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PRINCIPAL LHCC DELIBERATIONS

29TH MEETING OF THE LHCB RESOURCES REVIEW BOARD

31 OCTOBER 2012

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GENERAL

This document summarizes the principal LHCC deliberations concerning LHCb at the Committee's sessions in June and September 2012.

The LHCC considers that LHCb has made excellent progress in all aspects of the experiment and the Committee congratulates the LHCb Collaboration on its achievements.

CONCERNS FROM THE PREVIOUS LHCB RESOURCES REVIEW BOARD

No major concerns were reported to the previous LHCb Resources Review Board.

STATUS OF THE EXPERIMENT

PHYSICS

The LHCC **congratulates** the LHCb Collaboration for the high-quality physics results produced. To date 67 papers have been either submitted, accepted or published in refereed journals, as compared to a total of 56 shown at the LHCC session in June 2012. One of the highlights presented has been the work done to complete the constraint on the γ-angle from a combination of four different measurements. Results will be disclosed for the CKM-2012 Conference. First results have been shown for the pPb physics pilot run carried out for a few hours on the 13 September 2012. The detector successfully recorded the events without any evident problem and the preliminary study of the acquired sample indicates already an interesting strangeness enhancement, by a factor of three, between pPb and proton-proton collisions when normalising to the number of primary vertices.

OPERATIONS

The data-taking at 8 TeV centre-of-mass energy is now very stable. An average data-taking efficiency of 94.2% has been reached at an instantaneous luminosity of 4×10^{32} cm^{-2} s^{-1} by keeping the read-out related dead-time contribution to 2.4%. Long fills with an efficiency of 96-97% were sometimes followed by a small number of unclear failures, mainly happening at the start of a new run. These failures appear to be related to a de-synchronization problem, which is still under investigation. During this period, LHCb has also improved the correction for the response loss of the calorimeter system, which directly affected the Level-0 efficiency. The photomultiplier gain loss, corresponding to a decrease in the calorimeter trigger efficiency of 5% each 150 pb^{-1}, is compensated by high voltage adjustment, which is now being done more frequently (every 100 pb^{-1} instead of 150 pb^{-1}). The correction for the average scintillation loss (1.6% each 150 pb^{-1}) has also been applied. The collected data have a very high quality, only 1% (4%) has an overall (VELO) detector bad flag. So far during 2012, LHCb has recorded on disk 1378 pb^{-1}. Extrapolating this over the remaining physics days, LHCb expects to collect a total of 2.2 fb^{-1} by the end of this calendar year.

As planned, the deferred High Level Trigger (HLT) has been improved. The additional fraction of raw data stored on disks, and processed by the online farm during inter-fill periods, has been increased from 10 to 23%, reaching a stable situation and raising the overall HLT rate to ~5 kHz. The magnet polarity swaps have also become standard operation with the new optics arrangement and have been carried out successfully, collecting for each swap 150-200 pb^{-1} with a reasonably well balanced amount of data for the up and down cases.

COMPUTING

Due to the run extension, reprocessing has already started and LHCb is coping within existing resources to follow the reconstruction needs. The prompt processing has been reduced to only 50% of the sample and the time needed for full reprocessing extended: the plan is to have only 60% of 2012 data available for winter conferences. To save space on disk an aggressive reduction of prompt Data Summary Tapes (DSTs) and μDSTs is under way, and to save space on tapes, all output from 2012 prompt reconstruction will be removed. While LHCb foresees in the near future no problems for CPU and disk resources, a shortage of tapes in 2013 is expected due to the combination of three factors: the longer run, the increased HLT output rate and the increased size of the full DST format that now contains also a copy of the RAW data, to decrease the number of staging operations from tape. The LHCC expects that a solution can be found to overcome this imminent storage shortage.

UPGRADES

As planned, the LHCC has further examined the LHCb upgrade proposal as shown in the Framework TDR (FTDR), and asking the Collaboration to address a set of questions regarding physics reach, discussion of relevance and role of sub-detectors, optimisation of sub-detector layout, detailed cost-book and eventual staging scheme for the upgrade. The Collaboration replied in due time by adding three supporting documents, the first addressing the LHCC questions and the latter two reporting the detailed breakdown for cost and schedule. Overall, the LHCC is pleased with the work done.

The LHCb Collaboration has shown a clear comparison between the LHCb upgrade with 50 fb^{-1} and a generic e^+e^- B factory with 75 ab^{-1}. The complementarity of the two experiments is evident, together with a clear uniqueness of LHCb on charged-final states and the B_s system. The difference in physics reach, with and without the upgrade, has also been demonstrated: a factor of up to four improvement is achievable for the channels based on the hadron trigger (*i.e.* $\sigma[\gamma]$ from 2.5° to 0.7°).

A detailed description of the criteria for the design and optimisation of the overall tracking system has been reported, with strong supporting arguments for the relevance of the Trigger Tracker (TT). This system will improve the HLT by providing standalone tracking with 10% resolution, thus reducing the number of low momentum tracks and the window search in the T-stations. Moreover, it will allow reconstruction of a factor of two more vertices for K_S and Λ decays, improve the momentum resolution by 20-30% and decrease the ghost track rate by up to a factor of four. Minor optimisations seem possible for the overall tracking system; this aspect will be considered at the stage of the expected Technical Design Reports.

The LHCC considers the plan to aim initially for an instantaneous luminosity of $\sim 1 \times 10^{33}$ cm^{-2} s^{-1}, while constructing all detectors to be able to sustain an instantaneous luminosity of 2×10^{33} cm^{-2} s^{-1}, to be prudent. As shown in the FTDR, this suggests the need for a reserve of 3.5 MCHF to prepare the systems that will not be fully renewed (Particle Identification, Calorimeter and Muon System). This extra margin will add flexibility to the LHCb system and allow a faster transition to higher luminosity, as well as improving performance at an instantaneous luminosity of $\sim 1 \times 10^{33}$ cm^{-2} s^{-1}. The LHCC proposes to discuss the role of this reserve further once the Collaboration is ready with a more defined work plan.

The LHCC explored staging of detector upgrades and recognises that the only staging that would not be a show-stopper for the experiment is the reduction of the Low Level Trigger (LLT) rate, and the corresponding size of the Online Farm, in the starting phase of the upgrade. Initially restricting the rate to 5 MHz (instead of 10 MHz) will dilute the spending profile of common items by a few years without significantly decreasing the overall experiment efficiency.

Taking into consideration also these additional documents, the LHCC comments that the LHCb upgrade proposal and its physics goals are all based on solid grounds and acknowledges that the evaluation of cost, with the 15% contingency assumed, and the schedule presented in the FTDR, are well understood for this stage of the project. The LHCC **endorses** the upgrade plans of the Collaboration as presented and **urges** the Collaboration to proceed to the TDR and to make the necessary preparations without delay. This preparation requires adequate resources from the Collaboration as a whole and also from the partners that will engage in specific upgrades.