To be approved in the 22nd PAC meeting
KEK/J-PARC-PAC 2016-XX
January 15, 2016

J-PARC Program Advisory Committee

for the Nuclear and Particle Physics Experiments

at the J-PARC Main Ring

Minutes of the 21st meeting held on
13(Wed)-15(Fri) January 2016

OPEN SESSION:

1. Welcome and mandate to the committee: K. Tokushuku(KEK)
2. J-PARC Center Report: N. Saito (J-PARC/KEK)
3. J-PARC accelerator status & plan: F. Naito (J-PARC/KEK)
4. Hadron hall beam status: S. Sawada (J-PARC/KEK)
5. E07 (Double Strangeness System with a Hybrid Method): K. Nakazawa (Gifu)
6. E31 (Hyperon Resonances below KN Threshold): H. Noumi (Osaka)
7. E50 (Charmed Baryon): H. Noumi (Osaka)
8. FIFC Report: S. Uno (KEK)
9. E11 (T2K) Status of Detectors and Analysis, and Expression of Interest for the Second Phase: A. Ichikawa (Kyoto)
10. E11 (T2K) Beamline Status and Plan: T. Sekiguchi (J-PARC/KEK)
11. E14 (KOTO): T. Nomura (J-PARC/KEK)

12. E21 (COMET): Y. Kuno (Osaka)

13. E34 (g-2/EDM): T. Mibe (J-PARC/KEK)

14. E56 (Sterile ν Search): T. Maruyama (J-PARC/KEK)

15. E36 (Lepton Universality): S. Shmizu (Osaka)

16. P61 (NuPRISM): M. Wilking (Stony Brook)

17. Hadron Hall Floor Plan Update for 2015-2016: T. Komatsubara (J-PARC/KEK)

18. E42 (H di-baryon): J. Ahn (Korea)

19. E05 (Ξ Hypernucleus): T. Nagae (Kyoto)

20. E13 (Gamma-ray Spectroscopy of Light Hypernuclei):
H. Tamura (Tohoku)

21. E62 (Precision Spectroscopy of Kaonic Atom X-rays with TES) & E57 (Strong Interaction Induced Shift and Width of Kaonic Deuterium):
S. Okada (RIKEN)

22. E15 (Deeply-bound Kaonic Nuclear States): M. Iwasaki (RIKEN)

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

24. Beam time planning in 2016-2018 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), G. Isidori (UZH),
W. Louis III (LANL), H. Shimizu (Tohoku), W. Weise (ECT),
K. Tokushuku (IPNS Director), T. Kobayashi (IPNS Deputy Director),
and N. Saito (J-PARC Director)

Apologies: K. Inoue (Tohoku), H. Sakurai (RIKEN), and W.A. Zajc (Columbia)

1. PROCEDURAL REPORT

The minutes of the 20th J-PARC-PAC meeting (KEK/J-PARC-PAC 2015-11) were approved.

2. LABORATORY REPORT

2-1 Welcome and mandate to the committee (Katsuo Tokushuku, KEK IPNS director)

The director of the Institute of Particle and Nuclear Studies (IPNS), Katsuo Tokushuku welcomed the PAC members.

First, he reported on the status of FY2015 beam operation. The beam power for fast extraction (FX) and slow extraction (SX) from the main ring (MR) has been improved to about 350 kW and 42kW, respectively. The beam-time assignments were rearranged after the last PAC meeting due to the change in the budgetary situation. The allocated beam periods for FX and SX are 11.4 weeks (expected) and 16 weeks (completed), respectively.

Director Tokushuku gave the following mandate to PAC at this meeting.

-Review the new and updated proposals.

- P63: “Gamma-Ray Spectroscopy of Light Λ Hypernuclei II”
  This is a new proposal using the SKS spectrometer on the new K1.1 beam-line that will be ready in FY2017. The relative priorities of the K1.1 beam and high-p beam-lines should be set at the next PAC meeting.

- P61: updated

-Review the Technical Design Reports (TDR) from the experiments requesting Stage-2 approval.

- E16: (Electron pair spectrometer to explore chiral symmetry in QCD)
  The status will be reported by the FIFC, but the TDR was not ready at the time of this meeting.

- E42: (H-Dibaryon)

- E21(COMET)

-Assess the progress of on-going experiments and experiments in preparation towards the Stage-2 and set the priorities for operation during FY2016.

K1.8 line:

- E07 (Double Strangeness System with a Hybrid Method)

- E03 (X-ray from Ξ-Atom)

- E05 (Ξ-Hypernucleus)

- E40 (cross sections of Σp scatterings; presentation in previous PAC)

K1.8BR line:

- E31 (Hyperon resonances below KN threshold)

- E57 (Strong interaction induced shift and width of kaonic deuterium)

- E62 (Precision spectroscopy of kaonic atom X-rays with TES)

-Optimize the current plan before summer 2016 to assign beam time to T2K in April and to the experiments at the Hadron Hall in June considering the readiness of the Hadron Hall.

-Consider possible beam assignment options in the period Autumn 2016 – Summer 2017 and consider the case that the operations budget is not sufficient to run the entire period. It should be noted that the Hadron Hall cannot receive beam from July to February because of work on the primary beam-line.

Finally Tokushuku mentioned the renewal of the PAC membership in April 2016. He introduced the new members and expressed his gratitude for the work of the current members. He asked all current members to participate in the next PAC meeting to be held July 2016 when the hand-over between old and new members will take place.

2-2 J-PARC Center report (Naohito SAITO, J-PARC Center Director)

The J-PARC Director, Naohito Saito, welcomed the PAC members and reported on the status of J-PARC.

The facility upgrade budget for increasing the beam power of the Main Ring was approved by the government. This includes construction of new power supplies and new buildings necessary for them. A forest preservation issue related to this construction has already been solved after consultation with the local community.

Saito explained the budget situation of accelerator operations. J-PARC has made several efforts to provide user beam for sufficient period; in JFY 2015, J-PARC continues to operate the accelerator until the end of March thanks to internal efforts in resource allocation and optimization of the machine operation. In JFY 2016, J-PARC expects the same level of user beam time as in JFY2015.

The operation status of J-PARC in JFY 2015 was also summarized in prior to the detailed report by Fujio Naito. During the last few months before the PAC meeting, the accelerator was stably operated, delivering beam for 466 hours and 1752 hours to FX and SX users, respectively. The efficiency of operation is about 85% for both modes. The operation status of the MLF was also reported; Saito explained the details of the neutron-target vessel problem and related interruptions of MLF operations in May and October.

He also introduced two large future plans related to J-PARC. One is the facility upgrades to study “the origin of matter in the universe” through comprehensive particle and nuclear physics programs at J-PARC. The other is the Hyper Kamiokande project where J-PARC is expected to provide high-power proton beam producing neutrinos. Both have been selected as part of the 27 high-priority project plans by the Japan Science Council.

Saito reported the status of accelerator improvements achieved in 2015. Stable beam acceleration of a 1 MW-equivalent beam in the RCS was confirmed. He also mentioned on-going studies of high-intensity beam acceleration at the MR toward realizing 1 MW beam power. The results of this study shows the capability of the MR beam power to reach 1 MW with higher repetition rate. Further R&D directions such as an additional 8GeV booster ring construction and a proton driver ring installation in the KEKB tunnel were also shown toward even larger beam power realization in longer time scale.

2-3 J-PARC accelerator status & plan (Fujio NAITOH, KEK ACCL)

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

After showing the mid-term plan of the MR operation and describing the FX and SX power upgrades above 700kW and 70kW in 2019 for FX and SX, respectively, he explained the plan for the MR power supply upgrade including the associated building construction (D4, D5, and D6) for which the budget has been approved starting from JFY 2016. Construction of the three new buildings, will be completed in 2017. Significant mass production of power supplies will be carried out in the period 2016-2018. These supplies will enable the beam power upgrade described above.

Naito also reported on MR operation status in 2015. The beam power for the SX mode was successfully improved from 32kW to 42kW for user operation while FX operation was limited only for accelerator study because of the neutrino target station recovery process. Prior to this FX study, 4 RF cavities (FT3M cavities) were replaced with new ones that have a higher voltage gradient, enabling them to achieve 500kW equivalent beam acceleration in the MR. In the RCS the power supply for RF cavities was upgraded to cope with higher current (with a higher interlock limit) and a lower resonant frequency of 1.7 MHz. In addition, the beam injection painting method was improved, resulting in a successful reduction of the beam loss in RCS acceleration. This makes the practical operation of RCS at 1 MW more realistic. After a 400 MeV upgrade of the LINAC energy, there was no new hardware installation. Nevertheless careful maintenance work of the hardware was carried out in summer 2015 to achieve more reliable operation of the accelerator complex; at the LINAC it has been known that there

is instability in SDTL operation especially in the high klystron power output region above 400 kW. This was known to be due to residual dirt on the cavity surface. In summer 2015 hand cleaning of the surface of the STDL05-B cavity with proper solvents was done and it was found that the instability disappeared. The same treatment will be performed for the other cavities with instabilities (SDTL05-A and SDTL06-A&B) in summer 2016.

Finally Naito concluded his presentation by showing the operation schedule from January to March in 2016, in which FX operation for the T2K experiment is planned to start on January 31st and continues until the end of March.

2-4 Hadron Hall beam status (Shi'nya SAWADA, KEK IPNS)

Shin'ya Sawada reported on the status of beam operation during the fall-to-winter period in 2015. The proton beam was delivered to the Hadron facility during Runs 64 (from October 15th to November 12th) and 65 (from November 14th to December 18th). The total beam time was 692.5 and 816 hours, respectively. The beam time assigned to the users was 415 hours 59 minutes and 721 hours 52 minutes while the beam was stopped for 108 hours 10 minutes and 89 hours 4 minutes, thus the overall efficiency during the user data taking period was 74% and 87.7%, respectively. The primary cause of the beam downtime was accelerator troubles, especially in the LINAC. During these runs, the E05, E07, E14, E15, and E36 experiments took data.

Sawada introduced the newly installed "SX-Abort System", which aims at stopping beam extraction even during the beam spill and safely aborting the rest of the beam, circulating inside the MR ring, to the so-called abort dump. This system contributes much to improve safe beam operation.

Sawada explained the schedule for major work in the near future. Currently, three major activities, the SKS move, maintenance of the vacuum pumps in the upstream part of the primary beam-line at the Hadron Hall, and improvements of the KOTO detectors, are being carried out; these will be completed by middle of May, 2016. The Hadron facility will be ready to accept proton beam after completion of this work. After the summer shutdown period starts, a "Big Wall Opening" is planned, which involves construction work to install equipment into the shielding wall between the switchyard

and the Hadron Hall. In addition, maintenance of the vacuum pumps of the mid- and downstream parts of the primary beam-line in the Hadron Hall is planned. Taking into account the time required for this work, the Hadron facility will be able to accept proton beams again from March 2017.

Sawada also reported on the design of the new production target, following up on his report at the previous PAC meeting. He explained some details of the candidate design of the next version of the production target. The new indirect–cooling target will be able to accept proton beams up to 80 kW. Note that the lifetime of the current 50-kW target is estimated to be 7500 hours of beam operation. He stressed the importance of constructing a new target as the fabrication process of the indirect-cooling target has been already established and there is no spare unless a new target is constructed.

The PAC congratulates J-PARC on the stable operation and delivery of beam to the Hadron Hall. The PAC also took note of the plan of target development. The PAC recommends that the labs assess the long-term plan and provide a clear strategy toward achieving higher power operation.

2-4 Hall floor plan update in 2015-2016 (Takeshi Komatsubara, KEK/J-PARC)

Takeshi Komatsubara, the deputy head of Particle and Nuclear Physics division of J-PARC, explained the status of the Hadron Hall experiments and the floor plan for JFY2016.

In 2015, four beam-lines (K1.8, K1.8BR, K1.1BR, and KL) were in operation for physics data taking. The beam power reached 42 kW, i.e. 48 Tera 30-GeV protons every 5.52 sec. The efficiency of beam usage for users was stable and high, much better than 90%, in the latter half of Run 65 in December.

In the south area, the downstream part of the beam-line and the K1.1BR area will be removed in January and February; the SKS spectrometer will be moved from the K1.8 area to the south area in February and March; the roof of the KL area will be opened and the KOTO detector will be upgraded from February to April. The consolidation of the vacuum system for the primary beam-line, for which the work procedure was established and reviewed in September 2015, will take place in March and April for the

upstream part, and for the middle and downstream parts from November 2016 to February 2017. The breaking of South West Wall, which must be conducted when the MR is not operated, is scheduled during the summer shutdown of 2016. Thus, the hall cannot receive beam from July 2016 to February 2015 as already reported in Sawada's report.

The present status of the Stage-2 (i.e. fully approved) experiments at SX-HD was briefly reviewed. The KURAMA magnet will be installed in the K1.8 area for E07 and the subsequent experiments. The E31 experiment at K1.8BR is ready to take physics data. The beam-time plan for K1.8 and K1.8BR was presented and explained to the PAC members by Toshiyuki Takahashi of KEK in the closed session.

2-5 FIFC report (Shoji Uno, KEK IPNS)

Shoji Uno reported on the Facilities Impact and Finance Committee (FIFC). The last committee meeting was held on December 16th, 2015. In the FIFC meeting, the Liquid Hydrogen target for E40, a status report of E16, a review report for the high-p/COMET beam-line and a second comprehensive review of the COMET experiment, and the feasibility of the E42 experiment that requests Stage-2 approval were discussed. Discussions and recommendations made in FIFC were reported in the PAC meeting.

E40: Two issues were pointed out in the previous FIFC meeting. One is the choice of the hydrogen liquefaction method and the other is bonding characteristics with Araldite glue at cryogenic temperatures. For the hydrogen liquefaction method, the experimental group prefers to use a GM cryo-cooler; the FIFC agrees with this decision. For the bonding characteristics, the experiment group produced three real targets and performed several tests. No serious problems are found at the moment. The FIFC requires further tests to confirm the absence of hydrogen leakage.

E16: There were several issues raised in the previous FIFC meeting. The feasibility of the tracking system is the most serious concern. The performance with an optimized tracking algorithm is not yet satisfactory and further study is required. The FIFC recommends considering additional tracking layers. Other recommendations including the manpower issue should still be carefully considered.

E21: Prior to the FIFC meeting, a technical review committee on the High-p/COMET beam-line and a PAC sub-panel review on the COMET experiment were organized. FIFC heard a brief summary of discussions in these meetings. A report is available from the PAC sub-panel review.

The technical review committee on the High-P/COMET beam-line reviewed the beam-line, which provides proton beam to both high-P and COMET experiments. The review committee made several recommendations, such as further investigations of failure cases of accelerator operations, handling material with residual radioactivity and radiation damage, which might be an obstacle in COMET Phase-II, as well as radiation effects on the thermal conductivity of the graphite target. A full report will be provided by the technical review committee. The FIFC recommends holding a follow-up meeting to conclude on their suggestions and concerns. In the technical review committee on the High-p/COMET beam-line, a serious concern was raised on the feasibility of a 15kW-loss target to be located in SY for the high-momentum secondary beam-line. FIFC suggests that IPNS revisit this issue. The PAC also recommends further efforts to optimize the design of the beam-line and evaluate safety issues.

E42: The FIFC evaluated technical details of the E42 experiment, which requests Stage-2 approval. The FIFC made several comments and recommendations. Information on the trigger, DAQ, and the detectors of the KURAMA spectrometer is not sufficient to approve the experiment for the next stage. An important concern is charge-up on the wall of the field cage of the TPC. The mutual electromagnetic force between the superconducting Helmholtz-type magnet and KURAMA magnet should be evaluated carefully. In addition, the trigger rate should be estimated reliably and further improvements in the trigger logic should be carefully designed. An updated TDR is required in order to respond to these issues.

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

E07: Systematic Study of Double Strangeness System with an Emulsion-counter Hybrid Method

Nakazawa presented the results of a commissioning run in October 2015, and the beam time request of the E07 experiment. The objective of E07 is to search for double hypernuclei with a hybrid-emulsion method and a data sample with more than ten times the statistics of the previous KEK experiment in order to make a mini-chart of double hypernuclei. The hybrid-emulsion tracking system consisting of an SSD and an 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 commissioning run in October 2015 consisted of a 20 hours beam study, a 9.5 hours Aerogel Cherenkov (AC) counter study, and a 24.5 hours emulsion exposure. This run allowed the E07 group to tune the beam parameters, to establish the positioning method of the hybrid-emulsion tracking system, and to confirm the performance of the AC. The alignment accuracy is better than 1 micron.

The E07 group requests 6 days of KURAMA commissioning, and 6 days of physics data taking before summer 2016. With 6 days of running, 20 out of 118 stacks of the emulsion can be exposed. If the run is successful, two publications are expected based on this data set. The E07 requests another 29 days of physics data taking in autumn 2016.

The PAC understands the importance of emulsion exposure to a K-beam in a timely manner to avoid further deterioration of the emulsion, and the physics impact with a relatively short running time. The PAC recommends assigning high priority to the E07 run before summer 2016.

E31: Hyperon resonances below KN threshold via the (K^-,n) reaction on deuteron

A progress report on the analysis of pΣ missing mass spectra deduced from d(K^-,n) pΣ with neutrons detected in the forward direction, using data taken in a 2.2 days run during April and May 2015 was given. The original aim of E31 was to explore properties of the Λ(1405) and related mechanisms near the Kbar N threshold. Theoretical approaches based on the chiral SU(3) symmetry breaking pattern of low-energy QCD describe the K(1405) as a Kbar N quasi-bound state imbedded in the pΣ continuum, i.e. as a coupled-channel system featuring a characteristic two-pole structure. In particular, this theory suggests a Kbar N dominated pole at 1420 MeV rather than at the nominal 1405 MeV. An accurate determination of pΣ spectra in all three charge configurations ($\pi^+\Sigma^-$, $\pi^-\Sigma^+$ and π^0 Σ^0) is therefore expected to contribute important information to the understanding of such mechanisms in the region around the Kbar N threshold.

The statistics of the data available so far remains insufficient for drawing firm conclusions. The Λ (1405) signal below Kbar N threshold is not evident, whereas a pronounced excess in the summed πΣ spectrum above Kbar N threshold around 1450 MeV is observed together with indications of a possible structure at 1420 MeV. In the meantime, dedicated three-body calculations of the d(K^-,n) πΣ reaction, using coupled-channel amplitudes based on SU(3) effective field theory, have become available. The E31 collaboration should conduct further detailed analysis in contact with such theoretical developments.

As in the previous 20th PAC meeting, the E31 collaboration points out that altogether 27 days of running with a 40 kW primary beam would increase the statistics by about a factor of 20. Five days of dedicated running would permit a statistically significant separation of the $\pi^+\Sigma^-$ and $\pi^-\Sigma^+$ channels, while ten days of running at the same beam power would provide a measurement of the neutral $\pi^0\Sigma^0$ spectrum in order to obtain complete information on the I = 0 and I = 1 isospin channels.

The PAC supports the efforts to substantially increase the data statistics subject to the availability of beam time. In particular, a prime focus should be on a convincing analysis of the separate π^+ Σ^- and π^- Σ^+ spectra. The origin of the broad structure above

Kbar N threshold needs to be understood, and a possible structure around 1420 MeV must be clarified. The collaboration should quantify the statistics requirements using a MC simulation in order to reach a reliable conclusion. Active communication with theory groups is strongly recommended for the interpretation of the data.

E50: Charmed Baryons Spectroscopy via the (π, D^{*-}) reaction. (Hiroyuki Noumi, Osaka Univ.)

E50 presented an update on their plans for a charm baryon experiment using the recoil mass technique. Following PAC suggestions, the collaboration has started a closer interaction with QCD lattice theorists to better investigate the hadronic amplitudes relevant to this experiment, and correspondingly optimize its physics goal. The PAC looks forward to see the first results of this interaction.

At the same time, the collaboration has started to investigate a possible extension of its physics program joining forces with other experimental groups interested in related activities on the high-P beamline at J-PARC. Particularly interesting could be the possibility of studying the formation of the recently discovered pentaquark state, via an appropriately modified experimental set-up aimed at precise identification of di-muon resonances (J/ψ, etc.).

The PAC strongly encourages this and other extensions of the physics program of E50, as well as the extension of the original experimental set-up toward a "multi-purpose" detector. A systematic analysis of possible realistic options along these lines should be pursued.

Concerns on safety aspects of the high-P beam-line for E50 have been raised by the FIFC. In view of this potentially serious impact, the PAC suggests that IPNS further investigate this issue in detail.

E11 (T2K)

The T2K experiment is well positioned to possibly obtain evidence for CP violation in the lepton sector in the coming decade. The results so far from T2K, NOvA, and the reactor neutrino experiments are tantalizing and hint that CP violation may be close to

maximal with a value of $\delta_{CP} \sim -\pi/2$. The NOvA experiment at Fermilab is complementary to T2K with a longer baseline, so that a joint analysis of the experiments may also be able to determine the mass hierarchy. In addition to measuring δ_{CP}, T2K and NOvA will be able to test unitarity and the 3-neutrino paradigm. The existence of non-standard neutrino oscillations or non-standard neutrino interactions could produce values of CP violation that are outside the range predicted by 3-neutrino mixing, which would be evidence for physics beyond the Standard Model. Everything considered, T2K should have very high priority at J-PARC, and the PAC strongly supports T2K's request of an additional $\sim 6 \times 10^{20}$ POT by summer 2016 and an additional $\sim 8 \times 10^{20}$ POT by spring 2017.

The future addition of Gd to SuperK is an interesting development that may possibly enhance T2K sensitivities. Although there is uncertainty with regard to nucleon emission in neutrino interactions in water, it may be possible to tag neutrino and antineutrino interactions by whether or not there is a recoil neutron. If this tagging is reliable, then T2K could reduce the wrong-sign neutrino events in the antineutrino mode and also reduce neutral-current pion background, where approximately half the events will have a recoil proton and half a recoil neutron. It is reassuring that SuperK has the ability to remove the Gd in case it has detrimental effects on event reconstruction and particle identification. An evaluation of the T2K sensitivity with the addition of Gd to SuperK should be undertaken by the T2K collaboration. There should be good planning for the timing and scheduling of the Gd inclusion.

For the future, T2K will benefit enormously from higher beam power, lower systematic errors, the inclusion of more charged-current events, and more running time. The increase in beam power from 400 kW to 750 kW and eventually to 1.3MW would more than triple the rate of data collection. With increased statistics, the effect of systematic uncertainties becomes more important, and it is encouraging that plans were discussed for reducing systematic errors to ~6% and possibly to ~4% in the future. Furthermore, analysis improvements such as an addition of charged-current pion events and hardware improvement would increase statistics by an additional 50%.

With these improvements, and with ample running time as presented by the EOI (a total of 20×10^{21} POT), the measurement of CP violation at the 3σ level becomes possible.

The observation of CP violation in the lepton sector would be a major discovery that would have possible implications for the baryon asymmetry of the universe. The development of the EOI into a full proposal is strongly encouraged.

Various issues for T2K have been successfully dealt with over the past several months. The target He leak problem, which delayed beam by 2 months, has been fixed, new software is being prepared that will alleviate problems with the beam profile monitor, a new horn power supply and a new magnet control system have been installed, and the collimator has been re-aligned. With these upgrades, T2K will be ready for beam for the upcoming run periods: February 2016 – June 2016 and October 2016 – March 2017. With no spare horns at present, it will be crucial to build additional horns in the coming years.

E14 (KOTO)

Since the last PAC meeting, the KOTO experiment collected about 750 hours of physics data at an average power of ~40 kW. This sample, corresponding to about 1200 kW-days, exceeds the request of 500 kW-days of physics data. The current sample is about 20 times the 2013 data sample, and should make it possible to reach the Grossman-Nir limit (derived from the current experimental upper bound on the $K^+ \to \pi^+ \nu\nu$ mode). As planned, the group implemented data compression in the ADCs, re sulting in an improvement in lifetime from 75% to 85%.

The group presented initial studies of new techniques to improve n/γ separation. The techniques appear promising, but the Collaboration has not yet measured the overall background level achieved in the 2015 sample. The PAC recommends that a background evaluation in sideband regions be performed as soon as possible.

The construction of the new inner barrel veto, which will add 5 radiation lengths to the 13.5 radiation lengths of the current main barrel, was just completed. Following a cosmic-ray test at KEK, the detector will be brought to J-PARC for installation in February. The group would then like to collect at least 10 days of physics data with the new inner barrel before the summer of 2016. The PAC supports this beam request and encourages a timely analysis of the 2015 data. It is worth noting that the Grossman-Nir limit might change in the near future depending on the results of the NA62 experiment

at CERN. Any further beam requests should be considered once the background level in the 2015 data has been demonstrated.

E21 (COMET)

An external review of the COMET Phase I TDR (Technical Design Report) was held December 4, 2015. The COMET experiment has a two-step program: Phase I and Phase II (with the full S-bend and highest beam intensities). COMET Phase I should take data before the competing experiment Mu2E starts at Fermilab.

The report of the TDR review committee (co-chaired by Claude Vallee and Junji Haba) is posted. There has been excellent progress on the construction of the beamline. In addition, the stringing of the central drift chamber wires has been completed (November 24, 2015) and the readout boards have been produced.

A series of beam tests of various components are planned in 2016. The ICEDUST simulation package is now ready for extensive use.

Initial responses from COMET to the TDR review in December were posted on January 12, 2016. Although there has been excellent progress, these responses are not complete and do not, for example, include a revised schedule with a cosmic ray and engineering run.

A revised TDR incorporating all the suggestions and comments from the TDR review should be posted by April 2, 2016. This work will require a mobilization of the collaboration. The revised TDR document will be checked and reviewed by a dedicated external review committee before a decision is made on readiness for Stage-2 approval at the July 2016 J-PARC PAC meeting.

A technical review of the COMET beam-line was held December 14, 2015. The review committee was chaired by Y. Fujii and included accelerator, beam transport, facility, and radiation experts.

E34 (New Measurement of the Muon Anomalous Magnetic Moment and Electric Dipole Moment)

The E34 Collaboration aims at measuring the muon anomalous magnetic moment with four times better accuracy than the BNL E821 experiment. The result of the BNL measurement is 3.5 standard deviations above the Standard Model prediction. The E34 competitor, the Fermilab g-2 experiment, is a continuation of the BNL measurement on the Fermilab site, which plans first test runs in 2017 with the same final accuracy.

Following the recommendations of the 20th PAC meeting in 2015, E34 submitted a revised 436 page TDR on January 12, 2016, just before this PAC meeting. In particular, it includes a significant addition to the muon acceleration part and refined evaluation of the systematic uncertainties.

The E34 collaboration continues to grow and currently has 137 collaborators from 49 institutions in 9 countries. Its R&D demonstrates good progress in various areas.

Simulation shows that low- and mid-beta LINACs satisfy the design requirements. The first prototype will be manufactured in March 2016. Preparation of the muon acceleration test at H-line/MLF is underway.

A collaboration has been initiated with the Fermilab g-2 experiment on cross calibration of NMR B field probes at ANL.

A recent estimate shows that significant improvement of systematic uncertainties is possible in E34 compared to E821 at BNL: by a factor of 3 for spin precession and by a factor of 2.5 for magnetic field measurements.

The J-PARC PAC has the following recommendations for E34:

1) Carry out a focused review of the new g-2 TDR with a panel of external detector and accelerator experts. The review panel should include experts from the Fermilab g-2 experiment.

2) The focused review would also examine the overall plan and milestones for R&D before starting the experiment.

3) Given the high scientific interest in the physics of g-2, J-PARC and KEK management might explore other sources of funding in addition to KEK to accelerate the realization of the project.

E56 (Sterile Nu Search)

The PAC heard an update on activities of E56. The collaboration is working to fix the detector location. Several issues, including allowable floor loading, fire protection, and leak protection are being investigated with the MLF. So far, no show-stopper has been identified, although the location of the detector inside the MLF is more complicated than expected because of structural problems and safety procedures. In case these problems prevent performing the experiment on the 3rd floor of the MLF as originally planned, the group has considered a site outside the building. Such a site would double the baseline, and would require a factor of 4 increase in fiducial mass to reach the same sensitivity, implying a significant increase of the costs.

R&D efforts to demonstrate the required rejection of fast neutrons from cosmic rays continue to make good progress. The PAC encourages continued R&D and looks forward to knowing the exact location of the detector and receiving a full TDR for the experiment. In particular, further discussion with the MLF is encouraged, in order to find a suitable location of the experiment inside the MLF building.

E36 (Test of Lepton Universality in Kaon Decay)

The E36 experiment has completed its data-taking run and is being dismantled. E36 ran from October 15-December 18, 2015 and recorded 5×10^{11} kaons on target (or 1000 kW days). This resulted in 40K K_{e2} events, which is far below the originally proposed aim of 250K K_{e2} decays. This implies the final sensitivity to R_K of about 0.6% including systematics. This is comparable to NA62 but slightly worse. However, the E36 experiment used stopped kaons and hence will have systematic uncertainties that are quite different from those of the in-flight experiments.

Particle identification is based on Aerogel Cerenkov (AC), lead glass Cerenkov detectors (PGC) and time of flight (TOF) detectors. Particle identification is important for distinguishing K_{mu2} and K_{e2} events.

K_{e2} and K_{mu2} signals are clearly visible in the data. However, the calibration is still in progress. For instance, time-walk corrections have not been applied to the TOF system. The energy loss correction in the stopping target needs improvement. Similarly, reconstruction needs to be improved. The PAC looks forward to a timely completion of the lepton universality analysis, with an effort in maximizing the use of all available data.

E36 is also preparing complementary analyses of dark sector particles, which decay to e^+e^-. The results should improve on KLOE results and have good sensitivity below 100 MeV. E36 should also carry out dark sector searches for particles that do not leave visible decay products, such as K→pA (with A→ invisible). The PAC encourages a timely completion of all E36 analyses, taking into account that a new high-statistics experiment on charged kaons (NA62) has started data taking at CERN.

P61 (NuPRISM)

NuPRISM is a creative proposal for reducing systematic uncertainties in T2K (and its possible extension) measurement by building a near detector with adjustable off-axis angles at a distance of ~1km from the neutrino target. It has several advantages over the existing ND280 near detector in that it would have the same water target (with Gd) as SuperK, a neutrino flux very similar to SuperK, a much lower photon background for reconstructing electron-neutrino events, and a lower systematic uncertainty that is reduced from ~5.6% to ~4%. Furthermore, NuPRISM will be able to determine the biases in neutrino energy reconstruction, the multiplicity of recoil neutrons in neutrino and antineutrino interactions, and the separate fluxes of electron neutrinos, electron antineutrinos, muon neutrinos, and muon antineutrinos.

In addition to the advantages above, NuPRISM will also have good sensitivity to short-baseline active-sterile neutrino oscillations that is comparable to the oscillation sensitivity of the SBN (Short Baseline Neutrino) program at Fermilab. After the full data collection of 20×10^{21} POT with T2K-II, expected in ~2025, the combination of NuPRISM and SuperK will cover the entire LSND allowed oscillation region at the 5σ level.

In summary, NuPRISM is an excellent proposal. However, as already stressed in the previous PAC meeting, this proposal is intimately related to the extension of the T2K program, for which only an EOI has been submitted. Given the physics interest of NuPRISM, the PAC strongly encourages the continuation of R&D studies in close collaboration with the proponents of the T2K-II program. The PAC recommends that NuPRISM be considered for Stage-1 status following an evaluation of the T2K-II proposal.

E42: Search for H-Dibaryon with a large acceptance hyperon spectrometer

E42 presented a progress report on the H-dibaryon search near the ΛΛ threshold using the kaon beam at K1.8. The flavor-singlet S=-2 dibaryon (H-dibaryon) close to the ΛΛ threshold has stimulated renewed interest driven by the reports of enhanced ΛΛ production from E224 and E522 at the KEK-PS and by the recent theoretical prediction from lattice QCD simulations. It is, therefore, timely to carry out an experimental search in the ΛΛ, Λpπ$^-$, Ξ$^-$p, and Σ$^-$p channels with good mass resolution and high statistics.

E42 reported that the results of the prototype test of their hyperon spectrometer (HypTPC) meet the performance requirements of 1 MeV ΛΛ mass resolution, and test results of the full-size TPC are consistent with the prototype test. On-going studies to respond to the comments and suggestions from the last FIFC (December 16, 2015) were also reported, especially those related to the configuration of the coil suspensions in the cryostat, the electromagnetic force on the superconducting magnet due to KURAMA, the design of the field cage wall, optimization of the GEM layer configuration, and the performance of the trigger and DAQ systems.

The PAC acknowledges the studies by E42 in response to the FIFC's comments and suggestions. However, further clarifications are necessary in some issues, for example, the new field-cage of the TPC designed to avoid the charge up issues needs to be proven to work, and further improvements on the trigger and DAQ that allow data taking with higher rates are desirable. The PAC encourages E42 to continue these studies and submit an updated TDR for further reviews by the FIFC and PAC before Stage-2 approval. In addition, the PAC recommends that E42 investigate potential signals in the

cases that (i) the H-dibaryon lies between ΛΛ and NΞ thresholds and has a width larger than 5 MeV, and (ii) the H-dibaryon is located above NΞ threshold.

E05: Spectroscopy of Ξ-hypernuclei

The objective of E05 is a spectroscopic study of Ξ-hypernuclei. Results were reported of a successful pilot run for 12.5 days in October / November 2015 that included both $K^-p \rightarrow K^+\Xi^-$ and $^{12}C(K^-,K^+)$ reactions. The SKS spectrometer with its large acceptance and good resolution (~ 6 MeV) was used before it was moved out from the K1.8 area. The final goal is to study Ξ-hypernuclei by measuring the $^{12}C(K^-,K^+)$ reaction with a resolution better than 2 MeV at the S-2S spectrometer, which is currently under construction and to be installed in 2016.

The pilot run benefited from excellent kaon beam conditions achieved during November 2015, with 600k K^-/spill at 39 kW beam power providing 6000 Ξ per day. The $K^-p \rightarrow K^+\Xi^-$ cross section was measured with high statistics in a momentum range 1.5 - 1.9 GeV/c, and an optimum was found at 1.8 GeV/c. Altogether 80k quasi-free $^{12}C(K^-,K^+)$ events were collected with an estimated 40 events located in the interesting subthreshold range in which the Ξ is potentially bound to the Be core. A detailed analysis focusing on these subthreshold events is in progress.

The PAC congratulates the E05 group for the successful completion of this pilot run and looks forward to seeing the analysis of the subthreshold data, which are potentially expected to yield information about the real part of the (weakly attractive) $^{12}C(K^-,K^+)$-nuclear potential. A further important physics issue, not yet addressed so far, is the determination of the ΞN coupling to KK and the corresponding conversion width.

E13 (Gamma-ray spectroscopy of light hyper-nuclei) and P63 (E13-2)

In the first part of E13, an unexpectedly large charge symmetry breaking effect was observed in the ${}^{4}_{\Lambda}He$ hypernucleus compared to the world's available data for ${}^{4}_{\Lambda}H$. This result was published in PRL and was selected as a PRL editor's choice. The PAC congratulates the collaboration on this success.

A new proposal was submitted for a modified second part of the E13 experiment according to the new arrangement of beam-lines at the Hadron Hall. The SKS magnet used in the E13 experiment will move to the new K1.1 beam area. The experiment aims to study ${}^{4}_{\Lambda}H$ and ${}^{7}_{\Lambda}Li$ hypernuclei with a precision γ-ray spectroscopy technique.

The ${}^{4}_{\Lambda}H$ is produced as a hyperfragment by the ${}^{7}Li(K^{-},\pi^{-})$ reaction. The energy of the ${}^{4}_{\Lambda}H(1^{+}\rightarrow 0^{+})$ γ transition will be measured with Ge detectors to investigate charge symmetry breaking in A=4 hypernuclei by comparing with that of the ${}^{4}_{\Lambda}He(1^{+}\rightarrow 0^{+})$ γ transition, which was measured in the first part of the E13 experiment with the best precision to date.

The "effective" g-factor of Λ inside a nucleus is another subject of the proposed experiment. Employing a simple hypothesis, namely the weak coupling of Λ with the core nucleus, the proponent shows how to deduce an effective g-factor of Λ from an accurate future measurement of B(M1) for ${}^{7}_{\Lambda}Li$ hypernuclei. The effective g-factor to be obtained in this experiment would contribute prominently to the discussion of the quasi-particle properties of a Λ in a hypernucleus and stimulate the theoretical investigation of exchange current effects in the Λ-nuclear interaction involving $\Lambda-\Sigma$ coupling. An assessment of the experimental systematic errors is needed to reach the necessary precision on the g-factor, in addition to detailed theoretical work necessary to examine the hypothesis.

The PAC recognizes that the E13 collaboration has sufficient expertise with Ge detectors to accomplish the proposed experimental goals as they already demonstrated in the first part of the E13 experiment. P63 aims to establish the charge symmetry breaking effects first seen in E13 and provide a high-precision measurement of a hypernuclear B(M1) value. The PAC agrees that this is important in the field of hypernuclear physics and recommends that the P63 proposal be approved for Stage-1 status.

E62 and E57 (K-atomic X-ray experiments)

The objective of E62 is to measure X-rays of K- ^{3}He and K- ^{4}He atoms with very high precision using a newly developed cryogenic Transition Edge Sensor (TES) detector to study K- He strong potential through measurements of energy shifts and widths. The

use of a TES detector is essential to achieve this goal and may have an impact on other exotic-atom X-ray experiments. The previous PAC reconfirmed Stage-2 approval to E62.

The objective of E57 is to measure X-rays of K-D atom for the first time, which are important to study K-n interaction at threshold. The previous PAC recognized the importance of the measurement and recommended Stage-1 status and supported a commissioning run to study backgrounds before seeking Stage-2 approval.

E62 and E57 together requested a commissioning run (4 days in total) at the K1.8BR beam-line in June 2016. It includes a tuning of the K1.8BR beam-line to optimize the stopping K^- rate vs background and commissioning of the X-ray detectors, TES and Silicon Drift Detectors (SDD).

The PAC recognizes the importance of the commissioning run for E62 and E57 to propose realistic run plans and experimental setups to achieve their goals for both experiments. The PAC appreciates that two groups will perform the commissioning run together to minimize the beam time. The PAC recommends allocating 4 days of the beam time as requested for the commissioning run during next available beam period for the Hadron Hall before the summer shutdown in 2016.

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

PAC heard the status report of E15 experiment, which is searching for a prototype of kaonic nuclei, K^-pp, via the ^{3}He(K^-, n) reaction at the K1.8BR beamline. The status of the analysis of the first E15 run and progress on the 2nd run were described.

The first run of E15 was performed in May 2013. In this run, E15 group accumulated 5.3×10^9 kaons on target, which is only ~1% of the proposal. A semi-inclusive analysis of ^{3}He(K^-, n)X data showed some signals in the shallowly bound region below K^-+p+p threshold. This result of the first run has been published in Prog. Theor. Exp. Phys (PTEP). Since then, E15 group carried out further analysis of the exclusive data of ^{3}He(K^-, Λp)$n_{missing}$. Identifying a proton and a Λ, they investigated the Λp invariant-mass and missing-mass spectra. When the missing mass is restricted to be near the

neutron mass (n-window), the Λp invariant-mass spectrum is found to have a peaking structure near the K^-+p+p threshold. A global fit was attempted to determine the components of the events in the n-window. As a result, the Λp invariant-mass spectrum is well reproduced with the 3NA process, and the peak structure near the K^-+p+p threshold can be fitted with an S-wave Breit-Wigner function. A χ^2 test indicates a structure about 15 MeV below K^-+p+p threshold with a very large width (~100MeV). More careful analysis is required, since the statistics is low and the simple assumption of a Breit-Wigner shape is not necessarily valid for a peak near threshold.

In November-December 2015, a second E15 run accumulated 43×10^9 kaons on target (~10% of the proposal). The analysis of the newly obtained data is now going on. The statistics is substantially improved compared with the first run: ~50 times better for ^{3}He(K^-, Λp) n, and ~7 times better for ^{3}He(K^-, Λpn). Therefore, the data from the second run is expected to provide more clear information on the K^-pp subthreshold region.

The PAC looks forward to the results of the analysis of the second run, and recommends investigating channels other than Λp, such as Σ^0p.

4. BEAM TIME ALLOCATION FOR FY2016

As mentioned in the notes for the experiments above, the PAC puts higher priorities on the upcoming beam operation (January to June 2016) for E11 (T2K) in the FX mode and the 1st stage of E07 and pilot runs of E62/E57 in the SX mode. The PAC recognizes that additional data accumulation could be useful for E31 to quantify the statistics requirements for obtaining firmer conclusions. Considering the timetable for renovation work in the Hadron Hall, PAC suggests that SX mode operation should be scheduled at the end of the beam period before summer for E07 (12 days as requested), E62/E57 (4 days as requested), E31 (several days to accumulate 3 times more data) and necessary tuning/maintenance for SX. The remaining beam time would be allocated to the FX operation for E11(T2K) data taking.

Since additional renovation work in the Hadron Hall is planned after the summer shutdown, FX operation should start from the earliest possible time in the autumn. A detailed arrangement will be defined at the next PAC meeting.

5. DATES FOR THE NEXT J-PARC PAC MEETING

The next J-PARC PAC meeting will be held on 27-29 July, 2016 attended jointly by the new and current committee members.

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

- Minutes of the 20th J-PARC PAC meeting held on 15-17 July, 2015 (KEK/J-PARC-PAC 2015-11)
- Proposals
  - Proposal of the 2nd stage of E13 experiment (P63) (KEK/J-PARC-PAC 2016-2)
  - Update of and Correction to P61 Proposal (KEK/J-PARC-PAC 2016-4, 5)
- Technical Design Reports
  - Update of E21 TDR (KEK/J-PARC-PAC 2016-1)
  - Update of E34 TDR (KEK/J-PARC-PAC 2016-6)
- Status Reports
  - E56 Status Report (KEK/J-PARC-PAC 2016-3)
- Letter of Intent

- Searching for Muon Neutrino Disapearance using Mono-energetic Netrinos from Kaon Decay-at-rest at the J-PARC Materials and Lifescience Facility (KEK/J-PARC-PAC 2016-7)
- Precise measurement of the lifetime of Hydrogen Hyperisotopes ${}^{3}_{\Lambda}\mathrm{H}$ and ${}^{4}_{\Lambda}\mathrm{H}$ (KEK/J-PARC-PAC 2016-8)
- Study of Odd-Parity Σ(1670) and Ξ(1690) Resonances in K-p Reactions with the Hyperon Spectrometer (KEK/J-PARC-PAC 2016-8)
- Expression of Interest for an Extended Run at T2K to 20×10^{21} POT (KEK/J-PARC-PAC 2016-9)