ATLAS Commissioning

cosmic-ray campaign +

first beam (in 2008)

Moriond QCD ’09

Masaya ISHINO (Tokyo)

on behalf of ATLAS collaboration
ATLAS Detector

Calorimeter

EM:
\[ \sigma(E)/E = 10%/\sqrt{E} + 0.7\% \]

Hadron:
\[ \sigma(E)/E = 50%/\sqrt{E} + 3\% (\eta < 3) \]
\[ \sigma(E)/E = 100%/\sqrt{E} + 10\% (\eta > 3) \]

Inner Tracker

2T, |\eta| < 2.5
\[ \sigma/P_T = 0.05\% P_T + 1\% \quad (2\% @ 20\, \text{GeV}) \]

- 80 μm x 6 cm
  7M ch.
- 50 x 400 μm²
  80M ch.
- 4 mm φ
  350k ch.

Toroid Magnets
Solenoid Magnet
SCT Tracker
Pixel Detector
TRT Tracker

B*dL = 2 to 6 T*m
Muon Spectrometer in ATLAS

- Precise Momentum measurement (MDT + CSC) \( |\eta|<2.7 \)
- Trigger (RPC + TGC) \( |\eta|<2.4 \)
  - doubly placed chambers having two-different functionalities
  - Toroid Magnets (2~6 T m) for the stand-alone momentum analysis

\[ \text{sagitta of 10GeV Muon is \sim 5cm} \]

\[ \text{P_T<300 GeV, resolution is limited by Multiple Scattering & Energy-Loss fluctuation} \]

Masaya ISHINO 2009.03.15
Muon Spectrometer: Optical ALIGNMENT

Barrel: 250μm: to be improved
Endcap: 40μm: OK

Quality of Alignment checked by comparing track intersection in middle layer with expected chamber position after alignment

<table>
<thead>
<tr>
<th>tracks</th>
<th>Mea</th>
<th>RM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>χ²/ndf</td>
<td>351.9 / 94</td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td>4.630</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>4.630</td>
</tr>
<tr>
<td></td>
<td>Sigma</td>
<td>0.235</td>
</tr>
</tbody>
</table>

Mean: 0.25 mm

After

Before

Moriond-QCD '09
End-Caps
Masaya IS

2009.03.15
I’m going to pick-up “THE PLOTs” from TWO view points

1. **TRIGGER**: Timing alignment of LVL1- triggers with **LHC single-beam**

2. Achievement of Detector Commissioning with **high-statistic** data sample with **Cosmic-Ray**
strategy for taking Data

1. trigger by **BPTX** (Beam Pick-Up)
   
   \[11\text{kHz} \times \text{n-Bunch (n=1 in Sep. 2008)}\]

2. Minimum Bias trigger Scintillator **MBTS** @ Calo End-Cap

   find BX “something happened”
strategy for taking Data

3. By using trigger given by BPTX & MBTS, **adjust timing** of LVL1 trigger of Muons & Calorimeters

4. ... the story was terminated here in ’08
Commissioning with Cosmic-Ray

Moriond-QCD '09
Masaya ISHINO
2009.03.15
- One of the main subject is to illuminate PIXEL + Silicon and do their alignment

\[ O(300Hz) \] L1 rate from \( \mu \)-trig. (and is pre-scaled)

Estimation \( O(<1Hz) \) ‘golden’ tracks going through all ID components

successfully, introduced LVL2 Trigger

(Inner Detector tracking trigger)
PIXEL / Silicon : alignment / eff.

**Residual Pixel**
- Aligned geometry: \( \mu = 3\,\mu m, \sigma = 23\,\mu m \)
- MC perfect geometry: \( \mu = 0\,\mu m, \sigma = 15\,\mu m \)
- Nominal geometry: \( \mu = 66\,\mu m, \sigma = 398\,\mu m \)

**Residual Silicon**
- Aligned geometry: \( \mu = 0\,\mu m, \sigma = 28\,\mu m \)
- MC perfect geometry: \( \mu = 0\,\mu m, \sigma = 23\,\mu m \)
- Nominal geometry: \( \mu = 0\,\mu m, \sigma = 182\,\mu m \)

**Efficiency Pixel**
- Aligned geometry

**Efficiency Silicon**
- ATLAS Preliminary SCT barrel layer+0.5*side

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2009.03.15
EM Calorimeter ~ response study

- Non-Uniformity of response vs. $|\eta|$ is studied
  - due to the difference of Cell inductance

Uniformity agrees with simulation within < 2%
Muon & Inner Detector Tracking

Energy Loss of ~3GeV in Calorimeter is seen

difference of momentum by Muon / Inner-Tracker

consistency of direction in azimuthal angle between Muon & Inner-Tracker

~ good agreement ...

Moriond-QCD ‘09

Masaya ISHINO

2009.03.15
Summary

- with using data
  - single beam for 3-days
  - high-statistics cosmic-rays

the commissioning of Detector, DAQ, Monitoring systems are progressed.
  - LVL1 Trigger Timing
  - Procedure for aligning Tracking detectors

- ATLAS will re-start combined Data taking mode starting from ~May 2009
END
Muon Spectrometer in ATLAS: 

- Identify **Bunch ID** having high-Pt muons based on multi-layer Coincidence Logic \((3/4 + 1/2)\)

  **bunch space = 25\text{nsec}**

- According to the hit-correlation between layers, **momentum** is estimated by on-detector electronics (latency < \(\sim 2.5\text{\mu sec}\))

  6, 8, 10, 15, 20, 40 GeV

- Information of **Region of Interest** (RoI= LVL1 active region) is sent, and limited data around RoI is handled by LVL2
Calorimeter

Energy measured in the full readout (offline)

energy measured in **trigger towers**
(0.1x0.1 in \( \eta \times \phi \)) by LVL1 CALO Trig.