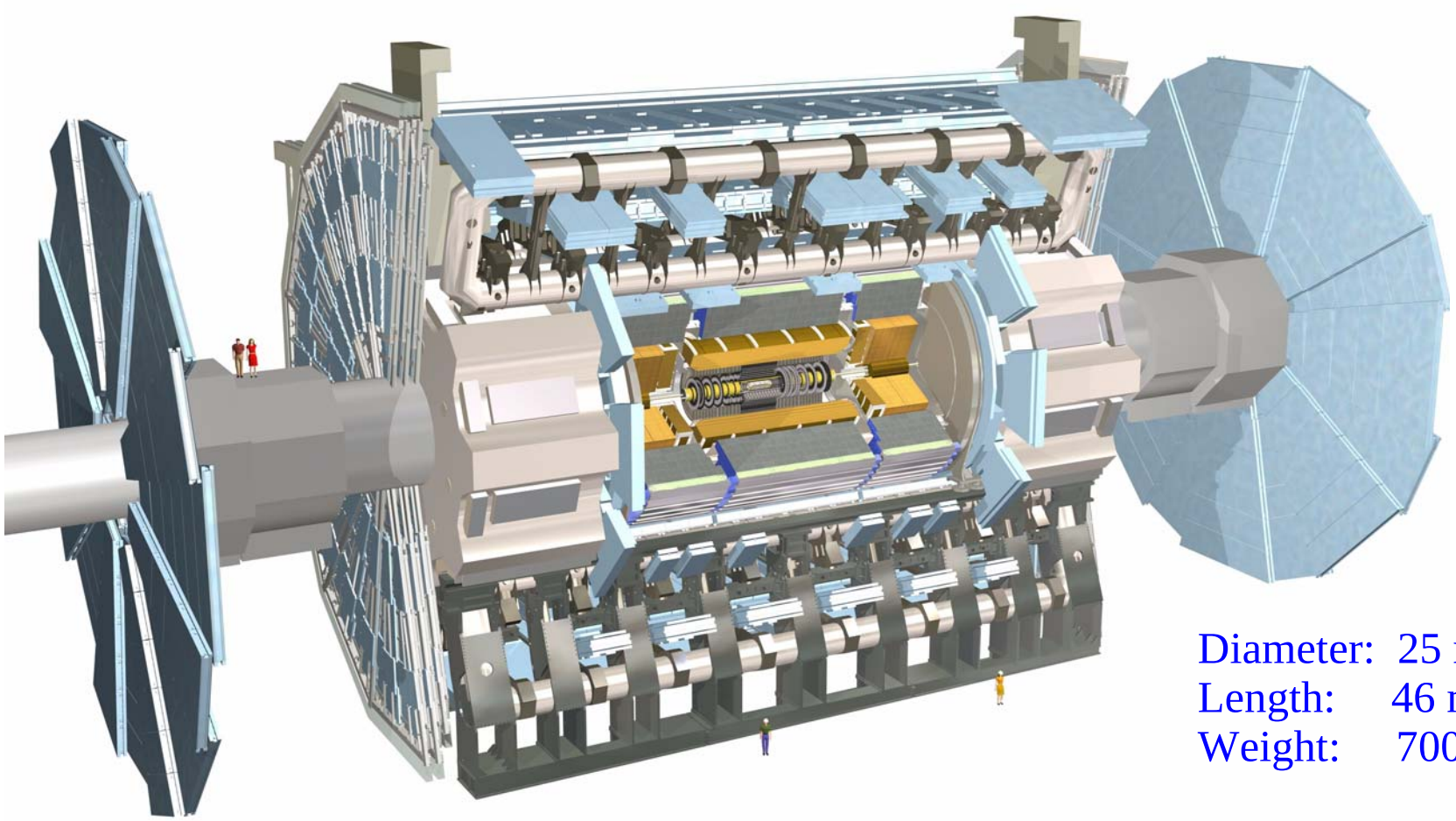
ATLAS detector and commissioning status

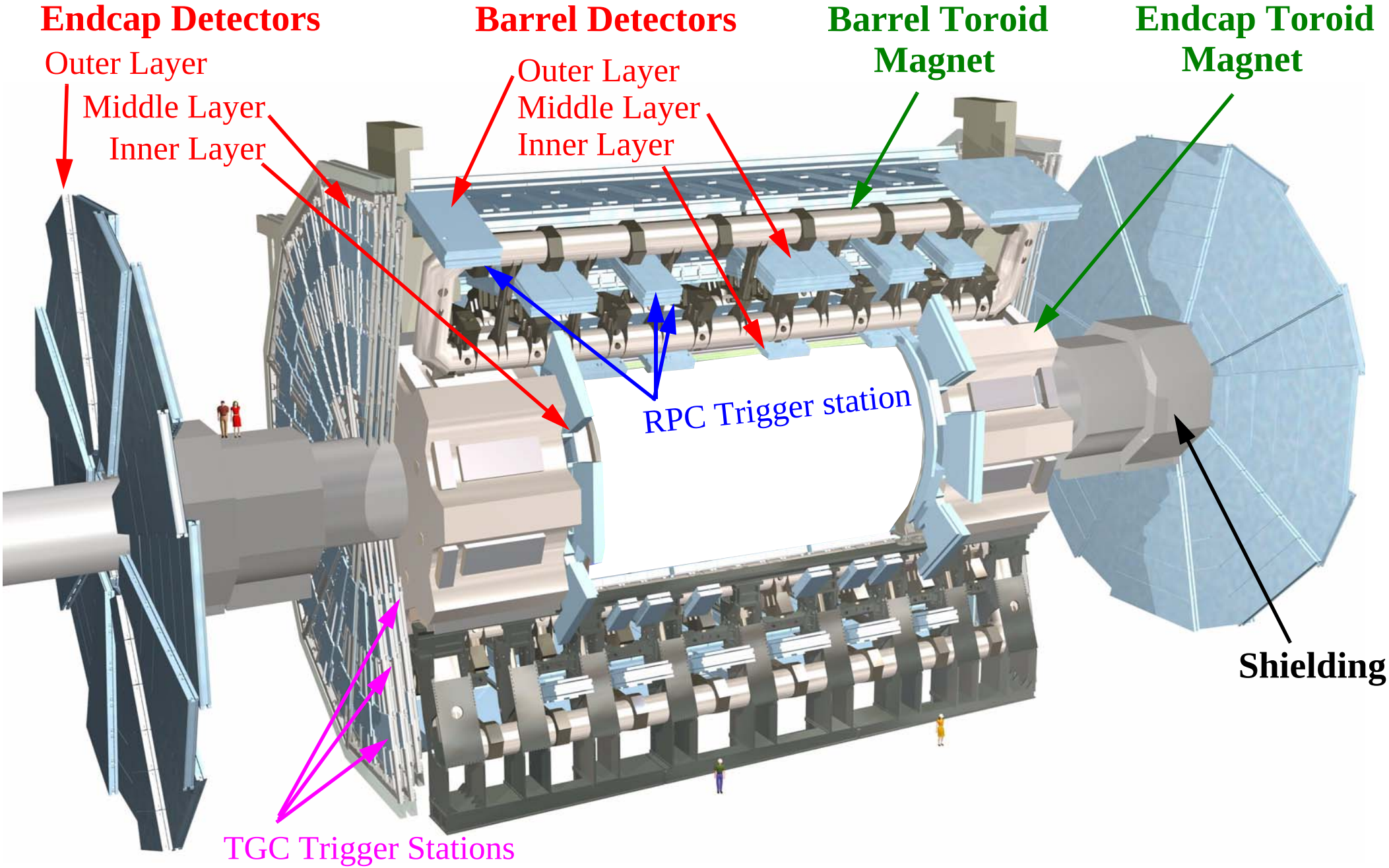
V. Hedberg - CERN & Univ. of Lund

The muon spectrometer ($|\eta| < 2.7$, $B_{peak}=4T$)
The calorimeters ($|\eta| < 5$)
The inner tracker ($|\eta| < 2.5$, $B=2T$)



Diameter: 25 m
Length: 46 m
Weight: 7000 tons

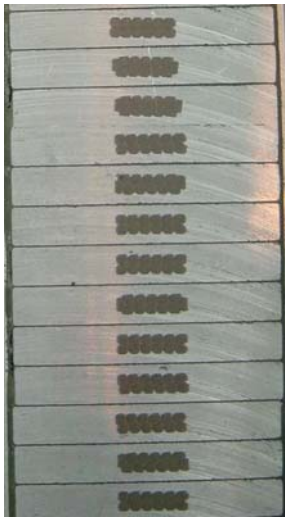
The Muon Spectrometer



The Barrel Toroid Magnet

The superconductor consists of Niobium-Titanium strands in an aluminium case.

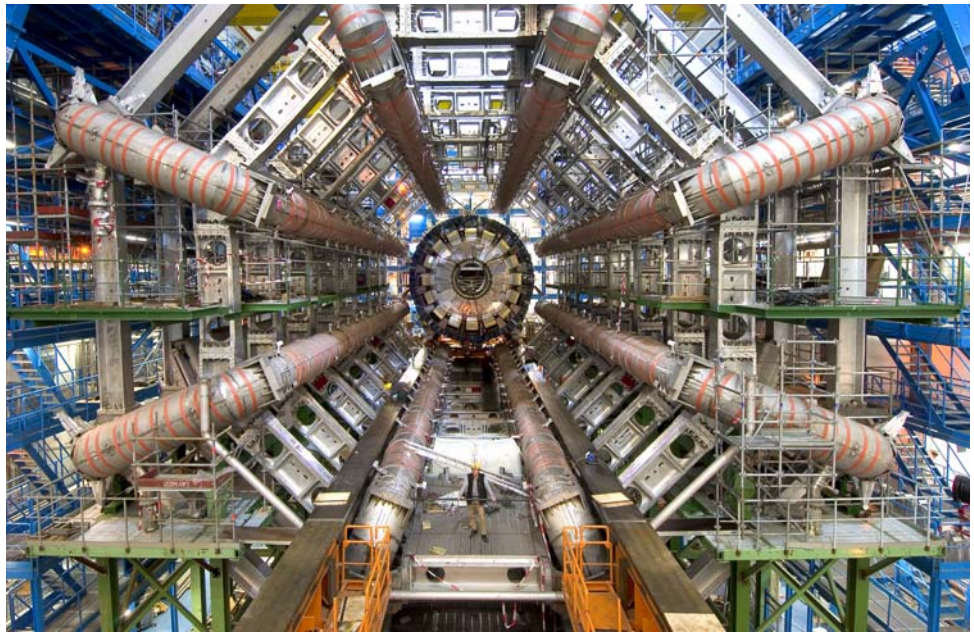
These are packed in a “pancake” configuration,



There are two double “pancakes” in each coil giving 120 turns of the conductor.

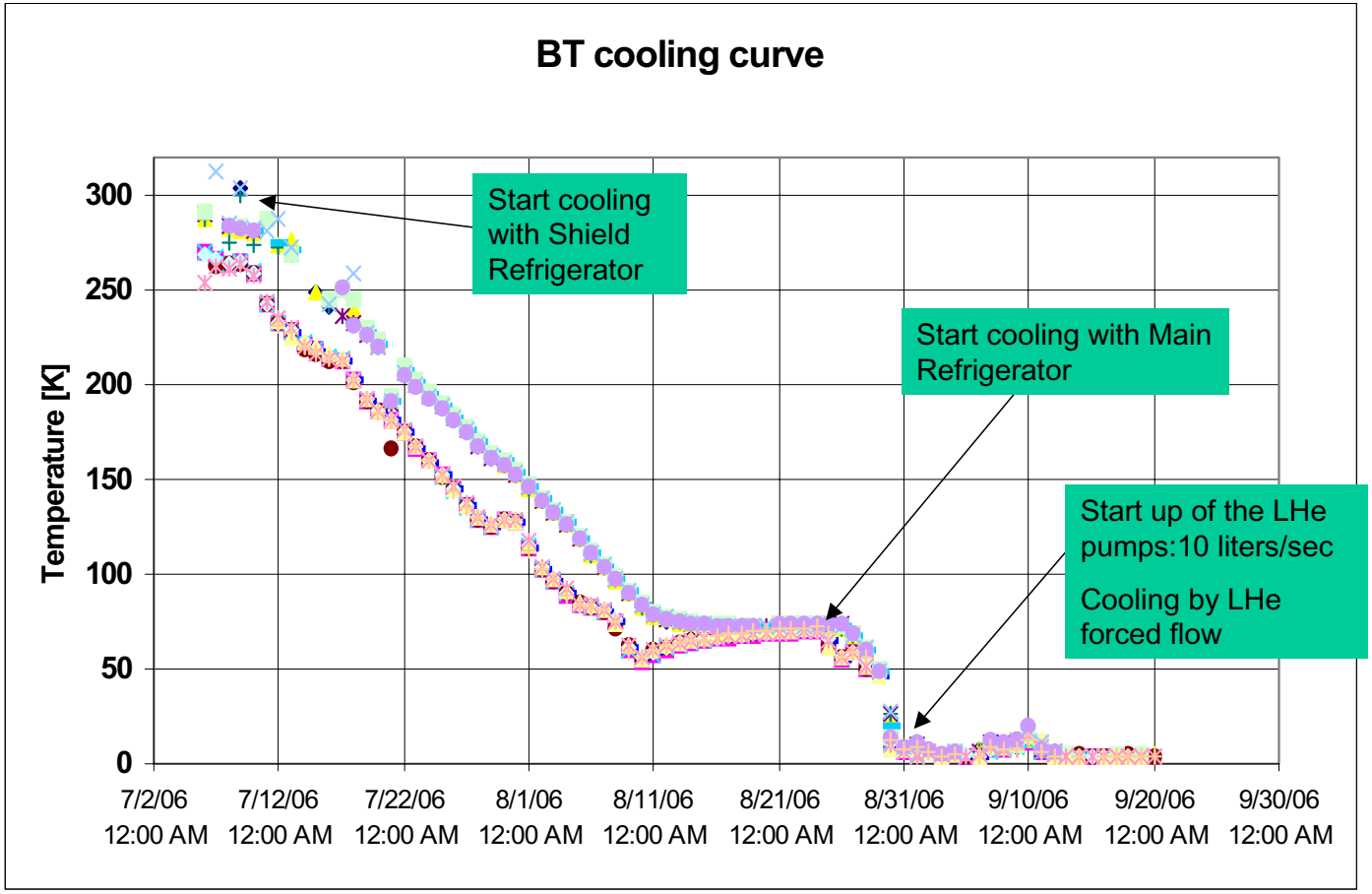
These will give a peak field of 4 Tesla.

The first coil was installed two years ago.



The worlds largest superconducting toroidal magnet after installation in ATLAS.

Commissioning of the Barrel Toroid Magnet



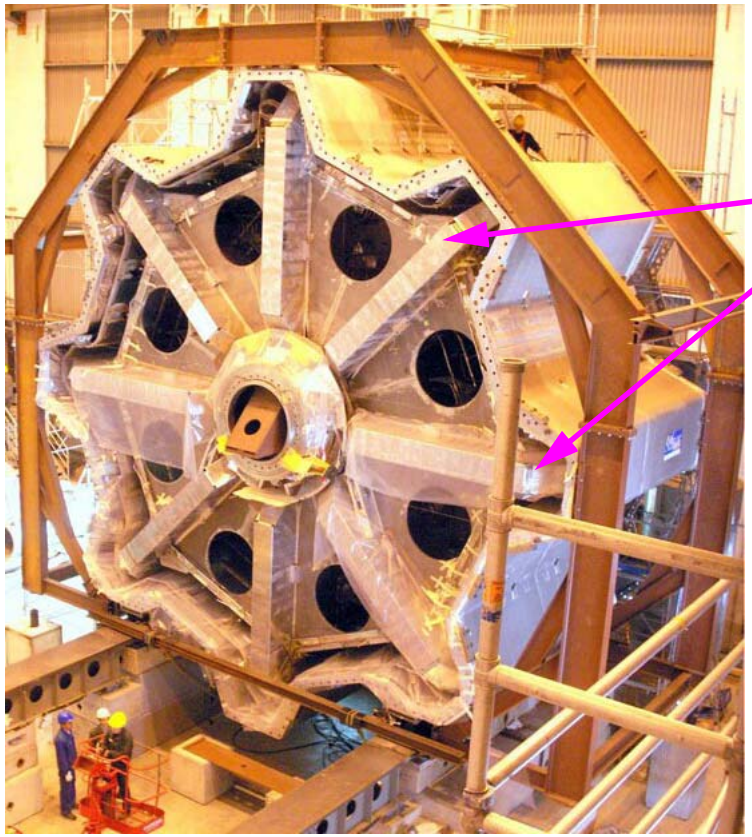
Phase 1: Cooling down the magnet and tests up to 300 A - COMPLETED.

Phase 2: Tests with currents up to 5 kA - October

Phase 3: Tests with current in steps between 10 kA and 20.5 kA - November

The Endcap Toroid Magnets

The installation of the first cold mass inside the cryostat is almost finished.



The cold mass of the second endcap is being assembled.

Several problems have been encountered during the assembly. Solutions have been found but it has resulted in delays.

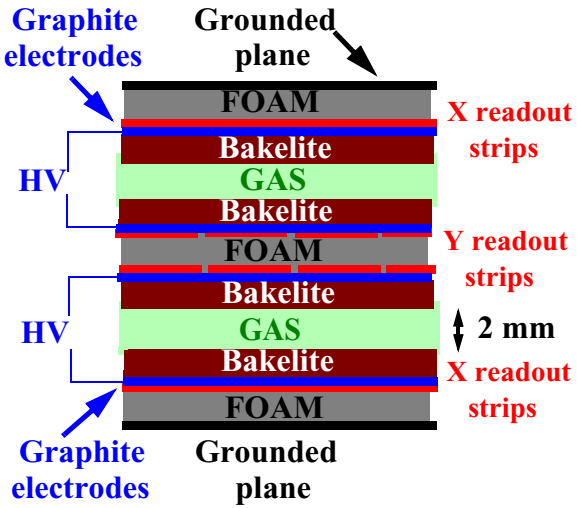
The current estimate is that the two magnets will be ready in March and June 2007. This is too late and could seriously disturb the ATLAS installation schedule.

To gain time the second toroid will be assembled in parallel and might not be tested above ground before installation.

The Barrel Muon Chambers

RESISTIVE PLATE CHAMBERS

1112 chambers
374 000 channels

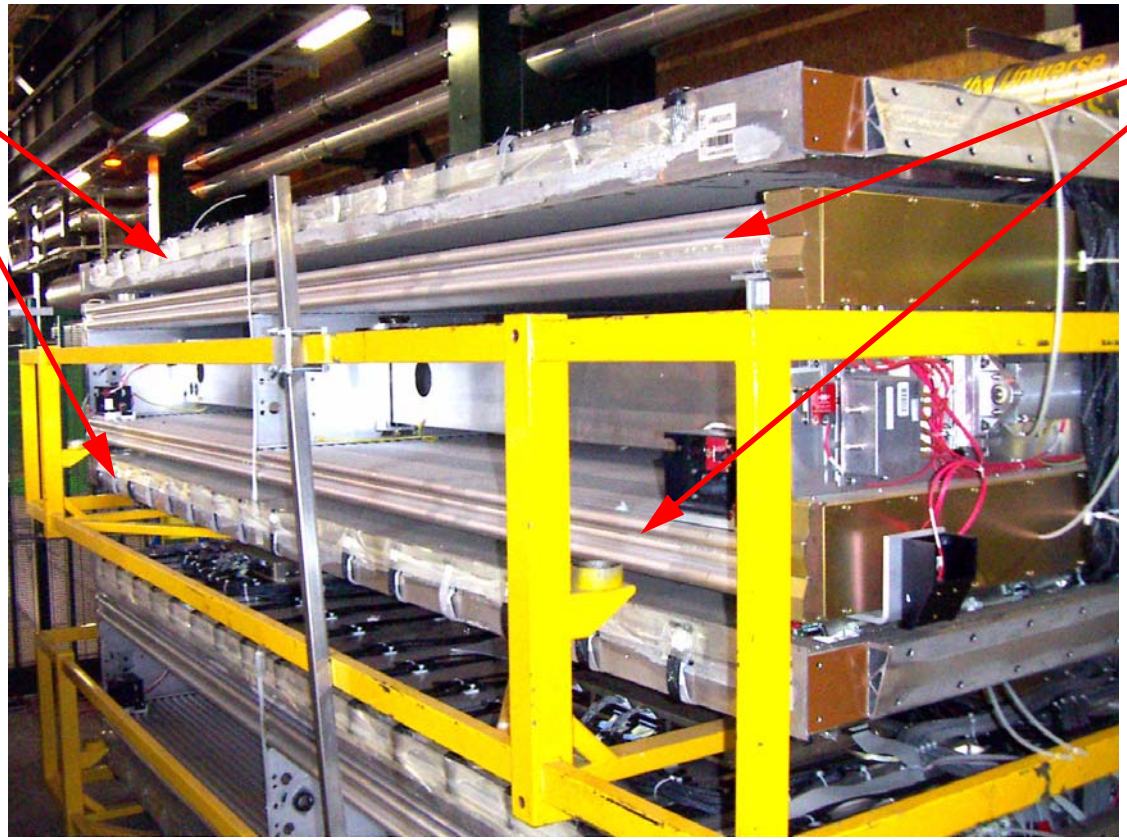


GAS: 94.7% $C_2H_2F_4$+5%C_4H_{10}+0.3%SF_6

Avalanche mode

Time resolution: 1-2 ns

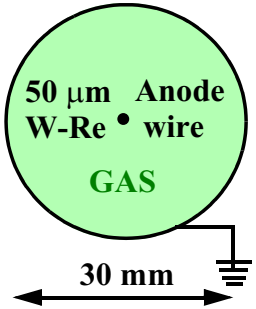
Spatial resolution: 5-10 mm



DRIFT TUBES

1170 chambers
354 000 channels

Alumimium Cathode tube

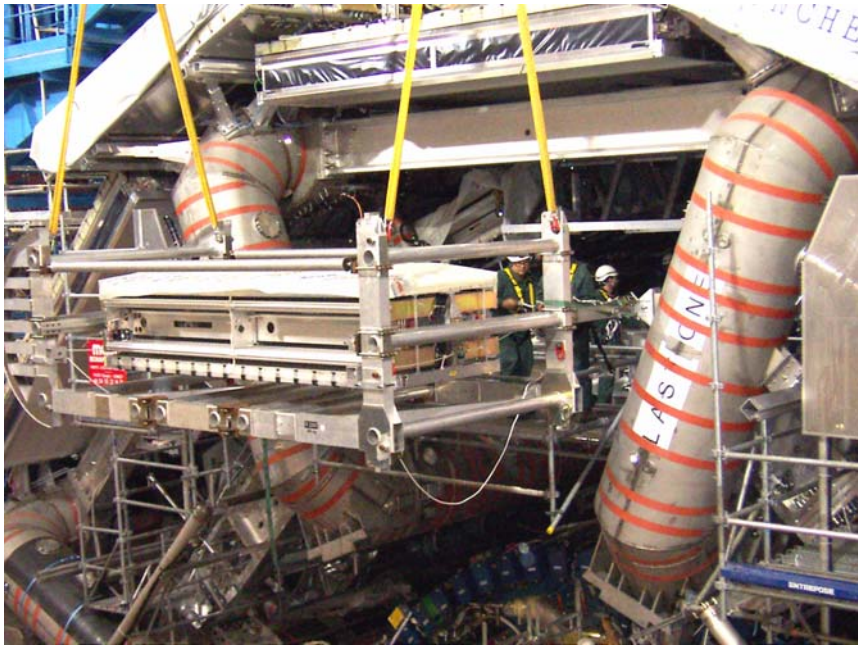


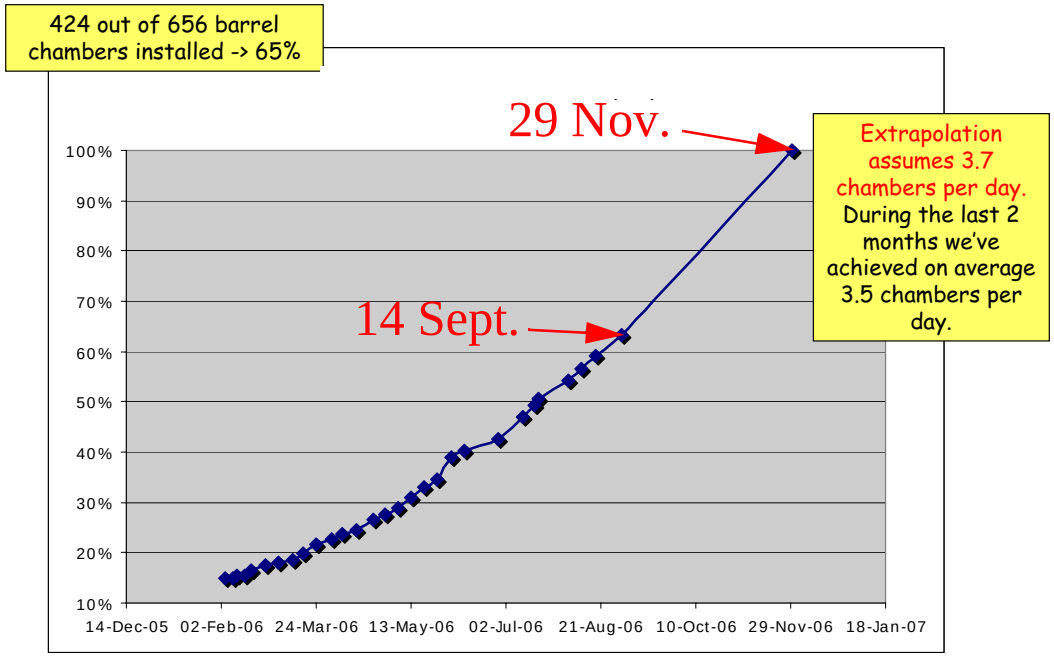
GAS (at 3 bar):
93% Ar + 7% CO_2

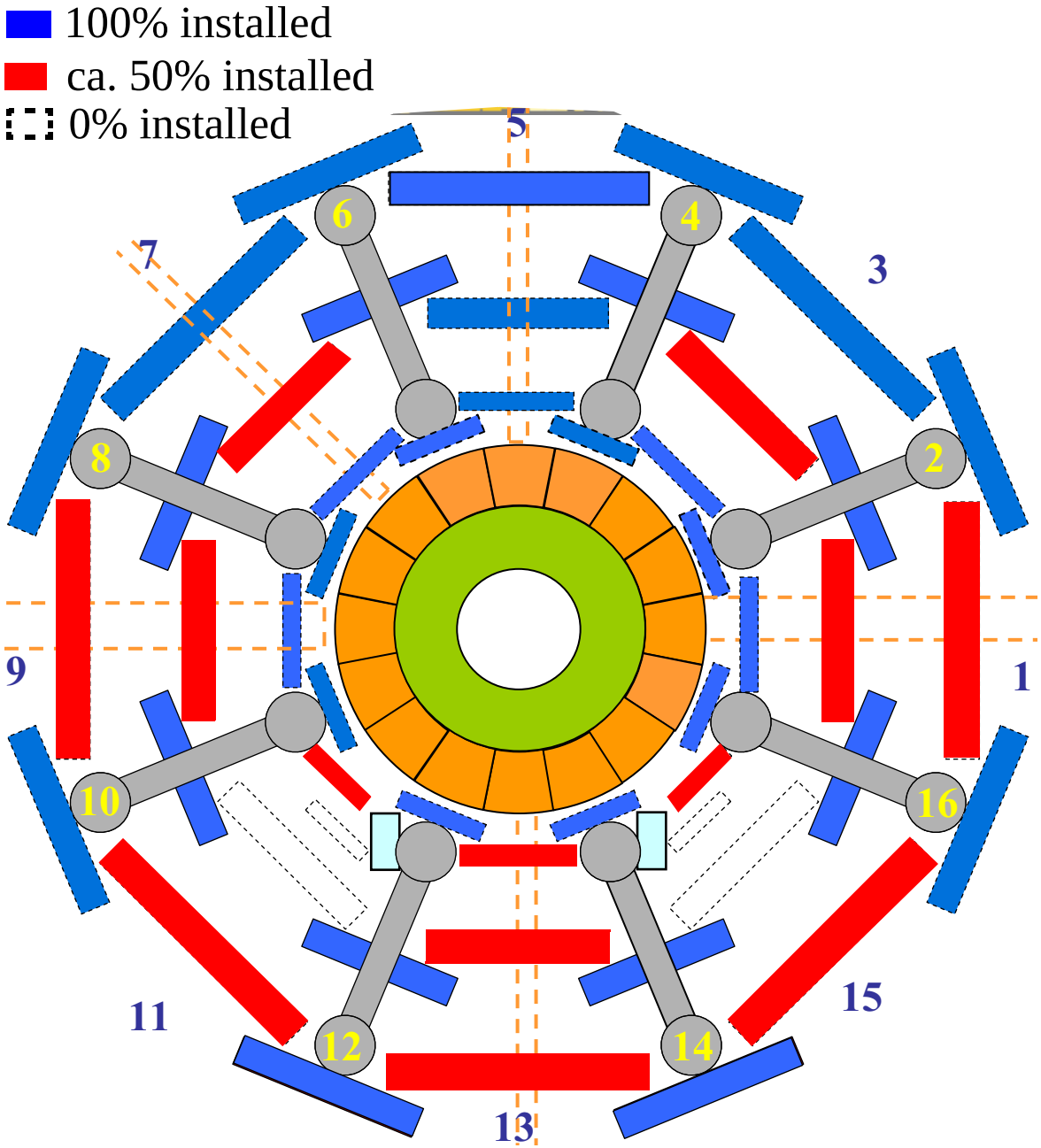
Max drift: 710 ns

Spatial Resolution:
80 μm

The Barrel Muon Installation



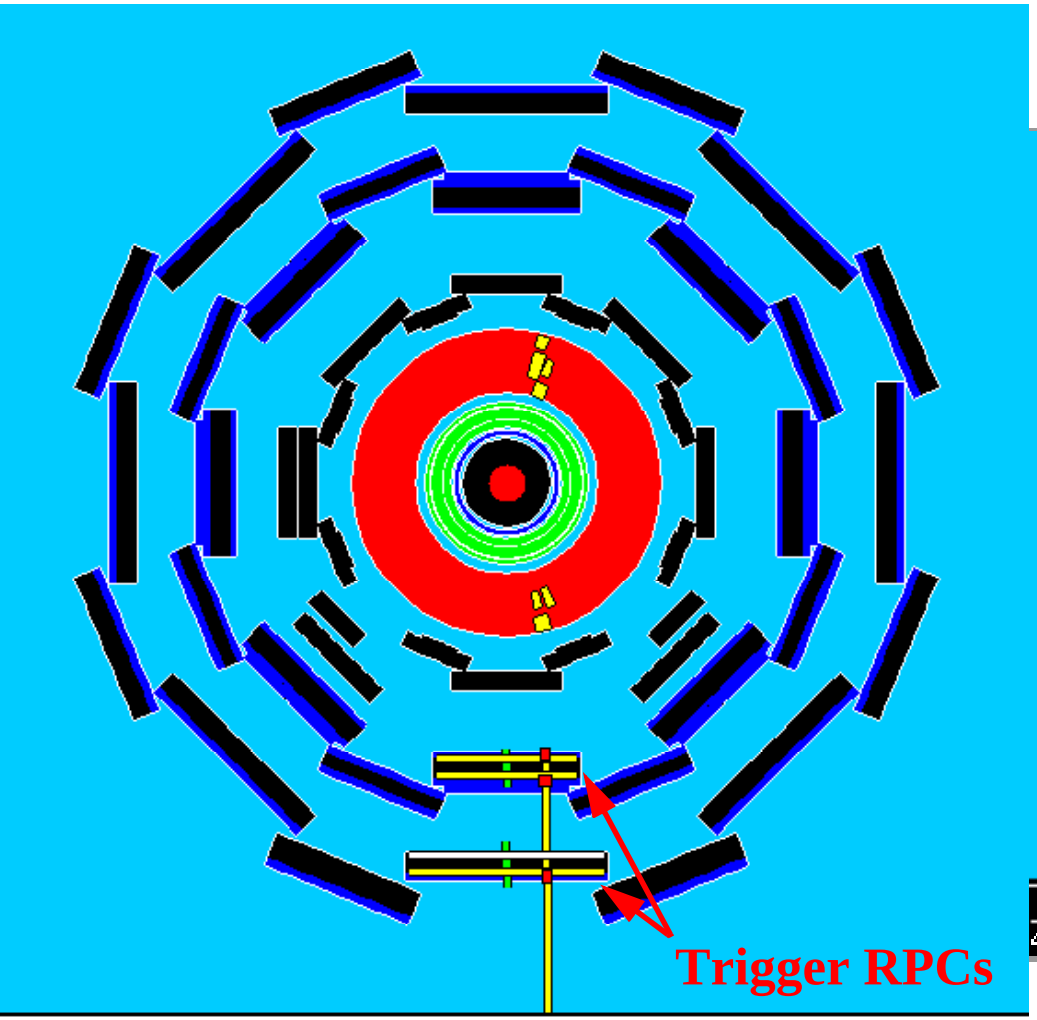


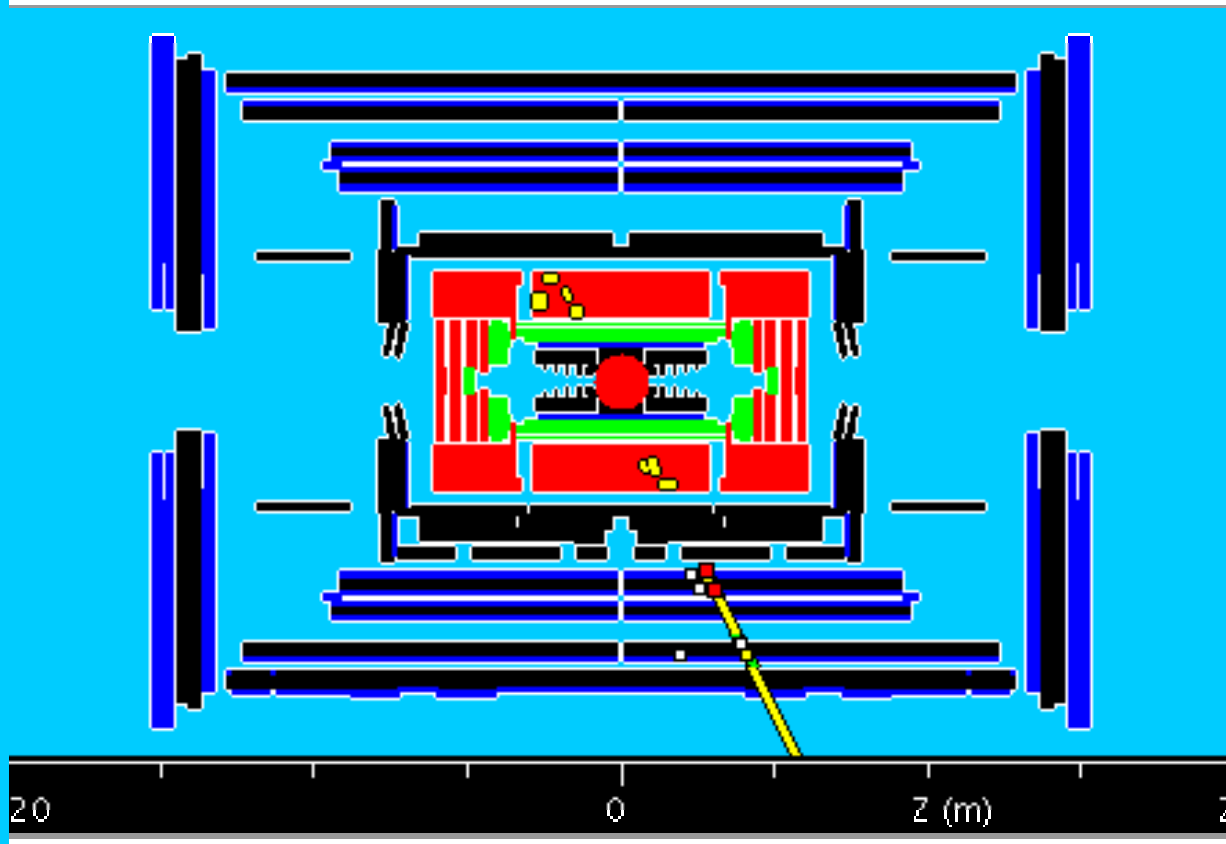


The Barrel Muon Commissioning

The barrel detectors are detecting cosmic muons !

The first combined drift tube + resistive plate chamber + tile calorimeter cosmic run was carried out in August 2006.





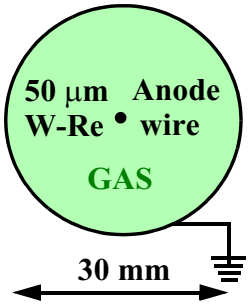
The Forward Muon Chambers

Monitored Drift tubes are used for precision measurements in the forward region.

Thin gap multi-wire chambers are used for triggering in the forward region.

DRIFT TUBES
1170 chambers
354 000 channels

Alumimium Cathode tube

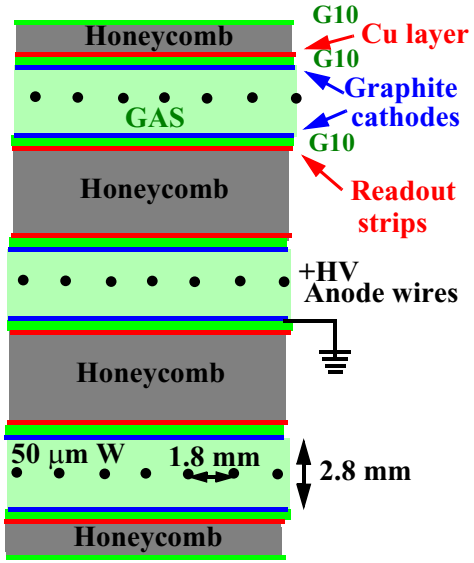


GAS (at 3 bar):
93% Ar + 7% CO_2

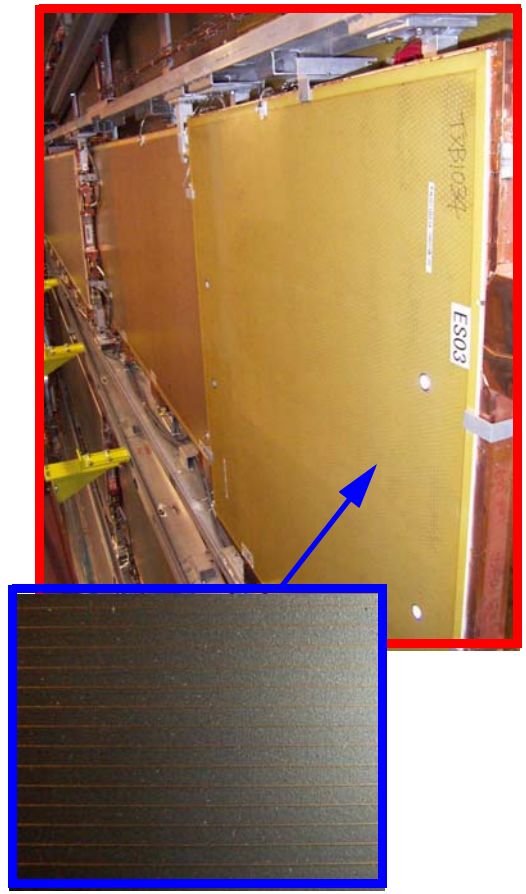
Max drift: 710 ns

Spatial Resolution:
80 μm

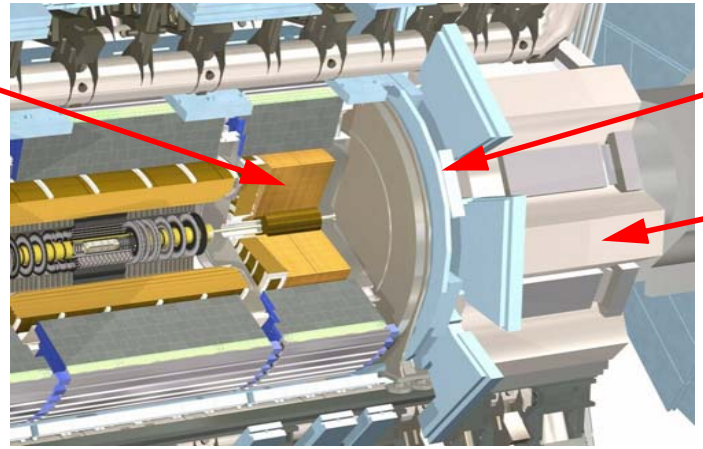
MULTI-WIRE CHAMBERS
1578 chambers
320 000 channels

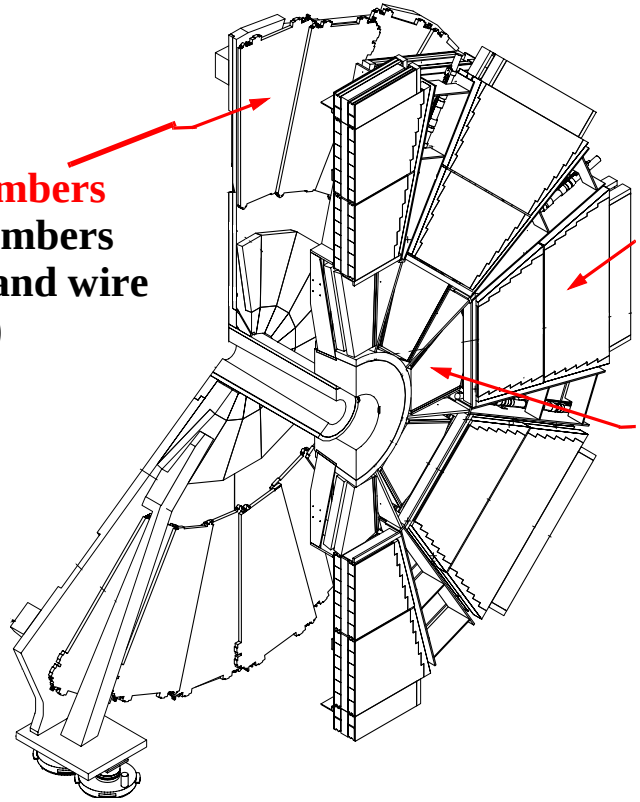


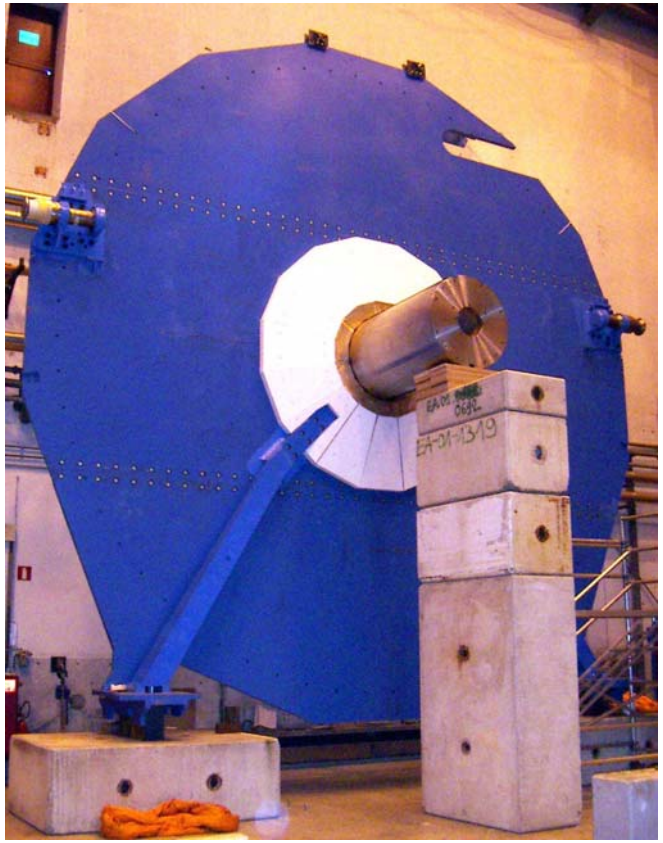
GAS: 55% CO_2 + 45% n-Pentane
Saturated mode



The Inner Forward Muon station

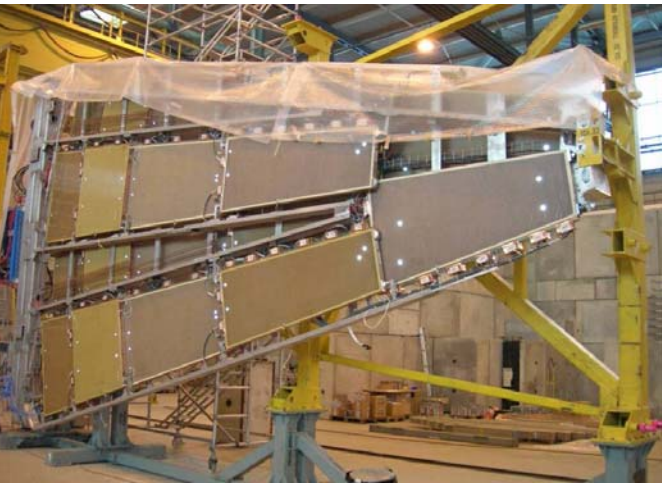




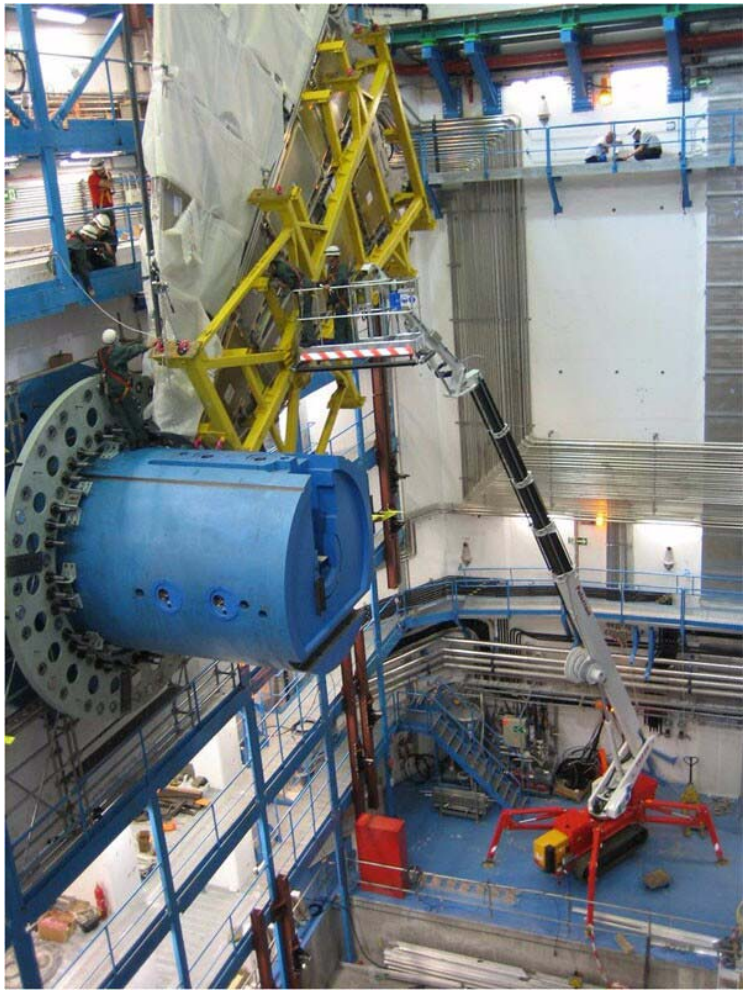


One of the two mechanical supports/shields have been assembled. The installation is planned for June-July 2007.

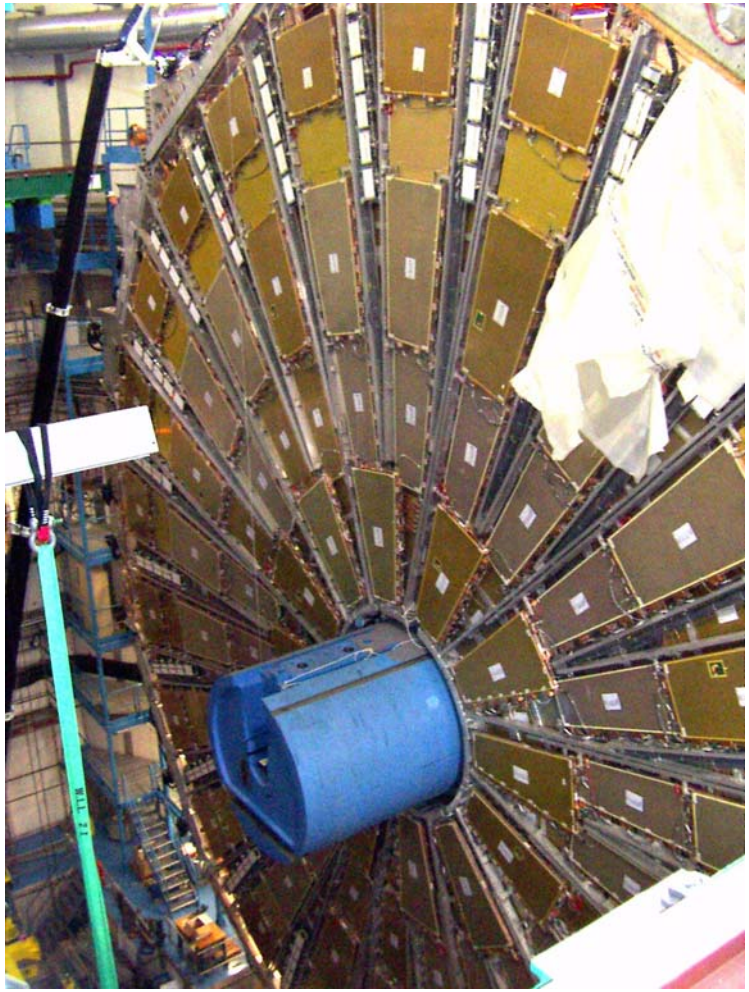
The Middle Forward Muon station



TGC sectors (top) and MDT sectors (bottom) are being assembled at present.

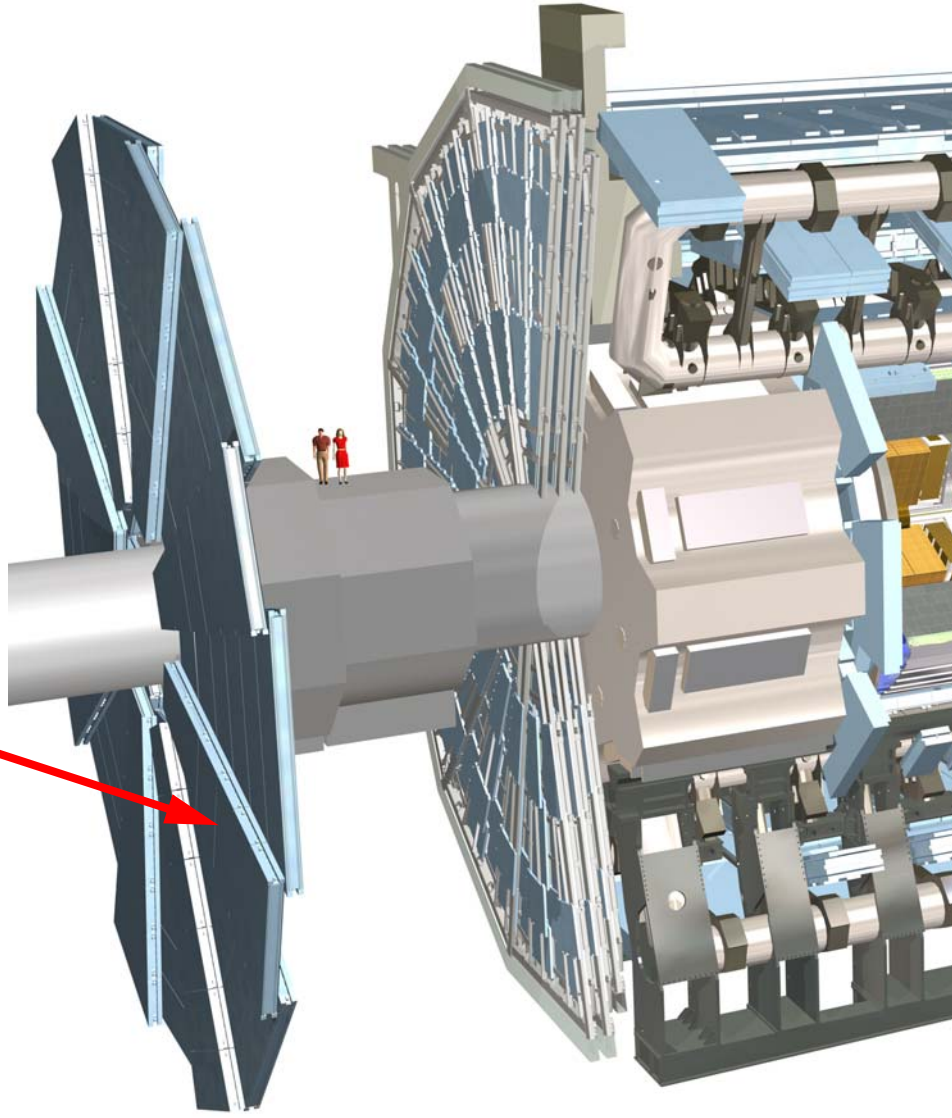


They are then installed in the ATLAS cavern.



One complete plane of detectors (out of 8) has been installed.

The Outer Forward Muon station



The chambers for the outer forward muon stations are all at CERN but still in their boxes.

According to the planning they will be the last detectors to be installed in Sept. - Oct. 2007.

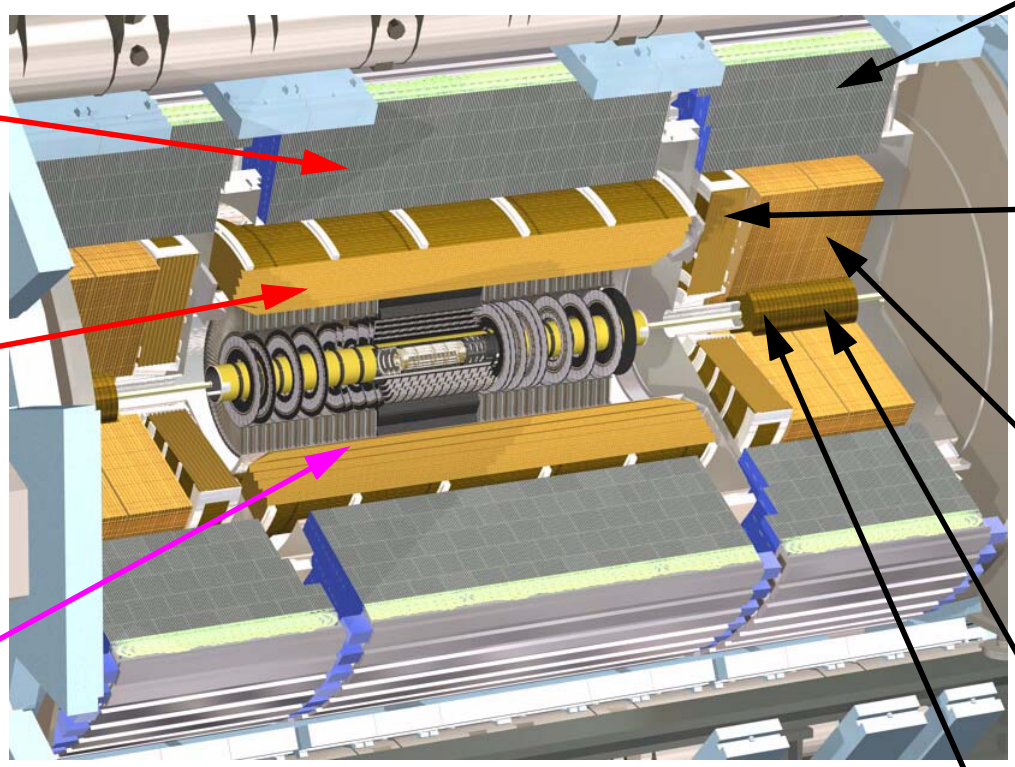
The Calorimeters

Barrel

Hadronic Tile Calorimeter
Flat iron absorbers
Scintillator tiles

EM Liquid Argon calorimeter
Accordion lead absorbers
Liquid Argon

The Solenoid



Endcap

Hadronic Tile Calorimeter
Flat iron absorbers
Scintillator tiles

EM Liquid Argon calorimeter
Accordion lead absorbers
Liquid Argon

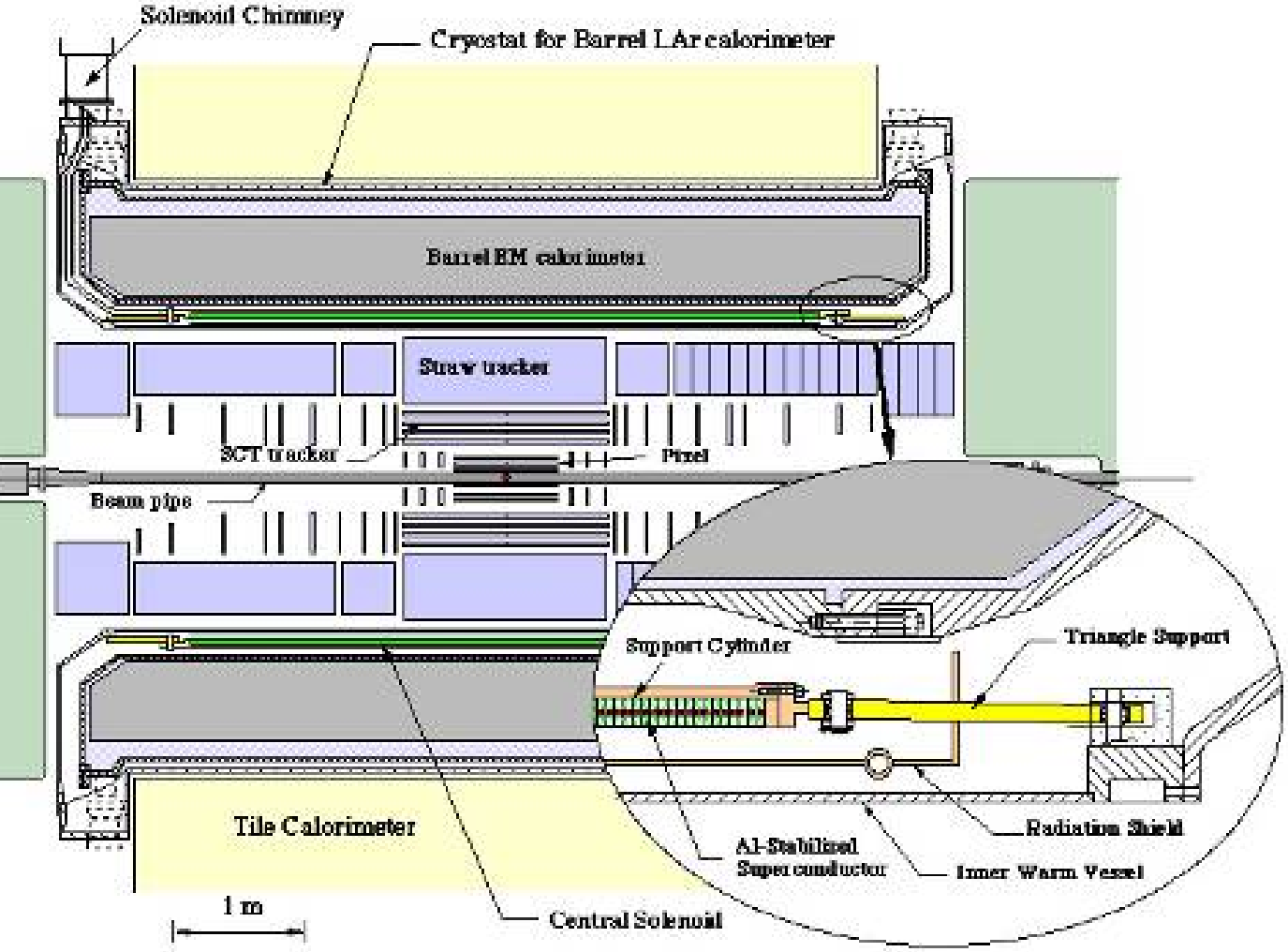
Hadronic Liquid Argon calor.
Flat copper absorbers
Liquid Argon

Forward had. LAr calorimeter
Tungsten absorbers with rods
Liquid Argon

Forward LAr EM calorimeter
Copper absorbers with rods
Liquid Argon

The Solenoid

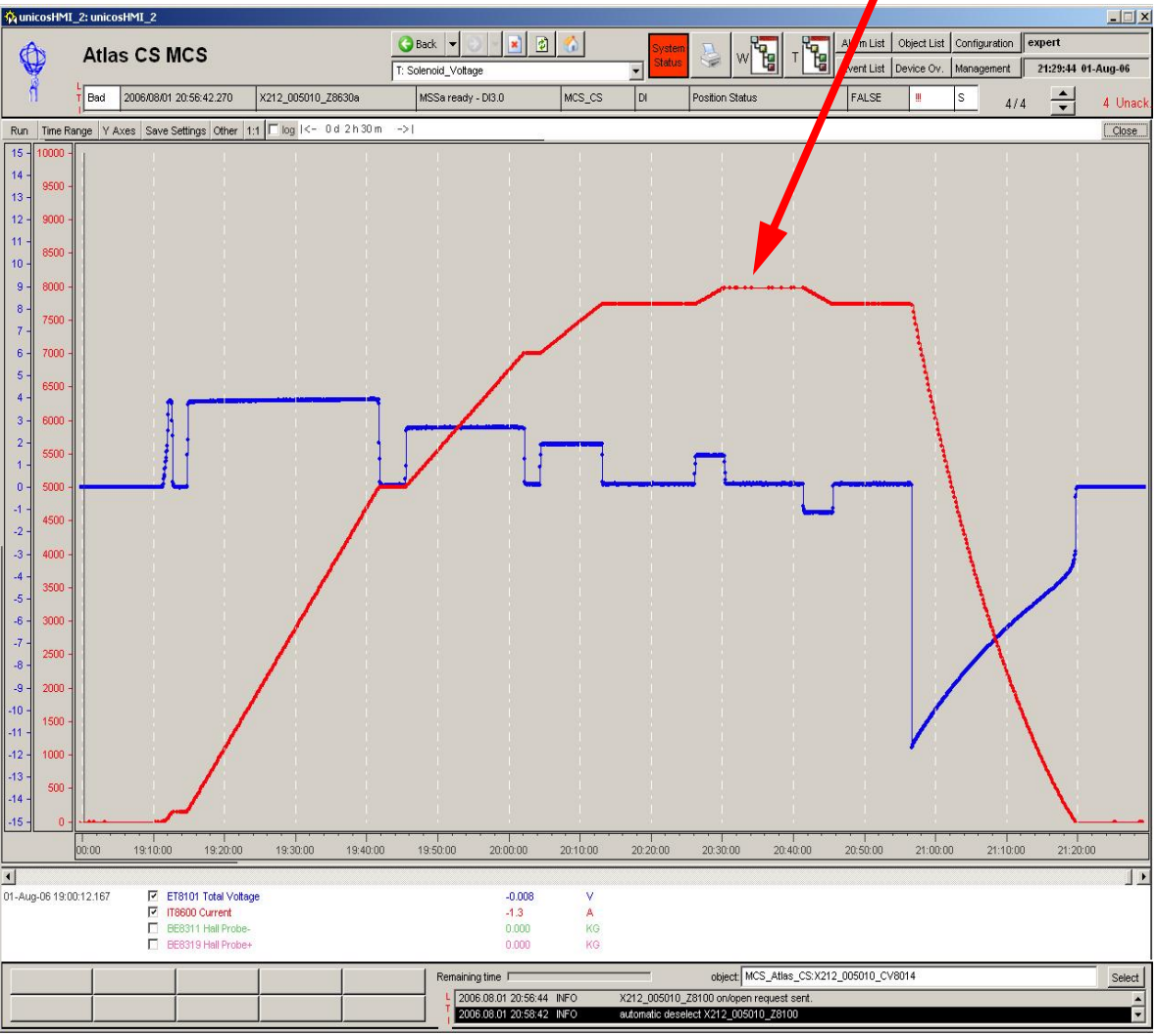
The solenoid is made of 1154 turns of superconducting niobium-titanium strands set in an alumnium plated copper matrix. It shares the cryostat with the liquid argon calorimeter. It provides a field of 2.0 Tesla at 7730 amperes.

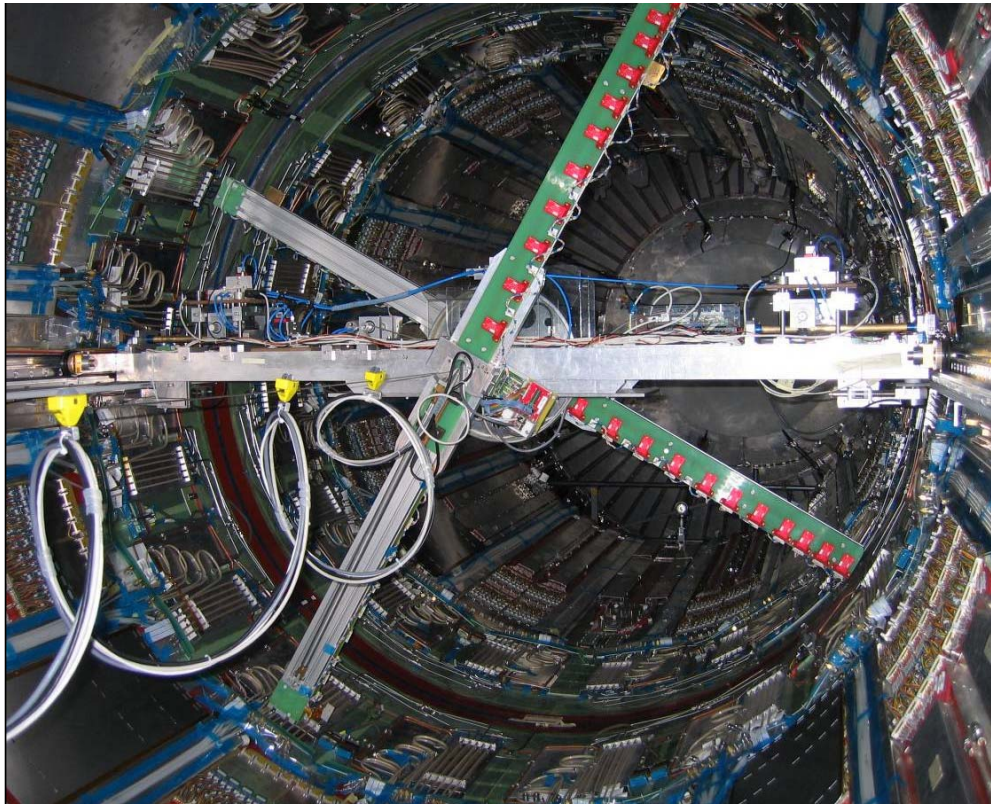


Commissioning of the Solenoid

The solenoid has been commissioned to 8 kA in ATLAS during August 2006.

The field has then been mapped in 250,000 points using a machine with 48 Hall probes.

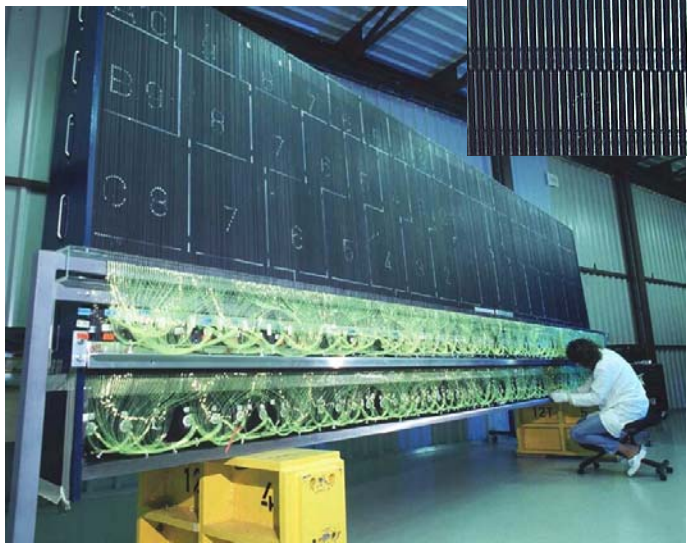




The Calorimeters

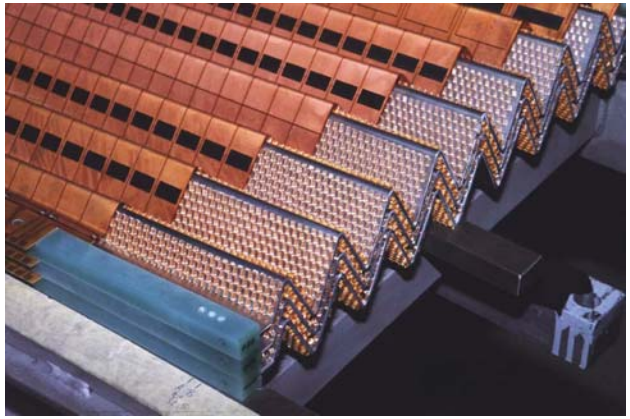
Hadronic Tile Calorimeter

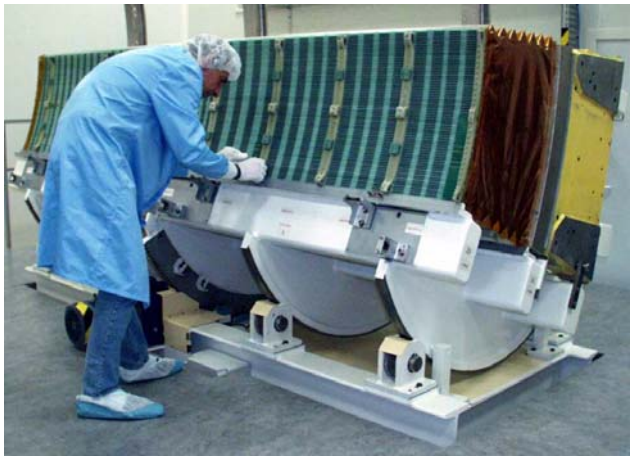
Flat iron absorbers
500,000 Scintillator tiles



EM Liquid Argon calorimeter

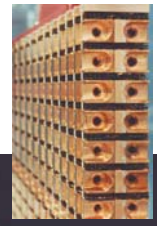
Accordion lead absorbers
Liquid Argon

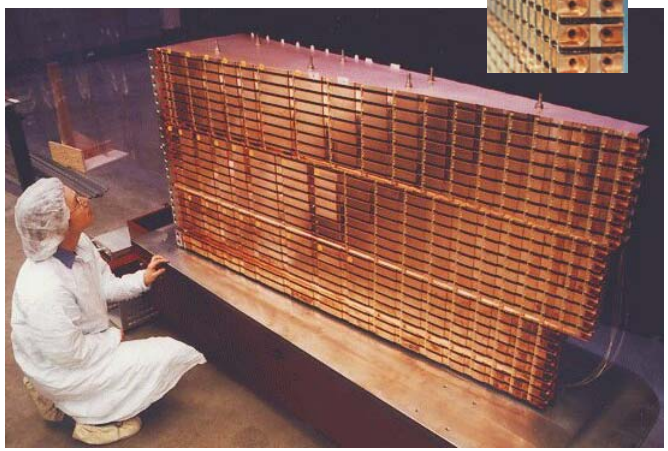


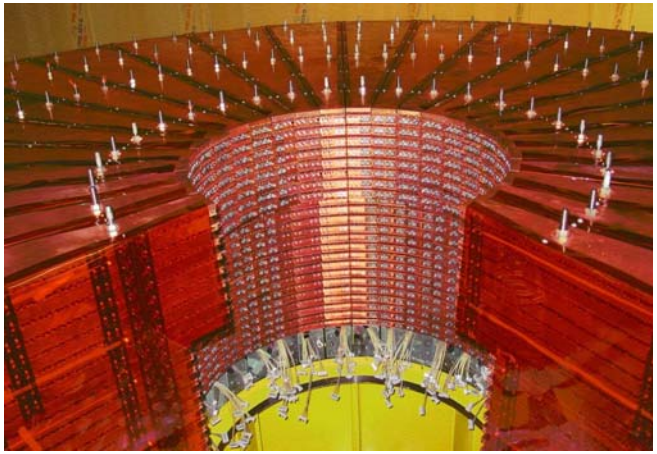


Hadronic Liquid Argon calor.

Flat copper absorbers
Liquid Argon





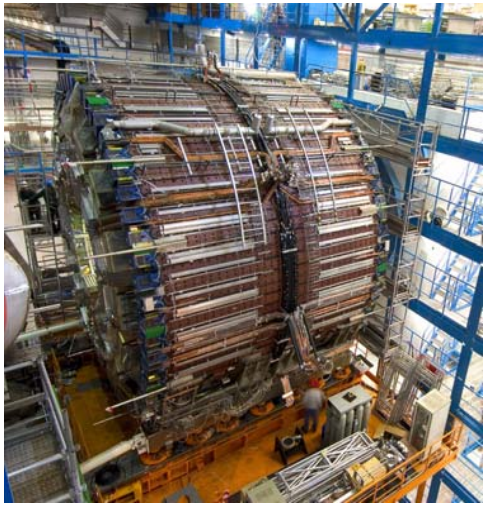


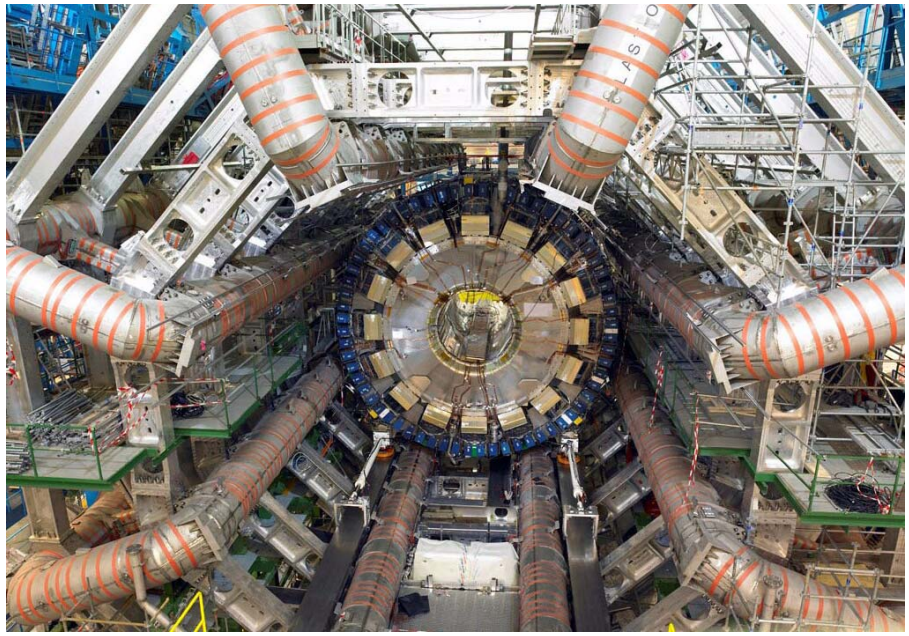
Installation of the Calorimeters

Barrel

The barrel LAr and Tile calorimeters have been installed since January 2005.

Cooldown:
May 2006

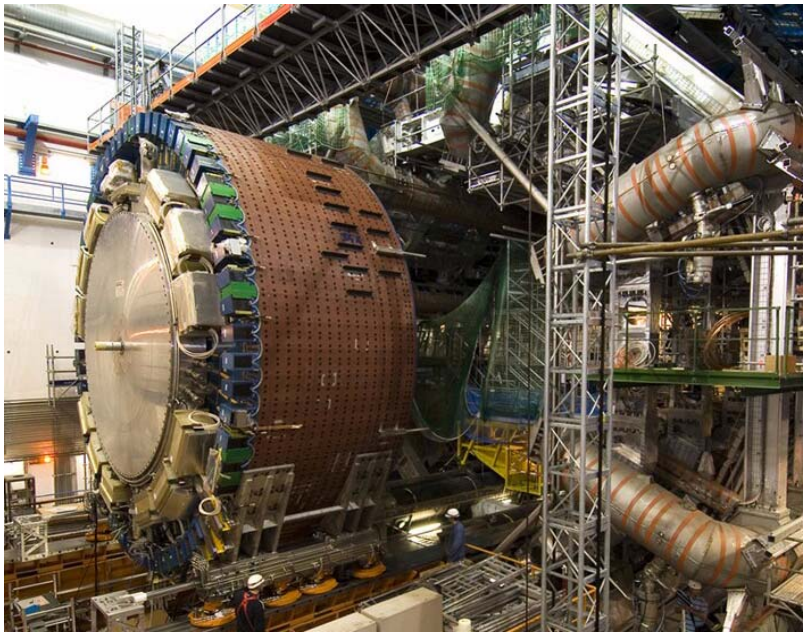




Endcaps

The two endcap calorimeters was assembled in the cavern during the spring of 2006.

Cooldown:
Nov. 2006
Feb. 2007



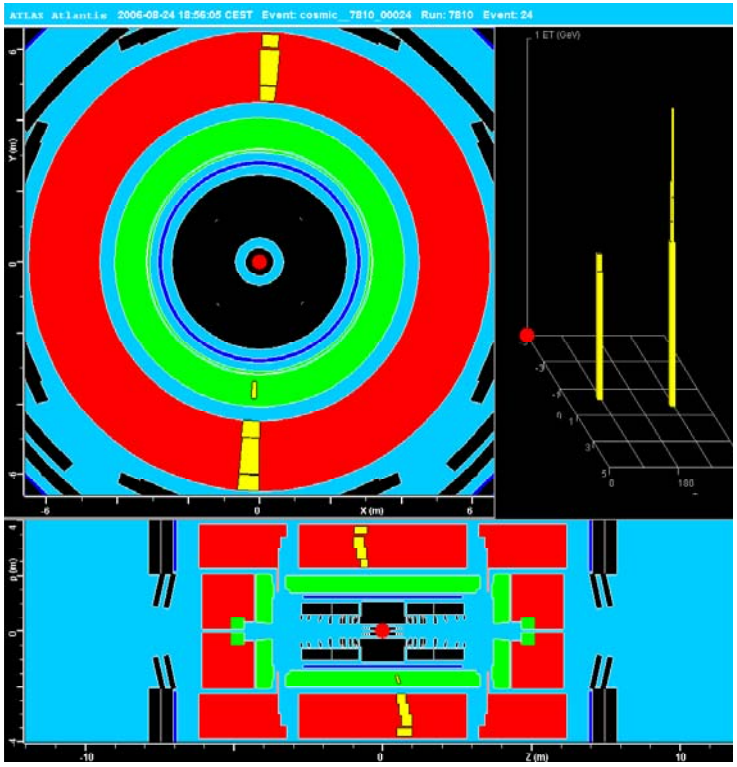
Commissioning of the barrel calorimeters

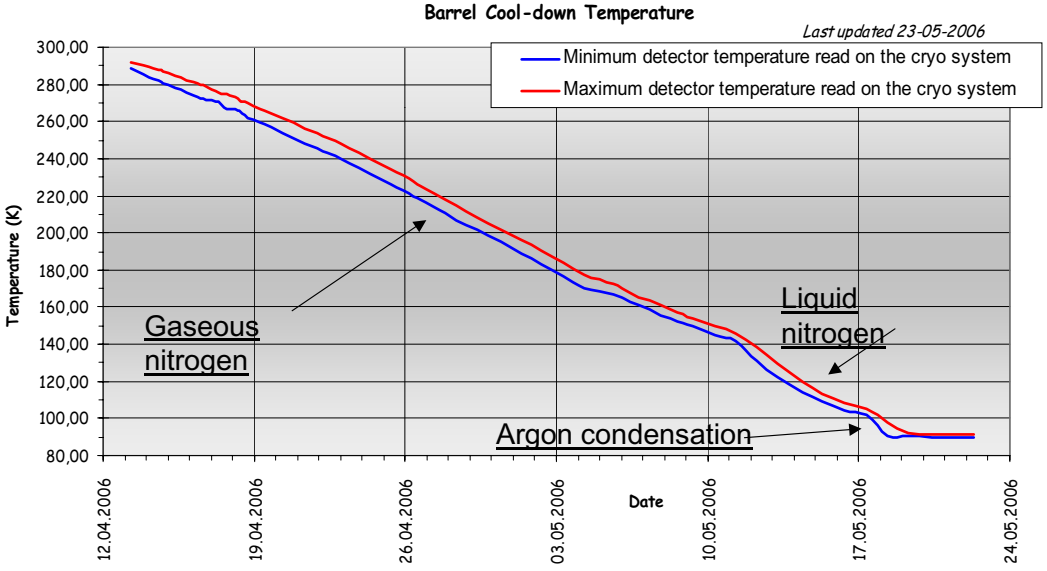
The liquid argon calorimeter was cooled down in April-May 2006.

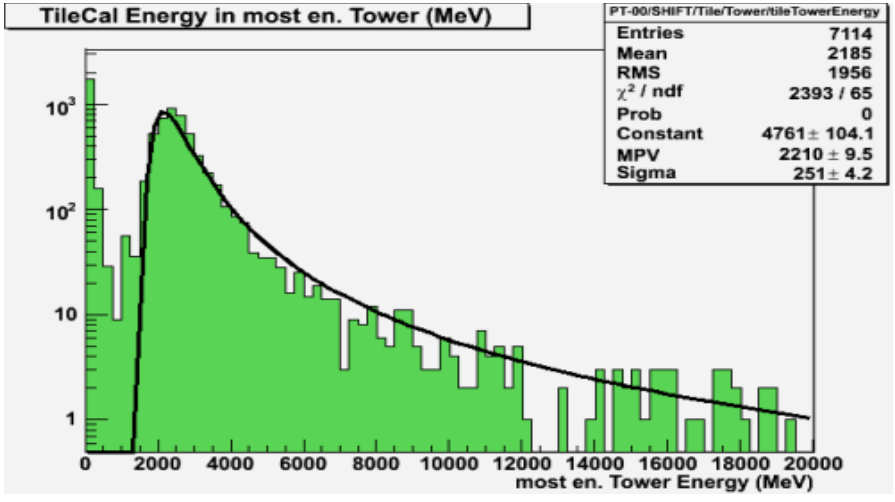
The installation of front- and back-end electronics is proceeding well but problems with some low and high voltage supplies.

HV shorts found in a couple of sectors.

The first combined LAr + Tile calorimeter cosmic run took place in August.

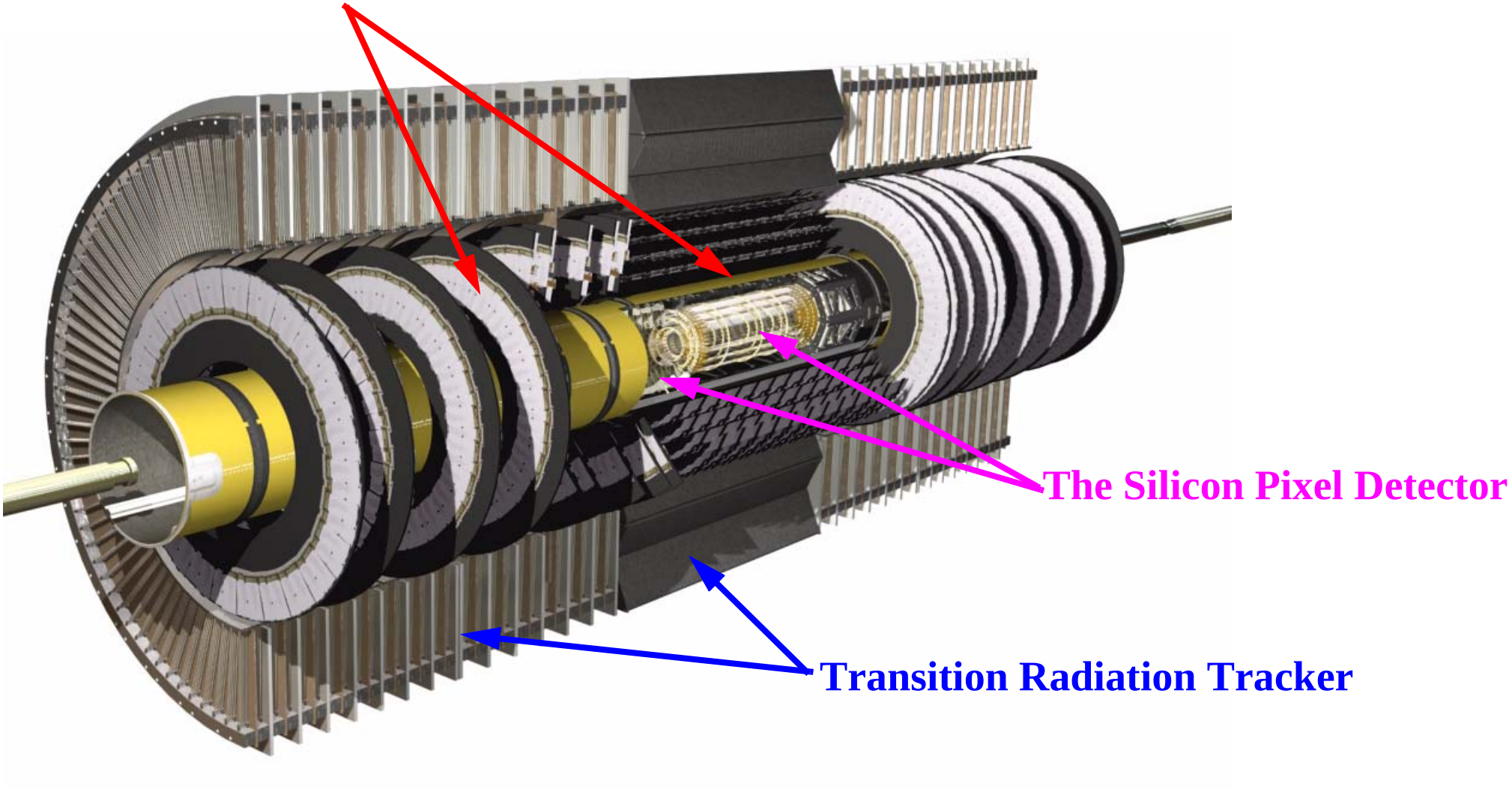






The Inner Detector

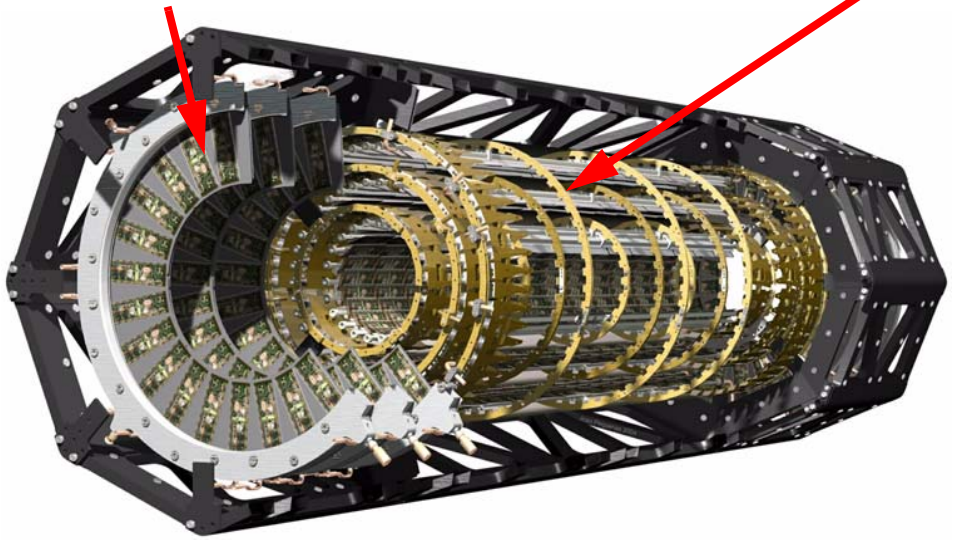
The Silicon Strip Detector
(The SemiConductor Tracker)



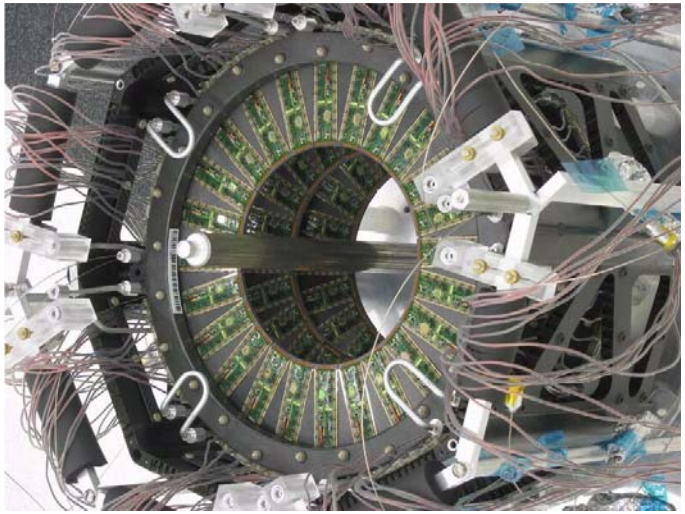
The Pixel Detector

The pixel detector contains 80 million pixels with the size 50 x 400 μm.

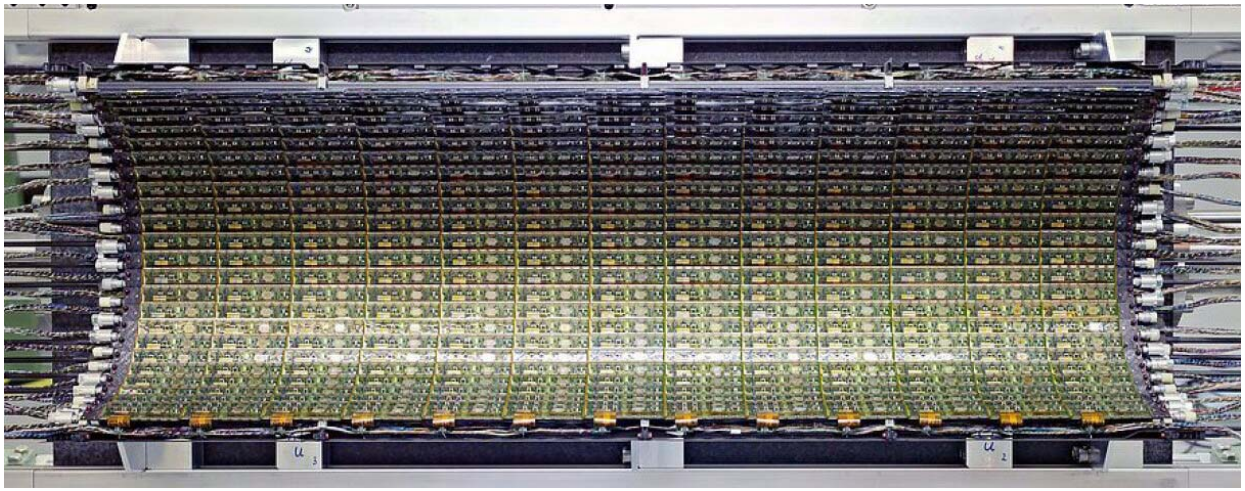
The 1744 modules (each with 46080 pixels) are arranged in three barrel layer and three disks in each endcap.



The support tube

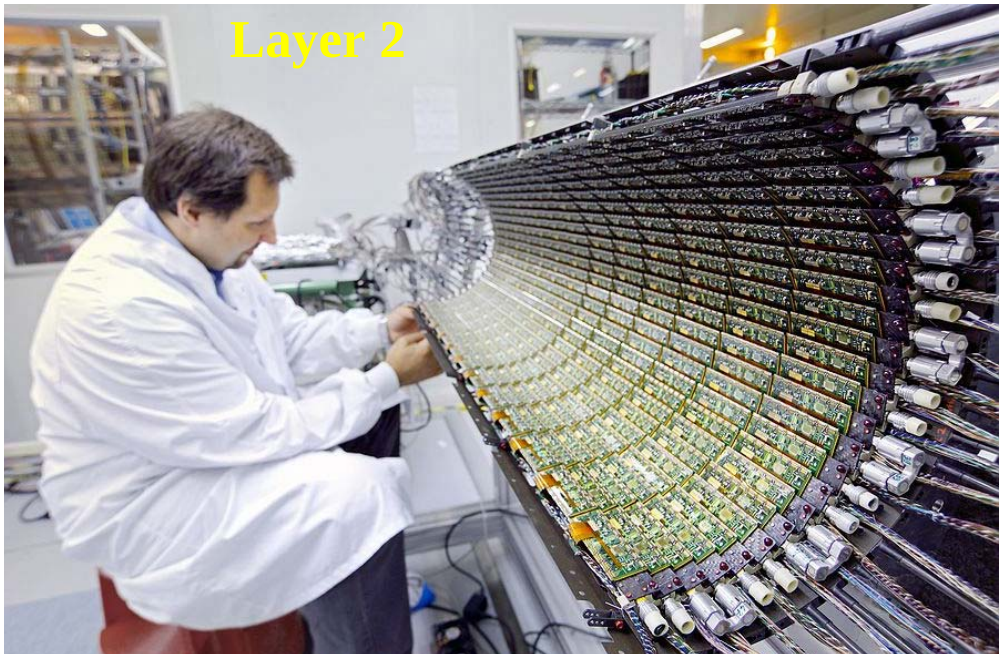


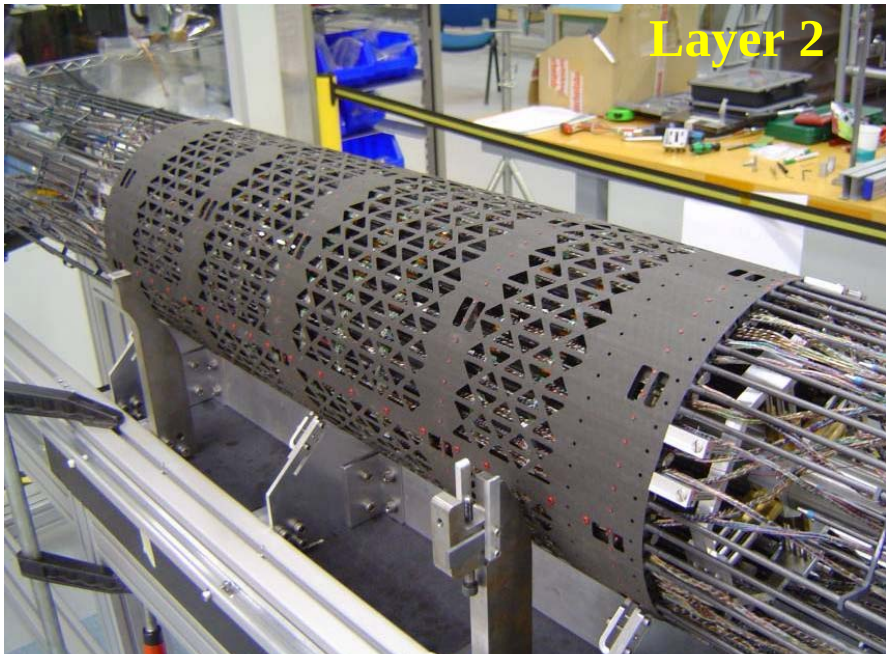
The endcap detector



The barrel detector

The Pixel Detector status





Barrel

All modules have been delivered with a good yield.

Layer 2 has been fully integrated and the work is now with layer 1.

Problems with cooling pipes and broken cables have resulted in delays but installation is still foreseen for April 2007.

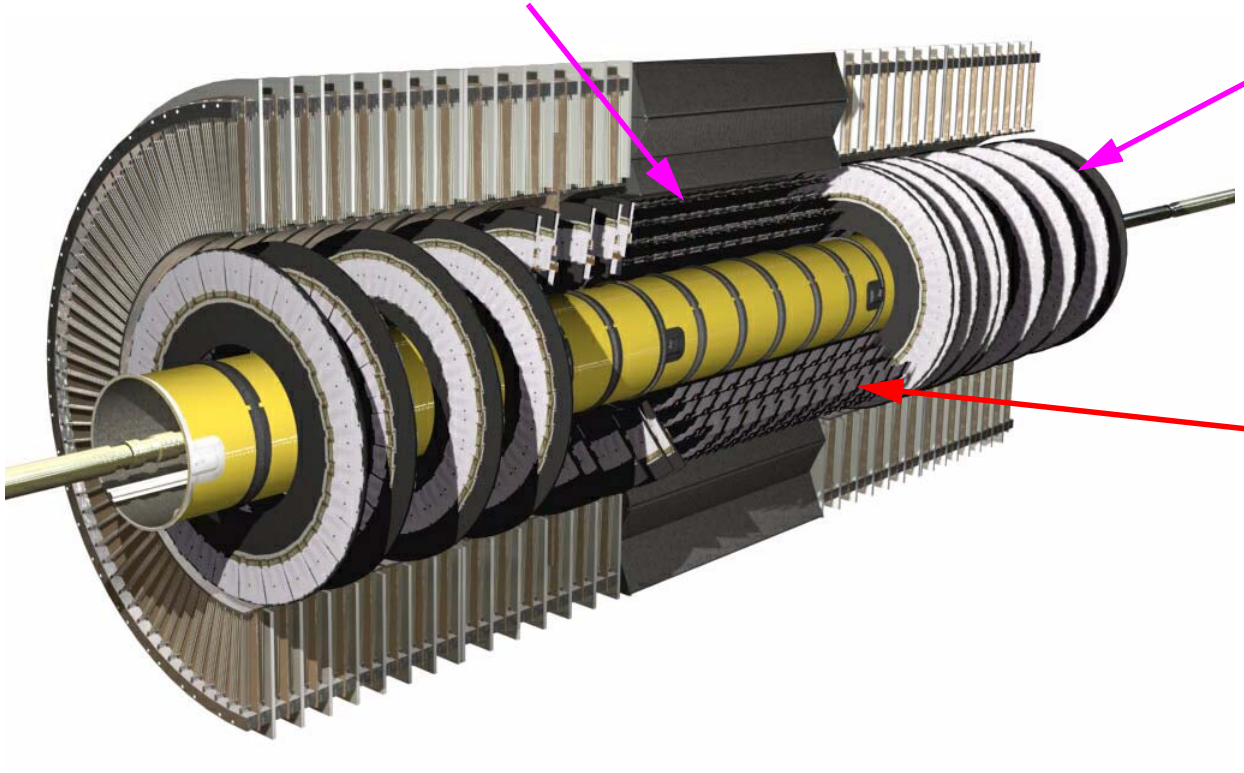
Endcaps

Both endcap detectors have been integrated, delivered to CERN and acceptance tested.

One detector will be tested with cosmics from October onwards.

The Silicon Strip Detector

There are 4 layers of modules in the barrel and 9 disks in each endcap.



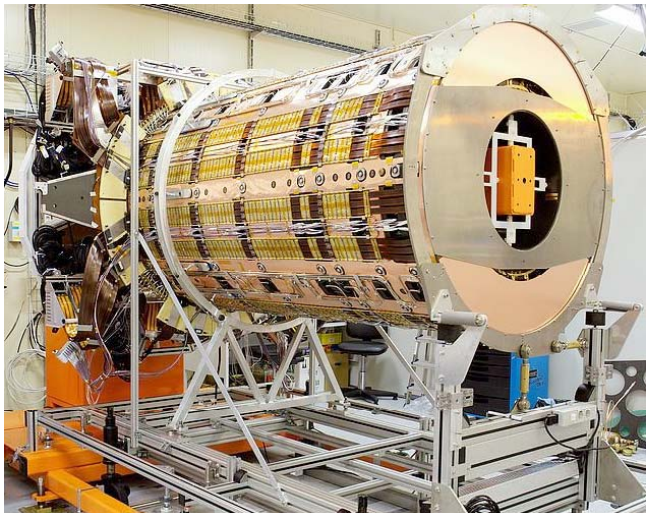
The semiconductor tracker consists of 4088 modules with 2 x 63 mm long strips with a pitch of 80 μm in the barrel and 55-95 μm in the forward disks.

Each module has 768 single sided p-on-n strips glued back to back to another 768 strips with a 40 mrad stereo angle.

The detector has 6.3 million channels and a silicon area of 61 m^2.

Status of the Silicon Strip Detector

Endcap A

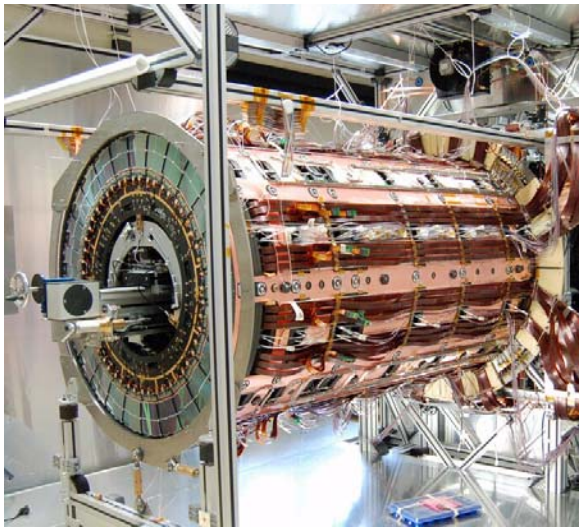


Work on the thermal enclosures. Integration with the Transition Radiation Tracker is planned to start in November.

Barrel

The barrel has already been integrated with the Transition Radiation Tracker and installed in ATLAS.

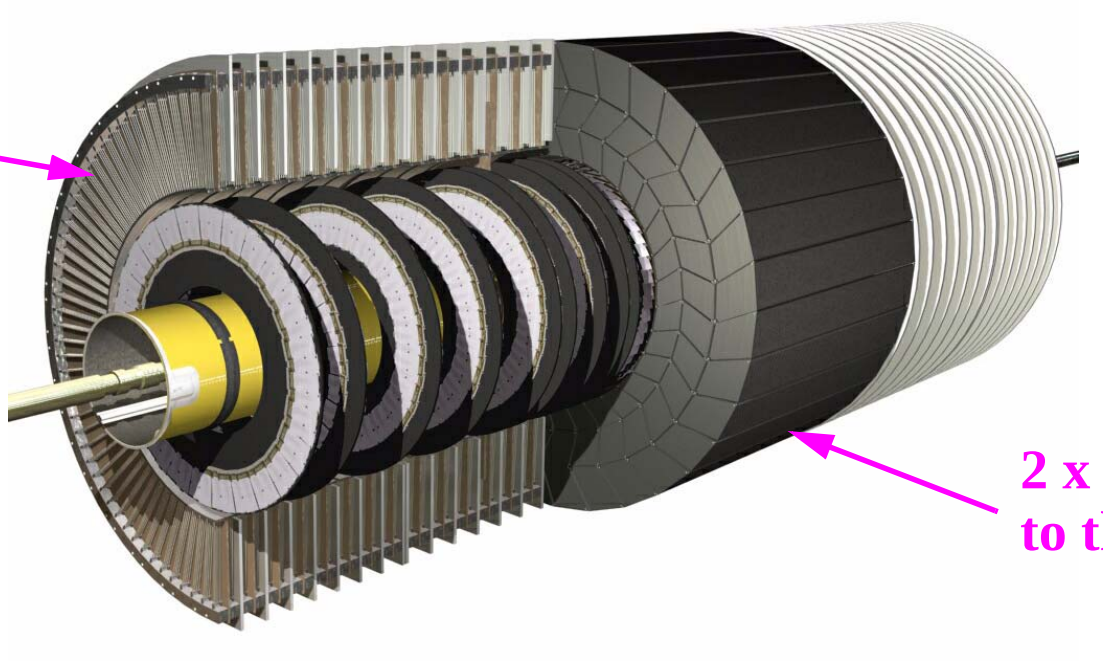
Endcap C



In the process of being integrated with the Transition Radiation Tracker after all tests on the sub-assemblies.

The Transition Radiation Tracker

420,000 radially distributed straws in the endcaps.



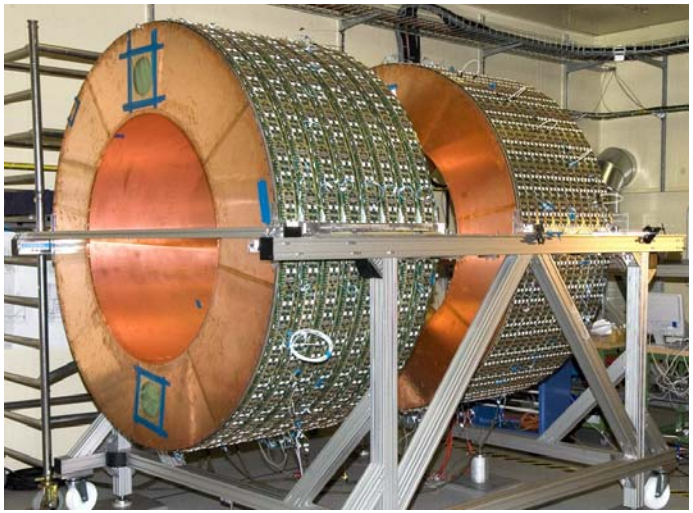
2 x 53,000 straws parallel to the beam in the barrel.

The 4 mm diameter straws are made of kapton with a conductive coating and filled with a Xenon gas.

In the middle of each straw is a 30 μm gold-plated tungsten wire.

15 polypropylene radiators between the straws makes it possible to use the straws both as drift tubes for tracking and for electron identification.

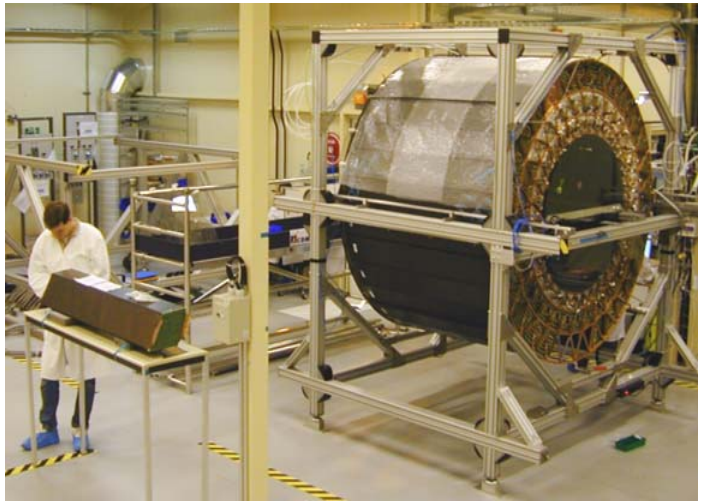
Status of the TRT

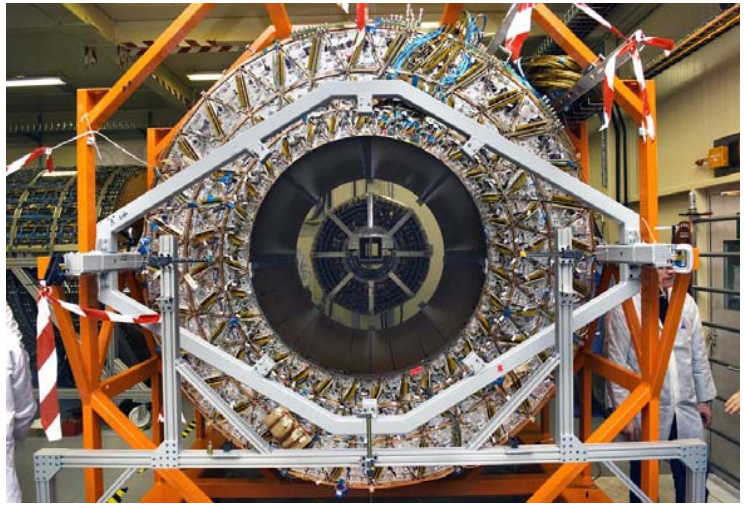


Endcaps

Side A: **Assembled and tested (0.3% dead channels).**

Side C: **Assembled and tested (0.5% dead channels).**





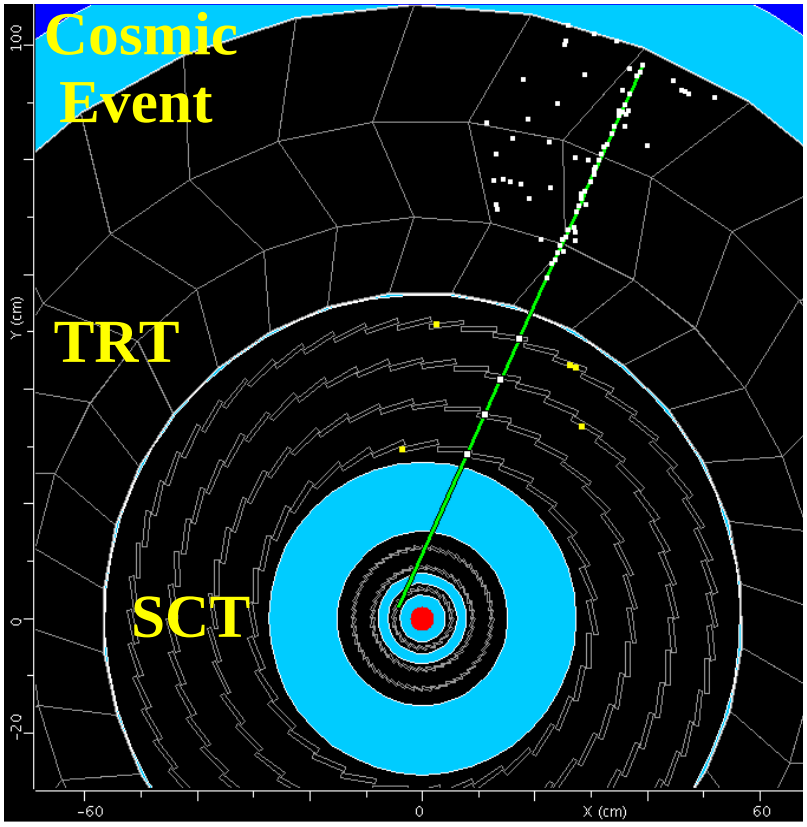
Barrel

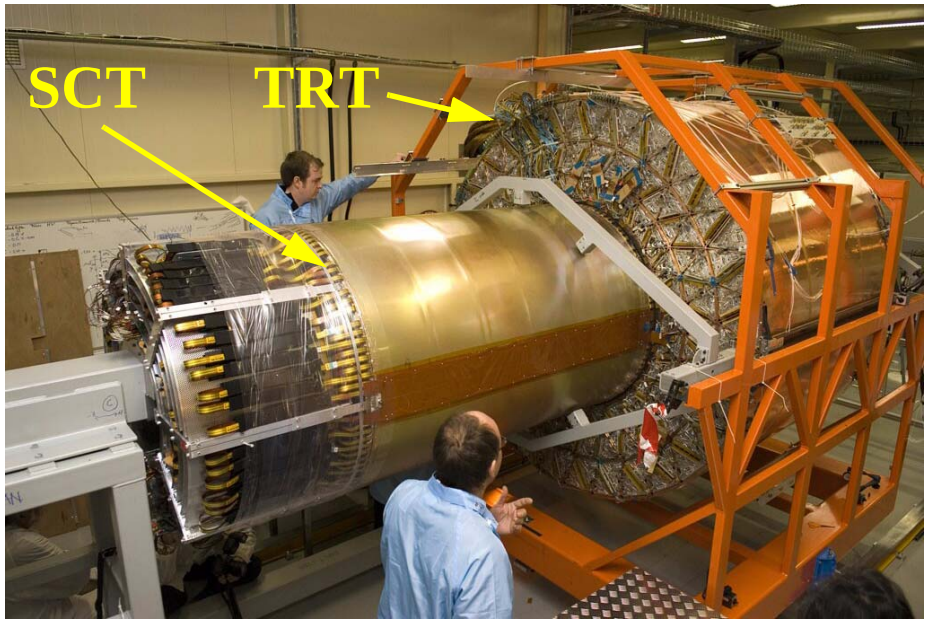
Assembled, tested and integrated with the SCT. Installed in ATLAS.

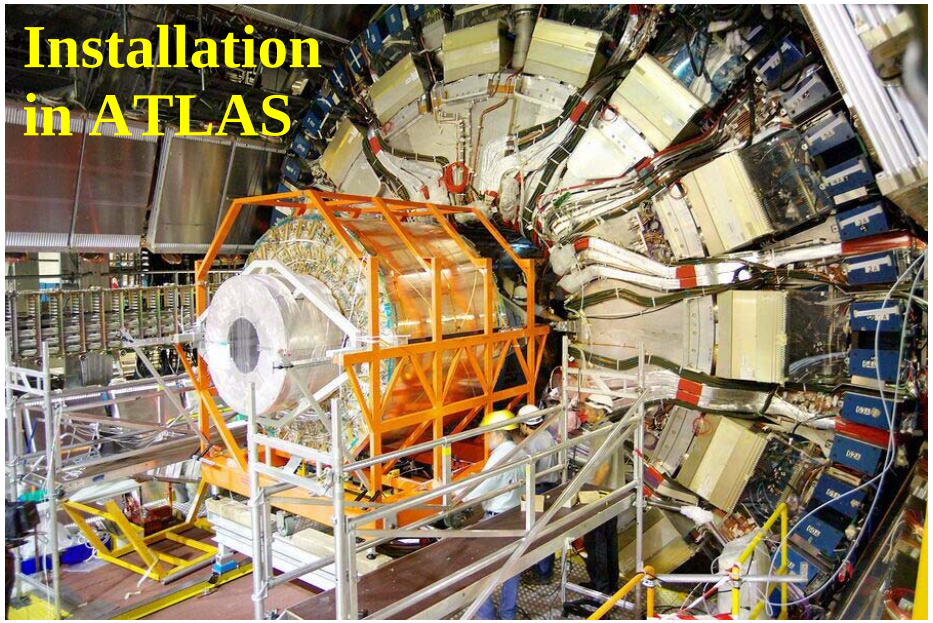
Inner Detector Barrel Installation

450k cosmic events with 1/8 TRT + 1/4 SCT and full readout gave information about dead channels (0.2% SCT & 1.5% TRT), noise, cross talk, alignment, resolution etc.

SCT tracking efficiency > 99%

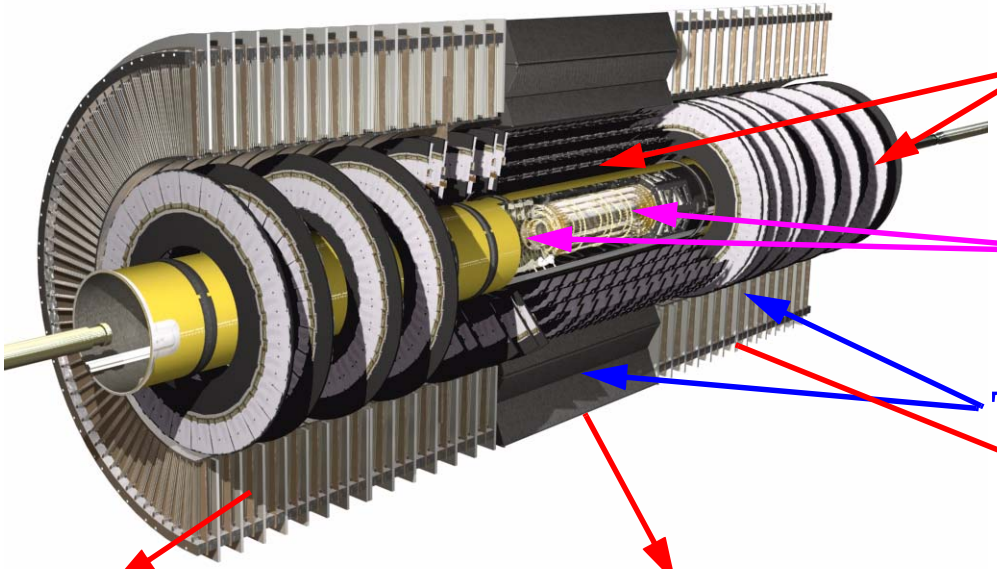






The barrel TRT and SCT detectors have now been fully assembled and installed in ATLAS.

Inner Detector status



	ENDCAP A	BARREL	ENDCAP C
PIXELS:	The detector is assembled and is being tested.	The assembly of the detector is underway. Problems with cooling pipes and broken cables have resulted in delays. Installation scheduled for April.	The detector is assembled and is being tested.
SI STRIPS: **TRT:**	The SCT and TRT detectors are ready and being tested. First integration, then installation in Jan.	Installed in ATLAS.	The SCT and TRT detectors are ready and being tested. Integration under way. Installation in Dec.

Conclusions

The experiment is well on its way to be ready in 2007 but there are critical issues. The main ones being:

The construction and testing of the endcap toroids.

The assembly and installation of the forward muon stations.

The delivery of Low- and High-voltage supplies for the calorimeters.

The inner detector schedule is very tight (no float left).

Many parts of the experiment has already recorded cosmic muon events and we are looking forward to record collisions at the end of 2007 !