Short Summary
B-Factory Programme Advisory Committee
The 10th Annual Meeting

7 – 9 February 2016 at KEK

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21 February 2016

Short Summary of the Annual Meeting

The 10th Annual Meeting of the Belle Programme Advisory Committee (BPAC) took place from 7 to 9 February 2016 at KEK and covered all the relevant issues of the Belle II experiment. The committee was very impressed by the amount of work and progress made and applauds the collaboration for this achievement. The BPAC was particularly fortunate to witness the first circulation of positron bunches through the SuperKEKB Low Energy Ring during the meeting. This is a short report summarising only the most essential recommendations of the BPAC and a full comprehensive report will follow shortly.

The SuperKEKB operation team is now commissioning the machine with beam. The BEAST Phase 1 detector, consisting of various sensor devices, has been installed at the Belle II interaction region to observe beam circulation and to provide useful information to the machine group. The BPAC notes that the Phase 2 machine commissioning run is now shifted to the autumn of 2017 due to constraints on the KEK operation budget. However, the start of the Phase 3 physics run is unchanged. Given the international visibility of the project, the committee appreciates the effort for keeping the starting date of physics run. The committee was also informed that the Belle II data taking period would be limited to seven months per year rather than nine months as originally assumed. Considering the impact of timely physics results from the Belle II experiment, the BPAC urges the KEK management to find a way to restore the original running time. The committee also encourages the Belle II collaboration to periodically revisit the physics programme in order to ensure and maximise its impact. The BPAC would like to stress that having a clear machine operation plan for the coming years is particularly important for the foreign participants in order to secure and optimise their funding.

The committee was very impressed by the achievement of publishing 23 physics papers with Belle data in 2015. Successful migration of Belle data analysis to the Belle II physics analysis framework guarantees continuation of exploiting Belle data. Newly

developed analysis tools for the Belle II experiment, such as full event tagging, will also enhance the Belle physics results. The committee encourages revisiting of important previous analyses, which could result in significant improvements by using the Belle II analysis framework.

The Belle II collaboration, together with the machine operation group, should define a quantitative goal in understanding of the beam background for the Phase 2 machine commissioning. The committee recommends that the Belle II management carefully monitors the BEAST Phase 2 plan and activities, in close collaboration with the machine group, such that a smooth and efficient transition to the Phase 3 physics running can be achieved.

The committee is pleased to see improved coordination between the Pixel Detector (PXD) and Silicon Vertex Detector (SVD) groups for the assembly activities and encourages them to extend this effort to the operation aspect. They should establish a unified procedure for the operation of both detectors, since the working environment and control system of the two are strongly coupled.

Due to delay in the production of the final ASICs, the construction schedule of the PXD is very tight without contingency for the start of the Phase 3 physics run in October 2018. The committee urges the PXD group to examine carefully the production plan in detail to ensure that nothing has been forgotten and to see whether some contingency can be generated.

For the SVD, delamination of the Origami Kapton flex cable producing bubbles after the reflow soldering step is a big concern. The cause is considered to be the water absorbed by the Kapton while being stored at the soldering company without humidity control. The SVD group is currently examining two ways to deal with the problem; either to solder all the components by hand or to dry the cable first by baking at lower temperature. It should be verified whether there is any other chemical contamination or not and production of a new set of cables should not be precluded. The committee thinks that long term operation of the detector should be the most important aspect for the solution to be adopted and a hasty decision should not be made. Production of the Layer 6 ladders at IPMU is clearly on the critical path. The committee encourages strongly the idea of opening a second production line at IPMU and securing the necessary resources for this.

The barrel particle identification detector (TOP) has made very impressive progress in terms of component procurement and assembly of the bar boxes, as well as the production and bench testing of electronics. Installation of the bar boxes is set to start shortly, although it appears that the module acceptance procedure is not yet well established and little time remains to measure the bar box quality before installation. The committee urges the TOP group to produce a procedure that ensures the optical and mechanical integrity of bar boxes and the viability of the installed electronics, and to proceed with the acceptance test as soon as possible. The planned cosmic ray test together with the Central Drift Chamber using the Belle-II data acquisition system is of great importance and the committee recommends that a realistic plan be formulated and executed soon.

For the end-cap particle identification detector (ARICH), the cause of the large pulses observed in some of the Hybrid Avalanche Photo-Detectors (HAPD) when operated in a magnetic field has not yet been fully understood. Simulation studies by the ARICH group show that dead time introduced by the large pulses has only a minor impact on the particle identification capability. On the other hand, very little is currently known about possible correlated effects and long-term behaviour of the HAPDs. The committee fully

supports the effort by the ARICH group to investigate further the HAPD behaviour in the magnetic field and to study a possible design change so that the HAPDs can be easily replaced in situ.

The committee sees several loose ends in various sub-detectors, such as the decision on the high voltage system for the ARICH and the production of the readout boards for the barrel RPC of the K-Long Muon detector. Although they are not fundamental technological problems, immediate attention should be given to them in order to avoid any possible delay for the Phase 2 commissioning.

A fully functioning Belle2link is becoming essential for many sub-detectors for their test and commissioning activities and a concentrated effort should be made to get it working. It is also important to ensure that all documentation is kept updated and changes swiftly communicated to the sub-detector groups. In parallel, the committee recommends pursuing simulation studies of the readout system to deepen the understanding of the system's behaviour. Development work for the detector control and interlock system is advancing. However, the committee feels that analysis at an architecture level is missing and recommends to develop, in consultation with the sub-detector groups and the SuperKEKB operation team, an overall architecture for the safe and efficient operation of the Belle II detector.

A better understanding of the required computing resources for the coming years was presented. The BPAC thinks that a computing model for analysis is urgently needed for estimating the required computing resources for physics analysis, which may have a large impact on the overall resource requirement. The committee noted the plan by the Belle II collaboration to host collaborative tools, i.e. computing infrastructure and software that enable collaboration, at DESY. This kind of service is usually provided by the host laboratory.