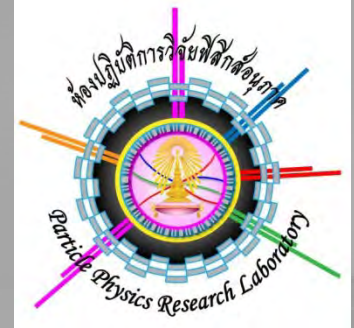




จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University
Pillar of the Kingdom



NATIONAL E-SCIENCE
INFRASTRUCTURE CONSORTIUM



e-Science ในงานวิจัยด้าน ฟิสิกส์อนุภาคที่ CERN

ดร.บุรินทร์ อัครวิภาพ

ภาควิชาฟิสิกส์ คณะวิทยาศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

NECTEC-ACE 2012

โรงแรมสวิสโฮเทล

20 กันยายน 2555

Conseil
Européen pour la
Recherche
Nucléaire



<http://www.cern.ch>

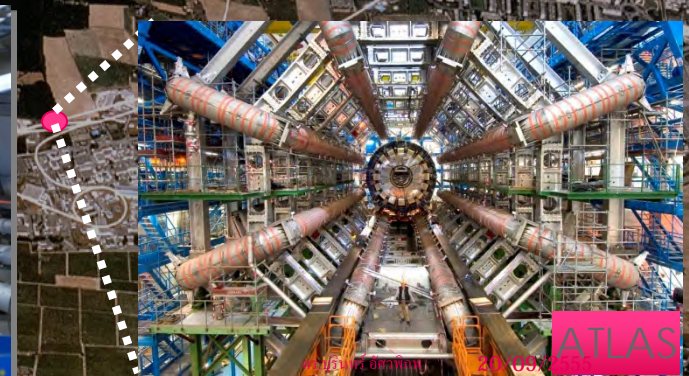
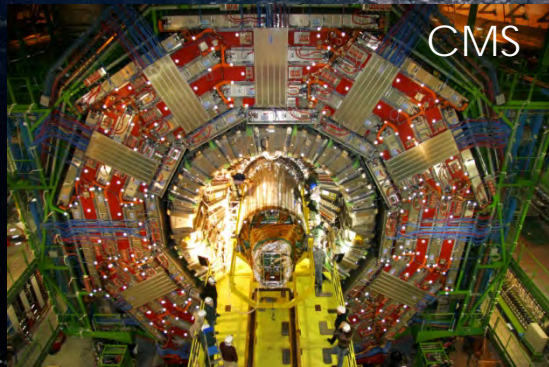
Where the Web was born



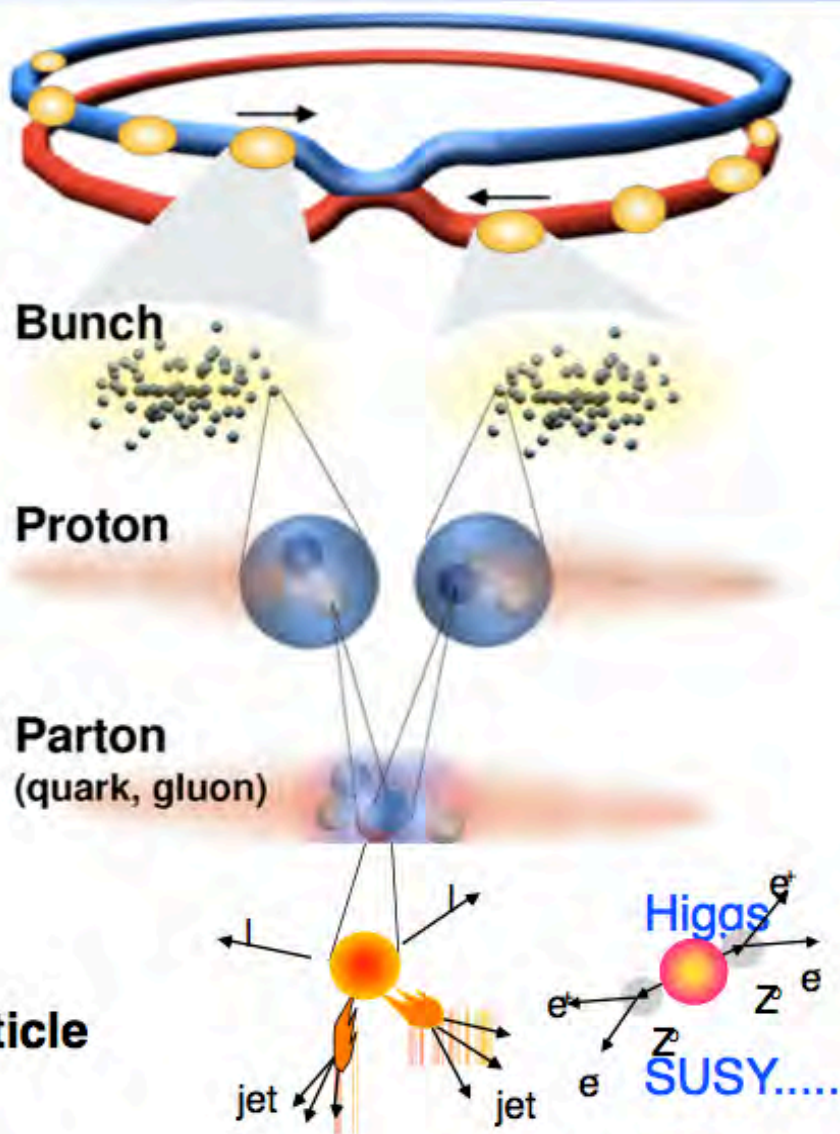
Tim Berners-Lee, a scientist at CERN, invented the World Wide Web (WWW) in 1989.

The Web was originally conceived and developed to meet the demand for automatic information sharing between scientists working in different universities and institutes all over the world.

Large Hadron Collider



Collisions @ LHC



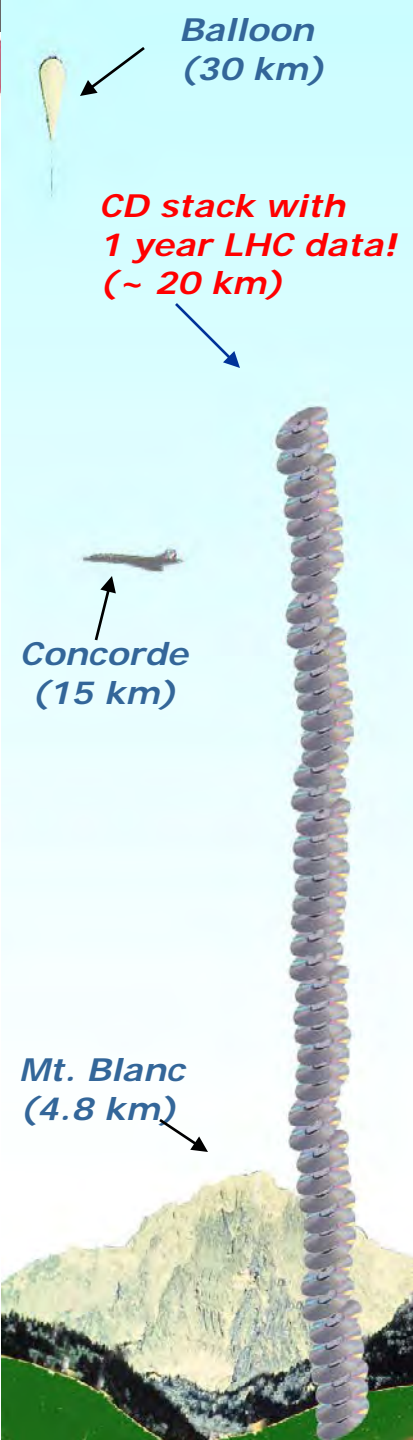
Proton - Proton	2808 bunch/beam
Protons/bunch	10^{11}
Beam energy	7 TeV (7×10^{12} eV)
Luminosity	$10^{34} \text{cm}^{-2} \text{s}^{-1}$

Crossing rate	40 MHz
----------------------	---------------

Collision rate \approx	10^7-10^9
--	--

New physics rate \approx	.00001 Hz
--	------------------

Event selection:
1 in 10,000,000,000,000



Data @ LHC

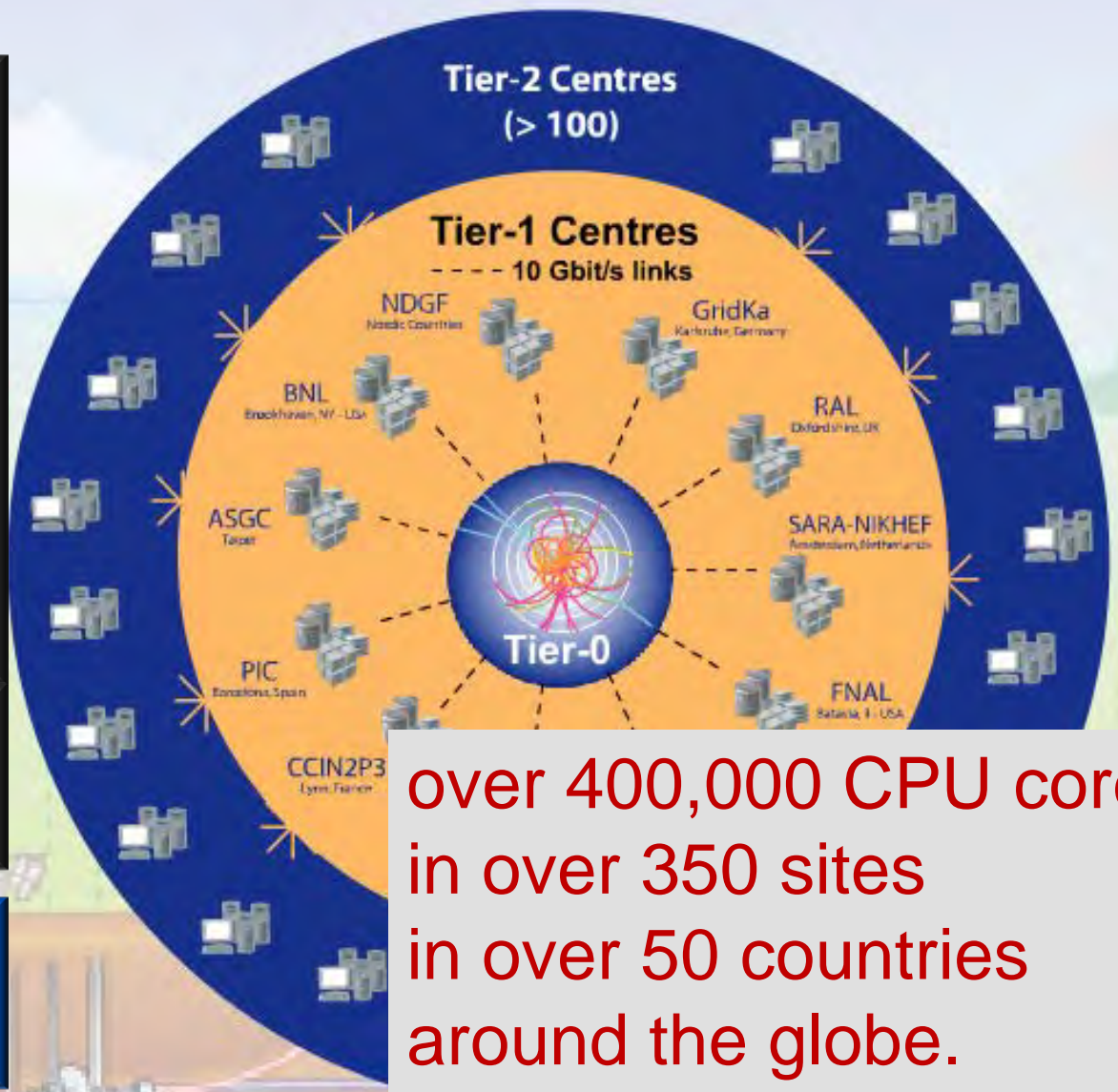
- 40 million events per second
- Select (on the fly) the ~200 interesting events per second to write on tape
- “Reconstruct” data and convert for analysis: “physics data” [→ the grid...]

(x4 experiments)	Per event	Per year
Raw data	1.6 MB	3200 TB
Reconstructed data	1.0 MB	2000 TB
Physics data	0.1 MB	200 TB

Worldwide LHC Computing Grid

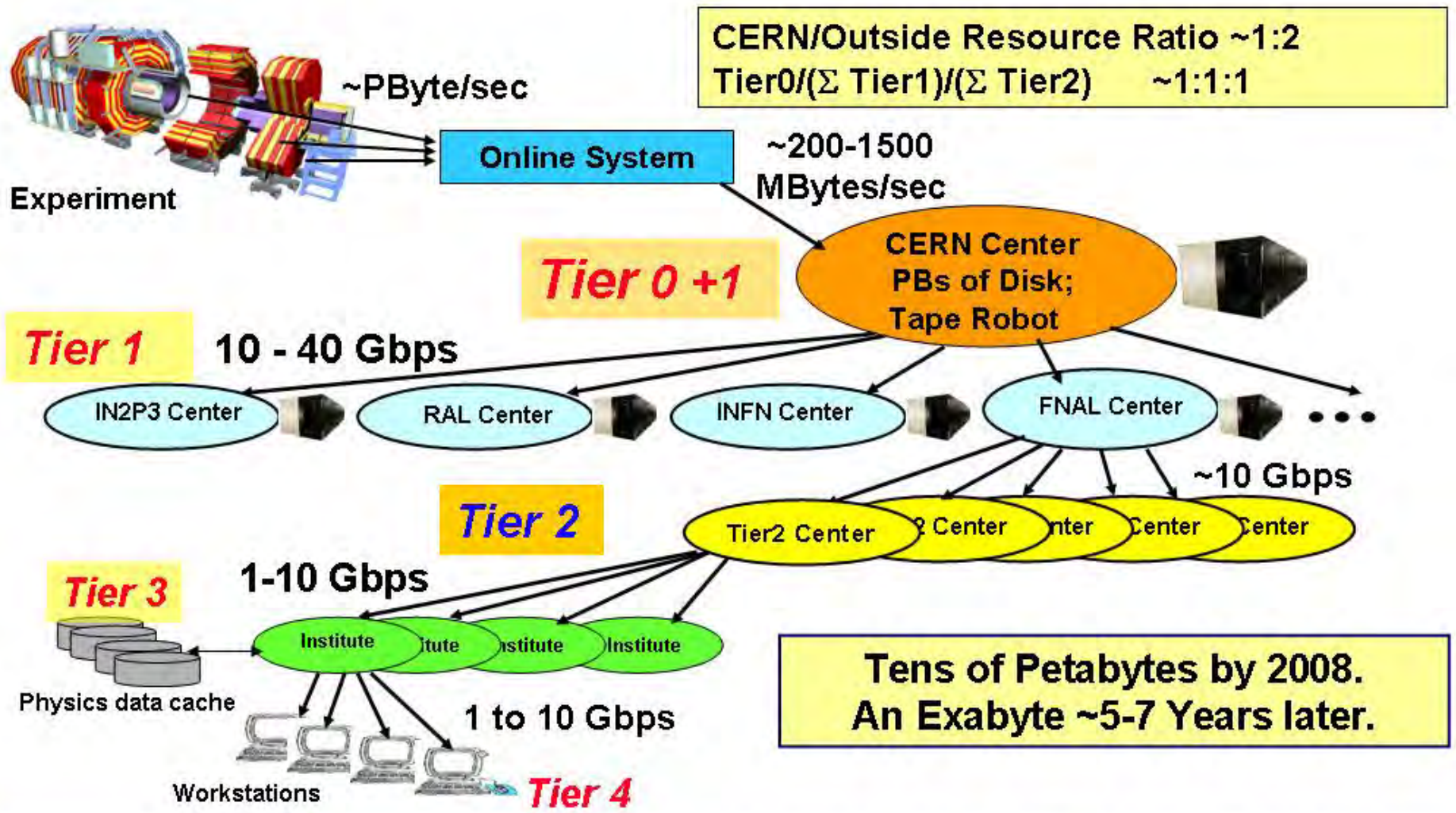
- Tier-0 (CERN):**
- Data recording
 - Initial data reconstruction
 - Data distribution
- Tier-1 (11 centers):**
- Permanent storage
 - Re-processing
 - Analysis
- Tier-2 (~130 centers):**
- Simulation
 - End-user analysis

CU-NECTEC
CMS Tier-2



over 400,000 CPU cores
in over 350 sites
in over 50 countries
around the globe.

LHC Data Grid Hierarchy:



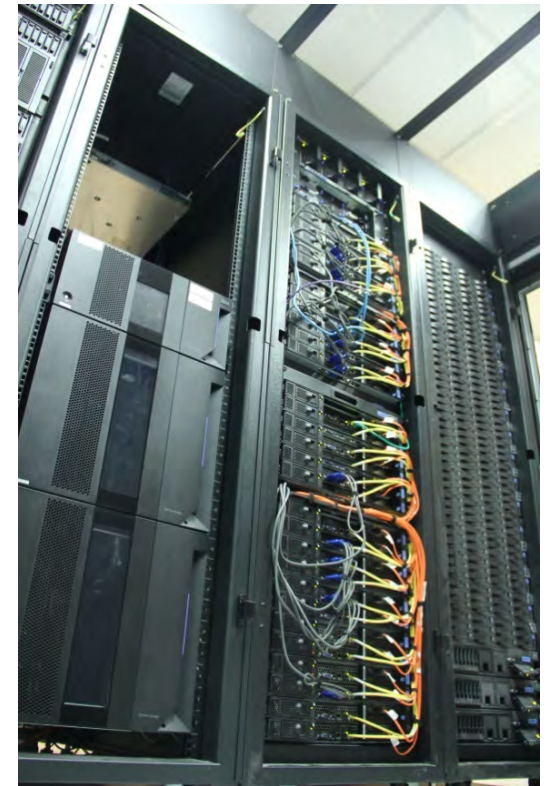
Emerging Vision: A Richly Structured, Global Dynamic System

Tier-0 @ CERN



CMS Tier-2 in Thailand

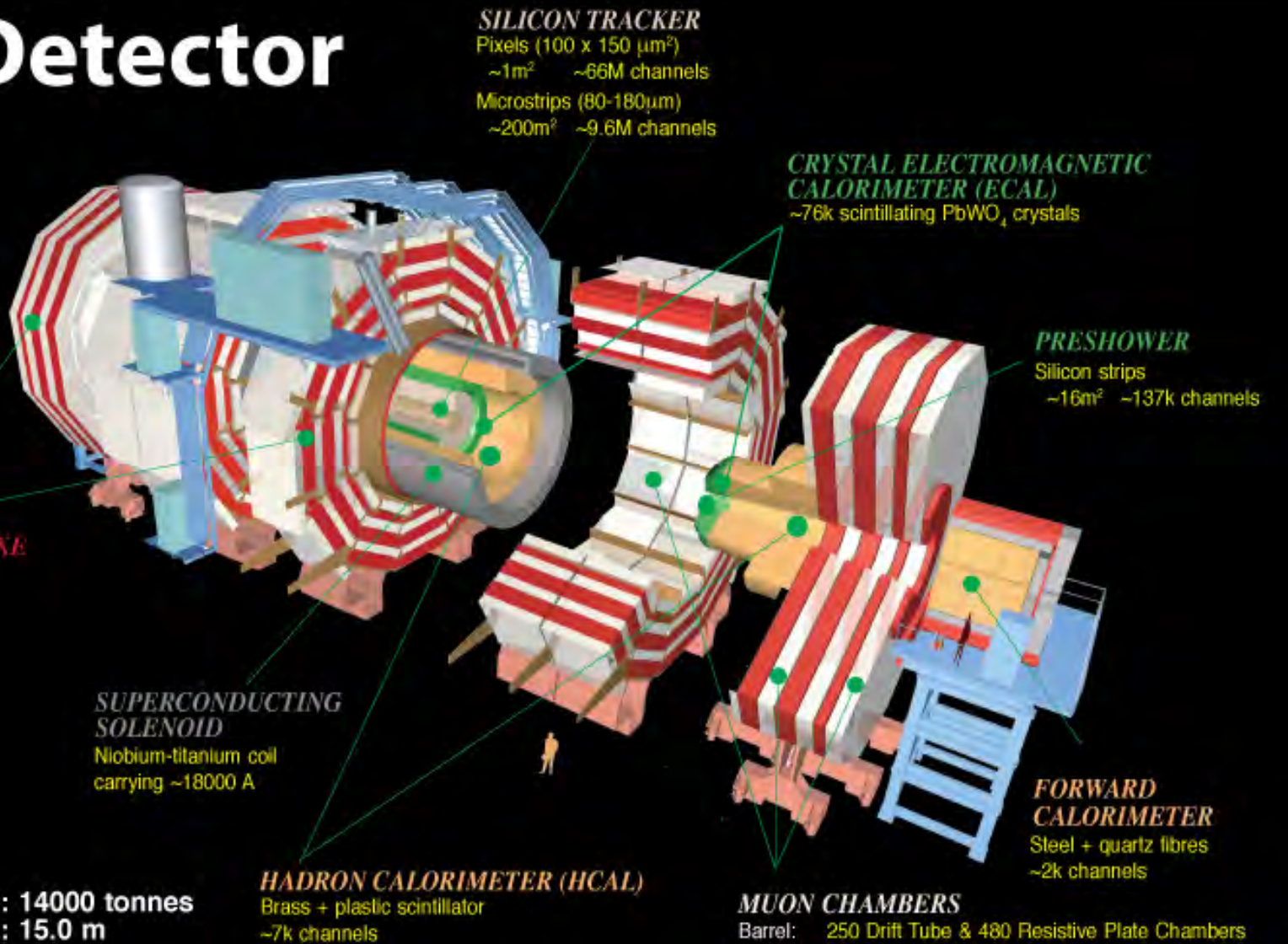
- **CMS Tier-2 (CU+NECTEC)**
 - **200 CPUs for central CMS + 60 CPUs for local users**
 - **5 management nodes (60 CPUs) + backup**
 - **200 TB storage**
 - **Operational by 2012**



Compact Muon Solenoid

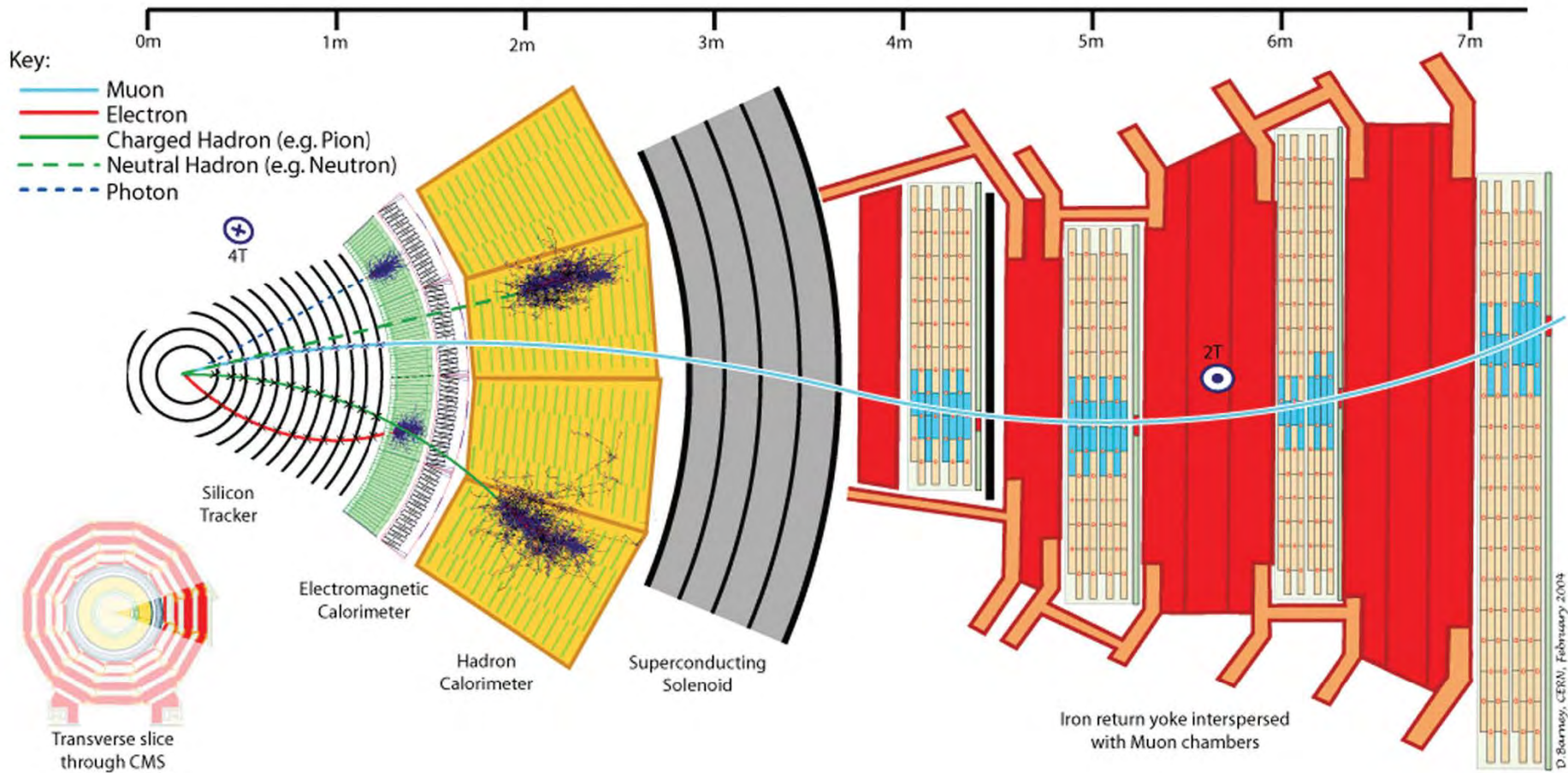
CMS Detector

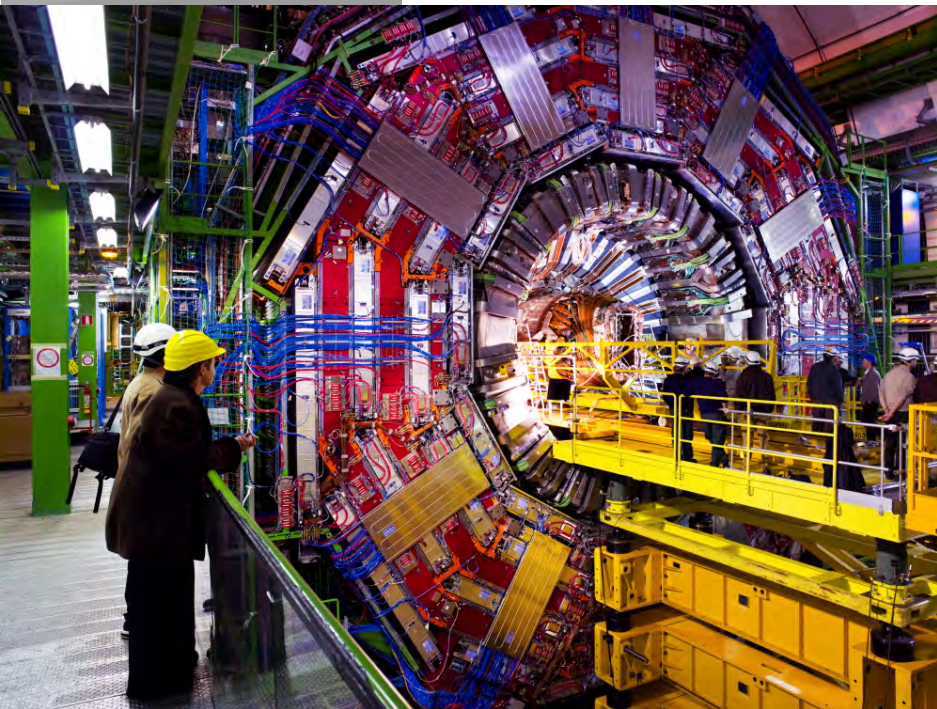
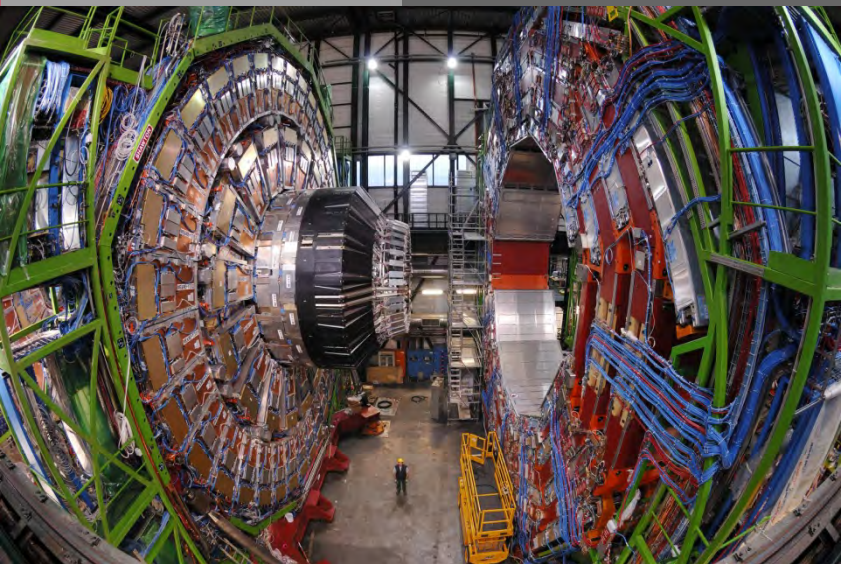
Pixels
Tracker
ECAL
HCAL
Solenoid
Steel Yoke
Muons



Total weight : 14000 tonnes
Overall diameter : 15.0 m
Overall length : 28.7 m
Magnetic field : 3.8 T

Where are they going?





CU-CMS Collaboration



สมเด็จพระเทพรัตนราชสุดาฯ สยามบรมราชกุมารี เสด็จประทับเป็นองค์ประธานพิธีลงนามบันทึกข้อตกลงความร่วมมือระหว่าง
จุฬาลงกรณ์มหาวิทยาลัย และ The Compact Muon Solenoid Collaboration

ณ พระตำหนักเขียว วังสระปทุม

วันเสาร์ที่ ๑๔ กรกฎาคม ๒๕๕๕ เวลา ๑๒.๑๕ น.

4 July 2012 @ CERN



The Success

“Without the worldwide computing, the grid computing, this result would not have been possible,”

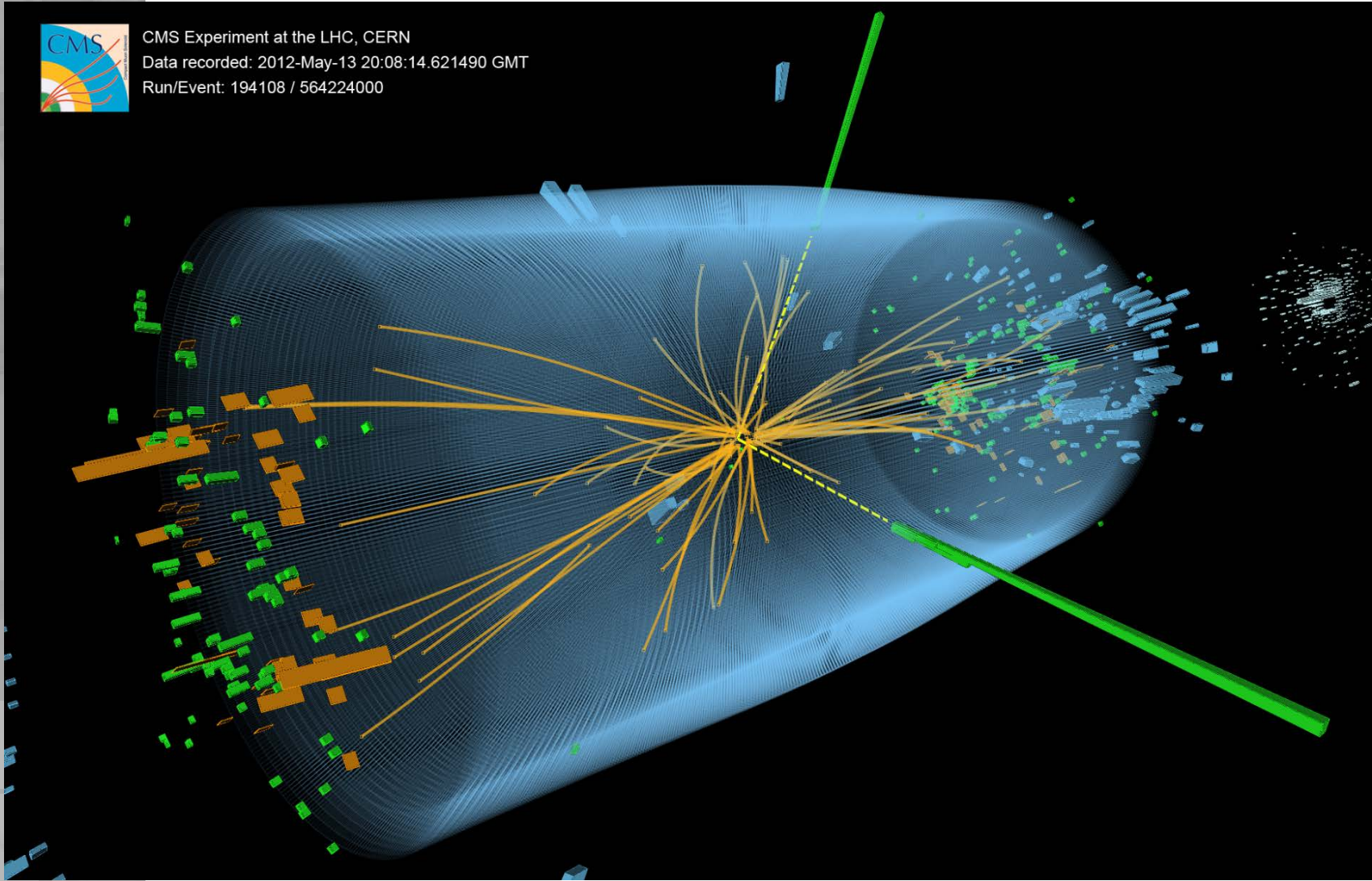
CERN Director General, Rolf Heuer



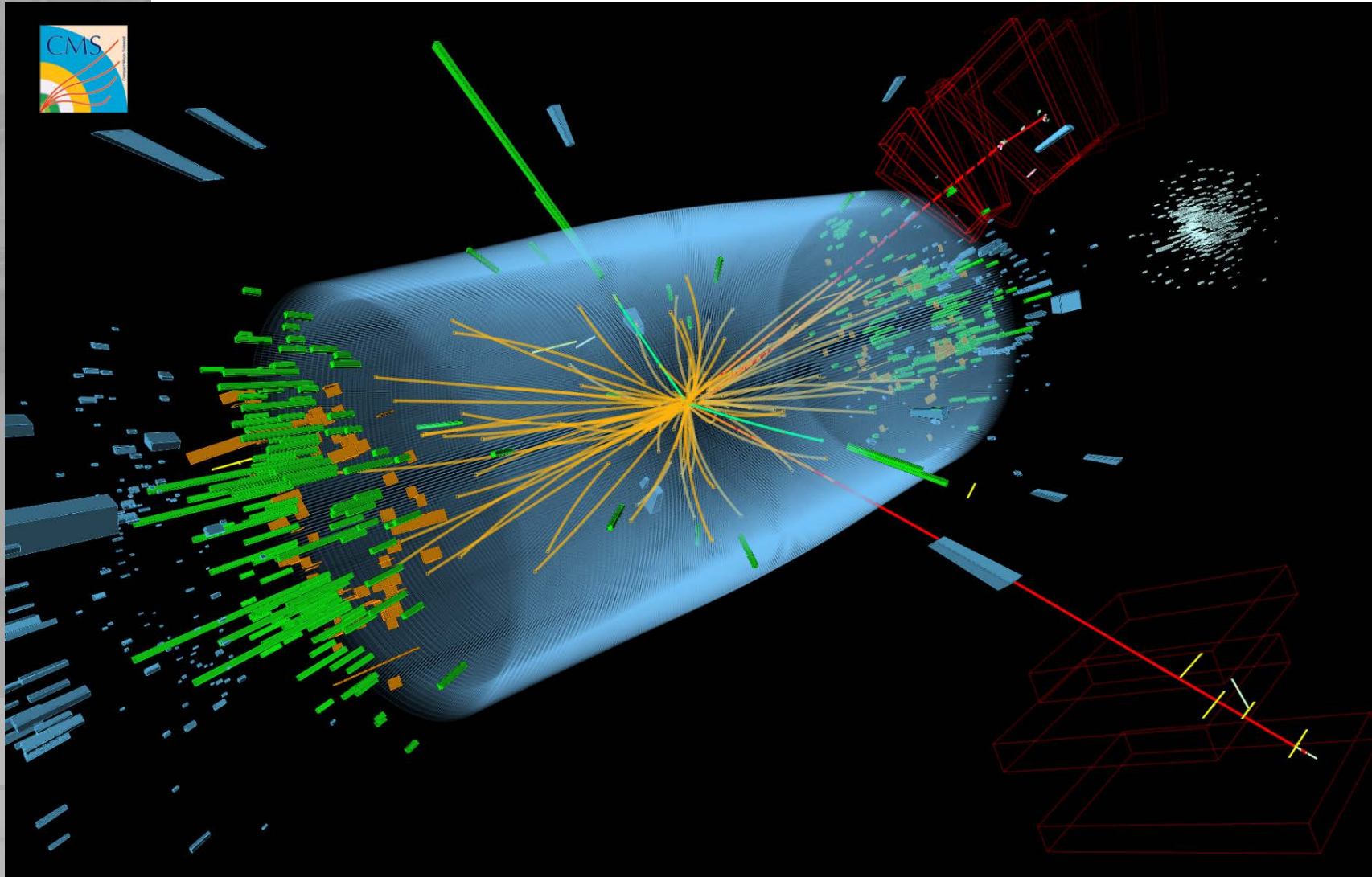
$$H \rightarrow \gamma\gamma$$



CMS Experiment at the LHC, CERN
Data recorded: 2012-May-13 20:08:14.621490 GMT
Run/Event: 194108 / 564224000



$H \rightarrow e e \mu \mu$



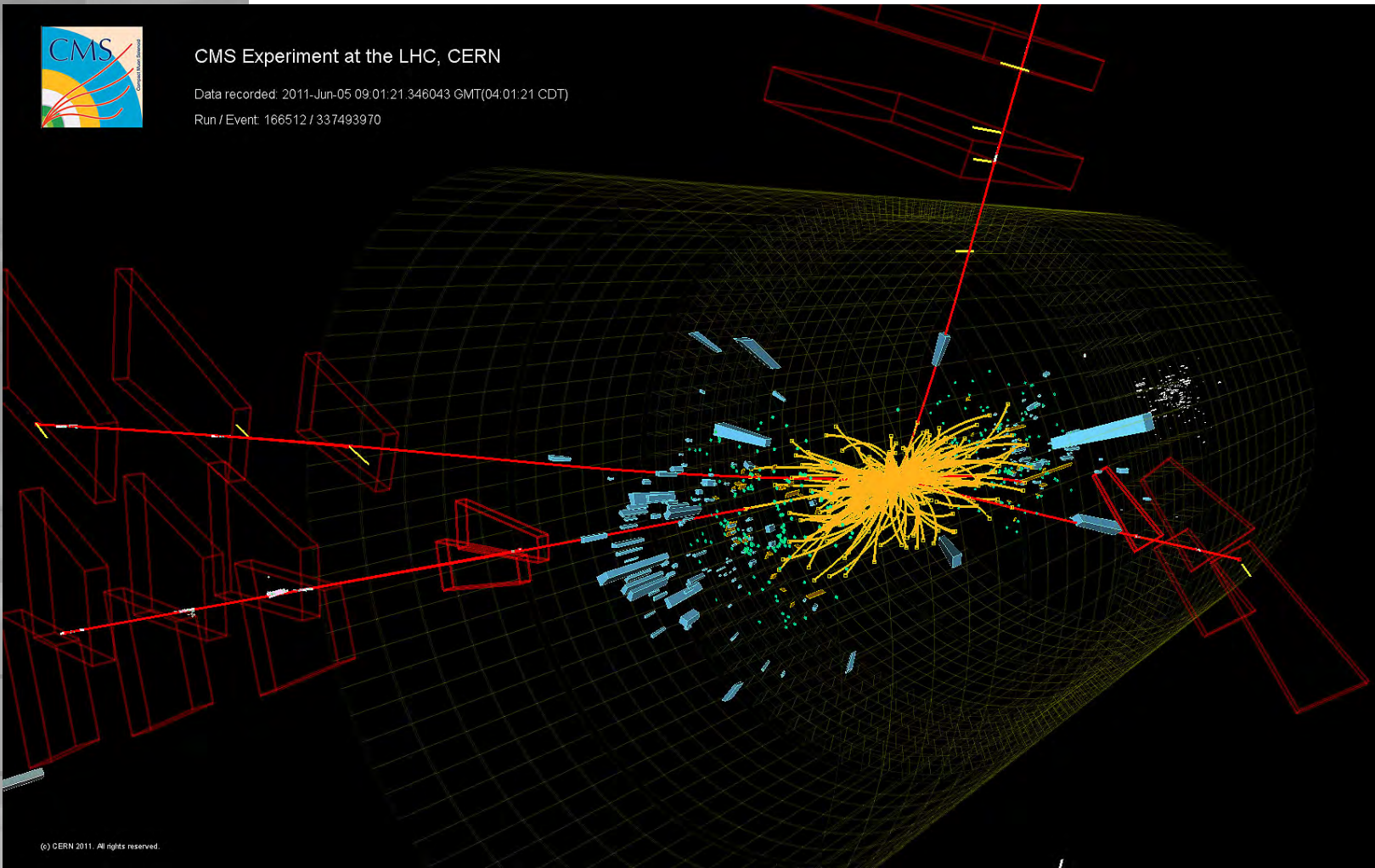
$$H \rightarrow 4\mu$$



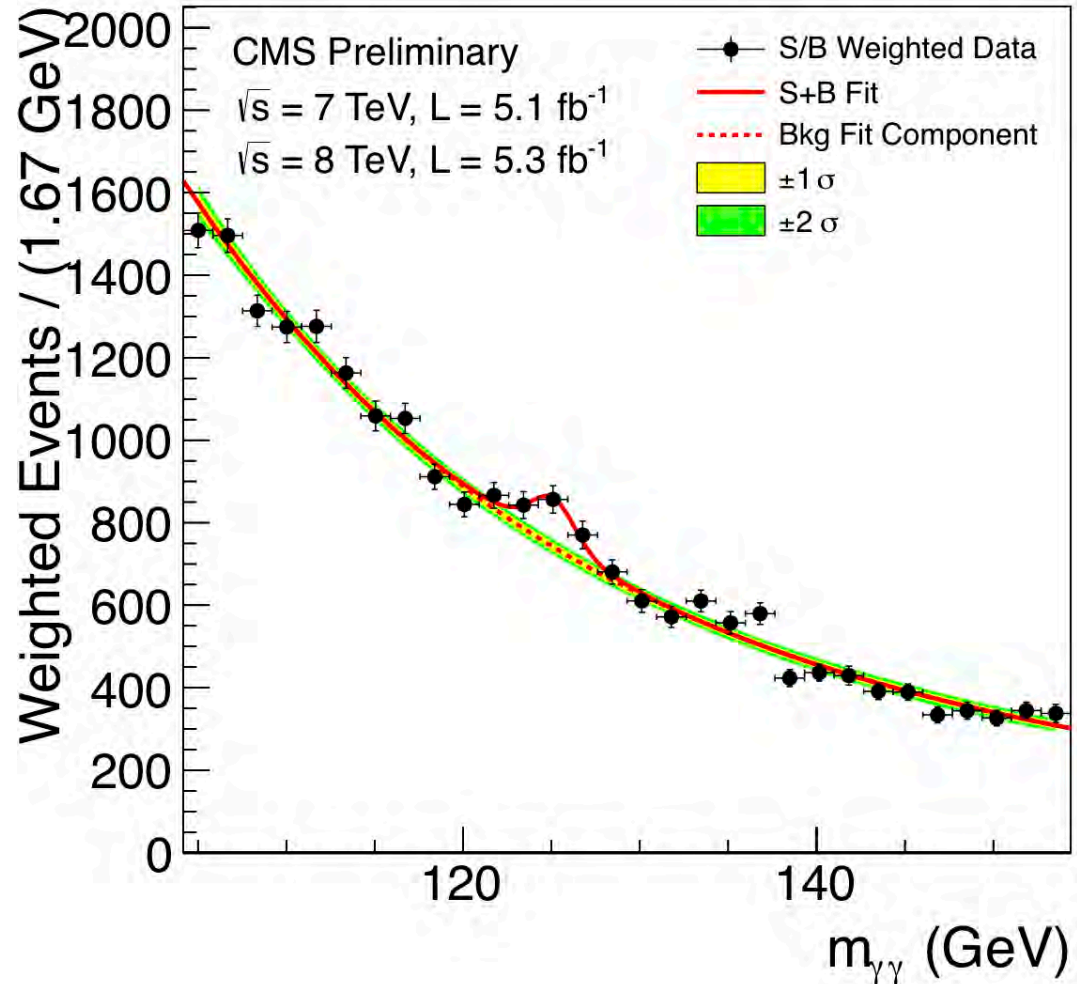
CMS Experiment at the LHC, CERN

Data recorded: 2011-Jun-05 09:01:21.346043 GMT(04:01:21 CDT)

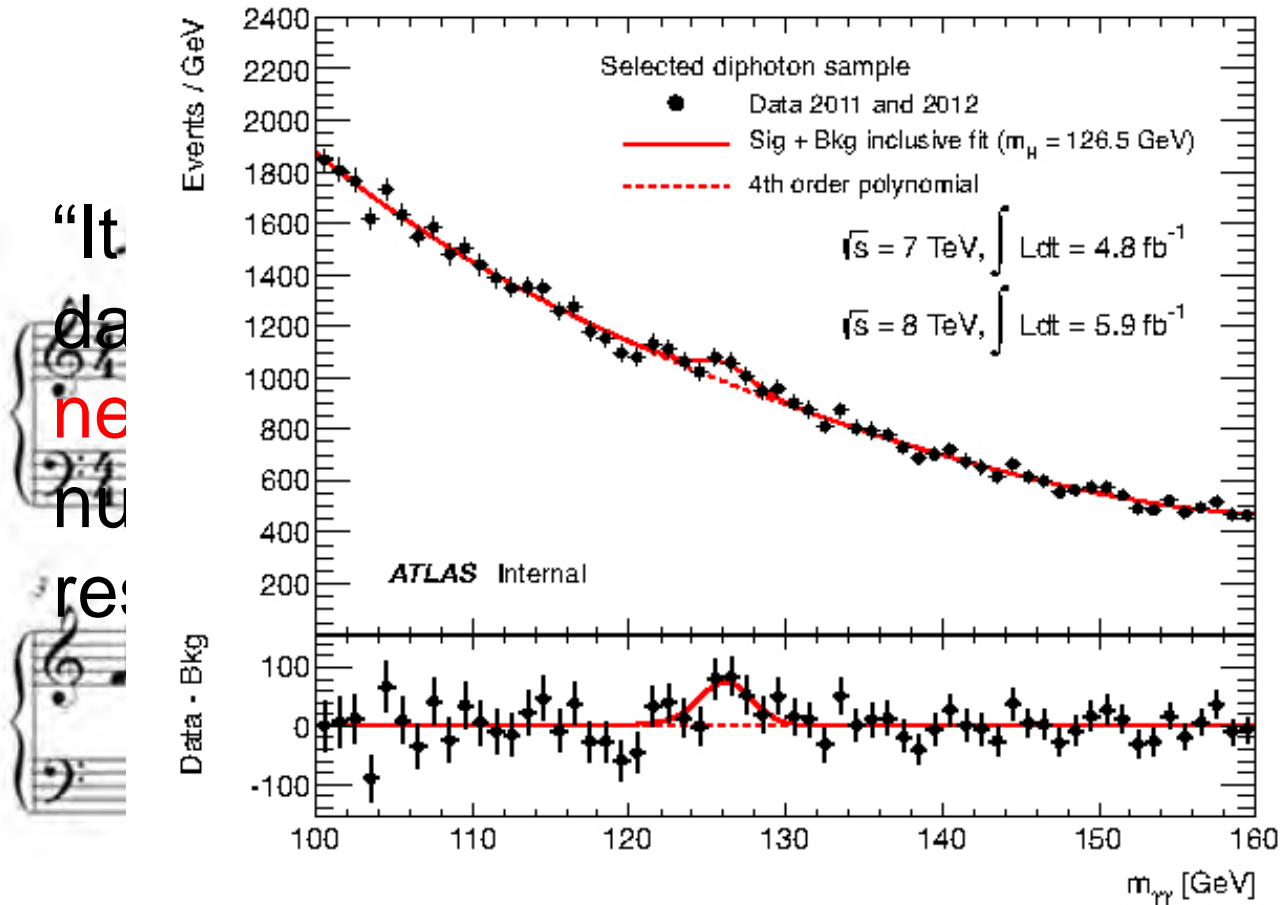
Run / Event: 166512 / 337493970



$$m_H = 125.3 \pm 0.6 \text{ GeV}$$



Can you “hear the Higgs”?



<http://www.forbes.com/sites/alexknapp/2012/07/11/scientists-set-the-higgs-boson-to-music/>