KEK/J-PARC-PAC 2006-1
2 July 2006

**J-PARC Program Advisory Committee**

**for the**

**Nuclear and Particle Physics Experiments at the J-PARC 50 GeV Proton Synchrotron**

Minutes of the first meeting held on
Friday, Saturday and Sunday, 29 June-1 July 2006

**OPEN SESSION (29-June-2006)**:

1. Charge of the Committee: F. Takasaki
2. J-PARC Overview: S. Nagamiya
3. Status of J-PARC Accelerator: Y. Yamazaki

**Proposal Presentations (29-30-June-2006)**:

1. P03: Measurement of X rays from $\Xi^-$ Atom: K. Tanida
2. P05: Spectroscopic Study of Ξ-Hypernucleus, $^{12}_{\Xi}$Be, via the $^{12}$C($K^-$, $K^+$) Reaction: T. Nagae
3. P07: Systematic Study of Double Strangeness System with an Emulsion-counter Hybrid Method : K. Nakazawa
4. P10: Study on Λ-Hypernuclei with the Charge-Exchange Reactions : A. Sakaguchi
5. P13: Gamma-ray spectroscopy of light hypernuclei : H. Tamura
6. P18: Coincidence Measurement of the Weak Decay of $^{12}_{\Lambda}$C and the three-body weak interaction process : H. Bhang
7. P01: Proposal on measurements of the spin rotation parameters A and R at the J-PARC in the resonance region of p-N elastic scattering : V. Sumachev

8. P04: Measurement of High-Mass Dimuon Production at the 50-GeV Proton Synchrotron : J. C. Peng

9. P06: Measurement of T-violating Transverse Muon Polarization in $K^+ \rightarrow \pi^0 \mu^+ \nu$ Decays : J. Imazato

10. P11 Tokai-to-Kamioka (T2K) Long Baseline Neutrino Oscillation Experimental Proposal : K. Nishikawa

11. P14 : Proposal for $K_L \rightarrow \pi^0 \nu\bar{\nu}$ Experiment at J-PARC : T. Yamanaka

12. P15: A Search for deeply-bound kaonic nuclear states by in-flight $^3$He($K^-$, n) reaction : M. Iwasaki

13. P16: Electron pair spectrometer at the J-PARC 50-GeV PS to explore the chiral symmetry in QCD : S. Yokkaichi

14. P17: Precision spectroscopy of Kaonic $^3$He 3d->2p X-rays : R. Hayano

15. P19: High-resolution Search for $\Theta^+$ Pentaquark in $\pi^- p \rightarrow K^- X$ Reactions : M. Naruki

**CLOSED SESSION**:

Present: T. Bressani, A. Ceccucci, H. En'yo, K. Hagiwara, E. Hiyama,
Y.B. Hsiung, K. Inoue, J. Imazato (Secretary), T. Ishii, T. Kishimoto,
S. Nagamiya (J-PARC Center Director)*, T. Nakano,
K. Nishikawa (Secretary), H. Nozaki (IPNS vice director),
T. Oshima*, J-C. Peng*, H. Sakai*, M. Shaevitz,
F. Takasaki (IPNS director)*, K. Tokushuku (Chairman),
*) Part of the time

## 1. PROCEDURE

The chairman appointed T. Nakano as the deputy chairman.

The charge to the committee was presented by the INPS director. They were

(1) Evaluation of the scientific merits, technical feasibility and recommendation about the neutrino program at J-PARC

(2) Evaluation of the scientific merits and technical feasibility of proposals at the hadron hall and prioritization of the secondary beam lines (K1.8 / K1.8BR / K1.1 / K1.1BR / K0 / others )

(3) Prioritize proposals as to which are to be day-one experiments.

The approval procedure for proposal was discussed. A two-stage approval scheme was adopted as follows.

Stage-1 approval will be given by the IPNS director based on the recommendation of the PAC, if the scientific merit of the proposal is high and the experimental methods are sound. This approval will help the proponents negotiate with funding agencies.

After stage-1 approval, the PAC will judge the feasibility of the experiment and gives a recommendation for a stage-2 approval to the IPNS director. The feasibility judgment will be based on the technical achievability, the reliability of the cost estimate and the manpower allocations. If necessary, after the stage-1 approval, the IPNS director can ask the Facilities Impact and Finance Committee (FIFC), which is a new committee to be setup under the IPNS director, to evaluate the various aspects of the feasibility with respect to the Laboratories program. Based on this information, a stage-2 approval may be given by the IPNS director through the J-PARC center to the proponents, based on the recommendation of the PAC and consideration of the financial situation. The second stage approval is a green light for the experiment to proceed.

Twenty proposals were received for this meeting. The committee members were pre-assigned as referees as follows:

- Neutrino experiment (P11) : Hagiwara, Inoue, Shaevitz
- Kaon rare decay experiments (P06, P09, P14)
  : Ceccucci, Hagiwara, Hsiung, Oshima
- Muon experiment (P20) : Oshima, Hagiwara, Shaevitz
- Hypernuclei experiments (P03,P05,P07,P10,P13,P18):

: Bressani, Hiyama, Ishii, Nakano

- Kaonic Atoms, Drell-Yan, and the others

  (P01, P02, P04, P08, P12, P15, P16, P17, P19):

  :En'yo, Hiyama, Kishimoto, Peng, Sakai

It was decided that letters of intent (LOIs), such as P02, P09, P12 and P20, would not be discussed this time. P08 had no presentation and will be discussed in the future meeting.

On Friday and Saturday, the proposals were presented in the open sessions by the proponents. Each proposal was assessed in closed sessions. Based on discussions by the full PAC, the referees drafted recommendation on each proposal. On Sunday, the decisions were made for individual proposals. Based on these decisions, the priority of the beam line was determined and day-1 experiments were chosen.

## 2. Proposal Evaluation

1. **P01:** Proposal on measurements of the spin rotation parameters A and R at the J-PARC in the resonance region of p-N elastic scattering

The main goal of this proposal is to obtain new pion-proton spin-rotation A and R data which would better constrain the partial wave analysis (PWA) needed for deducing the existence and properties of various non-strange baryon resonances (N* and Δ*). The proposed measurements would use pion beams at several momenta between 600 and 2100 MeV/c together with a polarized proton target and a proton polarimeter. The polarized proton target has been built at PNPI and the cost for building the additional drift chambers and hodoscopes is estimated to be less than 100,000 Euros. The proposed measurements require no new technology and are judged to be achievable.

While the PAC recognizes the interest of extracting precise information on the properties of non-strange baryon resonances, it is not clear how the proposed measurements would accomplish this goal. The impact of the proposed new measurements relative to the huge amount of existing pion-nucleon scattering data remains to be established. Specific baryon resonance states and the underlying physics issues which are relevant to the proposed measurements were not identified.

Moreover, basic experimental information such as the total amount of requested beam time and the expected statistical and systematic uncertainties were not discussed in the proposal.

**As a result of these concerns, the PAC recommends that this proposal be rejected.**

2. **P03:** Measurement of X rays from $\Xi^-$ Atom

The major aim of the proposal is to obtain information on the baryon-baryon interaction in the S=-2 sector, through the measurements of X-rays from the $\Xi^-$-nucleus atomic state on an iron target. Since there is little knowledge on the ΞN interaction so far, the information on this interaction is important. The measurements would especially provide the Ξ-nucleus interaction at large distances and would therefore be complementary to the proposed searches for Ξ-hypernuclei such as P05.

The experiment is planned at the K1.8 beam line. The proponents request the Kurama magnet for the $K^+$ spectrometer in order to maximize acceptance. The PAC suggests that the proponents pursue an option to use the SKS spectrometer to reduce the down time to rearrange the detector setup.

Backgrounds from nuclear γ-rays may obscure X-ray measurements. Although an estimation of this background is not straightforward, the PAC thinks that studies need to be done and presented before stage-2 approval.

**The PAC recognizes the importance of the measurements and recommends stage-1 approval.**

3. **P04:** Measurement of High-Mass Dimuon Production at the 50-GeV Proton Synchrotron

This experiment tries to study sea quarks in the nucleon, in particular the u-bar/d-bar ratio in the large *x* region. Dimuons from the Drell-Yan process will be measured at 50 GeV. This experiment will exploit the unique opportunity to study the sea quark distribution at the 50 GeV J-PARC accelerator. The PAC recognizes the physics potential and expects that interesting results will come from the experiment.

However, the experiment requires a primary beam line which will not be ready at day-1. Furthermore, the physics case is stronger for the primary beam energy at 50 GeV, whose timescale is uncertain. The proponents presented an option to study J/ψ production at 30 GeV. The PAC considers that this measurement is also interesting but feels that the experiment is less justified when the study of J/ψ production becomes the primary purpose.

The proponents have submitted a similar proposal to Fermilab with a much higher beam energy, 120 GeV. The proposal has been approved but the funding is not yet promised. The cost and schedule of the experiment at J-PARC strongly depends on the situation of the Fermilab experiment.

Under the current circumstance the PAC cannot evaluate this experiment as day-1. On the other hand, the PAC considers that the current information is not enough to make a final conclusion. **Thus the PAC leaves this experiment in a deferred status.** The PAC recognizes the importance of the primary beam line (High-*p* line) and the goal of reaching the full 50 GeV beam energy.

4. **P05:** Spectroscopic Study of Ξ-Hypernucleus, $^{12}_{\Xi}$Be, via the $^{12}$C($K^-$, $K^+$) Reaction

The aim of the experiment is to obtain spectroscopic information of the $\Xi^-$-hypernucleus $^{12}_{\Xi}$Be, produced via the $^{12}$C($K^-$,$K^+$) reaction by using the high-intensity $K^-$ beam at the K1.8 beam line. The existence of $\Xi^-$-hypernuclei is not yet well established. If these hypernuclei exist, they will be observed by this experiment for the first time with reasonable statistics and with the very good energy resolution of 3 MeV. The $\Xi^-$ single-particle potential obtained from the measurement of the $K^+$ energy spectra, regardless of the existence of $\Xi^-$-hypernuclei, will provide information on the $\Xi^-$-N interaction. This is of great importance for the verification of different models of the Baryon-Baryon interaction. The PAC feels that this experiment is the first step towards the exploration of the S= -2 hadronic systems, and that this subject can be uniquely studied experimentally only at J-PARC. As a matter of fact, the access to the so-called "S= -2 world" was one of the important scientific motivations for the construction of J-PARC.

The experiment will be performed using the SKS spectrometer, suitably modified by the addition of a large-aperture dipole magnet and implemented with some additional detectors and upgraded electronics. The experiment is well designed to

achieve the experimental goals and the competence of the Collaboration to perform the proposed program is well substantiated by their previous record of providing the best set of high quality and scientific important data for the S=-1 sector.

**The PAC recognizes the importance of the measurements and the readiness of the experiment for day-1 and recommends stage-1 and stage-2 approval. Furthermore the PAC considers this experiment to be the best candidate for a Day-1 experiment in the hadron experimental facility.**

5. **P06:** Measurement of T-violating Transverse Muon Polarization in $K^+ \to \pi^0 \mu^+ \nu$ Decays

This proposed search for T-violating transverse muon polarization, $P_T$, in stopped $K^+$ decay at the sensitivity of $10^{-4}$ or below is a significant step beyond the previous KEK-E246. The experiment is uniquely suited for J-PARC and has high scientific merit and a good baseline detector design. Currently there is no other similar competing experiment except the continuing measurement of neutron electric dipole moment. The potential physics impact of P06 is large in probing physics beyond Standard Model (SM). Although T-violating effects from the SM are expected to be very small in this mode, there are non-SM sources of CP- or T-violating effects that have predicted contributions to $P_T$ at the $10^{-4}$ level. A discovery in this channel would be very important and would have a profound impact and value even in the LHC era.

However, a 20-fold improvement in the $P_T$ sensitivity requires a 400-fold increase in statistics and more than an order of magnitude improvement in many of the experimental systematic uncertainties. The experiment will reuse the existing KEK-E246 detector setup with modest detector upgrades and new detector elements, such as new active target, active muon polarimeter and a new muon magnet to greatly improve the sensitivity. An increase of the detector acceptance by a factor of ten and an increase of integrated 800 MeV/c $K^+$ beam flux by at least 30 times for a one year's running at the K1.1BR beam line are required to achieve the $10^{-4}$ sensitivity.

The PAC would like the proponents to show that the improvement on the sensitivity and systematic uncertainties below $10^{-4}$ is attainable via detailed Monte Carlo studies, e.g. acceptance, B-field offsets, detector misalignments and the new active muon polarimeter.

**Due to the high scientific merit and good baseline detector design, the PAC recommends stage-1 approval.**

6. **P07:** Systematic Study of Double Strangeness System with an Emulsion-counter Hybrid Method

The previous hybrid emulsion experiments at KEK-PS pioneered experimental study of the S=-2 system, in particular, by providing the key information on the Λ−Λ interaction, namely $\Delta B_{\Lambda\Lambda}$. However, there exists some ambiguity due to insufficient knowledge of the structure of a double-hypernucleus. The proposed experiment will remove this ambiguity by observing 10 times more double-hypernuclei and studying nuclear number (A) dependence of $\Delta B_{\Lambda\Lambda}$. It may also address the possible existence of the H particle by identifying its $\Sigma^-$ p decay together with small A-dependence of $\Delta B_{\Lambda\Lambda}$.

The experiment is planned at the K1.8 beam line. Since the experiment does not require high intensity and the experimental method is firmly established, this experiment would be ideal to be carried out in the initial stage of J-PARC if it does not cause a delay to the higher priority experiment (P05) which uses the same beam-line. The proponents request the Kurama magnet for the $K^+$ spectrometer to keep a larger acceptance. The PAC suggests that the proponents to pursue an option to use the SKS spectrometer in order to reduce the down time to rearrange the detector setup for P05.

The proponents also plan to measure X-rays from Ξ atoms. As already mentioned for the P03 proposal, the PAC is concerned that the success of X-ray measurements depends on understanding the backgrounds from nuclear γ rays with similar energy. However, the main aim of this proposal does not depend on these X-ray measurements.

**The PAC recommends Stage-1 approval under the condition that it does not cause a delay to the higher priority P05 experiment which will use the same beam-line.**

7. **P10:** Study on Λ-Hypernuclei with the Charge-Exchange Reactions

The proposal contains a series of steps for the continuation of the systematic study of S=-1 Λ-hypernuclei, in particular concerning the mirror and neutron-rich

hypernuclei of a given mass number (A) (like ${}^{7}_{\Lambda}\mathrm{H}, {}^{7}_{\Lambda}\mathrm{He}, {}^{7}_{\Lambda}\mathrm{Li}$). The experimental methods outlined in order to obtain neutron-rich Λ-hypernuclei by means of the ($\pi^-$, $K^+$) reaction and mirror hypernuclei by means of the ($\pi^-$,$K^0$) reaction will need the use of different spectrometers, the existing SKS for the reaction ($\pi^-$, $K^+$) and a new system for the ($\pi^-$,$K^0$) reaction. Once in operation, the addition of several arrays of counters will allow a study of the non-mesonic decay of light (A=4) Λ-hypernuclei. The program is ambitious, and the Collaboration looks capable of performing the experiments. However, **the lack of a unique installation for the whole series of measurements convinced the PAC to defer a decision, waiting for a more detailed scheduling of the activities.**

8. **P11:** Tokai-to-Kamioka (T2K) Long Baseline Neutrino Oscillation Experimental Proposal

The T2K neutrino oscillation experiment is one of the highest priority experiments for J-PARC as well as the worldwide HEP and NP program. With four years of neutrino data, T2K will measure the atmospheric oscillation parameters, $\Delta m^2_{23}$ and $\sin^2 2\theta_{23}$, with a precision of an order of magnitude better than the current measurements. Determining how close $\theta_{23}$ is to the full mixing ($45^0$) is of eminent theoretical and experimental interest. In addition, through the $\nu_e$ appearance channel, T2K will have a sensitivity to the $\sin^2 2\theta_{13}$ mixing parameter at the 0.01 level which is a factor of twenty below the current CHOOZ upper limit. Measuring this mixing angle is the next key step in understanding neutrino oscillations. A measurement of a finite value for $\theta_{13}$ will not only complete the measurements of the neutrino mixing matrix but also set the stage for CP violation searches in the neutrino sector. Other possible measurements of $\theta_{13}$ may also become available from reactor disappearance experiments such as Double CHOOZ and KASKA but these measurements will be more complementary rather than competitive. Among the worldwide neutrino oscillation program, T2K is in the lead to make the first observation of a $\nu_e$ appearance signal. To remain in this position, it is important that the first beam be delivered in 2009 with a ramp up to 0.75 MW beam power as soon as possible.

From the documentation provided to the PAC, it appears that the realization of the T2K experiment is going well. The beam design, prototyping, and construction are well advanced and on schedule for a completion in 2008. The progress is being monitored by IPNS and by an external "Neutrino Technical Advisory

Committee" (NeuTAC). At the next meeting, the PAC would like to hear a report from the chairman (or other designee) of NeuTAC committee. The PAC was also shown that the refurbishment of the SuperK detector was completed in April, 2006 and will be calibrated and exercised with cosmic ray and atmospheric neutrinos over the next several years until the start of beam in 2009. The PAC would like to hear periodic reports on the progress of the SuperK calibrations and analysis.

One of the critical components of the T2K experiment is the near detector. This detector is needed in order to provide the base neutrino flux and background determinations for the oscillation measurements. The design of this detector is being finalized and funding for the components is being secured. However, due to the limited information and time available at this first J-PARC PAC meeting, a technical review by PAC of the complex near detector system was not possible. For this reason, the PAC requests a review of this system at the next meeting. Details of the design with simulations and justifications should be documented and presented. The presentation should also include the status of the funding, group responsibility, and schedule for each sub-component. If possible, IPNS should also set up a technical review committee to examine the near detector system with the goal of reporting an assessment of the project to the PAC at the next meeting.

**Due to the high scientific merit and excellent technical progress of T2K, the PAC recommends stage-1 and stage-2 approval for this high priority project.** A full review of the near detector system should be set up for the next PAC meeting as outlined above.

9. **P13:** Gamma-ray spectroscopy of light hypernuclei

The proponents have been developing gamma-ray spectroscopy for Λ-hypernuclei at KEK-PS and at BNL. Many gamma transitions from p-shell Λ-hypernuclei have been successfully observed. The proposal is to continue the study with much improved gamma-ray detectors.

The proposed measurements will provide information on YN spin-orbit force such as the spin-spin force, the spin-orbit force and the tensor force. In particular, the information on the ΛN-ΣN coupling and the charge symmetry breaking effect will be accessible.

The PAC recognizes that ${}^{4}_{\Lambda}\mathrm{He}$ and ${}^{11}_{\Lambda}\mathrm{B}$ are particularly important to provide the precise data to study charge symmetry breaking effects. Also the measurement of the width of the Λ spin-flip M1 transition is challenging but interesting to understand the magnetic moment of Λ in a nucleus. The strength of the group has already been demonstrated by the previous experiments. Ongoing upgrades of the gamma ray detectors will be ready by day-1

**Due to the high scientific merit and the sound technical feasibility, and due to the readiness of the experiment at Day-1, the PAC recommends stage-1 and stage-2 approval for this project. The committee considers this experiment to be the second best candidate for a Day-1 experiment in the hadron experimental facility.**

10. **P14:** Proposal for $K_L \rightarrow \pi^0 \nu\bar{\nu}$ Experiment at J-PARC

The Collaboration proposes a two-step strategy towards accomplishing a measurement of the $K_L \rightarrow \pi^0 \nu\bar{\nu}$ branching ratio (BR). The aim of the first step (Step1) is to approach the Standard Model (SM) Single Event Sensitivity (SES) by exposing an upgraded version of the E391a spectrometer to a neutral beam emerging from T1 target with a 16 deg production angle. According to the proponents, one could measure 3.5 SM events with a signal to background (S/B) ratio of about 1.4. To do so, $1.8 \times 10^{21}$ POT would be required. This figure corresponds to running the slow extracted beam with full efficiency and full intensity for three years (about four months per year are assumed by the proponents). Following Step1, a new, larger detector and a new beam-line would be needed in order to measure the BR with an error of order 10% or smaller.

The written proposal addresses mostly Step1 and the PAC discussion focused on this first stage. The physics case for Step1 is very strong, because a successful experiment would bridge the BR region between the Grossman-Nir model independent limit and the SM, where in principle new CP violating physics can hide. Step1 will incorporate all the know-how acquired by analyzing the data of E391a, the pilot experiment performed at the 12 GeV KEK PS. For instance, it is proposed to replace the calorimeter crystals by the longer and more granular "KTeV CsI crystals". The length of the KTeV crystal ($27X_0$) will reduce the photon punch-through probability significantly. The granularity will be improved by a about factor of 8 and reduce backgrounds induced by photon fusion significantly.

The proposed experiment requires a K0 beam-line which, according to the current construction time schedule of the Hadron Experimental Facility, may become available in 2010.

A first series of technical questions were answered by the Collaboration. Most concerns were answered. Further results from the pilot experiment are eagerly awaited to understand whether the proposed experimental technique, which is based on incremental improvements, is viable to reach the proposed sensitivity.

**The PAC recommends Step 1 of P14 for stage-1 approval.** Before considering stage-2 approval, the PAC will need to review the experimental technique in more detail. This will take place in due time, once improved results from the pilot experiment (KEK-E391a) become available.

11. **P15:** A Search for deeply-bound kaonic nuclear states by in-flight $^{3}$He($K^-$, n) reaction

The experiment P15 intends to search for deeply bound kaonic states with a helium-3 target. This experiment is motivated by the proponent's previous experiments with helium-4 targets at KEK-PS (E471 and E549/E570). While these experiments were performed with a stopped $K^-$ beam, the proposed experiment will use a new setup to exclusively measure the in-flight kaon reaction: $K^-(^3He, K^-pp)n$. A possible bound state of the $K^-pp$ system is searched for both in the invariant mass spectra of the decay products of the $K^-pp$ system and in the missing mass spectra from the forward escaping neutron with a mass resolution of 10-20 MeV. Having the over-constraint of both sets of information, the proponents aim to obtain a conclusive answer on the existence of the bound $K^-pp$ system.

Although the proposed detector with a cylindrical drift chamber and a forward neutron counter is more advanced than the ones at KEK-PS, there are no technical difficulties for it to be constructed by Day-1. The strength of the group has already been demonstrated by the previous experiments. The detector can be ready for the day-1 with no impact on the current construction schedule.

The PAC notes that the preliminary results on $^{4}$He from the E570 experiment indicate possible inconsistencies with the E471 results and that the theoretical interpretation is under active development. The PAC considers that this experiment is capable of clarifying the kaon nucleus interaction quantitatively even if its outcome refutes the existence of deeply bound kaonic nuclei. This experiment

addresses a very important physics issue of theoretical interest which was inspired by the discovery at the KEK-PS made by this same collaboration. Although the present world-wide situation looks controversial, the importance of the physics remains unchanged.

**Due to the high physics merit and the experimental readiness of the proposal, the PAC recommends stage-1 approval.** Before going to a stage-2 approval, the PAC would like to hear the results from E590 at KEK-PS and the proponent's strategy based on the results. The priority of this experiment as to suitability for Day-1 will then be assessed.

12. **P16:** Electron pair spectrometer at the J-PARC 50-GeV PS to explore the chiral symmetry in QCD

The goal of this proposal is to search for experimental evidence for the onset of chiral symmetry restoration in nuclear matter. Various theoretical calculations in QCD have suggested that the properties of hadrons, such as their masses and widths, can be significantly modified in a nuclear medium as a result of the partial restoration of chiral symmetry. Despite many experimental effort, unambiguous evidence for chiral restoration remains to be found. The proponents of this proposal have carried out an extensive investigation in the experiment KEK-PS E325, which indicated that the masses of the ρ, ω, and φ mesons are modified in a cold nuclear medium. In particular, their recent analysis suggested that roughly 20 percent of the slow-moving $\varphi \rightarrow e^+e^-$ events produced in p+Cu interactions have masses lower than the free φ meson. The present proposal intends to improve the statistics of $\varphi \rightarrow e^+e^-$ by a factor of 100 using several targets (p, C, Pb). This two order-of-magnitude improvement in rate is anticipated as a result of the larger acceptance and the high-rate capability of the proposed detectors. The proposed approach appears feasible. However, additional simulation studies and prototype detector tests are needed to ensure the rate capability.

The physics addressed by this proposal is considered by the PAC to be important and worth pursuing at J-PARC. However, the toy-model used by the experimenters for describing the phenomenon of chiral symmetry restoration in p-A interaction appears too simple and unrealistic. To better evaluate the significance of the E325 results and the physics potential of this proposal, it would be extremely helpful to have additional information and clarification on the theoretical model used in the

analysis. **The PAC therefore recommends that the decision on this proposal be deferred until more information on the theoretical interpretations becomes available.**

13. **P17:** Precision spectroscopy of Kaonic $^3$He 3d->2p X-rays

This experiment is to measure 3d -> 2p X-rays of kaonic helium-3 atoms, which will show a shift of up to 10eV depending upon the depth of K- nucleus potential. The experiment aims to measure the shift with 2 eV precision. Together with the data already taken by the same group with a helium-4 target at the KEK-PS, a crucial test can be made as to the existence of deeply bound kaonic nuclei.

The group has already demonstrated the experimental feasibility with the success of the previous experiment and the modifications for P17 are minor. The experiment can be done either in the K1.8BR or K1.1 beams with either the new P15 setup or reusing a part of the existing setup from the KEK-PS experiement. Both possibilities were presented at the PAC meeting.

**Stage-1 approval should be given to this experiment, but as an add-on to the P15 experiment.** This experiment is relatively easy and small, and has enough physics merit and feasibility to be carried out at J-PARC. However the PAC considers the physics impact of this proposal *alone* as not strong enough to merit the construction of the beam line, or to rank as a day-1 experiment. If the proponents are not satisfied with this coupling to P15, the P17 group should resubmit the proposal to the PAC as a detached experiment from P15. The PAC will then reconsider this proposal as a stand alone experiment.

14. **P18:** Coincidence Measurement of the Weak Decay of $^{12}_{\Lambda}$C and the three-body weak interaction process

The aim of the experiment is the determination of the contribution of the ΛNN—NNN weak decay mode to the usual non-mesonic decays. Theoretical calculations predict sizeable contributions (up to 20%) of the Λ-NN interaction to the Λ-N one, which would explain some ambiguities in the current analysis of the data. The goal of the experiment is to detect and measure the energy of three nucleons emitted in coincidence, from the decay of $^{12}_{\Lambda}$C, formed through the

($\pi^+$,$K^+$) reaction. The experimental layout is quite similar to the previous one used by the same authors at the KEK PS with the SKS spectrometer. The number of neutron detectors is considerably increased, and thus the acceptance for detecting three nucleons in coincidence. The competence of the collaboration is good, as shown by the series of previous similar experiments (only 2 nucleons in coincidence). However, there are some uncertainties in disentangling 3-body weak decay events from those due to 2-body weak decays followed by final state interactions (FSIs), as well as the effects of the thick targets. Furthermore, the PAC needs to have more information on the importance of the 3-body weak interaction in the decay of hypernuclei. For these reasons, the PAC recommends that **a decision on the experiment be deferred until further information is shown from the proponents**.

15. **P19:** High-resolution Search for $\Theta^+$ Pentaquark in $\pi^-p \rightarrow K^-X$ Reactions

This experiment will attempt to observe the $\Theta^+$ pentaquark by the ($\pi^-$,$K^-$) reaction. The proposal is based on the signature observed in the same reaction carried out at KEK-PS. The proposed experiment is sensitive to a cross section 20 to 50 times smaller than that of the previous observation. Although the proposed improvements of the sensitivity are not well justified, the experiment should clearly see the signal if the previously observed signature was real. This experiment requires a pion beam and the SKS spectrometer; the requested beam time can be accommodated without much impact on other experiments.

The PAC appreciates the physics motivation and sees no difficulty to carry out the proposed experiment under the condition that the K1.8 beam line and the SKS spectrometer can be ready.

**Due to the high scientific merit and the experimental simplicity once the SKS spectrometer is on K1.8 beam line, the PAC recommends stage-1 approval.**

## 3. PRIORITY OF THE BEAMLINES IN THE HADRON EXPERIMENTAL FACILITY

The current strategy for beam line construction in the hadron experimental facility was determined based on the assessment of letters of intent by the Nuclear and Particle Physics Facility Committee (NPFC). The committee evaluated the physics

impact in the letters of intents received in 2003 and recommended a few day-1 experiments.

The current beam line construction plan was shown at the J-PARC PAC meeting. Considering the evaluations of the current proposals, several experiments with high physics merits will be able to be performed with the K1.8/K1.8BR beam lines. The experiments are expected to produce science output and measurements rather quickly. **The PAC therefore endorses the current strategy of the J-PARC Project Team that the K1.8 beam line is to be built with the highest priority.**

The PAC also recognizes that there are strong physics cases in the proposals to use the K0 and K1.1/K1.1BR beam lines. These beam lines will give unique opportunities for nuclear and particle physicists around the world to perform excellent experiments with neutral kaons and with low momentum charged kaons. **The PAC recommends that these beam lines be realized as soon as possible. In particular, the installation schedule should be carefully planned to take into account the high levels of radiation that will come about due to beam line commissioning and operation.**

The committee notes that the experiments with the primary proton beam are also important. A plan to construct the high momentum beam line should be worked out.

## 4. DAY-1 Experiments

**The PAC recommends the following experiments as the day-1 experiments: P11 on the neutrino beam line, P05, P13 and P19 on the K1.8 beam line and P15 and P17 on the branch of the K1.8 beam line. Among the experiments in the hadron experimental facility, the committee considers that P05 is the experiment with the first priority since the experiment is unique at J-PARC and explores the new field on nuclear structure with strangeness -2, with the high resolution SKS spectrometer. P13, which studies the hyper-nuclear structure with the lambda hyperon has the second priority.** P19 can be performed with the short beam time if the beam line and SKS spectrometer is ready. The priority of P15 and its parasitic experiment P17 will be determined after the strategy of P15 is reviewed at the time when results of the previous experiment (E570) at the KEK 12GeV PS are available. A detailed schedule including the time

sharing between the experiments should be determined later when the machine schedule and the beam intensity at the early phase of J-PARC operation are known.

## 5. Date for the next J-PARC PAC meeting

Date for the next meeting is 10-12 January 2007. The tentative agenda is;

- Expected financial status of J-PARC and plans for JFY2007
- Report on the neutrino beam line from the NeuTAC committee
- Report on T2K near detector
- P08 proposal presentation
- P16 presentation on the theoretical interpretation
- P18 presentation on the final state interaction and on the effect of the thick target.