CERN-RRB-2010-008
20 April 2010

ATLAS Progress Report for the April 2010 RRB

1. Introduction and Collaboration Composition

The period since the October 2009 meeting of the RRB has been exceptionally exciting for the ATLAS Collaboration. Since the LHC recommenced operations in November 2009, a rapid sequence of events culminated in the first collisions at the unprecedented energy of 7 TeV in the centre of mass. With these events, the Collaboration has experienced both the satisfaction of the completion of its twenty-year campaign to construct an apparatus to explore a new energy frontier and the excitement of embarking upon a new twenty-year campaign of measurements and discoveries.

The chronology of events for ATLAS started with first beams circulating in the LHC at 450 GeV on 20 November 2009, followed by observation of first collisions at 900-GeV centre-of-mass energy just three days later, on 23 November. During the following four weeks, ATLAS operated smoothly and collected a sample of events adequate to publish its first physics paper, in addition to reaching near-nominal performance for the long LHC physics run at 7 TeV. Before the end of the first LHC run on 16 December, ATLAS also recorded data with 2.36 TeV collisions, the world record at the time. Following the Winter 2009/2010 technical stop, the LHC resumed operation on 27 February. On 19 March, first (single) beams were ramped to the full 3.5-TeV energy for 2010, and ATLAS began to use these beams to study its detector. Finally, on 30 March, the LHC provided, and ATLAS observed, first collisions at 7 TeV.

The ATLAS detector 'as built' and its basic performance have been documented in a comprehensive publication in the Open Access journal JINST. It can be briefly recalled that the detector concept uses a superconducting magnet system with a Central Solenoid around the Inner Detector and large air-core Toroid Magnets for the Muon Spectrometer. Between the two are the Liquid Argon and Tile Calorimeters. A hierarchical three-level Trigger and Data Acquisition system collects the data for the collaboration-wide computing and physics analysis activities. The initial staged detector configuration, now operational, corresponds to the financial framework which was defined in the Completion Plan as presented and approved at the October 2002 RRB (CERN-RRB-2002-114rev1) and updated at the October 2006 RRB (CERN-RRB-2006-069). An extensive report (*Expected Performance of the ATLAS Experiment - Detector, Trigger and Physics*, CERN-OPEN-2008-020, arXiv:0901.0512v3) summarizes evaluations of the detector performance and of the experiment's physics potential.

Early data-taking experience has demonstrated that the ATLAS detector performs very well, with only a few percent of non-operational channels and with data-taking efficiency that has reached greater than 95%. Furthermore, detector performance is generally better than was expected for this stage and is close to nominal. Agreement of simulation and data has also been found to be very good, benefiting from years of work with data from test beams and cosmic rays. The ability of the Collaboration to extract results very quickly, in just a few hours in some cases, has demonstrated that the whole experiment from detector operation to analysis on the wLCG operates efficiently. The first ATLAS journal article on collision data *Charged-particle multiplicities in pp interactions at sqrt(s) = 900 GeV measured with the ATLAS detector at the LHC*, CERN-PH-EP/2010-004, is now in press with Physics Letters B. ATLAS is well prepared for the upcoming long LHC physics run in 2010/2011.

The ATLAS Collaboration now consists of 173 institutions from 37 countries with almost 3000 scientific authors (including approximately 1000 students). At its February 2010 meeting, the Collaboration Board endorsed the admission of Northern Illinois University (USA). At this meeting an Expression of Interest was announced from a joint South African team from the Universities of Johannesburg and Witwatersrand.

On 1st January 2010, Gregor Herten (Albert-Ludwigs-Universität Freiburg) succeeded Kerstin Jon-And as Collaboration Board Chair. Jon-And is now Deputy Collaboration Board Chair for 2010.

2. Maintenance and Operation of the Magnet System

The ATLAS superconducting magnet system comprises the Central Solenoid (CS), the Barrel Toroid (BT), two End-Cap Toroids (ECT), and their common services.

Status: The magnet system has been running smoothly for six months. Some cryogenics problems, *e.g.* clogging of some filters in the cold circuits, and some heating problems in the current leads were remedied during the 2009/2010 technical stop. Major consolidation work on the magnet services is planned for the long LHC shutdown in 2012. Plans include installation of a redundant main refrigerator compressor and adoption of booster compressors, which will preclude a possible year-long ATLAS downtime in case of main compressor failure. Similar consolidation work is also foreseen for the electrical, vacuum, and controls services.

Changes: None.
Concerns: None.
Plans: Routine maintenance and operations of magnet system and services. Consolidation work, including redundant main refrigerator compressor, during 2012 shutdown.

3. Commissioning, Maintenance and Operation of the Inner Detector

The Inner Detector (ID) combines three concentric sub-systems, the Pixel detectors, the Silicon strip detectors (SCT), and the Transition Radiation Straw Tracker (TRT), listed from inside to outside.

Status: The entire Inner Detector has been operating with very good efficiency. Largely as a result of the detailed calibration work of 2009, including alignment with cosmic ray data, Inner Detector data was rapidly useful for physics studies and became the basis of the first ATLAS physics publication. An Inner Detector performance paper based upon cosmic ray data is presently undergoing the internal ATLAS review process prior to journal submission.

The evaporative cooling plant has been operating with close to 100% efficiency, and has been always available during collisions. Nonetheless, leaks in the cooling plant and wear of the piston rings in the compressors continue to be concerns. In February 2010, a new problem was observed in the cooling plant, when the inlet valves failed on three compressors (now fixed). Fortunately, there are seven compressors in the plant, and the system can operate with just four. Only one of 204 cooling loops is not being operated, affecting just 13 of 4088 SCT modules. Additional sensors installed on the distribution racks have allowed more frequent leak down measurements to track the evolution of leaks inside the detector volume. These tests have so far revealed that the number of Pixel circuits with a high leak rate is stable, and one new SCT circuit has developed a leak.

There have been no additional failures of the thermal enclosure heater pads since three of eight barrel pads failed during June/July 2009. These pads are large-area copper-kapton heaters that should ensure thermal neutrality of the silicon volumes compared to the TRT, and of the Inner Detector volume compared to the outside. Although a thermal configuration that does not lead to over-cooling of the TRT has been established, there are concerns for the longer term, after the SCT modules have been exposed to significant radiation and need to operate at reduced temperature. A risk analysis continues, along with more refined studies of bias voltage and leakage current evolution as a function of radiation dose and temperature. A more effective coolant mixture is also being investigated. A modification of the heater pad power supplies to reduce the chance of further failures is being prototyped.

The off-detector opto-transmitter plug-ins used in both the Pixels and SCT that were previously a reliability concern are operating well. There has been only one additional failure since October 2009.

Changes: None.
Concerns: Maintenance of the compressor plant remains at a high level, and a new failure mode of the valves has been observed. Barrel thermal enclosure heater pad failures may affect long-term thermal management and hence silicon detector lifetime.
Plans: Closely monitor leak rates of pixel cooling circuits. Develop alternative technologies to replace compressor plant. Refine models for silicon radiation damage as a function of temperature.

4. Commissioning, Maintenance and Operation of the Calorimeters

The calorimeter systems include a liquid argon (LAr) electromagnetic calorimeter, a barrel and two extended barrel Tile hadronic calorimeters, end-cap liquid argon hadronic calorimeters (HEC), and liquid argon forward calorimeters (FCal).

Status: All calorimeter systems have performed well during the data-taking period at the end of 2009 and in 2010. Since the detector was closed in May 2009, two main failures have continued to affect the LAr calorimeter: the loss of redundancy for five low voltage power supplies (LVPS) and the failure of optical transmitters (OTx) on nineteen Front End Boards (FEB), which corresponds to 1.3% of the total acceptance, and on three controller boards. These figures include one additional LVPS and two additional OTx failures since November 2009. As the medium and long-term reliability of the retrofitted LAr LVPS is a concern, it has been decided to purchase LVPS replacements. The new LVPS will be available for the shutdown in 2012, and they will be operated on a large-scale test bench prior to installation. The cause of the LAr optical transmitter failures is still being investigated. Two backup solutions for possible future installation are in development. In the Tile calorimeter, four LVPS and one front-end drawer (out of 256 drawers) have malfunctioned, affecting 2% of the Tile cells. Over the past three years, the Tile calorimeter LVPS have shown a failure rate of ~ 3-4 LVPS per year. The most recent two LVPS failures occurred in the beginning of 2010, after continuous operation for 2-3 years. In order to address this reliability concern, the thirty spare Tile calorimeter LVPS will be refurbished by summer to be more robust against trips and to be available for replacement during the 2010/2011 technical stop. In addition, a prototype of a new LVPS design has been constructed and tested in a realistic environment. Five additional prototype units will be constructed and tested for stability and robustness.

A wealth of cosmic ray and test beam data has been used to tune the calorimeters and measure their performance in advance of the availability of collision data. Two LAr performance papers based on cosmic ray data have been submitted to *European Physical Journal* C (EPJC), and a draft Tile calorimeter performance paper based on cosmic ray data is in the internal ATLAS review process. In addition, two performance papers on combined test beam results are in advanced stages of preparation.

Changes: None.
Concerns: Long-term reliability of the LAr low voltage power supplies requires replacement. Medium- and long-term reliability of the Tile Calorimeter low voltage power supplies and long-term reliability of LAr optical transmitters may require future replacement.
Plans: Continue development of long-term backup solutions in areas of concern, including purchase of new LAr low voltage power supplies. Purchase additional (4%) spare photomultiplier tubes for Tile calorimeter.

5. Commissioning, Maintenance and Operation of the Muon Detectors

The Muon Spectrometer is instrumented with precision chambers for the momentum measurement (Monitored Drift Tube chambers, MDTs, and for a small high-radiation forward area Cathode Strip Chambers, CSCs) and with fast chambers for triggering (Resistive Plate Chambers, RPCs, in the barrel, and Thin Gap Chambers, TGCs, in the end-caps).

Status: The complete muon chamber instrumentation for the initial detector configuration was available for the LHC start-up in 2008. Installation of additional chambers in the region between barrel and end-caps was started during the 2009 shutdown and will be completed during subsequent shutdowns. The short LHC technical stop between 2009 and 2010 was used to perform routine maintenance, including repair of gas leaks and electronics. The MDT gas system was also thoroughly leak tested, and the water admixture to its gas was finalized. Ventilation of the top barrel RPC sectors was improved in order to reduce the ambient temperature in that region, although the temperature remains somewhat high in certain locations. For 2010/2011 running, the MDT coverage is 99.7%, CSC coverage is larger than 98.5%, RPC coverage is greater than 97.5%, and TGC coverage is 99.4%. Because of redundancy, the trigger coverage for both the RPCs and TGCs is nearly 100%.

Repair of the readout limitation with the Readout Drivers (RODs) of the CSCs is almost complete. The readout rate performance is still being tuned; however, the CSCs are now integrated fully into data-taking. Collision events have been recorded, and commissioning is well underway.

A small number of maintenance issues continue to be monitored. High voltage and low voltage power supplies require regular replacement. RPC gas inlets are fragile, and broken inlets are being replaced as needed during maintenance periods. A batch of RPC high voltage connectors is fragile, and all connectors may be replaced during a future shutdown if necessary. Cracking on a few gas jumpers of MDT chambers has been observed.

Cosmic ray muon data recorded in 2008 and 2009 has been used extensively for commissioning, alignment, and standalone performance studies of the Muon Spectrometer, and for studies of the combined reconstruction of muons using both the Muon Spectrometer and the Inner Detector. Chamber resolutions and efficiencies have been measured and agree with expectations. Preliminary trigger timing of the RPCs was performed with cosmic muons, but must be finalized with muons from collision data. Trigger timing of the TGCs to within one bunch crossing has been obtained from muons produced by a single, low-intensity beam colliding on an upstream collimator ("beam splashes"). The MDT calibration procedure is operational and performing to specifications. A draft Muon Spectrometer performance paper based on cosmic ray muon data is in the internal ATLAS review process and will be submitted to EPJC.

Changes: Full integration of CSCs into ATLAS data-taking. Completion of preliminary trigger timing of RPCs and TGCs. Completion of the support structure for additional small MDT chambers on the C side of the detector.
Concerns: Final CSC readout rate has not yet been demonstrated. High ambient temperature in some regions of the top barrel RPC sectors may lead to RPC ageing.
Plans: Complete improvements to CSC readout rate. Establish final muon trigger timing in the barrel region using collision data. Finish chamber commissioning, particularly of RPCs and CSCs. Provide additional cooling during the next long shutdown in order to further reduce ambient temperature in the top barrel RPC sectors. Monitor maintenance concerns, and implement remedies as needed.

6. Forward Detectors

The forward detectors for the first phase of ATLAS consist of a Luminosity Cerenkov Integrating Detector (LUCID) placed around the beam pipe inside the forward shielding at 17 m from the Interaction Point (IP), of a Zero Degree Calorimeter (ZDC) placed in the absorber structure TAN where the beams enter separate beam pipes at 140 m away from the IP, and of an Absolute Luminosity for ATLAS (ALFA) detector in Roman Pots at 240 m from the IP. A proposal for an ATLAS Forward Physics project (AFP) is being considered as a possible upgrade project.

Status: Both LUCID and the ZDC participated from the beginning of the first data-taking in November 2009. The first LHC collisions were extremely useful for optimizing both these systems. LUCID demonstrated sensitivity to luminosities as low as 10^{26} cm^{-2} sec^{-1}, and the coincidence between its two arms was free of backgrounds. Some minor problems were identified and corrected during the technical stop. ZDC commissioning with beam also revealed some points to improve, and the technical stop was again useful in this respect. The first ALFA detector was installed in the LHC tunnel during January 2010. This first detector will sit in the beam halo during the 2010 run for some initial commissioning.

Changes: Installation of the first ALFA detector (1 out of 8).
Concerns: None.
Plans: Finish commissioning of LUCID and ZDC with collisions. Finish the production of remaining ALFA detectors and validate each detector in the September 2010 test beam. Install remaining ALFA mechanics and detectors in the 2010-2011 technical stop if LHC planning allows. Install the electromagnetic part of the ZDC when the LHCf experiment is removed.

7. Commissioning, Maintenance and Operation of the Trigger and DAQ System

The major sub-systems of the Trigger and Data Acquisition System are the Level-1 Trigger (with the sub-systems calorimeter, muon and central trigger processor (CTP)), the High Level Trigger (HLT), the Data Acquisition (DAQ), and the Detector Control System (DCS).

Status: The Trigger and Data Acquisition System has long been operational at Point-1, since detector installation began. The full trigger and DAQ chain is working well. It operated with excellent efficiency in collision data-taking, approximately 90% in 2009 and better than 95% in early 2010. At this stage, the HLT is still in reduced configuration, as available for the initial staged detector, with about 35% of the final HLT CPU capacity presently installed and operational. The annual technical stop was used for routine maintenance and for consolidation work focused on further improvements to data-taking efficiency and on robust operations for the extended 2010/2011 data-taking period. Significant progress in establishing the timing of the Level 1 Trigger has been accomplished with data from first collisions.

In the 2009 run and for 2010 data-taking to date, the full physics rate (up to ~100 Hz until now) has been recorded using only the Level 1 trigger and two sets of scintillation counters, one on each side of the interaction point. In parallel, the HLT was commissioned with a complete set of trigger algorithms in operation, but not yet rejecting events. A dedicated algorithm running in the HLT provides continuous online measurement of the LHC beam spot in ATLAS, thereby providing useful “live” feedback to the LHC team.

There has been continued consolidation of the operation and monitoring of the TDAQ system as a whole, based on the experience accrued with first collisions. Operational efficiency has been increased by streamlining initialization of detector systems at the beginning of data-taking runs and by implementation of procedures that enable exclusion of faulty elements of the detector readout, and re-insertion when repaired, without interrupting data-taking. These improvements and documentation contribute directly to the excellent data-taking efficiency now achieved. In order to ensure the quality of recorded data, further improvements have been made to the infrastructure used for monitoring data quality based on feedback received from detector systems; moreover, online and offline data quality monitoring tools for TDAQ have been implemented. Improvements have been made to computer security and access in order to prevent deliberate or incidental interference with operations.

The rolling replacement of computing hardware that has reached the end of warranty has commenced. The foreseen purchase and installation of a further 13% of the final HLT has been delayed until second quarter of 2010, reflecting changes in needs due to evolution of the LHC schedule. This purchase will bring the total HLT capacity to approximately 50% of its final capacity.

Changes: Improvements to system stability and operational efficiency. First rolling hardware replacement.
Concerns: None for the initial system. However, it is reminded that in accordance with the Cost to Completion plans, the initial TDAQ configuration was limited in funds. High-Level Trigger processors are being added to the initial configuration as deferred funds become available.
Plans: Continue to commission the trigger and to optimize the full TDAQ and DCS system during collisions. Purchase further HLT capacity during the course of 2010 according to needs.

8. Shutdown Activities and Detector Operations

Status: The 2009/2010 technical stop was used for routine and preventive maintenance activities on the general infrastructure (electricity, cooling, ventilation), magnets, detectors, and trigger and data acquisition. The most important of these maintenance activities have been discussed in the preceding detector sections of this report. In addition, a few additional muon chambers and supports and an ALFA detector were installed. Improvements were also made to the operability of the ATLAS detector, trigger, data acquisition, and control systems, as well as to generic and detector-specific software to assess and ensure the quality of recorded data. Detector commissioning continues now with first data from 7 TeV collisions, and is greatly facilitated by the increased energy and the much larger, and rapidly increasing, data samples.

The annual review of Operation Tasks (OTs) estimated that operating ATLAS requires 600-700 FTE in 2010 (shifts not included). Operation Tasks include all activities essential to the operation of ATLAS, from central shifts and on-call tasks at Point-1 to the computing and data preparation tasks, some of which can be executed remotely. Responsibility for Operation Tasks is shared among the Institutions in proportion to their number of authors. Project leaders and activity coordinators were asked in 2010 to enable more tasks to be performed at remote sites and to streamline certain tasks in order to reduce the overall FTE requirements. Further reductions are expected in the future.

Concerns: Operation (in the broad sense as specified above) requires significant resources for which Funding Agencies need to plan.
Plans: Operate ATLAS throughout the extended 2010/2011 LHC data-taking period. Continue to use early data to tune calibration, alignment, and performance. Perform minimal urgent repairs during the Winter 2010/2011 technical stop, and more extensive repair and consolidation work during the 2012 shutdown.

9. Computing and Software

The collaboration-wide distributed computing infrastructure is fully embedded into the framework of the wLCG, of which ATLAS is a very active partner. In addition to this Grid infrastructure, a very sizable experiment-specific effort is required to interface effectively the ATLAS software suite and analysis framework to the wLCG infrastructure.

Status: The entire ATLAS and wLCG computing and software chain has been operational with real data since ATLAS combined cosmic ray data-taking began in 2008. Since collision data-taking started in November 2009, LHC data has been routinely processed by the Tier-0 centre and distributed worldwide within a few hours of data-taking. In addition, intensive calibration work has been performed at the CAF (Calibration and Alignment Facilty) at CERN. The global Tier-1 computing infrastructure and the reconstruction software have been successfully exercised several times to reprocess cosmic ray events collected in 2008 and 2009, and more recently the 2009 collision data. Large-scale programs of distributed data analysis at Tier-2 centres using simulated and real (cosmics and LHC) data were started in 2009 in order to prepare optimally for the analysis of 2010 LHC data. Simulation production continues using all available resources at Tier-1 and Tier-2 centres, with an average of approximately fifty thousand jobs running concurrently. Shifts are operated at the Point-1 control room and worldwide to support production operations and user analysis.

Software performance related to distributed database access and to speed of distributed analysis jobs has been improved. Significant reductions have been made to the execution time of GEANT4-based simulation production, without deterioration of the quality of the simulated data.

ATLAS has made full use of the computing resources made available at all wLCG sites in 2009, including opportunistic usage of idle CPU cycles. Additional copies of RAW and event summary data (ESD) produced during the short LHC run at the end of the year have been distributed in order to ease access to the complete information for first LHC events to all members of the Collaboration. Tools have been developed to remove from disk these additional copies when disk space is needed for new and more popular data. Analysis on the wLCG is in full swing, with several hundreds of people routinely submitting jobs.

The present LHC machine schedule, with an extended data-taking period through 2010 and 2011, will require the full computing resources requested for 2010 and additional computing resources in 2011 (with respect to that which would have been required by a schedule with an LHC shutdown in 2011). Timely availability of these resources during 2011 will be critical to timely ATLAS physics productivity, and to the ability of everyone in the Collaboration to access the data easily and quickly.

Adequate manpower to fully address ongoing software developments in several technical areas is not available, and progress to address this issue has been slow despite efforts. The core computing infrastructure and services tasks, defined as M&O Category A, play a crucial role for the smooth operation of the full software and computing chain. They enable ATLAS to exploit the large investments of computing resources made worldwide by the wLCG collaboration partners.

Changes: None.
Concerns: Manpower in some technical software and computing areas.
Plans: Operate and consolidate the software and computing infrastructure for the collaboration-wide, distributed approach, in full coherence with the wLCG infrastructure backbone. Expand processing and storage capacity as required by extended 2010/2011 LHC data-taking.

10. Data Collection and Physics Output

After the long break that followed the LHC incident in September 2008, ATLAS was pleased to start collecting proton-proton collision data on 23 November 2009. Almost a million collision events were collected in the three weeks of data-taking until the end of 2009, mainly at a centre-of-mass collision energy of 900 GeV, and with a little over thirty thousand events at a collision energy of 2.36 TeV. Approximately half of the 900-GeV collision events were recorded with stable beam conditions, meaning that all detectors could be safely operated at nominal voltages. The data collected as a function of date is illustrated in Fig. 1.

During the technical stop, the collision data, as well as the cosmic ray data, from 2009 was extensively used to understand and calibrate the performance of the individual detector systems and of ATLAS as a whole. Journal articles reporting on ATLAS detector performance with first LHC data and with cosmic ray muons are in advanced stages of preparation, and many performance results have already been reported at conferences.

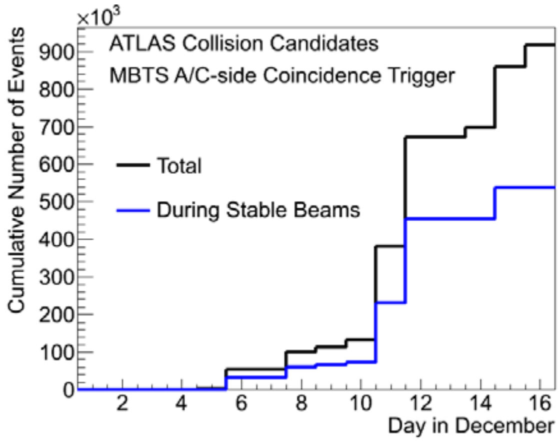

Figure 1: Number of collision events collected in 2009 data taking. Cumulative totals are shown indicating all events collected, and those collected with stable beam conditions, when all ATLAS detectors could be switched on safely.

The first ATLAS publication on collision data, *Charged-particle multiplicities in pp interactions at sqrt(s) = 900 GeV measured with the ATLAS detector at the LHC*, CERN-PH-EP/2010-004, analysed the full 2009 collision data sample with all detectors operational, and is now in press at Physics Letters B. This analysis found that a very good description of the tracking performance is provided by fully simulated events. Systematic errors are derived either purely from data, or from detailed studies of the matching between data and simulation. In addition to the measurements contained in this paper, a wealth of detailed performance studies has been performed regarding the reconstruction and identification of physics objects (electrons, photons, muons, jets, *etc*.). In most cases, the data and simulation agree quite well,

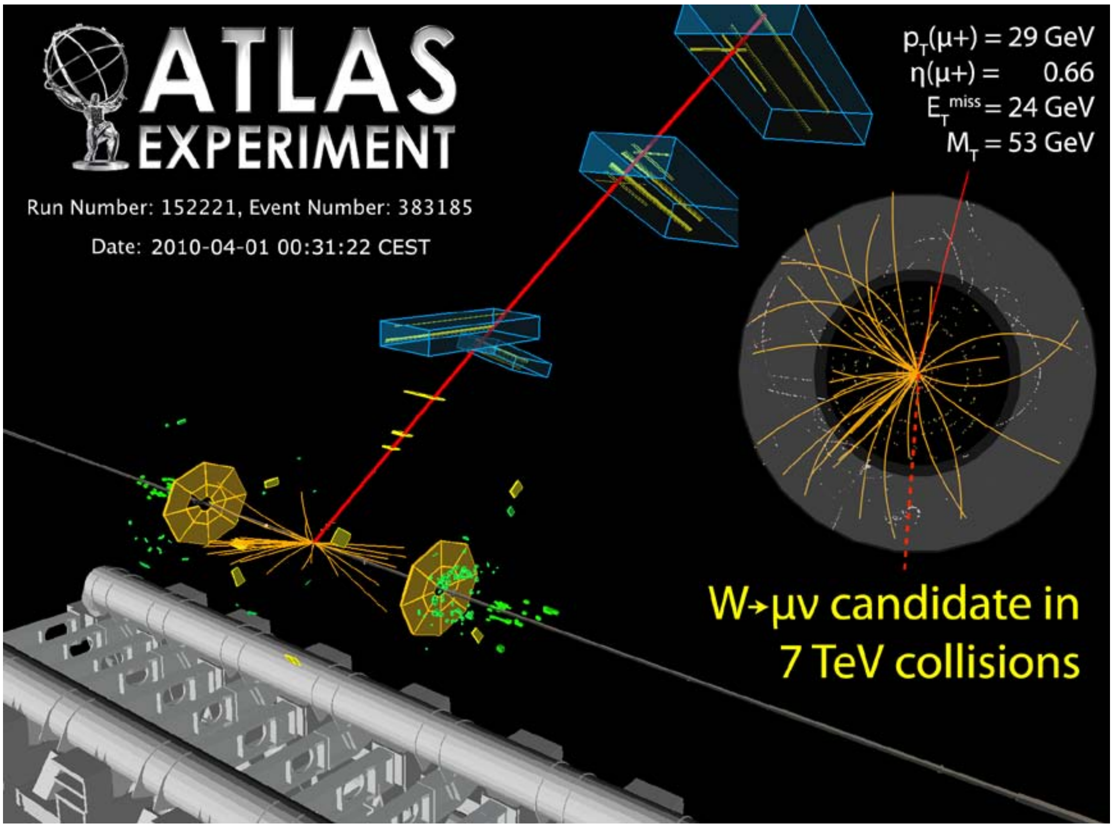

Figure 2: Candidate decay of a W*-boson to muon and neutrino, collected on 1 April 2010.*

indicating both that ATLAS performance is near the nominal expectations incorporated into the simulation and that the simulation reproduces very well the details of the detector and its performance. Work is ongoing to understand the source of residual observed discrepancies.

Data-taking at 7-TeV centre-of-mass energy began on 30 March 2010. At the time of writing, one week later, more than ten million minimum-bias events had been collected, and the first candidate *W*-decay events are starting to appear (See Fig. 2). Detailed plans have been made and work is well in progress for the production of physics results in the coming months as the data sample increases.

11. Updates on Due Construction Contributions

ATLAS is grateful to the Funding Agencies for their continuous support over nearly two decades. At present, the Collaboration still faces an income deficit of 4 MCHF in the total accepted construction costs (CORE+CtC), including open commitments, mainly due to late payments of baseline Common Fund contributions. Due contributions arriving from Funding Agencies are reported elsewhere (CERN-RRB-2010-017).

The Collaboration most strongly urges all Funding Agencies that have not yet committed to their full calculated share of CtC funding, or have not yet financed their baseline Common Fund contributions, to continue their utmost efforts to secure the missing resources. Only a strong solidarity across all funding partners will allow the Collaboration to unstage the full detector and to exploit completely the immense LHC physics potential as early as possible.

12. Status of FDL Activities

The 2002 Completion Plan reduced the scope of the Full Design Luminosity (FDL) detector as a temporary measure. The staged items included common elements, such as shielding and processors, as well as components of the Inner Detector, Calorimeter systems, and Muon systems. Some of these items have meanwhile been restored; whereas, the fate of other items depends upon the measured performance of the ATLAS detector. It is clear that infrastructure, particularly shielding and cooling/gas/cryogenic systems, will require improvements.

An interim memorandum of understanding is now being prepared for the insertable replacement of the Inner Detector pixel b-layer (IBL, Insertable B-Layer) as a part of the FDL detector. A Technical Design Report is planned for Summer 2010, to be then submitted to the LHCC. A status report on FDL detector activities is provided in CERN-RRB-2010-012.