Experiencing the earthquakes on March 11th and the situation afterwards

(Special Session regarding March 11th)

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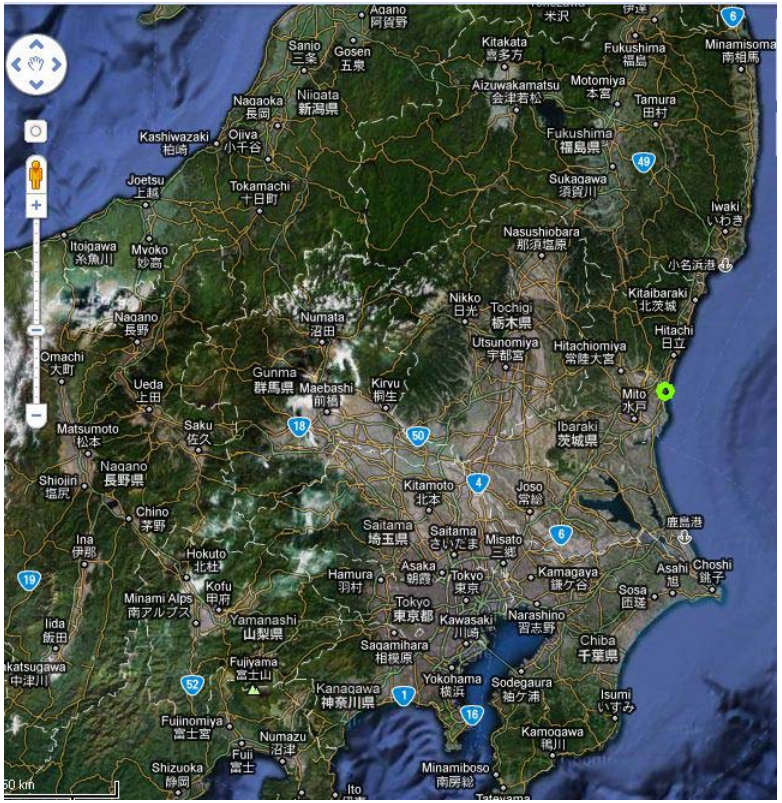
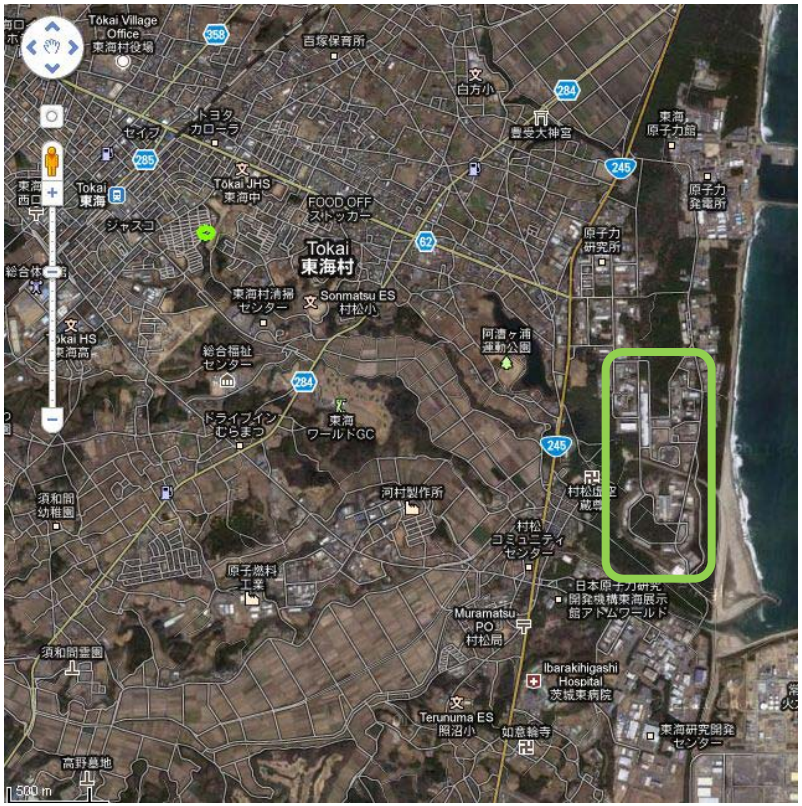
Overview

- Introduction to J-PARC
- Introduction to my work
- Earthquake personal experience
- Earthquake damages at J-PARC
- Accelerator repair work

Location of Tokai-mura and J-PARC

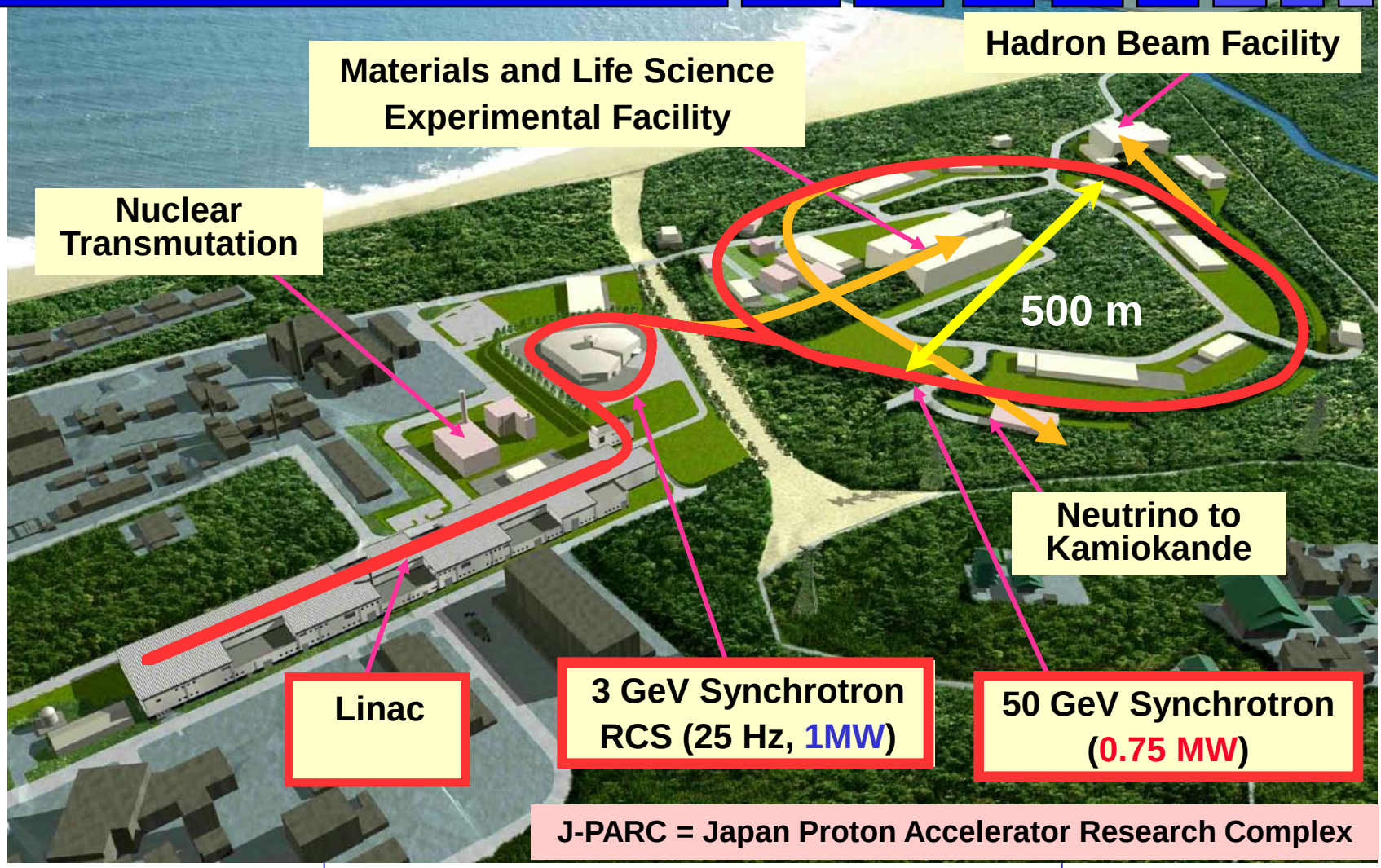


Tokai-mura



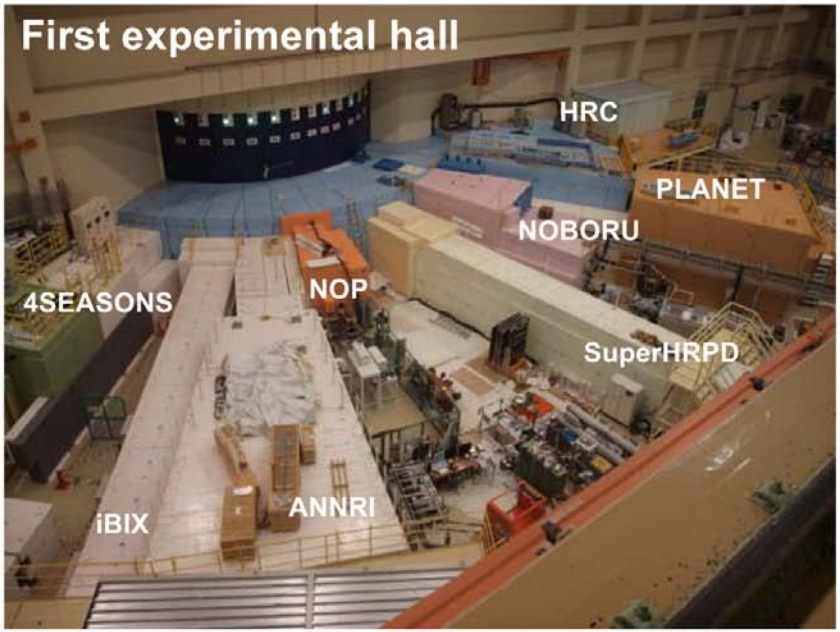
J-PARC

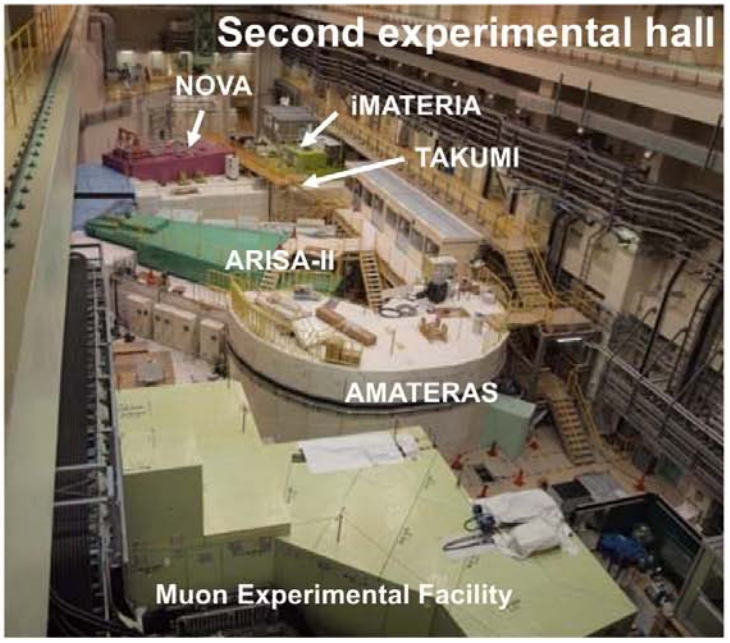
J-PARC Facility



Joint Project: KEK and JAEA

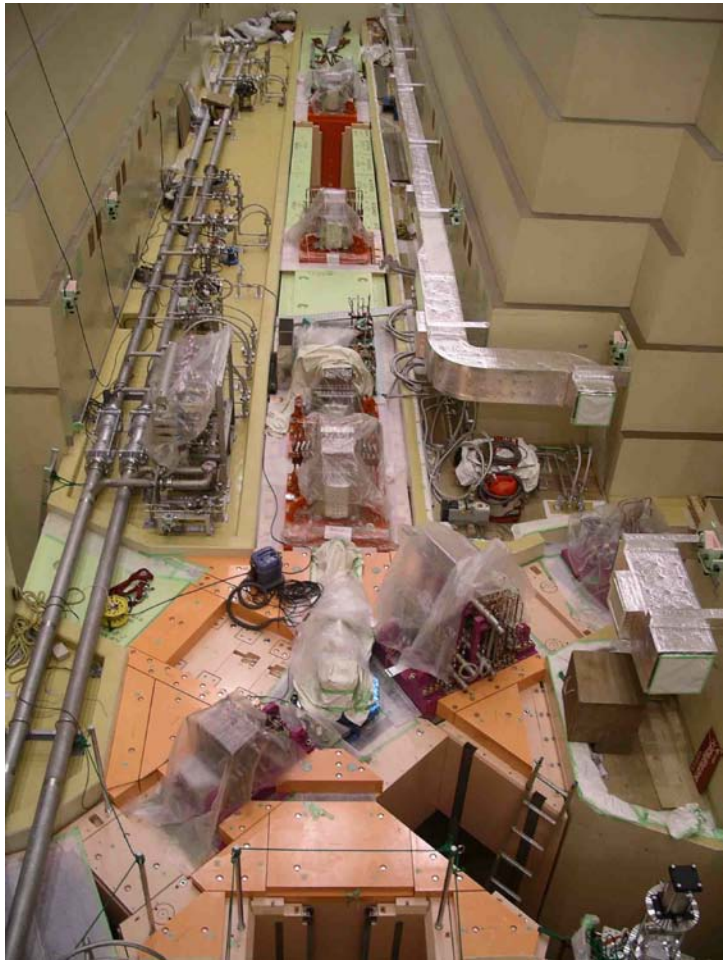
MLF experimental Hall (slide from J-PARC director)





18 of 23 neutron beam-lines occupied

Muon Beam Area (slide from J-PARC director)

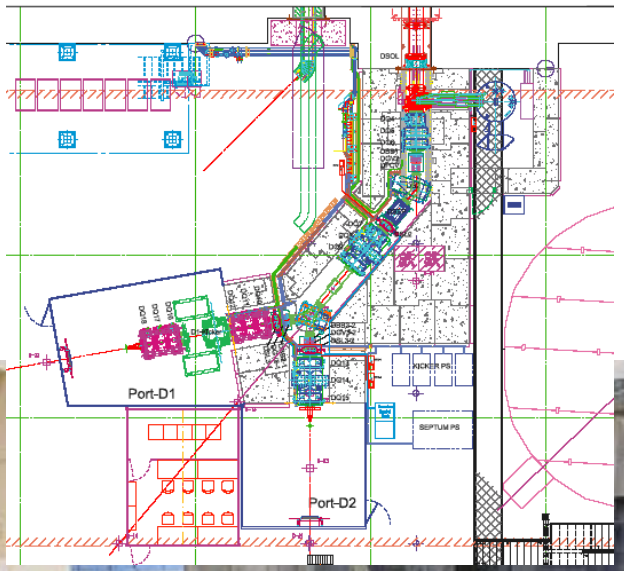


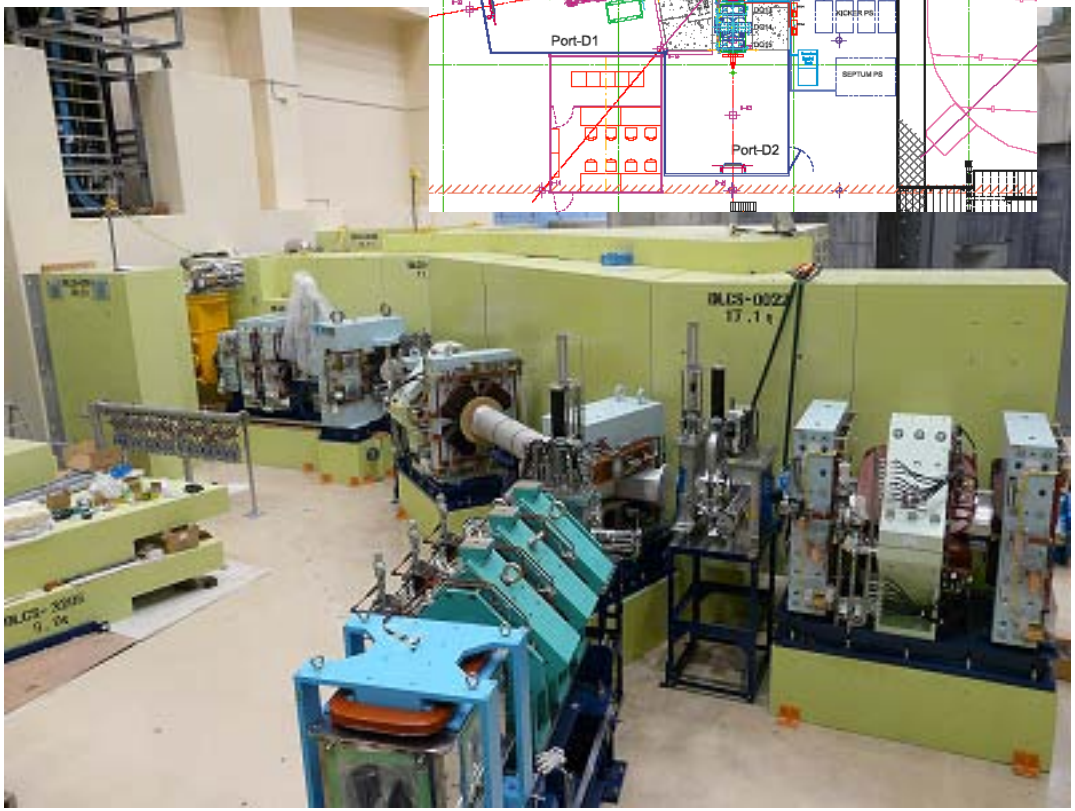
(testing FineMet)

Spin 0 Spin 1/2

$\pi \rightarrow \mu + \nu$

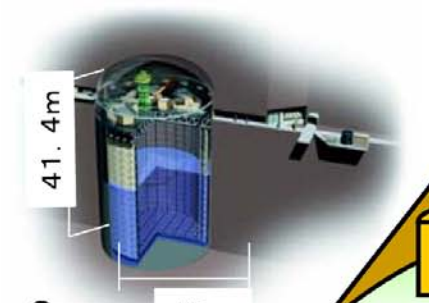
Muon is naturally polarized

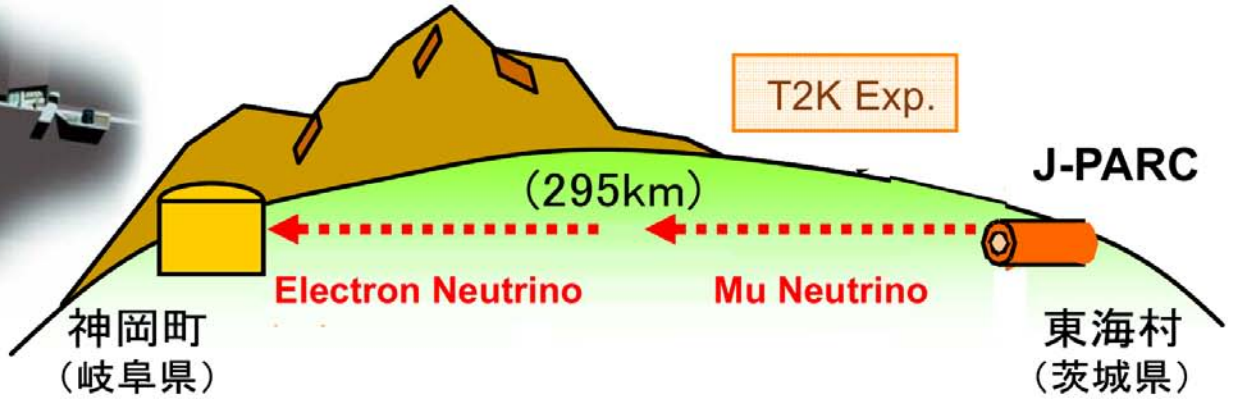


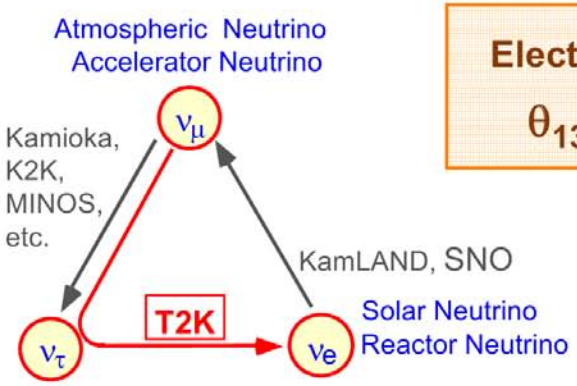


Neutrino Oscillation (T2K experiment)

(slide from J-PARC director)







Electron neutrinos ⟵ Mu neutrinos

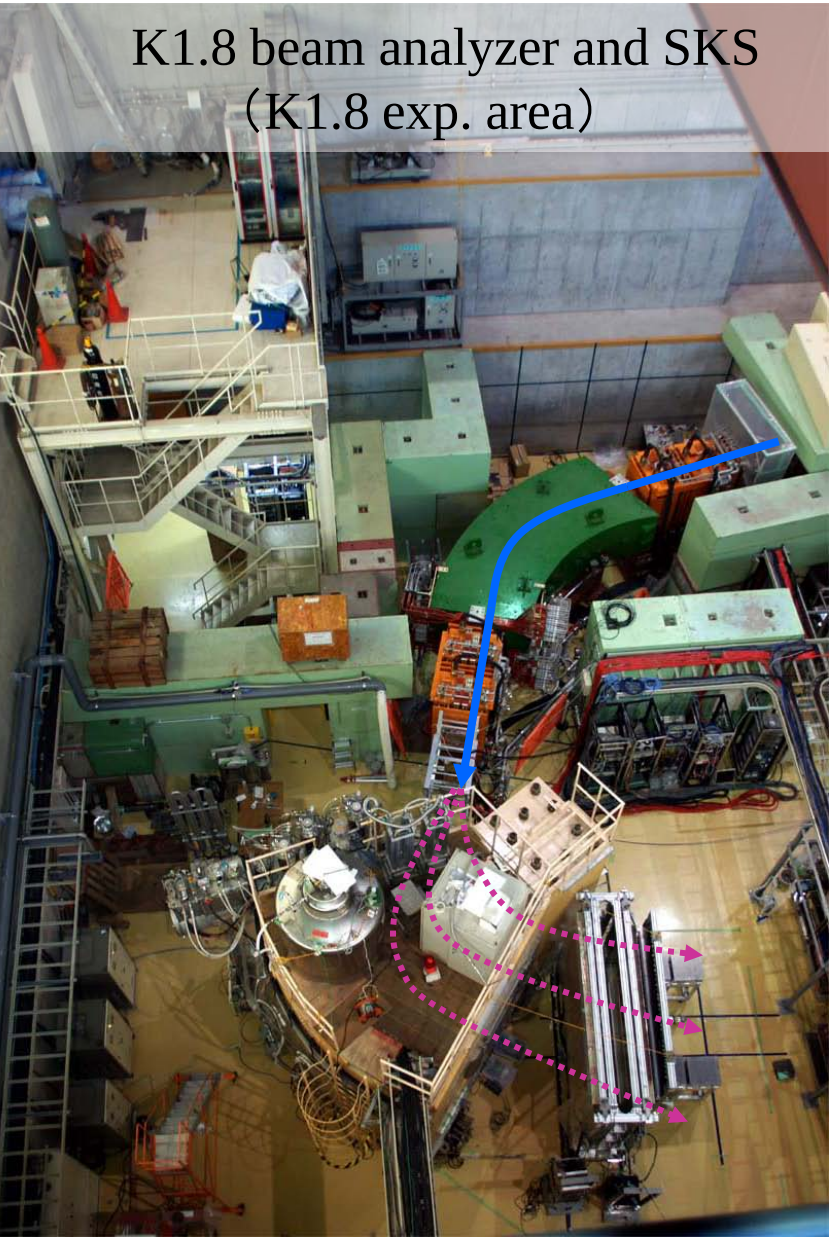
θ_{13} ⟷ Mixing between the 1st and 3rd generation

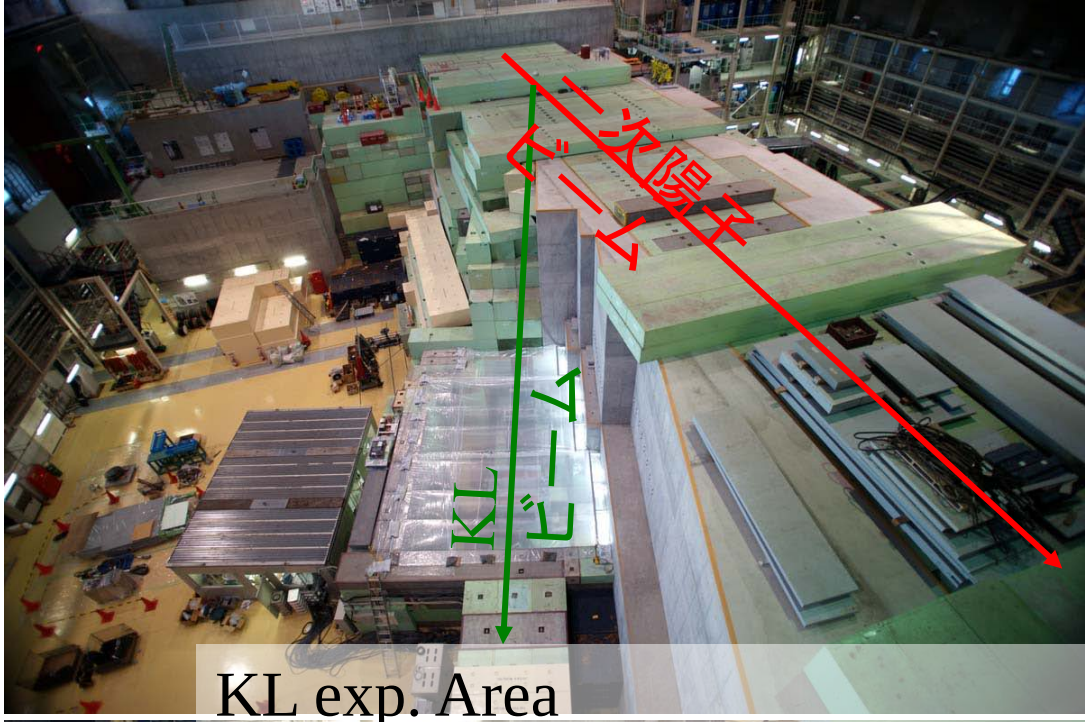
Already 500 non-Japanese joined this experiment !
(Japanese participants are only 70)

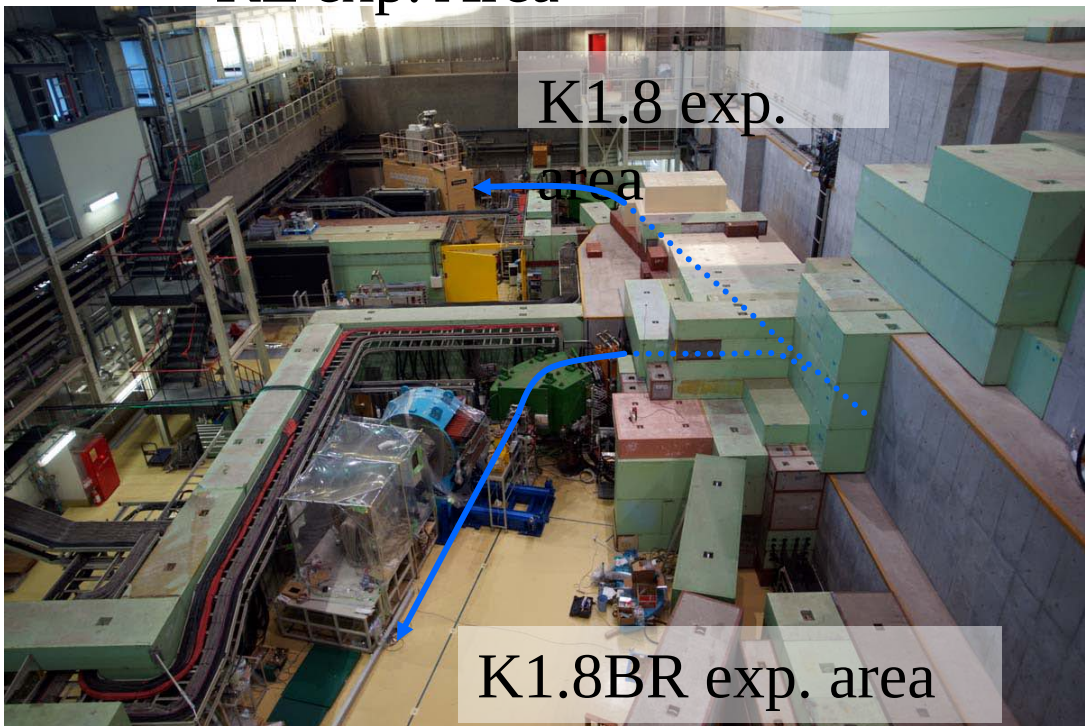
Goal is to measure $\sin^2 2\theta_{13}$ down to 0.01

Competition with Diya Bay, FNAL, etc.

Hadron Area


K1.8 beam analyzer and SKS
（K1.8 exp. area）


二次陽子ビーム
KL ビーム
KL exp. Area

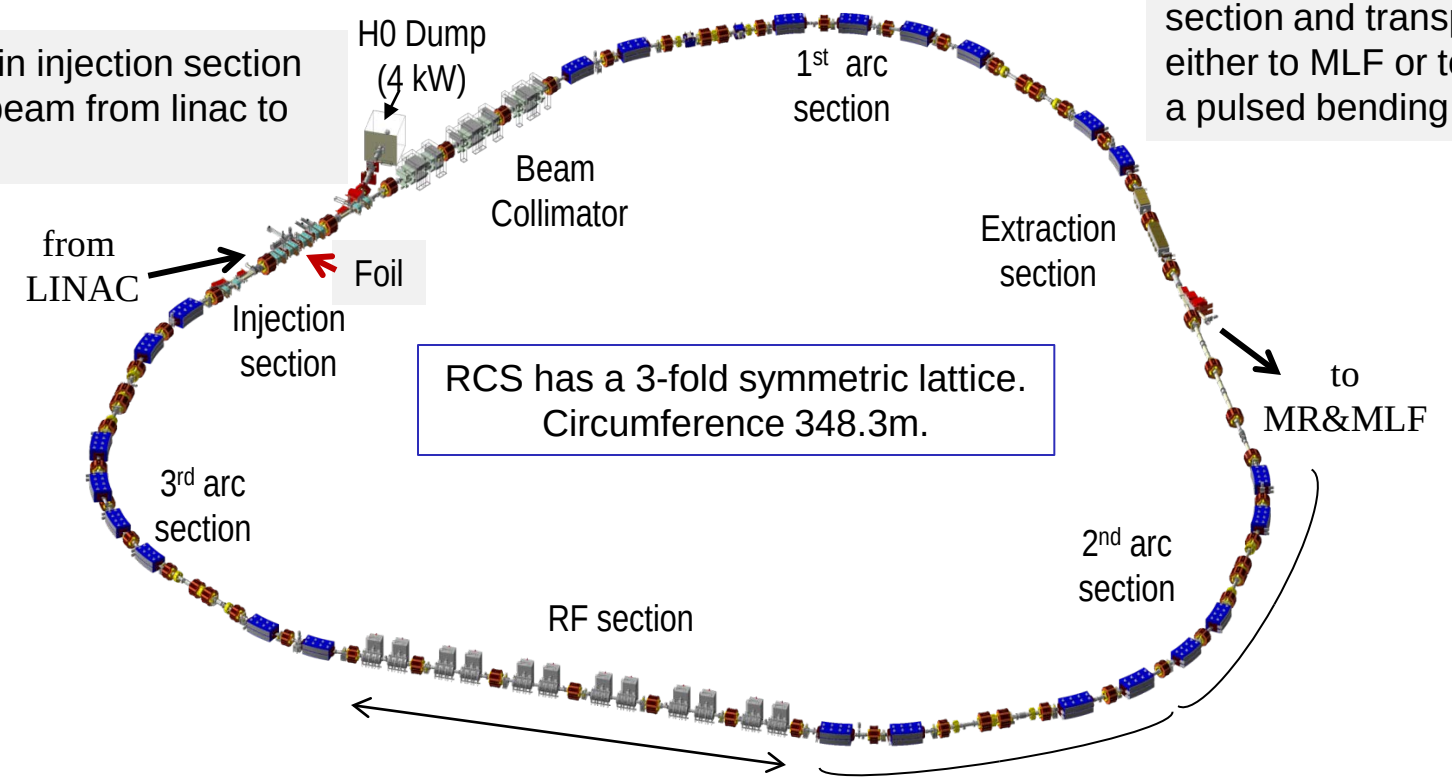

K1.8 exp. area
K1.8BR exp. area

3GeV-RCS in J-PARC (slide from RCS group leader)

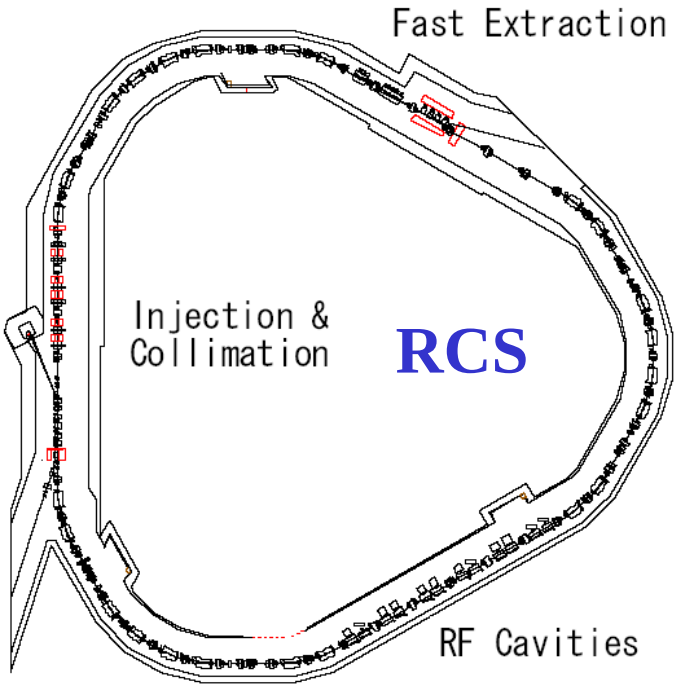
Injection dump dumps unconverted beams at the stripping foil.

Beam is extracted by kicker magnets and DC septum magnets at the extraction section and transported either to MLF or to MR with a pulsed bending magnet.

Stripping foil in injection section converts H- beam from linac to protons.



3 GeV Rapid Cycling Synchrotron RCS: RF

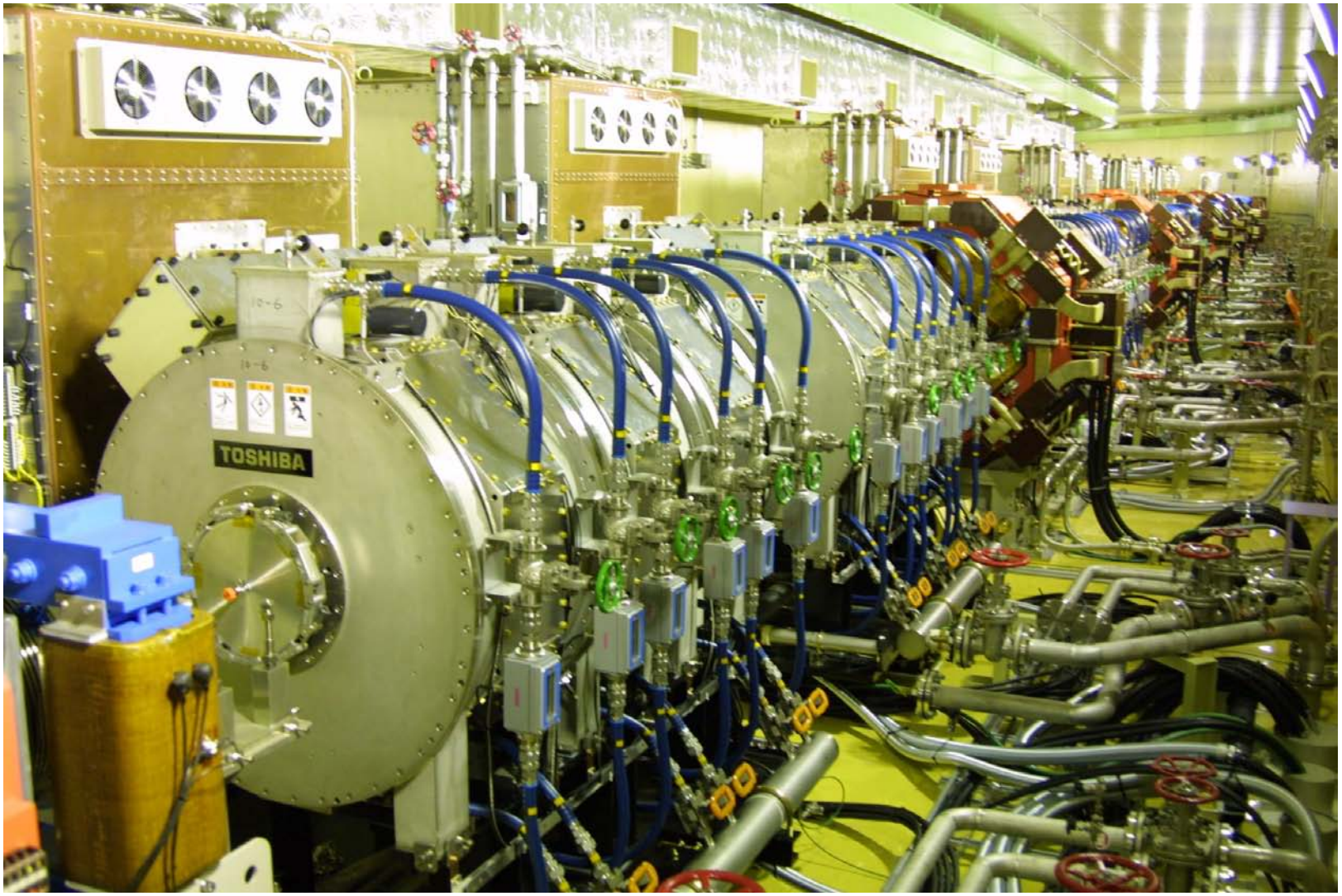


11 RF cavities for 450 kV total.
Space for 1 spare.

181 MeV protons to 3 GeV in 20 ms.

- Design: 1MW beam power. Rapid cycling
- Stable acceleration for Low beam loss
- Reliable operation (neutron target)
- Powerful RF-system for acceleration and multi-harmonic beam loading compensation
- dual harmonic alleviates space charge effects => Q≈2
- Magnetic alloy (MA) loaded cavities: higher gradient than ferrite cavities and stable at high fields
- First large volume MA application.
- successful 3 GeV acceleration 31.Oct 2007
- Beam extraction to MLF (up to 300kW), and Main-Ring (MR)

RCS cavities in the tunnel

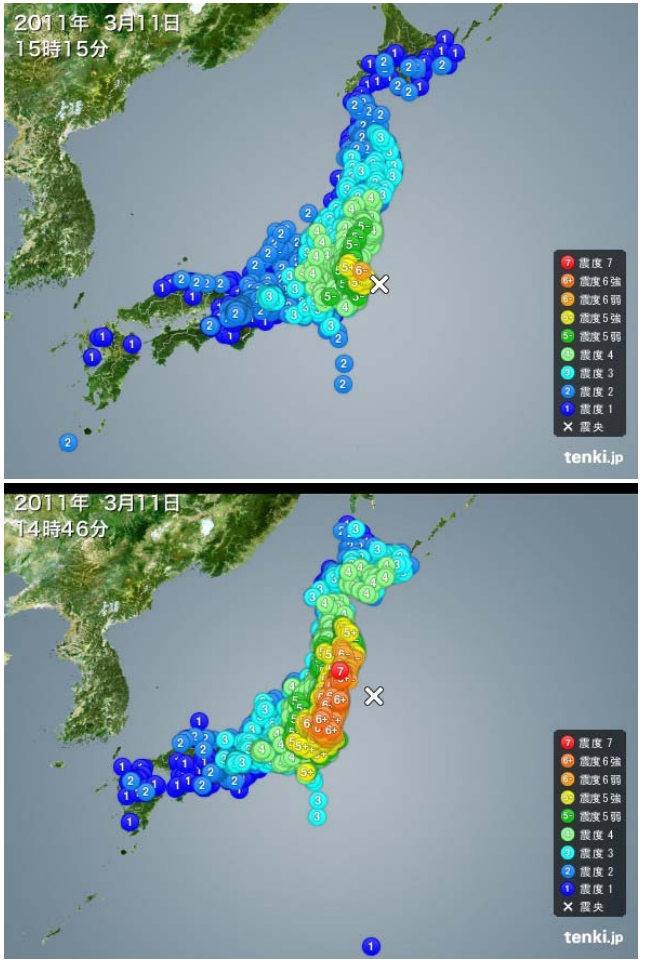


Work topics in J-PARC Ring RF group

- RCS acceleration cavities (11+1) and related high power, low power and control systems
  (topic: beam loading)
- MR acceleration cavities (6+2) and related high power, low power and control systems
- Development of MA (Magnetic alloy) core production for higher gradient cavities
- Band limited noise to improve the duty factor of the beam during slow extraction.

Earthquakes on 2011, 11th March (Fri)

Time	Center (coastal waters)	Magnitude	Strength (Shindo)
15:57	Ibaraki Prefecture	M6.1	4
15:49	Iwate Prefecture	M5.8	3
15:46	Miyagi Prefecture	M5.7	4
15:41	Iwate Prefecture	M5.7	4
15:15	Ibaraki Prefecture	M7.4	6 weak
15:06	Sanriku	M7.0	5 weak
14:46	Sanriku	M7.9	7



This list is a small selection. So far >1000 more earthquakes.

First earthquake March 11th at 14:46

- At time of first earthquake I was in office, synthesizing narrow band rf signals by computer for April beam-study.
- Seconds before the quake, there was a warning by internal speakers (Shindo 4), but in reality it was stronger.
- Sitting on a chair with rollers, the movement felt not so severe, but the shaking became stronger and stronger. The lights went out and the emergency lamps went on.
- Grabbing my helmet I positioned myself between desks and bookshelves. The shelves kept position, but books and other items were distributed on the ground.
- Two sliding glass doors of the shelves slipped out, but fortunately were not damaged.

Office space (1 day later 12th March)

Colleagues place (before cleanup)

The first quake recedes

- After the first shaking got smaller, and confirmation that the situation is more or less safe, I went out to the emergency assembly place. Assembled persons where checked against the list.
- The JAEA mobile phone system (PHS) stopped working, because there was no power for the base-station(s).
- Using my mobile phone to call family was not possible - the network was overloaded. Sending an e-mail, which consumes less bandwidth, was possible.
- Some mobile phones have a built-in (one-Seg) tuner, so it was possible to watch (NHK) TV live reports.
- Only for short time to conserve battery power.

Hendel Experimental hall outside

Building panels partially damaged

Car roof was hit
(only this one).

Shutters
damaged

Saturday, 12th March.

Check for missing persons and way home

- As announced, a tsunami came, but it did not flood J-PARC, because the coast line was high enough. As I learned later, some flooding happened to the nearby ports of Hitachinaka and Ooarai.
- After the second strong quake, it took some time until the situation was regarded as “stable”. Then some safety checks were performed, and it was checked, if there were injured persons left behind in buildings.
- There were no injuries in the whole JAEA area.
- Around 17:00, after further earthquakes, we were allowed to go home. I gave up using my car to return home, because there was a long line of cars, which did not move. So going by bicycle.
- Back home, my wife and our 3 kids were in my wife’s compact car. No injury.
- As they had learned in Kindergarten, the kids went under the living room table, when the shaking started. My wife had made sure that kitchen shelf and dish washer did not tumble.

On the way and back home

On the first weekend

- The company house is made from Ferro-concrete and seemed not damaged. I tried to pick up my car on Friday night, but it was not possible due to traffic jam. We decided to clean up the sleeping room and sleep in the house. Many aftershocks, so almost no sleep.
- Saturday morning, we started cleanup. In the afternoon I picked up my car and took pictures. Sunday afternoon, cleanup was almost finished.
- As there was no electricity until Sunday night, we couldn’t watch TV and were only able to listen to local emergency radio. Initially, we did not know about tsunami damage, for example in Fukushima. Also no communication.
- Sunday morning, my wife had seen a report about the tsunamis in the car navigation TV and was shocked. She was with our 3 kids in the car and had the motor running to warm up.
- Sunday night, after electricity was restored, it took some time for us to understand the scope of the damage.

Distorted road in Tokai and Joban-line train

Saturday, 12th March.

Joban-line train tracks

Infrastructure (1)

- After the earthquake, the infrastructure (life-lines) failed: no water, no gas, no communication (mobile phone), no phone, no e-mail. Also: no trains and highways closed.
- Fortunately the refrigerator was full, because my wife had prepared for the weekend. Without electricity, ice melts, so children were happy to get ice-cream on Friday evening. We still had enough bread and already cooked rice, so we had cold dishes on Saturday and Sunday, depending on what needed to be consumed from refrigerator.
- From Sunday afternoon on, gas was restored for cooking, and after 21:30 electricity re-appeared. After a while phone, Internet and communication with mobile phone became possible – base-stations were powered again.
- Lesson learned: we need a simple phone for emergency and a 12V to 100V AC inverter for the car. (bought in April)

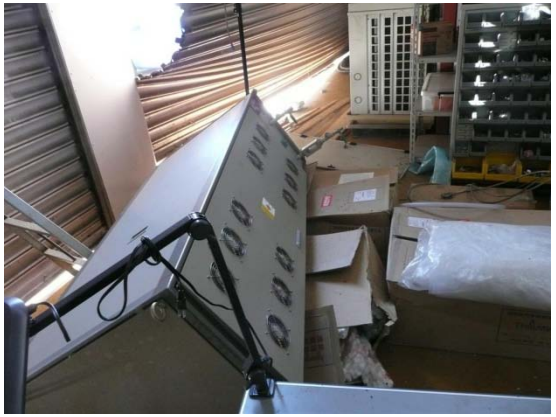
Hendel Experimental hall inside

Mercury lamps from above

Floor partially sagged.

Parts distributed

Cable rack falling.



RF amplifier

Saturday, 12th March.

Infrastructure (2)

- Drinking water became available in limited amount from Sunday 13th in community centers. Waiting time 1 to 4 hours. Water for the toilet came from a water puddle on a lower lying construction area by filling a small bucket into bigger buckets and transporting them home.
- Shops and restaurants: closed. Some shops sold limited items (food, toilet items and tea) outside on tables. Long waiting lines 1 to 2 hours.
- Heater fuel and gasoline available for short time on Monday 14th, after electricity was restored. Gas stations pumps need electricity.
- Tap water had to wait until Saturday 19th. The low pressure allowed only washing hands. For bathing, toilet or washing machine, pressure was not enough. I went to a public bath on 19th, when it re-opened.
- Sunday 20th, the water pressure gradually increased, so that washing clothes became possible.
- After Monday 21st, situation in Tokai normalized. Post, Banks and shops changed from emergency to normal service. Limits on food and drinks gradually disappeared. On 25th car fuel was still limited and needed long waiting time.
- Still now in May: stems to protect shelves are out of stock.

Colleagues and communication

- Japanese colleagues
  - Gave warnings, where J-PARC had become unsafe and started making plans how to analyze the situation in a safe way.
  - Inspection work started Wednesday 23rd, and I was also involved.
- Foreign scientists
  - With electricity, Internet communication was possible, so I could access official laboratory information. Conferences and business trips were cancelled.
  - Foreign scientists with short time stay at KEK or J-PARC were advised to return to home institutes, because scientific work was not possible. Foreign scientists were asked not to visit until infra-structure is restored.
- Former colleagues, friends and relatives
  - Former colleagues from FZ Juelich were afraid that the situation of the nuclear power plants in Fukushima and Tokai might be life threatening and suggested to leave Tokai. Same advice from German embassy. Different TV reporting in Japan and Germany.

Initial situation at work (JAEA / J-PARC)

- On Sunday after the quake JAEA (Japanese Atomic Energy Agency) asked us not to come to work, but stay at home (home standby) until further notice that safety in JAEA / J-PARC can be guaranteed.
- On Tuesday 22nd morning, I was back at work from 9-12 and cleaned up my office space. In Hendel building was only electricity for lights, but not for outlets, computer or heating. No water. Toilets did not work.
- From Wednesday 23rd, checking the accelerators for damages and for possible ways to repair started. Only from morning to lunch time, because still there was no water, no toilets and no electricity.
- From Monday 28th , J-PARC working time was back to normal, 9:00-17:30. Electricity and toilets in the offices were partially restored.

RCS (Rapid cycling synchrotron) environment

Road distorted

March 23rd.

Broken concrete foundation

Holes in the ground

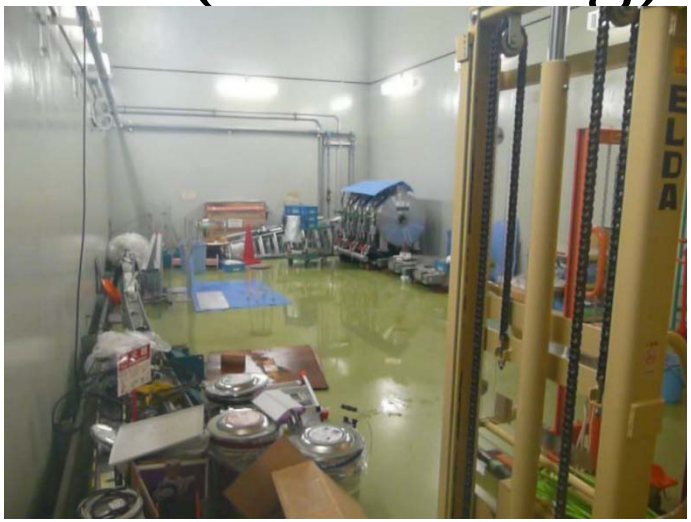
RCS outside

Ground outside RCS building going down

How to repair (ongoing process)

- On many places outside the accelerator buildings the ground has sagged and concrete foundations show cracks.
- Probably, first it is necessary to repair the access roads.
- Then, with mobile cranes one can remove heavy systems like transformers and switching boards, which are not damaged.
- The concrete foundations can be removed / repaired and the ground made flat again. Then systems can be re-installed.
- Cable racks and cables are bend, and bolts were broken. This needs check and repair. Also cooling system pipes need some replacement.
- To analyze the damage in the accelerator tunnels of RCS and Main Ring (MR), electricity for light is necessary.
- MR electricity was restored at the end of March, while RCS had to use up to 4 mobile 50 kW generators until May 16th just for light.

J-PARC pictures MR (Main Ring)



Humidity creates “rain”.

Crane in tunnel near rf stations

Cooling tower

Air conditioner Exp. Area

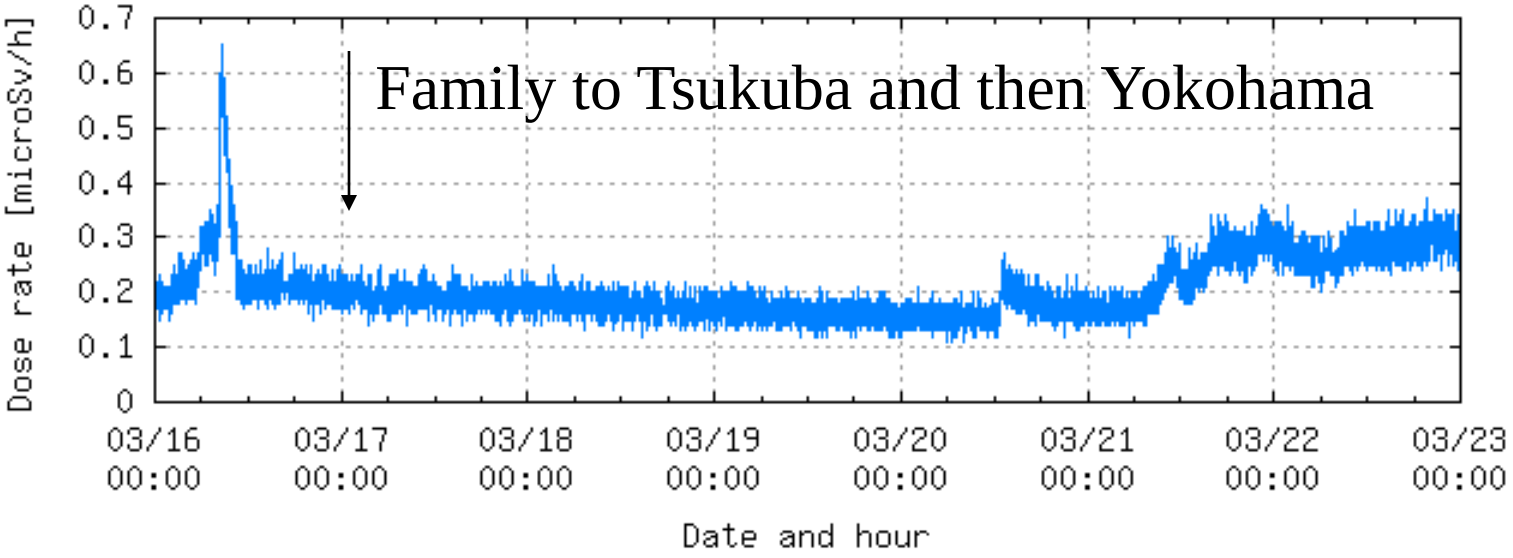
J-PARC pictures (Hadron hall)

Steel construction no longer fixed to the concrete.

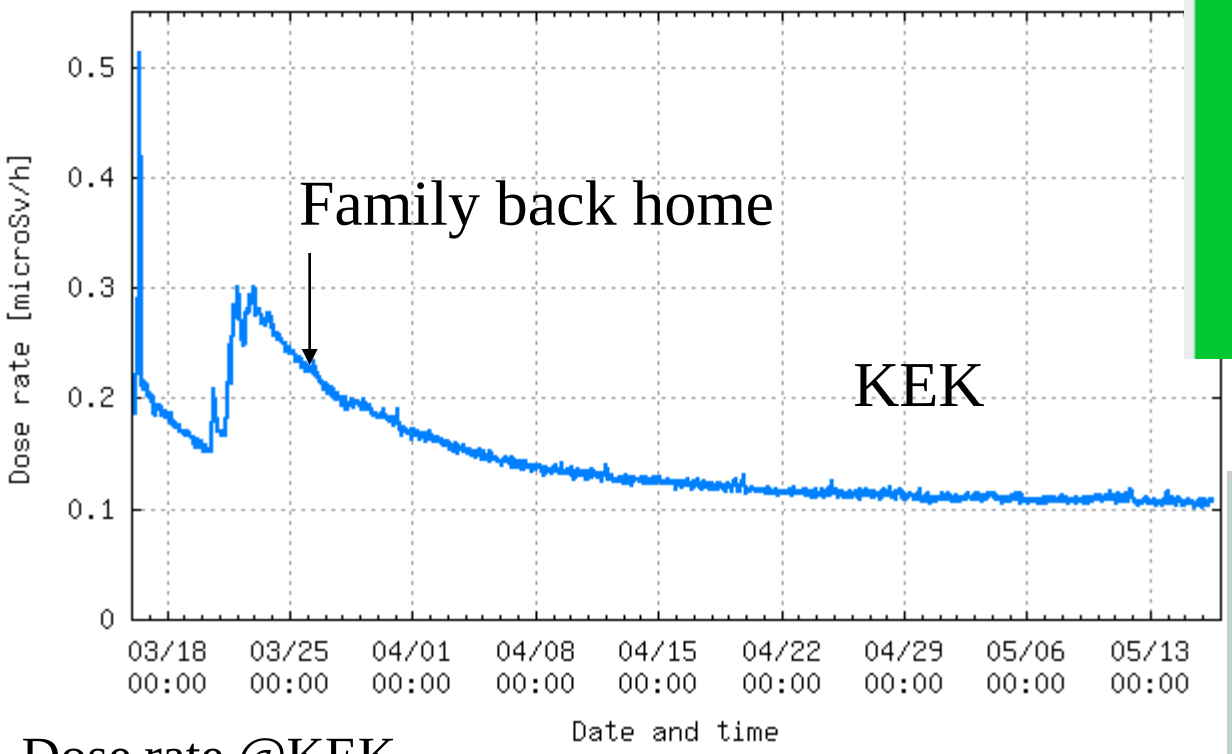
Concrete blocks moved and rack tripped.

Family (1)

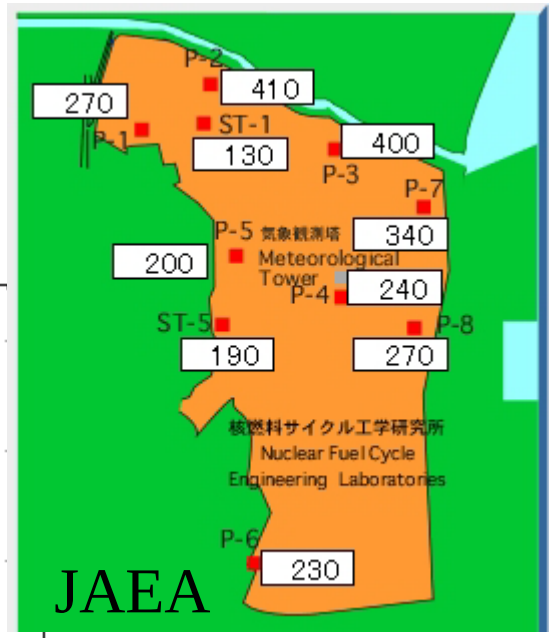
- The situation in Fukushima is the reason, my wife went to Tsukuba and 1 day later continued to Yokohama on 17th march with our 3 kids. More distance helps to reduce the radiation dose, important for babies and little children. I stayed in Tokai, because at age 46 the risk is lower (no need for iodine pills anymore). Still, I was prepared to follow.
- On Friday 25th, my family returned to Tokai. Our oldest son, who became 6 years, joined the Kindergarten graduation ceremony and prepared to go to primary school.



Radioactivity monitors



Dose rate @KEK
Oho 1, Tsukuba 305-0801
rcwww.kek.jp/norm/index-e.html



2011 May 17 7:00-8:00
(1 hour Avg) [nGy/h]

www.jaea.go.jp/04/ztokai/
kankyo_e/realtime/map_vllg.html

Family (2)

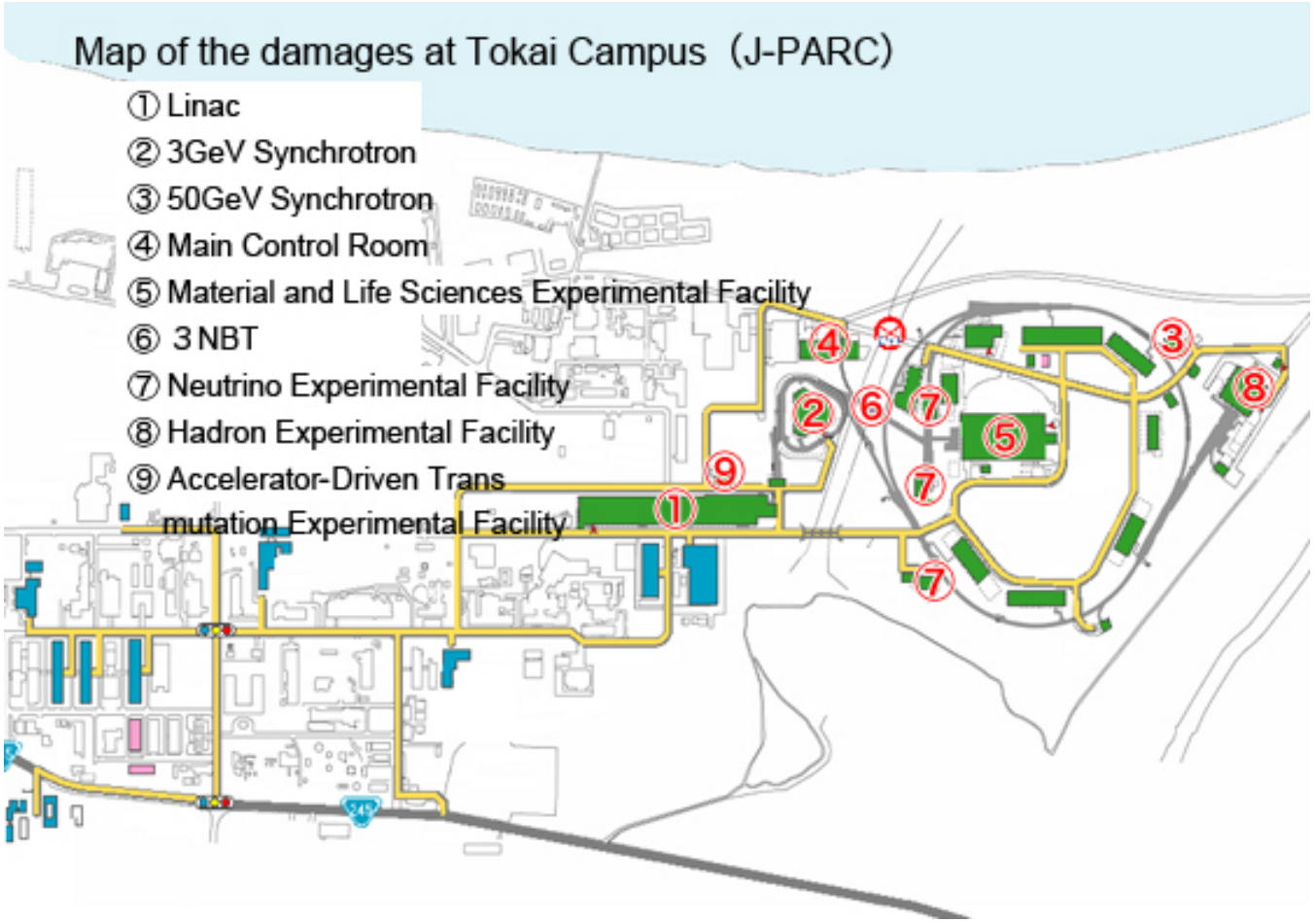
1st Jan. 2011 in Yokohama

6th birthday, Yokohama 20th march

2nd birthday, back in Tokai 27th march

Making towers to play earthquake

Damaged J-PARC area



Source: www.kek.jp/intra-e/Introduction/column/images/quake110311J-PARC_e.jpg

KEK Statements on the WEB (from Atsuto Suzuki, Director General, edited and shortened here)

Until May 8th

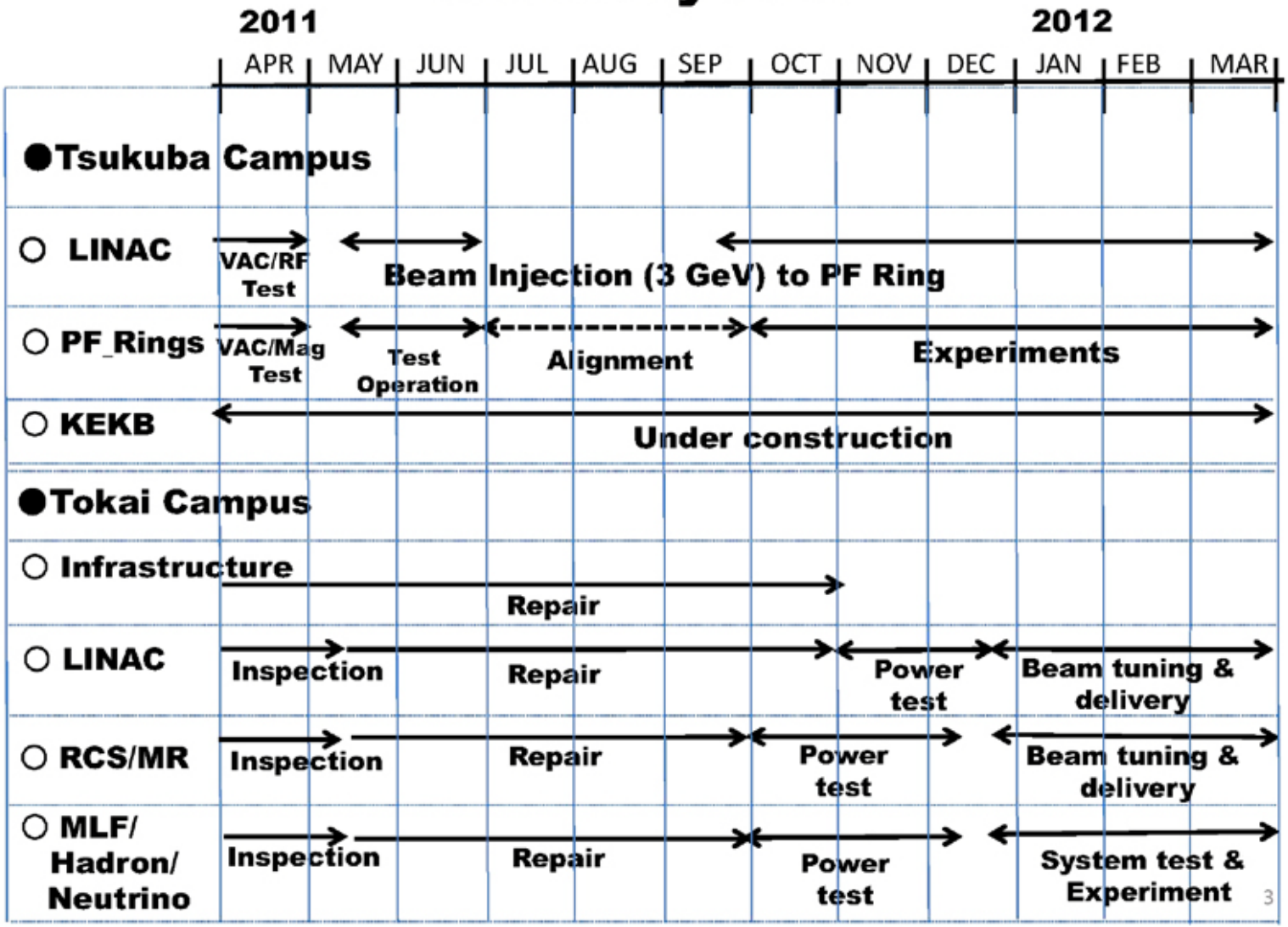
- KEK evaluated the severe damage facilities have sustained. This is not sufficient to deter us from conducting our research activities.
- Due to shortage of electricity in eastern Japan, we must limit its use. First priority is to restore facilities and reopen the lab.

After May 9th

- Both KEK-Tsukuba and KEK-Tokai (J-PARC) sites experienced tremors exceeding 6 (Japanese seismic intensity scale), even distant from epicenter. This caused significant damage to both facilities.
- The tsunami did not affect J-PARC. Cracks appeared in surrounding roads, with partial collapse of accelerator/detector buildings. Fortunately, no serious damage to accelerator and detector devices underground.
- Highest priority: restore both campuses to resume scientific activities.
- J-PARC damage evaluation and repair/reconstruction of accelerators, detectors, buildings and equipment will be completed by December. Then, commissioning for all systems will take place.

Original source: www.kek.jp/intra-e/Introduction/column/

Recovery Plan



Source: www.kek.jp/intra-e/Introduction/column/images/RecoveryPlan2011.jpg

Example: RCS repair work

RCS road repair May 11th

Maybe yard can be lifted up.

Additional material: official reports

- J-PARC photos showing damaged places
  - Source: j-parc.jp/picture/2011/03/StatusEnglish0328.pdf
- J-PARC status April 22nd
  - Source: j-parc.jp/picture/2011/04/StatusEnglish0422_1.pdf
- J-PARC Recovery Schedule May 20th
  - Source: j-parc.jp/picture/2011/05/J-PARC-Recovery_schedule.pdf