The Large Hadron Collider

At Discovery's Horizon

Joel Butler
Fermilab
U.S. CMS Operations Program Manager

Introduction to the Large Hadron Collider (LHC) at CERN

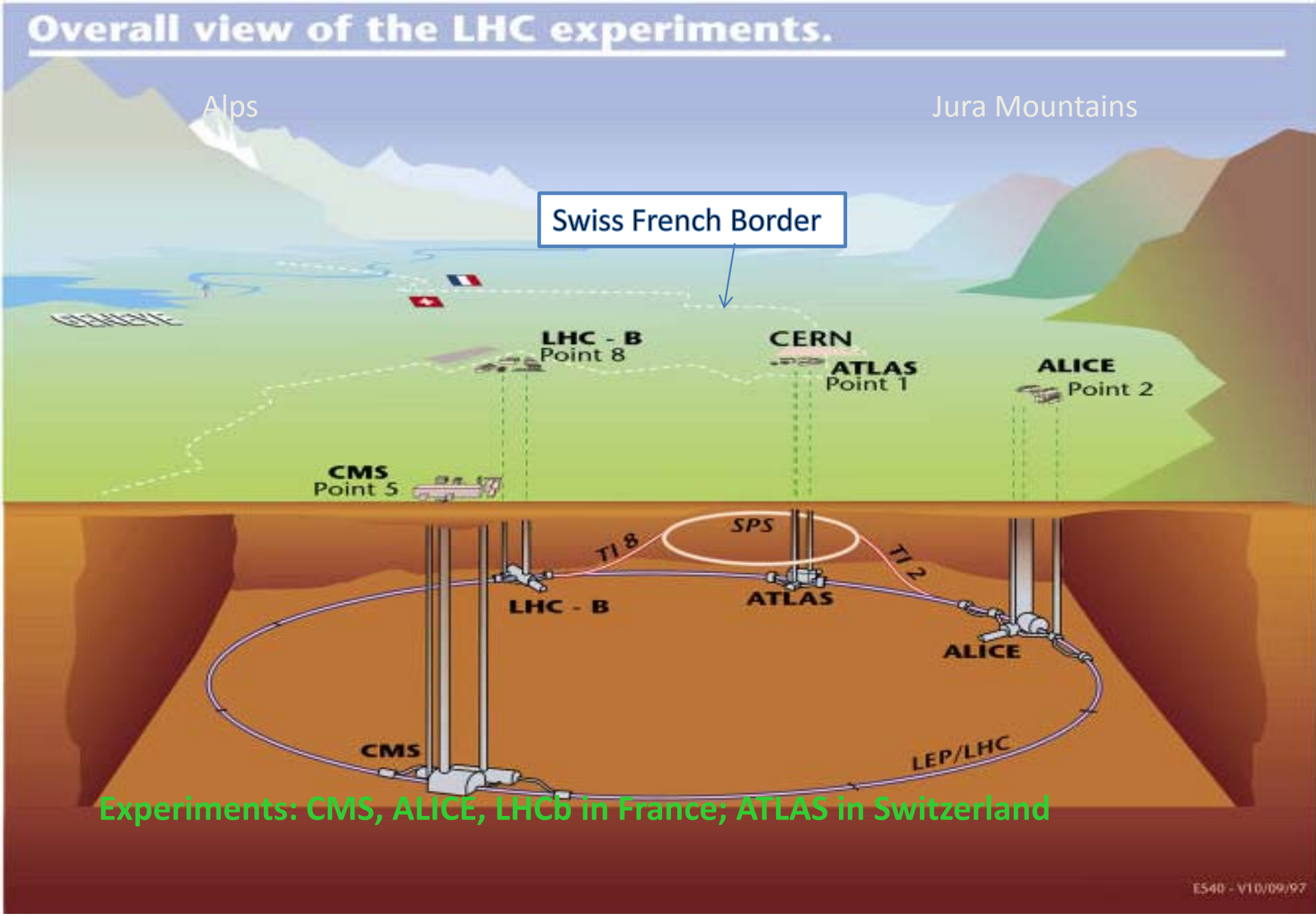
Fermilab U.S. DEPARTMENT OF ENERGY CERN National Science Foundation

LHC at CERN

A machine that collides two beams of counter-rotating protons
Each beam has the energy you would get by
stacking about 5 trillion batteries in series or 7 TeV

Circumference of ring is 17 miles
More than 4 times FNAL

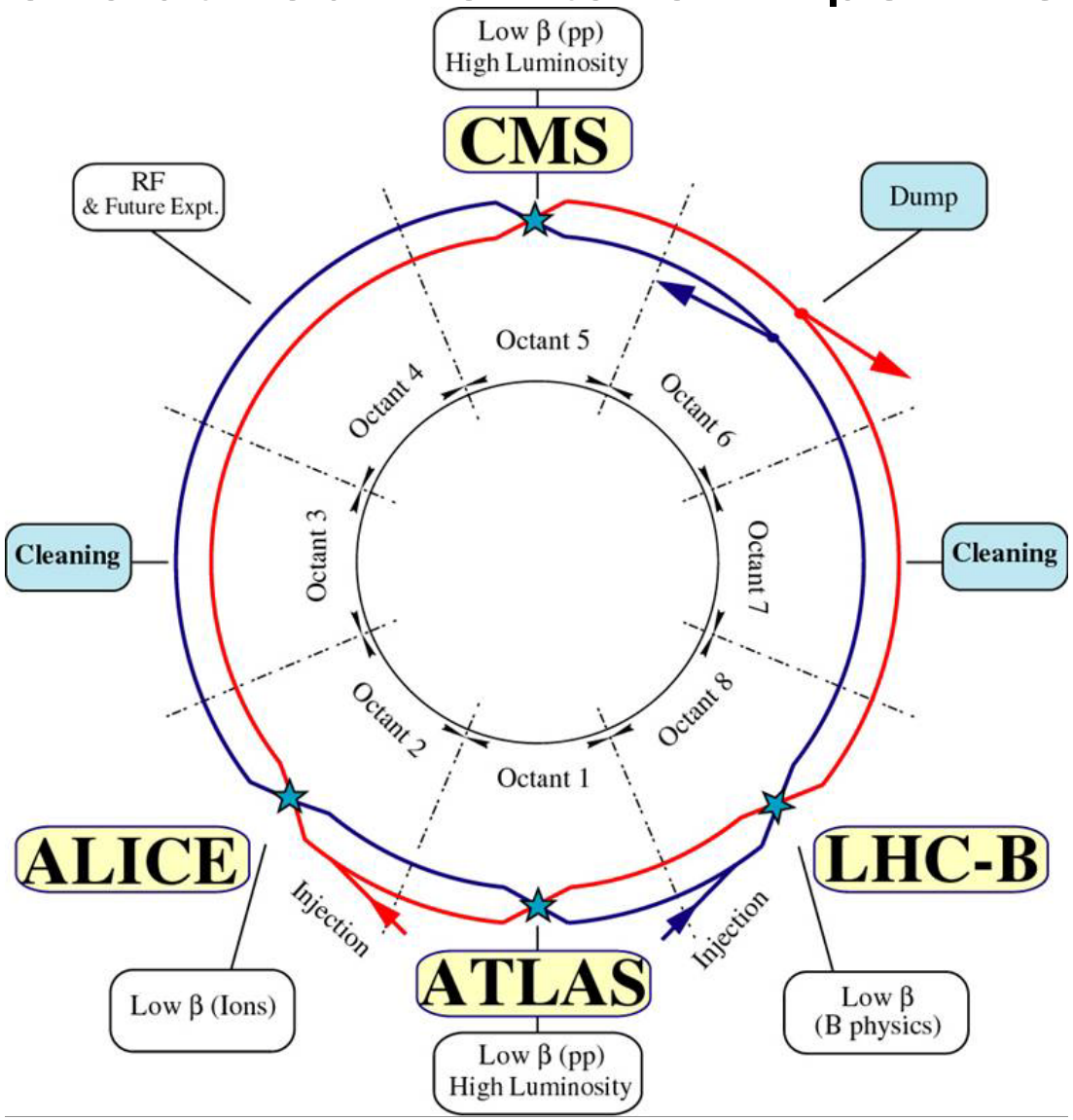
Geneva Airport


Overall view of the LHC experiments.
Alps
Jura Mountains
Swiss French Border
LHC - B
Point 8
CERN
ATLAS
Point 1
ALICE
Point 2
CMS
Point 5
SPS
TI 8
TI 2
LHC - B
ATLAS
ALICE
CMS
LEP/LHC
Experiments: CMS, ALICE, LHCb in France; ATLAS in Switzerland
E540 - V10/09/97

Welcome to The large hadron collider

•The LHC accelerates protons to 99% of the speed of light and
• smashes them together up to 600 million times a second

Collisions at Four Points for Experiments



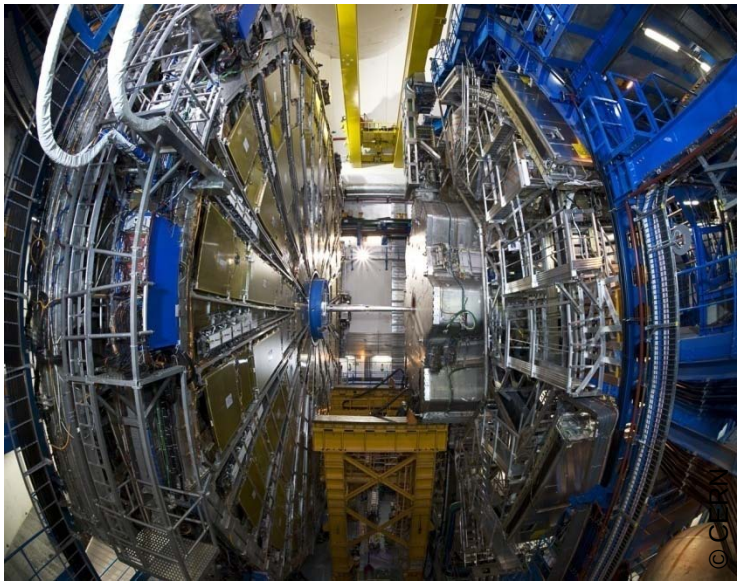
Boldest:
A global adventure

Building the LHC brought together

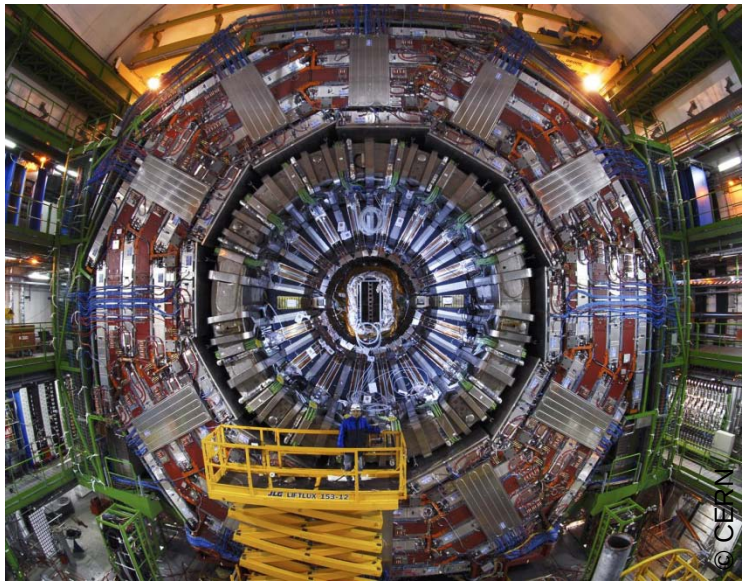
More than 10,000 people from 60 countries

biggest

Largest, most complex detectors ever built

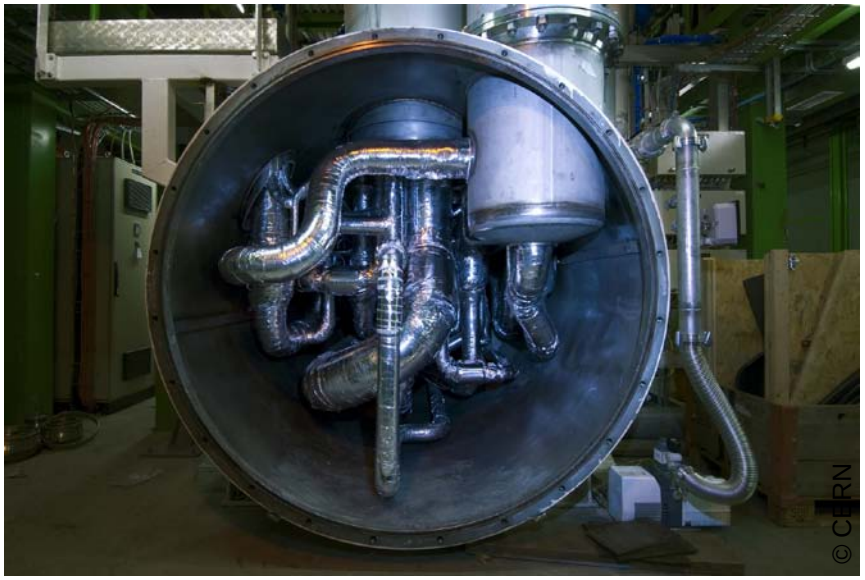


Study the tiniest particles with incredible precision



Coldest

LHC’s superconducting magnets operate at -456°F

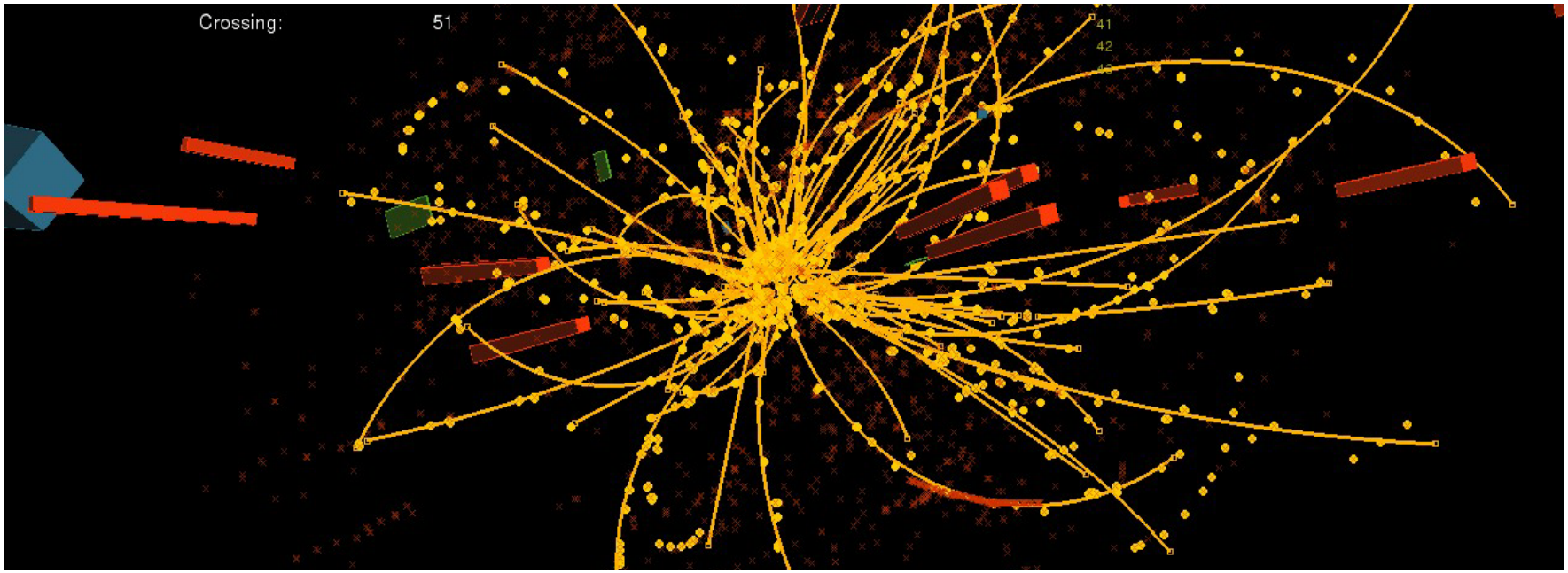


Colder than the vacuum of outer space

"CERN's big chill" - it could be the sensational title of a science-fiction novel, but it's actually a sensational scientific reality! At the beginning of April, a 3.3-km section of the Large Hadron Collider (LHC) was cooled to a chilly -271°C, just a couple of degrees above the lowest temperature possible, absolute zero, and colder than outer space!

hottest

Colliding protons generate temperatures one billion times hotter than the center of the sun



Something from nothing

- High-energy proton collisions
- Can release enough energy
- To create new, heavy particles

$$E=mc^2$$

LHC Summary

- Tunnel (originally built for "Large Electron-Positron" Collider –LEP)
  - Circumference: 26.659km ~ 17 miles
- Number of magnets
  - Main bending magnets: 1232
  - Total magnets: ~9300
- Operating temperature: 1.9^{o}K
- Revolution frequency: 11.2455 KHz
- Energy in each proton beam (peak) 7 TeV is 350 MegaJoules
  - 175 times the Tevatron
- Power consumption: ~120MegaWatts

The laws of physics seem to go crazy at about 1 TeV. Usually, that means there is something new about to appear and that's why there's all the excitement and high expectations!!!!!