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PRINCIPAL LHCC DELIBERATIONS

36TH MEETING OF THE ATLAS RESOURCES REVIEW BOARD

16 APRIL 2013

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GENERAL

This document summarises the principal LHCC deliberations concerning ATLAS at the Committee's sessions in December 2012 and March 2013.

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. The highlight of the recent period has been the further understanding of the recently-discovered new particle that is consistent with a Higgs boson.

CONCERNS FROM THE PREVIOUS ATLAS RESOURCES REVIEW BOARD

SUB-SYSTEM	CONCERN	STATUS
Transition Radiation Tracker (TRT)	Xenon gas leaks	There was not a significant change in the TRT leak rate since December 2012. However, the experiment did fill a few small sections of TRT with argon during the proton-Pb run with some positive effect on the electron identification in those regions. The working hypothesis is that the leaks result from brittle plumbing caused by ozone either at or close to the elbows. ATLAS is optimistic that the end-cap leaks can be fixed during LS1, but the ones in the barrel are inaccessible.

STATUS OF THE EXPERIMENT

PHYSICS

ATLAS has submitted or published 240 papers with collision data to date with a total of 470 conference notes. Approximately 30 new and updated analyses were shown at the Moriond Conference, including a full update of Higgs decays in the vector boson channels. Spin-parity 0+ is favoured, and the signal strength continues to look Standard Model-like. ATLAS expects to release many more search results with the full data set in the coming weeks and months.

ATLAS published its 2011 luminosity paper with a final 1.8% uncertainty. The 2012 uncertainty is 2.8% but will be reduced as the differences between the various relative luminosity estimators versus time are better understood.

OPERATIONS

The ATLAS detector reached the end of LHC Run I operating well. ATLAS has completed a very successful 2012 proton-proton run, during which the LHC machine delivered an integrated luminosity to ATLAS exceeding 23 fb^{-1}. Around 90% of all proton-proton data delivered is good for physics analysis. ATLAS also completed a very successful proton-Pb run at the start of 2013 (with 95% efficiency). A very important few days of low-energy proton-proton running at the start of 2013 and 13 pb^{-1} of proton-proton collision data with 25 ns bunch spacing were also accumulated. The Long Shutdown 1 (LS1) is underway and the ATLAS detector is being opened up.

COMPUTING

ATLAS is using its computing resources fully. In preparation for Run II, the experiment is reviewing its analysis model in an attempt to merge derived analysis formats back into the Analysis Object Data (AOD). ATLAS is planning a 1 kHz trigger rate for 2015. This will enable them to maintain current trigger thresholds in the higher energy and higher luminosity environment expected. With this 1 kHz trigger output rate, the challenge is to use substantially less CPU per event, and to gain more in terms of storage. The experiment is trying to reduce the number of copies of data in order to fit within a "flat" computing budget.

LONG SHUTDOWN 1

The experiment has two significant challenges to deal with during the LS1 in addition to the consolidation plans and installation of the Insertable B-Layer (IBL): 1) remove the Pixel Detector to install new Service Quarter Panels (SQPs) to provide better access to the read-out opto-boards, and 2) address the Transition Radiation Tracker (TRT) leaks in the end-cap.

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The decision to remove the Pixel Detector and bring it upstairs to replace the SQPs and prepare for IBL installation was made on the basis of risk. It was deemed a much safer operation to do that than to install the IBL support tube *in situ*. Furthermore, not replacing the SQPs has been estimated to impact the b-tagging efficiency by 20% or more by the end of the decade. Finally, after careful studies and measurements, the experiment decided to remove insulation material between the central region of the IBL and the beam pipe, being convinced that its presence is not necessary for safe cooling of the detector during the beam-pipe bake-out. A bump-bonding problem for the IBL modules has been resolved, although the original cause is not fully understood. The production has now been switched to a more modern bump bonder that is solderless. This is working well thus far. The time lost solving the bump-bonding problems means the IBL schedule is tight but achievable.

There are more than 250 work packages that are planned for execution during LS1. The main project includes the IBL and SQP installation. The Tracker will also get a new evaporative cooling plant. There will be new power supplies installed in the calorimeter, new muon chambers, and a rework of the cryogenic and the electrical systems. The ATLAS teams are working 12-hour shifts from 7am to 7pm leaving overnights and weekends as contingency.

UPGRADES

The experiment presented the LHCC with its Phase-2 Letter of Intent (LoI). The LoI covers the upgrades planned for installation in the early 2020s, during Long Shutdown 3 (LS3), in preparation for the High-Luminosity LHC (HL-LHC) phase of operation. The LoI content is consistent with previous presentations and discussions. The physics case includes improving substantially the measurements of the Higgs boson properties, as well as significantly increasing sensitivity to new physics. The upgrades are well motivated. They are designed to handle the HL-LHC machine goals, maintain complete physics reconstruction capability and partially even improve the resolution. The case is compelling.

ATLAS intends to replace the inner tracker, adapt the calorimeter read-out for the high luminosities, add a track trigger, upgrade the forward calorimetry (if conditions require it), and maintain as far as possible the current trigger thresholds. The various detector upgrades are of varying sizes and degree, with the inner tracker taking more than half the required resources. The entire CORE cost of the upgrade is estimated to be 230 MCHF.

Detector options are spelled out in the LoI while exact technologies and final detector configurations are not yet chosen. The LoI describes a technically sound and realistic programme with the options and risks well defined. The upgrades are well matched to the HL-LHC physics programme and its new and challenging environment. The LoI provides an excellent summary of the planned design and will allow the ATLAS Collaboration to proceed to the next steps, including continuing R&D where needed to consolidate the remaining options. The LHCC **supports** the continuing exploration of innovative solutions, in particular in the areas of sensors and front-end processing, especially in cases where early technology decisions are not needed.

The LHCC **welcomed** the LoI, which provides excellent guidance for the required R&D and which is well motivated by the required physics capability of the detector. The Committee **fully endorses** the strategy outlined and recognises the urgency for R&D on the technologies, both because of sheer scope and because of their innovative character. The overall plan will be presented to the Resources Review Boards and Funding Agencies to support the R&D. Technical Design Reports for each upgrade are expected in the coming years, which will describe the technology selection and outline the particular physics benefit for that detector implementation.