

B-factory Programme Advisory Committee  
Short Summary for the Focused Meeting  
Review on Readiness toward Phase 3

24–26 June 2018 at KEK

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The Belle Programme Advisory Committee (BPAC) is very impressed by the rapid progress made by the SuperKEKB collider for the Phase 2 run, rapidly achieving luminosities well above  $10^{33} \text{ cm}^{-2}\text{s}^{-1}$ . Similarly, commissioning of the Belle II detector is also advancing fast, demonstrating full capability to reconstruct B mesons.

The goal for the Phase 2 run was set to achieve a luminosity of  $\sim 10^{34} \text{ cm}^{-2}\text{s}^{-1}$  with machine background under control. While the luminosity achievement is good, understanding of the background requires quite some more work. The background level is much higher than anticipated from the simulation studies. Some of the background sources are not yet identified. In this situation, it is very difficult to extrapolate reliably the level of background at the design luminosity. Systematic studies of background require the machine to be operated in a stable condition. Given that the machine luminosity is already quite high, the committee thinks that some dedicated time should be given to the background studies in between the attempts to further increase the luminosity. Continuous injection must be thoroughly tested during the Phase 2 run so that it can be routinely applied without affecting the detector operation during Phase 3. Although there is still much work to be done, the committee is confident that the SuperKEKB can be ready for Phase 3 operation after the long shutdown that will start in July this year. Adding the proposed additional collimators in the Low Energy Ring is strongly endorsed.

The general detector operational status indicates that there is no show stopper for the transition to the Phase 3 run, provided that a mechanism for safe running of the detector is validated. Sequences of operations can bring the detector to a dangerous

state, particularly with high voltage. The safety of the detectors should be protected by a robust control system, which is backed up by hardware interlocks. It should be noted that even the best operational procedures can never prevent human error. Operation of the vertex detector must be particularly well protected. The beam-abort system, based on very robust detectors such as diamond sensors, is essential and should be installed with sufficient redundancy. All the background information should be shared with the SuperKEKB control room.

The committee is very pleased to learn that the ladder assembly of the Silicon Vertex Detector (SVD) has been completed and that the ladder mounting of the second half shell is expected to be complete in early July. It is on track to be ready for installation during the summer shut down for the Phase 3 run. It is also very pleasing to see how well the SVD and PXD wedge has been integrated into the Belle II data taking and is making valuable contributions to the background studies.

On the other hand, production of the Pixel Detector (PXD) has experienced considerable delay and only the first layer can be fully equipped where one of the ladders comes with a poor quality sensor and no spare ladder is available. The second layer can be equipped with only two ladders. The committee considers that the PXD group should complete the detector with this configuration and the system should be sent to KEK for the preparation to be installed together with the SVD. Although the system is incomplete, it will provide indispensable operational experience and be useful for physics. One of the two half shells for the first layer has already been mounted with well functioning ladders. However, the PXD group is planning to make some intervention by dismounting ladders in order to rework the electrical insulation. Although practiced with dummies using the second half shell, this operation involves a risk without guarantee for success. Therefore, the committee recommends the PXD group to make first a careful risk assessment and validation of the effectiveness of the rework from the second half shell. In parallel, the PXD group should make an effort to produce one more Layer-1 ladder after re-examining the production process and failed ladders. If successful, it would become a valuable spare in case of an accident in the repair process, or eventually a replacement for the ladder with poor sensor quality. The current plan presented is to replace the present PXD with a fully equipped PXD during the next long shutdown considered for summer 2020. Given the long construction time, the preparation work has to start now. The committee stresses that enough sensors be fabricated in order to make sure that the new system will be equipped with first grade sensors and be ready for installation by summer 2020.

The committee recommends that the Belle II management closely follows the development of the PXD project and has experts external to the PXD group analyse the ladder production procedure.