J-PARC status

Yujiro Ikeda

J-PARC Center

JAEA
KEK
J-PARC

3 Accelerators
3 User facilities

International User Facility

Linac (400MeV)

3 GeV synchrotron RCS (25 Hz, 1MW)

30 GeV synchrotron MR (0.75 MW)

Neutrino facility (T2K)

Materials & Life Facility neutron・muon

Hadron Facility
Accelerators and experimental facilities

Major progresses in last 6 months
### Operation Summary in JFY2012 (Sep - Dec, 2012)

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
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<tbody>
<tr>
<td>Sep. 28 - Oct. 17</td>
<td>Accelerator study.</td>
</tr>
<tr>
<td>Oct. 18</td>
<td>Beam delivery to the MLF and NU for user operation restarted.</td>
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<tr>
<td>Nov. 12 - 20</td>
<td>RCS high power study.</td>
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<tr>
<td>Dec. 14</td>
<td>Operation mode of the MR switched from FX to SX.</td>
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#### 2012: Accelerator maintenance & User operation plan

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- **Maintenance**
- **Tuning & Study**
- **Beam Delivery**
- **MLF User Operation**
- **MR User Operation**

*Run#44 2012 Sep-Nov*

*Run#45 2012 Nov-Dec*
Schedule in JFY 2012 (Jan. – March, 2013)

Jan. 7 -17: MR mode is SX. Beam of 10-20 kW for study and 10-15 kW for users.
Jan. 17-March 6: MR mode is FX. Beam of 200-220 kW for the T2K experiment.
March 7-25: MR mode is SX. Beam of > 20 kW for study and 15-20 kW for users.
March 26-April 11: MR mode is FX. Beam of 200-220 kW for the T2K experiment.

Additional MR study will be negotiated with users.
Operation Statistics in JFY 2012
- RUN#42-45 (April 5th to Dec 27th) -

Availability (including beam stops due to troubles in the experimental facilities):
93.4% for the MLF users, 88.0% for the T2K experiment, 90.2% for the HD users
Beam power history at MLF from 3GeV RCS

- 280kW: 2012.6.29~7.1
- 200kW since 2012.3.15
- MR@200 kW
- Smooth recovery
- ~10 months interruption

- Average beam power (kW)
- Average availability (%)
- Cumulative beam power (MWh)
- Cumulative beam power (MWh) (New target)
Delivered beam power to the T2K experiment is 217 kW in max.
Pressure waves mitigated by microbubbles

Displacement & Vibrational time were reduced by microbubbles

Microbubble mitigation effect on pressure waves was verified
J-PARC leads pulse neutrons performance

Neutrons/pulse
Unit: neutrons/(sr \cdot pulse)

Now 300 kW
Future 1 MW
Now 1 MW
Future 1.4 MW
2nd Target 48 kW

5.4 \times 10^{12}
18 \times 10^{12}
4.2 \times 10^{12}
5.9 \times 10^{12}
4.0 \times 10^{12}

already world record

Pulse frequency
J-PARC
SNS
ISIS-2

25Hz
60Hz
10 Hz

Future
J-PARC leads pulse neutrons performance
MLF Instrumentation (Neutron, Muon)

- Diffractometer for advanced battery development 「SPICA」
  Ceremony (September 4)

- Diffractometer for high pressure science 「PLANET」 Ceremony (September 27)
It was observed that two different sites of rare earth hydride under high pressure more than 13 (Lanthan hydride) important findings for sable and high hydrogen density materials development.

LaD$_2$ (T-site) $\rightarrow$ LaD (NaCl-fcc, O-site) + LaD$_3$ (fcc, T- and O-sites)

NEDO Project (2007~2011)
Neutron Instrument status

16 In operation • 2 commissioning, 2 under construction: 20 instruments (out of 23)

- **SPICA** (KEK, Kyoto U, NEDO)
  - in commissioning
- **PLANET** (U. Tokyo, JAEA)
  - in operation
- **High resolution chopper** (KEK)
  - in operation
- **Low energy chopper** (JAEA)
  - in operation
- **Testing port** (JAEA)
  - in operation
- **HRPD** (KEK)
  - in operation
- **Spin Echo** (KEK)
  - in operation
- **ANRRI** (Nucl Cross Section) (T.I.T, JAEA, Hokkaido U.)
  - in operation
- **Bio single crystal** (Ibaraki)
  - in operation
- **Back scattering** (JAEA: Public)
  - in operation
- **High intensity chopper** (Public)
  - in operation
- **Total Scattering** (NEDO, KEK)
  - in operation
- **Power Reflectometer** (Ibaraki)
  - in operation
- **Imaging** (JAEA: public)
  - in operation
- **Vert. reflectometer** (JAEA: public)
  - in operation
- **Single crystal** (JAEA: public)
  - in operation
- **Engineering Reflectometer** (JAEA)
  - in operation
- **Corrosion**
  - in operation
- **Under construction**
  - in operation

- **SANS** (JAEA: Public)
  - in operation
- **Horiz. reflectometer** (KEK)
  - in operation
- **Vert. reflectometer** (JAEA: public)
  - in operation
- **Single crystal** (JAEA: public)
  - in operation
- **Engineering Reflectometer** (JAEA)
  - in operation

16 In operation • 2 commissioning, 2 under construction: 20 instruments (out of 23)
Muon $S-H$- Front end Installation

4 Electric Magnets and associated apparatus were placed in M2 tunnel area during 2012 Summer Shutdown Time
World highest pulse muon production was recorded at U-Line

Muon/pulse
30,000 (160kW) RIKEN RAL (UK)

J-PARC/MLF
@D line
First muon production
(2008/9/26)

Muon/pulse
(2009/12/10)
72,000 (120kW)
(D line)

2008 2009 2010 2011 2012

Capture solenoid electric magnet
(2009/3/11)

Muon/pulse (@U line)
25,000,000 (212kW)
(2012/11/7)

World record!

Proton Beam
Muons

World record!

Carbon Target

SC solenoid electric magnet
(2012/7/5)

SC axial Focusing Device
(H24/9/25)
Experiments at HD hall in Run45
December 14 ~ 27, 2012

Four existing beam lines are all busy for physics experiments.

Among them, E10 at K1.8 started data acquisition!

E10: Study on Lambda-Hypernuclei with the Charge-Exchange Reactions

E15: Search for deeply-bound kaonic nuclear states

Four existing beam lines are all busy for physics experiments.
Ceiling concrete in KL experimental area has been completed for high intensity run!

The new gold target for high intensity beam is ready!

### Typical operation status in Run45 (12/14-27)

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<tbody>
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<td>Run number</td>
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<tr>
<td>Shot number</td>
<td>637940</td>
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<tr>
<td>Last shot time</td>
<td>12/12/20 13:48:53</td>
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<tr>
<td>MR Power</td>
<td>11.1 kW</td>
</tr>
<tr>
<td>MR Intensity</td>
<td>1.4e+13 PPP</td>
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<tr>
<td>SX Duty</td>
<td>38.45 %</td>
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<tr>
<td>SX spill length</td>
<td>1.95 sec</td>
</tr>
<tr>
<td>SX extraction efficiency</td>
<td>99.24 %</td>
</tr>
</tbody>
</table>

### Beam power trend in Run45 (12/14-27). Over 10kW becomes usual!

- 6kW
- 11kW (during acc. study)
- 15kW
Accumulated number of proton $\sim 4.2 \times 10^{20}$ POT.
T2K: 11 candidate events

11 candidate events are observed

\[ N_{\text{exp}} = 3.22 \pm 0.43 \text{ for } \sin^2 2\theta_{13} = 0 \]

The probability (p-value) to observe 11 or more events with \( \theta_{13} = 0 \) is 0.08% (3.2\sigma)

Evidence of \( \nu_e \) appearance → open a possibility to measure CP violation in lepton sector
T2K status

- T2K took data from Oct. 2012
- Physics runtime fraction was 78.4% = 812h(took data)/1036h(allocated).
- Stable 210kW operation achieved
- Added $1.1 \times 10^{20}$ POT after this Summer & reached total POT of $4.2 \times 10^{20}$
- Super-Kamiokande is increasing neutrino events from J-PARC as expected
J-PARC Open house
July 29, 2012、~2,100 people
MR, MLF, Neutrino, Hadron facilities

4th J-PARC/MLF Symposium
October 10、@National Museum of Emerging Science and Innovation(MIRAIKAN)
~200 participants

1st J-PARC Colloquium
November 20、IQBRC
Lecturer：Prof. Guido Tonelli (Pisa Univ.)
CERN LHC CMS former leader
Topic：Origin of Mass in the era of LHC
– quest for the Higgs boson –
Schedule in JFY2013 (the first half)

The details have not been officially fixed.

600 kW study of the RCS

MR power for users:
SX mode > 20 kW.
FX mode 200-220 kW
The linac will start beam commissioning in December 2013, and the RCS start in January 2014. User operation will resume in the end of January 2014.
Schedule for MR power upgrade

FY2013: Linac 400MeV, FY2015: RCS MW
Development of PS, FY2018: MR 0.75 MW

We are here

Issues for MR
- PS
- High gradient Cavity
- High repetition
- Shielding
“Master Plan 2013” of Science Council of Japan
-- Large Facility Plans for Researches --

- Proposal is due in March, 2013.
  - Selection of 200 proposals in June 2013
  - Selection of 25-30 proposals in December 2013
  - To be finalized in April 2014
  - Will affect funding from JFY2015

- “Master Plan 2010” resulted in
  - Super KEKB

- J-PARC related proposals in preparation
  - Neutrino Program:
  - Hadron and Muon Fundamental Physics: “Origin of Matter”
  - MLF Program (Neutron and Muon Science) : N-, M- microscope for slow dynamics
  - ADS : R&D of target and sub-critical physics with spallation neutron.
Budget proposal for FY2013 suspended due to the national election and administration change.

Almost same budget profiles are kept as it was 6 month before.

It will be settled by the end of January at the funding agency level.

As emphasis is place on breaking away from deflation economy by the new administration, a large size supplemental budget will be possibly delivered.
1. Operation fee (Electricity, Operators, consumables, spares)
   - JAEA: 83 Oku-yen
   - KEK: 85 Oku-yen

2. J-PARC experimental facility and equipments
   - Muon beam line: KEK - 4-6 Oku-yen (1/5) Supple.?
   - High momentum beam line and COMET: KEK - 7.7 Oku-yen (1/3) new
   - Neutron Imaging BL: JAEA - 8.0 Oku-yen (2/3)
   - Polarized neutron BL: KEK - 2.9 Oku-yen (1/3) Supple.?

3. Improvement of user environment
   - User main building: JAEA - 6.5 15.0 Oku-yen (1/3) Supple.?
   - Access road: JAEA - 0.2 Oku-yen

4. ADS Development
   - ADS Target test facility → R&D: JAEA - 5.2 Oku-yen (1/4) new 1.5 Okuyen
Summary

- Under a slogan of full recovery from the damage due to the earthquake
  - User programs in progress extensively with powerful beam.
    - Finally, Hadron receive SX beams with 11 kW.
    - Neutrino has steadily accumulated events toward 5σ.
    - Neutron and Muon appreciates stable beam operation with 300 kW.
  - He bubble injection technique demonstrates effective PW mitigation.

- Next FY 2013
  - Linac: 400MeV energy upgrade, installation of Ion source, RFQ for 1MW
  - 6 cycles in user operation
  - Main building of user
  - Preparatory work for MW regime