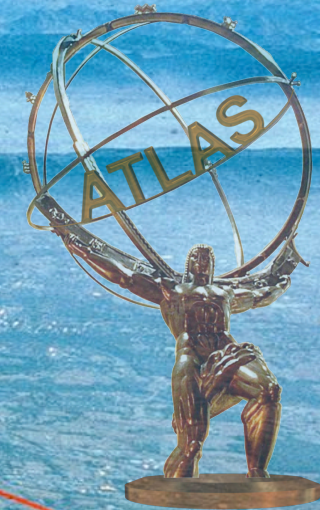


ATLAS/CH at First Beam

- ◆ The Swiss ATLAS Groups
- ◆ Physics Program Highlights
- ◆ The ATLAS Experiment - Readiness
 - ◆ ATLAS Detector
 - ◆ TDAQ
 - ◆ Computing - Swiss ATLAS Grid
 - ◆ Performance and Physics Examples
- ◆ Plans for the near future
- ◆ Summary



The Swiss ATLAS Groups

dpnc.unige.ch/atlas_welcome.html

Prof. A. Clark
Prof. A. Blondel
Prof. M. Pohl
X. Wu, L. Rosselet,
D. Ferrere, S. Gadomski

W. Bell, S. Gonzales, A. Hamilton
(A. Straessner, T. Vu Anh)
J. Navarro Garcia, G. Pasztor, P. Urquijo

T. Eifert, A. Robichaud-Veronneau
M. Backes, E. Berglund, F. Bucci
C. Mora Herrera, A. Abdelalim
(R. Thanauwong)
G. Alexandre

Mechanics and Electronics

(25)



www.lhep.unibe.ch

Prof. A. Ereditato
Prof. Emeritus K. Pretzl
PD HP. Beck
Mi. Weber

E. Cogneras, (B.K. Gjelsten), S. Haug
K. Kordas

A. Battaglia, C. Topfel, N. Venturi
C. Borer, Ma. Weber

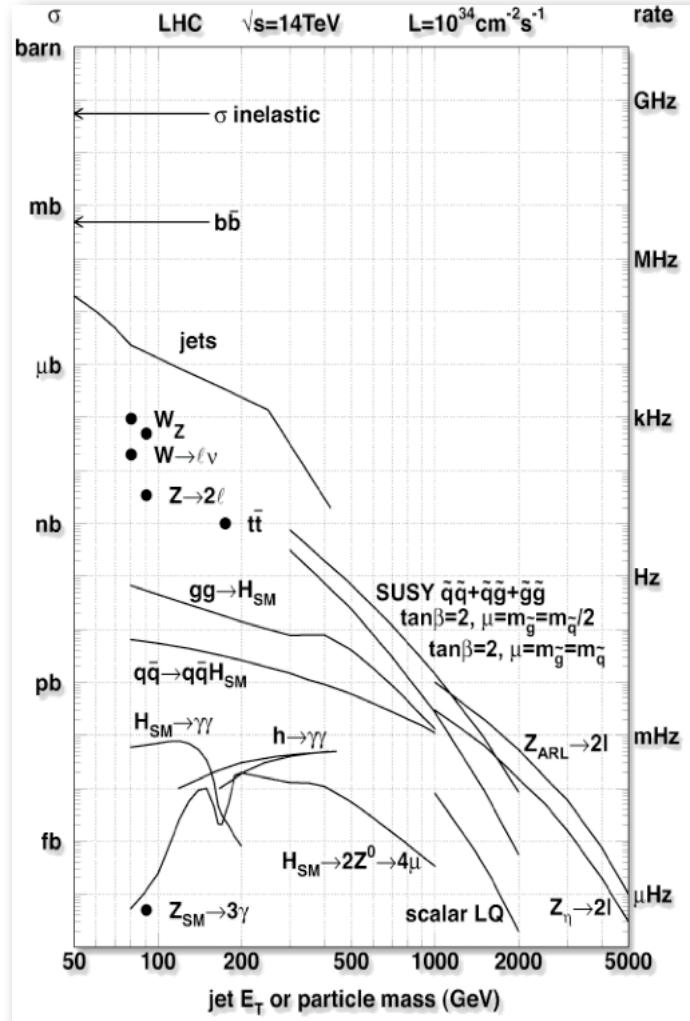
Mechanics and Electronics

(13)



The ATLAS Collaboration as of July 2008 : 37 Countries, 170 Institutions, 2200 Scientific Authors.

Physics Program Highlights



2008

A few pb^{-1} at 10 TeV

- Single beam (Sep 10) : beam gas, beam halo muons.
- Initial sync. Trigger. Calibration. Alignment. Material.
- Constrain pdfs.
- t , $O(10^4)$ Z and W. Even more Jets and Quarkonia.

2009

Expected total integrated luminosity 6 fb^{-1} (14 TeV)

- Improved alignment and calibration.
- Search for heavy non-SM Bosons and SUSY.
- Black holes, easy Higgs channels.

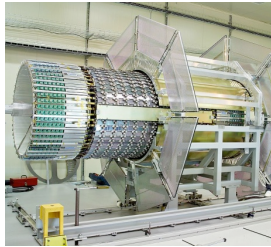
2010

Expected total integrated luminosity 18 fb^{-1} (14 TeV)

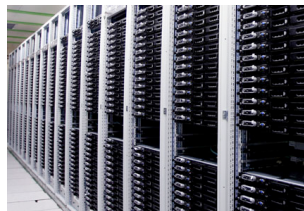
- Discover the SM Higgs ... improved search sensitivities ... SM precision measurements.

Luminosities from LHCC meeting on July 1.

The ATLAS Collaboration, G. Aad et al., "The ATLAS Experiment at the CERN Large Hadron Collider", 2008 JINST 3 S08003.



Tracker Support Structure
Geneva

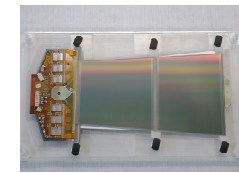
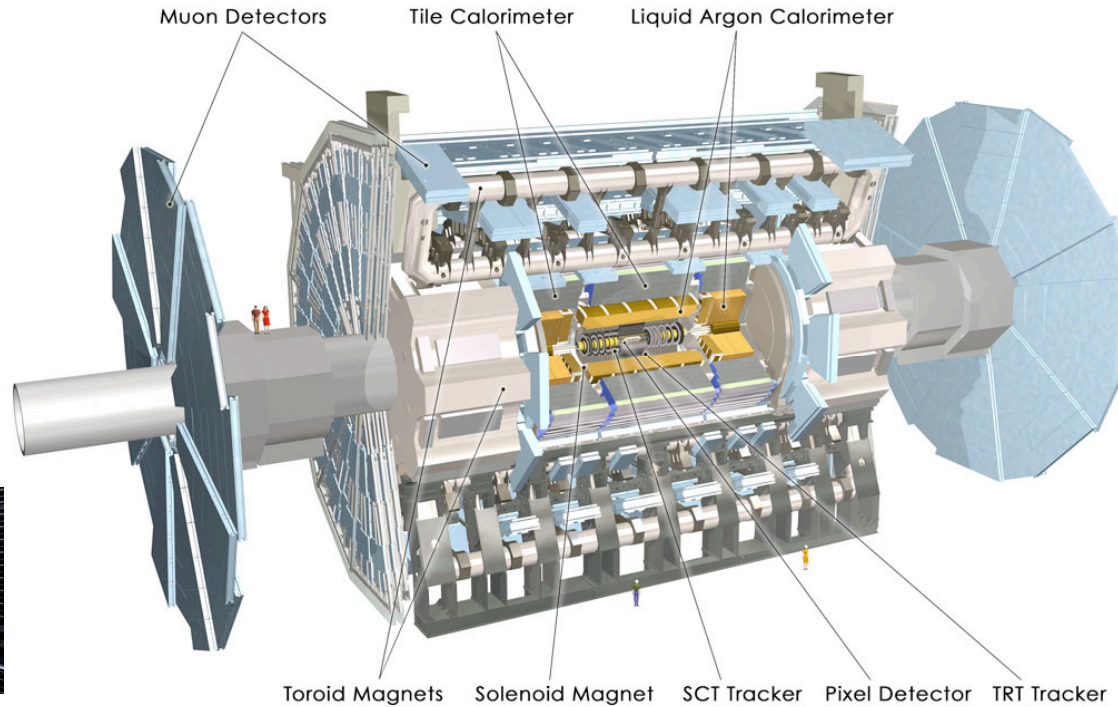


TDAQ - Trigger and Dataflow
Bern and Geneva

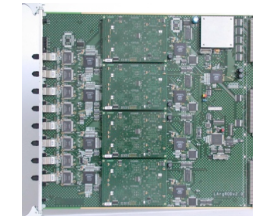
Online and Offline Software

Bern and Geneva

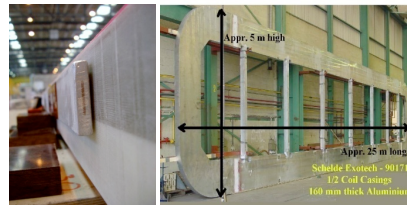
The ATLAS Detector
 Weight: 7000 tons
 Dimensions: 46 x 22 x 22 m³
 Magnetic Field: 2.6 T (solenoid) and 4.1 T (toroid)*



Semiconductor Tracker
Geneva



Electronics for Calorimeter
Geneva



Superconductor and Casings for Barrel Toroid Coil
Bern and Geneva

Physics and Computing

Bern and Geneva

SLHC Upgrade

*Peak field in the windings. Field range in the bore 0.9-2.0 T (Solenoid) and 0.2-2.5 T (Toroid).

The ATLAS Detector Commissioning ...

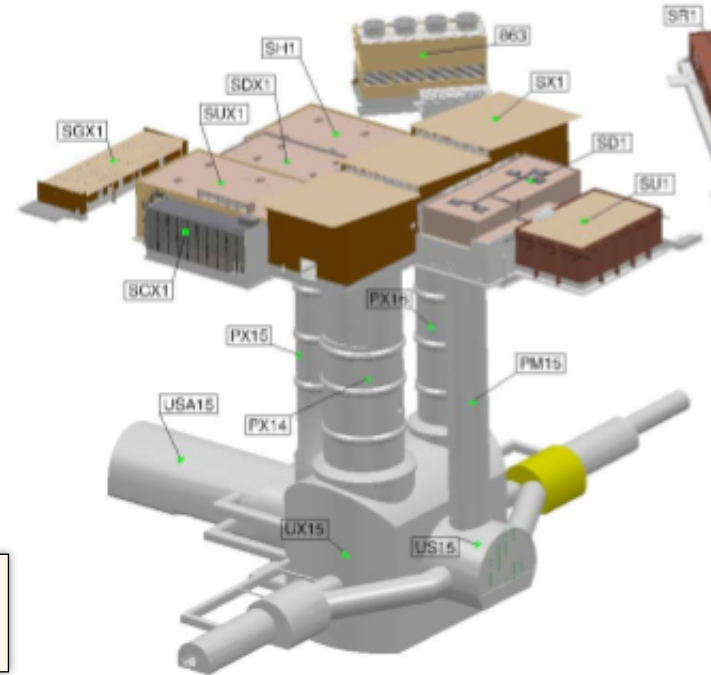
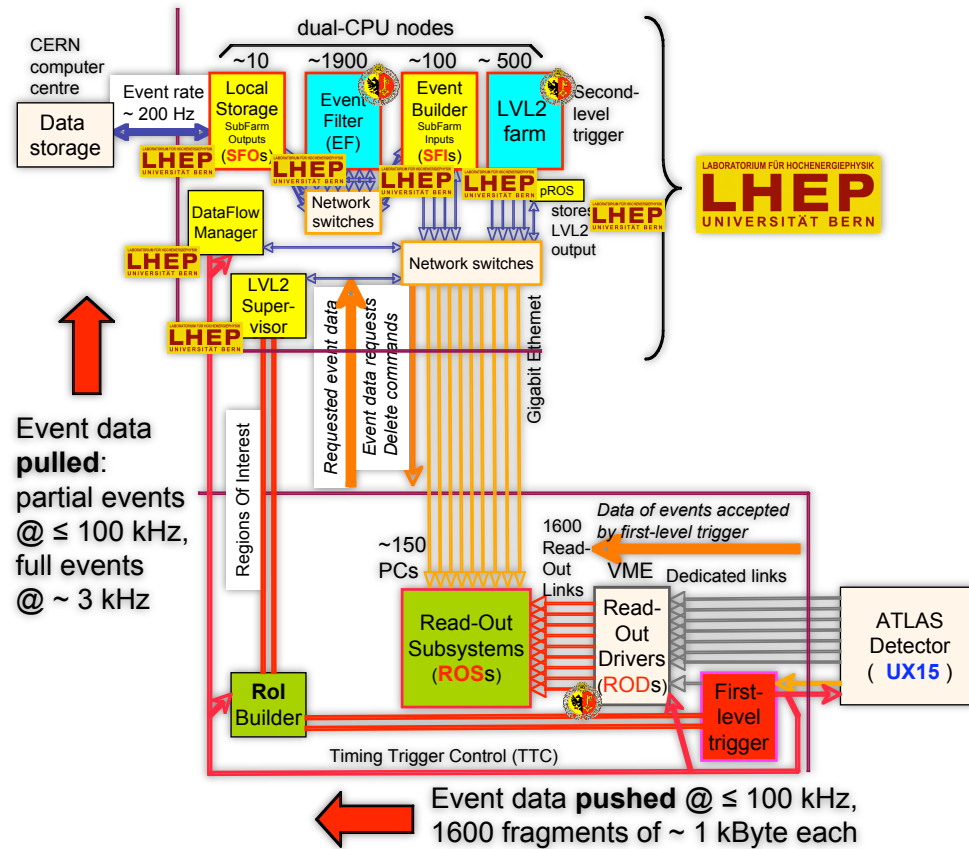
- LHC Beam pipe closed on June 16 with this last piece in the ATLAS cavern.
- ATLAS Magnets are fully available at nominal currents (7.73 kA and 20.5 kA).
- ID Sealed with end plates this spring. (Pixel 0.6% dead/problematic channels, end cap A with 4.2%, SCT 0.35%, end cap C 1.6%, TRT 1.2-2.0%. Commissioning. Cooling issues, but operational.)



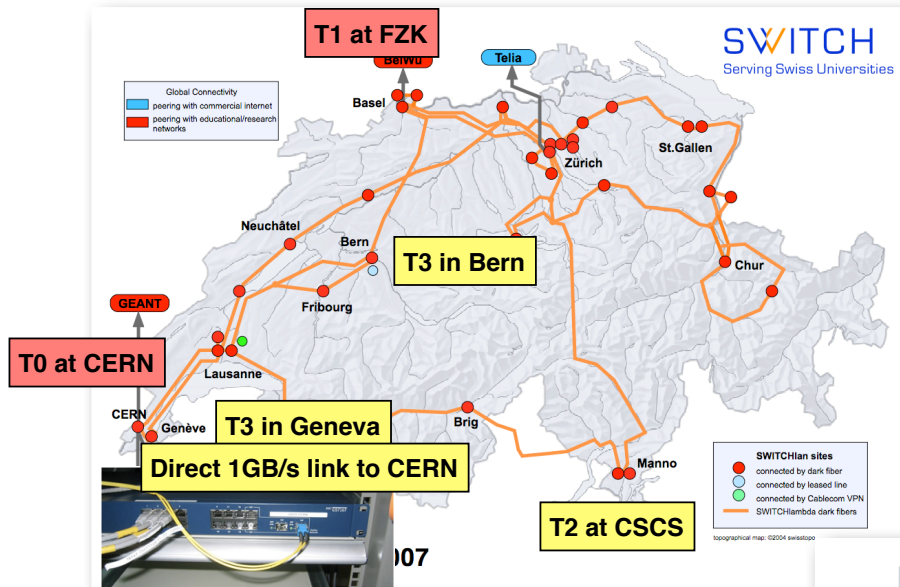
- LAr Calorimeter, 190k channels, 0.02% problematic channels.
- Tile Calorimeter, 10k PMTs in 5k cells, 0.4% problematic cells.
- Muon system complete on July 1, some chambers to be added in 2009 (financial).
- Cosmic runs and calibrations in milestone weeks (M1 June 06 - M8 July 08).
- Now in 24/7 shift operation mode.

... the ATLAS detector is operational !

The ATLAS Trigger System



ATLAS Data from CERN (T0) via FZK (T1) and CSCS (T2) to Bern and Geneva (T3s)



The Swiss ATLAS Grid
 In 2008 ~400 cores and ~200 TB disk in four clusters

- For ATLAS data storage, simulation and analysis.
- Two T3s and one T2 (in cooperation with CHIPP CB, CSCS).
- Since Jan 2008 operation organized in SwiNG WG.
 S. Haug (present lead), S. Gadomski, C. Topfel.
www.swing-grid.ch

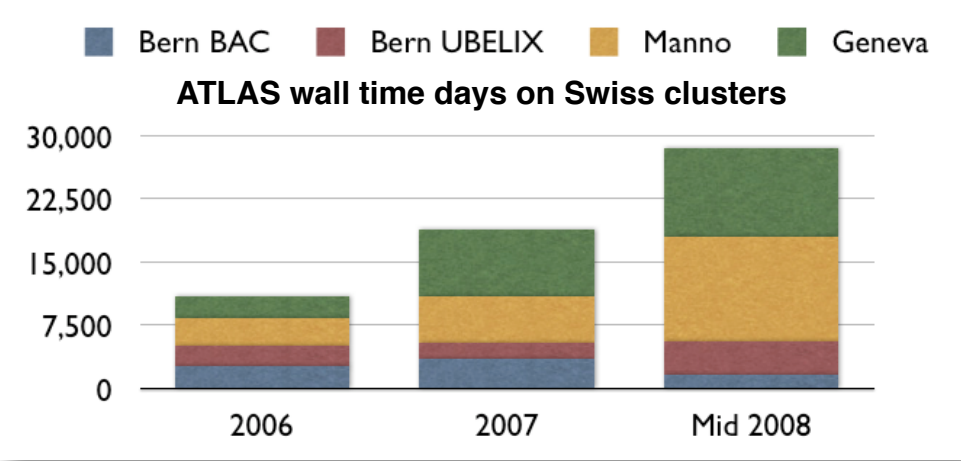
See also CHIPP Computing Board report - C. Grab.

Expect use of Geneva T3 for commissioning and Data Quality work on the ATLAS Trigger

- access to latest software via AFS (in place)
- access to latest data as at CERN (in progress)

If this use goes ahead, will be effectively extension of the CERN Analysis Facility, no contradiction with the Tier 3 role, which will continue planned flow of data:

- Commissioning: subsets of latest data from CERN.
- Analysis: data derived from large samples, from Grid.



Commissioning of TDAQ and computing system ...

- Trigger system exercised since two years. Technical Runs (TDAQ@40MHz) with strong Swiss involvement.
- Full Dress Rehearsal (FDR) from TDAQ to T3s in 2008. Data arrives at Swiss sites.

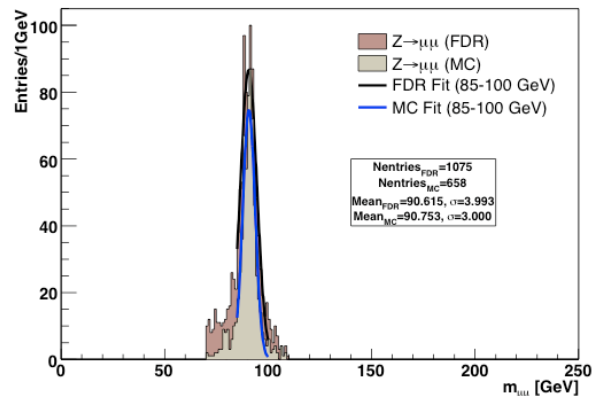


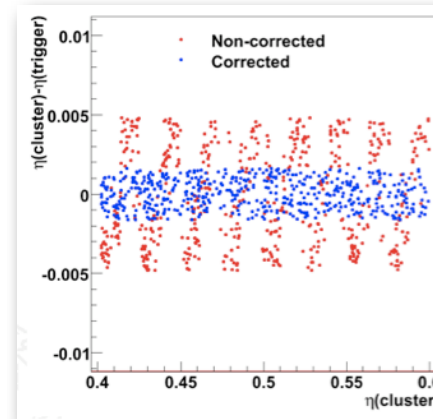
Figure 1.14: Reconstructed invariant mass from reprocessed FDR data and Monte Carlo simulations at a luminosity of 0.36 pb^{-1} . Run number 3070-3080

- 27k Wall time days of simulation on Swiss clusters - also jobs from the trigger production manager S. Gadomski in Geneva :-)
- Work on FDR data in Bern (streams, overlaps, luminosities, dileptons, efficiencies etc).

...TDAQ and distributed computing also on track.

Performance and Physics examples

- **e/photon trigger and tracking studies.**
HW and SW implementation for minimum bias events (Geneva). Tracking/Low pT e with 1st data, e.g. J/Psi (Geneva).
- **Muon and electron trigger efficiencies.**
Trigger rates. (Bern).



Example of trigger electron calibration (GE).

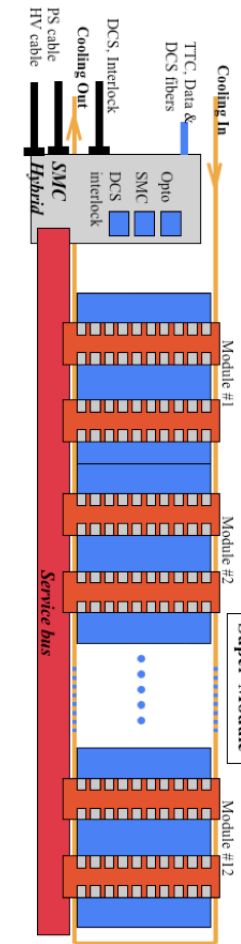
Table 8: Resulting SUSY sparticle masses and mass differences within SU3 and SU4 from the χ^2 minimization fit using the dilepton and lepton+jets edges... 1 fb⁻¹ for SU3 and 0.5 fb⁻¹ for SU4.

Observable	SU3 m_{meas} [GeV/c ²]	SU3 m_{MC} [GeV/c ²]	SU4 m_{meas} [GeV/c ²]	SU4 m_{MC} [GeV/c ²]
$m_{\tilde{\chi}_1^0}$	88 ± 60 ± 2	118	62 ± 126 ± 0.4	60
$m_{\tilde{\chi}_2^0}$	189 ± 60 ± 2	219	115 ± 126 ± 0.4	114
$m_{\tilde{q}}$	614 ± 91 ± 11	634	406 ± 180 ± 9	416
$m_{\tilde{\ell}}$	122 ± 61 ± 2	155		
Observable	SU3 Δm_{meas} [GeV/c ²]	SU3 Δm_{MC} [GeV/c ²]	SU4 Δm_{meas} [GeV/c ²]	SU4 Δm_{MC} [GeV/c ²]
$m_{\tilde{\chi}_2^0} - m_{\tilde{\chi}_1^0}$	100.6 ± 1.9 ± 0.0	100.7	52.7 ± 2.4 ± 0.0	53.6
$m_{\tilde{q}} - m_{\tilde{\chi}_1^0}$	526 ± 34 ± 13	516.0	344 ± 53 ± 9	356
$m_{\tilde{\ell}} - m_{\tilde{\chi}_1^0}$	34.2 ± 3.8 ± 0.1	37.6		

- **CSC Book on the 'Expected Performance of the ATLAS Experiment'. O(10³) pages, on physics and performance, CERN-ATL-COMPHYS-2008-063 (Bern contribution to SUSY mass measurements).**
- **Notes on spin and CP measurement for Higgs and 1-lepton SUSY search (Geneva).**
- **Inclusive SUSY search studies in both groups.**
- **Standard Model (background).**

Plans for the near future

- Operations - investments merit high performance operation.
 - Shifts and maintenance (detectors, TDAQ, data quality, distributed computing).
- Initial physics aims
 - Understanding first data with emphasis on e/gamma (BE+GE) and muon (BE) performance and track quality (GE).
 - Min bias, W/Z, W/Z + jets, basic SM measurements relevant for discoveries (both groups).
 - Continue and increase the involvement in the corresponding performance and physics groups.
- R&D and Planning for SLHC
 - Geneva R&D on Inner Detector : Stave/Module optimization, demonstrator fabrication, barrel mechanics, thermal studies, electronics, DAQ, DCS, B-Layer replacement (2013). See also back up slides and R&D workshop dpnc.unige.ch/CHIPP_WORKSHOP2008/.
 - Bern will have to refine the TDAQ accordingly.



Summary

- **ATLAS is built and commissioned. Continue commissioning with single beam. Ready for collisions !**
- **Swiss involvement in toroid, inner detectors, calorimeters, TDAQ and computing system.**
- **Proceed with maintainance, detector calibration, SM studies and searches. Slowly get ready for a potential upgrade.**



ATLAS Physicists playing in Stade de Suisse during the ATLAS Overview Week in Bern, www.lhep.unibe.ch/atlasweek08.

We are eager to face all the surprises to come ...

**Due to the limited time slot
many backup slides
follow
(remote material which I was not able to include)**

The Semi Conductor Tracker

- **Construction**
 - Complete – FE chip design and prototype, barrel mechanics, module design, prototype and construction

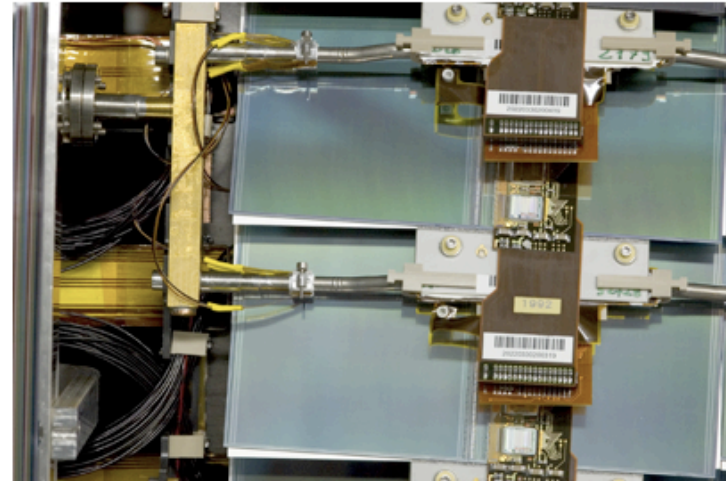
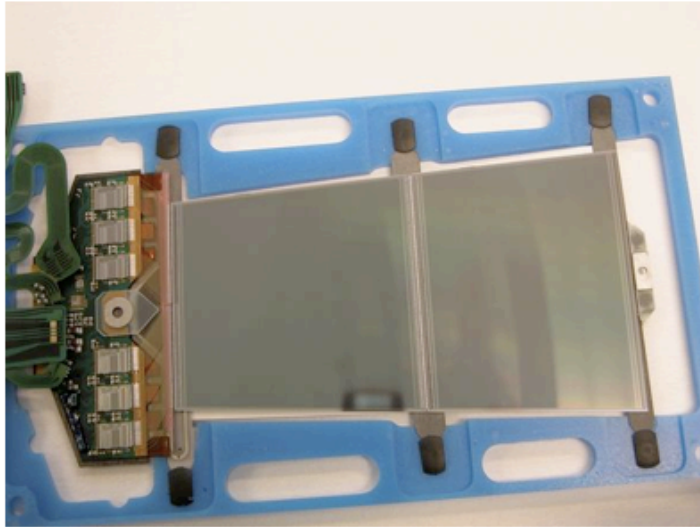
- **Installation**
 - Complete –

- **Commissioning (31.08.08)**
 - Commissioning of barrel and each end cap before installation successful (including cosmics)
 - A barrel sector was recently commissioned on surface for development studies
 - Commissioning in detector delayed by ~18 months (pixel and SCT) because of cooling infrastructure problems
 - 29.08.08 - full SCT powered with cooling successfully
 - So far module calibrations ~unchanged from surface and stable
 - Commissioning in full swing and expect full operation in 2008 run period
 - Major cooling infrastructure developments foreseen in future shutdowns

- **Following slides:**
 - Module, final integration at surface, installation, 2 figures showing operation during commissioning



The Semi Conductor Tracker



10 September 2009

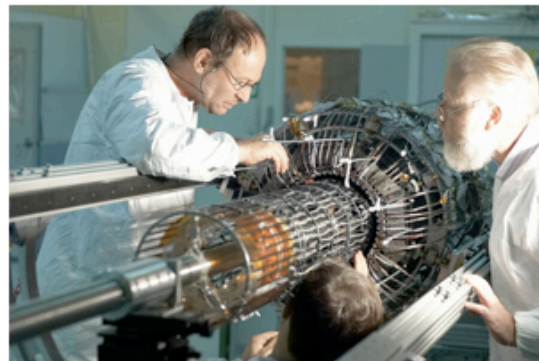


The Semi Conductor Tracker



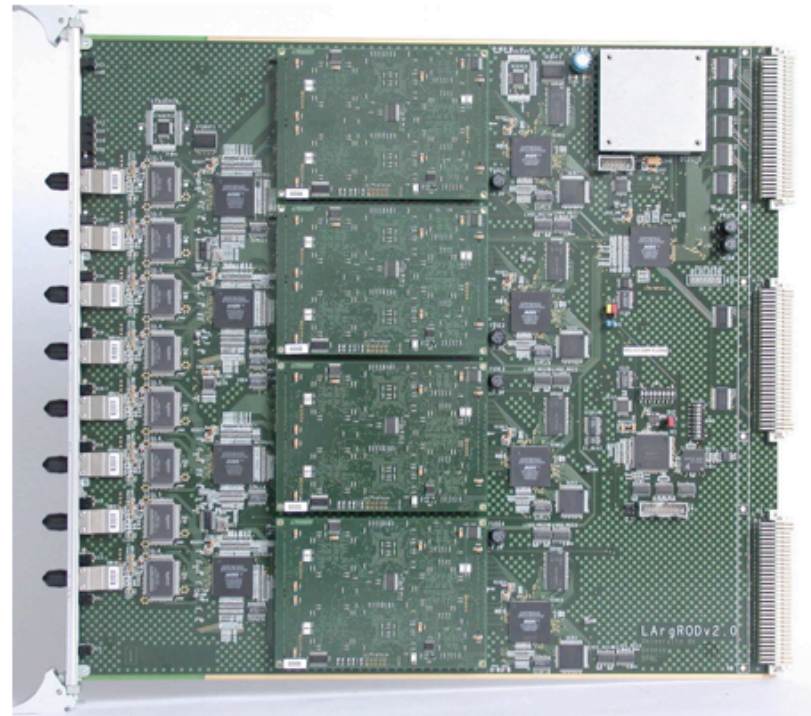
The Pixel Detector

- **Intregation**
 - Complete – DPNC role was technical
- **Installation**
 - Complete early 2008
- **Commissioning (31.08.08)**
 - Bake-out of beam pipe completed
 - Commissioning delayed by cooling infrastructure problems
 - No show stoppers yet and full operation in 2008 run period
- **(B-layer – see slides on the upgrade)**



The LAr calorimeter ROD readout

- **Design, construction**
 - Complete – 228 ROD boards + spares for LAr EM calorimeter and hadron calorimeter
 - Installation complete, associated DCS developments complete
 - Commissioning complete
 - Now maintenance



Trigger :: Event Data Model



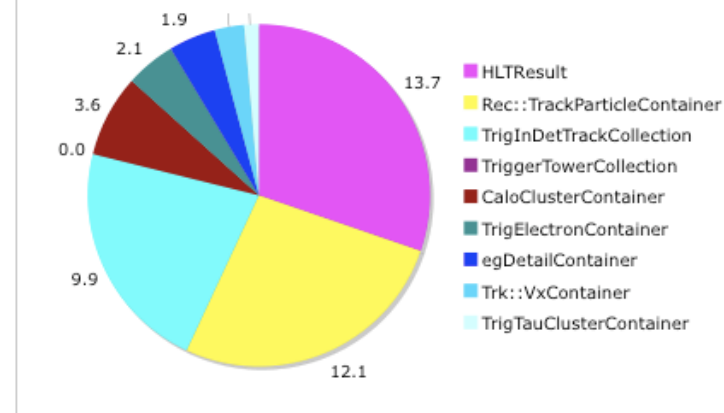
Progress in 2008:

- **data size:** reduced from $\sim 150\text{kB/evt}$ to $\sim 60\text{kB/evt}$ with very little reduction of information content
- **backwards compatibility:** framework is now in place for all data taken in 2008 to be backwards compatible in 2009 (and beyond)
- **AthenaROOTAccess:** allows lightweight access to trigger information is now functional

Data Readiness:

- trigger EDM is prepared for first collision data
- improvements in size and functionality will progress as data is better understood

AOD Trigger Content (kB per top event)

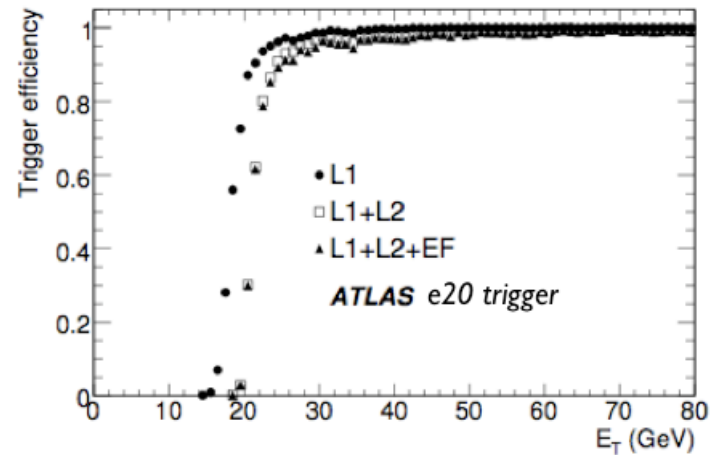


Trigger :: e/ γ Slice



Trigger Menus: Both commissioning and first physics menus have been developed

- Initial rate and efficiency estimates are complete



Ongoing Work at UniGe:

- development of base-line efficiency extraction tool
- maintenance of electron and photon trigger menus
- calibration of LVL2 electron (“s-shape” correction)
- development of sliding window clustering algorithm for LVL2
- performance comparison: soft electron vs. default electron



Preparation of Computing Infrastructure (S. Gadomski)

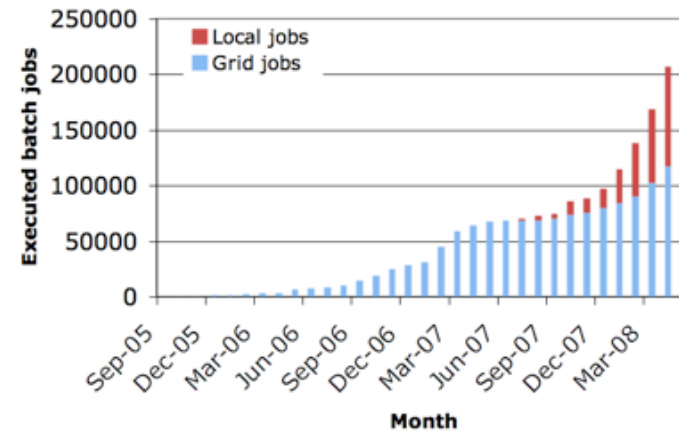


75 TB effective disk, 15 login machines, 38 batch nodes (152 CPU's)



Direct 1Gb/sec link to CERN IT.

- Tier 3 hardware – complementary to Tier 2 activities in CSCS Manno
- Operating well, heavily used



Reliable installation for local and for Grid use.



Preparations for First Data

- **Commissioning – see previous slides**
- **HLT Trigger Operations – see previous slides**
- **Computing operations – see previous slides**
 - S. [Gadomski](#) is ATLAS Trigger production manager
 - responsible for data samples produced on the Grid for Trigger studies
 - responsible for the Trigger activities at the CERN Analysis Facility
- **Performance Studies**
 - Trigger and tracking related initially to electron/photon identification
 - (W. Bell) implementing hardware and software for minimum bias events
 - Emphasis on understanding the tracking and low- p_T electron signatures with the 1st data e.g. J/Ψ triggers
- **Physics Studies**
 - Recent note on SP measurement for Higgs (A. [Straessner](#))
 - Recent notes on systematic SUSY searches with 1-lepton signature (T. [Eifert](#), M. [Backes](#))
 - Studies of SUSY potential with [dilepton](#) signatures, Stop (A. [Robichaud Veronneau](#), C. Mora, Ph. [Urquijo](#))
 - Studies of SM and large emphasis on SM backgrounds (A. Hamilton et al., ALL)

10 September 2008

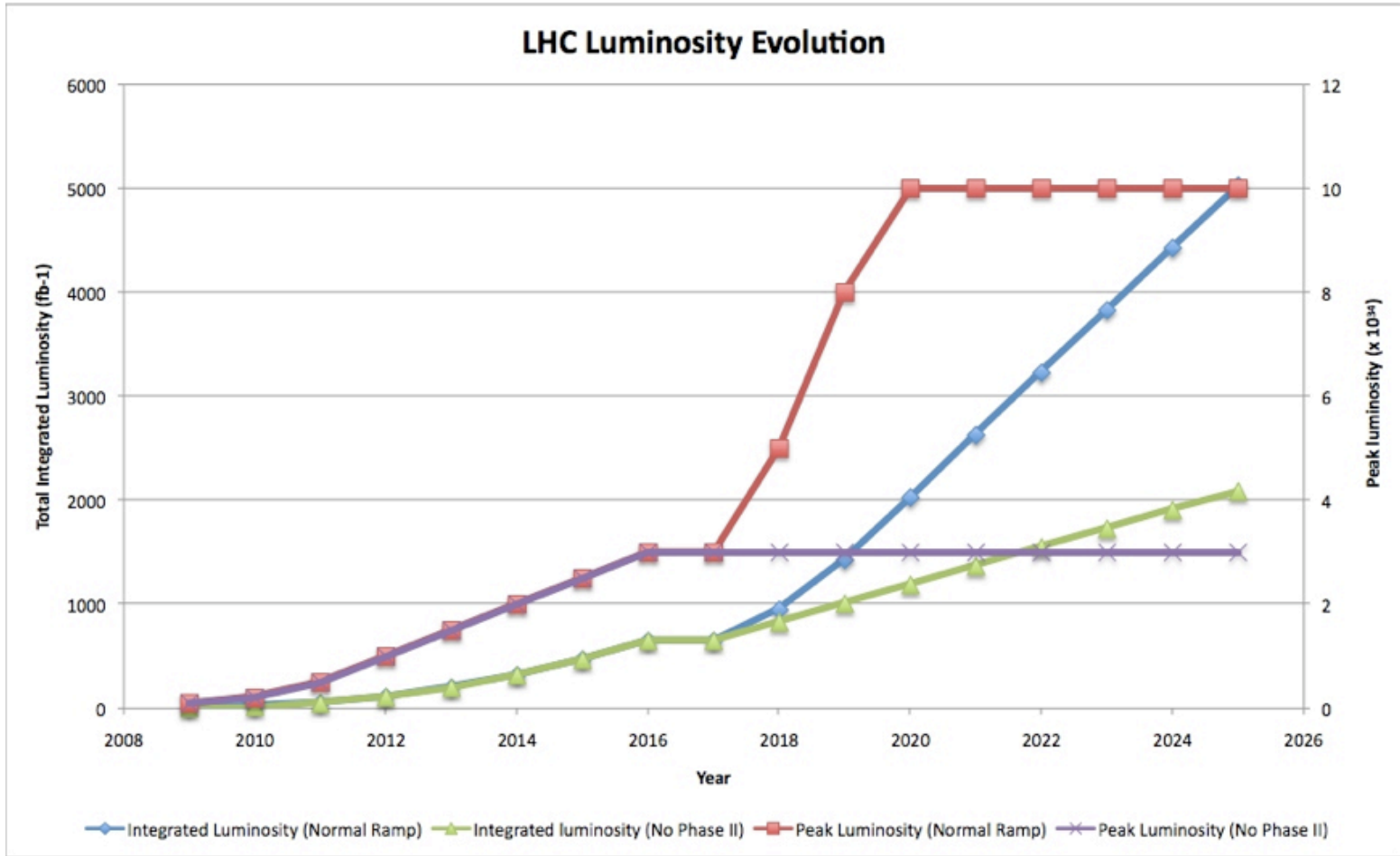
Everybody is BUSY!!

A luminosity profile and expected machine upgrades

- **2009 – 2012 ramp in L, up to 10^{33} - 10^{34}**
 - Shows 3 years exploitation of LHC at nominal or above luminosity
- **2012 – 2013 shutdown - expect new triplets & first injector upgrade**
 - **This may be up to ~6 months**
 - Potentially a nominal 2-3 increase in luminosity achievable before a long shutdown in 2016-2017 (up to $2-3 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$)
 - A nominal integrated luminosity of **$500-700 \text{ fb}^{-1}$** before the shutdown.
- **End 2016 – end 2017 shutdown - expect commissioning of new full injector chain**
 - *Experiments* require a long shutdown (> 12 months) to replace their full Inner Detectors
 - Expect an increase to $\sim 10^{35} \text{ cm}^{-2}\text{s}^{-1}$ peak luminosity and 3000 fb^{-1} integrated luminosity
- **This implies replacement of B-layer in 2012-3 and full ID replacement on 2016-7**
 - **The full SLHC upgrade will be a fully silicon tracker with pixels and silicon strips**
 - **The existing B-layer cannot be removed and replaced in an 8-month shutdown**
 - **Expect insertion of a new B-layer between pixel envelope and a smaller radius beam pipe**

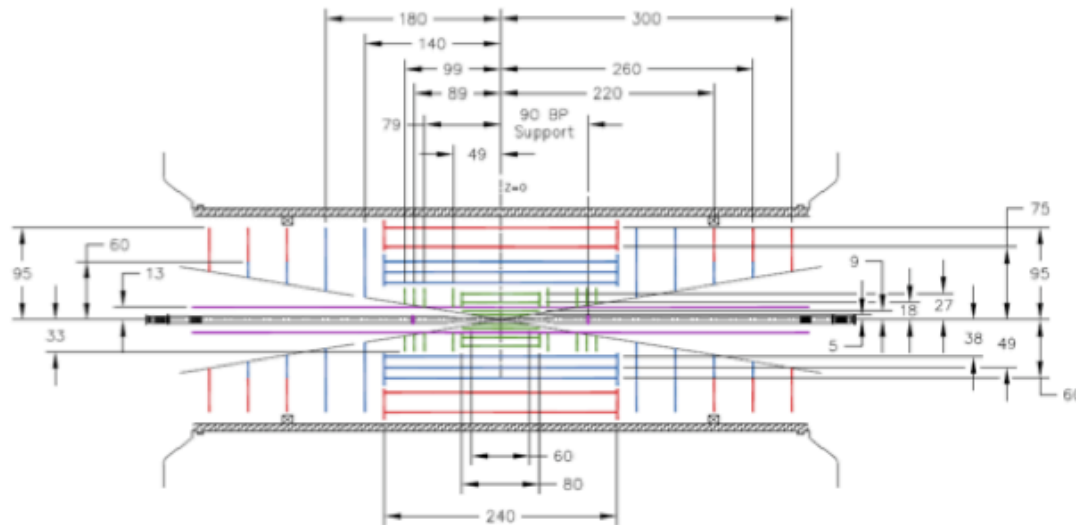


A luminosity profile and expected machine upgrades

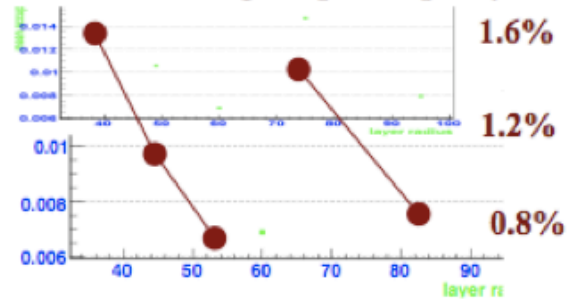


Expected Inner Detector Layout

V13-Fixed Length (Proposed)



Short and Long Strip Occupancy



Including disks this leads to:

Pixels: 5 m², ~300,000,000 channels

Short strips: 60 m², ~30,000,000 channels

Long strips: 100 m², ~15,000,000 channels



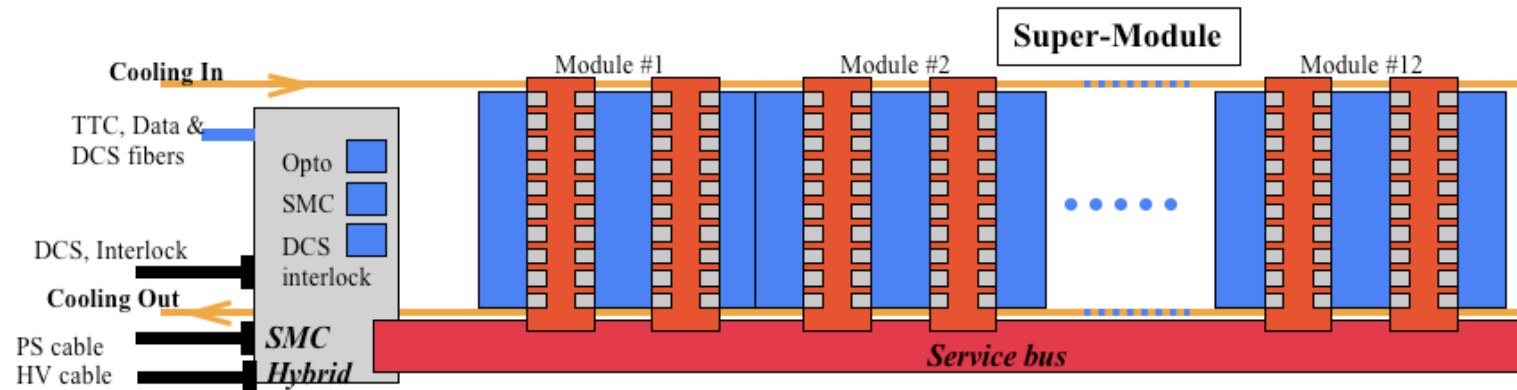
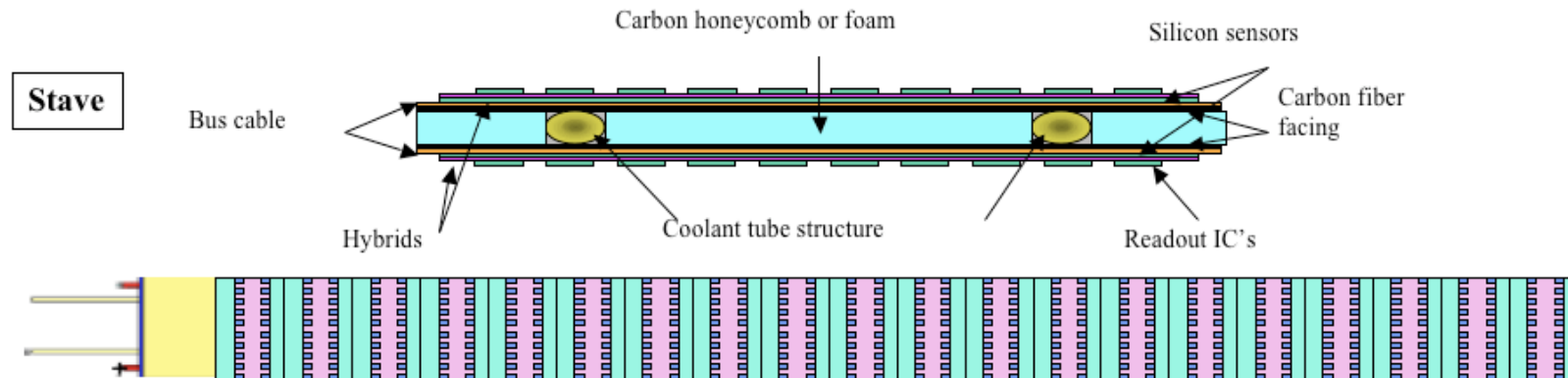
ATLAS ID SLHC Upgrade – actual DPNC participation

- **Stave/Module:**
 - - Design optimization
 - - Fabrication of a super-module demonstrator with end-insertion system
- **Mechanics:**
 - - End of barrel services layout and implementation
 - - Barrel structures: Stave/SM handling and mechanical FEA
- **Thermal:**
 - Super-module and Stave thermal performance
 - Thermal grease radiation hardness and properties
- **Electronics:**
 - ABCn: 250nm design, simulation and implementation of the digital architecture. Chip submitted in July and deliver
 - Future ABCn: 130 ou 90nm. Architecture digital en cours
- **DAQ: Under investigation for chip evaluation and for hybrid and module tests**
- **DCS: Architecture and specifications under investigation to be part of the global readout architecture**
- **Pixel B-layer replacement: Task force has written recommendations – future activity being understood**



Module Integration – Stave and Super-Module

Powering and readout are grouped for several modules and a pre-integration is considered on a ~1.2 m long stave (or Super-Module).

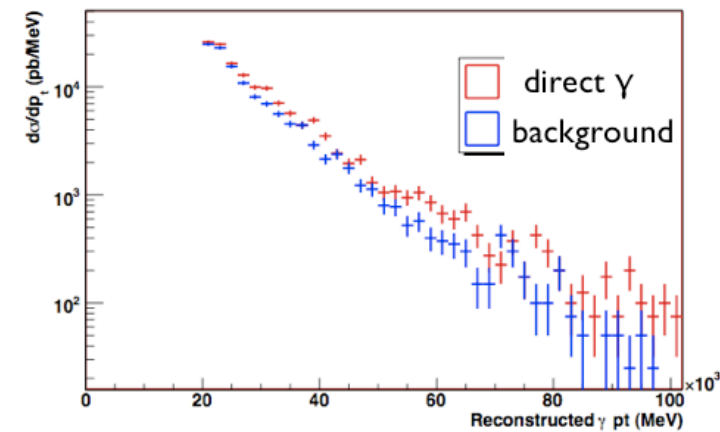
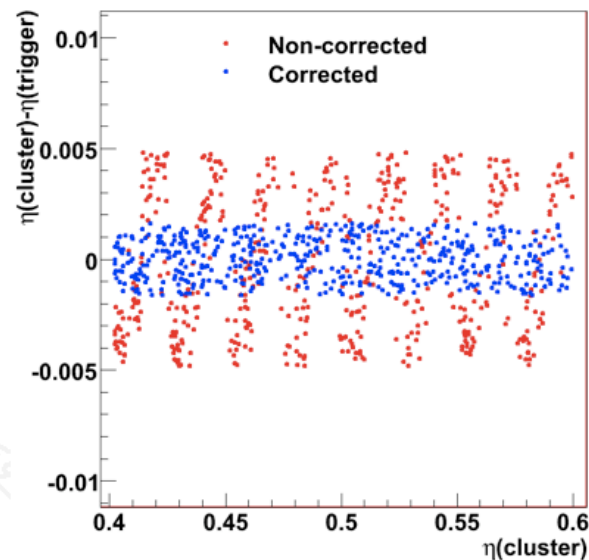


Other e/ γ Work



Direct Photon Physics:

understand the standard model
direct photon cross section is
important for many new physics
searches



Calibration of Trigger Electrons:

- called “s-shape” correction
- corrects the η position of a trigger LVL2 EM cluster based on it's position in a calorimeter cell



The assumed Large Hadron Collider (LHC) operational parameters

Energy	14 TeV	Two 7 TeV proton beams
Luminosity	$10^{33} \text{ cm}^{-2}\text{s}^{-1}$	2008 Luminosity
	$10^{34} \text{ cm}^{-2}\text{s}^{-1}$	2010 Design luminosity
Cross Section	$100 \text{ mb} = 10^{-25} \text{ cm}^2$	
Collision Rate	10^9 Hz	At design luminosity
ATLAS Trigger Rate	200 Hz	Luminosity independent

Physics Strategy

Mid 2008/2009: first 14 TeV physics run – $\mathcal{L} < 10^{32} - 10^{33} \text{ cm}^{-2} \text{ s}^{-1}$, $\mathcal{L}_{\text{int}} \sim 1 \text{ fb}^{-1}$

- commence tuning trigger menus / in situ calibration
- First SM measurements: min bias, PDF constraints, Z / W / top / QCD

2009/10: Low luminosity running – $\mathcal{L} \sim 2 \times 10^{33} \text{ cm}^{-2} \text{ s}^{-1}$, $\mathcal{L}_{\text{int}} \sim 10 \text{ fb}^{-1}$

- First B-physics measurements & rare decay searches (e.g. $B_s \rightarrow J/\psi \phi$)
- First searches: high mass dilepton / Z', inclusive SUSY, Black Hole production, Higgs in 'easier' channels e.g. $H \rightarrow 4l$

2010/11: Low luminosity running – $\mathcal{L} \sim 2 \times 10^{33} \text{ cm}^{-2} \text{ s}^{-1}$, $\mathcal{L}_{\text{int}} = 10 \text{ fb}^{-1}/\text{year}$

- First precision SM & B-physics measurements (systematics under control)
- Improved searches sensitivity (Z', W', KK ... @ 1 TeV)
- Light Higgs searches (ttH , $H \rightarrow gg$, VBF $qqH(H \rightarrow \tau\tau)$ etc.)

2011/14: High luminosity running – $\mathcal{L} \sim 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$, $\mathcal{L}_{\text{int}} = 100 \text{ fb}^{-1}/\text{year}$

- High precision measurements of New Physics (e.g. Higgs/SUSY/ED @ 1 TeV)
- Improved searches sensitivity (Z', W', KK ... @ 3 TeV)

2014/15: Shutdown – note: date and details of upgrade not yet fixed

- LHC machine and Detector upgrades

2015/19: SLHC – $\mathcal{L} \sim 10^{35} \text{ cm}^{-2} \text{ s}^{-1}$, $\mathcal{L}_{\text{int}} = 1000 \text{ fb}^{-1}/\text{year}$

- High precision measurements of New Physics (e.g. Higgs/SUSY/ED @ 3 TeV)
- Improved searches sensitivity (Z', W', KK ... @ 5 TeV)