



CMS at the LHC: The TeV Frontier

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Compact

- ➔ As small as possible to keep costs down

Muon

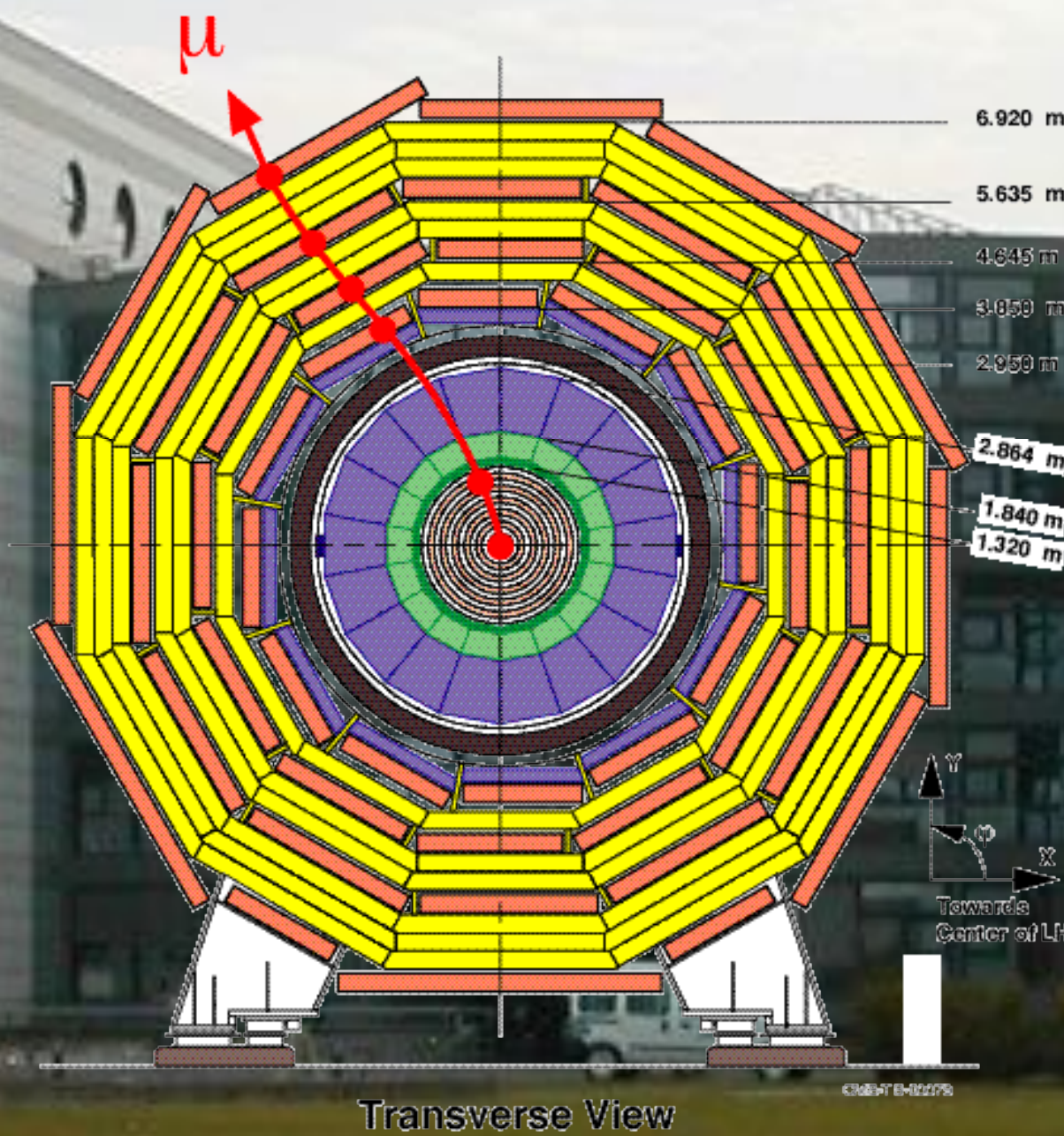
- ➔ Muons are an excellent probe for new physics
 - Used in the discovery of (among many others):
 - J/ψ , Υ , W , Z , top quark, Higgs

Solenoid

- ➔ Need a magnet to analyze the momentum of charged particles
- ➔ Most experiments have a central solenoid
- ➔ The CMS solenoid is one of the major elements of the overall detector design

6 story building
at CERN

My office →



CMS DETECTOR

Total weight : 14,000 tonnes
 Overall diameter : 15.0 m
 Overall length : 28.7 m
 Magnetic field : 3.8 T

STEEL RETURN YOKE
 12,500 tonnes

SILICON TRACKERS
 Pixel (100x150 μm) $\sim 16\text{m}^2 \sim 66\text{M}$ channels
 Microstrips (80x180 μm) $\sim 200\text{m}^2 \sim 9.6\text{M}$ channels

SUPERCONDUCTING SOLENOID
 Niobium titanium coil carrying $\sim 18,000\text{A}$

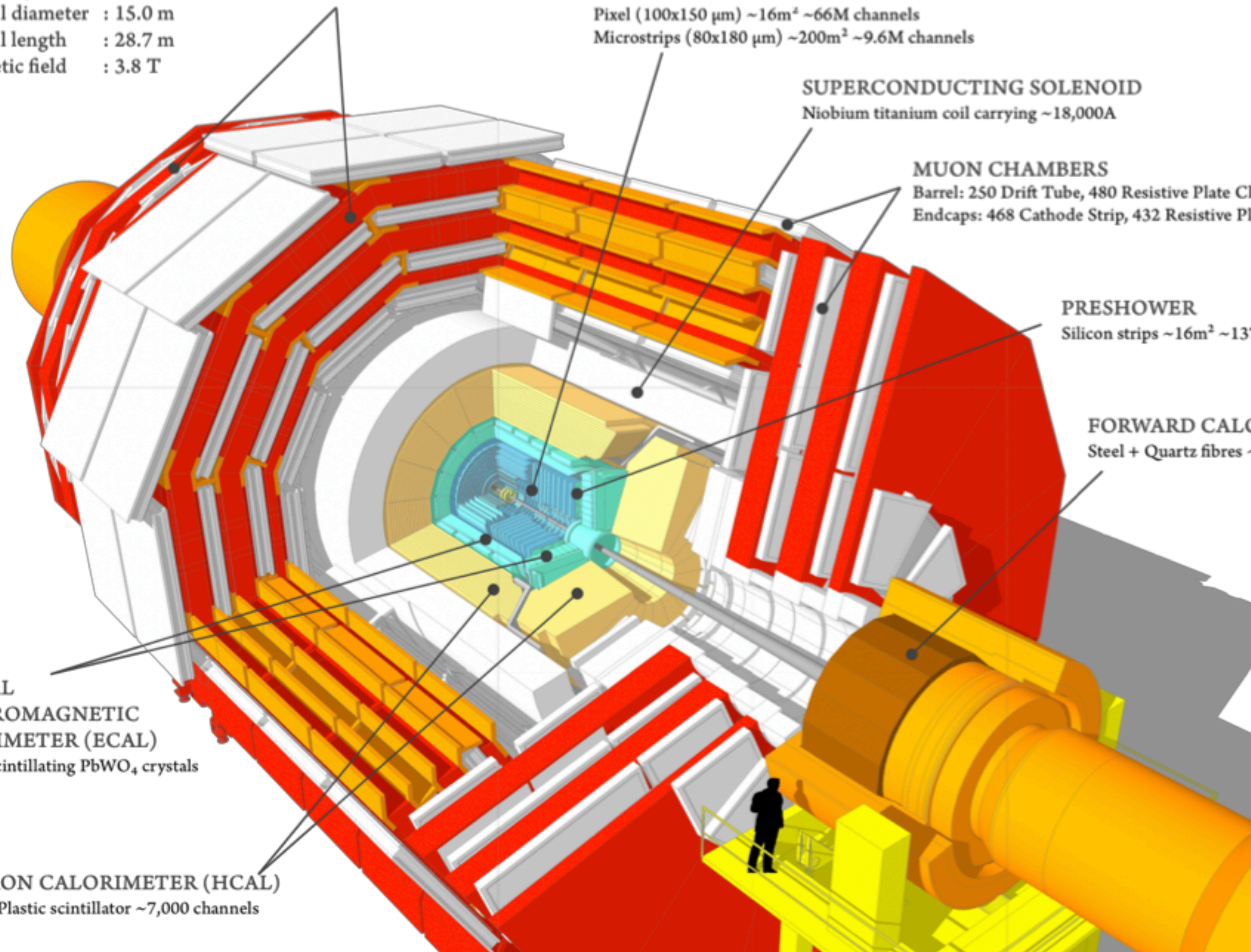
MUON CHAMBERS
 Barrel: 250 Drift Tube, 480 Resistive Plate Chambers
 Endcaps: 468 Cathode Strip, 432 Resistive Plate Chambers

PRESHOWER
 Silicon strips $\sim 16\text{m}^2 \sim 137,000$ channels

FORWARD CALORIMETER
 Steel + Quartz fibres $\sim 2,000$ Channels

CRYSTAL ELECTROMAGNETIC CALORIMETER (ECAL)
 $\sim 76,000$ scintillating PbWO_4 crystals

HADRON CALORIMETER (HCAL)
 Brass + Plastic scintillator $\sim 7,000$ channels



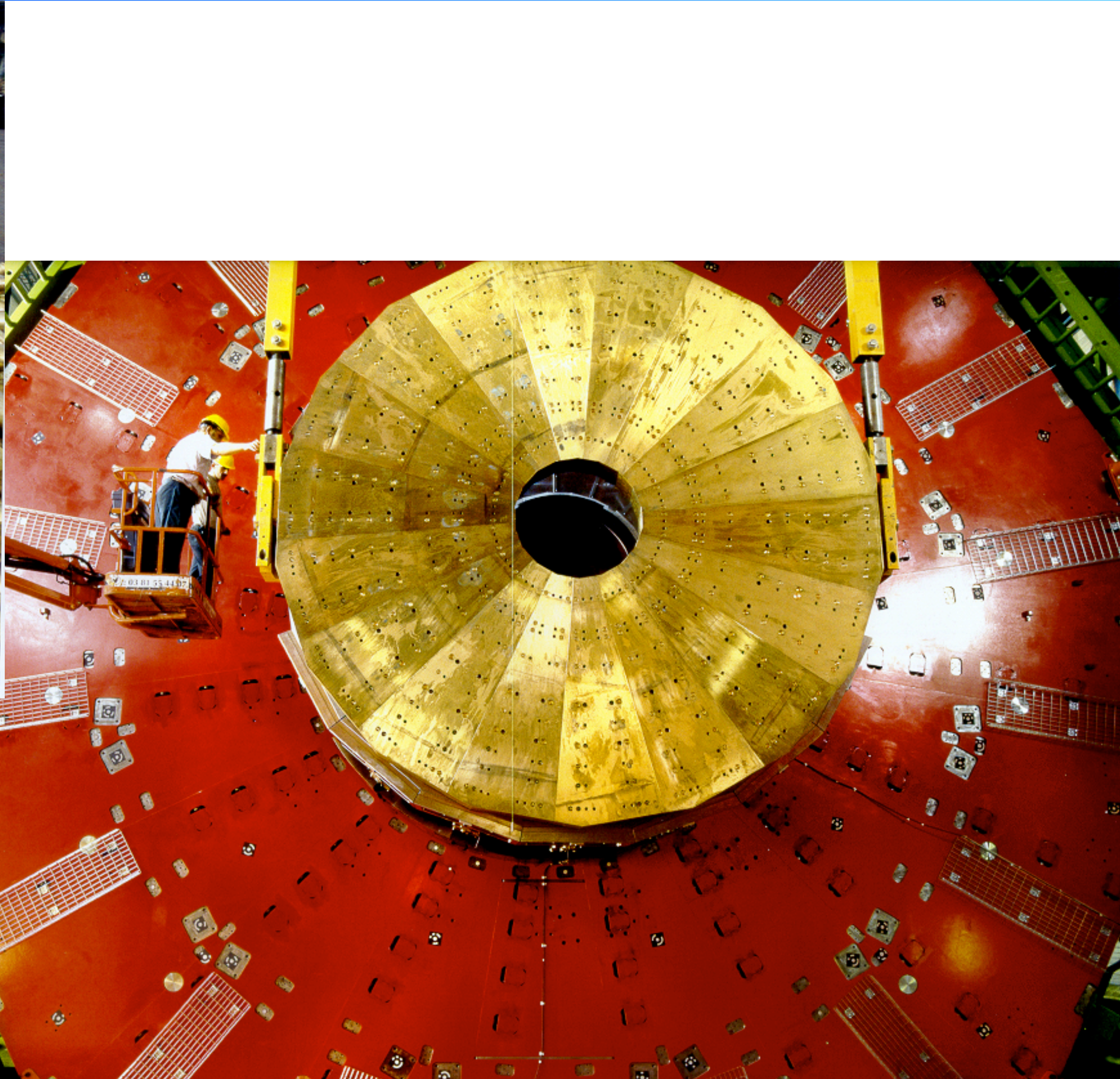
To look for:

- ➔ New particles, such as supersymmetric particles (a lot of theorists like them), gravitons (quantum gravity), mini black holes (more gravity?), or, even more exciting, completely unexpected ones

To understand:

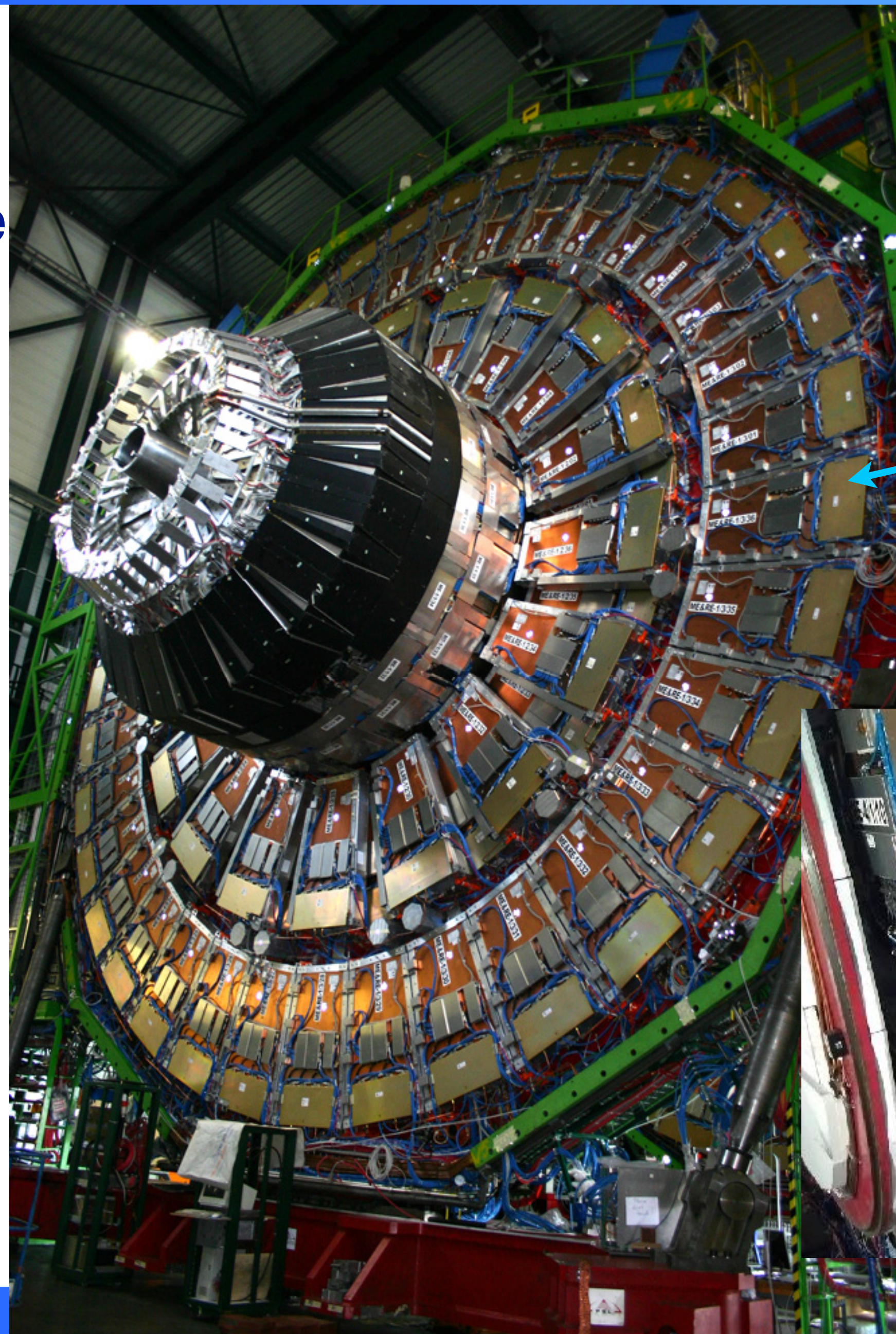
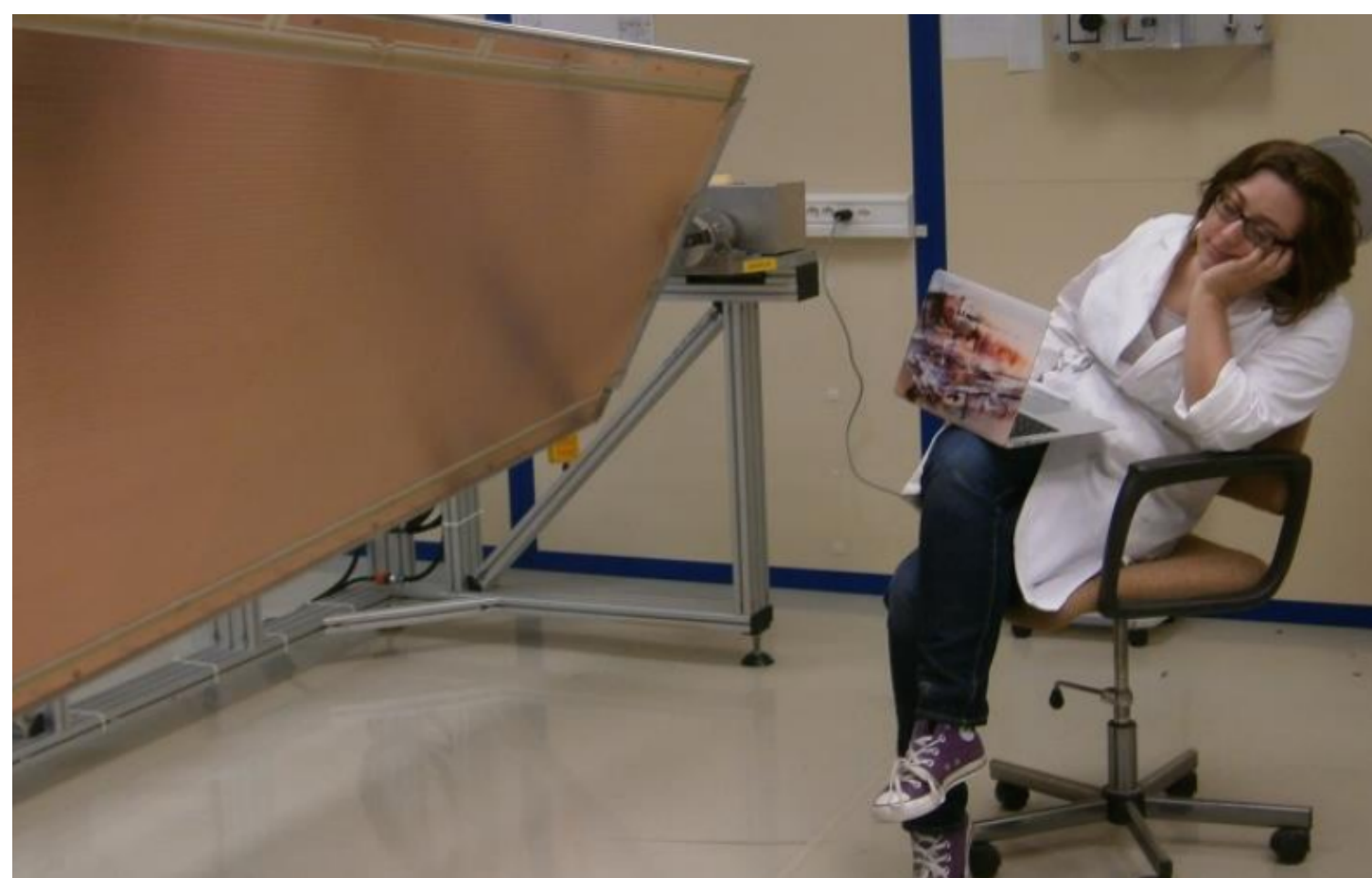
- ➔ why the world is the way it is
- ➔ why some particles weigh more than others (top is 350,000 times more massive than an electron)
- ➔ what is dark matter (quarks & leptons are only 4% of the universe!)
- ➔ are there more dimensions of space (we know of 4: x , y , z , t)
- ➔ the properties of the hot, dense plasma that existed in the early universe





Cathode strip chambers in the endcaps

UCR helped design and build the chambers



Cathode strip chamber

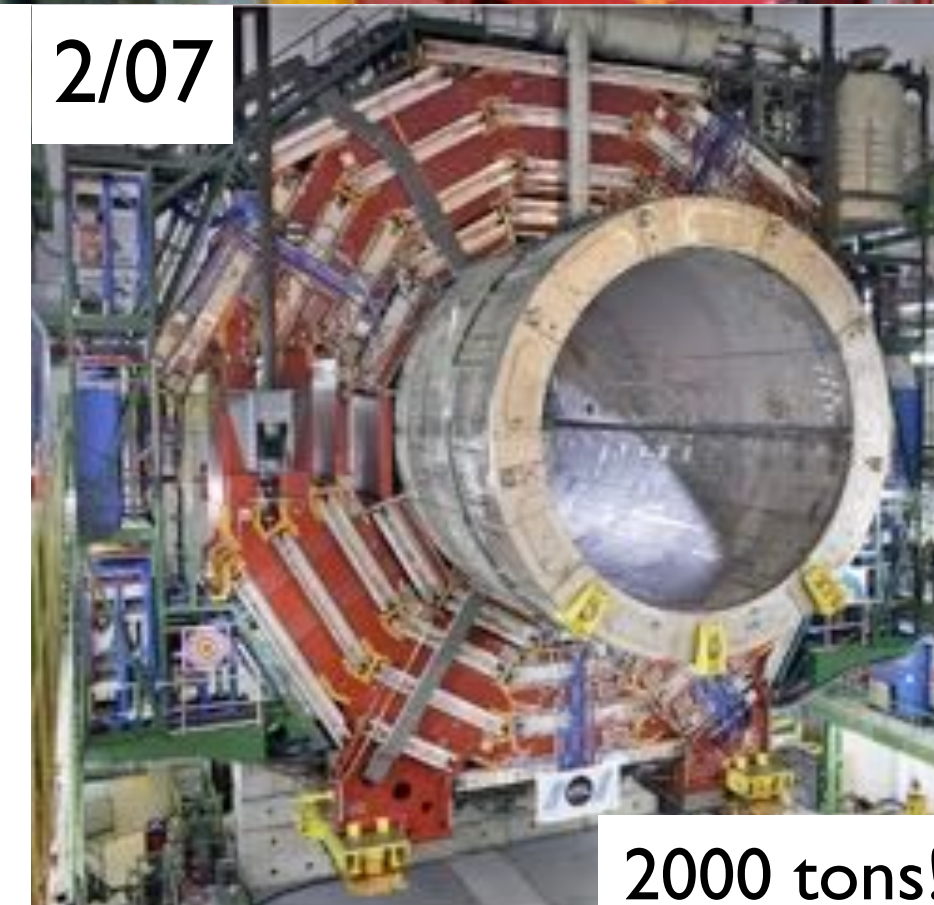
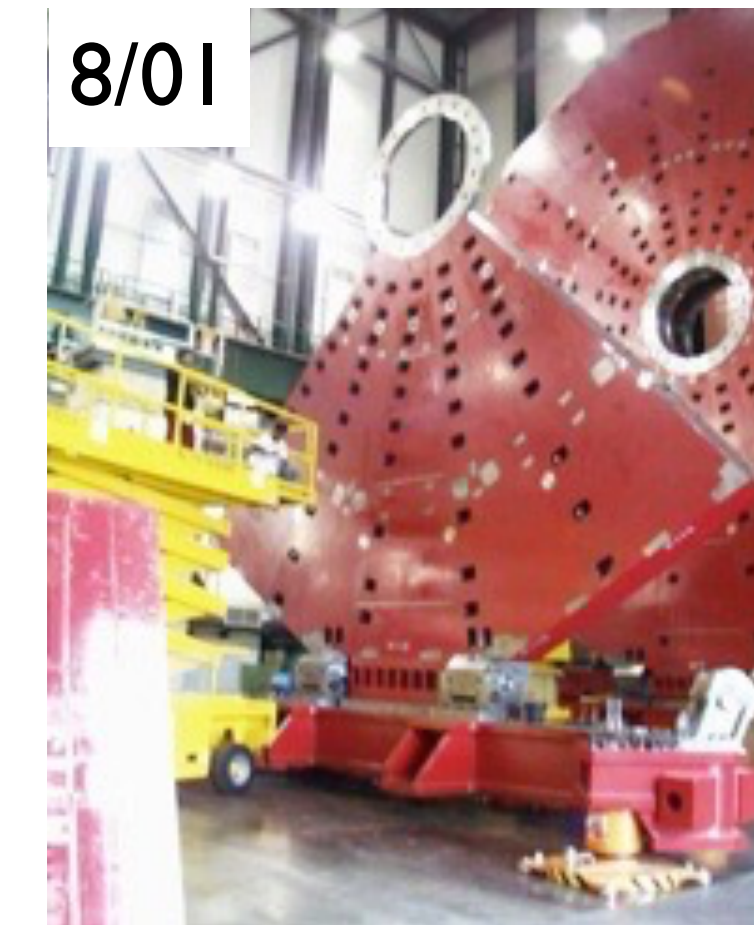
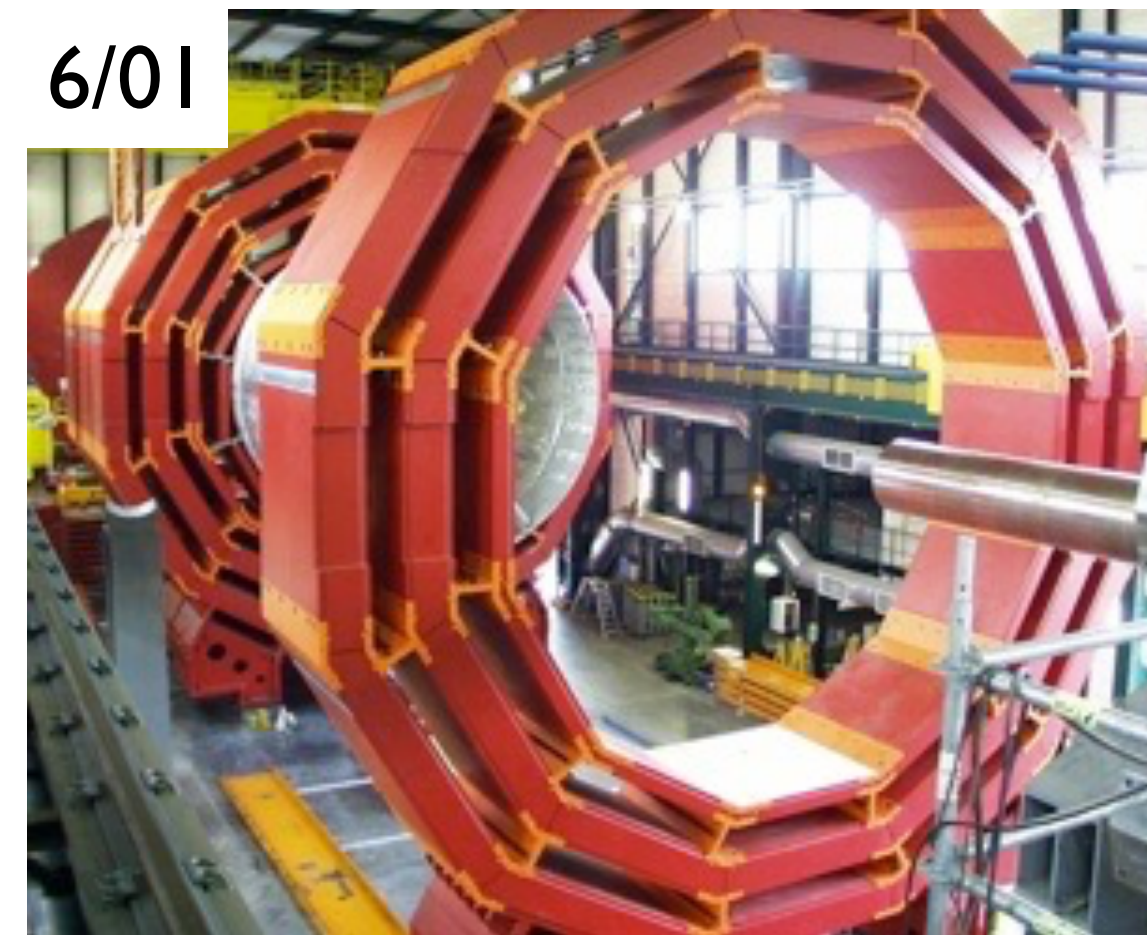
The last one!



The design of CMS started in 1992!

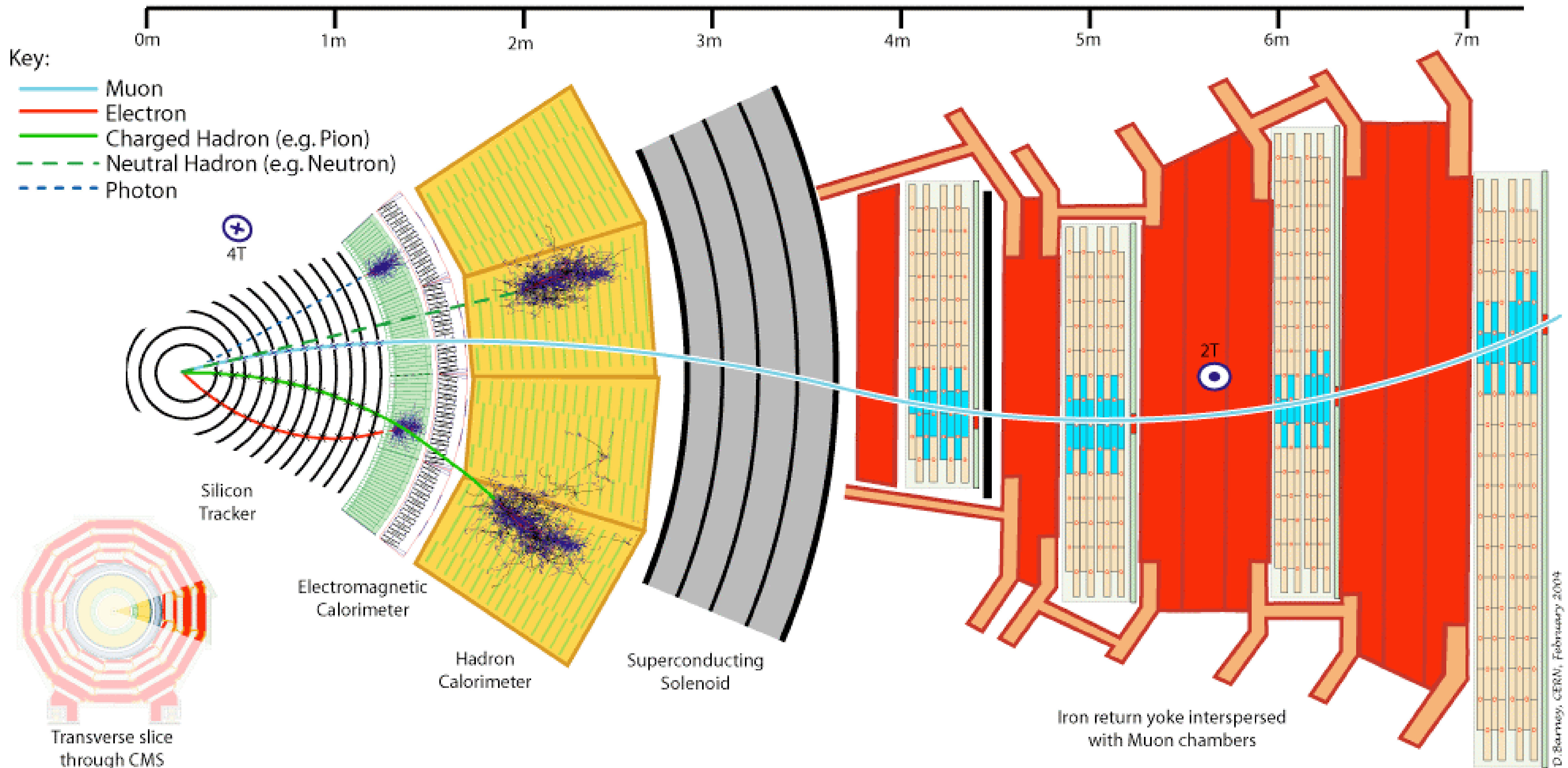
Major construction and assembly started in 2000.

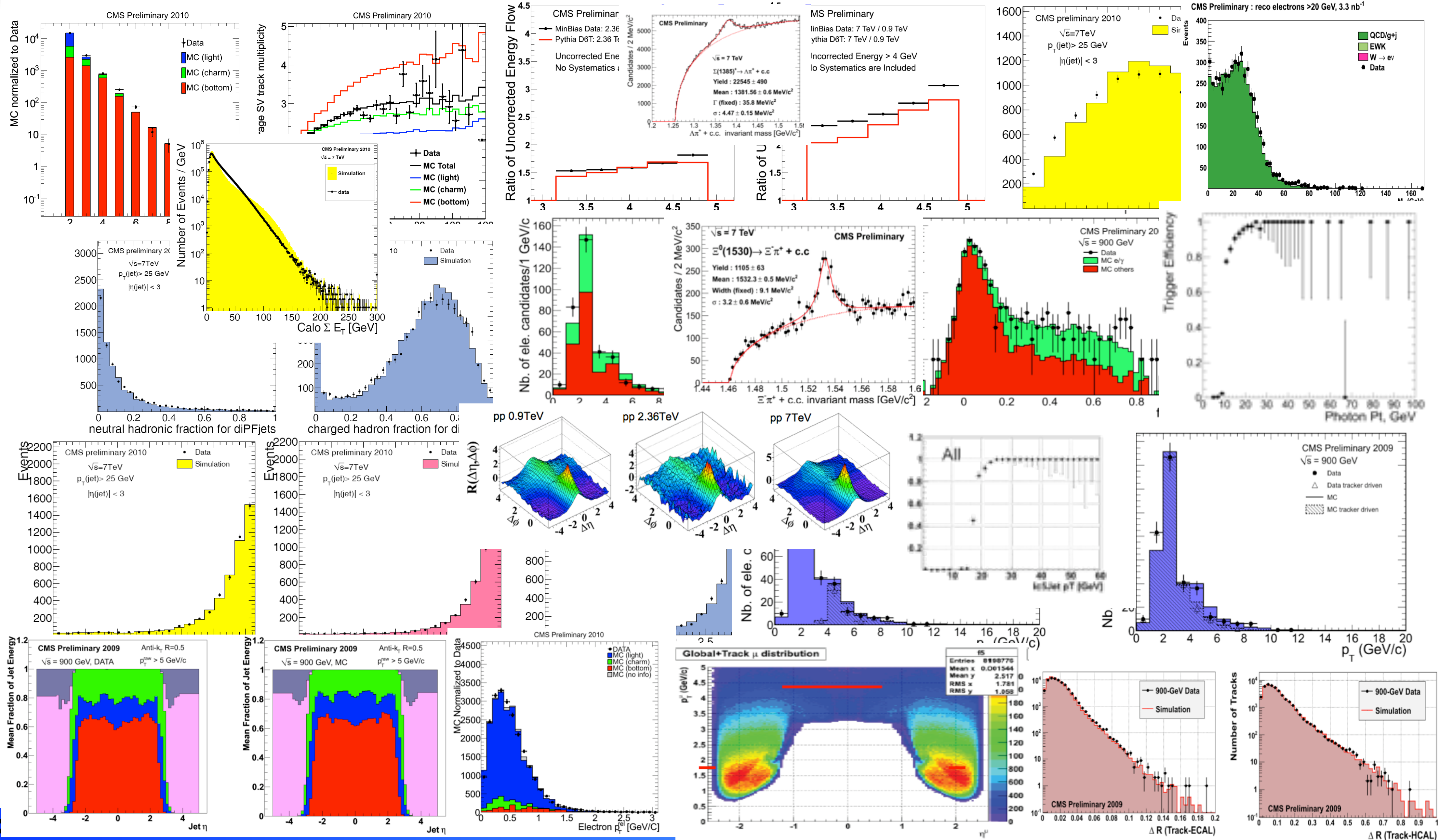
Lowering into the cavern started in 2006, and took 2 years.

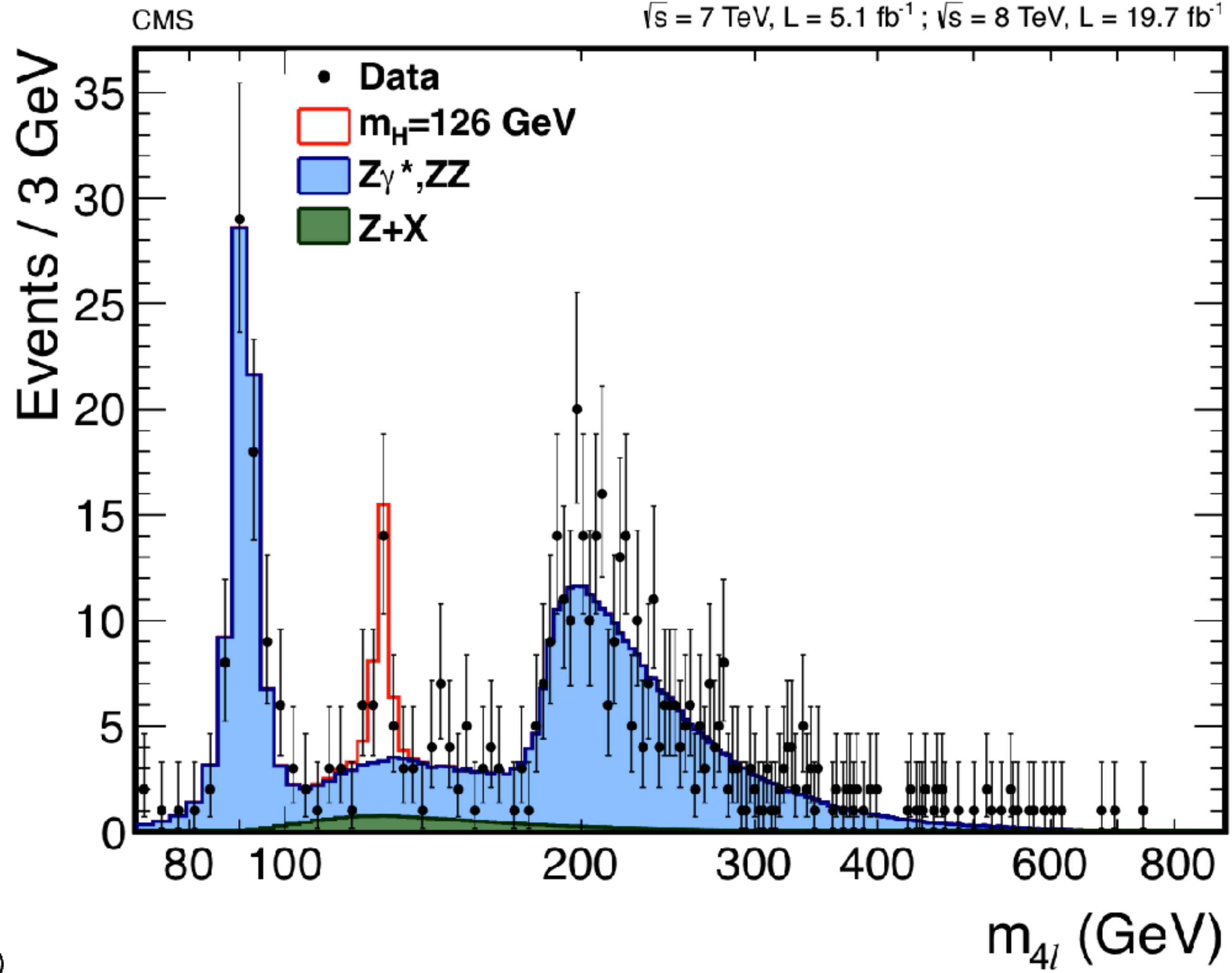
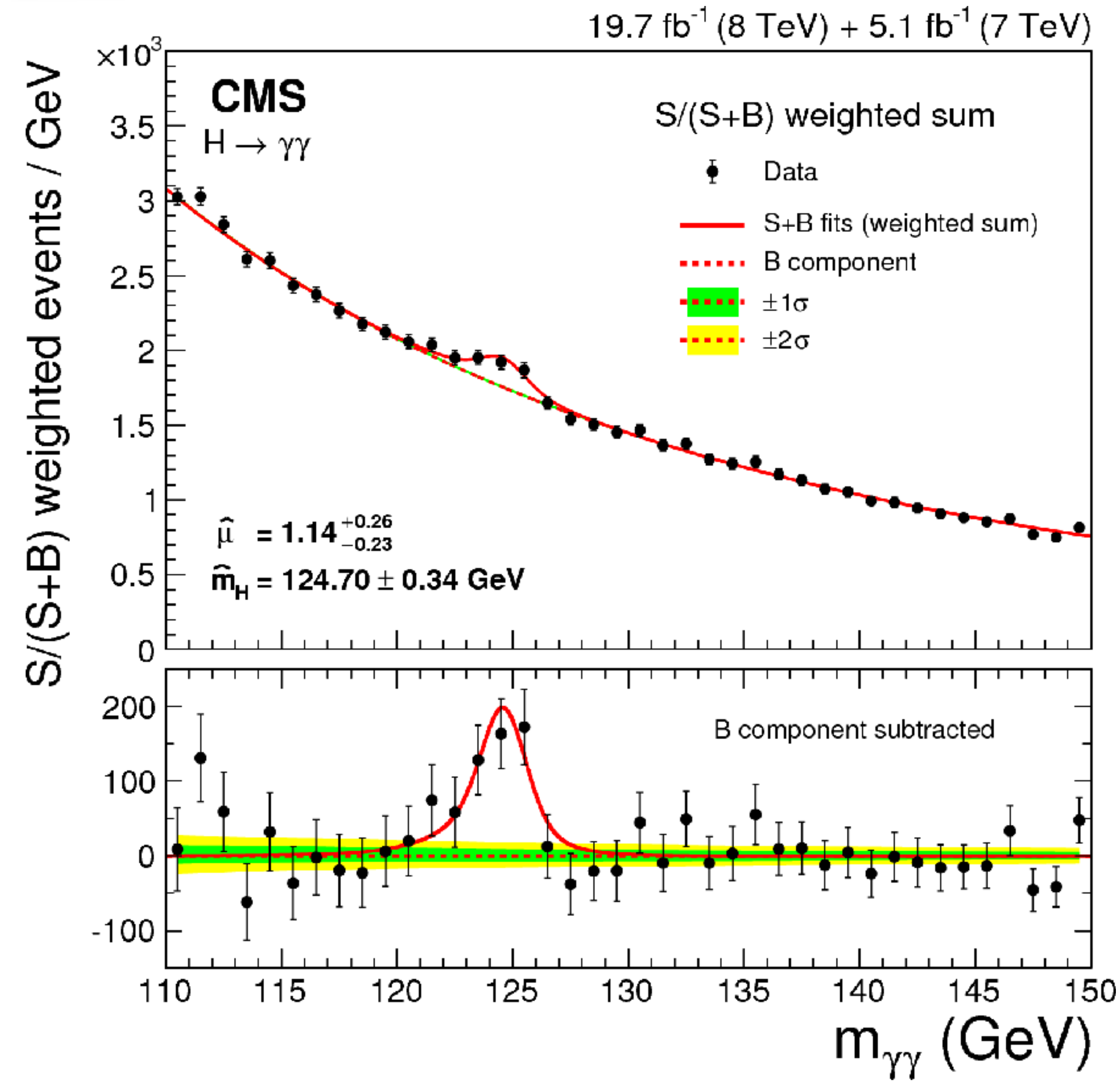


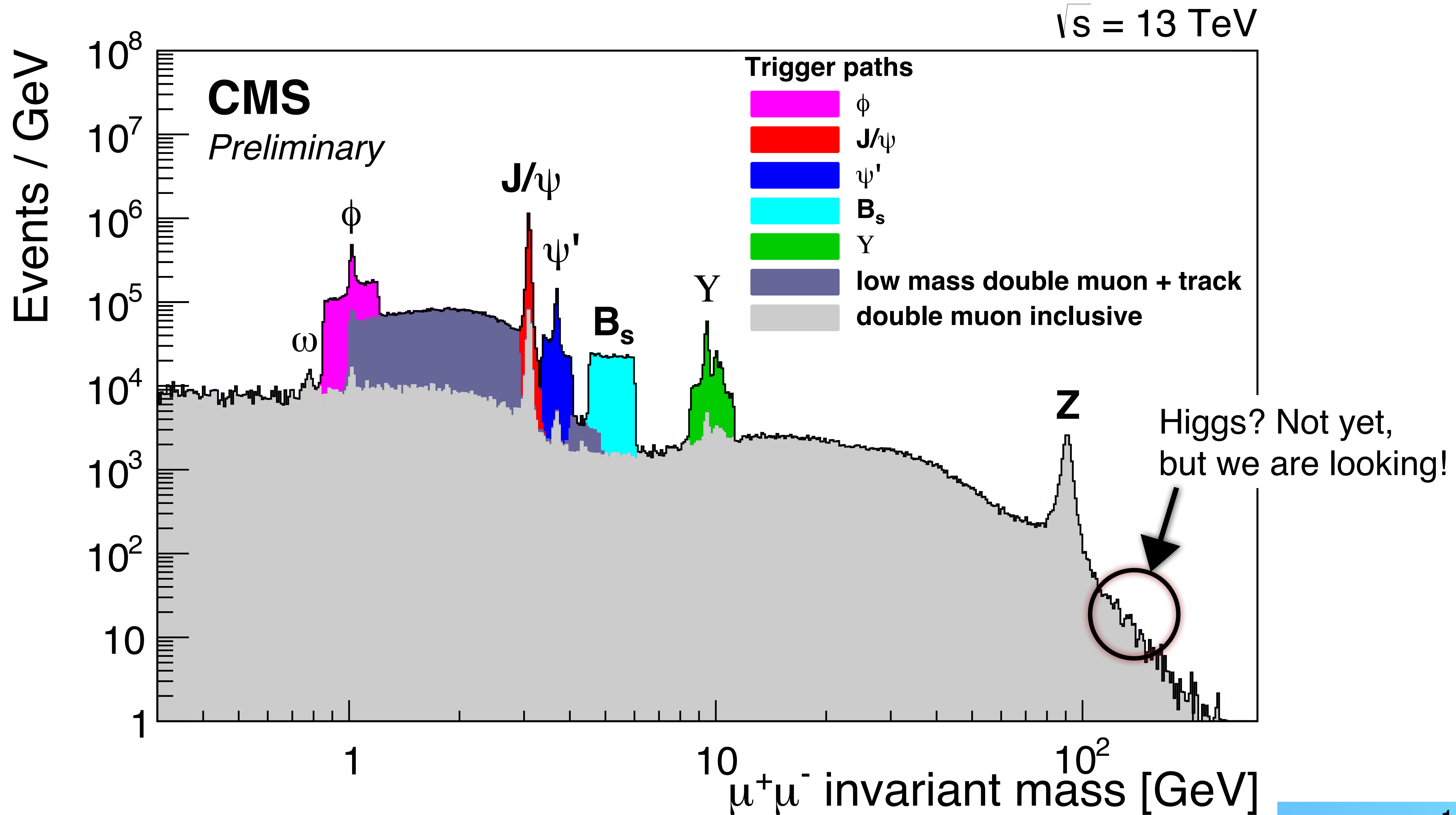
Closed and ready for beam!





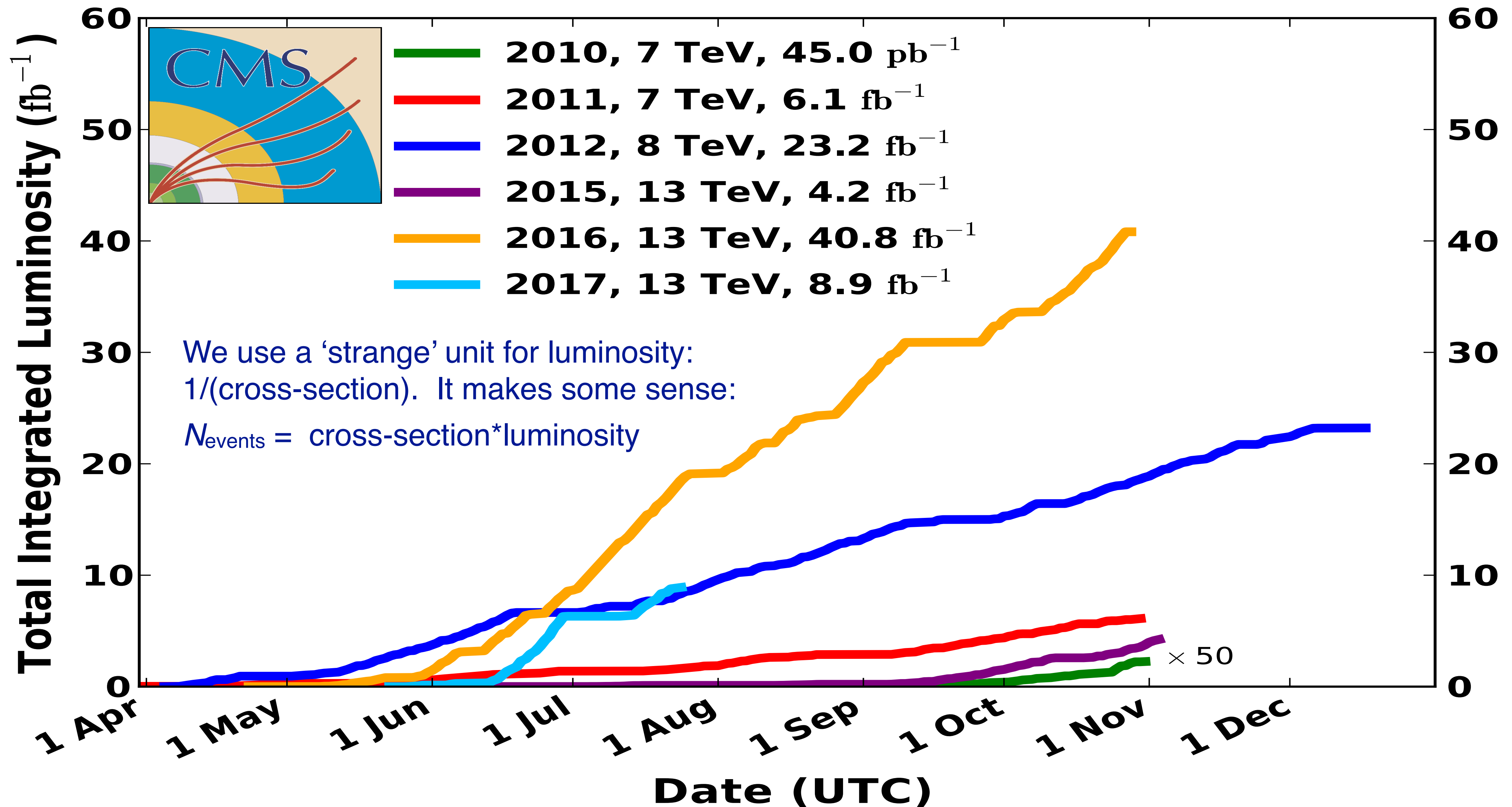






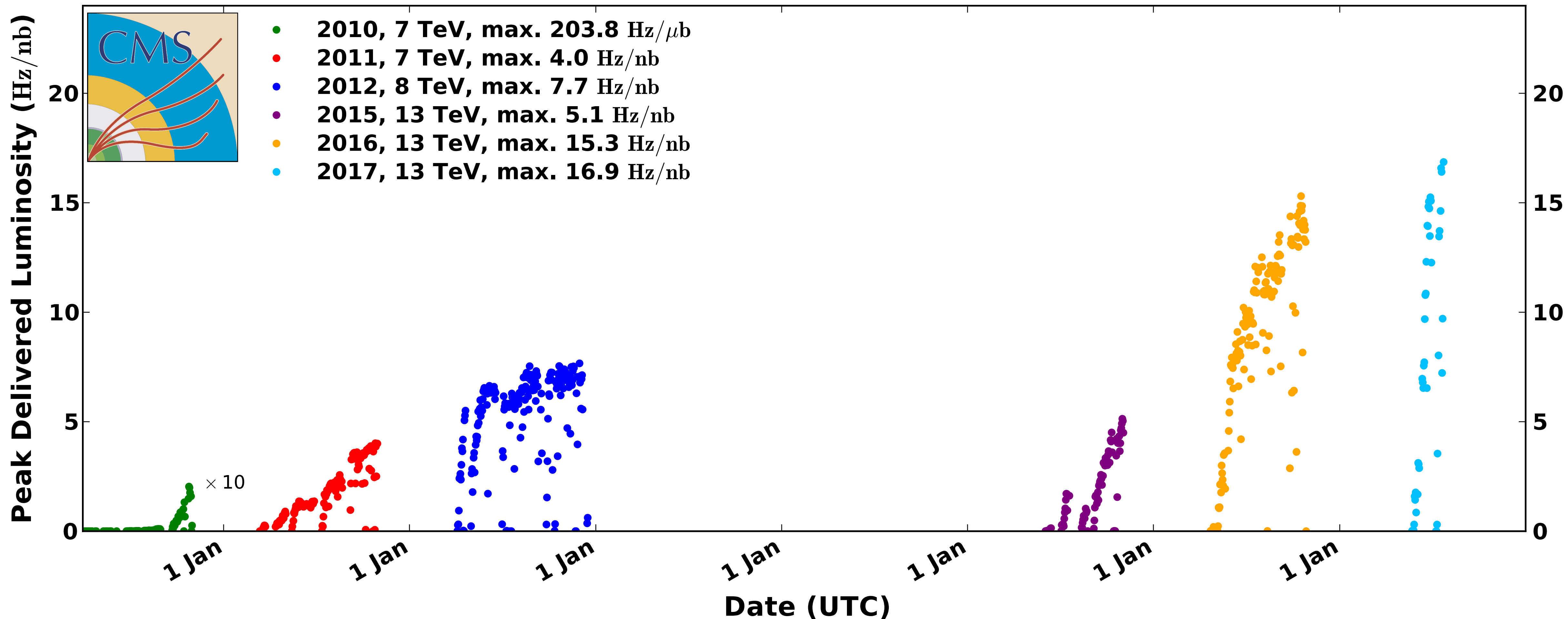
CMS Integrated Luminosity, pp

Data included from 2010-03-30 11:22 to 2017-07-24 03:55 UTC



CMS Peak Luminosity Per Day, pp

Data included from 2010-03-30 11:22 to 2017-07-24 03:55 UTC



Data taking started again in June.

We will more than double (hopefully!) our high energy data-set this year.

But most of our data is still to come in the next 20 years.



And thus...

Searches for New Physics will continue in earnest!