Focused Review Meeting of KEK B-factory Project Joint Committee of Accelerator and Experiment

17 April 2026, Remote meeting

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3 May 2026

Observations and recommendations

A joint review committee, consisting of six members from the KEKB Accelerator Review Committee and the KEK B-Factory Programme Advisory Committee, met on 18–19 December 2025 to evaluate the KEK B-factory project plan to achieve a total integrated luminosity of about 1 ab^{-1} and to reach a peak luminosity of 10^{35} $cm^{-2}s^{-1}$ before the 2026 summer shutdown.

A follow-up meeting took place on 17 April 2026 to review the progress of the run, the so-called 2026ab run, which started in January 2026. During this meeting, an operation plan for the remaining run period, i.e. until the end of June, was also presented. The main findings and recommendations of the committee are summarised below.

The committee is very impressed by the overall achievements of the machine group and the Belle II collaboration, including stable data taking with a luminosity of $\sim 5 \times 10^{34}$ $cm^{-2}s^{-1}$ and accelerator and detector operation efficiencies exceeding the goals set in December 2025. This has resulted in an average daily integrated luminosity of ~ 3 fb^{-1} in recent days. The committee congratulates the teams on this successful development. It is pleased to see the continuous improvement in overall detector efficiency to a consistent level of 90%, even with increasing luminosity. The Belle II detector is in good shape to be ready to integrate higher luminosity. It is also encouraging to hear that the end of the 2026ab run has been extended by one month, until the end of June.

On the other hand, the machine cannot be operated at more than $\sim 85\%$ of the beam currents planned in December 2025 due to Sudden Beam Losses (SBLs). Although the removal of Vacseal last year in the Low Energy Ring (LER) has drastically reduced the rate of SBLs, they still occur in both rings when the beam currents exceed certain values. This prevents the machine from reaching the required luminosity of $\sim 6 \times 10^{34}$ $cm^{-2}s^{-1}$ for accumulating 1 ab^{-1} by the end of 2026ab run. Identifying the causes of SBLs requires sufficient statistics. Since SBLs at high beam currents could cause damage to

both the machine and the detector, operation at high currents must proceed cautiously. Therefore, further study to identify the cause and to implement cures will take time, and improvements are expected to be gradual.

Accordingly, the proposed operation plan assumes only very small increases in the beam currents from their present values, while reducing β_y^* from the current 1 mm to 0.9 mm in steps of 0.05 mm. In the past, reduction of β_y^* was not successful due to low injection efficiency for the High Energy Ring (HER). Since this efficiency has improved and is now as high as 60%, the committee considers this a viable approach for increasing luminosity under current conditions. However, changes in β_y^* will require careful tuning of the machine to control beam background, which can reduce operation efficiency. The loss in data collection during tuning must be balanced against the potential gain in luminosity, and the operation plan should remain flexible in response to ongoing developments. There are indications that some conditioning of the machine occurs with continued running, so that the beam currents could be slowly increased before beam abort occurs: the beam current limit of stable operation should therefore continue to be probed, but very cautiously.

Since SBLs are unlikely to be completely eliminated, controlled beam abort through early detection of beam instabilities remains crucial. This has been emphasised repeatedly in the past, and the committee is pleased to see ongoing efforts in this direction and encourages continued work. Early detection of beam instabilities is also essential for safely operating the Belle II pixel detector.

No report on the status of simulation efforts was presented at the meeting. Simulation should provide useful guidance in tuning the machine operating parameters, particularly when reducing β_y^*. Well-validated simulation tools are essential for understanding beam-beam effects and for optimising the operating parameters to achieve the highest overall machine performance. The committee would like to hear about progress in this area at the next review.

The two-bunch injection to the HER is now operating smoothly, and the injection efficiency has reached a level of about 60%. However, this remains below the level achieved in the LER, which is approximately 90%. The long-standing issue of emittance growth in beam transport for HER injection should be understood and resolved so that the HER injection efficiency can reach a level comparable to that of the LER.

A steady increase in luminosity to well above 1×10^{35} cm^{-2}s^{-1} over the coming years is vital for the overall success of the SuperKEKB project. The current limitations indicate that a better understanding of the machine, including the injector complex, is still required. In this context, the committee considers it very important, at the end of the 2026ab run, to push the luminosity towards 1×10^{35} cm^{-2}s^{-1} as far as possible, even if this requires the detector to be switched off for safety reasons for a limited period. Such studies would provide valuable information for the machine group to plan and implement the next steps in luminosity improvement.