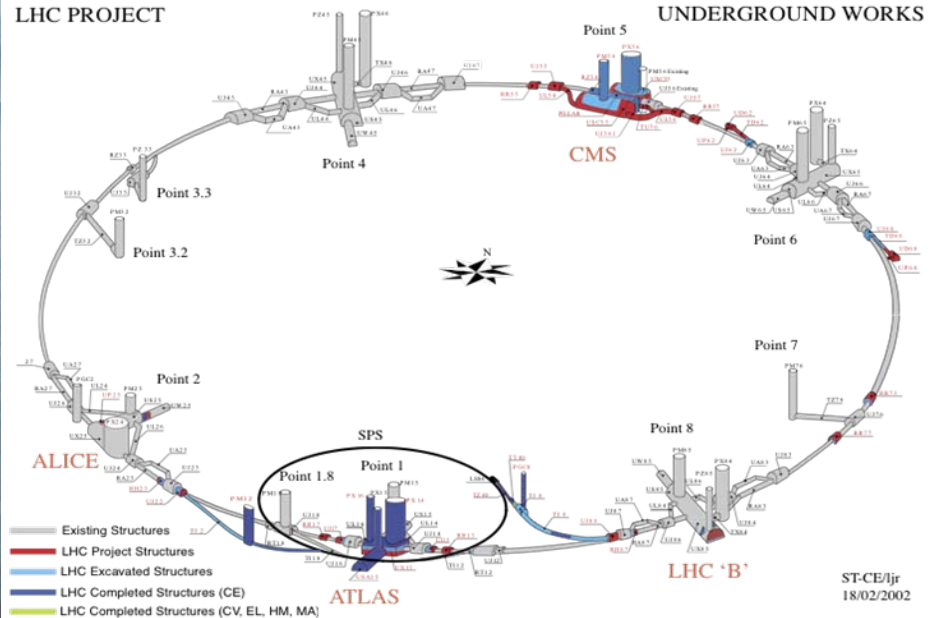
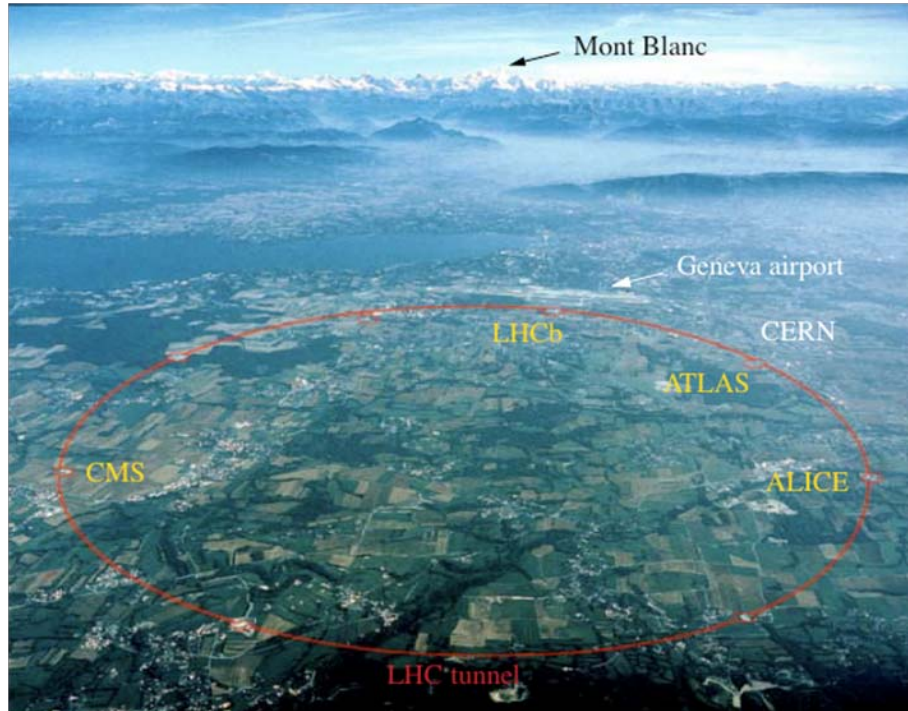




US Study Abroad View from US CMS

Professor Nicholas Hadley
The University of Maryland
US CMS Collaboration Board Chair
June 1, 2009

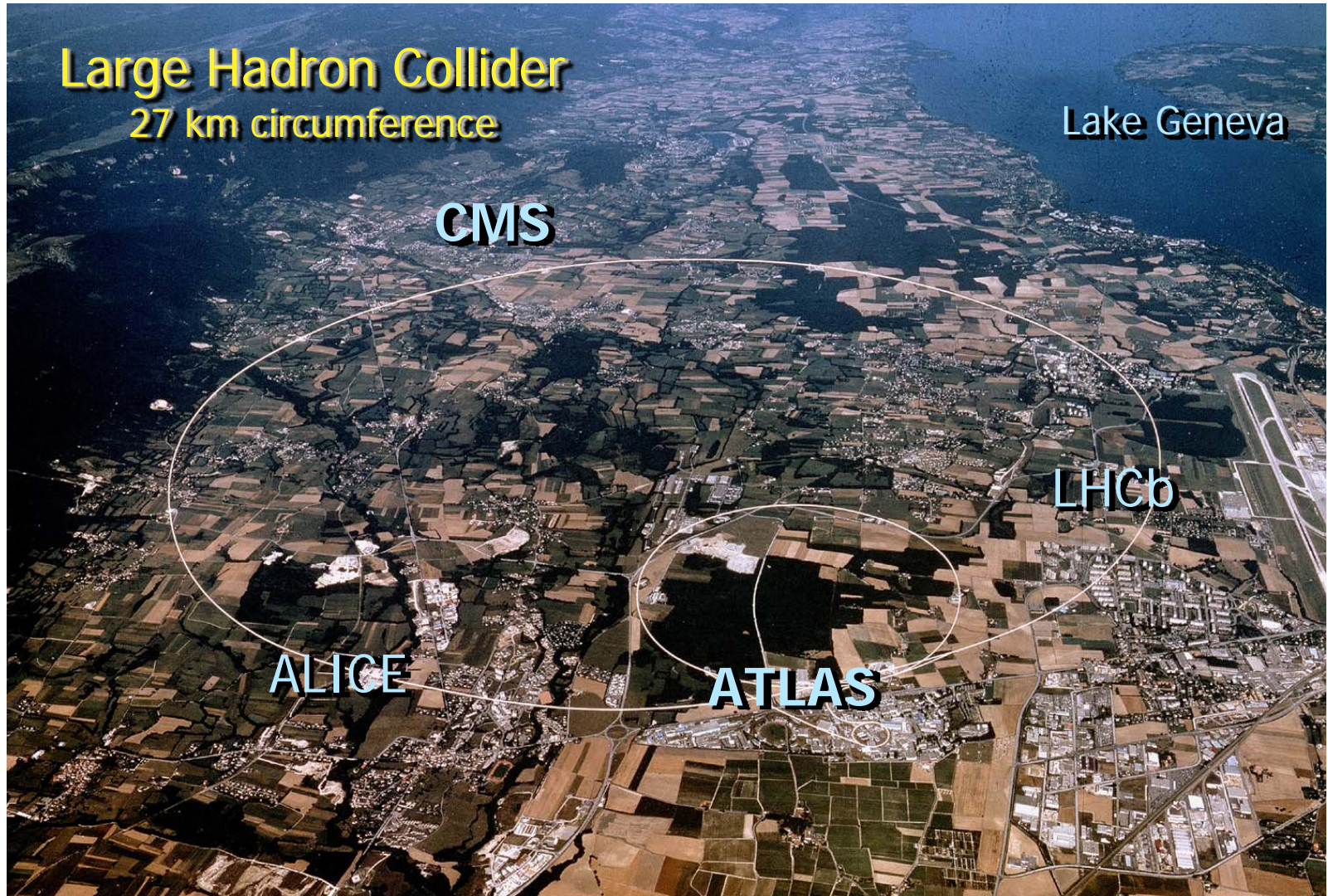
The Large Hadron Collider (LHC)



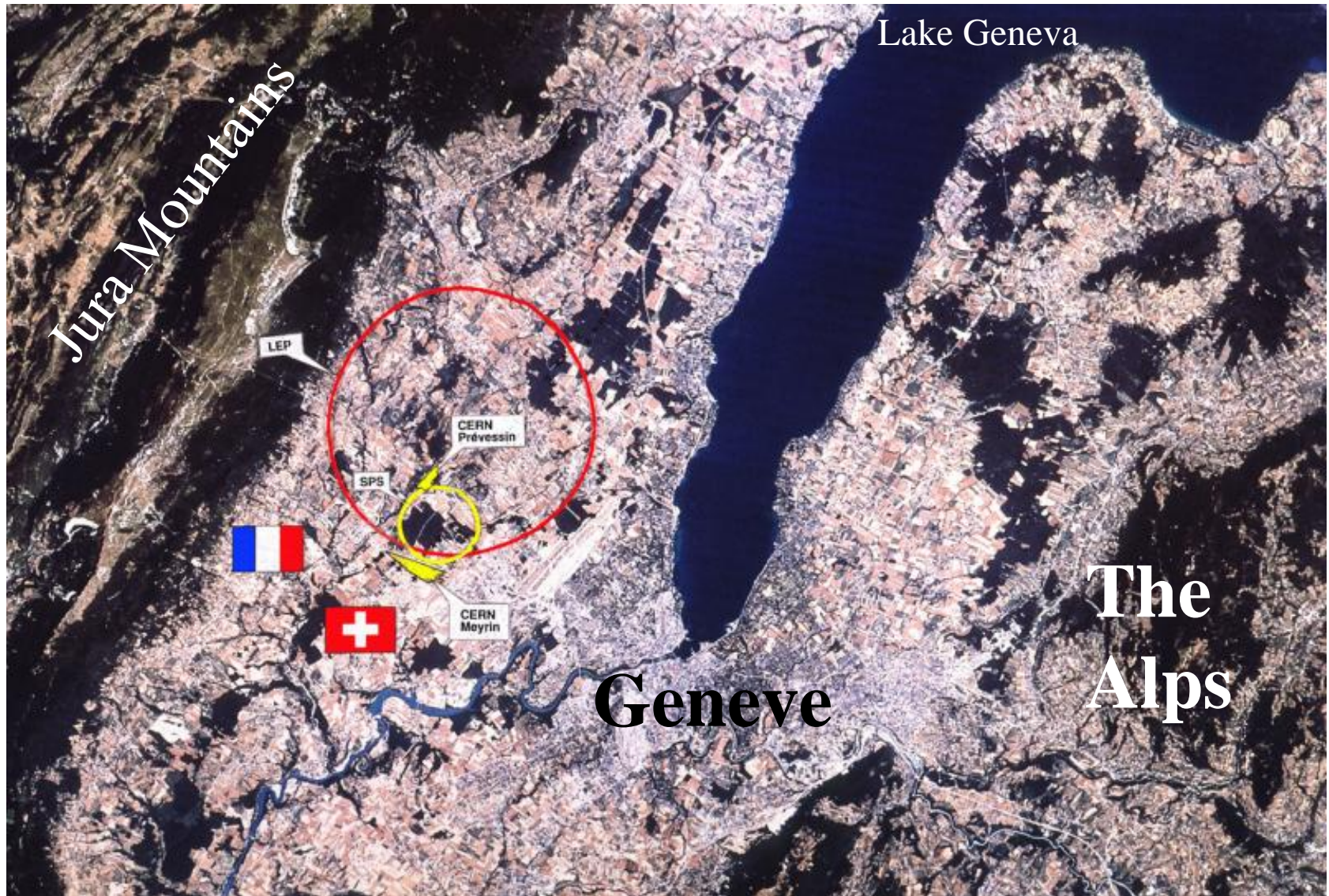
- ★ proton proton Energy = 14,000 GeV $L=10^{34} \text{ cm}^{-2} \text{ s}^{-1}$
- ★ circumference of 27 km (16.8 miles)
- ★ crossing rate 40 MHz (25 ns)
- ★ Used to study the known particles and their interactions, and it look for new particles/interactions



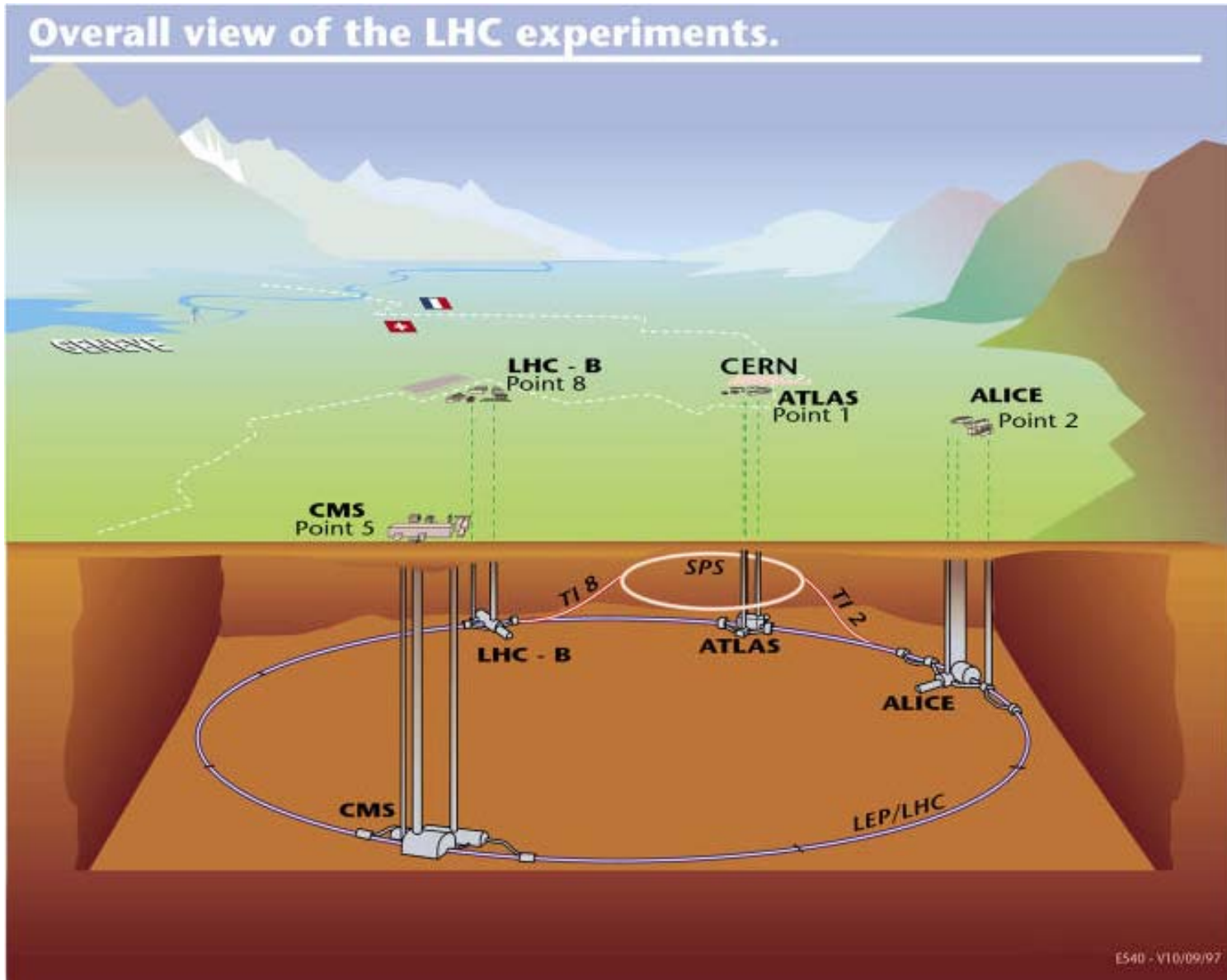
Large Hadron Collider at CERN



Really big



LHC (cont)





LHC tunnel ready for magnet installation



...27 km of dipoles...a formidable achievement!



Collision Facts



- Very messy collisions
- Hundreds of objects after collision



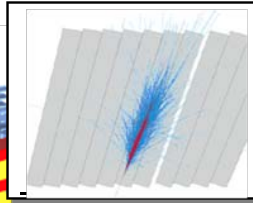
- Need to simplify the measurement

Experimentalist's View

SUPERCONDUCTING COIL

Total weight : 12,500 t
Overall diameter : 15 m
Overall length : 21.6 m
Magnetic field : 4 Tesla

ECAL Scintillating PbWO_4 Crystals



CALORIMETERS

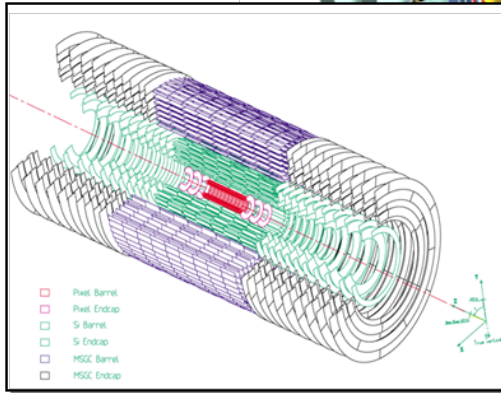
HCAL

brass Plastic scintillator sandwich

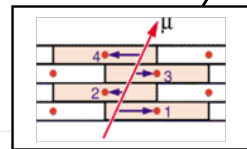
IRON YOKE

MUON ENDCAPS

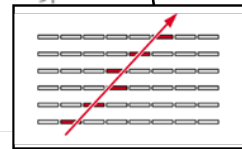
TRACKERS



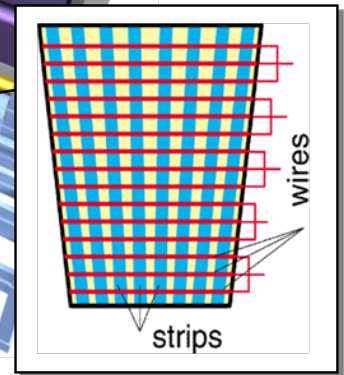
Silicon Microstrips
Pixels



Drift Tube Chambers (DT) Chambers (RPC)



MUON BARREL



Cathode Strip Chambers (CSC)
Resistive Plate Chambers (RPC)

CMS Caverns



ENC 10m5 - GRC55 Cavern - Formwork Preparation

ENC 10m5 - GRC55 Cavern - Formwork Preparation - 17/09/2005 - CERN/CE



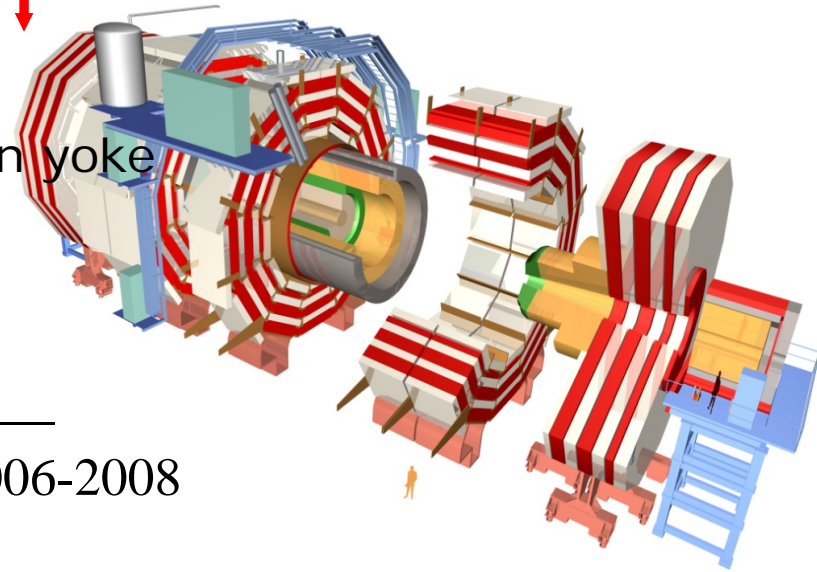
Assembly Sequence



SURFACE : *independent of underground Civil Engineering*

- * construct magnet barrel yoke & pre-cable
- * prepare solenoid vac tanks
- * construct endcap yoke & pre-cable
- * assemble hadron calorimeters
- * install muon chambers (barrel+endcap) in yoke
- * assemble coil & insert in vac tank
- * insert HCAL inside coil
- Test magnet + parts of all subsystems
- * separate elements and lower sequentially

2000-2007



UNDERGROUND :

- * re-install HCAL
- * install ECAL barrel & cable central wheel
- * install Tracker & cable
- * install beampipe & bake-out
- * install ECAL endcaps
- * close & finish commissioning

2006-2008

15 heavy lowerings of
objects of 380 tons -1920 tons

Heavy Lowering: HFs



2 Nov



9 Nov

both HF
in Cavern

HF+ arriving safely in UXC





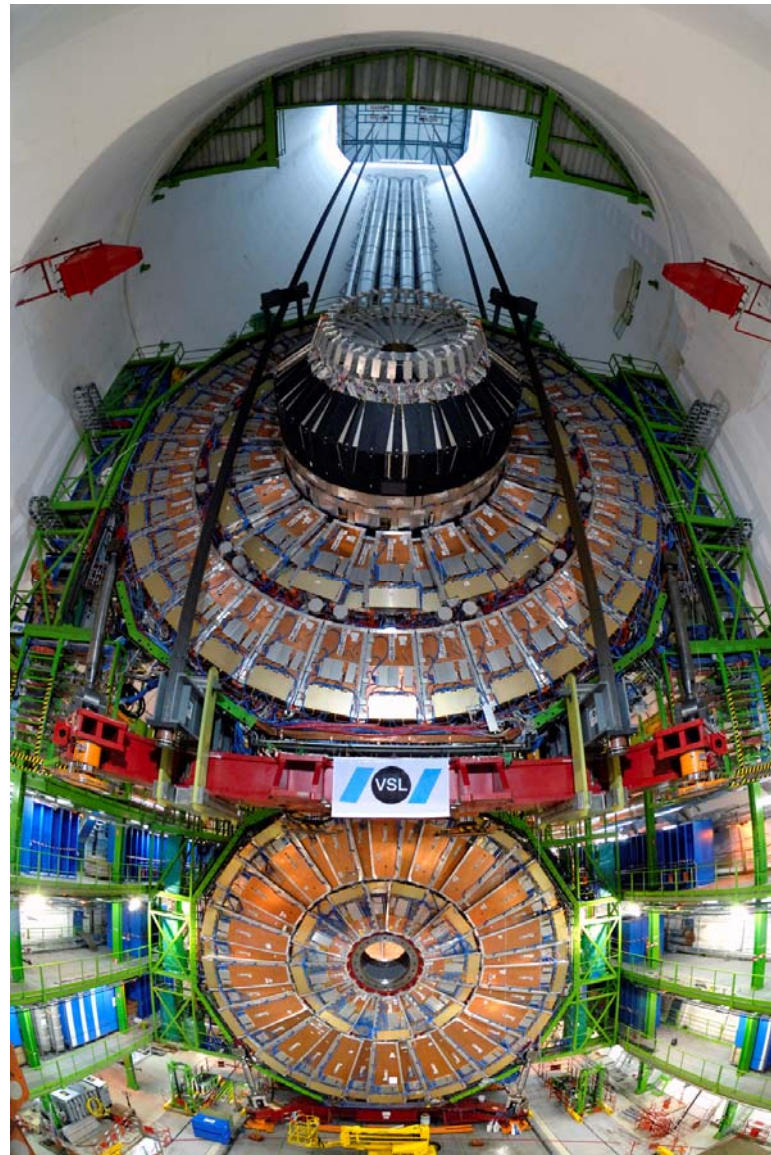
Heavy lowering: YE +3 & +2



30 Nov: YE+3 leaves garage (SX5) and 11 hours later touches down safely in cavern (UXC)

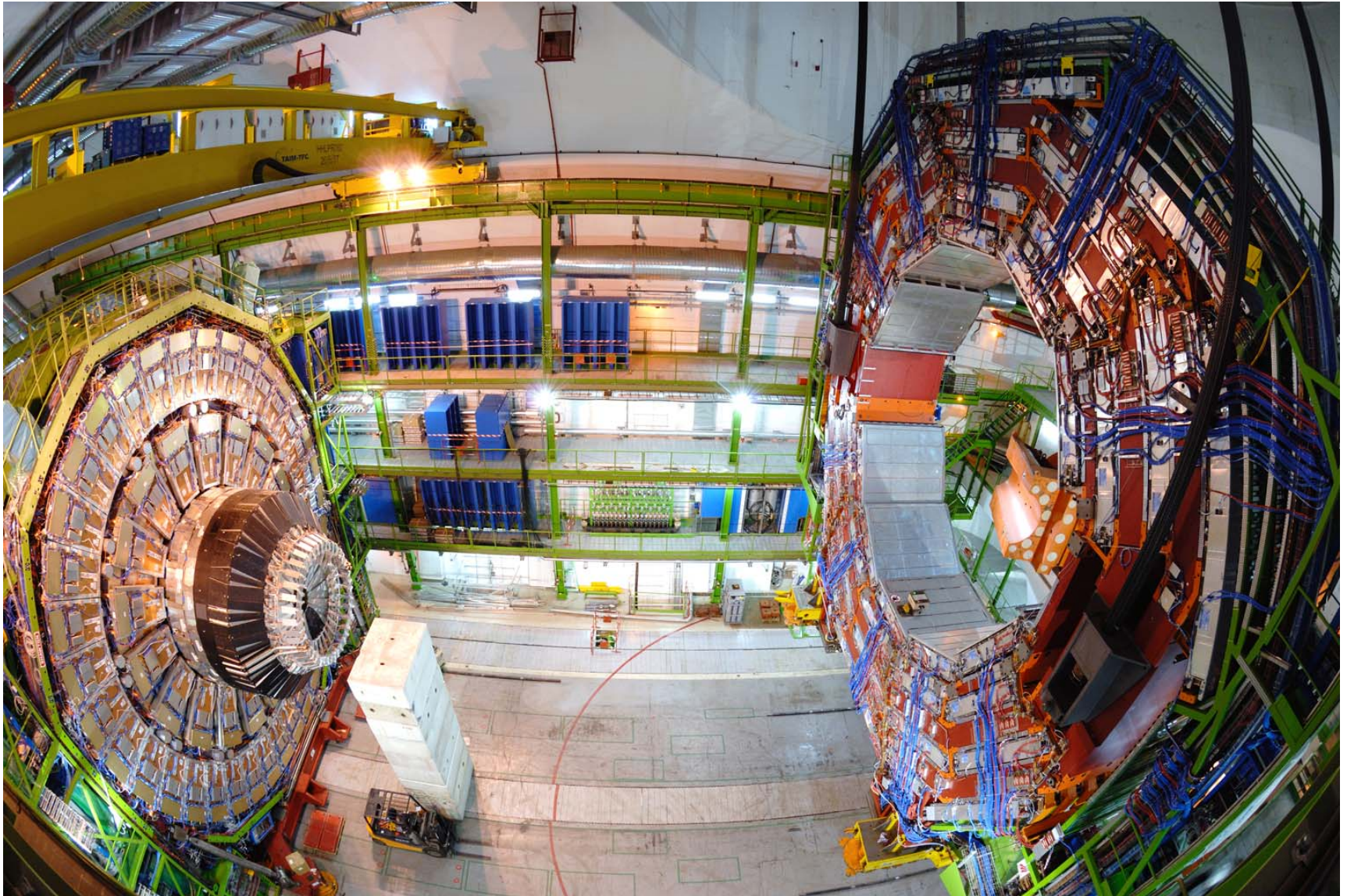


YE+1 Lowering (9 Jan)

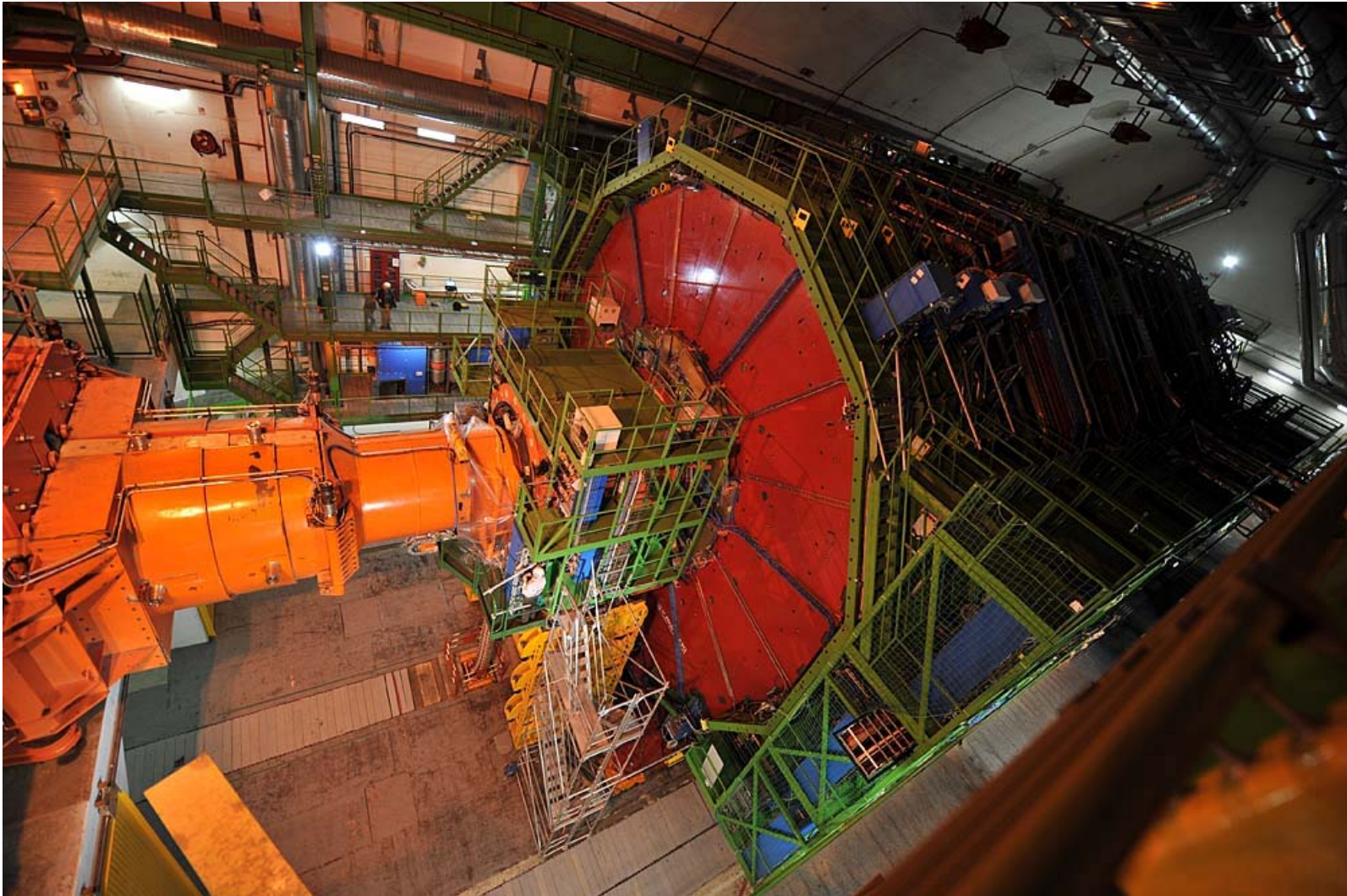


1300 tons

YB+2 Lowering (19 Jan)

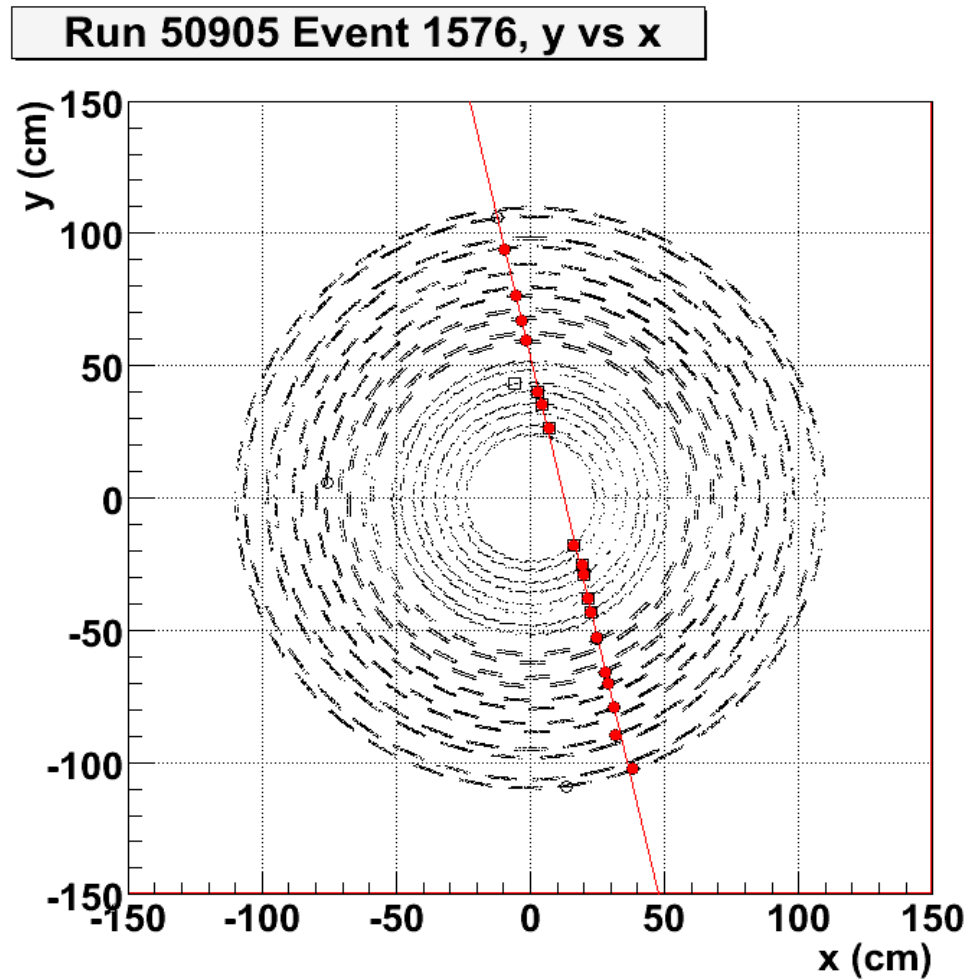


Final Closure – Sept.'08



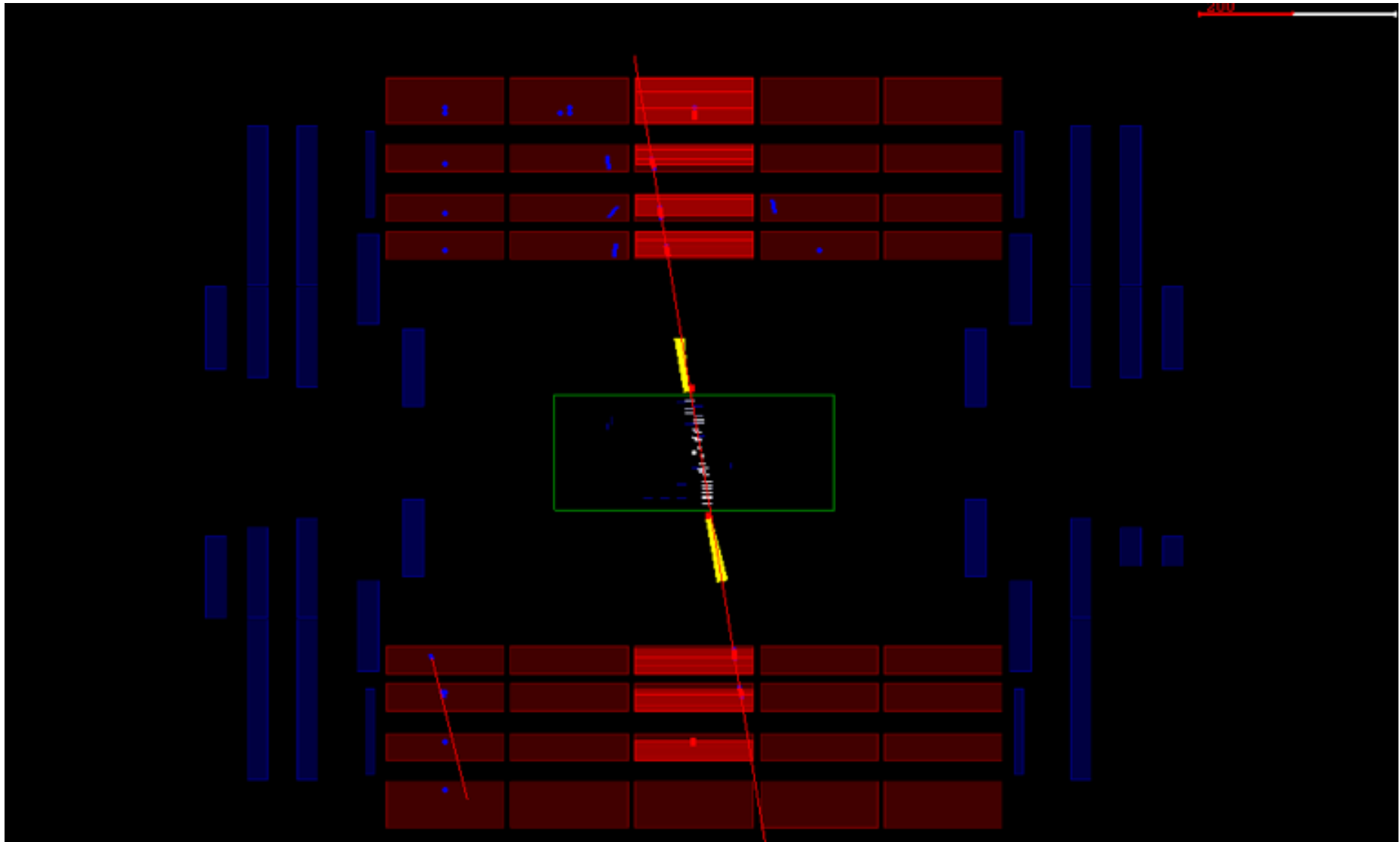


CRUZET3: Cosmic Rays in the Tracker





CRUZET4: Events





First Beams



**After almost 20 years of design and construction
CMS started taking data with LHC beams.**

(Congratulations to the Machine)

- **Sun/Mon, 7-8 Sept.**
 - Single shots of Beam 1 (clockwise via ALICE) onto collimator 150m upstream of CMS, ~ 1 hour
- **Tues, 9-Sept**
 - 20 shots of Beam 1 onto collimator 150m upstream of CMS
- **Wed., 10 Sept.**
 - Nice splash events observed when beam onto collimators (as before), 100-1000 TeV observed in ECAL-HCAL
 - Halo muons observed once beam started passing through CMS
- **Thu, 18-Sep**
 - Return to beam 1 operation, CMS takes data overnight
- **Friday noon, 19-Sep**
 - Massive helium loss in one arc of the tunnel (3-5 tons)
 - Broke insulation vacuum in sector
 - Failure of interconnection between quadrupole and dipole magnet during 5 TeV commissioning of last sector of LHC



CMS Status



- LHC Repairs are in progress
 - Took advantage of downtime to complete detector, make repairs and improvements
- Will have to wait until Fall 2009 for first data
- Run at lower energy: 10,000 GeV
- Run for the next 12 months
- Maybe see something really new

be ready for the unexpected

(photo credit: Joe Lykken)





LHC and Study Abroad



- LHC represents a tremendous opportunity to get students hands on experience with exciting science
- LHC is near Geneva, Switzerland, (not Geneva, Illinois - Fermilab)
 - A program is needed for undergraduates to both study and experience frontier research



CMS/U.S. CMS Demographics/Resources

•CMS

- 39 Countries
- 181 Institutions
- 1940 Scientific Authors total
- 1283 paying M&O share

•U.S. CMS

- 48 institutions
- 639 Scientific Authors
- 442 with Ph.D 34.5%
- 197 Graduate Students

•CMS – “long stays”

- 26 Professors
- 16 Scientists
- 57 Post Docs
- 86 Graduate Students
- 24 Professionals
- 4 Technicians
- 4 staff

•217 total

One-year snapshot in October 2008 (now being updated)
There is a very large USCMS “long stay” community at CERN.

With 1/3 of the community at CERN and 2/3 in the US, we need to make it possible to work on both sides of the Atlantic



US CMS and Study Abroad



- Poll of US CMS Institutions (done last week)
 - Unanimous support
 - Only concerns:
 - Cost
 - fit into academic program
- US CMS collaboration strongly supports study abroad
 - Nearly all US CMS universities have existing study abroad programs
 - Strong support from university administrations as well