Evaluation of the KEK Project Implementation Plan

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1 Introduction

A review meeting on the KEK Project Implementation Plan (PIP) took place at KEK on 22nd and 23rd of May. It started with a welcome address by the KEK Director General, who also provided the following charges for the review committee:

- Assess the following three running projects funded by the Ministry of Education, Culture, Sports, Science and Technology (MEXT):
  1. Japan Proton Accelerator Research Complex (J-PARC)
  2. SuperKEKB collider and Belle II experiment
  3. Photon Factory
- Comment on the KEK management's decisions for the three projects supported by the KEK general funds from the MEXT.
  1. An Energy Recovery Linac (ERL) will no longer be considered as a replacement of the current Photon Factory and related work will be terminated.
  2. Current leasing contract for the two super computers used for computational physics will end in 2017. A renewal of the contract will be considered as one of the projects requiring a new dedicated funding from the MEXT.
  3. The International Linear Collider (ILC) activities at KEK has been reorganised and technical responsibilities of various R&D works are put directly under the responsibilities of the relevant existing structure.
- As a replacement of the current Photon Factory machines, the KEK proposes a 3 GeV storage ring with novel lattice structure that will provide performance superseding the storage ring facilities currently under construction in the world. Provide an opinion on this project. Furthermore, the KEK selected the following seven activities as projects which require new dedicated funding from the MEXT:
  1. COMET Phase-II Experiment at J-PARC.

2. Upgrading of J-PARC accelerators for the Hyper-Kamiokande projects.
3. Extension of the J-PARC hadron experimental facility.
4. Computational physics for lattice QCD calculations with a super computer.
5. Upgrade of LHC and ATLAS for high luminosity operation.
6. Extension of a muon beam line for the Muon $g-2$/Electric Dipole Moment measurement and Muon microscope.
7. Extension of experimental facilities for radioactive nuclei beams.

Select three to four projects with priorities, and comment on the non-selected ones.

The Director General's talk was followed by the presentations of the all projects under consideration and discussion. The meeting was open to all participants. The committee reached its consensus after thorough discussion in its closed session and all the conclusions were agreed unanimously. Immediately after the conclusions had been made, they were reported to all the people attended the meeting.

2 Assessments on the three projects funded by the dedicated MEXT budget

2.1 J-PARC

This is a unique facility supporting many fields of science research and technological projects by providing different types of particle beams, attracting a large number of users worldwide. In order to keep its leading position, it is essential to maintain sufficient beam time for the experiments and to keep improving its performance.

2.2 SuperKEKB and BELLE II

This Japanese flagship facility for particle physics will extend the success of KEKB and Belle, whose contribution has been internationally well recognised beyond any doubt. Keeping the anticipated schedule and design performance of the project is essential.

2.3 Photon Factory

The KEK Photon Factory, constructed more than 30 years ago, was one of the pioneers to provide synchrotron light to probe the structure of material leading to many important discoveries. Although the number of users remain large, its performance is no longer competitive compared with the current generation of synchrotron light source facilities, and a new machine is urgently needed for the KEK to remain forefront for providing advance tools for researchers.

2.4 Common remarks

Experiments in all the fields are generally getting more complex and larger. The amount of data produced is also increasing rapidly and many analyses start to deal with "big data". The KEK should preserve and enhance its technical and engineering support for

the experiments as well as enhancing the area of information technology to respond to the needs of future experiments.

3 Opinions on three management decisions for the research projects financed by the KEK general fund

3.1 ERL Development

The committee fully supports the decision of the KEK management to no longer consider the ERL technology for the replacement of the current Photon Factory. On the other hand, the committee is pleased to hear that some fruitful applications could be developed in other areas based on the successful R&D results obtained by the Compact ERL activities at the KEK.

3.2 Changing of funding source for the leasing of super computers

The committee expresses its concern on this matter. The KEK has been providing a substantial fraction of computing resources needed by the Japanese lattice QCD community, which is no longer just for particle physics but also for nuclear physics. Losing this computing resource would make a significant negative impact on their research programme, which currently enjoys worldwide high recognition. They are providing crucial theoretical inputs to J-PARC experiments and Belle II for the physics interpretations of their data. A solution does not necessarily need to be hosting super computers at the KEK, but could be just finding required computing resources for them elsewhere. This might even lead to a more cost effective solution. Given the uncertainty in obtaining a dedicated new funding from the MEXT and time criticalness of the matter, the committee urges the KEK management to find a solution for providing appropriate computing resources within the general fund. For this reason, we will not include the Computational Physics project in our prioritisation exercise.

3.3 The ILC

The committee fully supports the organisation implemented for the KEK participation in the ILC activities. For technical contributions, it is indeed efficient to place the activities where the competence and resources are located. The organisation installed will contribute effectively to providing answers to the questions posed by the Science Council of Japan and the MEXT.

4 Projects that need new funding

4.1 New Photon Factory

The committee fully endorses the proposed project to build a 3 GeV storage ring with advanced lattice structure as a machine to replace the current Photon Factory, instead of previously proposed one based on the ERL technology. Given the rapid advancement of synchrotron light facilities in the world, the project should be carried on with utmost

urgency for its timely implementation. Designs of the machine and beam lines must proceed in consultation with the users, and keep flexibility to cope with future evolution of the user requirements and advancement in accelerator technology.

4.2 Prioritisation of the remaining projects

All the proposed projects are of the highest quality in their scientific discipline. Therefore, we had to apply other factors in order to decide on the priorities[1]: e.g. whether a project provides benefit to others, how does it affect the Japanese and international community, how unique is the project internationally, etc..

1st: Upgrade of the J-PARC accelerator for the Hyper-K experiment. Increase of the beam intensity will benefit many experiments at the J-PARC, including the T2K experiment which might reveal the first evidence of CP violation in neutrino oscillations, which is a real breakthrough.

2nd: Contribution to the LHC upgrade programme. The LHC and ATLAS are worldwide projects in particle physics where Japan has a firmly established position. And the role of the KEK in these projects is undisputed.

3rd: Extension of the Muon beam line. The muon $g-2$ is one of the measurements in particle physics that exhibit a possible deviation from Standard Model predictions. The project gives other interesting aspects such as developing a source for ultra cold muons and their re-acceleration, where those muons can also be used by a muon microscope, which by itself provides unique capabilities for the other research area such as material and life science.

4th: Extension of the J-PARC hadron experimental facilities. The current Hadron Hall has indeed space limitation to accommodate the increasing number of experiments and to provide the needed variety for the beam lines. However, the committee suggests the group to study a staging scenario and cost reduction.

4.3 Projects not selected for prioritisation

COMET Phase II Experiment: The committee recommends the COMET collaboration and KEK to start the COMET Phase-I as soon as possible for achieving its goals. Experience obtained by the COMET Phase-I is essential for validating the Phase-II design and expected performance. This is a necessary input for considering the priority setting of the COMET Phase-II in the future KEK-PIP meetings.

Radioactive nuclear beam: The committee recognises unique physics opportunities and a clearly laid down realisation plan for the KISS project. Given rather small amount of resources required, the committee encourages the project to move forward based on external funds.

[1]Computational science is excluded from the consideration as explained in Section 3.2