B-factory Programme Advisory Committee
Short summary report

for the annual meeting on 10–12 February 2020 at KEK

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Short Summary

The annual review meeting of the Belle Programme Advisory Committee (BPAC) took place at KEK from 10th to 12th of February 2020, where presentations including the physics results of the Belle experiment, the machine status of the SuperKEKB, as well as the status of the Belle II experiment, were given. This document provides the most important findings and recommendations of the committee. A full report will follow later.

The committee is highly impressed by the productivity still maintained by the Belle physics effort, which has produced 25 refereed journal papers in 2019. For fully exploiting the potential of the Belle data, it is important that computing resources at KEK for the Belle data analysis remain adequate until the amount of Belle II data collected becomes comparable to that of Belle. The Belle physics analysis clearly benefitted from the development of the BASF2 analysis tool by the Belle II physics group. The committee would like to see further collaborative efforts by the two physics groups, particularly in the area of dark-photons search where Belle II could have a significant impact at this early stage.

The SuperKEKB machine was able to achieve luminosities above 10^{34} cm^{-2}s^{-1} with less than half the beam current of the KEKB accelerator. This is a clear success of colliding bunches with very small spot sizes achieved by the low-emittance beams. It demonstrates the potential of the SuperKEKB to further increase luminosities. However, achieving the design goal of $\sim 8 \times 10^{35}$ cm^{-2}s^{-1} with a tolerable level of background for

the experiment will still involve substantial work and new efforts, such as testing the crab-waist scheme in the next run, would be required. The committee encourages the SuperKEKB and Belle II teams to work out a plan for the future work.

There has been a continuous effort to reduce machine background and this effort will remain crucial. While a steady increase of luminosities toward the design goal is important, the current background level is already at the limit for safe operation of the Belle II detector. Therefore, efforts such as identifying the sources of backgrounds through simulation studies and improving the beam collimation and absorption of the synchrotron radiation must continue vigorously. The background condition for the injection is a worry, since the continuous injection is essential for achieving large integrated luminosities. Therefore, reducing the injection background is clearly one of the highest priorities. To facilitate this effort, the committee encourages the current close collaboration between the Belle II background study group and the SuperKEKB machine team to be extended to include the team operating the injection system.

The committee is pleased to note the progress in the commissioning work of the Belle II detector, as well as in computing and software. Although the experiment is not yet operating at full capability and further work is still needed to completely understand the detector performance, the Belle II experiment is now ready to record substantial data samples for physics analysis under stable conditions. Therefore, the committee supports the scenario where the installation of the new Pixel Detector (PXD) with two layers will happen in early 2022. This may allow the Belle II experiment to collect ~ 1 ab^{-1} of data and thereby surpass the sensitivity of the Belle data and move towards the world leading position in some analyses, before the installation of the new PXD. Since there are still some uncertainties in the evolution of the SuperKEKB luminosities and in the stability of the Belle II detector, the production of the new PXD should continue with full-speed such that it could be installed in summer 2021, in order to maintain schedule flexibility.

The recording of these large data samples requires stable operation of the detector. Therefore, the detector performance and machine conditions must be carefully monitored and further improvement in simplifying the monitoring tasks is encouraged. For collecting a large amount of data, it is equally important to have an efficient trigger and data acquisition (DAQ). The committee urges that more work should be invested in these critical areas, specifically all of the trigger components should be implemented and causes for the DAQ downtime should be carefully analysed and reduced as much as possible.

Finally, the committee would like to stress that it has now become very important for the Belle II experiment to have sufficient running time. The KEK management is strongly urged to make all possible effort for securing resources necessary for the yearly machine operation in the coming years to be substantially more than 5.4 to 6.5 months indicated during the meeting.