

REPORT:
THE FOURTH MEETING OF
THE KEK SCIENCE ADVISORY COMMITTEE

March 15, 2023



1. Executive Summary

The KEK Science Advisory Committee's fourth meeting took place from February 22 to 24, 2023. The agenda of the meeting can be found in Appendix A. The membership of the SAC and the charge to the SAC are provided in Appendices B and C, respectively. The SAC was asked to focus on the progress of the research program in general and other activities of KEK by looking at a broad perspective. The SAC much appreciates the many people who participated in thoughtful presentations and candid conversations during this meeting. The SAC thanks our hosts for the facility tours of the Tsukuba and Tokai campuses, and for educating us regarding the Inter-University Research & Education Alliance, the University Research Administrator (URA) system, roles of the URA, and the Applied Research Laboratory that serves in a transversal mode as a support unit for different activities related to many technical systems of the whole KEK.

KEK enables unique scientific opportunities for researchers from academia and industry in Japan and abroad, covering accelerator science, particle physics, nuclear physics, cosmology, materials science, and the life sciences. KEK operates and develops world-leading electron-based and proton-based accelerator facilities at Tsukuba and Tokai campuses, respectively. Using various types of beams from these facilities, KEK pursues fundamental laws of nature and the origins of the function of materials. KEK develops the next generation of accelerator technologies for a wide range of sciences and collaborates with industry on research aimed at developing useful products for society. KEK strengthens its portfolio by partnering in activities at other world leading research laboratories and facilities, including LHC/ATLAS experiment at CERN, KISS at RIKEN, UCN at TRIUMF, KAGRA at the Kamioka mine and LiteBIRD in space.

The past year has been challenging due to the pandemic and Russia's invasion in Ukraine. Although KEK has lifted covid-restrictions so that research can be conducted under conditions similar to the pre-pandemic era, the supply-chain challenge has remained, affecting various programs and projects. The rapid rise in electricity prices has caused significant limitations on the operation of the accelerators. MEXT implemented a generous policy of providing subsidies for electricity costs in the current fiscal year. Electricity price hikes are expected to settle down later this year.

KEK continues to lose knowledge and expertise due to retiring staff (e.g., accelerator physicists and engineers, as well as beam-line scientists). Because of the small number of new hires, the number of staff has been decreasing while the demands of operating the machines continue to grow.

Despite all of these difficulties, KEK's achievements in the past year are truly remarkable and impressive. KEK implemented last year's recommendations by the SAC and completed the KEK-PIP 2022. This together with the KEK Roadmap plays a key role in guiding KEK's research.

Discussions with MEXT are currently underway to make this a reality. MEXT started funding the “Additional contribution to HL-LHC at CERN” from JFY2023. Together with the ILC’s global and Japanese community, KEK proposed to organize the “ILC Technology Network” to conduct technological development for ILC by the collaboration between the international accelerator laboratories. This would result in an increase of MEXT’s budget for ILC by a factor of two with respect to last year.

There have been initiatives, resulting in the launch of new Centers such as Instrumentation Technology Development Center and Scientific Innovation Center. Besides KEK’s strong international collaborations (e.g., Belle II and T2K), KEK has multiple programs to promote international cooperation between KEK and institutes abroad.

Significant efforts have been made to enhance more female students and researchers joining KEK. In addition, a significantly enhanced flextime policy and a childcare-leave/family-care-leave system have been introduced to the staff. Gender balances at KEK have been improved in all categories in the last 5 years.

Comments

The SAC commends KEK for its remarkable achievements in the past year despite many challenges, including high electricity costs, supply chains and staffing. The SAC appreciates the support by MEXT in providing subsidies for electricity costs in the current fiscal year. However, the electricity-price issue may remain in the near future and the uncertainty on whether MEXT will continue to subsidize in the future may create issues for international collaboration and coordination. The SAC urges KEK to continue a dialogue with MEXT to minimize impacts due to high electricity costs. The SAC is deeply concerned about the steady decrease of KEK staff, and the SAC urges KEK to explore various mechanisms to identify resources that enable KEK to hire more staff. The SAC is pleased to see new Centers being launched and would like to learn more about their relationship to KEK’s divisions and departments. The SAC commends the KEK leadership for proactive efforts to improve gender balances.

Recommendations:

- 1. Perform planning exercises by considering various scenarios to prepare for high electricity costs in the future. In these exercises, consider the different energy consumption of the facilities, their maintenance and renovation plans, which may also depend on possible delays in delivering essential components.*
- 2. Develop ways to bring early-career staff to get trained (e.g., SuperKEKB commissioning) to mitigate staffing issues (both quantity and expertise).*
- 3. Continue to monitor progress of high-priority projects in the KEK-PIP 2022.*

4. *Consider upgrading legacy network infrastructure and systems that may be vulnerable to cyber security and digital hygiene issues.*
5. *Present at the next SAC meeting how various Centers and Research Labs fit in the KEK organization and how their activities are coordinated with those from KEK's divisions and departments.*
6. *Assess gender balances in leadership roles at KEK.*

2. Accelerator Facilities

J-PARC continues to deliver the world's highest-intensity pulsed neutron beam. The beam power in J-PARC has been steadily increasing by about 100 kW per year to 830 kW with availability above 96%. The Main Ring holds the world record in proton-per-pulse in a synchrotron with fast extraction and in highest efficiency in slow extraction.

In June 2022, SuperKEKB established a new luminosity world record of $4.7 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$. This is more than twice the previous KEKB record. Achieving so high a luminosity at lower beam current than KEKB's reveals the significant leap in energy efficiency already achieved, thanks to the nanobeam collision scheme. A total integrated luminosity close to 0.5 ab^{-1} has been delivered by summer 2022. Presently, during long shutdown 1 (LS1), the collimation system will be upgraded, by installing a collimator with carbon jaws after the LER injection point, and by introducing, for the first time ever, a nonlinear collimation system. Additional upgrades include a few new pulsed power supplies in the injector linac and J-PARC, a replacement of the front panel of the final quadrupole QCS for better background suppression, and an increased aperture at the HER injection point. Tunnel AC and cooling water are stopped during LS1 to save electrical power, which may impact the recommissioning time.

More substantial changes in the Interaction Region and in the injector complex of SuperKEKB are considered for Long Shutdown 2 (LS2), around 2027, and even larger modifications are expected for the 2030's.

The mandate of an International Task Force (ITF) for SuperKEKB, launched in July 2021, is to develop a realistic path to achieve $10^{35} \text{ cm}^{-2}\text{s}^{-1}$ after the LS1, and to conceive schemes for achieving $6 \times 10^{35} \text{ cm}^{-2}\text{s}^{-1}$ after LS2 with a view towards major modifications. The ITF is organized in the form of five subgroups, each of which includes international experts.

The cost of electricity has nearly doubled within the last two years, and even if there is a special support in terms of funding for reducing the impact, the present cost would reduce the anticipated J-PARC beam time in JFY2023 by more than half to 60 days for both RCS/MLF and the Main Ring. The cost and availability of electrical power also had a strong impact on the last SuperKEKB run 2022b, and led to an early start of LS1.

Replacing one J-PARC RCS radiofrequency cavity by a more efficient cavity with a high-impedance core, developed together with the Hitachi company, led to a 40% reduction in the cavity power consumption. It is planned to complete the replacement of all 12 RCS cavities by 2027.

The S-band accelerating structures of the SuperKEKB/PF/PF-AR injector linac stem from the 1980s and are operated at 2.5 times their original design gradients. About half of the 60 structures exhibit aging problems such as water leaks and wave guide discharges. These old structures are gradually being replaced by new structures with higher gradients and lower surface field. So far 4 structures have been exchanged.

Issues with equipment aging and obsolescence have occurred during the past years at both J-PARC and SuperKEKB including power supply systems (an accidentally opened circuit breaker leading to a damaged extraction septum; damage of insulated-gate bipolar transistor modules due to high ambient temperatures; and Programmable Logic Controllers that need to be replaced since they cannot be serviced any more), the Machine Protection System, accelerator utilities and infrastructures.

Several events of device and system failures during the commissioning of the new J-PARC MR power supply system exposed the vulnerability to a shortage of spare components with long procurement lead time.

PF/PF-AR has achieved an excellent performance in terms of availability, especially when considering the aging of systems and limited resources. The PF/PF-AR also plays an important strategic role as a test bench for a proposed future light source. This new and original hybrid-ring light source would operate with multiple beams to provide photons of different wavelengths, pulse lengths, and spot sizes. Basic characteristics of the new light source are still under consideration. Under discussion is a ring with 750 m circumference, and a (switchable) beam energy of 2.5 and 5 GeV.

In preparation for the new light source, at the PF, a new Multi-Functional R&D beamline is being constructed, covering a wide range of photon energies, and enabling the development of “two-beam” techniques. This new beam line will be built by substituting the aged BL-11. Other preparatory and original R&D at the PF includes a ceramic chamber with integrated pulsed multipole magnet, and a longitudinally-compact HOM-damped 500 MHz TM020 cavity.

For the HL-LHC, a 7-m long prototype large-aperture separation dipole D1 has already been shipped to CERN. An additional contribution, already approved, is the construction of quench protection heater power supplies, which will start in 2023. Further contributions are under discussion.

The Innovation Center for Applied Superconducting Accelerator (iCASA) was established in April 2022 to further promote industrial applications. Actively pursued accelerator projects include the compact energy recovery linac (cERL) for semiconductor lithography (EUV-FEL), and a superconducting RF accelerator using Nb₃Sn cavities for high-power electron irradiation.

The Ibaraki Boron Neutron Capture Therapy project (iBNCT) is jointly developed by the University of Tsukuba, KEK and others. Its compact & high-power proton accelerator is based on the J-PARC linac design, added to which were a neutron production target, moderator, collimator and shielding. An average current in regular operation of 1.9 mA has been demonstrated. Non-clinical tests were completed in December 2022. Clinical tests will start in JFY2023. The iBNCT will be one of the first linac-based facilities for BNCT worldwide.

Comments

The SAC congratulates for SuperKEKB's new world record luminosity and high energy efficiency. Congratulations are also extended to J-PARC for continuing to deliver the world's highest-intensity pulsed neutron beam, and for the Main Ring holding the world records of protons-per-pulse in a synchrotron with fast extraction and of highest efficiency in slow extraction.

KEK's accelerator-related researches have in general been proceeding in accordance with the KEK Roadmap 2021 and the KEK Project Implementation Plan 2022. J-PARC is progressing steadily with increasing beam power at high availability. Improvements and upgrades in the Main Ring, such as on the power supply, RF, and extraction systems, are consistent with KEK's missions, including the Hyper-Kamiokande and the extension of the J-PARC hadron experimental facility.

The KEK accelerator teams are commendable for pursuing energy-saving developments including replacement of J-PARC radiofrequency cavity with low-loss, high impedance cores, engaging in energy recovering linac (ERL) programs, and expansion of applied research using superconducting accelerators. Such developments will surely pay dividends, particularly in a climate of rising electricity costs.

The replacement of the J-PARC RCS cavities is a good example for how the overall energy efficiency of KEK accelerators can be improved by replacing old hardware with more efficient new one. Energy efficiency may be further increased also through the proposed replacement of many several decades-old and aging power supplies on both the Tsukuba and Tokai campuses by more modern devices.

The KEK accelerator teams are applauded for addressing equipment and infrastructure aging and obsolescence issues with maintenance and upgrade plans. Good maintenance and upgrade plans

are based on both observed failures (backward looking data) and schedules for anticipated obsolescence. Adequate funding must be secured to sustain systematic accelerator improvements and upgrades.

Systematic evaluations of critical operational spares need to be conducted by considering the estimated mean-time-between-failure, the mean down time, and the lead time for procurements. As the root causes of failure events are not all clear, contingency plans are needed to prevent further delays to user operations. Again, adequate funding must be secured to improve critical spares inventory.

Accelerator cyber security and digital hygiene are important in an increasingly conflicting world. In modern accelerators like LHC and FRIB, separated network systems are used for accelerator safety systems, accelerator technical controls, and office computers/phones. Vulnerability of aging and legacy systems with network access should be regularly evaluated and mitigated.

The SAC commends that two of the five subgroups of the SuperKEKB ITF have deputy chairpersons from outside KEK and Japan, which will facilitate gathering help and feedback from the international expert community. Accelerator projects pursued at iCASA for industrial applications are commendable due both to their high societal values and to cutting-edge technology for energy efficiency and portability. iBNCT is a successful collaboration with the nearby university and a pioneering facility, which will directly benefit society. The SAC appreciates the various studies and innovative developments undertaken at the PF in preparation for a future new and original hybrid-ring light source. The SAC recognizes KEK's important and increasing contributions to the HL-LHC project at CERN.

Recommendations:

- 1. Secure funding both for improving and upgrading aging and obsolete accelerator equipment and systems, and for stocking up adequate critical operational spares.*
- 2. Pursue accelerator sub-system upgrades that may lead to significant reduction in electrical power consumption, including J-PARC RF cavities and old power supplies.*
- 3. Consider upgrading legacy network infrastructure and systems that may be vulnerable to cyber security and digital hygiene issues.*
- 4. Develop a long-term succession plan for the many contributing rehired retired staff, which would preserve their often-unique expertise, and pursue the recruitment of new young staff members. Consider mechanisms to engage more PhD students and postdocs with the Accelerator Laboratory, which would also create a pool of candidates for KEK posts.*
- 5. Further advance the design of the future hybrid-ring light source, including parameter lists and a siting study for the Tsukuba campus, and present it at the next SAC meeting.*

3. Particle and Nuclear Physics

3.1 Particle Physics

Two flagship projects in particle physics at Tsukuba campus are Belle II and ATLAS. The original Belle detector was successfully upgraded as the Belle II detector, in order to exploit the luminosity upgrade of the KEKB e^+e^- collider, i.e. SuperKEKB. Although the data taking of Belle was completed in 2010, physics analysis and publication of the results still continue. Before the start of LS1 in June 2022, Belle II collected data that amounts to about a half of what had been collected by Belle. Thanks to the superior detector performance, it has already started to produce physics results comparable to the Belle experiment. For some cases, results are even unique, such as searches for dark sector particles. KEK is the host laboratory of the experiment and played an important role in the construction of almost all of the key detector components. The experiment could keep taking data during the COVID pandemic period thanks to the dedicated effort by the local team. Both SuperKEKB and Belle II are now being consolidated to prepare for data taking after LS1 with steadily increasing luminosity, which is expected to reach a few times $10^{35} \text{ cm}^{-2}\text{s}^{-1}$.

ATLAS is one of the large LHC experiments. While taking data, the ATLAS collaboration has been working on a major upgrade of the detector and the KEK group is taking a major responsibility in the muon system; detectors, electronics and trigger. The upgrade work is advancing well and their contribution will be one of the key elements of the experiment when it starts data taking after the major luminosity upgrade of the LHC machine, where KEK is also playing an important role in the production of a superconducting high-field dipole magnet, in 2029.

Hadron, muon and neutrino beams provided by the J-PARC facility offer a great opportunity for flavour physics experiments. The KOTO experiment is producing interesting results on the $K_L^0 \rightarrow \pi^0 \nu \bar{\nu}$ decays whose Standard Model prediction suffers little from the theoretical uncertainties due to soft hadronic interactions. The current results indicate that some serious effort is needed to understand the background. The KOTO II experiment is an essentially new experiment being considered and it could observe about 40 decays according to the Standard Model prediction. This is an interesting prospect but it would require substantial resources.

Two major experiments with muons are the one measuring the anomalous magnetic moment, and electric dipole moment, of muons, the $g-2$ experiment, and the other searching for lepton flavour violating decays, $\mu \rightarrow e$ conversion, COMET. Both experiments search for physics beyond the Standard Model of particle physics in the lepton sector. Although both experiments are making steady progress, still substantial effort is required to reach their goals. The recent progress in the Standard Model calculation of $g-2$ indicates that the long-standing discrepancy between the measurements and the theory predictions could be resolved. This puts a strong pressure on the $g-2$ experiment to be timely and to aim at a sensitivity as good as Fermilab's muon $g-2$ experiment if

not even better. For the COMET, timely completion of the Phase 1 is essential to decide on the next step.

T2K has been producing exciting results and will have a chance to detect neutrino CP violation. The neutrino beamline upgrade at J-PARC is critical for T2K and Hyper-K to reach their physics goals. Good progresses have been made in 2022. Several upgrades in the neutrino beamline have been done, including the cooling power of the target for 900 kW operation. Government approval for 1.3 MW has been obtained. The year 2023 might mark a milestone with the MR operating at 30 GeV to achieve 750 kW and two new detectors superFGD and High-Angle TPC being ready at ND280. The candidate site for the intermediate water Cherenkov detector (IWCD) of Hyper-K has been selected recently with extensive efforts.

Technical design of a linear e^+e^- collider based on the superconducting RF technology, running at a center of mass energy 250 GeV, International Linear Collider (ILC), has been developed over the last 20 years as a global effort supported by the International Committee for Future Accelerators. The Japanese community expressed their ambition to host the ILC in Japan with a preferred host in the Tohoku region. KEK continues to make a leading contribution to the technical development in particular the recent effort to improve the performance of the superconducting cavities. The Japanese government has not changed their position expressed in 2019, i.e., expressing a general interest in the ILC with no reference on whether to host it in Japan. On the other hand, it recently expressed an intention to promote further accelerator R&D activities by doubling the budget allocation. With this increased resources, KEK would be able to initiate the ILC Technology Network where the further development on the ILC engineering studies could be made in collaboration with the international partner laboratories in Europe and the U.S. A linear e^+e^- collider based on the ILC technology is currently the most technically mature and cost effective Higgs factory and adequate R&D activities should be continued, where KEK can play a leading role in this effort, till an appropriate time comes when a decision on the Higgs factory would be made.

Comments

Flavour physics is one of the most promising places to discover physics beyond the Standard Model of particle physics. KEK is in a unique position to provide an opportunity for a suite of flavour experiments in leptons and hadrons. Upgrade of the LHC machine and experiments is the highest priority of CERN and Japanese contribution to the LHC programme has been highly appreciated. Upgrades of the J-PARC experiments should be judged and implemented on a global context.

Recommendations:

- 1. Give full support to the running of the Belle II experiment in order to remain competitive against the LHCb experiment at CERN and to exploit the unique feature of an e^+e^- experiment.*
- 2. Provide further contribution to the LHC luminosity upgrade, which has been requiring further resources for completing timely this important worldwide project.*
- 3. Discuss the next step for KOTO and COMET in the international context.*
- 4. Keep the prominent role in the ILC related technology development by ensuring sustained support by MEXT.*

3.2 Nuclear Physics

The program in nuclear physics of the IPNS, which deals with frontier topics, is generally progressing very well.

J-PARC has advanced nuclear physics with its unique and excellent experiments on strangeness. The most recent results on the Hyperon-Nucleon scattering cross section are impressive. The differential cross sections of the Σ^+p elastic scattering showed that the interaction in this channel is moderately repulsive, which was assumed to be negative before the measurement.

Wako Nuclear Science Center at the RIKEN Wako campus has achieved many outstanding results with KISS and other instruments. With innovative MRTOF systems, the masses and lifetimes of many unstable nuclei have been precisely measured.

It is also important to acknowledge the IPNS Task Forces, led by university scientists, on major projects which are playing an important role in advancing the programs. The Hadron Physics Task Force promotes, supports and also contributes to the realization of the Hadron Hall extension.

Recommendations:

- 1. Continue efforts to realize KISS-II in order to maintain the leading position in the field, closely cooperating with RIKEN and strengthening the international collaboration.*
- 2. Secure funding to provide sufficient beamtime in a planned manner in order to ensure that experiments conducted by international research groups can be carried out efficiently and systematically.*
- 3. Begin discussions with MEXT to proceed with the Hadron Hall extension according to the currently defined time-line.*

3.3. Theory Center

The Theory Center at IPNS conducts research with a broad coverage of important physics topics in the field of particle physics, nuclear physics, astro-physics and cosmology, as well as quantum field theory and string theory. The Center is praised to have been conducting active and impressive research programs relevant to the current and future KEK projects, and has been productive in recent years.

The particle physics and nuclear physics groups coordinate with KEK experimental programs, providing support to Belle II, J-PARC experiments, hadron physics and the other experiments world-wide. The Astro-physics, cosmology and gravitational wave physics groups are engaged in the broad community. Quantum field theory and string theory groups remain to be leaders in the field. The Center organizes conferences and topical workshops, and hosts visitors as valuable service to the community in Japan and the world.

The Center is encouraged to continue the impressive work, and to enhance the important role as a national physics Center in the global context.

4. Materials and Life Science

KEK capacity of offering multimodal research instruments with different probing beams, now including also the new 4 cryo-electron microscopes (Cryo-EM), is a competitive advantage, which is recognized and enhanced by the establishment of CIQuS. The excellent scientific examples shown during the presentation speak for themselves.

The IMSS manages this unique analytical toolbox comprising multiple probes: SR photons, positrons, neutrons, muons and electrons. A plan to integrate the first four of these (referred to as quantum beams) analyses through a stepwise process of common sample preparation and transport is underway, with the ultimate goal in the next few decades to combine multi-beams in a simultaneous measurement of selected samples.

This is a bold vision.

Technical aspects

From the broader perspective it is one fraught with obvious experimental difficulties. These include sample preparation where significant variations in sample quantity required may exist together with differing “climate” conditions under which sample handling is managed across the beam platforms.

Initially, to avoid these concerns a single platform X-ray photon multifunctional two beam R&D beamline prototype is being built at the PF over the next few years. In the long term a unique new ring design with simultaneously hard and soft X-ray beam analysis is proposed. These are well thought out and together open up a myriad of possibilities with control of energy and beam positions unique in the field. This would include measurements in time dependent domains that exhibit for example superconductivity, ferromagnetism and ferroelectricity and simultaneous chemical measurements of catalysts and products.

This overall approach should definitely continue to be supported strongly and will, if successful, certainly become a new standard in beamline and perhaps ring design into the future.

The Transmission Muon Microscope (TMM) at the muSR facility (MUSE) has been selected in the KEK Project Implementation Plan (PIP) as a category II project. This challenging tool would allow unprecedented depth- and position-resolved studies of materials, including biological specimens, by the μ SR method. The central role played by the ultra-slow muon source in the TMM and other key projects such as the g-2/EDM experiment calls for a focused effort to meet its design parameters with regard to rates, beam phase space properties, and reliability. This not only would markedly reinforce the case of a pioneering project such as the TMM, but is also of crucial importance to achieve the statistical accuracy of the g-2/EDM experiment.

The scientific outputs of the IMSS currently involve individual probes covering for example energy materials and in structural biology continue to be of the highest quality. However, the overall experimental problems of cross-platform beam analysis still remain. A unique sample transfer system to move samples to different facilities is under development and it would be useful to outline the unique approach at the next SAC meeting.

User Community engagement

In addition to these technical aspects, adoption of the multibeam approach by the various user communities must be addressed. Different beamline single sample access across, for example, the SR community took many years to become standard and cross platform neutron and X-ray analysis in powder diffraction is common now. Cryo-EM is a standout and has been adopted by many in the SR user community over the past half dozen years and with the coordinated access to protein crystallography and SAXS and is a welcome addition by IMSS.

It would be interesting to see some details on the various user community education programmes and see some data on the user understanding/acceptance of this approach. For example, is there a regular mail-in powder diffraction programme for experiments using both neutrons and X-rays and is this popular? Is there any X-ray and neutron CT work or μ SR and neutron studies being regularly undertaken?

Integrated schools which demonstrate the advantages of combined or simultaneous use of different probes would be highly beneficial to strengthen the multi-probe/multi-beam approach and expand the user community. The creation of the Scientific Innovation Center is a welcome addition which should begin to bring a more detailed understanding of what is possible in the proposed multibeam approach.

All of these will give some indication of the level of user involvement in development of future multibeam analysis. The activities of KEK in material science can therefore be summarized into three equally important main roles: (1) the development beamlines and instruments of neutrons, muons, synchrotron radiations, and positrons, (2) operation of user programs for the facilities, and (3) research in material science using the facilities. The challenge will be combining these in a seamless way which engages the various existing user communities and creates potentially new communities.

Recommendations:

- 1. Further strengthen the quantum beam instrument capacity by providing CIQuS with adequate resources, with special emphasis on staffing, for increasing the already existing developments of common tools, in order to provide full packages of instruments able to solve complex problems.*
- 2. Detail the critical path in the transition to initially combining 2 quantum beams for user access. This should address for example the experimental set-up, like sample environment, common sample holders (where appropriate), and the software and data analysis level required. How will user engagement in this process be assessed?*

With muons, also key experiments addressing particle physics questions can be performed as explained in the particle physics section.

Appendix A: Agenda of the 4th Scientific Advisory Committee Meeting

Day 1 Wednesday, February 22, 2023

- 9:00 - 9:15 (15) Welcome address and mandate of SAC (M. Yamauchi, KEK D.G.)
9:15 - 9:30 (15) Status of the KEK Roadmap 2021 and KEK PIP2022 (Y. Okada, Exec. director)
9:30 -10:10 (40) Progress report on particle & nuclear physics (N. Saito, Director, IPNS)
10:10-10:40 (30) Break
10:40-11:20 (40) Progress report on material structure science (N. Kosugi, Director, IMSS)
11:20-11:50 (30) Progress report from Accelerator Lab. (T. Koseki, Director, ACCL)
11:50-12:20 (30) Progress report from Applied Research Lab. (Y. Namito, Director, ARL)
12:20-13:20 (60) Lunch

Status reports of the selected topics

- 13:20-13:40 (20) ILC (M. Yamauchi, KEK D.G.)
13:40-14:00 (20) HyperKamiokande (T. Nakadaira, Prof., IPNS)
14:00-14:20 (20) iCASA (S. Michizono, Prof., ACCL)
14:20-14:40 (20) International cooperation programs (Y. Okada, Exec. director)
14:40-15:00 (20) Break
15:00-15:20 (20) LHC and ATLAS upgrade (K. Hanagaki, Prof., IPNS)
15:20-15:40 (20) QUP (M. Hazumi, Director, QUP)
15:40-16:00 (20) Development of new light source (N. Funamori, Prof., IMSS)
16:00-18:00 (120) Facility tour at Tsukuba campus
18:00-19:00 (60) Transportation to Hotel
19:00-21:00 (120) Welcome dinner

Day 2 Thursday, February 23, 2023

Issues outside scientific program

- 9:00- 9:15 (15) Gender balance issue (J. Haba, Exec. director)
9:15- 9:30 (15) IU-REAL (K. Uchamaru, Exec. director)
9:30- 9:45 (15) Soaring electricity price & procurement issues (M. Yamauchi, KEK D.G.)
9:45-10:00 (15) URA system (S. Adachi, Exec. director)
10:00-10:30 (30) Break
10:30-11:45 (75) Executive session (Closed session)
11:45-12:30 (45) Discussion with KEK members
12:30-13:30 (60) Lunch
13:30-15:00 (90) Executive session and drafting (Closed session)
1500 Adjourn

Facility tour at the Tokai campus is scheduled in the morning of February 24.

Appendix B: Members of the Science Advisory Committee

Field	Name	Affiliation
HEP	Young-Kee Kim (chair)	University of Chicago
	Jun Cao	Institute of High Energy Physics, Chinese Academy of Science
	Tatsuya Nakada	EPFL, Ecole polytechnique fédérale de Lausanne
Theory	Tao Han	University of Pittsburgh
Nuclear	Takashi Nakano	Osaka University
	Angela Bracco	INFN, Istituto Nazionale di Fisica Nucleare
Accelerator	Frank Zimmermann	CERN, European Organization for Nuclear Research
	Jie Wei	Michigan State University
PF (Synchrotron Radiation)	Caterina Biscari (via zoom)	ALBA Synchrotron
	Robert Norman Lamb	University of Melbourne
Neutron	Robert Alan Robinson	University of Wollongong, Australia (retired, ex ANSTO)
	Sung-Min Choi	KAIST, Korea Advanced Institute of Science and Technology
Muon	Elvezio Morenzoni	PSI, Paul Scherrer Institute

Appendix C: Charge to the Science Advisory Committee

The KEK Roadmap and KEK-PIP, which play an important role in guiding KEK's research, have been completed with recommendations by the SAC in the previous years, and discussions with MEXT are currently underway to make this a reality. Therefore, we do not ask for recommendations on any particularly important issues at this SAC meeting. The purpose of this meeting is to report to the SAC on the progress of the research program in general, discussions with MEXT, and on KEK's activities other than research, and to ask for your opinion from a broad perspective.