Approved at the 24th PAC meeting
KEK/J-PARC-PAC 2017-7
January 13, 2017

J-PARC Program Advisory Committee

for the Nuclear and Particle Physics Experiments

at the J-PARC Main Ring

Minutes of the 23rd meeting held on
11(Wed)-13(Fri) January 2017

<u>OPEN SESSION</u>:

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. T2K/T2K-II status and Plan 1	
— Neutrino Beam —	T. Ishida (J-PARC/KEK)
5. T2K/T2K-II status and Plan 2	
— Detectors and Physics —	T. Nakaya (Kyoto)
6. E61(NuPRISM):	M. Hartz (IPMU)
7. E56 (Sterile ν Search):	T. Maruyama (J-PARC/KEK)
8. Hadron Hall Status, Schedule, and Target R&D Plan:	
	H. Takahashi (J-PARC/KEK)
9. E14 (KOTO):	T. Nomura (J-PARC/KEK)
10. Report from the g-2/EDM review panel:	S. Kettel (BNL)
11. E34(g-2/EDM):	T. Mibe (KEK/J-PARC)

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

13. FIFC Report: S. Uno (KEK)

14. E07(Double Strangeness System with a Hybrid Method) :
K. Nakazawa (Gifu)

15. E31 (Hyperon Resonances below KN Threshold): H. Noumi (Osaka RCNP/KEK)

16. E57 (Strong Interaction Induced Shift and Width of Kaonic Deuterium):
J. Zmeskal (SMI-OeAW)

17. E62 (Precision Spectroscopy of Kaonic Atom X-rays with TES):
S. Okada (RIKEN)

18. E16 (Measurements of Spectral Change of Vector Mesons in Nuclei):
K. Aoki (J-PARC/KEK)

19. E40 (Measurement of the Cross Sections for Σp Scattering):
K. Miwa (Tohoku)

20. E42 (H Dibaryon Search): J.K. Ahn (Korea U)

21. E03 (Measurement of X-rays from a Ξ-Atom): K. Tanida (JAEA)

22. E50 (Charmed Baryons): H. Noumi (Osaka RCNP/KEK)

23. E36 (Lepton Universality): S. Shimizu (Osaka)

24. Beam Time Schedule in 2016-2018: T. Kobayashi (J-PARC/KEK)

CLOSED SESSION:

Present: N. Aoi (Osaka/RCNP), T. Browder (Hawaii), S. I. Eidelman (BINP),
J. Haba (Chair, KEK), K. Hanagaki (KEK/Osaka), D. Harris (FNAL),
T. Hatsuta (RIKEN), G. Isidori (UZH), S. Kettell (BNL), R. Kitano (KEK),
M. Kuze (Tokyo Inst. of Tech.) , J. Pochodzalla (Mainz),
W. Weise (TU Munich), H. Tamura (Tohoku), W.A. Zajc (Columbia),

K. Tokushuku (KEK-IPNS Director), T. Kobayashi (KEK-IPNS Deputy Director), and N. Saito (J-PARC Director)

1. PROCEDURAL REPORT

The minutes of the 22nd J-PARC-PAC meeting (KEK/J-PARC-PAC 2016-22) 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.

Tokushuku reminded the committee of the general mandates and the approval process of the proposals. A summary of the experimental proposals submitted since J-PARC was founded was shown.

The MR was operated in the neutrino beam mode since last summer. The consolidation works in the Hadron Hall are in progress and will be completed by mid-March as scheduled. No new proposal was submitted for this PAC meeting. Tokushuku asked the committee to evaluate the following experiments requesting stage-2 approval: E16, E42 and E34.

Tokushuku asked the committee to give priorities for the beam time allocation up to the 2017 summer shutdown given the extremely tight JFY2017 budget situation. The budget for JFY2017 was announced in late December and is at a level similar to JFY2016. The anticipated increase of ~30 oku-yen for the ongoing MR magnet power supply (PS) upgrade was not included in the approved budget plan. Re-baselining of the operation and upgrades of the J-PARC facilities is in progress; the revised plans were not ready to be presented at this meeting.

The lab may be required to change its strategy for the first priority in beam operation. There is a need to invest more for upgrade and consolidation work in order to maximize the total protons on target (POTs) in the coming years. In JFY2017 the beam operation period will be short so that the MR power upgrade can be completed earlier. Even following this strategy, completion of the MR power upgrade will be delayed from 2018 to 2019 or later.

On the other hand, the lab clearly recognizes the importance of the currently running experiments. As a tentative plan, at least 5-cycle beam operation time would be kept in JFY2017, which might be divided into about 2 cycles before the summer with the remainder after the summer. Tokushuku asked the committee to give a recommendation for optimized beam allocation assuming this tentative beam delivery plan.

The committee took note of the severe situation in the J-PARC budget and encourages the continuation of negotiations with the government for an increased budget that would provide the appropriate beam time to the ongoing experiments along with a timely intensity upgrade of the facilities. The committee would like to hear a report on the detailed long-range plan for the JPARC facilities, taking into account a realistic budget profile, at the next meeting.

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

The J-PARC Director, Naohito Saito, welcomed the PAC members and presented an overview of the J-PARC facilities.

Saito showed prospects for improving the accelerator beam power and various science programs with the two MW-class proton synchrotrons at J-PARC, the RCS and the MR. At this moment the RCS beam power for MLF is limited to ~150 kW to minimize the unexpected load on the installed MLF mercury target after problems in the vessel of the previous target were found in 2015. The construction of a new MLF target operational at 1 MW is in progress and the new target will be installed in autumn 2017. The MR accelerator team has already achieved beam power exceeding 400 kW for FX.

They have already clarified that the MR has the potential to reach 1.3 MW once the power supply upgrade is completed.

J-PARC is making efforts for accelerator and facility upgrades following the KEK Project Implementation Plan (KEK-PIP) released in August 2016. In the KEK-PIP the MR power upgrade has the highest priority while the completion of COMET-phase-1 should be carried out at full speed along with facility reinforcements for the T2K experiment. Meanwhile construction of the high momentum beam line should be carried out using the J-PARC project budget. J-PARC will also try to improve the campus for users and plans better access and better working spaces on the J-PARC site. However, the very limited operation budget secured in 2017 to KEK makes it difficult to operate the JPARC facilities as desired in JFY2017, which has to be the focus of all efforts.

Finally, Saito concluded his presentation by mentioning the ongoing collaborative work with other laboratories exploring the intensity frontier, FNAL, ORNL, PSI and so on. One of these activities is an international collaboration to investigate radiation damage of materials; this is an area in which J-PARC plans to make a significant contribution.

2-3 J-PARC Accelerator Status & Plan (Fujio NAITO, J-PARC/KEK ACCL)

Fujio Naito summarized the J-PARC accelerator status and plan. He gave an overview of the J-PARC accelerator complex and introduced three accelerators: the 400 MeV Linac, the RCS, and the MR. He presented the status and beam power history of the accelerators as well as details of the beam time allocation after the last PAC meeting. After an intensive effort in accelerator tuning, stable operation of the MR in the FX mode was finally established at a beam power of 425 kW.

He described three newly installed devices for realizing a faster 1.3 second repetition cycle. These are an injection septum magnet and its power supply, new power supplies for the Q-magnets, and FT3L cavities. During the installation and commissioning processes several problems were found but have been successfully solved now.

Naito then presented the mid-term plan for the MR beam power upgrade. Originally, a long shutdown for installing new power supplies was scheduled in 2018. However, due to the tight budgetary situation in JFY2017 the long shutdown period will be shifted by one year in the current plan.

Finally, he concluded his presentation by showing the operation schedule for the coming three months. The operation of accelerators will continue until the end of June 2017.

2-4 Hadron Hall Status, Schedule, and Target R&D Plan (Hitoshi TAKAHASHI, KEK/J-PARC)

Hitoshi Takahashi reported on the status and schedule of the Hadron Hall and the R&D plan of the next stage of the primary target (T1 target). He explained four topics: consolidation work of the vacuum system, construction of the high-p/COMET beam line, target R&D, and the construction schedule. Consolidation work on the vacuum system was focused on the primary beam line where Al-alloy chain clamps were replaced by the stainless-steel ones. The work was successfully completed by the time of the PAC meeting. Construction work for the High-p/COMET beam line is in progress. An air-tight wall between the Hadron Hall and switchyard tunnel was built. Most of the necessary beam line magnets were placed in position in the air-tight wall last summer. A shielding wall for the COMET beam line is under construction at the moment.

An upgrade plan for the T1 target was reported. The next primary target will be operated with indirect water cooling capable of accepting primary beam power of up to 80 kW. This type of the target will be installed in 2018. Furthermore, another type of target operated with direct water cooling is being developed for the future. This is called a “euro-coin” type target composed of a nickel disk with a gold or platinum edge. The primary proton beam strikes the edge and the target is continuously rotated and directly cooled by water or He gas. The status of this R&D work was reported.

Finally, Takahashi presented a middle-term plan for Hadron Hall construction in which two cases were considered. For the first case, the K1.1 beam line is consolidated for use from March 2018 while the high-p/COMET beam line would be ready only after May 2019. For the second case, the high-p/COMET beam line becomes available in March 2019 while the K1.1 beam line can start to be used only at the end of JFY2019.

2-5 FIFC report (Shoji UNO, IPNS/KEK)

The final version of the FIFC report (FIFC-201612) has been submitted on February 2, 2017. The report is attached in the Appendix.

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

E11 (T2K) & E65 (T2K2)

T2K first presented the beam line and fast-extraction accelerator performance and described a few problems that occurred this year. They described two primary-beam component repairs that they would like to carry out during the summer 2017 shutdown: a turbo-molecular pump and a primary-beam monitor drive mechanism both need to be replaced. In spite of these problems with primary-beam monitoring, the proton beam angle was shown to be well within the specifications (based on the silicon-based muon monitor measurements). T2K notes that 4% of their beam time is given to the accelerator team so that tuning studies, which improve the proton power and ultimately increase the total integrated POT for the experiment, could be done. They described an upgrade to the radioactive-water drainage system that adds additional water dilution tanks. This would be needed for accumulation of more than $8.4\text{x}10^{20}$ POT in a given calendar year. A partial list of other improvements needed to achieve 750kW operations (and 320kA horn operations) was presented. Overall, there is a track record of continuing improvements in proton performance. The power has now reached the 450 kW level.

T2K presented its newest physics results and reported that a PRL article was submitted on January 2, 2017 that describes a combined analysis of all neutrino and antineutrino data taken through the summer of 2016. As promised in the July 2016 PAC meeting, they showed results from a new interaction channel added to their oscillation analysis to increase the statistical power of the data already taken. This new channel in which low-momentum pions accompany the electron in the final state, is predicted to provide 10% more statistics in electron neutrino appearance with a comparable purity to the original channels considered. Other new channels are also being investigated to further improve statistics. Three new neutrino-interaction results have also been released recently using ND280 data. Data stability is good; the fully-contained fiducial-volume event rates at SuperK and the INGRID event rates per proton on target were shown to be constant through December 15, 2016. A water module has been installed in INGRID for prototyping the ND280 upgrade and a first neutrino interaction in that module was shown. There were minor problems in the ND280 complex: before November 15 the magnet had to be opened to repair components in the FGD. Those problems were fixed but currently there is a problem with the ND280 magnet chiller so data taking is on-going without a magnetic field in ND280. Future plans for upgrading analyses for larger fiducial volumes, and coordination with NOvA for joint oscillation fits were described. Progress on the ND280 upgrade design was briefly mentioned, as well as coordination with the worldwide community on gas TPC neutrino detectors.

----- T2K Request and PAC discussion:

T2K has not collected as many POT as expected by this point in the fiscal year, and they request an additional 13.8 days of running in spring 2017 (i.e. after the scheduled FX stop on March 21, 2017), which is what they estimate would be needed to reach $7.3x10^{20}$ POT, the level suggested in the July 2016 PAC report. T2K also requests support for the pump and drive mechanism repairs during the summer 2017 shutdown. During the longer shutdown for the MR power supply upgrade they would like to upgrade the radioactive-water drainage system. The PAC asked what the risks were for future accelerator downtimes due to other new components that may be added before the long shutdown; that risk was evaluated to be low.

There is a strong physics motivation to time the power supply upgrade with the SuperK detector repairs; the detector repairs involve draining the whole tank and need a one year advanced warning to start planning. There are several beam line upgrades that should also be coordinated with the power supply upgrade, for example, the horn transformers, and the horn cooling upgrades needed to accommodate the increased repetition rate and increased horn current.

T2K is to be congratulated for their continued leadership in the world-wide neutrino oscillation community, and for their wide-ranging investigations on improving the experiment through upgrades to the near and far detectors, neutrino analysis strategies, and neutrino beam line. The PAC supports T2K's request for two weeks of additional beam time in the spring of 2017. The timing of these two weeks should be well before the summer conferences, which is typically when the international community meets to assess the status of neutrino oscillations. The 7.3×10^{20} goal would allow T2K to keep pace with NOvA in 2017. In the future, T2K requests 9.0×10^{20} per year to be competitive with the assumed NOvA plans to collect 6.0×10^{20} POT per year. The PAC endorses efforts to maximize the integrated POT after the 2017 summer shutdown, in particular by expediting the power supply upgrade. Timely completion of the upgrade will put T2K in a strong position to continue its leading role in the world-wide neutrino oscillation community.

E61 (NuPRISM)

The E61 (NuPRISM) experiment outlined their strategy for Phase-0 (on the J-PARC site at a 300m baseline) and Phase-1 (in a 50m-deep pit offsite at a baseline of 1 to 2 km). They have detailed plans for Phase-0. The physics goal for phase-1 is a measurement of the neutrino interaction spectrum at several different off-axis angles and well-defined neutrino energies. This program will minimize the uncertainties associated with neutrino energy reconstruction, and is important for measurements of CP violation in long baseline experiments. Phase-0's goals are primarily detector construction and performance verification.

They plan to reuse the Phase-0 detector in Phase-1, which is strongly endorsed by the PAC; the detector calibration and reconstruction/performance developed in Phase-0 will be directly applicable to Phase-1. They have developed a plan for a modular construction that should enable reuse of the entire detector in Phase-1. They are developing new multi-PMT designs that leverage Cubic Kilometer Neutrino Telescope

(KM3NeT) development and have requested funding from the Canadian CFI (Canadian Foundation for Innovation) with readout being developed by Canada and Warsaw. An initial site has been identified near the ND280 detector with the detector top near the grand level at 8° off-axis. They have started to develop rate estimates, detector and beam simulations, reconstruction techniques and calibration ideas. They are exploring neutron multiplicity measurements (making use of the planned Gd loading). Their simulation currently does not incorporate the multi-PMT design but that is planned for the near future.

E61 requests Lab support for the site characterization (including access to utilities and infrastructure) and neutron background measurements. The PAC endorses the request for lab support of phase-0 site characterization.

The PAC suggests that the NuPRISM collaboration focus on the physics-rich Phase-1 program and consider identification of potential Phase-1 locations in the near term as this may be a long lead-time item. The PAC also suggests that preliminary costs for the identified Phase-1 site be evaluated before the collaboration requests stage-2 approval for NuPRISM.

E56 (Sterile Neutrino Search)

E56 (JSNS^2 experiment) gave a status update in response to the comments given at the last PAC meeting. For the sterile neutrino search in the LSND-favored region, they are in competition with many other experiments, including the SBN (Short Baseline Neutrino) experiment at Fermilab, which has near and far detectors. E56 would like to start data acquisition in 2018 with one detector, while the funding for the second detector is being pursued.

Many of their estimated background components were verified with an in-situ measurement using a 500kg plastic scintillator. Based on this measurement a 12.5cm thick lead will be placed under the detector to reduce the gamma-ray background. On-bunch neutron background can be reduced to a negligible level by a spatial correlation cut.

They discussed with MLF experts and companies safety issues including the maximum floor load and oil leakage protection. They also started to work with companies on the design of stainless-steel and acrylic tanks along with their cost estimation. They will refurbish the PMT characterization system used in Double Chooz experiment and plan to use a Daya-Bay type magnetic shield (FINEMET). They have obtained CAEN HV power supplies used in Super-Kamiokande that have been tested and confirmed to work reliably. The PMT installation plan is being developed. Some material tests have started for liquid scintillator compatibility. All this work will continue towards the completion of their TDR, after which they will ask for the stage-2 approval, provisionally to be considered at the next PAC meeting.

The PAC is pleased to see their progress and encourages the collaboration to continue working towards completing the TDR, which will be scrutinized by the FIFC. It is desirable if they can obtain help from professional engineers or technicians at KEK or universities, for example in the design of the PMT support structure and the plan to fill the detector with liquid at the MLF entrance and move it to the experimental location with a crane. A careful assessment of the detector safety during this relocation should be performed.

E14 (KOTO)

KOTO published results obtained with the 2013 data. The PAC congratulates the team for getting these new results out. The upper limit for the $K_L \rightarrow \pi^0 \nu \nu$ mode is found to be 5.1×10^{-8} at 90% C.L.

KOTO presented the status of analysis of the entire 2015 data set, which will allow them to approach the Grossman-Nir limit, in response to the strong recommendation made at the 22nd PAC meeting. The data set consists of Runs 62 to 65, where the calibration/tuning of the detector is still in progress for the later half of the data.

In the analysis of the Run 62 data they tightened the event selection criteria. Some of the veto thresholds were lowered to 50% of their original values while retaining the same timing window. A new veto counter (HINEMOS) located on the inner surface of the Neutron Collar Counter (NCC) has also been introduced. At the cost of 30-35% relative loss of signal efficiency, the expected number of background events in the signal region was found to decrease from 1.82 to 0.77, while the single event sensitivity is degraded from 0.77 x 10^{-9} to 1.1 x 10^{-9}. The tighter veto cuts seem to have incurred a significant acceptance loss with an increasing rate primarily originating from the main barrel, which can be seen both in simulations with accidental data overlaid and in data with poor spill structure.

There was a significant discrepancy between the observed number of events and the expectation in the region downstream of the signal box when using the original event selection. With the new event selection, the discrepancy becomes smaller, i.e. two events are observed while 0.36 events are expected. As the KOTO group recognizes the possibility of an unexpected background source that could explain this discrepancy, the PAC recommends more careful and focused study to understand this background. In particular, deeper understanding of the neutron background and $K_L \rightarrow \pi^+\pi^-\pi^0$ background seems to be critical. Taking additional control samples may be useful for this purpose. A "Max Theta χ^2" cut has been developed based on comparison of the angle between two photons obtained by the vertex reconstruction and by the cluster shape analysis. Its effect on the neutron background needs further evaluation (the availability of control samples is a key issue for this purpose) as well as its correlations with the other cuts. Further efforts to reduce acceptance loss by improved timing and reduced veto window widths should also be considered.

The shift of the mass peak in $K_L \rightarrow 2\pi^0$ still remains. This is a longstanding problem and difficult to understand, because a simple energy rescaling does not explain this shift given their K_L reconstruction technique, which assumes the π^0 mass to determine the decay vertex position. Although this problem may not be critical, the PAC nevertheless encourages KOTO to continue their effort to understand this mass shift.

The PAC recommends evaluating a strategy for obtaining the desired background level by using the 2015 sample before opening the signal box. While 0.8 events is a significant improvement over 2, it is still uncomfortable for an assessment of whether the events found in the signal box are background or real signal. Additional selection requirements, for example, tighter veto cuts and/or the Max Theta χ^2 cut seem to be available to characterize the Signal/Background ratio for any possible events found inside the box, or to identify cleaner "inner-box" regions inside the larger signal box.

KOTO started to look at the 2016 data where the inner barrel is added, which should allow them to reach a sensitivity below the Grossman-Nir limit. The effect of the newly installed inner barrel is being investigated to characterize background reduction and the timing resolution. The PAC strongly recommends that KOTO analyze its new data in a timely manner in order to verify the detector performance in high intensity operation conditions.

Some work plans for 2016 and 2017 were presented. One of them is to fix the Level 2 trigger. In the 2016 run they were not able to accumulate physics data and control samples simultaneously. Because of the importance of collecting larger control samples to understand background, the repair of this trigger problem is of particular importance.

The PAC supports their plan with special emphasis on the attempt to understand the background near the signal box and the development of the event selection to reduce the background.

E34 (g-2/EDM)

The E34 experiment is designed to measure the anomalous magnetic moment of the muon (g-2) using innovative muon cooling techniques. The experiment will use a surface muon beam to produce muonium, which is ionized and accelerated to 300 MeV/c in a LINAC, and then injected into a solenoid magnet instrumented with silicon strip detectors in which the electrons from the muon decays are measured. The experiment reported on its initial plans to respond to the focused review held November 15-16, 2016. The PAC commends this general plan as a good start for their response. The PAC strongly encourages plans for development of a specific E34 systematic error table rather than re-using the BNL E821 table and expects that this will require substantial work over the next months from the newly formed task force.

Plans for a combined simulation of the entire experiment are encouraged. The PAC agrees that the TDR should fully explain the interfaces between slow muon production and the RFQ, and between the accelerator output and magnet injection. The simulations of the entire system should be described in more detail and some descriptions of the optimization of the initial electrostatic acceleration system and of the injection system should be included. A plan for managing all interfaces between and within subsystems should be developed and described.

A more detailed cost estimate should be developed that describes how each estimate was made and what the supporting documentation is. A more detailed schedule should be developed along with supporting documentation about how task duration lengths were estimated. It would be good to start to consider linkages between the various activities as well.

The slide showing the "experimental sequence" will make a valuable addition to the TDR by providing an overview for the reader. Additional follow-up on the simulation of each of the components and efficiencies and phase space of the various parts would be valuable.

New data from 2017 muonium production, RFQ and any possible laser ionization runs will be eagerly awaited by the PAC and will make important contributions to the TDR.

A description of the collaboration management as it is developed may warrant inclusion in its own chapter of the TDR or along with the Cost & Schedule.

E21 (COMET)

Following the last PAC review in July 2016, COMET Phase I was granted stage-2 approval.

The COMET team has now addressed a number of items that were highlighted at the last PAC review. The collaboration has now grown to 182 collaborators from 15 countries. The central drift chamber (CDC) was completed in June 2016. A cosmic ray test started in August 2016. Spatial resolutions of 150 microns were obtained in the central part of the chamber. A summary of the beam measurement program was presented.

Based on the presentation made at this PAC meeting, the PAC recommends the following:

1) A rough plan for detector integration and installation was presented. Installation requires more than seven weeks. However, detailed engineering and scheduling has not been worked out. Such a plan is necessary since the installation of the COMET detector through a small vertical aperture from the surface is quite challenging. KEK should find the needed engineering resources for this work.

2) The schedule and plan for the cosmic-ray run should be worked out and written down. All detector components including readout are expected to be available by summer 2018 as shown in the TDR. This would allow a cosmic-ray run starting in the latter half of 2018.

3) The plan for the initial engineering run was worked out in more detail as requested. However, some details are still needed and should be added to the TDR.

4) High rate tests of the readout and trigger are in progress with small prototypes in test beams, e.g. a test of the StrEcal at Tohuku is planned in March 2017. High rate tests of the full readout system with artificial triggers should be carried out.

5) There are still a number of items in the COMET TDR that should be improved. The final TDR document should be carefully edited and posted on the ArXiv. The progress of COMET as it approaches the installation stage should be closely monitored by KEK or a review committee.

Tests of main ring operation at 8 GeV (including measurement of the extinction factor) should be carried out in spring 2017 as planned. The request is two periods of 8 GeV running for a total of eight days.

A plan and schedule for engineering run(s) of COMET should be devised by KEK given the constraints of the operations budget. COMET has proposed a plan for a 4-week engineering run with a 2-week long physics pilot run.

E07 (Double Strangeness System with a Hybrid Method)

The objective of E07 is to search for double hypernuclei with a hybrid-emulsion method. The goal is to reach ten times the statistics of the previous KEK experiment (E373) and to make a mini-chart of s- and p-shell double hypernuclei.

A first 5-day physics run was performed in June 2016. About 15% of the existing emulsion stacks were exposed during that period. Although the number of plates analyzed so far is very limited, already 2 stopped Ξ^- events were identified in the initial analysis. For one of them the decay $\Xi^- \rightarrow \Lambda + \pi^-$ was observed within the emulsion stack. These yields are fully consistent with expectations and demonstrate that the standard analysis procedure is working very well.

E07 also reported significant improvements in the hardware and data taking procedure. Noise reduction in the SSD, more precise target positioning and an optimized DAQ efficiency lead to a reduction of the required exposure time for the remaining 100 emulsion stacks from 29 days down to 25 days. Furthermore, a better tracking algorithm for the KURAMA spectrometer provides a substantial increase in the number of reconstructed K^+s. The collaboration also reported on the status of the so-called Vertex Picker, which will allow the identification of Ξ events without referring to the spectrometer data. The PAC is pleased to see the good progress and encourages the implementation of the additional Vertex Picker analysis scheme.

The PAC understands the importance of the emulsion exposure to a K^- beam in a timely manner to avoid irreversible deterioration of the emulsion stacks stored at the Kamioka mine. Therefore, the PAC gives the experiment the highest priority for the upcoming running period in the Hadron Hall. The PAC supports the requested beam time for E07, which will allow completion of this measurement.

E31 (Hyperon Resonances below $\bar{K}N$ Threshold)

The goal of this experiment is a systematic study of the $\bar{K}N$-threshold and -subthreshold regions in order to clarify the complex nature of the $\Lambda(1405)$, which appears not to be a simple baryonic state. Theoretical approaches based on chiral SU(3) effective field theory suggest a double-pole structure of this baryonic state with a $\bar{K}N$ quasi-bound system embedded in the $\pi\Sigma$ continuum. In particular, coupled-channel dynamics predicts a pole around 1420 MeV, just below $\bar{K}N$ threshold.

The updated progress report at this PAC described the analysis of $\pi\Sigma$ missing mass spectra in all three charge configurations ($\pi^+\Sigma^-$, $\pi^-\Sigma^+$ and $\pi^0\Sigma^0$), measured in the first seven-day long run in May/June 2016. A detailed separation of the $\pi^-\Sigma^+$ and $\pi^+\Sigma^-$

channels was successfully performed and showed the expected interference between isospin I=0 and I=1 modes. In addition, data were taken for the d(K^-,p) reaction leading to a pure I=1 ($\pi^0\Sigma^-$) final state in which the $\bar{K}$N (I=0) pole does not appear. Preliminary data were also shown for the $\pi^0\Sigma^0$ pure I=0 channel, so that a complete isospin decomposition is now possible.

While a shoulder around 1420 MeV is visible in the data, a pronounced maximum above $\bar{K}$N threshold around 1450 MeV is also observed, which needs to be understood in close cooperation with theoretical work using advanced three-body calculations.

The $\pi^0\Sigma^0$ mode requires further efforts with higher statistics; a detailed assessment of background subtraction is needed in order to further establish the line shape and the behavior in the I=0 channel below $\bar{K}$N threshold. The E31 collaboration requests a second run of 20 + 2 days before the summer shutdown in 2017. The PAC supports these efforts, subject to constraints in the beam schedule, with the aim of completing this experiment.

E57 (Strong Interaction Induced Shift and Width of Kaonic Deuterium)

E57 proposes to make a pioneering measurement of X-rays from K^--d atoms. Precision measurement of the shift and width of these lines induced by the strong interaction will provide vital information on the kaon-nucleon interaction at threshold.

Working with the FIFC, E57 successfully demonstrated a safety factor in excess of two for a high-pressure cryogenic gas target cell. The cell for the deuterium target is designed to operate at 30 K and 0.3 MPa and is constructed from multiple layers of 25 μm Kevlar. Testing showed that the design was capable of maintaining the required conditions for 3 weeks. A destructive test demonstrated that 0.7 MPa was required to rupture the cell. The FIFC notes that in the event of a rupture the target gas volume of 28 liters (SATP) can be contained within the 100-liter volume of the vacuum chamber.

E57 also reported on progress towards assembling the Silicon Drift Detectors (SDD) that will be used to detect X-rays. Previously, they have demonstrated excellent in situ performance of prototype SDD’s in the K1.8BR beam line. Ultimately 48 SDD’s will be needed for the full experimental implementation. By the end of April 2017 the first 24 SDD’s will be mounted on ceramic substrates, bonded and tested. This schedule would permit availability for a beam test in mid-June 2017. The collaboration has requested 3.0 days of beam tuning for this test and 3.5 days of measurements with a liquid hydrogen target to validate their Monte Carlo estimates of backgrounds. The previous PAC endorsed this request. Installation for the test requires a 2-week switchover time from either E31 or E62.

The PAC notes that the projected mid-June 2017 readiness for the test represents a slight delay from the estimate of May 2017 presented to the previous PAC, but nonetheless assesses that the collaboration is making steady progress towards Stage-2 approval. While it is not possible to accommodate the request in the upcoming running period, the collaboration should be encouraged to consider the impact of conducting the test in closer proximity to production running on the deuterium target.

E62 (Precision Spectroscopy of Kaonic Atom X-ray with TES)

The E62 experiment aims to observe X-rays from the kaonic ^{4}He and ^{3}He atoms emitted in the transition from the 3d to the 2p orbitals. The energy shift and the width of these transitions are essential to resolve the long-standing problem concerning the depth of the K^- nuclear potential. Since the width of the transition is predicted to be as small as about 2 eV, a high-energy-resolution measurement technique based on a superconducting transition-edge-sensor (TES) was introduced.

Following the last PAC meeting, the development of the ^{4}He/^{3}He target system and the X-ray tube has been reported. The ^{4}He and ^{3}He target system is based on the one used previously for the E15 experiment. A target cell with a cylindrical shape 6 cm in diameter and 6 cm in length has been fabricated for this experiment. The vacuum chamber to mount the target cell has been modified so as to accommodate the TES detector. The cryogenic target has been cooled down successfully as expected and the TES detector worked well without having significant thermal fluctuation induced by the target system.

An X-ray tube has been introduced to irradiate the TES detector with intense X-rays, which will be used to monitor the energy calibration during the on-line measurements to compensate the change of the detector response due to fluctuation of the experimental circumstances such as the beam intensity. This is essential to ensure the accuracy and the reliability of the high-energy-resolution measurement.

The beam time allocation including four days for commissioning and 16 days for the physics run was requested assuming 45 kW of the beam power.

The PAC appreciates the progress in the development of the cryogenic target and the X-ray tube. The previous PAC supported the joint request of E62 and E57 to perform a commissioning run to optimize their beam line and target configuration. These measurements were performed in the K1.8BR line and showed good control and understanding of K^- stopping in a Li target. A test of the TES has also been performed and energy resolutions of 5.0 eV (6.7 eV) have been achieved under beam-off (beam-on) conditions.

A beam time allocation has been requested after March 2017, which includes four days for full commissioning and 16 days for the production run. Note that the experimental group now thinks it is better to perform the measurement with the 3He and 4He targets separately instead of measuring simultaneously using a mixed target as originally planned. It is not necessary to extend the beam time to realize the separate measurements.

The PAC recommends the requested beam time be allocated when the K1.8BR beam line becomes available after completion of the ongoing experiments.

E16 (Measurement of Spectral Change of Vector Mesons in Nuclei)

The E16 collaboration presented a brief update of their physics goals and their multi-stage strategy, and a detailed response to the points raised in the previous PAC report. They submitted a detailed TDR to the PAC, reiterating their request for Stage-2 approval for what they term Run-0 (40 shifts in early 2019 with a partial implementation of the detector) and Run-1 (160 shifts in Fall 2019 for the first physics data taking).

The physics goal of E16 is a study of the modification of spectral functions of light vector mesons (V=ρ,ω,ϕ) in the nuclear medium. The experiment aims at significantly improving the results obtained by its predecessor KEK-E325, which hinted to a significant modification of the spectral function for ϕ-meson production in p+Cu collisions [p+Cu -> ϕ+X □–> ϕ (e^+e^-)+X]. E16 should clarify the existence of this phenomenon with 100 times higher statistics, analyzing different nuclear targets. The PAC recognizes the interest of this physics goal, which could help to shed light on the structure of the QCD vacuum at finite nuclear density.

The experimental set-up consists of a modular structure with inner SSD trackers, GEM trackers (GTR), Hadron Blind Detectors (HBD), and lead-glass calorimeters (LG). The presently available budget allows the collaboration to build a minimal set-up consisting of 6 SSD + 6 GTR + 2 HBD + 2 LG modules. The final configuration, possible once additional funding becomes available, consists of 26 modules of each type. The Stage-2 approval request concerns two runs with minimal set-up: Run-0 for beam and detector commissioning + Run-1, for the first physics result.

The PAC recognizes the collaboration has achieved significant steps forward compared to the last PAC meeting. In particular, satisfactory answers have been provided about contributions to the background from bremsstrahlung effects, and the impact of Dalitz decays of π^0 and η mesons as well as ρ,ω,ϕ mesons. The detailed simulations of detector resolution effects and possible sub-detector misalignments reported in the TDR are also quite satisfactory. The analysis strategy based on (i) a naive Breit-Wigner parameterization of the spectral functions in absence of nuclear effects (E325 strategy), and (ii) the Gubler-Weise ϕ spectral function, is sound. Finally, the possibility to cross-check/calibrate the results via “fast” ϕ produced in p+C collisions seems very appropriate.

However, concerns remain within the PAC about backgrounds affecting the shape of the spectral functions in realistic beam and detector conditions. Similar concerns, including the reliability of the DAQ and trigger system under realistic conditions, have been raised also by the FIFC (December 2016 meeting). Last but not least, the long-standing problem of limited manpower for such a challenging experiment remains.

The main concerns of the PAC and the FIFC about the background and the reliability of the DAQ and trigger system should be addressed by a sector test under realistic beam conditions, with at least one complete set of modules (possibly more) fully equipped. To achieve this goal, the PAC encourages E16 to submit a revised proposal for Run-0 (test-run) with minimal running time (and the minimal detector configuration) in order to investigate the nature of the background with real data. The PAC would be ready to grant Stage-2 approval to this modified test run at its next meeting. At the same time, the PAC recommends the investigation of additional strategies to control the target-dependent background by data, such as varying the target material and shape, as well as measuring the modifications of the spectral functions as a function of the multiplicity of the event. The PAC also recommends that the collaboration quantify their ability to measure the ρ and ω spectral functions as well as the low-mass continuum below the ρ mass.

E40 (Measurement of the Cross Section of Σp Scattering)

The experiment measures the $\Sigma^{\pm}p$ scattering cross sections with high statistics on the K1.8 beam line with the KURAMA spectrometer and a new detector system (CATCH) for scattered protons. Stage-2 approval was granted one year ago, and the status of preparations was shown at this PAC meeting. The experimental group has successfully completed R&D and fabrication of the CATCH system as well as the new aerogel Cherenkov counter and the hydrogen target. They will confirm the performance of the entire CATCH system this January by measuring the p-d scattering cross section at the Tohoku cyclotron facility. After this test experiment they plan to move CATCH to J-PARC and have the experiment ready by November 2017.

The PAC is pleased to learn that the preparation of the experiment is going smoothly and appreciates the intensive efforts of the group. A beam time request of 5 hours for a beam size measurement before the summer of 2017 should be satisfied.

E42 (H dibaryon)

E42 presented an updated proposal on the search for S=-2 H-dibaryon near the ΛΛ threshold via the (K^-, K^+) reaction at K1.8. Measurements of the ΛΛ, $\Lambda p\pi^-$ and $\Xi^- p$ final states with good mass resolution and high statistics will provide key information on the possible H-dibaryon, which has been searched for by the previous E224 and E522 experiments at the KEK-PS and hinted at by recent lattice QCD simulations. The E42 hyperon spectrometer consists of a time projection chamber (HypTPC) and the superconducting Helmholtz magnet. In response to the comments and recommendations of the FIFC (December 2015), they have submitted an updated TDR with a detailed description of the detector components.

After the recommendations from FIFC in December 2015, E42 changed the GEM configuration of HypTPC to a 100+50+50 μm thick film layout, which gave better performance, and also changed the field-cage structure to avoid charge build-up. The operation of a gating grid was confirmed to work properly. E42 carried out an initial beam test of the TPC using single positron beams at low rate at the ELPH facility located at Tohoku University; tracks were successfully observed. The spatial resolution was around 500 μm without the magnetic field and it is expected to improve by a factor of two with the magnetic field in operation. The PAC strongly encourages further validation of the performance of the TPC under high-rate, multi-track conditions in the forthcoming proton beam test at RCNP scheduled in June 2017.

The Helmholtz-type superconducting dipole magnet was excited. The maximum quench field has reached 1.29 T. The design value is 1.5 T while E42 plans to operate at 1.0 T when actually running the experiment. Structural analyses have been conducted. However, there is not sufficient detail given in the TDR to demonstrate that every structural element can meet JIS (Japanese Industrial Standards) requirements. An update should include the results of the analysis in terms of the magnetic field interference between the superconducting dipole and KURAMA magnets. The separation of these two magnets is designed to be only 20 cm at the moment, which should be optimized by further structural analysis. The PAC requests that the group compile all necessary information to justify robustness of the mechanical design of the magnetic system as suggested by the FIFC.

Concerning the trigger rate estimation, the use of Forward Water Cherenkov (FWC) and TPC Hodoscope Multiplicity (TPH) triggers reduces the rate to significantly below 1 kHz, giving acceptable dead time (around 10%). The DAQ can handle up to a 1kHz trigger rate with partial readout and zero suppression.

The PAC recommends that the E42 proposal be approved as Stage-2 under the condition that the group updates and resubmits their TDR taking into account the comments at this PAC meeting on the superconducting magnet and the forthcoming FIFC final report. The group is encouraged to carry out further simulations on the potential signal of the H-dibaryon near the ΞN threshold with small coupling to the ΛΛ channel.

E03 (Measurement of X-ray from Ξ-atom)

The E03 proposal aims at observing for the first time the X-rays from a Ξ^--Fe atom to obtain the optical potential between the Ξ^- and nuclei. When the Ξ^- is orbiting just around the nucleus before being absorbed by the nucleus, the orbit is strongly affected by the nucleus and thus, the energy shift and the width of the X-rays contains information on the real part and the imaginary part of the optical potential, respectively. In the case of the Ξ^--Fe atom, the transition from the level with principal quantum number n=6 is expected to have significant information on the potential.

The experiment is planned at the K1.8 beam line. The Ξ^- particle produced by the (K^-, K^+) reaction on the Fe target will stop in the target forming a Ξ^- atom. The X-rays emitted from the Ξ^- atom will be measured by a Clover-shape Ge detector array in coincidence with identification of the K^+ by the large acceptance KURAMA spectrometer.

A two-phase strategy was proposed at the last PAC. The first phase aims at optimizing the experimental setup by observing X-rays with relatively high intensity emitted from the level with n=7. The second phase aims at accomplishing the goal of this experiment, namely, observation of the energy shift and the width of the transition from the orbit with n=6.

Although the E03 experiment is basically ready to run, the E03 collaboration requested at the present PAC meeting a one-day commissioning run to be performed before the 1st phase in the coming spring, considering the tight schedule of the beam time of J-PARC, where early allocation of the beam time for the 1st phase would be difficult.

The PAC understands the importance of the commissioning run, and recommends the requested one-day beam time be allocated before the summer 2017 shutdown.

E50 (Charmed Baryons)

E50 is an experiment to perform a spectroscopic study of charmed baryons via the (π, D*) reactions using the missing mass technique. The method should provide a few thousand Λc(2625) events although other existing or possibly existing states will be observed with much smaller statistics. While the E50 spectroscopic studies would be unable to compete with the existing results from CDF and B-factories as well as with those expected at LHCb and BelleII in the future, the method should allow a study of the production mechanism of excited charmed baryons and a measurement of the branching fractions of their decays since it does not require full reconstruction of individual decay modes.

The experiment will use a high-resolution (0.1%) and high-momentum (up to 20 GeV/c) secondary pion beam line. The designed intensity is 10^7 πs/sec at 20 GeV/c. The team (the High-p Collaboration) includes E50, E16 and J-PARC staff members as well as other potential users. Discussion of the secondary beam line specifications has already been started; various issues should be addressed. The production target is essentially the same as the current T1 system. The radiation level was estimated using the MARS code; the design of radiation shield has already been initiated based on this. Investigations concerning safety issues such as a monitoring system, the maintenance scenario, a safety simulation in case of a severe accident, have been started. It is pointed out that the beam loss of 15 kW at the production target would have a serious impact on the operation of the facility and thus should be addressed with extreme caution.

The PAC recommends that E50 present a detailed technical plan specifying possible costs of various parts of the project in order to better understand the cost-effectiveness.

As suggested at the last PAC meeting, the FIFC, IPNS and E50 should investigate the feasibility of the high-momentum secondary beam line.

E36 (Lepton Universality)

E36 has completed data taking and is now preparing for a lepton universality test. Due to the relatively short data-taking period, the expected sensitivity on the lepton universality ratio is 0.5% rather than 0.3% as originally planned.

Since the last PAC meeting in July 2016, there has been significant progress on calibration and analysis of the data. The tracking has been upgraded from 4-point tracking to 5-point tracking using the scintillator-fiber tracker (SFT). The momentum resolution has improved from 1.4% to 0.9%. There has also been an important improvement in the particle identification, which combines three detector systems; an overall muon rejection of 10^5 has now been achieved. The time-walk correction has now been implemented in the TOF system. The time resolution is 200 psec and some further improvement is expected with a consequence of better muon rejection.

A clear Ke2 signal from a small data subsample is now visible, along with Kμ2 feed-down and a Ke3 tail. The separation of the various channels is expected to improve when tracking and particle identification are refined, and the contribution of the radiative modes will also be included. The latter are under study using the CsI(Tl) calorimeter, in order to constrain the SD (structure-dependent) component from data.

E36 expects to complete their systematic studies by fall 2017. The PAC hopes for continuing progress/improvements and regular updates on the progress of the analysis at the upcoming J-PARC PAC meetings.

There is also world-wide interest in dark photon searches including on-going dedicated experiments at JLAB and Mainz as well as searches by collider experiments (e.g. at KLOE, BaBar and Belle). Progress in this area was not presented and should be shown at the next PAC meeting. The PAC recommends a timely analysis in this sector given the pressing competition from the NA62 experiment at CERN.

4. BEAM TIME ALLOCATION FOR FY2017

Since we now realize that the operation budget for JFY2017 will be extremely tight, the PAC was asked to reconsider the beam schedule from April 2017 assuming 2 cycles of MR operation before the summer and total running time not longer than 5 cycles in JFY2017 unless an increased budget is injected later.

The PAC recommended at the 22nd meeting that the beam would be delivered to the Hadron Facility from the end of March to June to complete ongoing experiments, namely E07 and E31, and to carry out an 8 GeV/c beam study for the COMET experiment and several short pilot or survey runs. After the re-evaluation at this meeting, the PAC reiterates the importance of an early beam investigation for 8 GeV/c COMET operation and timely completion of the experiments as suggested at the last meeting, and strongly recommends providing the necessary amounts of beam time for the Hadron Facility. Following the suggestion given at the last PAC meeting, the E07 and E31 collaborations reduced their beam time requests of 27 days and 22 days, respectively, but their requests do not fit in the 2-cycle beam time proposed by the labs.

Considering the severe international competition in long baseline neutrino research and the POT accumulated so far in T2K after the summer of 2016, which is significantly lower than expected due to the relatively low accelerator availability, the PAC strongly supports a compensation of their beam time before the summer shutdown.

To conclude, the PAC recommends that the beam time before summer be prolonged to nearly 3 cycles. PAC suggests extending T2K beam operation until 11 April to maintain the current advantage of T2K over the NOvA experiment. Summing up the requests of the E07 and E31 experiments with beam line commissioning (4 days) and the COMET beam study (8 days), the PAC recommends that 61 days of beam delivery be allocated to the Hadron Facility starting from April 12, 2017. The PAC expects that further optimization and better arrangement would enable to accommodate several short pilot runs and beam surveys for the E03 and E40 experiments in the period.

The PAC recommends that the entire beam time after summer be delivered to the T2K experiment, if the total operation in JFY2017 is limited to 5 cycles.

5. DATES FOR THE NEXT J-PARC PAC MEETING

The next J-PARC PAC meeting will be held on July 24-26, 2017.

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

- Minutes of the 22nd J-PARC PAC meeting held on 27-29 July, 2016 (KEK/J-PARC-PAC 2016-22)
- Technical Design Reports
    - TDR for the Measurement of the Muon Anomalous Magnetic Dipole Moment g-2 and Electric Dipole Moment at J-PARC (KEK/J-PARC-PAC 2017-1)
    - TDR for the J-PARC E16 (KEK/J-PARC-PAC 2017-2)
    - TDR on the Proposal E42 (KEK/J-PARC-PAC 2017-3)
- Status Reports
    - Status Report on safety measures and risk assessment for the D_2 gas target (KEK/J-PARC-PAC 2017-4)
    - Report from the NuPRISM (E61) Collaboration (KEK/J-PARC-PAC 2017-5)
- Letter of Intent
    - Letter of Intent for the E05 next physics run with S-2S (KEK/J-PARC-PAC 2017-6)