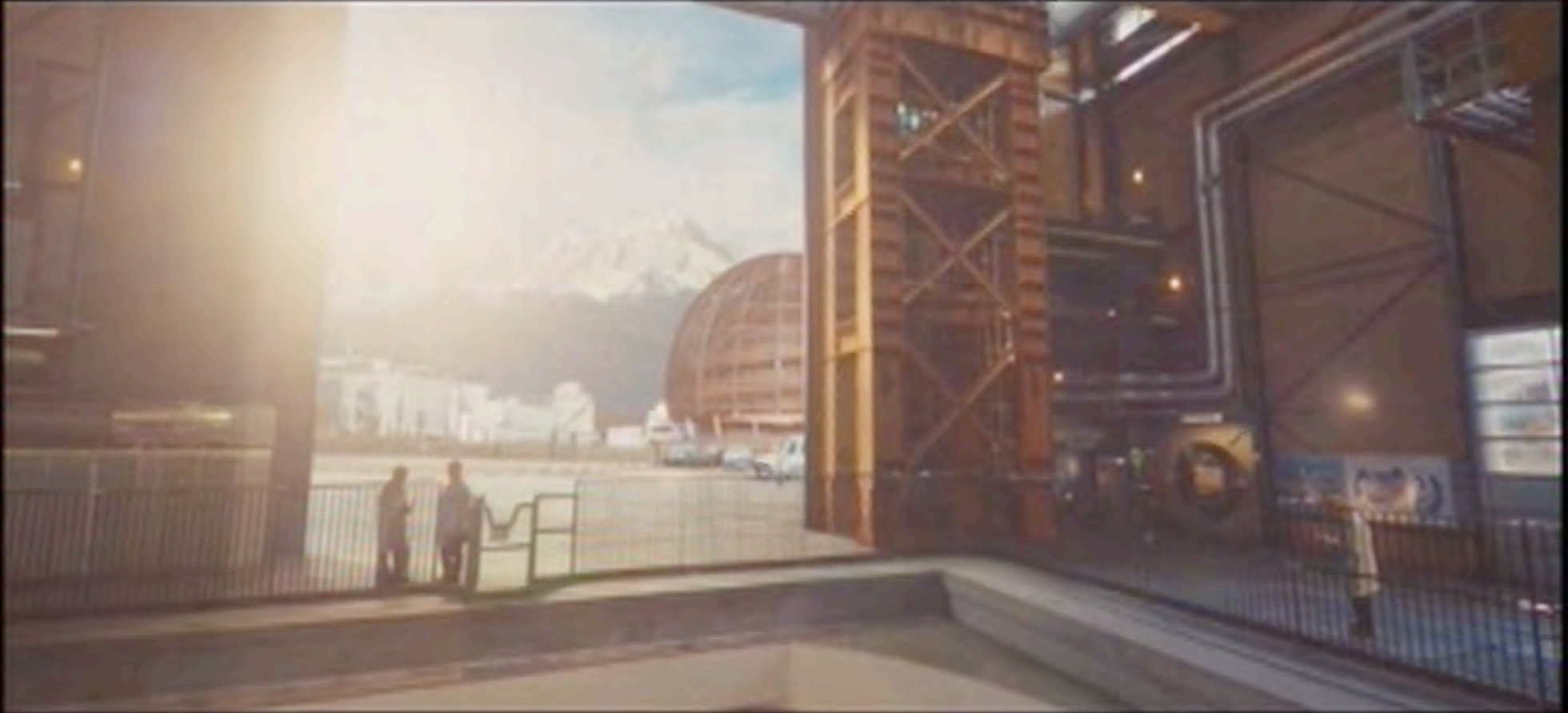


The ATLAS Experiment

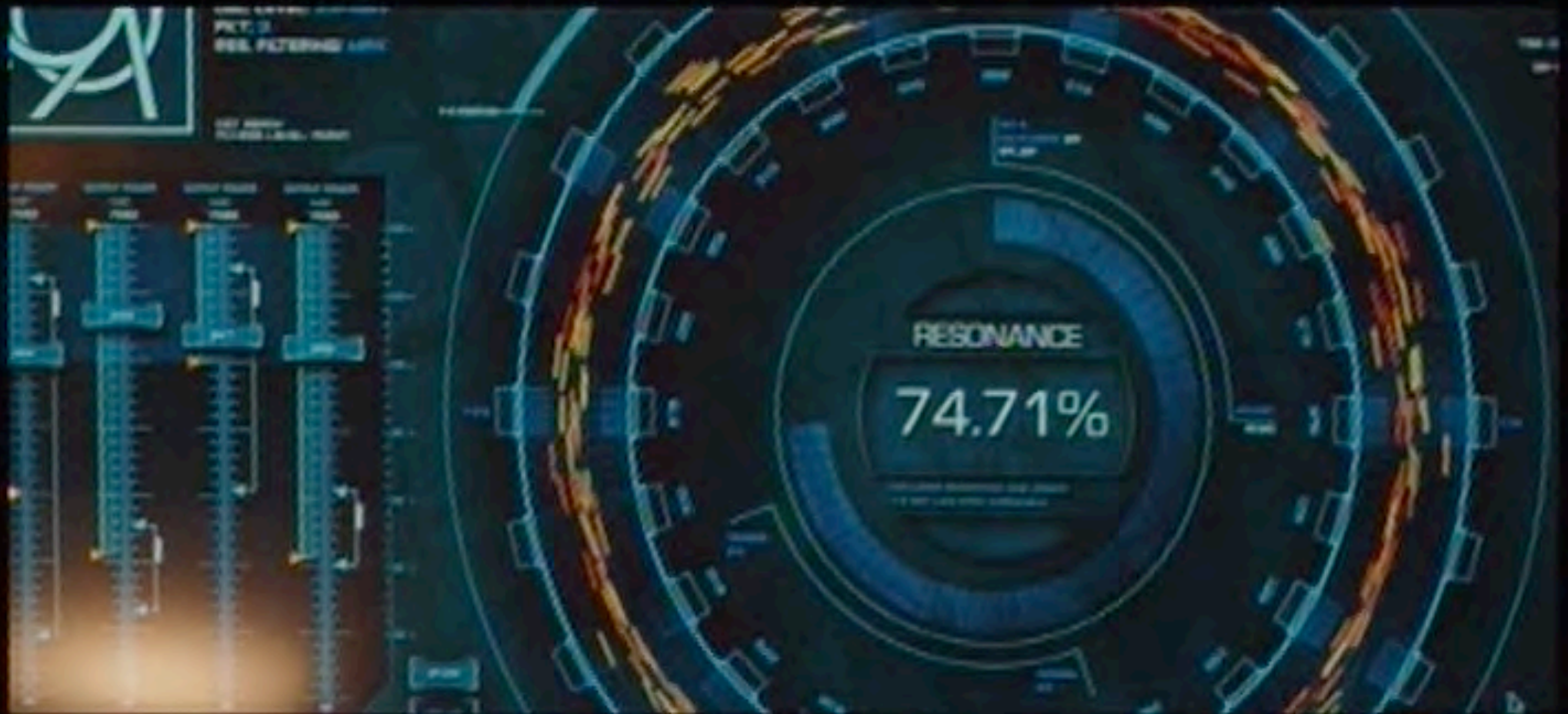
A very short introduction

Christoph Rembser (CERN)

CERN and the Large Hadron Collider (as seen in the movie “Angels and

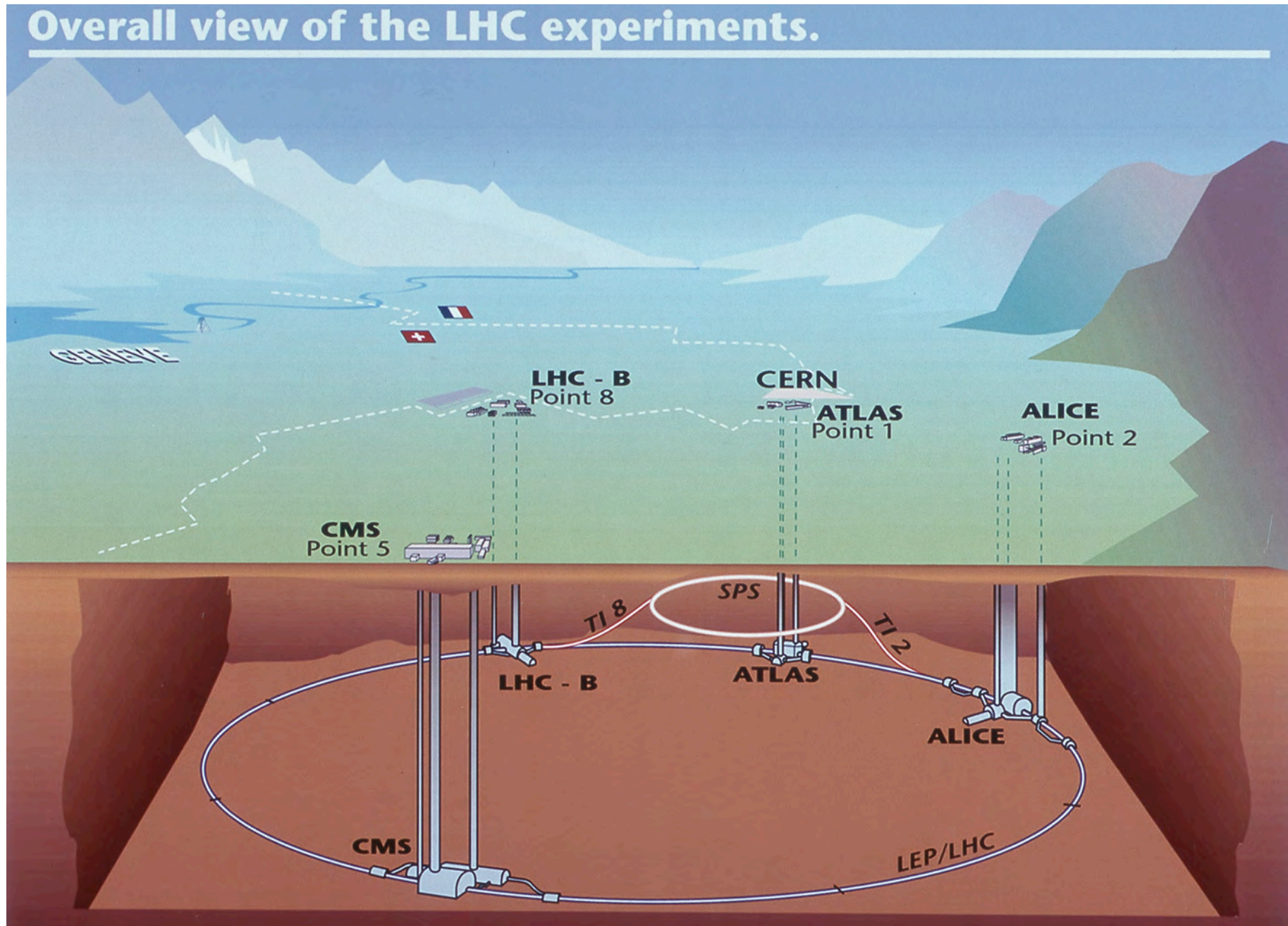


CERN and the Large Hadron Collider (as seen in the movie “Angels and

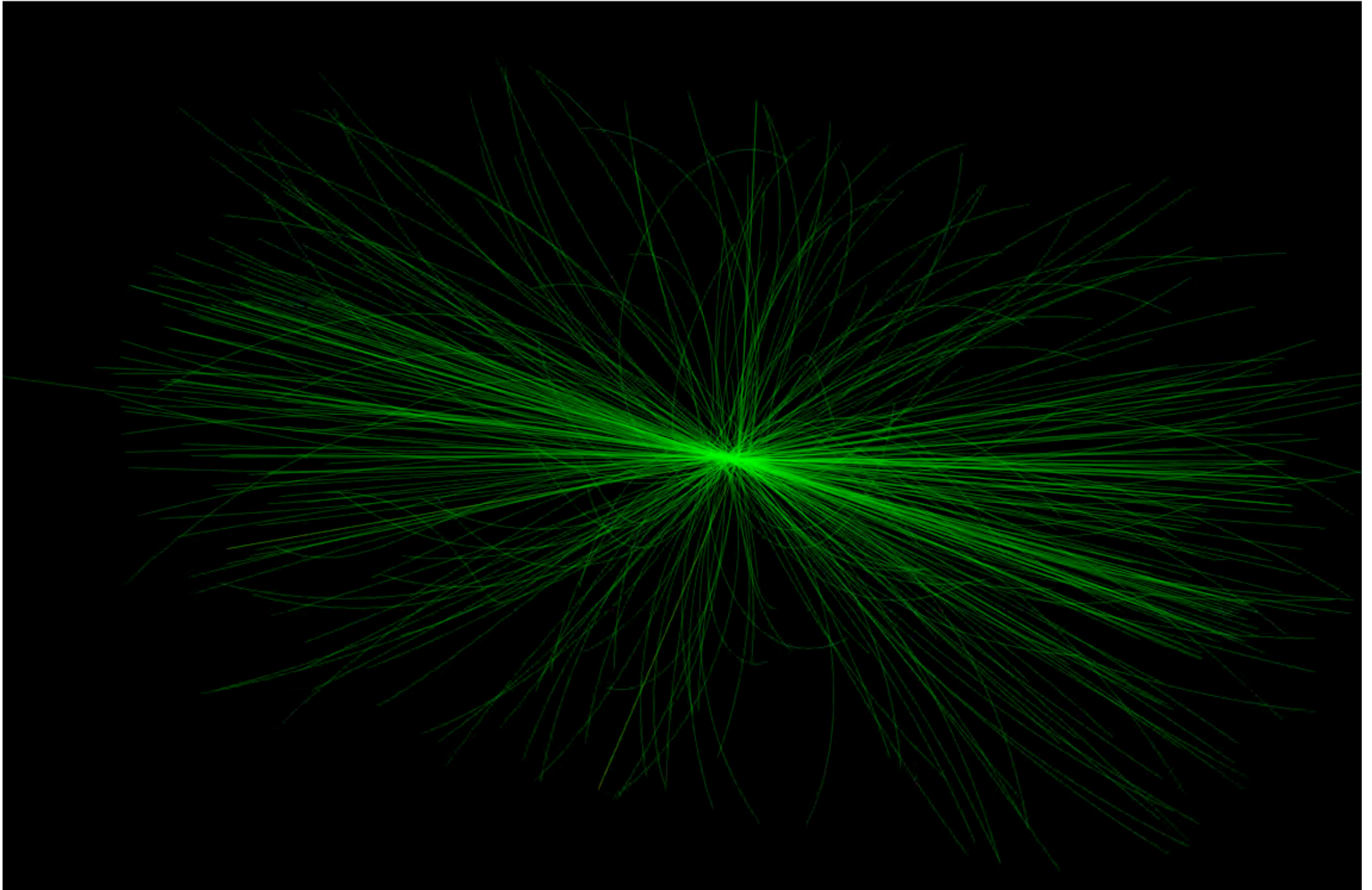


*Capture should begin
at any moment.*

The LHC and its experiments

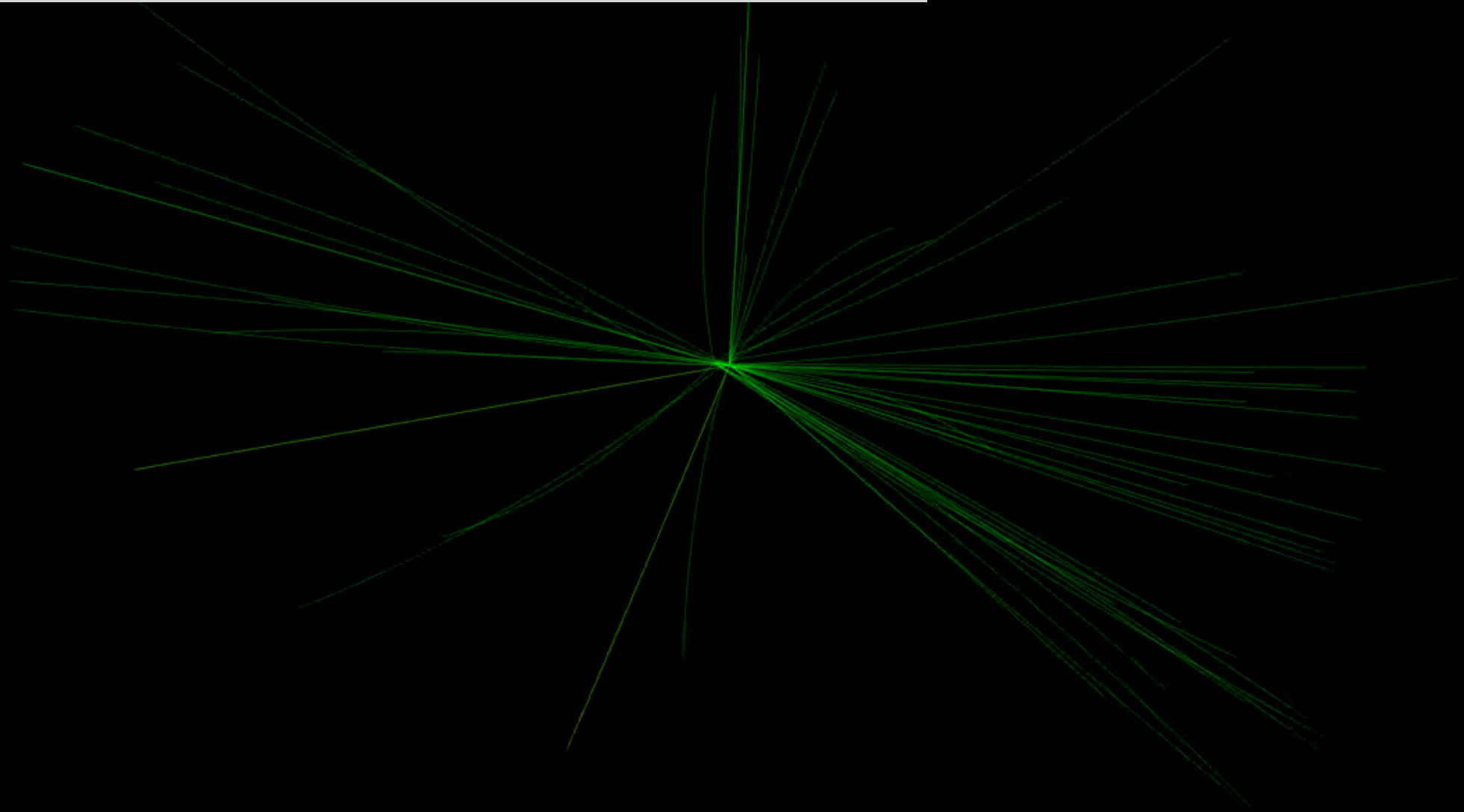


Higgs Production: $p+p \rightarrow H \rightarrow ZZ \rightarrow \mu\mu\mu\mu$



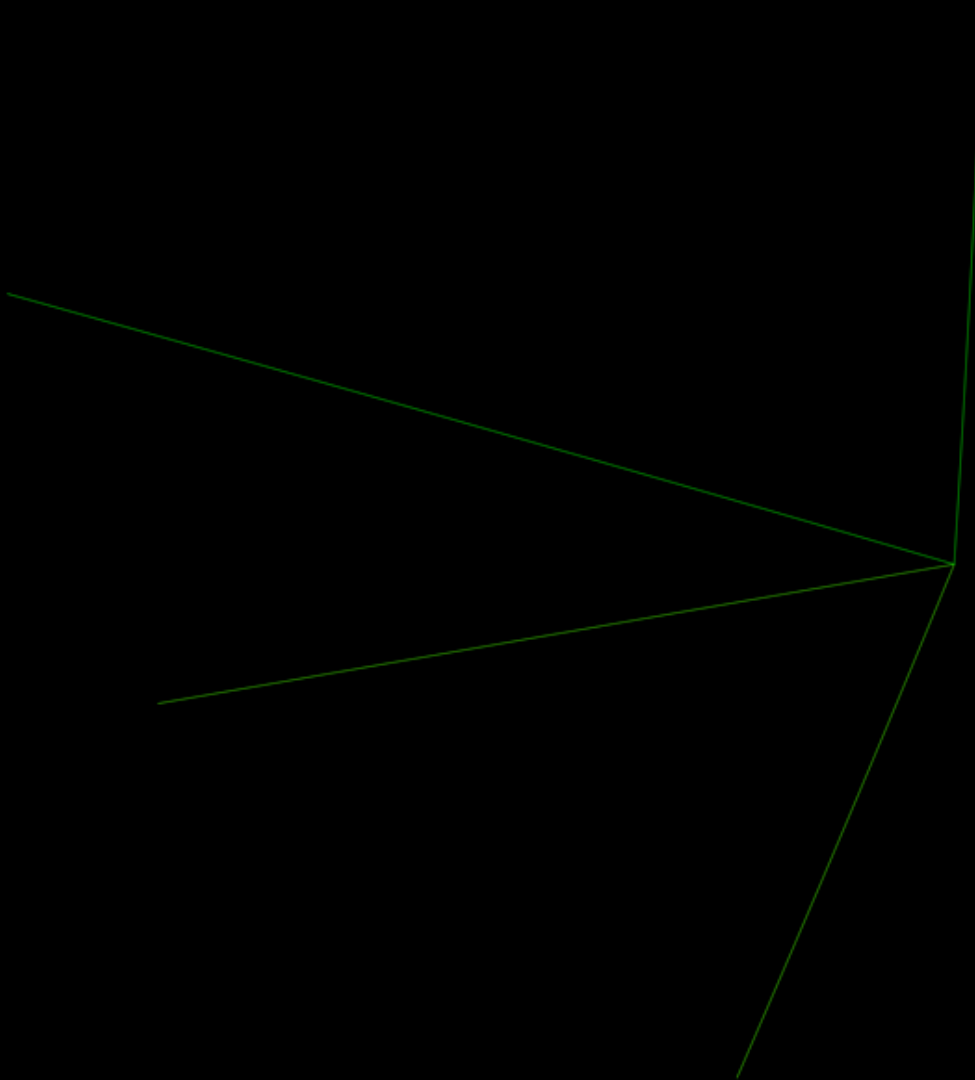
Higgs Production: $p+p \rightarrow H \rightarrow ZZ \rightarrow \mu\mu\mu\mu$

Clean-up: select tracks with momenta which are higher than 5GeV



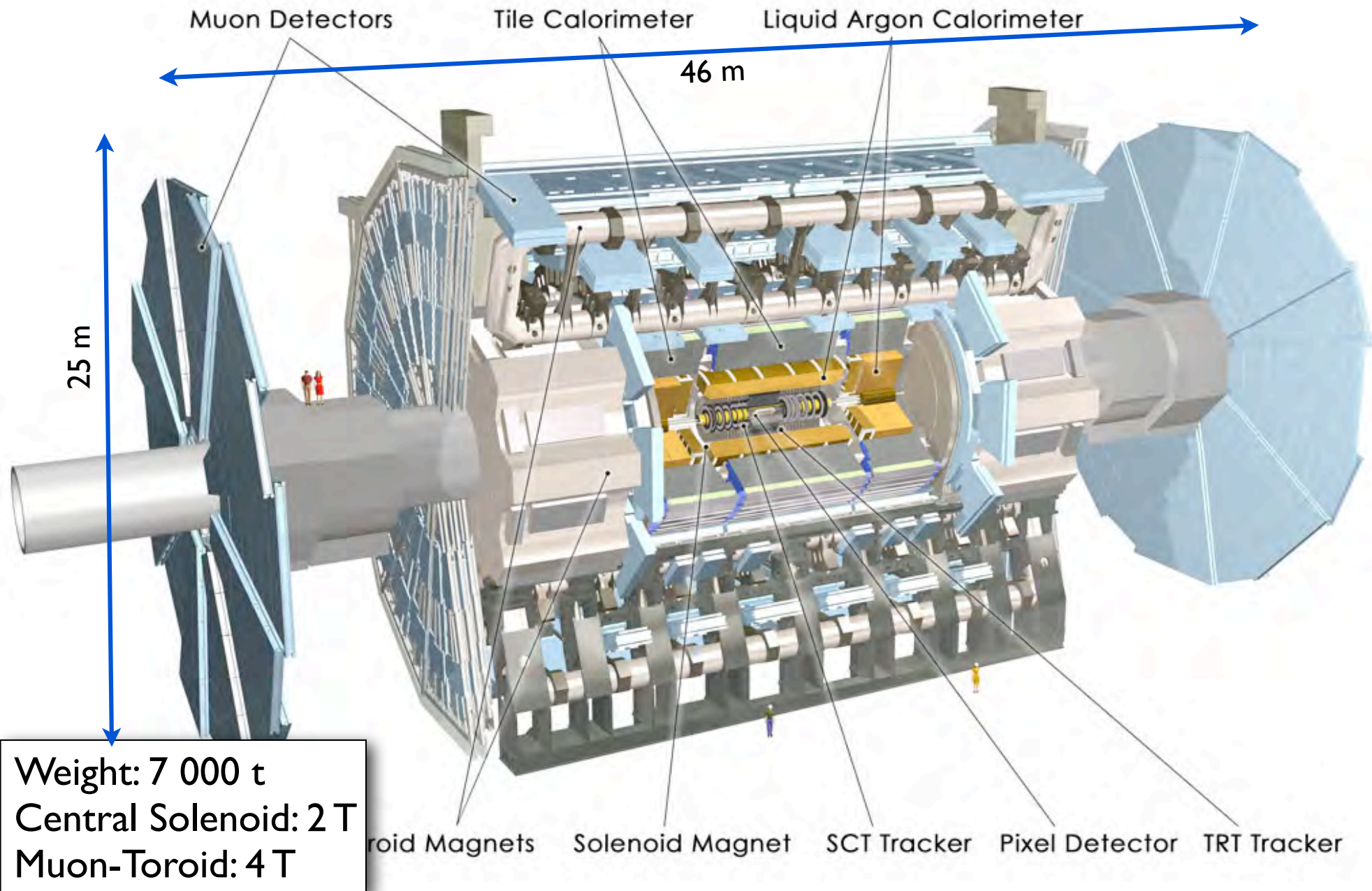
Higgs Production: $p+p \rightarrow H \rightarrow ZZ \rightarrow \mu\mu\mu\mu$

...and higher than 10GeV

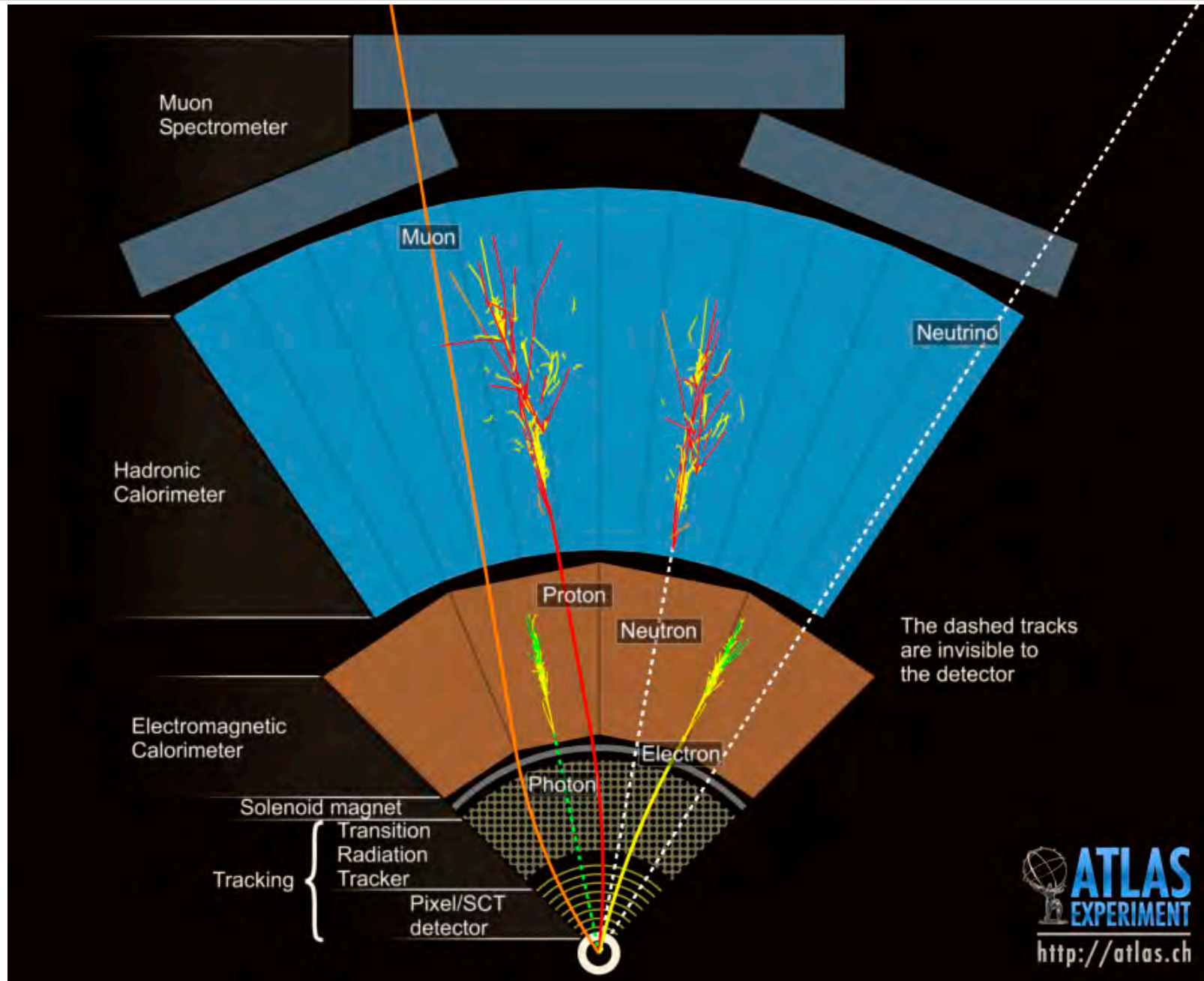


...Voila!!!

ATLAS: the largest detector in particle physics

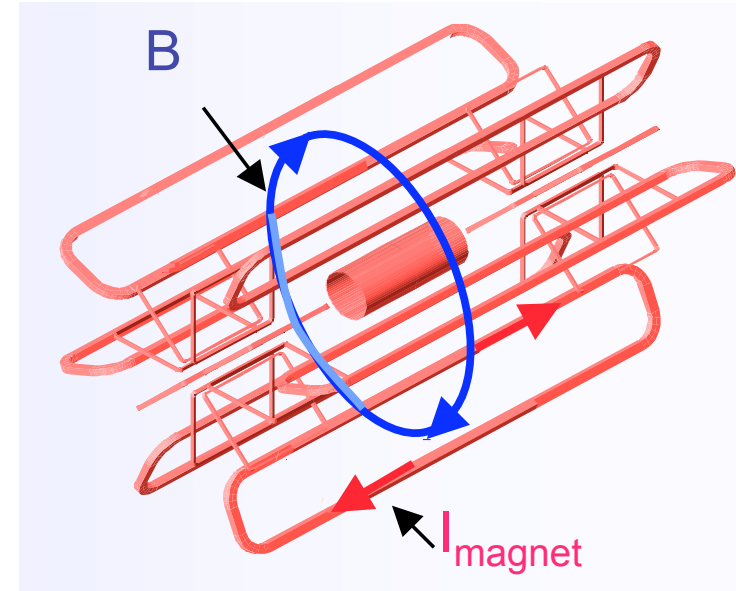
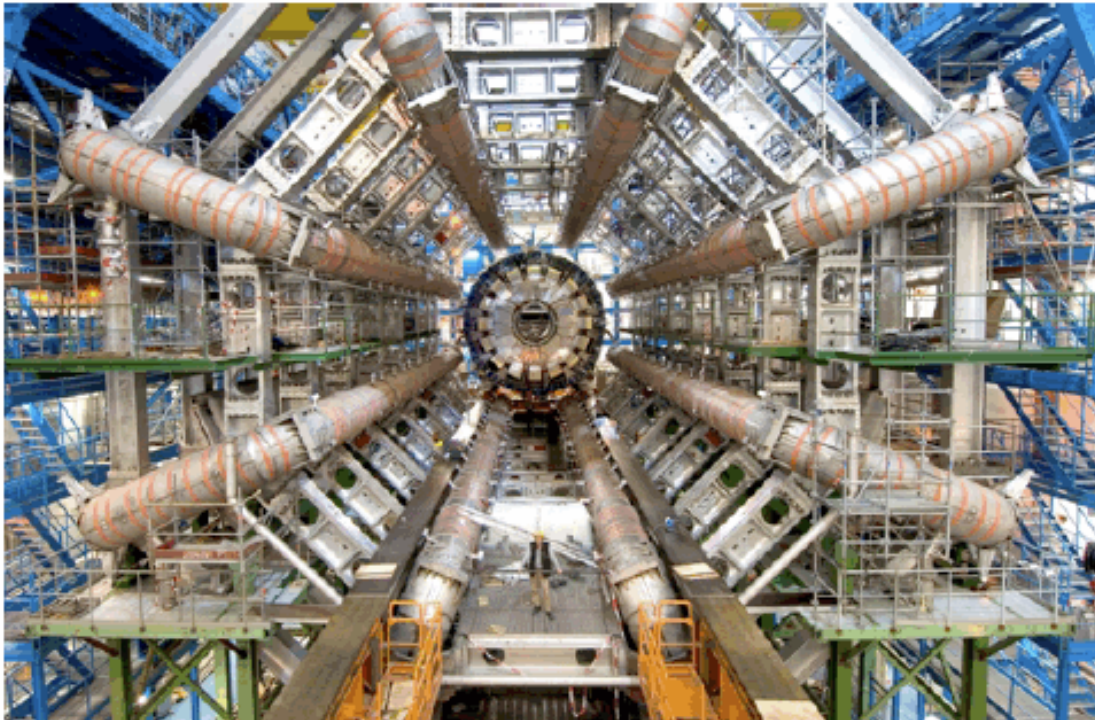


Layers of the ATLAS detector



Magnet concept: ATLAS \Rightarrow toroid

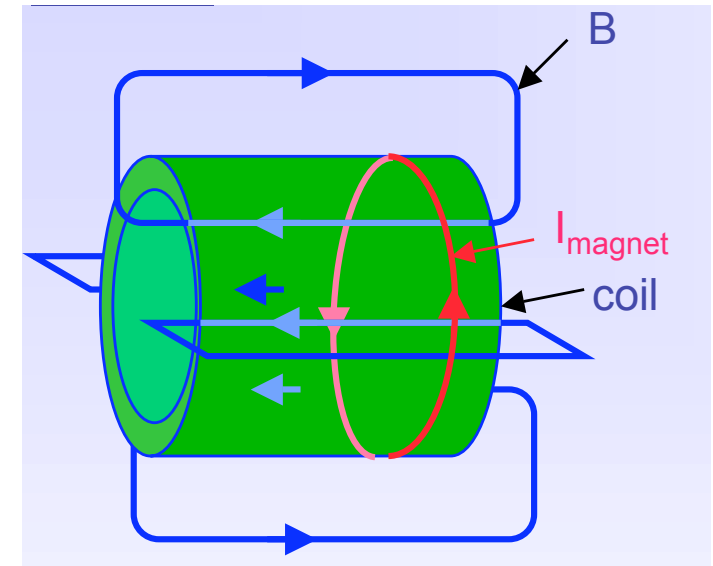
the largest magnet in the world



- Central Toroid field within Muon-System: 4 T
 - Closed field, no yoke
 - Complex field
- 2 T Solenoid-field for trackers

- + field always perpendicular to p_T
- + relative large field over large volume
- non uniform field
- complex structure

Magnet concept: CMS → one solenoid



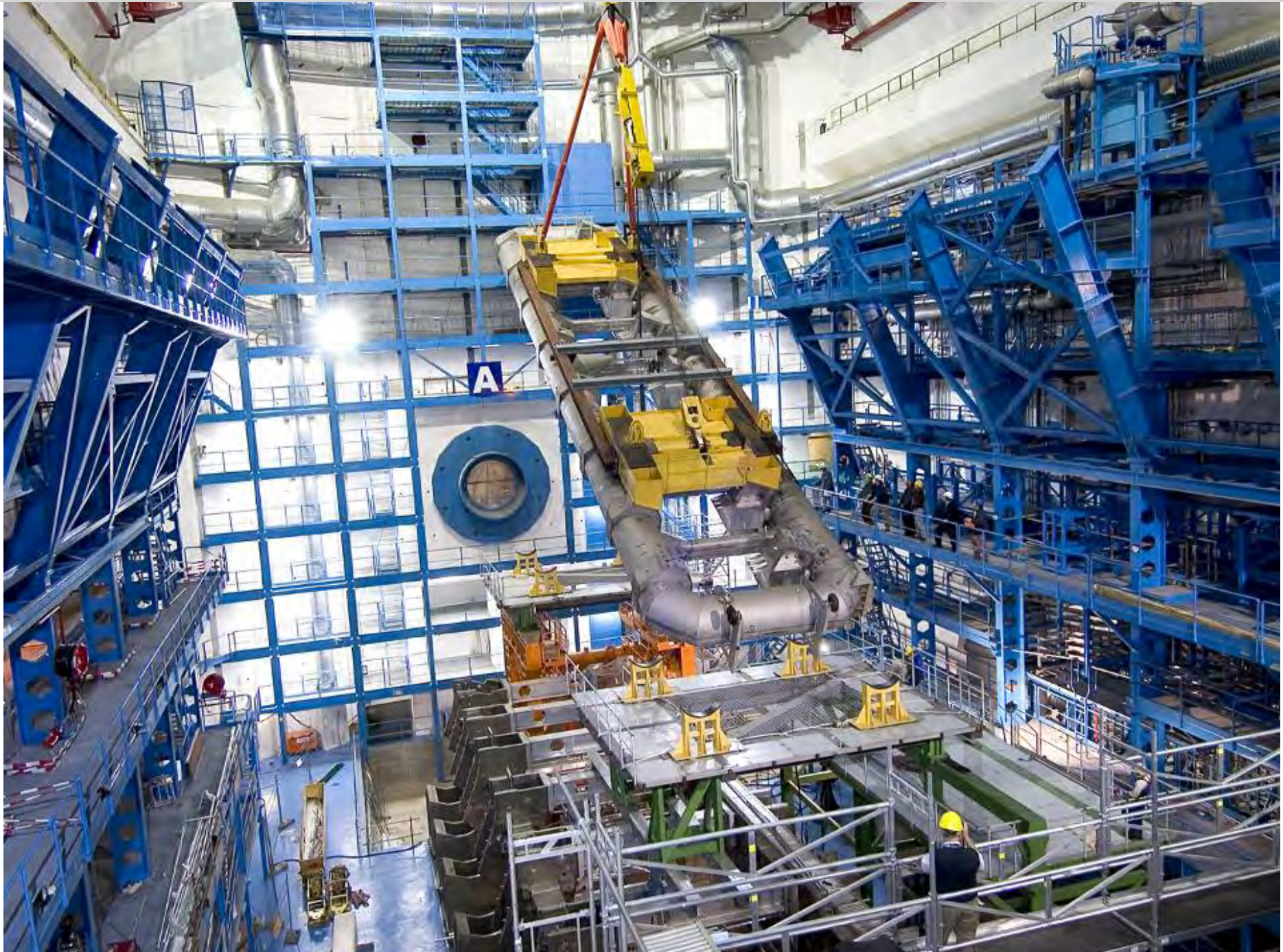
- Largest Solenoid in the world:
 - superconducting, 4 T field
 - encloses trackers and calorimeter
 - 13 m long, inner radius 5.9 m, $I = 20$ kA, weight of coil: 220 t

- + large homogeneous field inside coil
- + weak opposite field in return yoke
- size limited (cost)
- relative high material budget

How ATLAS has been installed



How ATLAS has been installed



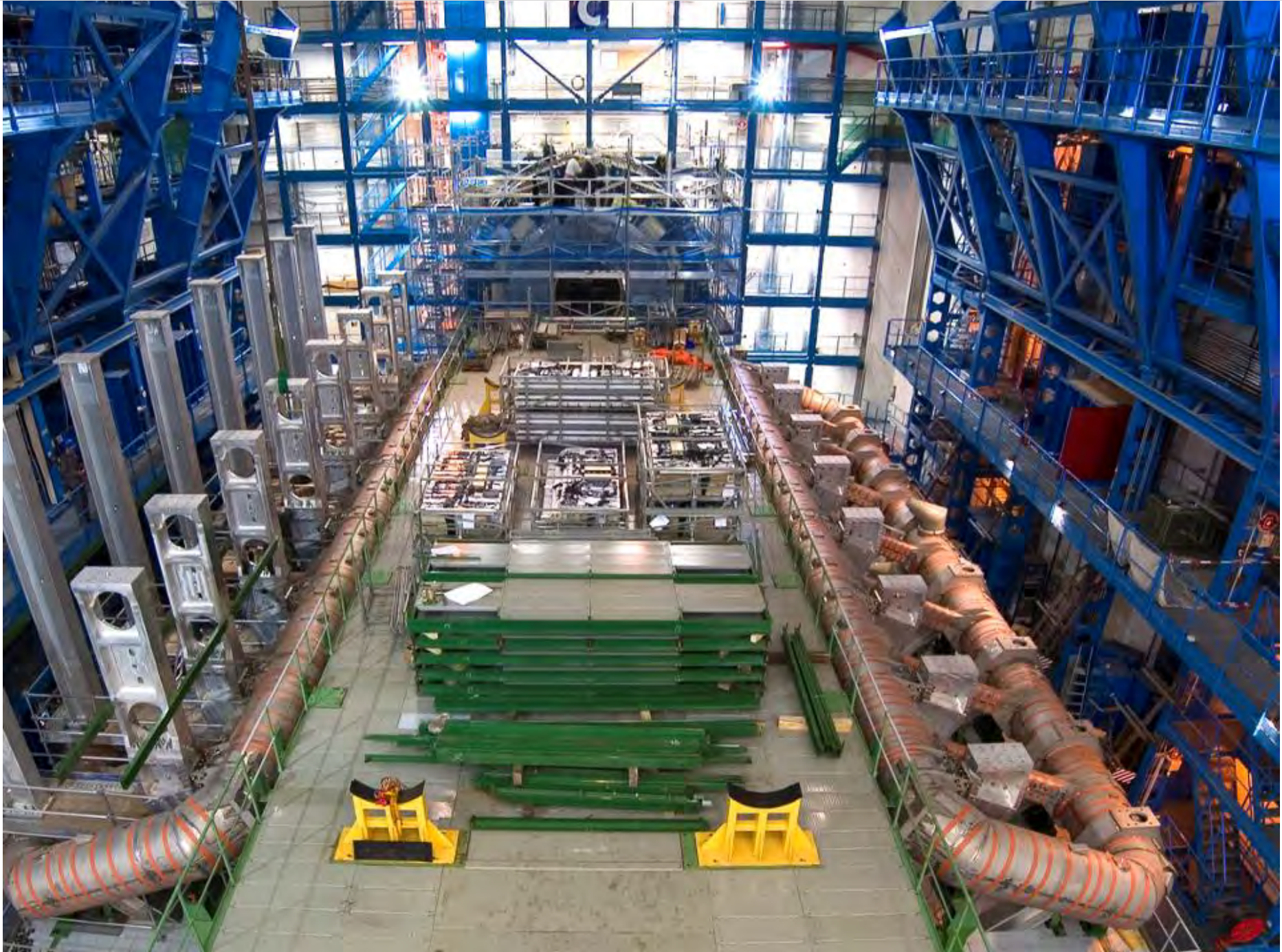
How ATLAS has been installed



How ATLAS has been installed



How ATLAS has been installed



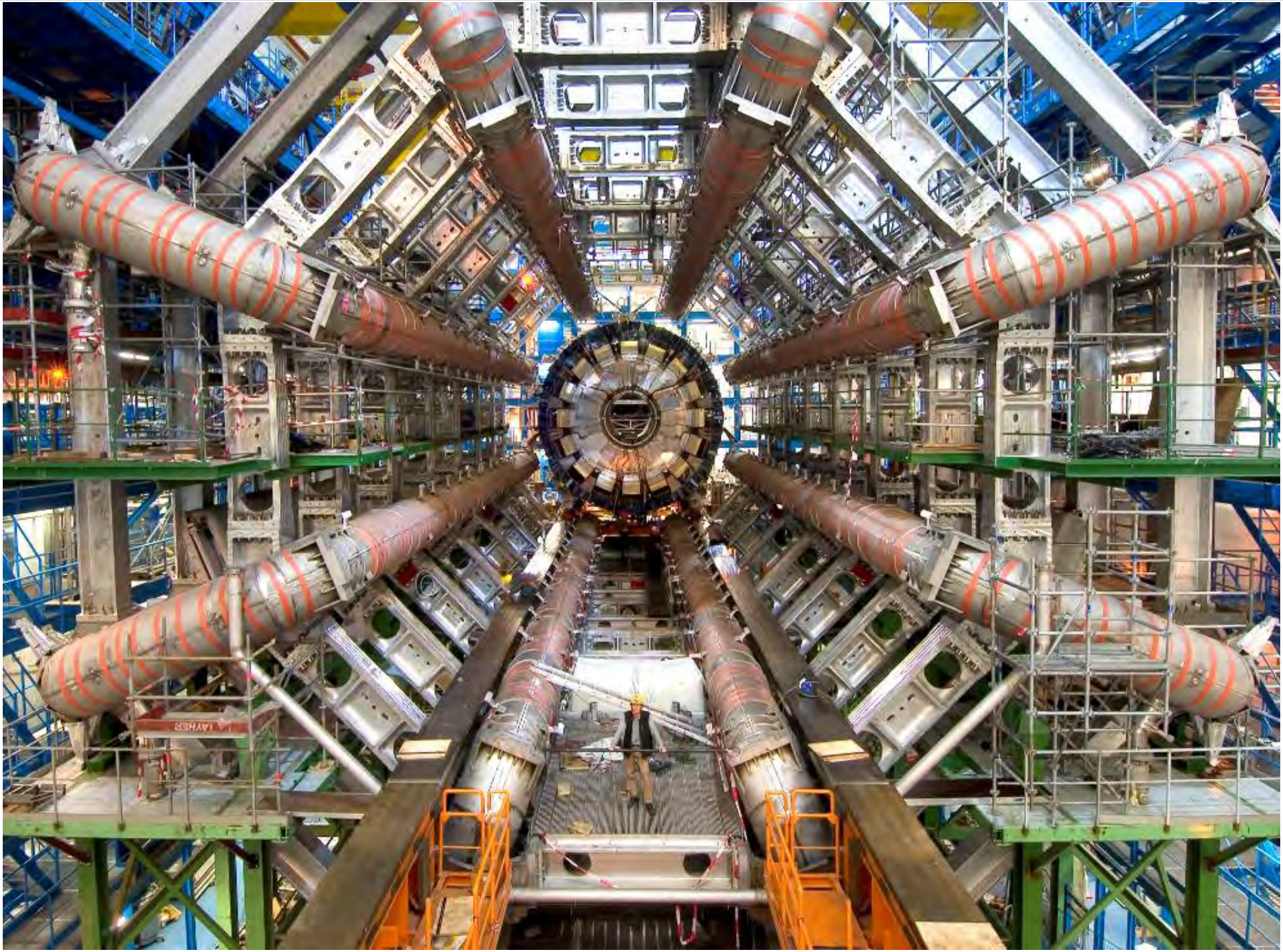
How ATLAS has been installed



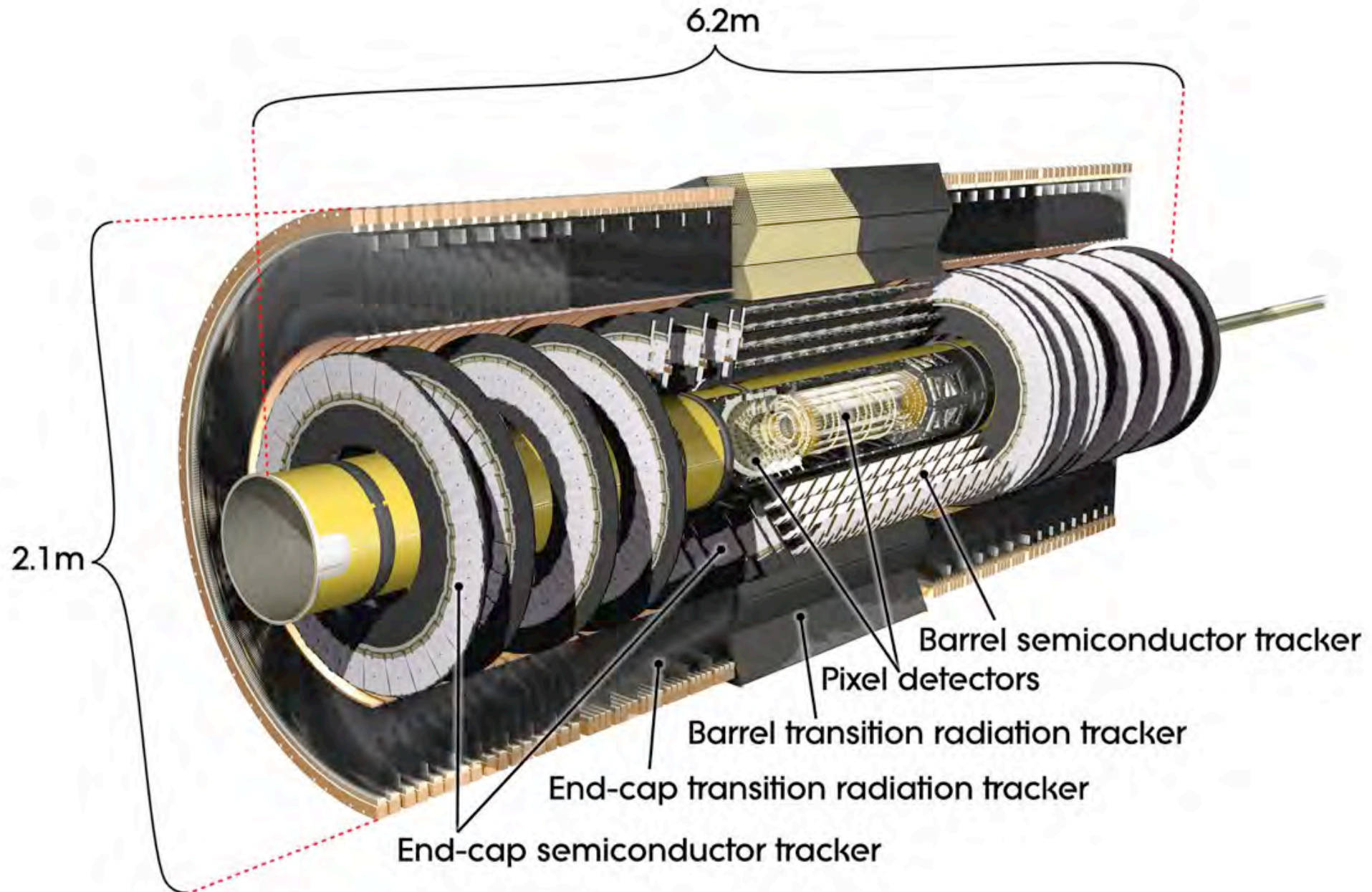
How ATLAS has been installed



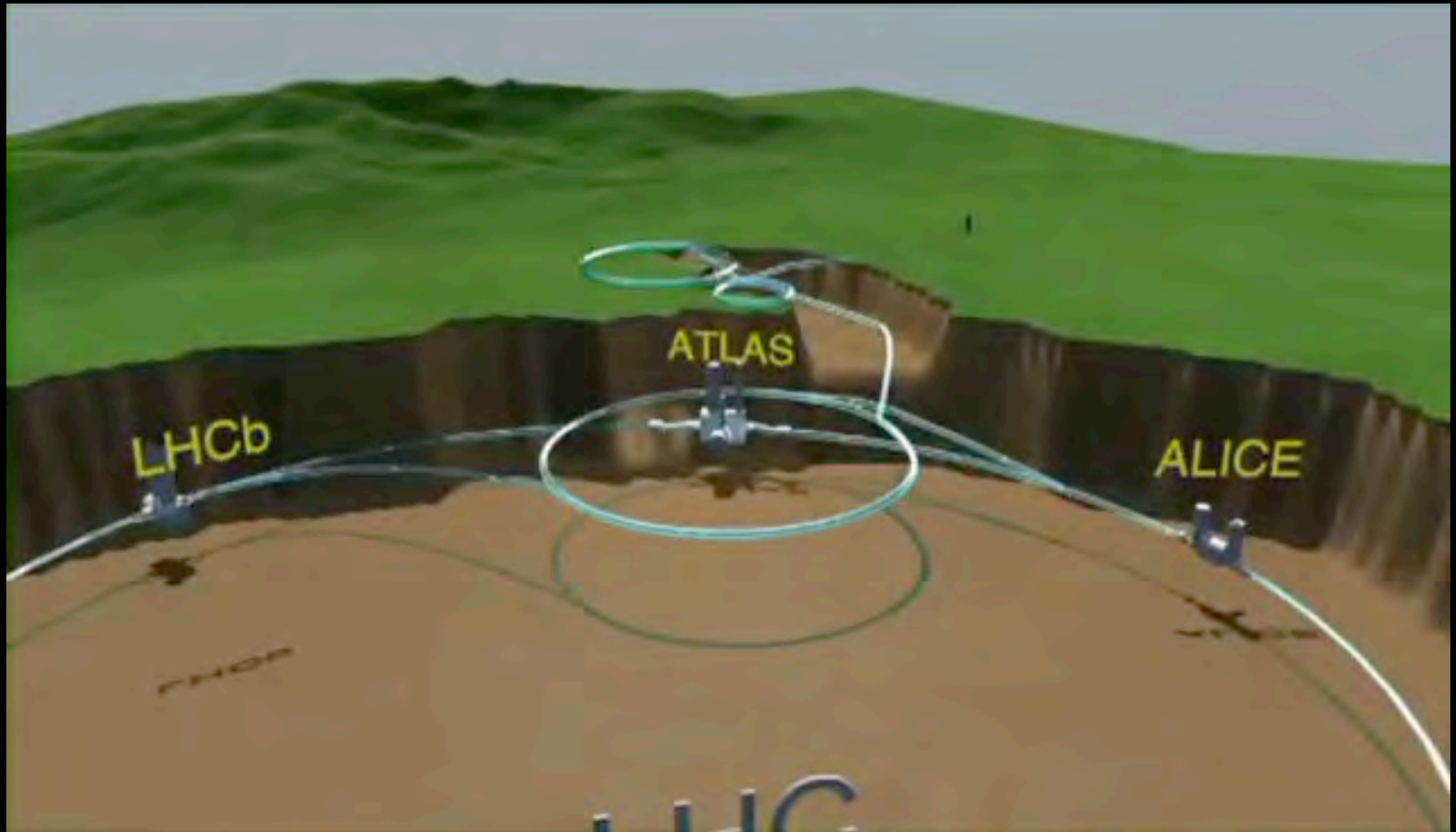
How ATLAS has been installed



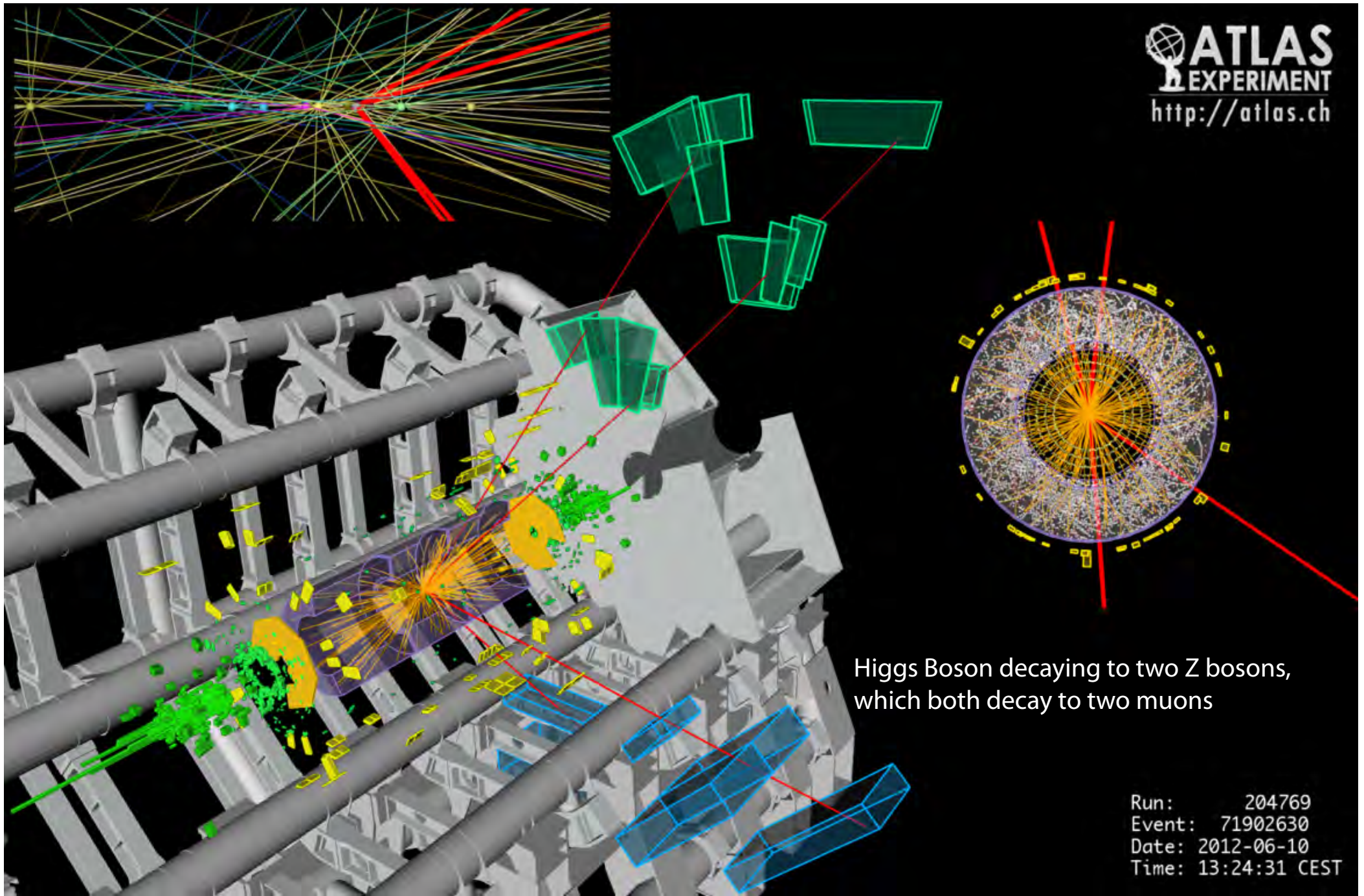
The ATLAS Inner Tracking Detector



Collisions in the LHC

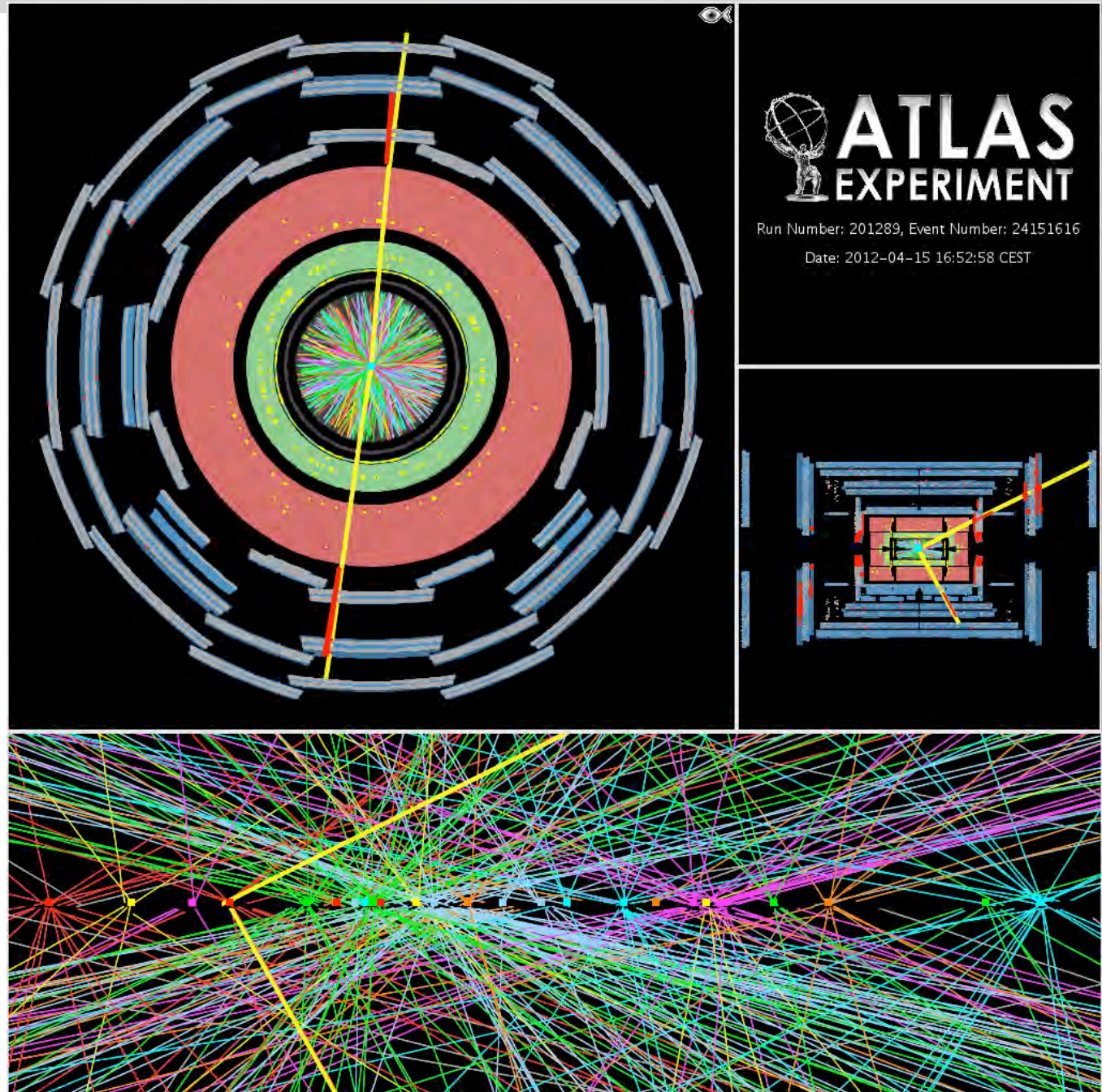


A real Higgs candidate event

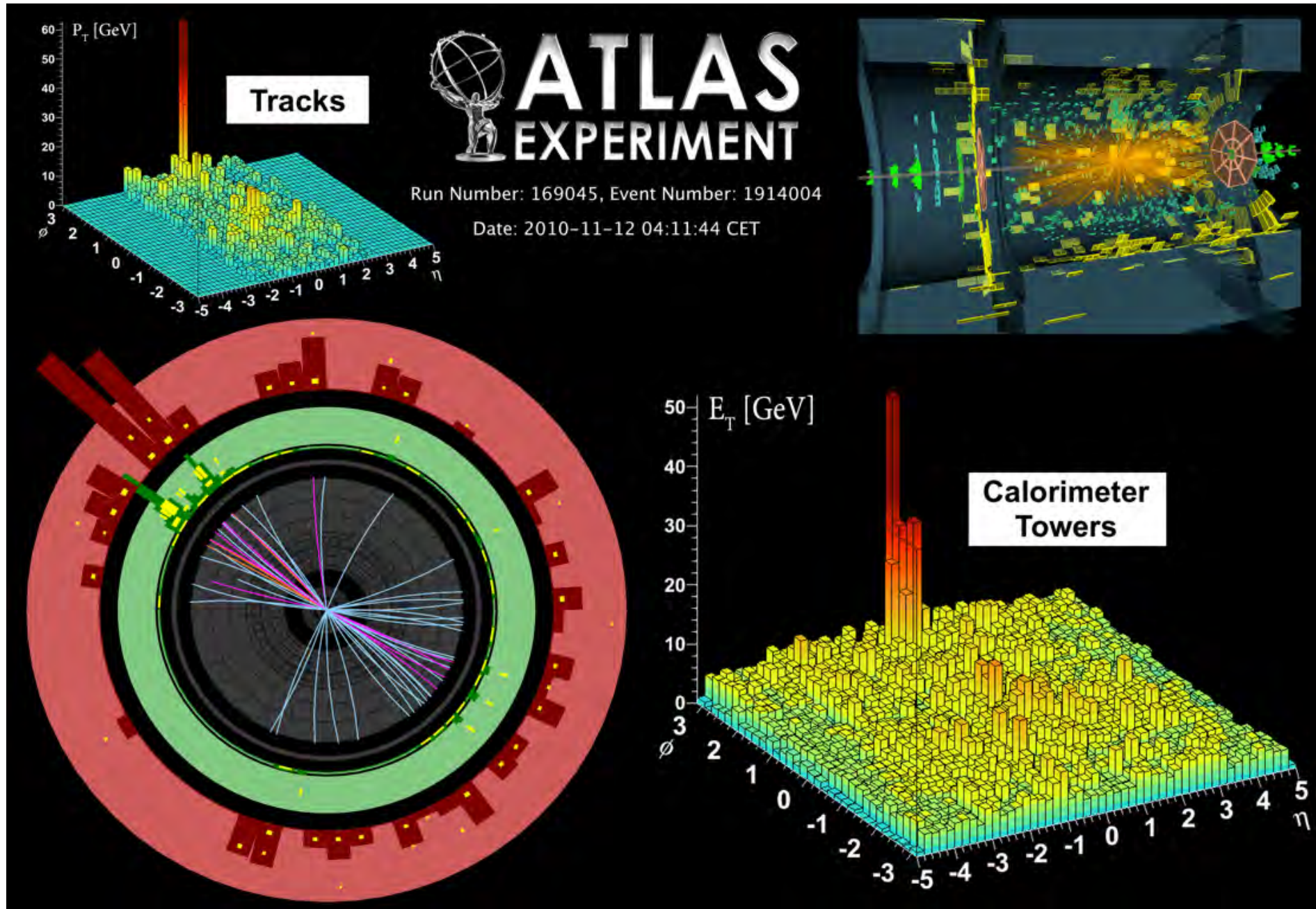


Challenge: tracking in LHC environment

- data from 2012
- 25 collisions in one event!



A heavy ion event in ATLAS



The history of an LHC detector

Example: the ATLAS TRT

- 1989: R&D for the TRT begins (1990: RD6)
- 1994: LHC machine approved. First full-size TRT prototype completed (10'000 channels for end-cap wheel)
- 1996-1998: major Technical Design Reports for ATLAS construction approved, test beams
- 2000: assembly of barrel modules and end-cap wheels start. Front-end electronics specified and vendor chosen.
- 2002: wire-joint trouble
- 2003-2004: web trouble
- 2000-2007: many other troubles
- 2006: first cosmic tracks recorded
- 2006: installation of barrel ID in ATLAS
- 2007: installation of ID end-caps in ATLAS
- 2008: TRT routinely operated, first LHC beam seen (beam splashes)
- 2009: first proton collisions recorded
- 2010: first high energy proton collisions

Own contribution to the ATLAS detector the Transition Radiation Tracker

TRT end cap wheel production

- basic element: wheel with 4 straw planes



Installation of straws
(tests leak tightness)



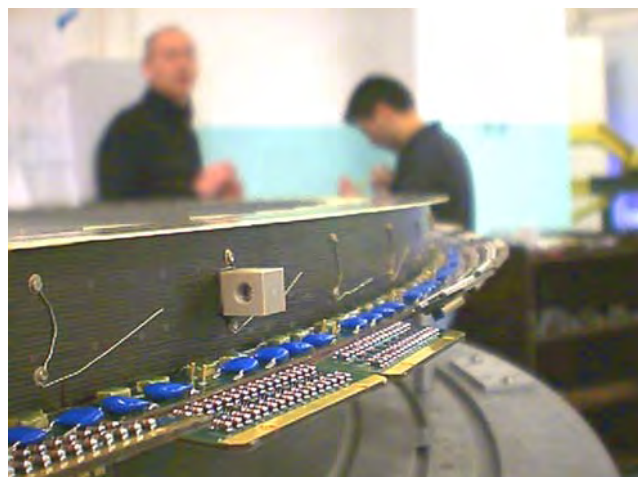
Transfer of wheel...



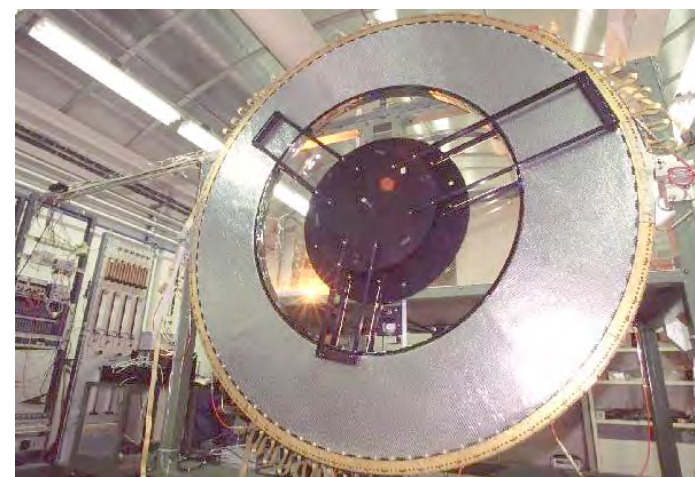
...to string wires



Fixating and connecting wires
(tests wire tension & HV)



Sealing of wheel
(tests leak tightness & HV)



Final acceptance tests
(test wire centricity etc.)

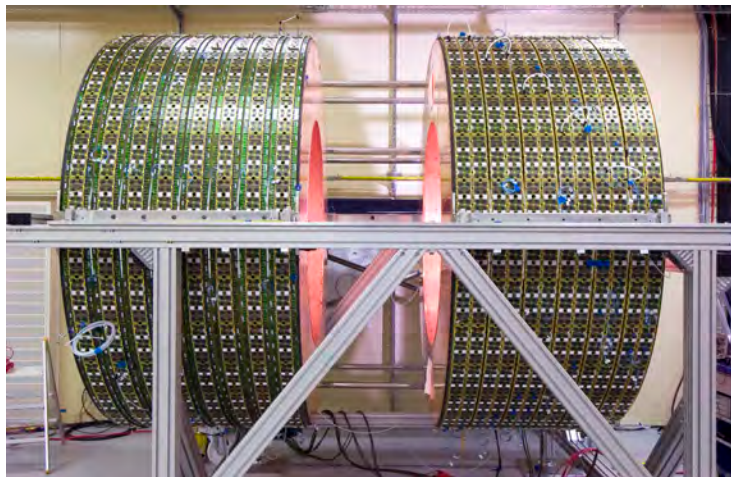
Mounting TRT end cap



After the wheels have been stacked...

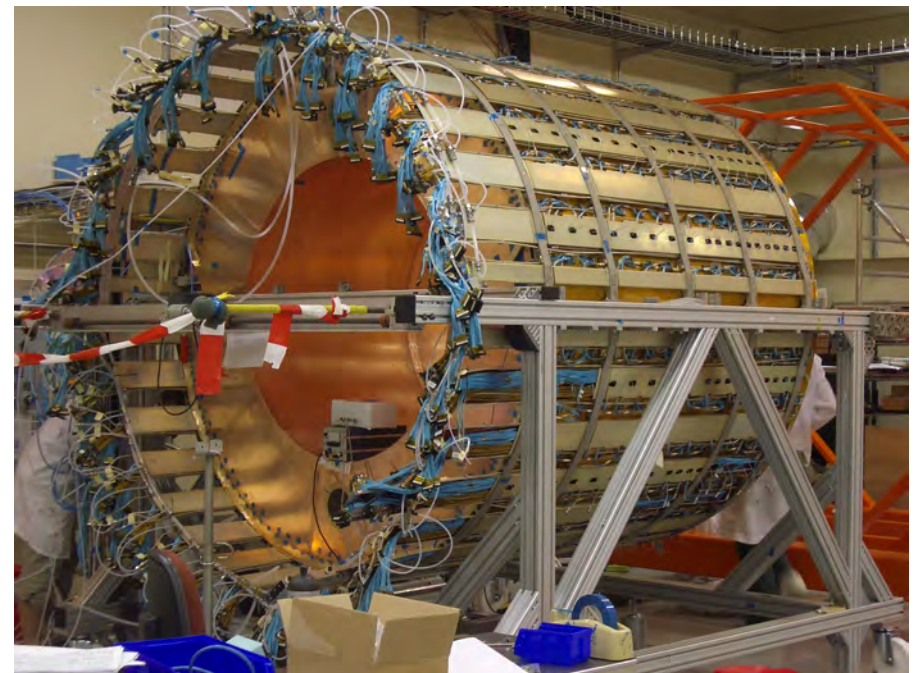


...the stack is rotated.



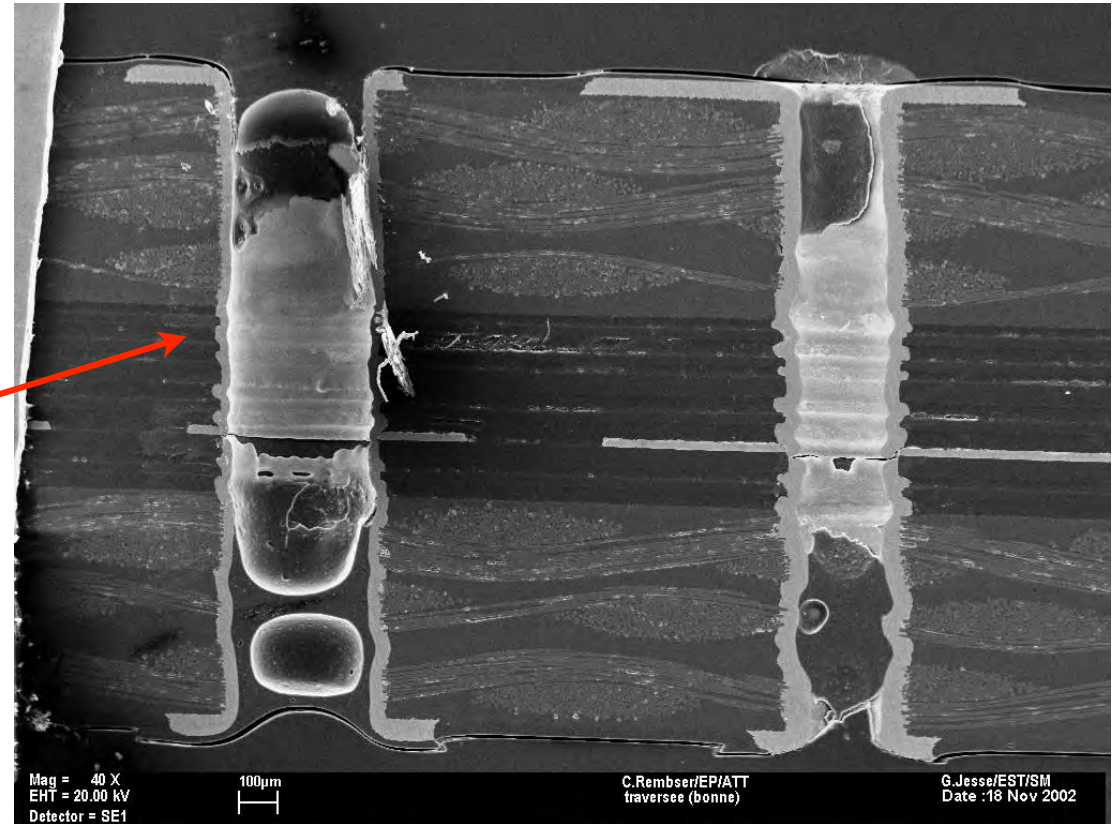
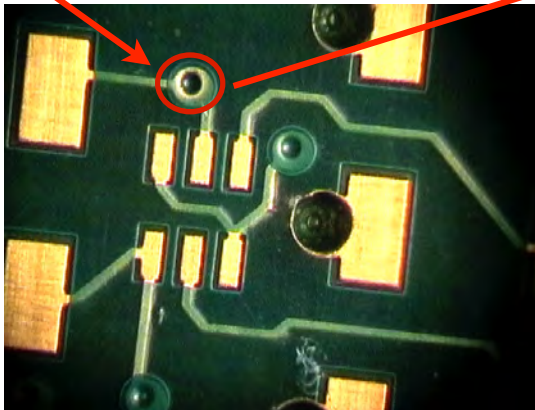
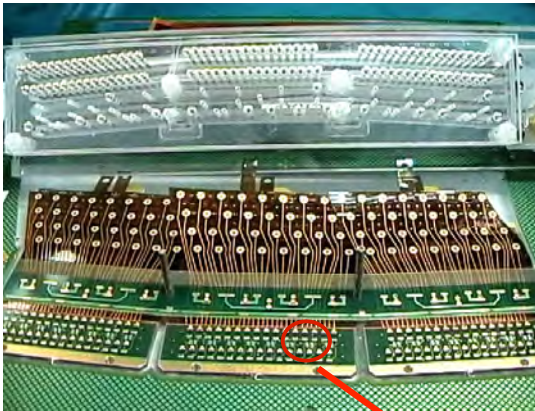
The two stacks of an end cap

The ready end cap, with all cables, pipes and supports (0.8% dead channels; ~50 man years of work)



Bad surprises (I)

- Wheel end cap electronics boards
(connecting straws to HV, read-out and main mechanical structure of end-caps)
- ➔ many problems during production and manufacturing

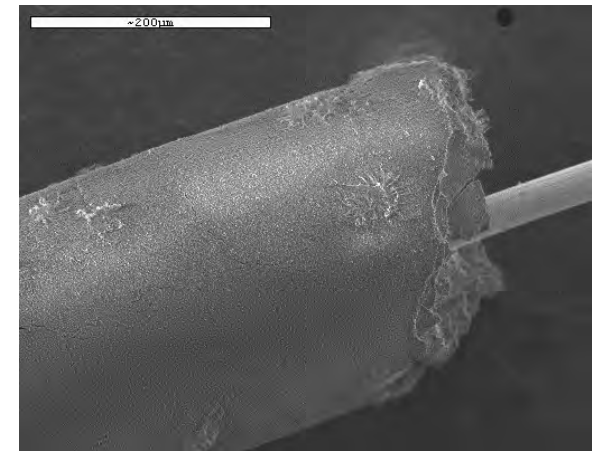


When building detectors

- ensure excellent quality control!!!
- ensure good contact to production companies!!!

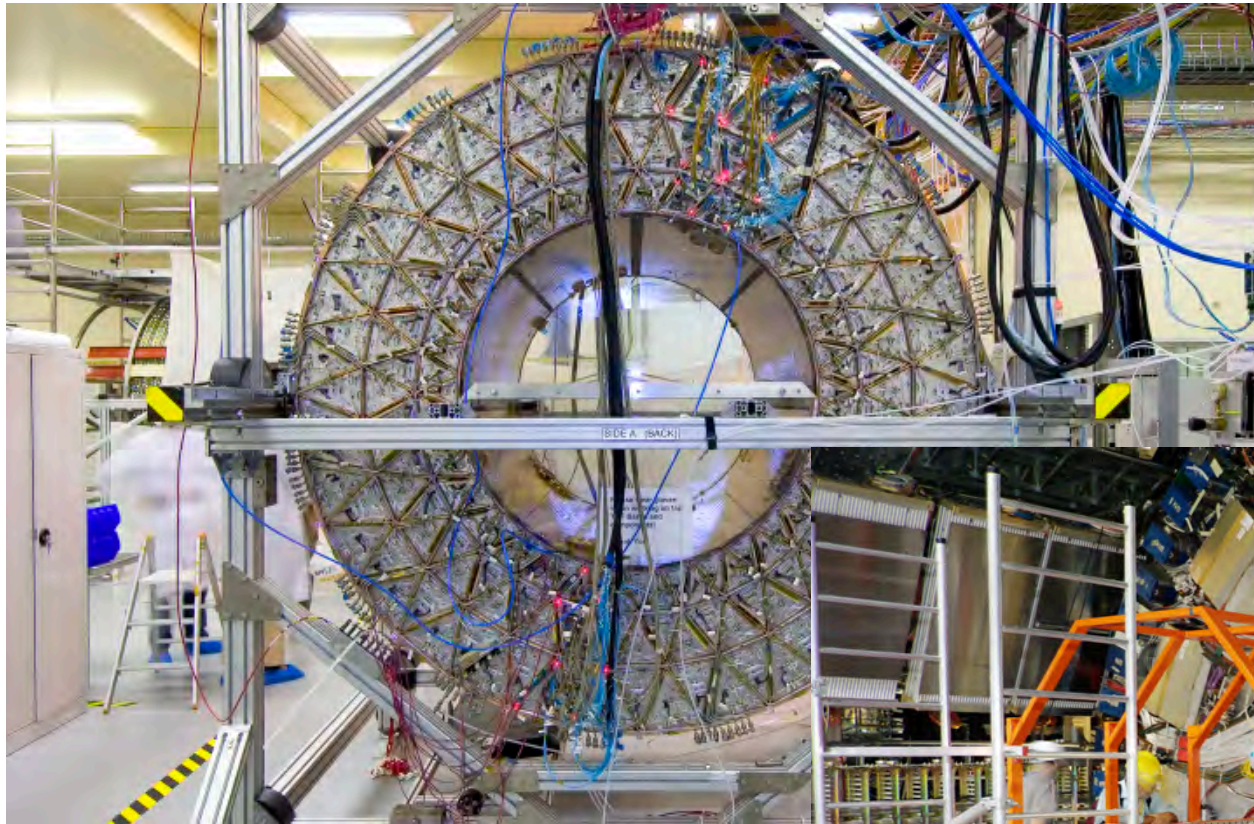
Bad surprises (2)

- Original TRT gas mixture (70% Xe, 20% **CF₄**, 10% CO₂) was destroying the detector (2002)
 - ➔ glass wire joints of barrel TRT “melting” with radiation 0.3-04 C/cm, less than 1 year nominal LHC operation
 - ➔ Reason: hydrofluoric acid HF



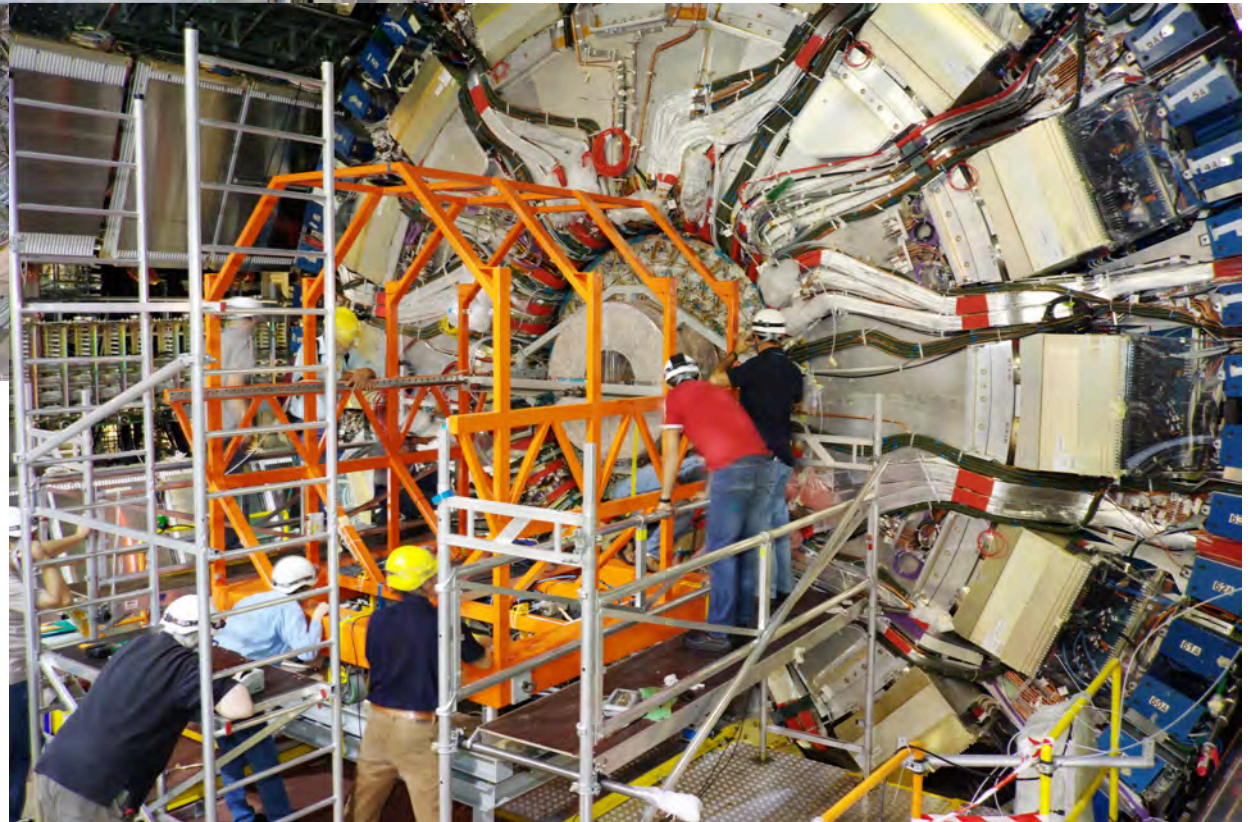
- Within one year, a new mixture was developed 70% Xe, 27% CO₂, 3% O₂
 - ➔ O₂ very unusual, strong quencher (“eats” electrons)
 - ➔ only works for TRT as straws have small diameter (lucky!)

But we managed...



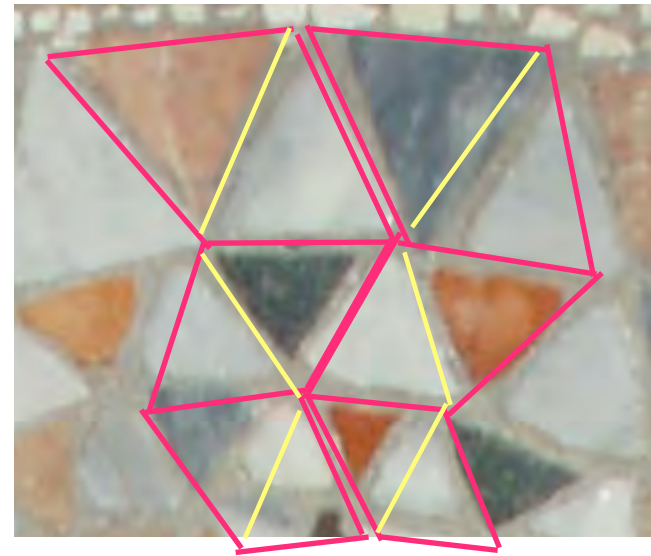
The TRT barrel in the assembly site

Installation into
ATLAS



Inspired by a historical design (?)

- ATLAS - a 12th century mosaic in the Otranto cathedral in Italy



“Original” design has foreseen 4 layers.