

# B-factory Programme Advisory Committee Focused Review Meeting

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D. Cassel (Cornell), M. Frank\* (CERN), N. Neufeld<sup>+</sup> (CERN),  
B. Ratcliff\* (SLAC), M. Sullivan (SLAC), H. Tajima (Nagoya),  
and chaired by T. Nakada (EPFL)

\* Expert members

<sup>+</sup> Participated remotely.

Short Summary  
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The main purpose of this meeting was to review the readout integration status of the Belle II experiment. In addition, recent incidents for the two subsystems, i.e. Silicon Strip Vertex Detector (SVD) and Barrel Particle Identification System (TOP) were reported. This is a short summary with essential conclusions of the review and a full report will provide more comprehensive information. It should be noted that the review for the integration of the Vertex Detector System is planned to be held later in October, 2017.

## Short Summary on the Readout Integration Status

The back-end implementation of the systems related to the data handling of the Belle II experiment, such as the Data Acquisition (DAQ) and run control, condition and configuration database, high level trigger and data storage, detector control and interlock system and detector and data monitoring, are well in place and ready to be used by the subsystems for their commissioning work. Although further optimisation and refinement are needed, all the necessary functionalities for the Phase 2 and Phase 3 data taking are in place. The central DAQ framework should ensure stable running up to a rate of 30 kHz so that the commissioning and debugging work of subsystems can be carried out smoothly to reach the design performance. The committee appreciates successful effort by the central DAQ team to attract outside groups for well identified tasks, such as the high level trigger and data quality monitoring. This has allowed the central DAQ team to concentrate on the core issues and provided essential expert advice to all the subsystem groups. The committee has no major concern with the overall progress.

Readout integration of the subsystem is at various stages. All the subsystems, except the end-cap Particle identification system and the end-caps of the K-Long Muon detector,

can now be included in the Belle II central DAQ system and they participated in the global cosmic ray data taking tests. The electromagnetic calorimeter and central drift chamber system (CDC) are particularly in a good state. While the central DAQ team must ensure that the commonly used Belle2links and COPPER readout boards are flawless, the subsystem teams should continue their effort in the firmware development of their front-end electronics. Guidance to the subsystem teams provided by the central DAQ team is crucial. Sharing experience among the subsystem groups is a good practice and effort being done along this direction is appreciated. The committee is looking forward to hearing about further progress on the integration of subsystems in future meetings.

The first level trigger is affected by a stability problem in the high-speed serial links, which does not allow currently to transfer all required data for the CDC trigger. Finding a solution may require very specialised knowledge on the FPGA's used in the system and consulting the vendor could be useful. In parallel, the amount of CDC data required for the triggering could be revisited.

## **Concerning the delamination of PEEK frames of the TOP modules**

A problem with the unexpected movement of photon detectors (PMTs) for the barrel particle identification system (TOP) due to the solenoidal magnetic field of the Belle II detector was first reported to the committee during its meeting in October 2016. This problem seems to be now well understood and under control. The vacuum tightness of the PMTs is also shown to be unaffected.

On the other hand, apparent delamination of the PEEK frames glued to the prism, newly reported in this meeting, is alarming. Not only is the cause of this phenomenon unknown, the picture taken by the CCD camera mounted inside of the module does not provide unambiguous identification of the delamination spots and their extent. There is some evidence that the optical silicone oil has entered into the gap caused by the delamination which makes it difficult to identify the delamination area and to know exactly when it occurred. This also generates a concern that the oil may have entered into the prism side of the module and that the bar box is open to the electronic readout side. In this case, the quartz bar box may be exposed to the external atmosphere and to the oil. The committee thinks that the highest priority for the TOP group is to understand the exact situation of the delamination. They must develop a reliable method which can unambiguously identify the affected areas and determine how far delamination has progressed. They should also examine whether the quartz bars are now exposed to the external atmosphere. Analysing data on the N<sub>2</sub> flow, i.e. the flow rate, its composition and especially dew point, might provide further information. By correlating them with the apparent moment of delamination, one might gain more insight on the process and the degree of contamination inside the module through the delamination. In parallel, available prototypes and purpose made mockups, including Module 01 when appropriate, should be used urgently to understand the cause of the delamination, e.g. whether it

is due to external forces, which may or may not be due to the detector magnetic field, thermally induced forces from the warm readout side or intrinsic to the design and material choices. The effect of contamination due to the external atmosphere and the oil vapour on the quartz bar surface should be investigated, as well as the effect on the physics performance. Although it is still premature to launch any direct intervention on the detector now, every effort must be made to avoid any possible further damage and possible repair methods should be worked out and practiced.

## **Concerning the delamination of Kapton flex cables of the SVD**

In this meeting, reoccurrence of delamination of the Kapton pitch adapters is reported. The forward module of a newly made Layer-4 ladder again developed delamination of pitch adapters. Further reinforcements are introduced and tests show very good results. In order to better identify infant mortality, the additional waiting period is added to the production procedure, which is also re-optimised to minimise the delay. The quick responses by the SVD group to the problem and all the actions being taken are fully appreciated. However, the committee recommends strongly to perform full thermal cycle tests of the reinforced ladders. For this purpose, class-C modules should be sufficient.