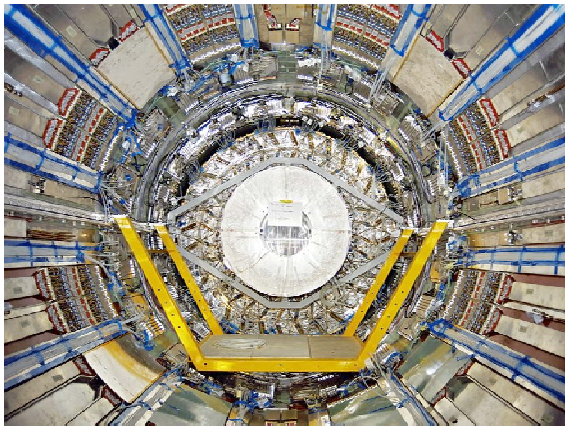


Status of the ATLAS Experiment

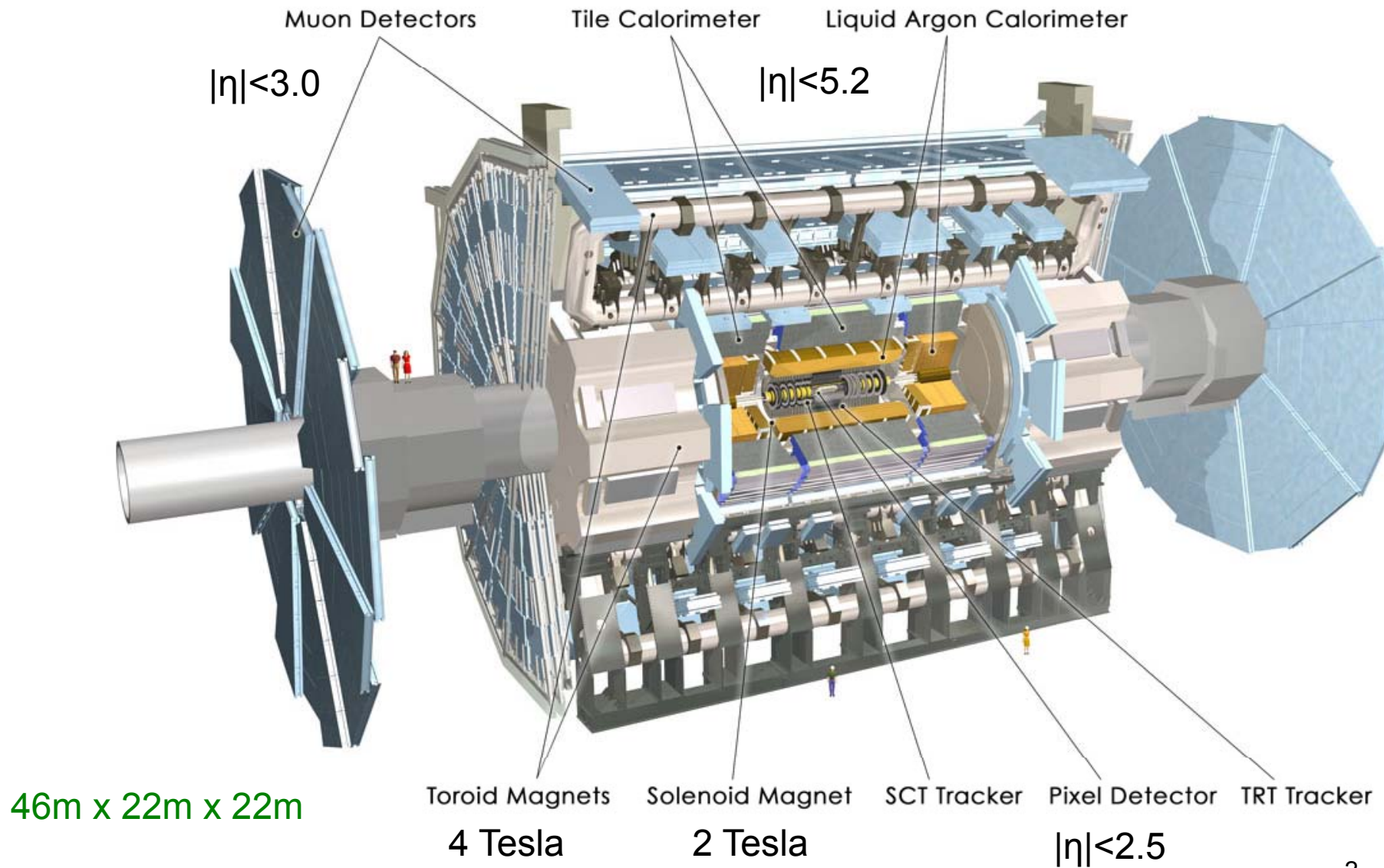
Arno Straessner
on behalf of the Bern and Geneva ATLAS groups



- ATLAS detector construction
- Trigger and DAQ system
- Physics preparation in Bern and Geneva
- Swiss ATLAS computing resources and usage
- Outlook

The ATLAS Detector

- general purpose detector at the LHC
- 14 TeV proton-proton and heavy-ion collisions



Swiss ATLAS Groups



- Professors and Faculty
 - Prof. A. Ereditato, PD H.P. Beck, Prof. K. Pretzl, M. Weber
- Post-Docs
 - B. Gjelsten, S. Haug, K. Kordas
- PhD students
 - A. Battaglia, C. Topfel, N. Venturi

High-level trigger, DAQ, Computing

Supersymmetry

- Professors and Faculty
 - Prof. A. Clark, Prof. A. Blondel, Prof. M. Pohl
 - X. Wu, L. Rosselet, D. Ferrere, S. Gadomski
- Post-Docs
 - O. Gaumer, A. Hamilton, A. Straessner, T. Vu Anh, A. Limosani, M. Keil, P. Urquijo
- PhD and master students
 - T. Eifert, A. Robichaud-Veronneau, F. Bucci, C. Mora Herrera
 - A. Abdel-Alim, I. Shreyber, I. Badhrees, G. Alexandre

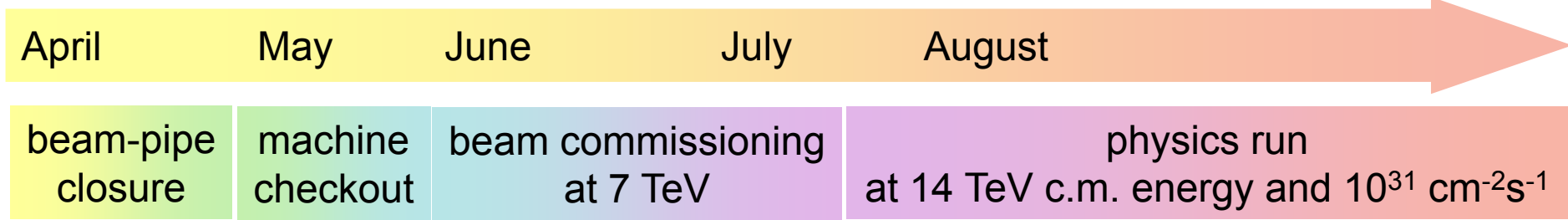


SCT, LAr Calorimeters, High-level trigger, Computing

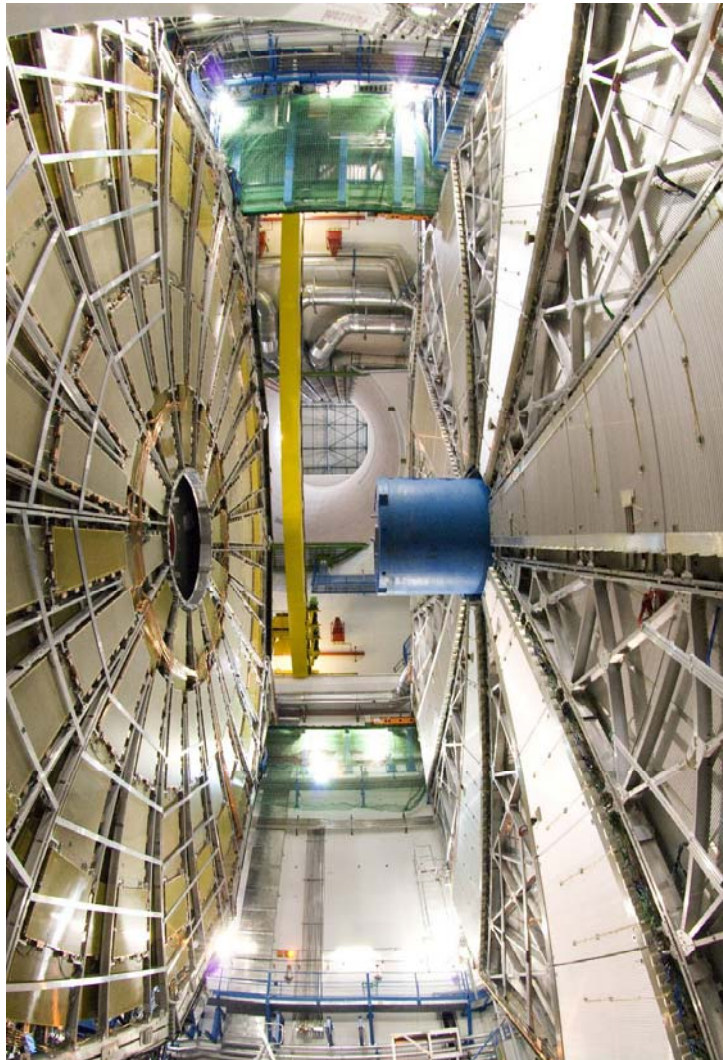
Standard model, Supersymmetry, Higgs, Heavy ions

LHC Construction Advances

- Last dipole magnet went down in April 2007
- Recent problems with quadrupole focusing magnets and interconnection modules solved or under control
- LHC schedule in 2008:

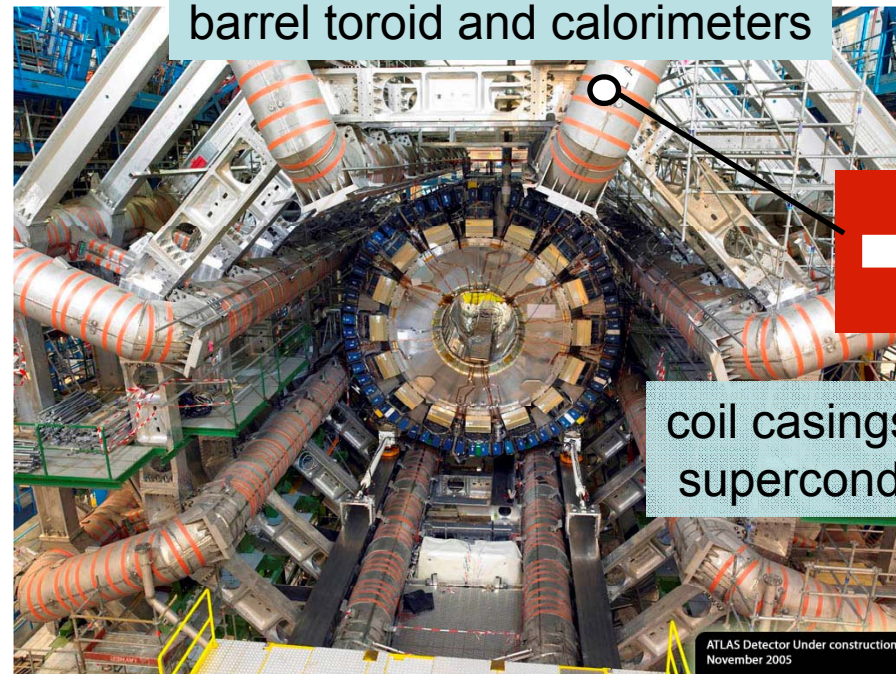


The ATLAS Experiment beginning of 2007

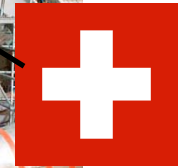


big TGC and MDT muon wheels

MDT=Monitored Drift Tubes
TGC=Thin Gap Chambers

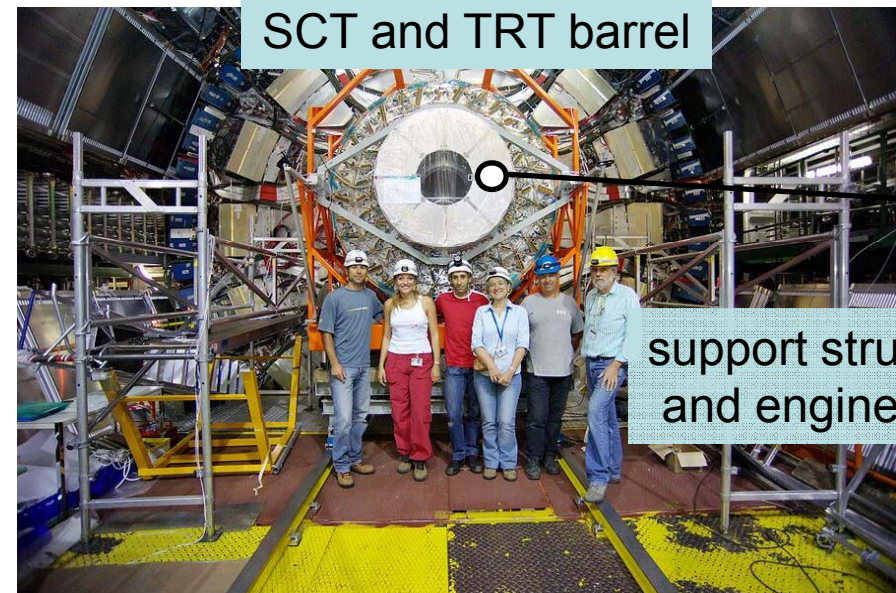


barrel toroid and calorimeters



coil casings and superconductor

ATLAS Detector Under construction
November 2005

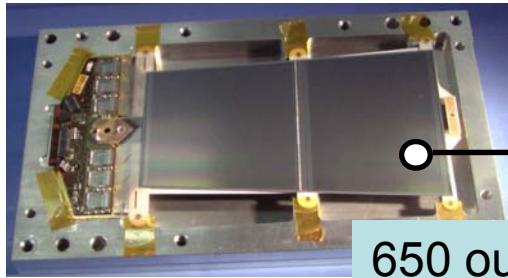


SCT and TRT barrel

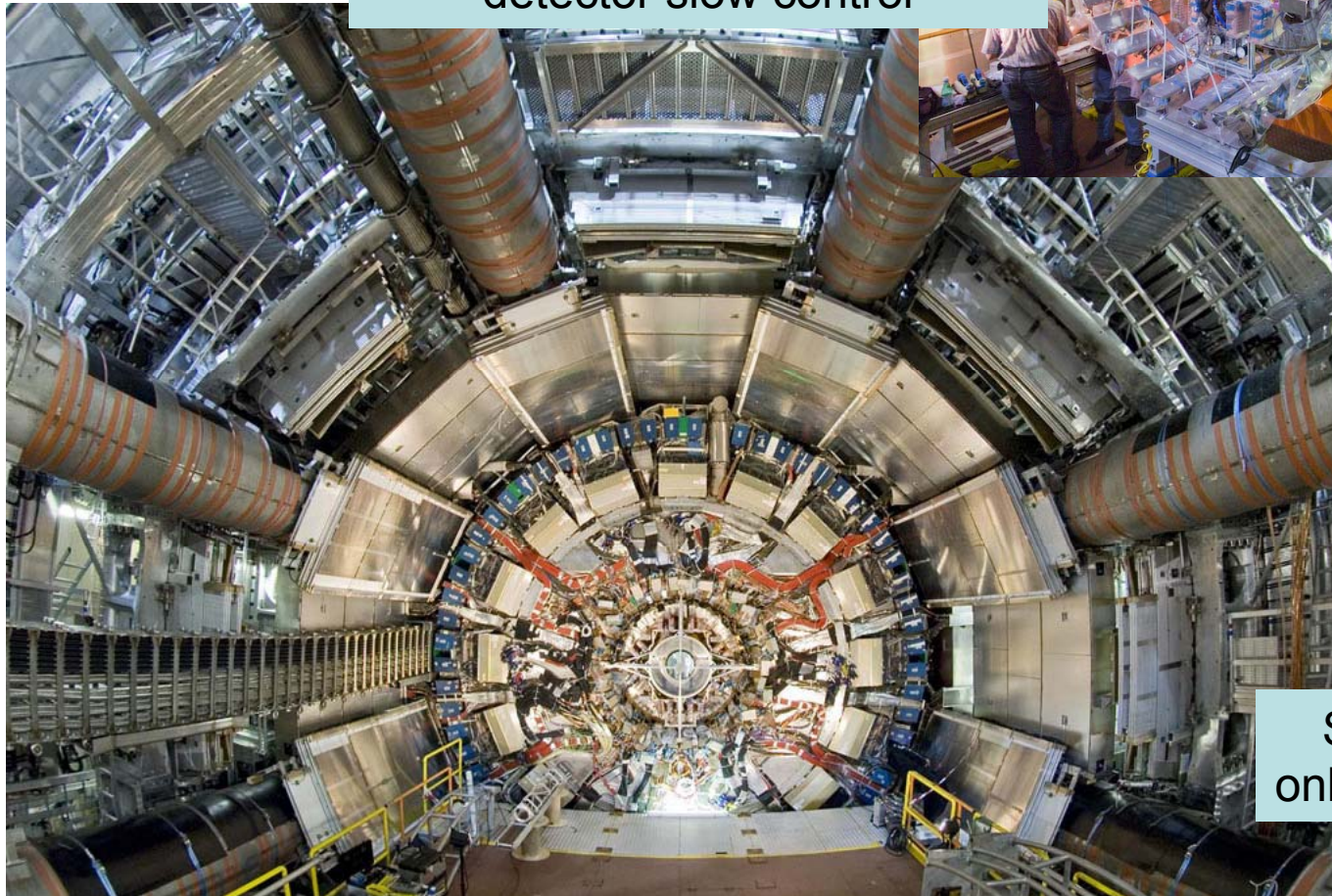
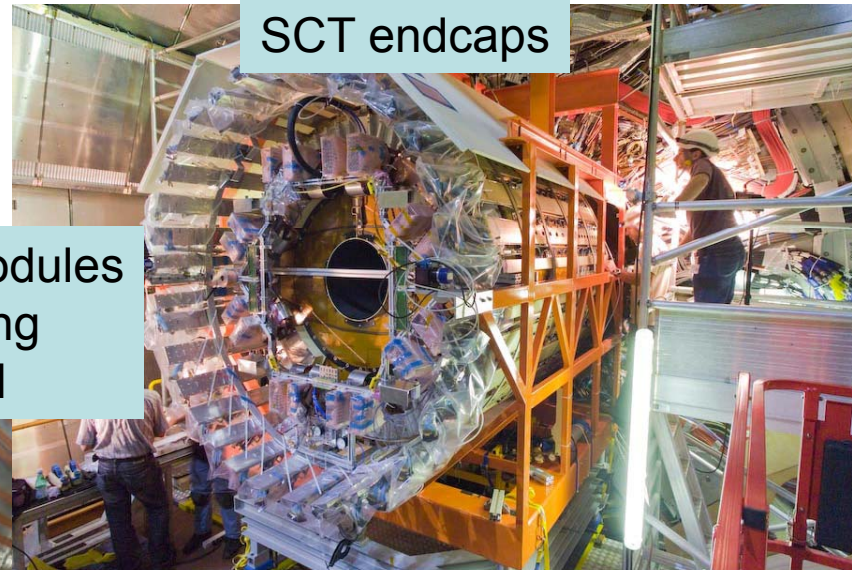


support structure and engineering

SCT Endcap Installation in May and June 2007

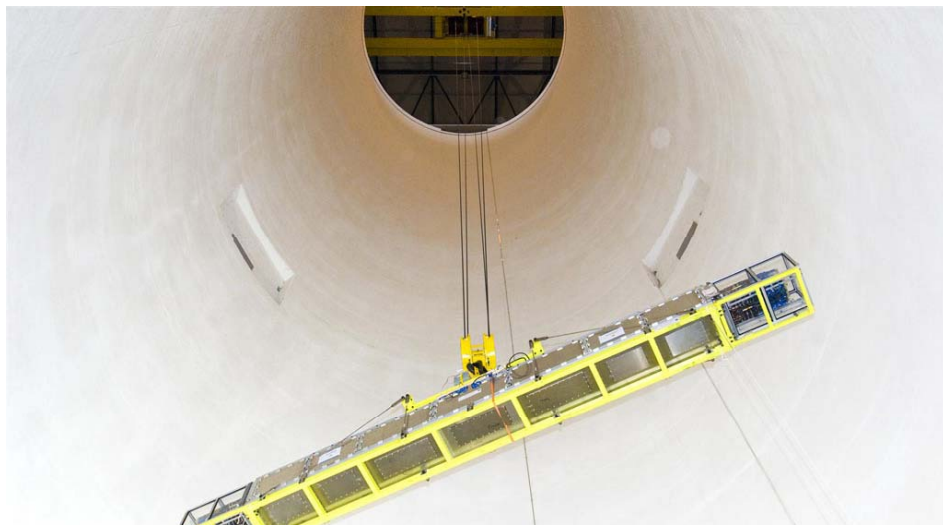


650 out of 2000 silicon modules
mechanical engineering
detector slow control

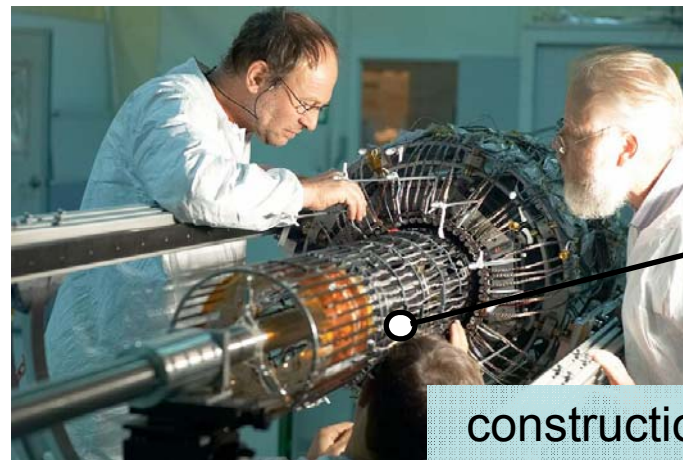


SCT commissioning:
only 0.3% dead channels

The Pixel Detector Arrives - June 2007



Pixel detector

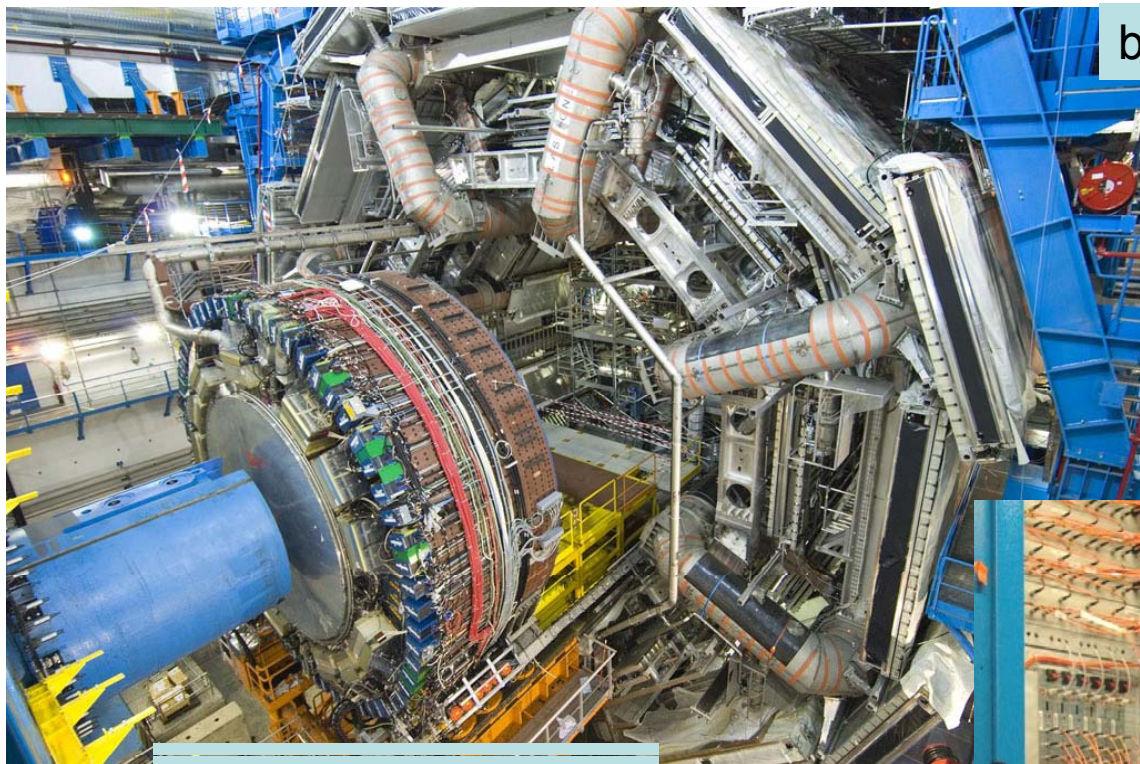


construction of the
2nd barrel pixel layer



Pixel connections and testing: Nov '07 - Mar '08

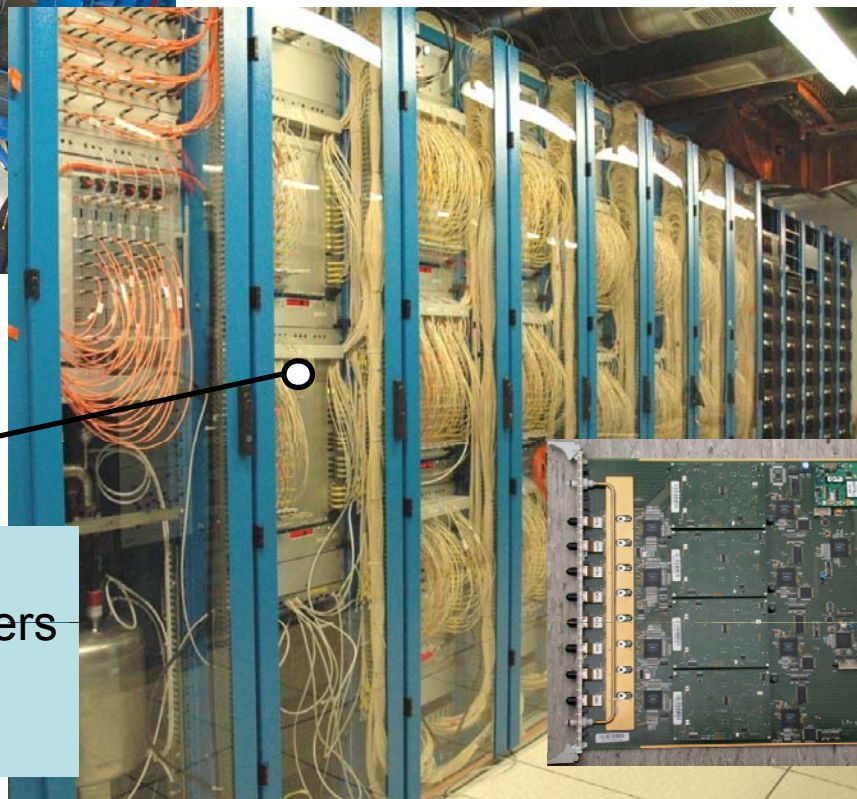
Muons and Calorimetry - June 2007



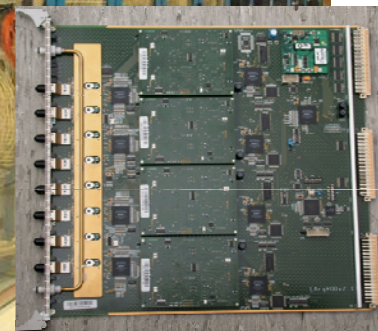
barrel muon chambers

now: 75% of all barrel muon chambers installed

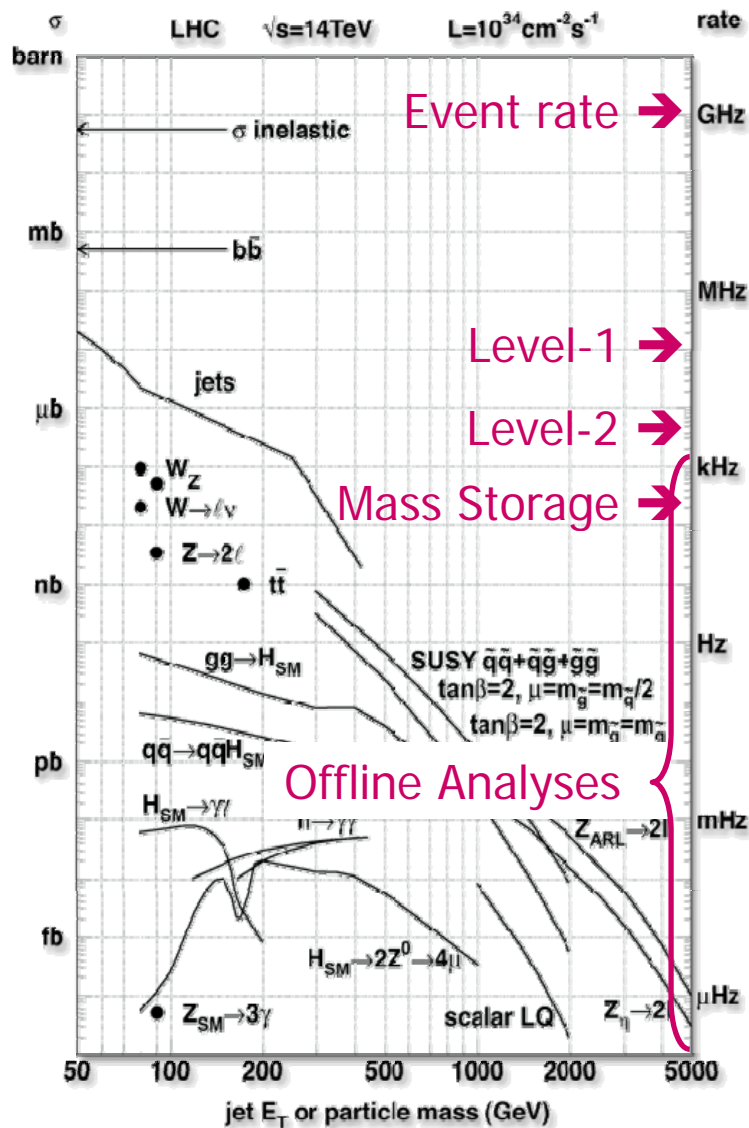
Liquid Argon and Tile Calorimeter endcaps



245 read-out driver boards
for all Liquid Argon Calorimeters
and the Tile Calorimeter
+ slow control



From Detector To Physics: The Trigger



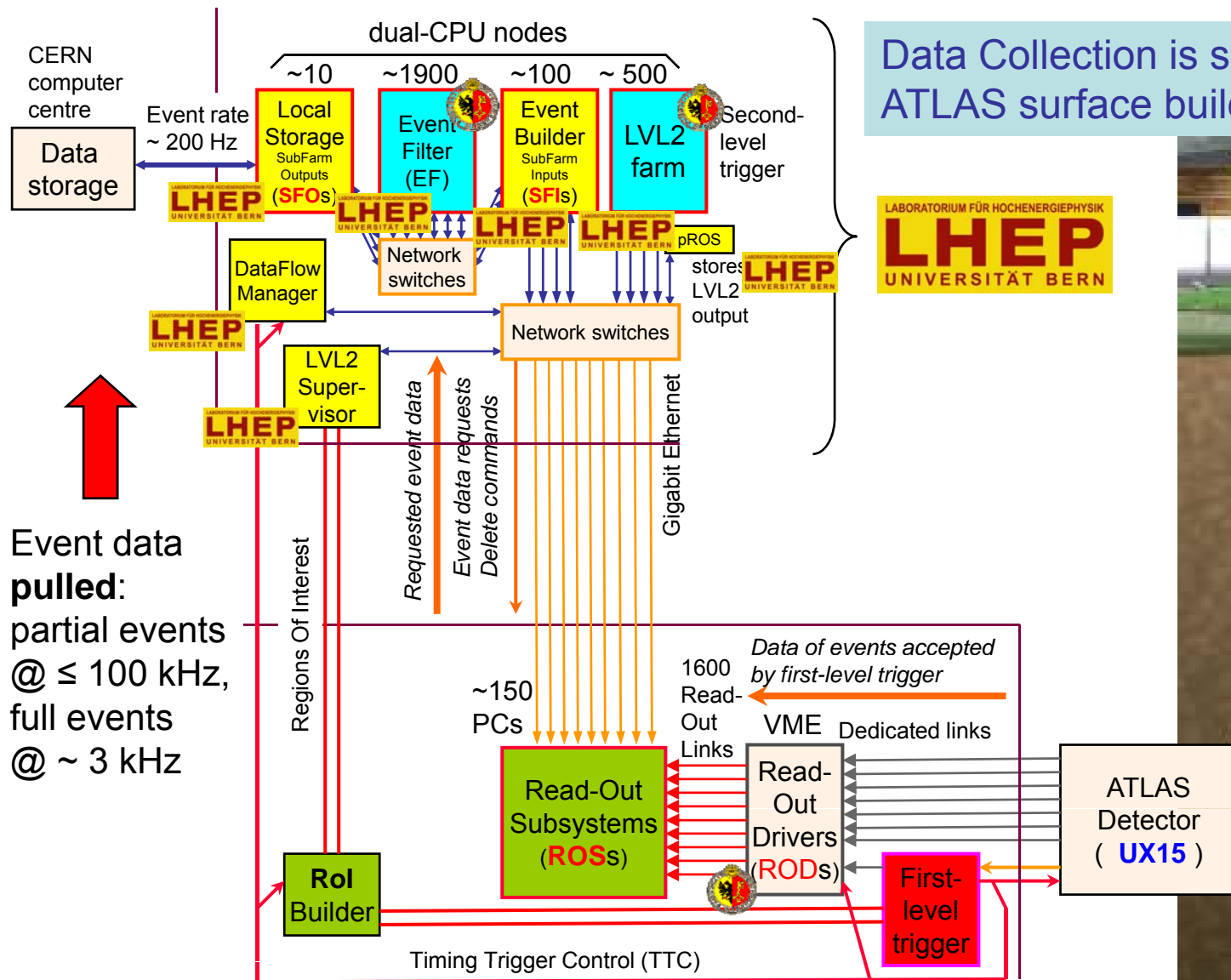
- Bunch crossing 40 MHz
- σ total 70 mb
- Event rate ~ 1 GHz
- Number of events/BC ~ 25
- Number of particles/event ~ 1500
- Event size ~ 1.5 MB
- Mass storage rate ~ 200 Hz

- Need to have trigger of high performance
 - 6 orders of rate reduction
 - complex events and 140 M channels

- Level-1: hardware based at 40 MHz
- Level-2: software based at 100 kHz
- Level-3: event filter at 3 kHz
- Storage at 200 Hz

PC farms

ATLAS Trigger & Data Acquisition at Point-1



Data Collection is situated in ATLAS surface building (SDX1)

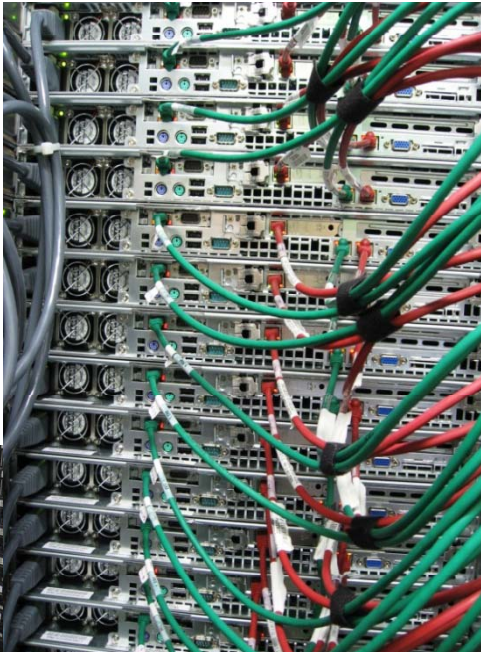


Event data pulled:
partial events @ ≤ 100 kHz,
full events @ ~ 3 kHz

Event data pushed @ ≤ 100 kHz,
1600 fragments of ~ 1 kByte each

The DAQ Hardware

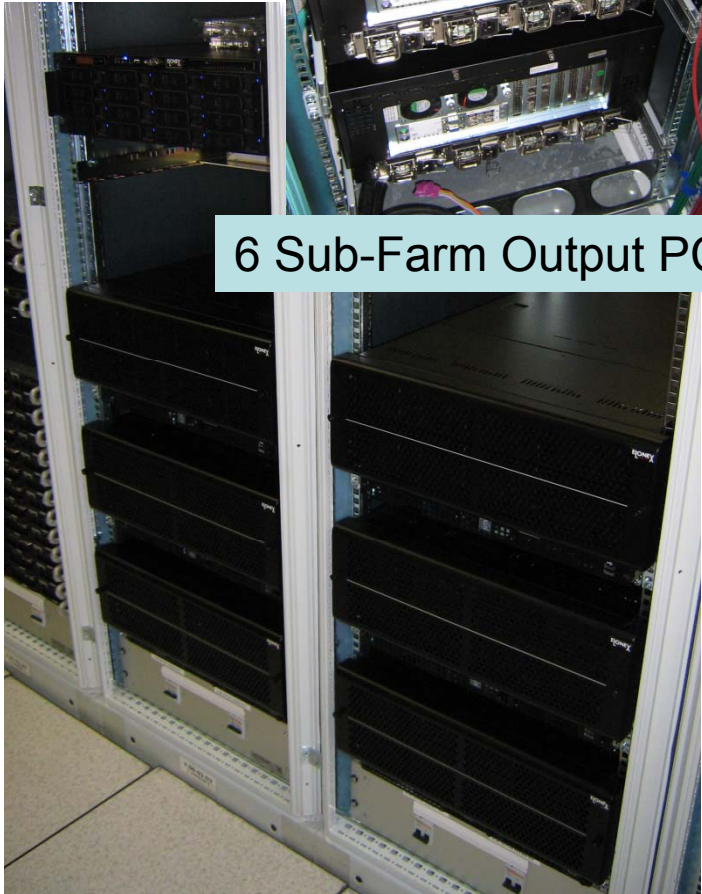
1/3 of Event Building nodes installed



32 Sub-Farm Input PCs
final system: ~100

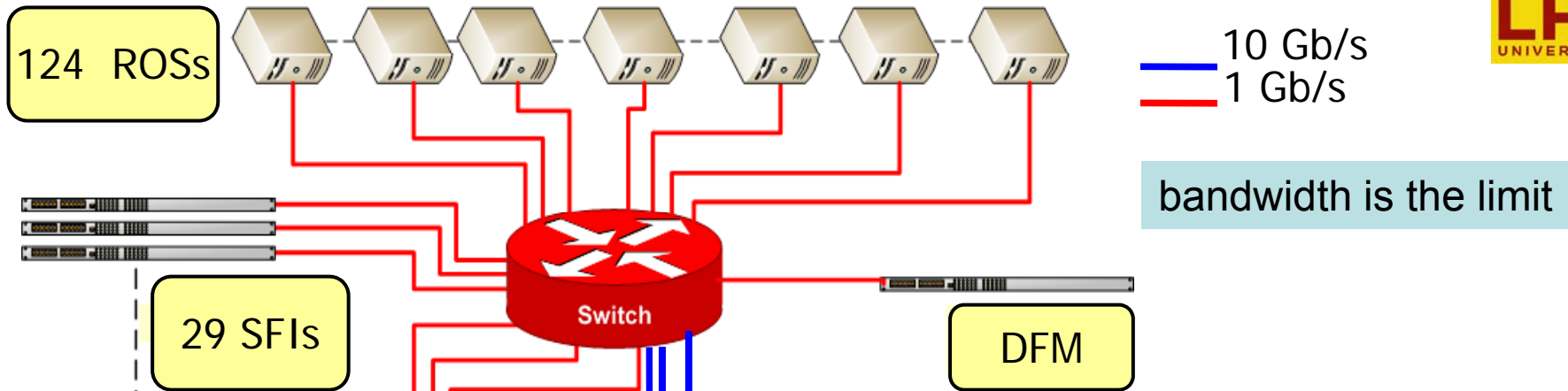


6 Sub-Farm Output PCs

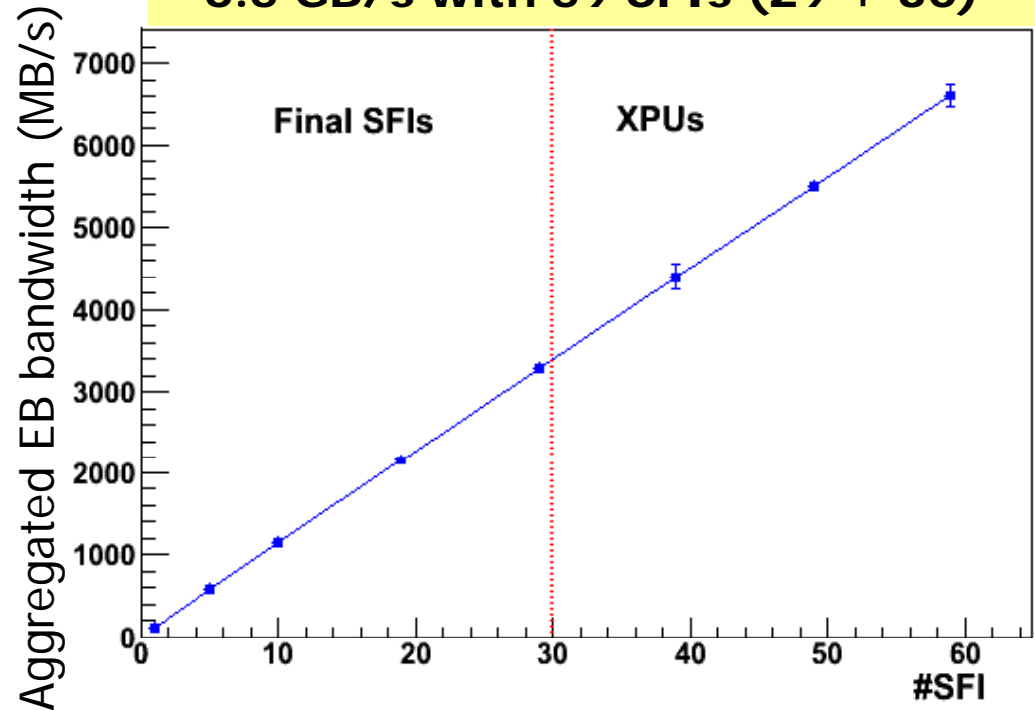


All Data Logging machines installed

Event Builder: throughput scaling



6.5 GB/s with 59 SFIs (29 + 30)

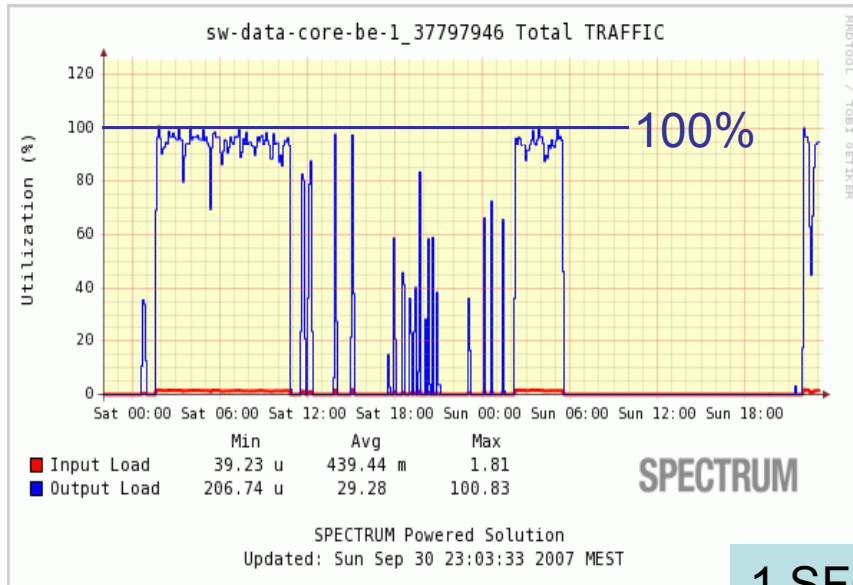


- Perfect scaling with size of Event Builder farm
- 60% of EB system does more than ATLAS EB requirements when saturating the bandwidth
- Evaluation with addition of L2 traffic in progress

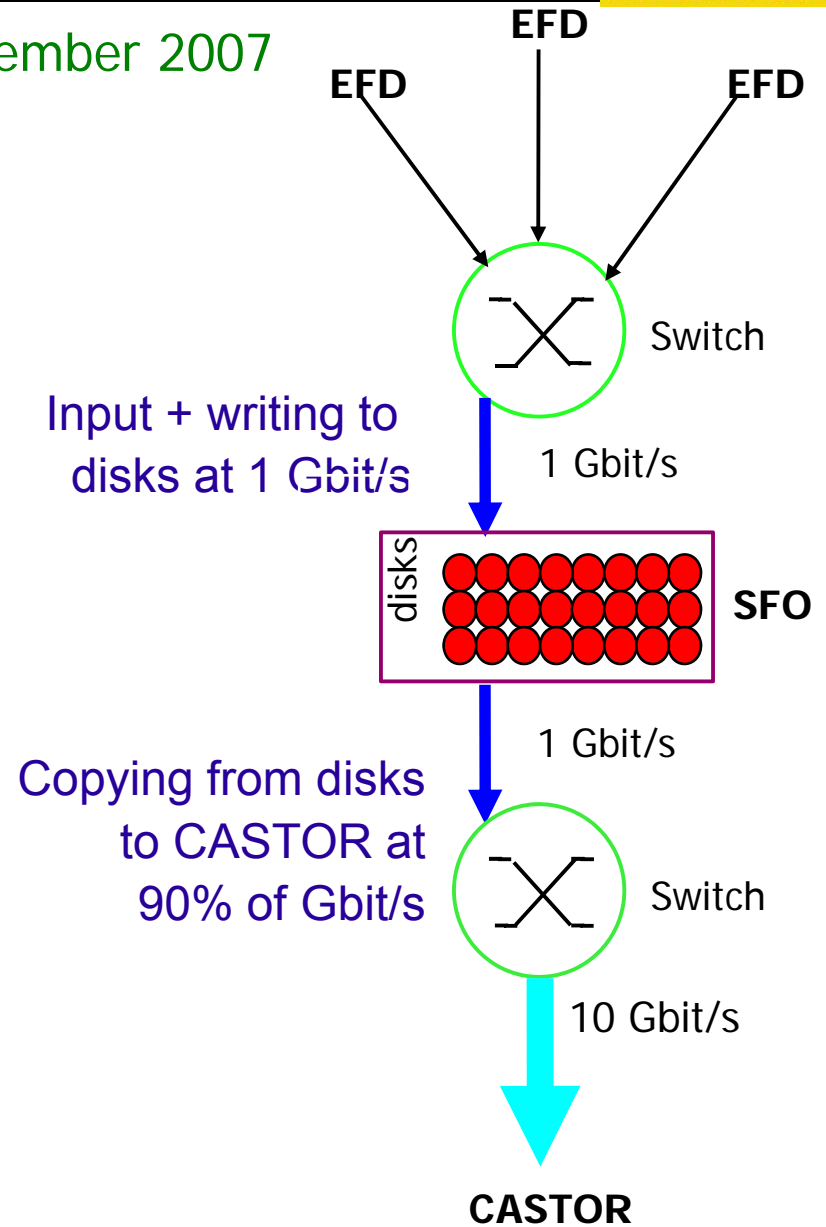
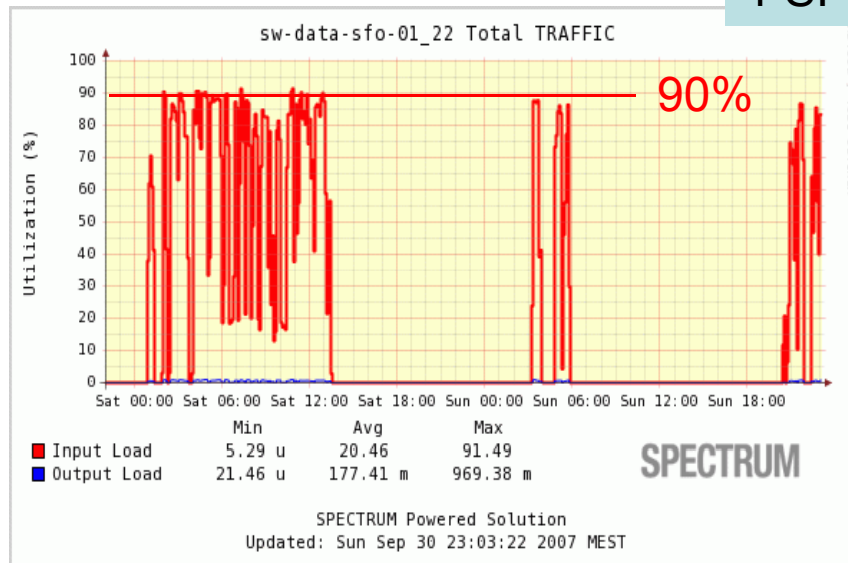
Sub-Farm Output Commissioning

- first results from TDAQ Technical Run: September 2007

Bandwidth (% 1-Gbit link)



1 SFO



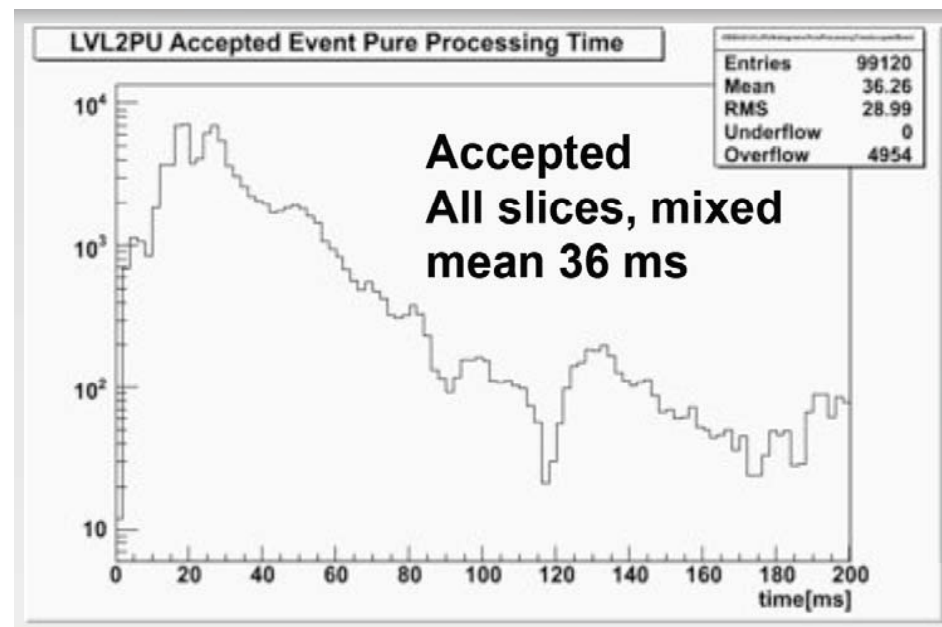
time

High-Level Trigger Software

- Many Swiss activities:
 - new deputy trigger convener (X. Wu)
 - HLT steering framework development
 - persistency of trigger information (event data model)
 - level-2 calorimeter trigger calibration
 - missing ET trigger development
 - trigger menus for physics in "express stream"
 - online integration of HLT algorithms (as an example):



- recent result from September technical run:
total L2 time/event ~ 50 ms
- need to understand timing structure



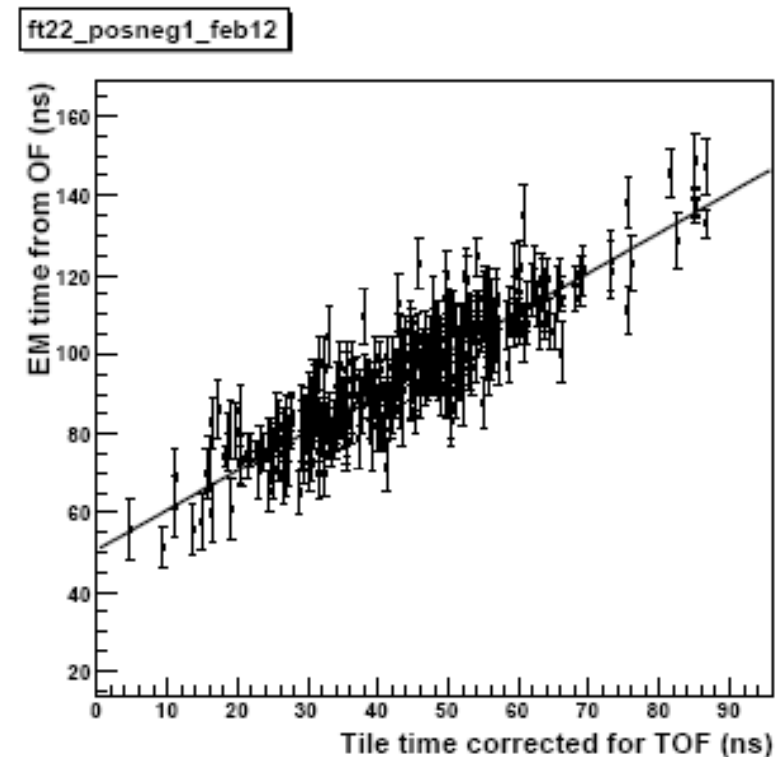
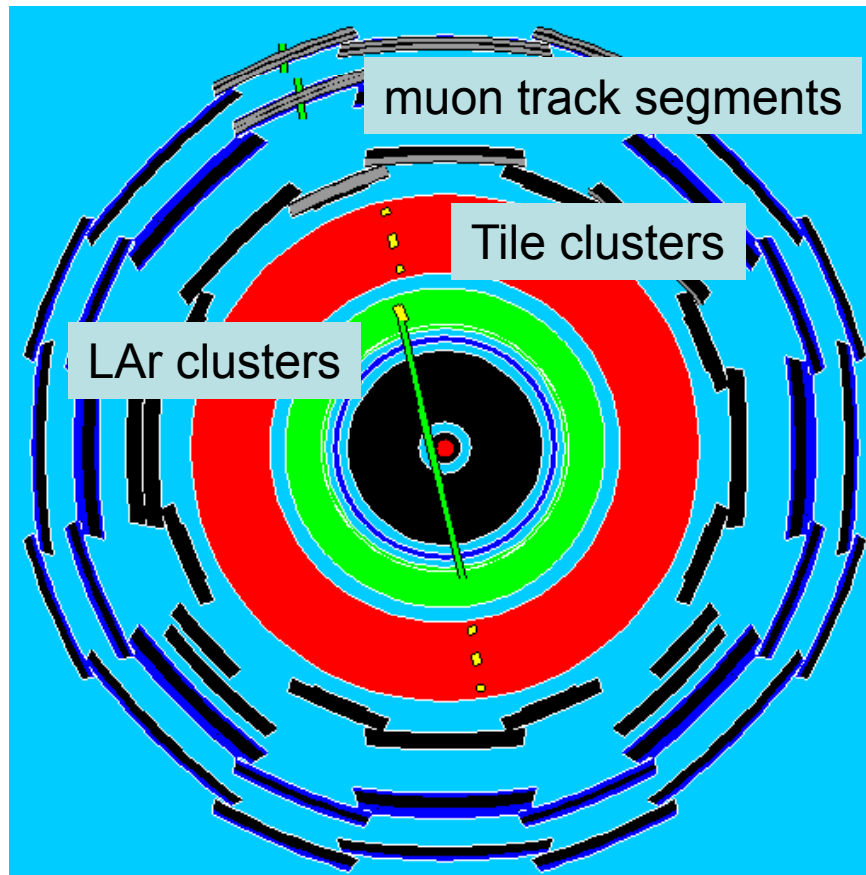
trigger slices: e/ γ , muon, jets, tau, missing ET, b-physics

ATLAS Commissioning With Cosmics



- dedicated "Milestone" week in summer
 - M-weeks every two months until beam-pipe closure
 - combined runs with as much infrastructure as possible

Run20720
Event16779032

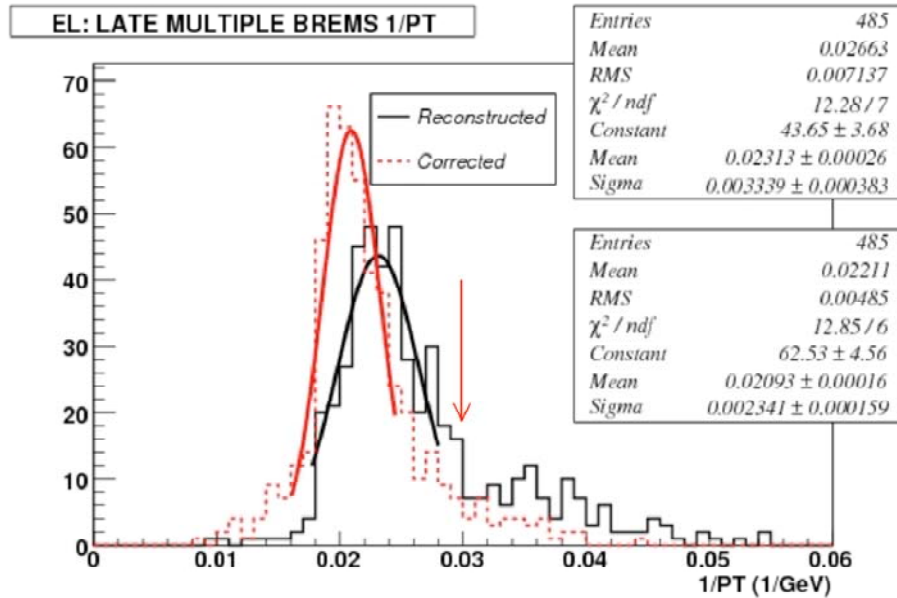


timing comparison between TileCal and Liquid Argon calorimeter

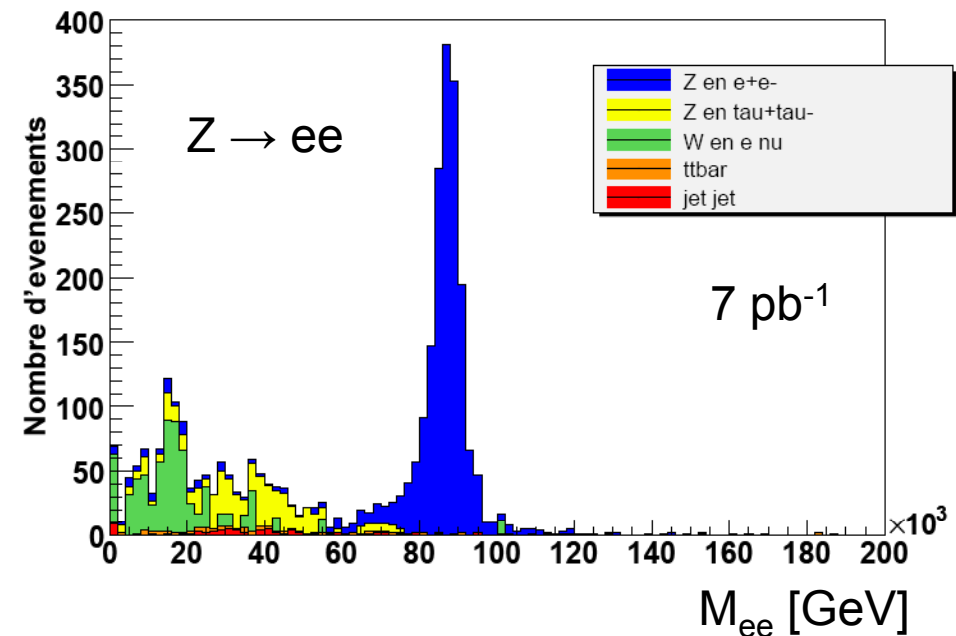
Electron and Photon Reconstruction



- detector material in front of calorimeter → photon radiation / bremsstrahlung
- reconstruction studied with test-beam data: 50 GeV electrons

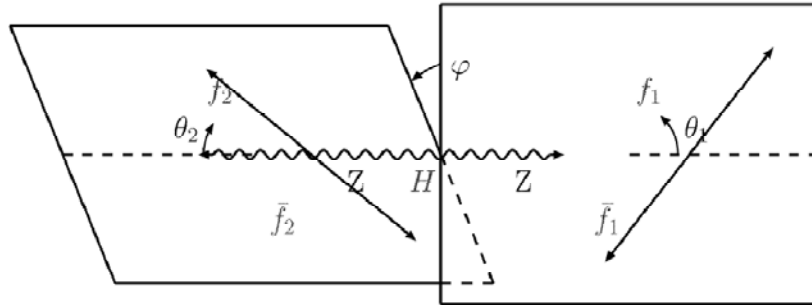


- early data analysis
- Drell-Yan production of Z's is a main reference channel
- reconstruction, trigger, backgrounds



Helicity Structure of the $H \rightarrow ZZ \rightarrow 4\ell$ Decay

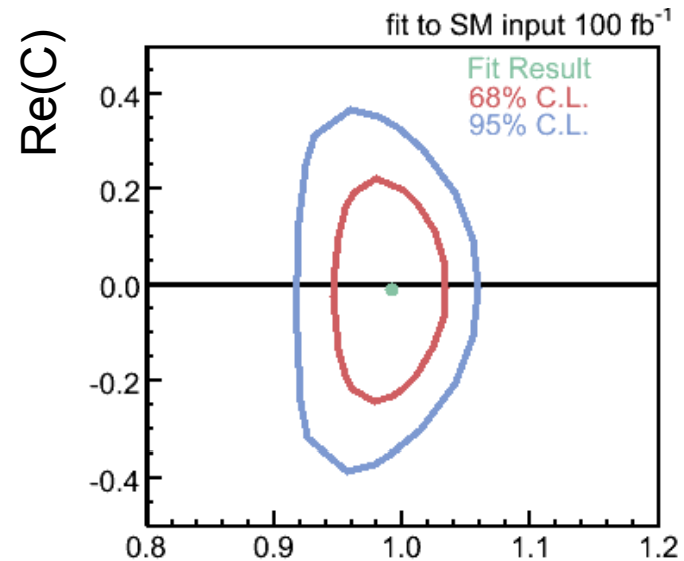
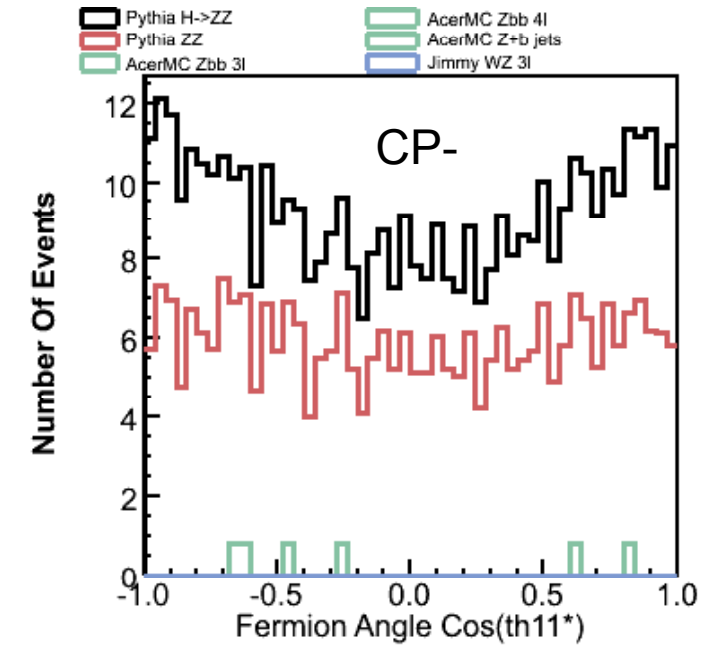
- ZZ decay plane correlations and fermion decay angles



$$i \frac{g M_Z}{\cos \theta_W} \left[\underbrace{A g_{\mu\nu} + B p_\mu p_\nu}_{\text{CP+}} + \underbrace{C \epsilon_{\mu\nu\rho\sigma} p^\rho k^\sigma}_{\text{CP-}} \right]$$

SM

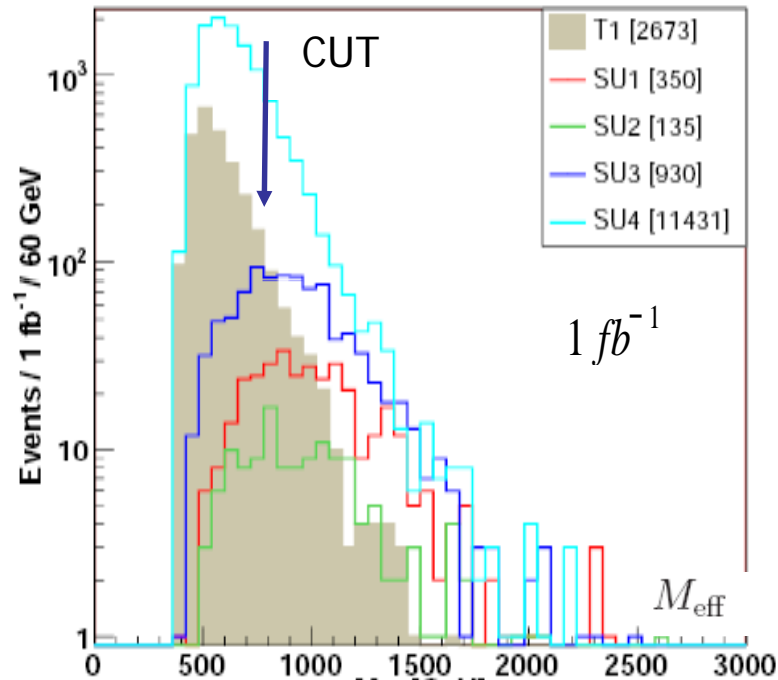
- test CP values of the Higgs (when it's found)
- limit anomalous CP contributions



Inclusive SUSY Study



- Search for signal abundancy beyond SM
- Analysis of SUSY benchmark points (SU1, SU2,...)



- SUSY characteristics → search criteria
 - Large transverse missing energy
 - Many hard jets
 - Large effective mass defined as:

$$M_{\text{eff}} = E_T^{\text{miss}} + \sum_{i=1}^4 p_T^{\text{jet}[i]}$$

Sample	$M_{\text{eff}} > 700\text{GeV}$	S/B	$S/\sqrt{S+B}$
T1	487		
SU1	303	0.62	10.8
SU2	111	0.23	4.5
SU3	744	1.53	21.2
SU4	3752	7.70	61.0

$$E_T^{\text{miss}} > 100\text{GeV}$$

$$p_T^{\text{jet}[1]} > 100\text{GeV}$$

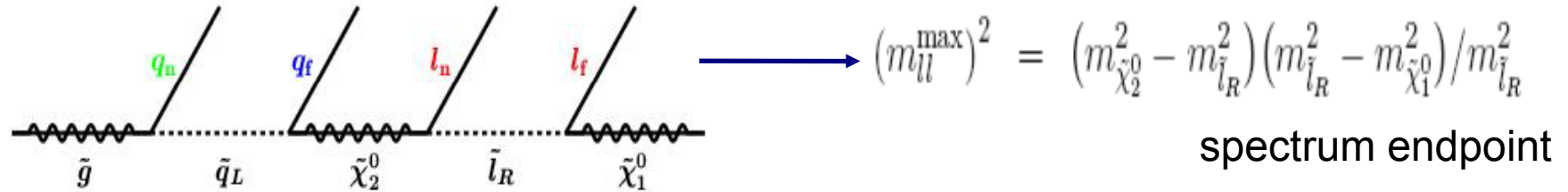
$$p_T^{\text{jet}[4]} > 50\text{GeV}$$

$$M_{\text{Eff}} > 700\text{GeV}$$

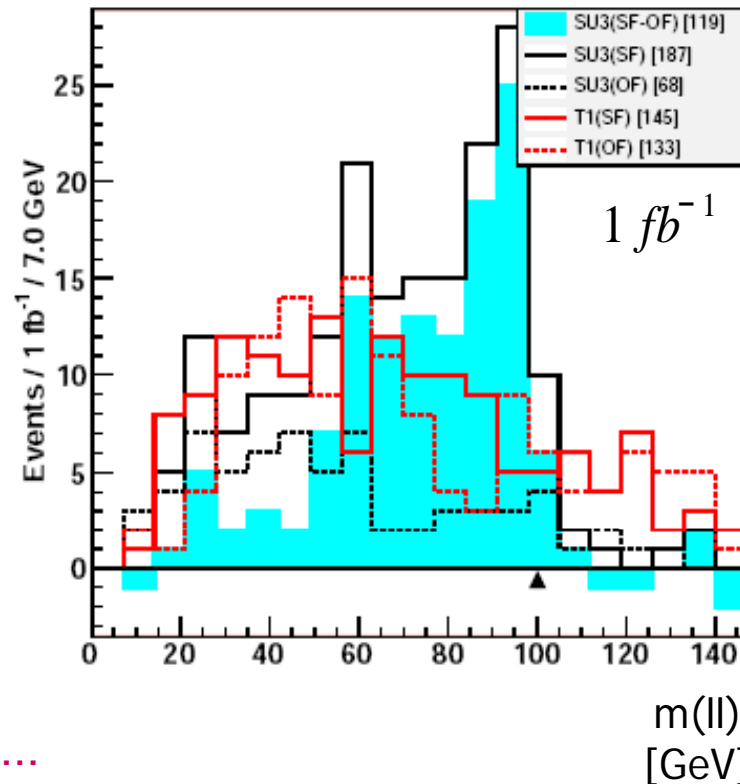
- promising signal significances

Exclusive SUSY Search

- problem: lightest SUSY particle cannot be detected
- kinematical endpoints carry information on sparticle masses



typical three body gluino decay chain from SU3 → lepton flavour is conserved!



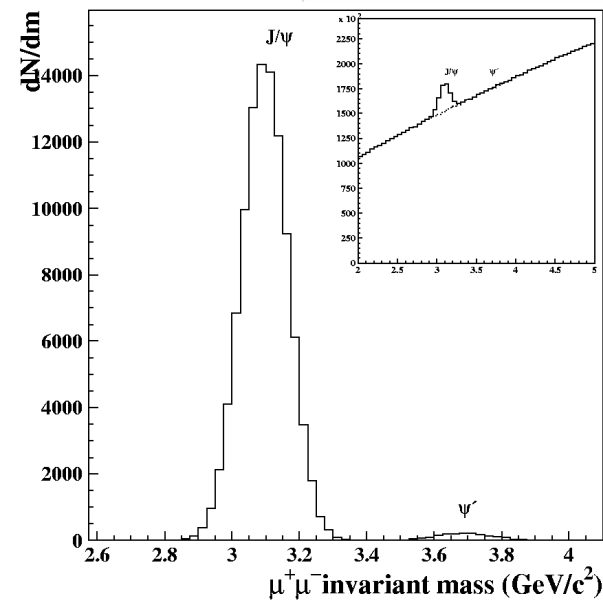
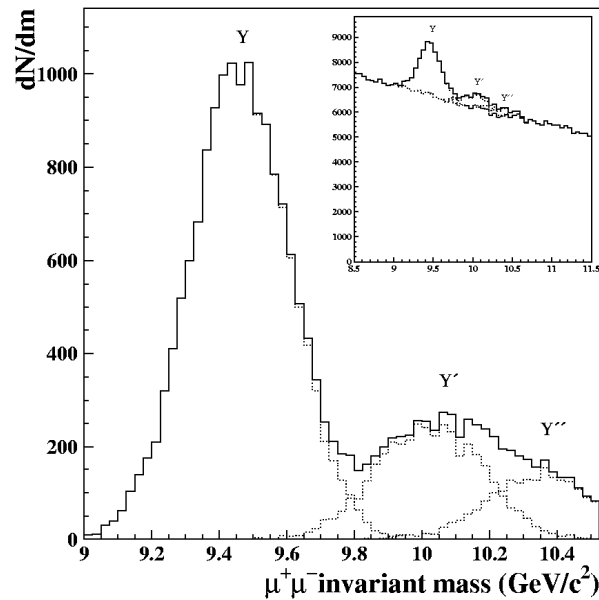
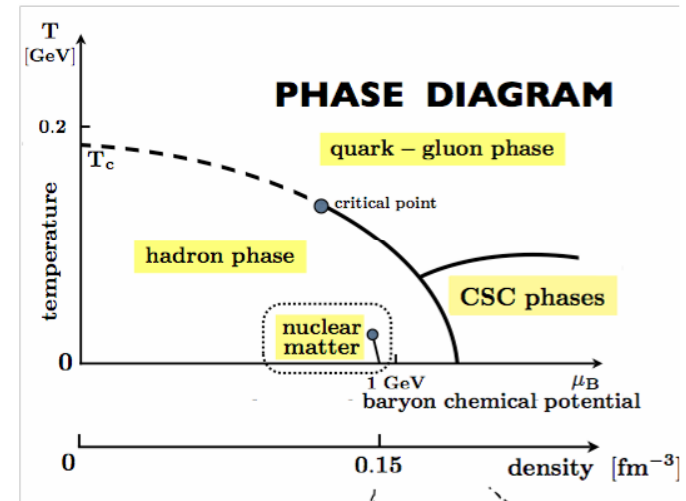
SF = same flavour
 OF = opposite flavour
 T1 = top background

final goal:

- add qql, qql, \dots
- solve equations for sparticle masses

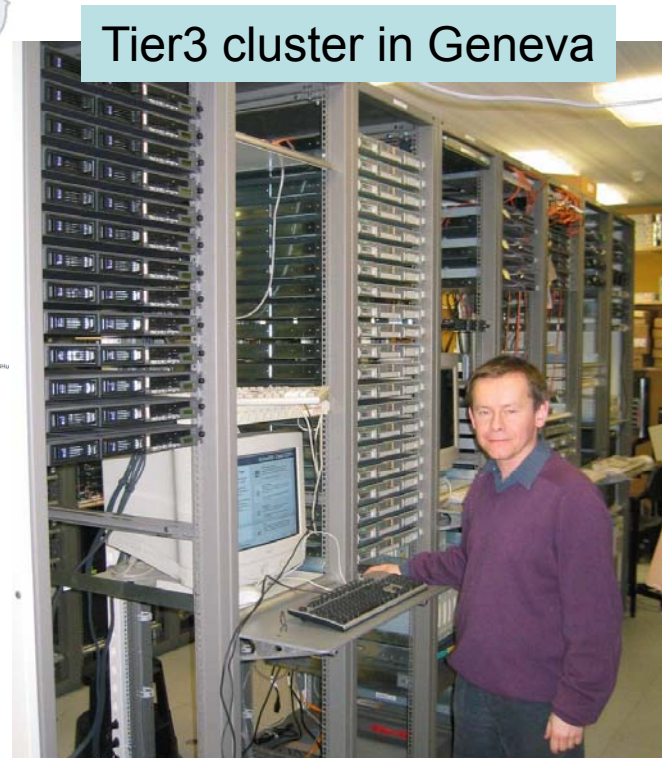
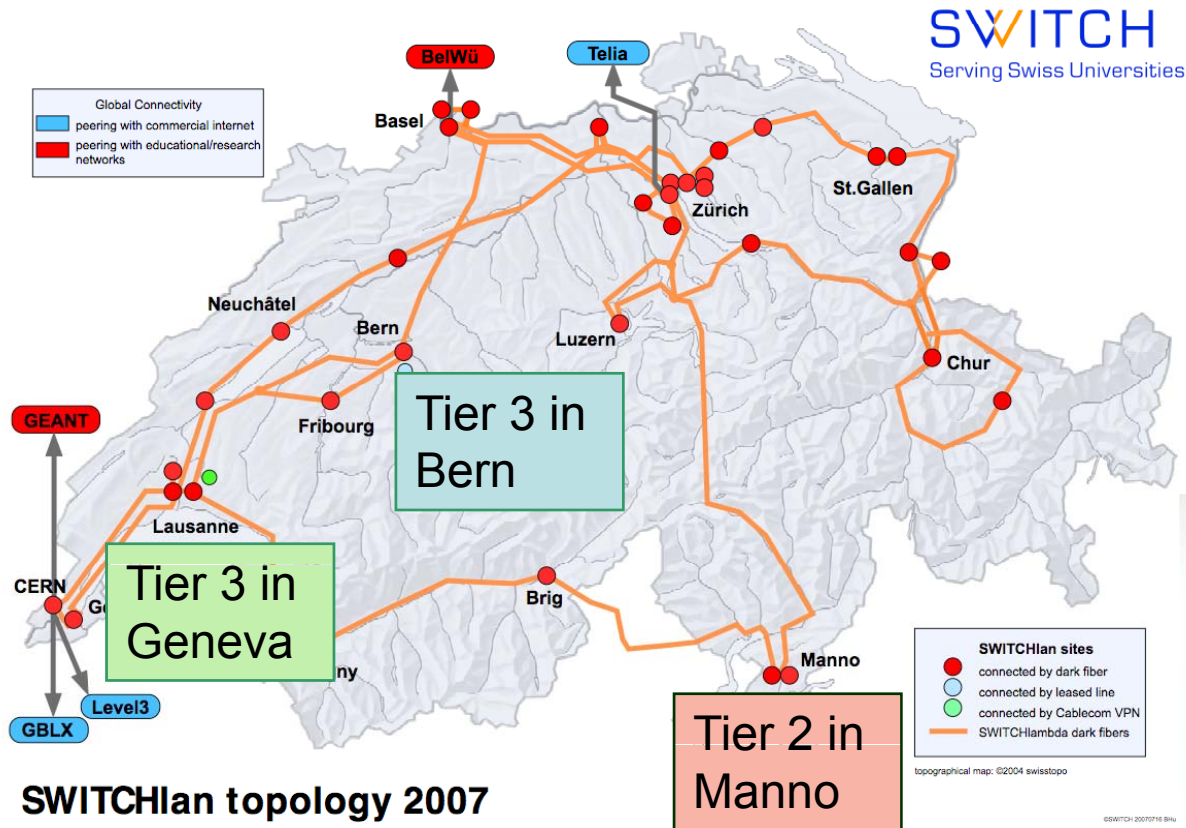
ATLAS Physics: Heavy Ions

- analysis example:
 - Y and J/ψ suppression when $T \rightarrow T_{\text{trans}}$ to QGP
 - μ chamber occupancy in Pb-Pb collisions lower than in pp



- 15k $Y \rightarrow \mu\mu$ and 100k $J/\psi \rightarrow \mu\mu$ per month expected
- studies of a low p_T trigger for muons on the way

ATLAS computing resources in Switzerland



ATLAS computing in Switzerland

Year	Bern		Manno	Geneva
	BAC (Bern ATLAS Cluster)	UBELIX (University of Bern Linux Cluster)	Phoenix	DPNC
# CPU	16 ⁰⁶ 30 ⁰⁷ 50 ⁰⁸	288 ⁰⁶ 512* ⁰⁷ 512 ⁰⁸	30 ⁰⁶ 130* ⁰⁷ 400 ⁰⁸	24 ⁰⁶ 84 ⁰⁷ 188 ⁰⁸
Storage (TB)	12 ⁰⁶ 12 ⁰⁷ 33 ⁰⁸	0	8 ⁰⁶ 52* ⁰⁷ 225 ⁰⁸	9.6 ⁰⁶ 26 ⁰⁷ 75 ⁰⁸
Mem. per Core(GB)	1 ⁰⁶ 1 ⁰⁷ 2 ⁰⁸	1-2 ⁰⁶ 2 ⁰⁷ 2 ⁰⁸	1 ⁰⁶ 2 ⁰⁷ 2 ⁰⁸	1-2 ⁰⁶ 1-2 ⁰⁷ 1-2 ⁰⁸
OS	SLC	Gentoo	SLC	SLC

* shared resources

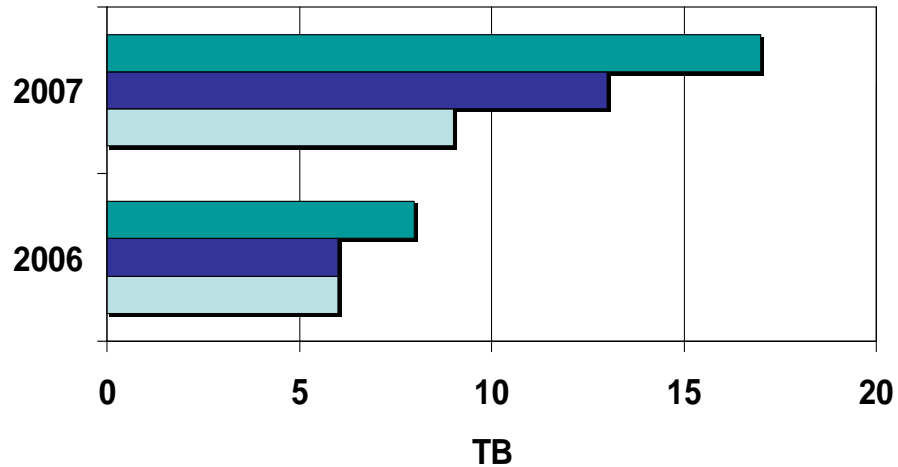
- main usage by members of Bern and Geneva groups
 - production of SUSY, Higgs, SM event samples → >1000 jobs/sample
 - fast and full simulation
 - physics analyses: test-beam, cosmics, pp physics
 - development and testing of ATLAS trigger code and trigger rate studies
 - data storage: cosmic data, Monte Carlo samples, in 2008: data!
- ATLAS "production" jobs via NorduGrid on all clusters, also via LCG on Phoenix T2 (Manno)



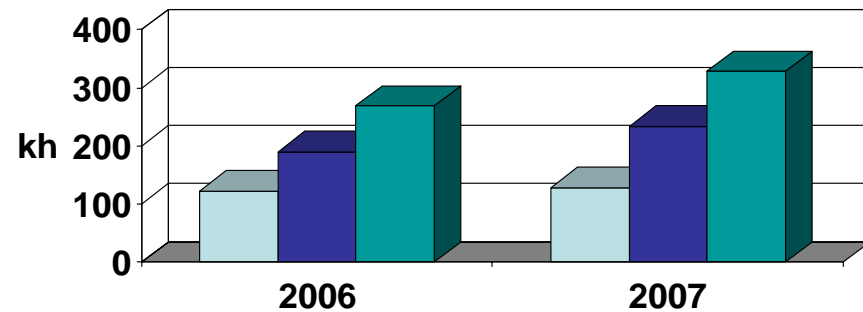
Increasing Computing Usage



Peak Disk Usage



Wall Time Usage



- Bern T3
- Bern T3 + Geneva T3
- Bern T3 + Geneva T3 + Phoenix T2

- trend will continue with increasing number of physics analyses

Conclusion and Outlook

- ATLAS detector construction will finish in time - the puzzle is nearly complete
- Commissioning of all sub-detectors in full progress



- Bern and Geneva groups very active in many fields:
 - play important roles in hardware and software
 - construction and commissioning
- Preparation of physics analyses gets more and more into the focus
 - increasing computing needs

- Still a lot of work ahead of us
- Looking forward to see pp collision events on the ATLAS online event display in Summer 2008



- Could not talk about detector upgrade: front-end electronics and sensors for a new ID tracker



The Bern LHEP group looks forward to the successful start-up of the experiment in 2008 and would be honored to welcome you to Bern next year for the Overview Week !



The ATLAS Jigsaw Puzzle

500 piece photo of the detector, made by Ravensburger.
The puzzle can be purchased at the ATLAS Secretariat.



[Click here for the full image.](#)

15 CHF

Prices:

1 box @ 15 CHF a box
2 boxes @ 14 CHF a box
3 boxes @ 13 CHF a box
4 boxes @ 12 CHF a box
5 or more boxes : 10 CHF a
box
(CHF = Swiss Franc)