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PRINCIPAL LHCC DELIBERATIONS

33RD MEETING OF THE ATLAS RESOURCES REVIEW BOARD

17 OCTOBER 2011

EMMANUEL TSESMELIS

SCIENTIFIC SECRETARY, LHCC

GENERAL

This document summarizes the principal LHCC deliberations concerning ATLAS at the Committee's sessions in June 2011 and September 2011.

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

CONCERNS FROM THE PREVIOUS ATLAS RESOURCES REVIEW BOARD

SUB-SYSTEM	CONCERN	STATUS
Semiconductor Tracker (SCT) & Pixel Detector	Failure of optical links.	The mitigation plan consists of removing the Pixel Detector in 2013 and replacing the existing Service Quarter Panels (SQPs) with new SQPs whose lay-out facilitates access to the optical links.

STATUS OF THE EXPERIMENT

DETECTOR

In terms of overall detector performance, ATLAS is progressing very well. Minor issues have been identified, but in line with what may be expected with detectors as complicated as ATLAS and with the desire to always have a full working detector. ATLAS has a few minor issues that will be discussed below but nothing that is impacting the physics programme. At the time of the LHCC meeting in September 2011, the machine has delivered a very impressive 3.3 fb^{-1} of data and ATLAS has >3 fb^{-1} on tape. Data taking efficiency is 94% for 2011 and the overall data quality for top physics (the most stringent since it requires all detector systems to be working well) is at 90%; while for less stringent analyses it can be as high as 98%. At the June 2011 LHCC meeting the Committee noted that several detectors were experiencing high voltage trips at the highest store intensities. That has been much less of a problem by the September 2011 LHCC session even with the dramatic growth of instantaneous luminosity during this period.

The Pixel Detector's optical links have been troublesome for quite some time. The failures are still only in the read-out racks – none of the links on the detector have failed thus far. As a reminder, the working hypothesis is that it could be correlated with the number of cycles – and those optical links in the read-out racks distribute clock information and thus work much harder than those on the detector, which only send data. However, there is mounting evidence that the failures might be humidity related. The mitigation plan consists of removing the Pixel Detector in 2013 and replacing the existing Service Quarter Panels (SQPs) with new SQPs whose lay-out facilitates access to the optical links. Thus, if failures occurred inside the detector in the future, repairs could be made during the annual Technical Stop whereas now repairs are impossible. This solution comes with the risk of performing a very invasive procedure on what is still an excellent working detector system. ATLAS has therefore established a Task Force to perform a risk analysis with the goal of having an answer

and making a decision on how to proceed by summer 2012. As a reminder, there are additional upsides of performing this swap if it can be done well. The Pixel Detector currently has 97% of all channels operating. Two of those 3% of dead channels could be fixed. It would facilitate the installation of the Insertable B-Layer (IBL) because it could be done on the bench and not in the collision hall and currently at the highest expected luminosities, the "busy fraction" will be quite high. This could be mitigated by installing additional read-out fibers and Read-out Drivers (RODs). Finally, if the SQPs are replaced, a diamond telescope could be installed as an additional handle on measuring the luminosity.

The Committee also noted that the LAr Calorimeter optical links had also been troublesome. These faulty links were replaced last winter and there have been no further problems, so this is a solved problem and will be removed from the LHCC "watch list".

The ALFA Roman Pots were installed last winter. Commissioning had begun but is still incomplete. The pots have been calibrated and interlocked. The drive system on one side operated fine and was commissioned. There was a fault with the Programmable Logic Controller (PLC) controlling the pots on the other side. Rather than try to affect repair with beam in the machine (which could be risky) ATLAS decided to stop. Since then, the PLC has been replaced and it is now complete. ATLAS expects two LHC machine stores in September-October 2011, which it will use to get physics out of these devices.

At the June 2011 LHCC session, the LAr Calorimeter had a significant dead read-out region, with 1/64th of two layers being off due to a blown fuse in a clock distribution board. The experiment was able to devise some very clever fixturing with remote cameras which allowed them to make the repair in what was originally assumed to be in an inaccessible region. That problem is fixed and the LAr Calorimeter is working well.

Over the summer, thunderstorms have caused a number of power glitches which have adversely affected the Tile Calorimeter. Currently, 3.5% of the 256 drawers are experiencing failures. The problem is mainly in the power supplies which have been known to be quite sensitive. The experiment has designed new supplies and has placed an order for 256 new ones to fix the entire detector in the 2013 shutdown. Up to 40 new power supplies from the pre-production are now in house. The plan will be to install these 40 in the 2011-2012 Technical Stop and to repair the broken drawers and make the most critical regions more resilient by upgrading those supplies.

OPERATIONS

ATLAS continues to make rapid and impressive progress The accelerator has continued to exceed expectations in terms of its ability to deliver luminosity reliably after only a relatively short period of time. ATLAS continues to adapt gracefully to ever more demanding beam conditions with initial instantaneous luminosities now reaching 3.3×10^{33} cm^{-2} s^{-1} and as many as 20 interactions per crossing. The trigger systems are keeping up and the granularity of these sophisticated detectors and sophisticated reconstruction algorithms are able to cope with what is now in many ways the expected design condition.

With the impressive accelerator performance, the experiment is having now to cope with an average of 12 interactions/crossing and to handle as many as 20 interactions/crossing in some collisions. The reconstruction algorithms and physics algorithms are sufficiently sophisticated to make sense of these events and still maintain efficiency.

TRIGGER AND COMPUTING

The trigger functioned well over the last few months. ATLAS had adopted a strategy where it held the trigger settings fixed for its summer conference data set to facilitate ease in analysis. Once that data set was established, the experiment tightened its single lepton trigger criteria in order to adapt to the increased instantaneous luminosity at the beginning of stores. The Level-1 trigger is operating consistently at 50-65 kHz and the plan will be to maintain it at that level for the foreseeable future. For 2011, the experiment is writing data to tape on average at 275 Hz but hits peaks of 500 Hz at the highest store luminosities.

In terms of computing, the offline systems have been able to keep up with both data processing and reconstruction demands as well as the analysis efforts. Its flexible computing model continues to pay dividends. The experiment is now doing dynamic data placement – moving data where it is needed. In so doing, the experiment has also realized that the amount of data it is moving is less than expected – meaning people are focusing on certain popular data sets at the moment. The current data sample is sufficiently small that it can be easily moved to local machines and thus GRID computing is not fully used for analysis purposes. This will not be the case much into the future where analyzers will be forced to make more use of GRID services. As a result, computer usage patterns are still in flux and long term plans have to remain flexible until things stabilize further. ATLAS has requested a doubling of its Tier-0 CPU to deal with the increased reconstruction time as a result of increased pile-up.

ATLAS is in the process of concluding its first and only major reprocessing of the 2011 data set in 2011. Over the course of the year it has improved tracking and muon alignment significantly. The reconstruction algorithms are improved as well as the pixel hit clustering algorithms. The reprocessing has been done in a few short weeks once all the validation checks have been performed. ATLAS expects this reprocessing campaign to be completed in early October 2011.

PHYSICS

ATLAS had an impressive showing at the summer conference season with about 60 new results for the International Europhysics Conference on High Energy Physics and for the International Symposium on Lepton Photon Interactions at High Energies, which were highlighted by the ATLAS Higgs results and searches for physics beyond the Standard Model.

ATLAS has submitted 54 papers thus far in 2011 alone on collision data and made 138 conference notes available in that same time period. That can be compared with 16 papers in 2010. The highlights of the summer were the Higgs results with up to 2.3 fb^{-1} of data, in which it has ruled out at 95% CL most of the high mass window between 146 and 470 GeV. The low mass channels ($H\rightarrow\gamma\gamma$, $H\rightarrow WW^*\rightarrow l\nu l\nu$ and $H\rightarrow ZZ^*\rightarrow 4l$) are sufficiently sensitive that ATLAS could be able to either exclude or find a Higgs from 114 GeV on up with the data expected by the end of 2012. ATLAS presented a wide range of search results for physics beyond the Standard Model and has set stringent limits on some SUSY models below 600 to 800 GeV. As for the Standard Model topics, ATLAS measured the top quark production cross-section with 7% uncertainty and the top quark mass to 1.6% uncertainty. The precision of the cross-section is already competitive with that at the Tevatron and the top quark mass is close behind. The referees note that the lack of enthusiasm for heavy flavor physics has put ATLAS behind in important analyses such as $B_s\rightarrow\mu^+\mu^-$.

ATLAS UPGRADE

The LHCC took note of the Insertable B-Layer (IBL) project as described in the Technical Design Report. The LHCC **endorses** the plans for early installation of the IBL detector.The experiment has evaluated the two competing technologies (3D and planar) and deemed that both were very mature and both could be made to work within the envisioned timeframes and budgets. The experiment decided that the planar solution was more conservative and chose that as its default technology and will order sufficient sensors to complete the entire IBL. However, it proposed a hybrid plan where it would also make 25% of the overall sensors with 3D technology, which would be installed in the forward directions. 3D may offer better resolution in the beam direction and the experiment would like to get additional experience with this technology as it may be the technology for the Phase-2 Tracker upgrade. The Committee felt the approach is sensible and encouraged the experiment to continue with their detector development. The LHCC asked for a short document detailing the hybrid plan, which will be reviewed at the next LHCC session for final approval of the IBL project.

The ATLAS Letter of Intent for the Phase-1 upgrade is still under preparation. ATLAS expects to have a draft in our hand by year's end. The Fast Tracker Trigger (FTK) was approved by the ATLAS experiment to proceed to the Technical Design Report phase. Final design, prototyping, and the complete Technical Design Report are presently planned to be completed by the end of 2012.