KEK/J-PARC-PAC 2021-5
April 15, 2021

J-PARC Program Advisory Committee

for the Nuclear and Particle Physics Experiments

at the J-PARC Main Ring

Minutes of the 31st meeting held
20(Wed.)-22(Fri.) January 2021

OPEN SESSION:

1. Welcome and J-PARC Center Report: N. Saito (J-PARC/KEK)
2. J-PARC Accelerator Status & Plan: Y. Sato (J-PARC/KEK)
3. Hadron Facility Status & Plan: H. Takahashi (J-PARC/KEK)
4. Welcome and Mandate to the Committee: K. Tokushuku (KEK)
5. E56 /P82 (Sterile Neutrino Search): T. Maruyama (J-PARC/KEK)
6. P79 (Search for an I=3 Dibaryon Resonance): T. Ishikawa (Tohoku)
7. P80 (Systematic Investigation of the Light Kaonic Nuclei): F. Sakuma (RIKEN)
8. T77 /E73 ($^{3}_{\Lambda}$H Mesonic Weak Decay Lifetime Measurement): Y. Ma (RIKEN)
9. E42 (Search for H dibaryon): J.K. Ahn (Korea)
10. E71 (NINJA): T. Fukuda (Nagoya)
11. E16 (Measurement of Spectral Change of Vector Mesons in Nuclei): S. Yokkaichi (RIKEN)

12. T2K(E11) / T2K-II (E65): T. Lux (IFAE)

13. E14 (KOTO): T. Yamanaka (Osaka)

14. E21(COMET): Y. Uchida(ICL)

15. E34(g-2/EDM): T. Mibe (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), K. Tokushuku (KEK-IPNS Director), T. Kobayashi (KEK-IPNS Deputy Director) and N. Saito (J-PARC Director)

1. PROCEDURAL REPORT

The minutes of the 30th J-PARC-PAC meeting (KEK/J-PARC-PAC 2020-12) were approved.

2. LABORATORY REPORT

2-1 Welcome and J-PARC Center Report (Naohito SAITO, J-PARC Center Director)

The J-PARC Director, Naohito Saito firstly mentioned that J-PARC was suffered from COVID-19 as well as many labs all over the world. Saito reported that the J-PARC operation was suspended at the end of April triggered by the national state of emergency raised. The operation was resumed in mid-May by careful preparation of preventive measures against COVID-19 at J-PARC. He introduced an overview of J-PARC facilities as well as science at J-PARC. Saito showed the operation status of J-PARC and discussed the beam power histories of Main Ring (MR) and Material and Life Science Experimental

Facility (MLF). Saito showed that the current budget plan (JFY2020 Supplementary and JFY2021) secured by MEXT would allow most of planned activities in JFY2021; an MR operation for 1.5 months for Slow Extraction (SX), production of new power supplies for the MR to be completed in JFY2021, and facility and accelerator upgrades to 750-kW level in addition to the Hyper-K related J-PARC upgrades. Saito also mentioned that the lab would fully support the preparation of COMET-phase-I aiming for its completion in coming the two years.

He introduced that the MEXT Roadmap 2020 was published. The MEXT Roadmap 2020, which defines fifteen large-scale science projects to be selectively funded in Japan, is based on thirty one important projects established by the Science Council of Japan as Master Plan 2020. The MEXT Roadmap contains the J-PARC projects including the realization of 1.3 MW and 9-cycle operation of the MR and facility upgrades including muon g-2/EDM , Hadron hall extension and COMET phase-II. Saito summarized his talk after introducing the timeline of the J-PARC decadal plan.

2-2 J-PARC Accelerator Status (Yoichi Sato, J-PARC/KEK)

Yoichi Sato reported the status of J-PARC accelerator, mainly about the MR. He explained the beam power history provided at RCS and MR. Following 1MW beam operation test in June 2020, LINAC and RCS are ready to start 1-MW operation for providing beam to MLF. There was no Fast Extraction(FX) MR operation after the last PAC meeting while 55-KW SX operation was achieved, which is the highest beam power ever achieved in SX. He also explained the operation statistics of MLF and FX/SX in JFY 2020. They successfully provided the beam to MLF with larger availability than 95% while the beam availability in SX was around 86%. The loss was mainly due to accelerator troubles during the operation period.

Sato explained status of beam tuning of MR both for SX and FX. They installed two new devices in summer shutdown in 2020. One is a set of 2^{nd}-harmonic 2 RF cavities and the other is a diffuser in front of the SX Electric Static Septa (ESS). The diffuser is expected to work to reduce the beam loss and improve the extraction efficiency in SX. During the machine operation in SX mode in December 2020, they performed further beam tuning of the linear coupling resonance to reduce the beam loss at the injection timing, successfully reducing horizontal and vertical emittances by a factor of 2. In addition, they newly adopt a new method of beam de-bunching, called “2-step voltage de-bunch”. This enabled them to further suppress the beam instability during the de-bunching phase and

to achieve the beam power of 55.6 kW. Using all these new tools, they anticipate achieving beam power of around 60 kW in 2021 SX operation.

As mentioned above, they didn't have the chance to operate the MR in FX mode after the last PAC meeting. However, they investigated possibility to reduce beam loss in the FX mode and confirmed that beam operation at ~515 kW will be realized in March 2021 operation.

Sato showed a mid-term plan for MR in the period of JFY2020-2024 along with a concept of beam power upgrade; increasing the number of protons and reducing the repetition cycle time. They have been working on manufacturing new magnet power supplies, 2nd harmonic RF system, FX kicker power supply improvement and new septa, and upgrade of collimator capacity in MR. These activities will be completed with their installation in a long-term shutdown period in JFY 2021. They plan to start this significant installation work of new equipment in July 2021, followed by test and beam commissioning in 2022.

Sato summarized his presentation by showing MR operation schedule in spring 2021 – fall 2023. In April – June 2021 MR is ready for 1.5-cycle user operation. Then MR will be shut down in the period of July 2021 – March 2022. Before the summer shutdown in 2022 they plan to carry out high-power test of newly installed devices for SX/FX in April – May 2020 and FX beam tuning with 1.32-sec. beam repetition cycle in June 2022. Finally, they will be ready for user operation for FX with a beam repetition cycle of 1.32-sec. in Fall 2022. SX operation is anticipated after this, and SX beam repetition cycle is to be determined at this occasion.

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

Hitoshi Takahashi reported on the status and schedule of the Hadron Experimental Facility. The report included the status of the recent beam operation, restoration after the water trouble, and the facility upgrade plan during the coming long shutdown.

The beam operation of the facility was carried out last December. More than a half of the beam time was used for the accelerator tuning, and the maximum beam power was successfully increased to 55.6 kW. Moreover, further intensity upgrade is planned in the next run. In the last beam time, only the A-line was operated, and E03, E42 (detector and trigger test), T78, and E14 were conducted. The accelerator live ratio during user time was 87%.

The next SX beam time, originally scheduled from January 11th 2021, was postponed due to the cooling water trouble in the hadron hall. The restoration work inside the radiation shields was completed, and the shield recovery started. The facility will be ready for beam early February.

Takahashi introduced the planned major works during the long shutdown. Construction of the new primary beam line to the COMET (C-line) will be completed, and the partial completion of the COMET apparatus in the Hadron South building will be made by the end of the long shutdown. The first beam to the COMET will come in winter JFY2022 (called "Phase-α"). In the K1.8 experimental area, the KURAMA spectrometer will be replaced with the S-2S spectrometer during the long shutdown.

2-4 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. He reported progress after the 30th PAC meeting. Following the PAC's recommendation, stage-1 status was given to the E73 experiment and stage-2 approval was given to the E65(T2K-II). Two test experiments, T78 and T81, were also approved.

Hyper-Kamiokande Program Advisory Committee (HK-PAC) has been formed jointly by KEK and the University of Tokyo. The first meeting was held in September 2020, where choice of photo sensors and proposal of intermediate water Cherenkov detector (IWCD) were discussed. Since the IWCD is reviewed as part of the Hyper-Kamiokande project, the E61(NuPRISM/TITUS) is not discussed further in J-PARC PAC. The role of HK-PAC and J-PARC PAC on the Hyper-Kamiokande project in the operation phase will be defined at the later stage.

Tokushuku reminded the committee of the general mandates and the approved process for proposals. One new proposal, P82, was received and there are update reports from two pending proposals, P79 and P80.

As discussed in the Hadron facility status and plan talk, the beam operation has been halted since the beginning of January with the cooling water problem and the restoration work is continuing. The plan is to resume the beam delivery on 8th February. A working plan of the beam allocation, reflecting this delay was shown. He requests the PAC to give

advice on the run plan before the long shutdown, with the uncertainty in the recovery plan in the SX beam line.

There was a question from the PAC committee about impact of COVID-19. Tokushuku explained that the beam operation itself has not been affected so far, while some experimental groups have suffered as some researchers cannot come to J-PARC.

After several clarifications, the committee took note of the mandates. The guideline of the beam allocation before the long shutdown was discussed in the closed session, and the recommendation is written in a separate section of the minutes.

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

E56/P82 (Sterile Neutrino Search)

The JSNS^2 experiment aims to directly confront LSND's evidence of sterile neutrinos from stopped muons. The PAC congratulates the JSNS^2 collaboration on their speedy analysis of the data collected in June 2020. The PAC was pleased to see the preliminary analysis of the beam-off data and the demonstration of Gadlinium Loaded Liquid Scintillator (GdLS) and Liquid Scintillator (LS) stability after cycling through the detector. We look forward to the analysis of the beam-on data that is currently being acquired to confirm the projected sensitivity. A demonstration of the new triggering scheme, in a future PAC meeting, would be appreciated.

The PAC supports Stage-1 status assignment for the second detector (AD2) at 48 m as proposed in P82. AD2 will allow JSNS^2 to cover the region of small $\sin^2 2\Theta$ below $\Delta m^2 = 1 eV^2$ that is allowed by LSND. Other neutrino experiments have leveraged dual or multiple detectors to reduce systematics, reduce model dependence and improve the robustness of the results. Since the projected P82 sensitivity only just covers the allowed region from LSND at the same C.L., great care should be taken to ensure that the full potential of the dual detector configuration is realized. The committee has concerns about the maintenance of stable operations, with a known target mass, with a deployment of AD2 without a new building. The potential impact of the differences between AD1 and AD2 on the sensitivity should be investigated. Besides the differences in target mass, the committee identified possible differences in neutrino flux, detector efficiency and "spill-in" and "spill-out" effects. The committee urges careful consideration of these effects for the final design of AD2.

P79(Dibaryon resonance search)

P79 aims to search for the D_{30} dibaryon by measuring the $pp \rightarrow \pi^-\pi^-(\pi^+\pi^+pp)$ reaction. A signature of the D_{30} dibaryon was observed at 2.37 GeV in the $\pi^+\pi^+$ pp invariant-mass spectrum with a width of 0.07 GeV by the WASA-at-COSY collaboration. A recent calculation solving the $\pi N\Delta$ Faddeev equation suggests the D_{30} dibaryon should appear around 2.4 GeV as a molecular-like state. On the other hand, the MIT bag model calculations predict that the D_{30} dibaryon as a 6-quark state has a higher mass of about 2.7 GeV. The experimental information on the mass and width of the D_{30} dibaryon would shed a light on the internal structure of D_{30} as well as the $\Delta\Delta$ interaction.

At PAC30 the PAC requested P79 to consider a possibility that D_{30} is not a narrow resonance around 2.4 GeV as suggested by the WASA at COSY, but it is a wider resonance at a higher energy. In the PAC31, P79 showed that higher-mass D_{30} can be detected as the enhanced invariant mass spectrum at beam momentum of 4.5 GeV/c. As a result, P79 additionally requests a beam time at a higher beam momentum of 4.5 GeV/c to improve the sensitivity for resonances at higher energies with larger widths.

The PAC recognizes the scientific importance and the plausibility of the experimental procedure with the E50 detector complex, and thus supports the stage-1 status assignment at J-PARC. The PAC also encourages P79 to proceed with further experimental considerations. An accurate estimation of the background shape is crucial to identify D_{30} from a huge amount of background events. A clear strategy to achieve the physics goal is also desired. For stage-2 approval, P79 should present clearer physics motivations and plans to establish significant signals.

P80 (Light Kaonic Nuclei)

The P80 is a proposal for stage-1 status assignment of a systematic study of light kaonic nuclei with the kaon beam of the K1.8BR beamline. P80 is the successor to the E15 Experiment, which has found an interesting signal of a possible K-pp state.

The proposal was already presented at the previous PAC30 meeting, where several points were raised by the PAC. These points were satisfactorily addressed by the P80 Collaboration in the PAC31 meeting:

- Firstly, the cooperation with theoretical groups has been intensified and a support letter from the Strange Nuclear Physics Section of J-PARC Branch KEK Theory Center was received.
- Concerning the expected improvements with respect to the E15 experiment, the predicted increase in binding energy in heavier systems (K-NNN ,K-NNNN)

was emphasized. The observation of a signal of the K-ppn state in the two-body Λ-d decay channel was defined as the primary goal of P80. Such a result would not only confirm the existence of kaonic nuclei but would also pave the way for the investigation of the mass-number dependence of the kaonic nuclei.

- The PAC was concerned in the PAC30 meeting about the number of personnel associated with what will be a complex experiment. Consequently the collaboration has reached out to other groups. The share of responsibility for the different detector components within the collaboration was presented.
- The spectrometer design was briefly addressed. A new concept envisages a "simpler system" in which "detectors will be constructed with matured and well-studied technology". The PAC supports this move and would like to encourage the collaboration to work on a comprehensive TDR on all detector components on its way to stage-2 approval. Some concerns were raised that the re-design of a complex spectrometer within a single year (2022) is very challenging without a detailed technical planning in advance (this year).
- As a last point, the collaboration presented work in progress on the beam line modifications demonstrating a strengthened cooperation with the Hadron beamline group. Radiation shielding calculations started. The PAC was pleased to see these efforts.

PAC31 recognizes P80 as a scientifically important research activity and recommends the stage-1 status at J-PARC.

E73/T77[K1.8BR] ($^{3}_{\Lambda}$H mesonic weak decay lifetime measurement)

E73 is a unique experiment to determine the lifetime of the lightest strange nucleus $^{3}_{\Lambda}H$ directly via the ^{3}He $(K^{-}, \pi^{0})^{3}_{\Lambda}H$ reaction. The lifetime is determined event-by-event by the time difference between the starting time and the decay product pion. The experiment has been granted the stage-1 status.

Previously the proponents of the experiment had successfully carried out a pilot run with the ^{4}He $(K^{-}, \pi^{0})^{4}_{\Lambda}H$ reaction. This time they request for a pilot run with the ^{3}He target with 350 kW·day before the long shut down in 2021. The aim of this pilot run is to determine the unknown production cross section of $^{3}_{\Lambda}H$ with the ^{3}He target. This will then allow them to make an informed estimation of the total beam time which is required for the final physics run.

The PAC suggests the experiment to complete the analysis of $^{4}He\ (K^{-}, \pi^{0})^{4}{}_{\Lambda}H$ reaction in a timely manner and report the results in the next PAC meeting.

Given the importance of the measurement, the readiness of the experiment and the competition from other high energy experiments, the PAC recommends the management to secure the needed resources to carry out the pilot run, with $^{3}He\ (K^{-}, \pi^{0})^{3}{}_{\Lambda}H$ reaction and 5 days × 70 kW before the 2021 long shutdown.

E42 [K1.8] (Search for H dibaryon)

The main goal for the E42 experiment is to identify the H-dibaryon, which consists of 6 quarks with s=–2 via $^{12}C(K^{-},K^{+})$ reaction. The existence of the H-dibaryon is one of the hot topics in hadron physics. E42 is an important experiment in this arena.

In this PAC meeting, the E42 reported the current preparation work status and some of their performance test results, including conditioning of the Superconducting magnet, ToF detector, Water Cherenkov counter, and the TPC. All detectors are found to be ready for the detector commissioning.

The E42 also presented the plan to shorten the switch-over time between the apparatus change from the E03 to the E42 setup. This effort has made the E42 physics run possible as scheduled, even though the beam delivery was delayed, due to the problem with the cooling water system in the hadron hall.

The PAC still has concerns about the schedule as the E42 setup is to be completely dis-assembled during the coming long-shutdown period to install a new detector, the S-2S spectrometer, on the same beamline. The completion of data taking of the E42 before the long shutdown is critical for the physics program organization of the hadron hall.

The PAC encourages E42 to make a careful plan for commissioning and possibly seek evaluation by outside reviewers on the progress.

E71 (NINJA)

The NINJA (Neutrino Interaction research with Nuclear emulsion and J-PARC Accelerator) collaboration presented an update on its data-taking and analysis program. With a low proton threshold enabled by the emulsion technology, the experiment is designed to study 2p2h neutrino interactions and to make exclusive electron and muon neutrino cross-section measurements. It is housed in the T2K near detector

complex in the on-axis neutrino beam peaked near 1 GeV. It uses the BabyMIND detector to measure the charge and momentum of muons exiting NINJA.

The experiment has completed two preliminary "pilot" and "detector" runs and is now executing its first physics run, with 0.48×10^{21} POT collected between Nov. 2019 and Feb. 2020. This data is currently being scanned, with completion expected in Sep. 2021. The collaboration also plans the second physics run in 2022. A short detector run in 2021 has been approved to evaluate the performance of two new types of emulsion shifters.

The PAC was quite pleased and impressed to see that, since the previous PAC meeting in summer 2020, the collaboration has submitted two papers on charged-current neutrino interactions using data from the preliminary runs, one of which has been published in Physical Review D. It is also developing analyses of cross sections for exclusive channels including CC0π1p and CC0π2p.

Three workshops have been held focused on how NINJA results can be used by the wider neutrino community, including T2K. An initial attempt has been made to incorporate NINJA data into a T2K oscillation analysis. The NINJA data has little impact on oscillation systematics, but this is thought to be due to constraints of the current T2K analysis infrastructure that prevent incorporation of NINJA hadron kinematic data. NINJA plans to collaborate with T2K to improve this infrastructure.

The PAC congratulates the NINJA collaboration on their successful progress since the last status report. The PAC is particularly impressed by the submission of two manuscripts and significant progress towards incorporation of NINJA data into T2K analysis. The committee encourages the collaboration to keep up this progress, and to engage the theory community as they consider how to maximize the impact of NINJA data.

The impact of the NINJA data is clearly tied to the level of systematic uncertainties the experiment is able to achieve, and the committee had many questions on the details of the treatment of systematics. The experiment claims that its two-dimensional cross sections are model-independent, but only showed 1-dimensional uncertainty summaries in which models were the largest source of uncertainty. Truly model-independent neutrino cross section measurements are difficult to achieve, and the committee would like to see studies supporting this claim in a future PAC meeting.

E16 (Spectral change of Vector Mesons in nuclei)

J-PARC E16 aims to measure the spectral change of vector mesons in nuclei with the e^+e^- decay channel, using 30-GeV primary proton beam to confirm the observation by KEK-PS E325 and obtain more precise information of the spectral change of vector mesons in dense nuclear matter.

The first part of the commissioning run (Run-0a, 160 hours) was performed in June 2020. While the detectors were confirmed to work as designed, two problems were found: the time structure of the beam spill showed a spike, and the single rates of the detectors were found to be two times as high as the estimate. The proponent discussed these problems in this PAC meeting. The observed high-rate structure at the first 200 ms of each spill affects the trigger rate. The Hadron beamline group found a method to improve the spill time structure by controlling the beamline magnets in each spill ("ramping control") which will be adopted in the next beam period. The second problem, the additional counts, could be caused by a beam loss at upstream of the beamline, or back-scattering from the beam dump; the single rate without target amounts to around 55 % compared with that with target. In order to investigate these high rates, E16 requests the beam of 12 hours for the background study after Run-0b, not simultaneously with A-line operation.

The latter half of the commissioning run (Run-0b, 184 hours) is re-scheduled to February 2021. With the help of the KAKENHI grant (Kiban S, 2018-2022), 2 GTR+2 HBD are additionally installed after the Run-0a and the updated configuration with 6 SSD + 8 GTR + 6 HBD + 6 LG are waiting for the beam. Some physics results can be obtained in Run-0b, and the background study will be also performed in cooperation with the Hadron beamline group.

The PAC congratulates E16 for obtaining the newly approved KAKENHI grant (Kiban S, 2020-2024) and for having two more students. The PAC understands the need for the additional beamtime for the background study and recommends that they take this beam time before the long shutdown provided that the budget allows and E42 runs are completed. The PAC encourages E16 to complete the analysis of Run-0a data by this summer and expects them to show the physics results in the next PAC meeting. The PAC is pleased to see the new LOI where the measurement of phi-meson via K^+K^- pairs in the upgraded E16 detector is proposed. The final physics results will benefit greatly from both e^+e^- and K^+K^- pairs being detected within the same experiment.

E11/E65 (T2K, T2K-II)

E11(T2K) is an ongoing long-baseline neutrino oscillation experiment with a near-detector complex located at J-PARC and the Super-Kamiokande detector (SK) as the far detector.

The T2K Collaboration presented the readiness of the beamline, the near-detector system and the far detector for the upcoming run in February 2021. SK, now with ~0.01% of Gd concentration in water (SK-Gd), is ready for beam. Using an Am-Be source and spallation neutrons produced by cosmic-ray muons, SK-Gd clearly can detect neutrons captured on Gd. Furthermore, no degradation in performance of particle identification was observed. The PAC congratulates the collaboration on the success of realizing and commissioning of SK-Gd. For the near-detector complex, INGRID and WAGASCI/BabyMIND are ready for operation; ND280 is not due to the COVID-19 pandemic. International travel ban has stopped the replacement of components of the DAQ and ECal of ND280 as well as filling over 90% of the ND280 shifts.

E65(T2K-II) is the continuation of T2K with the ND280 detector and the neutrino beam upgraded. The PAC has learned that COVID-19 has negatively impacted the progress of the upgrade of ND280 but it is still on track to be ready for beam in the fall of 2022. We congratulate the T2K collaboration on progress made despite the challenge. A major uncertainty is whether travel is permissible in the near future when assembly of detector subsystems is scheduled to take place. The PAC has concern and strongly encourages the T2K collaboration to explore options and come up with creative solutions to overcome this obstacle now to avoid further schedule slippage.

The first result from the joint T2K-NOvA analysis is expected to be available in 2021-2022. The PAC strongly endorses this effort. We also encourage the collaboration to utilize the NINJA results along with the other neutrino interaction measurements to reduce the systematic uncertainties.

E14 (KOTO)

The experiment E14 (KOTO) aims to measure the rare decay $K_L \rightarrow \pi^0 \upsilon\upsilon$. With its tiny branching ratio – 3.2×10^{-11} in the Standard Model – and small theory uncertainties, this channel offers an excellent probe of New Physics. At this PAC meeting, the collaboration provided a status report.

The analysis of the 2016-2018 data set has been completed and the results are currently under peer-review. In particular, the newly identified backgrounds from charged kaon

decays and from halo $K_L \rightarrow \gamma\gamma$ decays have been thoroughly investigated. The total expected background is now determined as 1.22 ± 0.26 events, consistent with the three events observed in the signal region. The PAC congratulates KOTO on the completion of the analysis.

To reduce the K^+ background, an upstream charged veto (UCV) has been developed. The data taken with a prototype UCV prove the expected performance in K^+ background suppression, and the full UCV has been installed in December 2020. The PAC is pleased to hear about this progress in the control of the background.

The PAC congratulates KOTO on their success in minimizing the impact of the Covid-19 pandemic. The PAC encourages the collaboration to continue their effort to improve the robustness of their analysis with respect to their analysis workflow, background suppression and unblinding strategy. The PAC requests a re-evaluation of KOTO's ultimate sensitivity in light of the newly discovered backgrounds for the next PAC meeting.

E21 (COMET)

The COMET experiment searches for coherent neutrino-less conversion of muon to electron utilizing the new beam line (C-line) in the Hadron Experimental Hall.

The COMET collaboration reported the construction status and updates of the beam line, facility, detectors, electronics and software. The PAC is pleased to learn that steady progresses are made on all fronts, from design refinements to assembly and testing. The assembly of the Straw-Tube Tracker is ongoing; some schedule delays occurred due to COVID-19 and implementation of additional assembly procedures. The COMET collaboration believed that they can still meet the schedule, despite COVID-19. Assembly of the tracker is aimed to be completed by the end of FY2022.

T78, 8-GeV operation test/extinction measurement, was approved at the previous PAC meeting and will be conducted at the K1.8BR beam line. Test of the detector, front-end electronics and DAQ was conducted successfully. Preparation for the high-intensity run at K1.8BR is almost ready. The PAC was pleased with the progress of T78. International participation on site has been affected by COVID-19; the collaboration is making efforts to overcome this challenge.

The COMET collaboration intends to carry out the low-intensity beam run (Phase-α) in JFY2022. Preparation is proceeding well. The Phase-α Study Note was released this month. The COMET collaboration explained the status and schedule. The PAC was satisfied with the COMET collaboration's assurance that no further delay should occur due to Phase-α.

One of the next steps is to perform analyses on a large-scale MC simulation; production of simulated data is currently ongoing. The PAC looks forward to the result in coming PAC meetings.

The PAC congratulates the COMET collaboration on their strong progress and encourages them to make every effort to conduct the 8-GeV beam tests and Phase-α preparation.

E34 (g-2/EDM)

The E34 (g-2/EDM) experiment aims to measure the magnetic and electric dipole moments of the muon using innovative muon cooling techniques with independent systematics than the previous (BNL) and the ongoing (FNAL) experiments. We are happy to hear that international efforts on the Standard Model prediction of the anomalous magnetic moment have been recently performed and that the next theory initiative workshop will be hosted by KEK in 2021, supported by the KEK-IPNS theory center.

In this PAC meeting the collaboration presented the progress report on development of various experiment components. Construction of major parts of H-line was completed and the first beam is expected to be delivered during FY2021. For muon source, a laser power of 10μJ was achieved with 1S-2P transition and 20μJ laser is being tested to achieve >30% ionization efficiency while a demonstration experiment with 1S-2S is scheduled at the new area (S-line) in 2021. Full-scale cavity is being designed and beam monitors are in preparation for LINAC operation. US-Japan cross-calibration data were taken at 1.45T and 1.7T for the field monitoring system of the storage magnet. There are several progress reports on the positron detector and software development for track reconstruction and to increase simulation statistics.

The collaboration received a grant-in-aid funding which allows construction of the positron detector, DAQ system and a part of computing resources as well as B-field monitoring systems, injection beam transportation and partial RF cavities.

The PAC congratulates the collaboration for this newly secured significant funding and steady progress and encourages the continuous efforts to complete remaining parts of H-line together with the lab. We also continue to encourage the lab to keep working on budget requests and technical supports towards the successful construction of the experiment. A formal review with the lab would be recommended to make a concrete plan to move forward if useful.

The PAC also looks forward to further reports on critical R&D progress and hearing more concrete (resource-driven) milestones in the coming PAC meetings.

4. GENERAL REMARKS AND RECOMMENDATIONS

The committee was happy to hear that J-PARC continues to make progress despite the challenging environment of the global pandemic. > 500 kW operation for Fast extraction was established last year and slow extraction at > 50 kW has been re-established in 2021. It is expected that in the upcoming runs, FX will continue to operate at > 500 kW and that SX operation will be at somewhat higher power of > 60 kW.

We were also very pleased to hear that the budget for the plan of 1.5 months of SX running before the shutdown has been approved. As well, the current budget will allow the production and installation of new power supplies for the MR to be completed in JFY2021 and facility and accelerator upgrade up to ~750 kW. In addition, the budget allows Hyper Kaminokande related upgrades. The laboratory has also decided to aim for the completion of COMET phase-I in the next two years. The MEXT roadmap 2020 is published that includes the realization plans for 1.3 MW operations and a robust operation plan. The next decadal plan for J-PARC has been evaluated favorably by MEXT. The committee warmly congratulates J-PARC on these successes.

We heard with some concern, a problem with the cooling water system that has pushed the data taking start to February. We were happy to hear that the type of flange connection that caused the problems are systematically being replaced throughout the system. We urge the laboratory to continue to take measures of preventive maintenance and continuously review possible weak points.

The recommendation for the short-term schedule remains mostly unchanged. After the resumption of beam E03/E16 should take the remaining data, followed by 22 days of FX running for T2K. After this, T78 extinction test should take place followed by the completion of E42 before the shutdown. The committee urges that J-PARC make a

strong effort to obtain further funds for several more days of data taking that the current calendar, in principle, allows. If such funding can be obtained, the priority should be 1) completion of E42 (if not already done) and 2) the test run for E73. There is a request of 12 hours of running to investigate the background for E16. We hope the laboratory should be able to find a way to accommodate this last request before the shutdown.

5. DATES FOR THE NEXT J-PARC PAC MEETING

The next J-PARC PAC meeting will be held in July, 2021.

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

- Minutes of the 30th J-PARC PAC meeting held on 20-22 July, 2020 (KEK/J-PARC-PAC 2020-12)
- Proposals:
  - Proposal: JSNS^2-II (KEK/J-PARC-PAC 2021-1)
  - Proposal of test experiment for technical improvements of neutrino measurements with nuclear emulsion detector (KEK/J-PARC-PAC 2021-5)
- Reports:
  - Addendum of Proposal: Search for an I=3 dibaryon resonance (KEK/J-PARC-PAC 2021-2)
  - Status Report: Status of COMET Phase-α Study (KEK/J-PARC-PAC 2021-4)
- Letter of Intent
  - Study of in-medium modification of ϕ inside the nucleus with $\phi \rightarrow K^+K^-$ measurement with the E16 spectrometer (KEK/J-PARC-PAC 2021-3)