KEK/J-PARC-PAC 2015-11
July 17, 2015

J-PARC Program Advisory Committee

for the Nuclear and Particle Physics Experiments

at the J-PARC Main Ring

Minutes of the 20th meeting held on
15(Wed)-17(Fri) July 2015

OPEN SESSION:

1. Welcome address:	M. Yamauchi (KEK)
2. J-PARC Center Report:	N. Saito (J-PARC/KEK)
3. Welcome and mandate to the committee:	K. Tokushuku (KEK)
4. J-PARC accelerator status & plan:	F. Naito (J-PARC/KEK)
5. E11 (T2K) Beam status and plan	T. Nakadaira (J-PARC/KEK)
6. E11 (T2K) Detector/analysis status and plan	M. Wascko (ICL)
7. Hadron hall beam status:	S. Sawada (J-PARC/KEK)
8. FIFC Report:	S. Uno (KEK)
9. E16 (electron pair spectrometer):	S. Yokkaichi (RIKEN)
10. E40 (Σp):	K. Miwa (Tohoku)
11. E05 (Ξ-Hypernucleus):	T. Nagae(Kyoto)
12. E34 (g-2/EDM):	T. Mibe (J-PARC/KEK)
13. P62 (NuPRISM):	M. Wilking (Stony Brook)
14. E14 (KOTO):	H. Nanjo (Kyoto)
15. E36 (Lepton universality):	M. Kohl (Hampton)
16. E21 (COMET):	Y. Kuno (Osaka)

17. E56 (sterile ν search): T. Maruyama (J-PARC/KEK)

18. Hadron Hall floor plan update for 2015-2016: T. Komatsubara (J-PARC/KEK)

19. E13 (Gamma spectroscopy of light hypernuclei): H. Tamura (Tohoku)

20. E15 (Deeply-bound kaonic nuclear states): M. Iwasaki (RIKEN)

21. E31 (Hyperon resonances below KN threshold): H. Noumi (Osaka)

22. E17 (Precision spectroscopy of kaonic ^{3}He): S. Okada (RIKEN)

23. P57 (Kaonic deuterium): J. Zmeskal (Stefan Meyer Inst.)

24. E50 (Charmed baryons): H. Noumi (Osaka)

25. E05 (SKS pilot run proposal): T. Nagae (Kyoto)

26. E07 (Double Strangeness System with a Hybrid Method):
K. Hosomi (JAEA)

27. E03 (X-ray from Ξ-atom): K. Tanida (JAEA)

28. T60 (Emulsion based test experiment in Neutrino beam line):
T. Fukuda (Toho)

29. Beam time planning in 2015-2016 T. Kobayashi (J-PARC/KEK)

CLOSED SESSION:

Present: E. Blucher (Chicago), T. Browder (Hawaii), A. Dote (KEK),
S. I. Eidelman (BINP), J. Haba (Chair/KEK), K. Hanagaki (KEK/Osaka),
T. Hatsuta (RIKEN), K. Imai (JAEA), K. Inoue (Tohoku),
G. Isidori (UZH), H. Sakurai (RIKEN), H. Shimizu (Tohoku),
W. Weise (ECT), W.A. Zajc (Columbia),
K. Tokushuku (IPNS Director), T. Kobayashi (IPNS Deputy Director),
and N. Saito (J-PARC Director)

Apologies: W. Louis III (LANL)

1. PROCEDURE

The minutes of the nineteenth J-PARC-PAC meeting (KEK/J-PARC-PAC 2014-27) were approved.

2. Report from the laboratory

2-1 Address from KEK DG

The Director General (DG) of KEK, Masanori Yamauchi, welcomed the PAC members.

The DG introduced the new director of IPNS, Katsuo Tokushuku. Yamauchi had previously served as the director of IPNS for the last three years and became DG of KEK in April 2015. He expressed his deep gratitude for the efforts of the PAC members during the last three years.

The DG briefly reported on the financial situation of KEK. The KEK directorate is making efforts to ensure that there is sufficient beam time during the next Japanese Fiscal Year. He remarked that suggestions and endorsements given by the J-PARC PAC are quite important.

2-2. Address and report from J-PARC Center Director

The J-PARC Director, Naohito Saito, welcomed the PAC committee members and introduced the new J-PARC research building in which the July PAC meeting was being held. Construction of this building has been completed while some interior work is still in progress.

Saito introduced the new management team of the J-PARC, which was renewed in April 2015. The team is led by the director, Naohito Saito, and deputy-directors, Tadashi Koseki, Masa Futakawa and Tetsuro Ishii. The previous Director, Yujiro Ikeda, remains as an adviser to the team.

After this introduction, he explained J-PARC efforts to resolve the following issues;

- increasing the operation budget to allow for more beam time,
- the beam power upgrade with new Main Ring (MR) power supplies,
- renewal of agreement with local community on forest preservation in the JPARC campus, and

- fully open of the new research building, which was already described above.

J-PARC and KEK sent a budget request to the Ministry of Education, Culture, Science and Technology in Japan (MEXT) for more operation time in JFY2016, following the recommendations made by an external committee, the International Advisory Committee (IAC). The IAC held a meeting in February 16-17, 2015 and stressed the importance of increasing machine operation at J-PARC to provide more beam time for on-going experiments in addition to promoting new experiments.

New power supplies for MR magnets are mandatory to achieve the beam power upgrade expected starting in 2017. These power supplies are expected to be very effective both for Fast Extraction (FX) to realize faster repetition and for Slow Extraction (SX) where the ripple noise of magnet power supplies will be reduced. Increasing the beam power is equivalent to increasing the machine operation time given the limited operations budget. A separate funding request to install new MR magnet power supplies has been made by KEK and J-PARC to the government. Saito noted the importance of a timely modification of the agreement on forest preservation with the local community for the building to house the new power supplies.

Saito then reported on the status of beam operations up to Summer 2015 and the plan until the end of JFY2015. Operation of the Hadron Experiment Facility (HEF) was restarted at 11:03 am on April 24, 2015 although there was a short interruption caused by an MLF target problem.

Finally Saito mentioned the near term future plan for J-PARC. As was previously reported, the J-PARC upgrade including the hadron hall extension, COMET Phase II, and muon g-2/EDM measurement, along with the Hyper-K experiment, were selected among the 27 important projects within the pool of 209 proposals reviewed by the Japan Science Council. The J-PARC upgrade plan will be evaluated in a few months at the MEXT. If approved, construction can start in JFY 2017 in parallel to achieving the design intensity for further science outputs during the next 5 years.

2-3. Welcome and mandate to the committee

The director of Institute of Particle and Nuclear Studies (IPNS), Katsuo Tokushuku presented a mandate to the PAC members at this meeting.

Firstly he listed the new and pending proposals which are to be accessed in this meeting. He also requested the committee to monitor ongoing programs.

In response to the previous PAC and IAC recommendations, the lab is working on the middle-term plan. The first version was shown in the IAC meeting in February. An update version, with a more conservative budget scenario was presented in this meeting. The priority is on the 9-cycle operation in each year, keeping the limited maintenance and improvement works. There will be, however, an extra consolidation works in the hadron hall in order to replace the vacuum system in the primary beam line. The start of the use of the COMET beam line is expected to be in 2019, which is delayed by one year compared with the plan shown in February. Comments from the committee were highly welcome.

After the reorganization of the magnet spectrometer in K1.8 beam line, some experiments have expressed the continuation of the experiment in the K1.1 beam line. As the K1.1 and High-p lines cannot operate simultaneously, priority on the experiments on the two lines should be accessed by the committee. Both lines will be ready for physics programs in FY2017, so that the lab will ask the proponents to re-submit their proposals adopted to the K1.1 beam line. Evaluations of the proposals and priority discussions will be foreseen in the PAC meetings in 2016.

2-4 J-PARC accelerator status

Fujio Naito explained the status and operations plan of the accelerator along with the beam power upgrade of the MR.

After the linac energy upgrade to 400 MeV intensive studies have been performed toward high-power operation of the machine. Operation of the H^- ion source at 50mA, which is mandatory for RCS 1MW operation, was demonstrated. The accelerator team succeeded in accelerating a 50mA beam although emittance growth between MEBT-1 and SDTL was observed. Further beam studies are required to solve this problem. In spite of this situation they conducted a second trial of 1 MW equivalent operation of the RCS in a single shot and successfully demonstrated the required performance. For continuous operation at such high beam power, careful studies are necessary; the beam loss at the foil used for conversion of H^- to H^+ must be reduced.

Naito reported the progress of MR operation after the recovery of the Hadron Hall. SX operation has reached a beam power of 33 kW with a spill duty factor of 37-40%

and extraction efficiency above 99.5%. The possibility of increasing the effective beam power by shortening magnet ramping was also explained. Another effort by the accelerator group to realize a pulsed 8GeV beam to the HEF for COMET was presented. He also reviewed studies for higher-power operation of FX at the MR. The highest beam power so far achieved in the MR is 372 kW, indicating 380 kW operation will soon be possible for FX. At the moment the repetition cycle of FX is 2.48 seconds, which will be reduced down to 1.3 seconds by changing magnet power supplies and installing new RF cavities with higher gradients. These results suggest that operation around 750 kW is possible as long as the beam loss rate stays constant after the various improvements.

Naito reviewed the history of accelerator operations and the near-term future schedule in JFY 2015 together with the beam-power upgrade plan of the MR. The mid-term upgrade plan involves achieving a higher repetition rate of FX by replacing magnet power supplies and RF cavities to reach beam power of 750 kW. In addition, higher beam power in SX above 50 kW and aiming toward the 100 kW level will be achieved by replacing beam ducts and chambers with titanium components in order to reduce the residual dose in addition to replacing power supplies. It should be noted that the forest preservation issue addressed by the J-PARC Director has to be solved for the construction of the buildings that will house the new power supplies.

2-5 Hadron Hall Beam status

Shin'ya Sawada reported on the renovation of the hadron experimental facility, beam operations in April through June, and the status of R&D for a new production target.

The renovation of the hadron experimental facility was completed in January 2015. The renovation includes a new design of the production target, airtight enclosure of the primary beam line, construction of controlled ventilation systems, and the related improvements. All improvements were tested to work properly as designed.

Sawada reported on the status of beam operation in April through June. Beam operation at the hadron facility restarted in April 2015. The entire system including newly installed equipment worked as expected. The beam line group checked the responses of the equipment, such as the temperature sensors of the target. They also verified that beam profiles were consistent with the results of simulations. After step-

by-step beam tuning, user operation restarted on April 24th. By the end of beam operation, the total integrated user operation time was 568 hours with a maximum beam power of 33 kW.

Sawada also reported on a new design of the production target for future power upgrades. A new indirect cooling target and a rotating euro-coin type target are both under study. The new indirect cooling target is a natural extension of the present target design, and will be ready to replace it. He expects that such a target can accept up to a 70kW proton beam. The PAC requested that the development group evaluate the target options more quantitatively and show the maximum allowable proton power at the next meeting.

2-6 FIFC report

Shoji Uno reported on the Facilities Impact and Finance Committee (FIFC). The committee members were renewed from April 2015, and the last meeting was held on June 17th, 2015. The FIFC made the following recommendations about the CF_4 target for E13 and the feasibility of the experiments requesting stage-2 approval (E16 and E40).

E13: The CF_4 target was confirmed by the committee to be safe for the E13 experiment. E13 successfully finished the experiment using the CF_4 target without any problem.

E16: Concerning the high momentum beam-line, the radiation safety issues (the radiation near the Lambertson magnet, interlock and so on) must be examined further by the radiation safety estimation committee of J-PARC. The technical issues should be summarized or will be reviewed somewhere in an integrated way if this has not been done yet.

The FIFC had serious concerns about the global tracking system. It was not demonstrated that just three GEM planes are sufficient to provide redundant tracking in an environment with an intense beam background or to handle an extremely non-uniform magnetic field, possible alignment uncertainties and so on. A full simulation study of the global tracking system must be performed. For the Hadron Blind Detector (HBD), the aging of the photocathode should be tested with their own prototype, and a proper monitoring system should be implemented. The orientation of the lead glass for PID should be optimized carefully.

The performance of the final detector system should be demonstrated with a full simulation especially for the partial detector configuration. The FIFC also has concerns about budget and manpower issues. The schedule of the beam commissioning should be planned in a reasonable way based on the available budget. The beam background environment should be measured with low intensity beam.

E40: The discussion with J-PARC safety division on the liquid hydrogen target should be done on time. The bonding characteristics with Araldaite glue should be checked carefully at cryogenic temperatures.

There is no significant concern except for the liquid hydrogen target. FIFC supports the new experimental setup with the KURAMA magnet, which enlarges the momentum acceptance. For the drift chambers, the fiber trackers, the aerogel counters, TOF and BGO crystals, the required performances have been demonstrated. The DAQ is well tested, and has enough margin for higher trigger rates. In addition, the trigger is well studied. The single counting rate should be estimated taking into account the background from the beam dump.

The design of the aerogel counter and more information for physics simulation should be described in the TDR. Verification of the simulation for physics performance studies should be considered.

The written report of the last FIFC meeting will be submitted to IPNS director by the middle of August 2015. The next meeting will be held in November or December 2015.

2-7 Hall floor plan update in 2015-2016

Takeshi Komatsubara, the deputy head of Particle and Nuclear Physics division of J-PARC, explained the Hadron Hall floor plan and constraints on the operation schedule of the hall. As of the beginning of 2015, four beam-lines (K1.8, K1.8BR, K1.1BR, and KL) are in operation. A middle-term plan using the current beam lines was explained.

A floor plan in the south area of the hall for the next three years was described with the following constraints to be considered: the SKS spectrometer will be moved to the K1.1 area by the end of JFY2015; the construction work on the High-p/COMET beam

line between the Switch Yard and Hadron Hall will be done during the summer shutdown of 2016.

Thus, the area and the downstream part of the K1.1BR beam line should be removed by the end of JFY2015 at the latest.

In addition, the aluminum-alloy chain clamps at the primary beam line in the hall will be replaced with stainless-steel clamps to avoid possible vacuum failure in the future. To carry out the replacement work at a reasonable radiation level, the work should be done not later than JFY2016. Currently the work is planned for late JFY 2015 and JFY 2016.

2-8 Beam time planning in 2015-2016

T. Kobayashi, head of Particle and Nuclear Physics division of J-PARC, presented a longer-term plan following the recommendations by the international advisory committee (IAC) on the J-PARC project and the PAC. Following the 5-year case study plan shown at the last IAC meeting, Kobayashi presented an updated version including recent prospects for accelerator improvement and taking into account constraints from the hadron experimental hall arrangement.

IPNS plans to carry out the middle-term operation scenario until FY2020, which is based on the following four assumptions; (1) the main ring power supply upgrade is funded, as we expect in FY2016-2018, (2) an adequate budget is provided for “6.5 cycle operation” during FY2016-2020, (3) vacuum clamp replacement work on the hadron primary line is completed, (4) the strategy for the production target of the HEF, capable of handling more than 100kW beam power should be redefined and the necessary funding should be found.

The short-term beam-time requests from each experimental group shown in this PAC meeting were summarized. The sum of these requests exceeds the available beam time. There are three constraints on the beam time assignment; the shutdown of the K1.1BR beam line, the limited operations budget, and the lifetime of the emulsion for the E07 experiment. Several short-term operation scenarios were shown to clarify the impact of these constraints for the PAC members.

3. Special remark from the PAC on J-PARC operations in the coming period

The committee congratulates the HEF for its successful restart and confirms that J-PARC is providing unique and rich scientific opportunities to the world physics community. Progress in particle and nuclear physics will be greatly harmed if J-PARC operation is seriously limited by a budget shortfall. The committee continues to encourage the managements of IPNS and J-PARC to persuade the funding agencies to secure a sufficient length of time for the operation of its facilities.

In view of the completion of the new J-PARC research building, the PAC recognizes the importance of interactions between experimentalists and theorists in order to maximize the harvest from the facility and to plan very important future experiments. The PAC thus encourages J-PARC to promote initiatives that strengthen cooperative efforts between theory and experiment at the J-PARC site, involving the KEK theory group as well as other researchers from Japan and abroad who pursue theory activities directed towards the goals of the J-PARC physics program.

4 EVALUATIONS OF THE PROPOSALS AND STATUS OF THE ONGOING EXPERIMENTS

E16: Measurements of spectral change of vector mesons in nuclei

Experiment E16 is focused primarily on investigating possible changes of the ϕ meson spectral function in the nuclear medium, using a high-p beam on C and Cu targets and a dedicated dilepton spectrometer system. A status report was presented in response to the requests by the 19th PAC and to the FIFC's assessment.

The PAC underlined once more the importance of the physics case that motivates these measurements. Previously raised questions were addressed concerning: a) the size of the collaboration and its extension to include international members; b) detailed simulations in order to demonstrate the feasibility of reaching the expected momentum resolution of 1%; c) accurate field measurements of the spectrometer magnet; d) budget issues.

The E16 collaboration has been successful in attracting new members from several Universities in Japan. Efforts were also made in preparation of an MoU with the HADES collaboration at GSI-FAIR, which could provide significant exchange of expertise in dilepton

spectrometry. The PAC encourages E16 to pursue such efforts towards international collaboration in order to further enhance the capabilities of the experiment.

The experiment should carry out simulations including the effects of pileup and physics background. Some of the requested simulations concerning the reconstruction efficiency of ϕ mesons, momentum resolution etc. have been started but are not yet completed at the level of a fully developed TDR. Possible limited precision in magnetic field determinations are to be examined by detailed simulations in the tracking region. A maximum of 8 out of the foreseen 26 modules are expected to be installed in the spectrometer by the time the high-p beam becomes available. It is thus necessary to demonstrate the physics sensitivity for operation with only a partial detector. It is further necessary to check whether the tracking system is sufficiently robust to achieve the physics goals. The PAC is concerned because the budget, even for this reduced number of modules, is not yet secured.

Prior to Stage-2 approval, the PAC re-iterates its request to receive, at its next meeting, a completed TDR in which these remaining open issues are clarified.

E40: Measurement of Σp differential cross sections

E40 will measure differential cross sections in Σp elastic scattering. These data will permit an isospin-separated systematic study of the ΣN interaction to better understand the flavor dependence of the short-range core in the baryon-baryon system, with applications to hypernuclei and high-density matter in neutron stars.

The experiment will use the K1.8 beam line together with the KURAMA spectrometer to tag Σ's produced in the $\pi^- p \rightarrow K^+ \Sigma^-$ reaction, and then measure the differential cross section for $\Sigma p \rightarrow \Sigma p$ scattering. The desired statistical precision requires a high intensity (10 MHz) pion beam in combination with a large acceptance optimized for the detection of the scattered proton. Previously, the FIFC had charged the experiment to address three points: a) to develop a realistic design of the liquid-hydrogen target including safety control in the Hadron Hall, b) to verify the final detector configuration with a full simulation, and c) to provide a detailed plan for implementing a trigger and DAQ system capable of handling beam power up to the 50 kW level.

The LH_2 target system has been developed and shown to have a safety factor of three via destructive testing. The E40 collaboration has performed full simulations to establish the final detector configuration and to verify that the particle identification, background rejection and triggering necessary to identify exclusive events will function at high rate. This optimization

procedure has led to a factor of 1.5 increase in the acceptance for Σ's. A layer of the Cylindrical Fiber Tracker (CFT) and the BGO crystals used to identify scattered protons have been used in a test beam and shown to perform at a high level, and the second frame of the CFT is under construction. Resources are available to complete the construction of all of the required subsystems.

The PAC recommends that E40 be approved for Stage-2 status.

E11: Tokai-to-Kamioka Long Baseline Neutrino Oscillation Experiment (T2K experiment)

The T2K collaboration reported on the status of neutrino beam operations and their data analysis. They reiterated their primary goal of studying CP violation in neutrino oscillations with 7.8E21 POT, divided equally between neutrino and antineutrino data taking. The current data set is 1.1E21 POT, with 0.7 POT in neutrino mode and 0.4E21 POT in antineutrino mode. The collaboration will release disappearance and appearance results using the 4E20 POT antineutrino sample on July 23, 2015, at the EPS Conference. The committee commends the T2K collaboration on the rapid production of physics results -- the July 2015 results will include data collected through June 2015.

The beam intensity continues to increase, reaching an average power of 329 kW during the most recent running period. The beam quality is not compromised at higher intensity. The committee expressed concern about the risk of running without a replacement horn, and encourages the completion of a replacement horn as soon as budget conditions permit.

The collaboration has collected less than a month of data in the current fiscal year. They presented a goal of an additional 6E20 POT (0.5E20 in neutrino mode and 5.5E20 in antineutrino mode) by summer 2016. Assuming ~400 kW operation, about 4 months of running would be required to reach this goal. Combined with data already collected, this sample should allow the first evidence of appearance with a statistical significance better than 95% CL, depending on the CP violating phase, and would help T2K to retain their world leadership in long baseline neutrino oscillation experiments. The PAC supports the T2K beam time request, and in particular, recommends that T2K receive 2 months of running time before the end of FY2015.

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 E34 collaboration submitted the TDR as a single document of 412 pages in May. The overview of the TDR and the recent progress were shown to the PAC. They request the evaluation of the TDR for the stage-2 approval.

The completion of the TDR demonstrates the good overall progress of the experiment on several fronts. Given the complexity of the experiment, the PAC recommends the formation of a panel of experts for evaluation of the TDR in view of the stage-2 approval. In particular, the PAC notes that the TDR needs to be improved, especially the section on muon acceleration. Some concern on the manpower for the muon acceleration was also raised. In the TDR the muon yield is reduced by 1/3, and the polarization is reduced to 1/2, compared to the values in the CDR. This results in degradation of the statistical precision for the g-2 measurement from 0.14ppm (original figure in the CDR) to 0.36ppm. To compensate for the lower muon yield and the small polarization, the requested running time has been doubled.

The committee recommends to continue the optimization of the target (which is at present based on laser drilled aerogel) in parallel to the completion of the other milestones (e.g. achievement of full laser power for muon production). Despite the slight degradation of the sensitivity for the muon g-2 measurement, at least during the first stage of the experiment, the physics case of E34 is still very interesting. The proposed time scale is reasonable and would allow E34 to produce a competitive measurement of g-2 on a time scale close to that expected by the Fermilab experiment, using a completely different (and innovative) technique. At the same time, E34 will be able to provide a factor of 70 improvement in statistical sensitivity on muon EDM.

The funding for the silicon detector construction is secured, which allows the transition from the R&D phase to construction. However, additional very significant funding is needed in order to build the storage magnet, the beam line and various related infrastructures. Despite the difficult funding situation, the PAC encourages IPNS to consider the request to start R&D with the beam transfer line, recognizing the importance of the physics goals of E34. The next milestone is the muon acceleration test. The committee is looking forward to results on this test.

P61: Proposal for the NuPRISM Experiment in the J-PARC Neutrino Beamline (NuPRISM)

One of the largest systematic uncertainties in long baseline neutrino experiments is the limited knowledge of neutrino-nuclei interaction cross sections as a function of the incident

neutrino energy. The main scope of the NuPRISM experiment at JPARC, presented for the first time at the 20th PAC meeting, is the reduction of such uncertainties using direct experimental measurements.

NuPRISM is a water Cherenkov detector capable of observing charged-current neutrino interactions over a continuous range of off-axis angles, ranging from 1 to 4 degrees. By combining measurements obtained at different angles, taking advantage of the variation of the neutrino energy spectra at different angles, the NuPRISM experiment would make it possible to reconstruct the cross sections for "pseudo-monochromatic" neutrino beams. This information, in turn, would largely remove the model-dependence in the interpretation of the neutrino scattering data in the far detector.

In the baseline design, the detector would consist of a tank to be placed in a vertical shaft, with diameter of at least 10m and height of at least 50m, to be placed at distance between 1 and 2 km from the neutrino production target. Only a subsection of the tank, about 10m tall, would be instrumented with PMTs mounted on a movable structure able to span the whole tank. The cost and the construction time are estimated to be about $16M and 3 years, respectively.

As explained in detail in the proposal submitted to the PAC, additional goals of the experiment include: i) the search for sterile neutrinos; ii) the use of precise data on neutrino-nuclei interaction cross-sections in conjunction with atmospheric neutrino oscillation data, in order to exploit the sensitivity of the latter to CP violation.

The PAC recognizes the interesting physics goals of the experiment. NuPRISM would certainly be a very valuable addition to the future J-PARC neutrino physics program, especially in view of the Hyper-Kamiokande project. On the other hand, its impact on the current program is more limited. The PAC notes that the main goal of the presently approved T2K program (up to 7.8E21 POT), namely the measurement of the leptonic CPV phase, is expected to be statistically dominated. The PAC defers any decision about the status of this experiment until there is clarity about the future neutrino program at J-PARC. However, given the intrinsic physics interest of NuPRISM from a long-term perspective, the PAC encourages the continuation of R&D studies, including a possible optimization of the location.

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

The committee was pleased to see a report on the first data taking of the KOTO experiment since the 100 hour run in May 2013. During April-June, 2015, KOTO collected 5.3 times more protons on target than during the 2013 run. The beam power ranged from 24 kW at the start of

the 2015 run period to 33 kW in June 2015. During the last two years, several detector modifications were made to address backgrounds observed in the 2013 data sample. These include modifications to suppress low p_T events, to reduce $K_L \rightarrow \pi^0\pi^0$ background, and to reduce halo neutrons. To reduce dead time, a new in-beam charged veto using three wire chambers was installed in place of the original veto, which used a 3 mm plastic scintillator. The new system has 1/3 the rate of the old veto, but retains almost 100% efficiency.

Unfortunately, the April-June run had a 75% DAQ efficiency because of a bottleneck in the level 2 trigger. KOTO will implement data compression in the ADC to fix this problem for the next run. About 1/4 of the running time was used for special "calibration" runs, including 70 hours of data with an Al target in front of the detector to understand the signature of hadron interaction events. In spite of additional beam tuning, the experiment still sees background from the primary beam line next to the KL beam line. KOTO would like to add an iron shield between their detector and the primary beam line during summer 2016.

The near-term goal of the KOTO collaboration remains reaching the Grossman-Nir limit, as determined by the present experimental bound on $B(K^+\rightarrow\pi^+\nu\nu)$, namely $B(K_L\rightarrow\pi^0\nu\nu) < 4.4 \times B(K^+\rightarrow\pi^+\nu\nu)_{exp} < 1.5 \times 10^{-9}$ (90% CL). To reach this goal, they request 625 kW-days of data, including 500 kW-days of physics data. The committee strongly supports this request.

During the coming winter (Dec. 2015 – Mar. 2016), the collaboration will install the new inner barrel photon veto, which will add 5 radiation lengths to the 13.5 radiation lengths of the current main barrel, and will reduce the punch-through inefficiency by a factor of 50. Once the inner barrel is installed, they would like to collect as much data as possible. In particular, to keep pace with the improvement in the Grossman-Nir limit expected from future NA62 data on $K^+ \rightarrow \pi^+\nu\nu$ (assuming a Standard Model-like result), KOTO requests an additional 4000 kW-days of data by 2017. Before commenting on this future beam request, the PAC would like the collaboration to report on the background level achieved in the 2015 data taking.

E36: Measurement of $\Gamma(K\rightarrow e\nu)/\Gamma(K\rightarrow\mu\nu)$ and search for heavy sterile neutrinos using the TREK detector system (Lepton universality)

Detector preparation was carried out between November 2014 and April 2015. The first commissioning run took place from April 8 - May 7, 2015. However, the toroid magnet was not available until April 24. A second commissioning run took place from June 3-26, 2015. During this run 2.5% of the expected kaon yield was delivered (10M $K_{\mu 2}$ and 6K K_{e2}).

Although several delays in the startup of the hadron hall and initial problems including lack of cooling in the hall and the initial poor quality and stability of the beam led to some

difficulties in the initial commissioning of the experiment, the detector system was not yet fully ready and encountered a severe problem with readout dead time during the most recent commissioning period.

Initial examination of the commissioning run data does not show the expected PID performance (i.e. μ-e separation). Major improvements are expected from better tracking and optimized selections and combinations of the three available PID systems.

Given the tight constraints of the accelerator and construction schedule, we recommend that E36 run for the longest available period in 2015. The on-going summer shutdown period should be used to improve detector dead time, trigger (modify firmware to include a more sophisticated algorithm) and tune particle identification performance (especially the TOF system).

Although a check of lepton universality in charged kaon decay remains a very compelling physics topic, the statistics and detector performance requirements are very stringent. Given the possibility that the running time may not be sufficient, we recommend that the collaboration fully implement the dark photon signature trigger lines (e.g., $K \rightarrow \pi \mu \nu A$, $A \rightarrow e^+e^-$).

Such trigger lines should not require much more than 1% of the DAQ bandwidth each if optimized. There is worldwide interest in dark photon searches including on-going dedicated experiments at JLAB and Mainz as well as searches by collider experiments (e.g. KLOE, BaBar and Belle).

E21:An Experimental Search for μ−e Conversion at a Sensitivity of 10^{-16} with a Slow-Extracted Bunched Beam (COMET)

The PAC observed the completion of COMET experimental hall construction, and that the superconducting curved solenoid for muon transport has been produced and delivered.

Production of both the CyDet for the μ-e conversion search and the StrEcal for beam BG study are making good progress. About 24% of the total number of CDC wires in the CyDet have been strung; the chamber will be completed in December if the current production pace is maintained. Eight CDC readout modules (RECBE) have been produced at IHEP, Beijing and performance tests have been done. Mass production of electronics will start soon in July. As for the StrEcal, mass production of straw tubes at JINR is ongoing and will be completed this summer. Smaller and thinner straws are also being developed for COMET phase-II. Detector assembly of the first station will be done in FY2015 and the remaining four stations will be completed in FY2016. A prototype straw tube tracker has been made and characterization studies are ongoing at KEK. A test beam experiment with a 100 MeV electron beam will be done at ELPH/Tohoku this autumn. An MC simulation for the StrEcal is being developed and

close to completion. The readout module for StrEcal (ROESTI) is being upgraded for better radiation hardness.

An ECAL test beam campaign was organized at PSI to demonstrate PID performance using a $\pi/\mu/e$ beam; the preliminary results show good performance. A CDC prototype beam test has also been performed at SPring-8. A trigger/DAQ system demonstration with a minimum scale setup (RECBE- FCT- GLIB- MIDAS system) has been also conducted successfully at IHEP and was remotely controlled from Osaka.

Some tension found in the measurements of proton emission by the COMET collaboration and by TWIST should be understood for better estimation of the COMET sensitivity. The PAC recognized that as a whole the R&D for COMET phases I and II is proceeding very well. The growing collaboration strengthens the feasibility of the experiment.

However, the shortfall of the FY2015 budget is very serious and the start of the COMET experiment had to be delayed by one year to 2019. The PAC expects IPNS to make every effort to secure the necessary funding for the completion of the high-p/COMET beam line and the COMET capture solenoid. On the other hand, the PAC recommends that the COMET collaboration should now prepare a detailed and optimized construction and detector integration schedule given the budget plan. There should be a comprehensive external review of the final TDR, construction schedule and integration plan. Completion of this review is required for consideration of stage-2 status.

E56: A Search for Sterile Neutrino at J-PARC Materials and Life Science Experimental Facility (Sterile Neutrino)

A status report on E56 was presented to the PAC. Two key points need to be addressed in view of stage-2 status: i) the precise location of the experiment at the MLF, ii) a precise estimate of the cosmic-induced background rejection factor using the current design of the detector. The collaboration reported recent R&D studies performed to address the point ii), testing both the Cherenkov technique and the Pulse Shape Discrimination (PSD) technique.

The capability of achieving a 1/100 rejection factor on fast neutrons seems to be a realistic goal, given that it has already been achieved at the LSND experiment (which has a quite similar configuration). However, this level of rejection still needs to be proven for the E56 set-up. The first results based on small prototypes of detector components have provided encouraging results. More studies are needed to clearly demonstrate this rejection factor capability. The PAC recognizes the progress achieved by E56 and encourages the continuation of R&D studies.

E17: Precision spectroscopy of K-^{3}He 3d-2p X-ray

(to be assigned as E62 and henceforth referred to as Precision Spectroscopy of kaonic atom X-rays with TES).

The E17 experiment will carry out precise spectroscopy of K-^{3}He 3d-2p X-rays, originally aiming to measure the energy level shift with a precision of 2eV using SDD technology. However, they have now decided to use transition edge sensors (TES) rather than SDDs. Since the resolution of a TES is 5eV, which is much better than 150eV for a SDD, the PAC members appreciated their change of plan. At the same time, the committee requested an update of their proposal with a realistic study of TES performance. In response to this request, the updated proposal with recent studies was shown at this PAC meeting by the E17 collaboration. They conducted a beam test at the PiM1 beam line at PSI to check the rate dependence of the energy resolution, in which a pion beam was injected into a carbon target to generate pionic carbon that yields an X-ray at about 6.5keV. Based on the performance obtained with the beam test at PSI, the signal yield and energy spectrum at E17 were estimated. They found a linear rate dependence of the energy resolution, which if interpolated to the rate expected at the J-PARC, results in the expectation of 5-6eV resolution. This is still much better than that from an SDD. They also identified the source of the degradation of energy resolution as thermal cross talk of the Si substrate. The committee appreciates their beam test study, and is encouraged to learn that the resolution under realistic conditions is expected to be comparable to that without beam. Given the results shown in the updated proposal and the fact that they will use novel TES technology, the committee concludes that the stage 2 should be reconfirmed. This experiment should be registered as E62 and referred to as precision spectroscopy of X-rays from kaonic atoms with TES.

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

The P57 collaboration has proposed to measure the shift and width of the kaonic deuterium atom 1s state with accuracy of 60eV for shift and of 140eV for width to elucidate the anti-kaon-nucleon interaction. The 18th PAC recognized the importance of the measurement. According to the request of the 19th PAC, the collaboration updated the proposal including a more detailed study of the signal-to-background ratio including the possible duty factor of the beam.

The proponents reported a full simulation result on the signal-to-background (S/B) ratio. The evaluated value is expected to be 1-to-3 after introducing a vertex cut gate and charged

particle veto. This S/B ratio is adequate to determine the shift and width with the statistics requested. P57 also reported the current status for the detector and electronics systems, the cryogenic target system and the ASIC readout system. Preparations and test for all of the systems have started towards the physics run.

The Collaboration has the expertise needed to accomplish the experimental program. The PAC recommends stage-1 status and also supports their request for a commissioning run of the K-D apparatus with hydrogen gas for 100 kW-days before seeking stage-2 approval.

E50: Charmed baryon production

E50 presented an update on their plans for a charm baryon experiment using the recoil mass technique. Although Belle and LHCb have larger samples of exclusively reconstructed charm baryons, there is interest in the critical role of diquarks as well as in the production mechanisms in hadroproduction. These topics can be investigated in E50.

The PAC reiterates the recommendation of a closer interaction with lattice QCD theorists to understand the role of diquarks in charmed baryons. It is also desirable to discuss further with theorists in order to develop reliable predictions for the hadroproduction cross sections they plan to measure. These predictions would be useful to better plan the experimental set up and, at the same time, to better exploit the physical consequences of the planned measurements.

Extracting a small charm signal from the combinatorial background in hadroproduction requires a sophisticated detector and significant manpower for construction. The current E50 plan includes a scintillating fiber tracker (SFT), and a hybrid ring-imaging Cherenkov detector (RICH) with aerogel and CF_4 gas radiators for particle identification. A flexible trigger and DAQ using several hundred CPU's is planned. The output of the DAQ is 0.5 Gbytes/spill. The data will be stored at the KEK computing center.

Given the large uncertainties in hadronic cross sections, it would be wise to plan for an initial run with a flexible DAQ/trigger system that could be used to record data on non-charm Sigma and Lambda baryons.

A TDR should be prepared for the detector and carefully reviewed. An engineering run should be included in the overall plan. Data taking requires the construction of the high-p beam line and could start in 2019.

E13: Gamma-ray spectroscopy of light hyper-nuclei

The E13 collaboration successfully completed the first part of their experiment at the end of June 2015. The experiment was conducted at the K1.8 beam line and studied the $\Lambda - N$ interaction through (K^-, π^-) reactions.

Hyperball-J, a Ge detector array, was employed together with a ^{4}He target to determine the energy spacing of the ground-state spin doublets $(0^+, 1^+)$ of ${}^{4}_{\Lambda}He$. By measuring γ rays for the $1^+ \rightarrow 0^+$ M1 transition between the doublet states, the energy spacing was found to be $1.406 \pm 0.002 \pm 0.003$ MeV. Compared to the corresponding energy spacing, 1.09 ± 0.02 MeV, in the mirror hypernucleus ${}^{4}_{\Lambda}H$, this result shows a clear charge symmetry breaking in the $\Lambda - N$ interaction. The first study for s-d shell hypernuclei was performed by utilizing a CF_4 target in response to the discussion on the target material at the previous PAC. A data analysis is now underway to determine the energy spacing of the ground-state spin doublets of ${}^{19}_{\Lambda}F$.

The PAC is impressed by the recent results from the E13 experiment and encourages the collaboration to resubmit a new proposal for the second part of their experiment, which is planned for the new K1.1 beam line.

E05: Spectroscopy of Ξ-hypernuclei --Beam time request for a pilot run

T. Nagae presented a beam time request for a pilot run of E05. The objective of E05 is a spectroscopic study of Ξ-hypernuclei via the ^{12}C(K^-, K^+) reaction. The final goal is to study Ξ-hypernuclei by measuring the ^{12}C(K^-, K^+) reaction with 1.5MeV resolution at the S2S spectrometer, which is currently under construction. The proponents requested a pilot run with the SKS spectrometer, which has a larger acceptance with a reasonably good energy resolution of 5MeV.

The PAC understands that there is a good chance to obtain a meaningful result on Ξ-nucleus potential even with this short pilot run. The PAC also recognizes the importance of the measurement of $K^-p \rightarrow K^+\Xi^-$ cross-sections to determine the beam momentum for the spectroscopy of Ξ-hypernuclei.

The SKS spectrometer has to be moved out from K1.8 in FY2015 to install the Kurama spectrometer for E07, which needs to run in FY2016 to avoid further deterioration of the emulsion stored at the Kamioka mine. This coming autumn run is, therefore, the last chance to carry out this pilot run with the SKS.

The PAC recommends carrying out the proposed pilot run for E05 before the SKS is removed. The PAC also suggests E05 group should make an effort to improve the trigger rate and/or DAQ efficiency to maximize the physics output given the limited beam time allocated for hadron hall experiments..

E07: Double hypernuclei with emulsion---Beam time request for emulsion test

K. Hosomi presented a status report on E07 and a beam time request for a test run in coming autumn. The objective of E07 is to search for double hypernuclei with a hybrid-emulsion method with more than ten times statistics than the previous KEK experiment and to make a mini-chart of double hypernuclei. The hybrid-emulsion tracking system (SSD and emulsion) is new and different from the previous KEK experiment, although other parts of the apparatus including the Kurama spectrometer are similar to those used in the previous KEK experiment. The E07 group requested 3 days of beam time to demonstrate their new method. They also reported the status of the emulsion stored at Kamioka.

The PAC understands the importance of emulsion exposure to a K-beam in a timely manner to avoid further deterioration of the emulsion and also recognizes the importance of the test run for the key apparatus in autumn to be able to start a physics run in early FY2016. The PAC recommends assigning high priority to the E07 test run in Autumn and also recommends a quick change from SKS to Kurama at K1.8 to start the E07 physics run in a timely manner and retain flexibility on the scheduling of the beam allocation.

E03: Measurement of X rays from Ξ^- atom

E03 proposes the first measurement of X rays from a Ξ^--Fe atom by using Ξ^- 's generated by the Fe(K^-, K^+) reaction and then stopped in a Fe target. The goal is to first establish the proposed experimental method and then to extract the Ξ^--A optical potential (both the real and imaginary parts) from, e.g., the (n,l)=(6,5)→(5,4) transition. Data from this experiment would provide useful constraints on the properties of Ξ^- in finite nuclei and possibly in the core of neutron stars. After the previous FIFC and PAC reviews, the 4th PAC recommended stage-2 status in 2008.

Commissioning beam time together with E07 to test common detectors and to measure the beam profile is requested in autumn 2015, and beam time of at least 1×10^{11} K^- on target is requested after the E07 experiment in JFY2016 to observe the (7,6)→(6,5) transition and the potential signature of the (6,5)→(5,4) transition. The latter request of approximately 600 kW-

days corresponds to roughly 10% of their total request, and needs 2 months after E07 running to re-install Hyperball-J.

The PAC recommends carrying out a common test of E03 detectors with E07 in autumn 2015. The PAC also encourages active communications with the theorists to update the physics case of the experiment.

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

M. Iwasaki reported E15 status and requested a beam time allocation for the 2nd stage run. The objective of E15 is to search for the $\bar{K}NN$ bound state via the ^{3}He(K$^-$, n) reaction at K1.8BR using a neutron counter array and CDS for charged particles. The preliminary results of recent calibration runs with H_2 and D_2 targets were presented. The calibration runs seem to have been quite successful for determining the efficiency and response of the neutron counter array. E15 also presented the results of the 1st stage runs with a ^{3}He target. The missing mass spectrum of the semi-inclusive process, K$^-$ +^{3}He → n + X, shows an excess of events below $\bar{K}NN$ threshold. The Λp invariant mass spectrum in ^{3}He(K$^-$, Λp)n process was also shown. Because of very limited beam time of the 1st stage runs, much more statistics is needed to obtain conclusive results.

The PAC supports the E15 request for ten times higher statistics than that of the 1st stage run to obtain a conclusive result on the Λp invariant mass spectrum and establish the possibility of performing a kinematically complete measurement. The PAC suggests making a careful choice of triggers to maximize the physics output given the limited beam time.

E31: Hyperon resonances below $\bar{K}N$ threshold. Beam time request for a pilot run

First measurements were reported for the d(K$^-$, n) reaction leading to πΣ final states in both charge combinations ($\pi^+\Sigma^-$ and $\pi^-\Sigma^+$), with the neutron detected in the forward direction. This experiment, performed in close correspondence to E15, is aimed at investigating the nature of the Λ(1405) located less than 30 MeV below the $\bar{K}N$ threshold. Theoretical approaches based on the chiral SU(3) symmetry breaking pattern of low-energy QCD describe the Λ(1405) as a $\bar{K}N$ quasibound state imbedded in the πΣ continuum, i.e. as a coupled-channel system featuring a characteristic two-pole structure. An accurate determination of the πΣ spectrum is thus expected to contribute to the understanding of the mechanisms underlying the Λ(1405).

A limited run of 2.2 days in April and May has generated a first d(K^-, n) $\pi\,\Sigma$ missing mass spectrum and demonstrated the feasibility of the measurements. The statistics of these preliminary data are not sufficient for drawing conclusions yet. The $\Lambda(1405)$ signal below $\underline{\bar{K}N}$ threshold is not evident, whereas a pronounced maximum above $\underline{\bar{K}N}$ threshold at 1450 MeV is observed that needs to be understood in close contact with theorists and with dedicated calculations.

The E31 collaboration requests altogether 27 days of running with a 40 kW primary beam in order to increase their statistics by about a factor of 20. It is pointed out that 5 days of running would permit a statistically significant separate analysis of the $\pi^-\Sigma^-$ and $\pi^-\Sigma^+$ channels. Ten days of running at the same beam power would provide a measurement of the neutral $\pi^0\Sigma^0$ spectrum in order to gain complete isospin I = 0 and I = 1 information.

The experiment is prepared to continue at any time that a deuteron target can be placed on the beam line; coordination with E15 is flexible. The PAC supports the efforts to substantially increase the data statistics subject to the availability of beam time. Continued active communication with theory groups is strongly recommended, especially concerning the analysis and interpretation of the data.

5 BEAM TIME AND PROGRAM ARRANGEMENT FOR FY2015-2016

The PAC recognizes that the renovation of primary beam line related to the vacuum clamps at hadron hall strongly constrains the scheduling of beam time for the hadron hall experiments. About 6 months are required for cooling of radioactivity and renovation of the primary beam line. There is another concern about possible renovation work in the neutrino production target cooling system. Given these constraints, the PAC has discussed possible beam plans and suggests IPNS a possible beam time plan in which

1. SX operation will be made in the period starting from October to November. The length of operation will be decided taking the available operation budget and readiness of the experiments at HEF into consideration.
2. FX operation starts from January 2016 and continues as long as the budget allows. The PAC expects a possible extension of MR operations thanks to a supplemental budget allocation as well as lower electricity costs in the coming season.

3. Priority of the requests for K1.8/1.8BR were discussed considering various constraints and possible physics outputs for the pilot runs of E05 and E07 (the short E03 request is included within the E07 request), and the physics runs of E15 and E31. The PAC suggests that the E07 and E05 pilot runs should be completed in 2015 with E15 (2nd stage) followed to be completed earlier. E31 will have a beam time during a later period.

6 DATES FOR THE NEXT J-PARC PAC MEETINGS

The next PAC meeting will be held from January 13-15, 2016.

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

- Minutes of the 19th J-PARC PAC meeting held on 3-5 December, 2014 (KEK/J-PARC-PAC 2014-27)
- Proposals
  - Proposal of T60 extension (KEK/J-PARC PAC-2015-4)
  - Proposal of the nuPRISM experiment (KEK/J-PARC-PAC 2015-5)
  - Updated proposal from E17 (KEK/J-PARC-PAC 2015-6)
  - Updated proposal from P57 (KEK/J-PARC PAC-2015-7)
- Technical Design Reports
  - E34 g-2/EDM TDR (KEK/J-PARC-PAC 2015-1)
  - E16 TDR (KEK/J-PARC-PAC 2015-2)
  - E40 TDR (KEK/J-PARC-PAC 2015-3)
- Status Reports
  - E56 Status Report (KEK/J-PARC PAC-2015-8)
  - E31 Status Report (KEK/J-PARC-PAC 2015-9)

- E50 Status Report & Executive Summary (KEK/J-PARC 2015-10)