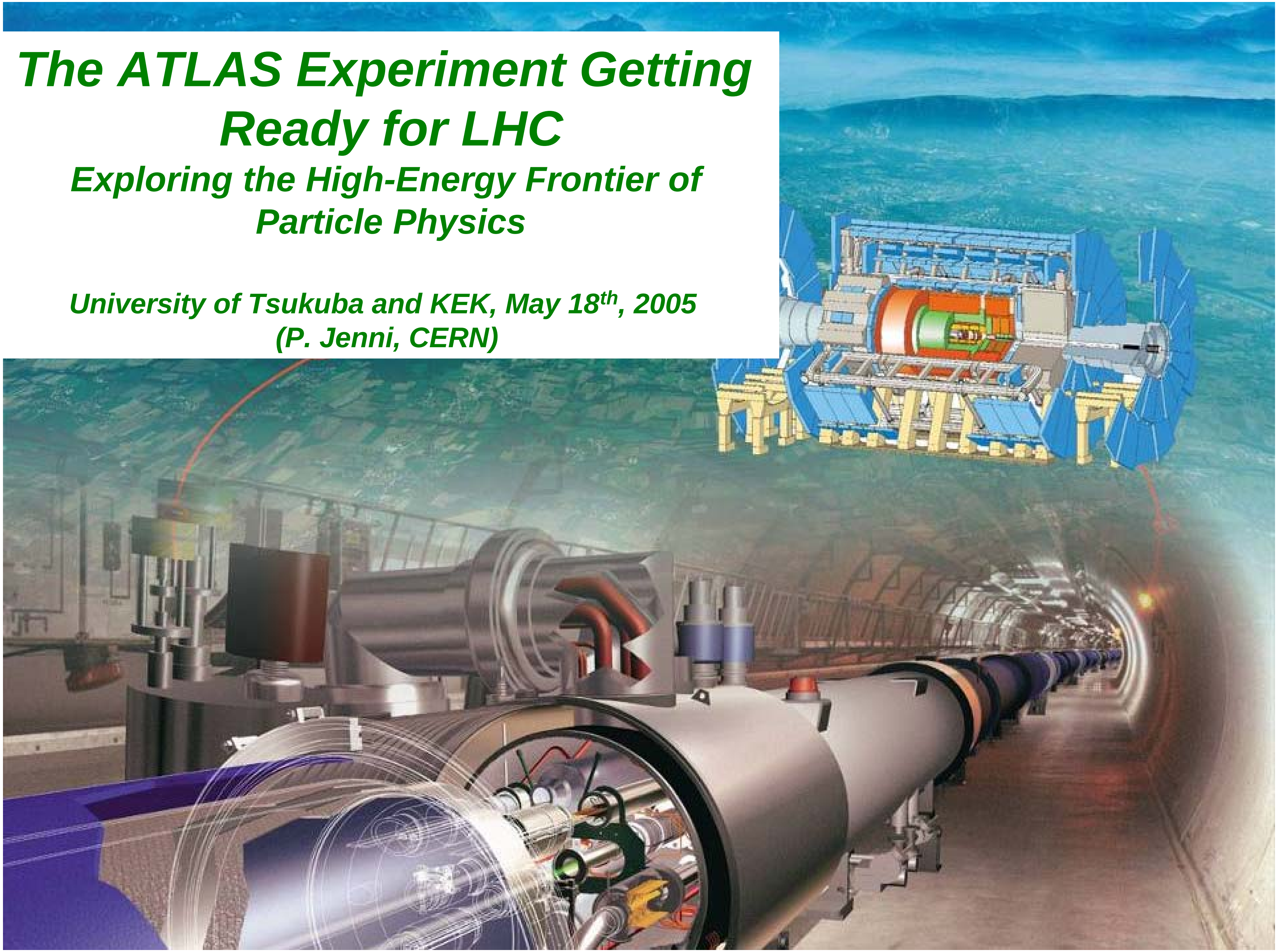
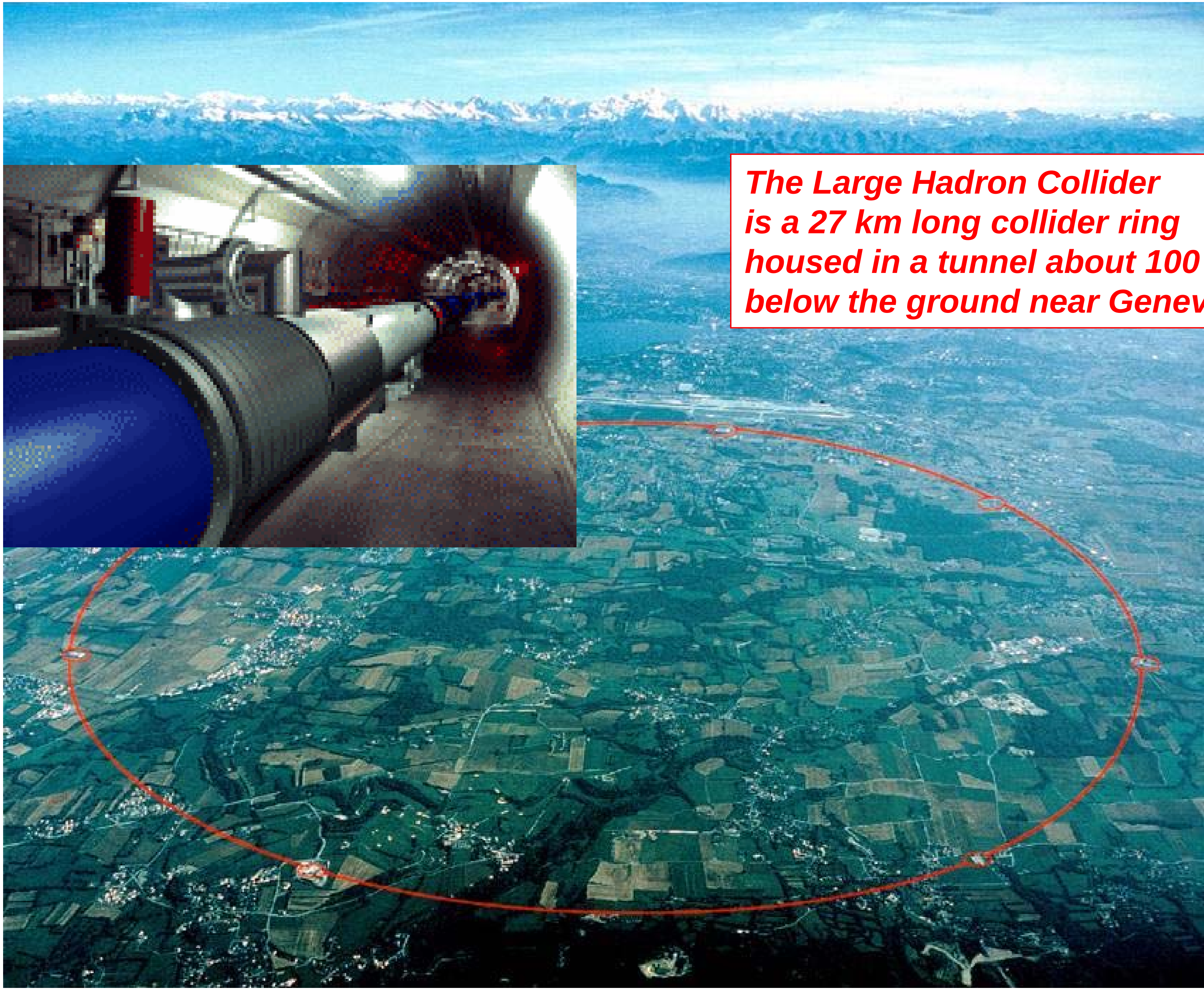
The ATLAS Experiment Getting Ready for LHC

Exploring the High-Energy Frontier of Particle Physics

University of Tsukuba and KEK, May 18th, 2005

(P. Jenni, CERN)





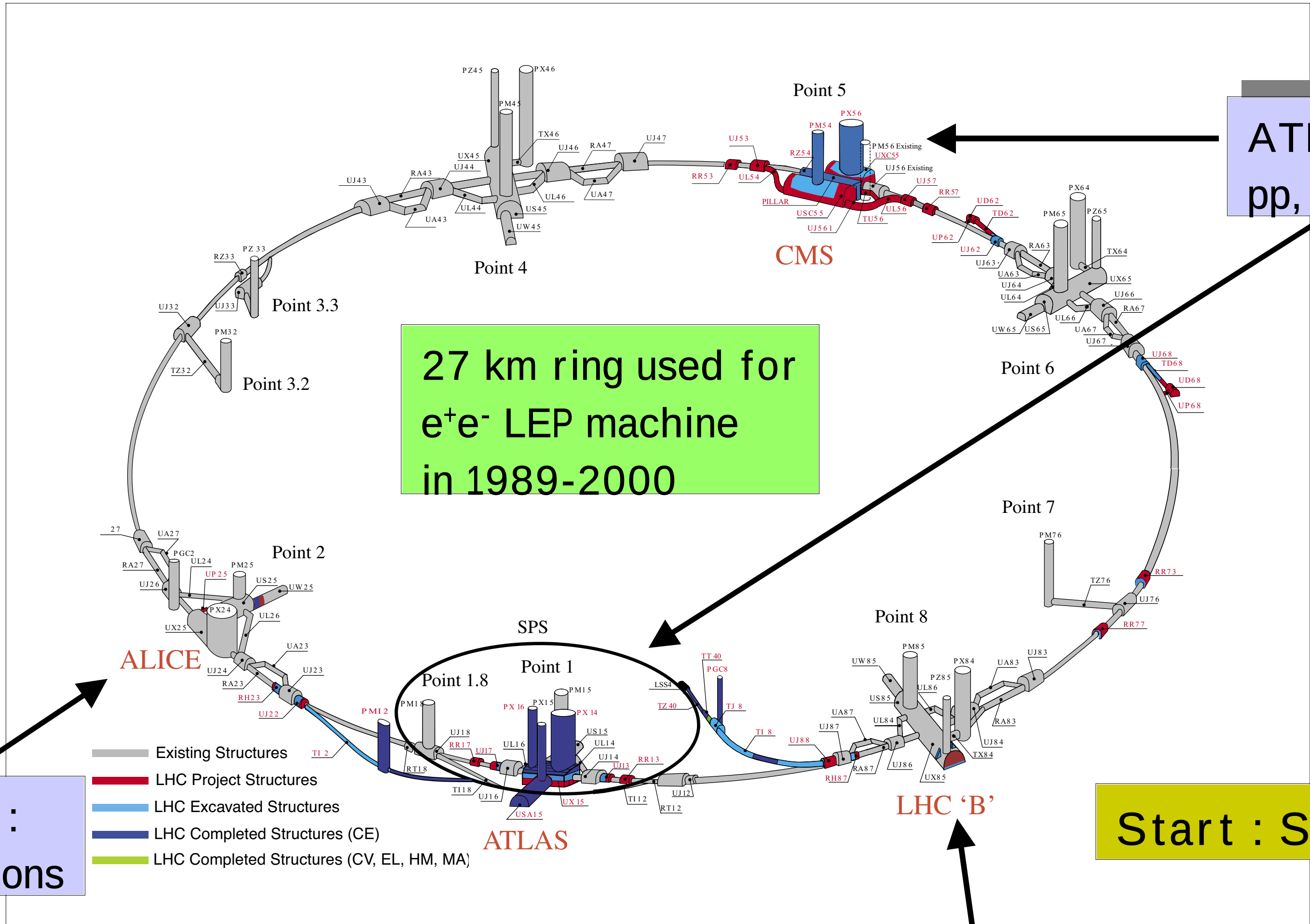
The Large Hadron Collider
is a 27 km long collider ring
housed in a tunnel about 100 m
below the ground near Geneva

LHC

pp

- $\sqrt{s}$ = 14 TeV (7 times higher than Tevatron/Fermilab)
  → search for new massive particles up to m ~ 5 TeV

- $L_{design} = 10^{34}$ cm^{-2} s^{-1} (>10^{2} higher than Tevatron/Fermilab)
  → search for rare processes with small σ ($N = L\sigma$)



27 km ring used for e^+e^- LEP machine in 1989-2000

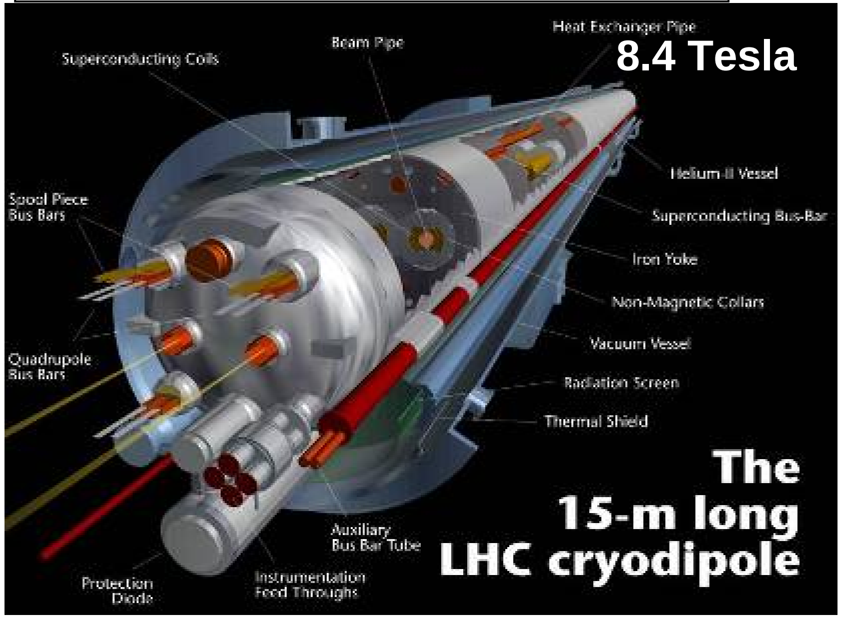
ATLAS and CMS : pp, general purpose

ALICE : heavy ions

LHCb : pp, B-physics

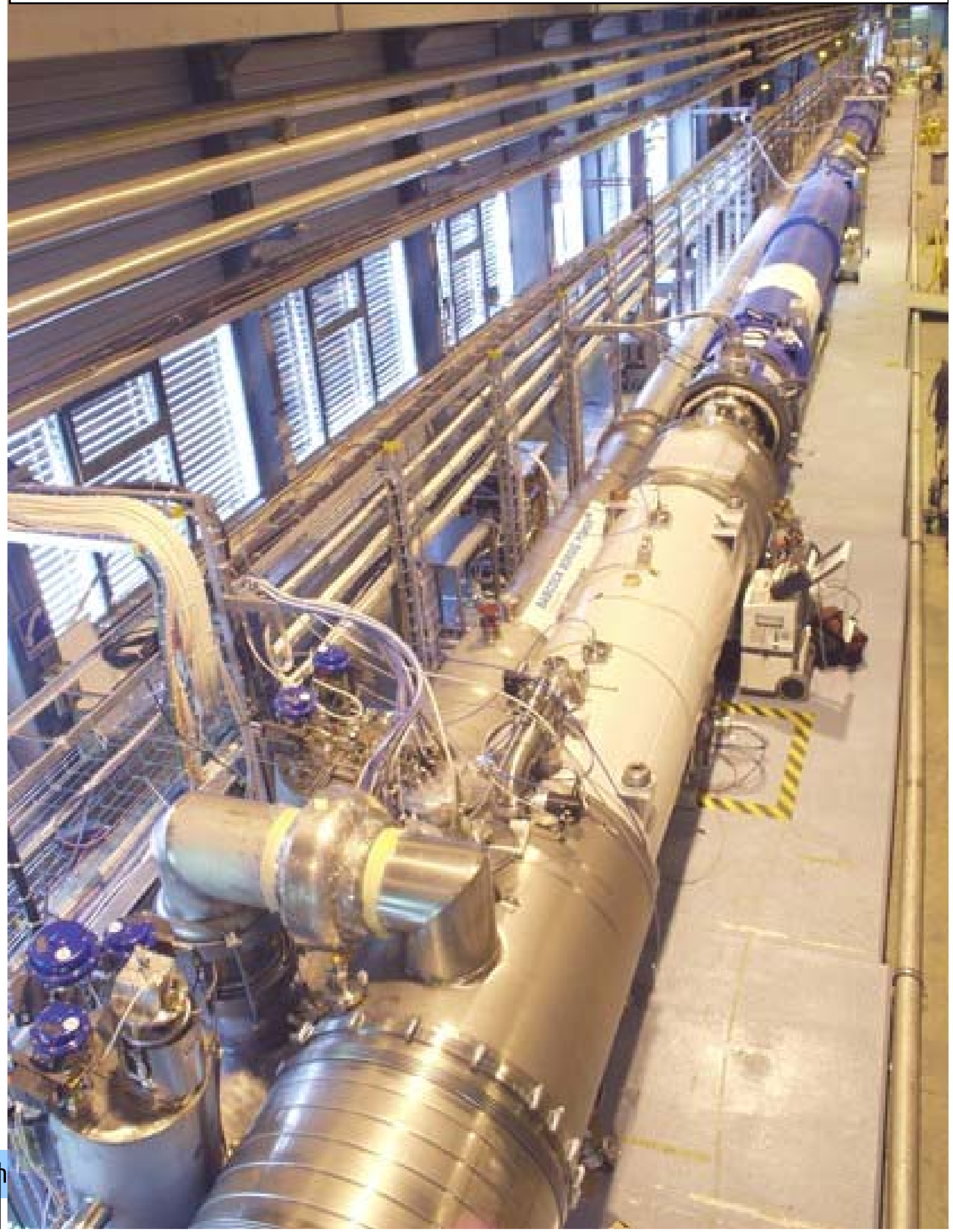
Start : Summer 2007

The LHC machine



More than half of the 1232 dipoles are produced

First full LHC cell (~ 120 m long) :
6 dipoles + 4 quadrupoles;
successful tests at nominal current (12 kA)




DAYS TO COMPLETION
DIPOLES TO COMPLETION
TODAY
DEADLINE
7 MARS 2005
DIPOLE
nº 616

LHC construction and installation

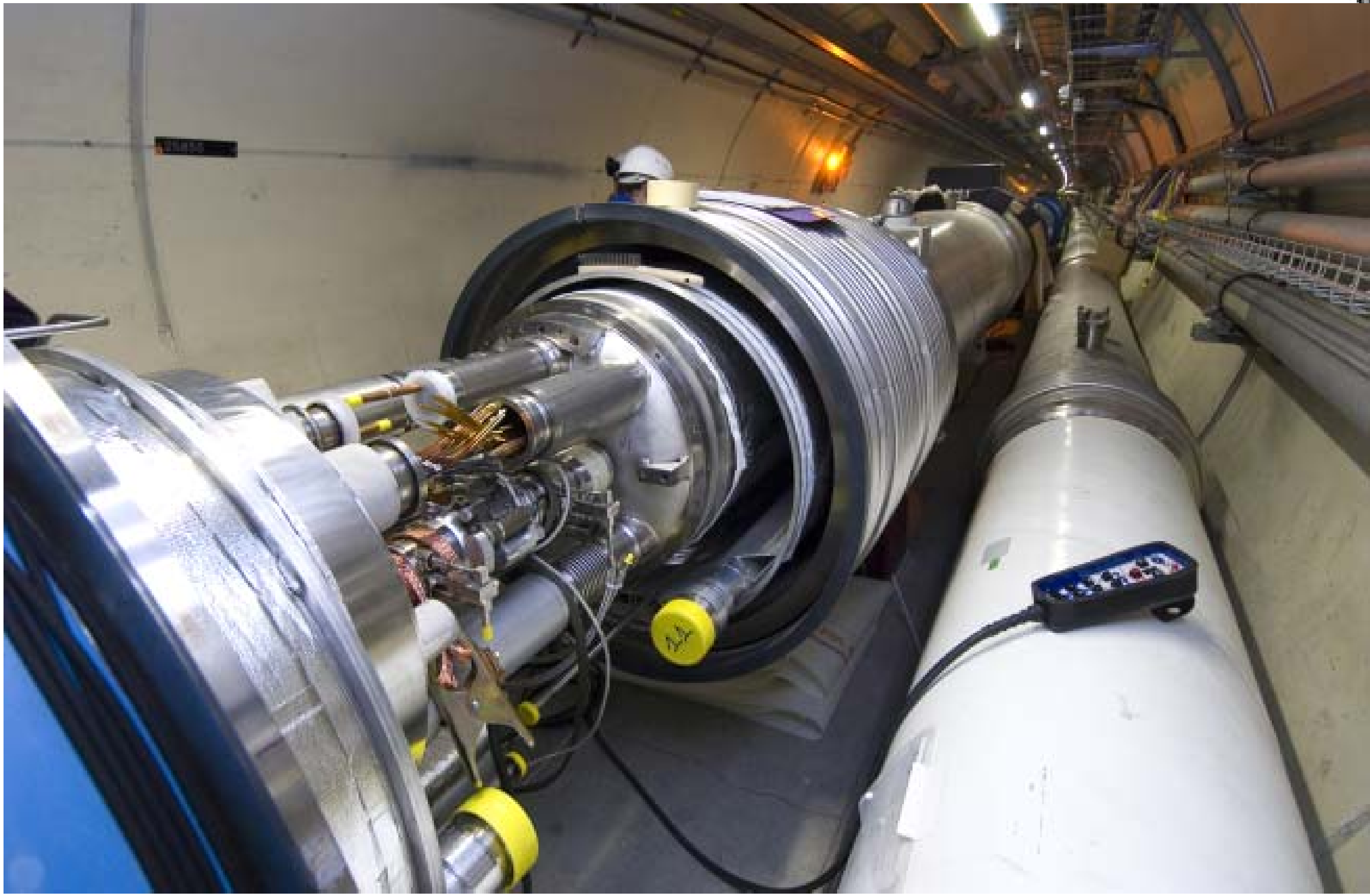
Dipoles ready for installation

Cryogenics (QRL) in the tunnel

Dipole installation in the tunnel

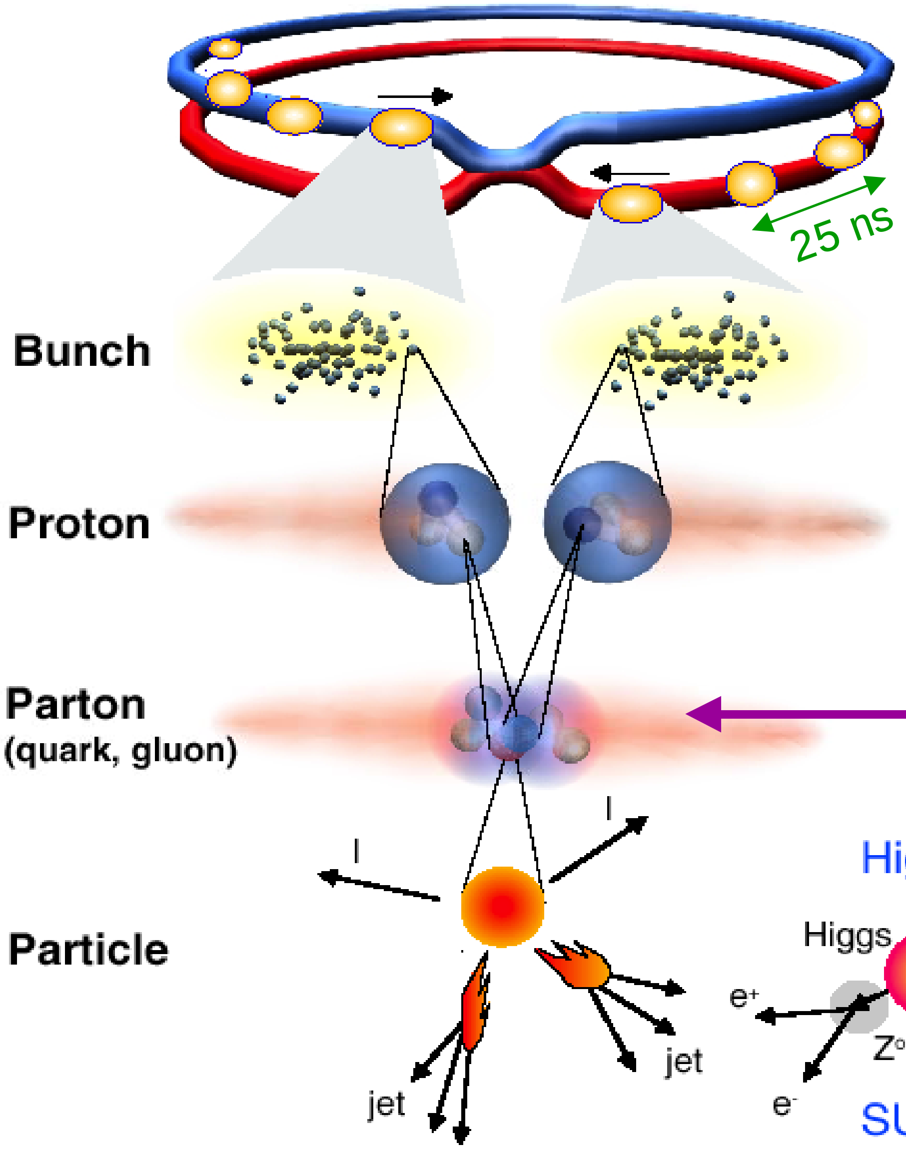
The magnet production proceeds very well and is on schedule, also the quality of the magnets is very good

On the critical path for the first collisions, which are planned for Summer 2007, is the installation of the LHC in the tunnel, in particular due to delays in the cryogenic services lines (QRL) which initially had problems, and for which a recovery plan was implemented successfully



Inner triplet containing US and Japanese magnets

Collisions at LHC



Proton-Proton

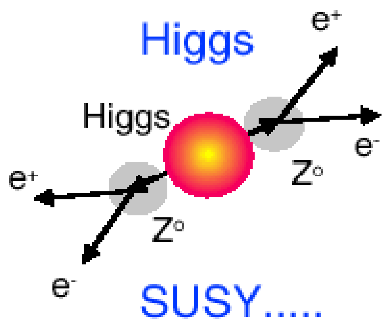
Protons/bunch	**10^{11}**
Beam energy	**7 TeV ($7x10^{12}$ eV)**
Luminosity	**10^{34} cm^{-2} s^{-1}**

Event rate in ATLAS :

N = L x σ (pp) $\approx$ 10^9 interactions/s

Mostly soft (low p_T) events

Interesting hard (high-p_T) events are rare



Selection of 1 in 10,000,000,000,000

→ very powerful detectors needed

The ATLAS physics goals

Search for the Standard Model Higgs boson over ~ 115 < m_H < 1000 GeV

Search for physics beyond the SM (Supersymmetry, q/l compositeness, leptoquarks, W'/Z', heavy q/l, Extra-dimensions, ….) up to the TeV-range

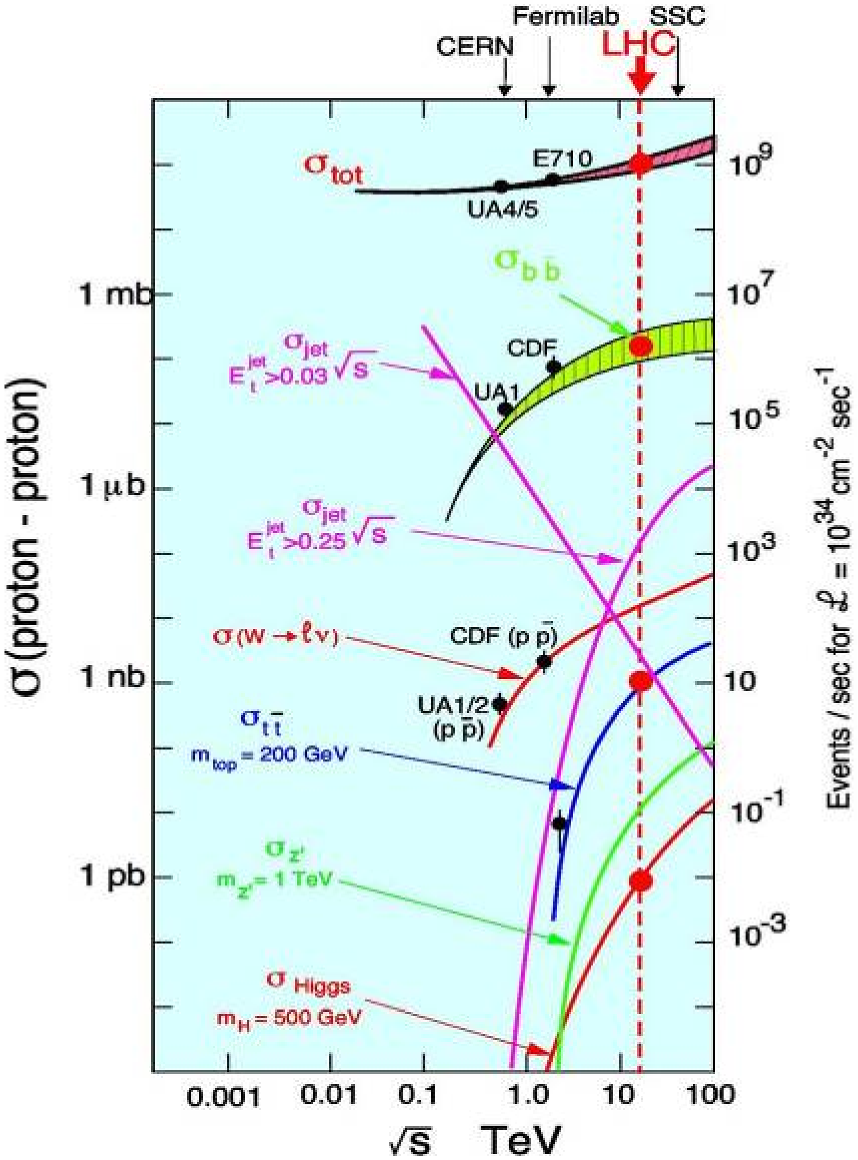
Precise measurements :

- **-- W mass**
- **-- top mass, couplings and decay properties**
- **-- Higgs mass, spin, couplings (if Higgs found)**
- **-- B-physics (complementing LHCb): CP violation, rare decays, B^0 oscillations**
- **-- QCD jet cross-section and α_s**
- **-- etc. ….**

Study of phase transition at high density from hadronic matter to plasma of deconfined quarks and gluons (complementing ALICE).
Transition plasma → hadronic matter happened in universe ~ 10^{-5} s after Big Bang

Etc. etc. …..

Cross Sections and Production Rates



Rates for L = 10^{34} cm^{-2} s^{-1}: (LHC)

• **Inelastic proton-proton reactions:**	**10^9 / s**
• **bb pairs** • **tt pairs**	**5 10^6 / s** **8 / s**
• **W → e ν** • **Z → e e**	**150 / s** **15 / s**
• **Higgs (150 GeV)** • **Gluino, Squarks (1 TeV)**	**0.2 / s** **0.03 / s**

LHC is a factory for:
top-quarks, b-quarks, W, Z, ……. Higgs, ……

(The only problem: you have to detect them !)

Which physics the first year(s) ?

Expected event rates at production in ATLAS at $L = 10^{33}\ cm^{-2}\ s^{-1}$

Process	Events/s	Events for 10 fb^{-1}	Total statistics collected at previous machines by '07
$W \to e\nu$	15	10^8	10^4 LEP / 10^7 Tevatron
$Z \to ee$	1.5	10^7	10^7 LEP
$t\bar{t}$	1	10^7	10^4 Tevatron
$b\bar{b}$	10^6	$10^{12} - 10^{13}$	10^9 Belle/BaBar ?
H m=130 GeV	0.02	10^5	?
$\tilde{g}\tilde{g}$ m= 1 TeV	0.001	10^4	---
Black holes m > 3 TeV (M_D=3 TeV, n=4)	0.0001	10^3	---

➡ **Already in first year, large statistics expected from:**
-- known SM processes → understand detector and physics at $\sqrt{s}$ = 14 TeV
-- several New Physics scenarios

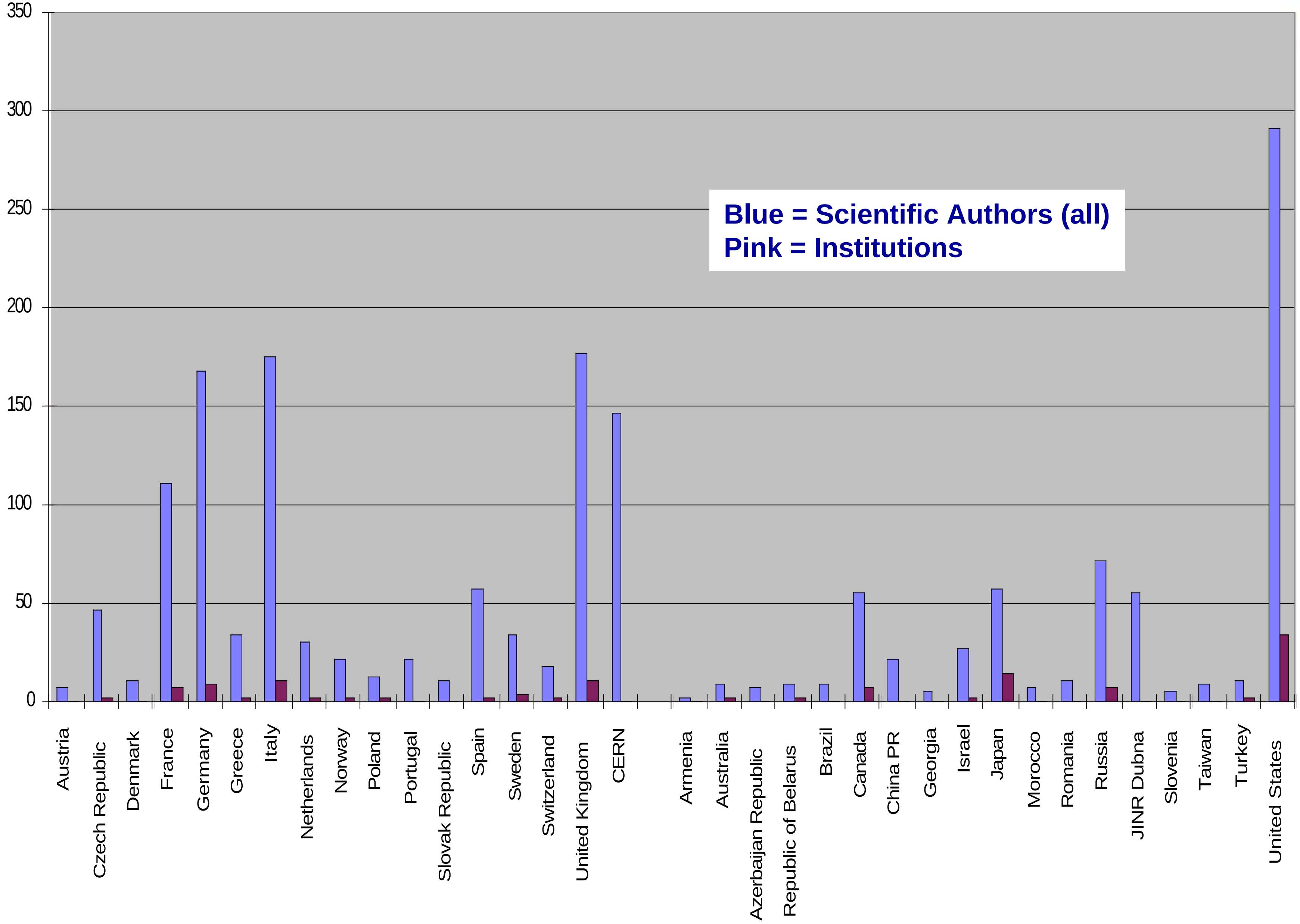
ATLAS Collaboration

34 Countries
151 Institutions
1770 Scientific Authors

There is a long-standing excellent partnership with Japanese teams since the beginning (R&D started in 1990)

It is a particular pleasure to note a very fruitful cooperation with both teams from KEK and from the University of Tsukuba

Albany, Alberta, NIKHEF Amsterdam, Ankara, LAPP Annecy, Argonne NL, Arizona, UT Arlington, Athens, NTU Athens, Baku, IFAE Barcelona, Belgrade, Bergen, Berkeley LBL and UC, Bern, Birmingham, Bonn, Boston, Brandeis, Bratislava/SAS Kosice, Brookhaven NL, Bucharest, Cambridge, Carleton, Casablanca/Rabat, CERN, Chinese Cluster, Chicago, Clermont-Ferrand, Columbia, NBI Copenhagen, Cosenza, INP Cracow, FPNT Cracow, Dortmund, JINR Dubna, Duke, Frascati, Freiburg, Geneva, Genoa, 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, 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, FIAN Moscow, ITEP Moscow, MEPhI Moscow, MSU Moscow, Munich LMU, MPI Munich, Nagasaki IAS, Naples, Naruto UE, New Mexico, Nijmegen, BINP Novosibirsk, Ohio SU, Okayama, Oklahoma, LAL Orsay, Oslo, Oxford, Paris VI and VII, Pavia, Pennsylvania, Pisa, Pittsburgh, CAS Prague, CU Prague, TU Prague, IHEP Protvino, Ritsumeikan, UFRJ Rio de Janeiro, Rochester, Rome I, Rome II, Rome III, Rutherford Appleton Laboratory, DAPNIA Saclay, Santa Cruz UC, Sheffield, Shinshu, Siegen, Simon Fraser Burnaby, Southern Methodist Dallas, NPI Petersburg, Stockholm, KTH Stockholm, Stony Brook, Sydney, AS Taipei, Tbilisi, Tel Aviv, Thessaloniki, Tokyo ICEPP, Tokyo MU, Tokyo UAT, Toronto, TRIUMF, Tsukuba, Tufts, Udine, Uppsala, Urbana UI, Valencia, UBC Vancouver, Victoria, Washington, Weizmann Rehovot, Wisconsin, Wuppertal, Yale, Yerevan



350
300
250
200
150
100
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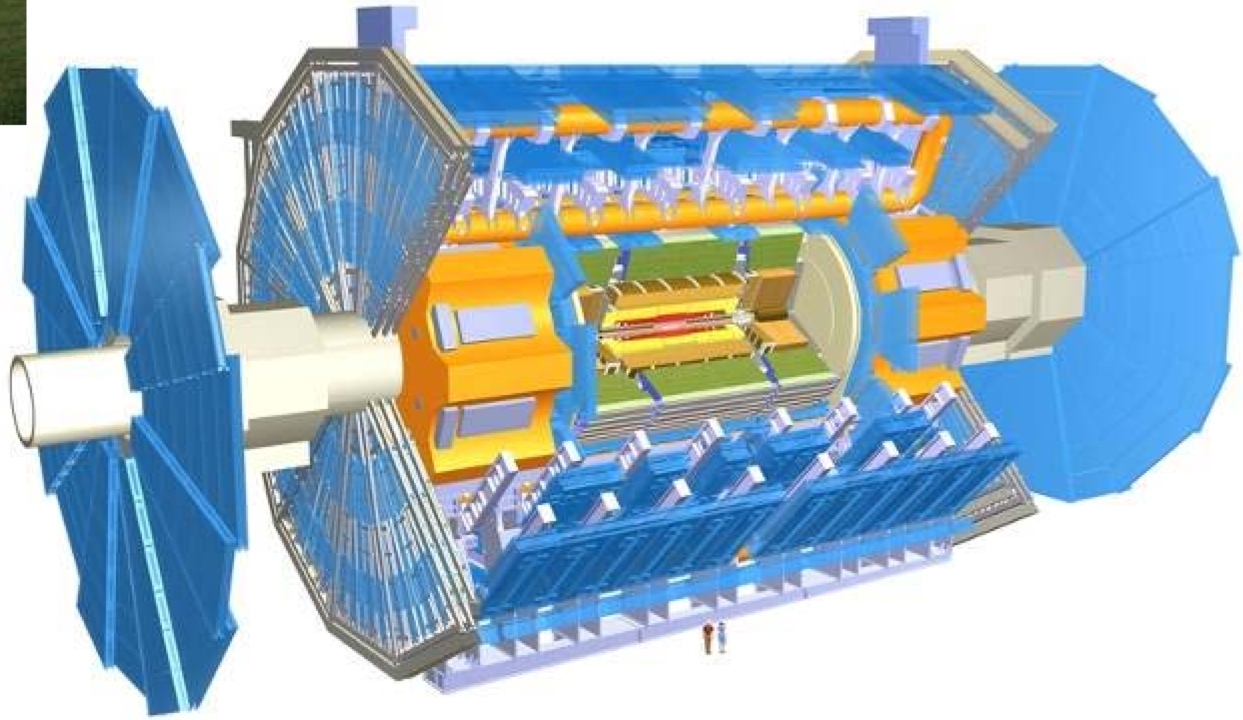
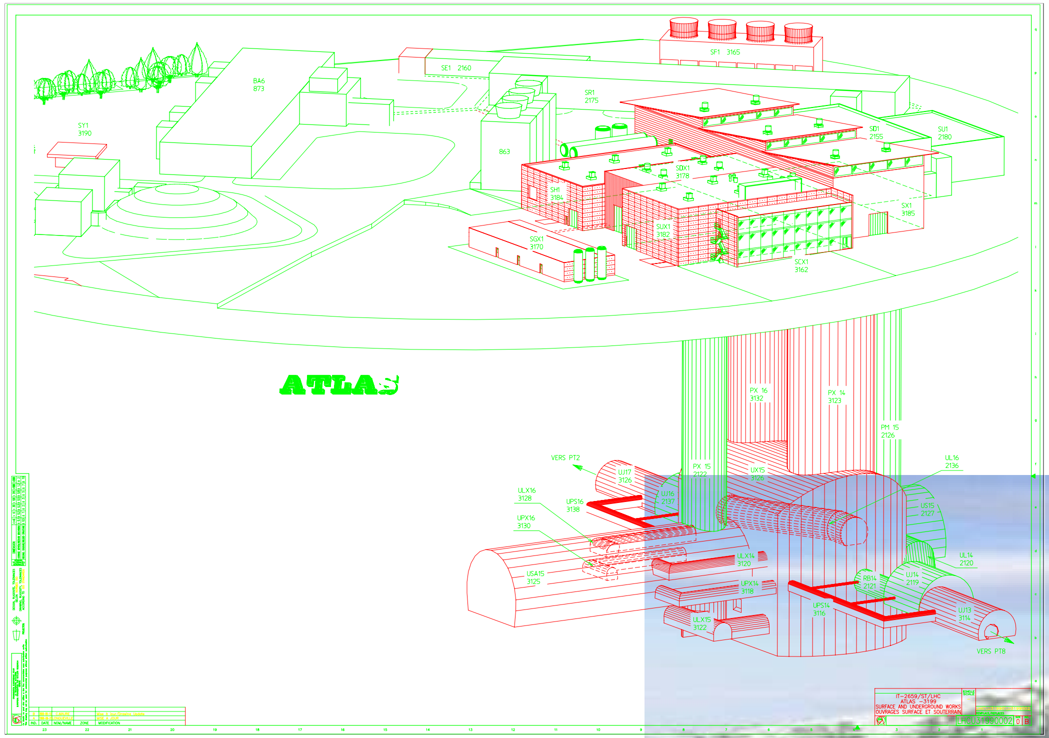
Blue = Scientific Authors (all)
Pink = Institutions
Austria
Czech Republic
Denmark
France
Germany
Greece
Italy
Netherlands
Norway
Poland
Portugal
Slovak Republic
Spain
Sweden
Switzerland
United Kingdom
CERN
Armenia
Australia
Azerbaijan Republic
Republic of Belarus
Brazil
Canada
China PR
Georgia
Israel
Japan
Morocco
Romania
Russia
JINR Dubna
Slovenia
Taiwan
Turkey
United States

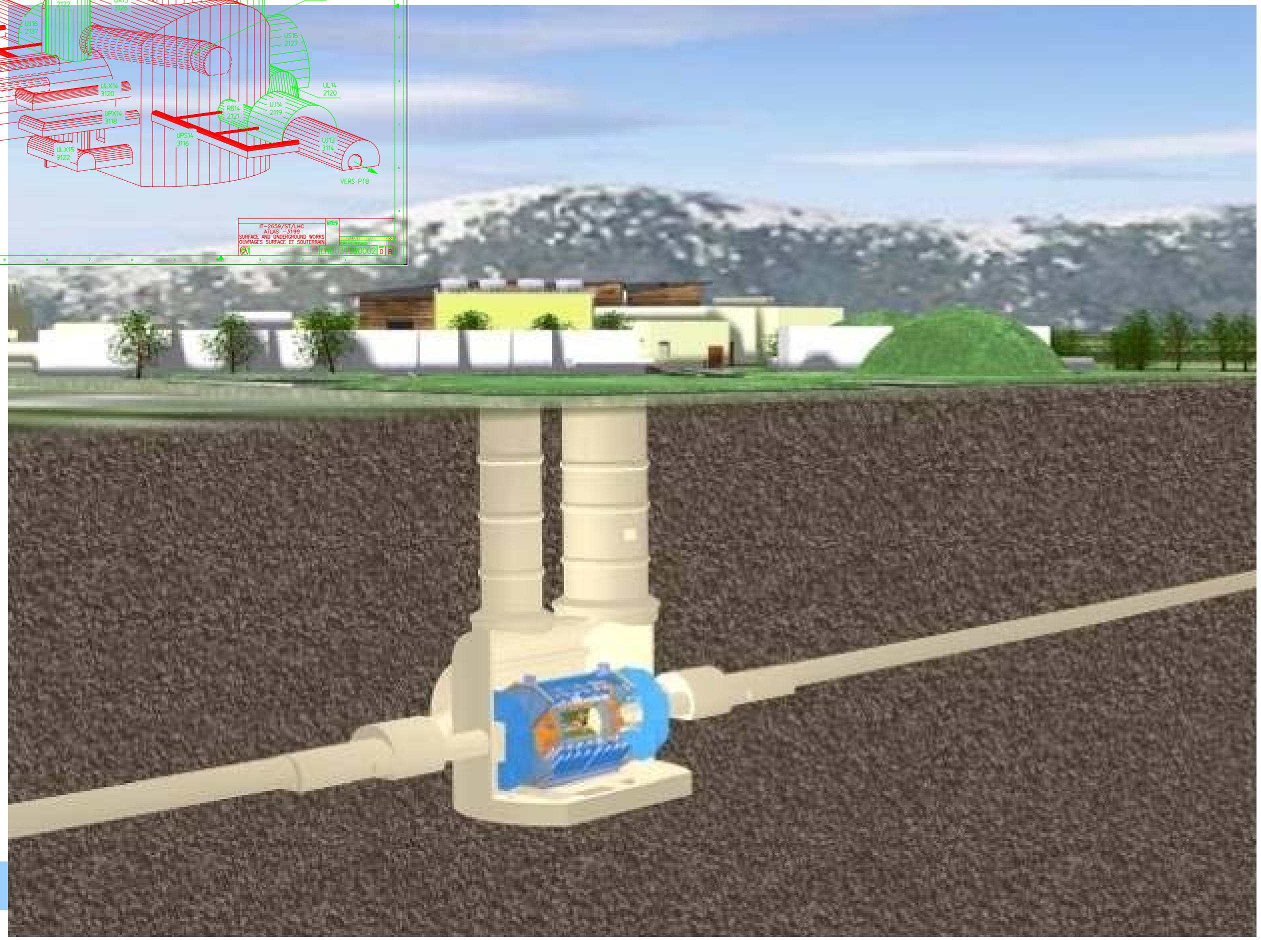
ATLAS superimposed to
the 5 floors of building 40

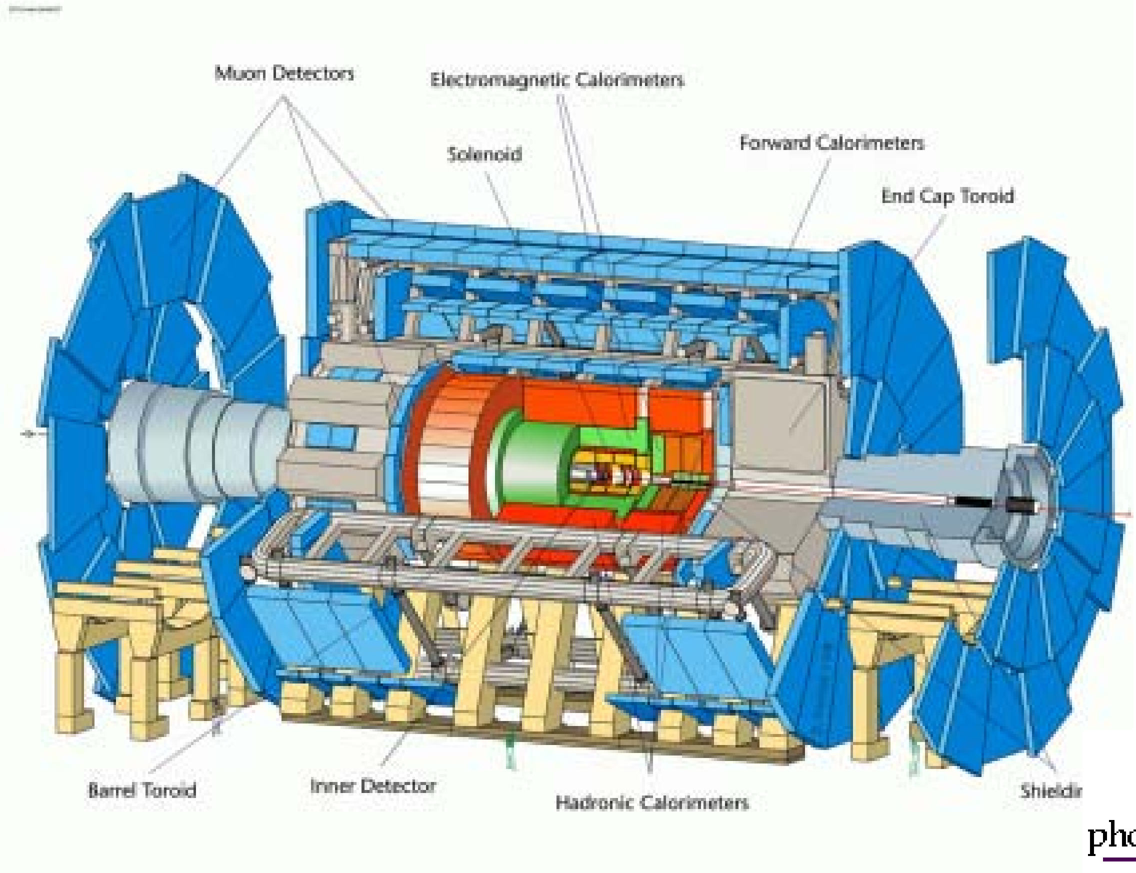
Construction, integration and installation progress of the detector systems



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

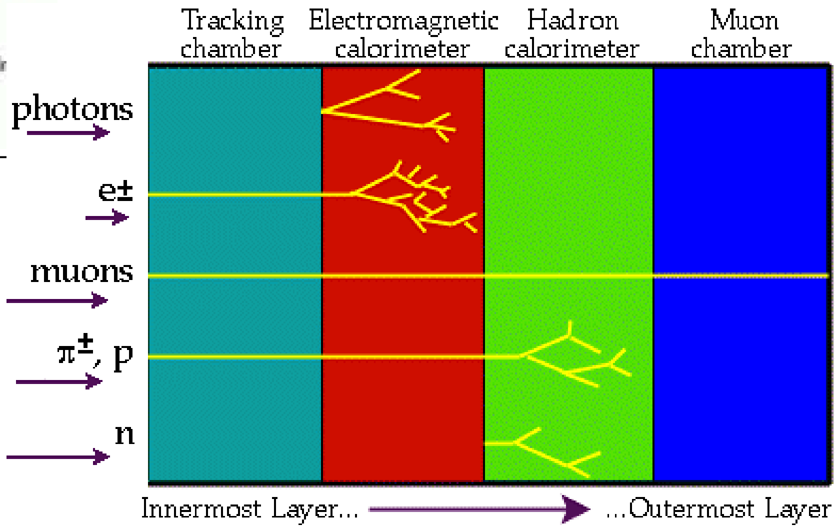

ATLAS





ATLAS

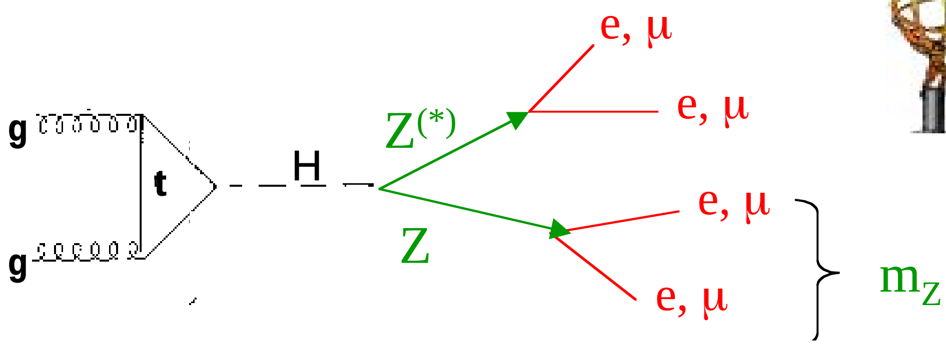
Length : ~ 46 m
Radius : ~ 12 m
Weight : ~ 7000 tons
~ 10^8 electronic channels
~ 3000 km of cables



- **Tracking ($|\eta|<2.5$, B=2T) :**
  - **-- Si pixels and strips**
  - **-- Transition Radiation Detector (e/π separation)**
- **Calorimetry ($|\eta|<5$) :**
  - **-- EM : Pb-LAr**
  - **-- HAD: Fe/scintillator (central), Cu/W-LAr (fwd)**
- **Muon Spectrometer ($|\eta|<2.7$) :**
  air-core toroids with muon chambers

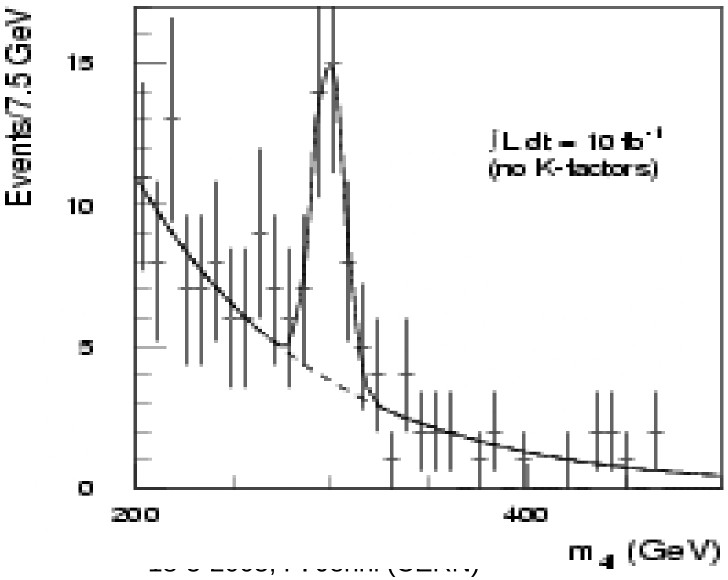
Physics example

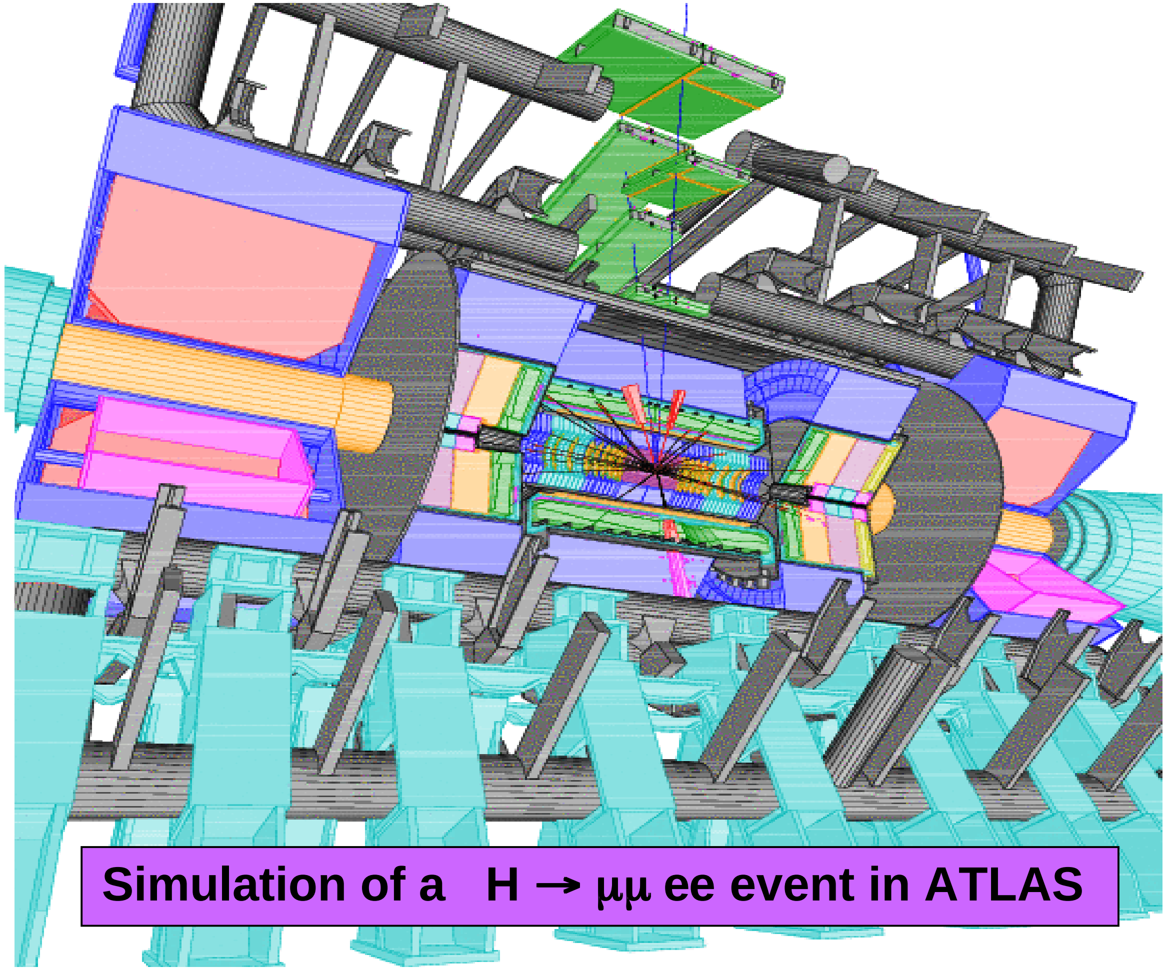
$H \rightarrow ZZ \rightarrow 4\,l$



"Gold-plated" channel for Higgs discovery at LHC

Signal expected in ATLAS after 1 year of LHC operation





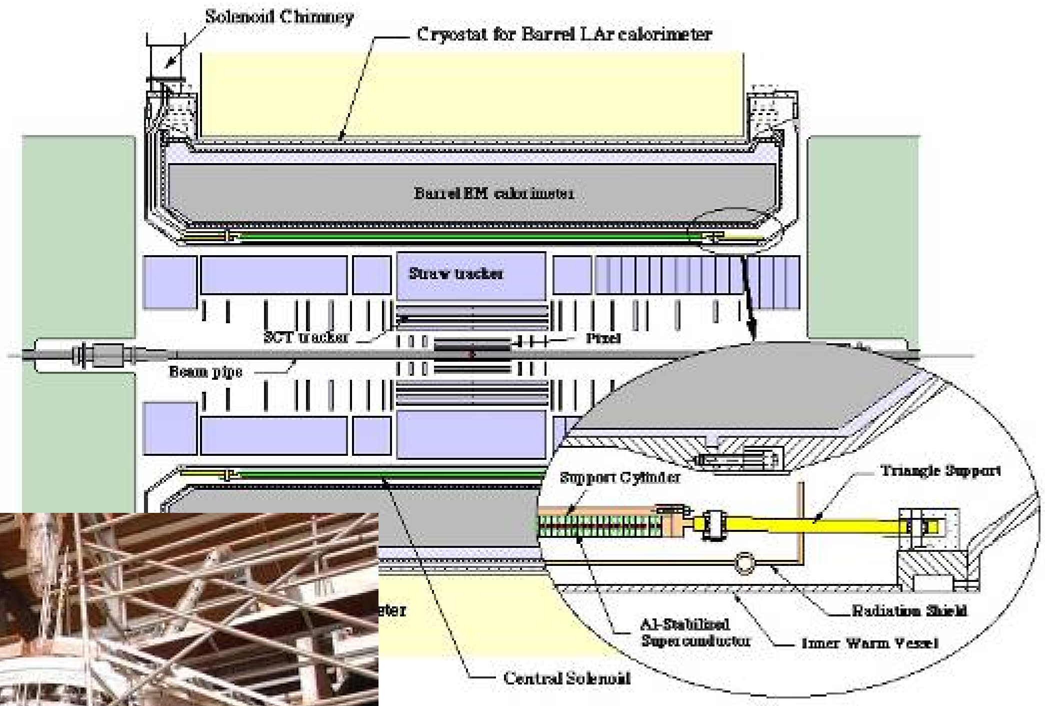
Simulation of a $H \rightarrow \mu\mu\, ee$ event in ATLAS

Magnet System

Central Solenoid

2T field with a stored energy of 38 MJ

Integrated design within the barrel LAr cryostat



The solenoid has been inserted into the LAr cryostat at the end of February 2004, and it was tested at full current (8 kA) during July 2004

(Engineered, constructed and tested under full responsibility of KEK)

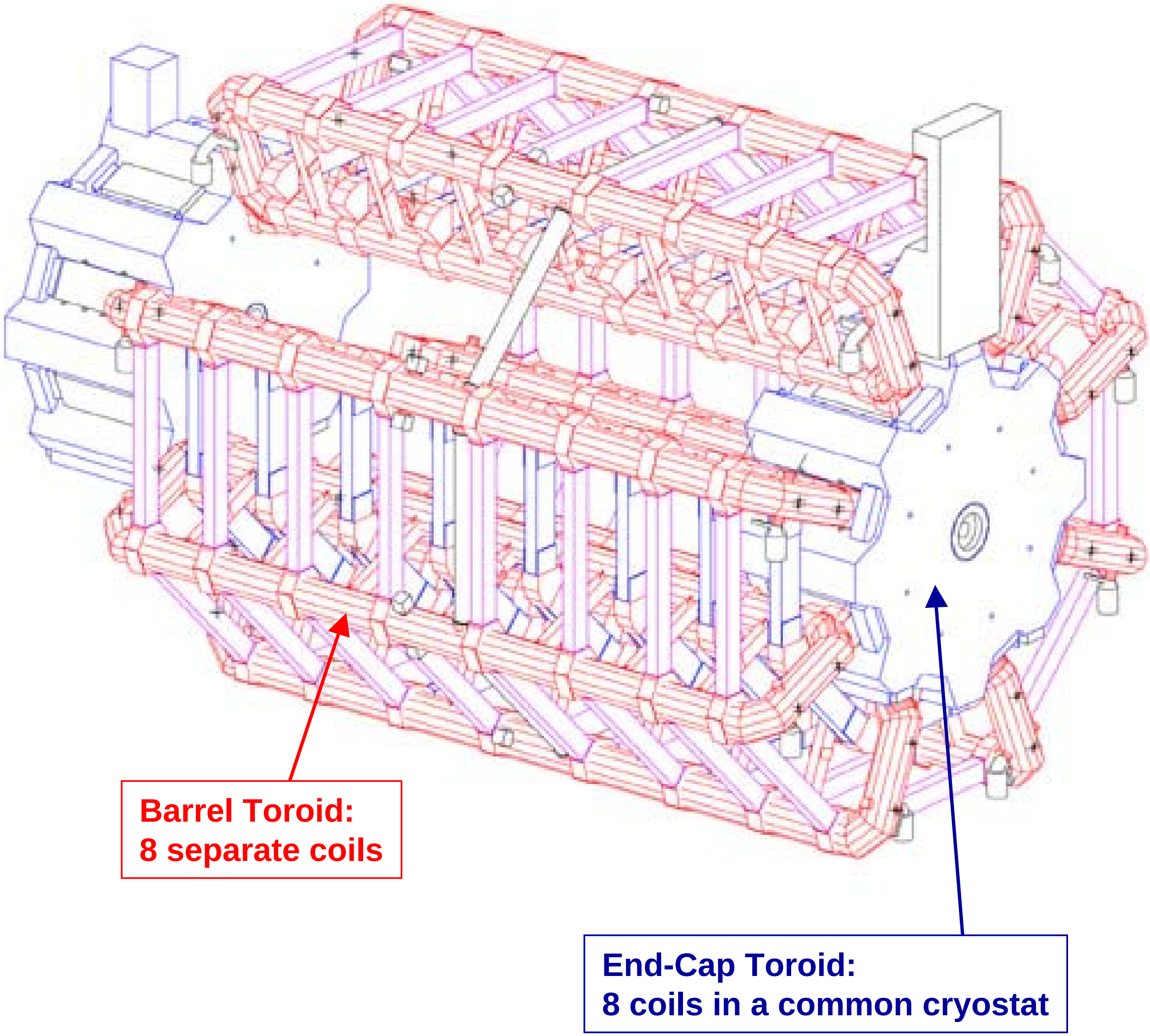
Toroid system

Barrel Toroid parameters

25.3 m length
20.1 m outer diameter
8 coils
1.08 GJ stored energy
370 tons cold mass
830 tons weight
4 T on superconductor
56 km Al/NbTi/Cu conductor
20.5 kA nominal current
4.7 K working point

End-Cap Toroid parameters

5.0 m axial length
10.7 m outer diameter
2x8 coils
2x0.25 GJ stored energy
2x160 tons cold mass
2x240 tons weight
4 T on superconductor
2x13 km Al/NbTi/Cu conductor
20.5 kA nominal current
4.7 K working point



Barrel Toroid construction status

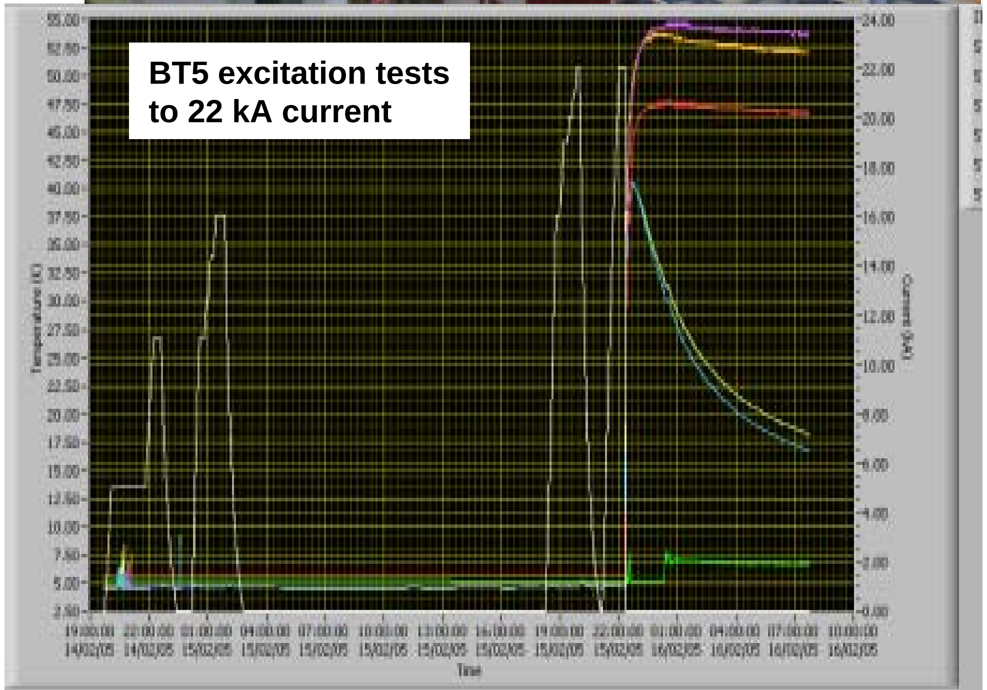
Series integration and tests of the 8 coils at the surface will be finished in June 2005

BT1 – BT4 are installed in the cavern

BT5 Ready at the pit for installation
BT6 Tests finished
BT7 On the test station, tests almost complete
BT8 Ready in a few weeks for starting the tests

Schedule for installation and commissioning in the cavern:

BT8 installation in July 2005
BT functional test by end of 2005



Barrel Toroid coil transport and installation

Inner Detector (ID)

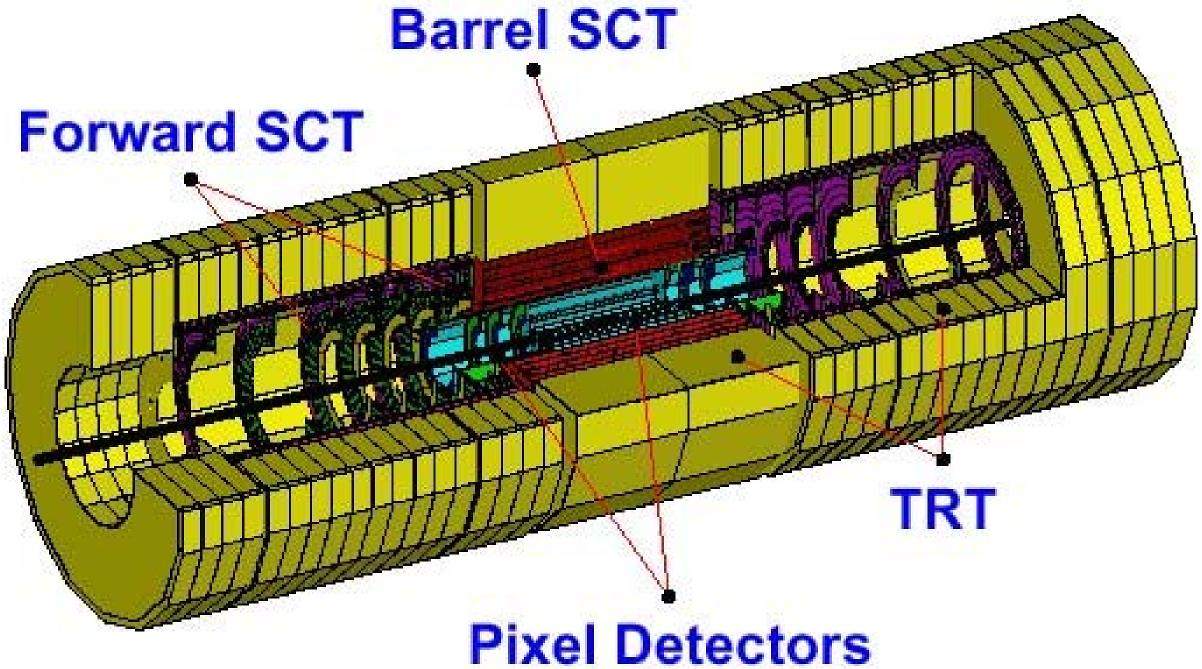
The Inner Detector (ID) is organized into four sub-systems:

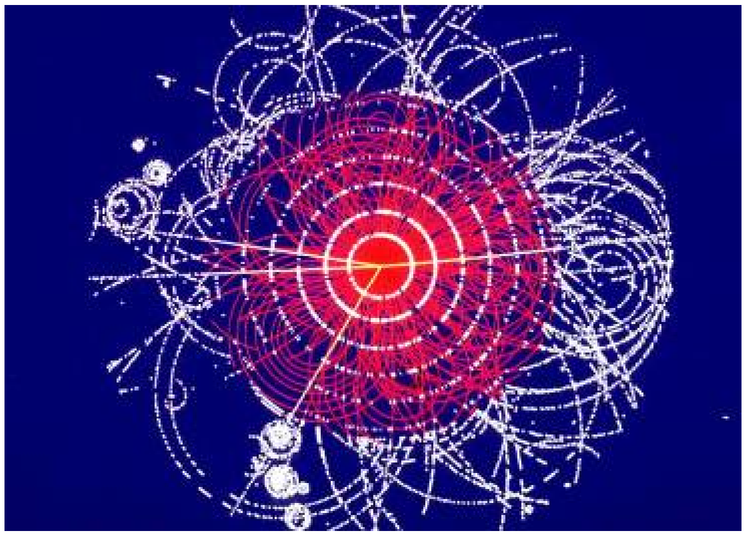
Pixels
($0.8\ 10^8$ channels)

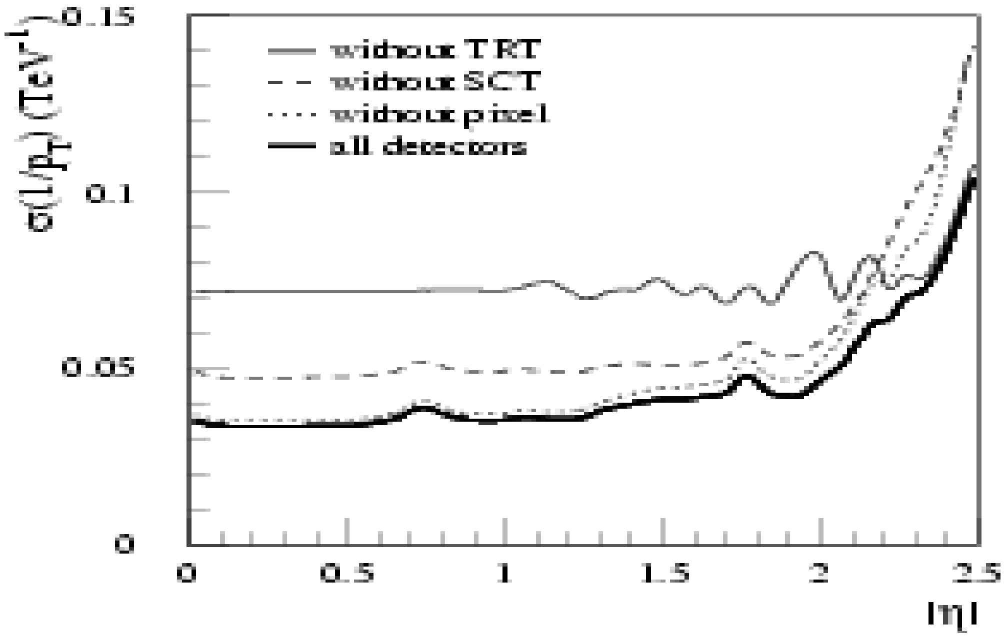
Silicon Tracker (SCT)
($6\ 10^6$ channels)

Transition Radiation Tracker (TRT)
($4\ 10^5$ channels)

Common ID items







Inner Detector Progress Summary

Pixels: **Steady 'on-schedule' progress on all aspects of the sub-system for 3 layers**

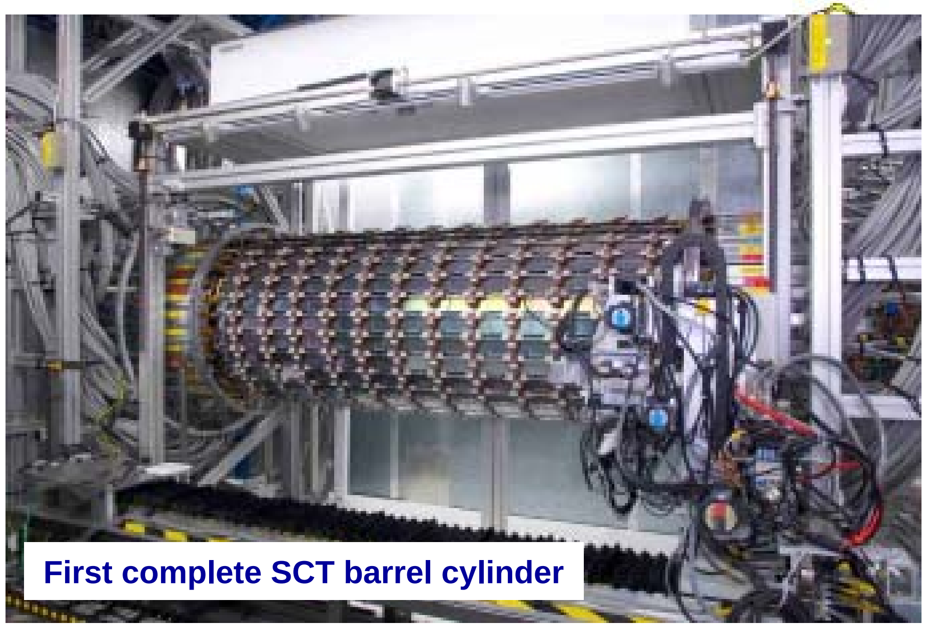
SCT: **Module mounting ('macro-assembly') on the 4 barrel cylinders ongoing (the first cylinder is finished and tested, and is now at CERN)**

The module mounting progressing on the forward disks (the first 4 disks are completed)

TRT: **Barrel module mounting into support structure is completed**

End-cap wheel production is now also smooth, and the stacking at CERN into the end-cap structures has started

The schedule for the Inner Detector remains very tight, without any float left (critical path: all SCT, and second TRT end-cap)

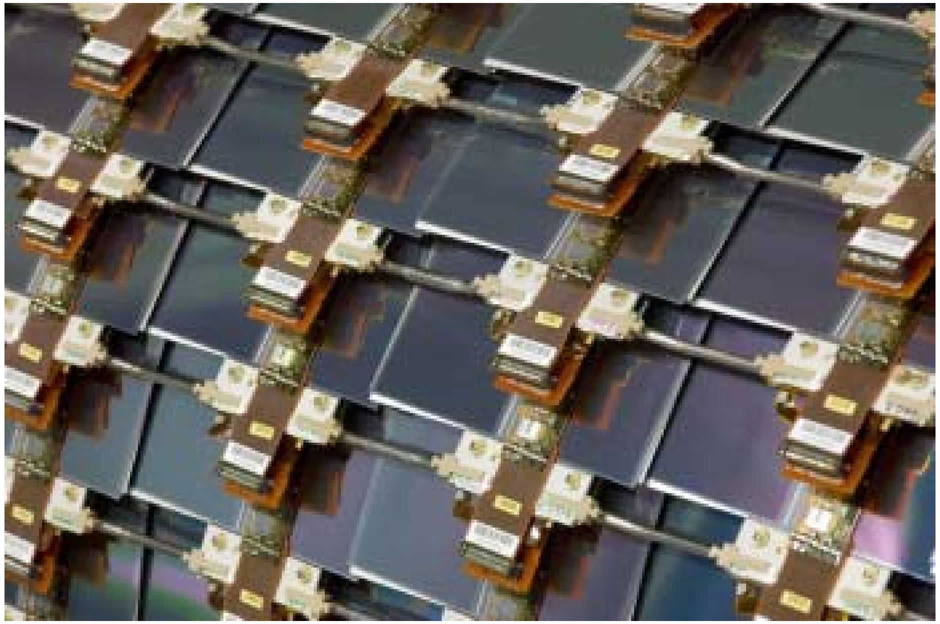


First complete SCT barrel cylinder

TRT barrel support with all modules

SCT

The barrel module production is complete, for the end-caps more than 70% are made

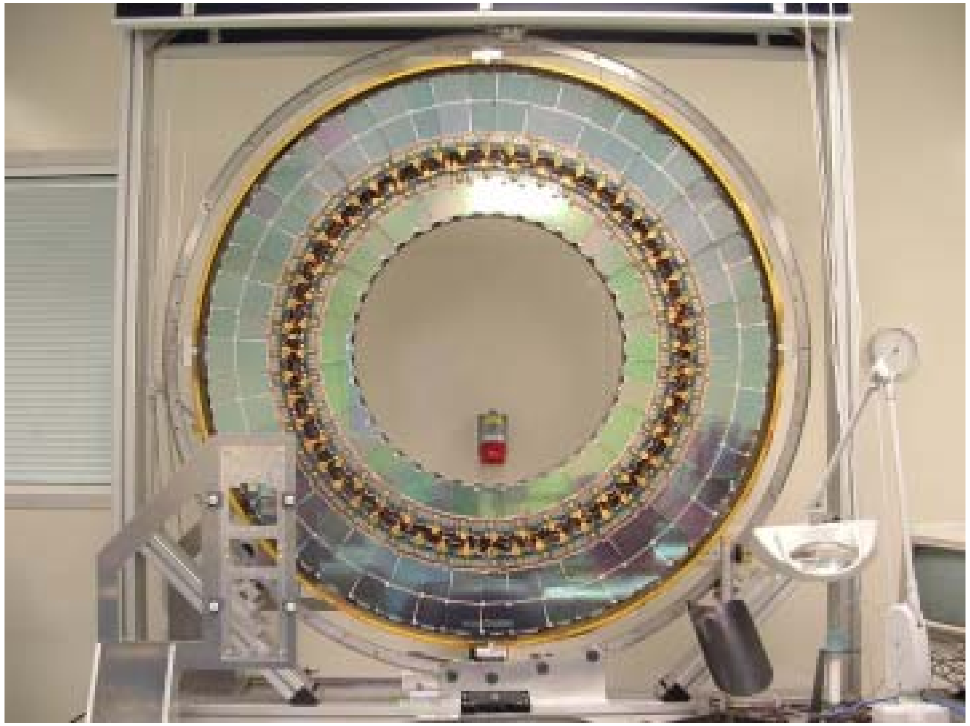


The first of the four barrel cylinders has been completed and delivered to CERN, tested in cooled operation conditions with good initial results (< 0.3% channels have problems)

Mounting on the three other cylinders is on-going, increased manpower is required to meet the schedule

The first four of the 18 disks for both end-caps have been mounted

This operation is late and on the critical path for various reasons including delays accumulated for the services



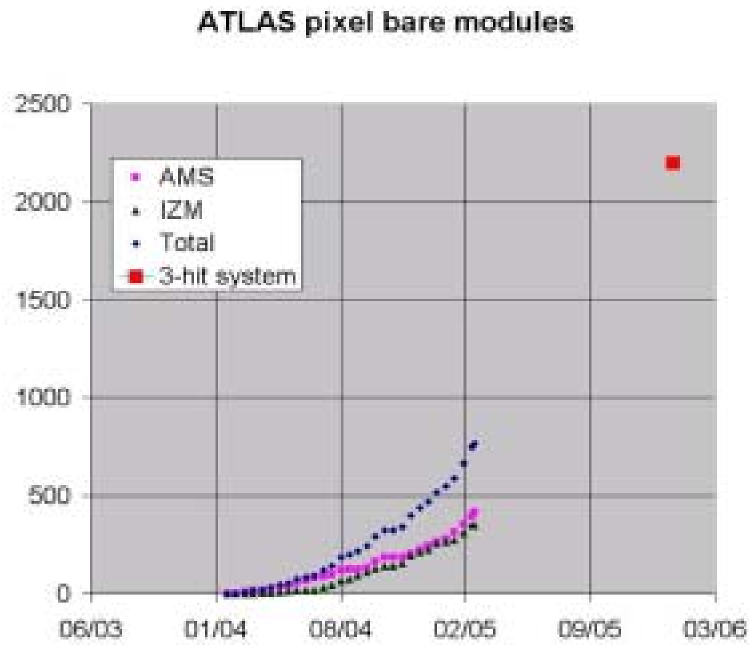
Japanese physicists and industry are playing a crucial role in the SCT project!

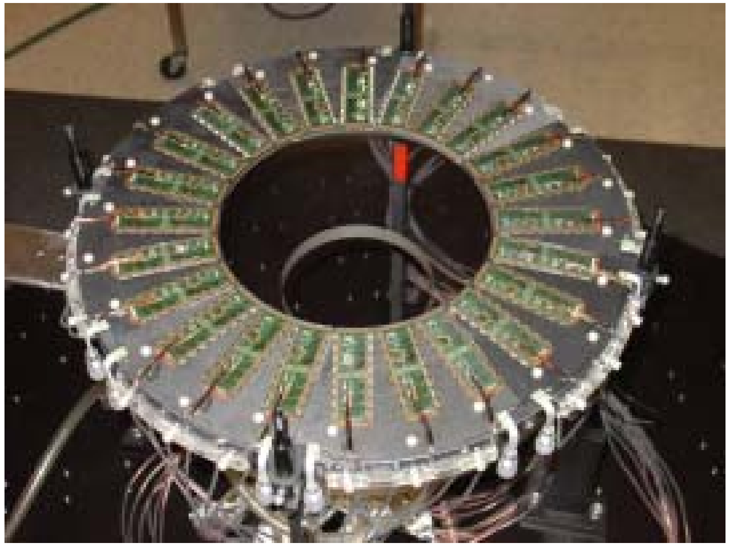
Pixels

All FE chips have been delivered (all tested, showing a yield of 82%)

The sensor production is finished for 2 layers, and on time for 3 layers

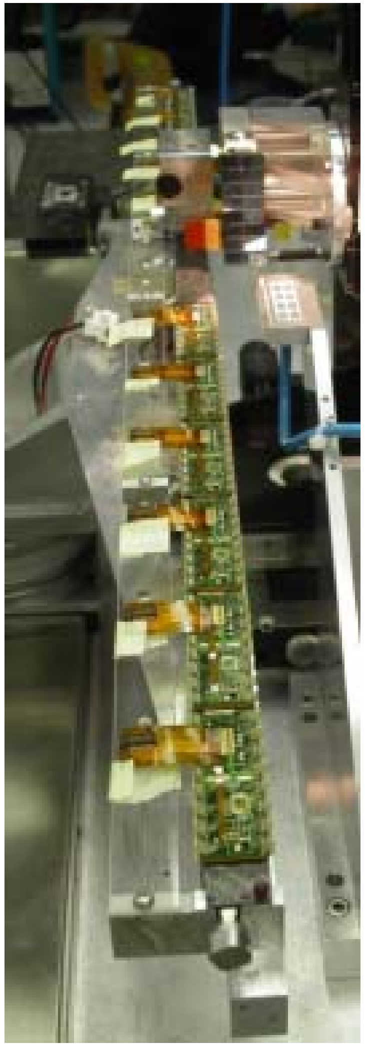
The module production rate (with bump-bonding in 2 industries) has improved, on track for 3 layers in time



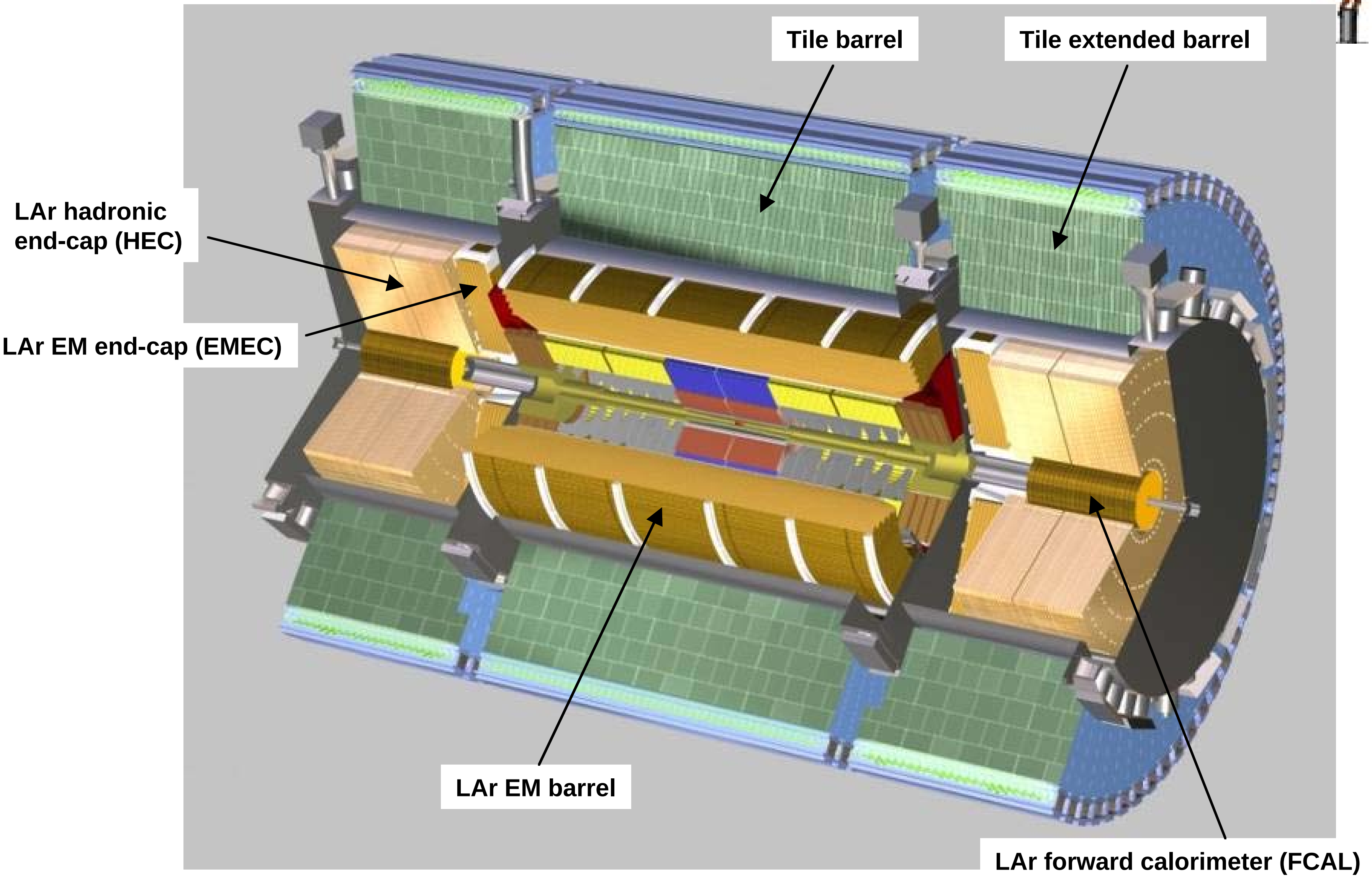


First completed disk (two layers of 24 modules each, with 2'200'000 channels of electronics

The series production of final staves (barrel) and sectors (end-cap disks) has passed the 10% mark, this activity is now on the critical path of the Pixel project



LAr and Tile Calorimeters



LAr EM Barrel Calorimeter and Solenoid Commissioning at the Surface

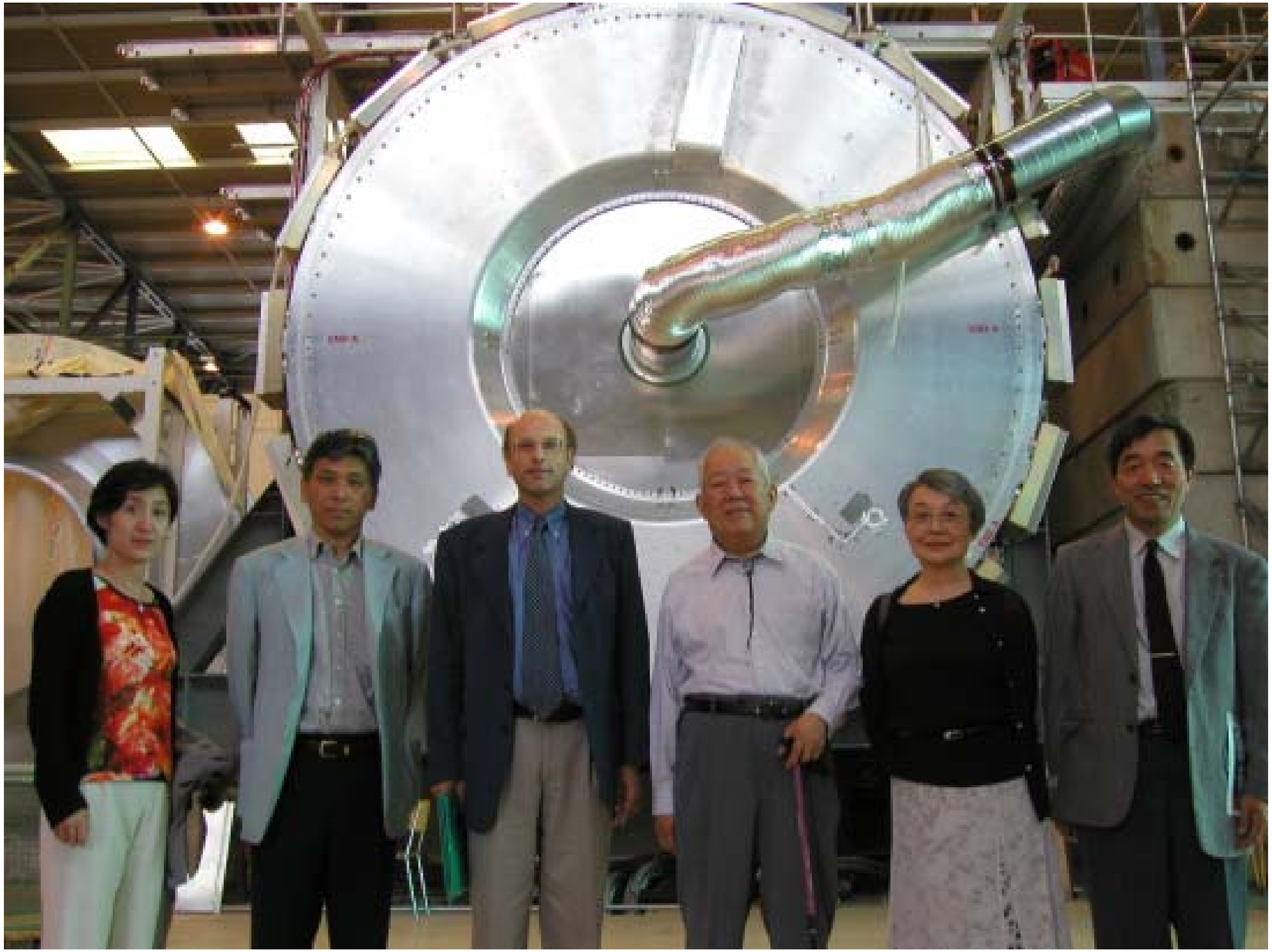
The barrel EM calorimeter is installed in the cryostat, and after insertion of the solenoid, the cold vessel was closed and welded

A successful complete cold test (with LAr) was made during summer 2004 in hall 180

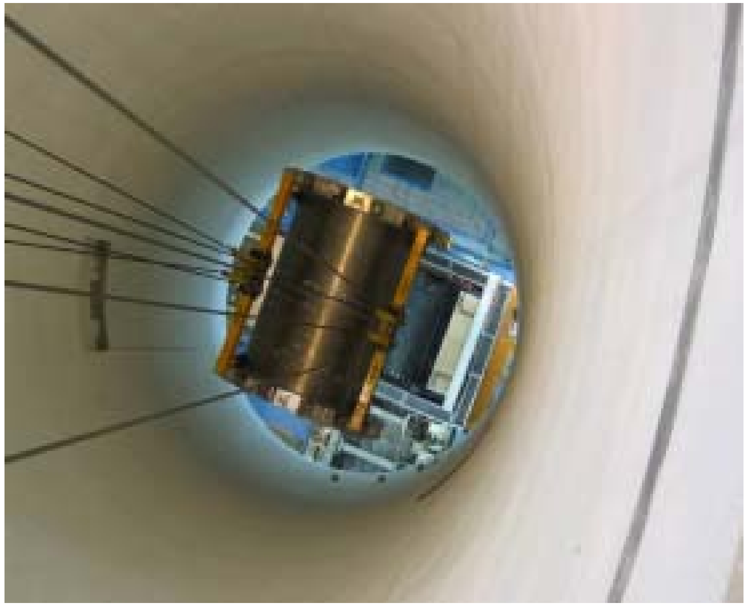
End of October the cryostat was transported to the pit, and lowered into the cavern

LAr barrel EM calorimeter after insertion into the cryostat

Solenoid just before insertion into the cryostat



Professor Masatoshi Koshiba visiting the ATLAS LAr barrel cryostat
(8th July 2003)



ATLAS Barrel Calorimeter

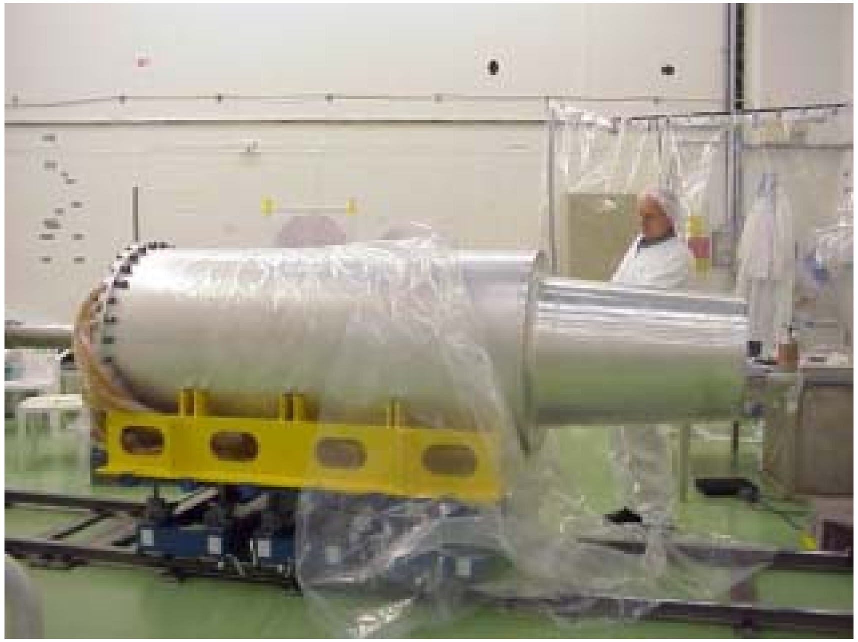
The mechanical installation of the LAr and Tile Barrel Calorimeters in the pit has been completed end of 2004 on the support trucks below the access shaft on the C-side

The installation of electronics and services is ongoing

LAr End-Caps

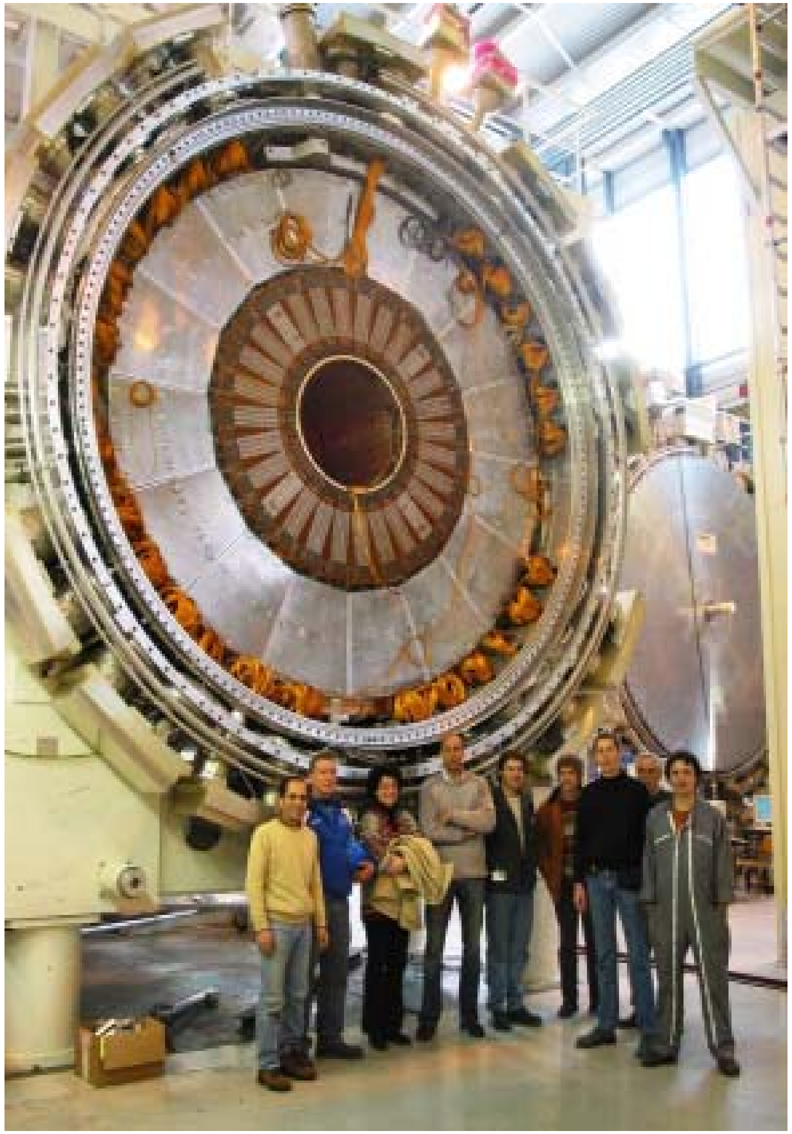
End-Cap C: **Surface cold tests with LAr are finished, with very good preliminary results**

End-Cap A: **Integration is finished, and cool down for surface test started**

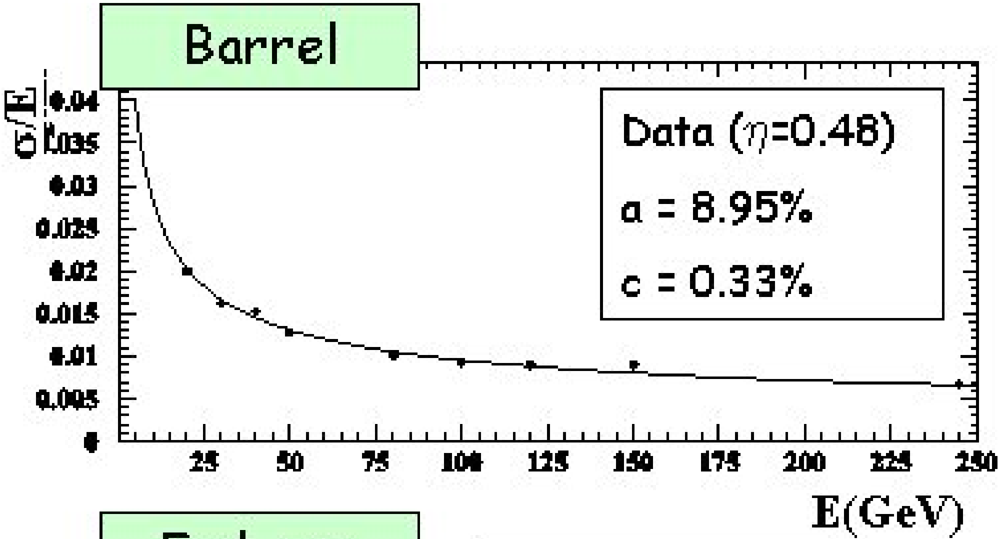


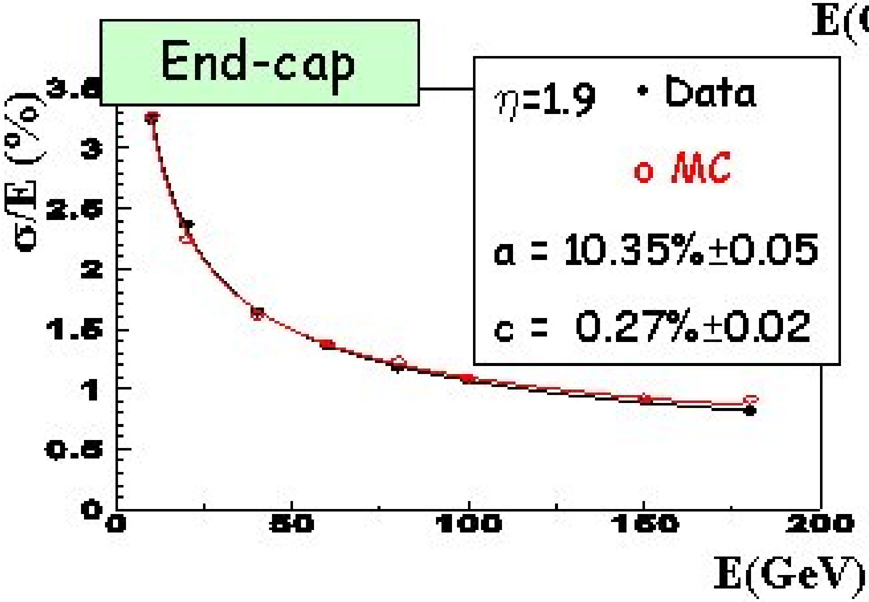
FCAL A before insertion

End-Cap cryostat A before closure



EM beam test results: Energy resolution





$$\sigma_E/E = a/\sqrt{E} \oplus c \oplus n/E$$

For every tested points:

Barrel	End-cap
a < 10%	a < 12.5%
c < 0.4%	c < 0.5%

- Within specifications
- Good agreement with MC

Impact on Higgs mass resolution

Simulations, m_H=130 GeV

✓ $H \rightarrow \gamma\gamma$

Resolution: 1% (low lum)

1.2% (high lum)

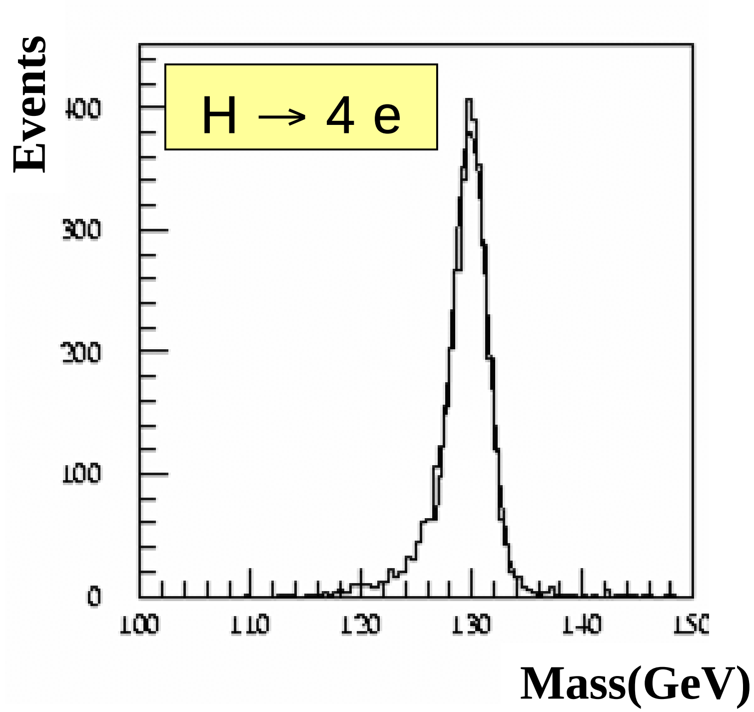
Acceptance: 80% within ±1.4 σ

✓ $H \rightarrow 4e$

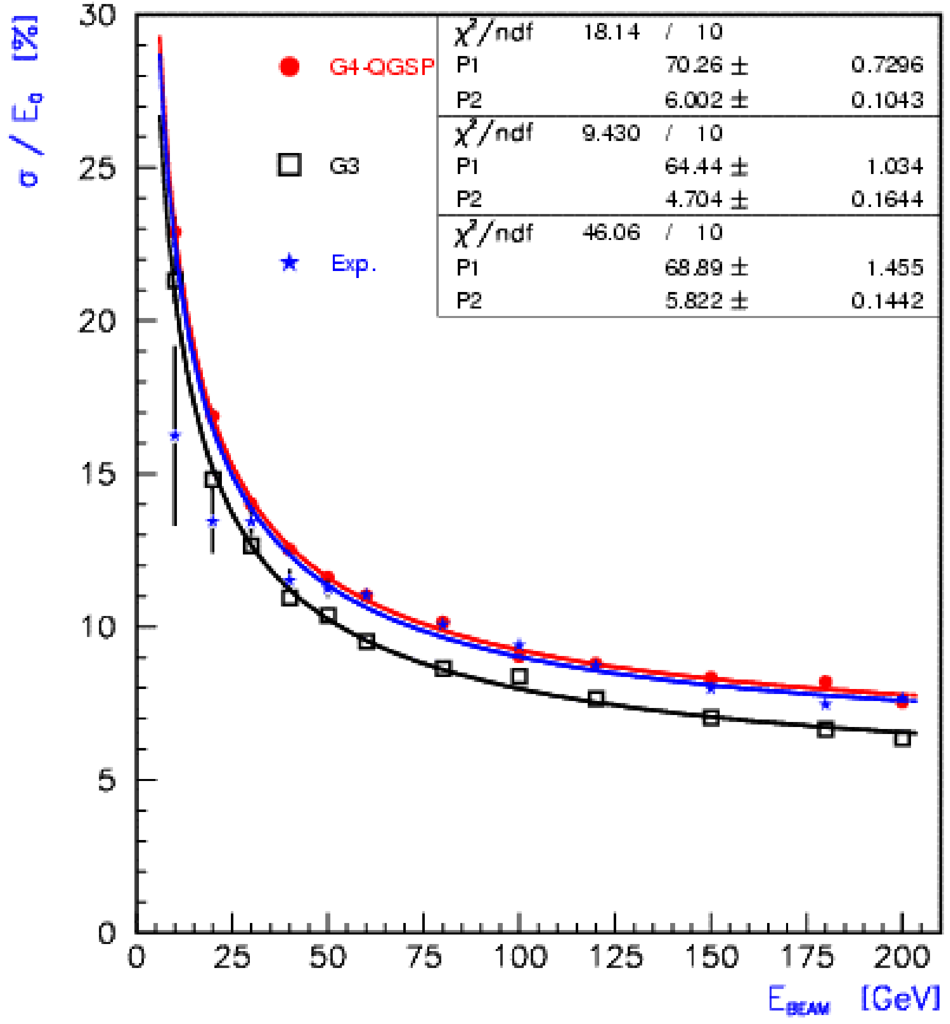
Resolution: 1.2% (low lum)

1.4% (high lum)

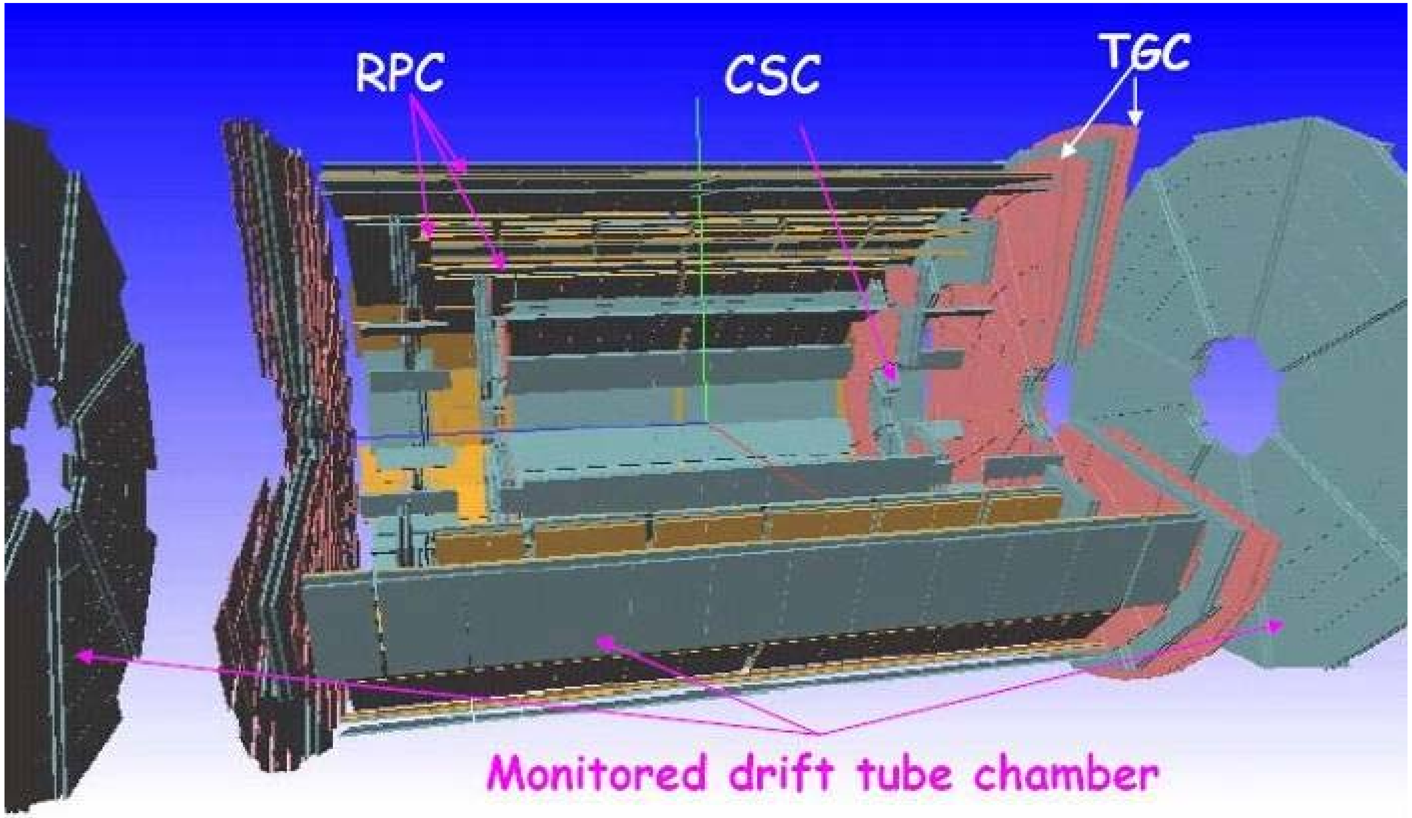
Acceptance: 84% within ±2 σ



$\pi^{\pm}$ E-resolution from ATLAS had. calorimeter test beam data: ~ 70%/√E



Muon Spectrometer Instrumentation



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

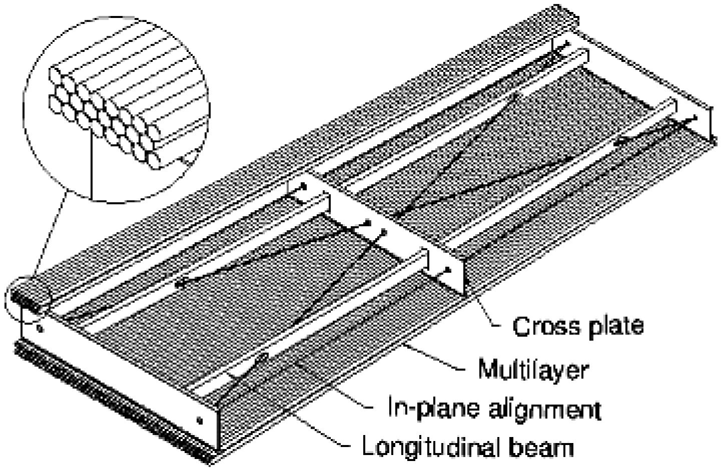
A crucial component to reach the required accuracy is the sophisticated alignment measurement and monitoring system

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

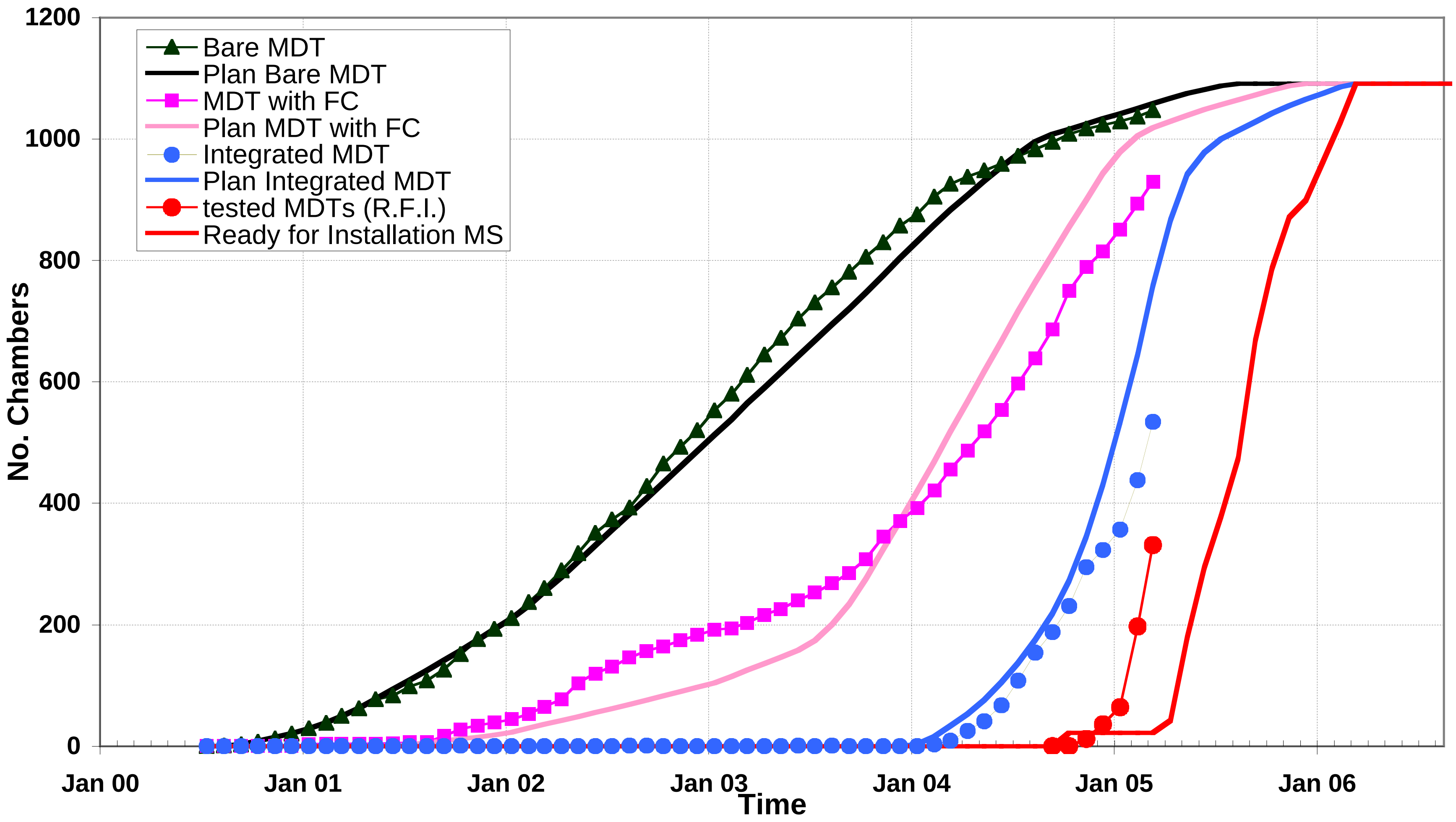
Trigger chambers:
- **RPCs in the barrel**
- **TGCs in the end-caps**

End-cap MDT chamber preparation for installation

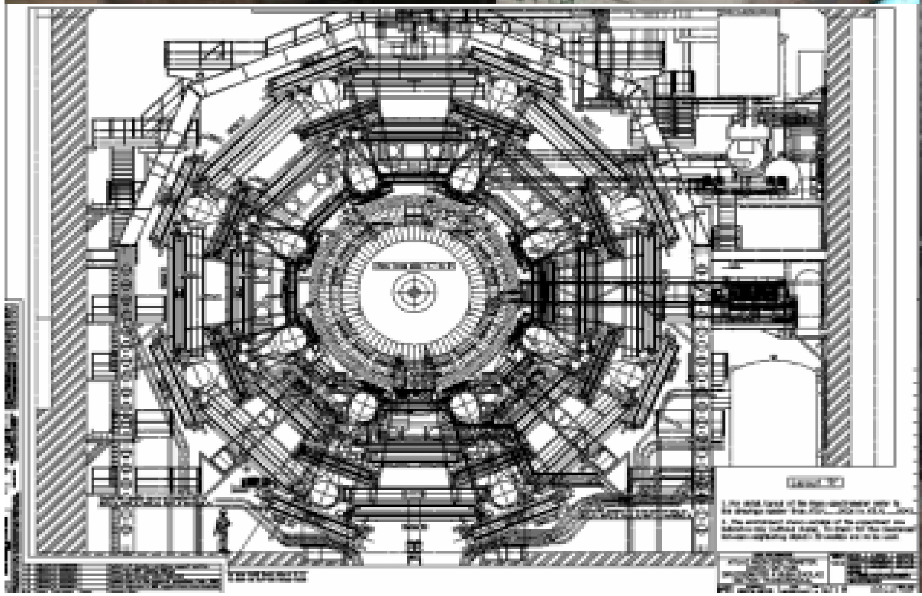
Barrel muon chamber station with an MDT sandwiched between two RPC trigger chambers



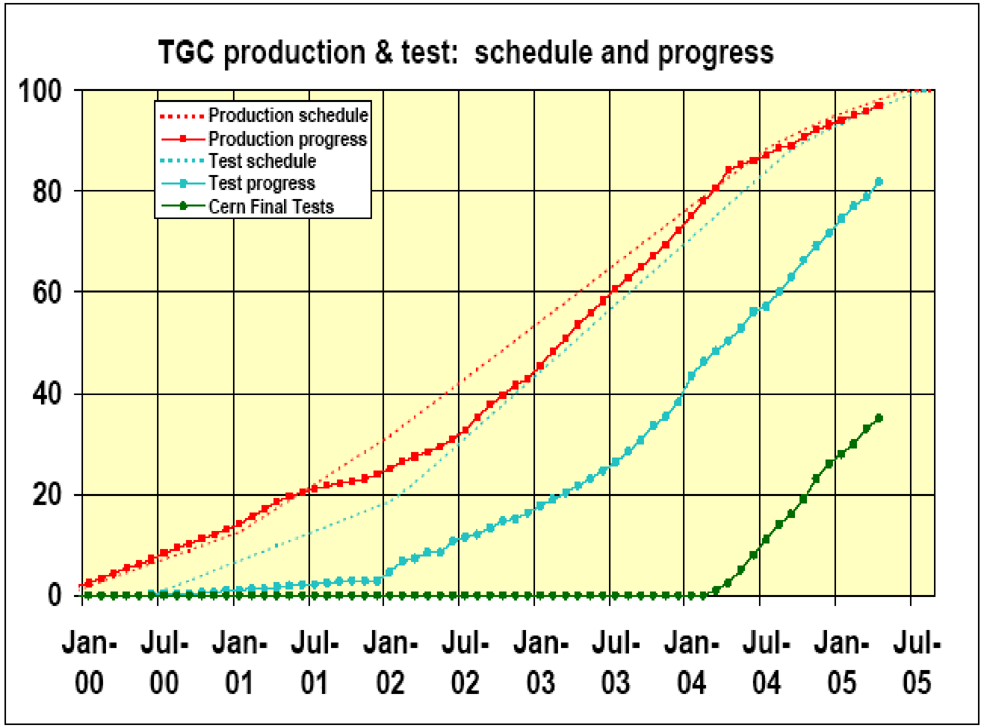
MDT Chamber Production (w/o EE)



The installation of the barrel muon station has started in the feet region of the detector



Pre-assembly of the end-cap muon 'Big-Wheels'



TGC end-cap trigger chamber production is nearing completion

Excellent work, on schedule, by the Japanese colleagues!

First MDT and TGC1 sectors and assembly tooling are now available at CERN

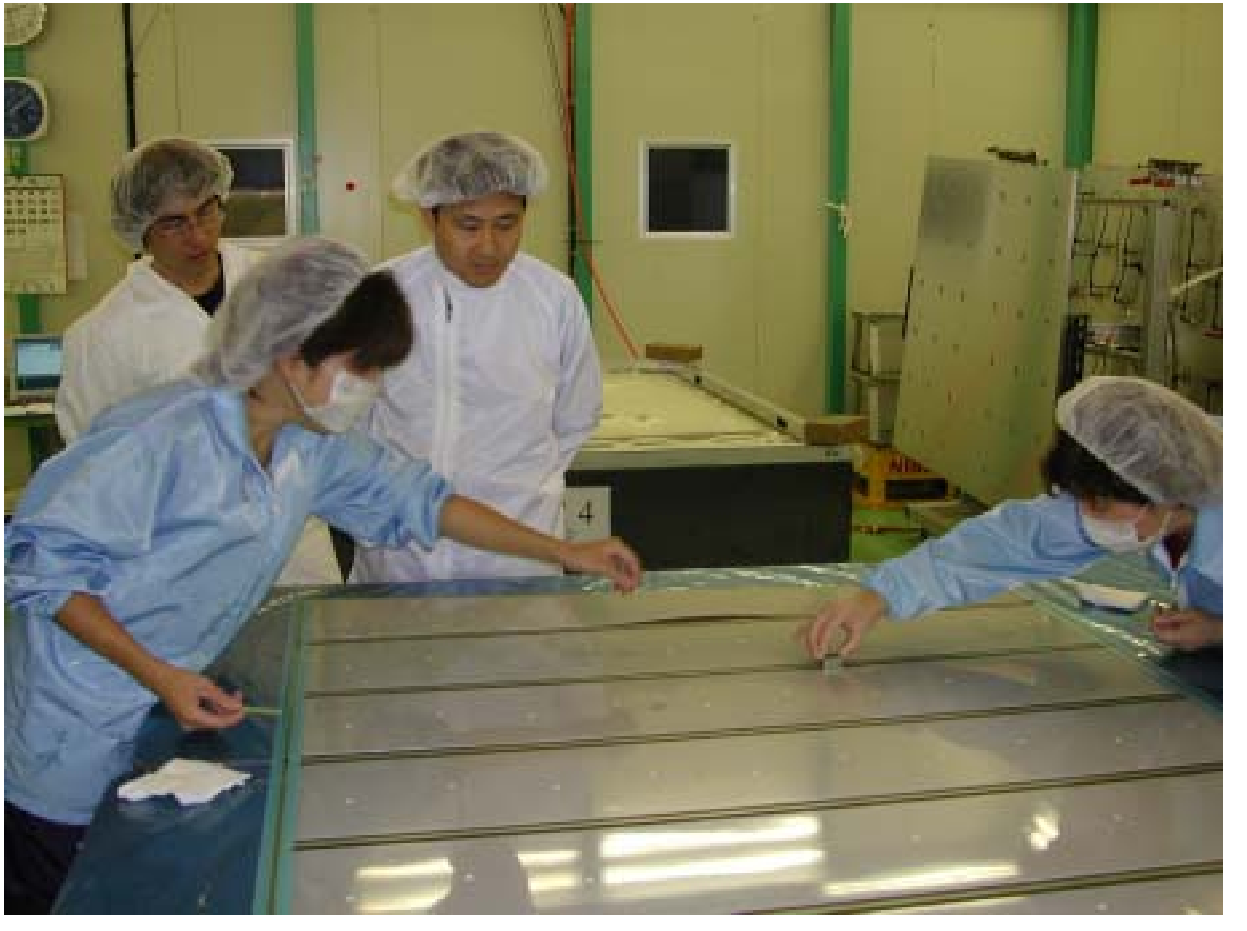
First TGC and MDT sectors are at CERN

72 TGC sectors and 32 MDT have to be assembled from Q2 2005 to Q3 2006 (15 months)

Big-Wheel sector assembly tooling

The Japanese teams have completed well on schedule their large share of the TGC series construction, and they are now very busy with

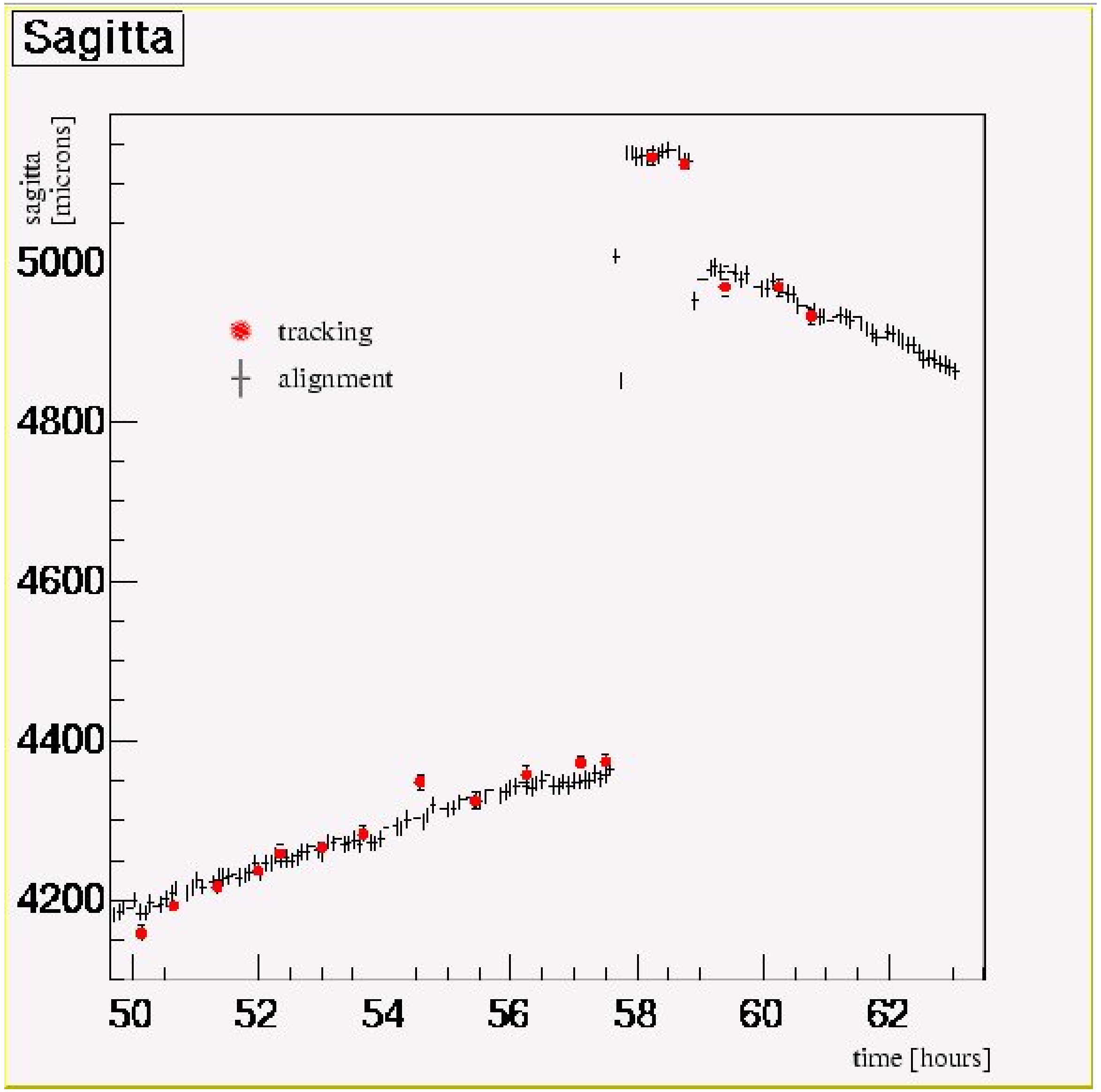
- **the integration at CERN preparing for the installation**
- **completion of the TGC trigger electronics**



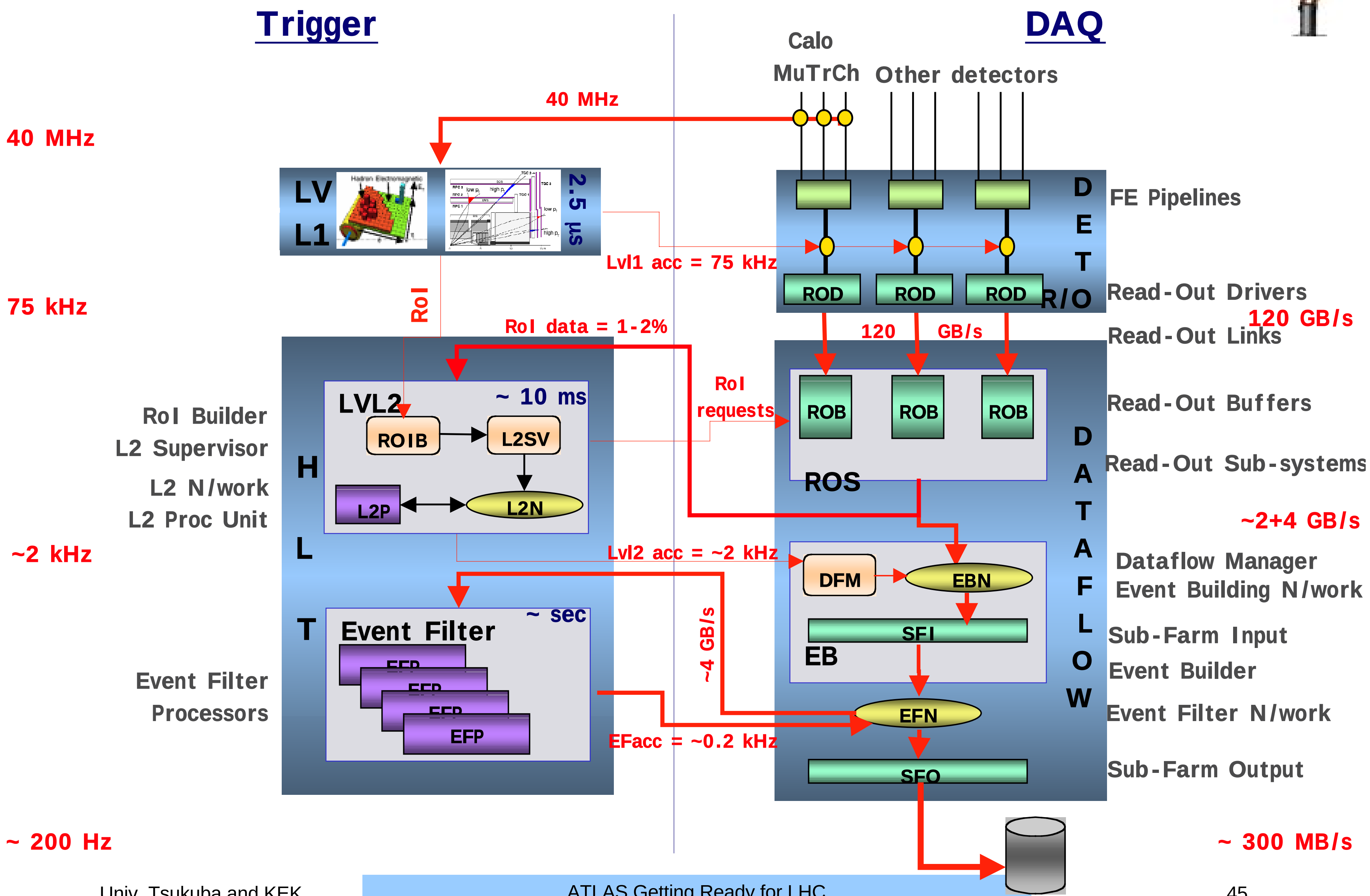
The large-scale system test facility for alignment, mechanical, and many other system aspects, with sample series chamber station in the SPS H8 beam

Shown in this picture is the end-cap set-up, it is preceded in the beam line by a barrel sector

Example of tracking the sagitta measurements, following the day-night variation due to thermal variations of chamber and structures, and two forced displacements of the middle chamber



Trigger, DAQ and Detector Control



Inner detector

	Channels	No. ROLs	Fragment size - kB
Pixels	0.8×10^8	120	0.5
SCT	6.2×10^6	92	1.1
TRT	3.7×10^5	232	1.2

ATLAS total event size = 1.5 MB
Total no. ROLs = 1600

Calorimetry

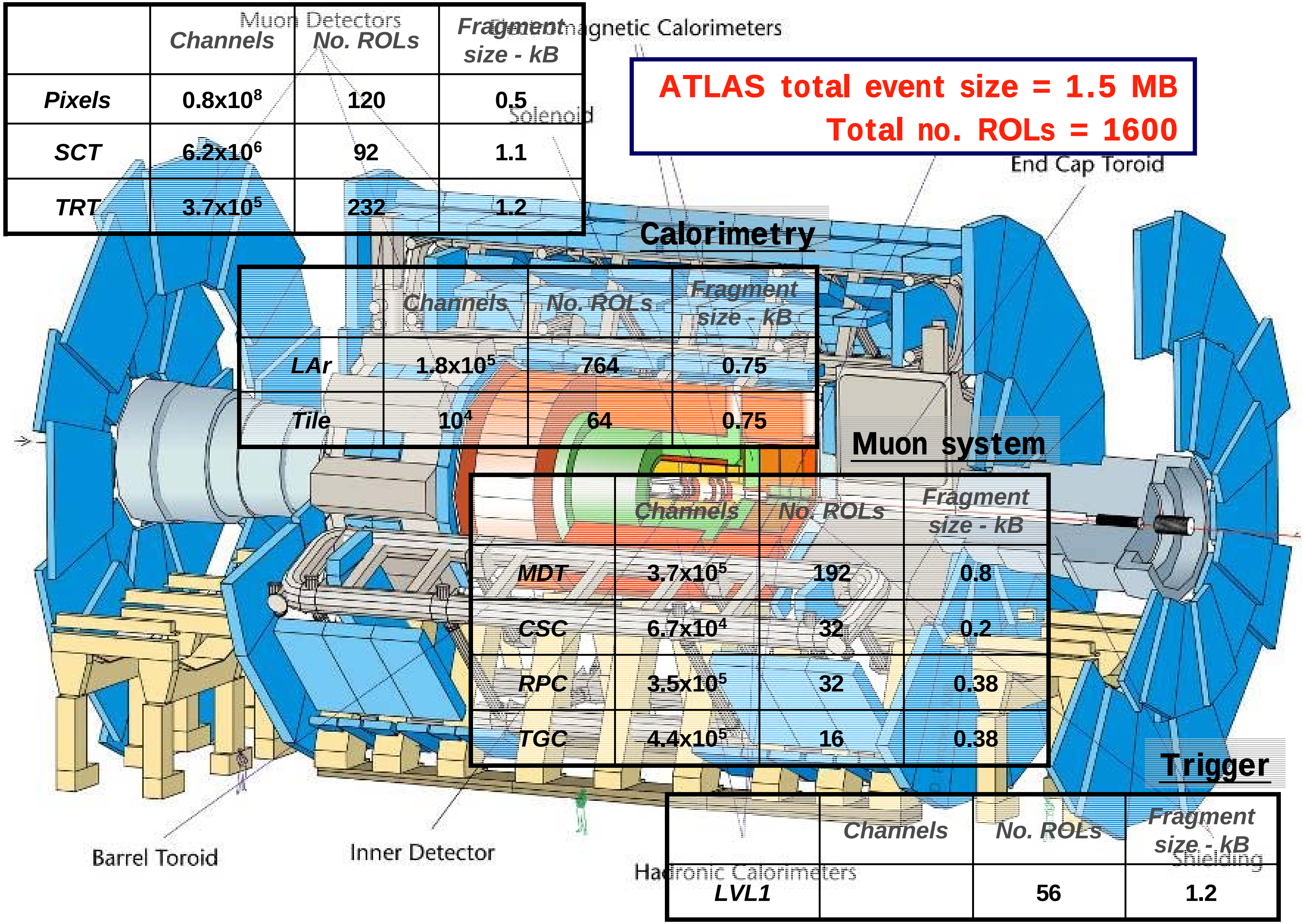
	Channels	No. ROLs	Fragment size - kB
LAr	1.8×10^5	764	0.75
Tile	10^4	64	0.75

Muon system

	Channels	No. ROLs	Fragment size - kB
MDT	3.7×10^5	192	0.8
CSC	6.7×10^4	32	0.2
RPC	3.5×10^5	32	0.38
TGC	4.4×10^5	16	0.38

Trigger

	Channels	No. ROLs	Fragment size - kB
LVL1		56	1.2



Level-1

The level-1 system (calorimeter, muon and central trigger logics) completed the final ASICs developments and testing of full-functionality prototype modules; series production has started

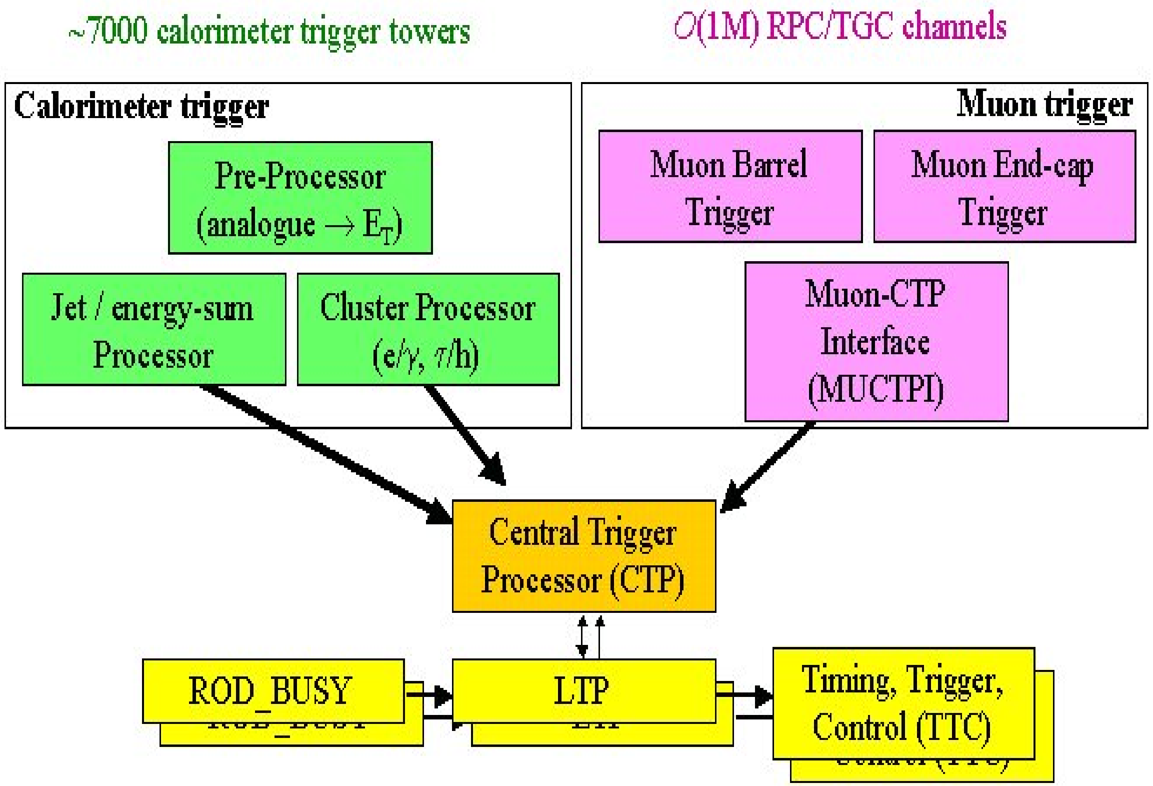
The calorimeter level-1 trigger has worked successfully at the combined test beam in 2004

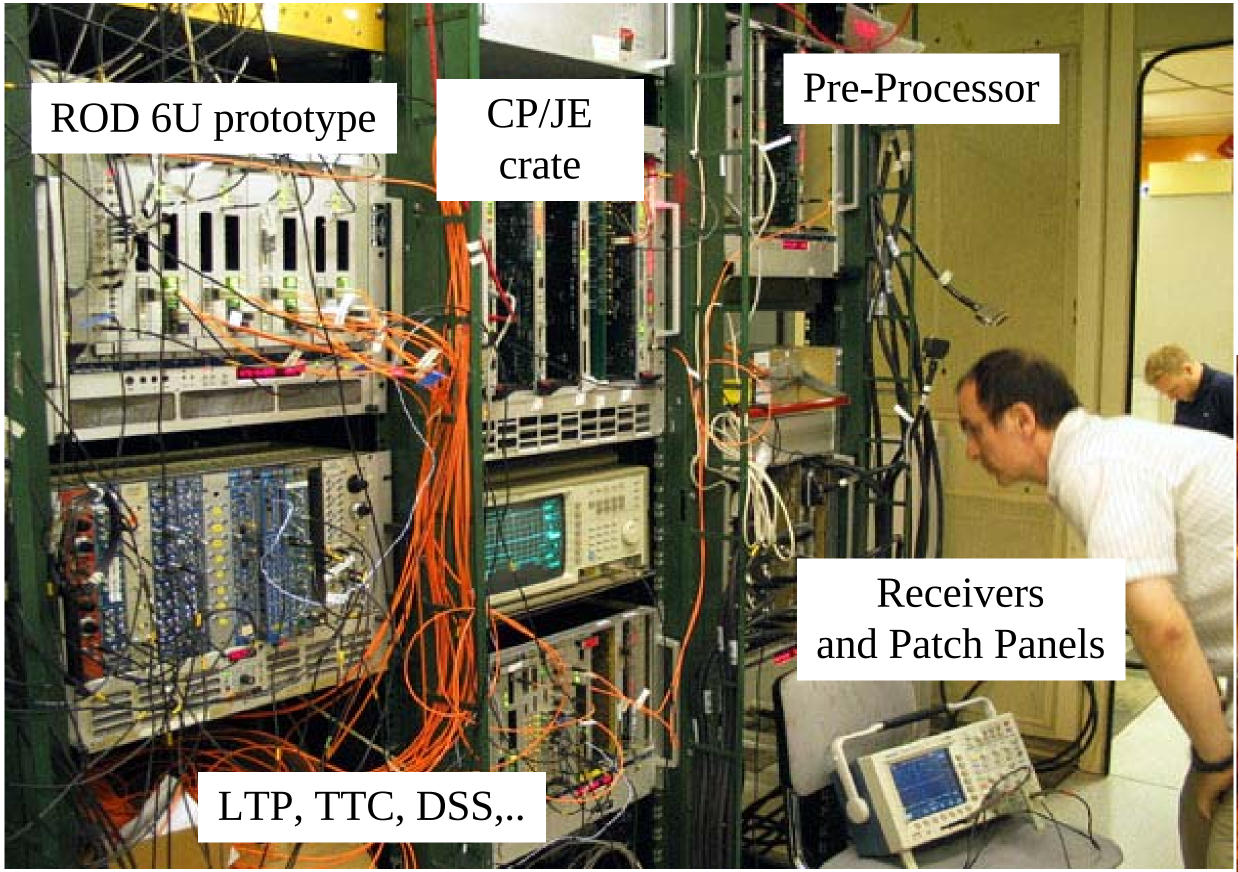
The muon level-1 trigger has been tested with 25 ns bunched test beams, final improvements were implemented in a last iteration

These final ASICs are now under tests, with very positive results, however

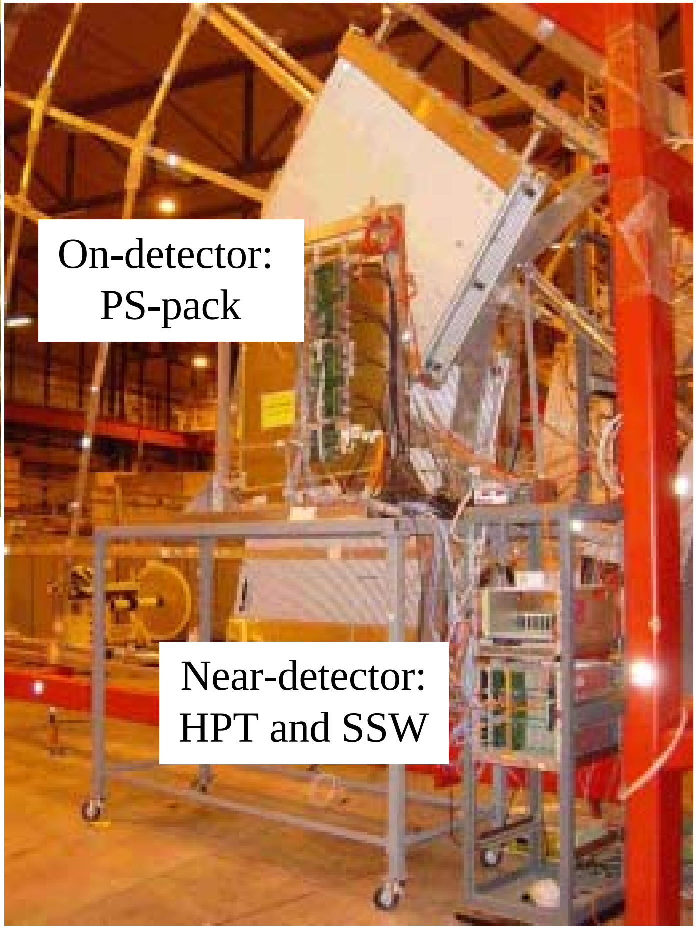
→ both the RPC and TGC ASICs are on the critical path (needed on-detector for integration)

The Central Trigger Processor progresses on schedule





Calorimeter Level-1 trigger at the combined test beam



Muon Level-1 trigger at the combined test beam

HLT/DAQ/DCS

The HLT/DAQ/DCS work proceeded within the framework of the TDR approved early 2004

HLT/DAQ prototypes worked in the 2004 Combined Test Beam, as well as in test beds for optimizing the final design

A pre-series system is now being purchased and will be installed in Pit-1 (as a 10% data flow test)

Local DAQ capability is being set up at the Pit-1 for initial detector commissioning, using The Read Out Driver (ROD) crate DAQ

It is recalled that an important criteria in the choice of the HLT/DAQ architecture was the ability to scale the system for staging needs during the initial running of ATLAS

Components of the DCS are in fabrication, and are already widely used, and the DCS is one of the first systems brought into operation at Pit-1

Final ROBIN module from pre-series

SDX1 HLT/DAQ room at the Pit-1 surface

Pre-series "Module-0" of final system: 8 racks at Pit-1 (10% of final dataflow)

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

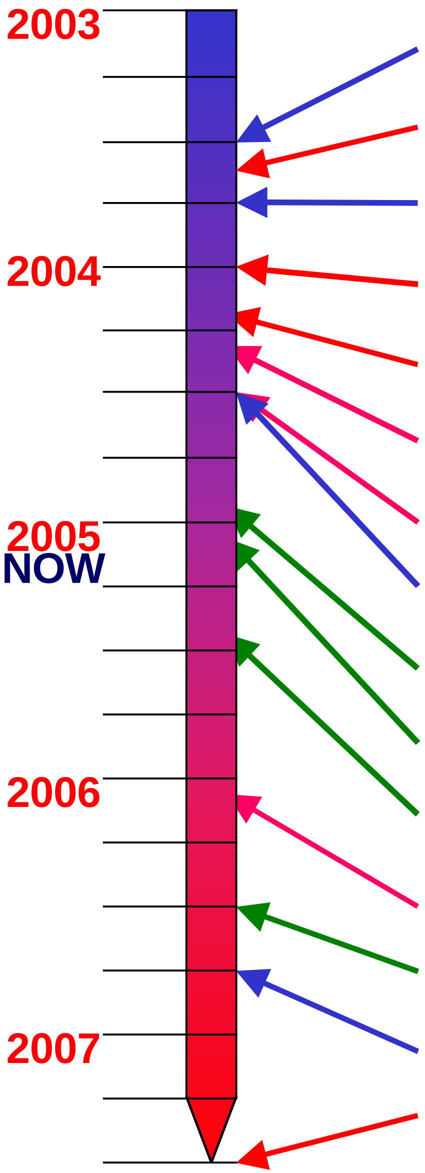
Partial EFIO rack
-
TDAQ rack
-
10 HE PC (6 SFI - 2 SFO - 2 DFM)

Partial EF rack
-
TDAQ rack
-
12 HLT PCs

Partial ONLINE rack
-
TDAQ rack
-
4 HLT PC (monitoring)
2 LE PC (control)
2 Central FileServers

ROS, L2, EFIO and EF racks: one Local File Server, one or more Local Switches

ATLAS Computing Timeline



- POOL/SEAL release (done)
- ATLAS release 7 (with POOL persistency) (done)
- LCG-1 deployment (done)
- ATLAS complete Geant4 validation (done)
- ATLAS release 8 (done)
- DC2 Phase 1: simulation production (done)
- DC2 Phase 2: intensive reconstruction (the real challenge!)
- Combined test beams (barrel wedge) (done)
- Computing Model paper (done)
- Computing Memoranda of Understanding (ready for signatures)
- ATLAS Computing TDR and LCG TDR (in progress)
- Computing System Commissioning
- Physics Readiness Report
- Start cosmic ray run
- **GO!**

Computing System Commissioning Goals

- We have recently defined the high-level goals of the Computing System Commissioning operation during the first half of 2006
  - Formerly called "DC3"
  - More a running-in of continuous operation than a stand-alone challenge
- Main aim of Computing System Commissioning will be to test the software and computing infrastructure that we will need at the beginning of 2007:
  - Calibration and alignment procedures and conditions DB
  - Full trigger chain
  - Tier-0 reconstruction and data distribution
  - Distributed access to the data for analysis
- At the end (mid-2006) we will have a working and operational system, ready to take data with cosmic rays at increasing rates

ATLAS DC2: countries (sites)

- Australia (1)
- Austria (1)
- *Canada* (4)
- CERN (1)
- Czech Republic (2)
- Denmark (4)
- France (1)
- Germany (1+2)
- Italy (7)

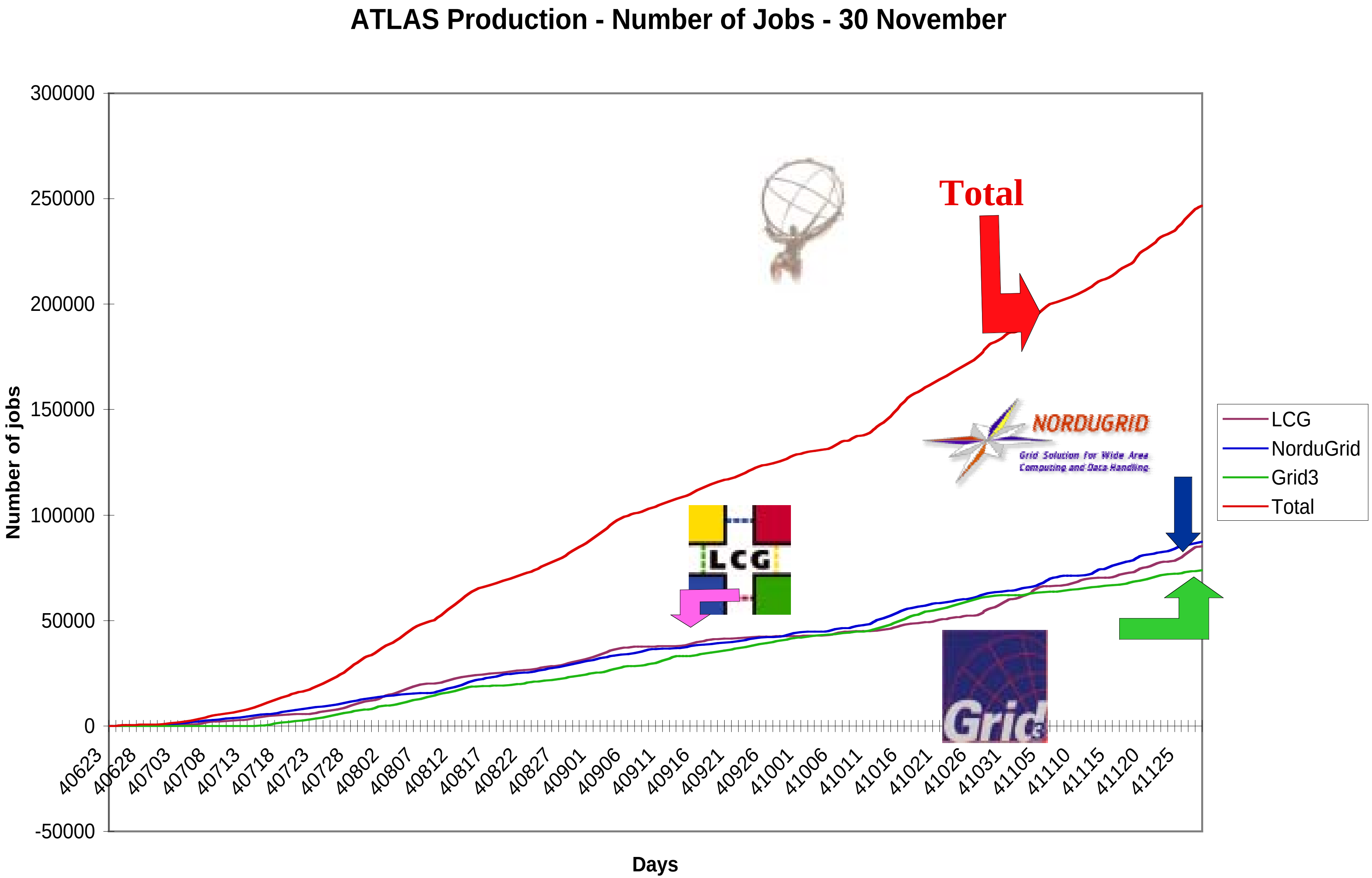
- Japan (1)
- Netherlands (1)
- Norway (3)
- Poland (1)
- Slovenia (1)
- Spain (3)
- Sweden (7)
- Switzerland (1)
- Taiwan (1)
- UK (7)
- USA (19)

20 countries
69 sites

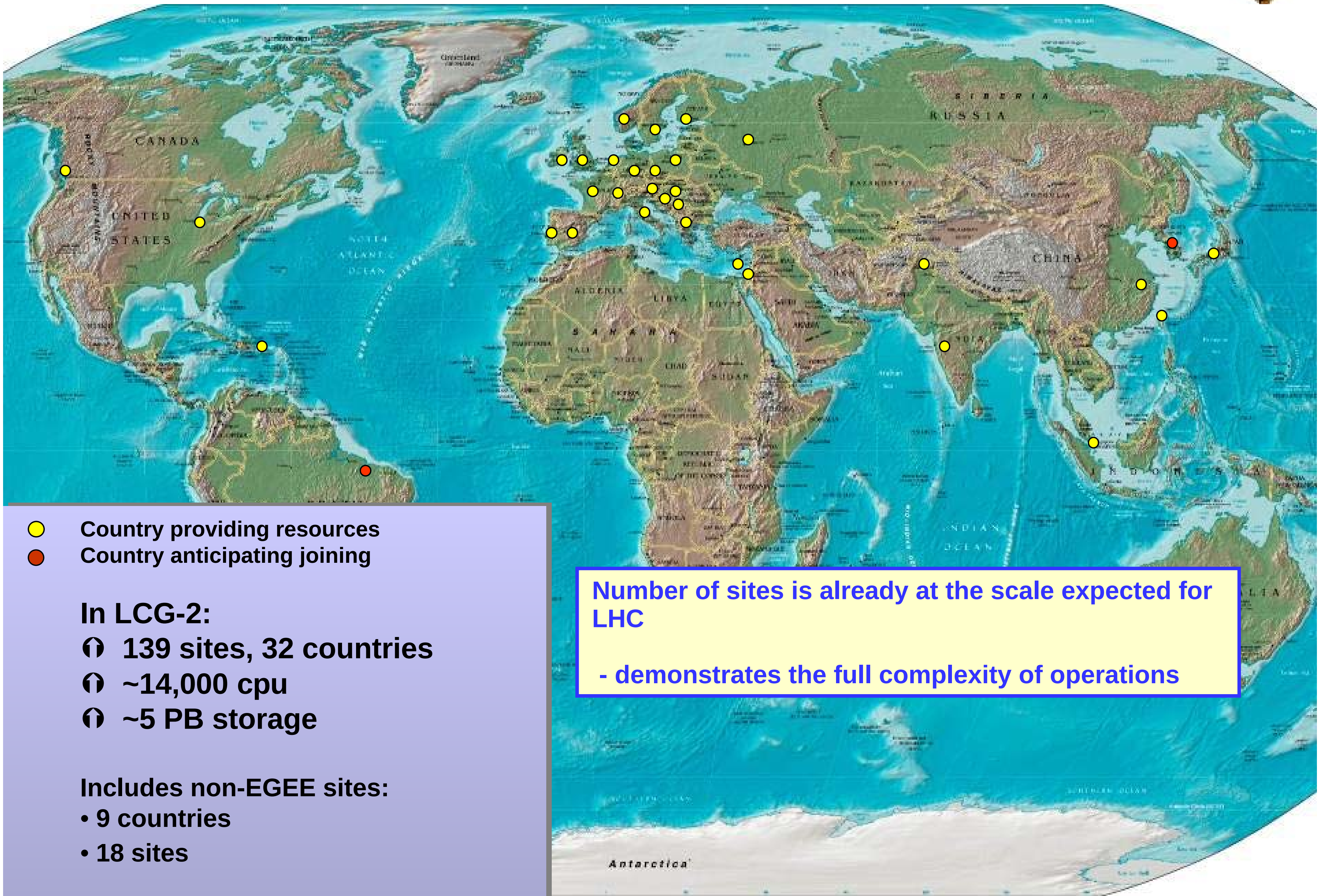
13 countries; 31 sites

7 countries; 19 sites

ATLAS DC2 production



LCG Computing Resources: May 2005



- 🟡 Country providing resources
- 🔴 Country anticipating joining

In LCG-2:

- **139 sites, 32 countries**
- **~14,000 cpu**
- **~5 PB storage**

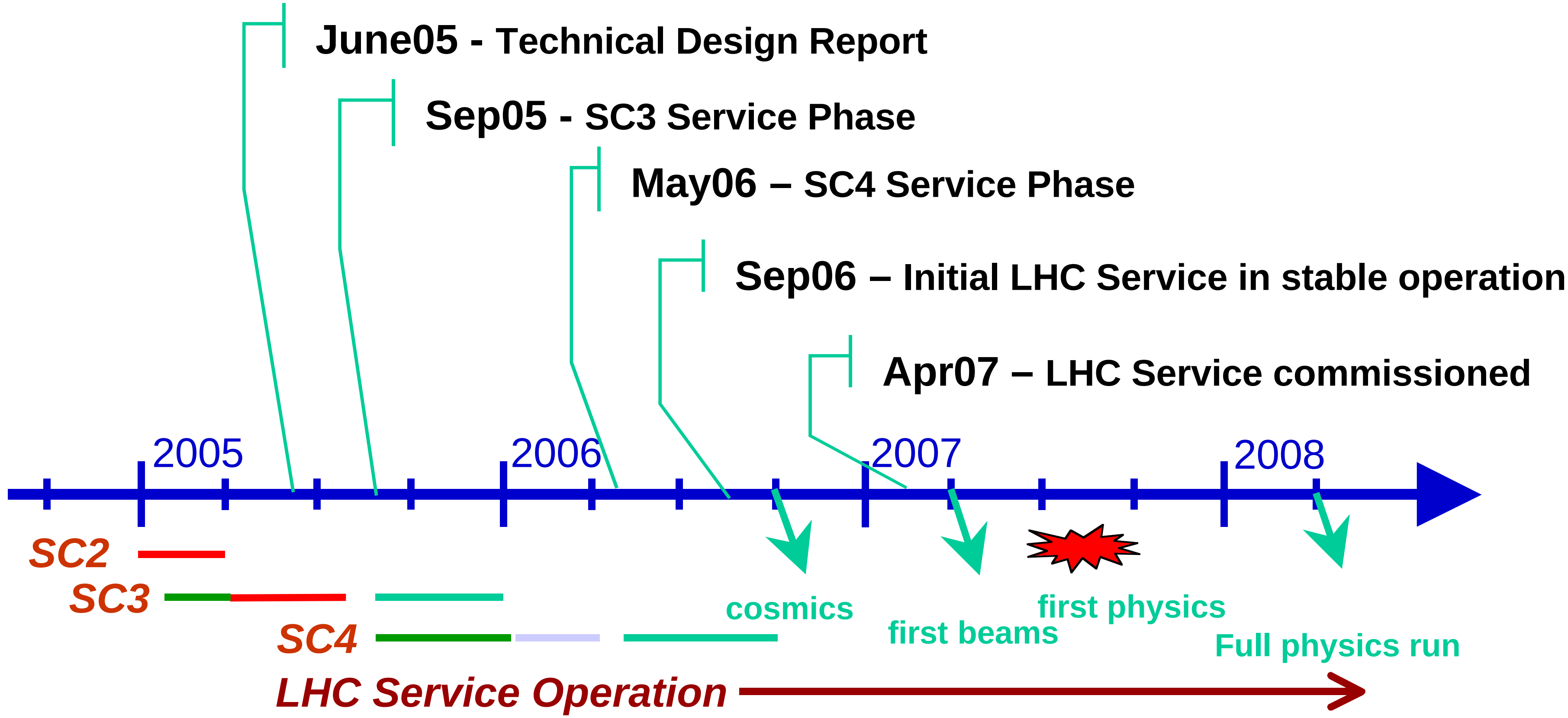
Includes non-EGEE sites:

- **9 countries**
- **18 sites**

Number of sites is already at the scale expected for LHC

- demonstrates the full complexity of operations

Service Challenges – ramp up to LHC start-up service



SC2 – Reliable data transfer (disk-network-disk) – 5 Tier-1s, aggregate 500 MB/sec sustained at CERN

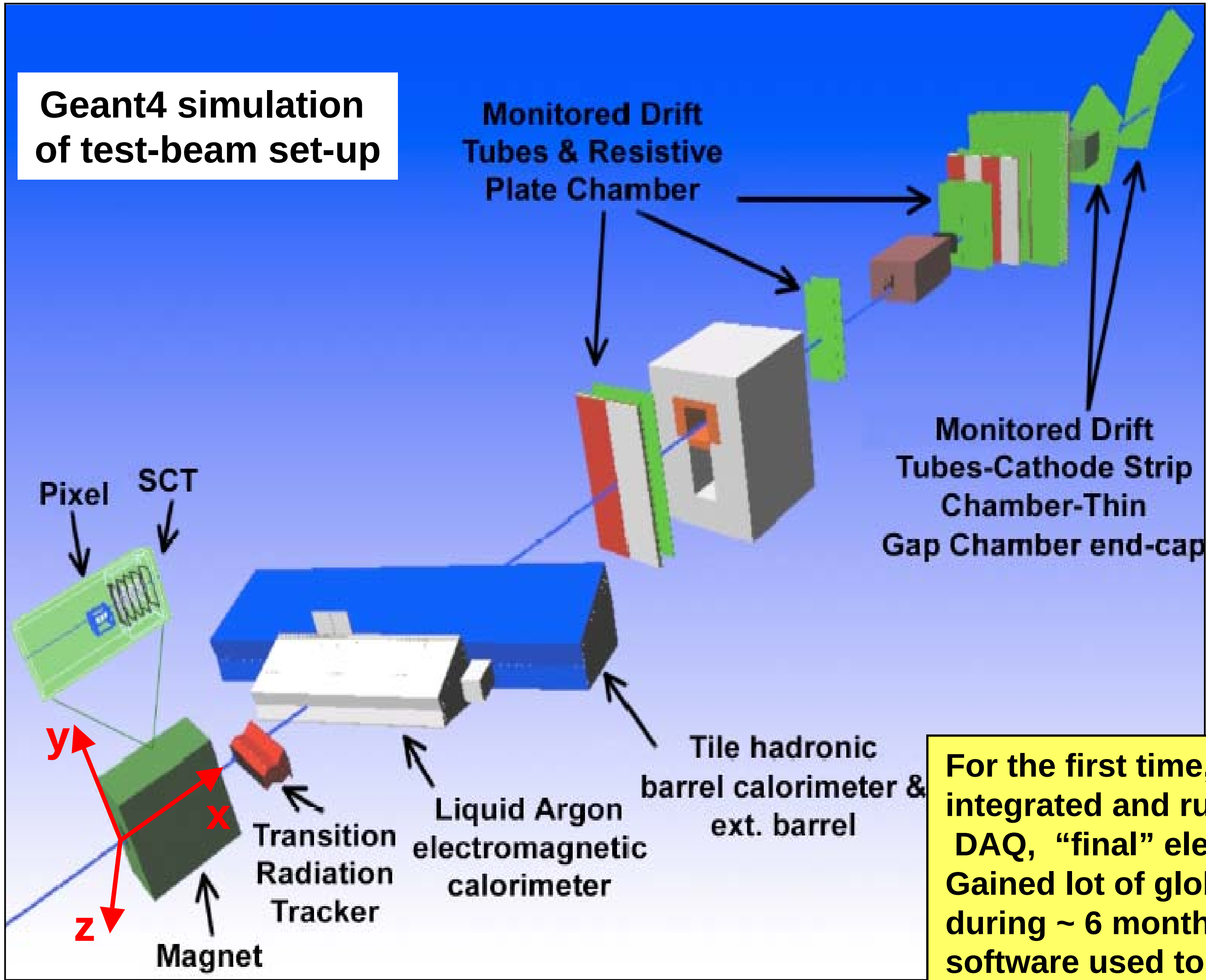
SC3 – Reliable base service – most Tier-1s, some Tier-2s – basic experiment software chain – grid data throughput 500 MB/sec, including mass storage (~25% of the nominal final throughput for the proton period)

SC4 – All Tier-1s, major Tier-2s – capable of supporting full experiment software chain inc. analysis – sustain nominal final grid data throughput

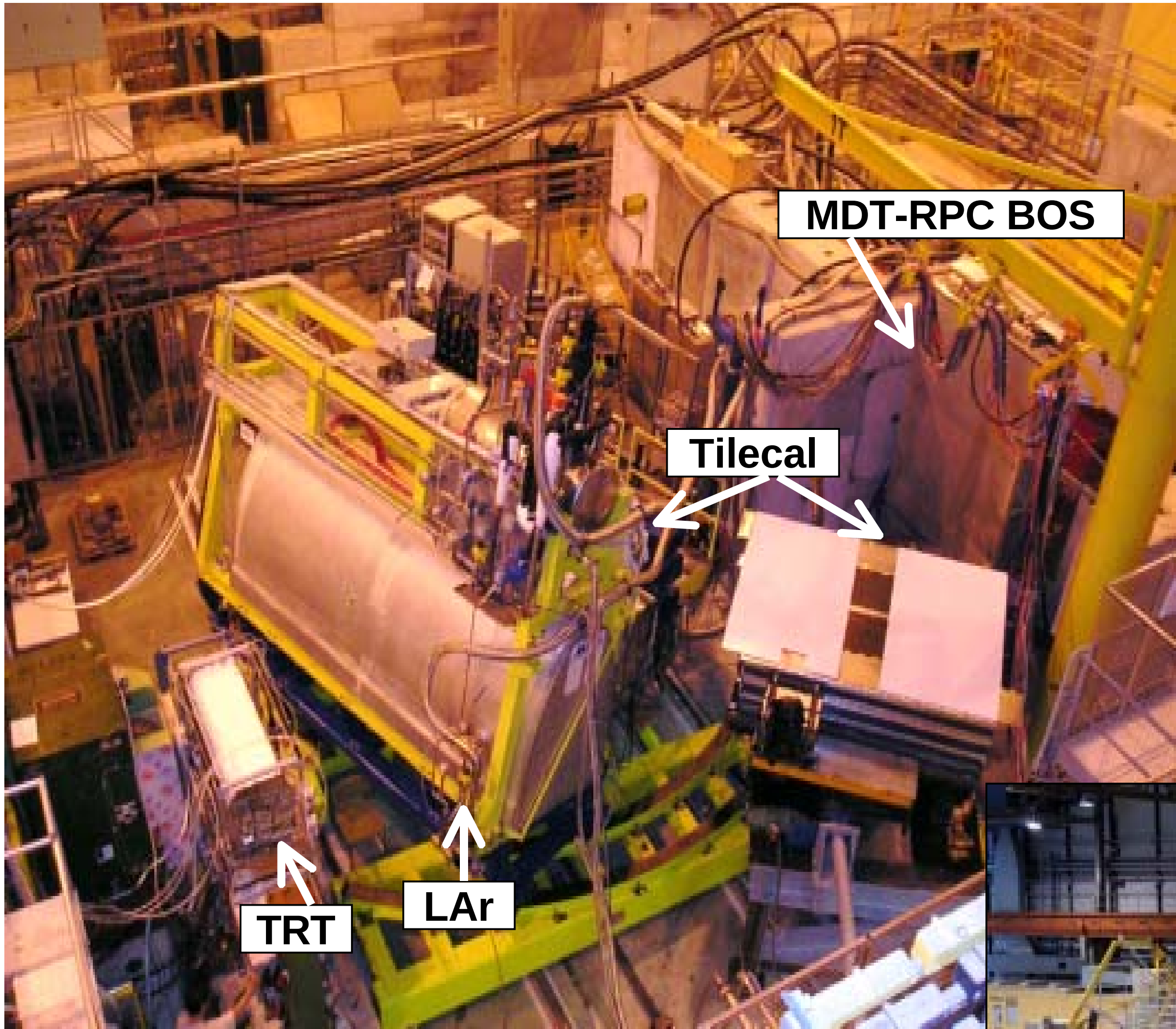
LHC Service in Operation – September 2006 – ramp up to full operational capacity by April 2007 – capable of handling twice the nominal data throughput

Towards the complete experiment: ATLAS combined test beam in 2004

Full "vertical slice" of ATLAS tested on CERN H8 beam line May-November 2004



For the first time, all ATLAS sub-detectors integrated and run together with common DAQ, "final" electronics, slow-control, etc. Gained lot of global operation experience during ~ 6 month run. Common ATLAS software used to analyze the data

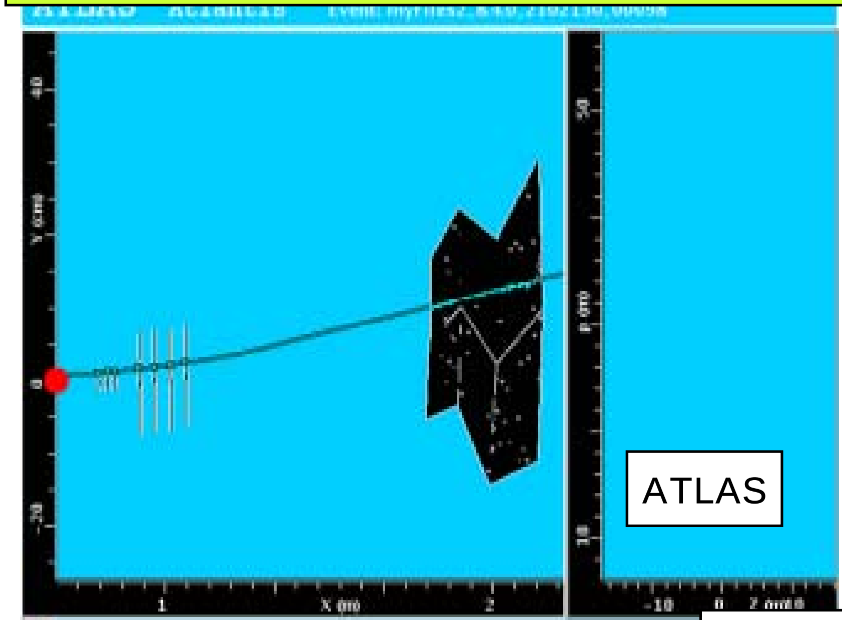


~ 90 million events collected
~ 4.5 TB of data:

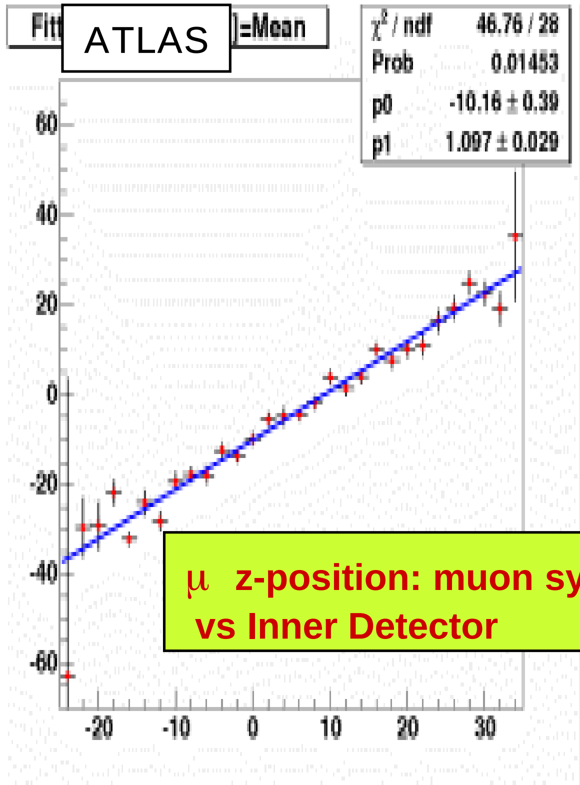
$e^{\pm}$, $\pi^{\pm}$	1 → 250 GeV
$\mu^{\pm}$, $\pi^{\pm}$, p	up to 350 GeV
γ	~ 30 GeV

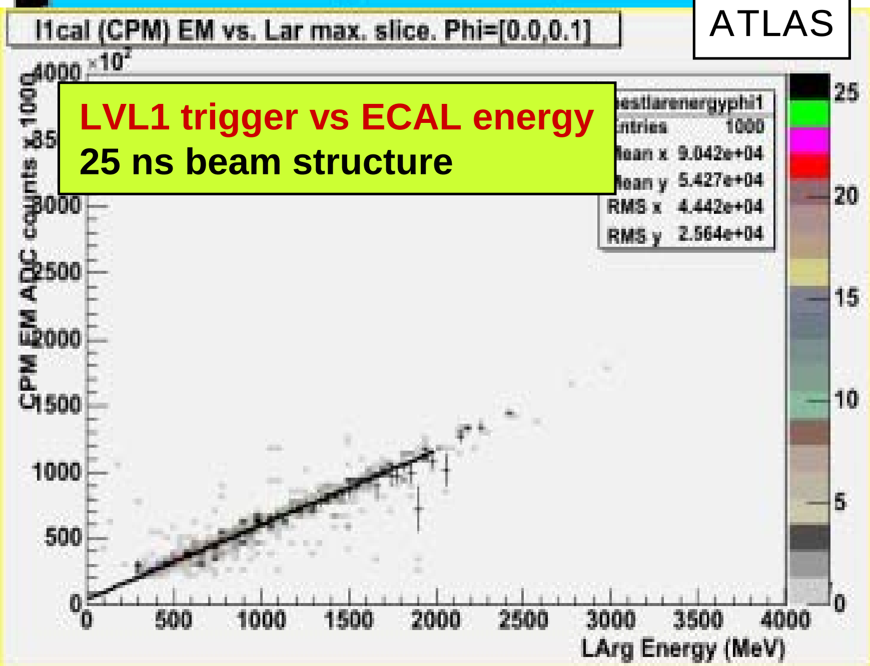
B-field = 0 → 1.4 T

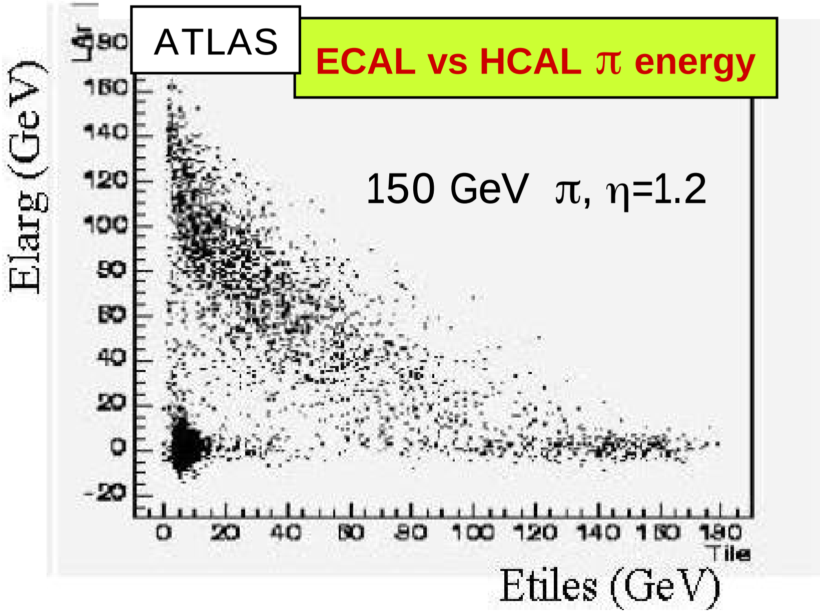
9 GeV pion track in Pixels, SCT, TRT (B=1.4 T)

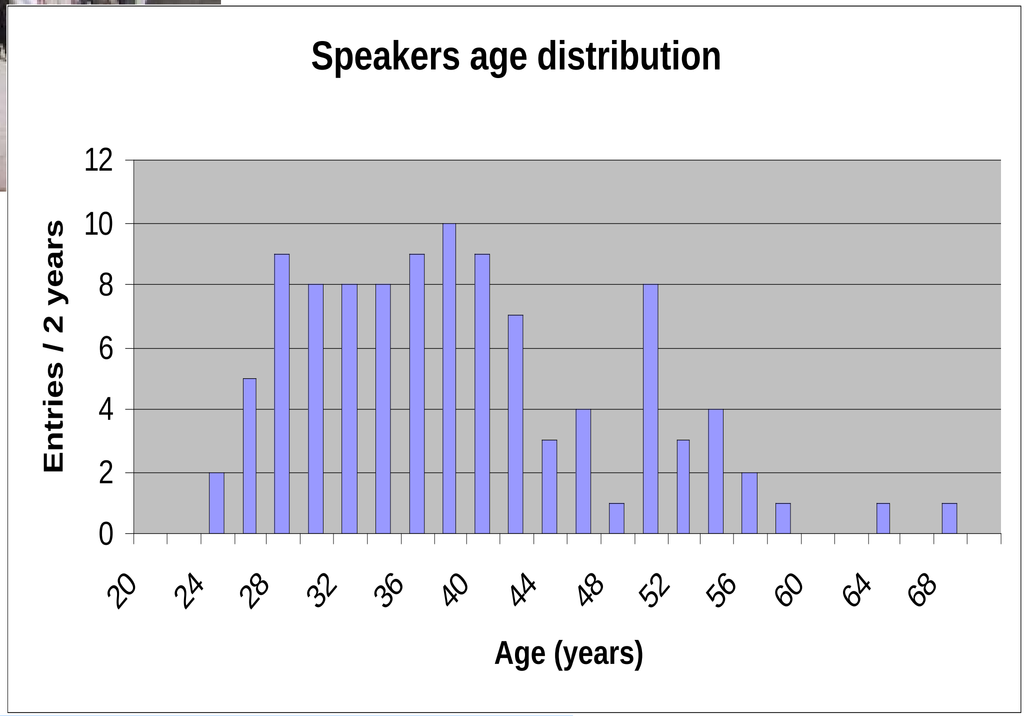


A few very preliminary results









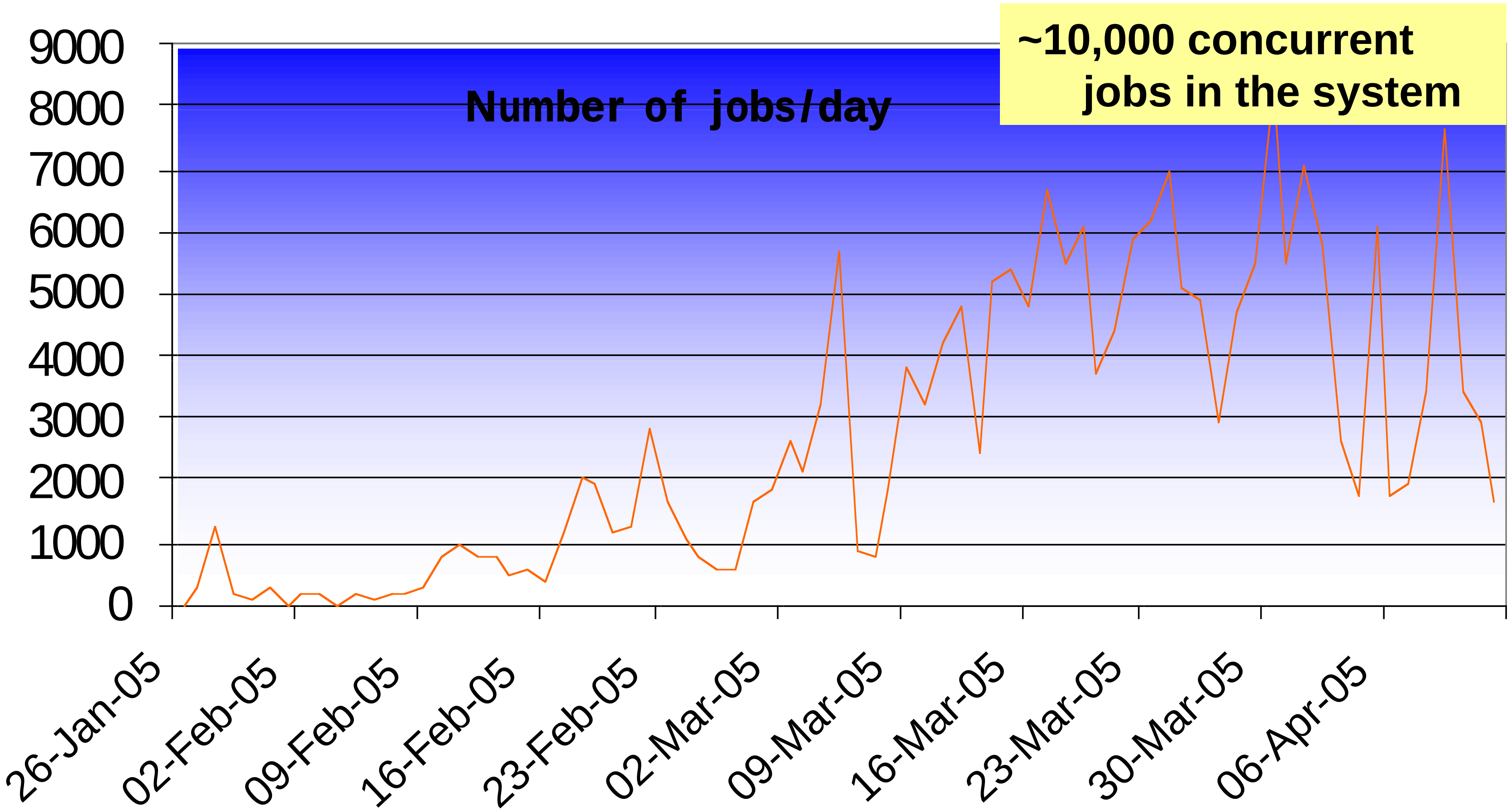
4th ATLAS Physics Workshop Athens, May 2003

(next one in June 2005 in Rome)

Speakers age distribution of 103 (of the 104) talks

28 female and 76 male speakers

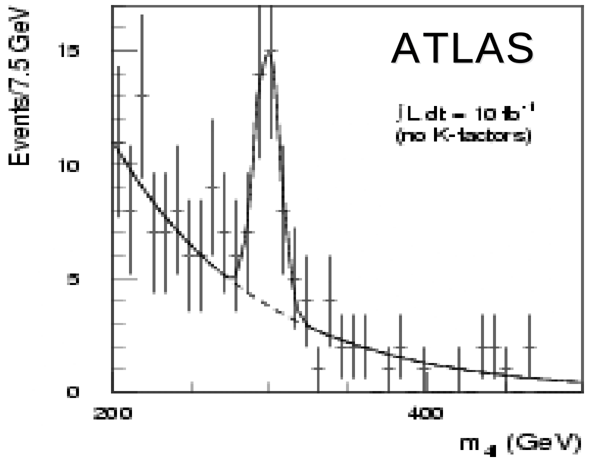
LCG use for the physics simulation for the Rome Physics Workshop

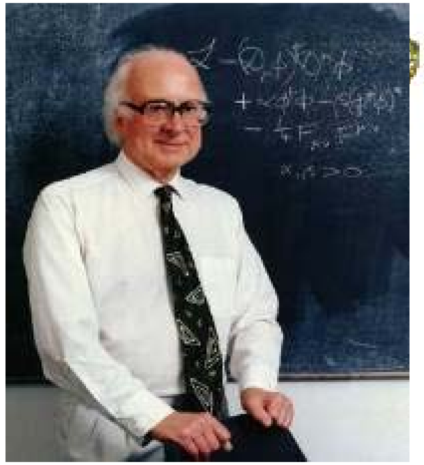


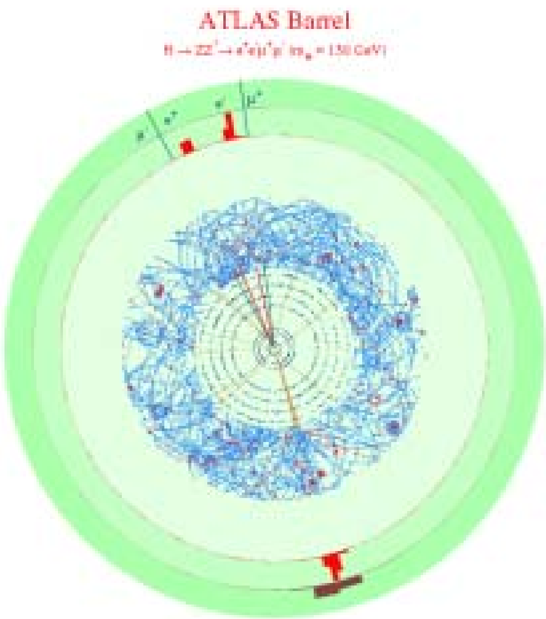
- ATLAS jobs in EGEE/LCG-2 in 2005
  - In latest period up to 8K jobs/day
- Several times the current capacity for ATLAS at CERN alone – shows the reality of the grid solution

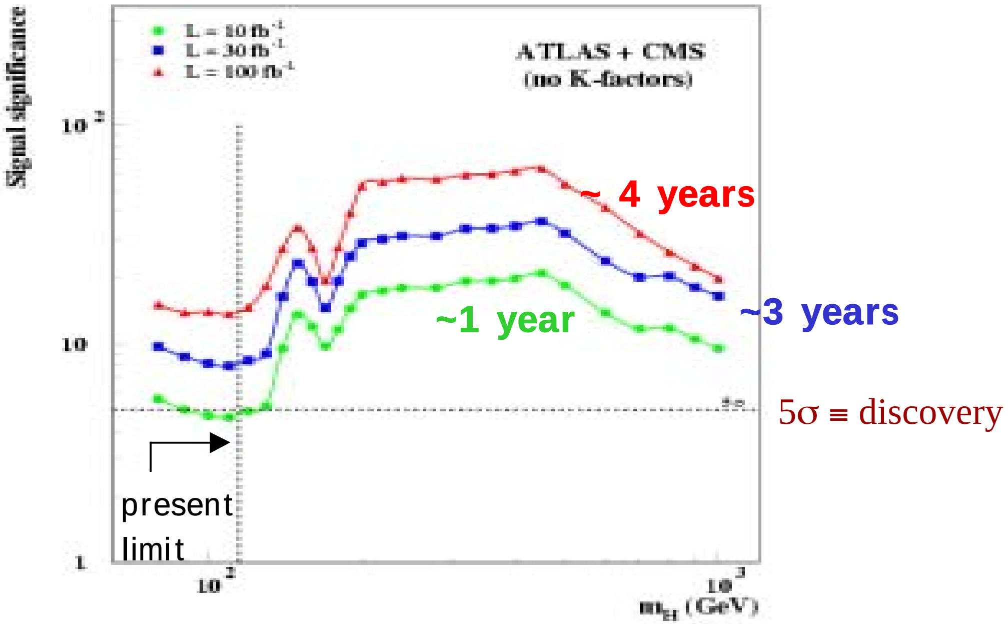
Search for the Higgs boson

$H \rightarrow ZZ^{(*)} \rightarrow 4l$

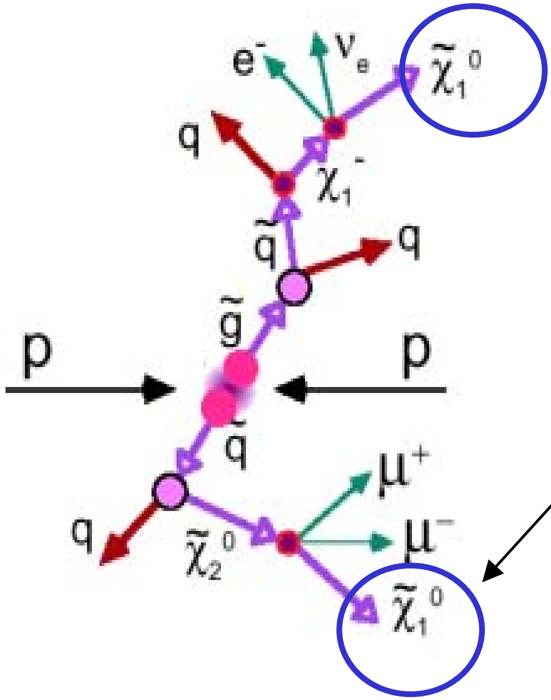








Supersymmetric particles and dark matter



This particle (neutralino) is a good candidate for the universe dark matter

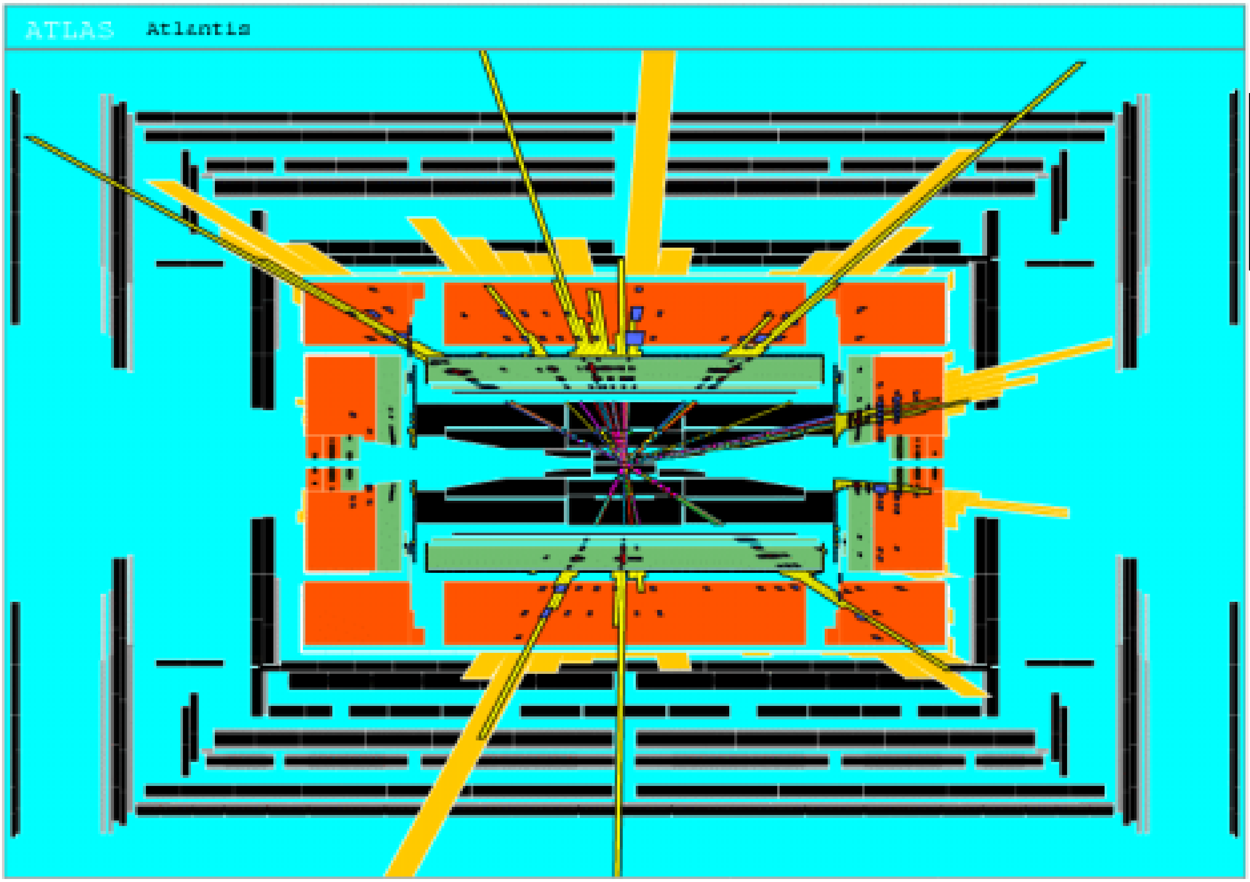
Strong impact of Japanese colleagues in the field of SUSY studies in ATLAS

ATLAS discovery reach

Time	reach in squark/gluino mass
1 month	~ 1.3 TeV
1 year	~ 1.8 TeV
3 years	~ 2.5 TeV
ultimate	up to ~ 3 TeV

Neutralino mass can be measured to 10% → SUSY discovery and neutralino mass measurement at LHC can solve problem of universe cold dark matter

If theories with Extra-dimensions are true, mini black holes should be abundantly produced and observed at the LHC.



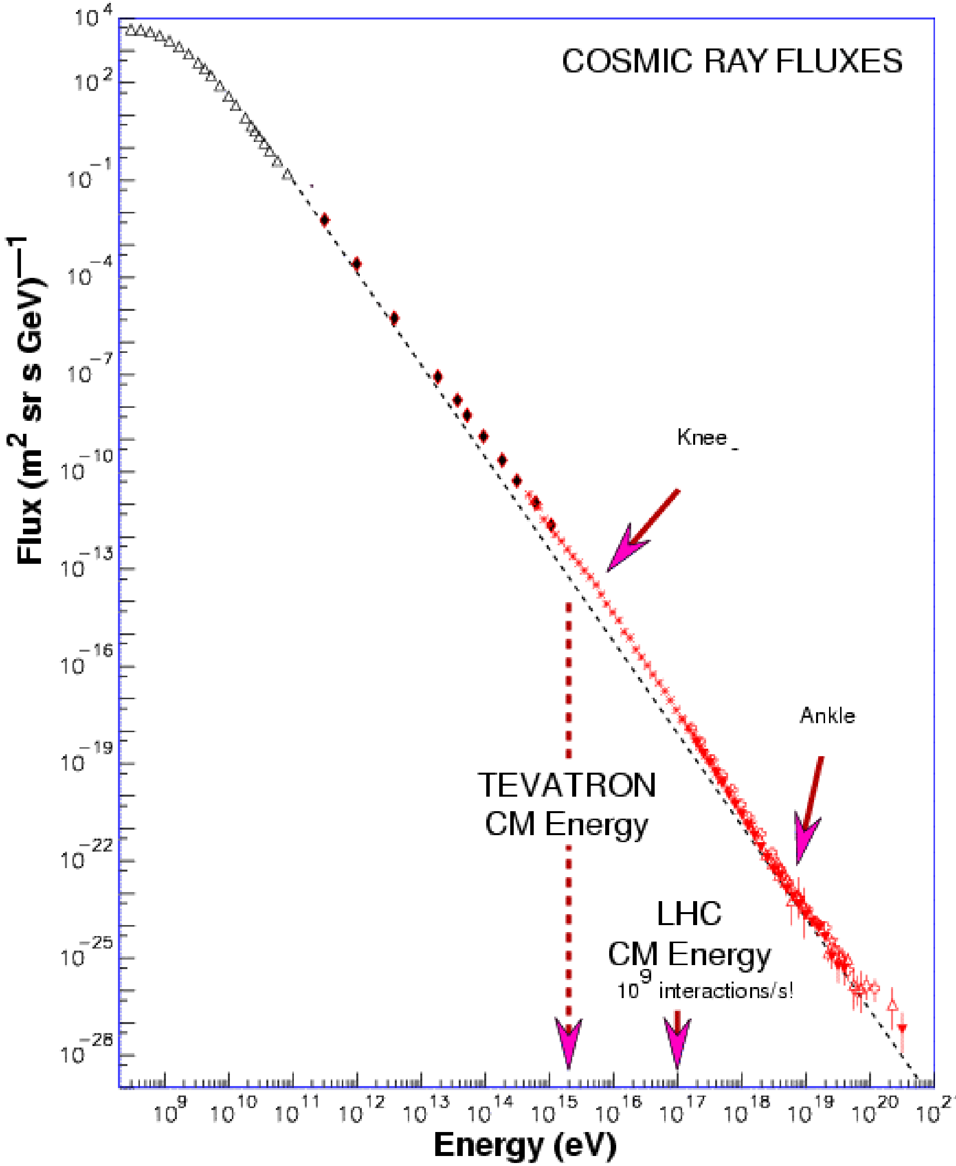
Simulation of a black hole event with M_{BH} ~ 8 TeV in ATLAS

They decay immediately
→ harmless ….

Also in this field there is a great activity in Japan for the ATLAS physics

Are there links with astrophysics and cosmology ? Yes, many ....

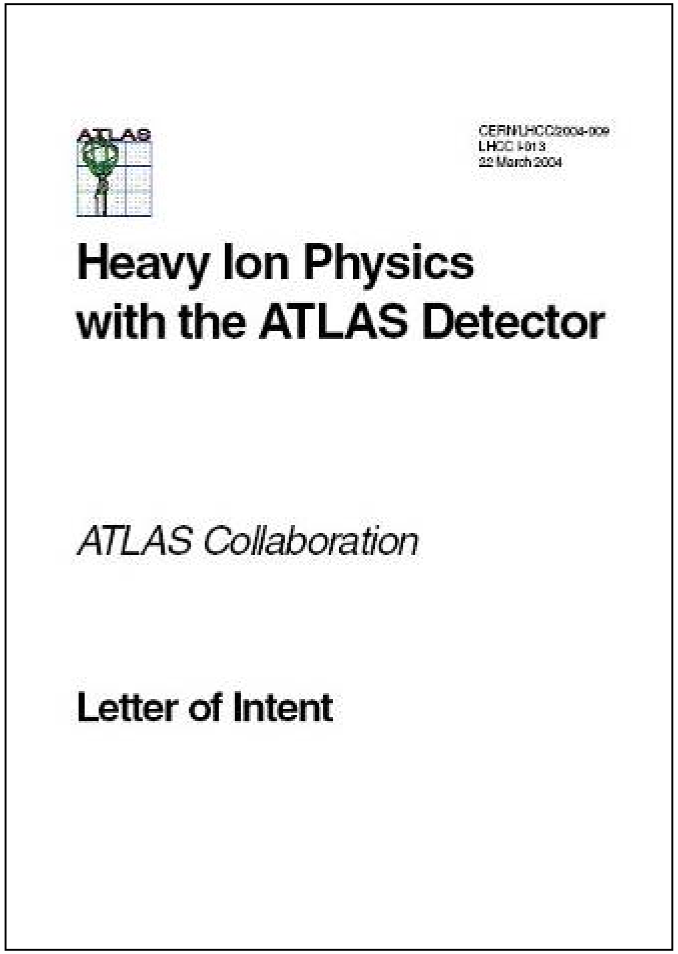
√s = 14 TeV → corresponds to E ~ 100 PeV fixed target proton beam



The LHC will be the first machine able to explore the high-E part of the cosmic ray spectrum

ATLAS potential for heavy ions

Specific strengths of the detector can be exploited for HI
- Best jet calorimetry at LHC → detailed jet quenching
- Tracking and muon spectrometer → production/suppression of heavy quark states

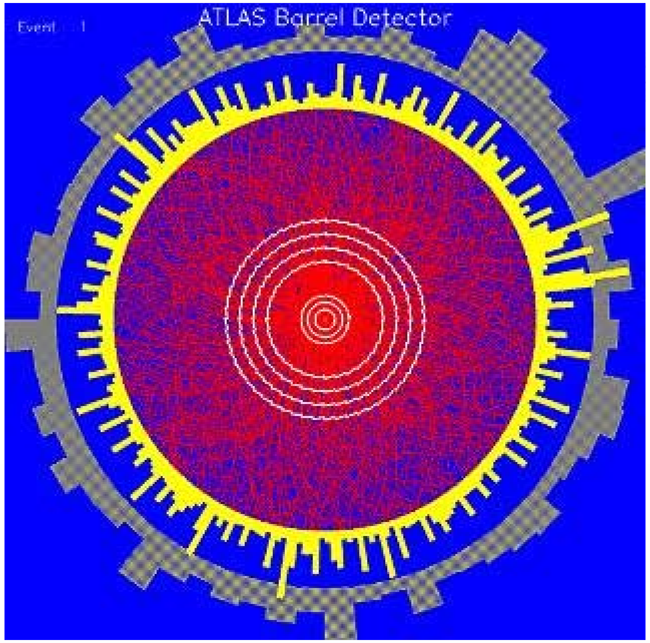

ATLAS
CERN/LHCC 2004-009
LHCC I-013
22 March 2004

Heavy Ion Physics with the ATLAS Detector

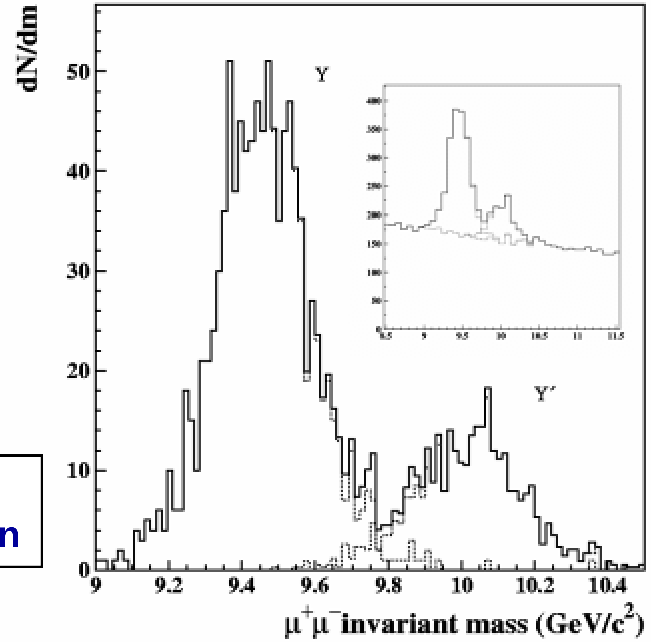
ATLAS Collaboration

Letter of Intent

Pb-Pb collision
b = 0, dy = 0.5
5.5 TeV/coll. nucl.
10^{27} cm^{-2} s^{-1}



Pb-Pb collision
Upsilon production

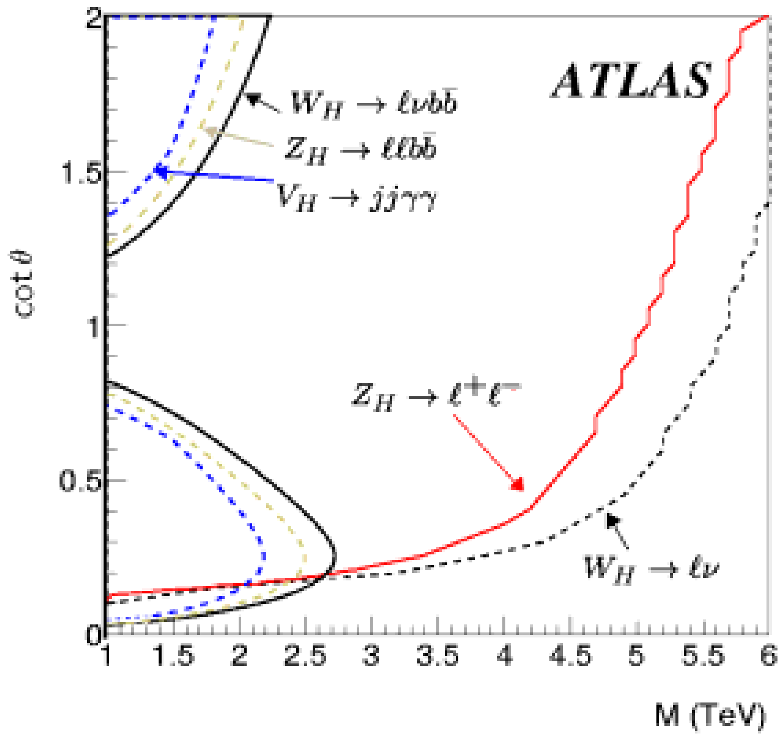


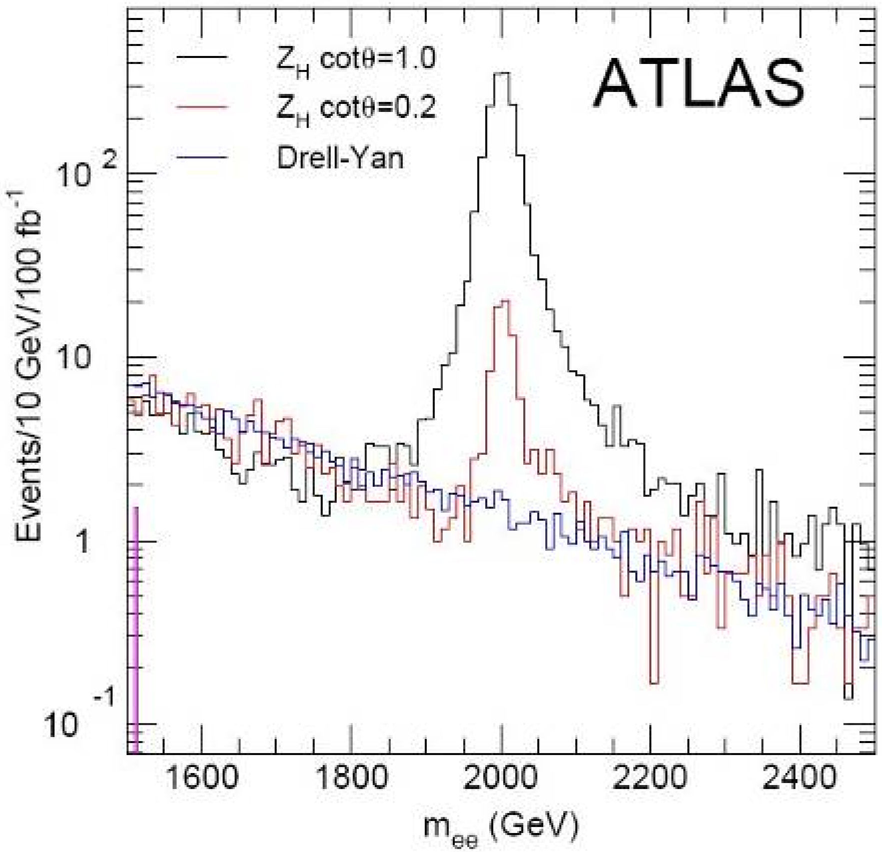
Very recent example: **ATLAS potential for 'Little Higgs Models'**
→ Scientific Note EPJ

LHM **New approach to the hierarchy problem, predicting a rich phenomenology with many new particles (heavy top T, new Gauge Bosons W_H, Z_H, A_H and Higgs triplet Φ^0, Φ^+, Φ^{++}),**

W_H and Z_H search shown is defined by boson mass (M) and mixing angle (θ) parameters

(reach plot is for 300 fb^{-1})

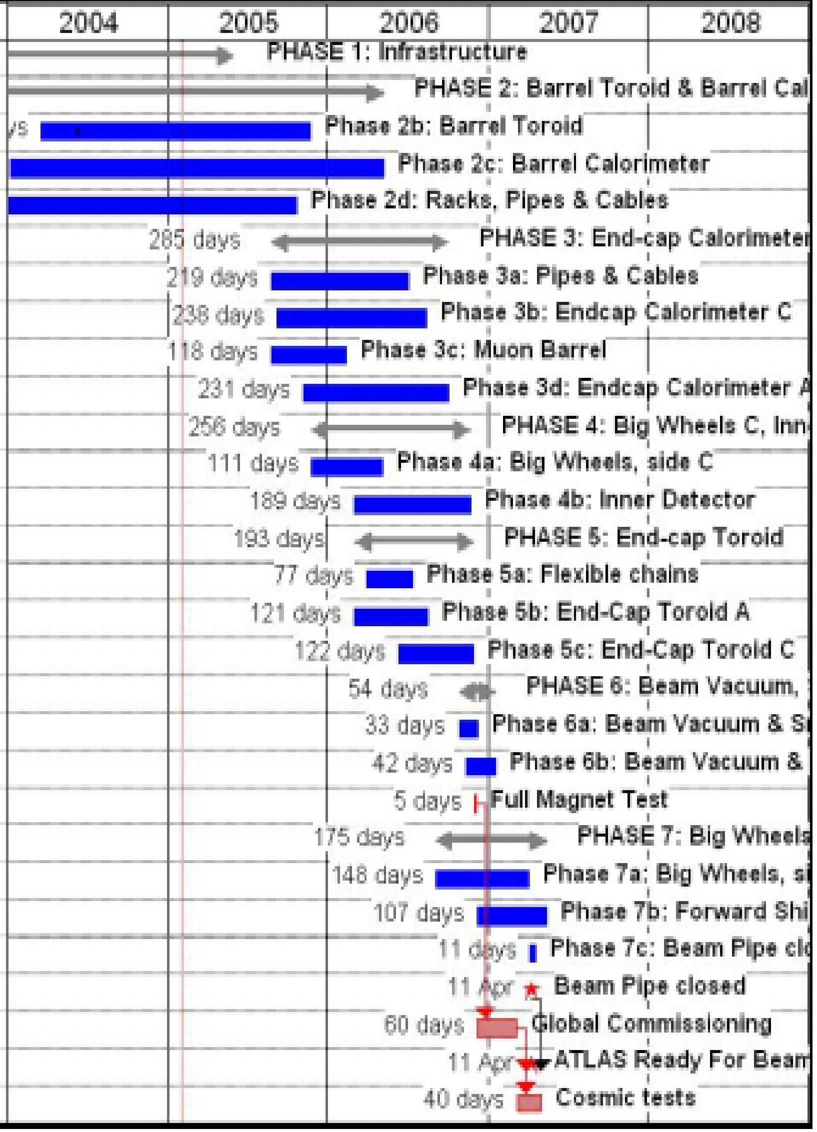




Overall summary installation schedule version 7.0

(New baseline approved in the February 2005 ATLAS EB)

Name	Start	Finish
PHASE 1: Infrastructure	4 Apr '03	27 May '05
PHASE 2: Barrel Toroid & Barrel Calorimeter	4 Mar '03	5 May '06
Phase 2b: Barrel Toroid	15 Mar '04	20 Nov '05
Phase 2c: Barrel Calorimeter	7 Jan '04	5 May '06
Phase 2d: Racks, Pipes & Cables	4 Mar '03	19 Oct '05
PHASE 3: End-cap Calorimeters & Muon Barrel	22 Aug '05	2 Oct '06
Phase 3a: Pipes & Cables	22 Aug '05	30 Jun '06
Phase 3b: Endcap Calorimeter C	6 Sep '05	14 Aug '06
Phase 3c: Muon Barrel	22 Aug '05	9 Feb '06
Phase 3d: Endcap Calorimeter A	3 Nov '05	2 Oct '06
PHASE 4: Big Wheels C, Inner Detector	21 Nov '05	21 Nov '06
Phase 4a: Big Wheels, side C	21 Nov '05	2 May '06
Phase 4b: Inner Detector	1 Mar '06	21 Nov '06
PHASE 5: End-cap Toroid	2 Mar '06	27 Nov '06
Phase 5a: Flexible chains	28 Mar '06	12 Jul '06
Phase 5b: End-Cap Toroid A	2 Mar '06	17 Aug '06
Phase 5c: End-Cap Toroid C	9 Jun '06	27 Nov '06
PHASE 6: Beam Vacuum, Small Wheels, Start closin	24 Oct '06	16 Jan '07
Phase 6a: Beam Vacuum & Small Wheels, side A	24 Oct '06	8 Dec '06
Phase 6b: Beam Vacuum & Small Wheels, side C	10 Nov '06	16 Jan '07
Full Magnet Test	*28 Nov '06*	*4 Dec '06*
PHASE 7: Big Wheels A, Forward Shielding & End w	30 Aug '06	10 May '07
Phase 7a: Big Wheels, side A	30 Aug '06	3 Apr '07
Phase 7b: Forward Shielding & End wall Chamb	5 Dec '06	10 May '07
Phase 7c: Beam Pipe closing and bake-out	4 Apr '07	18 Apr '07
Beam Pipe closed	*11 Apr '07*	*11 Apr '07*
Global Commissioning	5 Dec '06	6 Mar '07
ATLAS Ready For Beam	*11 Apr '07*	*11 Apr '07*
Cosmic tests	7 Mar '07	1 May '07




11th May 2005

Examples of major infrastructure being now commissioned for the project

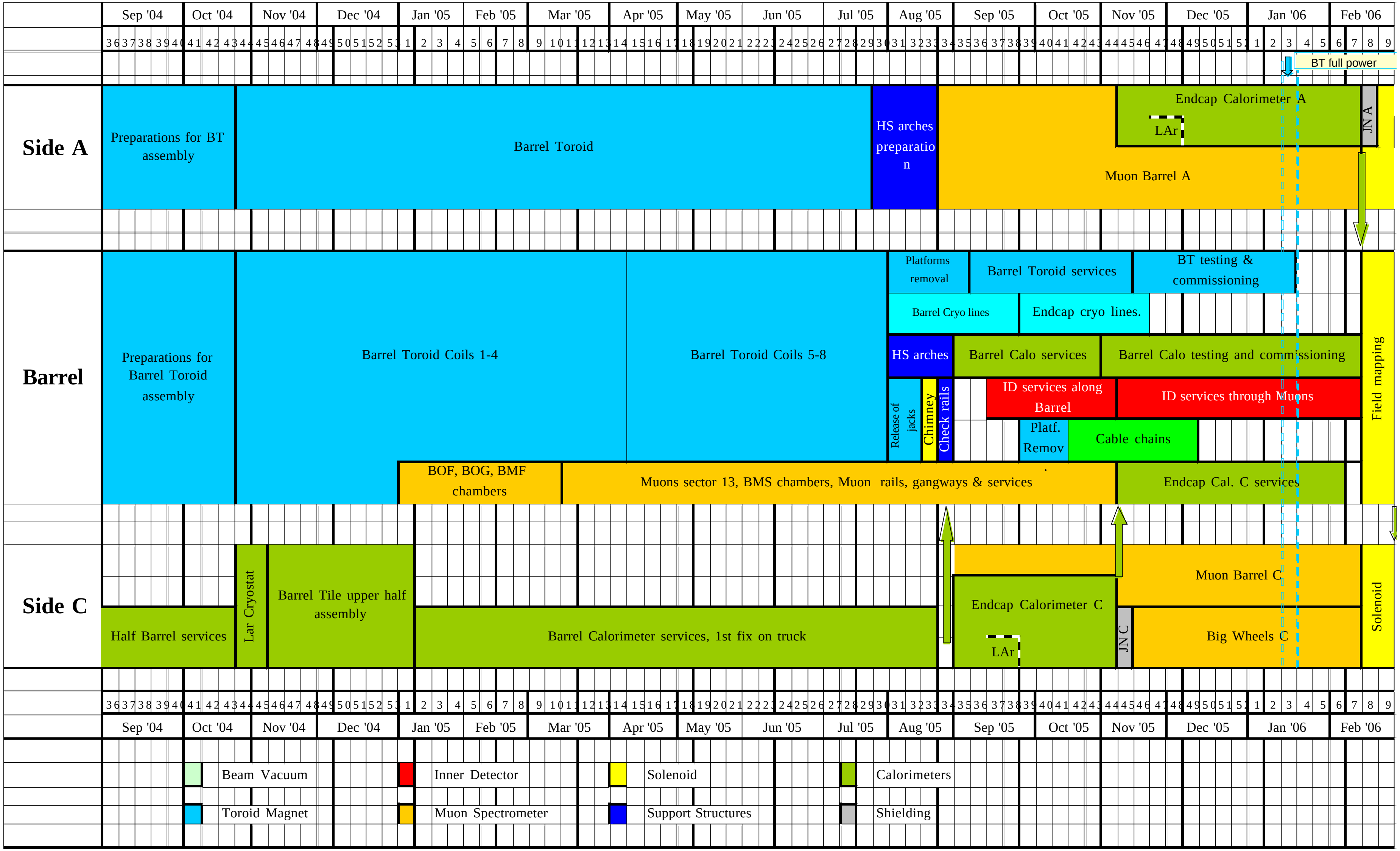
The external cryogenics, compressor room, the He refrigerators and transfer lines in the cavern

He tanks

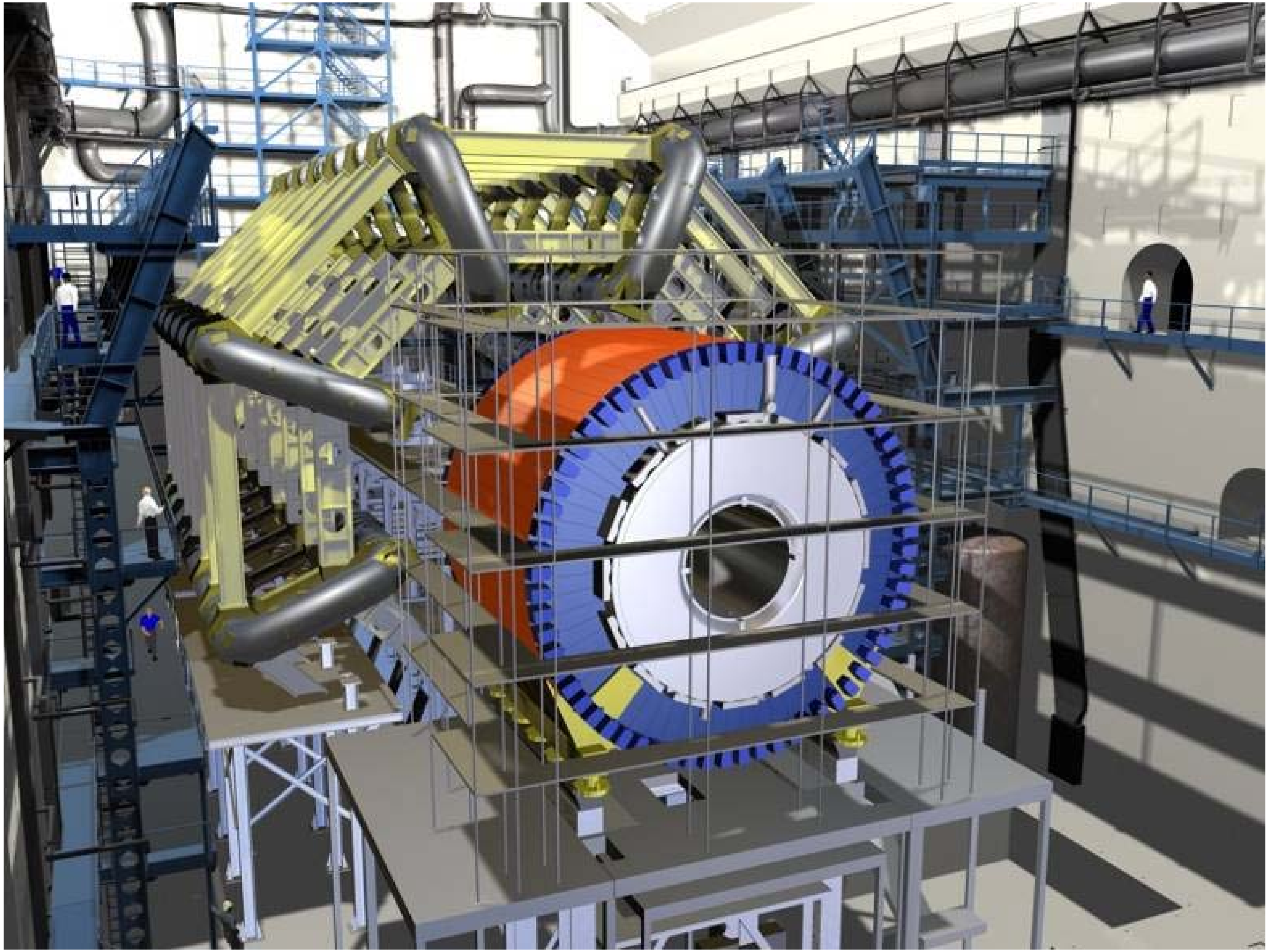
Compressor room SUX1

He refrigerator in USA15

Installation activity planning in the cavern (part I)



Back to virtual reality: planned status for August 2005 …



Conclusions

The CERN Management and the LHC machine project team are most strongly committed to deliver first collisions in Summer 2007, thereby opening a new chapter in particle physics which will be exploited in a truly world-wide collaborative effort

Many important milestones have been passed in the construction, pre-assembly, integration and installation of the ATLAS detector components

Very major software and computing activities are underway as well, using the LHC Computing Grid for world-wide distributed computing resources

Planning for the commissioning and the early physics phases has started

The ATLAS Collaboration is highly motivated, and on track, for LHC physics in 2007

Japanese teams are making outstanding contributions to the project:

- Solenoid
- SCT (silicon precision tracker in the Inner Detector)
- TGC (muon trigger chambers in the end-caps)
- Muon trigger in the end-caps
- Software and computing
- <u>Physics studies</u> (Higgs and SUSY, among others)

***The collaboration with the Japanese teams is excellent and very efficient,
in short: a great pleasure!***

(Informal news on ATLAS is available in the ATLAS eNews letter at http://aenews.cern.ch/)