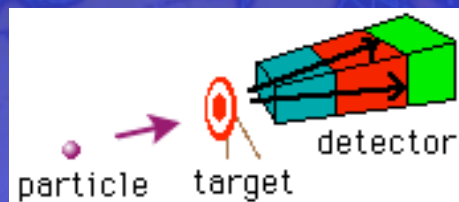


How do we see  
any of this?

# Particle Physics Experiments

- Source of High Energy Particles
- Target to collide with
- Detector to see the results

Fixed Target

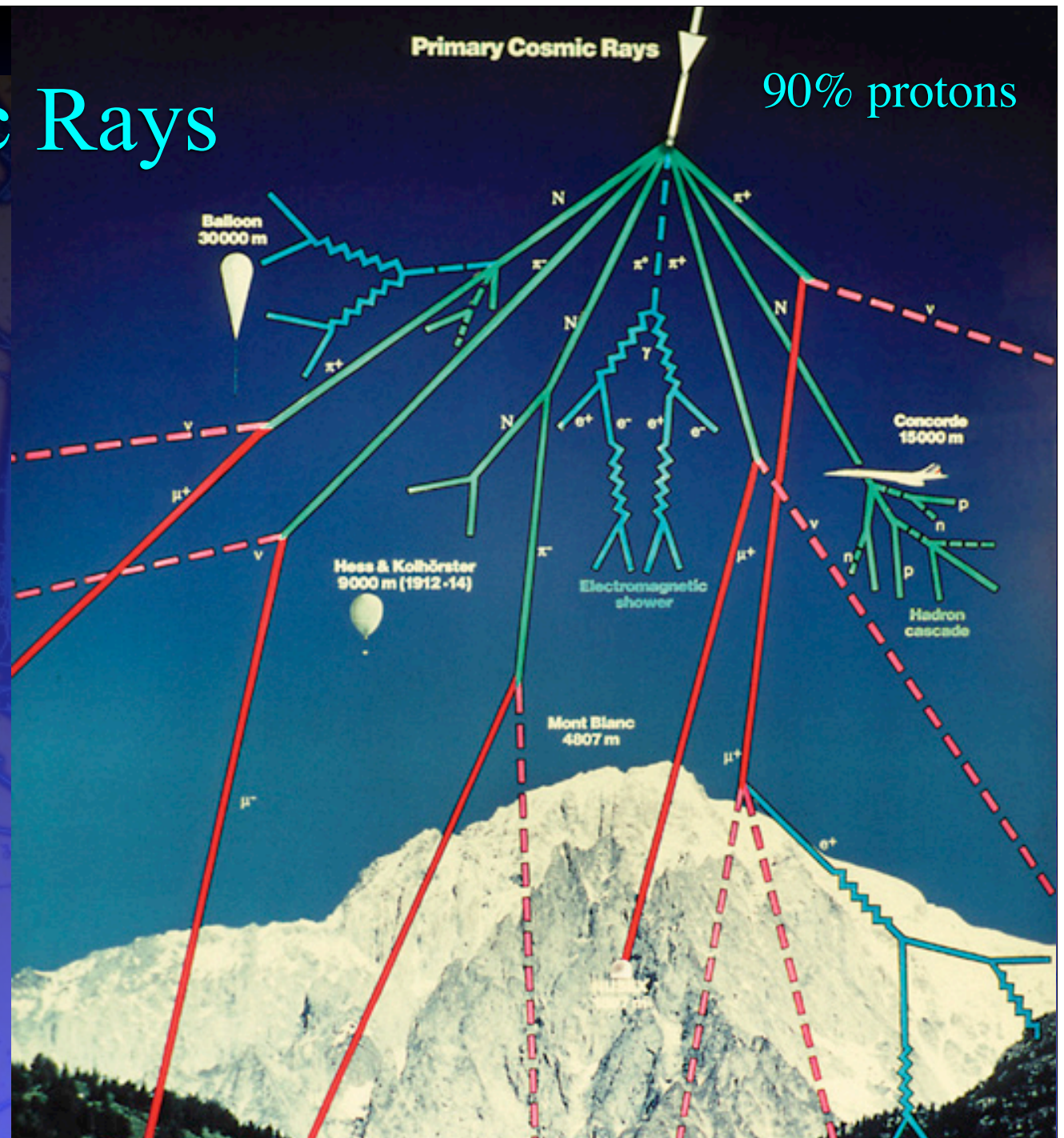


Colliding Beam



# Cosmic Rays

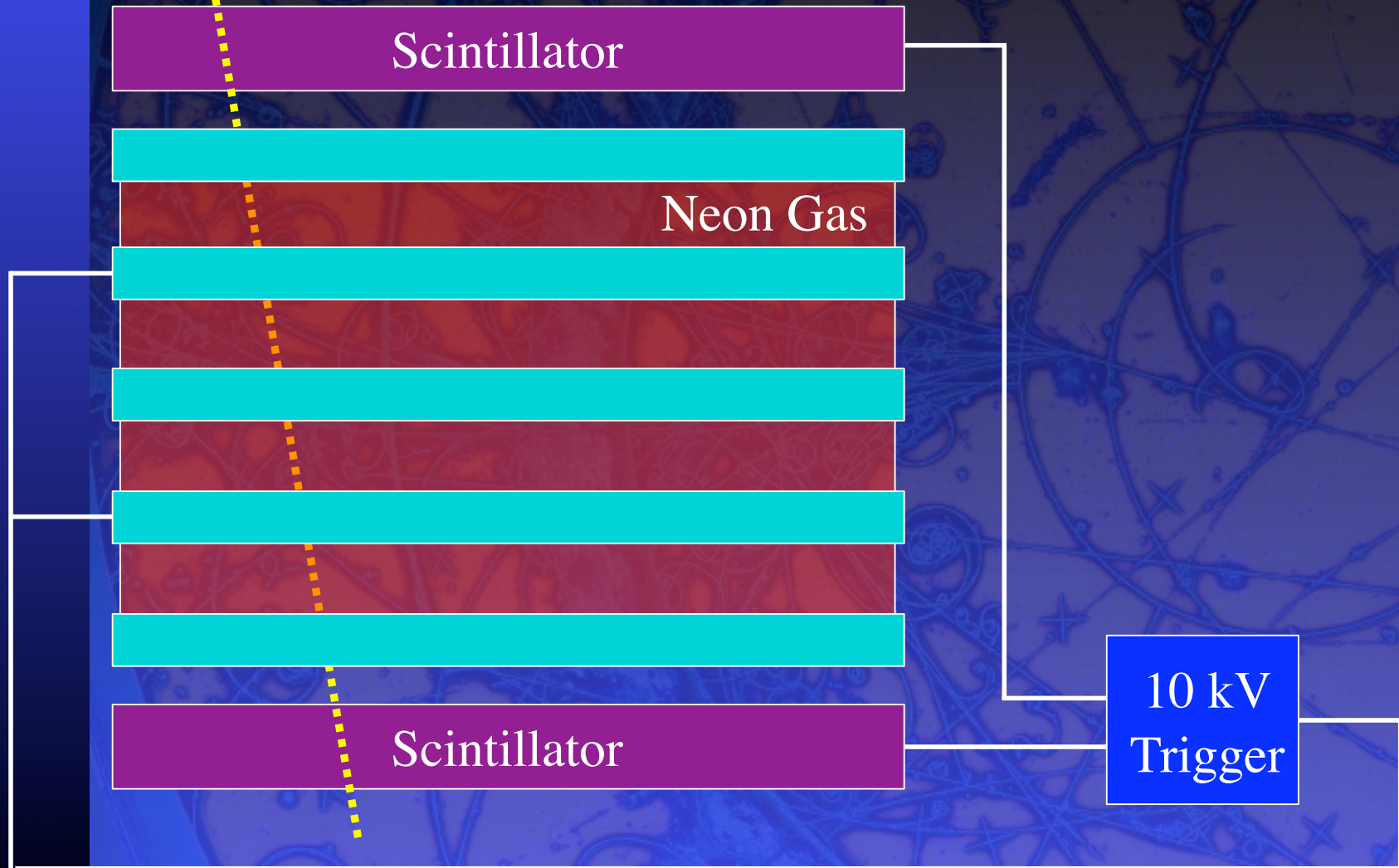
90% protons



Discovered 1912  
by Victor Hess

Mostly muons  
at sea level

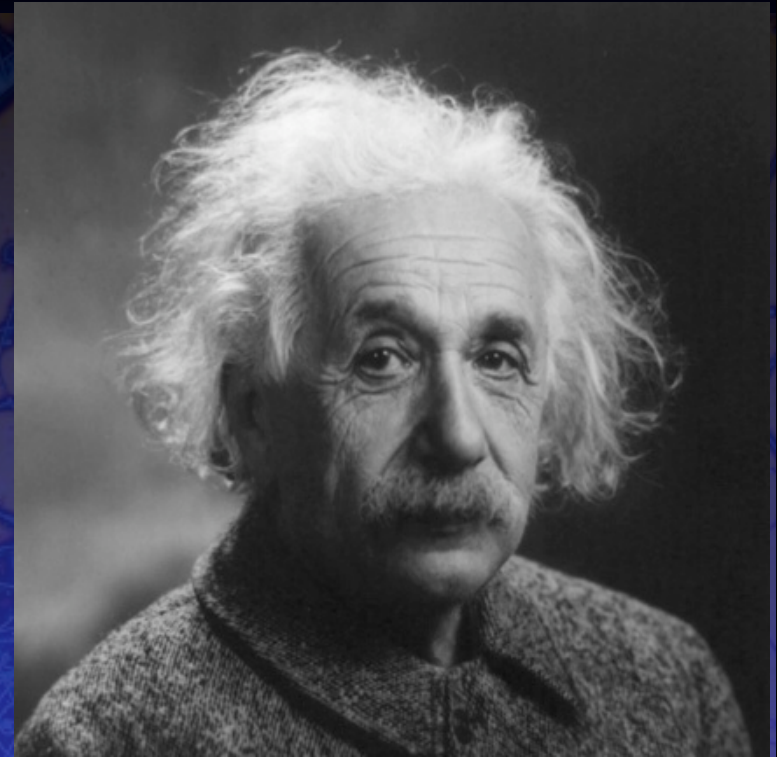
# Spark Chamber



Built by Matt Langston - University of Oregon student

# Why High Energy?

$$E = mc^2$$



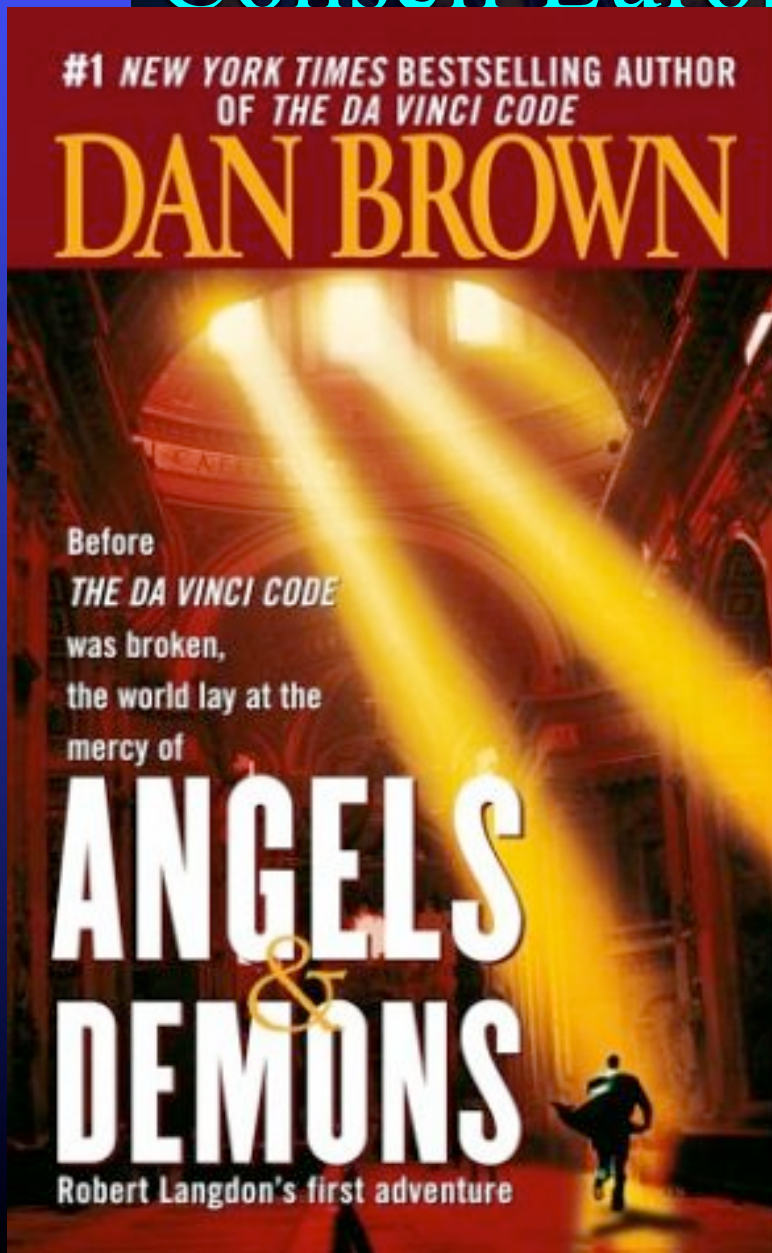
High Energy



High Mass

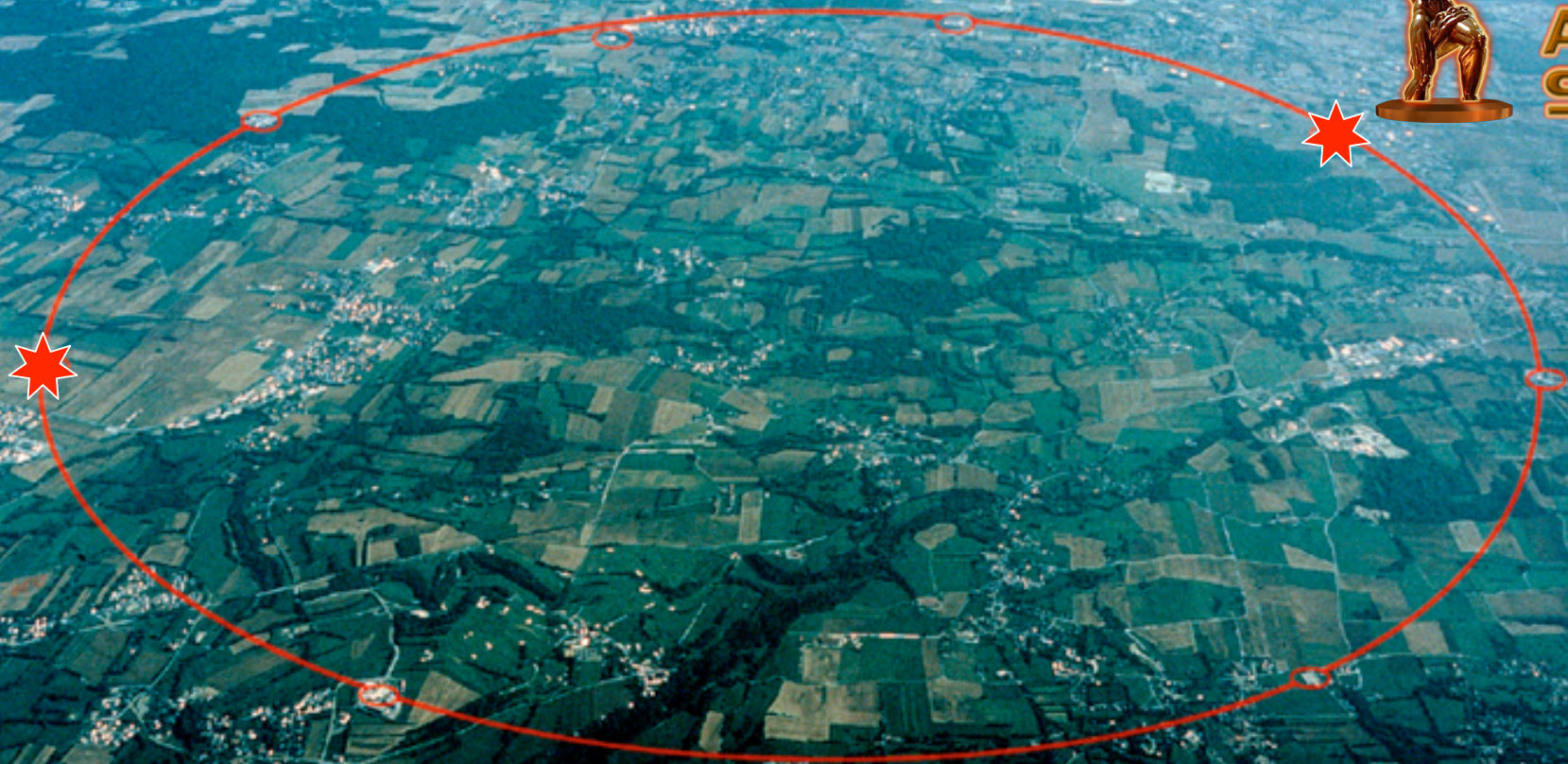
# Conseil Européen pour la Nucléaire (CERN)

laboratory for Particle Physics)





ATLAS



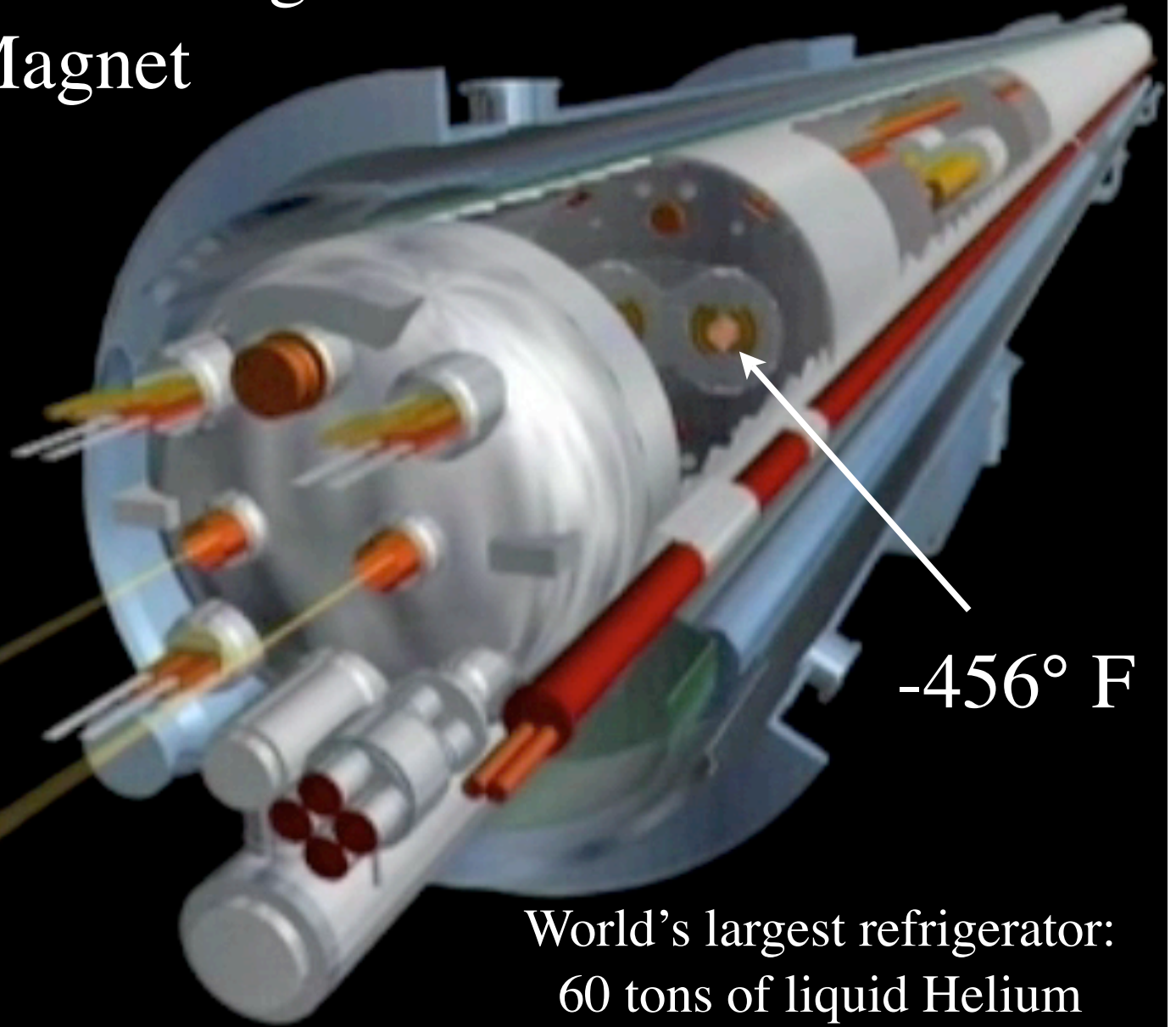
# Large Hadron Collider

A photograph showing the interior of the Large Hadron Collider tunnel. The tunnel is a long, curved passage with a concrete floor and walls. On the right side, a long row of large, cylindrical superconducting dipole magnets is visible, extending into the distance. The magnets are wrapped in a dark, protective material. The tunnel is illuminated by overhead lights, creating a bright, industrial atmosphere. The perspective is from the end of the tunnel, looking down its length.

**Proton - proton collisions**  
**17 mile ring circumference**  
**1200 SC dipoles @ 8.3 Tesla**  
**300 feet underground**



# LHC Superconducting Dipole Magnet



-456° F

World's largest refrigerator:  
60 tons of liquid Helium  
10,000 tons of liquid Nitrogen

# What is 14 Tera-electronVolts?

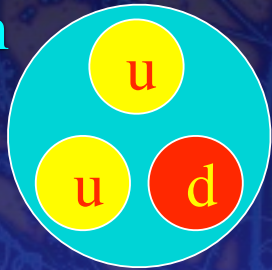
- 14 TeV = 14,000,000,000,000 eV
- 14 TeV = 14,925 proton mass
- 7 TeV proton travels at 99.99999991% c
- LHC Beam stores 700 MegaJoules  
(enough energy to melt 1000 lb of copper)

300 MegaJoules



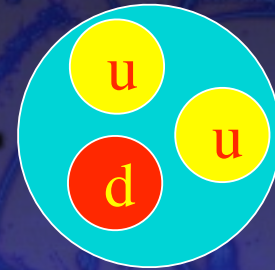
# Quark Collider!

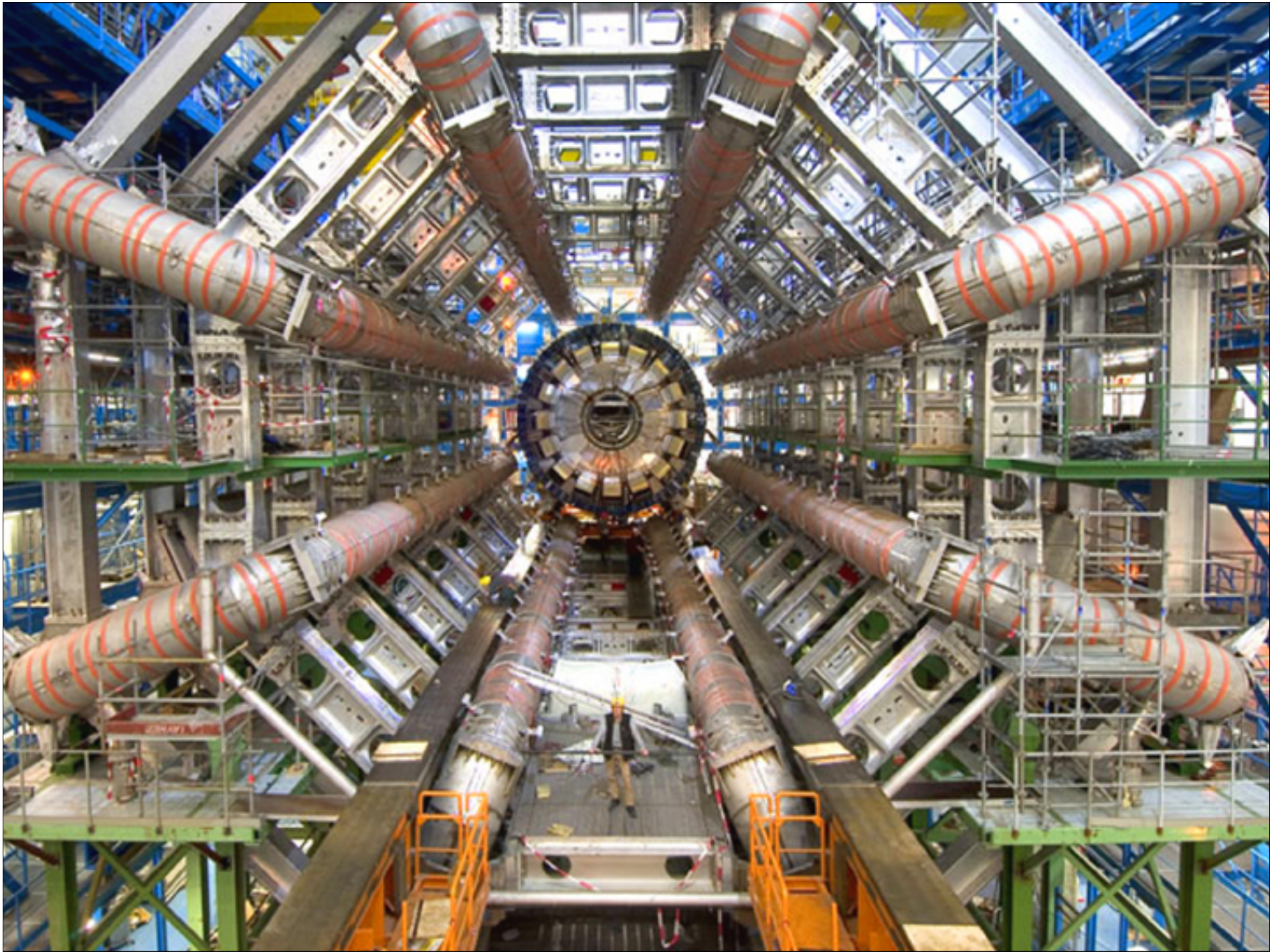
7 TeV  
proton



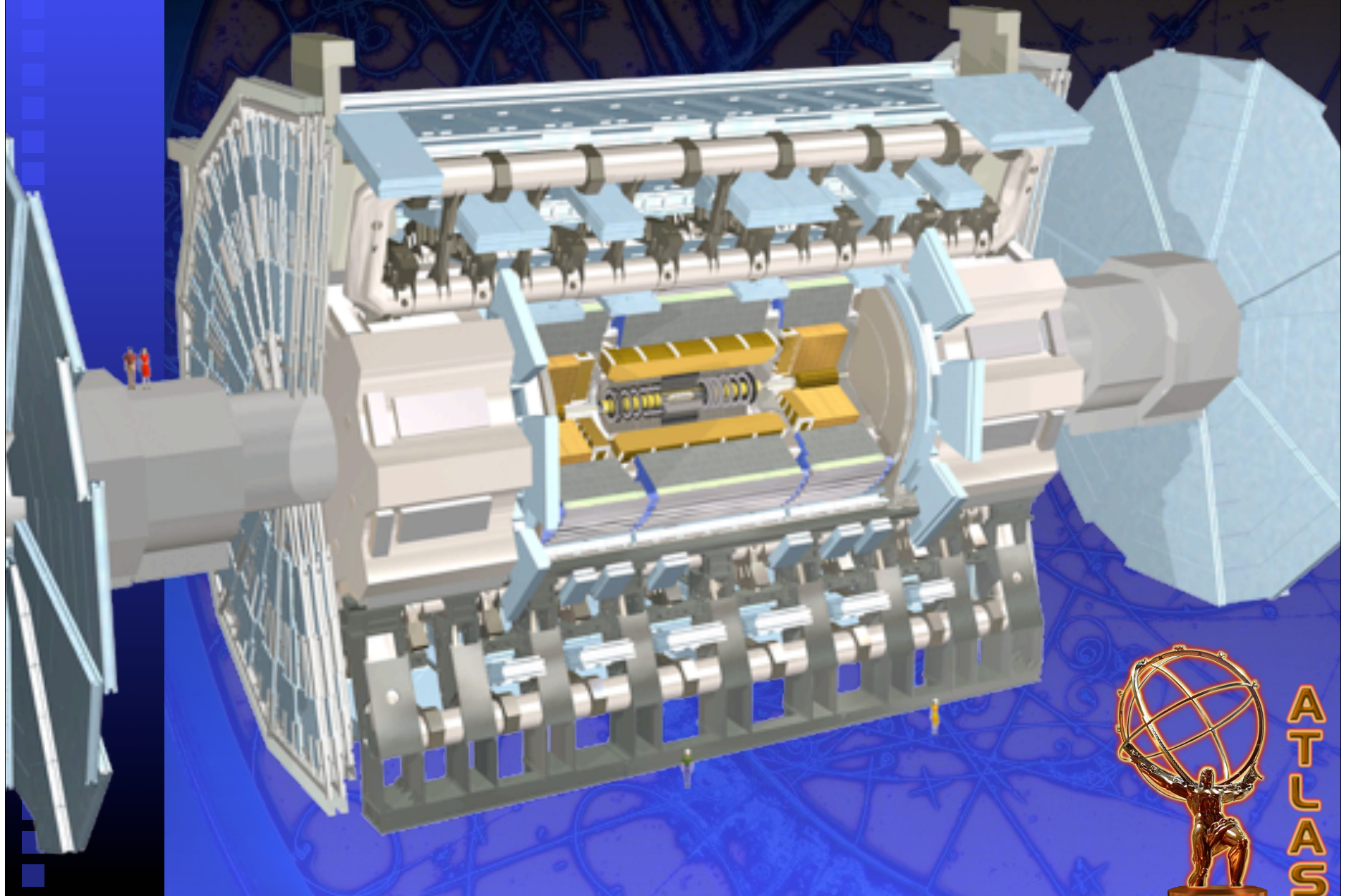
14 TeV

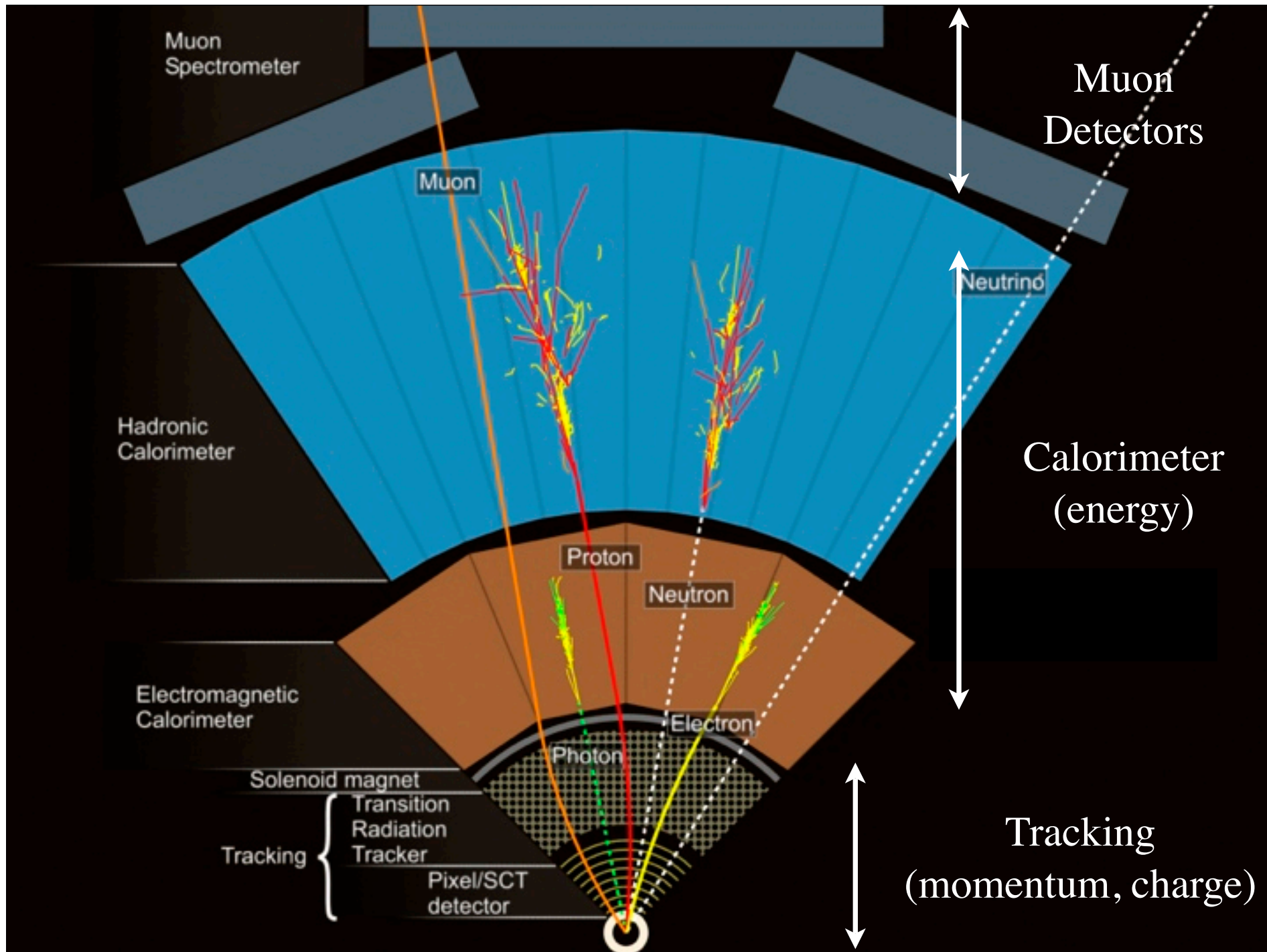
7 TeV  
proton



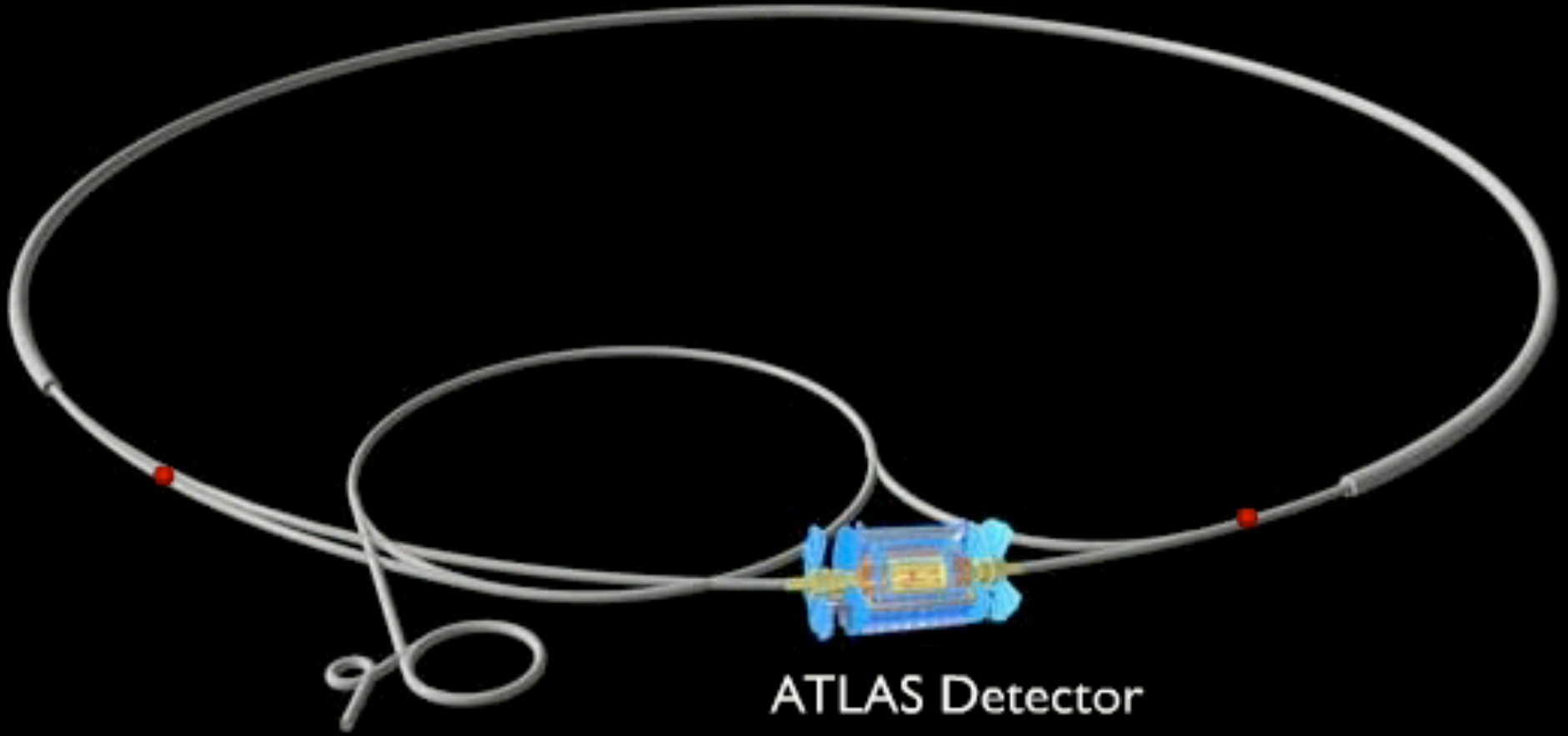


# ATLAS Detector

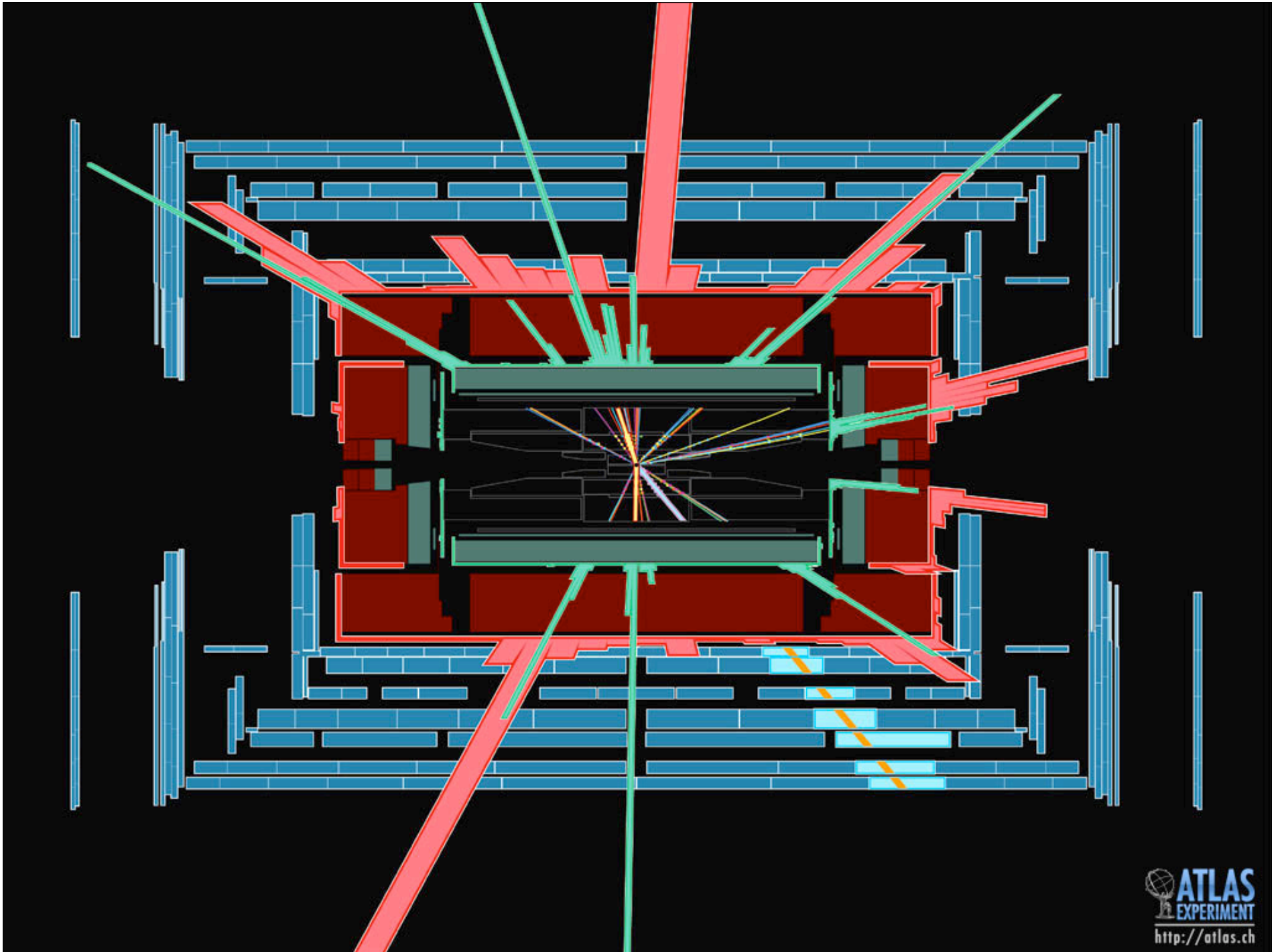




Large Hadron Collider



ATLAS Detector

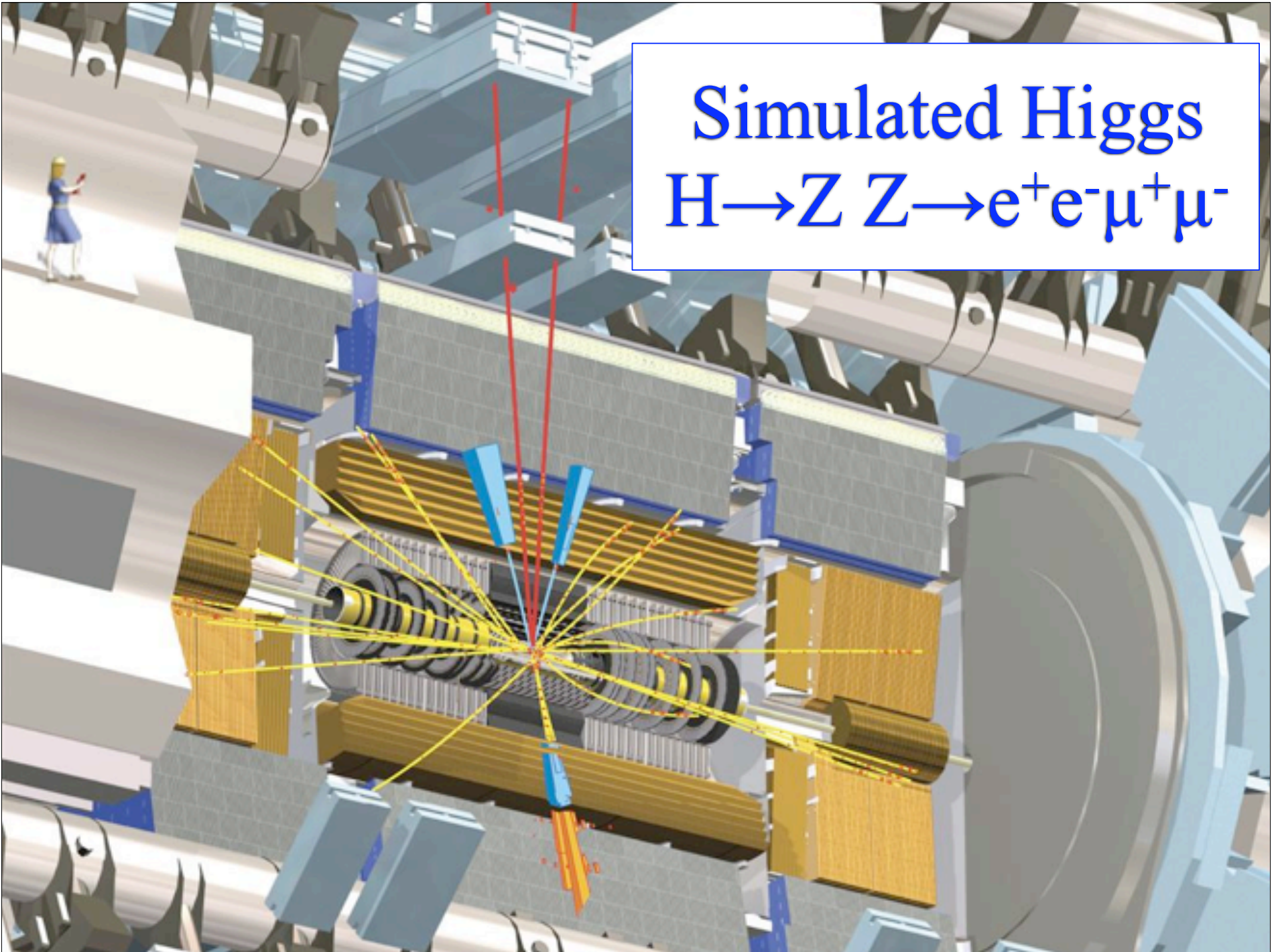


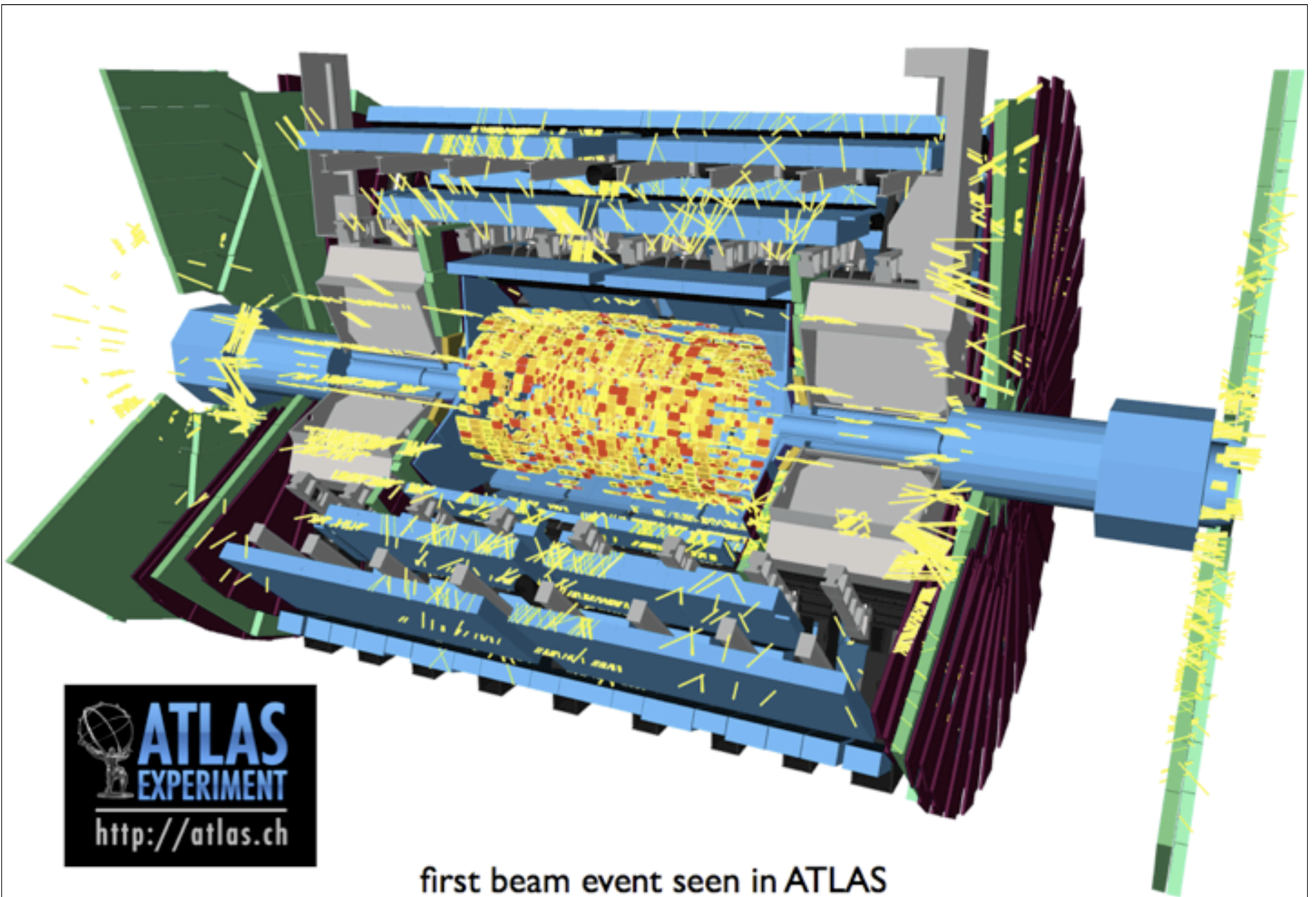


# Data Processing



Simulated Higgs  
 $H \rightarrow Z Z \rightarrow e^+ e^- \mu^+ \mu^-$





first beam event seen in ATLAS

September 10, 2008