The ATLAS Beam Conditions Monitor

- Design/Goal of BCM
- The Collaboration
- The detector system hardware
- Testbeam results
- Performance Simulations
- Canadian contributions

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ATLAS Beam Conditions Monitor

- ATLAS plans to use time of flight to distinguish beam collisions from background

- Optimal separation is 4.1m
- Ideal support in pixel space-frame 3.8m apart

- Use CVD diamond sensors
  - 10x faster and 10x more radiation hard than silicon

- Very fast, rad hard GaAs front end amplifier
Front-End Readout Electronics

- Designed and developed by the Vienna group
- Peaking time of less than 3 ns

- Response to test-pulses 5 ns apart
Who is Working on the ATLAS BCM

- Toronto
  - Diamonds, mechanical integration, simulation and testbeam

- Ohio State
  - Diamond characterisation, sensor preparation, packaging

- CERN
  - Module assembly and back-end readout

- Vienna
  - Front-end amplifier design/production

- Ljubliana
  - Testbeam analysis, radiation hardness, integration, cabling
Module with Cable
Module Support Bracket

- Designed in Toronto
- SLA manufactured by Pixel group
- Small parts + QA done in Canada
- Now all at CERN
BCM Geometry in Simulation

- Full GEANT model of BCM module boxes and support brackets
  - In ATLAS ID simulation

- Study occupancies and arrival times in minbias collisions
- First look at showers of lost particles
Minimum Bias Collisions

Number of BCM Hits per Bunch Crossing

Entries 1911
Mean 1.481
RMS 1.33

Entries 518
Mean 4.598
RMS 1.875

Entries 3428
Mean 0.8474
RMS 1.062

Number of A-C Coincidences per Bunch Crossing

Entries 1911
Mean 0.6599
RMS 1.364

Entries 518
Mean 5.398
RMS 4.591

Entries 3428
Mean 0.2684
RMS 0.8214
Simulated 7 TeV Lost Proton
Beam Scraping Simulations

- Three injection loss scenarios
  1. Scraping on ATLAS pipe
  2. Scraping on incoming TAS
  3. Scraping on outgoing TAS

- Angular distribution of BCM hits
Testbeam Setup at CERN
Beam Profile and BCM Hit Efficiency
Testbeam Signal Distributions

F405@±1000V, T11 setup1 CH3. signal

Time diff. ch1-ch2, RUN=1029

Entries 9788
Mean 0.7883
RMS 0.6867

NINO
Time res
~ 490ps
Digitisation Performance

- Using ALICE-TPC standard ADC (NINO) digitiser

- Results from 2007 testbeam
  - Median signal: 335 mV
  - Inferred noise: 31 mV
  - System S/N = 11:1
FPGA Back-End Beam Loss/Abort Logic

- Implemented/tested in 2007 testbeam runs with spare BCM modules
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Canadian Contributions to BCM

- Acquisition of 20 diamond sensors ($26k)
- Acquisition and integration of iSEG HV supplies ($10k)
- Source’d and acquired module power connectors ($3k)
- Design and QA for BCM module brackets (Cadabeschi) (SLA + PEEK parts $2k)
- Acquisition of Gore air-core signal cables ($7k)
- Implemented BCM geometry in ATLAS simulation (Bendavid, Mazini)
- GEANT simulations of lost beam and commissioning (Tan, Tardif)

Full partners in BCM – contributing 1/3 of effort and equipment
Summary

- Eight BCM modules installed in ATLAS June 2007
- First readout in pit early 2008
- Now working on beam accident simulations
- Use simulations to guide design of trigger logic
- Prepare and deploy final beam loss signals in spring 2008
- Fully integrate into LHC machine commissioning

Possibly the first detector to observe LHC collisions
Example from Phobos (RHIC)

On June 13th, 2000 at RHIC in Phobos

Monitor “in-time” & “out of time” coincidences vs time to give feedback to LHC operator for conditions in Atlas center?

Valid collisions

This was used during RHIC beam tuning and gave us collisions on the first day

H. Pernegger 25/4/2007