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PRINCIPAL LHCC DELIBERATIONS

32ND 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 November 2010 and March 2011.

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
Hadron Calorimeter (HCAL)	HCAL noise.	The 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. HPDs will be replaced in 2016 and PMTs in 2013.

STATUS OF THE EXPERIMENT

DETECTOR

The LHCC congratulates CMS technical coordination on a successful programme of work during the 2010-2011 Technical Stop, which included tasks such as the Hadronic Forward (HF) Calorimeter phototube sleeve replacement, the reduction of the Tracker cooling leak rate, mitigating the effects of the transient pressure changes in the Tracker cooling system and commissioning the magnet cold box regeneration at full field. Additionally, CMS is progressing with the hardware infrastructure needed for operations, maintenance and upgrade activities. The TOTEM T1 Telescope arms were successfully installed within the CMS detector envelope during the 2010-2011 Technical Stop.

TRIGGER & DATA TAKING

CMS data collection has resumed smoothly as beam returned in March 2011. CMS has the operational issues associated with the 2011 and 2012 data collection period in hand, including coping with anticipated levels of event pile-up. The radiation issues for the CASTOR Calorimeter have been reviewed with 2010 data and simulation, and found to be acceptable for 2011. The initial trigger menu (tuned for $5 \times 10^{32} \text{ cm}^{-2} \text{ s}^{-1}$ to $1 \times 10^{33} \text{ cm}^{-2} \text{ s}^{-1}$) is targeted to remain under 300 Hz. Trigger condition emulations match rate measurements to within 30% for a low luminosity fill. More will be known after data collection at nominal conditions is compared to the emulations, enabling some confidence in planning the evolution of the trigger menu as the instantaneous luminosity increases. CMS is considering increasing the trigger rate from 300 Hz to 400 Hz late in the 2011 if conditions

reach at least $2 \times 10^{33} \text{ cm}^{-2} \text{ s}^{-1}$, primarily to maintain thresholds for searches in the presence of pile-up and possible detector effects. Studies have been performed on the physics impact of increasing the rate for Higgs to di-photons, Higgs to WW for the electron-muon and electron-electron final states, and some SUSY models. These studies are progressing and enabling CMS to understand the trade-offs in physics potential balanced against the possible need for more computing resources or economies to live within the nominal resources. CMS is encouraged to continue these studies to enable them to make informed choices and as an element for a strong case for increased resources should the need arise.

COMPUTING

Planning for computing resource needs at all Tiers has reached a level of sophistication that accounts for changes to the beam month by month. Total computing resource estimates for 300 Hz and 400 Hz for 2012 have been presented to the Computing Resource Scrutiny Group (CRSG), with the 400 Hz option requiring 30% more resources for computing. CMS has found some operational economies that can be made in the computing model in order to fully support 300 Hz within the deployed resources for 2011; these changes include a requirement that the physics groups migrate quickly to new versions of the reconstruction as they become available. The LHCC encourages CMS to continue to find ways to adapt the computing model to deal with resource constraints while maintaining flexibility to increase the trigger rate if justified as beam conditions change over the course of the next two years.

PHYSICS

CMS Collaboration is making excellent use of the 2010 data to produce physics results with 38 papers in publication, 13 in collaboration review and many additional analyses to be presented at the winter conferences. The detector performance is well understood. CMS is expected to continue producing a rich programme of physics as more luminosity is integrated. In short, the CMS Collaboration has in a single year measured the key features of the Standard Model, developed the sophisticated analysis tools and techniques required to search for new physics and already has an excellent understanding of their detector and its simulation. By all accounts, 2010 was a remarkably successful year for CMS.

There are on-going discussions concerning the feasibility of a forward physics programme in collaboration with TOTEM. This programme must take place with special runs given the typical instantaneous luminosity during this running period. The integration of TOTEM in the CMS readout infrastructure, although technically feasible, seems not to be a realistic goal for 2011. There are, however, investigations on whether a common trigger signal can be brought into operation. The LHCC encourages further discussions on an integrated readout.

CMS UPGRADE

The CMS Draft Upgrade Technical Proposal, while needing some modifications and schedule adaptations, does provide a road-map for CMS that is sufficiently well documented to enable CMS to pursue avenues of funding in parallel to the development of detailed Technical Design Reports. The case for additional forward muon stations to complete the high luminosity Muon Detector is well established with a planned installation in 2013 and 2014. CMS is adapting to the implications of the decisions to change of schedule and run LHC in 2012. They note that installing a smaller diameter beam pipe in the 2013/2014 Shutdown is a necessary step towards retaining the option of installing

the upgraded Pixel Detector according to the original schedule, by exploiting an extended Technical Stop. Improved studies of the proposed upgrade Pixel Detector were presented as were preliminary results from fast simulation studies for $ZH \rightarrow \mu\mu bb$. These results are promising for ultimately demonstrating the physics case for the upgraded Pixel Detector necessary for a Technical Design Report. The Draft Upgrade Technical Proposal also includes critical improvements to the infrastructure, including building an additional helium compressor pair to provide redundancy for a critical single point of failure for the magnet. CMS will update the Draft Upgrade Technical Proposal to provide a reference for the overall programme of work, a preliminary cost and schedule, and a basis for the physics case. A much shorter working document will be produced that gives the overall scope of work, costs and timeline and will be more manageably updated in light of any possible future schedule changes.