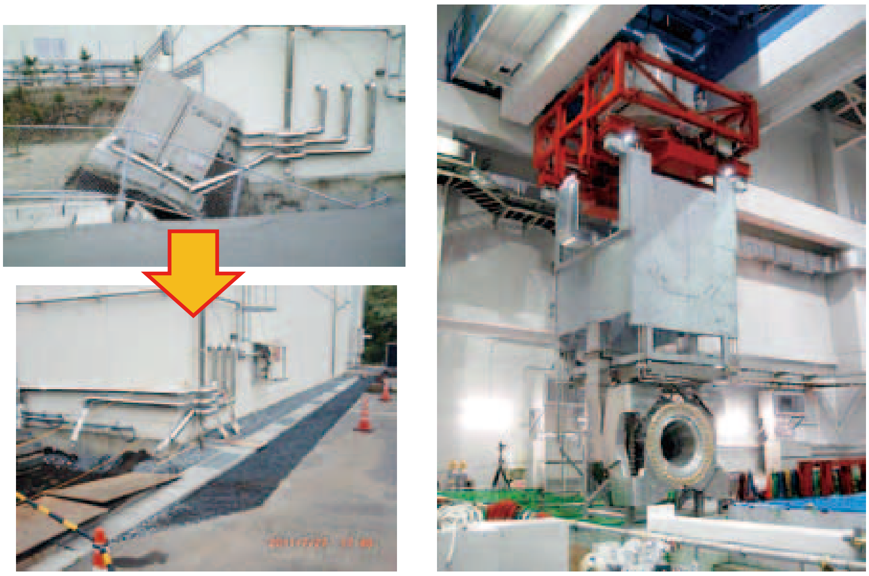


Photo 10. Neutrino experimental hall. Outside the hall, the air conditioning power was tilted (left). A photo of the 3rd horn under inspection (right).

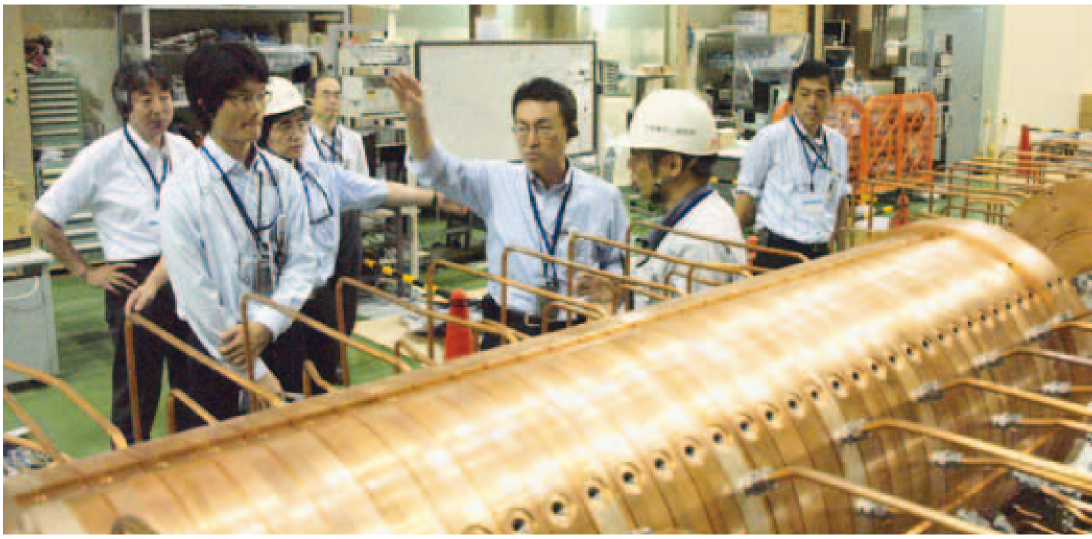
Photo 11. Hadron hall. The outside area of the building was lowered significantly.

5. Summary of the Earthquake Effects

Overall summary of The Great East Japan Earthquake is as follows:

- There were no tsunami effects caused by the earthquake in the J-PARC area. We are prepared for up to 8 m tsunami protection and the actual tsunami level was much lower.
- The main buildings were not much affected due to the many underpins installed to support them.
- However, many utility buildings, roads and added buildings were significantly damaged.
- Our goal is to complete the recovery by the end of 2011. We thus expect about 2 month operation of beams for users in Japanese fiscal year (JFY) 2011, which ends on March 31 of 2012
- In JFY 2012, we plan to run a full cycle operation, namely, a 200 day operation for users.

Linac
3 GeV RCS
50 GeV MR



Accelerators

Overview

The accelerator system had been stably operated after the recovery of the radio-frequency quadrupole (RFQ) linac in 2009, but was interrupted by the Great East Japan Earthquake on March 11, 2011. Though there was no serious damage to the accelerator devices themselves, significant damages were found in the buildings and utilities. J-PARC is making best efforts to obtain beams for the users within Japanese fiscal year (JFY) 2011. The details will be explained in the dedicated chapter.

This year we were successful in many areas, and the main achievements were as follows:

(1) 200 kW user run of rapid cycling synchrotron (RCS) for Materials and Life Science Experimental Facility (MLF) was started on November 26.

(2) 400 kW demonstration for MLF on January 18.

(3) 145 kW user run of MR - FX (Fast Extraction for neutrino) was started this year.

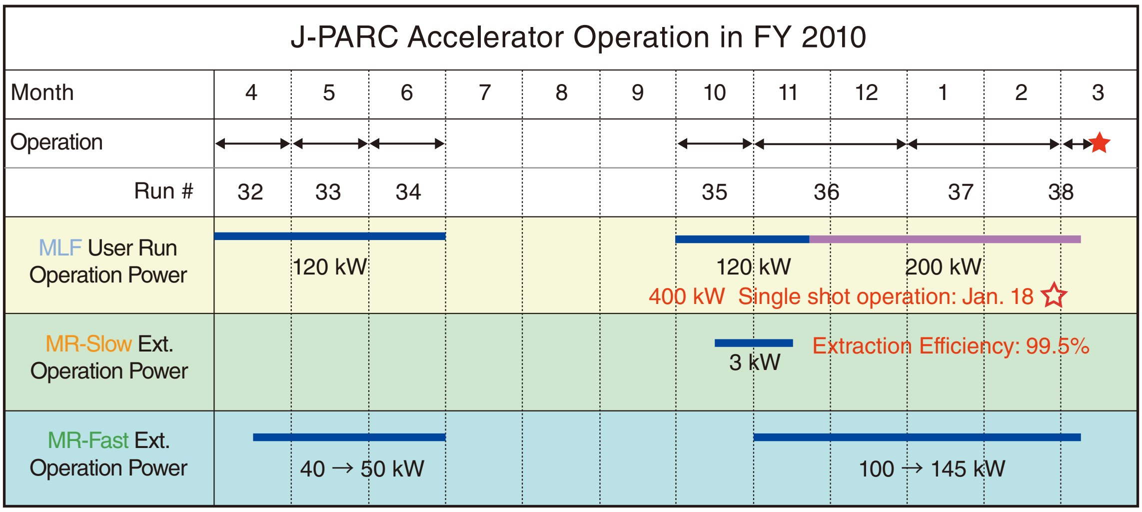
(4) 99.5% extraction efficiency of MR - SX (Slow Extraction) has been kept for Hadron user run. (But the beam intensity was ~ 3 kW.)

(5) 10 kW extraction of MR - SX was demonstrated on November 15.

(6) Successful 2-month continuous operation of the ion source in November and December.

(7) High power test of the annular-ring coupled structure (ACS) module was done on January 27 with a power of 1.6 MW which means an acceleration gradient of 4.5 MV/m (the designed value is 4.1 MV/m).

Table 1. The accelerator status in JFY 2010.



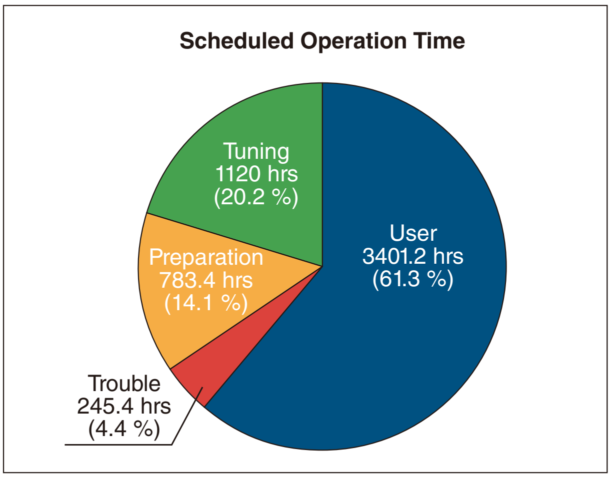


Fig. 1. Scheduled operation time of JFY 2010. Total scheduled operation time is 5550 hours. Preparation means conditioning, radiation survey and so on.

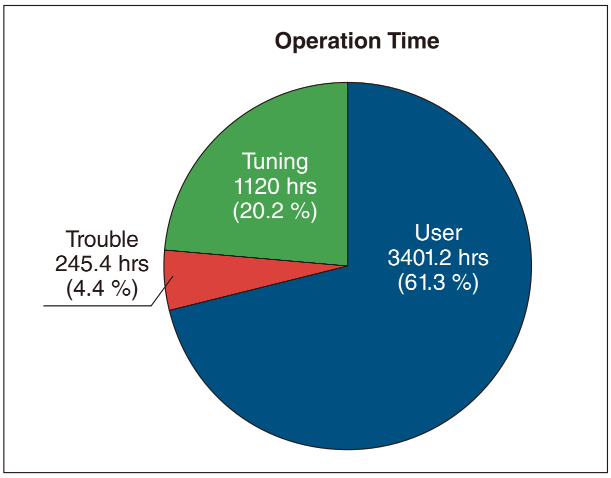


Fig. 2. Operation time of JFY 2010. Total operation time is 4766.6 hours.

The total scheduled operation time was 5550 hours and the total user time reached 3400 hours as shown in the following figures (Fig. 1 and Fig. 2). The total user times and average availabilities are shown in Table 2 and Fig. 3. As for the long user run times at Run #36 and #37, these are summarized in Table 3 and 4.

The steady progress toward 1 MW of RCS and 0.75 MW of MR had been proceeding along the schedule shown in Fig. 4. The 400 kW test in RCS verified the reality of 1 MW with the 400 MeV injection. However, the progress of beam commissioning has clarified many issues to be overcome in MR, and the discussion about setting a medium goal has started.

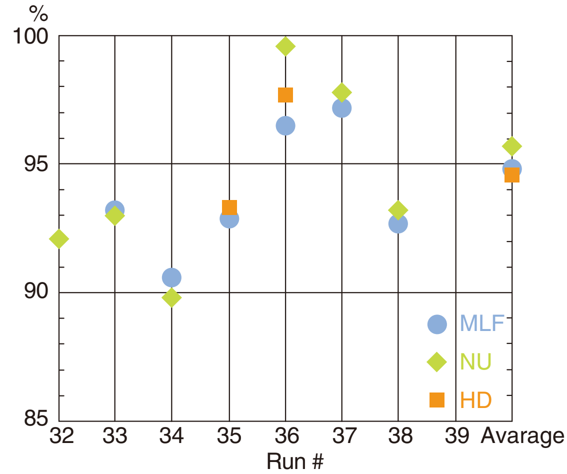


Fig. 3. Availability for the user run in JFY 2010.

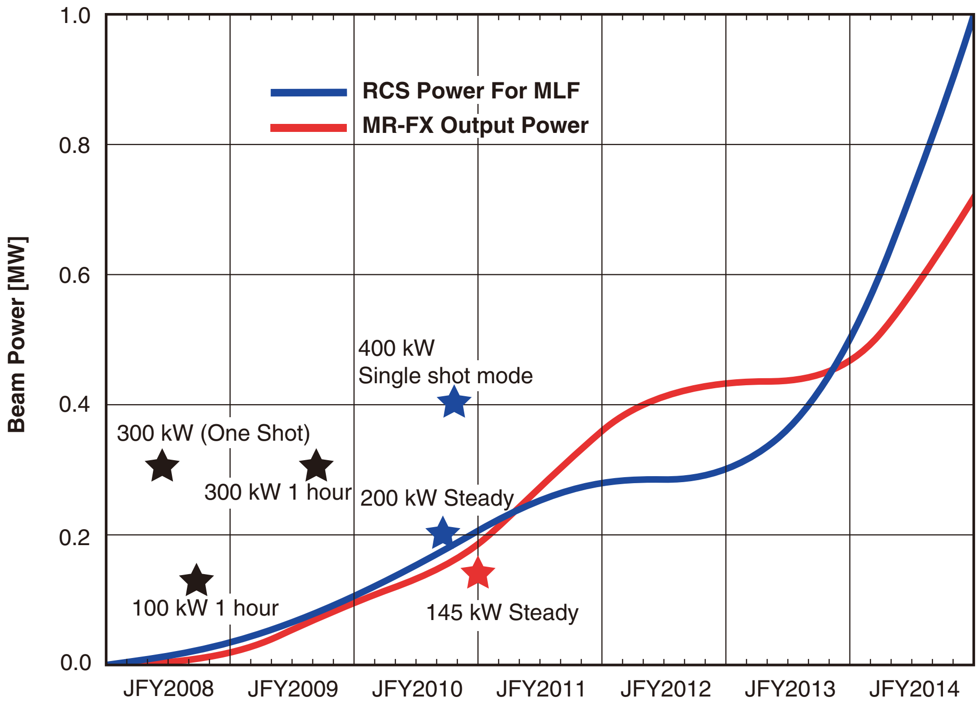


Fig. 4. Road to 1 MW in RCS and 0.75 MW in MR-FX.

Table 2. User time and average availabilities for JFY 2010.

user	hrs	Availability (%)
MLF	2388.0	94.8
Neutrino	2529.7	95.7
Hadron	450.9	94.6

Table 3. User time and average availabilities for the RUN cycle #36.

user	hrs	Availability (%)
MLF	713	96.5
Neutrino	682	99.6

Table 4. User time and average availabilities for the RUN cycle #37.

user	hrs	Availability (%)
MLF	656	97.2
Neutrino	783	97.8

LINAC

The radio-frequency quadrupole (RFQ), which had discharge problems from 2008 to 2009, was scheduled for conditioning in the operation calendar. The interval gradually extended from once a week while monitoring the number of trips in the RFQ. The performance of the RFQ was recovered through the demonstration of 19 days of continuous operation in June and nearly two months operation from November to December, in spite of several hours of conditioning at beam stops caused by other issues.

The beam trip in the linac was mainly caused by the RFQ and the separated-type drift tube linac (SDTL). The down time was approximately 43.5 and 30 hrs, respectively. When a beam trip occurs, the operators confirm the cause, then reset the interlock and restart the beam. Therefore, even if a beam trip lasts a few seconds, it takes at least one minute to restart the beam. The total number of downtime was 1,096 and 496 for the RFQ and the SDTL, respectively, and the recorded downtime in one year was more than 30 hrs. We are considering shortening the resuming time for insignificant trips such as RF minor discharges.

One of the major causes related to the SDTL cavity was a discharge problem in the coaxial feeder line in June 2010. The downtime following this incident was 7 hrs and 20 min. Because this phenomenon happens frequently, we are monitoring the temperature at the feeder lines to understand it.

The ion source is one of the factors that determines the operation hours. The typical ion source operation time is approximately 600 hrs for each run. The ion source chamber with a new filament was replaced as preventive maintenance. To evaluate the actual lifetime of the filament, we operated continuously for 2 months starting in November 2010. As a result, the ion source delivered the beam at a beam current of 16 mA for 1,270 hrs without maintenance. This duration was determined by the operation schedule at the end of 2010, not by the ion source. In the next run from January 2011, the ion source delivered the beam at a higher current of 25 mA for 217 hrs. This was deduced from the RCS beam study of the high power demonstration at 400 kW. Then, a continuous user operation at 16 mA was carried out. In this case, the filament broke after 1,029 hrs. At any rate, it was shown that a longer run cycle of 1,000 hrs would be possible.

We took some measures to reduce the time required for maintenance. Replacement parts were unitized and a vacuum chamber for storage was fabricated. We can keep the ion source assembly in vacuum conditions just before installation. As a result, the maintenance time has been shortened from four days to one or two days.

One of the major causes for the beam trip, which is related to high power RF components, is the discharge in the anode modulators. The electrode in the oil tank is covered with a polyethylene insulator. Some discharge traces have been found between the polyethylene surfaces and the inner surface of the tank. To remedy this problem, the arrangement of the equipment has been reviewed to provide enough insulation distance and some modulators have been modified.

It was found that the beam loss in the beam transport line was caused by the stripping reaction of H0 with residual gas. During the 2010 summer shutdown, some vacuum pumps were added to the SDTL section and the beam transport line. As a result, better vacuum minimized the beam loss; however, we did not see significant improvement at the SDTL section and further studies are needed.

An energy upgrade project from 181 to 400 MeV with an Annular-ring Coupled Structure linac (ACS) has been funded since JFY2008. Mass production of the ACS modules and installation of klystron power supplies and waveguides, cabling, etc. has progressed. The high power test for the first ACS module was successfully demonstrated in January, and it was confirmed that the mass production fabrication process was reasonable. Photo 1 shows the first mass production module under the high power test.

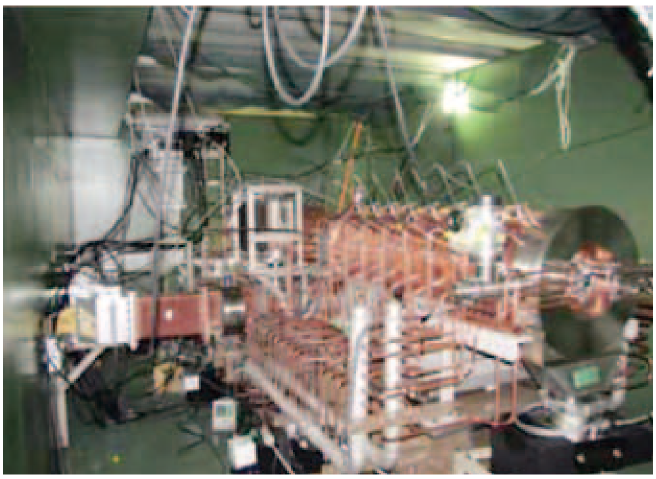


Photo 1. The first mass production module of ACS under the high power test.

RCS

The rapid cycling synchrotron (RCS) has been providing beam with good stability both for the Materials and Life Science Experimental Facility (MLF) user program and for the MR during this year. In parallel we have been challenged to realize higher beam power operations with better stability.

Figure 5 shows 1-hour averaged power and integrated power for MLF user operation for this year. Blue lines show 1-hour averaged power for a day and the green line shows an accumulated beam power from December 23rd 2008 for the MLF user operation. The scheduled maintenance period was from July to September as shown in Fig. 5. The MLF user operation was stopped according to plan from the middle of December to the middle of January to construct additional beam lines for the MLF users. The beam power for the MLF user operation was limited not by the performance of the accelerators but by a request form a neutron production target. Beam power equivalent to 300 kW has been delivered to the MR for the user operation. It could be realized full chromatic correction to be installed alternating current (AC) power supplies for sextupole magnets in the scheduled maintenance period. In the same time charge exchange foils with smaller size were installed to reduce beam losses in the injection area. All cable connectors of extraction kicker magnets and some pieces of MA core for RF cavities were also replaced to achieve better stability during this period.

Aside from being a user operation, we have also been challenging to realize higher beam power operations with better stability. High intensity beam studies could be done and we obtained parameters for 400 kW MLF user operation. It was possible to deliver the equivalent of 400 kW beam to the MR and it could be realize for beam to the MLF after reduction of beam loss at injection in the RCS.

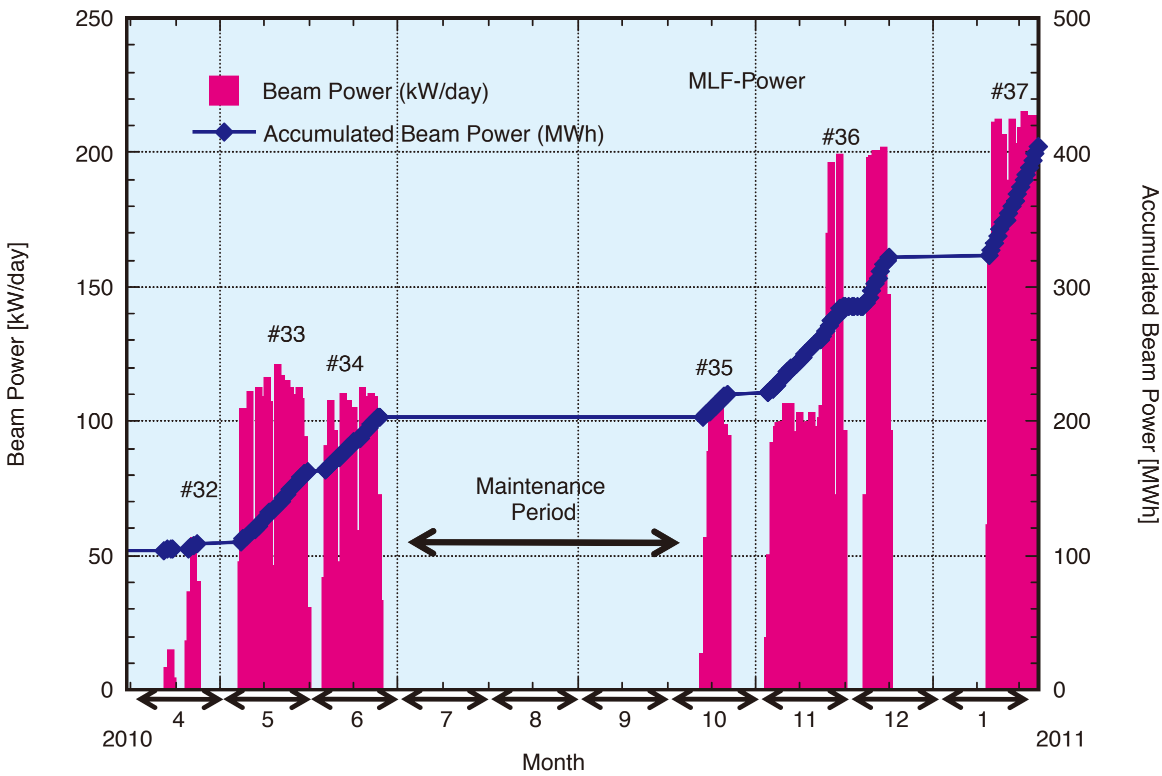


Fig. 5. 1-hour averaged power and integrated power for the MLF user operation in JFY 2010.

MR

The main ring (MR) has two beam extraction systems. One is a fast extraction system for beam delivery to the neutrino beam line of the Tokai-to-Kamioka (T2K) experiment, and the other is a slow extraction system for beam delivery to the hadron experimental hall.

Figure 6 shows the delivered beam power of the MR during the current fiscal year. Before the summer shutdown period, the MR was operated in the fast extraction mode with a cycle time of 3.52 s and six bunches. The delivered beam power was limited to around 50 kW because of a problem with the kick angle drift of the extraction kickers. The drift came from heating of the ferrite cores with the beam-induced wake field.

During the summer shutdown periods, we replaced the extraction kicker system with a newly developed one, which has a low beam coupling impedance to suppress the kick angle drift and a faster rise time to make possible the operation with eight bunches instead of six. We also improved the power supplies of the bending magnets to decrease the cycle time and increase the beam power. The energy recovery condensers of the rectification circuits were adjusted to shorten the deceleration time of the magnet current from 30 GeV to 3 GeV excitations. As a result, the MR cycle time could be reduced from 3.52 s to 3.2 s or less for the fast extraction operation. The other improvement, performed in the 2010 summer shutdown, was an upgrade of the beam collimators, which are located in the 3-50 BT (beam transport line between the RCS and the MR). The collimator system is installed to cut the beam halo and localize the beam loss in the collimator section. The loss capacity of the 3-50 BT collimators was 0.45 kW before the 2010 summer shutdown. The capacity should be increased for operation with the future MW-class beam. During the 2010 summer shutdown, additional iron shields were installed in the 3-50 BT collimators. Photo 2 shows the 3-50 BT collimator section with the newly installed gated-shape iron shields. The thickness of the shield is 0.72 m on top and 0.25 m in both sides. The shields are mounted and slide on a linear motion guide system to facilitate maintenance. The loss capacity of the 3-50 BT collimators is increased from 0.45 kW to 2 kW by the additional shields.

The MR restarted the operation in the slow extraction mode in the autumn of 2010. The slow extraction system has four bump magnets, two electrostatic septa (ESS1&2), and ten magnetic septa (SMS1_1~SMS3_4) in the straight section, which is connected to the beam transfer line between the MR and the hadron experimental facility. Eight sextupoles that are used to excite the third integer resonance are located in the arc sections. After the beam acceleration, the horizontal tune is gradually ramped up to the resonance line by changing

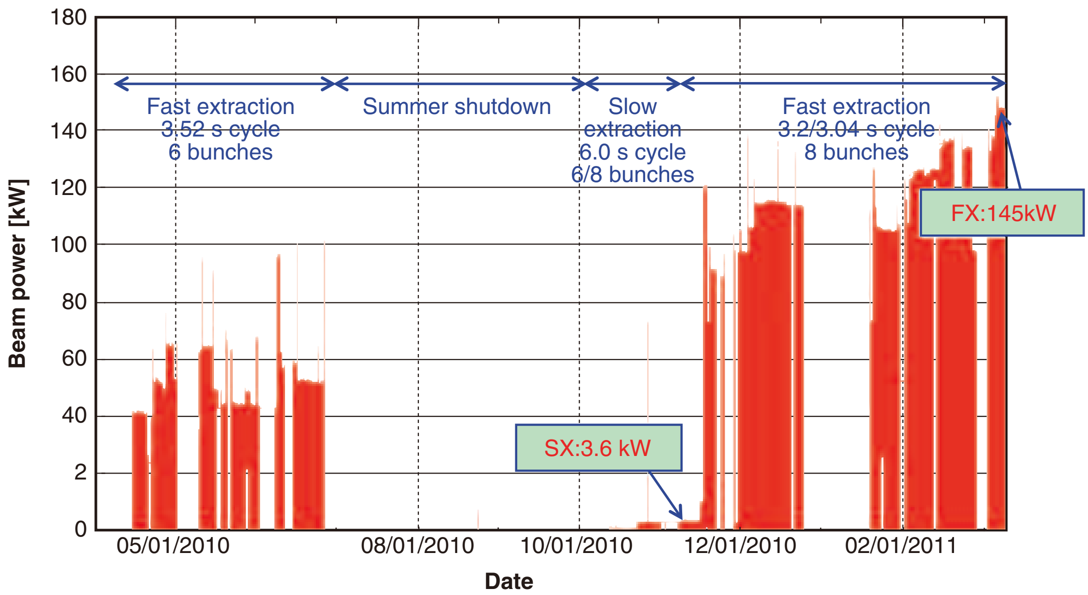


Fig. 6. Beam history of the MR in JFY 2010.

one of the quadrupole families, called QFN, which has 48 magnets located in the arc sections, and the beam is slowly extracted. The cycle time of the slow extraction is 6.0 s, which includes a long flattop period of 2.93 s for the extraction.

One of the most critical issues for the slow extraction operation is the formation of radioactivity in the components. High extraction efficiency is required to avoid leaving residual activity, which would make hands-on maintenance difficult. In order to improve the extraction efficiency, a dynamic bump system has been adopted in the operation since October 2010. This dynamic bump system controls the strengths of the four bump magnets to decrease the hitting rate of the beam on the ESS1 septum during the ramping of the QFN. As a result, the beam losses downstream of the ESS1 have been reduced in the extraction. Figure 7 shows the beam loss distributions in the SX straight section and time dependences of the beam loss for (1) fixed bump operation and (2) dynamic bump operation. The beam loss is drastically improved for the dynamic bump operation. The extraction efficiency for the fixed bump operation is 98.3%, whereas that for the dynamic bump operation is 99.5%, which is the world's highest extraction efficiency for slow extraction.

In the 2010 autumn operation, the maximum beam power delivered to the hadron experimental facility was 3.6 kW for the continuous user operation and 10 kW for a high power demonstration.

On November 16, we switched the operation mode from the slow to the fast extraction. We delivered the beam to the T2K experiment with a cycle time of 3.2 s and eight bunches. The delivered beam power was gradually increased as shown in Fig. 6. In the MR, coherent oscillation of betatron sidebands is observed above the intensity of 4×10^{11} ppb (particles per bunch) with a small bunching factor beam from the RCS (without RF second harmonics). In the routine operations, the chromaticity of the MR was set to be -5 ~ -7 to suppress the instability at the injection energy. Additionally, we adopted the bunch-by-bunch feedback system to suppress the instability in this autumn/winter run.

On March 7, the cycle time was shortened from 3.2 s to 3.04 s. Since then, the 145-kW beam power was delivered to the T2K experiment until the morning of March 11, the day of The Great East Japan Earthquake.

Photo 2. The 3-50 BT collimator section with the newly installed gate-shaped iron shields.

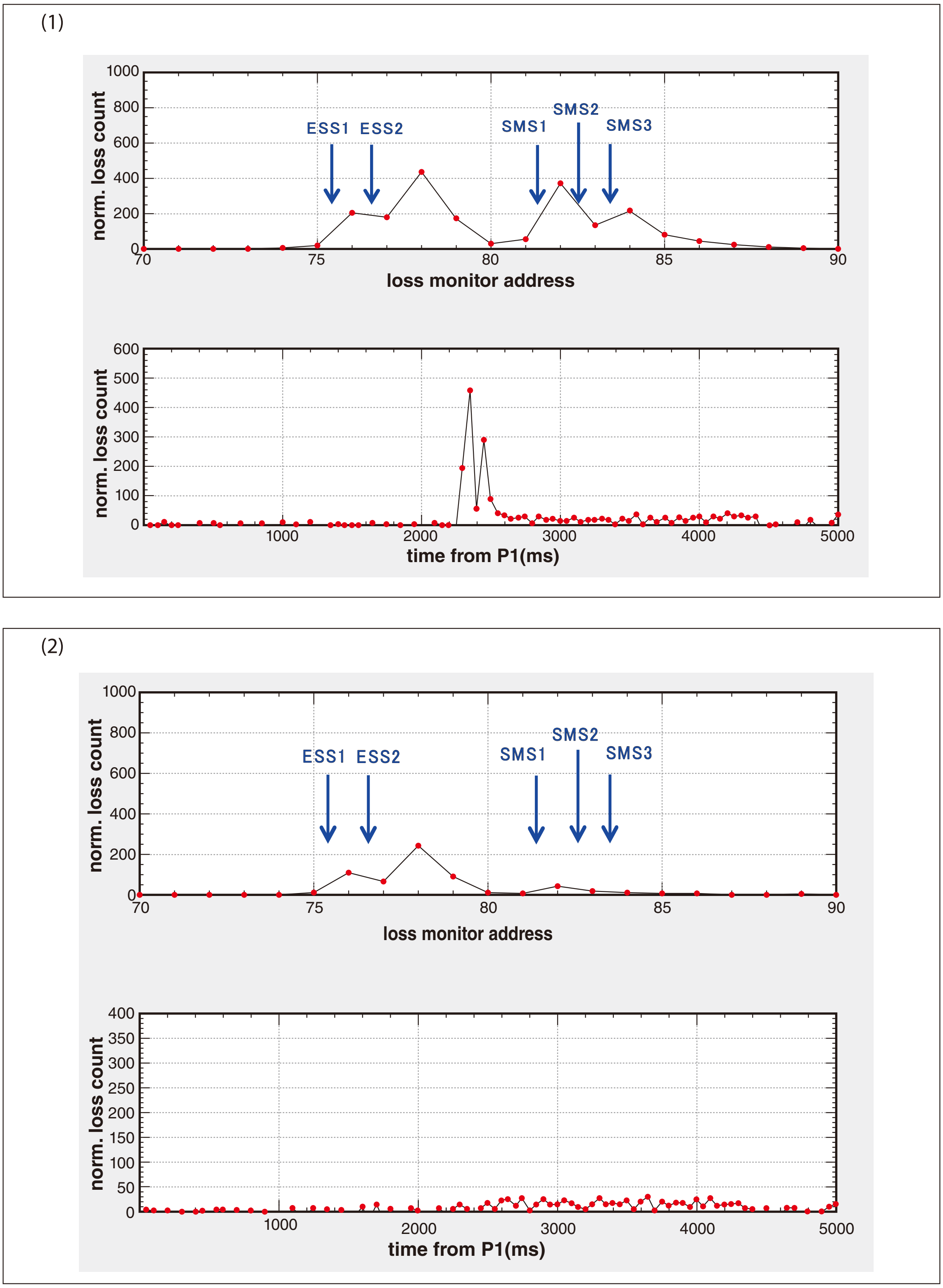
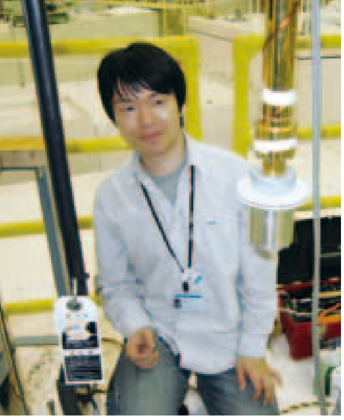


Fig. 7. Beam loss distribution in the slow-extraction straight section (upper) and time dependence of the beam loss (lower) for (1) fixed bump operation and (2) dynamic bump operation.




Materials and Life Science Experimental Facility

Overview

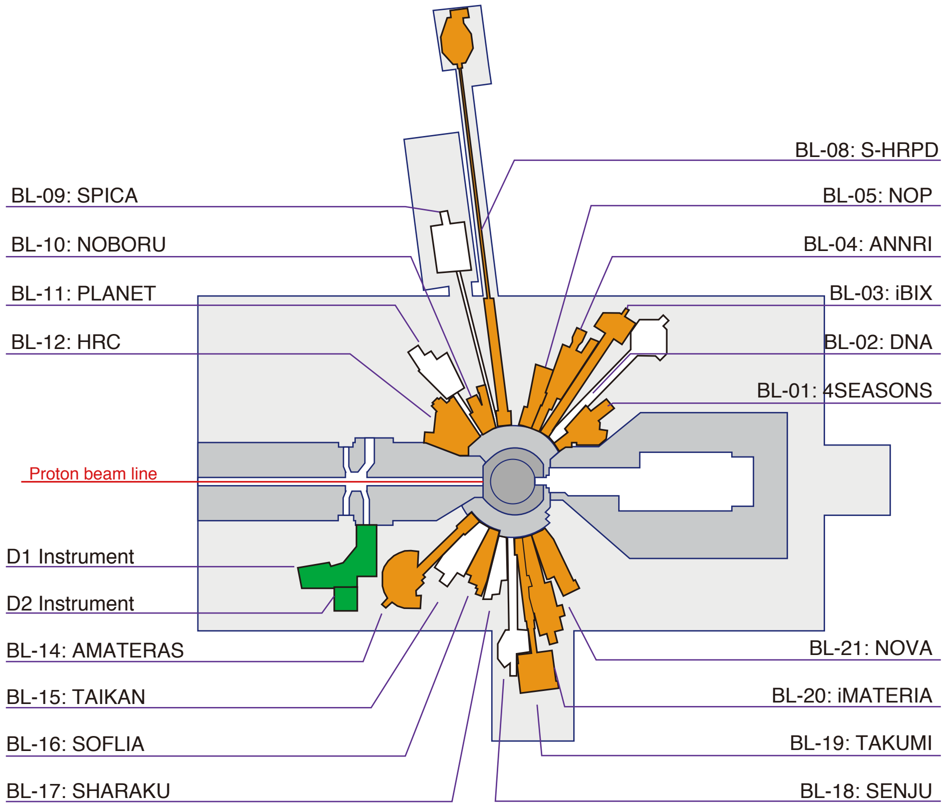
The recovery of the cryogenic hydrogen loop for the moderators from the accumulator trouble was the most urgent issue in the beginning of the Japanese fiscal year (JFY) 2010. An alternative operation sequence without accumulator function was adopted as the fastest measure so that the user programs could be resumed in May 2011 with a proton beam power of 120 kW. The proton beam power delivered from the accelerator was ramped up to over 200 kW in November with high beam availability of around 92%. During the autumn run cycles, we suffered unplanned beam shutdown for about 10 days in total due to the heat exchange degradation in the helium refrigerator of the cryogenic hydrogen system. Nevertheless, the annual neutron and muon production operation time for the user programs exceeded 2300 hours before the operation was terminated by the Great East Japan Earthquake on March 11, 2011. The approved experimental proposals reached 350 for 9 neutron and 2 muon instruments, which was a 30% increase from the last fiscal year.

Both the neutron and muon instruments are working quite reliably, producing very high quality of data. The constructions of six neutron instruments is in progress on schedule, four of those instruments were budgeted as a public beamline in terms of the Law for Promotion of Public Utilization of the Specific Advanced Large Research Facilities. According to the law, the public beamlimes shall be managed by the Registered Institution for Facility Use Promotion (RIFUP). For example, the proposal reviews and the user support activities are conducted by RIFUP independently. In March, the Comprehensive Research Organization for Science and Society (CROSS) was approved as a RIFUP at the initiative of the Ministry of Education, Culture, Sports, Science and Technology. The Muon group concentrated their effort on the construction planning of the ultra-slow muon beam line. The construction itself will start in the summer of 2011.

Table 1. Beam statistics for the MLF user program in Japanese fiscal year (JFY) 2010.

No. of run cycle	Nominal beam power (kW)	Duration	Scheduled Time(*) (h)	Availability (%)
#32	120	Only for target study		
#33	120	05/09/10 02pm - 06/01/10 07am	487	92.1
#34	120	06/07/10 01pm - 06/26/10 07am	397	89.5
#35	120	10/16/10 12pm - 11/01/10 06am	357	41.0
#36	120, 210	11/07/10 12pm - 12/18 /10 12pm	922	72.8
#37	220	01/21/11 03pm – 02/19/11 12pm	675	92.3
#38	220	03/07/11 03pm -	418(**)	

(*) Note: The scheduled time excludes the duration allocated for the purpose of the beam study for the 3-GeV proton beam transport line and/or the mercury target in MLF. Thus, the value in each run cycle differs from that shown in the Tables 2 to 4 in the Accelerators chapter.
(**) terminated by the Great East Japan Earthquake on March 11, 2011



Neutron Instruments

BL	Name of Instruments	Moderator	Status
BL01	**4SEASONS:** 4D Space Access Neutron Spectrometer	Coupled	in use
BL02	**DNA:** Biomolecular Dynamics Spectrometer	Coupled	under construction
BL03	**iBIX:** IBARAKI Biological Crystal Diffractometer	Coupled	in use
BL04	**ANNRI:** Accurate Neutron-Nucleus Reaction measurement Instrument	Coupled	in use (*)
BL05	**NOP:** Neutron Optics and Fundamental Physics	Coupled	in use(*)
BL06	**VIN ROSE:** VIllage of Neutron ResOnance Spin Echo spectrometers	Coupled	planning
BL08	**S-HRPD:** Super High Resolution Powder Diffractometer	Poisoned	in use
BL09	**SPICA:** Special Environment Neutron Powder Diffractometer	Poisoned	under construction
BL10	**NOBORU:** NeutrOn Beam-line for Observation & Research Use	Decoupled	in use
BL11	**PLANET:** High Pressure Neutron Diffractometer	Decoupled	under construction
BL12	**HRC:** High Resolution Chopper Spectrometer	Decoupled	in use (*)
BL14	**AMATERAS:** Cold-Neutron Disk-Chopper Spectrometer	Coupled	in use
BL15	**TAIKAN:** Smaller-Angle Neutron Scattering Instrument	Coupled	under construction
BL16	**SOFIA:** Soft Interface Analyzer	Coupled	in use
BL17	**SHARAKU:** Polarized Neutron Reflectometer with Vertical Sample Geometry	Coupled	under construction
BL18	**SENJU:** Single Crystal Neutron Diffractometer under Extreme Condition	Poisoned	under construction
BL19	**TAKUMI:** Engineering Materials Diffractometer	Poisoned	in use
BL20	**iMATERIA:** IBARAKI Materials Design Diffractometer	Poisoned	in use
BL21	**NOVA:** High Intensity Total diffractometer	Decoupled	in use

(*) Note: General use progam was not allocated in JFY 2010.

Muon Instruments

BL	Name of Instruments	Status
D1	**D1 Instrument**	in use
D2	**D2 Instrument**	in use

Fig. 1. Layout and status of the neutron and muon instruments at the MLF as of March, 2011.

Neutron Source

Progress of 3-GeV proton beam transport facility

An expert beam tuning system was developed for operators, who are not experts in tuning beams of the 3-GeV beam proton beam transport facility (3NBT). When the beam position detected by the beam monitors deviates from the reference value calculated with the MAD code, the system estimates the beam angles at the steering magnets necessary for beam correction and adjusts currents to those magnets automatically.

Extrapolating the beam profile obtained at the beam window to that at the target vessel, the heat deposited at the peripheral vicinity of the mercury target was estimated to be 0.3 W/cc even with larger beam size (Fig. 2). This value is smaller than the allowable level of 1 W/cc. Therefore, the 200-kW beam is currently delivered with the low peak heat deposition of 1.7 J/cc/pulse in the mercury target.

The beam optics study has been advanced to reduce the current density of the proton beam onto the target vessel to suppress the damage on the vessel, which is proportional to the 4th power of the peak intensity of the beam (P4 law). It was concluded that two octupole magnets with the magnetic field distribution of the differential coefficient of 3rd order of 800 T/m^3 could suppress the peak current density down to 68%, which equals a 20% reduction according to the P4 law, compared to the current beam profiles with expected flatter profiles in horizontal and vertical directions.

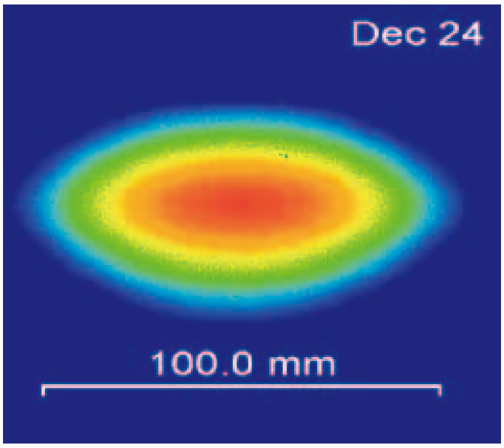


Fig. 2. Beam profile for 200kW operation.

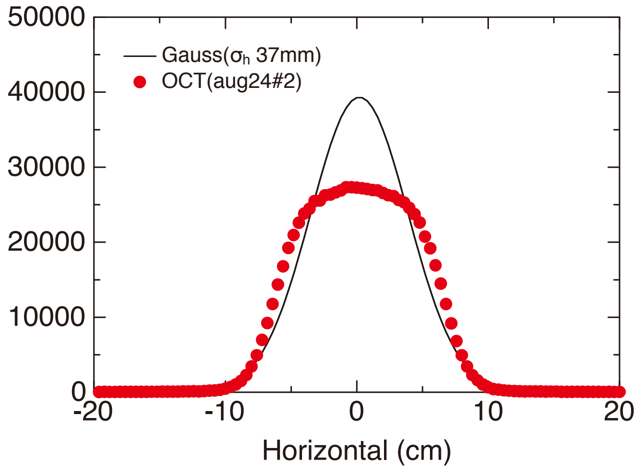


Fig. 3. Estimated beam profile in horizontal direction by introducing octupole magnets (red dots).

Progress of next generation mercury target development

To realize the mitigating pressure waves induced in the mercury target vessel for high intensity proton beam injection, we designed a target vessel with multi type swirl bubbler and its fabrication started at the contractor's factory. The design studies of the next-generation mercury target, from which the rear body can be separated, also advanced steadily while resolving some design issues. On September 29, 2010, we held a design review meeting for the separate-type target to which experts from outside organizations were invited. Based on the review comments, we built a for the practical use of the target vessel in the near future (see Fig. 4). The target vessel with the multi type swirl bubbler will be in use from the run cycle in the autumn of 2011. For the separate-type target, both the analytical and experimental studies of the flange structure connecting the fore and the rear bodies have advanced steadily to realize the seal performance criteria of 1x10^{-6} Pa•m^3/s.

For the existing target, the failure detection function was enforced by introducing a monitoring system to detect radioactive products which have leaked from the mercury into the intermediate helium layer through the most inner target vessel wall.

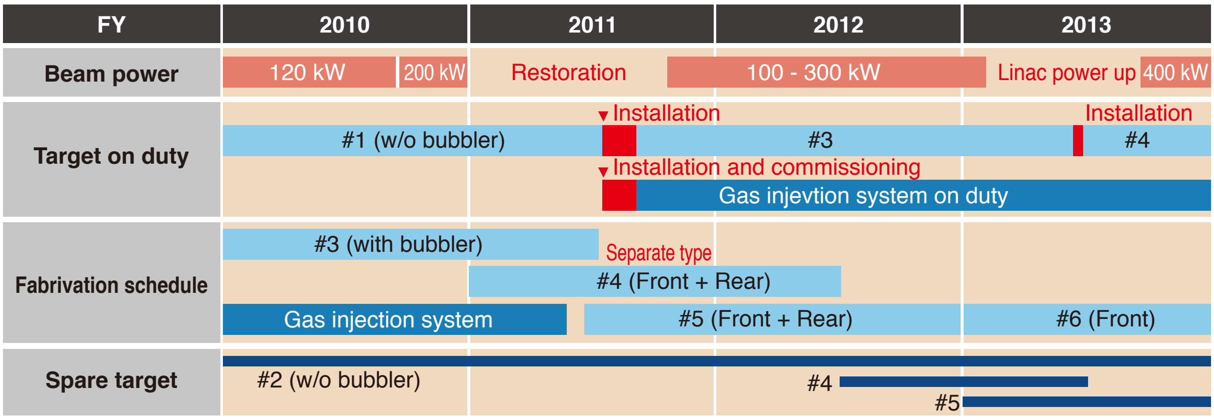


Fig. 4. Usage and construction plan of neutron production mercury target vessels.

Note: The operation in JFY 2011 is to begin in December, since the repair works of the damages caused by the Great East Japan Earthquake will be finished by then. The Linac energy recovery will be postponed to JFY 2013.

Operation of cryogenic hydrogen loop

The cryogenic hydrogen loop struggled with two big issues: the failure of the accumulator system, which occurred in February 2010 and the accumulation of impurities in the cryogenic helium refrigerator system during the autumn run cycles. The detailed inspections of the accumulator were performed in the JFY 2010, concluding that the welding section of the bellows fractured because the welding depth was less than the in-house standard. As a temporal measure, the accumulator function was replaced by a heater to control the volume change of the flowing hydrogen at the moderators. In this situation, the pressure rise was 40 kPa for the 120-kW proton beam operation, which was 10 times higher than the control with the accumulator but less than the limit value of 50 kPa.

The issue of the cryogenic helium refrigerator system came from the insufficient regeneration procedure after replacing the charcoal in the adsorber in the summer maintenance period. This required additional regeneration of the charcoal with dry nitrogen for about a month, forcing the interruption of the user program.

Photo 1. Exchange of the accumulator for cryogenic hydrogen system.
The cryogenic hydrogen system was recovered to receive 200-kW beam by exchanging the failed accumulator (right) to new one (left) in the summer shut-down period.

Neutron Science

Status of Instruments

In JFY 2010, we have operated five diffractometers (iBIX (BL03), SuperHRPD (BL08), TAKUMI (BL19), iMATERIA (BL20) and NOVA (BL21)), three chopper spectormeters (4SEASONS (BL01), HRC (BL12) and AMATERAS (BL14)), one reflectometer (SOFIA (BL16, upgraded from ARISA-II)) and three other instruments (ANNRI (BL04), NOP (BL05) and NOBORU (BL10)). Besides, six instruments were under construction: Biomolecular Dynamics Spectrometer DNA (BL02), Special Environment Neutron Powder Diffractometer SPICA (BL09), High Pressure Neutron Diffractometer PLANET (BL11), Smaller-Angle Neutron Scattering Instrument TAIKAN (BL15), Polarized Neutron Reflectometer with a Vertical Sample Geometry SHARAKU (BL17), and Single Crystal Neutron Diffractometer under Extreme Condition SENJU (BL18). In addition to these instruments' construction, we worked on a broad range of developments related to neutron scattering technique, such as new imaging technics, sample environments for time-transient measurements, computing environments, etc.

New Techniques

Pulsed Neutron Imaging - Bragg edge imaging of quenched iron rods

Figure 5 shows a transmission image of quenched iron rods (the diameter is 26 mm and the thickness is 20 mm) with wavelength 1 ~ 5 Å neutrons, and a wavelength-resolved transmission image around the {110} Bragg edge (4.089 ~ 4.100 Å). In the wavelength-resolved image, it is possible to distinguish the quenched zone. Figure 6 shows images of the real space distribution of the crystal lattice plane spacing of {110} for quenching depth 3, 5 and 7 mm samples. These images were obtained by analyzing the {110} Bragg edges of position-dependent transmission TOF spectra of the specimens. The quenched zones show the broader lattice spacing, because the martensite transformation is caused by the quenching. It is clear that the quenching depths are increasing as 3, 5 and 7 mm from the surface of each sample. The quenched depths are consistent with the induction hardening design of the manufacturer.

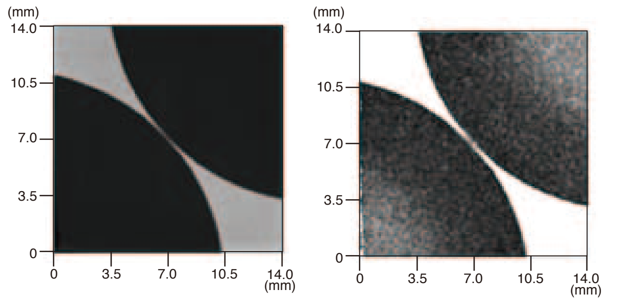


Fig. 5. Neutron transmission images of quenching depth 5 mm samples for wavelength 1 ~ 5 Å (left) and 4.089 ~ 4.100 Å (right).

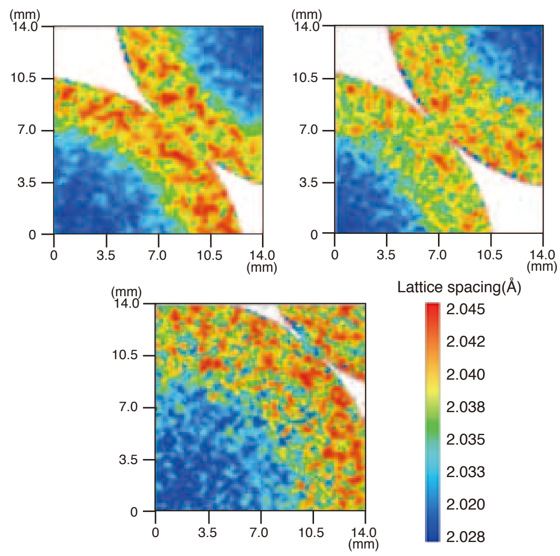


Fig. 6. {110} lattice spacing of quenched iron samples; quenching depth 3 mm (upper left), 5 mm (upper right) and 7 mm (lower).

Scientific Topics

Crystal Structure Change of Cathode for Li Ion Battery during Charge (Y. Idemoto et al.)

A new battery material, Li(Ni,Co,Cu)O_2, in which a portion of the (Ni, Co) is replaced by low-valence Cu with the aim of reducing the Ni^{2+} content to enhance the battery characteristics was synthesized and set up as a cathode material in a new coin type cell (Fig. 7) fabricated for neutron diffraction measurements to analyze structural changes caused by the charge – discharge process. After ex-situ charge-discharge cycles with the coin type cell, neutron diffraction measurements were performed with iMATERIA (BL20, J-PARC).

Figure 8 shows the profile fitting results for the cathode of the coin type cell after charging. The cathode charging reduced lattice parameter a and increased lattice parameter *c*. These changes are attributable to Li separation and increased repulsion between oxygen ions, respectively. After charging, the bond valence sum of the MO_6 octahedron became higher. It is presumably attributable to an increase in the valence of the Ni accompanying Li separation. Also, the MO_6 octahedral distortion in the cathode is increased by charging.

These results demonstrate that it is possible to evaluate the 8.5 mg of active material in the cathode (containing the binder) by neutron diffraction.

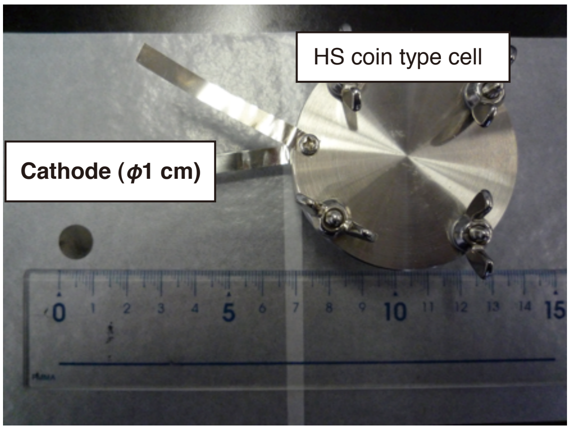


Fig. 7. Coin type cell and cathode (ϕ 1 cm).

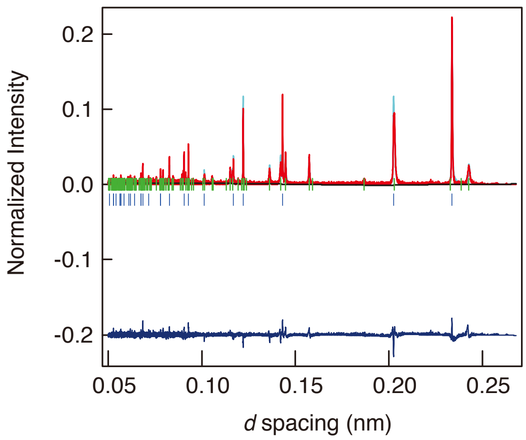


Fig. 8. Rietveld refinement patterns using iMATERIA for cathode of $Li_{0.613}Ni_{0.8}Co_{0.19}Cu_{0.01}O_2$ (after charging, Raw-BKG). The vertical marks indicate positions of allowed Bragg reflections. The curve at the bottom is the difference between the observed and calculated intensities on the same scale.

Strong $s_{\pm}$-like Spin Resonance in the Nodal Fe-Based Superconductor $BaFe_2(As_{0.65}P_{0.35})_2$ (M. Ishikado et al.)

The recent discovery of iron-based superconductors has renewed our interest in the relationship between unconventional superconductivity and magnetism. In the iron-based superconductors that show relatively high transition temperature (T_c), fully-gapped s-wave symmetry has been confirmed. On the other hand, line node symmetry has been observed in lower-T_c iron-based ones. Furthermore, the $BaFe_2(As,P)_2$ superconductor has demonstrated that this material possesses line nodes in the order parameter, in spite of its relatively high-T_c of 30 K. To characterize the magnetic excitation and the superconducting (SC) gap symmetry of $BaFe_2(As_{0.65}P_{0.35})_2$, inelastic neutron scattering measurements were performed to observe the magnetic resonance on a ~ 36 g powder sample with T_c=30 K. The dynamical structure factor $S(Q, E)$ of $BaFe_2(As_{0.65}P_{0.35})_2$ below (5 K) and above (32 K) T_c was measured by 4SEASONS (BL01) in J-PARC as shown in Fig. 9(a) and (b). The dynamical spin susceptibility $\chi''(E)$, which is calculated with observed $S(Q, E)$ shows that $BaFe_2(As,P)_2$ suggests that similar amounts of sign reversed process to the case of $s_{\pm}$-wave occur between Γ and M FSs in the present compound. This situation may be the possible reason why $BaFe_2(As,P)_2$ can hold the comparable T_c (= 30 K) to those of the iron-based high-T_c superconductors without nodes despite the existence of nodal symmetry.

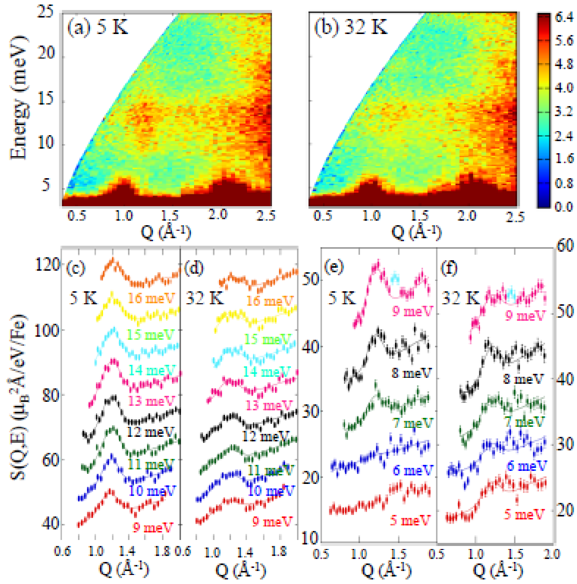


Fig. 9. Dynamical structure factor $S(Q,E)$ of $BaFe_2(As_{0.65}P_{0.35})_2$ measured with E_i= 45.5 meV at (a) 5 K (below T_c) and (b) 32 K (above T_c). (c) and (d) show constant energy cuts of $S(Q, E)$ at 5 K and 32 K, respectively, measured with E_i = 45.5 meV. (e) and (f) are those measured with E_i = 21.6 meV. Solid lines are the results of fits to a Gaussian function on a sloped background. The offset values of (c), (d) are 6, 12, 30, 41, 55, 70 for 10-16 meV, and 5, 10, 15, 20 for 6-9 meV of cuts (e),(f) for the clarity.

High Pressure Neutron Diffraction Measurements of LaD_2 (A. Machida et al.)

Investigation focused on the hydrogen-metal and hydrogen-hydrogen interactions under high pressure is the key to understand the limit of hydrogen storage capacity in metals. In case of LaH_2, observed phase separation by X-ray suggests that it forms domains of the hydrogen-poor and hydrogen-rich phases spontaneously by pressurization. To understand the origin of the structural transformations in LaH_2, a Paris-Edinburgh (PE) press (VX4, max. load 200 ton) with toroidal anvils was applied to the high-intensity total diffractometer, NOVA (BL21).

Figure 10 shows the selected neutron diffraction patterns of LaD_2 under high pressure. Above 11 GPa, several new reflection peaks (indicated by arrows) appeared. By analyzing the Bragg peaks and comparing them with those in x-ray diffraction, the formation of a NaCl-type monohydride in the rare-earth metal hydrides was confirmed. The discovery of rare-earth metal monohydride will open the way to clarify the site-dependent nature of hydrogen-metal interactions through comparison studies among mono-, di-, and tri-hydride.

This work has been partially supported by the New Energy and Industrial Technology Development Organization (NEDO) under Advanced Fundamental Research on Hydrogen Storage Materials (Hydro-Star).

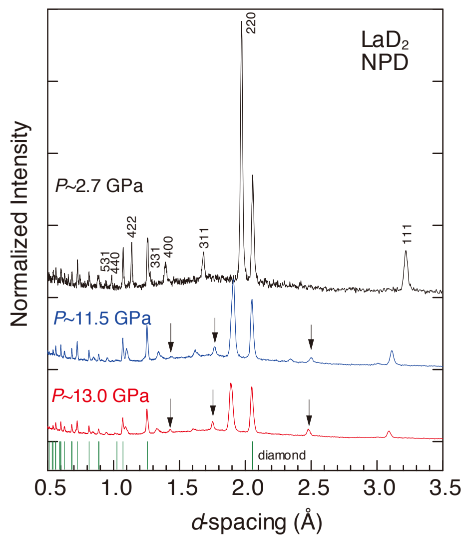


Fig. 10. Selected neutron diffraction patterns of LaD_2 at high pressures. Each profile is shifted for better visualization, and the base line for each pattern is shown by the stick marks on vertical axes. The background is not subtracted, showing the background is low even for high pressure diffraction.

Muon Science

In JFY 2010, the decay and surface muon beamline (D-Line) was operated for user programs at the Muon Science Establishments (MUSE). Other three beamlines, namely, superomega muon beamline for ultra slow muon (U-Line), dedicated surface muon beamline (S-Line) and high momentum muon beamline (H-line) were under designing.

Improvement of Muon Beam Transport at D-Line

D-line is the first beamline in MUSE and is capable of transporting the muons from decay-in-flight pions in the superconducting solenoid magnet. It may be possible to deliver negative as well as positive muons with momentum up to 120 MeV/c. In 2010, the limiting components of the D-line transport, namely, the electrodes and the high voltage power supplies of the Wien filter (DCsep) and two quadrupole magnets (DQ4 and DQ7) were replaced with ones with large bores and apertures to increase the beam transmission efficiency.

After the installation of the new components, beam tuning of D-line was performed according to the beam envelope calculation incorporating the measured fringing magnetic fields. The beam profile became much sharper than before, as shown in Fig. 12, which was consistent with the calculation. The beam intensity achieved 3.1×10^6 surface muons per second under 220 kW proton beam. The 50-MeV/c decay-muon beam intensity was ~1/3 of the surface one, and was almost identical for positive and negative muons. The last point is unexpected from a standard pion production model, but is certainly good news for researches using negative muons at J-PARC/MUSE.

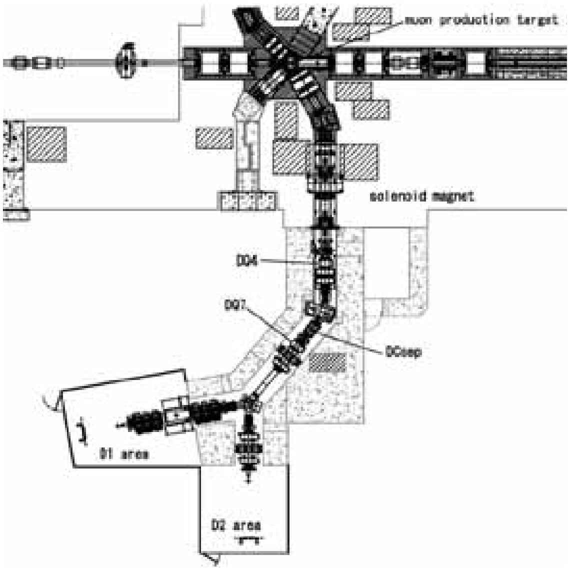


Fig.11. A schematic view of D-line. Newly replaced components are DCSep, DQ4 and 7.

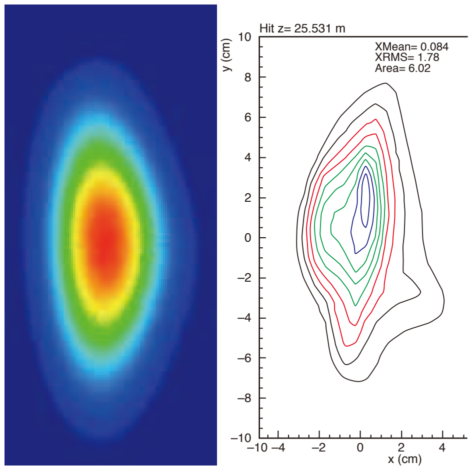


Fig. 12. A typical beam profile obtained by imaging plate. σ_x=14 mm and σ_y =28 mm (left) and the result of calculation (right)

Development of New Positron/Electron Detector System for Pulsed μSR

At pulsed muon facilities, muons come in a pulse which decay into positrons or electrons as in $\mu^\pm \rightarrow e^\pm + \nu$. Muon spin relaxation (μSR) measures these $e^\pm$'s in order to extract the time evolution of the muon spin. The requirement for the positron/electron detectors for pulsed μSR facility is the least count-loss, despite the huge event rate right after the arrival of muons (~100 Gcps at MUSE D-line).

In 2010, a prototypical detector system (Photo 2) was developed and successfully observed μ-e decay time spectrum (Fig.13). This system will eventually strengthen the existing detectors at μSR spectrometer DΩ-1 installed at D-line of J-PARC/MUSE.

The physica detector for $e^\pm$ is a plastic scintillator in which wave-length shifting fiber collects the scintillation light and delivers to a multi-pixel avalanched photo diode (APD). Analogue board extracts the timing information of $e^{\pm}$ events from APD and transfers it to digital board. Main component of digital board is field programmable gated array (FPGA) in which time to digital converter (TDC) and multi-hit event memory are configured.

The event data is transmitted to a data acquisition PC as a series of SiTCP Ethernet packets. The structure of the data packet is the same with the existing system at DΩ-1, so that a seamless expansion of the detector system is going to be possible.

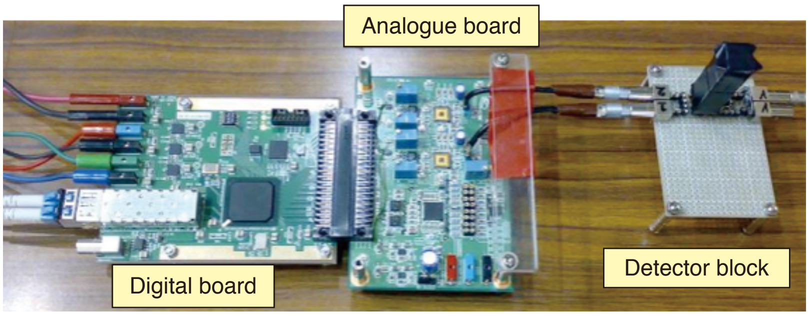


Photo 2. Prototypical new positron and/or electron detector system.

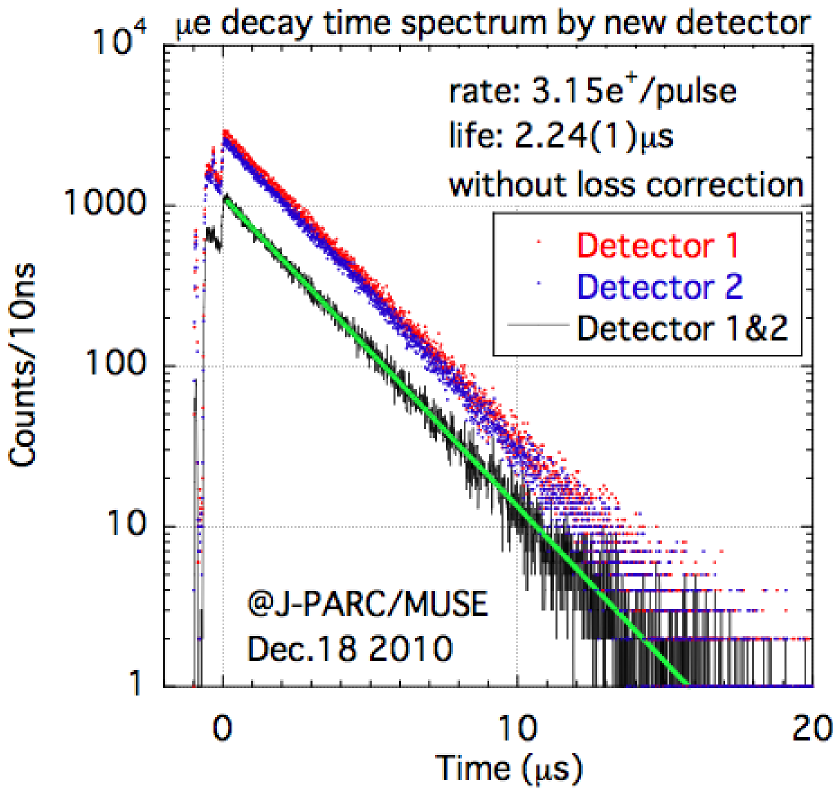


Fig. 13. The first μ-e decay time spectra taken by the prototypical detector system.

μSR Study on a Mott State in the Iridium Oxides

Recent findings of the novel insulating state in Sr_2IrO_4 have raised attention to the spin-orbit (SO) coupling induced Mott state. This novel insulating state is driven by large SO interaction and modest on-site Coulomb interaction in the 5d electron system. The SO driven Mott state has a similar total momentum J_{eff} = 1/2 with the parent materials of high-T_C cuprates. Therefore, there is an expectation that unconventional superconductivity may occur in carrier-doped SO Mott insulators.

We succeeded in synthesizing Ba_2IrO_4 which has flat IrO_2 square lattices with 180° Ir-O-Ir bond angles (Fig.14). The simpler structure of Ba_2IrO_4 is more suitable for studying the nature of SO driven Mott insulating state than in Sr_2IrO_4.

Using muon spin relaxation (μSR) at J-PARC/MUSE, we investigated the antiferromagnetic order of Ir moments in Ba_2IrO_4. As shown in Fig.15 and 16, muon detected the antiferromagnetic order of Ir moments below T_N~240 K. We estimated the size of the Ir magnetic moment to be 0.34 μ_B, which is significantly reduced from the full moment (1 μ_B). The reduction is most likely due to a low-dimensional quantum spin fluctuation as in La_2CuO_4. The ground state is therefore similar in two types of Mott insulators: cuprates and an Irridate.

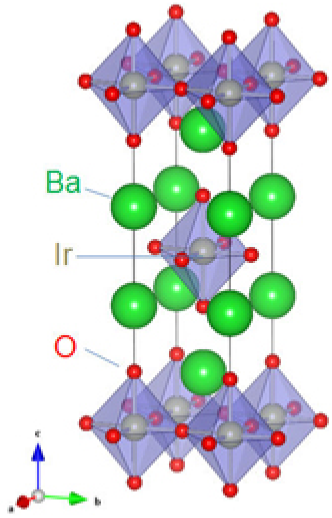


Fig. 14. Crystal structure of Ba_2IrO_4 which is similar to that of La_2CuO_4 a parent compound of high-Tc cuprate.

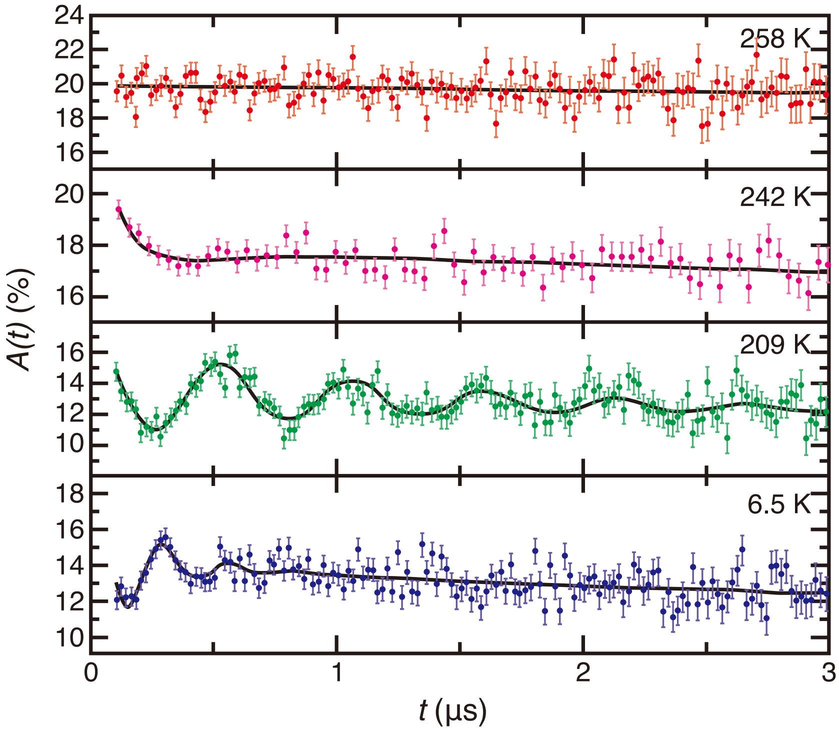


Fig.15. Zero-field μSR spectra of Ba_2IrO_4.

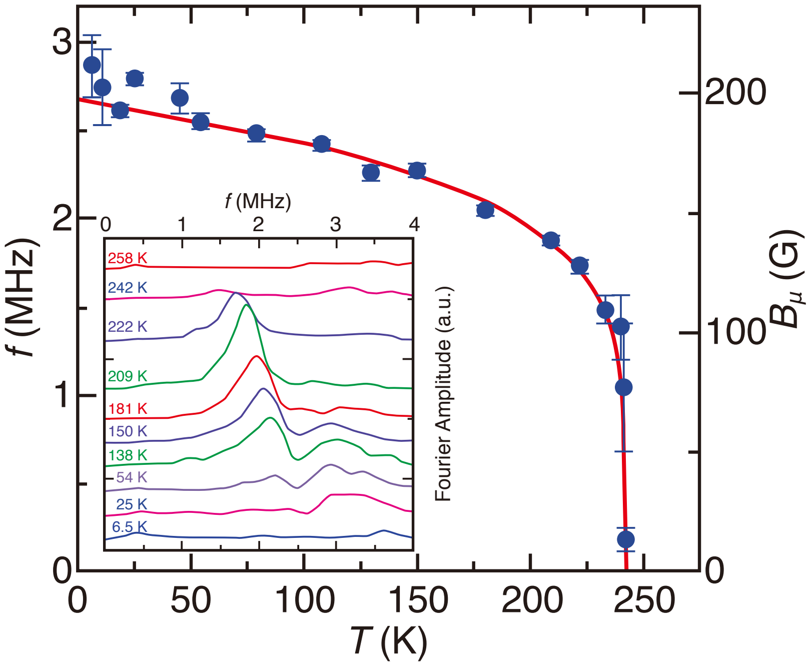


Fig. 16. Temperature dependence of μSR frequency.

Neutron Device

Two-Dimensional Scintillator Neutron Detectors for SENJYU (BL18)

A two-dimensional scintillator neutron detector module with a large detective area was successfully developed on the basis of the scintillator/wavelength shifting (WLS) fiber technology for a time-of-flight Laue single crystal diffractometer, "*SENJU*" instrument (BL18). The detector module accommodated the large detector head while the electronics hardware, encoder and DAQ, were similar to those installed on the currently running *iBIX* (BL03) instrument for system integrity

The WLS fibers were placed with a pitch of 4 mm in the detector head to create a neutron-sensitive area size of 256×256 mm^2. The detector exhibited high detector efficiency of 40% for thermal neutrons, suppressed the gamma sensitivity down to 3×10^{-6} by implementing the dedicated signal processing software into the encoder. Moreover, special care was paid to the magnetic shielding of the photomultipliers, ensuring the count rate stability under the stray field of 200 gauss. The detector performance was confirmed by the neutron diffraction pattern data obtained with a single crystal sample at BL10.

That detector performance enabled the SENJYU to cover the solid angle over 4 sr around the sample while maintaining a high spatial resolution, high detector efficiency, and low gamma sensitivity.

The detector was also designed to be as compact as possible resulting in a size of 300×300×300 mm and weight of 15 kg. This added flexibility to the instrument design and significantly lowered its cost. It helped the concept of movable detector bank which was one of the unique features of the SENJU. 31 detector modules were delivered to the beam line by the end of JFY 2011.

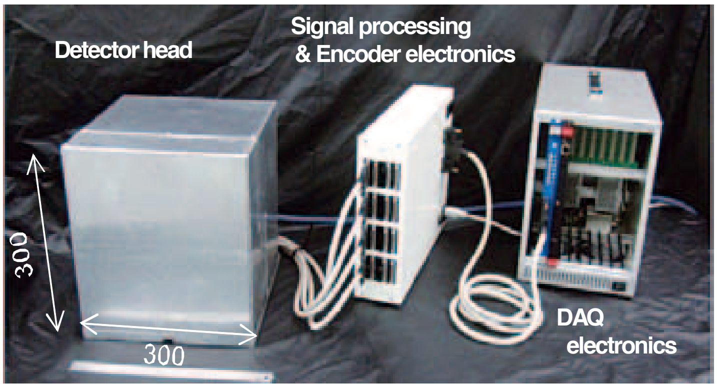


Photo 3. A detector module for SENJU.

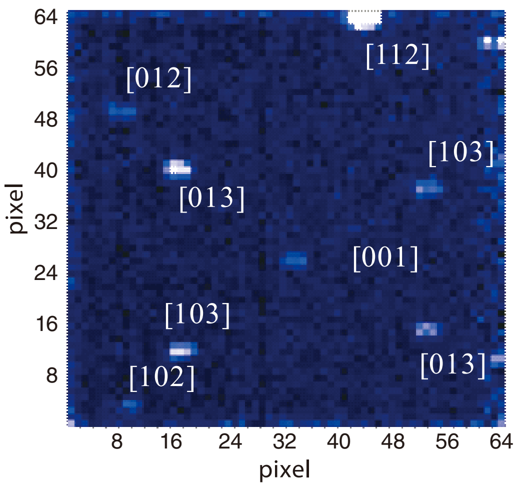
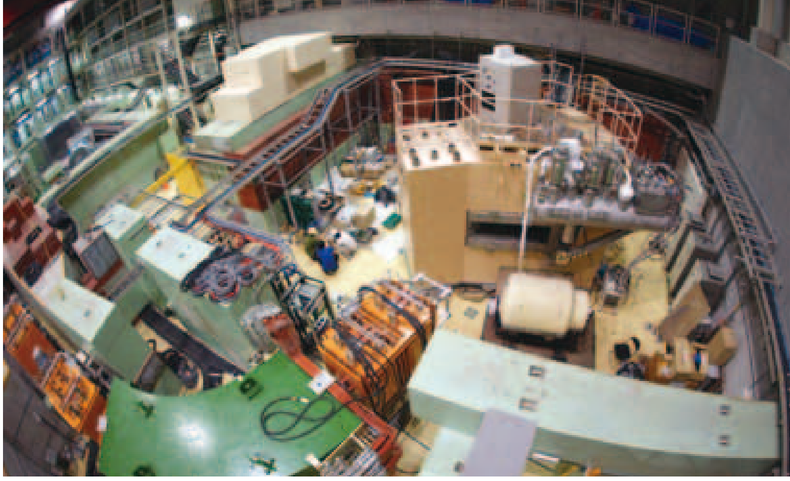
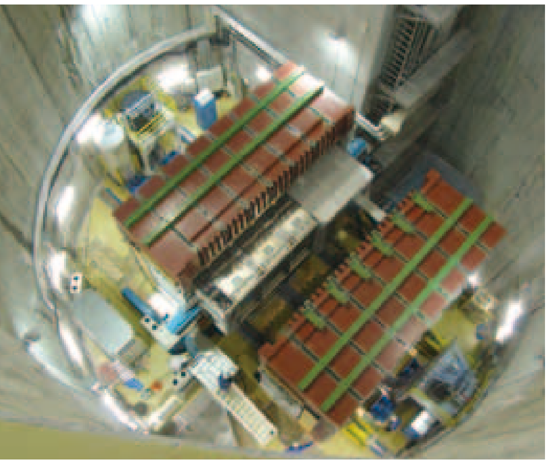
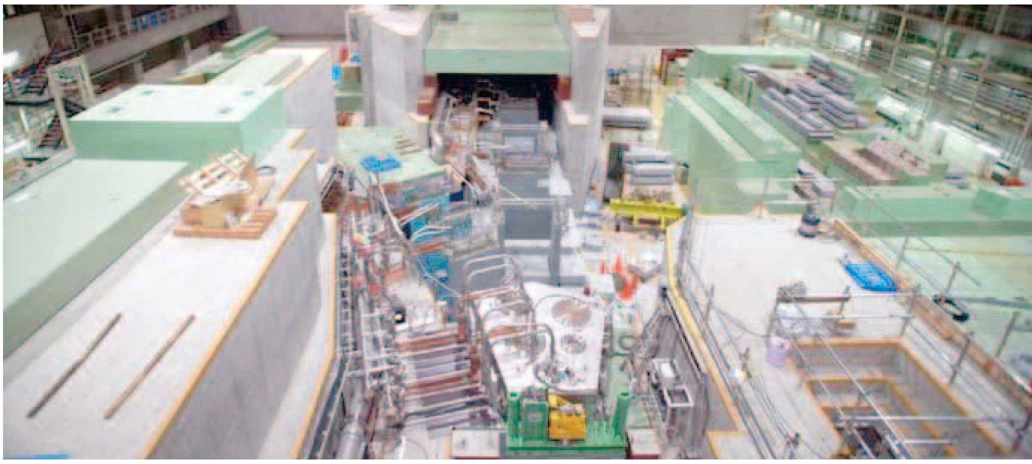


Fig. 17. A two-dimensional data of the neutron diffraction from a single crystal tin sample measured with the *SENJU* detector module.

Photo 4. Detector modules installed in the north bank of SENJU.

Particle and Nuclear Physics

First results from Nuclear and Particle Physics : Pentaquark Search and T2K

In 2010, the first experiments were carried out using the beam of the J-PARC Main Ring (MR) accelerator to explore the mysteries of fundamental nuclear and particle physics: E19[1] and T2K[2]. E19 was an experiment conducted to search for the pentaquark. The pentaquark is a hypothetical subatomic particle consisting of four quarks and one antiquark bound together. It is to be compared to three quarks in normal baryons. In T2K, neutrinos were shot 295 km underground across Japan to detect the very tiny signals that muon neutrinos transform into electron neutrinos. With an enhancement in the beam intensity and quality of MR, *i.e.*, 99.5% extraction efficiency at the Hadron Hall and stable operation of 145-kW beam at the neutrino facility, a significant amount of data has accumulated. The exciting first experimental results have been released.

The pentaquark is one of the exotic hadrons. The discovery of an exotic hadron consisting of four or more quarks will shed light on the hadron structure, which in turn will provide information on the strong interactions in the low energy region. Despite the first evidence for pentaquark Θ^+ [3], the existence of Θ^+ has not yet been established. The J-PARC E19 experiment was planned to confirm the existence of Θ^+ and study its production mechanism in a hadronic reaction with high mass resolution.

The E19 experiment was performed at the K1.8 beamline of the Hadron Experimental Facility. The search for Θ^+ in the p(π^-,K$^-$) reaction was carried out using the missing mass technique. A pion beam was irradiated on a liquid hydrogen target. Scattered kaons were identified using the superconducting kaon spectrometer (SKS). A sensitivity of 75 nb/sr was achieved with full statistics. The first physics run was performed at a beam momentum of 1.92 GeV/c in the autumn of 2010, accumulating 16% of the aimed statistics within 6 days of beamtime. The performance of the detectors was confirmed to be good. In particular, a missing mass resolution was estimated to be 1.4 MeV in full width at half maximum for the Θ^+ production mode by analyzing the Σ production data. This performance was better than that of the original design. The missing mass spectrum for the p(π^-,K$^-$) reaction is shown in Fig. 1. No significant structure was observed at the mass of Θ^+. Currently, the upper limit of the production cross section is estimated to be 0.3 μb/sr at the 90% confidence level. This upper limit is smaller by an order of magnitude than that estimated in the previous experiment [4]; however, it is comparable with theoretical predictions. The upper limit of the decay width of Θ^+ is given as ~1 MeV. The aim of the experiment is to achieve a sensitivity of 75 nb/sr which corresponds to the decay width of 0.2 MeV.

Neutrinos are ghost-like particles having a neutral charge. They interact with ordinary matter so weakly that they can travel through entire Earth at the speed of light without disturbance. Their mass is less than 1/1,000,000 of the mass of electrons and the lightest quarks. The three known types (flavors) of neutrinos are electron neutrinos (ν_e), muon neutrinos (ν_μ), and tau neutrinos (ν_τ), corresponding to their charged counterparts. Each of the neutrino flavor states appears as a superposition of different mass states, and the difference in their extremely small masses causes a periodic change in flavors during flight. This phenomenon is known as neutrino oscillation.

The primary goal of T2K is the discovery of ν_μ-to-ν_e oscillation, which indicates that the mixing angle between the first and third generations, θ_{13}, to have a finite value. To achieve this objective, T2K directs high-intensity muon neutrino beams with 99.5% purity. The muon neutrino beams produced at the neutrino experimental facility in J-PARC are directed toward the Super-Kamiokande detector (SK), which is located 295 km west of J-PARC. SK is the world's largest underground neutrino detector, which contains 50,000 tons of purified water as the target for the neutrino beam. The rare interaction between neutrinos and nuclei in the water can be detected by the ~11,000 photosensors fixed on the entire inner surface. The appearance of electrons in the water, charged counterparts of the electron neutrinos, is a clear sign of the ν_μ-to-ν_e oscillation.

The T2K physics experiment lasted from January to the end of June 2010, and after the summer shutdown, data collection was resumed from November 2010 until March 11, 2011. During the initial period, the J-PARC MR provided a stable beam of about 50 kW and accumulated 3.2×10^{19} protons-on-target (POT) in total. In the latter period, the J-PARC succeeded in increasing the beam power to 145 kW, which resulted in accumulation of 1.45×10^{20} POT in total.

An analysis of the initial dataset showed that 33 beam-induced neutrino interactions were obtained at SK. Thus far, one event has been selected as a candidate for the electron neutrino appearance signal (Fig. 2); the background estimation was 0.30 ± 0.07 events. T2K achieved two important measurements towards the detection of θ_{13} in 2011. One is the deficit of the muon-like events compared with the expectation from the null oscillation hypothesis. This deficit is consistent with other measurements on the disappearance of muon neutrinos. The other is the establishment of the low-background contamination with the detection of electron neutrino.

Thus, the path toward the discovery of finite θ_{13} has opened.

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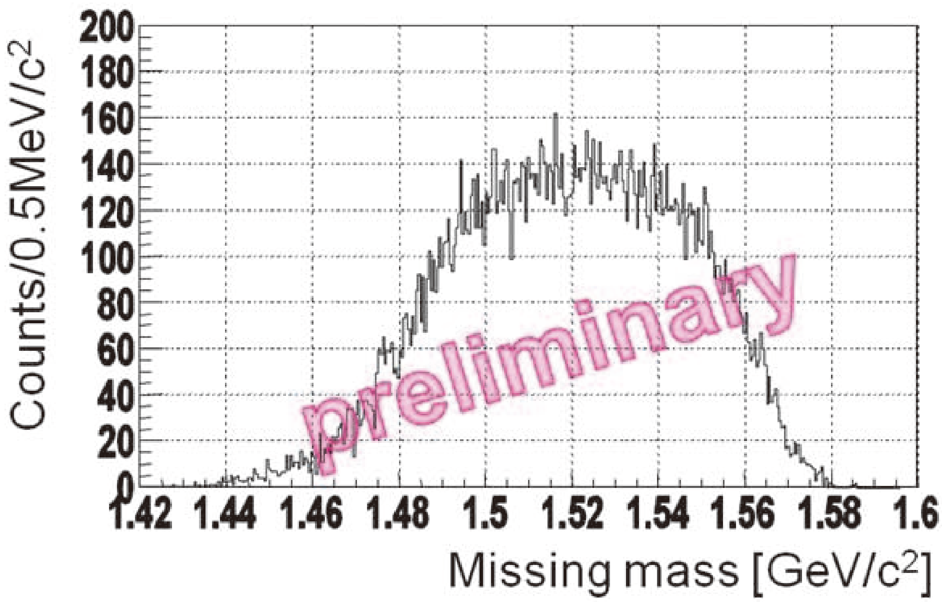


Fig. 1. Missing Mass Spectrum for p(π-,K-) reaction.

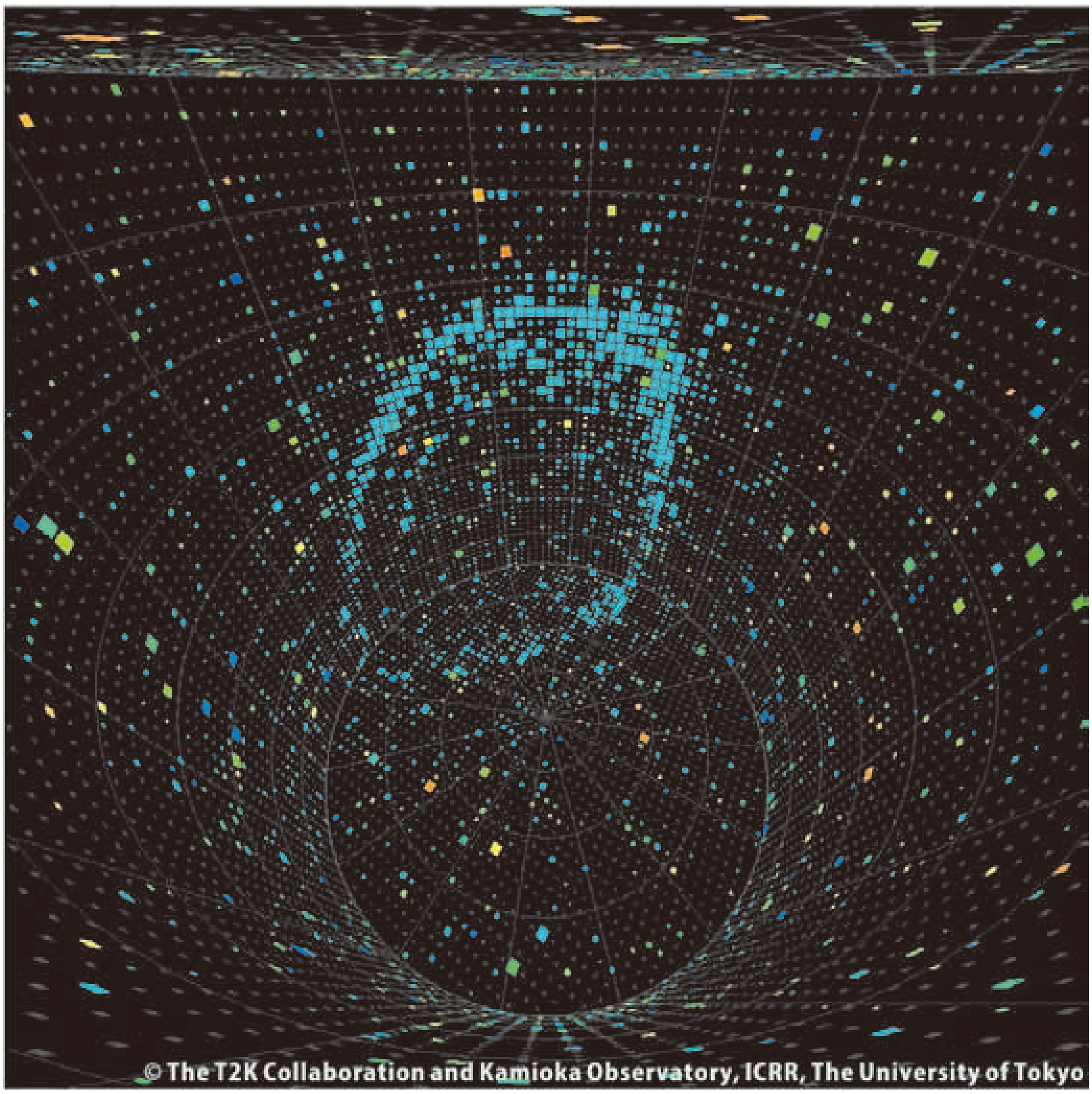
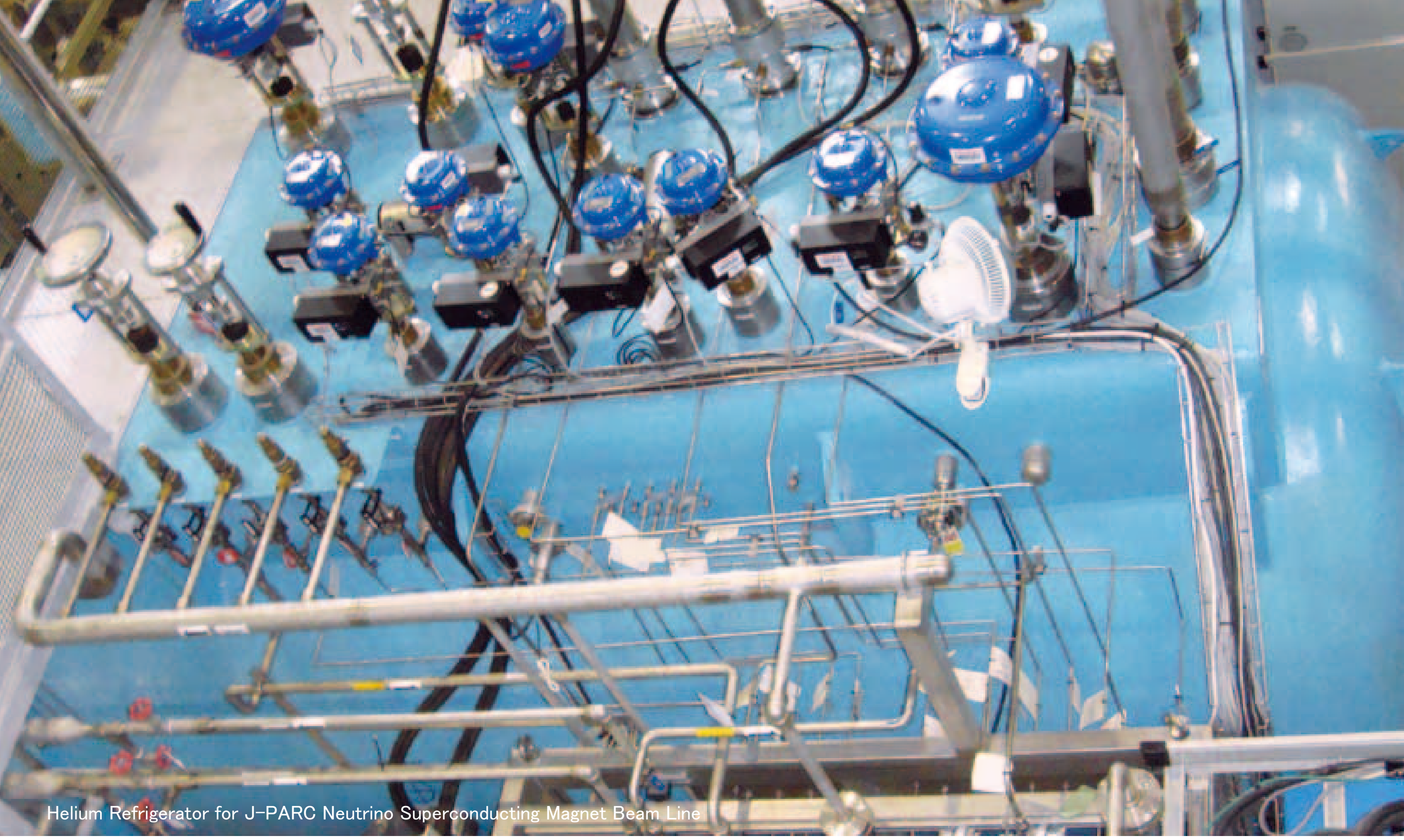


Fig. 1. Candidate for electron neutrino appearance.


Helium Refrigerator for J-PARC Neutrino Superconducting Magnet Beam Line

Cryogenics

Overview

The cryogenics section supports scientific activities carried out at J-PARC, in applied superconductivity and cryogenic engineering in numerous ways, including the supply of cryogens. The support works include the operation of the superconducting magnet system for neutrino beam line, as well as the construction support of the superconducting solenoid system for the Super OMEGA muon beam line at the Materials and Life Science Experimental Facility (MLF). The research and development (R&D) works to support for future projects in J-PARC are also very active.

Operation and Construction Support

The cryogenics section operates the superconducting magnet system for the neutrino beam line. The operation record for Japanese fiscal year (JFY) 2010 is summarized in Table 1.

Table 1. Operation history of the superconducting magnet system for the J-PARC neutrino beam line.

2010.4.1~2010.6.25	Steady state operation (beam operation)
2010.6.26~2010.7.2	Warm up operation
2010.7.3~2010.10.17	Maintenance
2010.10.18~2010.10.26	Cool down operation
2010.10.27~2010.12.27	Steady state operation (beam operation)
2010.11.28 16:13	Beam induced quench
2010.11.28 18:25	Operation resumed
2010.12.15 6:12	Interlock by false signal from a vacuum sensor
2010.12.15 8:25	Operation resumed
2010.12.28	Liquid Helium recovery operation
2010.2.29~2011.1.6	Short shutdown
2011.1.7~2011.3.11	Steady state operation (beam operation)
2011.2.5 8:18	Interlock by current lead operation error
2011.2.5 13:23	Operation resumed
2011.3.11 14:50	Shutdown by the Great East Japan Earthquake
2011.3.12~2011.3.31	Investigation of the system healthiness

The system had been operated regularly till The Great East Japan Earthquake with the exception of three interlock incidents that caused magnet shut downs. In all three incidents, the safety system worked properly, no major damages were observed, and the regular operations were resumed within a few hours. At the time of the earthquake, the system had the beam shut down automatically and safely. After the shutdown the helium was recovered to the buffer tank and no major helium leakage was detected. The investigation of the system's health has been taking place after the earthquake. No major damage has been detected by the end of April 2011.

The section also supports the Superconducting Kaon Supectrometer (SKS) operation. Its major contribution is the liquid helium supply for the cool down operation of the SKS. The liquid helium supply issues will be reported in the cryogen supply part.

The section also supports the operation and the construction of the Muon Beam Line in MLF. Especially the construction support for the Super OMEGA muon beam line was the major support job for the section in JFY 2010.

R&D for the Future J-PARC Projects COMET

A new experiment, COherent Muon to Electron Transition (COMET) has been proposed to search for coherent neutrino-less conversion of muons to electrons using the high intensity proton beam from J-PARC Main Ring. The Cryogenics Section has been involved in the COMET experiment to develop the superconducting magnet system. The project requires a large aperture solenoid that covers a pion production target. A solenoid using an aluminum stabilized superconducting cable was proposed and R&D works have been carried out. A major issue for the R&D is that irradiation of neutron to the solenoid. The neutron irradiation test at Kyoto University Research Reactor Institute has been started to investigate RRR degradation in stabilizer aluminum in Japanese fiscal year (JFY) 2010.

g-2 and HFS

The anomalous magnetic moment of the muon is directly sensitive to electromagnetic, strong, and weak forces, and the precise measurement of g-2 might lead the new physics beyond the standard model. An experiment at J-PARC to measure the g-2 value with a very high sensitivity level of 0.1 ppm has been proposed by the group in the Institute of Particle and Nuclear Physics Studies (IPNS). A very high precision superconducting solenoid magnet is expected to play an important role to storage muon beam in this experiment, and the development has been started with cooperation between IPNS and Cryogenics Science Center since JFY 2009. In addition to the g-2 project, a new experiment that measures Hyper Fine Structure of Muon (HFS experiment) was proposed in JFY 2010 in corporation with the g-2 group and the Muon Science Division of Institute of Materials Structure Science in KEK. The experiment also requires high precision magnetic field, but with narrower volume. It was proposed to build the solenoid for the HFS experiments as an smaller prototype of g-2 solenoid. The design of the solenoid (Fig.1) was made in JFY2010 by the Cryogenics Section and the construction is planned to be started in JFY2011.

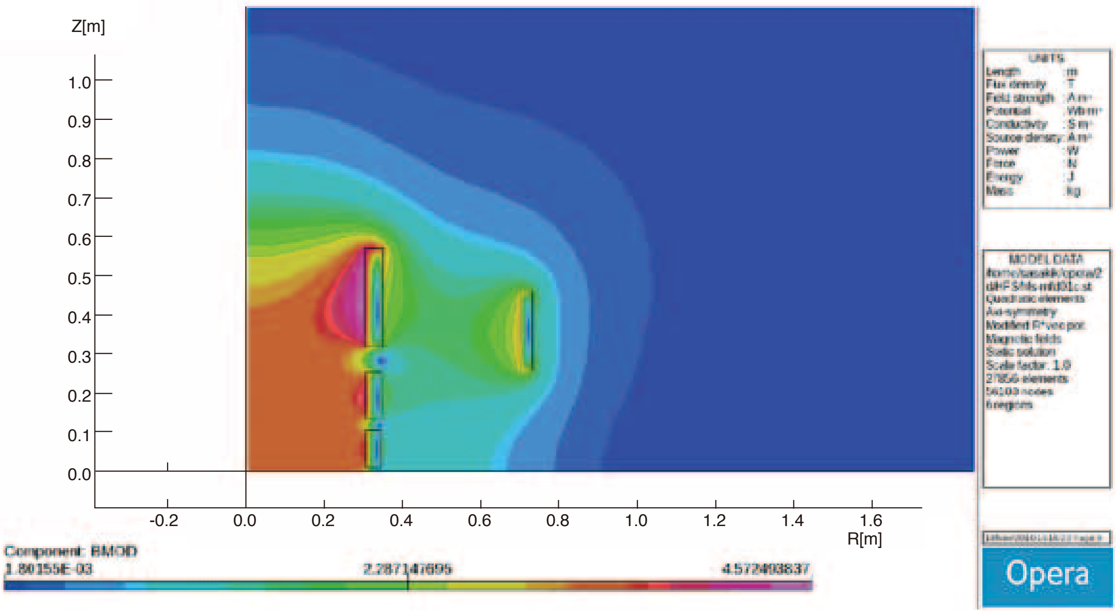


Fig. 1. Magnetic design of HFS solenoid.

Cryogen Supply at J-PARC

The Cryogenics Section provides cryogens for physics experiments in J-PARC. The liquid helium is supplied to the users in corporation with the Accelerator Division of J-PARC using the Helium liquefier owned by the Accelerator Division. The used helium is recovered by the helium gas recovery facility, constructed and operated by the Cryogenics Section. Figure 2 summarizes the liquid helium supply in JFY 2010. The major user of the liquid helium is SKS. The helium gas recovery rate was better than 90 % until The Great East Japan Earthquake on March 11. After the earthquake the electricity, as well as the helium recovery facility, was down for several weeks and all the helium stored in the SKS magnet and part of the helium stored in the dewers were lost. The amount of helium loss and the damages to the facility are still under investigation.

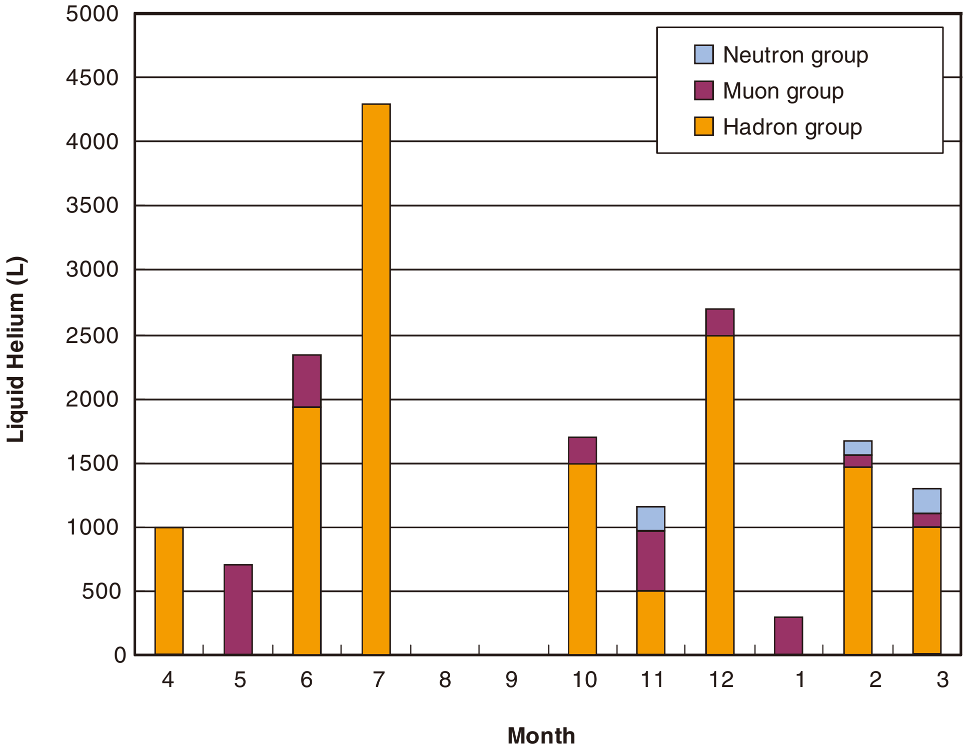
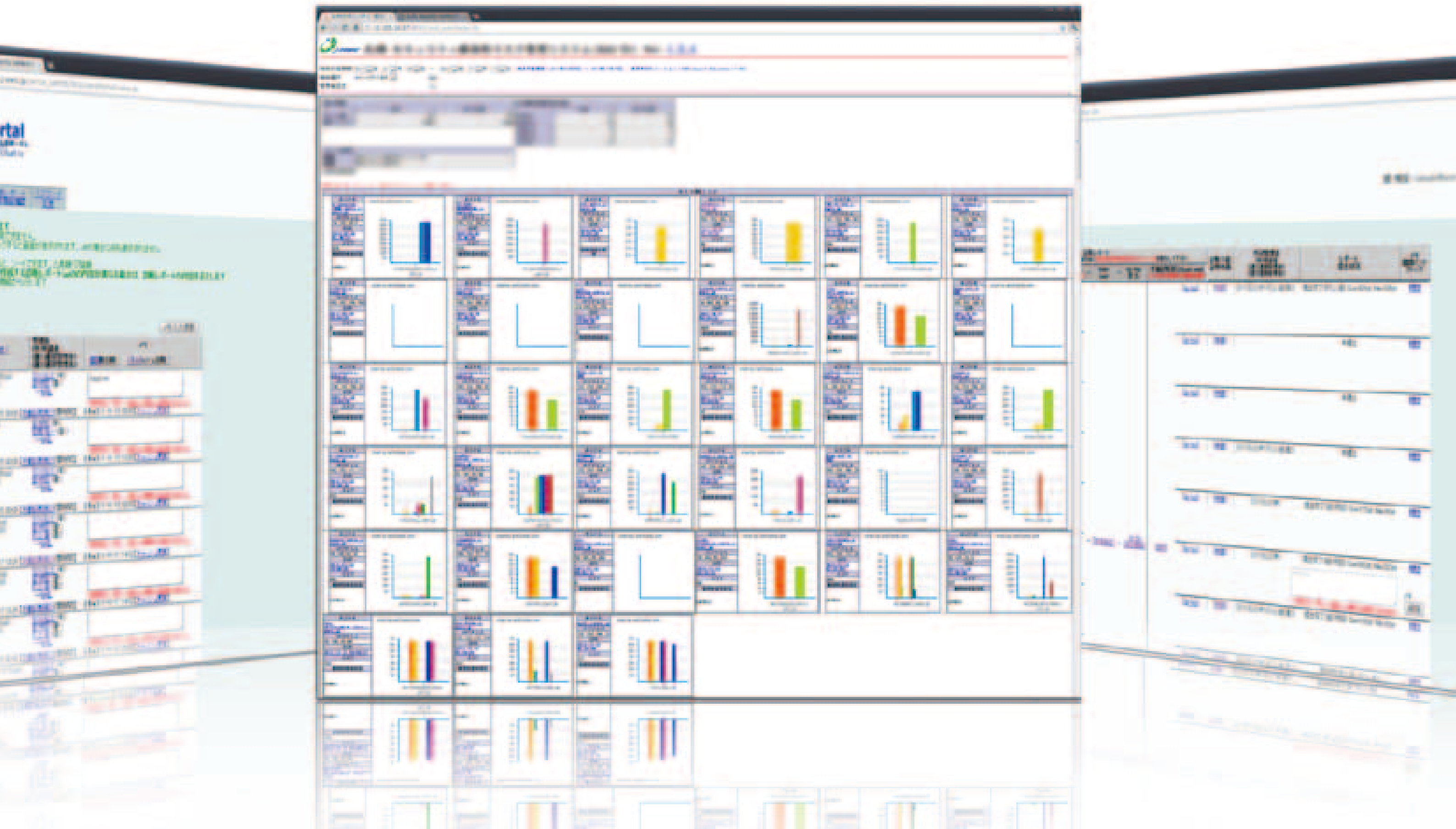


Fig. 2. Liquid helium supply at J-PARC in JFY 2010.



Newly developed “J-PARC” server vulnerability inspection system

Information System

Overview

Since 2002 a J-PARC network infrastructure called JLAN has been operated independently from KEK LAN and JAEA LAN for J-PARC public users and staffs in terms of logical structure and operational policy. The Information System Section designs, manages and operates the network system and also has activity of Authentication System and Data Base System for J-PARC. Each System is aiming to be both secure and easy-to-use ICT (Information Communication Technology) infrastructure for the J-PARC users.

Statistics of Network Utilization

In 2010 the total number of hosts on JLAN exceeded 2700 and was still increasing at a rate of 130% per year. The growth curve of edge switches, wireless LAN access points and hosts connected to JLAN are shown in Fig.1. JLAN has also an important role in connecting the Tokai area, where main J-PARC facilities were built, and the Tsukuba area, where the major computer resources for data analysis are located. Figure 2 shows the annual data transfer statistics between the two sites. The bandwidth for the connection is 2 Gbit/s (250 Mbytes/s) and still leaves enough margin for an upgrade of the accelerator intensity improvement in terms of average bandwidth in the near future.

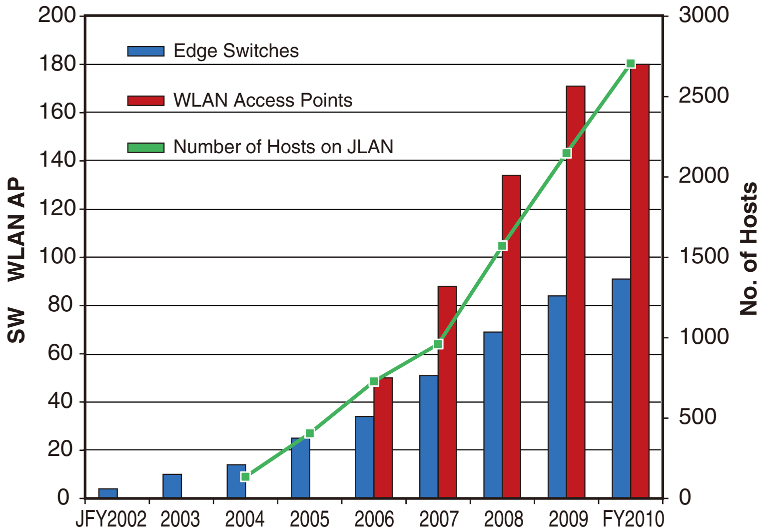


Fig. 1. Growth of J-PARC network

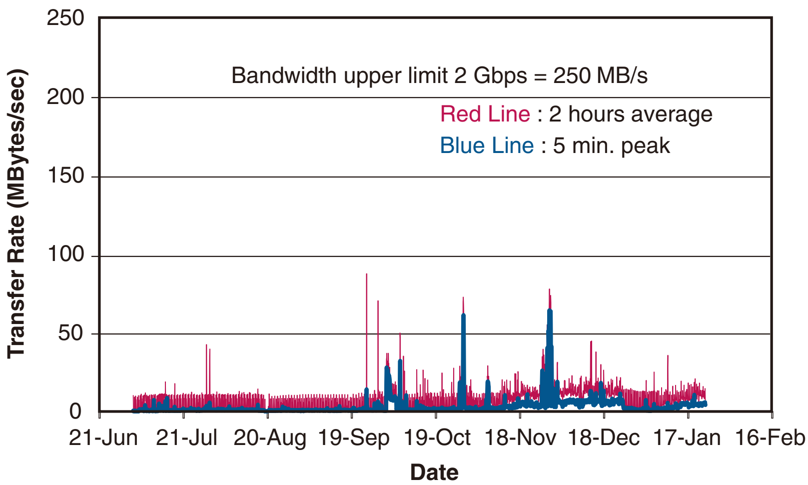


Fig. 2. Average Data transfer rate in Tokai-Tsukuba connection

Statistics of Computer Resource Utilization

J-PARC does not have its own computing facility, but it has been provided with the opportunity to shares with KEK their computing resources of 1600 SPECint06 computing power, 150 TBytes RAID disks and 2 PBytes tape libraries in KEK Central computer system at the Tsukuba site. In the Neutrino and Hadron experiments, data taken in the J-PARC experimental hall will be temporary saved at the Tokai site and then promptly transferred to, stored and analyzed at the system in Tsukuba. The storage of the system will also be utilized as a permanent data archive for MLF experiments. Figure 3 and 4 show the utilization statistics of the computer resource in 2010. The Hadron users who mainly used the system constantly were users who continued their series of experiments (Koto Exp. Group) from the former KEK 12 GeV Proton synchrotron to J-PARC. The Neutrino experiment group just started to use the system after the autumn run and they are steadily accumulating their data to reach up to 42 Tbytes in 2010. The MLF users are testing the system and still depend only on local computing resources at the Toukai area.

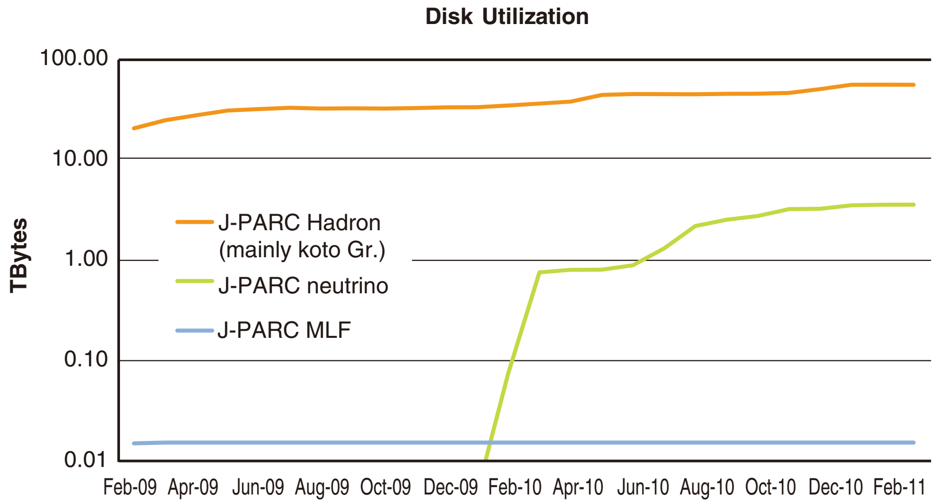


Fig. 3. Disk utilization of KEK Computer system by J-PARC Groups

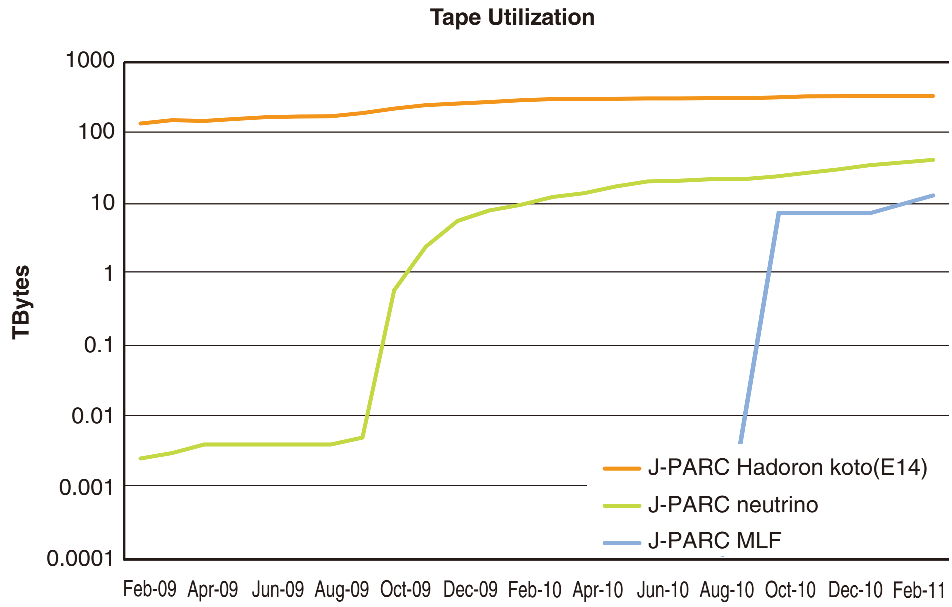


Fig. 4. Tape utilization of KEK Computer system by J-PARC Groups

Upgrade of SINET and IBBN Network and the Near Future JLAN Upgrade Plan

In March 2011, the National Institute of Informatics (NII) has upgraded SINET (Japan Science Information Network http://www.sinet.ad.jp) which is the main J-PARC network doorway to the Internet from version 3 to 4. Thanks to the NII support of J-PARC through the upgrade, the J-PARC network has obtained the possibility of a 10 Gbps network bandwidth both to the internet and to the Tokai-Tsukuba interconnection that previously was 1 and 2 Gbps, respectively. In the same month, IBBN (Ibaraki BroadBand Network (http://www.pref.ibaraki.jp/ibbn/)) which is utilized for backup line for the SINET was upgraded from 100 Mbps to 1 Gbps too.

In order to realize the potential of these upgrades and the increased bandwidth, the J-PARC network itself also should be upgraded, so the replacement of the J-PARC network from 100 Mbps edge switches to 1 Gbps switches is being planned for the next summer (2012). The near future plan for replacing a trunk network of JLAN called Phase2 JLAN, the KEK computer system, and the J-PARC mail system is shown in Fig.5.

Damage and Recovery from The Great East Japan Earthquake

JLAN itself sustained quite a little damage during The Great East Japan Earthquake on March 11. The network facilities, all fiber cables between the JLAN core network switch and the edge switches deployed around J-PARC related buildings and computer resources in KEK did not suffer serious damages. However, because the upper structure of an electric transformer, which supplied the JLAN core systems, was heavily damaged (Fig.6), it took 11 days to recover the JLAN functionality.

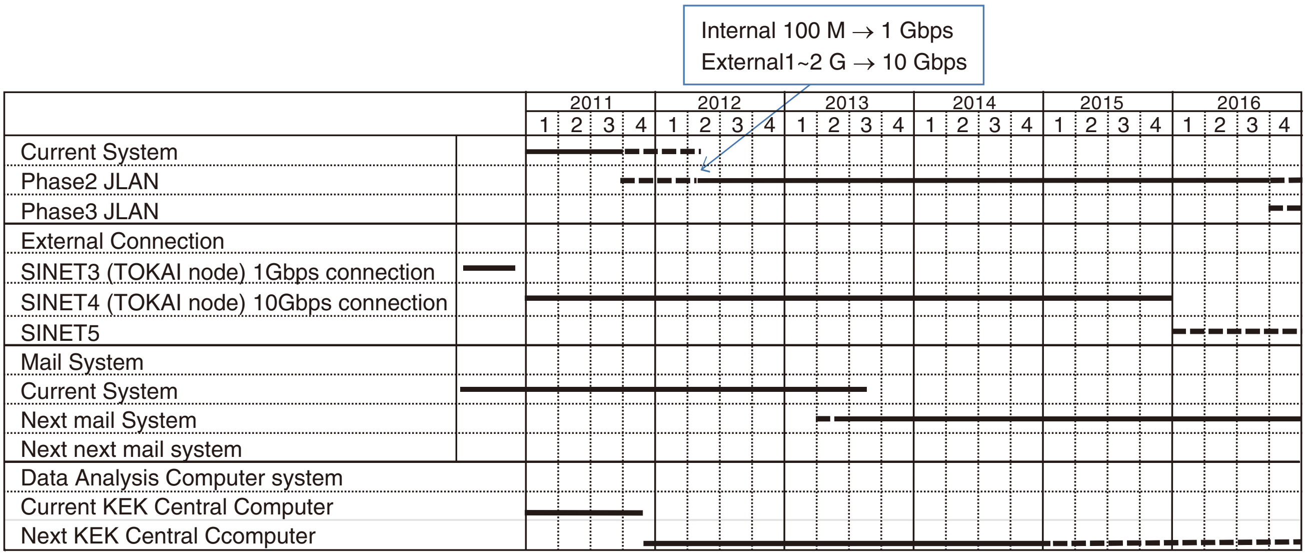


Fig. 5. Near future schedule of J-PARC network and computer resources

Fig. 6. A wall collapse of the information system center to a power trans retarded recovery of J-PARC information system.

Transmutation Studies

The Japan Atomic Energy Agency (JAEA) has been conducting research and development (R&D) on an accelerator-driven subcritical system (ADS) as a dedicated system for the transmutation of long-lived radioactive nuclides. The ADS proposed by JAEA is a lead-bismuth eutectic (LBE) cooled, tank-type subcritical reactor with the thermal power of 800 MWth driven by a 30 MW superconducting linear accelerator (Linac). Various R&D for ADS are under way in JAEA. As the next step before going to the large-scale demonstration of ADS, the Transmutation Experimental Facility (TEF) is planned as the Phase-2 of the J-PARC project. In the Transmutation Section, activities related to LBE technology and material science have been performed, we also worked on the design study of the experimental facility.

Activities

Modification of JLBL-1

In JAEA, to evaluate the feasibility of structural materials and to develop a LBE handling technique, the JAEA Lead-Bismuth material corrosion Loop (JLBL-1) was built in 2001. Since then, the device has operated for over 26,000 hours and performed 7 phases of material corrosion tests. Recently, the performance of the loop has deteriorated. For instance, we observed decreasing of the LBE flow-rate and a minor leakage of LBE at the oxygen sensor. To resolve these problems, some modifications and renovations were applied to JLBL-1: replacement and position change of the oxygen sensor, maintenance of Electro-Magnetic Pump (EMP) and exchange of filters. After that, we will conduct a test operation. Tests for the oxygen sensors (Photo 1) and the oxygen concentration control system will be done in the near future. The final goal is to perform corrosion/erosion test under the oxygen concentration controlled condition.

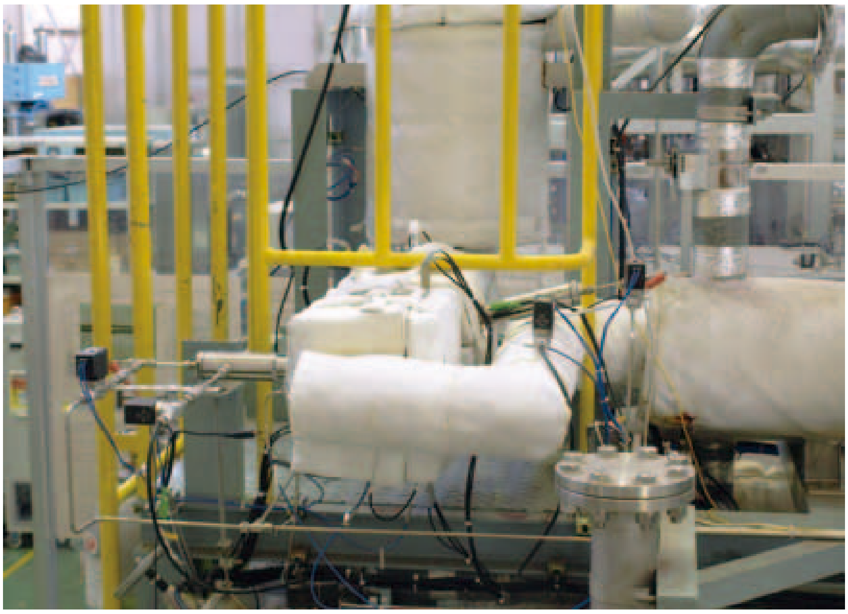


Photo 1. Two oxygen sensors were installed between the cooler and the surge tank.

Fundamental Study for Flow Visualization in Opaque Liquid Metals

The ADS proposed by JAEA utilizes LBE as a target material and a coolant. The beam window of ADS is exposed to severe environment consisting of the incidence of the proton beam external pressure by the LBE flow and the influence of corrosion. Grasping the LBE flow is essential for the detailed design of ADS because the flow behaviour closely relates not only to the thermal-fluid characteristic but also to the erosion/corrosion. Because of a lack of experimental data for the validation of this numerical analysis, the estimate of the reliability of a beam window design was insufficient. The flow measurement of the general liquid metals in a high temperature condition was difficult because of its physical characteristics. In the Transmutation Section, flow visualization techniques have been developed by using ultrasonic. The development of three elements is necessary to realize the measurement that assumes actual environment. The first one is development of heat-resistant improvement of the ultrasonic transducer. The maximum temperature of the present transducer for flow measurement is about 250 degrees. On the other hand, the minimum temperature of ADS in operating condition is 300 degrees (the maximum is about 500 degrees.). Because of that, we started the development of a transducer using Li oxide element (Photo 2). The second one is the wetting problem in LBE and structural materials boundary. However, this one was settled easily by past studies and development. The final one is development of a velocity measurement technique. The maximum limit of measurable velocity of the present method which utilizes the Doppler Effect is about 2,000 mm/s. The advanced method utilizes the correlation of the echo waves reflected from the measurement medium for calculation of the velocities. Moreover, this method would anticipate the decrease of the time resolution (about one place), because it needs only several times of emitting/reception of ultrasonic signals for a velocity profile measurement.

Photo 2. Prototype transducer using Li oxide element.

Thermal Fatigue Problem of the Fuel Claddings for ADS

The Transmutation Section is also conducting a design study on the ADS for transmutation of long-lived nuclear wastes. In the design study of ADS, one of the most important factors is the maximum temperature of the fuel cladding. In our design, the fuel claddings are made of Mod.9Cr-1Mo steel, and their maximum temperature is limited to below 550 °C to mitigate the corrosion by LBE. In addition, the integrity of the fuel claddings should be evaluated not only for a steady state but also for a transient state. Especially, frequent beam trips, as experienced in existing high-power proton accelerators, are considered problematic because they may cause thermal fatigue of the fuel claddings for ADS.

The evaluation results showed that the structural strength of the fuel claddings could be sufficiently kept under the conditions of both steady and transient state, if we do not consider irradiation effects. While irradiation effects on material properties are considered not so serious under the practical condition of the ADS based on conclusions from the existing irradiation data, it is important to accumulate further experimental data about material irradiation by protons and neutrons.

Post Irradiation Test

To obtain the irradiation data on structural materials of spallation target, an international experimental program called “STIP” (SINQ Target Irradiation Program, SINQ; Swiss spallation neutron source) is in progress. Post Irradiation Examination (PIE) of STIP specimens was carried out at Reactor Fuel Examination Facility (RFEF) in the Tokai Research and Development Centre, JAEA. The fracture surface observation on the bend-fatigue specimens of austenitic steels was conducted by using Scanning Electron Microscopy (SEM). The fracture surface of Japan Primary Candidate Alloy (JPCA) specimens irradiated up to 19.5 dpa showed ductile morphology, while Alloy800H specimens irradiated over 11 dpa showed partially inter granular fracture surface.

MEGAPIE

The world's first megawatt-class lead-bismuth target, MEGAwatt Pilot Experiment (MEGAPIE), was successfully dismantled at the Zwischenlager Würenlingen AG (ZWILAG) hot-lab and transported to Paul Sherrer Institute (PSI) hot-lab in April 2011. Several meetings on MEGAPIE were held at Luzern, Switzerland in September 2010. In the meetings, the dismantling process of the MEGAPIE target and the related hot-lab activities were reported. It became clear that the sample transport will be scheduled for May 2012. The results of the 2nd Round Robin Test (RRT) were also reported. The data from the five institutes were consistent with each other within bands which were much narrower than that of 1st RRT. The revised sample extraction plan and the preliminary distribution plan were distributed.

Safety

J-PARC is a proton accelerator complex with various experimental facilities, which 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). By the end of Japanese fiscal year (JFY) 2009, we have already submitted five applications to MEXT and received permission to deliver the 3 GeV/250-kW proton beams to the Materials and Life Science Experimental Facility (MLF), and 30 GeV/100-kW proton beams to the Neutrino facilities.

In JFY 2010, two applications shown in Table 1 were submitted to MEXT. In the first application, we submitted a request for usage of two experimental beam lines (BL-11 and -15) in MLF, and increase of the proton beam intensity of Linac, 3-GeV rapid cycling synchrotron (RCS), 50-GeV proton synchrotron ring (MR), MLF and Neutrino experimental facilities. We submitted the application to MEXT on June 24, 2010, and all items we applied for were approved on August 27, 2010. In the second application, a request for usage of three experimental beam lines (BL-02, -17 and -18) in the MLF and increase of the proton beam intensity of Hadron experimental facility was also submitted on December 15, 2010, and the item was approved on February 25, 2011.

As the five-year anniversary of radiation management is approaching in J-PARC, the first periodical inspection was carried out by NUSTEC on January 2011, to make sure that radiation installations are maintained in compliance with the technical standards established by the Radiation Hazards Prevention Law (see Photos 1 to 4). On the site, confirmation of the installation situation of the sign, operation tests on the safety interlocks, and measurement of the radiation dose rates were done. In addition to them, the records concerning the radiation management such as operating logs, exposure and educational records of radiation workers, etc. were checked. All items were deemed to be appropriate. Finally, J-PARC passed the inspection.

Fig. 1 shows the transition of the number of radiation workers since 2005. In JFY 2010, 2653 individuals were registered as radiation workers in J-PARC (about 23% increase compared with those in JFY 2009). Table 2 shows the distribution of annual doses by type of workers. The radiation exposure of the workers has been monitored individually with glass dosimeters and solid state nuclear track detectors. Almost all the records for individual exposure were undetectable, while 41 persons (1.5% of the workers) were recorded in less than 1.0 mSv.

Table 1. Application items for license in JFY 2010

Accelerator /Facility	item	Application (1) submitted : Jun. 24, 2010 approved : Aug. 27, 2010	Application (2) submitted : Dec. 15, 2010 approved : Feb. 25, 2011
Linac	max. accelerating particles	from $2.6x10^{18}$ /h (@17 kW) to $3.6x10^{18}$ /h (@23 kW)	-
3GeV RCS	max. accelerating particles	from $2.0x10^{18}$ /h (@260 kW) to $2.6x10^{18}$ /h (@350 kW)	-
MR	max. accelerating particles	from $7.5x10^{16}$ /h (@100 kW) to $2.3x10^{17}$ /h (@300 kW)	-
MLF	max. particles	from $1.9x10^{18}$ /h (@250 kW) to $2.4x10^{18}$ /h (@320 kW)	-
	Experimantal beam line	Add 2 Beam lines (BL-11 and BL-15)	Add 3 Beam lines (BL-02, BL-17 and BL-18)
Hadron	max. particles	-	from $3.8x10^{15}$ /h (@5 kW) to $3.8x10^{16}$ /h (@50 kW)
	Experimantal beam line	-	-
Neutrino	max. particles	from $7.5x10^{16}$ /h (@100 kW) to $2.3x10^{17}$ /h (@300kW)	-

Photo 1. Safety inspection by NUSTEC (1)

Photo 2. Safety inspection by NUSTEC (2)

Photo 3. Safety inspection by NUSTEC (3)

Photo 4. Safety inspection by NUSTEC (4)

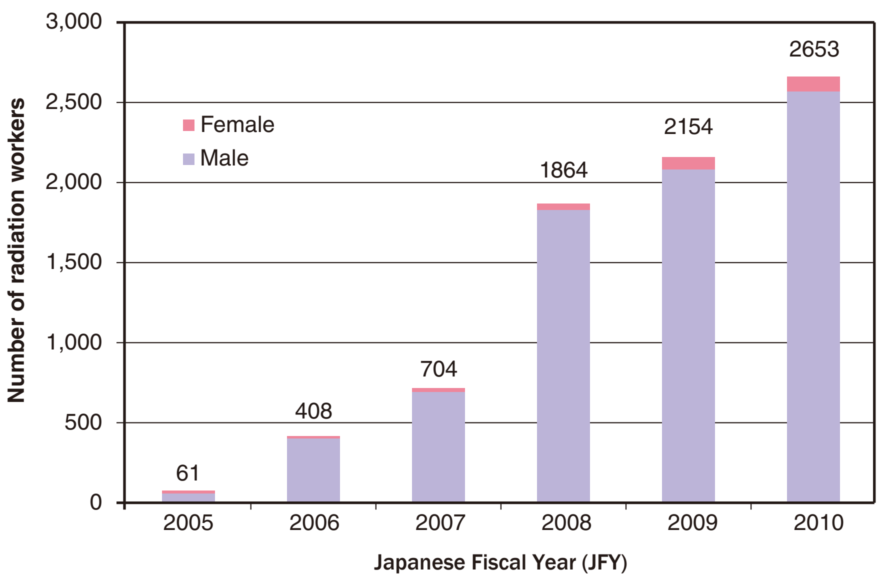


Fig. 1. Transition of the number of radiation workers.

Table 2. Distribution of annual doses by the type of worker in JFY 2010

	Dose range (mSv)						Collective dose (person-mSv)	Average dose (μSv)
	Undetectable	0.1 - 0.5	>0.5 - 1.0	>1.0 - 5.0	>5.0+	Total worker		
In-house staff	542	10	0	0	0	552	1.5	2.7
User	658	0	0	0	0	658	0	0
Contractor	1412	28	3	0	0	1443	7.1	4.9
Total	2612	38	3	0	0	2653	8.6	3.2

Users Office

The birth of the J-PARC Center Users Office (UO) dates back to 2007 when the J-PARC Center was organized. It has been part of the Users Affairs Section expected to offer one-stop services to the J-PARC users. The number of the J-PARC users has been increasing and in 2010 the number of annual users counted by person-days reached 29,000. The UO has wide-ranging tasks which cover from calls for proposals to accepting and managing experimental reports.

To perform the tasks, the UO was staffed in 2010 with 14 members including 3 system engineers and one Ibaraki prefecture staff. Of course, increasing the number of the staff was not the only way to deal with its increasing tasks. Taking the limited budget and human resources into consideration, other ways should be considered. Introducing a web-based system and making the most out of its advantages and the UO website was one of the answers.

When the experimental report management system started its operation in 2010, all the main four web-based systems were already available. They were proposal submission system, proposal review system, user support system and experimental report management system. Using the proposal submission system, proposals could be submitted 24 hours and the messages of acceptance or requesting correction could easily be sent by the system. The proposal review system facilitated the proposal review process by organizing the proposals and forwarding them quickly and accurately to the referees. There were some procedures the J-PARC users needed to go through such as submitting the letter of agreement, procedures for entering the J-PARC, accommodation reservation, procedures for J-PARC network use if needed, etc. User support system was adopted to execute these procedures effectively. In 2010 the UO website was renewed. Information for the users could easily be found on the top page and icons to log into the user support systems were displayed on the top page together with detailed contents revisions. Experimental report management became easy once the experimental report management system was adopted. Three system engineers were engaged in developing and operating the four systems.

Among the procedures or works were those the UO staff themselves needed to deal with, such as user registration approval, issuing J-PARC user ID cards, preparing glass badges, arranging safety instruction, or procedures for the J-PARC network use. Those procedures were dealt with by UO staffs. Although important or urgent information was posted on the UO website, the best way of informing the users would be by sending email to their PCs respectively. The UO generated a mailing list of the users who had approved accepting information by email, and such information began to be sent by one of the J-PARC advisors. When travel expenses support was applied for by inter-university research institute user KEK had accepted, the UO staff calculated its amount. User data management and collecting user statistics were also UO's tasks. Its staff collected fundamental user statistics from the standpoints of organizations, facilities, Japanese versus foreigners. They cover the period from December 2008 to the present.

The J-PARC Center Users Office Committee was held on August 26, 2010, it deliberated the measures to take for J-PARC users' requests on questionnaire concerning accommodations and transportation of the J-PARC conducted in June 2010. One of the main requests was to resolve the accommodation shortage. KEK constructed a new user dormitory with 49 rooms at the Ibaraki Quantum Beam Research Center as shown in Photos 1 to 4, which was opened in January 2011. Its rooms are booked through the user support system. The UO was responsible for part of its operations. Another request was to deal with the dark places with no lights on the way from J-PARC to Masago International Lodging. Eight lights were set up in December, 2010 at intervals of 30 m. And two old lights near Masago International Lodging were replaced with brighter ones for Route 245.

Photo 1. View of dormitory.

Photo 2. Entrance of the dormitory.

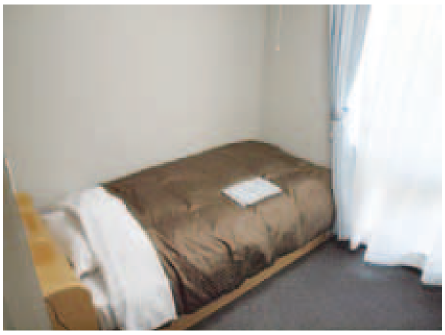
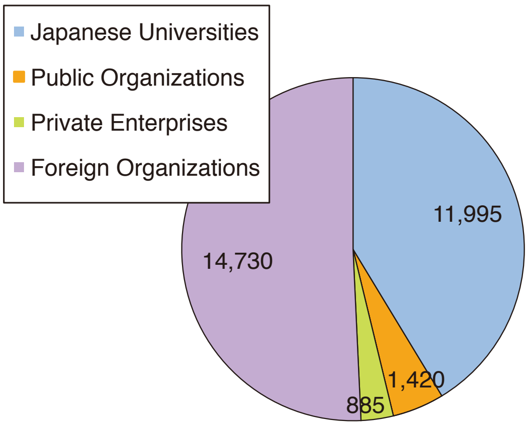
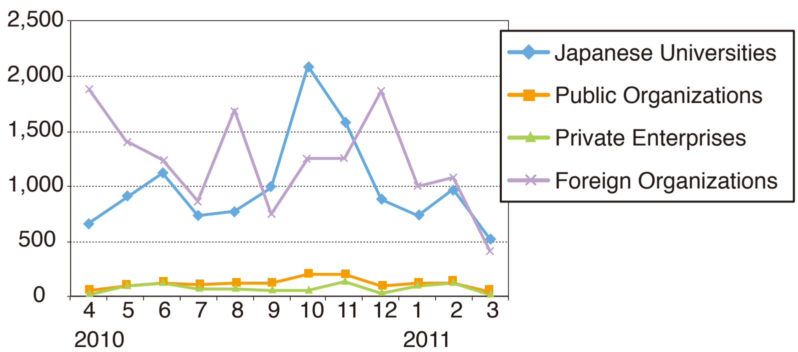


Photo 3. A bed in a room.

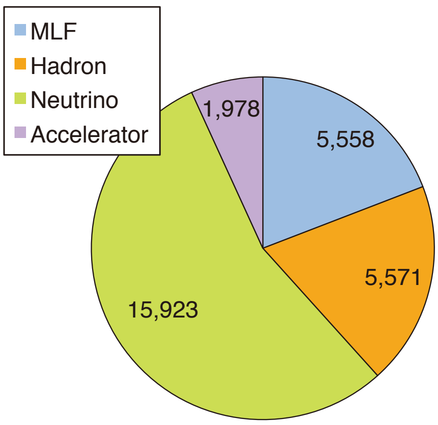
Photo 4. A desk and a chair in a room.

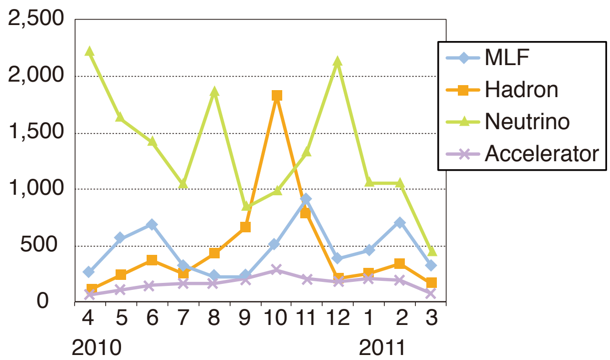
(1) Users in 2010 (according to organizations, person-days)



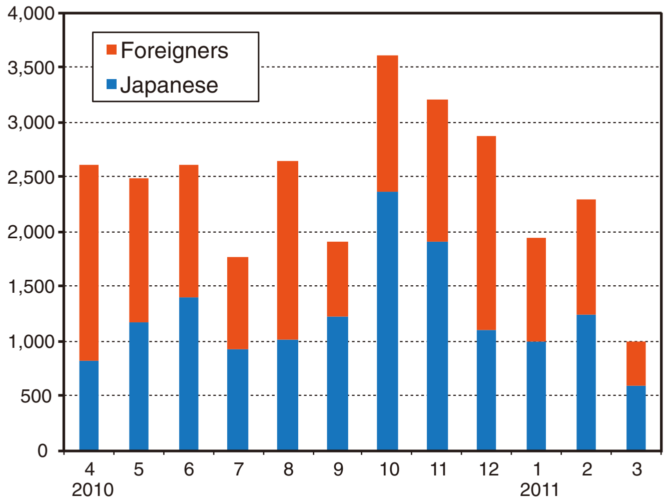


(2) Users in 2010 (according to facilities, person-days)



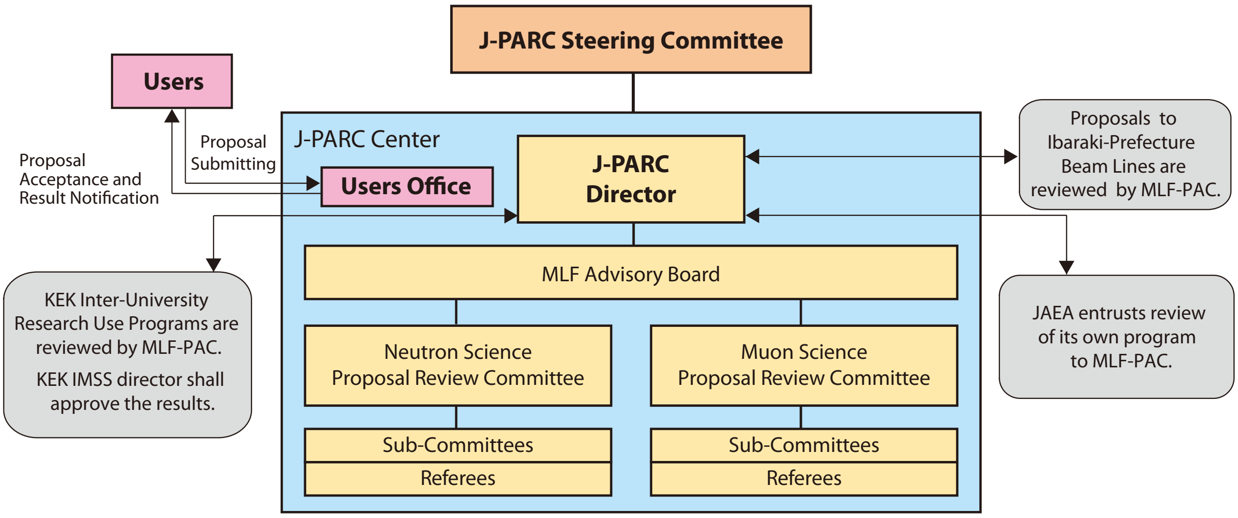


(3) Users in 2010 (Japanese · Foreiners, person-days)



User Program

1. Proposal Reviewing System for the MLF User Program



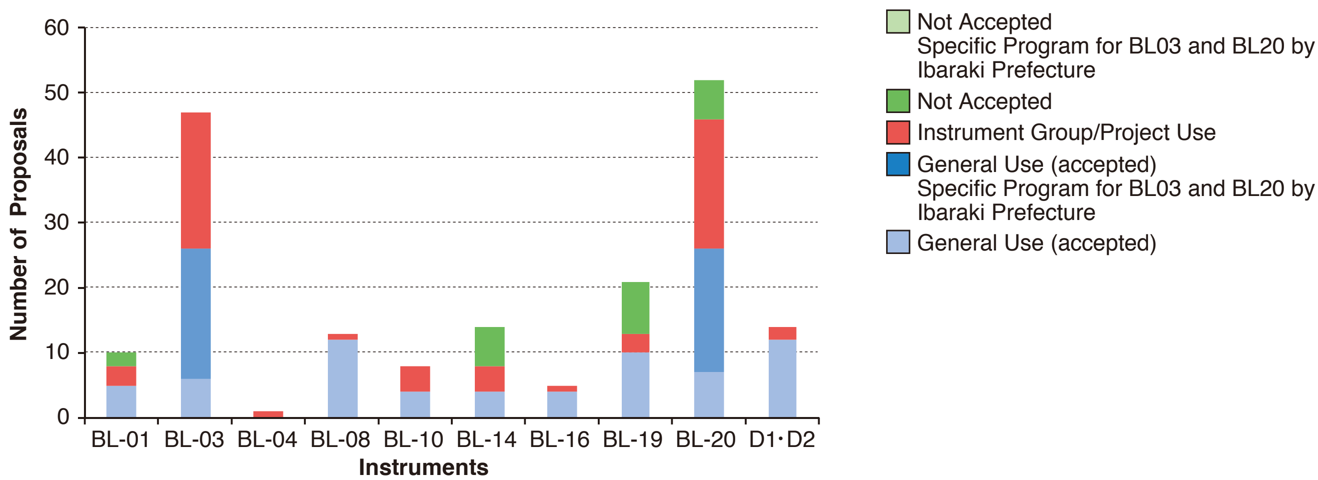
Call for proposals for the first half of 2010 (2010A term): Dec. 1, 2009- Jan. 7, 2010
The review results were announced on April 16, 2010.

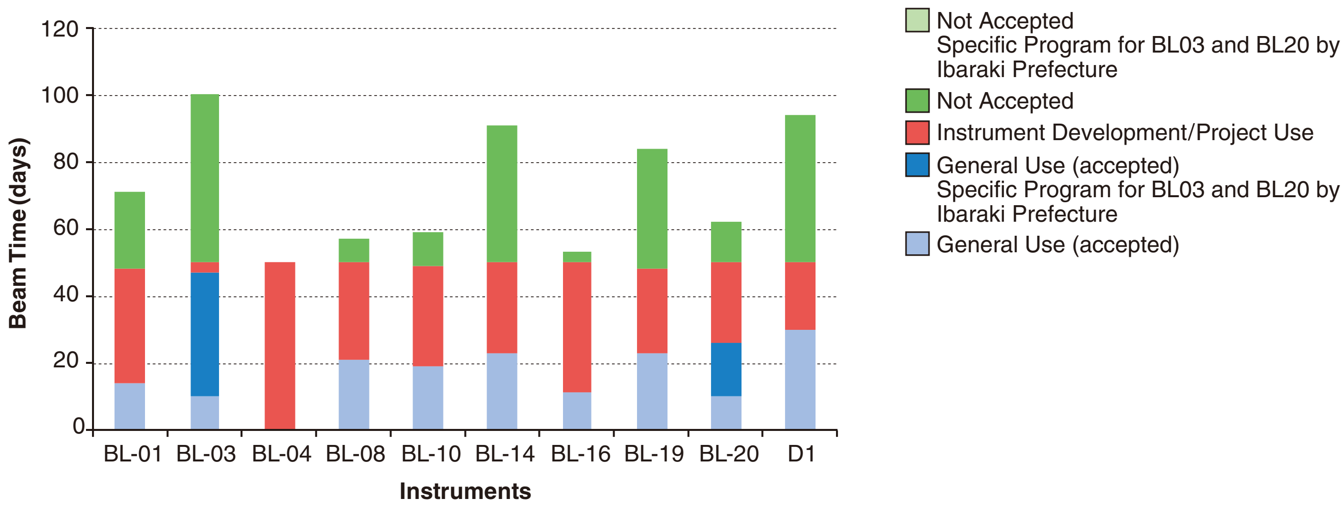
Call for proposals for the first half of 2010 (2010B term): May 17- Jun. 7, 2010
The review results were announced on September 29, 2010.

2. Summary of Applications and Review Results (MLF)

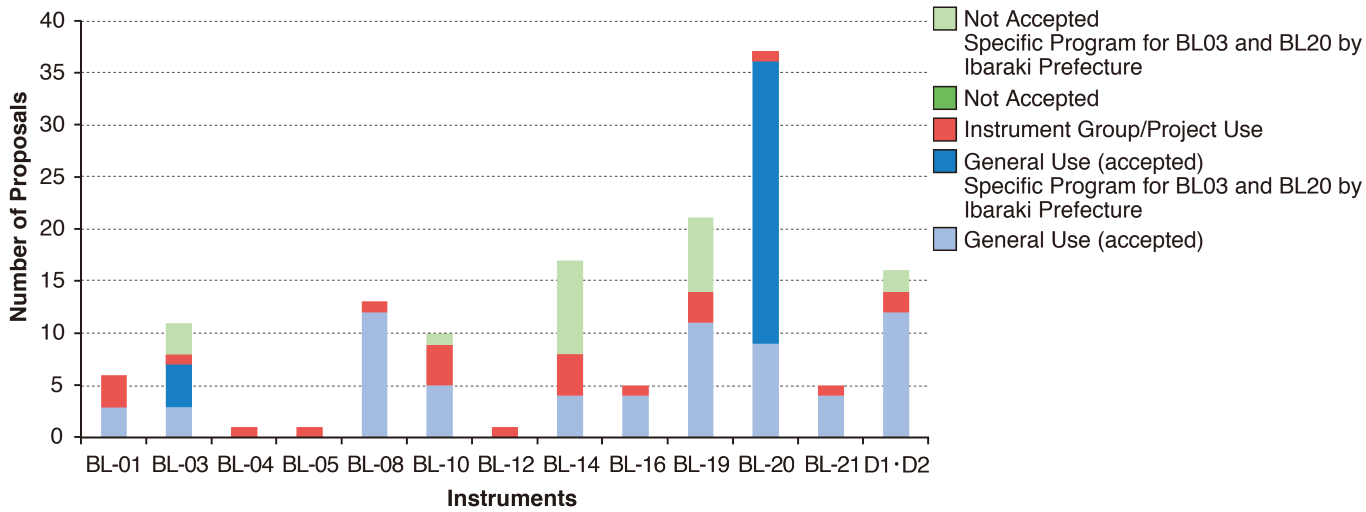
Number of proposals and beam time applied to each neutron and muon instrument for the 2010A and 2010B terms are summarized by each access mode in the following graphs. For the neutron instruments BL-03 and BL-20 which are operated by Ibaraki Prefecture, a specific program is conducted by Ibaraki Prefecture separately. The statistics for the specific program by Ibaraki prefecture is also included in this summary.

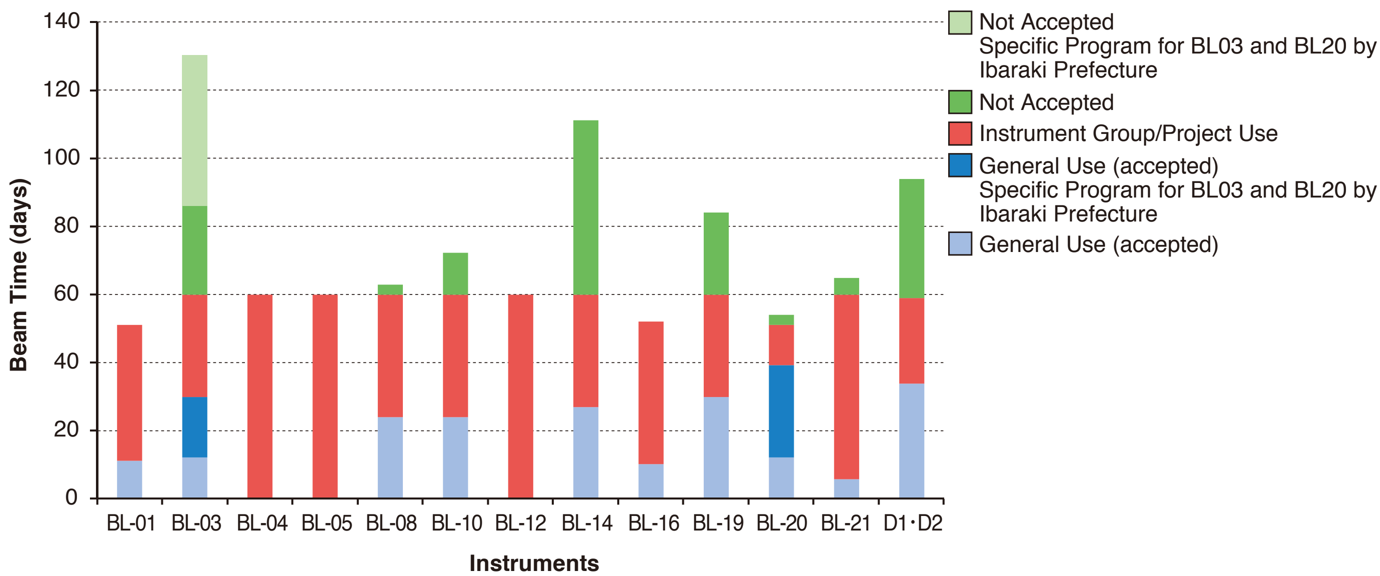
(1) 2010A




Beam Time (days)
0
20
40
60
80
100
120
BL-01 BL-03 BL-04 BL-08 BL-10 BL-14 BL-16 BL-19 BL-20 D1
Instruments
Not Accepted
Specific Program for BL03 and BL20 by Ibaraki Prefecture
Not Accepted
Instrument Development/Project Use
General Use (accepted)
Specific Program for BL03 and BL20 by Ibaraki Prefecture
General Use (accepted)

(2) 2010B


Number of Proposals
0
5
10
15
20
25
30
35
40
BL-01 BL-03 BL-04 BL-05 BL-08 BL-10 BL-12 BL-14 BL-16 BL-19 BL-20 BL-21 D1・D2
Instruments
Not Accepted
Specific Program for BL03 and BL20 by Ibaraki Prefecture
Not Accepted
Instrument Group/Project Use
General Use (accepted)
Specific Program for BL03 and BL20 by Ibaraki Prefecture
General Use (accepted)


Beam Time (days)
0
20
40
60
80
100
120
140
BL-01 BL-03 BL-04 BL-05 BL-08 BL-10 BL-12 BL-14 BL-16 BL-19 BL-20 BL-21 D1・D2
Instruments
Not Accepted
Specific Program for BL03 and BL20 by Ibaraki Prefecture
Not Accepted
Instrument Group/Project Use
General Use (accepted)
Specific Program for BL03 and BL20 by Ibaraki Prefecture
General Use (accepted)

3. Access Mode for MLF Use

(1) General use

The general use provides both local and international users with opportunities to conduct experiments. A variety of experiments are accepted both for academic researches and for industrial applications.

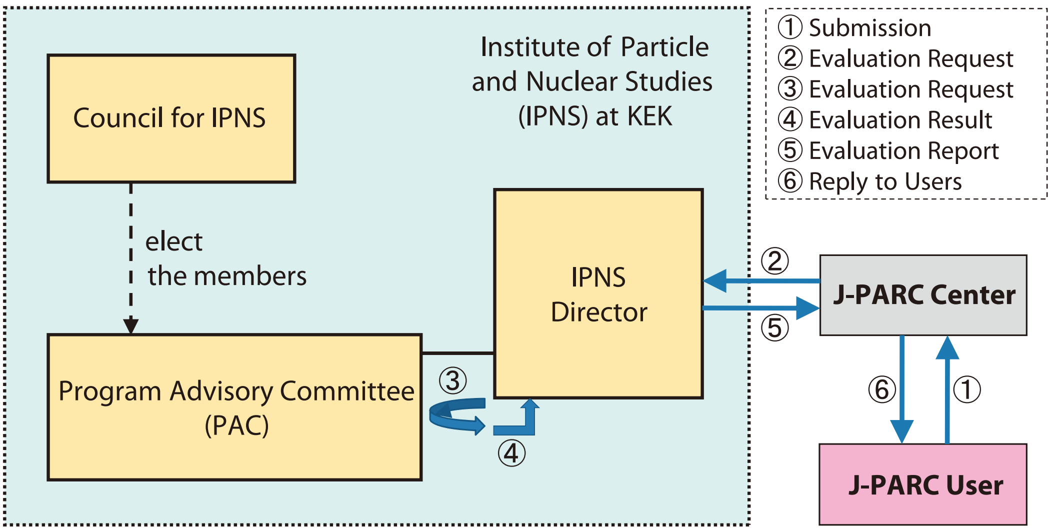
(2) Project use

The project use provides JAEA and KEK with opportunities to conduct their main-task-oriented programs such as inclusive scientific research projects, research programs proposed to fulfill the plans for midterm goals of JAEA, joint research programs and contract research programs with other institutes or organizations. The principal researchers in the project use may request beamtime, which is longer than one year.

(3) Instrument group use

The instrument group use provides the instrument scientists responsible for the beam-line instruments with opportunities to maintain and/or improve the performance of their instruments and conduct leading-edge research and development which would ensure maximum performance of the instruments so that MLF can always provide users with the most superior experimental conditions.

4. Process for Approving Experimental Programs in Particle and Nuclear Physics



The tenth Program Advisory Committee (PAC) meeting was held on July 16 – 18, 2010.
The eleventh PAC meeting was held on January 14 – 16, 2010.

5. Approval Summary of the Particle and Nuclear Physics Experiments after the 11-th meeting (January 14, 2011)

	(Co-) Spokespersons	Affiliation	Title of the experiment	Approval status (PAC recommendation)	Slow line priority		Beamline
					Day1	Day1 Priority	
E03	K.Tanida	Kyoto U	Measurement of X rays from Ξ^- Atom	Stage 2			K1.8
P04	J.C.Peng; S.Sawada	U.of Illinois at Urbana-Champaign; KEK	Measurement of High-Mass Dimuon Production at the 50-GeV Proton Synchrotron	Deferred			Primary
E05	T.Nagae	Kyoto U	Spectroscopic Study of Ξ-Hypernucleus, $^{12}_{\Xi}$Be, via the ^{12}C(K^-, K^+) Reaction	Stage 2	Day1	1	K1.8
E06	J.Imazato	KEK	Measurement of T-violating Transverse Muon Polarization in $K^+ \to \pi^0 \mu^+ \nu$ Decays	Stage 1			K1.1BR
E07	K.Imai, K.Nakazawa, H.Tamura	Kyoto U, Gifu U, Tohoku U	Systematic Study of Double Strangeness System with an Emulsion-counter Hybrid Method	Stage 2			K1.8
E08	A.Krutenkova	ITEP	Pion double charge exchange on oxygen at J-PARC	Stage 1			K1.8
E10	A. Sakaguchi, T. Fukuda	Osaka U	Production of Neutron-Rich Lambda-Hypernuclei with the Double Charge-Exchange Reaction (Revised from Initial P10)	Stage 2			K1.8
E11	T. Kobayashi	KEK	Tokai-to-Kamioka (T2K) Long Baseline Neutrino Oscillation Experimental Proposal	Stage 2			neutrino
E13	T.Tamura	Tohoku U	Gamma-ray spectroscopy of light hypernuclei	Stage 2	Day1	2	K1.8
E14	T.Yamanaka	Osaka U	Proposal for $K_L \to \pi^0 \nu$ ν-bar Experiment at J-PARC	Stage 2			KL
E15	M.Iwasaki, T.Nagae	RIKEN, Kyoto	A Search for deeply-bound kaonic nuclear states by in-flight 3He(K-, n) reaction	Stage 2	Day1		K1.8BR
E16	S.Yokkaichi	RIKEN	Electron pair spectrometer at the J-PARC 50-GeV PS to explore the chiral symmetry in QCD	Stage 1			High p
E17	R.Hayano, H.Outa	U Tokyo, RIKEN	Precision spectroscopy of Kaonic ^{3}He 3d->2p X-rays	Stage 2	Day1		K1.8BR
E18	H.Bhang, H.Outa, H.Park	SNU, RIKEN, KRISS	Coincidence Measurement of the Weak Decay of $^{12}_{\Lambda}$C and the three-body weak interaction process	Stage 2			K1.8
E19	M.Naruki	KEK	High-resolution Search for Θ^+ Pentaquark in $\pi^- p \to K^- X$ Reactions	Stage 2	Day1		K1.8
E21	Y.Kuno	Osaka U	An Experimental Search for μ – e Conversion at a Sensitivity of 10^{-16} with a Slow-Extracted Bunched Beam	Stage 1			New beamline
E22	S. Ajimura, A.Sakaguchi	Osaka U	Exclusive Study on the Lambda-N Weak Interaction in A=4 Lambda-Hypernuclei (Revised from Initial P10)	Stage 1			K1.8
T25	S.Mihara	KEK	Extinction Measurement of J-PARC Proton Beam at K1.8BR	Test Experiment	will be coordinated by JPNC		K1.8BR
P26	K.Ozawa	U Tokyo	Search for ω-meson nuclear bound states in the π-+AZ -> n+(A-1) ω(Z-1) reaction, and for ω mass modification in the in-medium $\omega \to \pi 0 \gamma$ decay.	Stage 1			K1.8
E27	T.Nagae	Kyoto U	Search for a nuclear Kbar bound state $K^- pp$ in the d(π^+, K^+) reaction	Stage 2			K1.8
P28	H.Fujioka	Kyoto U	Study of isospin dependence of kaon-nucleus interaction by in-flight 3He(K- ,n/p) reactions	approved as a part of E15			K1.8BR
P29	H.Ohnisi	RIKEN	Search for ϕ-meson nuclear bound states in the pbar + AZ -> ϕ + (A-1) ϕ(Z-1) reaction	Stage 1			K1.1
E31	M.Noumi	Osaka U	Spectroscopic study of hyperon resonances below KN threshold via the (K^-,n) reaction on Deuteron	Stage 1			K1.8BR
T32	A. Rubbia	ETH, Zurich	Towards a Long Baseline Neutrino and Nucleon Decay Experiment with a next-generation 100 kton Liquid Argon TPC detector at Okinoshima and an intensity upgraded J-PARC Neutrino beam	Test Experiment	schedule and beam time will be coordinated by JPNC		K1.1BR
P33	H. M. SHIMIZU	KEK	Measurement of Neutron Electric Dipole Moment	Deferred			Linac
P34	N. Saito, M. Iwasaki	KEK, RIKEN	An Experimental Proposal on a New Measurement of the Muon Anomalous Magnetic Moment g-2 and Electric Dipole Moment at J-PARC	Deferred			MLF
P35	T.Kajita	ICRR,Tokyo	A test experiment to measure sub-GeV flux in the on-axis direction at the J-PARC neutrino beam	to be Decided by E11 and Lab			neutrino

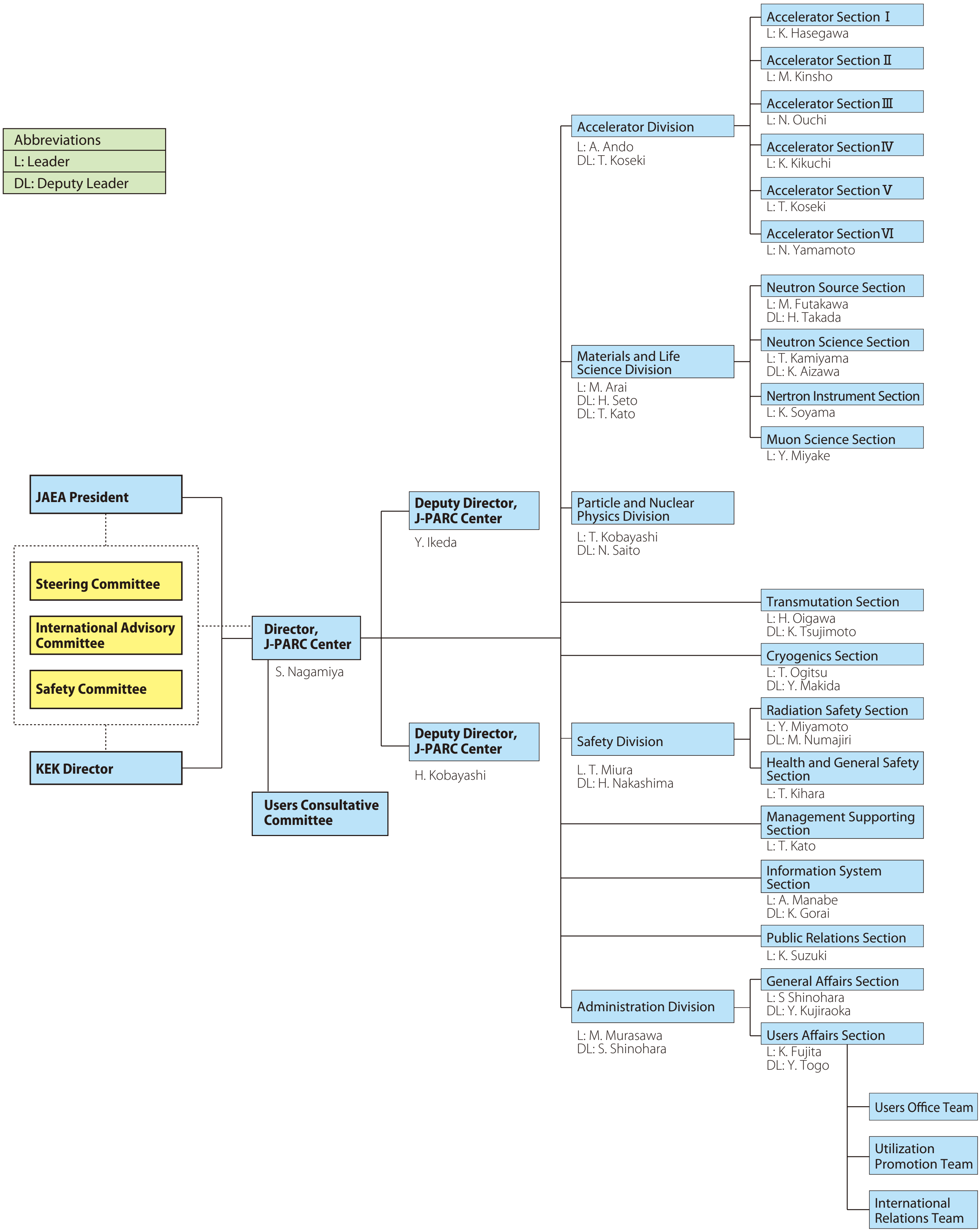
	(Co-) Spokespersons	Affiliation	Title of the experiment	Approval status (PAC recommendation)	Slow line priority		Beamline
					Day1	Day1 Priority	
E36	S.Shimizu	Osaka	Measurement of Γ(K+ -> e+ ν)/Γ(K+ -> μ+ ν) and Search for heavy sterile neutrinos using the TREK detector system	Stage 1			
T37	K.Inami	Nagoya	Test of TOP counter for B-factory upgrade	Test Experiment (withdrawn)	will be coordinated by JsPch-NeCdule		K1.1BR
T38	T.Nanjo	Kyoto	Proposal for Measuring Hadron Response at K1.1BR for KOTO Experiment	Test Experiment (completed)	will be coordinated by JPN"		K1.1BR
P39	K.Sakashita	KEK	A study of water Cherenkov detector for counting the number of neutrino at Near detector hall of J-PARC neutrino beam-line	to be Decided by E11 and Lab			neutrino
P40	K.Miwa	Tohoku U	Measurement of the cross sections of Σp scatterings	Deferred			K1.8
P41	M.Aoki	Osaka U	An Experimental Search for μ - e Conversion in Nuclear Field at a Sensitivity of 10-14 with Pulsed Proton Beam from RCS	Deferred			MLF




Organization and Committees

Organization Structure

(as of April 2010)



Members of the Committees organized for J-PARC

(as of March 2011)

1) Steering Committee

Hideo Hirayama	High Energy Accelerator Research Organization, Japan
Yukihide Kamiya	High Energy Accelerator Research Organization, Japan
Satoru Kondo	Japan Atomic Energy Agency, Japan
Shoji Nagamiya	J-PARC Center, Japan
Hideki Namba	Japan Atomic Energy Agency, Japan
Sohei Okada	Japan Atomic Energy Agency, Japan
Osamu Shimomura	High Energy Accelerator Research Organization, Japan
Fumihiko Takasaki	High Energy Accelerator Research Organization, Japan
Hiroshi Uetsuka	Japan Atomic Energy Agency, Japan
Hideaki Yokomizo	Japan Atomic Energy Agency, Japan
Keisuke Yoshio	High Energy Accelerator Research Organization, Japan

2) International Advisory Committee

Ian Anderson	Oak Ridge National Laboratory, USA
Sergio Bertolucci	CERN, Switzerland
Bernard Frois	CEA-Saclay, France
Hidetoshi Fukuyama	Tokyo University of Science, Japan
Stuart Henderson	Oak Ridge National Laboratory, USA
Young-Kee Kim	Fermi National Accelerator Laboratory, USA
Hugh Montgomery	Thomas Jefferson National Accelerator Facility, USA
Jean-Michel Poutissou	TRIUMF, Canada
Thomas Roser	Brookhaven National Laboratory, USA
Tsumoru Shintake	RIKEN, Japan
Hoerst Stoecker	GSI, Germany
Satoru Tanaka	The University of Tokyo, Japan
Andrew Taylor	Rutherford Appleton Laboratory and ISIS, UK
Eiko Torikai	University of Yamanashi, Japan
John W. White	Australian National University, Australia (chair)

3) Users Consultative Committee for J-PARC

Hiroaki Aihara	The University of Tokyo, Japan
Masatoshi Arai	Japan Atomic Energy Agancy, Japan
Hideto Enyo	RIKEN, 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
Takashi Kobayashi	High Energy Accelerator Research Organization, Japan
Yasuhiko Miyake	High Energy Accelerator Research Organization, 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
Naohito Saito	High Energy Accelerator Research Organization, Japan
Mamoru Sato	Yokohama City University, Japan
Mitsuhiro shibayama	The University of Tokyo, Japan
Hirokazu Tamura	Tohoku University, Japan
Eiko Torikai	University of Yamanashi, Japan
Kazuyoshi Yamada	Tohoku University, Japan
Taku Yamanaka	Osaka University, Japan (chair)

4) Accelerator Technical Advisory Committee

David Findlay	Rutherford Appleton Laboratory, UK
Ronald Garoby	CERN, Switzerland
John Galambos	Oak Ridge National Laboratory, USA
Stephen holmes	Fermi National Accelerator Laboratory, USA
Akira Noda	Kyoto University, Japan
Peter Ostroumov	Argonne National Laboratory, USA
Uli Ratzinger	Frankfurt University, Germany
Thomas Roser	Brookhaven National Laboratory, USA (chair)
Jie Wei	Michigan State University, USA

5) Neutron International Advisory Committee

Gunter Bauer	Forschungszentrum Julich GmbH (retired), Germany
Stephen Bennington	Rutherford Appleton Laboratory, UK
Kurt Clausen	Paul Scherre Institute, Switzerland
John Haines	Oak Ridge National Laboratory, USA
Toshiji Kanaya	Kyoto University, Japan
Yoshiaki Kiyanagi	Hokkaido University, Japan
Dan Neumann	National Institute of Standards and Technology, USA (chair)
Robert Robinson	Australian Nuclear Science and Technology Organization, Australia
Kazuyuki Yamada	Tohoku University, Japan

6) Muon Science Advisory Committee

Jun Akimitsu	Aoyama Gakuin University, Japan
Hiroshi Amitsuka	Hokkaido University, Japan
Robert Cywinski	University of Huddersfield, UK
Elvezio Morenzoni	Paul Scherrer Institute, Switzerland (chair)
Jean-Michel Poutissou	TRIUMF, Canada
Atsushi Shinohara	Osaka University, Japan
Jeff E. Sonier	Simon Fraser University, Canada
Eiko Torikai	University of Yamanashi, Japan

7) Radiation Safety Committee

Yoshihiro Asano	RIKEN, Japan
Shuichi Ban	High Energy Accelerator Research Organization, Japan
Hideo Hirayama	High Energy Accelerator Research Organization, Japan
Kenjiro Kondo	High Energy Accelerator Research Organization, Japan
Takeshi Murakami	National Institute of Radiological Sciences, Japan
Tetsuo Noro	Kyushu University, Japan
Takeo Oku	Japan Atomic Energy Agency, Japan

Kotaro Sato	High Energy Accelerator Research Organization, Japan
Seiichi Shibata	Kyoto University, Japan(Chair)
Hiroshi Uetsuka	Japan Atomic Energy Agency, Japan
Yoshitomo Uwamino	RIKEN, Japan
Yasuhiro Yamaguchi	Japan Atomic Energy Agency, Japan

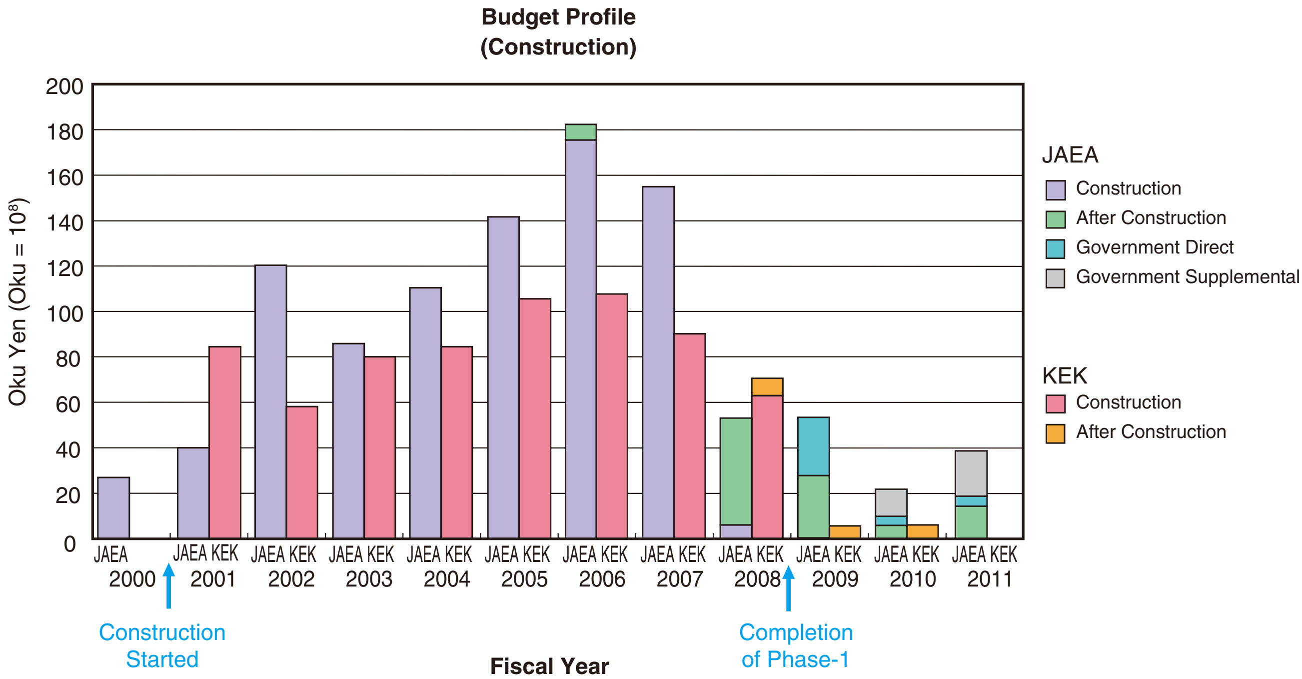
8) MLF Advisory Board

Masatoshi Arai	Japan Atomic Energy Agency, Japan
Toshiharu Fukunaga	Kyoto University, Japan
Makoto Hayashi	Ibaraki Prefecture, Japan
Susumu Ikeda	High Energy Accelerator Research Organization, Japan
Yujiro Ikeda	Japan Atomic Energy Agency, Japan
Ryosuke Kadono	High Energy Accelerator Research Organization, Japan
Kazuhisa Kakurai	Japan Atomic Energy Agency, Japan
Shinichi Kamei	Mitsubishi Research Institute, Inc., Japan
Takashi Kamiyama	High Energy Accelerator Research Organization, Japan
Toshiji Kanaya	Kyoto University, Japan
Yoji Koike	Tohoku University, Japan
Teiichiro Matsuzaki	RIKEN, Japan
Yasuhiro Miyake	High Energy Accelerator Research Organization, Japan
Junichiro Mizuki	Japan Atomic Energy Agency, Japan
Nobuhiko Nishida	Tokyo Institute of Technology, Japan
Yukio Noda	Tohoku University, Japan
Mamoru Sato	Yokohama City University, Japan
Hideki Seto	High Energy Accelerator Research Organization, Japan
Mitsuhiro Shibayama	The Univrsity of Tokyo, Japan
Hirohiko Shimizu	High Energy Accelerator Research Organization, Japan
Jun Sugiyama	Toyota Central R&D labs., Inc., Japan
Junichi Suzuki	Japan Atomic Energy Agency, Japan
Wataru Utsumi	Japan Atomic Energy Agency, Japan
Kazuyoshi Yamada	Tohoku University, Japan (chair)

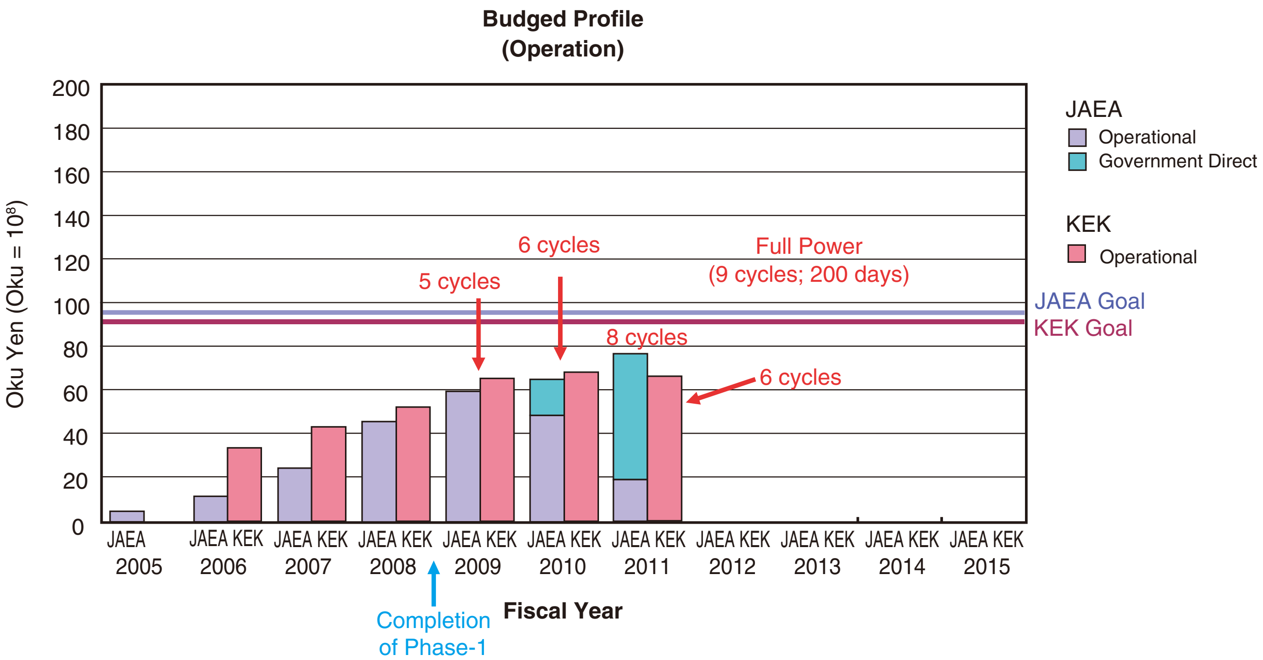
9) Nuclear and Particle Physics Experiments at the J-PARC 50 GeV Proton Synchrotron Program Advisory Committee

Ikaros I. Bigi	University of Notre Dame, USA
Avraham Gal	The Hebrew University of Jerusalem, Israel
Tadafumi Kishimoto	Osaka University, Japan
Konrad Kleinknecht	Mainz University, Germany
Shunzo Kumano	High Energy Accelerator Research Organization, Japan
Toshinori Mori	The University of Tokyo, Japan
Tomofumi Nagae	Kyoto University, Tokyo
Yasuki Nagai	Osaka University, Tokyo Institute of Technology, Japan
Satoshi Nakamura	Tohoku University, Japan
Matthias Grosse Perdekamp	University of Illinois, USA
Micheal Shaevitz	Columbia Univesity, USA
Susumu Shimoura	The University of Tokyo, Japan
Katsuo Tokushuku	High Energy Accelerator Research Organization, Japan (chair)
Robert S. Tschirhart	Fermi National Accelerator Laboratory, USA
Hitoshi Yamamoto	Tohoku University, Japan

Budget



Initial Construction (JAEA) = 858 Oku Yen (56%) After Construction (JAEA) = 200 Oku Yen incl. > 2010
Initial Construction (KEK) = 666 Oku Yen (44%) After Construction (KEK = 18 Oku Yen incl. > 2010



Notes;
Operational budget does not include salaries for JAEA and KEK. It includes, however, out-sourcing personnel's.
A new budget frame was adopted on the basis of the Law for the Promotion of Public Utilization of the Specific Advanced Large Facilities which was established on July 1, 2009.

Main Parameters

Present main parameters of Accelerator

Linac	
Acclerated . Particles	Negative hydrogen
Energy	181 MeV
Peak Current	15mA
Pulse Width	0.5 ms
Repetition Rate	25 Hz
Freq. of RFQ, DTL, and SDTL	324 MHz
RCS	
Circumference	348.333 m
Injection Energy	181 MeV
Extraction Energy	3 GeV
Repetition Rate	25 Hz
RF Frequency	0.938 MHz → 1.67 MHz
Harmonic Number	2
Number of RF cavities	11
Number of Bending Magnet	24
Main Ring	
Circumference	1567.5 m
Injection Energy	3 GeV
Extraction Energy	30 GeV
Repetition Rate	~0.3 Hz
RF Frequency	1.67 MHz → 1.72 MHz
Harmonic Number	9
Number of RF cavities	6
Number of Bending Magnet	96

Key parameters of Materials and Life Science Experimental Facility

Injection energy	3 GeV
Repetition rate	25 Hz
Neutron source	
Target material	Mercury
Number of moderators	3
Moderator material	Supercritical hydrogen
Moderator temperature/pressure	20K/ 1.5 MPa
Number of neutron beam ports	23
Muon production target	
Target material	Graphite
Number of muon beam extraction ports	4
Neutron instruments*	
Open for user program (general use)	9
Under commissioning/construction	3/6
Muon instruments*	
Open for user program (general use)	2

(* as of March, 2011)

Events

Events

● Minister Kawabata visited J-PARC on April 7.

Tatsuo Kawabata, Minister of Education, Culture, Sports, Science and Technology visited J-PARC on April 7, 2010. After an outline of the J-PARC activities was given, he listened to the explanation about the 50 GeV synchrotron, Materials and Life Science Experimental Facility (MLF), and Neutrino Monitoring Facility with keen interest, in the respective facilities.

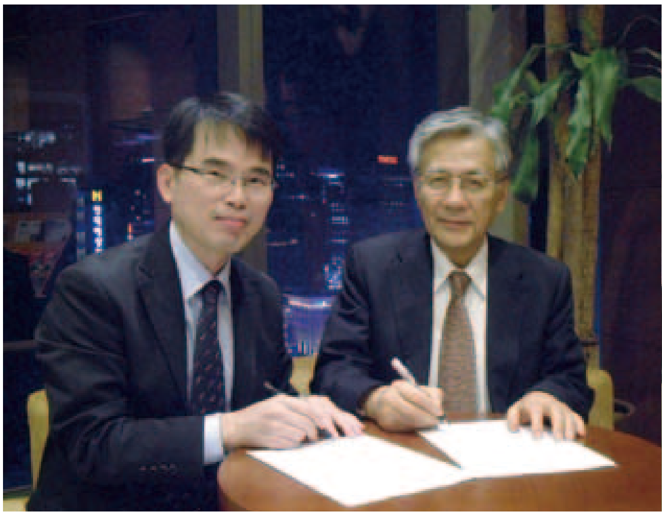
Minister Kawabata (middle).

● Established CKor J-PARC (2010, May)

Since there are more than 200 possible users in South Korea, Center for Korean J-PARC Users (CKor J-PARC) was established as an official contact in 2010 May for the purpose of support of the research of Korean users.

On October 1, J-PARC center concluded "MEMORANDUM OF COLLABORATION (MOC) BETWEEN CENTER FOR KOREAN J-PARC USERS AND THE HIGH ENERGY ACCELERATOR RESEARCH ORGANIZATION, JAPAN ATOMIC ENERGY AGENCY FOR INITIATING COOPERATIVE ACTIVITY IN THE FIELDS OF J-PARC RELATED RESEARCHES." with CKor J-PARC.

In addition, CKor J-PARC established the CKor J-PARC Japan Office in Ibaraki Quantum Beam Research Center, (Tokai, Ibaraki).



Left : Signing ceremony : Prof. Je-Geun Park, Director of CKor J-PARC (left) and Shoji Nagamiya, Director of J-PARC Center (right).
Right : Board members of CKor J-PARC (in front of the CKor J-PARC Japan Office)

● Toshihide Masukawa, Nobel laureate in physics (2008) visited J-PARC on July 16, 2010.

On July 16, 2010, Dr. Toshihide Masukawa (Director of KMI (Nagoya University: Kobayashi-Masukawa Institute for the Origin of Particles and the Universe (KMI)) visited J-PARC. He expressed his expectation for the research progress made by J-PARC, in a social gathering with the parties concerned, followed by meetings with each of the staffs of the Hadron Facility, Material and Life Science Experimental Facility, and Neutrino Monitor Facility.

Dr. Toshihide Masukawa

3rd from left, front: Dr. Masukawa
Rightmost, front: Hideaki Yokomizo, JAEA
Leftmost, front: Tatsuya Murakami, Mayor of Tokai village
2nd from left, back: Shoji Nagamiya, J-PARC

● Skull practice session with foreign users (Aug. 17)

Researchers and users from overseas working at J-PARC and Tatsuya Murakami, the Mayor of Tokai village had a skull practice session, discussing some issues in their everyday life, such as transportation from Narita Airport, the traffic signs in the village, accommodation, education for children, hospitals and the like. The succeeding confabulation was very successful.

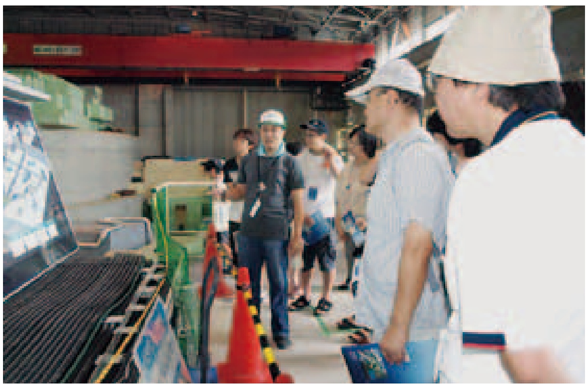
Picture of the social gathering.

Picture of the skull session.

● Open house held at J-PARC (Aug. 28)

On Aug. 28 2010, J-PARC was opened to the public for the third time since its establishment. Three accelerators (Linac, 3 GeV synchrotron, 50 GeV synchrotron) and each of the experimental facilities (Materials and Life Science Experimental Facility, Hadron Experimental Facility, and Neutrino Experimental Facility) went on public exhibition. In spite of the extreme heat on that day, 3,169 people came to J-PARC. Children were amazed to see the huge size of the most advanced scientific experimental facilities. There were some who took part in the experimental corner in each facility.

50 GeV synchrotron.



Hadron Experimental Hall.

● Linac 10/25th Linac international conference (Sept. 12-17)

From Sept. 12 to 17, 2010, LINAC 10/25th Linac international conference was held in Tsukuba International Congress center (EPOCHAL TSUKUBA). It is the most prestigious international congress in the world in the field of Linac, which is held once every two years. KEK and JAEA jointly hosted the congress. A total of 400 researchers and highly skilled technicians participated (270 of them came from overseas), 47 oral presentations and more than 300 poster presentations were provided. Techniques on Linac, science and researches concerned, and up-to-date conditions were introduced, which led to lively exchange of views and discussion.

On the last day of the conference, many of them enjoyed the J-PARC site tour.

Group photo in EPOCHAL TSUKUBA.

Site tour in J-PARC.

● Coverage by foreign media (Sept. 21)

A BBC reporter visited J-PARC on Sept. 21, 2010 to interview a researcher from the United Kingdom, who took part in the Neutrino international collaborative experiment (T2K experiment). In addition, Korean Educational Broadcasting System (EBS) had an interview with J-PARC on Oct. 12 to 15, as CKor J-PARC officially started to use the J-PARC facilities.

Reporters from BBC.

Reporters from EBS, Korea.

● The 2nd MLF Symposium (Jan. 17-18)

The 2nd MLF Symposium was held at Kobayashi Hall in High Energy Accelerator Research Organization (KEK) on January 17-18, 2011.

32 lectures and 70 posters were presented in the symposium, which covered the results of the studies using the world's highest intense neutrons or muons produced in the Materials and Life Science Experimental Facility (MLF), the statuses of the experimental instruments and facility operations, and related research and development.

In addition, on the first day of the symposium, the corporations, which are located in Ibaraki prefecture and participate in the IBARAKI Neutron Users and Instrument Fabricators Society, exhibited their products which were used in J-PARC.

Lecture.

Group photo (in front of Kobayashi Hall, KEK).

● Participants in HOPE meeting visited J-PARC (Mar. 9)

The HOPE meeting has been designed as an opportunity for selected graduate students and young researchers from Asian countries (over 100 of them) in physics and its related fields, to mingle with Nobel Prize winners while presenting or discussing their studies. It has also served as training to make them research leaders in future.

The participants visited J-PARC, and asked many questions throughout the briefing and the tour.

Visitors in MLF.

Visitors in Hadron Facility.

● Foreign visitors (2010)

Prof. Sebastian Schmidt, Jülich Research Centres and his colleague (Apr. 13, 2010).

Bo Sundman, visiting researcher: Commissariat à l'énergie atomique (May 18, 2010).

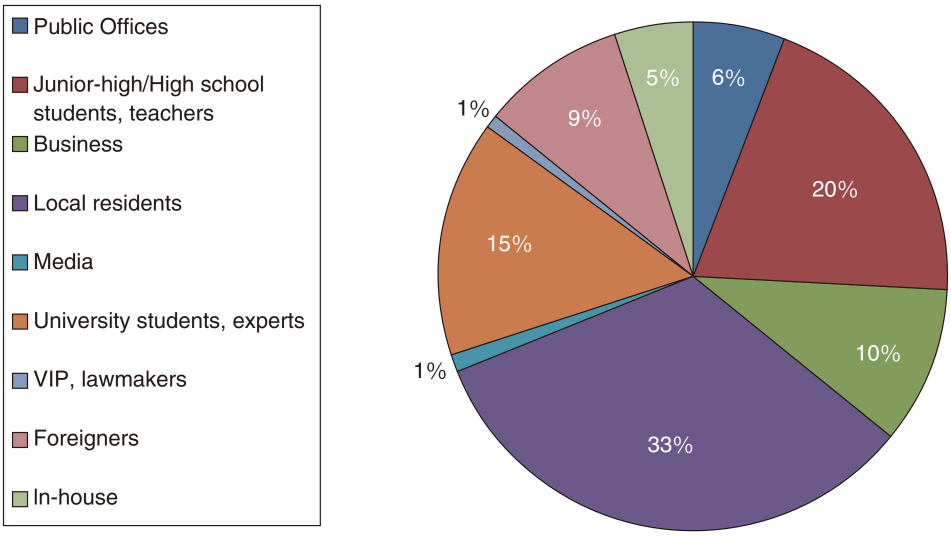
ESS delegate, Lund, Sweden (Nov. 9, 2010).

Visitors from University of Birmingham (Nov. 17, 2010).

Visitors from DESY (Deutsches Elektronen-Synchrotron) (Dec. 10, 2010).

● Visitors to J-PARC in Japanese fiscal year (JFY) 2010

In JFY 2010, 6,806 people visited J-PARC.
General public, local residents, and people related to education account for approximately half of the whole visitors.



Breakdown of J-PARC visitors in JFY 2010.

● The Great East Japan Earthquake (Mar. 11, 2011)

On March 11, when the Great East Japan Earthquake hit, 40 visitors from Chiba were in the site. When the earthquake occurred, a briefing was being carried out in our conference room, where the whole ceiling board fell down. During the incident the lecturer instructed the visitors to huddle under the table, so no one was injured.

Fallen ceiling board due to the earthquake on March 11, 2011.

Dates for Committees

1) Steering Committee

April 20th, 2010 at Ibaraki Quantum Beam Research Center, Tokai, Ibaraki
July 29th, 2010 at Tokai Campus, KEK
December 21st, 2010 at Tokai Campus, KEK

2) International Advisory Committee

February 21st and 22nd, 2011 at Ibaraki Quantum Beam Research Center, Tokai, Ibaraki

3) Users Consultative Committee for J-PARC

April 2nd, 2010 at Center for Computational Science & e-Systems, (Ueno), JAEA
October 6th, 2010 at Tokyo Office, JAEA
February 16th, 2011 at Tokyo Office, JAEA

4) Accelerator Technical Advisory Committee

February 17th - 19th, 2011 at Ibaraki Quantum Beam Research Center, Tokai, Ibaraki

5) Neutron International Advisory Committee

February 28th - March 2nd, 2011 at Ibaraki Quantum Beam Research Center, Tokai, Ibaraki

6) Muon Science Advisory Committee

February 18th and 19th, 2011 at Ibaraki Quantum Beam Research Center, Tokai, Ibaraki

7) Radiation Safety Committee

9th Committee : May 27th, 2010 at Nuclear Science Research Institute, JAEA, Tokai, Ibaraki
10th committee : December 7th, 2010 at Nuclear Science Research Institute, JAEA, Tokai, Ibaraki

8) MLF Advisory Borad

9th Board : August 12th, 2010 at Tokyo Office, JAEA
10th Board : March 11th, 2011 at Tokyo Office, JAEA

9) Nuclear and Particle Physics Experiments at the J-PARC 50 GeV Proton Synchrotron Program Advisory Committee

10th Committee : July 16th - 18th, 2010 at Tokai & Tsukuba campus, KEK
11th Committee : January 14th - 16th, 2011 at Tsukuba campus, KEK

Publications

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Chem. Lett., vol.39, 810 (2010)

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The near backscattering Si crystal analyzer spectrometer "DNA"
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Practical Applications of Permanent Magnet Multipoles
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Iwase, H. et al.
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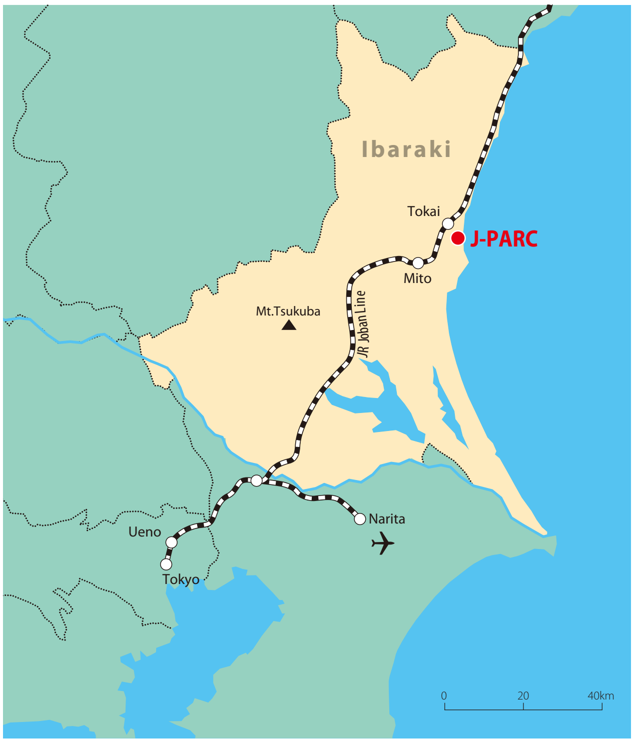

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