KEK/J-PARC-PAC 2014-17
May 16, 2014

J-PARC Program Advisory Committee

for the Nuclear and Particle Physics Experiments

at the J-PARC Main Ring

Minutes of the 18th meeting held on
14(Wed)-16(Fri) May 2014

OPEN SESSION (14-16 May 2014):

1. Welcome and Mandate to the committee:	M. Yamauchi (KEK)
2. J-PARC Center report:	N. Saito (J-PARC/KEK)
3. J-PARC accelerator status & plan:	T. Koseki (J-PARC/KEK)
4. E14 (KOTO):	T. Yamanaka (Osaka)
5. E11 (T2K) Current status of T2K: Beamline and Detector Status, and Analysis Results	T. Nakaya (Kyoto)
6. E11 (T2K) Physics Goals and Beam Time Request	C. K. Jung (Stony Brook)
7. P58 A long Baseline Neutrino Oscillation Experiment Using the J-PARC Neutrino Beam and Hyper-Kamiokande	M. Yokoyama (Tokyo)
8. E40 (Σ-p scattering)	K. Miwa (Tohoku)
9. Address from the J-PARC center	Y. Ikeda (J-PARC)
10. High-p/COMET beam line construction status	K. Ozawa (KEK)
11. E16 (electron pair spectrometer)	S. Yokkaichi (RIKEN)
12. E21 (COMET)	Y. Kuno (Osaka)
13. E34 (μ g-2/EDM)	T. Mibe (KEK)
14. P56 (sterile ν search)	T. Maruyama (KEK)

15. Hall floor plan in 2014-2015 and Hall floor plan in 2014-2015 and Charged Kaon yield with 24GeV/c beam — T. Takahashi (KEK)
16. FIFC report — S. Uno (KEK)
17. E36 (Lepton universality) — S. Shimizu (Osaka)
18. E13: HF target requirement — H. Tamura (Tohoku)
19. E15 (Deeply-bound kaonic nuclear states) — M. Iwasaki (RIKEN)
20. P50 (Charmed baryon spectroscopy) — H. Noumi (Osaka)
21. P57 Measurement of the strong interaction induced shift and width of the 1s state of kaonic deuterium at J-PARC — J. Zmeskal (SMI)
22. Update of the Hadron Hall accident survey — S. Sawada (KEK)
23. Safety improvement of Hadron Experimental Facility — T. Komatsubara (KEK)
24. New target design and plan — H. Takahashi (KEK)

CLOSED SESSION (14-16 May 2014):

Present: E. Blucher (Chicago), T. Browder (Hawaii), A. Dote (KEK), S.I. Eidelman (BINP), J. Haba (Chair/KEK), K. Hanagaki (Osaka), T. Hatsuta (RIKEN), K. Imai (JAEA), G. Isidori (UZH), W. Louis III (LANL), H. Sakurai (RIKEN), H. Shimizu (Tohoku), K. H. Tanaka (IPNS Deputy Director), K. Tokushuku (IPNS Deputy Director), M. Yamauchi (IPNS Director), W. Weise (ECT), K. Kleinknecht (Mainz)*, T. Nagae (Kyoto)*

Apologies: K. Inoue (Tohoku), W.A. Zajc (Columbia) T. Kishimoto (Osaka)*, M. G. Perdekamp (Illinois)*

*Departing members

1. PROCEDURE

The minutes of the seventeenth J-PARC-PAC meeting (KEK/J-PARC-PAC 2013-16) were approved.

2. REPORT FROM THE IPNS DIRECTOR

The IPNS director, Masanori Yamauchi, welcomed the PAC members.

He first summarized the financial situation of J-PARC. The operation budget for J-PARC in JFY2014 has been reduced by 13% compared to JFY2013. However, 2.6 oku yen is still needed for the completion of hadron hall renovation while the entire J-PARC facility must absorb a ~20% increase in the cost of electricity. As a result there may be a delay in the hadron hall construction schedule and in the MR power supply upgrade, reduced machine operation time and the need to operate the MR at lower energy (24 GeV rather than 30 GeV). There are two critical issues: how can the operating funds be recovered in JFY2014 and what will be the solution for the long-term future. The KEK directorate is making every effort to solve this problem.

He then summarized the developments since the last PAC meeting. These include: good progress on the renovation of the hadron hall, formation of a new group of beam line experts, the selection of the J-PARC upgrade plan by the Science Council of Japan as one of the 27 high priority projects. In addition, the Facilities Impact and Finance Committee（FIFC）has been reactivated.

The accelerator operation schedule before Summer 2014 was shown; the beam time from May 16 until the end of June is allocated to the neutrino program.

On this occasion, Director Yamauchi defined the cases in which a technical design report (TDR) is required for an experiment. When the PAC approves stage-1 status, it may request a TDR from the collaboration for further review, especially for proposals for large-scale experiments. The PAC may, in addition, request a detailed technical review from the FIFC if necessary. He also noted that the FIFC will review safety issues for all proposed experiments before giving the go-ahead for construction.

He mentioned the current status of the test beam facility. Because there are so many approved experiments waiting for beam, IPNS has to set lower priority on the test beam facility although there are several plans in the list. The test beam facility is thus unlikely to be available before 2017.

Finally, the Director summarized the issues to be reviewed at the meeting:

1) The schedule of the E36 experiment.
2) Planning of the hadron hall floor especially in the K1.8 area where many experiments are scheduled with various spectrometers magnets including the SKS, Kurama and S2S.
3) Progress of the hadron hall renovation.
4) Progress of experiments executed before May 2013: E11 (T2K), E14 (KOTO) and E15 (kaonic nuclear structure).
5) Physics program for the near future including E11 (T2K) and experiments at the high-p beamline, E21 (COMET) and E34 (gm-2/mEDM) at the MLF.
6) Necessity of the HF target for the E13 experiment.
7) Scientific merit and feasibility, results of background study of P56 (Search for a sterile neutrino at the MLF).
8) Evaluation of stage-2 approval for E40 (Σ-p scattering) and E16 (Electron pair spectrometer).
9) Evaluation of two new proposals: 1) strong interaction induced shift and width of the 1S states of kaonic deuterium, and 2) Hyper-Kamiokande.

Finally, Yamauchi presented a possible run plan in JFY2014 after Summer 2014, in which beam time for November and December is allocated to FX and that for January and February is allocated to SX. MR operation in March is unlikely without additional funds.

3. REPORT FROM THE J-PARC CENER

The J-PARC Deputy Director, Naohito Saito, presented the progress of the J-PARC organization since the hadron hall accident in 2013. A new Deputy Director for safety (Prof. Mamoru Baba) has been appointed at the J-PARC center. J-PARC has strengthened its safety division and renewed the safety management system. Based on this new organization J-PARC faced a local government review panel along with an on-site inspection of the J-PARC facility by the panel. Explanatory meetings for local residents were also organized to rebuild their trust in J-PARC.

He mentioned two review panels related to J-PARC particle and nuclear physics activities. One panel reviewed the design of the hadron hall renovation and the other panel is the International Advisory Committee for the J-PARC center. The outcomes of these reviews will be taken into account in the planning of future activities at J-PARC including the renovation work of the hadron hall.

He explained the status of the facility including the budgetary situation for this fiscal year. The LINAC energy upgrade to 400 MeV has been successfully completed. User operation of MLF resumed on 21st February and 300 kW operation of RCS has already been established. The neutrino facility will start operation shortly.

The budget allocated this fiscal year corresponds to the MR operation for 123 days implying a serious deficit to execute the scheduled programs. The possibility to operate the Main Ring for slow extraction (SX) at 24 GeV instead of 30 GeV is being considered to expand the operation period with reduced electricity consumption. The operation budget will remain a serious issue for this fiscal year.

4. REPORT ON THE J-PARC ACCELERATORS

The head of the J-PARC accelerator division, Tadashi Koseki, reported on the status and plan for the accelerators.

Characteristics of each accelerator, such as the J-PARC LINAC (LINAC), the Rapid Cycle Synchrotron (RCS), and the Main Ring (MR) were summarized. The beam power levels achieved so far in user operation of the MLF, fast extraction (FX) and slow extraction (SX) are 300 kW, 240 kW, and 24 kW, respectively.

The status of the operation of each accelerator was summarized. The LINAC was successfully upgraded to 400 MeV with the newly installed ACS system. The RCS successfully received 400 MeV beam and then accelerated it to 3 GeV. Beam loss was well managed up to beam power of 560 kW. MLF user operation resumed on February 17th, 2014. The MR started beam studies on March 24th. Beam delivery to the neutrino beam line started in May.

The final result of the investigation of the last accident in the SX was explained. A malfunction of the Extraction Quadrupole magnet (EQ) power supply (PS) triggered the accident. This occurred due to a fault in the control signal transmission of the PS, which has been repaired. Three preventive measures have been adopted for the power supply so as not to extract beam during a very short time interval.

A possible operation plan in JFY2014 was presented. For the MLF, beam power will be 300 kW before the summer of 2014 and higher power in the 300 - 600 kW range can be reached after November 2014. In addition, demonstration of 1 MW equivalent beam power is planned in October 2014. For the T2K experiment, beam power will be 200-300 kW in JFY2014. For the hadron experimental hall, user operation will be possible in the winter of JFY2014 after completion of repairs/improvement of the hadron hall. Note that the operating budget for the MR in JFY2014 has not been fully

secured yet. For longer beam operation, running the MR at a beam energy of 24 GeV is now considered for SX.

The five year mid-term plan was presented. The RCS will deliver 1 MW beam in 2015. The MR will be able to deliver the beam at the power up to 750 kW for the T2K experiment, and 100 kW for the hadron hall experiments in 2017. The basic scenario to achieve the 750 kW beam power is a higher repetition rate of 1 Hz at 30 GeV. R&D for magnet power supply operation at 1 Hz is on-going; this work is now making good progress.

5. ADDRESS FROM J-PARC CENTER

The J-PARC Center Director, Yujiro Ikeda, described the situation at J-PARC. He first summarized major events in the last year, which include the hadron hall accident on May 23, 2013, observation of ν_e appearance in July 2013, a successful LINAC energy upgrade, and resumption of facility operation. He highlighted the renovation work of the hadron hall, which will improve safety. He then summarized the work plan for J-PARC in JFY2014. This plan includes full recovery of the hadron facility, stable operation of 5 to 6 cycles for the MR, reinforcement of J-PARC safety management, demonstration of a 1 MW beam at the MLF, a progress review by the MEXT for the MR power supply. Completion of a user building and a new dormitory is also planned in this JFY. He presented a beam power upgrade plan: 750 kW at the MR is anticipated in JFY2018.

6. High-p/COMET beam line construction status

Kyoichiro Ozawa reported on the status of construction of the high-p/COMET beam line. Activities after the last PAC meeting were reported. To ensure a safe beam line, two external reviews were organized. The first one was a review of the target system and related matters; here, the design of the new beam line was briefly reviewed. There was then a second dedicated review for the High-p/COMET beam line, which was held on January 30th. Both review committees provided positive feedback and useful advice.

To enhance the physics menu at the new beam line, several workshops were held at Tokai. Discussions of new experiments and physics using the planned E16/P50 spectrometers were started. In addition, discussions with the heavy ion-physics community were also initiated.

The design and construction status of the new beam line was explained. The design satisfied the requirements of providing two beams, namely a primary beam and a

COMET beam. Several safety evaluations were performed after the last PAC meeting. These evaluations showed that the current design satisfied the requirements of radiation safety. The remaining issues are providing a realistic alarm algorithm and operation plans.

7. Hall floor plan in 2014-2015 and Charged Kaon yield with 24GeV/c beam

Toshiyuki Takahashi presented a plan for the hadron hall floor usage in the coming years. When hadron beam operation restarts, the K1.8, K1.8BR and KL areas will be almost the same as those at present and before the accident. Experimental programs that were planned for last year will be continued; E13 (gamma-ray spectroscopy of 4-Lambda-He and 19-Lambda-F) and beam tuning for E07 (emulsion experiment) at K1.8, E15 (search for K-pp) and the pilot run of E31 (Study of Lambda(1405)) at K1.8BR, and KOTO at KL. In addition to the above experiments, a toroidal spectrometer will be installed at K1.1BR and the E36 (lepton universality) experiment can be carried out up to the middle June 2015 before the summer shutdown. In JFY 2015, the SKS at K1.8 will be replaced by the KURAMA spectrometer for E07 and other experiments. On the south side, new beam lines, high-p and COMET beam lines will be constructed.

Takahashi also presented the charged kaon yield expected for 24 GeV operation estimated using the Sanford-Wang Parameterization. The calculation without kinematical reflection predicts a K^- intensity at 24 GeV that is about 70% of that at 30 GeV. If the kinematical reflection effect is included, this value increases to 80%, 88% and 93% for 1.8, 1.5 and 1.0 GeV/c, respectively. The calculation including the kinematical reflection seems more appropriate since it reproduces the kaon momentum dependence measured at the D6 line of the AGS. The K^+(0.8 and 1.0 GeV/c) yield at 24 GeV is larger than that at 30 GeV for the calculation with the kinematical reflection effect, while the calculation without the kinematical reflection effect gives a ratio (24 GeV to 30 GeV) of 63%.

8. FIFC report

Shoji Uno reported on the Facilities Impact and Finance Committee (FIFC). He introduced the roles and members of the FIFC. The mandate of the FIFC has been recently renewed; new members have been appointed and discussion of the safety of proposed experiments is now included. He explained the discussions at the last meeting on March 24th, 2014 at which the status and schedule of the hadron hall and T2K

experiments were reviewed with particular emphasis on the E31 deuterium target, the E13 liquid hydrogen fluoride (HF) target and the E36 experiment. The FIFC has submitted a report on the meeting to the IPNS director on April 30th.

Uno explained that the E31 liquid deuterium target containing 440cc deuterium in a PET container with a CRFP vacuum cylinder as a buffer tank can be operated safely in the hadron hall based on past experience with liquid hydrogen target operation in the hall. Even in the case of an unexpected leak from the PET container, deuterium is safely transferred to an evacuation line in the hall with $5m^3$/min air flow. The FIFC recommends that the E31 group prepare an instruction manual and provide information to all users in the hall during target operation. Continuous air from the target to the evacuation line is mandatory to enhance safety. Uno mentioned the FIFC discussions on the E13 liquid HF target. The E13 group proposes to use 900g of Liquid HF contained in a double wall structure target cell. He pointed out concerns about the target, particularly the thin Teflon bag of the cell. He concluded that the FIFC recommends establishing a dedicated sub-committee with professional members to deal with further evaluation of the safety of the target. He also requested discussion of the necessity of liquid HF in the experiment at this PAC meeting from the viewpoint of physics significance. Finally he provided a recommendation to the E36 group from the FIFC: because the construction and operation schedule is tight, the group should communicate with the facility groups and define a schedule with contingency.

The next FIFC meeting is scheduled provisionally for Summer 2014.

9. Updated of the hadron hall accident survey

Shinya Sawada reported the results of the observation of the gold target, used as the T1 production target and thought to be damaged by the accident last year, by a video scope in December 2013. The results confirmed the target temperature analysis and are quite consistent with the expectations from the model scenario of the accident. In addition, leakage routes of radioactive materials from the primary beam line to the Hadron Hall were investigated by smear tests of radioactivity. The results imply that the main leakage routes are the K1.1BR beamline and the P5 and P4 penetration structures. The radiation level around the target structure turned out to be acceptable for target replacement work.

10. Hadron Hall safety improvement

Takeshi Komatsubara reported on the safety improvement plan for the Hadron Experimental Facility (HEF). He pointed out three issues to be worked on: "hardware" (renovation), "software" (safety management system), and "safety culture" (to complete the renovation work safely). Since the last PAC meeting [September 2013], the Task Force for renovation was formed [October], an International Review Committee met to discuss the renovation and follow-up meetings were held [October 8,9 and January 29, respectively], and the gold target was observed through a fiber scope to confirm the extent of the damage [December 13, 14]. The Review Committee discussed the upgrade scenarios for Slow Extraction beam operation at 50 kW and a few 100 kW. Full-scale renovation work started in January 2014: the exhaust fans of the Hall have been removed and sealed, an improved ventilation system with a monitor and a stack as well as a truck yard are ready. In order to improve air-tightness of the primary beam line, work on the middle part of the upper shielding (ceiling) in the Hall was done; the work on the downstream part as well as on the exits to secondary beam lines and the radiation monitoring inside the Hall is now in progress. Replacement of the target is currently scheduled for September; the renovation work will be completed toward the end of the calendar year 2014. In parallel, the new South Building and Utility Buildings #1 and #3 are being constructed.

11. New target design and plan

Hitoshi Takahashi reported on the new design of a production target system at HEF. He presented the results of thermal analysis of the target material, for which two possible options were discussed for the material, gold and tungsten. To have design margin in normal slow extraction with 50kW beam power and to avoid possible risk caused by a short beam pulse, he and his group decided to adopt gold as the new target material. He also presented the results of dynamic thermal analysis on beam windows, which showed that the windows have sufficient strength even for short beam pulses. For 24 GeV operation, he showed both target material and beam windows are capable of handling 24 GeV-50kW beam. The target replacement is scheduled for September, and the hadron group will proceed with more R&D for the next generation target.

The hadron group’s plan for countermeasures was reviewed by several layers of committees, including the External Expert Panel at J-PARC, the Nuclear Regulation Authority (NRA), and an Ibaraki prefecture committee. Technical details were investigated in depth by the target system review committee October 8- 9, 2013, and on January 29, 2014. This committee endorsed their plan.

12. EVALUATIONS OF THE PROPOSALS AND STATUS OF THE ONGOING EXPERIMENTS

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

The committee heard a report on the status of the KOTO experiment. As described at the last PAC meeting, the experiment accumulated 100 hours of data (~1.6×10^{18} POT) before the radiation accident, 1/5 of the exposure planned with a goal of reaching the Grossman-Nir bound. Although results from this first analysis will not be shown until late summer 2014, many impressive data-MC comparisons were provided, demonstrating an excellent understanding of the detector performance. The PAC looks forward to the first analysis, which will give a first indication of potential background issues, and may improve on the E391a bound.

The collaboration requests 2000 kW-days of beam (24kW×83 days) before summer 2015 with a goal of reaching a sensitivity a factor of 2 below the Grossman-Nir bound. The PAC endorses this goal. The proposed running at a beam energy of 24 GeV is not optimal for KOTO (having a poorer K-n ratio), but is acceptable for this run. Work on the new inner barrel veto, planned for installation during the summer of 2015, is progressing well. The collaboration will be ready for high-intensity running following installation of this detector.

2. **E11:** Tokai-to-Kamioka Long Baseline Neutrino Oscillation Experiment (The T2K experiment)

After collecting 6.57E20 protons on target (POT), representing only 8% of its goal, T2K has made the world's best measurements of electron-neutrino appearance and muon-neutrino disappearance at the atmospheric neutrino mass scale. It is intriguing that the T2K measurement of electron-neutrino appearance is somewhat larger than expected from the reactor neutrino measurement of θ_{13} in the limit of no CP violation in the lepton sector. This discrepancy could be just due to a statistical fluctuation; however, it could also indicate CP violation or some other exotic physics in the lepton sector. In addition to the oscillation measurements, T2K is making important neutrino cross section measurements. For the future, T2K will also perform tests of Lorentz and CPT invariance and searches for sterile neutrinos and other physics beyond the Standard Model.

T2K began data taking a week after the J-PARC PAC review. The horns, power supply, and target have been replaced, which will allow higher intensity beam, the ND280 near detector has undergone maintenance, and the data analysis continues to improve with lower backgrounds and lower systematic errors. The run plan is to start up in neutrino mode and then to switch over to anti-neutrino mode through the end of June. For the subsequent run from October 2014 to June 2015, T2K requests a total of 0.4E20 POT in neutrino mode and 4.0E20 POT in antineutrino mode. Studies have shown that approximately equal POT in neutrino and antineutrino modes is optimal for the search for CP violation. With this additional data, T2K may be able to obtain the best measurement of muon antineutrino disappearance parameter at the atmospheric mass scale and has the possibility of enhancing the significance of CP violation in the lepton sector, which would be both remarkable achievements.

The committee strongly supports the request by T2K for a total of 4.4E20 POT in the running period from October 2014 to June 2015. T2K is statistics limited with a systematic error much smaller than the statistical error. These additional data will allow T2K to make a direct search for neutrino CP violation, by comparing neutrino and anti-neutrino oscillations, and to remain competitive with the NOvA experiment at Fermilab, which has begun taking data. T2K is complementary to NOvA, as the two experiments have much different baselines, and the best neutrino oscillation and CP violation sensitivities for the next decade will be obtained from a combined analysis of the T2K, NOvA, and reactor neutrino experiments. T2K is one of the flagship neutrino experiments in the world, and now that the experiment and data analysis are performing well, continued running of T2K towards its goal of integrating approximately 8E21 POT remains a high priority.

3. **P58:** A long Baseline Neutrino Oscillation Experiment Using J-PARC Neutrino Beam and Hyper-Kamiokande

P58 is a proposal to build a 1 Mton water Cherenkov detector, HyperK, near the existing SuperK detector and to expose it to the J-PARC neutrino beam. With a volume 25 times the size of the SuperK detector, HyperK would collect approximately 5000 electron-neutrino appearance events and cover 76% of the CP-violation phase space in the lepton sector at >3σ and 58% of the phase space at

>5σ after 10 years of running with the 750 kW J-PARC neutrino beam. In addition, a new ~1 kton near detector would be built at a distance of 1-2 km from the production target. In addition to measuring neutrino oscillations with accelerator neutrinos and atmospheric neutrinos, HyperK has a rich physics program that also includes searches for nucleon decay, sensitivity to supernova neutrino bursts, and the measurement of geo-neutrinos.

In order to maintain progress in the development of the proposal, P58 requests Stage 1 status, official recognition by J-PARC/KEK, and registration as J-PARC users. The committee recognizes the importance of the physics goals of the experiment and supports detector and beam R&D. The committee recommends that user support be given to scientists working on P58 R&D; however, the request for Stage 1 status is premature. The committee encourages the collaboration to carry out R&D to enhance the physics performance beyond the simple extension of beam power and detector volume. Increasing the neutrino yield per unit beam power or further improvement in the photon detector (larger area or better timing resolution) should be investigated.

For the next PAC meeting, the collaboration should report on comparisons between HyperK and LBNE and on their examination of other types of photon detectors. The PAC also encourages the collaboration to consider further extensions of the physics program, evaluating, in particular, the sensitivity to non-standard neutrino interactions (higher-dimensional operators, sterile neutrinos, etc.).

4. **E40:** Measurement of the cross sections of Σp scatterings

A status report on the measurement of the differential cross sections of Σ^+p and Σ^-p elastic scattering and $\Sigma^-p<->\Lambda n$ inelastic scattering was given. E40 provides fundamental data to understand hyperon-nucleon interactions needed to study hyperons not only in hyper-nuclei but also in neutron stars.

The 12th J-PARC PAC recommended (i) R&D for the fiber tracker system including the readout should be completed, (ii) operation of the detector system in a high beam rate environment at ~$1x10^7$/s is a key issue to be addressed, (iii) the rate capabilities of the calorimeter should be studied, and (iv) a realistic detector design should be provided after completing R&D for the detector systems. The

collaboration has fully responded to requests (i)-(iv) to a certain degree, continuing R&D for the detector system even after the J-PARC beams became unavailable at the Hadron hall. The PAC recommends reexamining the design of the BGO calorimeter so as not to lose detector acceptance for outgoing protons.

Before Stage-2 approval, the PAC encourages the collaboration to update the physics motivation of the Σp scattering experiments and to place much more emphasis on modern and rapidly developing theoretical approaches to baryon-baryon interactions based on chiral effective theory and lattice QCD. In addition, a complete simulation of the final configuration with the KURAMA spectrometer should be presented.

5. **E16:** Electron pair spectrometer at the J-PARC 50 GeV PS to explore chiral symmetry in QCD

This project involves the design of an electron pair spectrometer with the primary aim of measuring the modification of the φ meson mass in a series of nuclei. The experiment will be performed using the high-p beamline under construction at the hadron hall, providing 10^{10} protons per pulse at 30 GeV. The statistics reached in these measurements is expected to exceed those of the previous KEK experiment (E325) by two orders of magnitude.

Following Stage-1 approval in 2007, the collaboration has been working intensively on the detector system consisting of a GEM tracker, a hadron-blind detector and a lead-glass calorimeter. Tests were performed using electron and pion beams. The read-out electronics has also been installed and partly tested. The E16 team responded to the recommendations of the previous PAC meeting and submitted a detailed TDR including descriptions of the detector design and operation, together with an assessment of the budget situation.

The PAC was positively impressed by the overall technical progress. A few issues remain still to be addressed, such as possible background from conversion decay such as $\phi \rightarrow \pi^0 e^+ e^-$, and the calibration of the experimental line shape. The question of translating signals of φ mesons produced at high momentum into mass distributions characteristic of φ mesons at rest in the nuclear medium should also be addressed. These points should be included in a revised TDR.

The previous PAC report had recommended clarifying the underlying motivation of the measurements, by avoiding direct reference to ambiguous notions such as “mass shift” and “mass dropping”. The principal idea of measuring modifications of the ϕ meson spectral function in a nuclear environment is a well-founded motivation as it stands, and this should be expressed both in the title of the project and in a correspondingly improved version of the TDR. The committee recommends consulting or working with theorists in this area of research. An updated presentation should be given at the next PAC meeting before Stage-2 approval.

6. **E21**:An Experimental Search for $\mu - e$ Conversion at a Sensitivity of 10^{-16} with a Slow-Extracted Bunched Beam (COMET)

On May 8, 2014 proton beam operation at 8 GeV was tested at the Main Ring. Emittance was measured to be smaller than the acceptance and proton extinction of 1.1×10^{12} was demonstrated.

An external technical review was successfully held in January 2014 and resulted in a few general recommendations. To achieve the targeted muon intensity, a focused review of the proton target, pion focusing, muon transport and muon stopping target should be organized with relevant experts in beam physics, high intensity targets and superconducting magnets in a high radiation environment. The beam background measurement program should be more precisely defined. The two-phase strategy for COMET is considered adequate.

In the design of the Phase-I set-up, radiation hardness of detectors and beam line components should be examined. Management of the design and production should be strengthened from the engineering point of view. Support from KEK for engineering, construction and integration of the detector is necessary.

COMET will take all recommendations and update the design of Phase-I. The TDR in a single document form will be updated based on the review recommendations and submitted to the next PAC meeting for stage-2 approval so that the beam time allocation for COMET can be discussed. A document with the COMET response to the recommendations will be submitted in June.

The primary proton beam line and magnet review panel was held in January 2014. Beam time of 90 days with 3.2 kW beam power, as explained at the previous PAC meeting, is needed for Phase-I physics running. A graphite proton target will be used.

The status of the detector was reviewed. Work on superconducting solenoids is ongoing. A test of GSO and LYSO crystals for the electromagnetic calorimeter was carried out in March; the choice of crystals will be made soon. The design of the cylindrical drift chamber has changed. A test of the drift chamber prototype is ongoing.

The suggested schedule: Phase-I data taking will start in mid 2016 before the Mu2E experiment at Fermilab starts. Operation for 90 days with a 3.2 kW proton beam should result in a sensitivity of 3×10^{-15}. Phase-II should start data taking in 2019. Operation for 2×10^{7} sec at 56 kW should reach a single event sensitivity of 3×10^{-17}.

The PAC congratulates COMET on its continued progress and endorses their request for engineering support from KEK and J-PARC.

7. **E34:** An Experimental Proposal on a New Measurement of the Muon Anomalous Magnetic Moment g-2 and Electric Dipole Moment at J-PARC (μ g-2/EDM)

The status of the E34 was reported, where the main focuses are on the muonium production yield, the uniformity of the B field in the analysis magnet, and the reacceleration of positive muons, reflecting the recommendation of PAC17.

In order to develop an efficient production target, E34 tested a laser-drilled aerogel target and compared the muon yield with that obtained from the plain aerogel target. The result is very encouraging. The yield is improved by a factor of 11, which leads to an expected statistical uncertainty of 0.22ppm on $g\text{-}2_{\mu}$ for 100 % polarization of muons. The committee members acknowledge this large improvement, but also strongly recommend continuing to investigate more options. This is the most significant recommendation from the PAC to the E34 experiment.

E34 showed the status and their plans for muon reacceleration. An extraction and acceleration method will be developed using the D-line at J-PARC MLF without a laser, and at RIKEN-RAL with a laser.

A detailed study of the uncertainty and non-uniformity in the magnetic field is on-going. The E34 group identified several sources of uncertainty, and evaluated the impact from each source including the effects from the beamline magnet, the hole in iron yoke for beam transport etc.

The experiment should start in timely manner to be competitive with the Fermilab g-2 experiment, which will begin in 2016.

8. **P56:** A Search for Sterile Neutrino at J-PARC Materials and Life Science Experimental Facility (Srerile Neutrino)

The status of the proposal for a new sterile neutrino experiment to be performed at the J-PARC MLF was presented to the PAC. The experiment will use decay at rest to search for oscillations. The detector is a Gadolinium-loaded liquid scintillator, composed of two 25 ton fiducial-mass sub-detectors, very similar to those used for recent reactor neutrino experiments. The experiment assumes 1 MW operation at the MLF.

Following the recommendations in the previous PAC report, the collaboration has started a test experiment on the 3rd floor of MLF aimed to provide a direct on-site measurement of the beam background rate. The test experiment is composed of 24 plastic scintillators surrounded by cosmic veto scintillators. If the simulations of the beam background are correct, the test experiment should observe no background events during a data-taking period of 2 months. From this result, it would be possible to set a 90% C.L. upper limit of 2.3 events for the beam background in the real experiment. This level is consistent with the goals of the experiment.

The PAC congratulates the collaboration on the successful installation of the test experiment, and is eager to see the results at the next PAC meeting.

9. **E36**: Measurement of Γ(K→eν)/Γ(K→μν) and Search for heavy sterile neutrinos using the TREK detector system (Lepton uninversality)

Recall that the E36 experiment plans to measure the ratio $\Gamma(K \to e\nu)/\Gamma(K \to \mu\nu)$ to a precision of 0.25% (0.2%(statistical) and 0.15%(systematic)). This is a sensitive test of lepton universality and could reveal new physics if the above ratio deviates from SM expectations.

To carry out this program, the E36 collaboration will perform a cosmic ray shakedown by the end of 2014 and then will do a two month engineering run. This will be followed by a physics run. This plan follows the recommendations given by the J-PARC PAC at the last meeting (PAC17).

There has been good progress in preparing the final detector components: cosmic ray tests of the MWPC trackers have been completed; 7 (out of 84) Pb glass Cerenkov counter modules have been assembled; fiber ribbons of the scintillating fiber tracking have been wound; the components of the aerogel Cerenkov counter will be ready in June 2014; the CsI(Tl) counters and readout were completed (the FADC readout is now being debugged); TOF counters will be assembled soon at KEK and the active K^+ target was just completed at TRIUMF. However, the GEMs have not been funded and are likely to be late. To avoid distraction from the final push on detector integration, the PAC recommends that a decision on the deployment of GEMs be made soon.

There are a number of difficult constraints on the schedule. The E36 experiment must be completed by mid-June 2015 to allow the start of COMET Phase I construction. To achieve a useful sensitivity to lepton universality violation beyond the result of NA62, an earlier experiment at CERN, E36 must run for 50 days at 30 kW beam power. In addition, 10 days of calibration running are needed. Thus, a total of 60 days of running at 30 kW are required. The data run should fit into the months of April, May and June 2015. There is little or no contingency in the proposed schedule, which includes a two month engineering run and the data run.

Given these considerations, the PAC recommends that the cosmic ray checkout period be used effectively and that the engineering period be carefully planned. At the next PAC in early December, E36 should present first in-situ cosmic ray results and detailed plans for the engineering and physics runs.

10. **E13:** Gamma-ray spectroscopy of light hyper-nuclei

Special request for the use of liquid HF target was made by E13.

The E13 experiment plans to measure the g-factor of Λ in a nucleus as well as to study the ΛN-ΣN interaction. The experiment was approved long ago, but has not been carried out in 2013 because of the Hadron hall accident. The E13 collaboration proposes to use a liquid hydrogen fluoride (HF) target for the study of $^{19}_{\Lambda}$F. Since HF is an extremely toxic material, FIFC are discussing special protective measures to handle it. On the request from FIFC, the PAC also examined the physics importance of the measurement with this target. The Doppler-shift attenuation method makes it possible to observe clear signals corresponding to the spin-flip M1 transition of Λ in $^{19}_{\Lambda}$F only with a lower-density target such as HF, which also makes no γ-ray background. The simulation provided by the E13 group shows that 5 times more beam time is necessary if a CF2 target is employed in order to obtain the same sensitivity as that obtained with the HF target. The PAC understands the importance of the HF target and encourages the collaboration at the same time to continue investigation of other candidate materials for the target.

11. **E15:**A Search for deeply-bound kaonic nuclear states by in-flight 3He(K^-, n) reaction (Deeply-bound kaonic nuclear states)

The E15 program aims to search for the deeply bound kaonic state of K^-pp via the He-3(K^-,n) reaction at 1 GeV/c. At this PAC, preliminary results obtained from the 1st stage run were presented and beam time for the 2nd stage was requested.

The PAC found that the 1st stage program was successfully organized. The 1st stage run was conducted in March and May 2013 with 5E9 kaons. A careful and quick analysis with the limited statistics rejected as much of the physical background processes as possible and searched for the K^-pp state. The collaboration found 1) an excess of ~1mb/sr below K^-pp threshold in the formation channel of He-3(K^-,n) at zero degrees and 2) a significant signal in the decay channel of He-3(K^-, Λp).

The E15 collaboration requested 50E9 kaons on target for the 2nd stage program. Based on the statistics ten times higher than that of the 1st stage, the 2nd stage aims 1) to confirm the spectral shape of the Λp invariant-mass by the exclusive measurement of the He-3(K^-, Λp)n channel, 2) to explore the neutron spectrum at zero degrees with the full kinematics measurement of He-3(K^-, Λpn), and 3) to extend their study to other channels.

The PAC recognizes that the beam request of the 2nd stage is reasonable and necessary to further study the K^-pp system, and supports the beam request.

12. **P50:** Charmed Baryon Spectroscopy via the (π,D*-) reaction (Charmed baryon spectroscopy)

An updated discussion of the P50 proposal was presented to the PAC. Following the recommendations in the previous PAC report, the collaboration has performed more detailed studies about: i) the theoretical predictions of the πN → D*Yc cross sections and the possible implications of their measurements; ii) a possible enlargement of the physics scope of the experiment.

H. Noumi has reported the results of a recent study by S.-H. Kim, A. Hosaka and collaborators (arXiv:1405.3445). This theoretical work confirms the reference value of 1 nb for the production of the Λ_c ground state. Moreover, it shows that the ratio of the πN → D*Y_c cross-sections for different baryons provides a useful tool to test the description of such baryons in terms of quark-diquark pairs. Such information cannot be accessed in charmed baryon studies performed at e^+e^- and pp colliders.

As far as the physics goal of the experiment is concerned, the collaboration has presented a preliminary investigation of the physics reach on hyperons (study of πN → K*+ Λ/Σ production cross sections and hyperon decay channels). Surprisingly, the properties of a large fraction of hyperons (in particular the cascade baryons) are still poorly known. These states should be copiously produced at P50. Their systematic investigation would represent a valuable (and "risk-free") extension of the physics program of the experiment.

The PAC recognizes the physics interest of this proposal. Given the progress reported by the collaboration in the last two PAC meetings, the PAC agrees to

promote P50 to the stage-1 level. The PAC notes that the collaboration should not underestimate the difficulties posed by the detection of the tiny charmed-baryon signal via the missing-mass technique, which should remain the main goal of the experiment. In addition, the PAC emphasizes the importance of collaborative work with lattice QCD theorists to establish a coherent picture of excited hadrons with charm and strange quarks.

13. **P57:** Measurement of the strong interaction induced shift and width of the 1s state of kaonic deuterium at J-PARC

J. Zmeskal presented a new proposal on "Measurement of the strong interaction induced shift and width of the 1S state of kaonic deuterium". The low energy parameters of the antikaon-nucleon interaction such as the K-p and K-n scattering lengths are fundamental physics quantities for low-energy QCD and nuclear physics with strangeness. Precise measurements of X-rays from kaonic hydrogen have provided a strong constraint on the low energy antikaon-proton interaction. The measurement of X-rays from kaonic deuterium is, however, necessary to determine the values of both the I=0 and I=1 antikaon-nucleon scattering lengths. The proposed experiment is (apart from the SIDDHARTA2 project in Frascati) the first attempt to measure the shift and width of the 1S state of kaonic deuterium using X-rays. The proponent expects to measure the shift and width with accuracies of 60 eV and 140 eV, respectively, using the existing K1.8BR multipurpose spectrometer and newly developed Silicon Drift Detectors (SDD). The PAC recognized the importance of the measurement on kaonic deuterium and the expertise of the group in X-ray measurements of kaonic atoms.

There is an approved experiment, E17, on kaonic 3He X-rays with use of similar apparatus at K1.8BR. The PAC asks the proponent to provide an integrated plan with E17 to optimize the physics outputs given the limited beam time.

13. BEAM TIME AND PROGRAM ARRANGEMENT FOR FY2014

Given the recovery schedule of the FX and SX facilities, the beam for the T2K experiment will resume in May and continue until the end of June. After the scheduled summer shutdown the beam will be delivered to T2K until the end of December for a

running period that is as long as possible. After the completion of the renovation of the T1 target system and HEF, SX beam delivery should start at the earliest possible date, namely January 2015. Within the current budget projection, the operation of the MR for SX could be continued until the end of February with a MR beam energy of 24 GeV. The committee encourages the IPNS administration to secure additional funding to operate the FX in March. The schedule from January 2015 will be confirmed at the next PAC meeting in December when the supplemental budget for FY2014, the prospect of the budget for FY2015 and the status of the preparation of the HEF and the experiments will be updated.

There is a proposal (P59:KEK/J-PARC-PAC 2014-2) for the test experiment to be performed in the area of INGRID system at the neutrino facility. The test experiment committee recognized the merit of the test and recommended IPNS to support the experiment with the consultation of the T2K collaboration to manage the impact on the T2K experiment. The proponents were supposed to communicate with the KEK neutrino group and T2K collaboration on an adequate arrangement for the experiment. PAC adopts the conclusion of the committee.

14. DATES FOR THE NEXT J-PARC PAC MEETINGS

The next PAC meeting will be held from December 3-5, 2014.

The PAC would like to hear the status of T2K operation, updates from the experiments, the status of hadron hall renovation work as well as the preparation of the experiments to be executed in 2015.

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

- Minutes of the 17th J-PARC PAC meeting held on 25-27 September, 2013 (KEK/J-PARC-PAC 2013-16)
- Proposals
    - P57: Measurement of the strong interaction induced shift and width of the 1s state of kaonic deuterium at J-PARC (KEK/J-PARC-PAC 2014-1)

- P59: A test experiment to develop a 3D grid-like neutrino detector with a water target for measurement of neutrino cross sections at the near detector hall of J-PARC neutrino beam-line (KEK/J-PARC-PAC 2014-2)
- P58: A Long Baseline Neutrino Oscillation Experiment Using J-PARC Neutrino Beam and Hyper-Kamiokande (KEK/J-PARC-PAC 2014-3)

- Letter of Intent
  - Ξ Baryon Spectroscopy with High-momentum Secondary Beam (KEK/J-PARC-PAC 2014-4)

- Status Reports
  - E07 (KEK/J-PARC-PAC 2014-5)
  - E15 (KEK/J-PARC-PAC 2014-6)
  - E31 (KEK/J-PARC-PAC 2014-7)
  - E40 (KEK/J-PARC-PAC 2014-8 and another document from the previous meeting)
  - P50 (KEK/J-PARC-PAC 2014-9)
  - P56 (KEK/J-PARC-PAC 2014-10)

- E16 Technical Design Report (KEK/J-PARC-PAC 2014-11)
- Target Review Result (KEK/J-PARC-PAC 2014-12)
- High-p/COMET beam line review result (KEK/J-PARC-PAC 2014-13)
- E21 COMET Physics Review Closeout (KEK/J-PARC-PAC 2014-14)
- E21 COMET Magnet Review Closeout (KEK/J-PARC-PAC 2014-15)
- FIFC report (KEK/J-PARC-PAC 2014-16)