Status of J-PARC, KEK, and Super-KEKB

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J-PARC

Joint Project between KEK and JAEA

Materials and Life Science Experimental Facility

Hadron Beam Facility

Nuclear Transmutation

Linac (350m)

3 GeV Synchrotron (25 Hz, 1MW)

Main Ring (>0.75 MW)

Neutrino to Kamioka

500 m
T2K (Tokai to Kamioka) neutrino long baseline experiment

• Discovery of $\nu_e$ appearance $\Rightarrow$ Determine $\theta_{13}$
  $\Rightarrow$ open a way to CPV in the lepton sector

~500 members, 62 Institutes, 12 countries
Milestones

• 1999: Nishikawa&Totsuka proposed to measure $\nu_e$ appearance as a next critical step toward CP measurement
• 2001: “The JHF-Kamioka Neutrino Project” report published
• April 2004:
  – Officially approved by Japanese Government and 5yr construction started
  – T2K international collaboration officially formed
• **March 2009: Construction completed as scheduled**
• April 23, 2009: First neutrino beam production and commissioning started
• **January 2010: Data taking for oscillation search started!**
• Feb. 24, 2010: First SuperKamiokande Event!
Started data taking for oscillation!

- Delivered # of protons: $2.34 \times 10^{19}$ (Jan-May)
- Continuous run @ ~50kW level
- Trial upto 100kW done
- Event time distribution clearly show beam structure
- Observed # of Fully contained events: 22
- Expected non-beam BG: $<10^{-3}$ evts
SK events

Single-ring $\mu$-like event

Pink diamonds are placed on the wall in the beam direction starting from the reconstructed vertex.

Two-ring event

Super-Kamiokande IV
T2K Beam Run 0 Seq11 953136
Run 66933 Sub 410 Event 26831422

Charge (ps)
- 28.0 - 28.7
- 20.2 - 23.2
- 17.3 - 20.2
- 15.7 - 17.7
- 13.8 - 15.7
- 10.0 - 12.7
- 0.0 - 10.0
- 0.7 - 0.8
- 5.3 - 6.2
- 4.3 - 4.7
- 0.7 - 0.8
- < 0.2

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Beam Lines & Experiments Ready at Hadron Hall

High Resolution Spectroscopy

\( \Theta^+ \) via \( p(\pi^-, K^-) \) reaction

Pentaquark \( \Theta^+ \)

KL Rare Decay
\( K^0_L \rightarrow \pi^0 \nu \nu \)

Strangeness Nuclear Matter

kaonic nuclei via stopped \( K^- \)

for Test Experiments

FM Magnet is ready!
Neutron; 12 in use, 3 under construction, 3 will start construction

Temperature dependence of the precise bondlengths (Ru-O) was obtained at BL08.

Multi-Ei measurement have been demonstrated for the first time (Nakamura et al., JPSJ 2009)

Small amount of high-pressure-synthesized sample can now be used for structure solution. FeAs superconductor was studied with only 0.05 cc at BL08.

Structure of the polymer/water interface could be observed within 2 hours.
J-PARC MUSE (Muon Science Establishment)

The world-most intense pulsed muon beam has been achieved at the proton power of 120 kW (since November 2009).

<table>
<thead>
<tr>
<th>Muon source</th>
<th>Number of $\mu^+$/pulse</th>
</tr>
</thead>
<tbody>
<tr>
<td>J-PARC MUSE</td>
<td>72,000@120kW</td>
</tr>
<tr>
<td></td>
<td>180,000@300kW</td>
</tr>
<tr>
<td>RAL ISIS (U.K.)</td>
<td>30,000@160kW</td>
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The first result from J-PARC: Insular superconductivity in Co-doped Iron-pnictides


Inside the matter

Superconducting phase develops only around Co atoms (blue dots).

SC phase

Mag. phase

Domain size $\sim$1 nm
Achievement of the B Factories

Discovery of CP violation in BB system

Belle, July 05

\[ B^0 \rightarrow J/\psi K_S \]

\[ \bar{B}^0 \rightarrow J/\psi K_S \]

Confirmation of KM mechanism

PDG2008
Possible hints for NP?

Difference in CPV between $B^0$ and $B^\pm$?

Anomalous CPV in $b \rightarrow s$ processes?

Anomaly in $B \rightarrow K^*ll$ decay?

Inconsistency in unitarity triangle?

Unexpectedly large $D^0\overline{D^0}$ oscillation?
SuperKEKB

- New beam pipe & bellows
- Replace long TRISTAN dipoles with shorter ones (HER)
- TiN-coated beam pipe with antechambers
- Redesign the HER arcs to squeeze the emittance
- Low emittance positrons to inject
- Damping ring
- Low emittance gun
- New positron target / capture section
- Add / modify RF systems for higher beam current
- New superconducting / permanent final focusing quads near the IP

Positron source

Colliding bunches

- New IR
- New superconducting / permanent final focusing quads near the IP

\[ L = \frac{\gamma}{2e r_e} \left( 1 + \frac{\sigma_y^*}{\sigma_x^*} \right) \left( \frac{l - \varepsilon_{xy}}{\beta_y^*} \right) \left( \frac{R_L}{R_y} \right) \]

x 40 Gain in Luminosity
Belle-II Collaboration has been formed

2004.06  SuperKEKB LoI
2008.01  KEK Roadmap
2008.03  1st Proto collaboration meeting
2008.10  Detector study report
2008.12  New collaboration, Belle-II, started
          ~300 collaborators from 43 institutions in 13 countries
~2010.3  5th open collaboration meetings
Summary

• J-PARC commissioning is under way. Data taking for the T2K experiment has started. Charged and neutral Kaons are observed for experiments at Hadron Hall. Neutron and muon beams are delivered for users at Materials and Life Science Facility (MFL).
• Preparation for Super-KEKB and Belle-II is ongoing.