The ATLAS

Detector System and Collaboration

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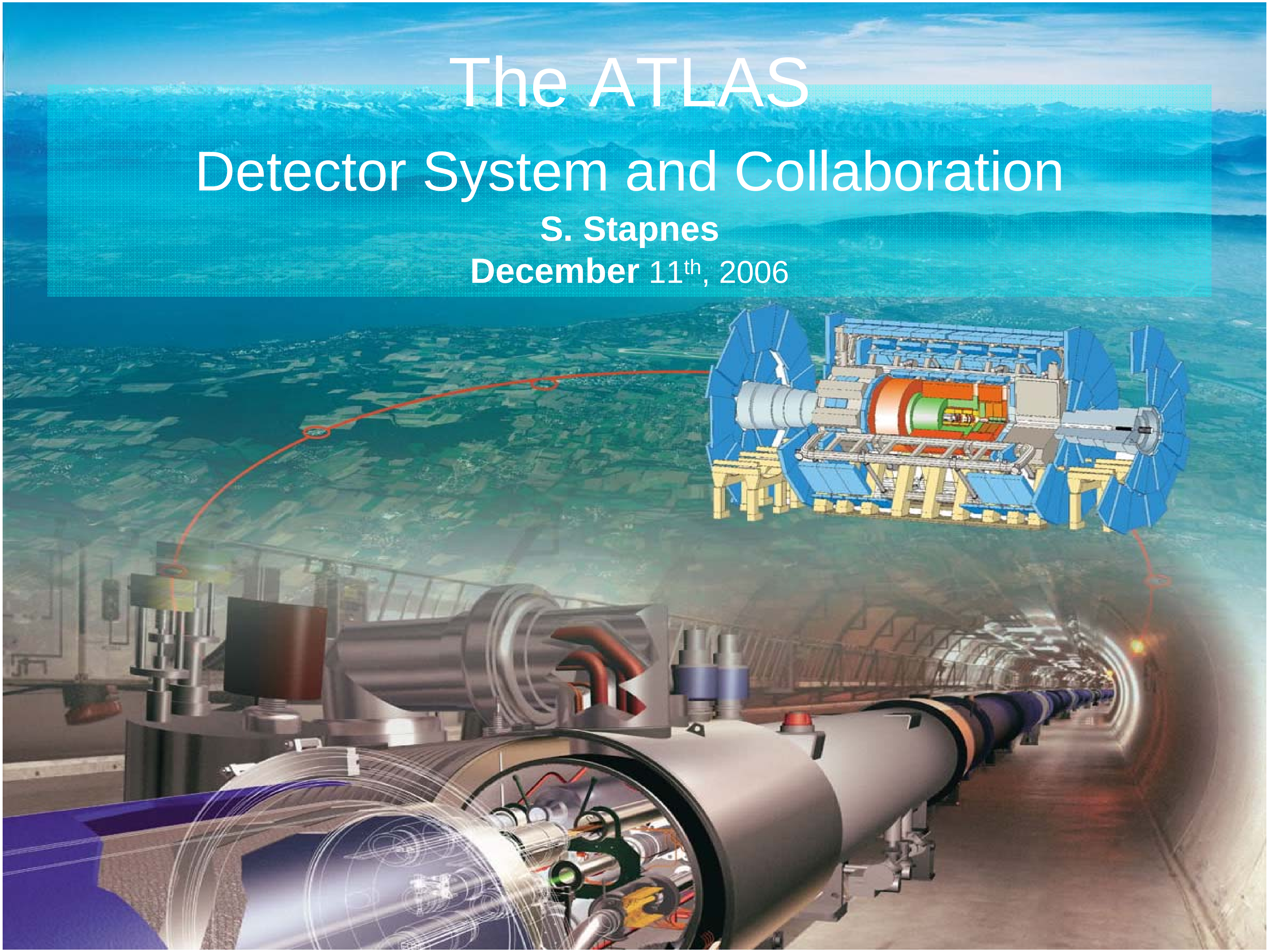
December 11th, 2006



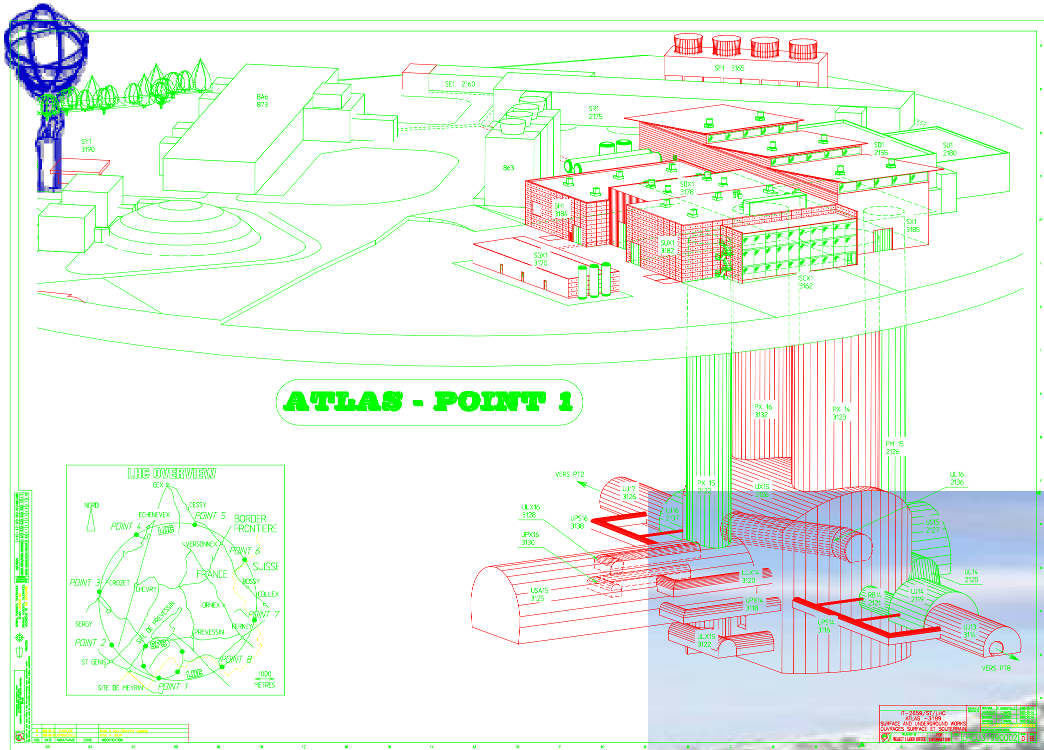
Outline

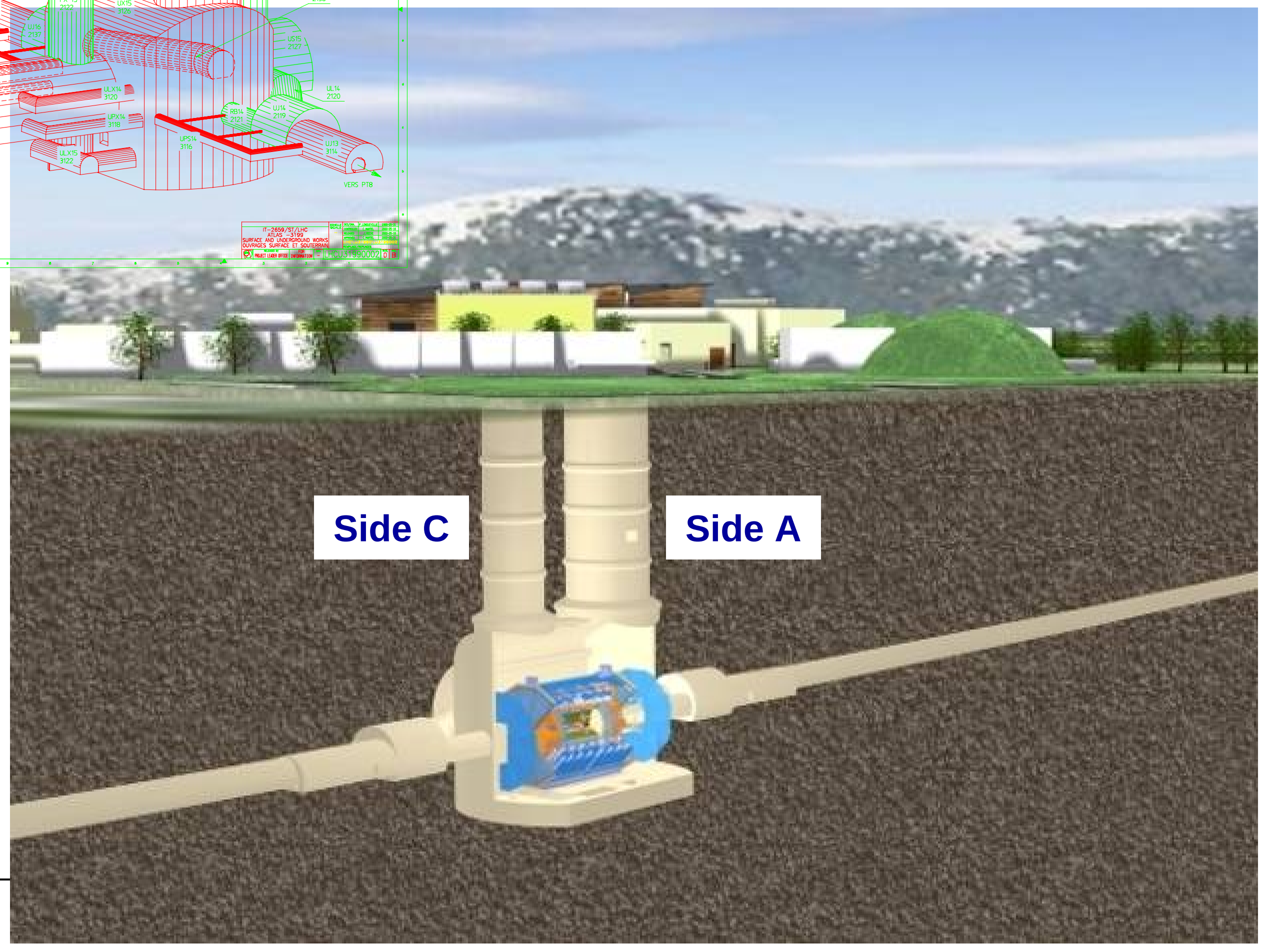
In this presentation:

- ATLAS experiment overview
- The ATLAS Collaboration
- Status, and timeline for Completion and Operation
- Some examples of Collaborative tasks
    - In general
    - For Operation of the Experiment
    - For a typical data analysis and physics analysis process leading to a paper
- Summary (ATLAS and Collaborative tools)

•*The slides are "collected" from many sources and people in ATLAS – many thanks to all*

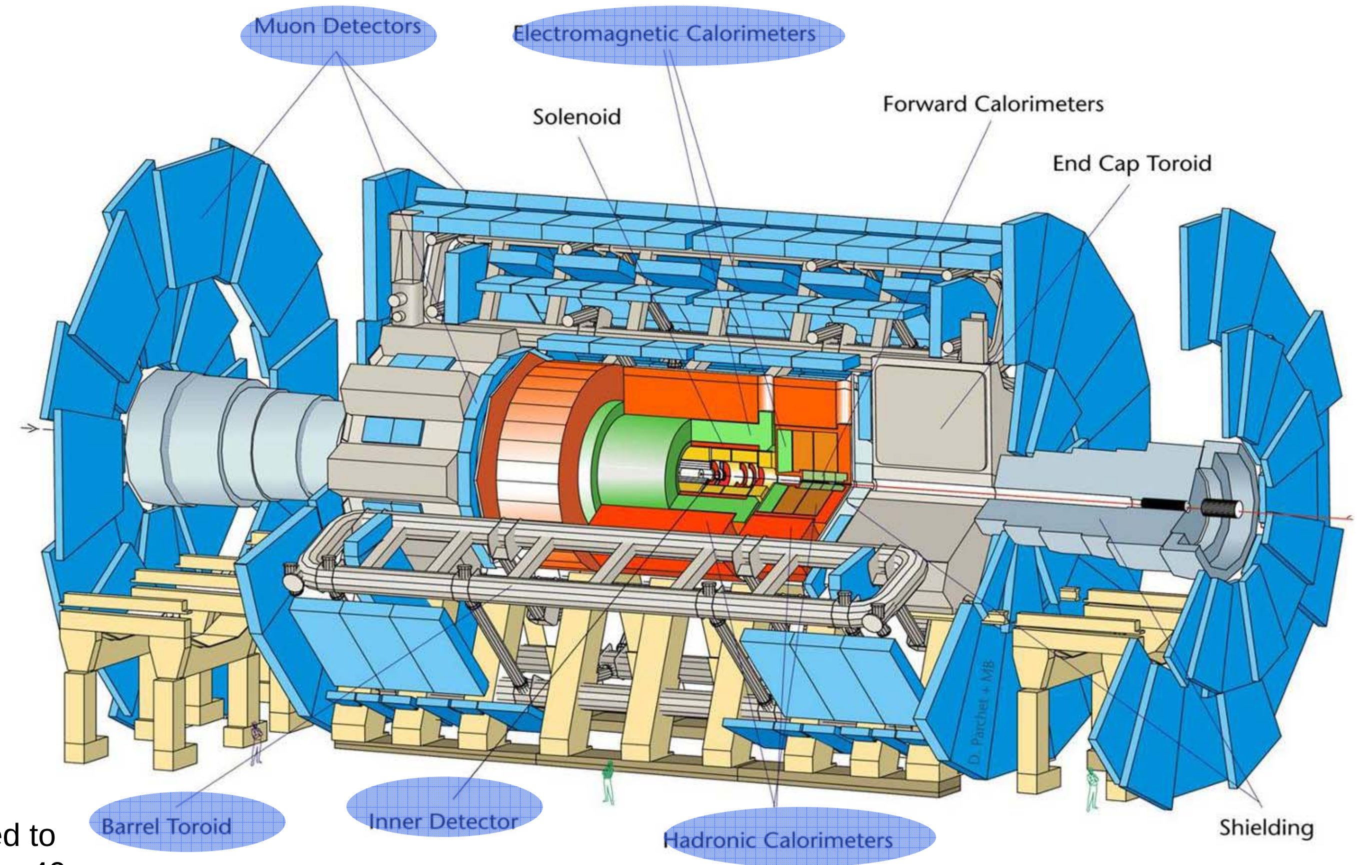
The Underground Cavern at Pit-1 for the ATLAS Detector





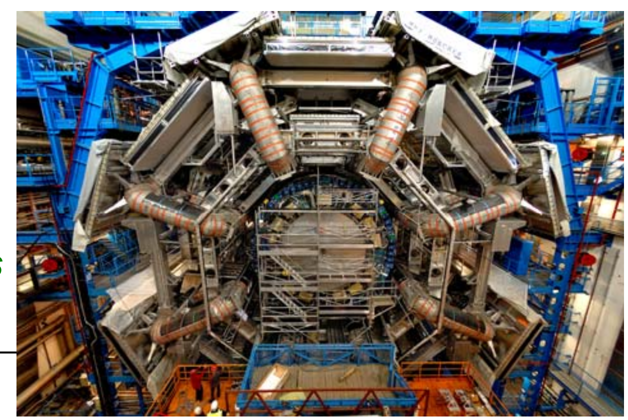
Length = 55 m
Width = 32 m
Height = 35 m

Construction progress of the detector systems



ATLAS superimposed to
the 5 floors of building 40

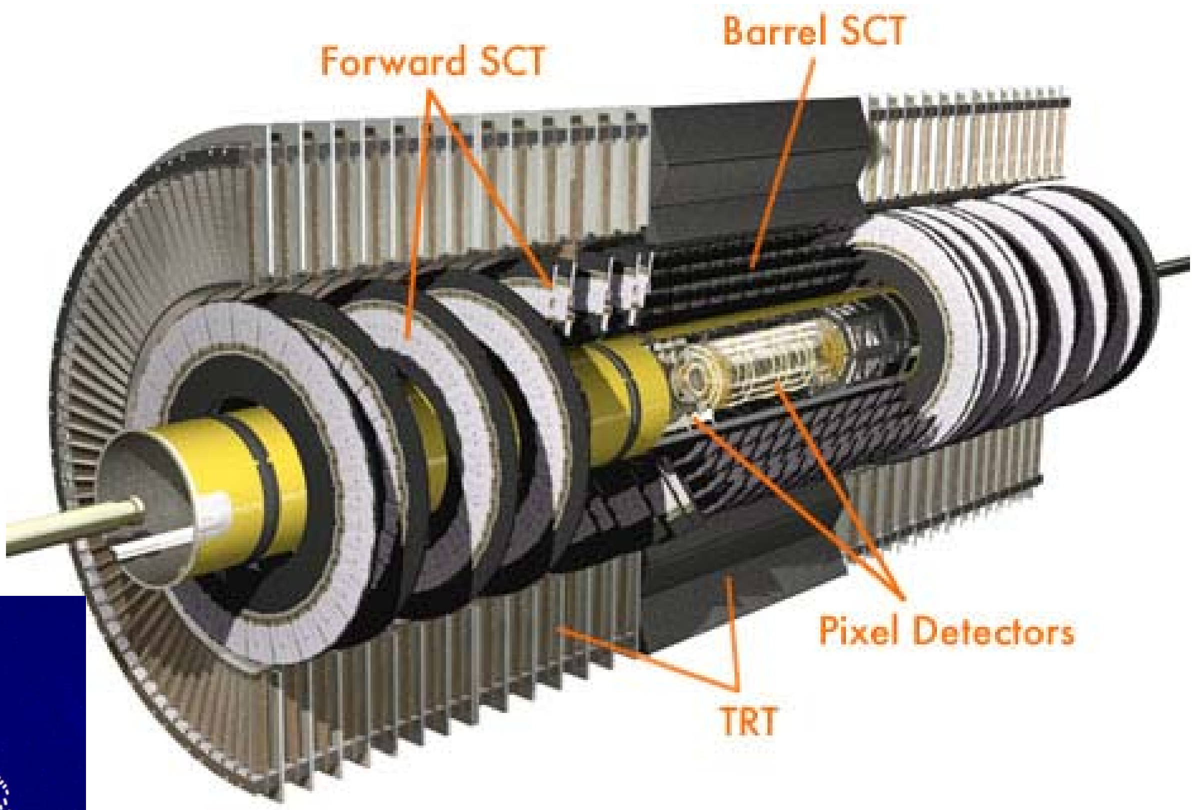
Diameter	***25 m***
Barrel toroid length	***26 m***
End-cap end-wall chamber span	***46 m***
Overall weight	***7000 Tons***

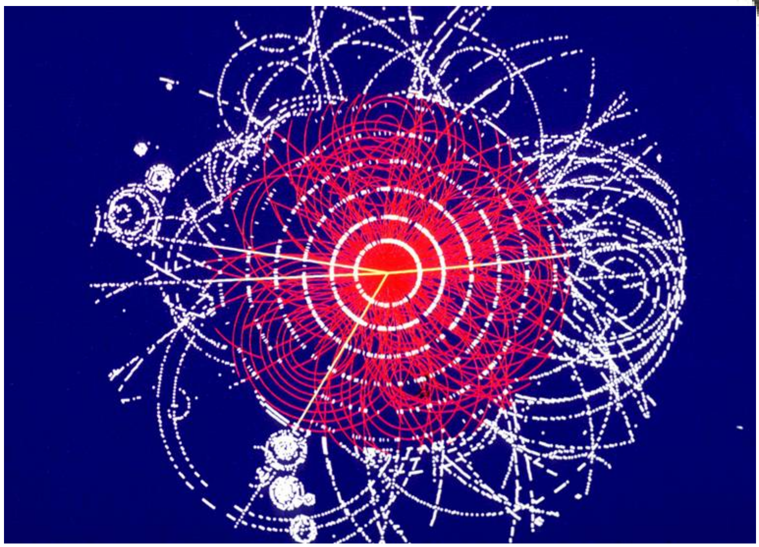


Inner Detector (ID)

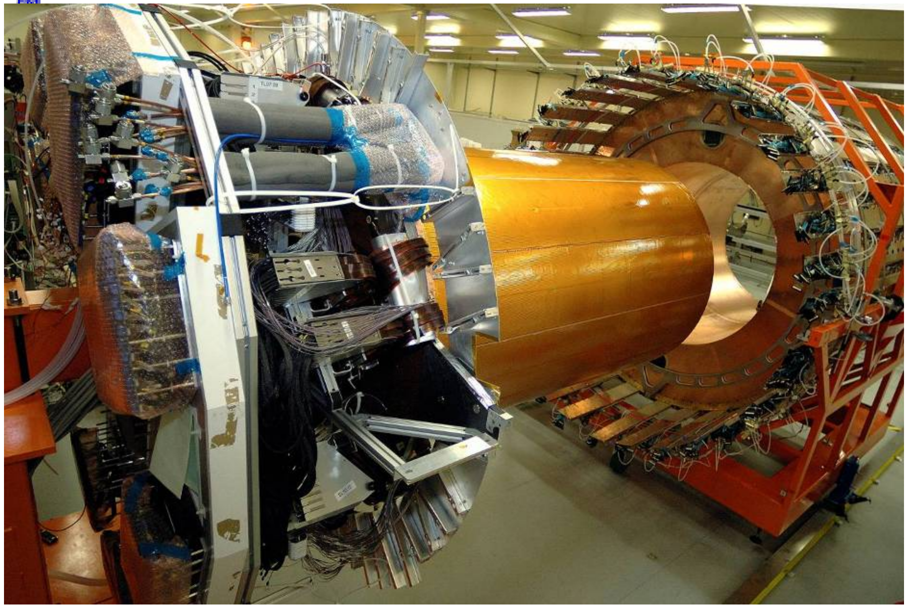
The Inner Detector (ID) is organized into four sub-systems:

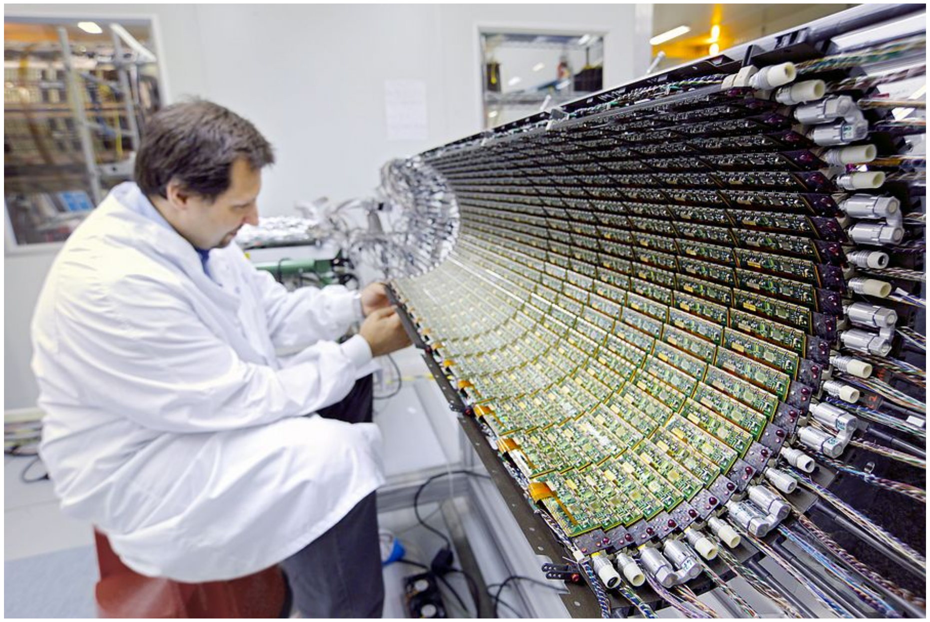
Pixels (80 10^6 channels)
Silicon Tracker (SCT) (6 10^6 channels)
Transition Radiation Tracker (TRT) (4 10^5 channels)
Common ID items





Inner Detector progress summary

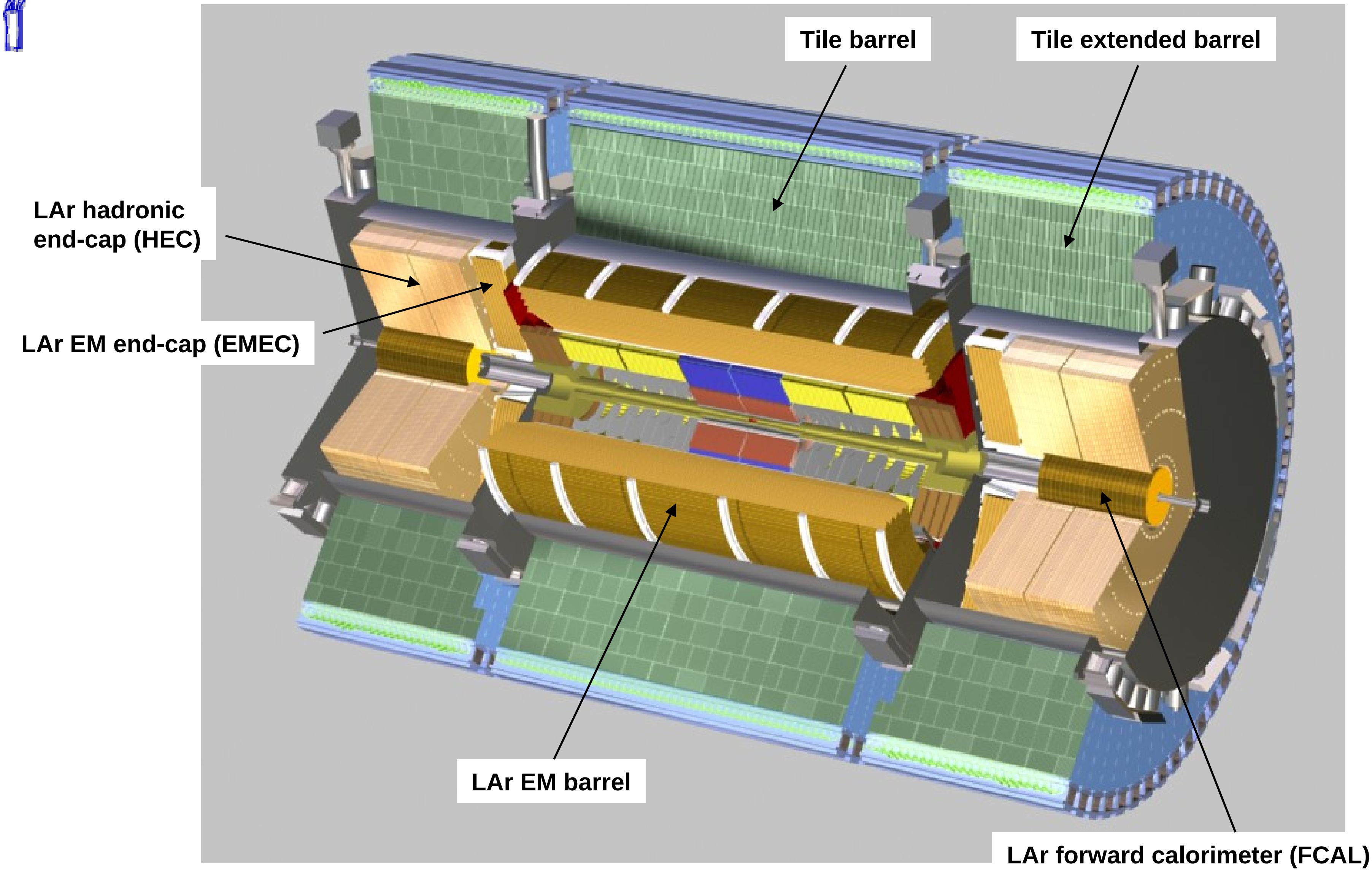




Above:TRT+SCT barrel completed in SR1, it is now installed inside the experiment

Top right: The endcaps being assembled.
Right: The PIXEL system

LAr and Tile Calorimeters

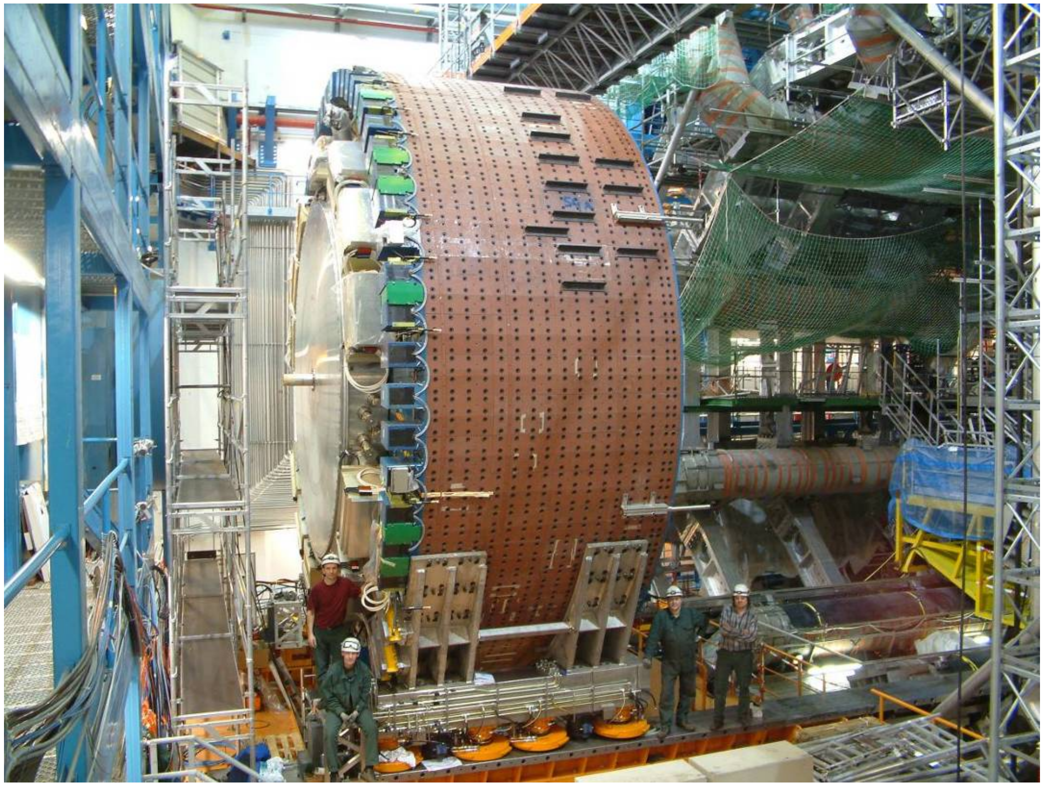


LAr and Tile Calorimeters

The barrel calorimeters are in their final position at the centre of the detector since November 2005

The final cool-down of the LAr cryostat took place over April and May 2006

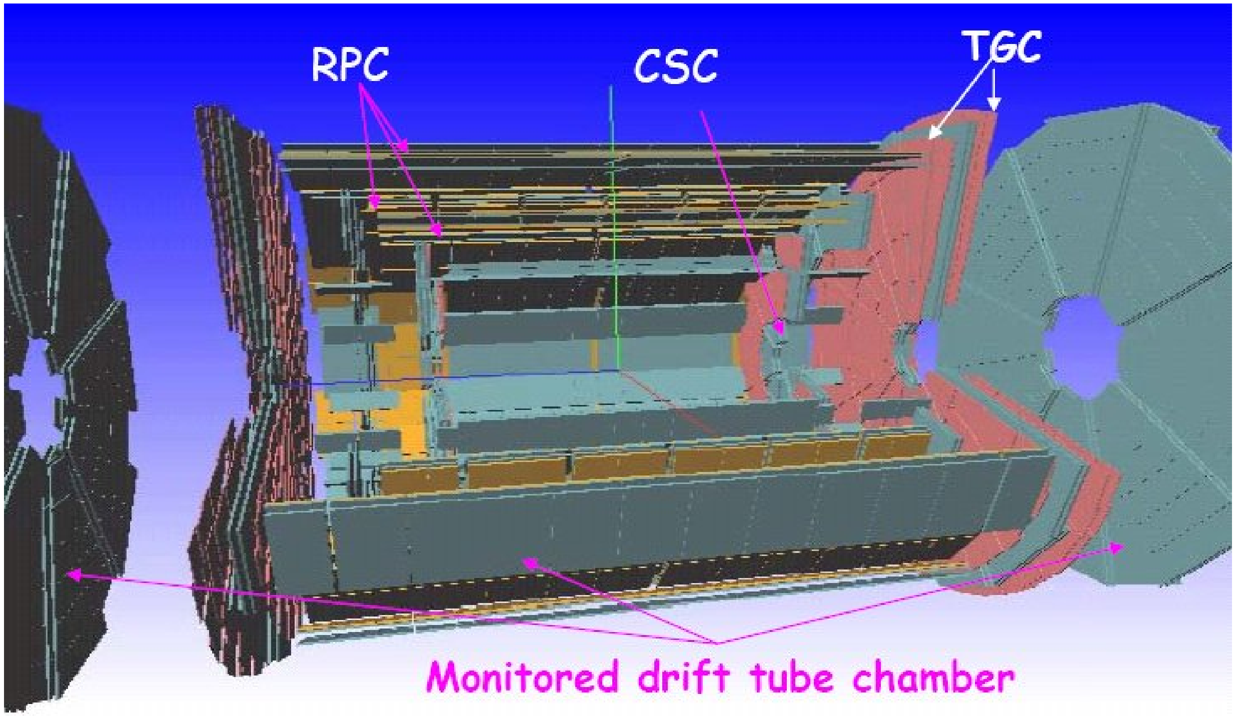
Calorimeter barrel after its move into the center of the detector (4th November 2005)



Completed end-cap calorimeter side C, just before insertion into the detector

The end-cap calorimeters on side C were assembled in the cavern by end of January 2006, and then the end-cap on side A followed in May 2006

Muon Spectrometer Instrumentation



The Muon Spectrometer is instrumented with precision chambers and fast trigger chambers

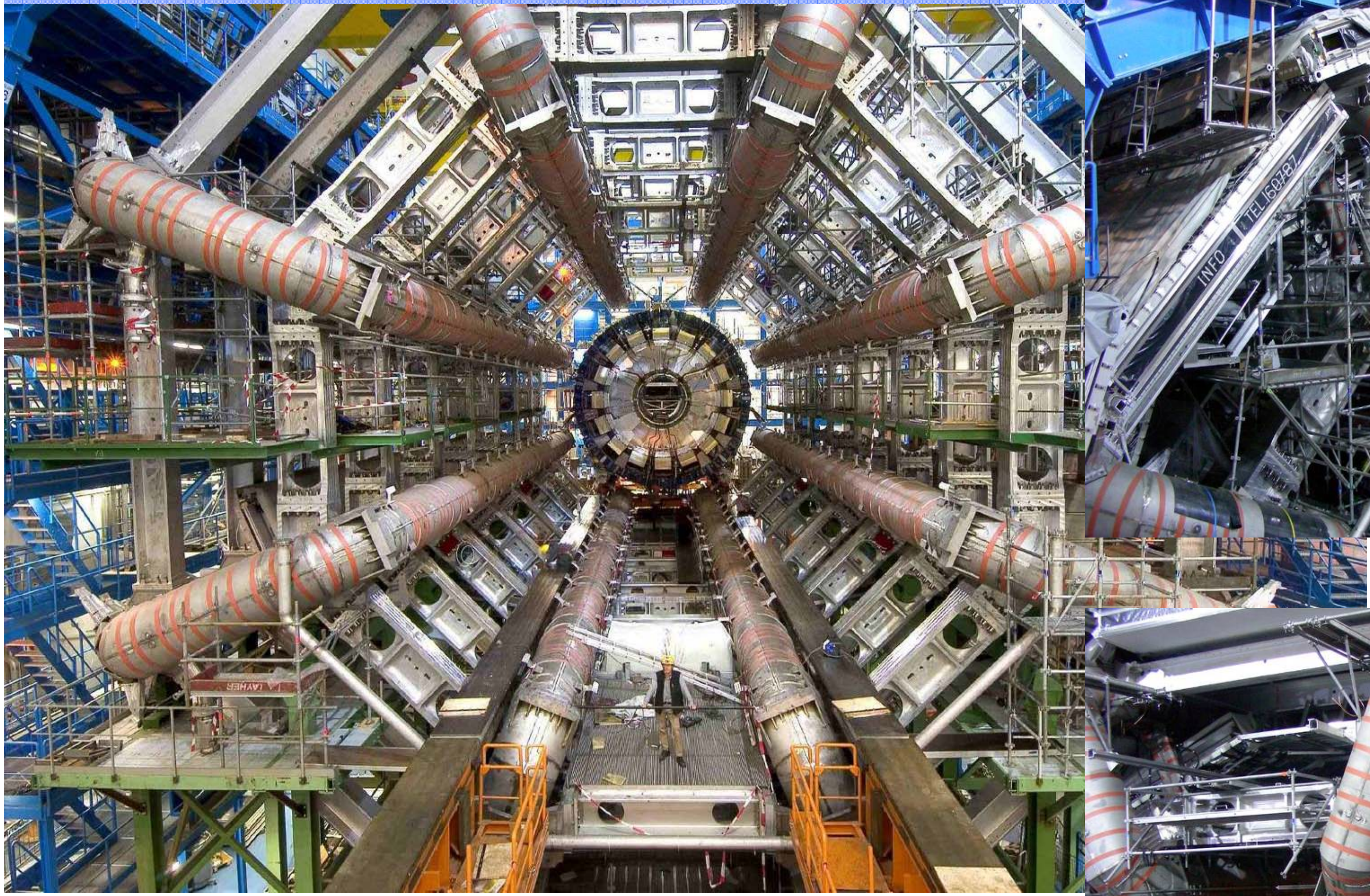
A crucial component to reach the required accuracy is the sophisticated alignment measurement and monitoring system

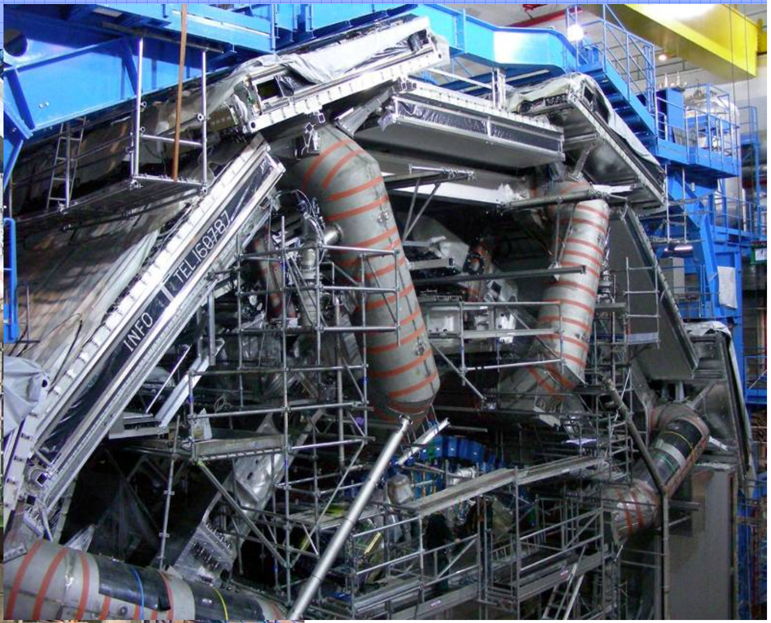
Precision chambers:
- **MDTs in the barrel and end-caps**
- **CSCs at large rapidity for the innermost end-cap stations**

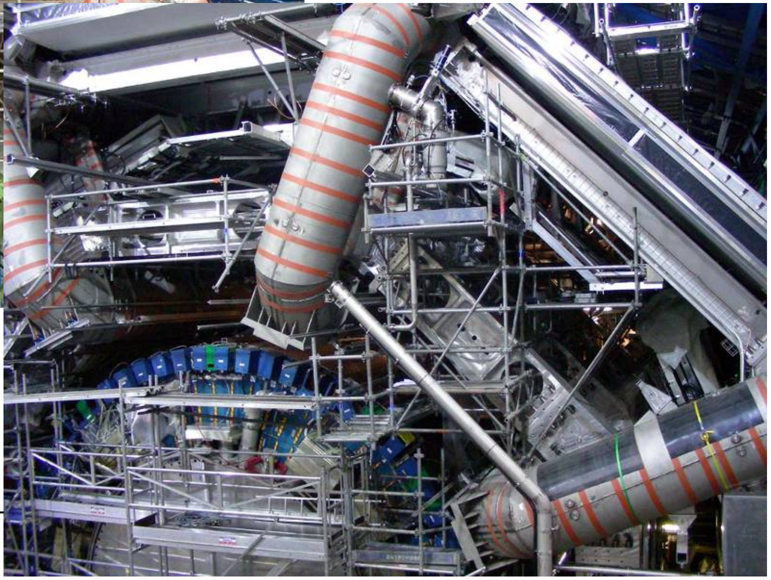
Trigger chambers:
- **RPCs in the barrel**
- **TGCs in the end-caps**

At the end of February 2006 the huge and long effort of series chamber production at many sites was completed for all chamber types

Barrel Toroid System and muon chambers

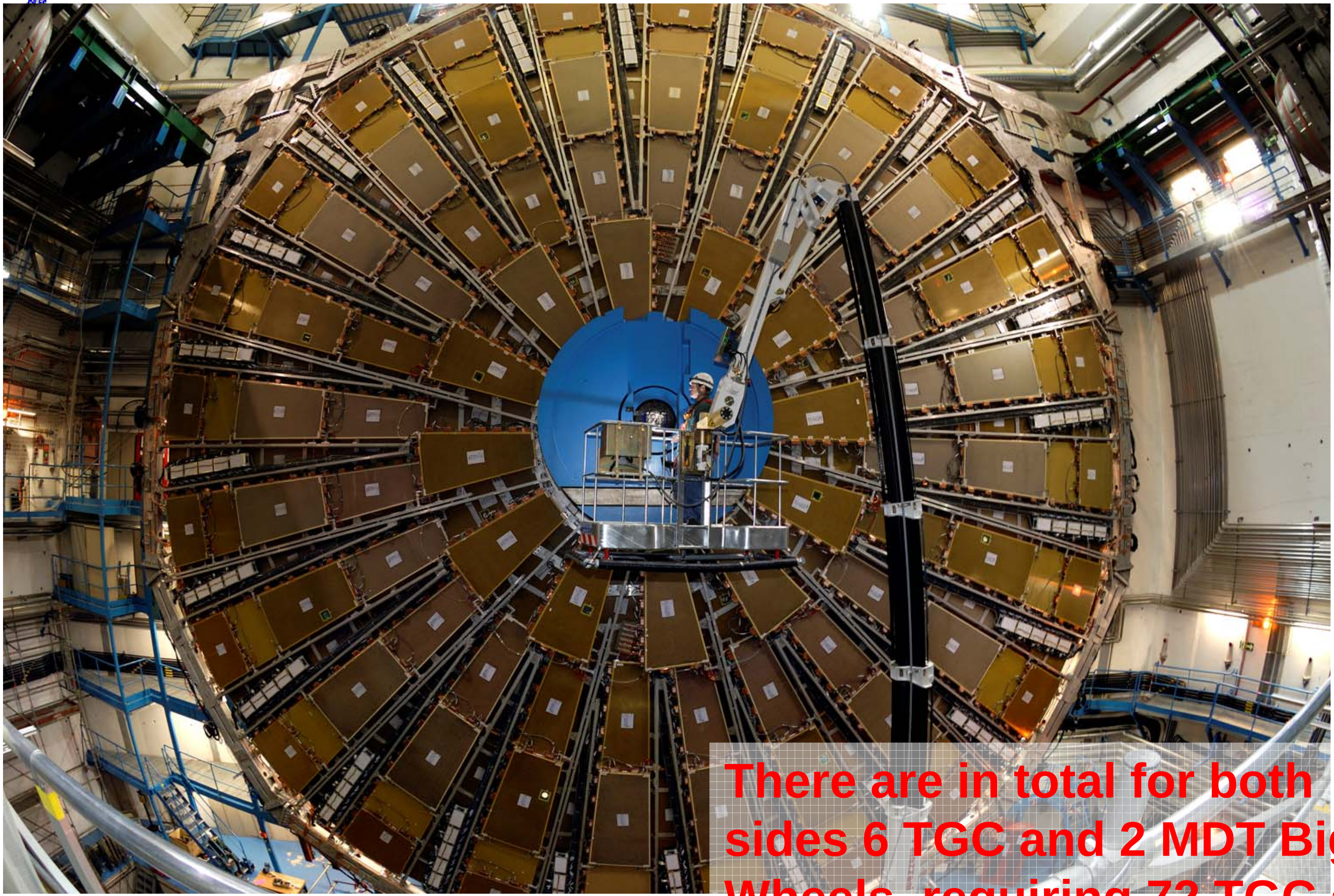






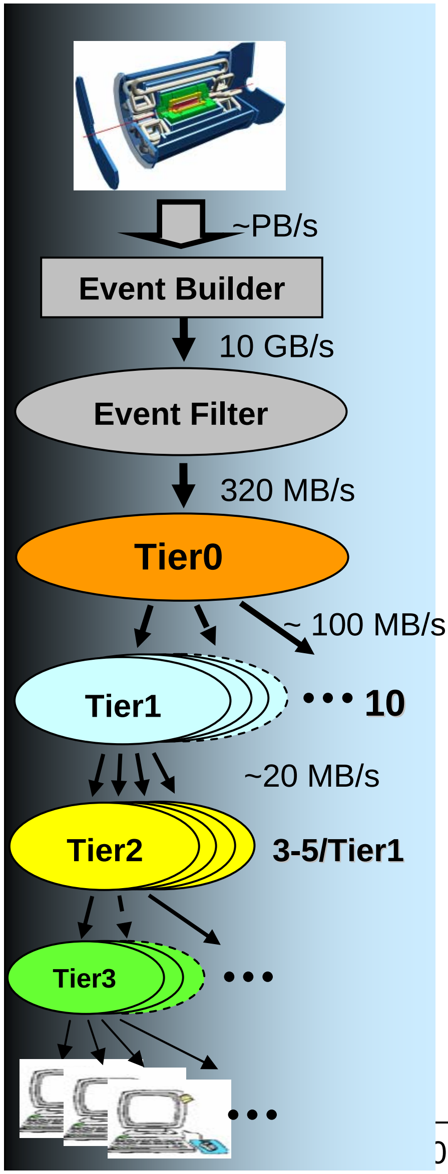
Barrel Muon Chamber installation:
Around 90 % installed today

First TGC 'Big-Wheel' assembled in the cavern early September 2006



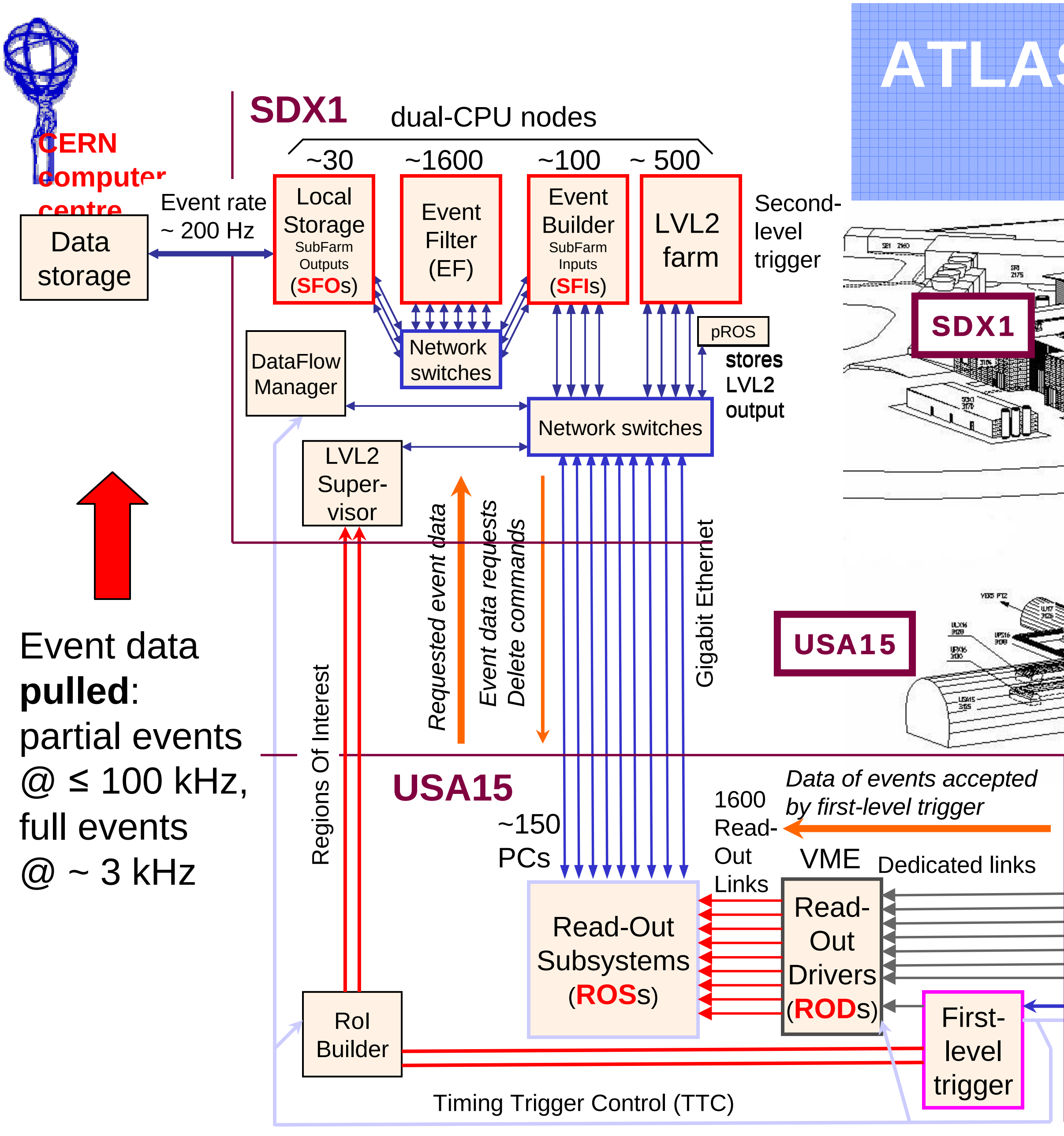
There are in total for both sides 6 TGC and 2 MDT Big Wheels, requiring 72 TGC and 32 MDT sectors

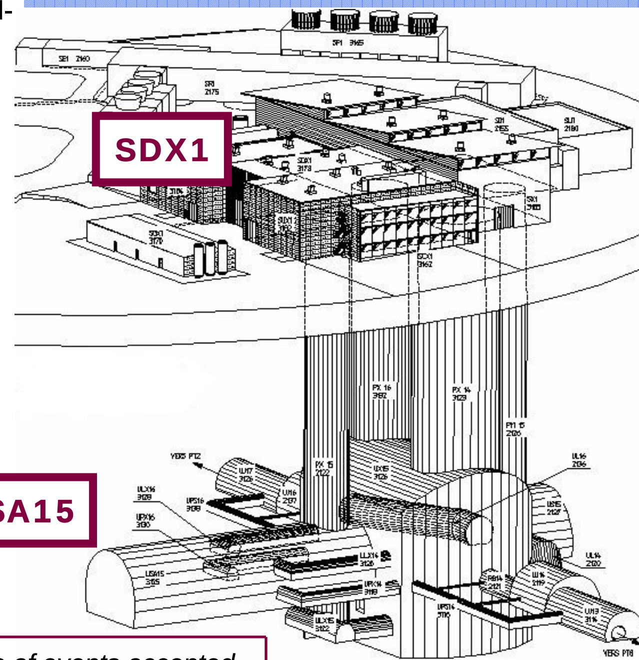
ATLAS data processing



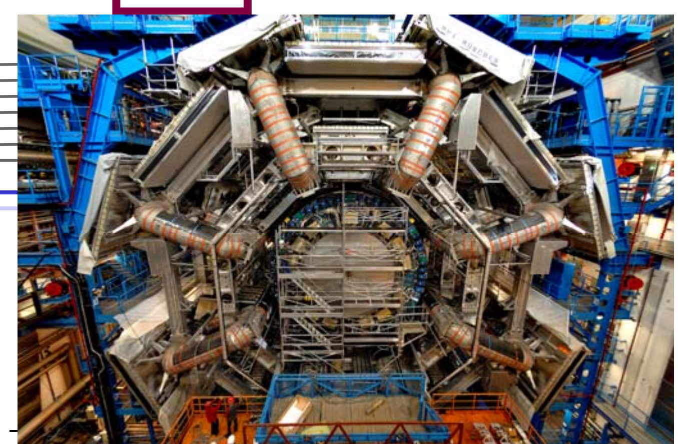
- Protons flying in opposite directions will collide with a centre-of-mass energy of 14 TeV (~14000 times the proton rest mass) in the centre of the ATLAS detector
- The particles produced are absorbed and detected by the ATLAS detector
- The ensemble of the electronic signals produced in all detector components by a single collision is called an “event”
- Collisions happens at a rate of 40 MHz, but “interesting” ones will occur much more rarely (100-1000 Hz)
- The online data acquisition system will collect together all signals that belong to the same event and select “interesting” ones (max. rate 200 Hz, limited by bandwidth and offline processing)
- These events are sent to the CERN computing centre (Tier-0) for processing and distribution

ATLAS trigger/DAQ data flow





UX15



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

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

The pre-series of final system with 8 racks at Point-1 (10% of final dataflow) is now in operation

USA15

SDX1

One ROS rack
-
TC rack + horiz. Cooling
-
12 ROS
48 ROBINs

RoIB rack
-
TC rack + horiz. cooling
-
50% of RoIB

One Full L2 rack
-
TDAQ rack
-
30 HLT PCs

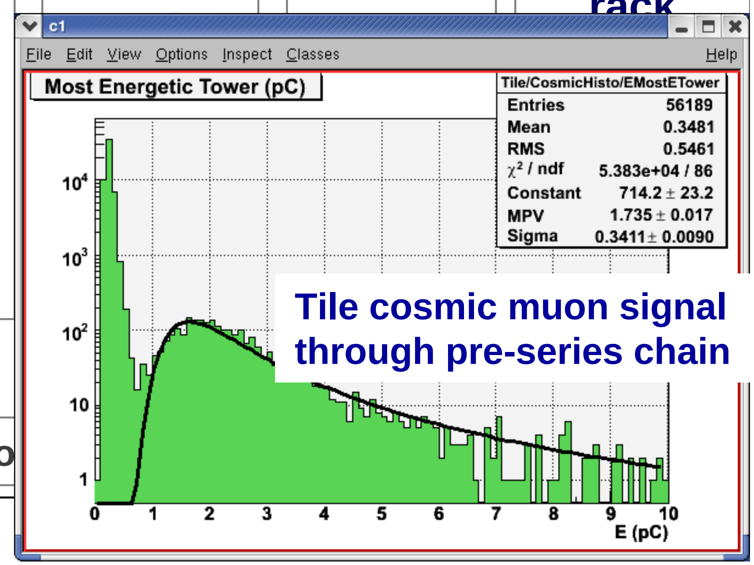
Partial Superv'r rack
-
TDAQ rack
-
3 HE PCs

One Switch rack
-
TDAQ rack
-
128-port GEth for L2+EB

Partial EFIO

Partial EF rack

Partial ONLINE rack

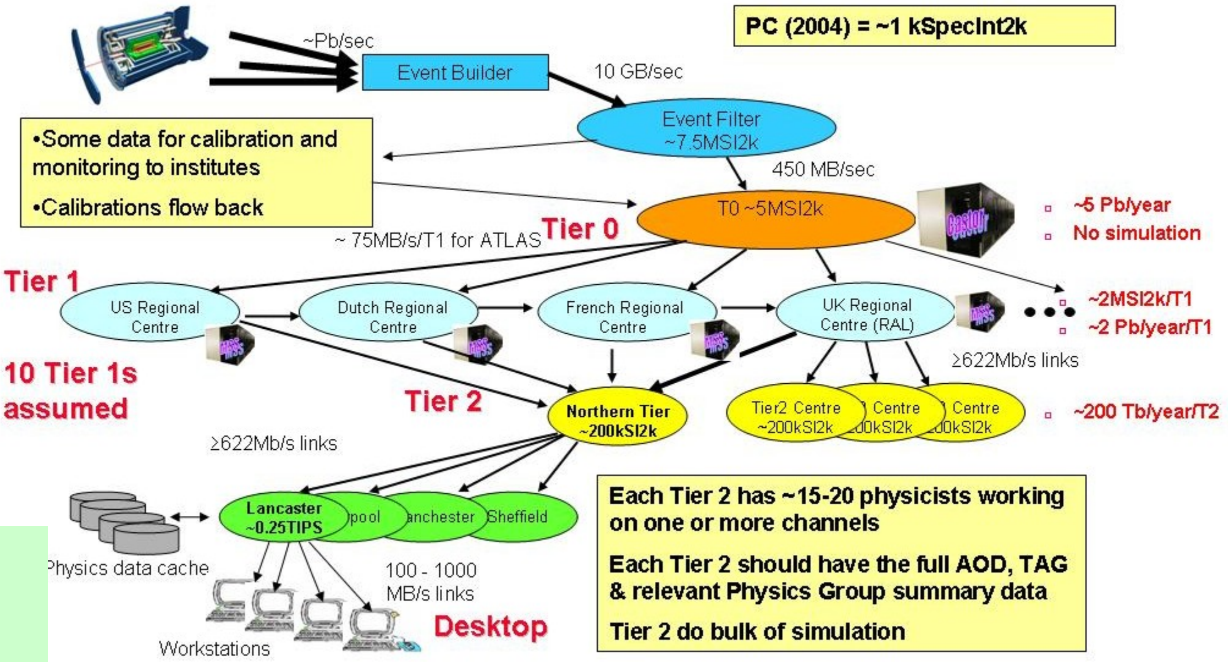


Tile cosmic muon signal through pre-series chain

ROS, L2, EFIO and EF racks: one Local File Server, one o

S.Stapnes, Geneve 11.12-2006

ATLAS offline data processing



Tier-0:
- Accepts data from DAQ
- Prompt reconstruction
- Data archive and distribution to Tier-1's

Tier-1's:
- Real data archiving
- Re-processing
- Skimming and other data-intensive analysis tasks
- Calibration
- MC data archiving

Tier-2's:
- User data Analysis
- MC production
- Import skimmed datasets from Tier-1 and export MC data
- Calibration/alignment

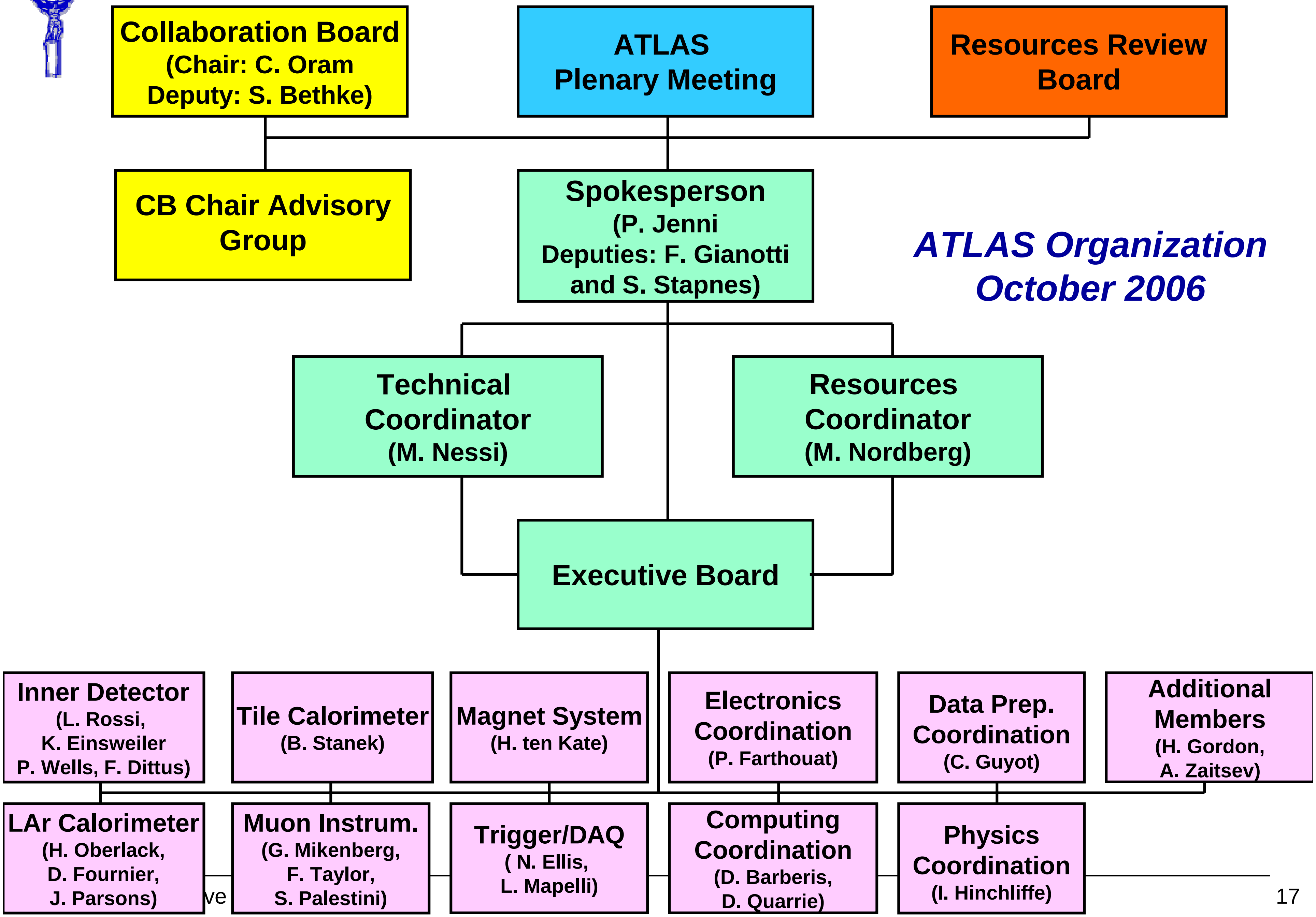
ATLAS collaboration

(As of the October 2006)

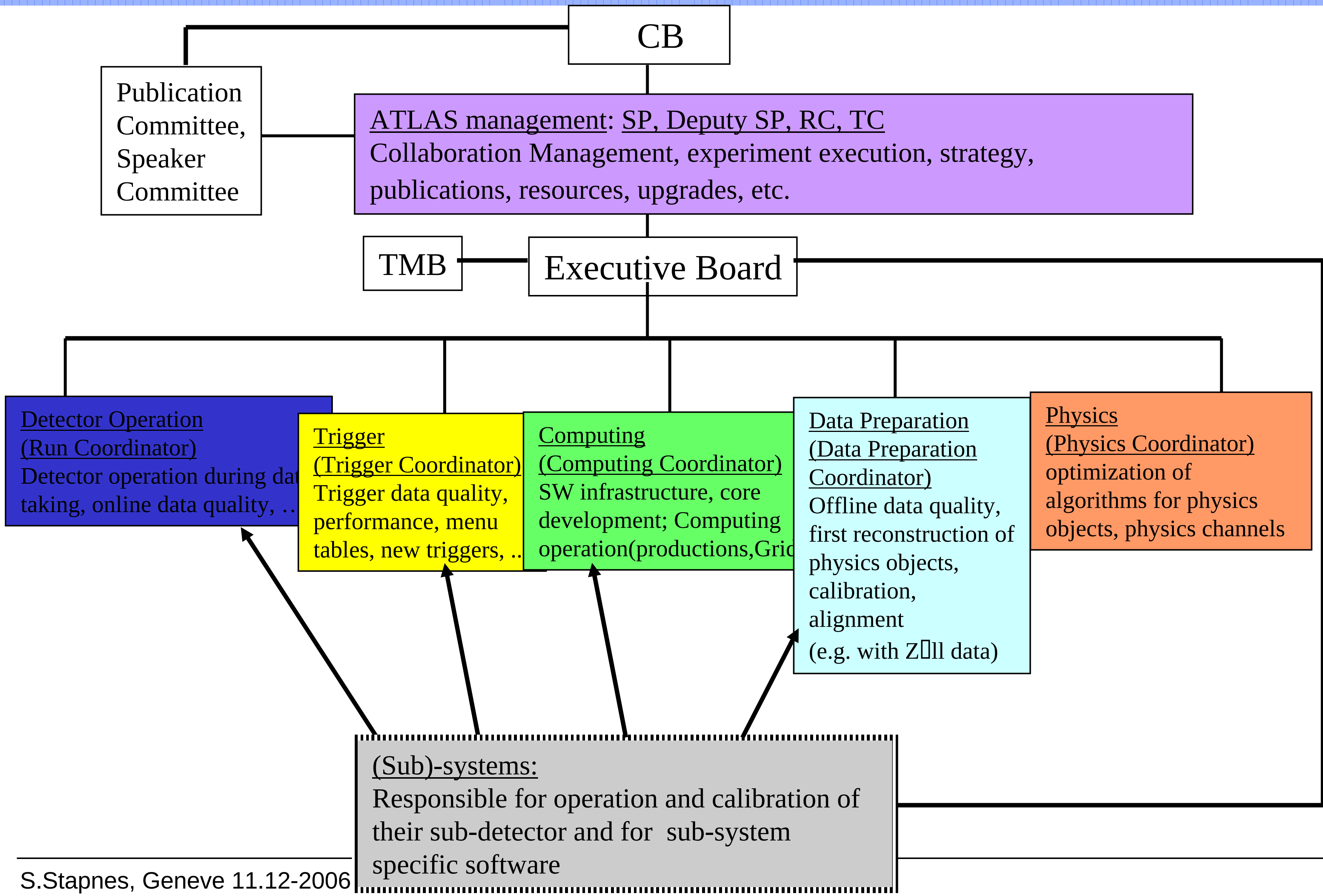
35 Countries
164 Institutions
1800 Scientific Authors total
(1470 with a PhD, for M&O share)

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, 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, 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, FH Wiener Neustadt, Wisconsin, Wuppertal, Yale, Yerevan

ATLAS Organization October 2006



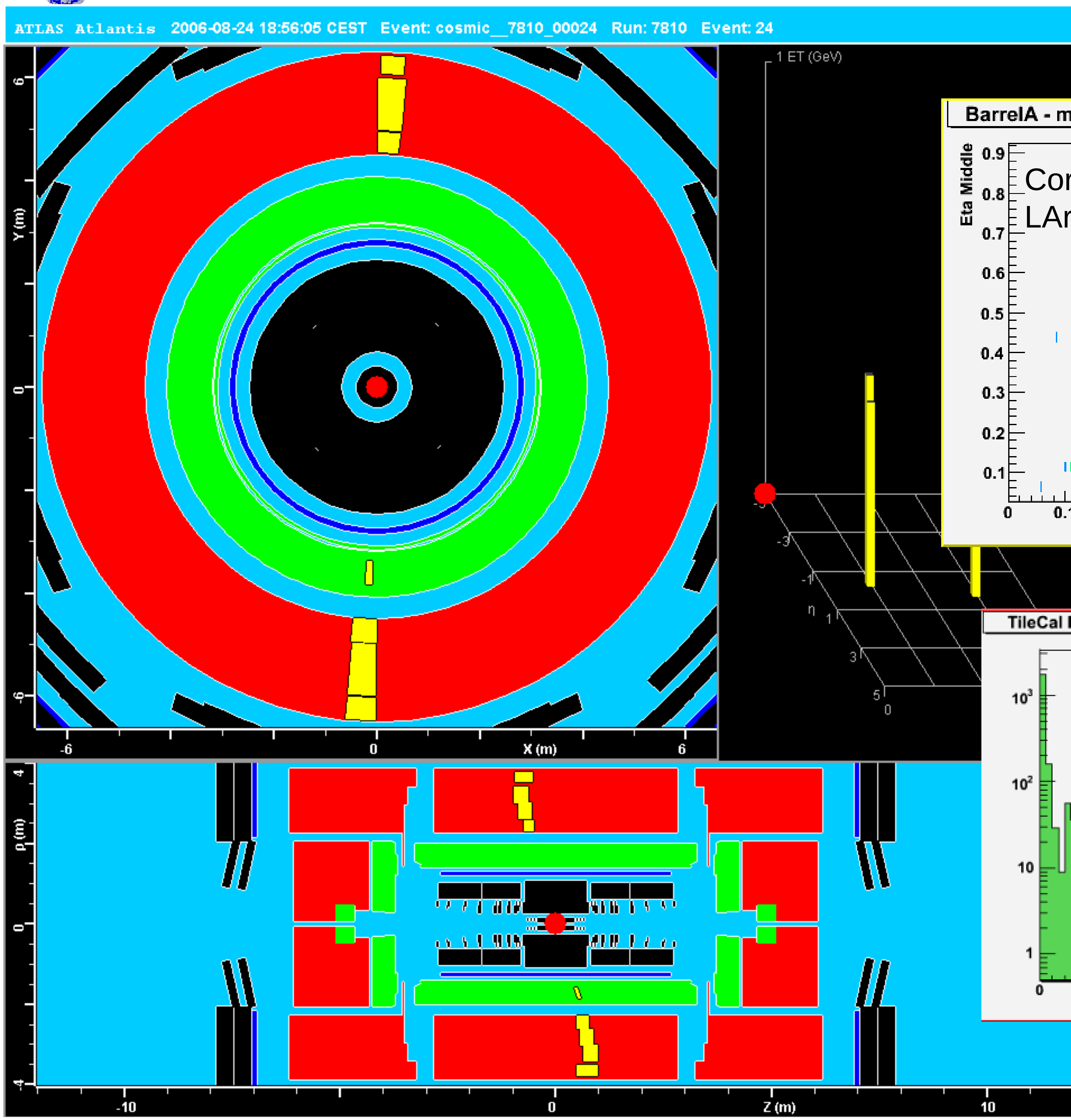
Operation activities for ATLAS

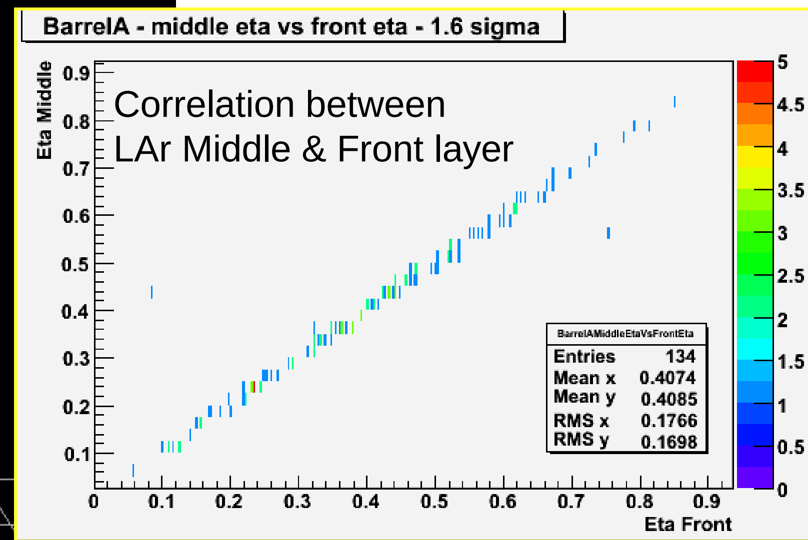


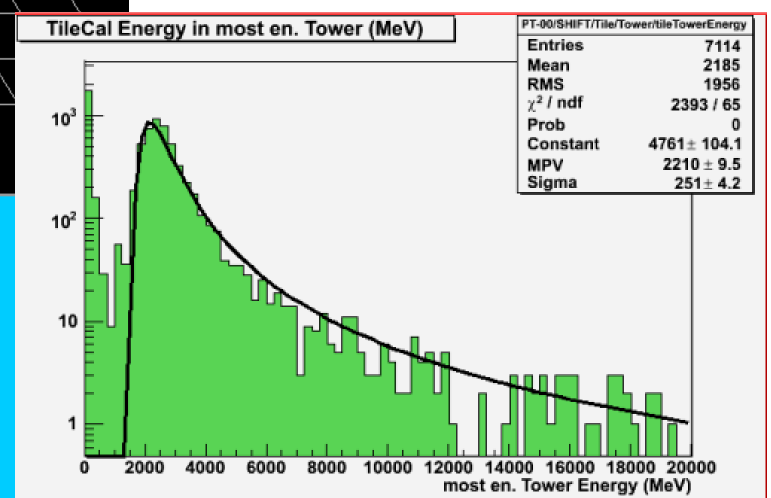
Next year

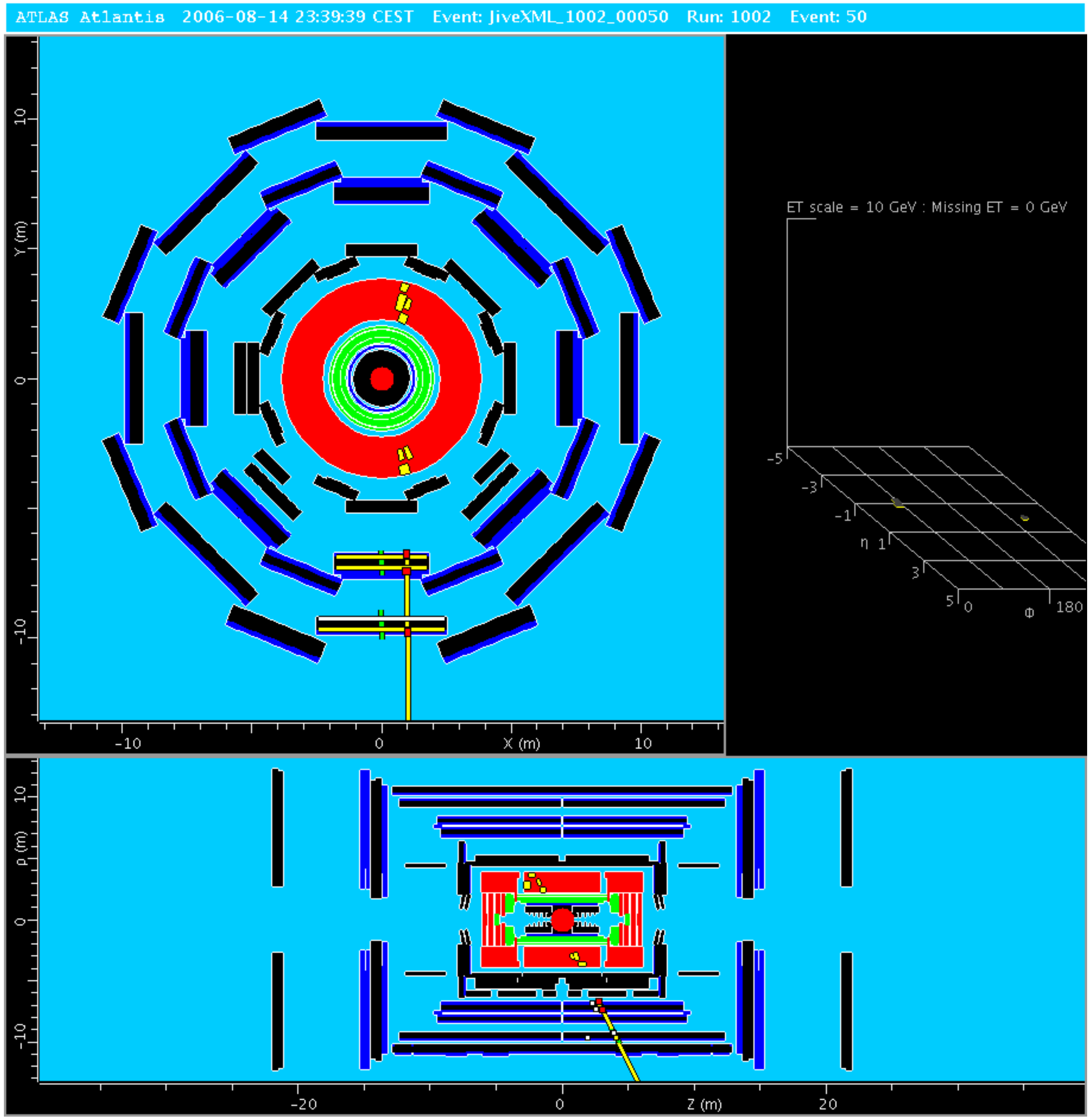
- The beamline will be closed in the autumn next year and we expect first collisions in Nov/Dec.
- Some main activities:
  - Completion of the detector in cavern
  - Cosmic data runs to exercise the detector
  - Software releases and validations
  - Calibration and alignment work
  - Online and offline systems checks including Tier 0 to 2
  - Realistic large scale tests

Event display from the first LAr + Tile Calorimeter barrel cosmics run









August 2006 saw the first combined MDT + RPC + Tile Calorimeter cosmic ray muon run

RPC trigger on sector-13

Main offline milestones 2007

Calibration Data Challenge:

- understand performance of "as-installed" detector
- re-calibrate/re-align with physics samples, calibration algorithms and DB infrastructure

Physics studies for the Computing System Commissioning:

- cover full physics programme of the experiment
- include "technical work" to test infrastructure and tools

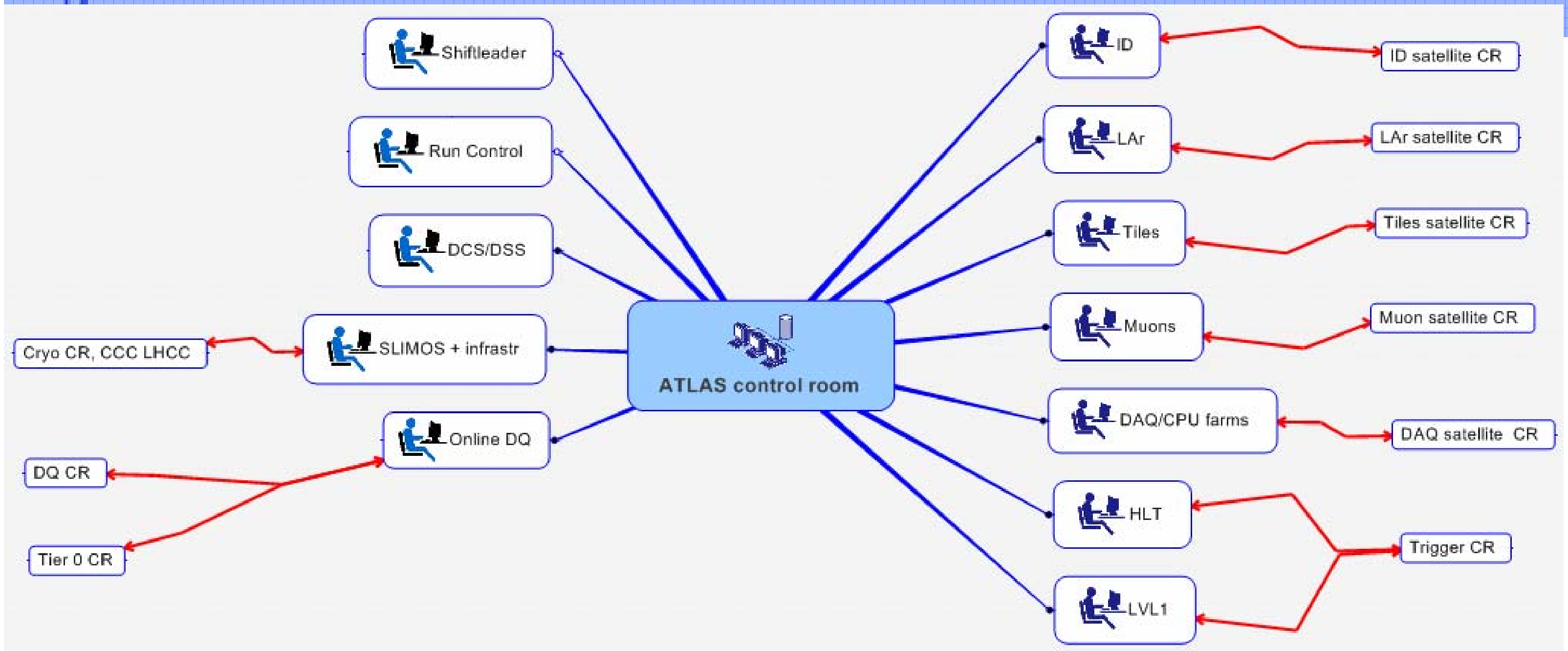
Organisational:

- strengthen Computing Operation, GRID tools, Distributed Data Management activities
- finalize Analysis Model

Collaborative tools

- Such tools heavily used:
  - For example: Construction of specific detector subsystem parts with 4-5 groups involved, usually separated by large distances and several timezones
  - Documentation sharing, phone and video meetings, common logbooks, application sharing ….
  - More generally for ATLAS wide meetings: Agenda System,Video and Webcasting
- Since around 20% of the collaboration is typically at CERN the ability to contact and communicate with the 80% outside is essential
- This need will continue and probably increase as we move into operation with our distributed computing and distributed physics analysis

Operation of the detector



- Control room and satellite control rooms (50m away)
- Will expect to move some of the monitoring functions to outside labs (maybe around the clock and around the world)
- Will need very reliable tools

Physics analysis

- We have 7 physics groups, each subdivided into subgroups studying more specific channels – going across the entire collaboration – for example a Higgs search group for a dedicated channel
- In an institute typically one or several faculties, with one or several post.docs and graduate students dedicate their research activities to such a working group (in addition to participating in operating the experiment)
- We will have regular PHYSICs week where analyses are discussed but in between these working groups meet regularly (using collaborative tools) to prepare and develop their analysis
- Related to this GRID processing (and reprocessing), and simulation work as needed for this study have to be agreed and carried out, some times in competition with similar demands from other working groups
- Finally when the analysis is close to completion an internal review process will start involving more wide presentations of the work to the entire collaboration
- The demands on reliable collaborative tools will increase, and our ability to involve all our experts and human resources will depend on having good tools available

Summary

- The ATLAS detector is coming together and we are preparing for data-taking in 2007
- Collaboration and organisation are adapting for Operation Activities
- Collaborate tools are crucial for our collaboration (for building parts, for reliable operation online and offline, for good physics analysis and for publications) - most of our collaboration members will stay at their home institutes and work for ATLAS there
- For outside participants in ATLAS these tools generally make it possible to participate fully in the exiting scientific research program being centered at CERN, while still being able to be a functioning (and present) member of a local group.
- During the operation phase we expect new demands for these tools, for operation (remote control room functions) and for distributed physics analysis and GRID computing operation in particular