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PRINCIPAL LHCC DELIBERATIONS

28TH MEETING OF THE LHCb RESOURCES REVIEW BOARD

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This document summarizes the principal LHCC deliberations concerning LHCb at the Committee's sessions in December 2011 and March 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

SUB-SYSTEM	CONCERN	STATUS
Ring Image Cherenkov (RICH-1)	Observation of high current in Hybrid Photon Detectors (HPDs).	The HPDs are replaced whenever possible; faulty ones are preferably placed at the detector edges so that the physics impact is small. Unfortunately, some of the replaced HPDs have to be substituted again. The five faulty HPDs in the RICH-1 detector were replaced during the year-end 2011-2012 Technical Stop.

STATUS OF THE LHCB EXPERIMENT

As planned, the LHCb Collaboration used the year-end 2011-2012 Technical Stop to bring all detector sub-systems back to full efficiency. Moreover, this period was also used to install the new aerogel box for the Ring Image Cherenkov detector RICH-1, which finally separated the gas volume from the aerogel. The LHCb experiment then went through a global re-commissioning in the last two weeks of February 2012 to power all systems and test the DAQ reliability by means of long runs with high "random" trigger rates. All work on the detector was completed on time and the cavern was closed on 9 March 2012. Shifts have also been under re-commissioning to restart training of personnel and of on-call experts, 24 hour/day shifts were expected to start in the first week of April 2012. Completion of the re-commissioning will also include testing of Level-0 and High-Level Trigger (HLT) with test collisions and one day of calibration (timing and ageing tests) with beams.

LHCb plans to operate with luminosity levelling, as they did at the end of the 2011 run, keeping the instantaneous luminosity at ~4×10^{32} cm^{-2} sec^{-1}, and aiming to integrate to 1.5 fb^{-1} by the end of the year. The 8 TeV centre-of-mass energy operations correspond to a net increase of ~10% in signal event rate and a similar increase in track multiplicity. In order not to become critical on dead-time, some work has been done to mitigate this: the Beetle de-randomizer read-out chip was partly corrected, lowering the maximum contribution of the related dead-time from 8% to 3%, a limitation in the Tell1 acquisition board was fixed and the farm operations were ameliorated by improving the HLT code (from 27 to 23 ms/event) and increasing the farm CPU by 10%. Usage of a deferred HLT triggering scheme has been proposed in order to increase the through-put to disk by an additional ~10%. All of this makes an overall HLT output rate of 4.5 kHz feasible. Specifically, the proposal of the deferred HLT trigger is based on the observation that the online farm remains essentially idle during inter-fill periods and each node is provided with 200 GB of disk space (which will be

upgraded). The scheme works by overrunning the farm processing capacity and storing the additional fraction of raw data on local disks. During inter-fill periods the surplus of acquired data will be processed and the run closed. This scheme has been tested and in case of the appearance of bottlenecks, such as saturating or exceeding the disk capacity, the old standard triggering and processing scheme can quickly be restored. Assuming a fast intensity ramp-up of the machine, LHCb expects to start with high luminosity levelling at an early phase of the upcoming run and is therefore paying special attention to the preparation and tuning of the online and offline monitoring.

LHCb expects to have one dedicated Van der Meer scan to calibrate its luminosity around June 2012, in order to have the SMOG system available and fully working. (SMOG deliberately injects gas in the VELO to trace the beams via beam-gas interactions). However, LHCb plans to get a preliminary estimate of luminosity by participating in the early scans assigned to ATLAS/CMS. LHCb has also agreed with the machine on moving of the IP8 interaction point crossing angle. The external crossing will be changed from horizontal to vertical, so as to decouple the machine crossing-angle from the change of horizontal angles when switching field polarity. A technical solution ("tilting after squeeze") exists and has to be carried forward. Once successful, the requirement of LHCb is to get three polarity switches in between technical stops, corresponding to 2×2 equivalent data sets of 100-150 pb^{-1}, each obtained after around 1.5 weeks of running.

STATUS OF THE LHCB PHYSICS ANALYSES

The LHCb Collaboration continues to present a wealth of impressive high quality physics results. The publication rate has been kept high, and to date 24 papers have been published in refereed journals, with another 15 submitted, 14 papers still under collaboration-wide review and many other analyses soon to be turned into publications. One of the highlights at Moriond has surely been the great improvement to the upper limit for $B_s \to \mu\mu$ decays, which was set to 4.5×10^{-9} at 95% CL, thus vastly improving the exclusion plots for simple TeV-scale SUSY models at large tan(β), which now look practically ruled out. In view of the importance of the result, the processing plans for 2012 have also been discussed and look adequate for the goal of proceeding rapidly with the data analysis by basing it on the first pass of data reconstruction. LHCb aims to perform a complete re-processing of the entire 2012 sample only at the end of the year, when data taking will have been completed. Assuming an overall sample of 2.5 fb^{-1} at the end of 2012 and a Standard Model production rate, a reasonable chance of a 3σ observation of $B_s \to \mu\mu$ decays exists. Moreover, the increased HLT rate, from 3.5 to 4.5 kHz, will allow the selection efficiency for dedicated channels to be improved, for example a factor of 3.5 gain in $D \to K_s \pi^+\pi^-$, the golden mode used for mixing and CPV in the charm system. In order to maintain the reconstruction output to disk within available resources, LHCb is extending the usage of the micro-DST format to most analyses and working on improving the compression (the current size is around 1/10 of the full DST). However, there are specific measurements, whose precision is limited by systematic uncertainties, that can be based only on full DST information and which, in case of the absence of additional disk space, will have to be deferred. A request for a ~20% increase of the disk space in 2013 has been put forward by LHCb and the LHCC **endorses** such a request.

LHCB UPGRADES

LHCb is progressing towards completion of an addendum to the Letter of Intent (LoI and which from now on will be referred to as the Framework Technical Design Report or FTDR), whose first draft is expected to be released in time for the June 2012 LHCC session. The LHCC agreed on the

time scale and on the overall skeleton of this addendum. The FTDR will contain an update of the expected physics performance and of the running requirements, the evolution of the R&D for all subsystems since the LoI, and an evaluation of costs together with an overall schedule, milestones, both for all sub-systems and for the common projects. The schedule will be important to evaluate its integration into the general framework of the LHC shutdown schedule, with plans to install the upgrade in time for the Long Shutdown 2 (LS2). The scientific interests of each participating institution will also be stated. On the physics performance, more information will be provided by a physics paper, which will be written on the same time scale. Supplemental documents will be added if needed. The second chapter will describe the evolution of the R&D for all sub-systems since the LoI. Finally, in the third chapter, for all sub-systems and for the common projects, a breakdown of costs will be reported, together with an overall schedule, including milestones. The schedule will be important to evaluate its integration into the general framework of the LHC shutdown schedule, with plans to install the LHCb upgrade during LS2. This FTDR will be helpful for a discussion with the national funding agencies. and, after a first informal presentation to the LHCb RRB in the April 2012 meeting, aims for LHCC endorsement followed by a formal presentation to the LHCb RRB for discussion and approval next autumn. The LHCC **appreciates** the work done for the upgrade proposal by the LHCb Collaboration.

The need for a new building to house the upgraded online farm has been put forward by LHCb. This building, proposed as an extension of the existing building SX8, should store the 5000 servers of the new farm and, possibly, the new control room and offices. The LHCC **supports** this proposal and expects to hear more details on this project at future sessions of the Committee.

LHCb has been invited to, and has already started participating in, the High-Luminosity LHC (HL-LHC) coordination group between the machine and the experiments. The LHCC **considers** this to be an important decision in pushing forward the LHCb upgrade.