ATLAS Status and Plans

David Strom, University of Oregon
Thanks LHC!

Very rapid rise in luminosity

Good machine stability leads to high integrated luminosity

Hope to be off the plot soon
Thanks LHC!

Very rapid rise in luminosity leads to high integrated luminosity.

Hope to be off the plot soon.

TALK OUTLINE:

• 2011-2012 Shutdown Activities
• 2011 and 2012 Detector Performance
• 2011 and 2012 Trigger
• Analysis Status
• Upgrade Plans
2012 shutdown activities

- Completely installed “EE” muon chambers on side C
- About ½ of chambers on side A installed
Shutdown activities – a few more examples

Improved muon shielding

Calorimetry improvements

• Tile hadron calorimeter
  • 45/256 on detector tile “drawers” refurbished
  • 40/256 new low voltage supplies improves SEUs and noise

• Liquid Ar calorimeters
  • 10 FEB and 12 low voltage supplies replaced
  • Bad channels decrease 385/182468 to 106/182468 (0.06%)
<table>
<thead>
<tr>
<th>Subdetector</th>
<th>Number of Channels</th>
<th>Appr. Operational Fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pixels</td>
<td>80M</td>
<td>95.9%</td>
</tr>
<tr>
<td>SCT Silicon strips</td>
<td>6.3M</td>
<td>99.3%</td>
</tr>
<tr>
<td>TRT Transition Radiation Tracker</td>
<td>350k</td>
<td>97.5%</td>
</tr>
<tr>
<td>LAr EM Calorimeter</td>
<td>170k</td>
<td>99.9%</td>
</tr>
<tr>
<td>Tile Calorimeter</td>
<td>9.9k</td>
<td>99.5%</td>
</tr>
<tr>
<td>Hadronic Endcap LAr Calorimeter</td>
<td>5.60k</td>
<td>99.6%</td>
</tr>
<tr>
<td>Forward LAr calorimeter</td>
<td>3.50k</td>
<td>99.8%</td>
</tr>
<tr>
<td>LVL1 Calo Trigger</td>
<td>7.15k</td>
<td>100%</td>
</tr>
<tr>
<td>LVL1 Muon RPC Trigger</td>
<td>370k</td>
<td>99.5%</td>
</tr>
<tr>
<td>LVL1 Muon TGC Trigger</td>
<td>320k</td>
<td>100%</td>
</tr>
<tr>
<td>MDT Drift Tubes</td>
<td>350k</td>
<td>99.7%</td>
</tr>
<tr>
<td>CSC Cathode Strip Chambers</td>
<td>31k</td>
<td>97.7%</td>
</tr>
<tr>
<td>RPC Barrel Muon Chambers</td>
<td>370k</td>
<td>97.1%</td>
</tr>
<tr>
<td>TGC Endcap Muon Chambers</td>
<td>320k</td>
<td>99.7%</td>
</tr>
</tbody>
</table>
# ATLAS Detector Status in 2011

**Overall data taking efficiency**
93.5% (94.7% w/o warm-start)

**Similar Efficiency in 2012**

**Fraction of data after data quality cuts used for analysis:**

<table>
<thead>
<tr>
<th>Cause</th>
<th>Inefficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead time</td>
<td>1.0</td>
</tr>
<tr>
<td>Warm-start</td>
<td>1.2</td>
</tr>
<tr>
<td>DAQ Actions</td>
<td>1.2</td>
</tr>
<tr>
<td>Equipment Failure (incl. Human Resp.)</td>
<td>2.8</td>
</tr>
</tbody>
</table>

**Luminosity weighted relative detector uptime and good quality data delivery during 2011 stable beams in pp collisions at $\sqrt{s}=7$ TeV between March 13th and October 30th (in %), after the summer 2011 reprocessing campaign**

**DQ efficiency for physics analysis $\geq 90\%$ for recorded data**

**Similar DQ Efficiency in 2012**
Data Taking Conditions in Proton Running

2012 pileup event

ATLAS Online 2011, √s=7 TeV \( \int L dt = 5.2 \text{ fb}^{-1} \)

ATLAS definition of \( \mu \) based on \( \sigma_{\text{inelastic}} \)
Hits on tracks are constant even at pileup of 30 (from special 2011 run)

• Number of tracks scales linearly with pileup
• Fakes increase but can be recovered with "robust cuts"

ATLAS Talk: S. STRANDBERG, Tracking, vertices and B-tagging performance (5D)
Several posters
Electron performance for high pileup improved!
Muon Performance

Mass resolution and isolation is well described by the Monte Carlo

*ATLAS Poster:* W. SPEARMAN, Study of the ATLAS muon identification efficiency in the presence of high pile-up (1D)

Isolation efficiency

Tracks: \( \sum 0.2 \frac{p_{trk}^t}{p_{\mu}^t} < 0.15 \)

Calo: \( \sum 0.2 \frac{E_t}{p_{\mu}^t} < 0.3 \)
Jet Energy Scale Performance

Use $p_T$ balance in events with jets recoiling against $Z$ ($e^+e^-$)

Uncertainty less than 2% for $p_T > 25$ GeV

$\sqrt{s} = 7$ TeV, $\int L \, dt = 4.7$ fb$^{-1}$

anti-$k_t$ $R=0.4$, EM+JES

- Data 2011
- $Z \rightarrow e^+e^-$ (PYTHIA)

ATLAS-CONF-2012-053, ATLAS-CONF-2011-159: Validating the measurement of jet energies with the ATLAS detector using $Z$+jet events from proton-proton collisions at $\sqrt{s} = 7$ TeV
ATLAS Performance Talks and Posters

ATLAS TALKS

S. STRANDBERG
Tracking, vertices and B-tagging performance (5D)
D. TSIONOU
Electron And Photon Performance Measurements (1E)

ATLAS POSTERS (1D)

S. BEDIKIAN
Reconstruction and Identification of Hadronically Decaying Tau Leptons
D. DUDA
Measuring the b-jet tagging efficiency using top anti-top events
A. PARODI
Measuring the b-jet tagging efficiency on c-jets containing D* mesons
C. JUNG
Measuring the b-jet tagging efficiency using samples of jets containing muons
W. SPEARMAN
Study of the ATLAS muon identification efficiency in the presence of high pile-up
I. VICHOU
Tile Calorimeter performance
G. WATTS
Combining b-tagging Calibrations
Recent improvements in tracking time at high pileup allow us to run with a 0.4kHz rate for prompt streams at Tier0.

Assumes 30% LHC duty cycle.

Can borrow CPU from general ATLAS pool at crucial times.
Trigger

- Trigger Menu is largely driven by level 1 constraints (75kHz max)
- Average prompt EF output rate (0.4kHz) is driven by offline processing and storage
- Excess bandwidth used by temporary “priority items”
- The EF delayed stream (2012 only, mainly B physics and extra jets) can be up to 0.2kHz

Event filter stream rates

- Raise electron thresholds
- Tighten muon Level 1
- Add delayed streams
Improvements to Trigger in 2012

- Pileup robust electron selection, based on 2012 offline selection
- Pileup robust tau selection (see slides)
- Use both inside-out and outside-in muon selections in the EF

- Missing $E_t$ (MET) improvements (threshold now lower than in 2011):
  - Optimize L1 noise cuts to match 2012 pileup
  - Fast Front End Board sums at Level 2
  - Use offline clustering for EF

- New L1.5 jet finding based on trigger tower information

D. TSIONOU, Electron and Photon Performance Measurements (1E)
Tau Trigger and Pileup

2012 trigger emulated on 2011 Z tag and probe sample

2012 Trigger tuned to have efficiency independent of pileup (e.g. using $\Delta z$)

Posters: D. ZANZI, Physics with Tau Lepton Final States in ATLAS (1D), S. Bedikian: Reconstruction and Identification of Hadronically Decaying Tau Leptons (1D)
# 2012 Physics Proton Trigger Menu (expectation for $L_{\text{peak}} = 7 \times 10^{33}$ cm$^{-2}$s$^{-1}$)

<table>
<thead>
<tr>
<th>Offline Selection</th>
<th>Trigger Selection</th>
<th>L1 Peak (kHz)</th>
<th>EF Ave (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$L_{\text{peak}}$</td>
<td>$L_{\text{ave}}$</td>
</tr>
<tr>
<td>Single leptons</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single muon &gt; 25GeV</td>
<td>15 GeV, 24 GeV</td>
<td>8</td>
<td>45</td>
</tr>
<tr>
<td>Single electron &gt; 25GeV</td>
<td>18 GeV, 24 GeV</td>
<td>17</td>
<td>60</td>
</tr>
<tr>
<td>Two leptons</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 muons &gt; 15</td>
<td>2x10 GeV, 2x13 GeV</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2 muons &gt; 20, 10 GeV</td>
<td>15 GeV, 18,8 GeV</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>2 electrons, each &gt; 15GeV</td>
<td>2x10 GeV, 2x12 GeV</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>2 taus &gt; 45, 30GeV</td>
<td>15,11 GeV, 29,20 GeV</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Two photons</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 photons, each &gt; 25GeV</td>
<td>2x10 GeV, 2x20 GeV</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>2 loose photons, &gt; 40,30</td>
<td>12,16 GeV, 35, 25 GeV</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Single jet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jet pT &gt; 360 GeV</td>
<td>75 GeV, 360 GeV</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>MET</td>
<td>MET &gt; 120 GeV</td>
<td>40 GeV, 80 GeV</td>
<td>2</td>
</tr>
<tr>
<td>Multi-jets</td>
<td>5 jets, each pT &gt; 55 GeV</td>
<td>4x15 GeV, 5x55 GeV</td>
<td>1</td>
</tr>
<tr>
<td>b-jets</td>
<td>b + 3 other jets pT&gt;45 GeV</td>
<td>4x15 GeV, 4x45 GeV+btag</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td>&lt;75</td>
<td>~400</td>
</tr>
</tbody>
</table>

- Tracking based isolation applied to single leptons at EF to limit rate
- Above triggers are used by most analyses, currently 564 items in the menu
- Many Specialized triggers, e.g. $J/\psi \rightarrow e^+e^-$ for efficiency studies.
- Hadronic trigger in delayed stream have lower thresholds
ATLAS Talks

- K. NAGAI, W and Z properties and cross sections (2E)
- S. GIBSON, Measurements of photons, jets and subjets (4F)
- J. ROBINSON, Particle production and diffraction (2F)
- S. LI: ATLAS diboson measurements (4F)

Combined ATLAS & CMS

- P. KRIEGER, Inclusive jet and multijet production (3B)
- M-A, PLEIER, Diboson physics at the LHC (3A)

+ talks from CMS speakers
### ATLAS Presentations

A. KNUE, Top quark properties (4E)

Y. TAKAHASHI, Top quark

### ATLAS and CMS presentations

W. VERKERKE: Top properties (4B) +CMS speaker

### ATLAS Posters (1D)

A.BECKER: Search Measurement of t-channel single top-quark production

J. GODFREY: Top quark pair production cross section with hadronically decaying tau lepton
B physics

• Opportunistically save B physics triggers whenever possible
• In 2012 some B triggers are not promptly reconstructed

B\textsubscript{c} observation
ATLAS-CONF-2012-028
Also $\lambda_b$ lifetime

D. SCHEIRICH: Heavy flavor production (4C)

B$\to$\mu$\mu$

arxiv:1204.0735

$\chi_b$

arxiv:1112.5154

T. MATSUSHITA: Onia production at ATLAS (2F)
Higgs

Excess seen in the low mass region:

Region between 130 and 486 GeV excluded at 99% C.L

Excess consistent with SM cross section

Global probability for such an excess on this plot is ~10%

Many interesting Higgs questions:
• Is there more than one Higgs?
• Are the couplings what one expects?
Excess seen in the low mass region:

- S. SNYDER, Higgs searches in ATLAS (5A)

- J. KEUNG, Combined search for the Standard Model Higgs boson (5C)

- T. MASUBUCHI, Searches for a Light Higgs boson (5C)

- A. MARTYNIUK, Searches for a Heavy Higgs boson (5D)

- O. SILBERT, Searches for Beyond-Standard Model Higgs Boson (5D)

Many interesting Higgs questions:
- Is there more than one Higgs?
- Are the couplings what one expects?

Local significance: 2.5 σ

Global probability for such an excess on this plot is ~10%

Excess consistent with SM cross section
New conference notes on lightest third generation scenarios:
• ATLAS-CONF-2012-058: Search for gluino-mediated scalar top and bottom quark production in final states with missing transverse energy and at least three $b$-jets
• ATLAS-CONF-2012-059: Search for light scalar top quark pair production in final states with two leptons

Example: 4b final state

T. EIFERT
SUSY and BSM searches in ATLAS (5B)

J. MCFAYDEN
Search for supersymmetric gauginos and third generation squarks with the ATLAS detector (5E)
SUSY

ATLAS SUSY Searches - 95% CL Lower Limits (Status: March 2012)

MSUGRA/CMSSM: 0-lep + j/s + E_T^{miss}

Pheno model: 0-lep + j/s + E_T^{miss}

GMSB: 1-t + j/s + E_T^{miss}

GMSB: 2-t + j/s + E_T^{miss}

GSM: \text{Y} + E_T^{miss}

Gluino med. \chi^\pm \rightarrow \text{f} \bar{f} \chi^0

Gluino med. \tilde{b} \rightarrow \tilde{l} \tilde{l} \chi^0

Gluino med. \tilde{t} \rightarrow \tilde{l} \tilde{t} \chi^0

Gluino med. \tilde{\tau} \rightarrow \tilde{\nu} \tilde{\tau} \chi^0

Direct h\rightarrow b\bar{b}

Direct \tilde{\tau} \rightarrow \tilde{\nu} \chi^0

Direct gaugino \chi^\pm \rightarrow \text{3l} \chi^0

Direct gaugino \chi^0 \rightarrow \text{3l} \chi^0

AMSB: long-lived \chi^0

Stable massive particles (SMP): R-hadrons

SMP: R-hadrons

SMP: R-hadrons (Pixel det. only)

GMSB: stable \tilde{\tau}

RPV: high-mass eqi

Bilinear RPV: 1-lep + j/s + E_T^{miss}

Hypercolour scalar gluons: 4 jets, m_3 = m_4

\text{Only a selection of the available mass limits on new states or phenomena shown}
**ATLAS TALKS**

- **J. MCFAYDEN**
  Search for supersymmetric gauginos and third generation squarks with the ATLAS detector (5E)
- **T. EIFERT**
  SUSY and BSM searches in ATLAS (5B)
- **E. KAJOMOVITZ**
  Inclusive searches for supersymmetric signatures with the ATLAS detector (5E)

**ATLAS POSTERS (1E)**

- **S. KING**
  Searches for supersymmetry and UED in events with three-leptons and missing transverse momentum
- **C. MARINO**
  Search for massive long-lived exotic particles with the ATLAS detector
- **E. CORDINA:**
  Search for supersymmetry in events with four or more leptons
- **Y. SASAKI**
  Search for supersymmetry in final states with jets, missing transverse momentum and one isolated lepton
Exotics

ATLAS Exotics Searches - 95% CL Lower Limits (Status: March 2012)

- Large ED (ADD) : monojet
- Large ED (ADD) : diphoton
- UED : $\gamma \gamma + E_{T,miss}$
- RS with $k/M_{Pl} = 0.1$ : diphoton, $m_{ll}$
- RS with $k/M_{Pl} = 0.1$ : dilepton, $m_{ll}$
- RS with $g/M_{Pl} = 0.1$ : 2Z resonance, $m_{ll}$
- ADD BH ($M_{Th}/M_{Pl}=3$) : SS dimuon, $N_{N, part}$
- ADD BH ($M_{Th}/M_{Pl}=3$) : leptons + jets, $\Sigma p_{T}$
- Quantum black hole : dijet, $F(m_{T})$

Cl
- qqq Cl : $ee, \mu\mu$ combined, $m_{ll}$
- uut Cl : SS dilepton + jets + $E_{T,miss}$

V
- SSM Z' : $m_{Z'}$
- SSM W' : $m_{W'}$

LQ
- Scalar LQ pairs ($\beta=1$) : kin. vars. in eejj, ejej
- Scalar LQ pairs ($\beta=1$) : kin. vars. in $\mu\mu\mu\nu, \nu\nu\nu\mu$

Excited quarks
- 4th generation : $Q_{T,WW}$
- 4th generation : $U_{T,WW}$
- 4th generation : $d_{T,WW}$

New quark b': $b_{T,WW}$

Excited form
- Excited quarks : y-jet resonance, $m_{ll}$
- Excited electron : e-y resonance, $m_{ll}$
- Excited muon : $\mu^{-}$ resonance, $m_{ll}$

Techni-hadrons
- Techni-hadrons : dilepton, $m_{bb}$

Other
- Major. neutr. (LRRM, no mixing) : 2lep + jets
- $W_{nu}$ (LRRM, no mixing) : 2lep + jets
- $H^{+}$ (DY prod., BR=$H^{+}$ to $\mu\nu$) : SS dimuon, $m_{ll}$

Color octet scalar : dijet resonance, $m_{ll}$

Vector-like quark : CC, $m_{q}$

Vector-like quark : NC, $m_{q}$

mass limits on new states or phenomena shown
Exotics

ATLAS TALKS

• R. MOORE
  Searches for Exotics physics states decaying to leptonic final states (5F)

• L. APERIO BELLA
  Searches for Exotics physics states in jets and boosted objects final states (5F)

ATLAS Posters (1D)

V. BANSAL
Contact Interactions (Non resonant dilepton final state searches)

M. PETTENI
A Search for ttbar Resonances in the di-lepton channel

A. RELICH
Search for Heavy Neutrinos

R. REZVANI
Search for mono-jet plus missing transverse energy

D. WENDLAND
4th generation searches
Jet finding in Events (2011 run)

Trigger algorithm finds jets independently of centrality, hope for pileup 200?

Recent results:
HP2012: http://www.ca.infn.it/hp12
Photons and Z Bosons in HI Events (2011 data)

No suppression seen for photons and Z bosons, scales as expected.
LHC plans (LS1, LS2, LS3)

2009
LHC start up, $\sqrt{s} = 900$ GeV

2010
$\sqrt{s} = 7$-8 TeV, $L = 6 \cdot 10^{33}$ cm$^{-2}$s$^{-1}$, bunch spacing 50 ns

2011
Go to design energy, nominal luminosity

2012
$\sqrt{s} = 13$-14 TeV, $L = 1 \cdot 10^{34}$ cm$^{-2}$s$^{-1}$, bunch spacing 25 ns
(likely to be more)

2013
LS1

2014
Injector & LHC Phase I upgrade to full design luminosity

2015
$\sqrt{s} = 14$ TeV, $L = 2 \cdot 10^{34}$ cm$^{-2}$s$^{-1}$, bunch spacing 25 ns
(likely to be more)

2016
LS2

2017

2018

2019

2020

2021

2022
LS3
HL-LHC Phase-2 upgrade, crab cavities?, IR

2023
$\sqrt{s} = 14$ TeV, $L = 5 \cdot 10^{34}$ cm$^{-2}$s$^{-1}$, bunch spacing 25 ns
Plan for 50% more

2030?

Plan for 50% more

PLHC

LS = Long Shutdown

4 June 2012
Main Improvements to Physics Capabilities

1. New small Be pipe

2. New insertable pixel b-layer (IBL) (drives shutdown schedule)

1. Finish the installation of the EE muon chambers staged in 2003 + additional chambers in the feet (new electronics) and elevators region

2. Add topological processing in level 1 of trigger

3. Improve L1 trigger readout rate to 100kHz
1. New muon small wheels with more trigger granularity and trigger track vector information
2. Higher-granularity calorimeter LVL1 trigger and associated front-end electronic
3. Fast track processor (FTK) using SCT and pixel hits (input to LVL2) expected installation before 2018
4. Forward physics detection station at 220m for new diffractive physics (full 3D edgeless and timing detectors, target 2017)
5. Topological trigger processors combining LVL1 information from different regions of interest (improvements starting well before 2018)
Phase-II (installation 2022-23)

Likely upgrades:
1. New Inner Detector (strips and pixels)
   *Very substantial progress in many R&D areas*
2. New LAr front-end and back-end electronics
3. New Tiles front-end and back-end electronics
4. TDAQ upgrade (add level 0 to the trigger?)

Under study:
1. LAr new FCAL
2. LAr HEC cold electronics consolidation
3. Muon Barrel and Large Wheel system upgrade
4. L1 track trigger
5. LUCID upgrade
Conclusion

- ATLAS had an excellent year in 2011 due to the high luminosity delivered by LHC and the hard work of the collaboration to deal with high pileup.

- Many excellent physics results based on the 2011 run will be described in detail at this conference.

- Data taking in 2012 is proceeding smoothly and improvements for high pileup have been largely successful.

- ATLAS is working diligently to design and build upgrades to cope with the high luminosities expected after LS1, LS2 and LS3.
ATLAS Detector

Height: ~25 m
Length: ~44 m
Weight: ~7000 tonnes

Diagram showing the components of the ATLAS Detector:
- Muon chambers
- Toroid magnets
- Solenoid magnet
- Transition radiation tracker
- Semiconductor tracker
- Pixel detector
- LAr hadronic end-cap and forward calorimeters
- LAr electromagnetic calorimeters
- Tile calorimeters
Event Display
No evidence of degradation of electron mass resolution with high $\mu$ in 2011.
Trigger Overview

- ~200 Level 1 items
- ~500 Level 2 chains
- ~500 EF chains

Limits

- DAQ readout rate significantly beyond design (lower thresholds)
- Sophisticated tools in place to predict resource usage throughout system
- Can complete CPU system during the 2012 run if necessary

Menus and Algos

- ~200 Level 1 items
- ~500 Level 2 chains
- ~500 EF chains

Menu complexity mainly for supporting items

arXiv:1110.1530
Trigger Evolution and Data Quality in 2011

Luminosity weighted relative trigger quality delivery during 2011 stable beams in pp collisions at $\sqrt{s}=7$ TeV between 13 March and 31 October (in %).

<table>
<thead>
<tr>
<th></th>
<th>L1</th>
<th>HLT</th>
<th>missing $E_T$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muon</td>
<td>99.0</td>
<td>99.9</td>
<td>99.3</td>
</tr>
<tr>
<td>Calo</td>
<td>100</td>
<td>100</td>
<td>99.9</td>
</tr>
<tr>
<td>CTP</td>
<td>99.8</td>
<td>98.6</td>
<td>99.9</td>
</tr>
<tr>
<td>electron</td>
<td>99.3</td>
<td></td>
<td>99.9</td>
</tr>
<tr>
<td>photon</td>
<td>99.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>muon</td>
<td>100</td>
<td>98.6</td>
<td>99.3</td>
</tr>
<tr>
<td>tau</td>
<td>99.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>jet</td>
<td>98.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b-jet</td>
<td>99.9</td>
<td>99.9</td>
<td></td>
</tr>
</tbody>
</table>

Level 1 Rate (EM scale for jets)
Muon trigger efficiency versus pileup

Little dependence of muon trigger with respect to muon efficiency on mean number of interactions per event

- 2 station level 1 seed used in barrel for $\beta^* = 1.5$ m
- 3 station level 1 seed used in barrel for $\beta^* = 1.0$ m

Z tag and probe, $p_t > 18$ GeV
Electron efficiency versus number of interactions

Small dependence of trigger efficiency with respect to offline selection

Data is has $\beta^* = 1.0\text{m}$
Schematic diagram of Jet triggers in ATLAS

Level 1.5 allows the an anti-$k_t$ Algorithm to be run on the jets.
SUSY – squark gluino

0-lepton jet+MET analysis (depends on MET trigger)

• J. MCFAYDEN
Search for supersymmetric gauginos and third generation squarks with the ATLAS detector (5E)

ATLAS-CONF-2012-033
Muon upgrade

Background for 20 GeV muons all in endcap

$P_T > 20$ GeV

Figure 2.1. Left: A z-y view of 1/4 of the ATLAS detector. The blue boxes indicate the end-cap MDT chambers and the yellow box CSC. Right: A view of a small wheel mounted on the JD disk shielding.
ALFA: goal to measure precisely luminosity and total cross section

2011 run $\beta^* = 90m$, detectors at 6.5$\sigma$ (~5mm):

- probe $|t|$ in range 0.01 to 0.2-0.4GeV$^2$
- measure $\sigma_{tot}$ via optical theorem (using vdM lumi)
- 100M events in total, 1.5M elastic and 2M diffractive events

2012 program

- Potential to reach Coulomb-Nuclear Interference (CNI) region
- Push $\beta^*$ to 500 - 1000m
- Move detector close to the beam to touch CNI region
- Measure $\sigma_{tot}$ and luminosity simultaneously

Angular correlation of protons on left & right indicating elastic scattering
HI OPERATIONS in 2011

ATLAS Online Luminosity $\sqrt{s_{NN}} = 2.76$ TeV

Peak Lumi: $512.0 \times 10^{24}$ cm$^{-2}$ s$^{-1}$

<table>
<thead>
<tr>
<th>Stream</th>
<th>Events Taken</th>
<th>Reco CPU/evt [s]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min Bias</td>
<td>60M</td>
<td>70</td>
</tr>
<tr>
<td>Hard Probes</td>
<td>54M</td>
<td>140</td>
</tr>
<tr>
<td>UPC</td>
<td>6.6M</td>
<td>30</td>
</tr>
</tbody>
</table>

CPU carefully optimized for the HI run

15 times more data than last year

Total Delivered: 161 ub$^{-1}$
Total Recorded: 153 ub$^{-1}$

Tier0 jobs – up to 5000 CPUs used

HI Tier0 backlog about 2 weeks
In 2011 High Level Trigger (HLT) essential to bring output rate down to 500MB/s (200Hz for HI events)

Two approaches used:
- Full scan reconstruction at EF on all min-bias events triggered by L1 (jets, muons),
- Region-Of-Interest (RoI)-based reconstruction seeded off the lowest-\(p_T\) threshold at L1 (muons, photons, electrons),

### Triggers for heavy ions

- **Peak luminosity** \(5.1 \times 10^{26} \text{cm}^{-2}\text{s}^{-1}\), gives 6 kHz of min-bias rate at L1:

<table>
<thead>
<tr>
<th>Signature</th>
<th>Trigger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jets</td>
<td>single jet (p_T &gt; 20\text{GeV})</td>
</tr>
<tr>
<td>Muons</td>
<td>single muon (p_T &gt; 4\text{GeV}) (\text{di-muon}) (p_T &gt; 2\text{GeV})</td>
</tr>
<tr>
<td>Electron/photon</td>
<td>single (\text{egamma}) (p_T &gt; 14\text{GeV}) (\text{di-egamma}) (p_T &gt; 5\text{GeV})</td>
</tr>
<tr>
<td>UPC</td>
<td>low track multiplicity cut</td>
</tr>
</tbody>
</table>
Number of tracks as a function of centrality

ATLAS preliminary

Pb+Pb $\sqrt{s_{NN}} = 2.76$ TeV, data 2011

Increasing overlap
Possible jet quenching

Track jet, $R = 0.4$
Calorimeter jet, $R = 0.4$
track $p_T > 2$ GeV
muon $p_T > 2$ GeV

Jet 1, $p_T = 206$ GeV
Jet 2, $p_T = 63$ GeV
Jet 3, $p_T = 39$ GeV

$A_J = 0.5$
Heavy Ion Physics

Symmetric dijet event

Run 193291, Event 11069627
Time: 2011-11-15 03:32:07 CET
FCal $\Sigma E_T = 2.3$ TeV

Track jet, $R = 0.4$
Calorimeter jet, $R = 0.4$

track $p_T > 2$ GeV
muon $p_T > 2$ GeV

Jet 1, $p_T = 416$ GeV
Jet 2, $p_T = 380$ GeV

$A_J = 0.05$
LS1: Consolidation and maintenance to preserve present performance
- New Aluminum beam pipes to prevent activation problem and reduce BG
- New pixel services (nSQP) (pending decision this month)
- New evaporative cooling plant for Pixel and SCT + IBL CO₂ cooling plant
- Replace all calorimeter Low Voltage Power Supplies
- Consolidate part of the LUCID system
- Upgrade the magnets cryogenics with a new spare main compressor and decouple toroid and solenoid cryogenics
- Add specific neutron shielding (behind endcap toroid, USA15)
- Preparations for Phase I upgrade (moveable beam pipe, AFP prototypes,…)
- Many others

LS2: Supporting Projects

1. Finish adapting central LVL1 trigger electronics to new needs
2. New tile crack-gap scintillators and some new trigger electronics
3. Adapt if proven necessary HLT (in particular network) to the new needs/conditions