

International Town Meeting on the Extension Project of J-PARC Hadron Experimental Facility (HEF-ex International Town Meeting 2025)
September 26, 2025
RIKEN Wako campus and online

<https://kds.kek.jp/event/55177/>

Overview (F.Sakuma)

F. Sakuma explained the purpose of the town meeting. The meeting was held to share information on the current status of the Hadron Experimental Facility's extension project (HEF-ex), exchange opinions, and discuss how to promote the extension and the existing projects.

What to expect at the town meeting (N. Saito, IPNS director)

IPNS director N. Saito gave expectations for the meeting. He began by outlining the current status of KEK and its projects and explaining why we need a better approach to promote the hadron hall extension.

The Large-Scale Academic Frontier Promotion Program (大規模学術フロンティア促進事業) of MEXT funds 11 large-scale academic projects, about 340 Oku-yen in total. These include four KEK-related projects: High-Luminosity LHC, Hyper-Kamiokande (HK), Super KEKB, and J-PARC operations. HK construction did not fit within this, requiring a supplemental budget. Additional projects do not fit anymore.

Electricity cost growth is a significant barrier to securing beam time. As known, SX and FX cannot run simultaneously by design. In addition, SX has two exclusive running modes: DC-type SX and bunched SX, the latter used for the COMET 8 GeV operation. In DC-type SX mode, Secondary beams from the A-line and the primary proton beam in the B-line are available simultaneously. Given the exclusivity, accommodating all requests across various experiments is already a challenge.

We need to seek supplemental budget or other funding sources, so we need convincing proposals, which is the director's expectation for the meeting. The director appreciates the contribution from Osaka University for pi20/mu20. The director also pointed out the importance of international involvement. Good examples are PANDA and KOTO-II. In the HK era, minimizing switching time is also important to overcome the limitation of beamtime. A multi-purpose detector is also a good idea. The director seeks good ideas to promote the extension project.

Extension Project to date (F. Sakuma)

F. Sakuma provided an update on the extension project. The project will double the experimental area of the hadron hall, adding a new production target and constructing four additional beamlines. It is to deepen the study of the origin and evolution of matter. The project has four pillars: flavor physics, hadron physics, and strangeness nuclear physics.

A task force has been formed within HUA to promote the extension project. Multiple workshops were held, and a white paper was published. The project was selected as the top priority project at KEK-PIP 2022. However, the cost increased to 200 + 20 Oku-yen, and it is impossible to achieve solely through KEK. The TF started discussions on the staging plan and other budgetary sources. We had 1st town meeting on Feb. 20, 2025, in Japanese. A summary in English and Japanese can be found at:

<https://www.rcnp.osaka-u.ac.jp/~jparchua/share/2025/hefex-tm-2025jp.pdf>

<https://www.rcnp.osaka-u.ac.jp/~jparchua/share/2025/hefex-tm-2025en.pdf>

Hadron Experimental Facility (H. Takahashi)

Hitoshi Takahashi presented cost-reduction, optimization, and staging plans for HEF-ex. HEF-ex faces a significant cost-inflation issue. The cost for phase 1 of PIP2022 (HIHR, K1.1, KL2, pi5.0) was 150 Oku-yen and has now increased to 200 Oku-yen. Phase 2 (K10, K1.1BR) was 40 Oku-yen; the current price has not yet been estimated. The cost for pi20 was 15 oku-yen and has now risen to 20 oku-yen.

At the time of the PIP 2022, we already had a staging plan, but we need a finer staging plan and optimization to reduce costs. Various ideas were considered: reducing the number of beamline magnets by optimizing the optics and shortening the primary beamline extension by 7 m. However, further cost reductions are needed. Many ideas were discussed, but most were discarded due to practical constraints. To keep the 1st step within 100 Oku-yen, the primary beam line should be kept as short as possible while maintaining the hall width.

Plans such as “KL2 at T1-northward”, “KL2 at T1-upward”, “KL2 at T1.5 + HIHR at T1 (as K1.1-ex)” and “KL2 and HIHR at T1.5” were presented. The T1.5 stands for the case where the second target is placed in the existing experimental hall, rather than in the extended hall, T2, to shorten the primary beamline. The plan with “T1” is to give up the second target in the first stage. Among these ideas, “KL2 and HIHR at T1.5” is the most promising. If we give up the second target, it will be more difficult to add beamlines later. It will cost more to add K10 later. The timeline of the plan (KL2 and HIHR at T1.5) for various construction orders and cost estimates were presented along with a comparison to the original PIP2022 plan.

The stage plan for Pi20 construction at high-p beamline was also presented. Phase 1 exploits the beam loss at the Lambertson magnet and delivers both positively and negatively charged beams by adding polarity-changing devices. The budget has been secured for Phase 1. Phase 2 is to achieve a higher-intensity beam by adding a thin production target, swinger magnets for zero-degree extraction, and additional radiation shielding. Phase 3, which aims for full-intensity Pi20 construction, requires a gas-tight production target and completion of the radiation shield.

HIHR/K1.1 (S.N. Nakamura)

Detailed knowledge of the baryonic force underpins our understanding of matter over an enormous span of scales, extending from femtoscale baryonic matter and atomic nuclei to macroscopic objects such as neutron stars. K1.1 provides detailed knowledge of the two-body force by the Lambda-p scattering experiment. HIHR provides detailed information on the three-body force by high-precision hypernuclear spectroscopy. The High-Intensity

High Resolution (HIHR) beamline uses the momentum dispersion-matching technique, enabling ultra-precise mass measurements. (π^+, K^+), (π^-, K^+), (π^-, K^0) reactions. Moreover, with decay-pion spectroscopy of hypernuclei being feasible, hypernuclear studies at HIHR can be systematically expanded to cover the entire mass range. If the maximum momentum in the beam line is limited to 1.2 GeV/c for the constant reduction, the cusp study (requires 1.7 GeV/c), and η/η' nucleus study (requires 1.8 GeV/c) becomes impossible.

Pi20/K10 (H. Noumi)

The physics goal of the HEF-ex is to quest for the origin and evolution of matter. Hadron physics, to be conducted at pi20 and K10, is one of the three pillars, and all three are needed together to achieve the ultimate physics goal. The emergence of hadrons is the first step of the big question.

The secondary beam was successfully measured at the high-p beamline, an important step toward realizing the full pi20 beamline. Hadron physics will be conducted at pi20 and continued at the K10 beam line.

KL2 (H. Nanjo)

H. Nanjo introduced the KOTO-II experiment. KOTO-II at KL2 will measure rare kaon decay, $KL \rightarrow \pi^0 \nu \bar{\nu}$, to search for physics beyond the standard model. KL2 will extract a beam at five degrees, which is smaller compared with that of KL (16 deg) for higher KL flux. More than 5-sigma discovery and measurement of BR with 25% are expected. KL2 will be the only dedicated program for rare kaon decays in the 2030s. KOTO-II received stage-1 status at J-PARC PAC.

Towards early realization of HEF-ex (K. Miwa)

K. Miwa called for ideas for a better promotion of HEF-ex. Although HEF-ex was selected as the top-priority project for KEK-PIP2022, securing funding is becoming increasingly difficult. The Large-Scale Academic Frontier Promotion Program (大規模学術フロンティア促進事業) is already occupied by existing projects, leaving no room for HEF-ex. Inflation made the situation worse. A new strategy and additional funding sources have to be pursued. The ripple effects of HEF(-ex) research in other fields must be identified to promote our project. EIC's funding source differs, and leveraging synergies with EIC is also important. He welcomes ideas.

Comments from KOTO-II

C. Lazzeroni, KOTO-II Co-Spokesperson, expressed interest in contributing to the KOTO-II experiment on behalf of the Universities of Birmingham, Edinburgh, Glasgow, Lancaster, Liverpool, Manchester, and Warwick.

M. Moulson, representing Italian facilities, INFN and University of Ferrara, Perugia, Pisa, and Marche Polytechnic University, expressed interest in contributing to the KOTO-II experiment.

D. M. Santos, Centro de Investigación en Tecnologías Navales e Industriales and Universidade de A Coruña, Spain, expressed interest in contributing to the KOTO-II experiment.

R. Wanke, representing his group at the University of Mainz, Germany, expressed interest in contributing to the KOTO-II experiment.

T. Husek at the University of Birmingham and M. Gorbann at the University of Liverpool expressed interest in a theoretical contribution to KOTO-II.

F. Mahmoudi and S. Neshatpour at Lyon University expressed their interest in a theoretical contribution.

G. Yang, representing L. Littenberg and G. Carini of BNL, expressed interest in contributing to the KOTO-II experiment.

Yau W. Wah, representing the University of Chicago, expressed interest in contributing to the KOTO-II experiment.

Yu-Chen Tung, representing National Kaohsiung Normal University, expressed interest in contributing to the KOTO-II experiment.

C. Lin from NCUE expressed interest in contributing to the KOTO-II experiment.

J. K. Ahn of Korea Univ., representing the Korean group, E. J. Kim of Jeonbuk National Univ., and S. H. Lim of Pusan National University, expressed interest in contributing to the KOTO-II experiment.

H. Nanjo of Osaka Univ., representing the Japanese group, K. Shiomi of KEK, T. Matsumura of NDA, and T. Tajima of Yamagata, expressed their will to make an effort as members of the host country together with KEK as a host.

Comments from C. Curceanu

C. Curceanu from INFN-LNF, Italy, expressed strong interest in J-PARC experiments on behalf of the groups participating in kaonic experiments at the DAFNE Collider. J-PARC represents a unique hub of excellence in hadron and exotic atom physics, providing unparalleled opportunities to study kaonic and other exotic atoms across a wide range of elements in the periodic table. Such systematic investigations, enabled in particular by the E57 experimental program and its proposed extension, are essential to explore the interplay between strong interaction effects and atomic structure from light to medium-heavy nuclei. These measurements offer a powerful and model-independent avenue to address fundamental questions in low-energy QCD, hadron–nucleus interactions, and possible manifestations of physics beyond the Standard Model.

She emphasized that kaonic atoms experiments would consolidate J-PARC's leading role in this field by enabling a coherent and long-term experimental strategy on exotic atoms, complementary to ongoing efforts worldwide. Conversely, she expressed concern that, if the extension is not realized, J-PARC risks losing both momentum and international leadership

in exotic atom physics, with significant consequences for the global community's ability to advance precision studies of fundamental interactions using exotic atoms as unique quantum laboratories.

Comments from T. Gunji

T. Gunji from QNSI, The University of Tokyo, presented expectations for J-PARC from EIC. J-PARC and EIC are complementary, enabling multi-scale nuclear science study. The Fundamental Quantum Science Program has been launched in RIKEN, allowing RIKEN to lead in quantum technology by 2030. It uses EIC to achieve this goal. QNSI, The University of Tokyo and RCNP, Osaka University launched International Quantum Physics Network (IQPN) to support international large collaborative activities of nuclear physics. EIC is the first project to structure the IQPN and it is natural to think about HEF-ex as the second project. EIC and J-PARC share many common interests in technology development, including MAPS, AC-LGAD, streaming DAQ, and computing technologies. J-PARC's intense beam is ideal for detector development.

J-PARC has made unique and important contributions to hadron physics. To further enhance its global visibility and scientific impact, it would be beneficial to attract a broader international research community. In this context, establishing a global research network that connects J-PARC with other major facilities, including the EIC, would be a natural and promising step forward.

Comments from J. K. Ahn

J. K. Ahn from Korea University, Korea, expressed strong concern that K10 is missing from the table of the HEF-ex plan. The K10 has the potential to become an iconic beamline at J-PARC, guiding a new era of hadron spectroscopy through the kaon beam. The Asia-Pacific Organization for Nuclear Physics, as an alternative to CERN, could be considered, and a bilateral partnership between Korea and Japan could serve as a starting point.

Regarding the current status of HEF, there are four beamline collaborations; however, better platforms need to be developed to gain greater recognition from the global hadron community. These include improvements to websites, liaison activities, schedules, bylaws, and related organizational structures. Joining a beamline collaboration or experiment was also identified as an issue at HEF.

Comments from B. Doenigus (ALICE collaboration)

B. Doenigus from Goethe University Frankfurt, Germany, expressed his opinion about the J-PARC. J-PARC has clear complementarity from a high-energy heavy-ion perspective: only masses up to $A=6$ are accessible, neutron measurements are not possible, and the momentum region is biased toward higher values. He wishes for the completion of the current experiments and a smooth start of the proposed J-PARC HEF and HEF-ex experiments, as the results will provide a baseline for experiments elsewhere. He expressed an interest in joining the HEF-ex program later.

Comments from K. Schonning

K. Schonning from Uppsala University, Sweden, expressed interest in joining HEF-ex. J-PARC is unique in offering the opportunity for tailor-made experiments. Her group is interested in hyperon polarization measurements and hyperon-nucleon scattering experiments. They have no funding yet, but they are applying for grants from Swedish funding agencies. They expect HEF(-ex) to fill parts of the gap created by the PANDA delay.

Comments from J. Ritman

J. Ritman from GSI, Germany, expressed his thoughts on HEF-ex. J-PARC and FAIR have tremendous synergy potential in the physics scope and also in timelines. Among FAIR projects, some are significantly delayed. Projects in HEF-ex face the same thing. He proposes to consider a General-purpose detector (GPD). GPD does not perform as well as many dedicated systems, but there are many examples worldwide that attract international collaborators.