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PRINCIPAL LHCC DELIBERATIONS

34TH MEETING OF THE ATLAS RESOURCES REVIEW BOARD

24 APRIL 2012

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GENERAL

This document summarizes the principal LHCC deliberations concerning ATLAS at the Committee's sessions in December 2011 and March 2012.

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 being considered 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

The ATLAS detector performed very well during the 2011 LHC run with no significant outstanding issues; ATLAS recorded data with 93.5% efficiency in 2011 and approximately 84-90% of the 5.6 fb^{-1} of delivered luminosity is available for physics analysis.

The year-end 2011-2012 Technical Stop was both a busy and productive one for the ATLAS Collaboration. A number of detector improvement projects as well as consolidation efforts were undertaken. Forty new low-voltage power supplies were installed for the Tile Calorimeter and 10 new power supplies for the LAr Calorimeter. The Tile Calorimeter now has less than 1% dead channels (this includes one power supply that recently failed in a drawer that was not touched in the Technical Stop). The End-cap EE muon chambers were installed on the Insertable B-Layer (IBL) insertion side and a partial system of EE chambers was installed on the opposite side. The magnet cryogenic compressors were refurbished at the construction firm. The compressors now show 20% less power, implying that all four of them have to operate simultaneously (only three were used in the past). This is not a concern for this year as there is enough headroom. Radiation measurements were also performed in the hall and in most cases agree to within 30% of what simulations show. This gives the Collaboration confidence that the simulations provide an important tool to understand and predict long-term detector ageing. Finally, additional neutron shielding between the calorimeter and muon spectrometer in the forward region was added to address a problem in that region.

One other area of concern is with the detector Read-Out Subsystem (ROS). The ROS read-out system is based on commercial PCs with custom buffers that read out the detector. As the experiment pushed this system to its design specification and beyond by installing higher

performance PCs, intermittent problems arose toward the latter part of the 2011 data run resulting in some ROS failures. To address this issue, ATLAS replaced all of the network interface cards, and so far this new hardware configuration is working reliably. Alternate PC motherboards have been purchased and will soon be available in case the problem recurs.

COMPUTING

ATLAS has adopted the concept of "data parking", whereby the experiment would open its trigger bandwidth beyond its current processing bandwidth and collect a data sample that it would not otherwise have access to. This data would just be stored and processed in 2013 and not in real time. This works because of the Long Shutdown 1 in 2013-2014. ATLAS's current thinking is to park up to approximately 150 Hz of data, about half of which would be from J/ψ triggers and the other half a mixture of other triggers. By comparison ATLAS operated with 350 Hz in 2011 and plans to operate at 400 Hz this year. The LHCC applauds the experiment for thinking outside the box and for finding ways to make optimal use of the provided collisions.

The ATLAS Collaboration has done a lot of work in its offline and reconstruction algorithms. The Monte Carlo simulation time is now 50% faster than it was at the start of 2011. Furthermore, the "fast" simulation effort is maturing and is now being used for some physics analyses. A new software release was recently cut which has many new tracking, lepton identification, and electron/photon improvements, mostly aimed at better performance in a high pile-up environment. This new release also has the modern release of the various event generators. ATLAS recently launched its 8 TeV centre-of-mass Monte Carlo effort utilising this release.

PHYSICS

ATLAS has submitted 128 papers for publication in refereed journals and more than 300 ATLAS Notes with results for conferences. The ATLAS search for the Standard Model Higgs boson is well underway, with ATLAS currently reporting an excess of events being observed around a Higgs mass of ~126 GeV. The 2012 LHC run will allow ATLAS to either discover or exclude the Standard Model Higgs boson. ATLAS has also performed a variety of searches for physics beyond the Standard Model and has placed stringent limits. SUSY limits are now approaching 1 TeV or beyond in many search channels, while mass limits on singly-produced new particles from other non-Standard-Model scenarios are beyond 1-2 TeV in many cases. Thus far, no significant signs of non-Standard-Model physics have been shown. ATLAS has an impressive top quark programme, releasing a broad variety of results, including top quark mass and cross-section results as well as its own observation of "single-top" produced through the electroweak interaction. There are papers on a range of QCD and electroweak physics, including recently a broad range of di-boson results, diffractive physics, as well as a successful heavy-ion set of publications.

ATLAS UPGRADES

PHASE-0 UPGRADE

In terms of the LHC Long Shutdown 1 (LS1 in 2013-2014), the IBL is on track. For ATLAS to have a chance of installing this device over a year earlier than it was originally foreseen everything had to go right. The wafers (sensors) needed to be produced, cut and tested with good efficiency, a read-out chip needed to be fabricated that worked, and low mass cables needed to be procured, amongst other tasks. The plan of installing a hybrid technology with 75% planar detectors and 25% 3D is still the default. Sufficient quantities of both technologies exist now. The group is busy making fixtures for

the case in which the entire detector is planar and for the case in which the detector is a hybrid. The group is now beginning the fabrication process, and there are no showstoppers expected.

Other Phase-0 work such as the new evaporative cooling plant, shielding, improved magnet cryogenics and calorimeter low-voltage power supplies are also on track. ATLAS expects each of these to be ready for installation in LS1 beginning next year.

The Collaboration continues actively to pursue the work needed for the Service Quarter Panel (SQP) replacement. This work was begun to address a potential danger with failing optical links and the current inability to make repairs should they fail. Furthermore, currently the Pixel Detector has between 4 – 5% dead channels due to module electrical or mechanical failures. Replacement of the SQPs would provide the opportunity to repair most of these. The new SQPs give a more uniform mass distribution in this very important region and allow the Collaboration to increase the read-out bandwidth by doubling the fibre read out – something that could be critical if the accelerator performs above expectation. The fabrication and testing of the new SQPs is going well and the Collaboration will decide in summer 2012 on the SQP installation.

PHASE-1 UPGRADE

At the LHCC session in December 2011, the ATLAS Letter of Intent (LoI) for the Phase-1 upgrades was presented to the LHCC for review. This set of upgrades is planned for the Long Shutdown 2 (LS2) scheduled for 2018 and will prepare the experiment for 2-3 $\times$ 10^{34} cm^{-2} s^{-1} running with 25 ns bunch spacing. With one exception, all of the upgrades put forward in this LoI are designed to maintain the physics capability of the experiment in ever more challenging beam conditions. These upgrades include new muon wheels with greater trigger granularity, a fast track trigger (FTK) for use with the silicon and pixel detectors, a higher-granularity calorimeter Level-1 (LVL1) trigger, a new tile 'crack-gap" scintillator and a full suite of Trigger/DAQ upgrades needed to take full advantage of the above hardware changes.

The one exception is the introduction of an ATLAS Forward Physics (AFP) detector. This is a new detector planned to be installed at 210 m at both sides from the interaction point. It is designed to give the experiment new diffractive physics capabilities and complement the existing ALFA Roman Pot programme.

The Committee considers that the LoI presented was excellent. It is very well written and the thought process behind was already quite mature. The LHCC considers that the physics justification was very well made for all of the upgrades that were designed to maintain capability. The Committee also considers that the technology options or choices were sound and sensible and consider that this programme could be executed and with it the Collaboration would be able to accomplish its physics goals.

The physics case for the AFP detector rests on the capability of using a proton double tag to constrain the centrally produced system and includes Higgs production and WW final states in a high-luminosity environment. Superb timing, at the 10 ps-level, will be required to associate the proper primary vertex and remove accidentals. Whereas the technical viability of the approach will have to be demonstrated, this detector extends the physics capabilities without interfering with the upgrade work on the detector proper.

The LHCC **endorses** the LoI and encourages the Collaboration to present its plans to the ATLAS Resources Review Board and Funding Agencies and to proceed to the next step of detailed Technical Design Reports for each upgrade.