KEK/J-PARC-PAC 2022-18
May 9, 2022

J-PARC Program Advisory Committee

for the Nuclear and Particle Physics Experiments

at the J-PARC Main Ring

Minutes of the 33rd meeting held
19(Wed.)-21(Fri.) January, 2022

OPEN SESSION:

1. Welcome and J-PARC Center Report: T. Kobayashi (J-PARC/KEK)
2. J-PARC Accelerator Status & Plan: S. Igarashi (J-PARC/KEK)
3. Hadron Facility Status & Plan: H. Takahashi (J-PARC/KEK)
4. Welcome and Mandate to the Committee: N. Saito (KEK)
5. Report from the focused review of HEF-EX: T.Hatsukda(RIKEN)
6. P83 SUB-Millicharge ExperimenT (SUBMET): J. H. Yoo (Korea)
7. P88 Study of in-medium modification of ϕ mesons inside the nucleus with $\phi \to K^+K^-$ measurement with the E16 spectrometer: H. Sako(ASRC-JAEA)
8. P90 High resolution spectroscopy of the Sigma N CUSP by using d(K^-,π^-) reaction: Y. Ichikawa (JAEA)
9. P91 Proposal for study of charm component in the nucleon via J/ψ measurement with the J-PARC E16 spectrometer: Y.Morino (J-PARC/KEK)
10. P92 Proposal for the E80 Phase-I Experiment : Investigation of $\bar{K}NNN$ bound state focusing on the Λd decay: F. Sakuma (RIKEN)

11. P93 Proposal of test experiment to evaluate performances of secondary beam mode at the high-momentum beam line: K. Shirotori (RCPN-Osaka)
12. E71(NINJA) : T. Fukuda (Nagoya)
13. E34(g-2/EDM): T. Mibe (J-PARC/KEK)
14. FIFC report : S.Uno (KEK)
15. E56/E82(JSNS2): T. Maruyama (J-PARC/KEK)
16. E75 Measurement of the formation cross section of $^{7}_{\Xi}He$ in the $^{7}Li(K^{-},K^{+})$ reactions : H. Fujioka (Tokyo Inst. of Tech.)
17. E73 Lifetime measurement of $^{3}_{\Lambda}H$: Y. Ma (RIKEN)
18. T2K(E11)/T2K-II(E65): D. Sgalaberna (ETHZ)

    S. Bolognesi (CEA Saclay)
19. E14(KOTO): T. Nomura (J-PARC/KEK)
20. E21(COMET): Y. Kuno (Osaka)
21. E16 Measurement of Spectral Change of Vector Mesons in Nuclei:

    S. Yokkaichi (RIKEN)
22. E45 3-body Hadronic Reactions for New Aspects of Baryon Spectroscopy :

    S. Hiroyuki (JAEA)
23. E70 Ξ hypernuclear spectroscopy: T. Gogami (Kyoto)
24. E72 Search for a narrow Λ^{*} resonance using the $p(K^{-},\Lambda)\eta$ reaction with the hypTPC detector: S.Hayakawa (Tohoku)
25. K1.8/K1.8BR plan and beam time request summary:

    M. Ukai (J-PARC/KEK)
26. Beam Time Schedule in 2022 T.Komatsubara (J-PARC/KEK)

CLOSED SESSION:

Present: P. Achenbach (Mainz), I. Adachi(KEK), M. Blanke (KIT), M. Endo (KEK),
L. Fields (FNAL), Y. Itow (Nagoya), D. Jaffe (BNL), T. Kawabata (Osaka),
F. Le Diberder (CNS/IP2N3/LAL), A. Ohnishi (YITP-Kyoto),
H. Ohnishi (Tohoku), A. W. Thomas (Adelaide), K. B. Luk (Berkeley),
N. Xu (LBNL), K. Yorita (Waseda), R. Yoshida (Chair, Argonne),
N. Saito (KEK-IPNS Director),
T. Komatsubara (KEK-IPNS Deputy Director)
and T. Kobayashi (J-PARC Director)

1. PROCEDURAL REPORT

The minutes of the 32nd J-PARC-PAC meeting (KEK/J-PARC-PAC 2021-17) were approved.

2. LABORATORY REPORT

2-1 Welcome and J-PARC Center Report (Takashi Kobayashi, J-PARC Center Director)

The J-PARC Director, Takashi Kobayashi, showed the beam power histories and plans of RCS and MR. He reported on the installation situation of the new power supply for MR. He also reported that a leakage in the new SM32 coil was found so that a new one has to be built by fall 2022. Kobayashi explained that in recent years, the period to receive approval by NRA (Nuclear Regulation Authority of Japan) for Radio Isotope facility modification is getting longer and longer (> 6 months), although it has been nominally 3 months in the past. He pointed out that it is a very serious problem and it already affected HD/NU user beam operation due to delays of approval lasting several months, twice in last few years. He showed that the current round of approvals is already getting tight and affects COMET phase-alpha, MR/NU 1.3 MW capacity and MLF MU H-line extension. Kobayashi presented the construction plan of the J-PARC access road. The more direct access to J-PARC site is long requested by the user communities. Kobayashi explained the budget of JFY2022 situations both for JAEA and KEK. In JAEA side, it includes the cost of 7.2 cycle operation of RCS/MLF. In KEK side, it includes costs for 4.5 cycle of MR operation, beam power upgrade for 750 kW and J-PARC upgrade for Hyper-Kamiokande project. Kobayashi presented the highlights of outreach activities of J-PARC. One is a special exhibition at National science museum at Ueno held from July 13th to October 3rd. More than 78,000 people visited there. The other is the J-PARC facility open house which was streamed via Youtube and niconico live. The number of connections were 1600 and more than 11,000, respectively.

2-2 J-PARC Accelerator Status (Susumu Igarashi, J-PARC/KEK)

Susumu Igarashi reported on the status of J-PARC accelerator. He presented the beam operation summary of MR; from March to April in 2021, the beam power of 510kW was achieved in FX operation. In May to June, SX 30GeV operation was successfully conducted at 64.5kW with an extraction efficiency of 99.5% and spill duty factor of 50-55%. A dedicated period in May 20th to 25th was spent for 8GeV acceleration and bunched beam slow extraction for the COMET beam extinction factor measurement. The beam power of 8GeV operation was 1.8kW with an extraction efficiency of 99.1% and spill duty factor of 55%. These were improved from 97.3% and 16% respectively in the previous test in 2018.

Igarashi discussed a machine issue that happened on 29th in June. A circuit breaker for the MR magnet power supplies accidentally opened during SX operation. It was found that this failure occurred from time to time in 2021. The failure that occurred in February 2021 actually resulted in the fatal damage of the electro-static septum ribbons. During the summer shutdown in 2021 they investigated a transformer connected to the power supplies and found that a pressure relief valve for the transformer oil has malfunctioned. They will replace the valve before starting operation in 2022.

Igarashi explained a mid-term plan for MR operation. Until 2021 operation, MR repetition cycle had been 2.48 seconds with the number of protons of 2.6×10^{14} ppp to provide 500 kW beam. The repetition cycle will be reduced to 1.32 seconds with the number of protons of 2.1×10^{14} ppp to achieve 750 kW operation after the long shutdown in 2021-2022. Magnet power supplies will be replaced by new ones with capacitor banks for energy recovery. Efforts to reduce the repetition cycle to 1.16 seconds while increasing the number of protons to 3.3×10^{14} ppp to realize 1.3 MW MR operation in 2028 will be continued. Installation of new RF cavities with higher accelerating voltage in 2022 and 2026 is mandatory to achieve this goal. Setup of the 2nd harmonic cavities installed in 2020 will be completed by the end of JFY2022. The extraction system including extraction kickers and high field septum magnets will also be upgraded in JFY 2022.

Finally, Igarashi summarized his presentation by showing the schedule for 2021 – 2022. The accelerator shutdown will continue until the end of March 2022. They will spend April and May 2022 to test newly installed power supplies, and June 2022 to check the upgrade system by accelerating the beam both in FX and SX modes. No user operation is schedule in this period. There will be a regular summer shutdown in July – October 2022, followed by MR operation in FX mode with 1.32 seconds repetition cycle as well as one-month operation in SX mode. Operation in FX mode is necessary in advance of SX operation for vacuum baking of the accelerator using beam after air exposure during the upgrade work. There is a slight delay of the start of the user operation due to a water leakage observed in a newly installed FX septum magnet coil. A new coil will be fabricated and accelerator conditioning plans are optimized to minimize the delay.

2-3 Hadron Facility Status and Plan (Hitoshi Takahashi, J-PARC/KEK)

Hitoshi Takahashi reported on the status and plan of the construction works during the long shutdown. The new primary beam line for the COMET (C-line) will be completed early in the next FY. The preparation for the COMET phase-α is now underway in the Hadron south building. In the K1.8 area, the previous spectrometer KURAMA has been replaced with the new spectrometer S-2S. Hadron facility will be ready for beam by the middle of November, 2022.

Takahashi also presented the status of the production target development. The current hadron target is a fixed gold target indirectly cooled by water, and capable of the beam power up to 95kW for 5.2-s spill cycle. In order to increase the beam power to over 100kW, a new target is now being developed. It is a rotating disk target directly cooled by He gas. The cooling efficiency of He gas was improved enough to accept the beam power of 150kW by adopting the disk with a turbo-fin shape. In order to further improve the cooling efficiency and to increase the life time of bearings, a gas bearing is now under development. The preliminary test of the first trial production of the gas bearing was performed successfully, and a realistic rotation test with a dummy disk is in preparation.

2-4 Welcome and Mandate to the Committee (Naohito SAITO, KEK IPNS director)

The director of the Institute of Particle and Nuclear Studies (IPNS), Naohito Saito, welcomed the PAC members. He first explained the government budget for Japanese Fiscal Year (JFY) 2022. For J-PARC, it includes approximately 4.5 cycles of MR operation while the run length based on the electricity cost at the time of budget request (June, 2021). It also includes the improvement budget toward 0.75MW and the Hyper-Kamiokande budget at the J-PARC side including the intermediate detector, the accelerator and the beam facility improvements toward 1.3MW. Saito mentioned that the electricity cost is a big concern because the cost, which depends on the oil price, has increased by around 20% from April, 2021. In this situation, an extra budget is necessary to deliver the scheduled beam time. He also mentioned that further increase is a big risk to for accelerator based science.

Saito explained the KEK Roadmap 2021 and Project Implementation Plan (PIP) 2022. The KEK Roadmap 2021 is an overall research strategy for a period from JFY2022 to JFY2027 based on the inputs from relevant communities. It has been published on May 31, 2021 and reflected the KEK Scientific Advisory Committee (SAC)'s recommendations. The PIP 2022 will be established as a prioritized list for budget request for the next 5 to 6 years after the SAC's review scheduled in March 7 to 11, 2022. A draft of the PIP 2022 prepared by the KEK Director General is being circulated within the relevant communities. Its outline is (1) priority is placed on beamtime when the budget is allocated, (2) then some hardware improvements will be implemented as next priority and (3) nine new projects requiring budget request are listed for prioritization. The nine new projects include projects relevant for particle and nuclear physics at J-PARC such as the hadron experimental facility extension and the COMET phase-II.

There are two technical design reports (TDRs) from E82 and E75 as well as the FIFC report submitted to the PAC33. There are also four new proposals submitted. Saito mentioned that a focused review will be necessary for one of the proposals, P93. He suggested to potential proponents of future proposals that if a proposal includes significant impact on the facility, they should contact and discuss with the facility representatives and directors in advance so that the IPNS can plan necessary reviews and discussions prior to the PAC meeting.

A focused review of the hadron experimental facility extension was conducted. The review report was given by the chairperson, Tetsuo Hatsuda (RIKEN) on the 1st day of the PAC33.

Saito requested the PAC to evaluate the new proposals and requests for stage-1 status and stage-2 approval and provide recommendations to the IPNS and J-PARC directors. He also requested assessments of the progress of the ongoing experiments as well as any advice on the run plan after the long shutdown.

He summarized his talk after introducing a new World Premiere Institute launched at KEK. It's an international center of Quantum-field measurement systems for studies of the Universe and Particles (QUP). It is a top-down, new independent organization in KEK, but it has strong cooperation with IPNS in order to bring a breakthrough to the field.

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

P83 (Sub-Millicharge ExperimenT; SUBMET)

P83 (SUBMET) is a proposed experiment to search for low mass millicharged particles arising from neutral meson decays from proton-on-target at the T2K beamline. The detector is to be placed in the Neutrino Monitor building, behind the INGRID detector. The P83 experiment can run in parallel with T2K operation and does not require dedicated beamtime.

The detector configuration consists of two sets of 10x10 arrays of scintillator modules with one PMT readout, each of 5x5x150 cm^3 dimension, and two sets are aligned so that the incoming millicharged particle penetrates through each module in both upstream and downstream sets. With this set-up, P83 can reach a sensitivity of $Q < 10^{-4}e$ for $m_x < 0.1$ GeV/c^2 and $Q < 10^{-3}e$ for $m_x < 1.6$ GeV/c^2 with 5×10^{21} pot, where Q and m_x are the charge and mass of the millicharged particle, respectively. This is a significant improvement compared to the experimental results obtained so far.

In a meeting with the T2K and NINJA collaborations, the P83 group developed two possible solutions to accommodate the space requirement for their experiment. Both options appear suitable and have been communicated to the Lab management. With the resolution of the space issue, the PAC recommends stage-1 status to P83. To understand the background situation and to get useful feedback for the technical design of the detector configuration, the PAC expects the P83 group to proceed with further communications with the T2K and NINJA collaborations.

P88 (Study of In-medium modification of ϕ mesons inside the nucleus)

The P88 experiment aims to measure the mass spectrum modification of phi meson in a nuclear matter via $\phi \rightarrow K^+ K^-$ decay channel, which might be a signal of the partial restoration of chiral symmetry in the nucleus. The final goal for the experiment is as same as the E16 experiment, but the proposed experiment focuses on one of the main decay modes of ϕ meson. Thus, investigation of the phenomena with high statistics is possible. Especially for this physics topic, simultaneous di-electron and di-Kaon measurement of the ϕ meson is desired to investigate the problem in detail. Therefore, PAC recognizes the importance of the proposed experiment.

Proponents have prepared answers for all questions asked to be considered in the previous PAC meeting, and all answers were found to be satisfactory. Also, they began to collaborate with theorists in order to prepare elucidations of physics concerning the spontaneous breaking of chiral symmetry in nuclear matter from data that will be taken in the future. PAC encourages the proponents to continue this effort. PAC recommends stage-1 status for the P88 proposal.

P90

The P90 experiment is proposing the missing-mass spectroscopy in the $d(K^-,\pi^-)$ reaction by using the S-2S spectrometer at the K1.8 beam-line with a liquid deuterium target. The aim of P90 is to study an enhancement of events near the ΣN threshold, which has been observed in previous experiments, e.g., J-PARC E27. Such an enhancement could be a signature of a ΣN bound state. The experiment will exploit the high momentum resolutions of the spectrometers and the high background suppression capability of the HypTPC to measure the ΣN mass spectrum with an unprecedented resolution.

The proponents presented simulated mass spectra for different hypotheses – a deeply bound ΣN state, a shallow bound ΣN state, and no bound state – and the sensitivity of scattering length and Breit-Wigner fits to the projected spectra.

The PAC shares the interest in the proposed study and appreciates the preparations for the experiment. It was demonstrated that the proposed experiment has a high sensitivity for identifying a deeply bound state. The sensitivity appears to be lower for differentiating between a shallow bound state and no bound state as threshold cusp appears in both cases. We consider a good mass accuracy – in addition to the good resolution – to be crucial for understanding the nature of the enhancement in the ΣN spectrum. We encourage the proponents to work out calibration procedures and to make a projection of the accuracy of the mass determination.

The P90 experiment is planned to be ready by the end of JFY 2023. The PAC recommends giving stage-1 status to P90.

P91

This experiment aims to investigate the existence of so-called intrinsic charm in the nucleon. Intrinsic charm is a potential non-perturbative component of the nucleon sea where the c-cbar pair carries relatively large Bjorken-x. Many attempts have been made to pin down this component of the structure of the nucleon with contradictory results. Some studies of DIS have put very stringent upper limits while others have claimed values as large as 0.5%. It would be interesting to have an experiment that could finally resolve this issue definitively.

The proposal here, which follows initial study in experiment E16, is to study backward J/Psi production in proton nucleus scattering on C, Ti and Pb targets. The signal proposed for intrinsic charm is that the cross section in the region x_F in the range (-0.3, 0.0) should scale as A^α with α~2/3. The beam time requested is 50 days using the E16 spectrometer.

The PAC was not convinced that the power α measured in this experiment would provide the definitive answer required. For future consideration by the PAC it would be helpful to have a full analysis of the E16 data as well as a much more detailed discussion of the theory needed to interpret the experiment. It would be useful to be able to test the theory in other regions of x_F and ideally to employ more than one theoretical method to analyze the data.

P92

The proponents of E80 analyzed the K^--^{4}He reaction data at 1 GeV/c taken in the T77 beam time, and found a peak structure below the mass threshold of K-ppn in the invariant-mass spectrum of the Λd channel. They claimed that this structure might be due to a K-NNN bound state, and requested urgent approval of 14-days beam time to confirm the K-NNN bound state with the present setup. However, it is not trivially obvious that the observed structure is really a K-NNN bound state because it might be a baryon bound state such as ΣNN. The PAC recommends that the proponents should carefully analyze the T77 data and seek further justification for the K-NNN bound state interpretation. The PAC also requests the proponents to clarify their strategy in combination with related experiments in which they propose to search for deeply bound kaonic states.

P93

P93 proposal consists of evaluations of beam properties (intensity, profile and beam species) as well as beamline modifications for secondary beams. In addition, the proponents request 80 hours of beamtime for some specific physics experiments, after the beamline modifications.

The variety of the particle species and momentum of the high-momentum secondary beam providing the π20 beamline, which was initially proposed by the E50 experiment, will enlarge physics opportunities on the hadron hall experiment. The PAC recognizes the importance of such a secondary beamline. The PAC also understands that the construction of π20 has led to some issues.

The PAC requests that the beamline modification part of the proposal be discussed with the Lab/Facility management for feasibility, both technically and from the point of view of resource allocation and scheduling.

Regarding the experiment part of the proposal, the PAC recommends the proponents make specific proposals, when the status of the possible beamline modifications become clear, and prepare for discussions in future PAC meetings.

E71 (NINJA)

NINJA is an experiment to study neutrino interactions in water by using an emulsion-water sandwich detector together with time stamp information provided by the emulsion-shifter and scintillating counters. Muons from NINJA can be measured by Baby-Mind to provide momentum and charge information. They have completed a first half of physics run with 4.8E20 POT by Feb 2020 (E71a). Digitization of tracks in the emulsion films by automated scanning system has been started.

At this meeting, NINJA reported the status and progress of data analysis of E71a and preparation of the 2nd half of the physics run (E71b). Scanning emulsion film will be completed in Jan 2022. Sufficient high tracking efficiency is confirmed. They have improved PID performance by using the newly developed data-driven method based on better knowledge on proton tracks recorded in emulsion. Now the systematic error due to detector response is comparable to that due to beam flux uncertainty in the cross-section measurement.

Active discussion with theorists and the T2K collaboration is ongoing in order optimize the implementation of their results in future neutrino analyses. A T2K-NINJA joint oscillation fit is foreseen after T2K conducts the oscillation analysis with ND280 upgrade measurements. We stress the importance of that fit and look forward to hearing an update at the next meeting.

Preparation for the next physics run E71b is ongoing. They have successfully developed a new automatic emulsion pouring system and an automatic scanning system to speed-up the processes. We encourage the collaboration to continue working with T2K to ensure E71b can be successfully deployed.

PAC congratulates NINJA on their progress and looks forward to seeing their first physics results from E71a which is expected at the next PAC meeting.

E34 (g-2/EDM)

E34 is an experiment designed to measure the anomalous magnetic moment and electric dipole moment of the muon. It relies on the innovative approach of using a cooled surface-muon beam that is accelerated and injected into a compact storage magnet. Within a couple of years of data taking, the experiment should provide a g-2 measurement with an accuracy similar to the ones achieved by BNL and FNAL Run 1 but with smaller, and different, systematics.

The collaboration is stable with above 100 persons (65% staff physicists) mostly from Japan (70%). In the 33rd PAC meeting, the collaboration reported encouraging progress on numerous elements of the apparatus. The PAC looks forward for updates on ongoing work, in particular; the final engineering designs; the analysis of the surface muon beam in the H1 area; the demonstration of muon-cooling and acceleration in the S2 area and the proof of principle of the 100mJ laser.

The overall schedule has been delayed by 1.5 years with respect to what was presented at the previous PAC meeting. This very significant delay is due to unexpected funding limitations that occurred at the end of December, together with construction issues with the experimental hall. The result being that the installation in the experimental hall is delayed to the end of JFY2025, instead of mid JFY2024. Data taking is now expected to start about mid JFY2027, leading to g-2 results towards the end of the decade. Considering that the next round of g-2 FNAL data analysis (adding Runs 2+3 to Run 1) is expected to be released in early FY2023, it appears very important that the laboratory takes the necessary steps, with precise contingency plans, to ensure that no further delay occurs.

The PAC congratulates the successful progress of the project in various aspects and encourages tighter collaborative work with the lab to secure funding for JFY2023 and beyond to ensure that the independent g-2 result from the collaboration is delivered in a timely manner, with the projected performance. We also congratulate the collaboration on progress with the acceleration and injection of a cooled muon beam, a new and challenging technique that should be encouraged and supported.

E56/E82 (JSNS^2, JSNS^2-II)

The PAC received the JSNS^2-II TDR in October 2021 and received updates on JSNS^2 and the JSNS^2-II proposal. JSNS^2 seeks to confront the LSND anomaly with the same muon decay-at-rest source as LSND but with detectors at two baselines with lower backgrounds and duty factor. JSNS^2-II comprises a new far detector (AD2) 48 m from the MLF target with a 32-t fiducial mass to add to the operating JSNS^2 near detector (AD1, 24 m, 17 t). The near detector has acquired 13% of the approved POT in 2021 and is now acquiring 2022 data.

The collaboration presented the status of AD2 construction and plans with a focus on key detector issues. The far detector will reside outside the MLF building and fabrication of the stainless-steel tanks and support structure are in progress and expected to be completed by April 2022. The AD2 acrylic vessels are designed and will be fabricated by the same company that made AD1. GdLS and LS, donated by the Daya Bay collaboration, are ready for AD2. DIN has been added (10% by weight) to the GdLS to enable the PSD performance as in AD1. $JSNS^2$-II plans to use ~220 PMTs donated by the Double Chooz collaboration (DC). If DC PMTs cannot arrive on schedule, there is a contingency plan to purchase Hamamatsu PMTs that would add a few months to the PMT-deployment schedule. Electronics will be ordered in summer 2022 with delivery expected in spring 2023. AD2 filling and data-taking is expected to begin in fall 2023.

There are seismic and environmental concerns as the AD2 structure will also house the electronics and cooling. The roof space contains sufficient cooling to ensure AD2 operates in the 18-28C range, the same as AD1. An extreme environmental excursion was considered; minimal scintillator deterioration is expected in the event of a long-term (~10 day) power outage. AD2 performance is expected to be comparable to AD1, but with lower rates of cosmogenic and accidental backgrounds. AD1 operation indicates stable, long-term performance of both ADs is expected. Other concerns related to the differences between the two ADs raised previously by the PAC were addressed. The combination of five (eight) years of running AD2 (AD1) at 5000h/year are projected to allow the 99%-C.L.-allowed LSND parameter space to be ruled out at three standard deviations.

The collaboration is performing a blinded analysis of the 2021 AD1 data. The analysis plan requires consistency between data and prediction of four sideband regions around the signal region in prompt and delayed energy.

The PAC congratulates the collaboration on the analysis progress as well as the progress on the design and construction of AD2, particularly under the restrictions imposed due to the COVID-19 pandemic. The first public results addressing the LSND anomaly will establish the crucial role of $JSNS^2$ and J-PARC, and will likely draw considerable attention from the world physics community. We reiterate the importance of a careful and well-presented analysis to ensure this role. In this regard, we request greater quantitative detail on the blind analysis plan. We also recommend addressing FIFC seismic concerns and considering extreme environmental excursions such as typhoons for AD2.

The plan for AD2 deployment and operation of both detectors appears largely sound and major concerns have been addressed. The PAC recommends stage-II approval for JSNS^2-II.

E75

The E75 aims to detect the $^{5}{}_{\Lambda\Lambda}$H hypernucleus, presumably the lightest double Λ hypernucleus, and to measure its binding energy via the ^{7}Li(K$^-$,K$^+$) reaction in coincidence with the sequential pionic weak decay of $^{5}{}_{\Lambda\Lambda}$H. The experiment provides invaluable information on the Λ−Λ interaction, particularly the effect of the ΛΛ−ΞN mixing by combining with the other ΛΛ hypernuclear data such as $^{6}{}_{\Lambda\Lambda}$He. The main obstacle in doing this experiment is that the $^{5}{}_{\Lambda\Lambda}$H yield depends on the yet unknown cross section of ^{7}Li(K$^-$,K$^+$)$^{7}{}_{\Xi}$H.

Thus the E75 experiment consists of two phases; in the phase-1, the E75 aims at a measurement of the relevant cross section, ^{7}Li(K$^-$,K$^+$)$^{7}{}_{\Xi}$H, and the $^{5}{}_{\Lambda\Lambda}$H hypernucleus will be measured in the phase-2. In the PAC33 meeting, the proponents showed expected spectrum of the $^{7}{}_{\Xi}$H formation and the background estimate. The proponent showed the expected K$^+$ spectrum using three NΞ potentials, ND, NSC04d, and HAL. The bound state formation cross-sections are evaluated as 79, 51, and 95 nb/sr. Since the HAL QCD potential predicts a large formation rate in the bound region and it has been found to explain the correlation function data obtained by ALICE, one can expect significant yield in the bound region. The background contains those from the K^0-K^{bar0} mixing suggested by the FIFC team. The K^{bar0} is produced in the charge exchange reaction ^{7}Li(K$^-$, K^{bar0}) followed by the mixing during the flight to form K^0, and another charge exchange reaction (K^0,K$^+$) produces K$^+$. This background yield is estimated as 3-4 nb/sr/MeV, smaller than the signal of ~ 10 nb/sr/MeV at the peak, and it is expected that one can measure the cross section in the bound region with the uncertainty of 10 %.

The PAC is glad to see the seriously evaluated formation spectrum with the background estimate. However, there is a concern about the rather large uncertainty of 10% (as commented by FIFC in this meeting). If one knows the shapes of the continuum (quasi-free) spectrum and the spectrum in the bound region sufficiently well, one can estimate the admixture of the continuum spectrum in the bound region and the leakage of the bound spectrum in the continuum. The PAC recommends the E75 to evaluate the systematic error from the unknown spectrum shapes.

The E75 requests 7-day (560 kW*days) beamtime, soon after the commissioning run or the physics run of E70, since the experimental setup for E75/Phase-1 is nearly identical to the E70 apparatus. Replacing the complex active target system of E70 by the much simpler, passive 7Li target, enables a fast conversion from the E70 to E75 setup. Therefore, running both experiments in a row might enable an efficient use of resources. The PAC recommends to stage-2 approval for E75 and to assign the beamtime in the near future.

E73 (Test for ${}^{3}_{\Lambda}H$ Decay)

The group has satisfactorily responded to all of the issues raised by the PAC. The data for ${}_{\Lambda}{}^{4}H$ has been analyzed and yielded a value for the lifetime in agreement with earlier values from KEK and STAR. It is now timely to proceed with the main aim of the proposal, namely to resolve the issue of whether the lifetime of the ${}_{\Lambda}{}^{3}H$ nucleus is anomalously short. While urging the group to take all measures to reduce the anticipated systematic errors, the PAC recommends stage-2 approval for data taking of 25 days (at 80kW).

E11/65 (T2K/T2K2)

T2K is a flagship long-baseline neutrino experiment using neutrinos produced at J-PARC and sent to the 50-kton SuperKamiokande (SK) detector. It also includes a suite of near detectors: INGRID, ND280, and WAGASCI-BabyMIND. The experiment has a central goal of measuring CP-violation by neutrinos at the 3-sigma level, and has been steadily working towards the smaller systematic uncertainties required for this goal.

At this PAC meeting, the committee heard about progress toward adding new information to the long-baseline fits, including neutron-tagged samples at the far detector, proton- and photon-tagged samples in the ND280, and new WAGASCI-BabyMIND data. The collaboration is also working on a re-analysis of T2K runs 1-10 using new samples and an improved flux model. They are in the midst of two separate joint fits, with the NOvA, SK collaborations and having a discussion to incorporate the NINJA measurement results with the NINJA collaborator. We congratulate the collaboration for all of this excellent analysis progress, including a first glimpse at the neutron data facilitated by the ongoing Gadolinium doping of SuperKamiokande.

T2K also reported the status of their ongoing beam and near detector upgrades. A number of improvements are being made to the beam during the long shutdown, including upgraded instrumentation, a new Horn 2, and replacement of both horns. The upgraded beamline will be ready for operation in Nov 2022. For the near detector, new SuperFGD, high-angle TPC, and TOF detectors are being constructed, and a number of changes are being made to the existing detectors. These changes and installation of the new detectors are expected to be complete and ready for beam by Feb/March 2023. Both the beam and near detector upgrade plans have been hindered by problems associated with the COVID-19 pandemic (e.g. shortages and inability of personnel to travel). These problems also create uncertainty as to when the beam and near detector will be available for operation. But the collaboration has worked hard to mitigate the COVID-19 issues and has a detailed plan for dealing with them going forward.

The T2K collaboration is requesting 2 weeks of beamtime for beamline commissioning in Fall 2022, which the PAC supports.

They have also requested additional running late in FY 2022, to maximize running with ND280. As described elsewhere in these minutes, the PAC will make recommendations about this request at the next meeting.

The committee congratulates the T2K collaboration on the progress on analysis and beam and detector upgrades. We look forward to hearing an updated status on both at the next PAC meeting, and would particularly like to hear more about progress on (and results of) the joint fits, if possible.

E14 KOTO

KOTO (E14) searches for the CP-violating rare decay $K_L \to \pi^0 \nu\nu$ in the J-PARC neutral beamline. This branching fraction is strongly suppressed in the Standard Model and precisely predicted so that its measurement would be a very sensitive probe of new physics. KOTO aims to analyze data taken in 2019-21 to produce new results to be shown at KAON2022 in September in Osaka. KOTO requests 60 days per year at 85 kW for 4 years to achieve a single event sensitivity below 10^{-10}.

KOTO is in the process of upgrading the DAQ and the upstream charged veto (UCV) prior to running again in early 2023. DAQ testing is ongoing at NTU, Osaka and U. Chicago with the goal to upgrade the DAQ at J-PARC this summer. In case COVID-19 restrictions make this impossible, the collaboration can either perform a minimal upgrade to address the current bottlenecks or can revert to the current system. A next generation UCV using thinner scintillator (0.2mm-thick) and more robust PMT readout is being developed. The UCV suppresses the $K^{\pm}$ background that dominated the 2016-18 results. For running beyond summer 2023, further $K^{\pm}$ background suppression can be achieved by replacing the downstream 0.5m of the second collimator with a dipole magnet to sweep out $K^{\pm}$ flux. The collaboration is also improving the identification and suppression of the halo K_L background revealed by the previous analysis. In addition, the effort to secure sufficient computing resources is ongoing under the US-Japan cooperation program to cope with the increasingly advanced background rejection and larger data volumes.

The analysis for the 2019-21 data is currently performing stability checks prior to cut optimization. Prior to unblinding the signal region, backgrounds and sensitivity will be estimated and checks will be performed with loosened or inverted cuts.

The PAC congratulates KOTO on improvements to the detector and understanding of backgrounds. We applaud the goal of new results for KAON2022, but caution the collaboration to reflect carefully to attempt to avoid problems similar to those that affected the unblinding of the 2016-18 analysis.

E21 COMET

The COMET experiment (E21) plans to look for muon converting to electron by stopping an intense beam of low-energy muons with an aluminum target in the Hadron Hall.

The PAC congratulates the COMET collaboration on the news that the Institute for Modern Physic, China, has joined and a new DFG grant from Germany has been awarded. These will strengthen the capability of the collaboration further.

Results from analyzing the T78 data that was collected at the K1.8BR beamline in May 2021 were presented. The Backward-Single Bunch Kick scheme with 600-ns shift can provide an encouraging extinction factor corresponding to a beam background low enough for COMET Phase-I. The PAC has also heard about the progress of Phase-α, a special run for determining the extinction factor with a proton beam in the C Line directly. This run also allows the COMET collaboration to study the characteristics of the proton beam and π/μ production yield in the backward direction. The third status report has been submitted. Preparation of the beamline and hardware is proceeding well. A preliminary run plan for Phase-α in 2023 is also shown.

Preparation for Phase-I continues to make headway at all fronts. Pre-production of a large-scale simulation (MC6) and cosmic-ray simulation has started. The PAC looks forward to hearing the results from these detailed simulations. COVID-19 has slowed down the progress of some tasks, such as the StrECAL. Despite the disruptions due to the pandemic, COMET still appears on schedule, ready for beam early in 2024. The PAC conveys strong support to COMET.

E16 Spectral Change of Vector Mesons in Nuclei

E16 reported the updates from the analysis of Run-0c to examine the origins of the time structures of the beam. It was inferred that the 5.2-μs structure was related to the dispersive optics at the Lambertson septum magnet while the 5-ms structure was due to ripples in the MR power supply. These beam structures cause a serious problem because they deteriorate the DAQ live time. E16 has contacted the Hadron beam line group and developed a new achromatic transport at the Lambertson magnet to flatten the 5.2-μs structure. E16 has also reported that the power supply of the MR will be replaced during the long shutdown, and a new stable power supply will possibly suppress the 5-ms structure. Furthermore, E16 has proposed the DAQ upgrade to improve the live time even if the beam structures remain unsolved. In order to test these improvements, E16 has requested an additional beam time of 101 hours for the B line. The PAC acknowledges these efforts and recommends allocating the requested beam time. The PAC also requests E16 to continue their efforts for the detector performance study and the background reduction although updates of these issues were not reported in PAC33.

E45

Experiment E45 at the K1.8 beam-line will use a liquid hydrogen target inside the large HypTPC embedded in a magnetic field. The experiment will study baryon resonances using pion beams and will greatly expand the database of differential cross section measurements in the (π, 2π) channel. At present, the $\pi N \rightarrow \pi\pi N$ database consists of a few measurements done in 1970's with limited statistics. There is a strong need for high precision data on this reaction to complete coupled-channel analyses of nucleon resonances.

In their report, the preparation status and the HypTPC performance at Experiment E42 were presented. In addition, the need to improve the data acquisition speed has been addressed. The E45 experiment also presented a letter of support from the HADES Collaboration at GSI, Germany, which will perform complementary measurements. A combined meeting between the E45 and HADES Collaborations took place in October 2021 to evaluate common interests and strategies.

The PAC understands the importance of this measurement that will bring further knowledge of the nucleon resonance spectrum. We were pleased to see the cooperation with HADES and congratulate the Collaboration for their initiative. The PAC also acknowledges the technical progress. The PAC suggests considering a strategy, e.g. a prioritization of momentum settings, in case the planned data acquisition upgrade is not bringing the desired improvement in data taking rate.

E70 Ξ hypernuclei spectroscopy

E70 experiment proposed to perform spectroscopic study of S = –2 Xi-hypernuclei $^{12}{}_{\Xi}Be$ via the $^{12}C(K^-,K^+)$ reaction. The study of strangeness –2 hypernuclei is new and J-PARC has unique capabilities to carry out these studies. This experiment aims to determine the binding energy of 12XiBe through missing mass measurement, with much improved energy resolution of the order of 2 MeV offered by S-2S spectrometer.

The collaboration requests two weeks of beamtime for commissioning in early 2023, and, followed by a production run, 20 days of beamtime with beam > 80kW and expect 104 counts.

The PAC congratulates the collaboration on the impressive progress in the development of this experiment, including the successful installation of the S-2S spectrometer. The

PAC encourages the experiment to complete the installation of the spectrometer and the allocation of beamtime will be discussed in the future PAC meeting.

E72

E72 aims to observe a narrow Λ resonance around 1665 MeV, just above the Λη threshold and to determine its spin and parity. The existence of this resonance is conjectured on experimental grounds, but is not established, yet. Earlier data suggest its spin-parity would either be $3/2^+$ (P wave) or $3/2^-$ (D wave). If confirmed, this would indicate that the resonance is exotic, a hadronic molecule state with finite orbital angular momentum which has been never confirmed before.

The angular distribution and polarization from the $K^- p \rightarrow \Lambda\eta$ reaction will be measured using a large acceptance detector, HypTPC with pK = 735 MeV/c (±2% FWHM) @K1.8BR beamline. The angular distribution tells us its existence and spin, the polarization, its parity.

Following January 2019 PAC request (PAC28), E72 is planned to proceed in two phases, where the angular distribution is measured in the first phase, and the polarization will be measured in the second phase. In the previous plan, the requested beam time for the physics run in the first and second phases was 2 and 19 days, respectively. In the PAC33 meeting, the proponent showed that the beam time for the second phase can be reduced to 8 days by the beam power increase from 50 kW to 80 kW together with the increase of the LH_2 target from Φ54mm to Φ80mm. The commissioning beam time of 6 days is necessary for the first phase, and the start-up time of 2 days is necessary for the second phase. Even with the higher beam intensity of 80 kW, the trigger rate is still lower than that in E42, which was carried out successfully. Based on the reduction of the beam time for the physics run to 1/3, the E72 asked the PAC to combine the two phase beamtimes into one. All R&D will be completed by the end of JFY2022. (Need 6 months to switch from CDS to HypTPC.)

The PAC thanks the E72 for saving the beamtime for physics run to one third than that in the previous request, and recommends combining the two phases into one, assuming there are no other constraints.

4. GERAL REMARKS AND RECOMMENDATIONS

The committee was pleased to learn that the long shutdown for MR power supply upgrade that commenced in July 2021 is proceeding well, despite some minor problems, and is on track for beam-start this November. We congratulate the J-PARC team for impressive progress despite the current COVID restrictions and supply issues. The RCS/MLF, important for some of the experiments reviewed here, has had very stable and efficient operations, and will increase to 800kW on trial basis in JFY2022, from the JFY2021 operation at 700kW. We also congratulate the laboratory on obtaining reasonable budgets for JFY2022 including for the MR upgrade, operations, and J-PARC upgrades for the Hyper-Kamiokande project. It was encouraging to see also that KEK is prioritizing beamtime in PIP 2022, and that important J-PARC projects, Hadron-Hall extension, and COMET phase-II, are getting emphasized.

There were a few worrying developments: first, the approval process by the Nuclear Regulation Authority of Japan for the Radio Isotope facility modification has now stretched to beyond 6 months whereas previously it was nominally 3 months. Also, the local government approval process appears to be also taking longer. Second, the electricity costs are rising with potential impact on the operation of the facility. While the J-PARC operation for JFY22 was funded at the level of 4.5 cycles, this was based on the electricity costs at the time of the funding decision. While both of these developments are out of the direct control of KEK and J-PARC, the committee urges the laboratory to continue to seek mitigation with efficient planning, and also with communication with the relevant authorities.

The committee notes that there was remarkable progress in the reported experiments, even though there were certain areas where COVID has led to delays and uncertainties. We congratulate the experimental communities. We encourage continued efforts from the facility as well as the experiments to enable work from foreign collaborators in Japan possible. We all look forward to the resumption of beam later this year.

There are quite a lot of different constraints in restarting beam operation after this long shutdown. The startup plan presented at this meeting that includes COMET phase-α appears to make use of the time in an efficient manner. The startup also includes a beam bakeout period whose length is hard to predict. It is nominally 1 month, and some limited SX test operation may be possible during this period.

There are still many uncertainties about the experimental startup including the readiness of various experiments, as well as the availability of funds in view of the rising electricity costs. The committee will revisit this subject in the next PAC meeting, with the hope that some of these would have become clearer by then.

5. DATES FOR THE NEXT J-PARC PAC MEETING

The next J-PARC PAC meeting will be held around the end of July to the beginning of August, 2022.

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

- Minutes of the 32nd J-PARC PAC meeting held on 14-16 July, 2021 (KEK/J-PARC-PAC 2021-17)
- Proposals:
  - High resolution spectroscopy of the Sigma N CUSP by using d(K^-,π^-) reaction (KEK/J-PARC-PAC 2022-3)
  - Proposal for study of charm component in the nucleon via J/ψ measurement with the J-PARC E16 spectrometer (KEK/J-PARC-PAC 2022-4)
  - Proposal for the E80 Phase-I Experiment : Investigation of $\bar{K}NNN$ bound state focusing on the Λd decay (KEK/J-PARC-PAC 2022-5)
  - Proposal of test experiment to evaluate performances of secondary beam mode at the high-momentum beam line (KEK/J-PARC-PAC 2022-6)
- Technical Design Report:
  - Technical Design Report (TDR): JSNS2-II (KEK/J-PARC-PAC 2022-1)
  - Technical Design Report J-PARC E75 Phase-1 (KEK/J-PARC-PAC 2022-2)

- Addendum to Technical Design Report for J-PARC E75 Phase-1 Experiment (KEK/J-PARC-PAC 2022-9)

- Reports:
  - Report on beam structures at High-p beam line measured in 2021 (KEK/J-PARC-PAC 2022-10)
  - Data analysis report for the J-PARC T77 experiment (KEK/J-PARC-PAC 2022-11)
  - Follow-up of 32th PAC meeting on J-PARC neutrino facility (KEK/J-PARC-PAC 2022-12)
  - Supporting letter from GSI-HADES to E45 group (KEK/J-PARC-PAC 2022-13)
  - Status of COMET Phase-alpha Study (COMET) (KEK/J-PARC-PAC 2022-14)
- Letter of Intent
  - Measurement of X rays from Xi C atom with an active fiber target system (KEK/J-PARC-PAC 2022-7)
  - Pion-induced phi meson production on the proton (KEK/J-PARC-PAC 2022-8)