

B-factory Programme Advisory Committee
Short summary report for
Focused Meeting

29–30 June 2020 Remote Meeting

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Short Summary

Due to travel restrictions caused by the spread of COVID-19, a focused review meeting of the Belle Programme Advisory Committee (BPAC) was held remotely on 29th and 30th of June 2020 focusing on the progress of the SuperKEKB and Belle II operation since the last BPAC annual meeting in February 2020. This document summarises the most important findings and recommendations of the committee.

In spite of the difficulties introduced by the spread of COVID-19, the SuperKEKB machine has been kept running and the Belle II experiment has been taking data. By introducing the crab waist scheme at the collision point, SuperKEKB has achieved the world's highest instantaneous luminosity, $2.4 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$, with an acceptable background condition for Belle II to take data. This is a great success of a close collaboration among the SuperKEKB, linac injector and Belle II background study groups. The committee congratulates their efforts and encourages continuous close cooperation to further improve the machine performance and data quality. The delivered integrated luminosity has been increasing smoothly and, although it is somewhat lower than planned, more than 63 fb^{-1} of data was accumulated for this run, which had started in March 2020, before the start of the summer shutdown. The committee appreciates the plan for the operation this autumn with the goal to reach a total integrated luminosity of more than 100 fb^{-1} before the end of the year break.

The Belle II experiment has been taking data with an efficiency of $\sim 84\%$, approaching the goal of 90% . The committee appreciates the Belle II effort to automate the

operation of the detector and online data controls for smooth and efficient running with a small number of shift crews onsite. This has been particularly important in this period, since the number of people at KEK is limited due to travel restrictions caused by COVID-19. The Belle II collaboration developed a mode of operation allowing effective remote participation in various online tasks by Belle II collaborators. Automation should be further implemented in the experiment from the detector operation to the data processing. The committee notes that a plan is in place for the forthcoming data taking, anticipating travel restrictions to continue at least till the end of this year. Some hardware problems require interventions by the experts onsite. For some of the subsystems, presence of the experts at KEK appears to be marginal. The committee recommends the Belle II collaboration enlarging the pool of detector experts by involving more collaborators in the detector operation. Significant improvement in understanding the detector performance has been made since the last BPAC meeting. The committee is looking forward to hearing further progress in resolving some of the outstanding discrepancies between data and simulation. It is pleased to observe that Belle II is making a unique contribution to dark sector physics for which the theoretical interest is increasing. Also, other analyses demonstrate significant progress in understanding the detector performance.

The production of the pixel detector replacement with two complete layers (PXD-2) is proceeding with an anticipated contingency of four to five months for the planned installation during the long shutdown in 2022. The committee recommends the Belle II management following closely the project advancement in order to ensure the timely completion of the production. Since PXD-2 will have many more signal cables than the current PXD, assembly and installation of the full vertex detector system must be studied well in advance. Longterm availability of hardware experts in the area of PXD and the beam pipe at the interaction region remains a concern. The Belle II collaboration together with KEK should develop a plan to maintain the knowhow in the pixel detector, beam pipe, QCS and other relevant areas, especially in light of potential future upgrades.

The BPAC is convinced that Belle II and SuperKEKB are now ready for a production run to accumulate data for physics. Therefore, the committee strongly recommends that the originally requested 6.5 months, if not more, of running in 2020 Japanese Fiscal Year be realised with an aim to collect as much as 240 fb^{-1} of data.

Based on the experience in operating SuperKEKB, the machine team has been developing ideas that could achieve the physics goal of the Belle II experiment with lower consumption of electricity. The committee understands that such an operation scenario over the next ten years was presented in the KEK submission to the MEXT Roadmap selection process, and finds this development timely and very attractive. Implementing such a plan requires an upgrade of the machine and detector. The BPAC strongly encourages a close collaboration between SuperKEKB and Belle II to further explore various ideas and conduct the necessary research and development work. Implementation of the necessary upgrade should then follow after positive evaluation of technical designs by the relevant committees. The BPAC is looking forward to hearing the progress in future meetings and strongly hopes for a positive outcome from the MEXT Roadmap selection.