

B-factory Programme Advisory Committee

Short Report for

Focused Review Meeting on LS1

26-27 June 2023

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Short Summary

The B-factory Programme Advisory Committee met remotely on the 26th and 27th of June 2023 to assess the status of the Long Shutdown 1 (LS1) work and progress in physics analyses.

For the LS1 status, the questions asked by the director of the Institute for Particle and Nuclear Studies are:

- *Have all issues to be resolved during the LS1 been addressed appropriately?*
- *Is the schedule of each work arranged well?*

The status of the LS1 work was presented starting with an overview followed by status reports on the accelerator complex (injector chain and SuperKEKB), vertex detector system (VXD) consisting of pixel detector (PXD) and strip detector (SVD), central drift chamber (CDC), barrel particle identification system (TOP), K-long and muon detection system (KLM), data acquisition system (DAQ), changes of raw data formats, and monitoring and alarm handling.

The committee unanimously agrees with an enthusiastic “yes” to both questions. All the issues are being thoroughly addressed and the work plan developed is very solid and indicates that the LS1 is advancing well to achieve the goal to resume operation

in December 2023. The committee appreciates the effort made by the accelerator team and Belle II collaboration for this achievement.

While the committee is confident that the LS1 work will continue with full steam, it is important now to start developing strategies for the start-up and commissioning process of the accelerator complex and the Belle II detector, in close collaboration of the two teams. Since many systems have been changed, work plans have to be carefully thought through. Some ideas have already been presented at this meeting and the committee is looking forward to assessing the full picture during the focused review meeting in November.

Here are some more comments on the individual items. The committee is very impressed by the progress in consolidating and improving the injector system and SuperKEKB rings. For VXD, the committee would like to congratulate on the successful assembly of the system and notes that some delicate work still remains, such as the installation and testing, which should be handled with utmost care. The committee is pleased to hear that ageing tests with a CDC test setup will finally start in August and is looking forward to hearing the first results in November. CDC needs continuous attention and any sporadic current activity inside the chamber has to be carefully monitored as the amount of water in the gas decreases. High statistics comparison of performances among different sectors in Layer 0 should be made with the normal state gas mixture in terms of oxygen content. For TOP, the successful exchange of photon detectors is very much appreciated. The committee is eager to learn further progress in understanding the differences in quantum efficiency measurements observed between those taken on the bench and in situ and in the degradation of the quantum efficiency with temperature. The group is encouraged to continue its efforts to monitor and hopefully reduce the operating temperature of the detector. For KLM, the committee thinks that comprehensive and systematic studies of all the test RPC chambers will be needed to decide whether the inefficient layers of KLM should be treated with ammonia gas. Since the KLM gas system does not allow an isolated gas flow for those specific layers during the detector operation, and because it takes a long time for the gas volume of those treated chambers to become clean from ammonia, it should be absolutely certain that ammonia does not cause any damage to the chambers. The committee fears that deciding in August would be premature. Concerning the DAQ, the committee appreciates that the PCIe40 upgrade is nearing completion and substantial progress has been made in speeding up error recovery. The committee looks forward to a report on trigger developments to improve the sensitivity to low multiplicity channels. The committee notes that work on data transfer from online to offline is well advanced with full system tests planned shortly after the BPAC meeting. While the work on monitoring and error handling by the central team is progressing well, the sub-detector teams should provide enough human resources to implement their systems.

For the progress in physics analyses, the questions posed are:

- *Is the progress toward summer conferences in good shape?*
- *Are efforts being put appropriately into analyses that should be focused on?*

After listening to three presentations on physics analyses, one summarising the overall situation and the other two focusing on dark sector physics and on hadronic B-meson decays, the committee again concludes “yes” to the two questions. The committee also applauds the successful effort to unify the analysis process for Belle and Belle II and produce combined results based on the two data sets, which is particularly important now for the core B physics program with the statistics of Belle and Belle II being comparable. Some of the physics results presented, especially when unblinding data sets, indicate that the sensitivity of the experiment has reached a level where in-depth understanding of the detector performance is required even for basic responses of sub-detectors. Being able to reproduce those responses with simulations will be crucial for the analysis. The committee is looking forward to learning about the progress in the understanding of the basic detector performance during the November meeting.

The committee learned about the ambitious goals of the experiment for 2024, i.e. to achieve a peak luminosity greater than $10^{35} \text{ cm}^{-2}\text{s}^{-1}$, a monthly integrated luminosity of 150 fb^{-1} and a total integrated luminosity exceeding 1 ab^{-1} . This will require very stable operation of the machine with high currents and low background, efficient data taking and sufficiently long running periods. The committee encourages the accelerator group, the Belle II collaboration, and the KEK management to strive towards this goal.