

KEK/J-PARC-PAC 2008-5

7 June 2008

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

Minutes of the 5th meeting held on
Thursday, Friday and Saturday, 5-7 June 2008

OPEN SESSION (5-June-2008):

1. Beam line planning committee: K. Nishikawa (KEK)

SESSION at J-PARC(5-June-2008)

2. J-PARC Status: S. Nagamiya (J-PARC)
3. J-PARC accelerator report: T.Koseki (KEK)

OPEN SESSION (6-June-2008):

4. E15/E17 Report : M. Iwasaki (RIKEN)
5. E06 Report : J. Imazato (KEK)
6. E14 Report : T. Yamanaka (Osaka)
7. E11 Report : Neutrino Beam Line Status: A. Ichikawa (KEK)
8. E11 Report : D. Wark (IC London)
9. P21 Report (An experimental Search for Lepton Flavour Violating mu-e conversion):
Y. Kuno (Osaka)

CLOSED SESSION(5,6,7-June-2007):

Present: T. Bressani, A. Ceccucci, H. En'yo, A. Gal, K. Hagiwara, K. Inoue*,
J. Imazato (Secretary), T. Kishimoto*, T. Kobayashi (Secretary), T. Mori,
Y. Nagai, S. Nagamiya (J-PARC Center Director)*, S. N. Nakamura,
T. Nakano, K. Nishikawa (Secretary), N.Saito (Secretary), M. Shaevitz,
F. Takasaki (IPNS director)*, R. Tschirhart, K. Tokushuku (Chairperson),
H. Yamamoto.

*) Part of the time

1. PROCEDURE

The Director of IPNS, Fumihiko Takasaki welcomed the new members of the committee and thanked the outgoing members for their dedication and invaluable help during the initial period for the J-PARC PAC.

The minutes of the fourth J-PARC-PAC meeting (KEK/J-PARC-PAC 2007-21) were approved without correction.

The director of IPNS informed the committee on the progress since the previous PAC meeting. A task force has been set up for the P21 mu-e conversion experiment to develop a possible plan and schedule along with considering where to locate the experiment. It will be chaired by Satoshi Mihara (KEK). In response to the PAC's previous recommendation for the T2K experiment, KEK and J-PARC have developed a plan to reach 550kW MR operation by increasing the operation frequency and eventually up to 1.6MW operation after the LINAC upgrade. Following the PAC's recommendation, the E03 experiment was given stage-2 approval but the stage-2 approval for E14 is still pending. Also, IPNS has appointed a new associate professor to work for E14 and K0 beamline in order to strengthen these efforts.

The director presented the charge for the committee at this meeting. Since no new proposal was submitted since the last PAC meeting, the main tasks were to be:

- 1) The assessment of the progress of the approved experiments,

2. DISCUSSION ON J-PARC GENERAL STATUS

The PAC visited the J-PARC site on June 5th. The J-PARC director, Shoji Nagamiya welcomed the members and reported the progress since the last meeting. Prof. Tadashi Koseki gave a progress report on the accelerator commissioning.

- After the first extraction of the 3GeV beam from the Rapid Cycle Synchrotron (RCS) in October, the commissioning has been moving well ahead of schedule. In late February, the intensity reached 50kW. The single bunch power was 5kW/pulse, which demonstrated that 130kW operation is possible.
- The commissioning of the Main Ring (MR) started in May. On May 22nd, the 3 GeV single bunch injected from the RCS was successfully circulated and captured by the RF in the MR and then extracted to the beam dump.
- On May 30th, the first beam from the RCS was sent to the target of the neutron facility. The neutron beam in beamline number 10 (BL10) was detected with the time-of-flight measurement and used for a test experiment with a steel target. The neutron facility will open to users starting in December 2008.
- Beamline construction of the hadron facility is progressing. The first beam in the K1.8BR line is expected in December.
- Superconducting magnets for the neutrino beam line are being installed in the tunnel and fast extraction is planned to start in April 2009.
- The J-PARC center has received the report from the review committee set up by the government. This committee recommended strongly to start the energy recovery of the Linac immediately after the completion of the Phase I construction. JAEA submitted a partial budget request for this project for FY2008 which has been approved. A four year plan to complete the Linac energy recovery was made and submitted for FY2009.
- The major upgrades for J-PARC have been discussed in the J-PARC user steering committee, where the representatives from the four communities (High energy, Nuclear, Neutron, and Muon) are included. The steering committee is in the process of developing a roadmap for the future of J-PARC.

- On March 5-7th, The 4th International Workshop on Nuclear and Particle Physics at J-PARC (NP08) was held in Mito.

The PAC congratulates the J-PARC center for their successes in commissioning the RCS and MR and for the establishment of first beam in the neutron line.

After the presentations, the PAC visited the hadron facility, the neutrino beam line, the T2K near detector site and experimental facility for the materials and life science. The PAC is very impressed by the clear progress in every area and **congratulates the J-PARC team for the success that has come from all their hard work to complete these facilities.** The tour not only provided the PAC with a clear picture of the status of the many projects but also helped by giving additional knowledge of experimental details.

3. SUMMARY OF THE PARTICLE AND NUCLEAR PHYSICS FACILITIES AND APPROVED EXPERIMENTS.

K. Nishikawa summarized the layout of the beam lines in the hadron facility and the neutrino line, and the current approval status of the experiments. As described in the minutes of the first PAC meeting, a two stage approval scheme is used by the J-PARC PAC. In addition to these stage-1 and stage-2 approvals, the PAC has made one more category to indicate the priority in the slow extracted beam lines by specifying “day1 experiments”.

Currently, E11 (T2K) is the only stage-2 approved experiment in the fast beam line. In the slow extracted beam lines, 7 experiments have stage-2 approval. Five of them (E05, E13, E15, E17, E19) are categorized as the day-1 experiments with E05 having first priority over E13.

The beam time requested by the approved stage-2 experiments in the hadron hall totals 13537 hours: 5204 hours for the K1.8/K1.8BR line and 8333 hours for the KL beam line.

A possible schedule of the beam delivery to the each beam line is as follows: The K1.8BR line will be ready in December 2008. The K1.8 line will be operational in 2009. The K0 line commissioning can start in 2010. The other beam lines will not be available to users before 2011.

The PAC again discussed the priority of experiments and **has endorsed the previous decisions on the day-1 experiments and their priorities.** The PAC takes note of the late availability of some of the beam lines and would like to hear from the laboratory at the next meeting, the strategy and plan for the beam line completions. The PAC also notes that the beam line and facilities for test beam experiments (i.e. detector R&D studies) is not mentioned and would like to hear a plan for these test beam lines at the next meeting.

4. PROPOSAL EVALUATION

1. E15: (A Search for deeply-bound kaonic nuclear states by in-flight ${}^3\text{He}(K^-, n)$ reaction) and E17 : (Precision spectroscopy of Kaonic ${}^3\text{He} \rightarrow 3d \rightarrow 2p$ X-rays)

The E15 experiment aims to study the $\bar{K}N$ interaction through both invariant mass and missing mass spectroscopy of the $K\bar{p}p$ system. The spectrum shape is sensitive to the $\bar{K}N$ potential, and the experiment may give a definite answer to the existence of the deeply-bound kaonic nucleus. However, in the previous PAC meeting, it was reported that the missing mass resolution could deteriorate to ~ 34 MeV/c² (FWHM) because there was not enough space in the K1.8BR beam area and the neutron flight path would be limited to 8~10m.

The E15 group reported a new layout of their detector in order to secure a 15-m neutron flight path which is necessary for the desired ~ 20 MeV/c² missing mass resolution. By inserting an extra dipole magnet in the K1.8BR beam line, the TOF can be located at ~ 15 m from the target. The reduction of the kaon yield due to the extra length in the beam line is 30%, but this is not expected to have any adverse impact on the E15 experiment. The beam channel group confirmed that this solution appears feasible. **The PAC encourages the group to adopt this new baseline layout** and make sure to keep good communication with the beam channel & hall group for its implementation.

The R&D status of the ${}^3\text{He}$ target, CDC, and other detector components was reported and appears to be on schedule. Beam tuning will be started as soon as the slow extraction beam becomes available at K1.8BR in late 2008. The E17 experiment will be ready in the spring of 2009, and the E15 experiment will be

ready in the summer of the same year. Both experiments will be carried out sequentially with the same ^3He target.

2. **P21: An experimental Search for Lepton Flavour Violating mu-e conversion (The COMET experiment)**

This proposal aims to improve the experimental sensitivity to mu-e conversion by 4 orders of magnitude over the current value which enters well into the region of branching fractions expected by many well-studied new physics models such as SUSY-GUT. As such, it could become one of the flag-ship experiments at J-PARC. Also, the muon source could be common with a future PRISM-type experiment which would improve on the COMET sensitivity by an additional two orders of magnitude using a muon storage ring.

At this meeting, the PAC heard a report from the P21 proponents that addressed some of the questions raised in the previous PAC meeting. At this preliminary stage, information is just starting to become available and the PAC looks forward to more detailed information from the collaboration and laboratory at future meetings addressing the present and past PAC questions.

The experiment needs extensive engineering support and requires direct involvement and commitment by the laboratory. Thus, the laboratory management needs to work with the COMET collaboration to develop a realistic overall design, set of milestones, schedule, and funding plan, including where and how to locate the experiment. In particular, at this stage of the development efforts should be focused on a realistic design of the muon source and the related accelerator and beam line issues which are naturally a joint responsibility of the collaboration and laboratory.

In this respect, **the PAC welcomes the formation by the laboratory of the Muon Task Force** that will study the issues for the accelerator operation and high-power muon source required by the experiment. The PAC also notes that a voluntary group of particle and accelerator physicists beyond the framework of the COMET collaboration has started to work on developing the muon source design.

The PAC thus would like to hear the following reports at the next PAC meeting: 1) A report from the muon task force on the study of the accelerator and muon source and 2) A R&D plan with milestones developed by the collaboration in conjunction with the laboratory for the experiment. A notable element of these reports is the

plan for demonstrating the inter-pulse extinction that is critical to the success of the experiment.

The PAC acknowledges that there is international collaboration and interest for the extinction hardware design, and encourages further international collaboration in the demonstration of this critical design parameter as well as other R&D aspects important for the experiment.

3. E14: Proposal for $K_L \rightarrow \pi^0 \nu \bar{\nu}$ Experiment at J-PARC (The KOTO Experiment)

The physics remains compelling and the phase 1 experiment is likely to reach single event sensitivity corresponding to the standard model. In doing so, indications of new physics may be encountered in the form of a branching ratio larger than what is expected by the standard model.

The proponents have made good progress in addressing previous questions from the PAC. In particular good progress has been made to reduce the ratio of halo to core neutrons by adjusting the beam line design. The neutral beam geometry is complicated by the expected presence of the K1.1 beamline. We encourage the formation of a design team that includes members of E14, E06 and the beam channel staff which is charged to develop a reference design to serve both experiments. Careful studies of the beamline installation procedure are needed to make sure that irradiated components do not cause problems in the actual construction of the K1.1 beamline, particularly if this construction is delayed. The PAC would like to hear a report from this design team at the next meeting.

A reasonable plan of the beam survey has been presented, even though some details such as the design of the neutron detector and the analysis techniques are still to be worked out. Continued studies of beam backgrounds, however, are needed to make sure that there are no major sources of backgrounds that have been missed.

The proposed neutral beam survey is well motivated and is the clear next step for the experiment to make progress. The conceptual design of the beam survey is sound, although some of the details remain to be worked out. The proponents estimate the cost of the beam line components required for the beam survey to be about 100 million yen. **The PAC recommends that the laboratory secure the funds to support this beam survey.**

4. **E06: Measurement of T-violating Transverse Muon Polarization in $K^+ \rightarrow \pi^0 \mu^+ \nu$ Decays (The TREK Experiment)**

E06 is a unique experiment in which physics which violates the time-reversal symmetry is looked for by observing the asymmetry of the muon spin normal to the kaon decay plane, which changes sign under the time reversal operation. If the experiment observes a non-zero asymmetry, this not only signals the existence of new physics but would also be recognized as the first experiment to discover new physics via a T-violation phenomenon. The improvement by a factor of 30 over the previous experiments makes the physics reach of the experiment significant and complementary in the LHC era. This experiment is also uniquely feasible at J-PARC.

The proponents presented an update on the systematic errors induced by the detector and magnetic field misalignments, which showed that the expected misalignments would be acceptable. A study of a combined-function magnet proposed in the previous meeting to increase the acceptance was presented. It is found to be incompatible with the possible future operation of the downstream beam line at 1.1 GeV/c momentum.

The PAC appreciates the progress presented on the detector R&D. The PAC was impressed by the results of the analysis of the systematic error due to the polarimeter misalignment: the presented results, based on a high statistics Monte Carlo simulation, indicate that the systematics can be kept within the level of the proposed experimental sensitivity.

There has been some progress on funding from Japan and the money to build the polarimeter chambers is secured. Some support from Canada to continue the R&D has been approved. The total amount of secured funds is, for the time being, only a small fraction of what is needed to perform the experiment. Even though the PAC supports that E06 should go forward at J-PARC, more progress will be needed on this front before a Stage-2 approval recommendation can be granted.

Despite the current state of detector funding, **the PAC recommends that the laboratory try to install the upstream beam line elements that might be difficult to install once nominal operation of the T1 target starts.** Such an investment will help the proponents in securing funding from domestic agencies and international partners.

If the installation of the entire K1.1 beamline is delayed, one should make sure that the effect of beam line component irradiation induced during the early running of the T1 line does not prevent the eventual installation for E06.

5. E11: Tokai-to-Kamioka Long Baseline Neutrino Oscillation Experimental Proposal (The T2K experiment)

The PAC heard two reports from the T2K collaboration; one describing the status of the neutrino beamline construction and one describing the status of the T2K detectors. For the beamline, the construction is expected to be completed at the end of March and will be followed by the first neutrino beam in April, 2009. The primary proton beamline to the neutrino production target will be completed in November, 2008 and all magnets will be energized in February, 2009. The target and horn installation will take place in January with final commissioning in March, 2009. One possible worry is associated with the maintenance of the high intensity horn systems used downstream of the neutrino production target. Such systems have been subject to failure in past experiments so one need to have spare horns and well tested remote replacement methods in case of failure. Overall, the installation and commissioning plans look to be well organized and the T2K beam work is proceeding on schedule. The collaboration and laboratory reiterated their goal to provide 100 kW of beam to T2K for 10^7 seconds by the summer of 2010. **The PAC commends the T2K collaboration and laboratory for the progress on the beamline and the accomplishments made over the past six months.**

For T2K, the mechanical upgrade of the far SuperK detector has been completed and the new electronic readout and data acquisition will be completed by October, 2008. The new electronics will allow deadtimeless recording of all hits during the J-PARC beam spill with improved dynamic range. The analysis organization for the joint SuperK and T2K collaborations has now been worked out for software development and data sharing. The PAC notes that there are some issues associated with archiving the ND280 data at KEK due to the problems with network connections between JAEA(Tokai) and KEK(Tsukuba); hopefully, this will be worked out among the two laboratories. The main detector project remaining is the construction, installation, and commissioning of the 280m near detector (ND280). The experimental pit for ND280 was completed in March, 2008 and installation of the detector was immediately started. The UA1/NOMAD magnet is currently being installed. Funding for all ND280 detector components are almost

secured and construction for all systems is underway. There is still some uncertainty for the UK funding but the collaboration has plans to make sure that this does not impact the schedule. The MPPC photo detectors, which were of some worry as to availability and performance, are now well in hand. All ND280 detector elements should be installed and commissioned by December, 2009 and first neutrino results are expected about a year later. The analysis software is under rapid development and first integrated simulation results were promised for the next PAC meeting. **The PAC was impressed with the progress of T2K in general and especially with respect to the ND280 detector. The PAC looks forward to reports of continued progress at the next meeting in October including a list of high-level milestones for tracking the project in this crucial final phase.**

5. PROCEDURE OF THE APPROVAL OF SMALL EXPERIMENTS

In response to the charge of the IPNS director, the PAC discussed the approval procedure for small experiments such as beam time requests for detector R&D. The PAC considers that the evaluation and approval of detector R&D experiments can be done in a committee set up by J-PARC and IPNS. The PAC, however, would like to hear periodic reports at the PAC meetings in order to make sure that the plan does not conflict with the primary physics program at J-PARC.

6. DATE FOR THE NEXT J-PARC PAC MEETING

The date for the next meeting is 16-17 October 2008. The tentative agenda is;

- Status report on J-PARC
- Report from the muon task force
- Strategy on the beam line completion in the hadron facility, including a plan for a test beam line.
- Status report from the T2K, KOTO and TREK experiments

The 7th meeting date is set to 6-7 March 2009.

7. FOR THIS MEETING, THE J-PARC PAC RECEIVED THE FOLLOWING DOCUMENTS:

- Minutes of the J-PARC PAC meeting held on 7-9, January 2008 (KEK/J-PARC-PAC 2007-21)
- Progress Report to the 5th J-PARC PAC meeting by the E06 (TREK) Collaboration (KEK/J-PARC-PAC 2008-1)
- Extinction Measurement of J-PARC Proton Beam by the COMET collaboration (KEK/J-PARC-PAC 2008-2)
- J-PARC E15 status report by the E15 Collaboration (KEK/J-PARC-PAC 2008-3)
- Status report of liquid ³He target for J-PARC E15/E17 experiments (KEK/J-PARC-PAC 2008-4)