

B-factory Programme Advisory Committee

Short Report for

Focused Review Meeting on LS1

13-14 November 2023

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Short Summary

A focused review meeting of the B-factory Programme Advisory Committee (BPAC) took place on the 13th and 14th of November 2023, in remote mode, with the following charges:

- *Are all LS1 works properly completed?*
- *Are the preparations for Run 2 being addressed and planned appropriately?*
- *Are we ready to use run dependent MC for physics analyses targeting winter conferences?*

Here are the responses of the BPAC to those questions.

The LS1 work for the machine, i.e. the injector complex and SuperKEKB rings, has been successfully completed. Extensive consolidation and improvement work should lead to more stable machine operation with increased luminosity compared to that achieved during Run 1. The committee considers that a goal of achieving luminosities above $10^{35} \text{ cm}^{-2} \text{ s}^{-1}$ is realistic. The committee appreciates that the major Belle II LS1 work, such as the installation of the new pixel detector (PXD2) and replacement work of photon detectors for the barrel particle identification system (TOP), has been successfully completed. Completion of replacing the old DAQ modules from the Belle era with

more performant modules is also well appreciated. Concerning the incident encountered during the insertion of the superconducting quadrupole focusing magnet (QCS) in the forward region, where the QCS hit the cable cage, it was fortunate that no serious damage occurred to the cables. This, nevertheless, delayed the start of Run 2 towards the end of January 2024. The committee thinks that the incident could have been avoided by paying more attention to the installation procedure and should be reflected in the future work. Although a little more work is left to complete the LS1 detector work, the BPAC is confident that it will be completed by the revised Run 2 starting date.

The committee considers that the commissioning plan for the machine has been well thought out and adequately developed. With many changes introduced in the machine, commissioning must proceed cautiously and the plan to start with β_y^* at 1 mm and gradually reducing to 0.8 mm is very much appreciated. The Belle II detector commissioning plan also appears to be in good shape. Monitoring, error detection and error handling must be reviewed and well tested before the start of Run 2. Onsite detector experts must be secured during the commissioning period.

The Belle II collaboration has reconfirmed their commitment to use run-dependent simulated data for the analyses to be presented in the winter conferences. The necessary computing environment and production tools are in place, though some issues related to data fragmentation and the corresponding need of many user jobs to access data still exist. The committee would like to see the actual production plan and progress during the next review in February 2024.

In conclusion, **the committee's responses are positive for the three questions of the charge.**

Here are some important additional reflections on the subjects presented during the review meeting. Much more detail can be found in the full report.

Operation of the two PXD2 ladders, which exhibit limitations in the gliding mechanism, must be carefully planned. This is important not only for those ladders themselves but also for the whole PXD2. Tests with the mock-up detector would be very useful.

For the DAQ, outstanding installation of optical links is important and the work should be pursued.

Various trigger algorithms are now in place. The committee thinks that they are sufficient to cope with evolution of the running conditions resulting from the increasing luminosity.

While the ageing problem of the Central Drift Chamber appears to be under control, careful monitoring of the water content in the gas mixture should continue. The committee is looking forward to hearing the progress with work on the laboratory ageing test that is now ready to start.

The committee understands that the ammonium treatment for the damaged Resistive Plate Chambers of the K-long Muon detector system could be done in an isolated gas environment. However, even a very small amount of residual ammonium in those chambers could damage the other chambers, once those chambers are put back into the normal gas circuit. The collaboration must be absolutely sure that any intervention will

not damage the other chambers and a review that includes external experts should be conducted before making a decision.

For the calibration, the BPAC supports the policy to keep data processing at a single dedicated site rather than using distributed sites. Long-term maintenance of the workflow management tool based on Airflow is uncertain due to the departure of an expert. A solution should be developed by consolidating with other Belle II computing tasks that use different workflow management tools.

Continuous effort by the Belle II collaboration to gain further understanding and improvement of the detector performance is highly appreciated. The committee would like to hear in-depth presentations, in particular those on the responses of sub-detectors, during the next meeting in February 2024.

Physics analyses have been producing many very interesting results. The committee is looking forward to seeing further exploitation of the Run 1 data and combined analysis results with the Belle data.

An upgrade project to introduce longitudinal beam polarisation in the Belle II experiment is considered to be a very interesting option by the committee. However, this should be judged together with the other upgrade projects being considered by the collaboration, and weighed against potential disturbance of the approved programme. In order for the BPAC to provide its opinion, an overall comprehensive upgrade plan for the machine and the Belle II detector with well-defined physics objectives would be required. The committee is looking forward to receiving further information in future meetings.