

# B-factory Programme Advisory Committee

## Short report of the Annual Review Meeting

3-5 March 2025, Tsukuba, Japan

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27 March 2025

### Short Summary

The annual review meeting of the B-factory Programme Advisory Committee (BPAC) in 2025 took place at KEK from 3rd to 5th of March, with the presentations from the accelerator and Belle II groups on the status of the project as well as the progress in the upgrade plan. The committee is pleased to observe the high level of dedication demonstrated by the machine people and the Belle II collaboration. In this short report, the committee gives feedback on the five questions asked by the management of the Institute of Particle and Nuclear Studies. A detailed report on the findings of the committee will be found in a separate document.

#### 1. **Are physics analysis plans in this year and toward a few 1/ab convincing?**

The Belle II collaboration has already been superseding various Belle results with an integrated luminosity half of that of Belle, by exploiting its better detector performance and more advanced analysis techniques. The committee is looking forward to seeing further progress with the substantially increased statistics from the coming data taking. While the recent Belle II results in the dark sector physics are unique and world-leading, the committee recommends *a more generic/inclusive approach rather than focusing on too specific theoretical models.*

2. **Are all the efforts (computing, data production, performance, software) to publish physics results in a timely manner well organized and sustainable?**

Belle II data processing has been stable and its functionality has been continuously improved. The tracking software should be *revisited to take the actual performance of the Central Drift Chamber (CDC) with some inefficiencies into account*. If the current level of effort is sustained, the committee thinks that the Belle II computing will be able to cope with the future demands of the timely analysis of the data.

3. **Is the strategy to address the issues of the machine performance, beam background and sudden beam loss in collaboration with SuperKEKB clear?**

The committee acknowledges the continuous effort to improve the SuperKEKB performance and ongoing hardware improvement activities during the current shutdown period. It is understood that various machine groups as well as the Belle II members are involved in the activities. Since the machine has to achieve high luminosities while keeping the background level safe for the detector, *participation of the Belle II group is crucial*. Given the limited resources available for the machine groups, *involvement of the Belle II group beyond the machine detector interface issues is encouraged*. An effort to *seek support from foreign accelerator laboratories with relevant expertise* is also welcome. In order to profit from the effort coming from those different sources, *introduction of a centralised project structure with a strong leadership to coordinate and prioritise the work is highly recommended*.

The sudden beam loss (SBL) remains as one of the major obstacles for achieving stable runs. A vacuum sealant, Vacseal, which was heavily used to ensure the vacuum tightness of the beam pipe joints, has recently been identified as a possible main cause for the SBL. While this appears promising, the process how the Vacseal causes the SBL is still unknown. The committee thinks that there are likely to be multiple causes for the SBL. Hence removing the Vacseal could reduce the occurrence of the SBL by an order of magnitude, but other SBL will remain. In order to operate the machine without damaging the detector, *further effort to improve the early detection of the SBL and the fast beam abort is crucial*. This will allow more efficient machine studies to increase the luminosity and Belle II to accumulate the data.

4. **Are all the detector issues found during the 2024 operation understood and are the measures to be taken during this shutdown sufficient?**

Although the general status of the Belle II operation appears good, there remain several concerns. *PXD2 needs further work to define the beam condition criteria for switching on during the data taking*. Understanding the gain from switching on PXD2 in physics analyses for different machine background conditions could help to weigh the risk against gains. *Long term stability of the CDC operation is a major concern*. The chamber has already accumulated a significant amount of

charge and further increase of the current can hardly be tolerated. Continuous attention to the operation is needed as well as the effort with the test chambers to understand better the characteristics of radiation damage in CDC. Although it is still in the early stage of inquiry, the recently discovered problem with the cooling of the frontend electronics for the ARICH end-cap particle identification system could be serious. The presented plan for the investigation is adequate and the committee is *looking forward to hearing an update during the June meeting*. In the data acquisition, some of the subsystems still require manual intervention for recovery. *This should be all automated.*

**5. Are the procedure and timeline to define the objectives and to make the detailed schedule of SuperKEKB and Belle II upgrades in Long Shutdown 2 clear? Are all critical or limiting points identified?**

While the new date for the start of Long Shutdown 2 (LS2), around 2032, is more realistic for the upgrade work to be completed than the previous date of 2028, it introduces some concerns whether the subsystems continue to operate till that date with the required performance, in particular for the CDC. Judging from the work plan presented for the new pixel vertex detector (VTX) and final focusing quadrupole magnet (QCS), LS2 could start even later. For this reason, the committee encourages the Belle II collaboration to consider *the decoupling of the CDC upgrade from the VTX-QCS upgrade*. As soon as the layout of the interaction region with the QCS is completed, the design work of a new CDC should start in such a way that the new CDC can be installed in the present Belle II set up as well as with the new QCS-VTX configuration. This will make the upgrade plan more flexible, while maintaining the detector performance until LS2.

**NB**

The committee took note of the presented computing resource accounting for 2024 and estimates for 2026 to 2029. A dedicated discussion and recommendation will be given by the expert group consisting of G. Carlino, W. Hulsbergen, P. McBride and P. Mato, and chaired by the BPAC chair, after receiving the written accounting report and request.