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PRINCIPAL LHCC DELIBERATIONS

31ST MEETING OF THE CMS RESOURCES REVIEW BOARD

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GENERAL

This document summarizes the principal LHCC deliberations concerning CMS at the Committee's sessions in May, July and September 2010.

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

CONCERNS FROM THE PREVIOUS CMS RESOURCES REVIEW BOARD

SUB-SYSTEM	CONCERN	STATUS
Electromagnetic Calorimeter (ECAL)	Detector noise spikes.	The ECAL noise is generated by slow secondaries and occur in cosmic-ray and beam crossings. Analysis shows that both with timing and topological cuts the rates can be effectively reduced by orders of magnitude.
Hadron Calorimeter (HCAL)	HCAL noise.	The noise is traced to the Hybrid Photon Detectors (HPDs) and Photomultiplier Tubes (PMTs), has been well characterized and can be eliminated with timing and topological cuts. HPDs will be replaced in 2016 and PMTs in 2012.

STATUS OF THE EXPERIMENT

DETECTOR

CMS continues to operate the detector in a very efficient manner. The detector availability is exceptionally high for all components. CMS is well prepared to adapt to changes of running conditions as exemplified by the response to the luminosity increase. Detector performance is monitored with short delays in feedback.

The Committee received a thorough analysis of the Electromagnetic Calorimeter (ECAL) spikes and Hadronic Calorimeter (HCAL) noise. The ECAL signals are generated by slow secondaries and occur in cosmic-ray and beam crossings. The analysis showed that both with timing and topological cuts the rates can be effectively reduced by orders of magnitude. This convincing study continues and will

be extended to jets for detailed assessment as soon as larger data and simulation samples are available.

The HCAL noise, traced to the Hybrid Photon Detectors (HPDs) and Photomultiplier Tubes (PMTs), has been well characterized and can be eliminated with timing and topological cuts. The PMTs will be replaced during the 2012 shutdown and the HPDs during the envisioned 2016 shutdown. The plan to provision for sufficient HPD spares through 2016 is to turn off the Hadronic Outer (HO) second ring now. The physics impact is low. These HO HPDs will be replaced with Silicon Photomultipliers (SiPMs) in 2012.

TRIGGER & DATA TAKING

Typically, 86% of the recorded data has been used in analyses in which good status of all detector components has been requested.

Since the start of data taking CMS has used 10 sets of trigger selections (menus) to cope with the exponentially increasing luminosity. The accuracy of trigger rate prediction is good and shows that the overlap in a given trigger group (of some 30%) is well understood. CMS are ready to absorb another factor of ten luminosity increase with the prepared trigger menus. The physics groups are closely involved in the definition of the trigger selection. Monitor triggers take a considerable fraction of the budget. Methods should be in place to eventually reduce the dependence on e.g. calibration procedures using these triggers when rates become prohibitive.

PHYSICS ANALYSES

The integrated luminosity has exceeded 3 pb^{-1} and has increased by an order of magnitude since the International Conference on High Energy Physics (ICHEP) in July 2010. Many new analyses have thus become possible.

The di-muon mass spectrum reaches from zero to beyond the mass of the Z-boson and shows much detail; it resolves e.g. the three radial excitations of the Y and demonstrates the superb momentum resolution of the CMS tracking system. The di-electron mass reconstruction depends on both tracker and calorimeter. The jet and missing transverse energy distributions are used in many physics channels. The b-analyses use the reconstructed vertices. The b-tagging efficiency is known to roughly 10% using data-driven methods. The distributions are well described by the simulation even in the far tails.

CMS set up a high-multiplicity High Level Trigger to select events with >70 charged tracks. This trigger led to the analysis presented in a special seminar at the time of the LHCC session in September 2010 on two-particle correlation studies for events with many particles; the publication was accepted on the same time scale.

HEAVY-ION RUN

The heavy-ion programme of CMS was presented to the LHCC in much detail. The programme is in many aspects complementary to that of ALICE. The hermeticity of the CMS detector will provide full coverage for reconstruction of the final state and the DAQ and trigger are very flexible.

The multiplicities will be very high in heavy-ion scattering. CMS plans to read out non-zero suppressed data for all events. The reason is that the baseline of the tracker read-out will shift with occupancy which affects the resolution and efficiency. Depending on the actual value of occupancy the baseline correction is expected to change. Consequently, a 1.5 PByte data volume will be written to Tier-0 by CMS during the heavy-ion run, a substantial fraction of the annual volume. At the same time ALICE expects to have the CERN resources available. An initial stress test of the system performed during the LHCC week showed that the computing centre will be able to cope with the recording and networking if everything goes according to plan. CMS is prepared to throttle back should the need arise. The LHCC supports these plans of CMS and encourages CMS and ALICE to negotiate a policy for relief actions beforehand in case a bottleneck arises during the heavy-ion run.

The heavy-ion run is an effort well supported by the entire CMS Collaboration; the data taking is well prepared. Heavy-ion experts will be deeply involved in the data taking.

CMS UPGRADE

A preliminary copy of the upgrade plan has been made available shortly before the September 2010 session of the LHCC. The goal of this document is to cover all updates for the decade, whose timing is largely driven by the shutdowns in 2012 and 2016.

The Committee took note of the CMS upgrade plans and encourages the CMS Collaboration to further their studies and continue developing their experimental design. The LHCC will discuss extensively the CMS upgrade plans at its session in November 2010 and encourages preliminary discussions with the funding agencies on possible commitments to be addressed in detail at the April 2011 session of the Resources Review Boards.