LHC Point 1:
The ATLAS experiment

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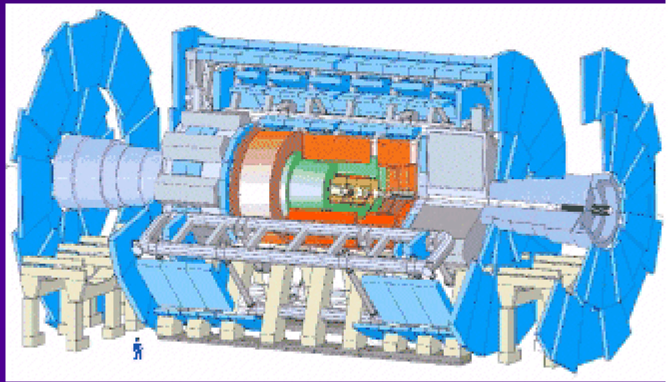
TS/LEA

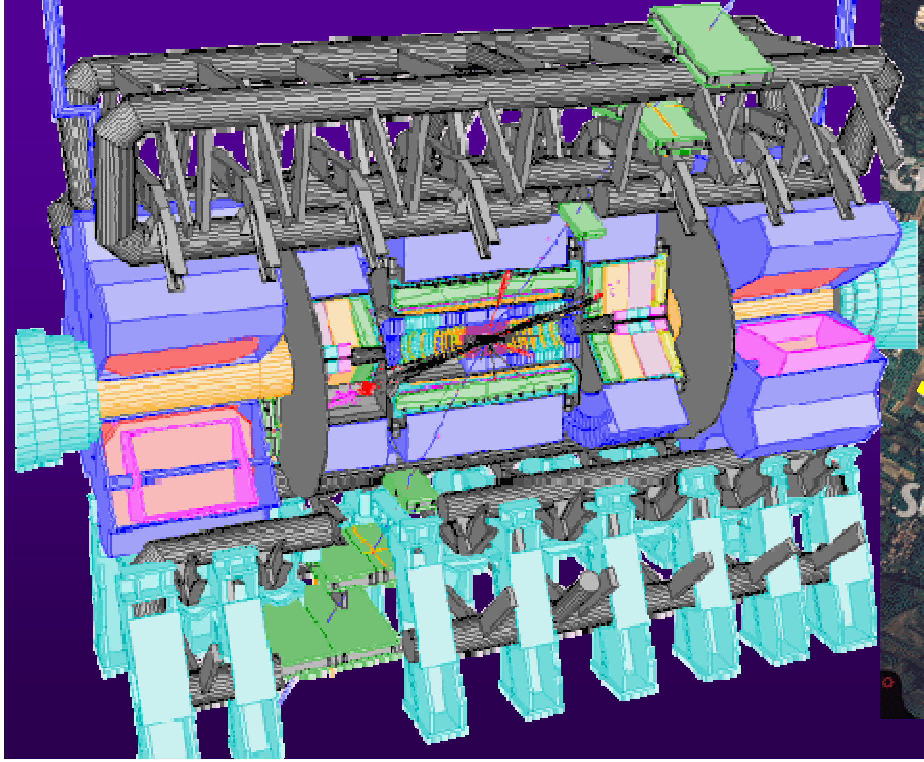
ATLAS at LHC

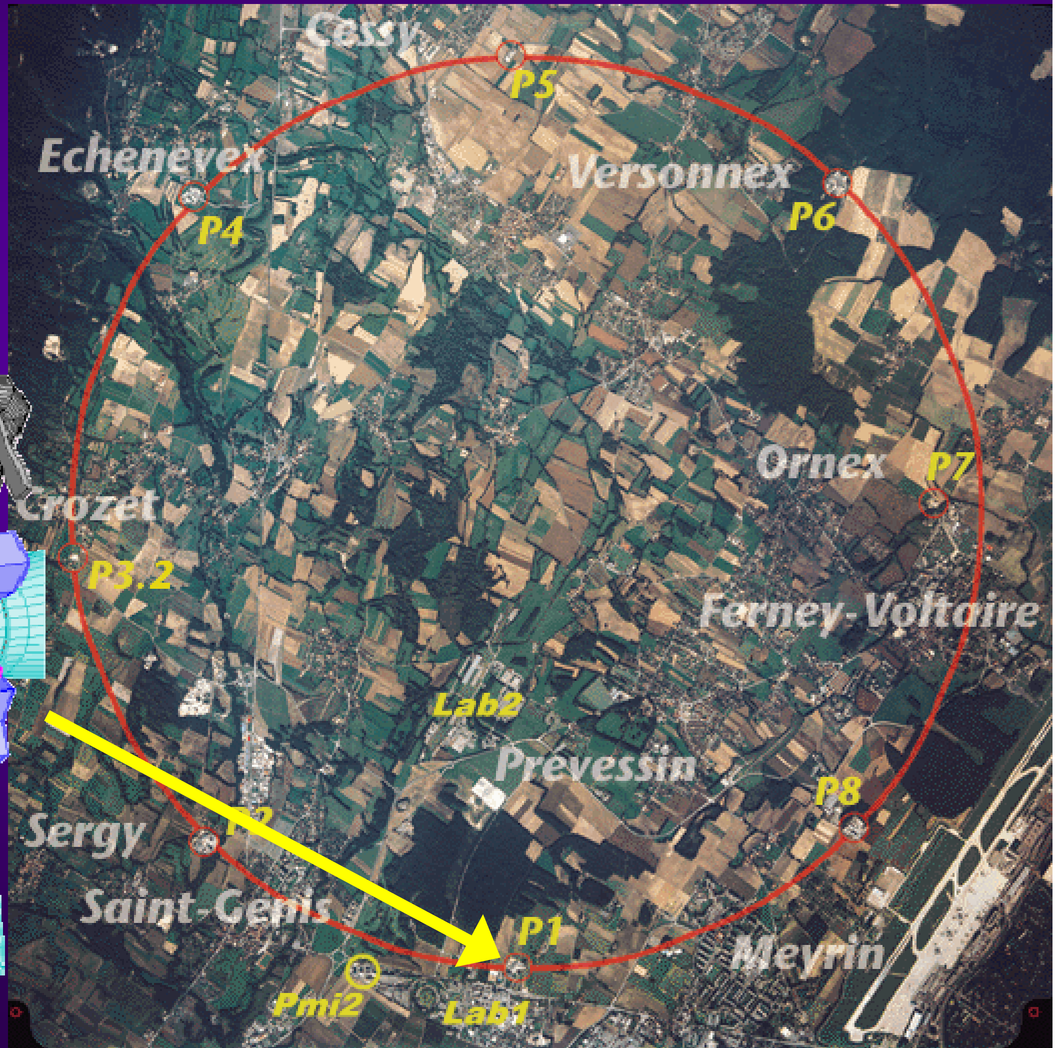
- Introduction to ATLAS
- Status of experimental area
- Status of detector installation
- Installation organization
- Safety management
- Interfaces with LHC machine
- ATLAS choices and consequences
- What we learnt
- Some conclusions



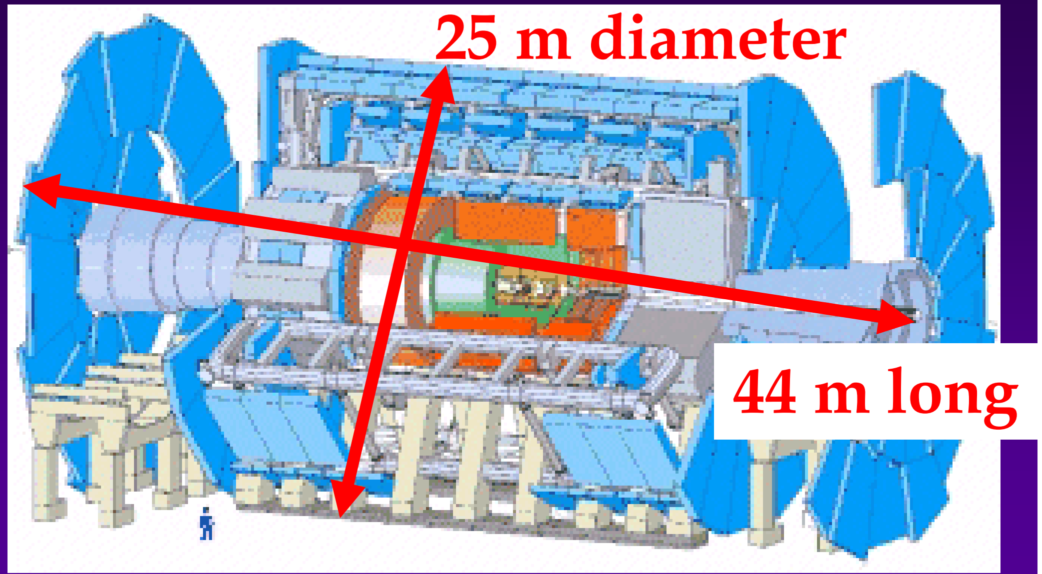
Introduction to ATLAS

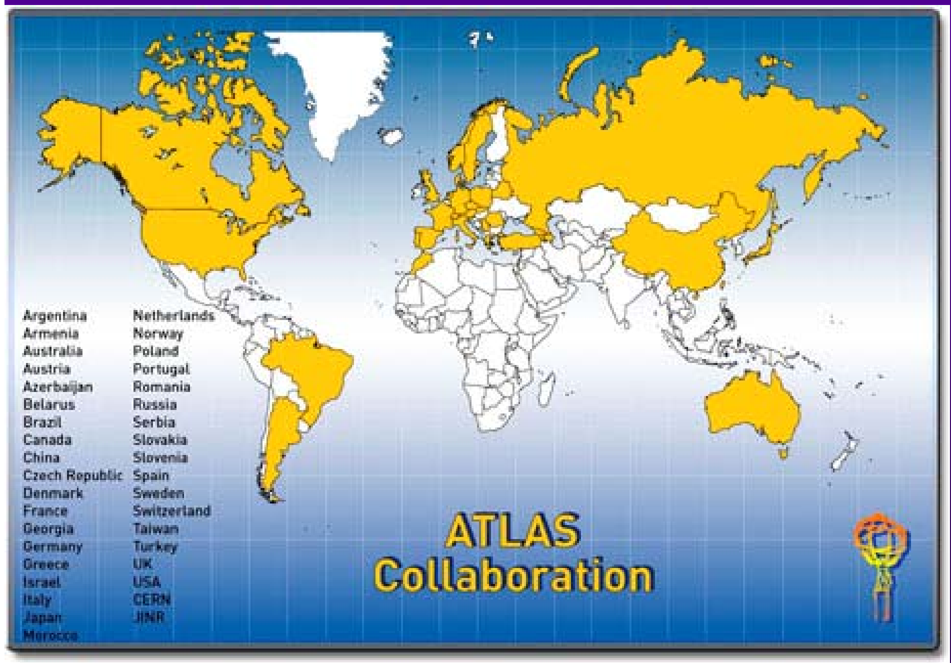
- **ATLAS experiment is being installed at Point 1 of LHC**





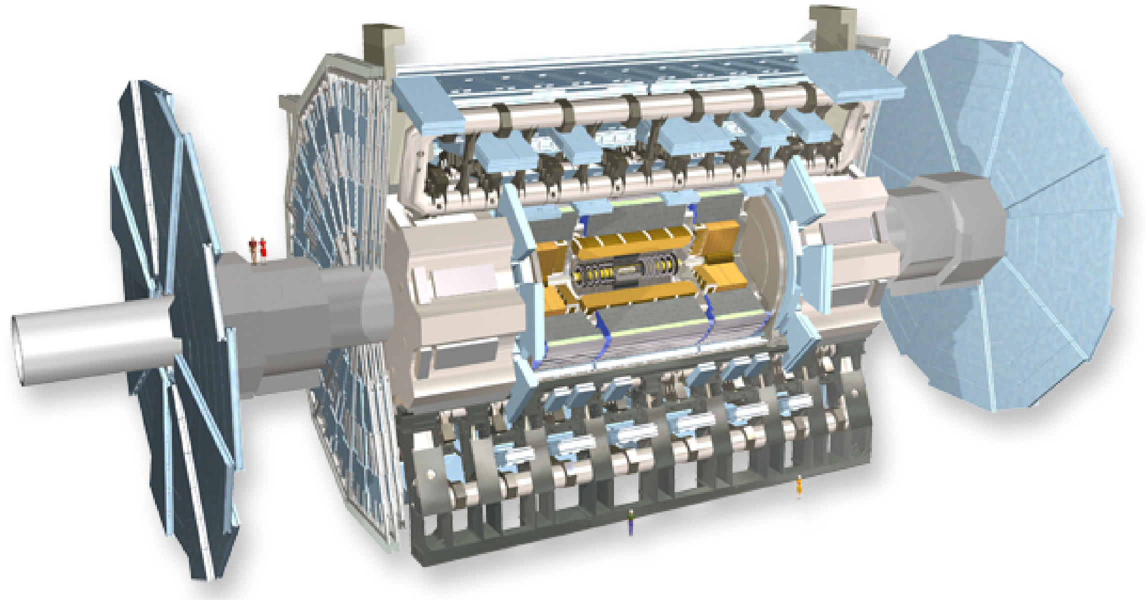
◆ **ATLAS is the largest of the four LHC experiments**





A huge collaboration:
2000 people
34 countries
160 institutes

ATLAS particularities

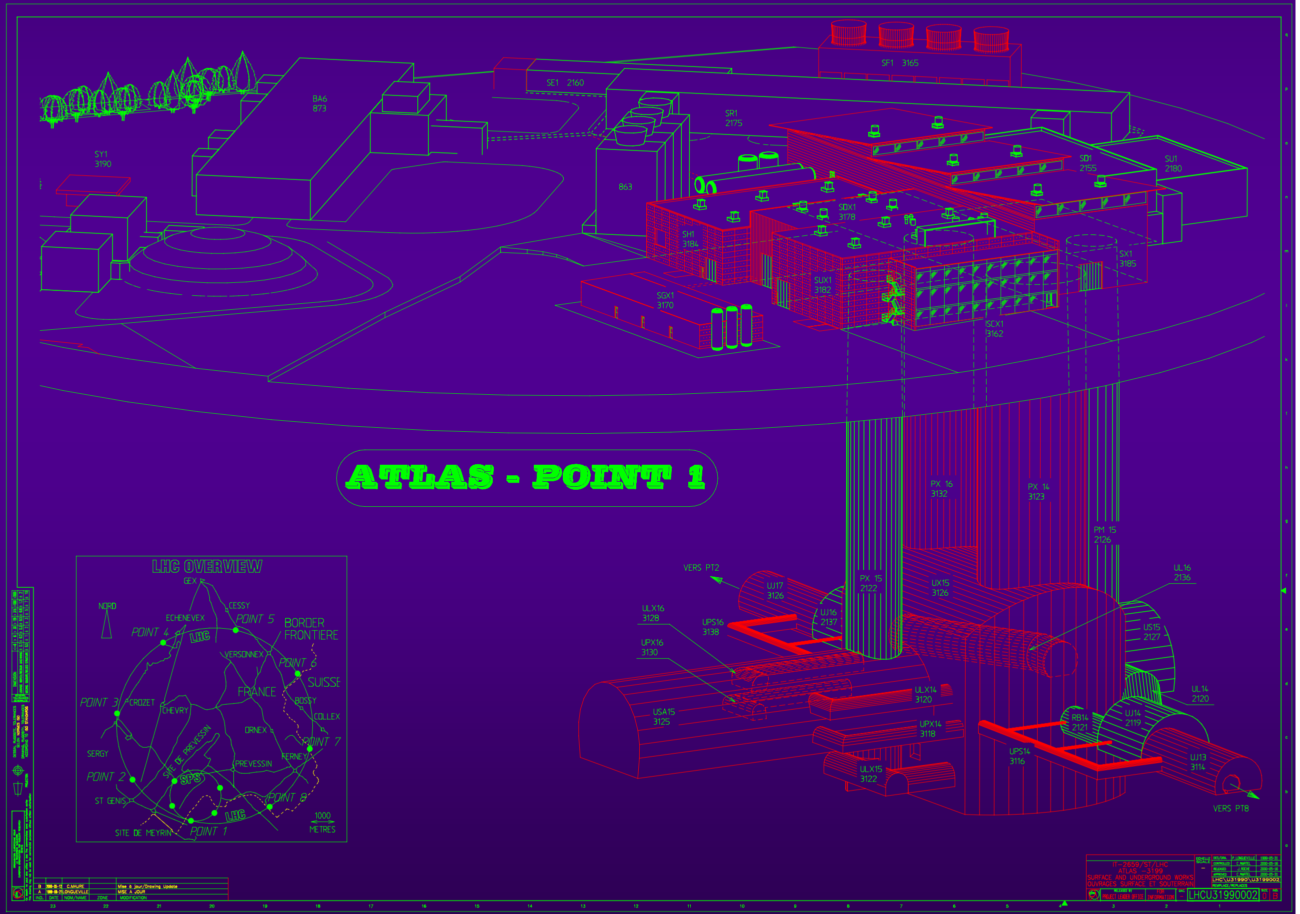


- A huge **air core** supra-conducting **toroidal** magnet system

- Housing the largest **muon spectrometer** ever built

Status of ATLAS Exp Area

- **All buildings and underground caverns delivered to end users**
- **Infrastructure 100% complete**
- **Detector installation and commissioning in progress underground**



Installation of first LHC/ATLAS element underground in April 03

Delivery of UX15 cavern in June 03

Intense activity for infrastructure installation: December 03

In parallel, installation of infrastructure (cryo, CV, gas, electricity etc) in service caverns and buildings

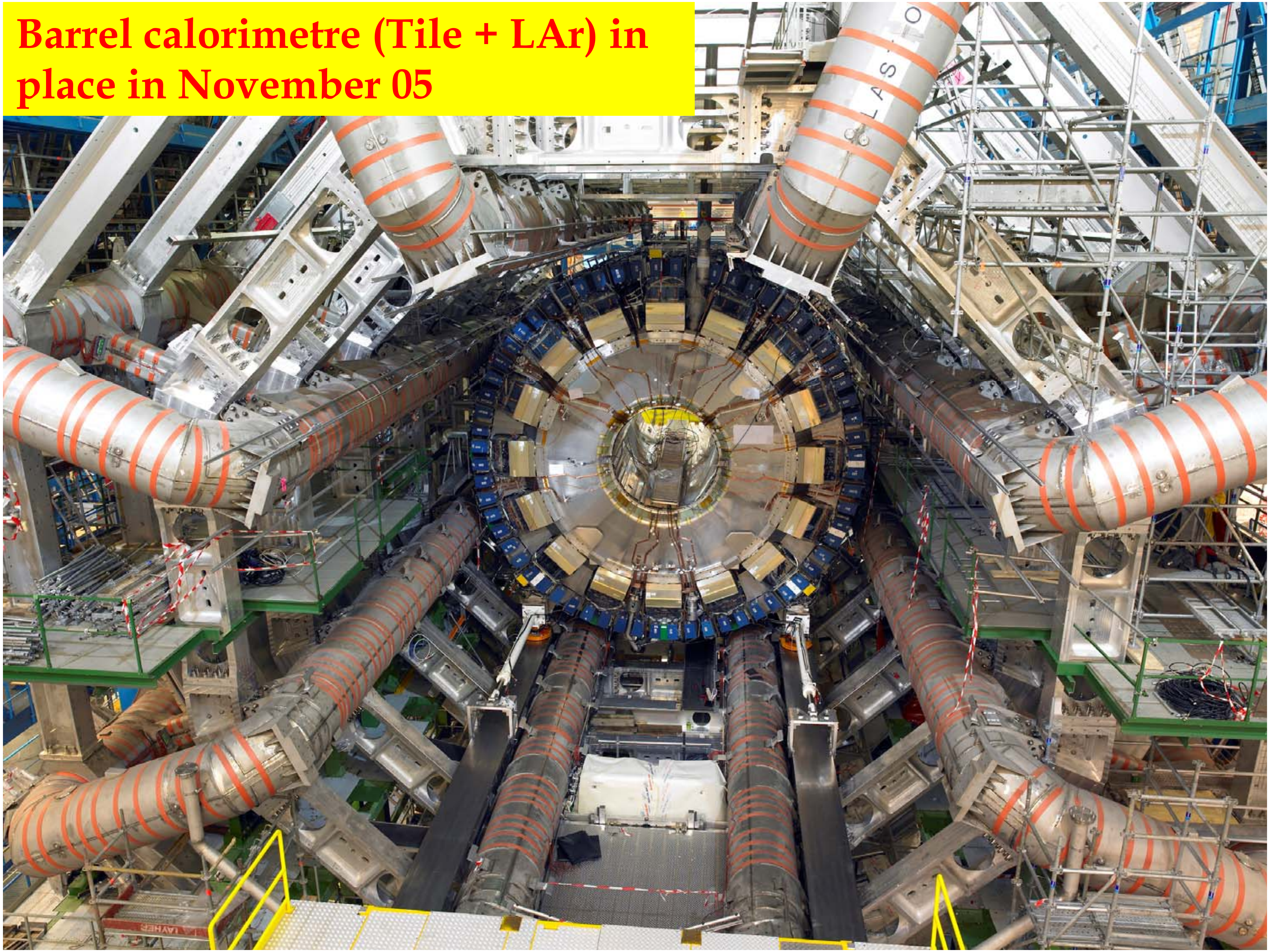
ATLAS support feet installed in January –February 04

Tile calorimeter is lowered in segments as of March 04

First toroid barrel coil lowered in October 04

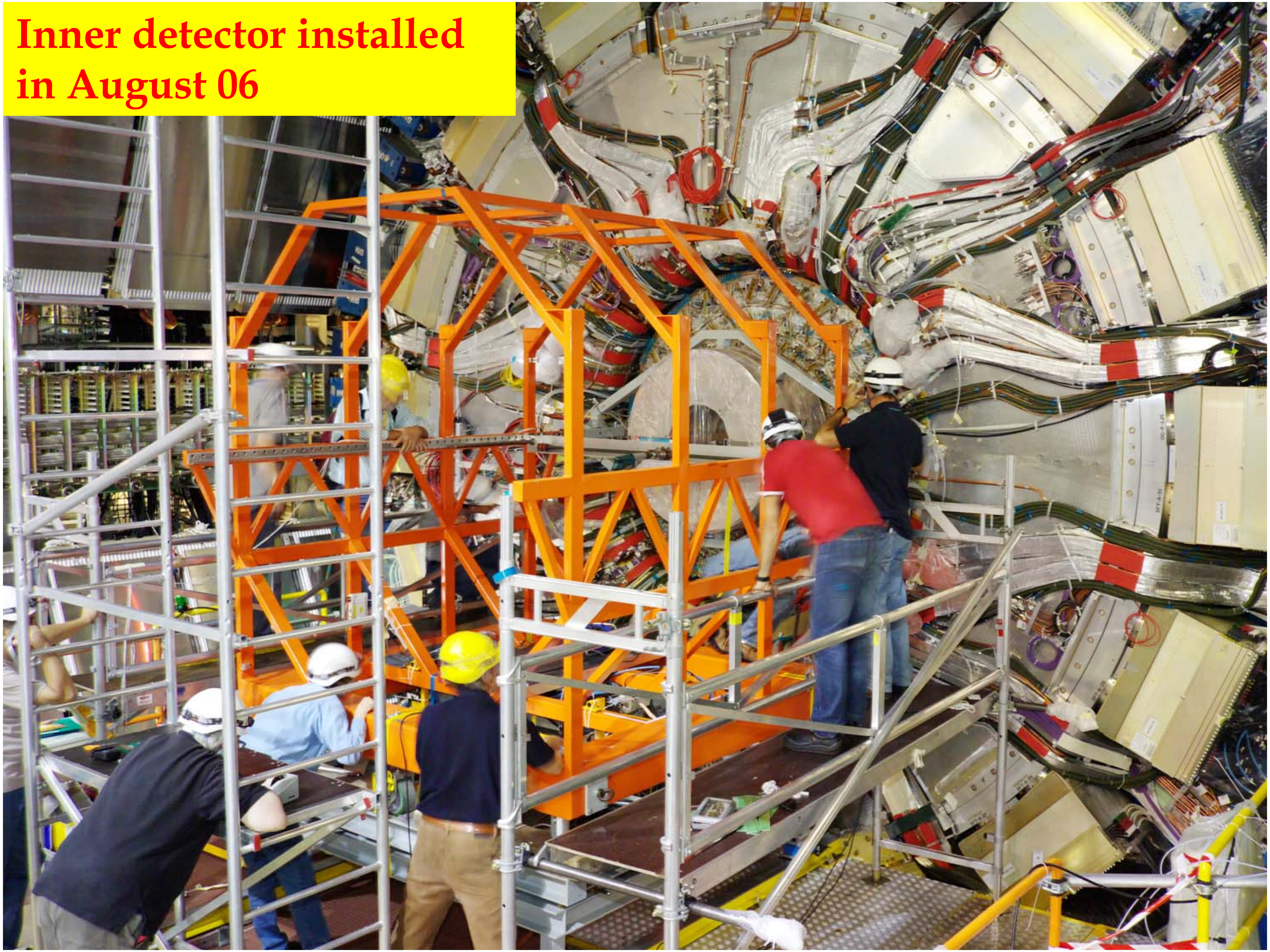
Last toroid barrel coil installed in August 05

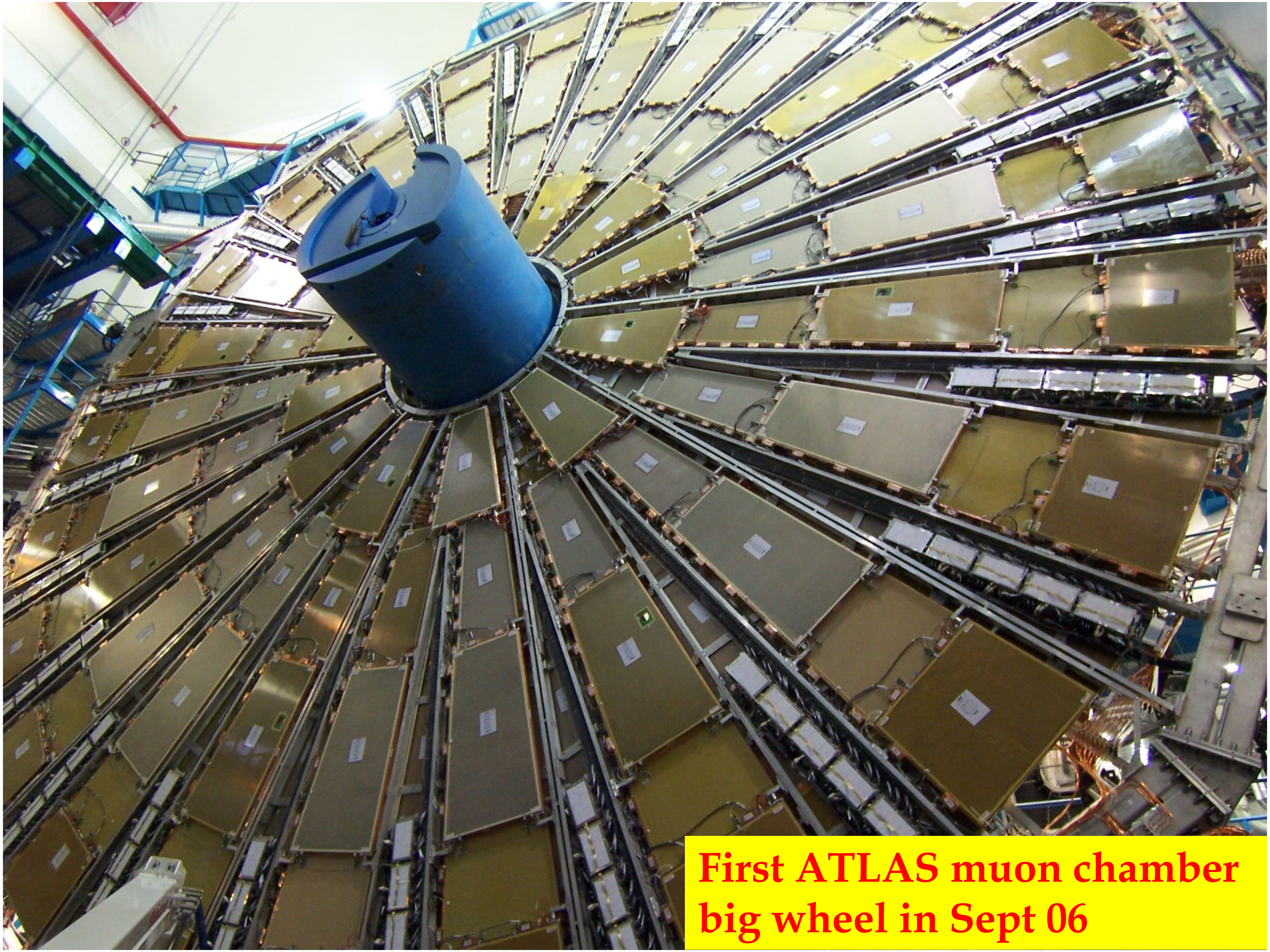
Barrel calorimetre (Tile + LAr) in place in November 05



Encap calorimetres (Tile + LAr)
Feb 06

Inner detector installed in August 06





First ATLAS muon chamber big wheel in Sept 06

Organization of ATLAS for installation stage

- The installation is managed directly by the technical coordinator, with a group of 10 engineers
- Central team of approx 35 engineers and draftsmen for configuration control, integration, installation preparation etc.
- Team of 5 persons for the Experimental Area Management
- 3 teams of 5 « ATLAS » mechanics for specific items installation
- 1 large cabling team (approx 30 persons) from the russian collaboration with 2 engineers permanently on site
- Teams from institutes and from contractors for detectors installation and for related services installation
- In all, approx 250 persons working continuously on site, from 50 different companies or institutes

EAM Organisation

Scheduling:

1: TS meeting: review schedule, update, refine

2: ATLAS meeting: integrate with detector installation schedule

WP Analysis:

analyse work method of WP to come, review documentation (PPSPS, schedule etc)

Exp. Area Management:

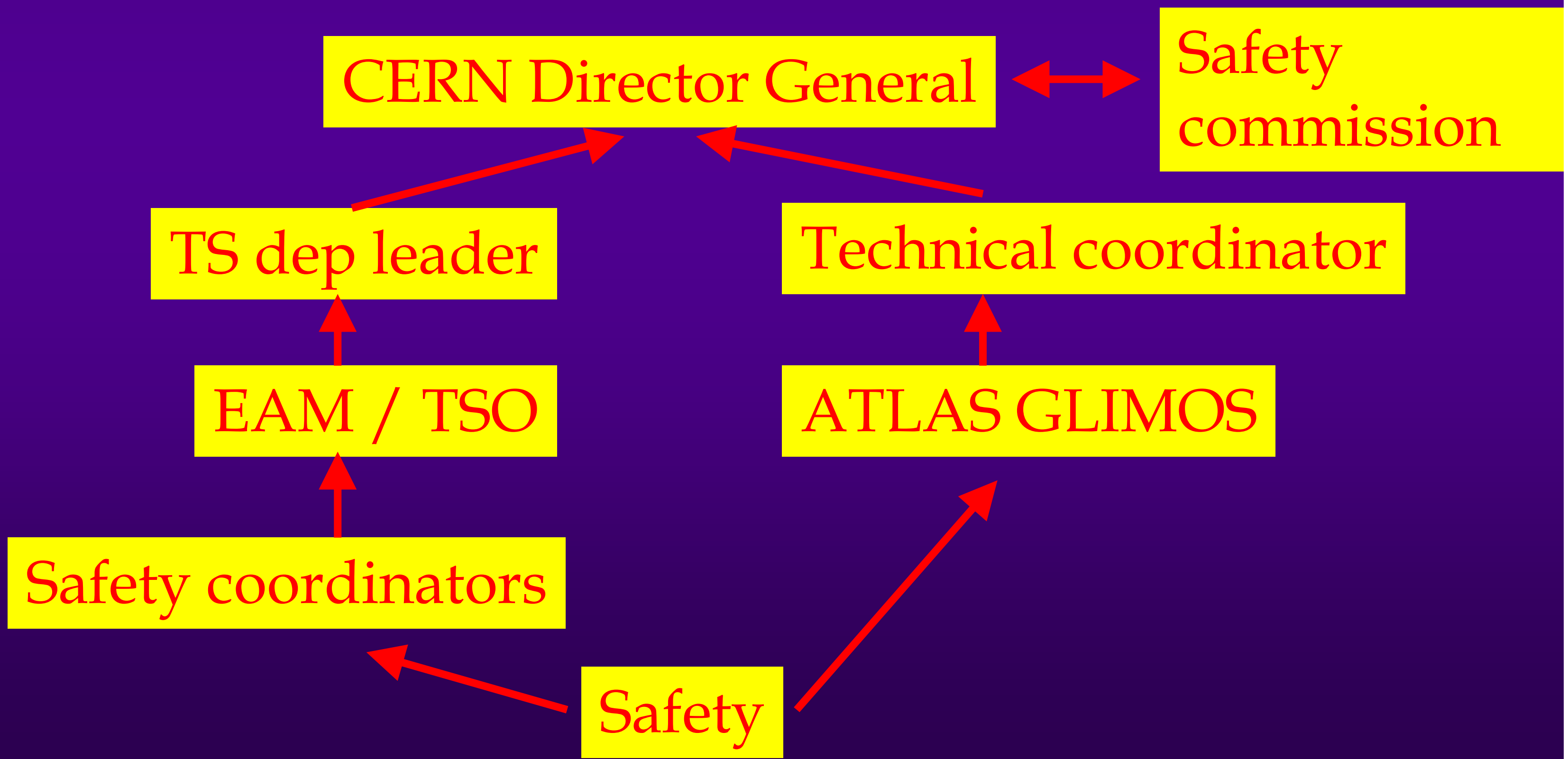
Presence on site, including evenings and week ends

Supervision, maintenance of the area

Weekly review: safety, transports, work zones attribution, action list

Safety management

- **We learnt that safety must ALWAYS have precedence over schedule…**



Safety organization

- T0 – N years: number of safety reviews (GLIMOS / SC)
- T0 - 4 weeks: Work Package analysis / PPSPS review (EAM / safety coordination)
- T0 – 1 week: Visite d'Inspection Commune (Safety coordinators)
- T0 + N weeks: supervision and follow-up by EAM. Regular inspection by GLIMOS, Safety coordination, host state work safety inspectors…

EAM safety management

- Insist on early preparation of PPSPS, request presentation of work method in presence of safety coordinator
- Enforce display of PPSPS's and their application: change of work method implies amendment !
- Weekly tour of site by GLIMOS and safety coordinator, report in EAM meeting
- 1 safety action man: in charge of enforcing safety measures, correcting obvious problems.

Choices for ATLAS and consequences (1)

ATLAS is far too big for surface assembly and transfer underground

- Choice of a huge and “light” air core toroidal magnet

Direct consequences

- Long period planned for underground assembly
- Good schedule and flexibility are essential
- Early delivery of civil engineering
- Choice of a “good” site, with little CE technological risk
- Emphasis on good quality of handling means and teams and high level of organization of handling operations
- 2 access shafts vital (lifts pbs). Some redundance in cranes is appreciated

Choices for ATLAS and consequences (2)

Associated risks and issues:

- Risk of dammage of already installed elements (muon chambers)
- Some pieces are »impossible » to replace in case of failure (eg toroid coils, central calorimeter or solenoid)
- Omni presence of work at height: personnel must be trained
- Vast number of scaffoldings with associated risks (control, maintenance, steel)
- Presence of large quantities of cryogenic fluids
- Visits…

Work between the muon chambers layers

What we learnt (1)

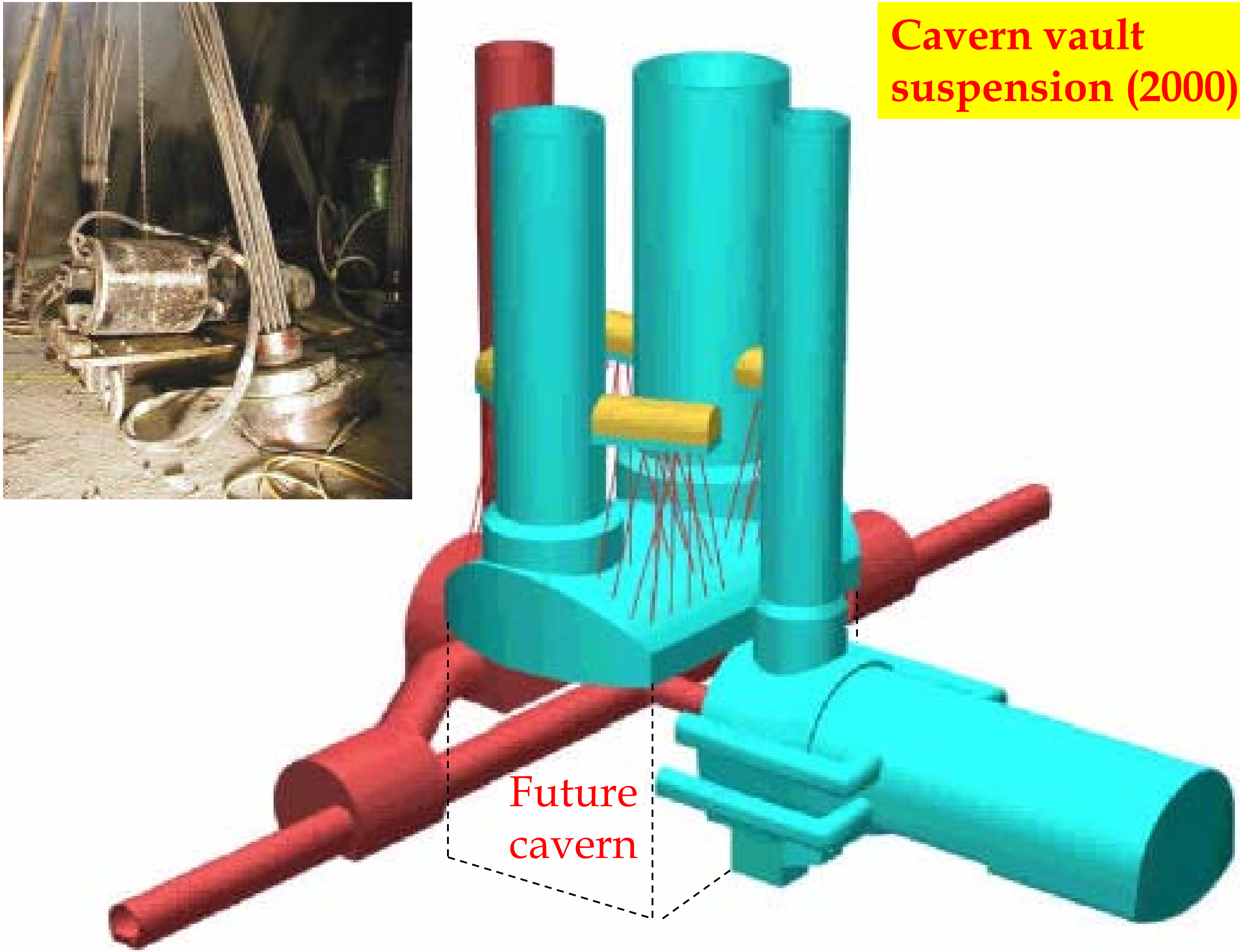
Works usually take longer than anticipated

- CE had 1 year delay, over a total period of 6 years of work
- Do not under-estimate the difficulties for companies to work underground (large delays for CV contacts and lift installation)
- Cranes are fully operational only after long delays

Exotic solutions can be found:

- Suspension of UX15 cavern 7000t concrete vault to continue running LEP in 2000
- Insertion of 10m high, 20 t N2 dewar behind structures with 1cm clearance
- Installation of 650 barrel muon chambers…

Cavern vault suspension (2000)



20t N2 dewar insertion 2003

What we learnt (2)

Good handling team is essential

- Difficult to have 100% efficiency with cranes usage
- Accurate (1mm) installation possible with surface cranes

Work in parallel underground

- Many works can be done in parallel, but…
- Interferences are unavoidable and will lead to reduced efficiency (cranes usage, super-imposition)

What we learnt (3)

- Access control must be fully operational at an early date (including counting of persons underground) and allow big flows of workers
- Lighting, ODH monitoring, evacuation systems must be implemented at an early stage
- Secured / Assured / UPS power MUST be FULLY tested before cryo and vital systems are commissioned
- Design engineers should remain involved in installation stages
- Work supervisors presence on site is essential

Interfaces with LHC machine

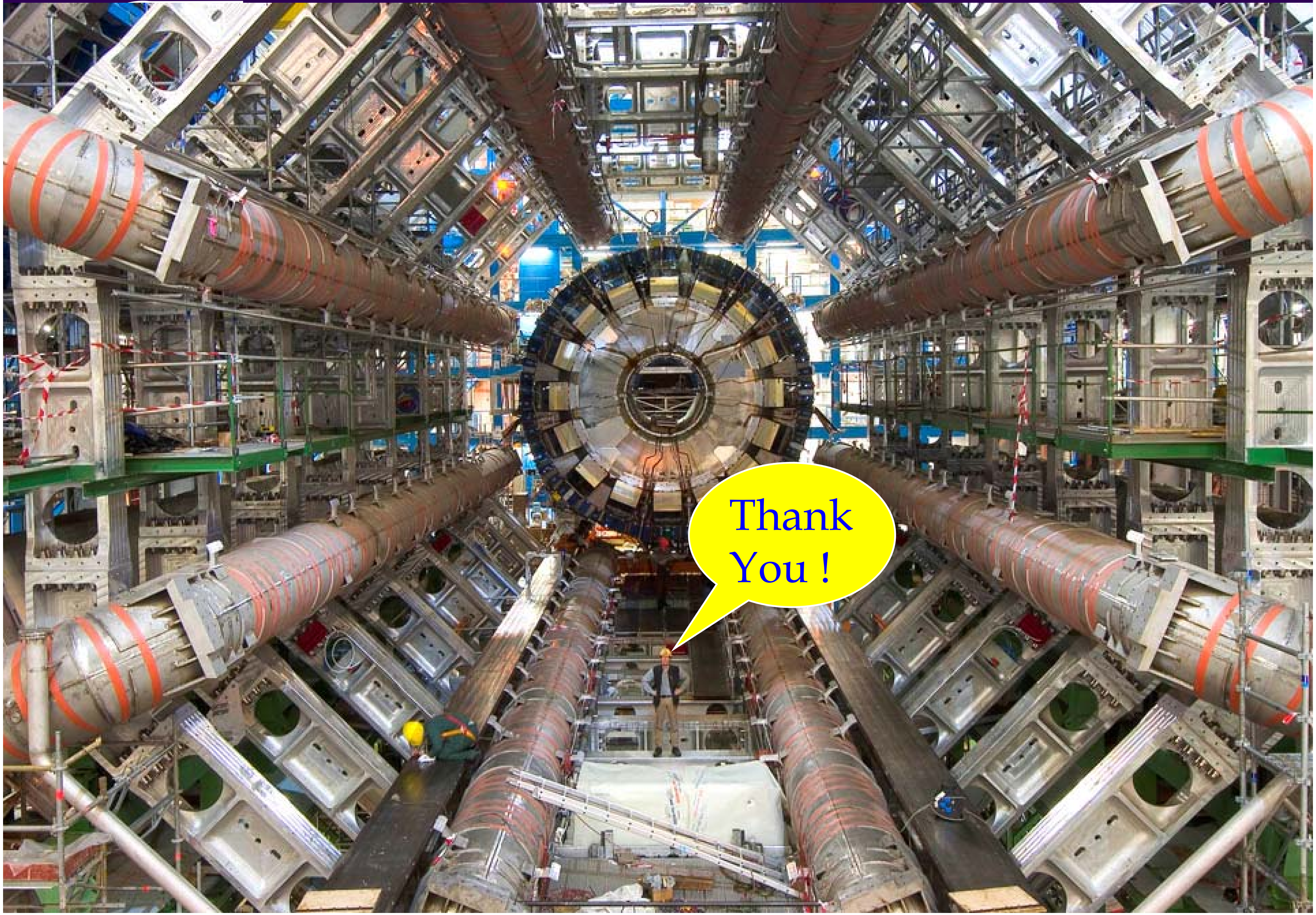
- ATLAS and LHC areas are fairly well separated: no transport / storage / schedule conflicts
- Access US15 / UX15 still under discussion
- Main interface is the beam pipe: technological choices made at a rather early stage, but installation not yet done…
- Other interface: collimator and associated shielding. Engineering / procurement / installation done by EAM

Some conclusions…

- Underground installation leads to extremely dense installation work
- Critically dependant on transport / handling means and teams
- Specific issues related to safety (superimposition, work under loads) lead to enexpected delays
- Access pbs for companies / institutes: more training, more equipment, more delays

…and thoughts

- Experiment installation is progressing well, approx 85% of the total value is now installed underground and already being commissioned in the real environment
- No more delays / overcost than others
- Over 50 contractors/institutes working on the ATLAS site, mostly satisfactorily
- No serious accident so far
- A number of issues in ATLAS are more related to the geometry of the detector (access inside, work at height, impact of magnetic field) than to the fact that it is installed underground


Thank
You !