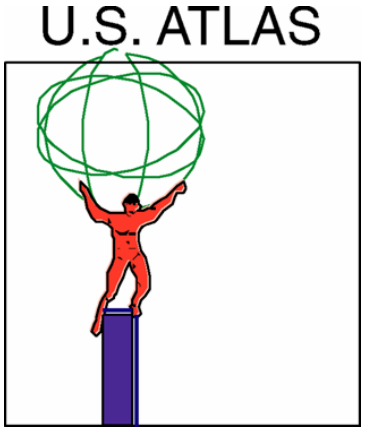
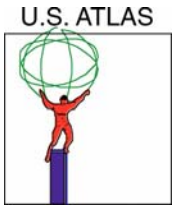


ATLAS Status

Mike Tuts (Columbia University)



Outline

- Detector Overview
- Status Detector Systems
- Status of Computing

- What I won't cover …
  - Budgets
  - Upgrade R&D activities

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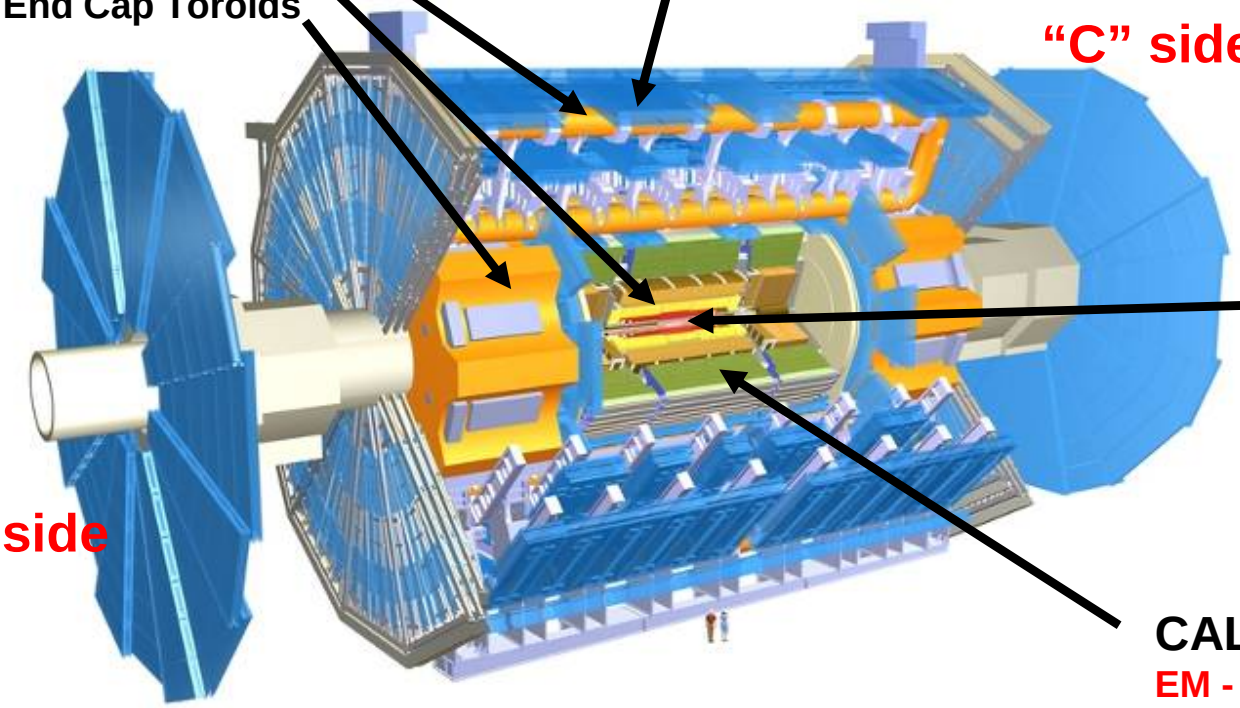
ATLAS Layout

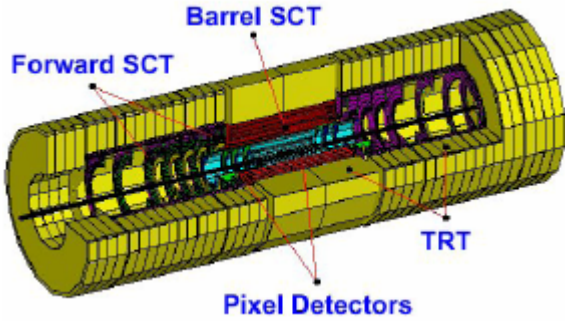
MUON SYSTEM
Monitored Drift Tubes (MDT) (3.7×10^5)
Cathode Strip Chambers (CSC) (6.7×10^4)
Resistive Plate Chambers (RPC) (3.5×10^5)
Thin Gap Chambers (TGC) (4.4×10^5)

MAGNETS
8 Barrel Toroids
Central Solenoid
End Cap Toroids



"C" side

"A" side



INNER DETECTOR (ID)
Pixels (8×10^7 ch)
Silicon Strip (SCT) (6.2×10^6)
Transition Radiation Tracker (TRT) (3.7×10^5)

CALORIMETERS
EM - Liquid Argon – Lead (1.8×10^5)
HAD - Scintillator Tile (10^4)

Diameter 25m
Length 46m
Weight 7,000 tons

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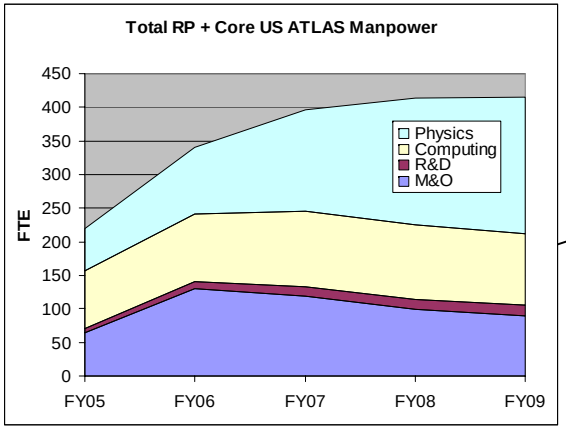
ATLAS Collaboration

(As of the October 2006)

35 Countries
164 Institutions
1830 Scientific Authors total
(1470 with a PhD, for M&O share, of which 285 US)



Albany, Alberta, NIKHEF Amsterdam, Ankara, LAPP Annecy, Argonne NL, Arizona, UT Arlington, Athens, NTU Athens, Baku, IFAE Barcelona, Belgrade, Bergen, Berkeley LBL and UC, HU Berlin, Bern, Birmingham, Bologna, Bonn, Boston, Brandeis, Bratislava/SAS Kosice, Brookhaven NL including UT Dallas, South Carolina, Buenos Aires, Bucharest, Cambridge, Carleton, Casablanca/Rabat, CERN, Chinese Cluster, Chicago, Clermont-Ferrand, Columbia, NBI Copenhagen, Cosenza, AGH UST Cracow, IFJ PAN Cracow, DESY, Dortmund, TU Dresden, JINR Dubna, Duke, Frascati, Freiburg, Geneva, Genoa, Giessen, Glasgow, LPSC Grenoble, Technion Haifa, Hampton, Harvard, Heidelberg, Hiroshima, Hiroshima IT, Indiana, Innsbruck, Iowa SU, Irvine UC, Istanbul Bogazici, KEK, Kobe, Kyoto, Kyoto UE, Lancaster, UN La Plata, Lecce, Lisbon LIP, Liverpool, Ljubljana, QMW London, RHBNC London, UC London, Lund, UA Madrid, Mainz, Manchester, Mannheim, CPPM Marseille, Massachusetts, MIT, Melbourne, Michigan, Michigan SU, Milano, Minsk NAS, Minsk NCPHEP, Montreal, McGill Montreal, FIAN Moscow, ITEP Moscow, MEPhI Moscow, MSU Moscow, Munich LMU, MPI Munich, Nagasaki IAS, Nagoya, Naples, New Mexico, New York, Nijmegen, BINP Novosibirsk, Ohio SU, Okayama, Oklahoma, Oklahoma SU, Oregon, LAL Orsay, Osaka, Oslo, Oxford, Paris VI and VII, Pavia, Pennsylvania, Pisa, Pittsburgh, CAS Prague, CU Prague, TU Prague, IHEP Protvino, Regina, Ritsumeikan, UFRJ Rio de Janeiro, Rome I, Rome II, Rome III, Rutherford Appleton Laboratory, DAPNIA Saclay, Santa Cruz UC, Sheffield, Shinshu, Siegen, Simon Fraser Burnaby, SLAC including Iowa, Southern Methodist Dallas, NPI Petersburg, Stockholm, KTH Stockholm, Stony Brook, Sydney, AS Taipei, Tbilisi, Tel Aviv, Thessaloniki, Tokyo ICEPP, Tokyo MU, Toronto, TRIUMF, Tsukuba, Tufts, Udine, Uppsala, Urbana UI, Valencia, UBC Vancouver, Victoria, Washington, Weizmann Rehovot, Wiener Neustadt, Wisconsin, Wuppertal, Yale, Yerevan

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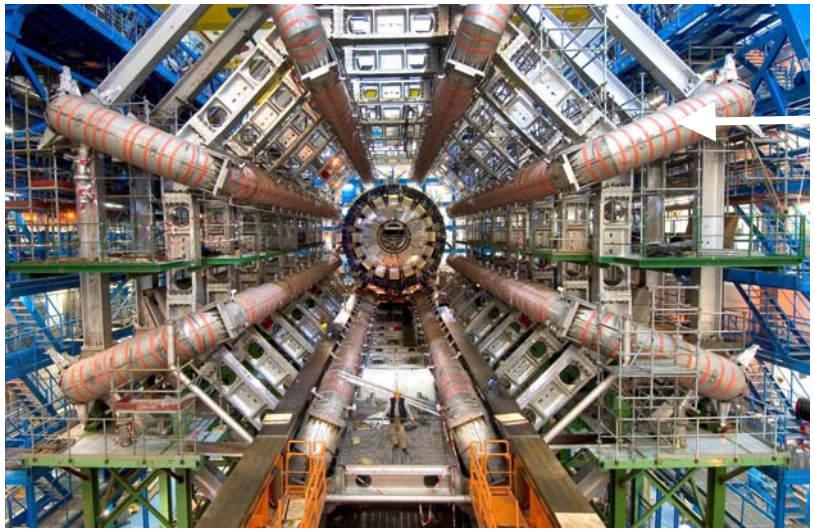
LHC Schedule

year	*energy*	*luminosity*	*physics beam time*
2007	450+450 GeV	$5x10^{30}$	protons - 26 days at 30% overall efficiency ➔ $0.7*10^6$ seconds
2008	7+7 TeV	$0.5x10^{33}$	protons - starting beginning July $4*10^6$ seconds ions - end of run - 5 days at 50% overall efficiency ➔ $0.2*10^6$ seconds
2009	7+7 TeV	$1x10^{33}$	protons:50% better than 2008 ➔ $6*10^6$ seconds ions: 20 days of beam at 50% efficiency ➔10^6 seconds
2010	7+7 TeV	$1x10^{34}$	TDR targets: protons: ➔ 10^7 seconds ions: ➔ $2*10^6$ seconds

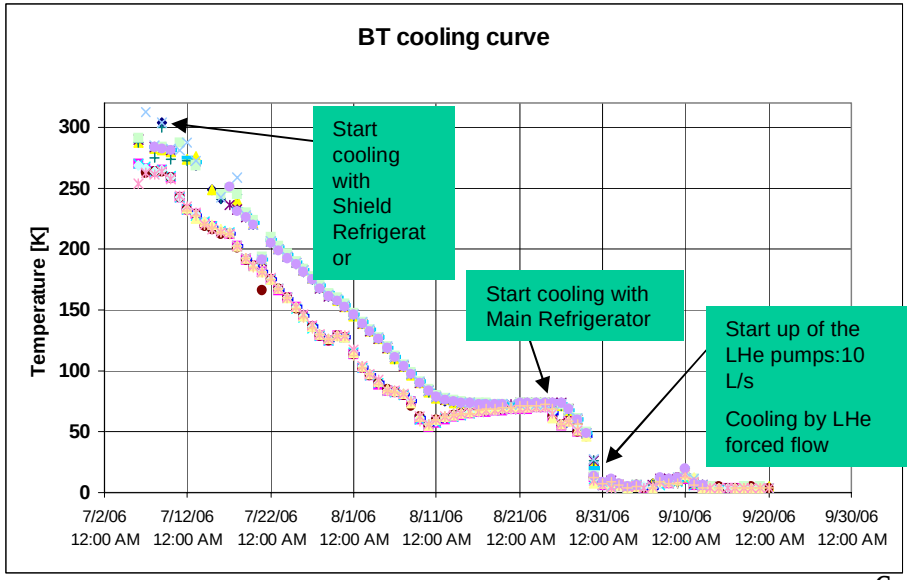
From Roger Jones, ATLAS computing

ATLAS Status - Magnets

- **Barrel Toroids**
  - Vacuum & cryogenics ~completed
  - Cooled in late August
  - Barrel Toroid Test Plan
    - Phase 1: <300A
      - toroid indictance, resistance,…
    - Phase 2 (10/9-20): 1-5kA
      - safety system test,…
    - Phase 3 (10/20-12/1): 5-20kA
      - all iron loose removed, fast/slow dumps, adjustments,…

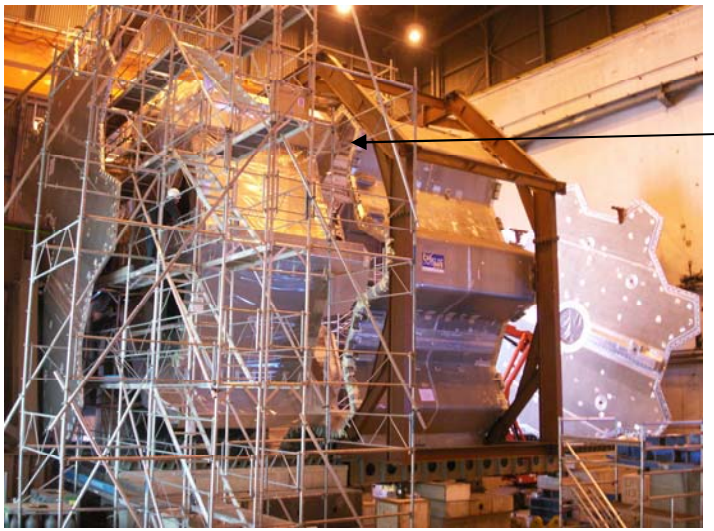


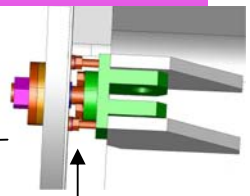
Barrel Toroid (8 total) – last one installed Aug 2005



ATLAS Status – End Cap Toroid

- **End Cap Toroids**
  - **Axial Force Tie rods problem resolved**
    - **Cause due to assumption of rigid cryostat - resolved**
    - **Modifications introduced delays (overall 6 months)**
    - **Catch up with parallel assembly of ECT-C**
  - **ECT-A currently being inserted into cryostat**
    - **80K test 2/07; install 3/07; commission 3-6/07**
  - **ECT-C being integrated**
    - **2 cold mass halves ready in B191**
    - **Cannot integrate in cryostat till ECT-A is out of B191 in 2/07**
    - **Integrate 2-4/07; 80K test 5-6/07; Install 6/07; commission 7-9/07**
- **ECT is a schedule driver**





Tie rod modification

End Cap Toroid A (ECT-A) in enclosure

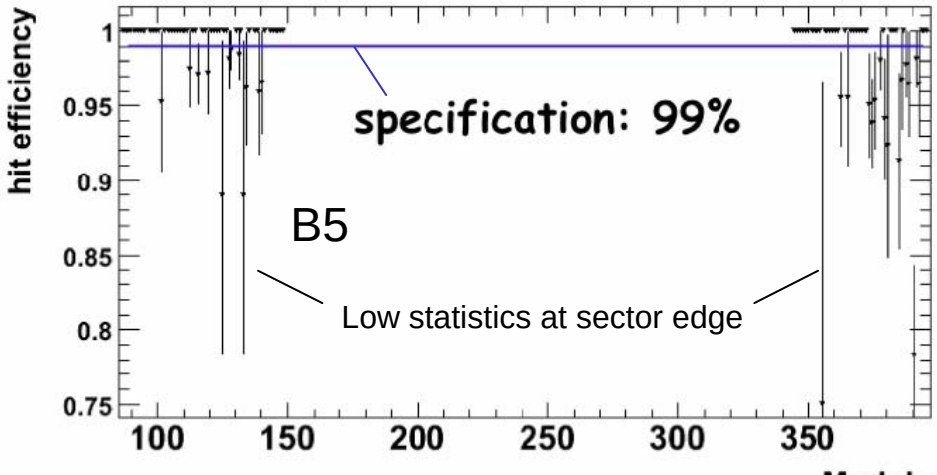
Two halves of End Cap Toroid C (ECT-C) cold masses under assembly in B180

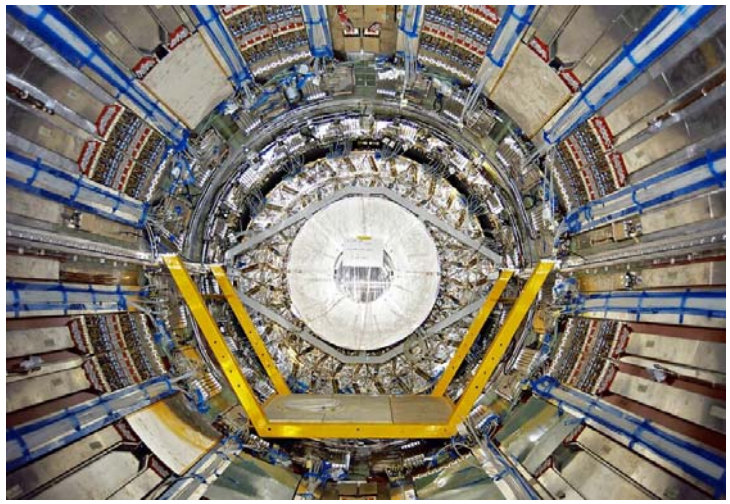
ATLAS Status – Barrel Inner Detector

- **Inner Detector (ID) – Barrel**
  - ID means the integrated SCT (silicon) & TRT detectors
  - Cosmic commissioning above ground
  - Barrel ID moved to z=0 Sept
    - TRT then SCT connections underway (done by Feb 07)

8/24/06 Barrel inner detector (SCT & TRT) being inserted in the bore of the Barrel Calorineter

Barrel SCT efficiency by module; thresh 1fC

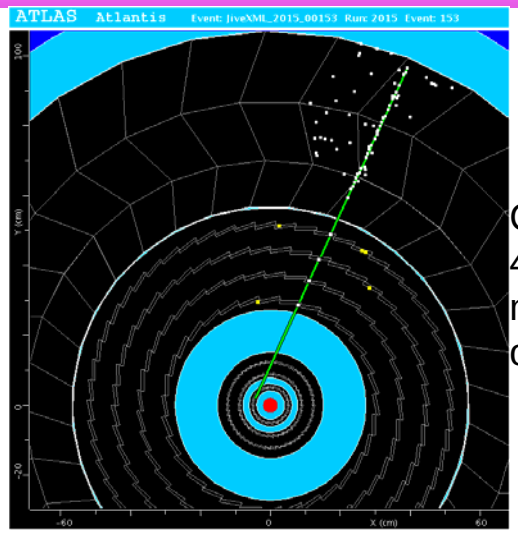




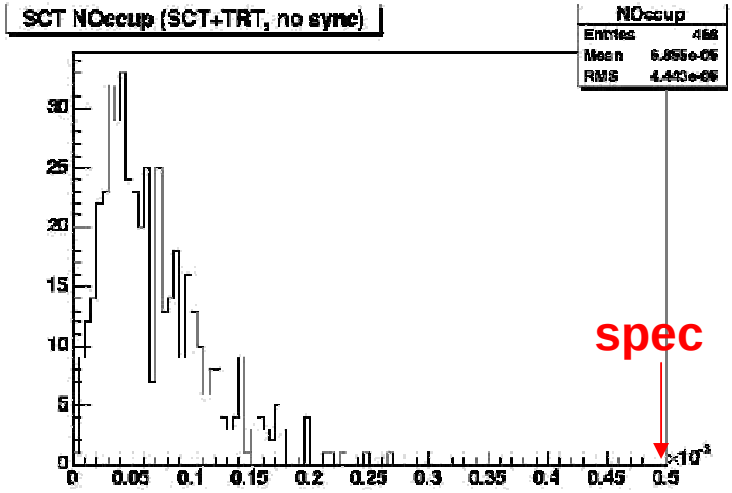
Barrel inner detector (SCT & TRT) at z=0 in the Barrel Calorineter

ID Commissioning

- **System tests and Cosmic ray running (above ground)**
  - **Jun-July 2006**
  - **Tracks found**
  - **Noise when operated w/ TRT well below specs**
  - **no interference between TRT and SCT**



Cosmic using 468 SCT modules (20% of total)

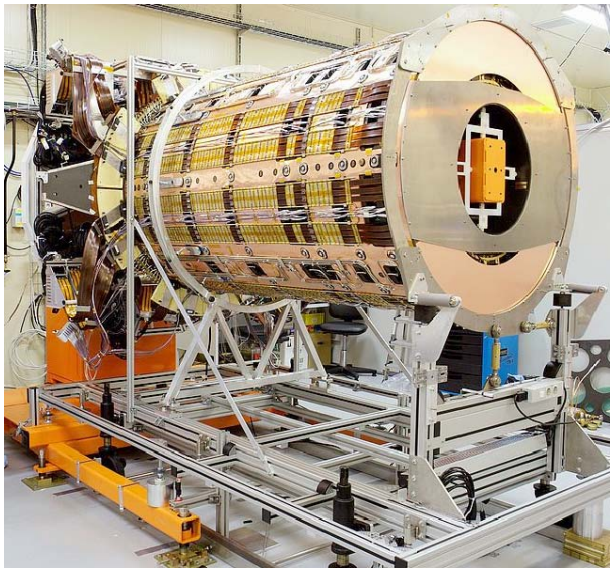


Noise measurements w/ TRT

ATLAS Status – Endcap Inner Detector

- **Inner Detector (ID) – End Caps**
  - **Endcap C**
    - **10/2/06 TRT & SCT endcap C integrated**
    - **1/15/07 Move to pit**
  - **Endcap A**
    - **11/15/06 ready for TRT & SCT EC integration**
- **Combined SCT + TRT C-side test in Nov-Dec**

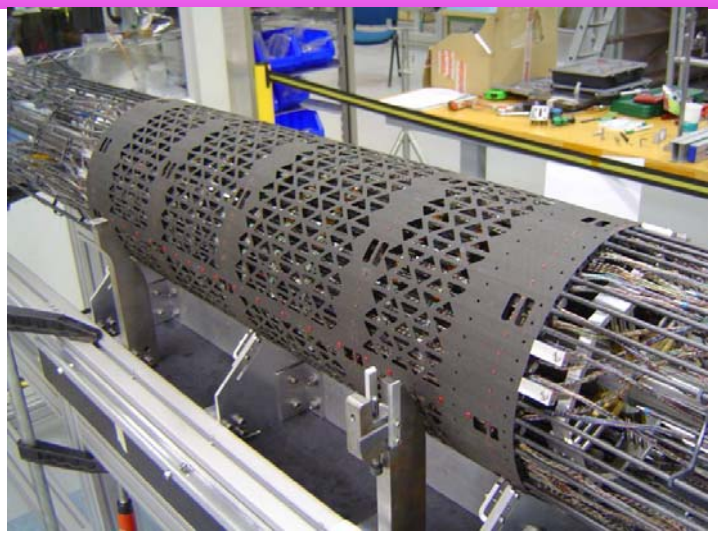
SCT End Cap C being inserted in TRT End Cap C



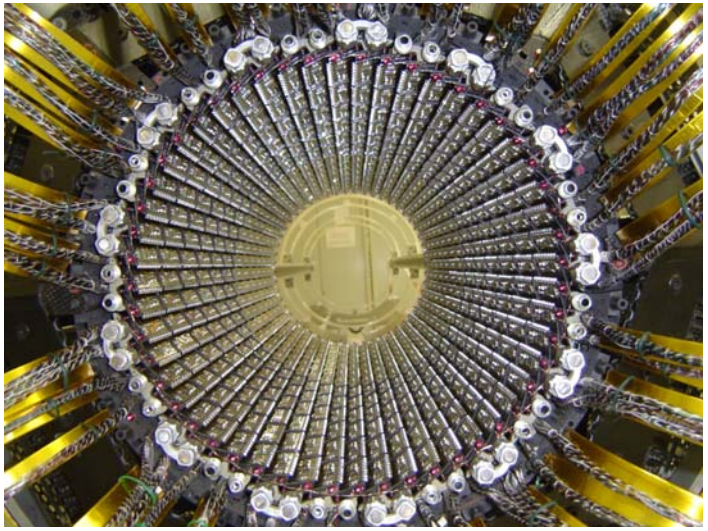
SCT End Cap A with all disks tested and dressing of services shown

ATLAS Status – Pixel Barrel Detector

- **Pixels Barrel**
  - Three layers
    - 2 (outer) – done
    - 1 (middle) – 50% done
    - b (inner) finish mid-Nov
  - All modules delivered, all staves produced
  - Problems solved: Al cables, cooling
  - Layer 2 has <0.3% bad ch, others expected better
  - Integration has gained a month in schedule!



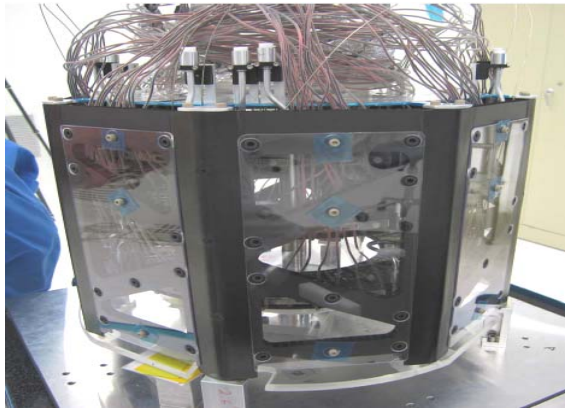
Pixel layer 2, two halves closed up



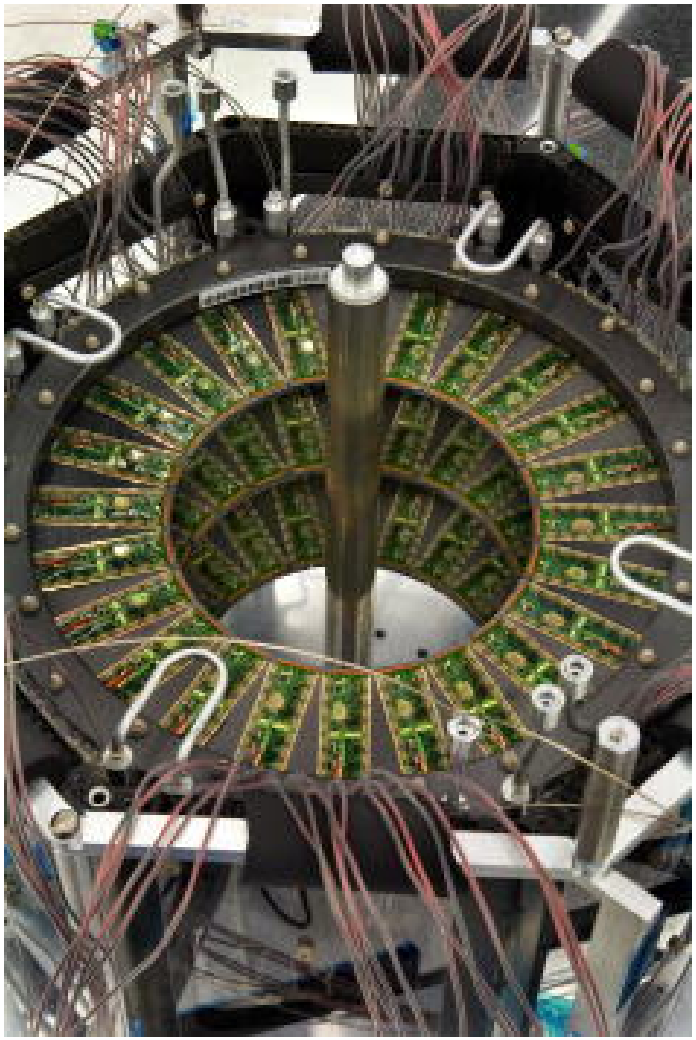
End view of Pixel layer 2

ATLAS Status – Pixel Endcap Detector

- **Pixel Endcaps**
  - **Both (A&C) at CERN**
  - **Passed acceptance tests (0.2% ch bad)**
  - **ECA starting system & cosmic ray test through end of 2006**



Pixel end cap A readied for cosmic ray test

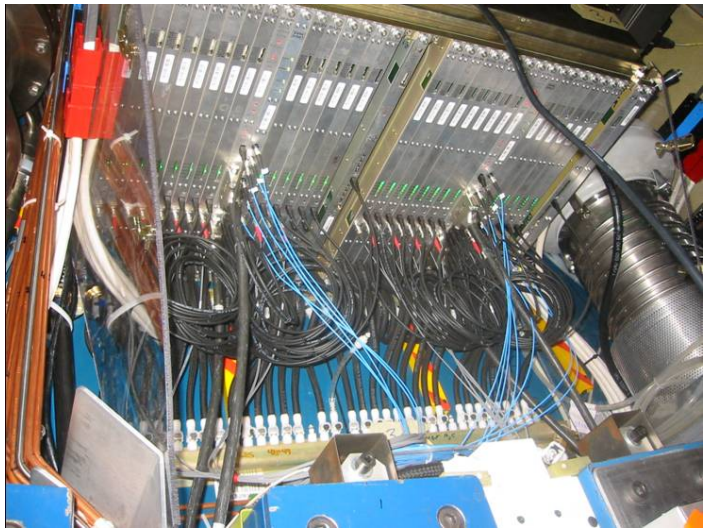


Pixel end cap disks

ATLAS Status – LAr Calorimeter

- **All calorimeters in pit**
  - **Central solenoid commissioned, 2T**
  - **8/06 Field mapped to 10G (can even see winding details!), reproducible to 10^{-5}**
  - **Chasing few HV shorts (~10, but most have ½ signal) – fill/refill calorimeter**
- **Installation of electronics well underway**
  - **LVPS delivery a concern**

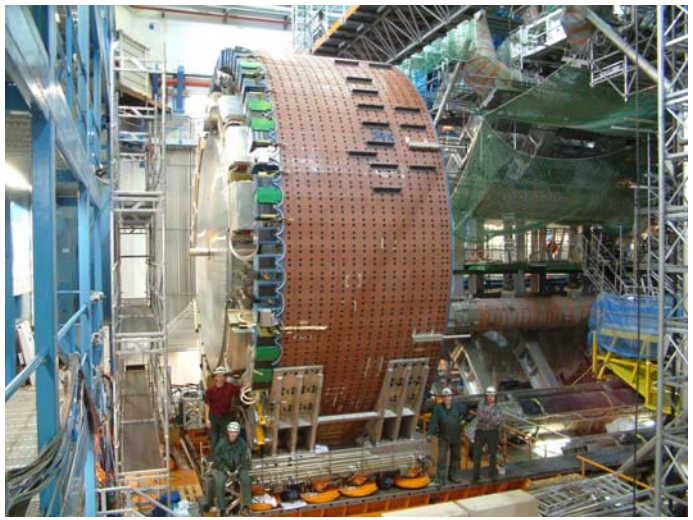
Barrel Calorimeter Installed in Toroids



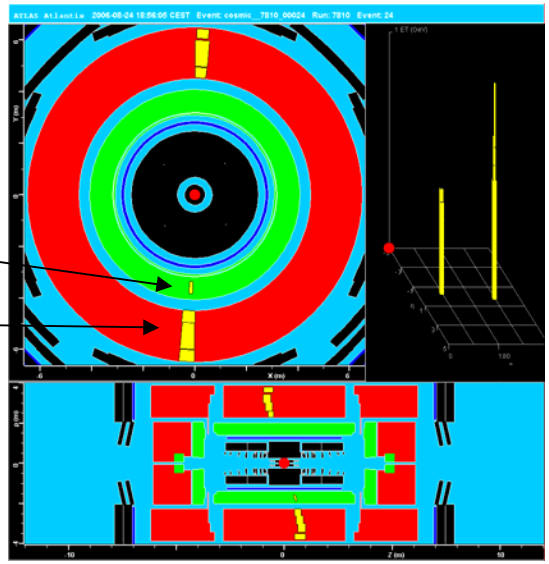
On detector Barrel Calorimeter Front-end electronics crate

ATLAS Status – LAr Endcaps

- **End Caps**
  - C side: cooldown Feb 07, cold commissioning Apr 07
  - A side: cooldown mid-Nov 06, cold commissioning Feb 07
- **Cosmics w/ Tilecal**
  - Barrel ~10/06; ECA ~3/07
  - Have run LAr and Tilecal together



LAr ECC before insertion



Cosmic run TileCal + LAr barrel

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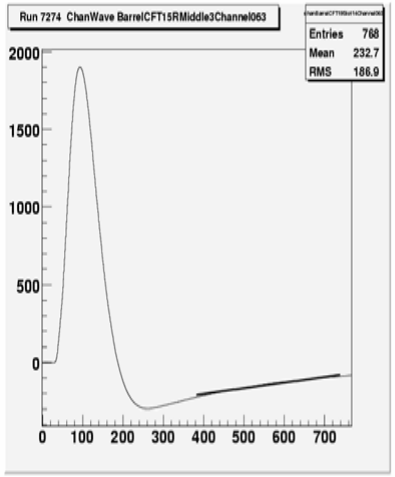
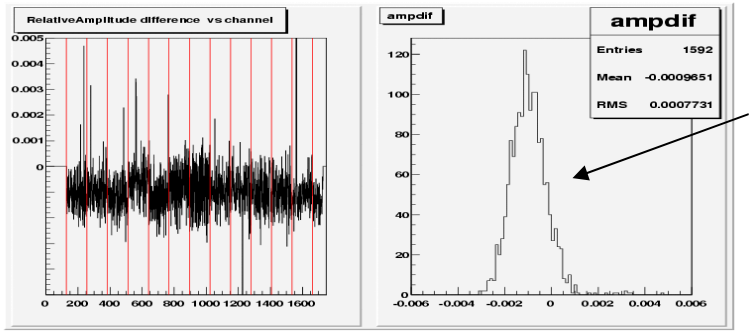
Calorimeter Commissioning

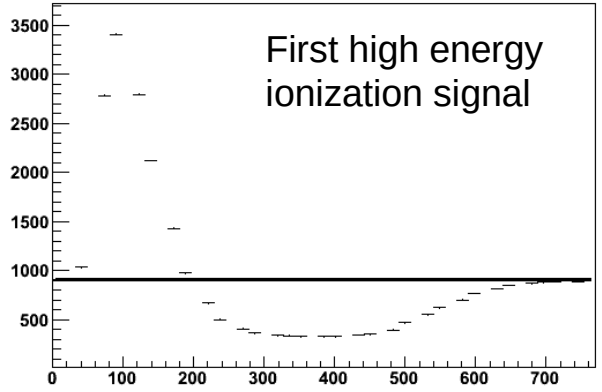


Calibration pulse studies…

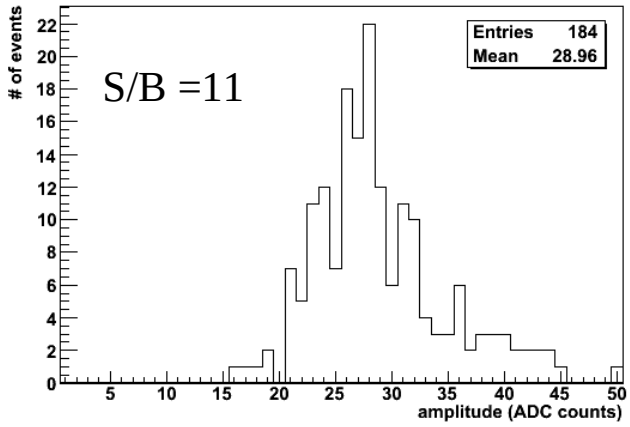


0.1-0.2 % amplitude stability over one month

Muons in cosmics…

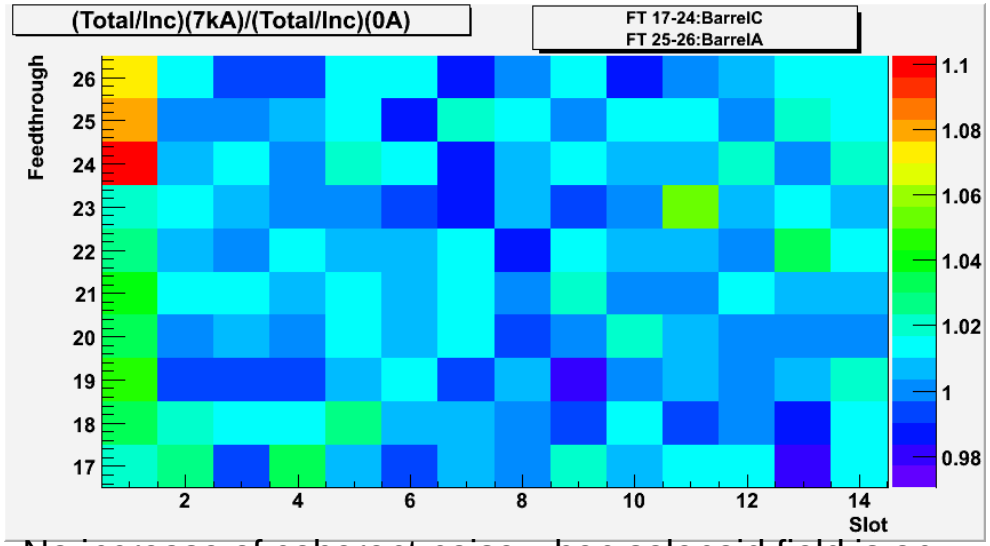


First high energy ionization signal



S/B =11

Noise studies…… day to day work to track coherent noise



No increase of coherent noise when solenoid field is on

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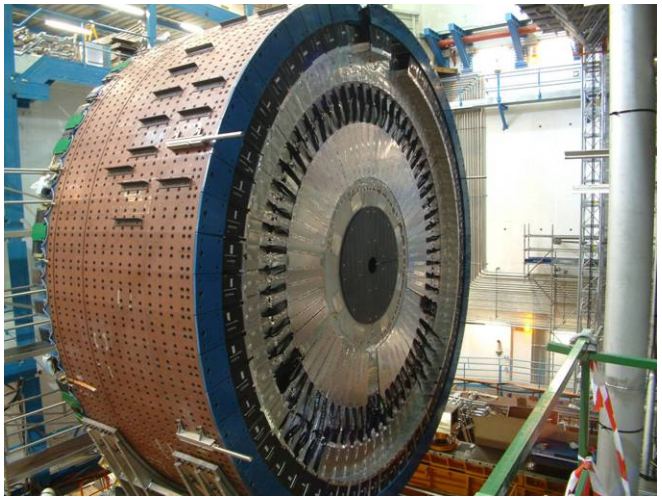
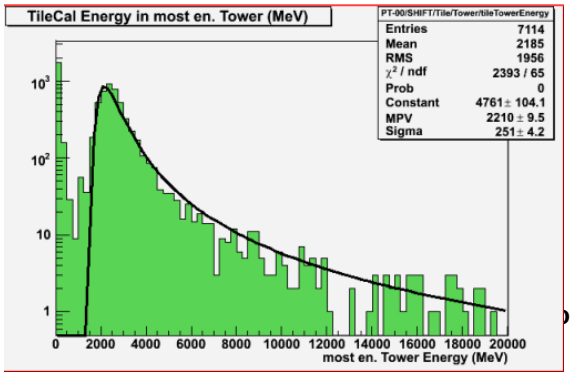
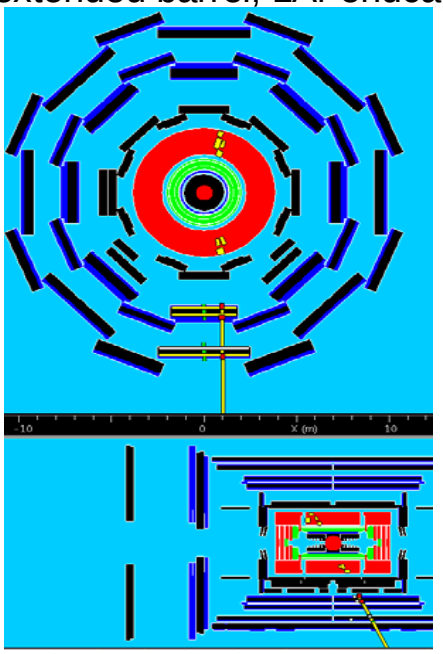
ATLAS Status - TileCal

- **All 3 detectors in pit**
  - **Barrel (12/04); Extended barrel C(2/06), A (5/06)**
  - **Gap, crack, and MBT scintillators installed**
- **Electronics & services**
  - **Well advanced, over 50% done for barrel**
- **Cosmics w/ LAr, Muons**



TileCal extended barrel, LAr endcap, scintillators

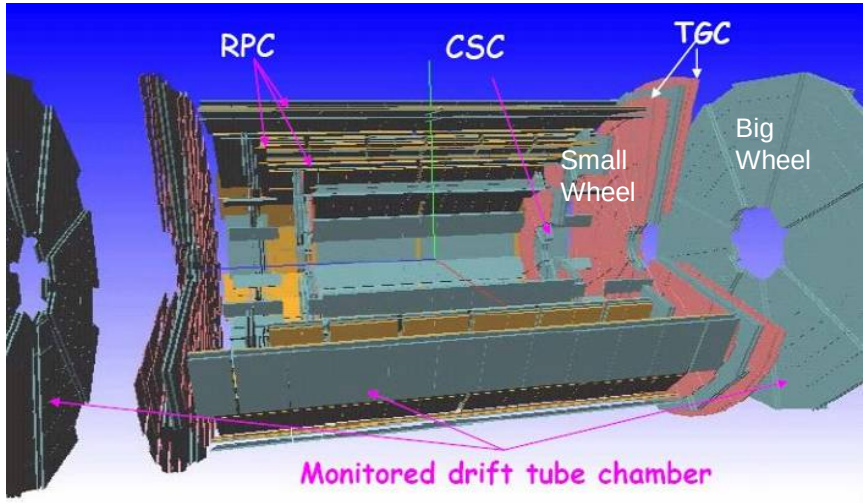


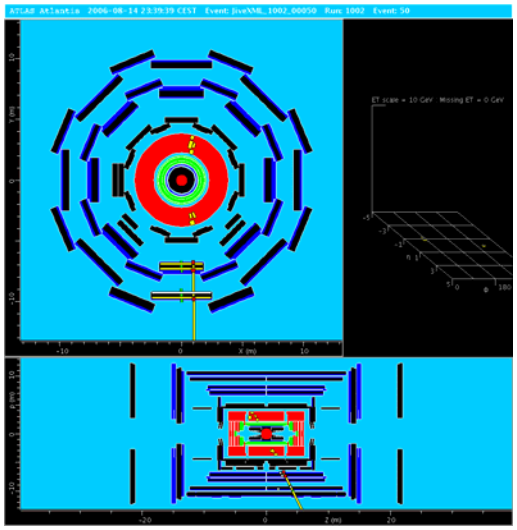


Aug 06
MDT +
RPC +
Tile

ATLAS Status – Barrel Muons

- **Muon System**
  - Trigger: RPC, TGC
  - Precision: MDT, CSC
- **Barrel**
  - Reaching installation rate of 3.5 chambers per day
  - ~514 installed (~74%)
  - Commissioning well underway – cosmics w/ MDT+RPC (and TileCal)





Barrel Muon station being installed

ATLAS Status – Endcap Muons

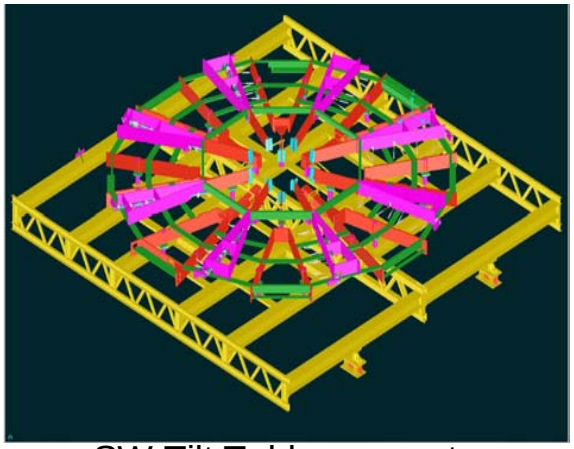
- **End Cap**
  - **Big Wheel (BW)**
    - **MDT: 29 of 32 sectors completed**
    - **TGC: 29 of 72 sectors completed**
    - **1 TGC wheel installed**
  - **Small Wheel**
    - **Starting now**
    - **Delay in End Cap Toroids (ECT) cause occupancy problem**
  - **CSC chambers (32/32 completed)**
- **Delays in ECT make for tight schedule**

One of 32 MDT Big Wheel sectors ready for installation

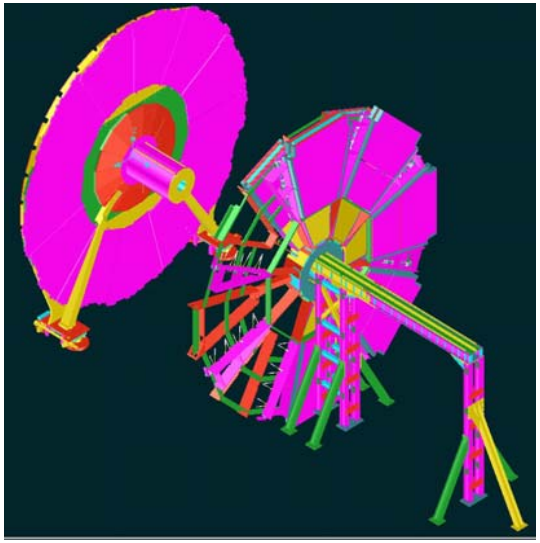
CSC chamber

First of 6 TGC wheels installed in detector

ATLAS Status – Muon Small Wheel



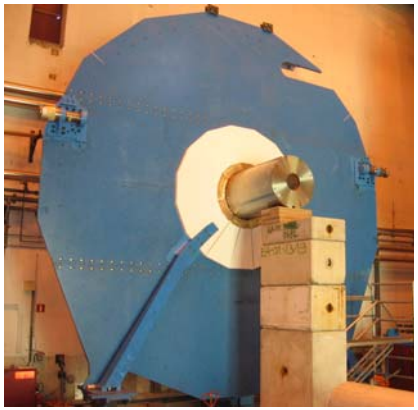
SW Tilt Table concept



SW-JD Assembly concept

- **SW Preparations**
  - **Pieces are at CERN**
    - **Tilt table**
    - **Small Wheel structure**
    - **Assembly tooling being delivered**
  - **Shielding disk assembled (JD disk)**
  - **Expected start Oct 2006**

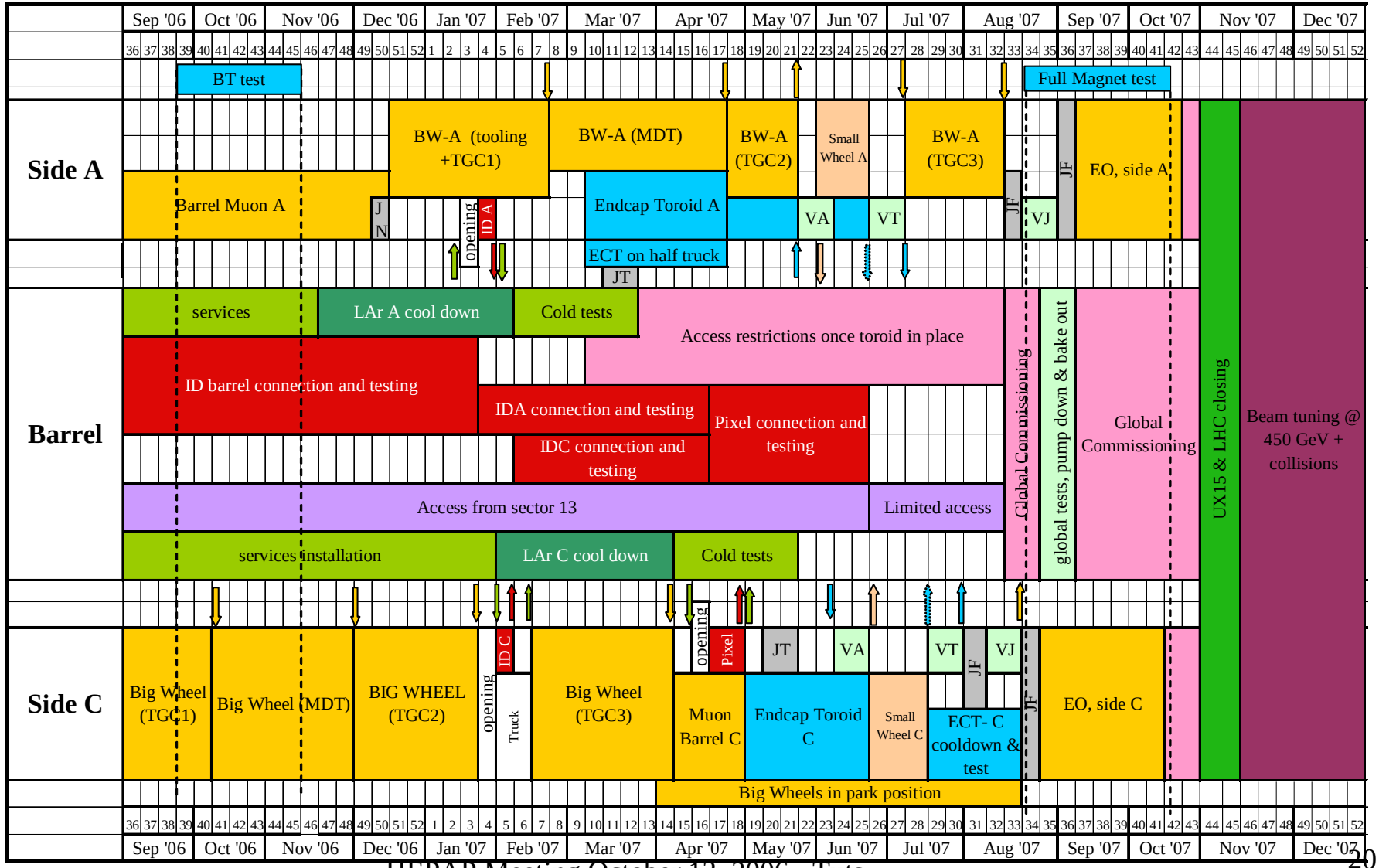
SW Tilt Table - CERN



JD in B191

SW at Hatehof - Israel

ATLAS Schedule – Ver 8.1



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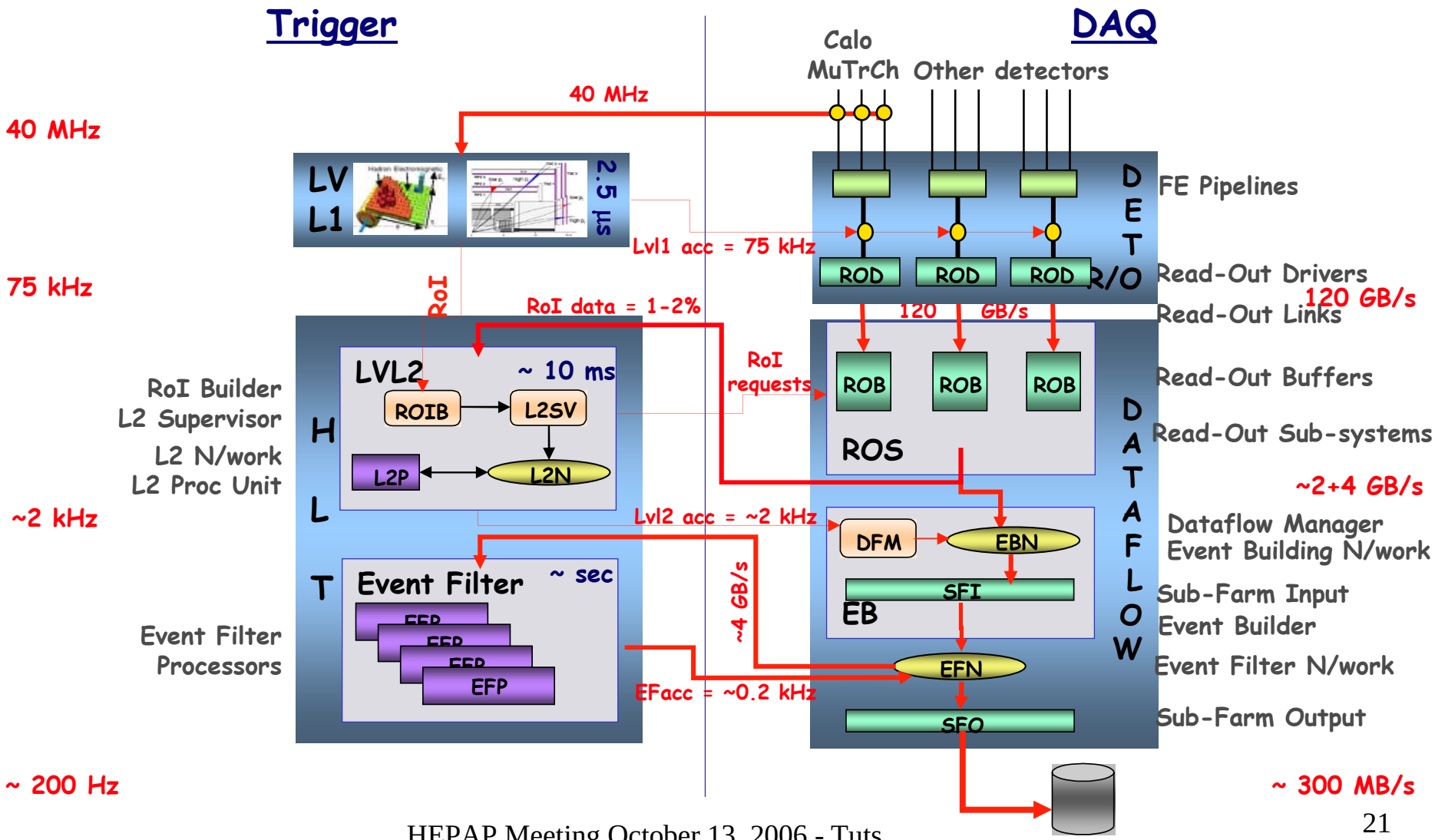
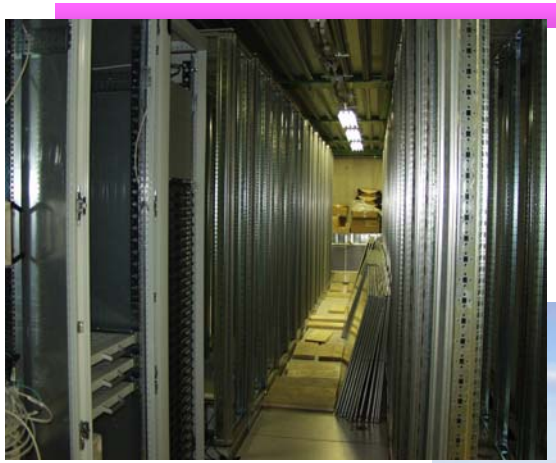
Trigger & Data Acquisition

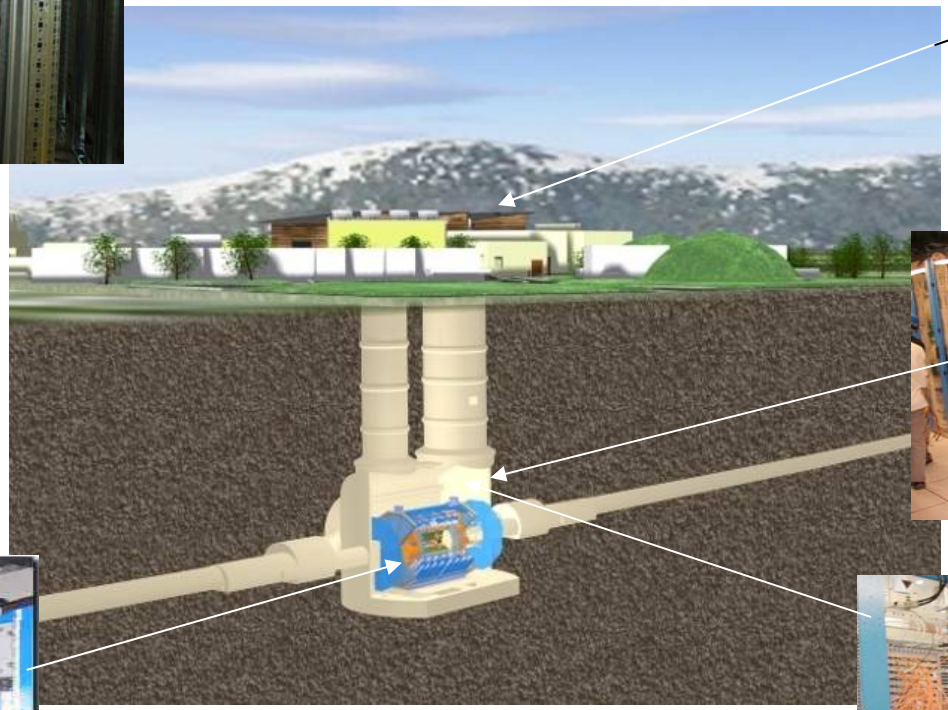


ATLAS Status - TDAQ



Racks for 2500 multi-core PC's that form High Level Trigger (HLT)

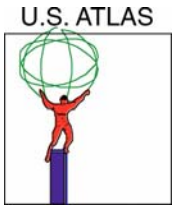
Pre-series High Level Trigger (HLT)



Read-Out System (ROS)

Level 1 Trigger

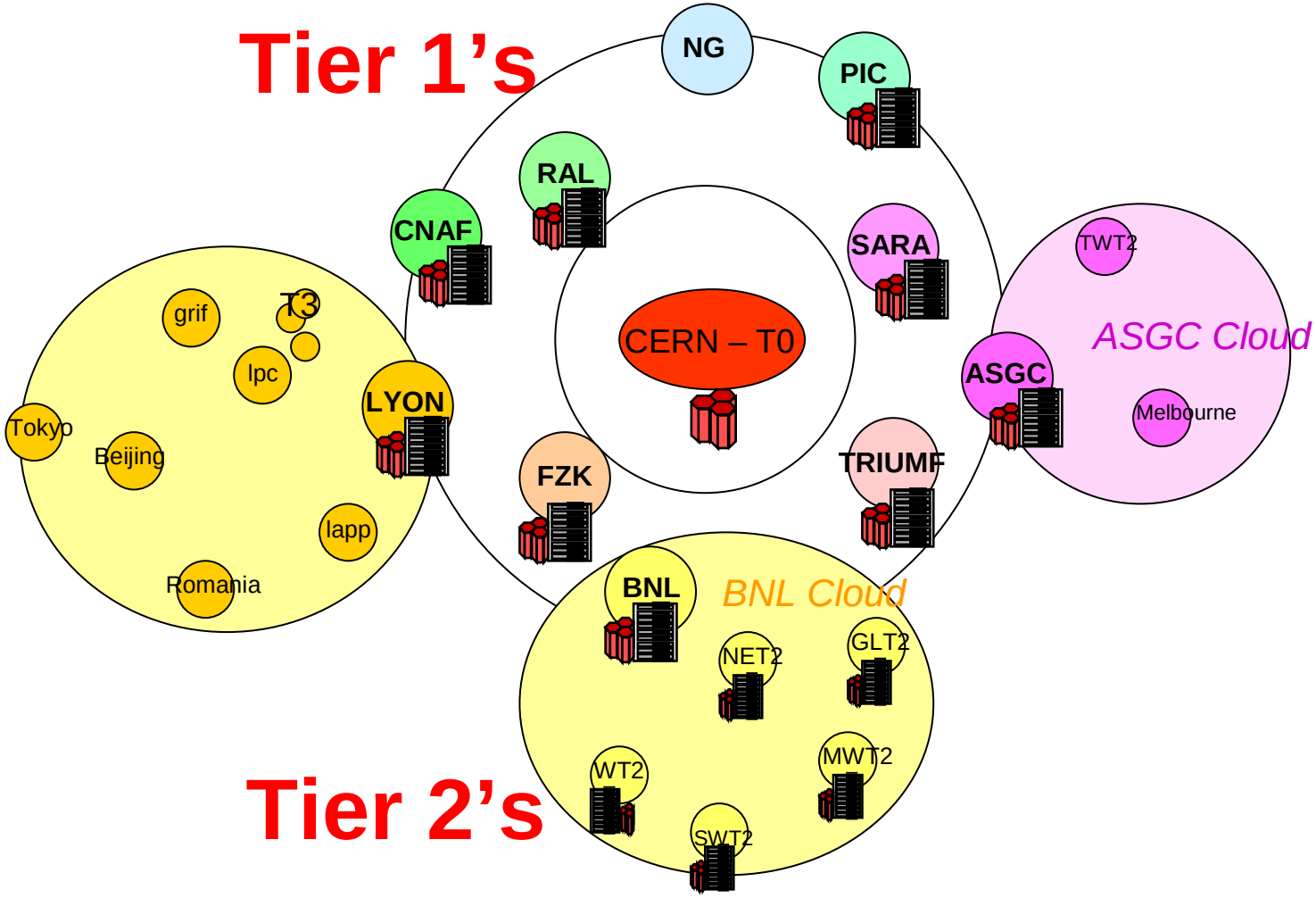
Read-Out Driver (ROD)



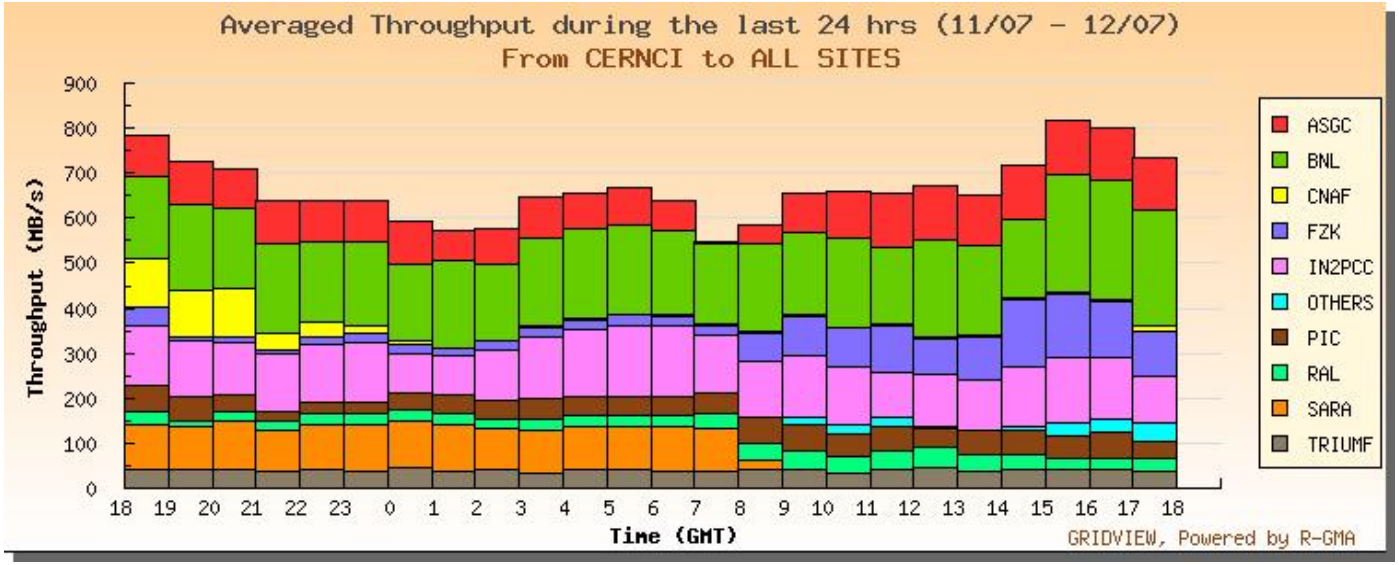
ATLAS Status - Computing

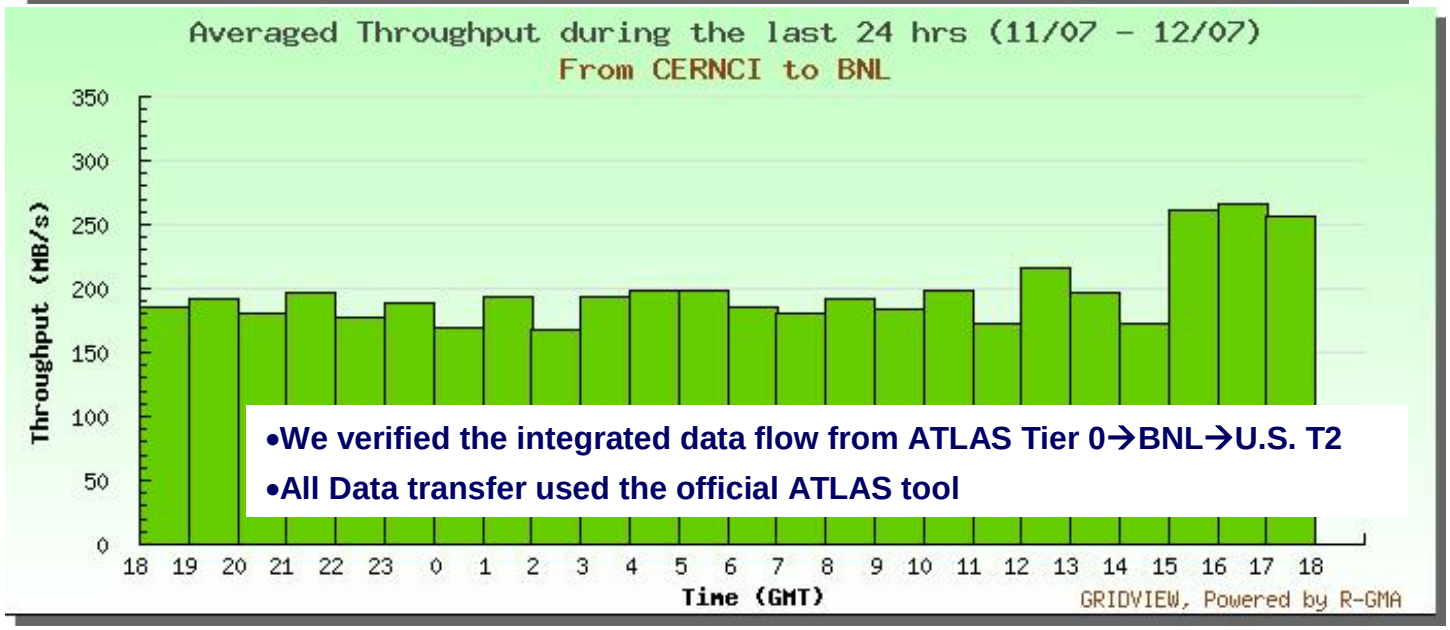
- Tiered system
  - T0: at CERN
    - copy of RAW data, reconstruction – event summary data, calibration
  - T1: 10 sites
    - BNL, CCIN2P3 Lyon, NIKHEF/SARA Amsterdam, RAL, FZK Karlsruhe, CNAF Bologna, PIC Barcelona, NDGF, TRIUMF, ASGC Taipei
    - Fraction of RAW data, reconstructed data; full summary reconstructed data; serve T2's
  - T2: ~20 sites
    - 5 US sites (4 NSF RP + 1 DOE RP support) BU/Harvard, Chicago/Indiana, UT Arlington/Oklahoma, Michigan/MSU, SLAC
    - Simulation, user analysis
- Connected through worldwide (wLCG) computing grid(s):
  - Three "flavors" of Grid
    - LCG, OSG (US Grid), Nordugrid
    - Interoperable

ATLAS Computing



wLCG Service Challenge 4 Service Phase (All ATLAS Tier 1 site)





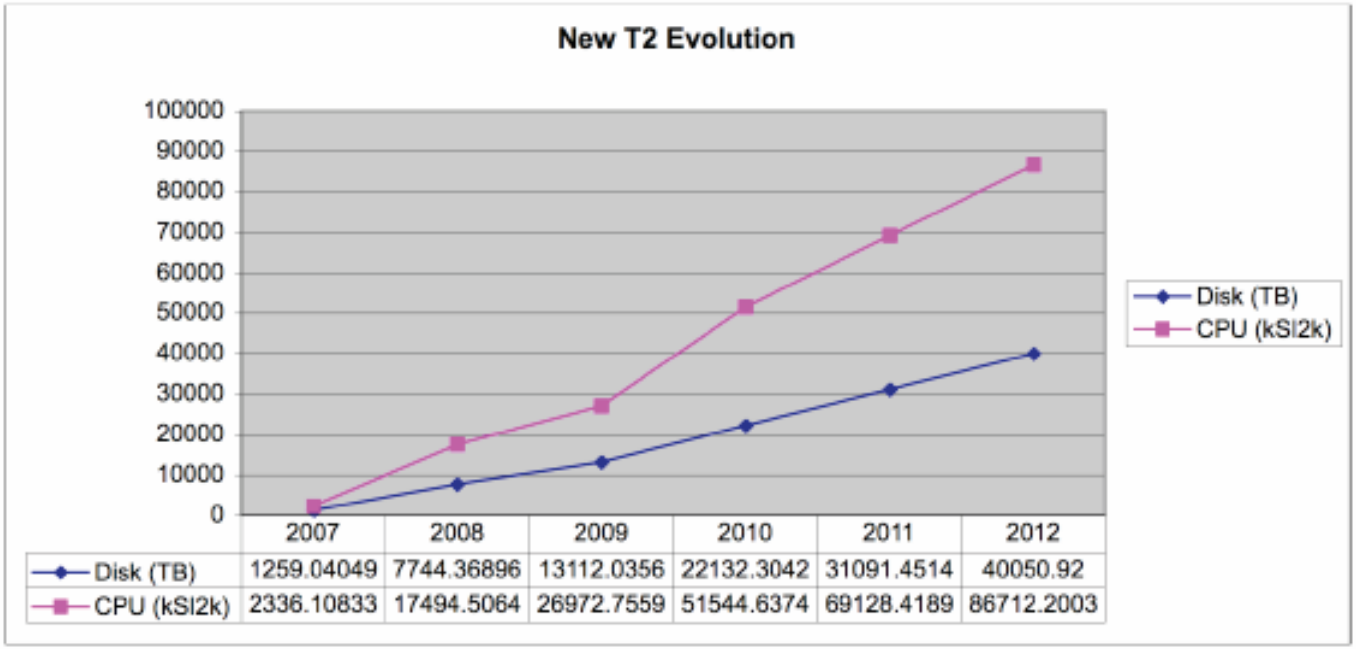
- **We verified the integrated data flow from ATLAS Tier 0→BNL→U.S. T2**
- **All Data transfer used the official ATLAS tool**

Goal for BNL is 200 MB/s

U.S. ATLAS

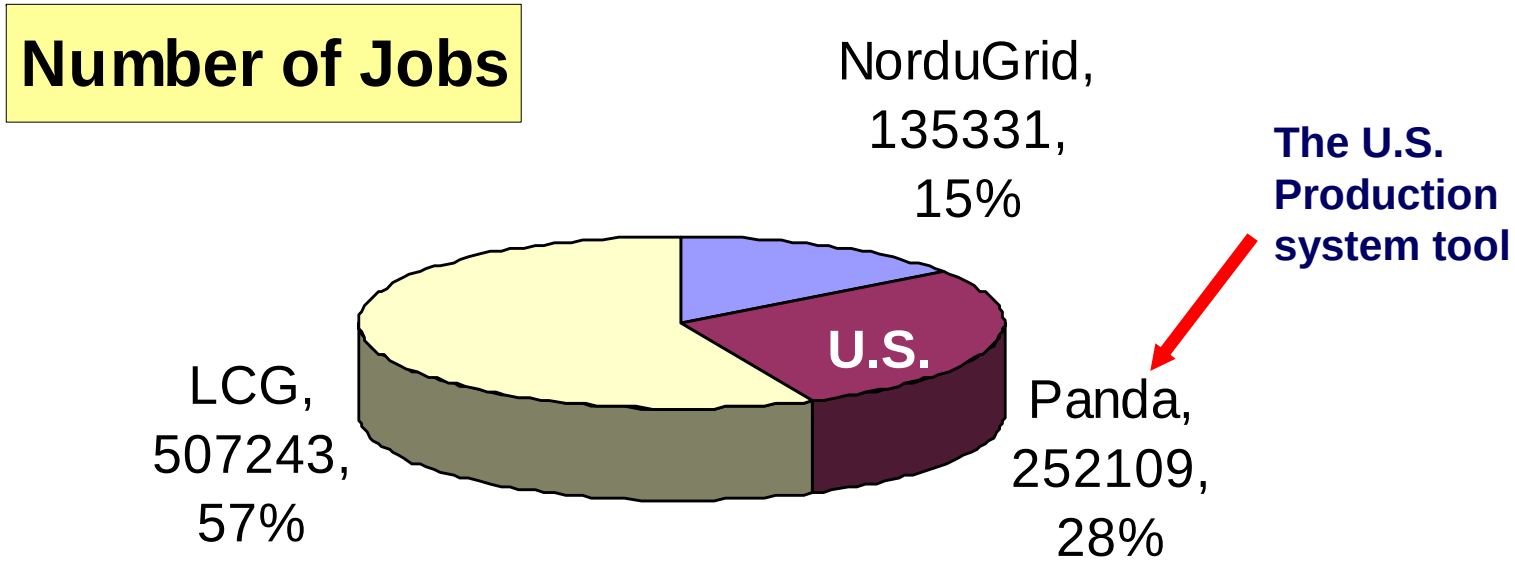
Tier 2 centers ramping up

- Re-evaluated in light of latest LHC ramp-up
- US still on track for the 2008 target of approximately 1000 kSi2k (~best unit for ATLAS software)

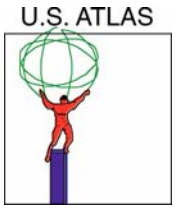


	2007	2008	2009	2010	2011	2012
Disk (TB)	1259.04049	7744.36896	13112.0356	22132.3042	31091.4514	40050.92
CPU (kSI2k)	2336.10833	17494.5064	26972.7559	51544.6374	69128.4189	86712.2003

ATLAS Computing Service Challenge Production

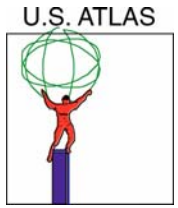


Panda production – 50% of the jobs done on Tier 1 facility at BNL
50% done at U.S. ATLAS Tier 2 sites



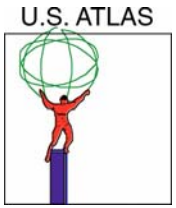
Near Term Commissioning Plans

- Integration of experiment
- Global aim: ATLAS operational in summer 2007
- First milestone: initial ATLAS core operational in fall 2006
  - Participants
    - Barrel calorimeters (with at least a minimal geometry)
    - DAQ
    - Central DCS
    - Online DataBases
    - Control room
    - Common trigger using TTC, LTP, CTP
  - Additional “ingredients”
    - Monitoring system, “combined” monitoring
    - A cosmic trigger for real particles in the detector
      - Offline analysis



"Dress Rehearsal"

- **In 2007, few months before start plan on "dress rehearsal"**
  - **Generate O(10^7) evts: few days of data taking, ~1 pb^{-1} at L = 10^{31} cm^{-2} s^{-1}**
  - **Inject emulated data into HLT, into Tier 0**
  - **Perform calibration & alignment at Tier0 (also outside ?)**
  - **Run reconstruction at Tier0 (and maybe Tier1s ?) → produce ESD, AOD, TAGs**
  - **Distribute ESD, AOD, TAGs to Tier1s and Tier2s**
  - **Perform distributed analysis (possibly at Tier2s) using TAGs**
- **An ambitious program**



Conclusions

- Tremendous progress
  - Detector installation & commissioning
    - Major changes daily!
  - Computing
    - Grid computing becoming a reality
  - Preparation for Physics
    - Plans are being implemented
  - Surely there will be bumps in the road, and the schedule is tight -- but no show stoppers
- On track for first collisions in 2007 and 14TeV physics in 2008