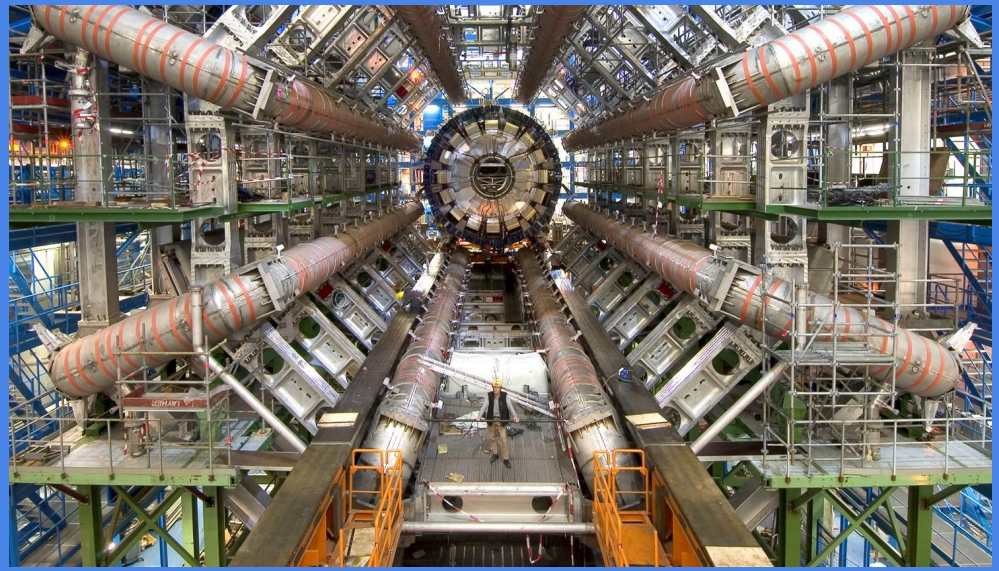
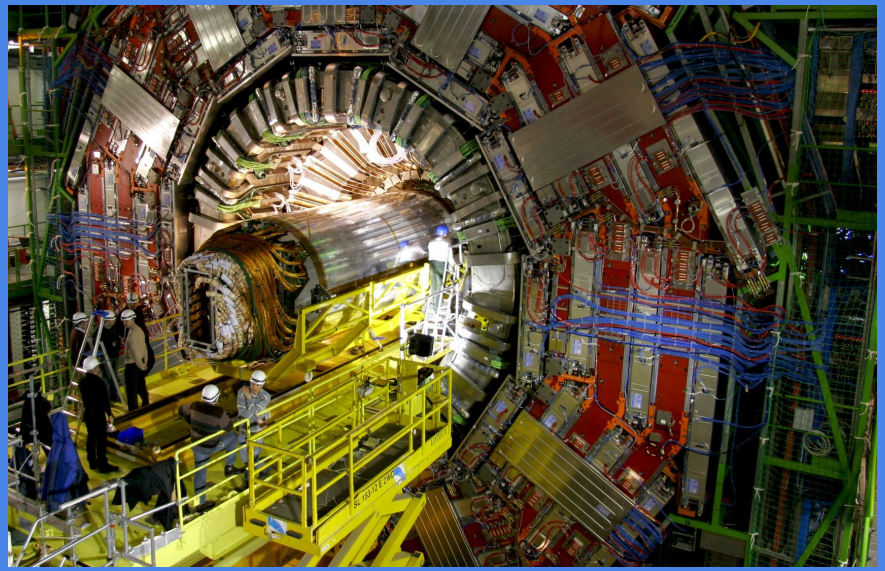
I rivelatori ATLAS e CMS @LHC

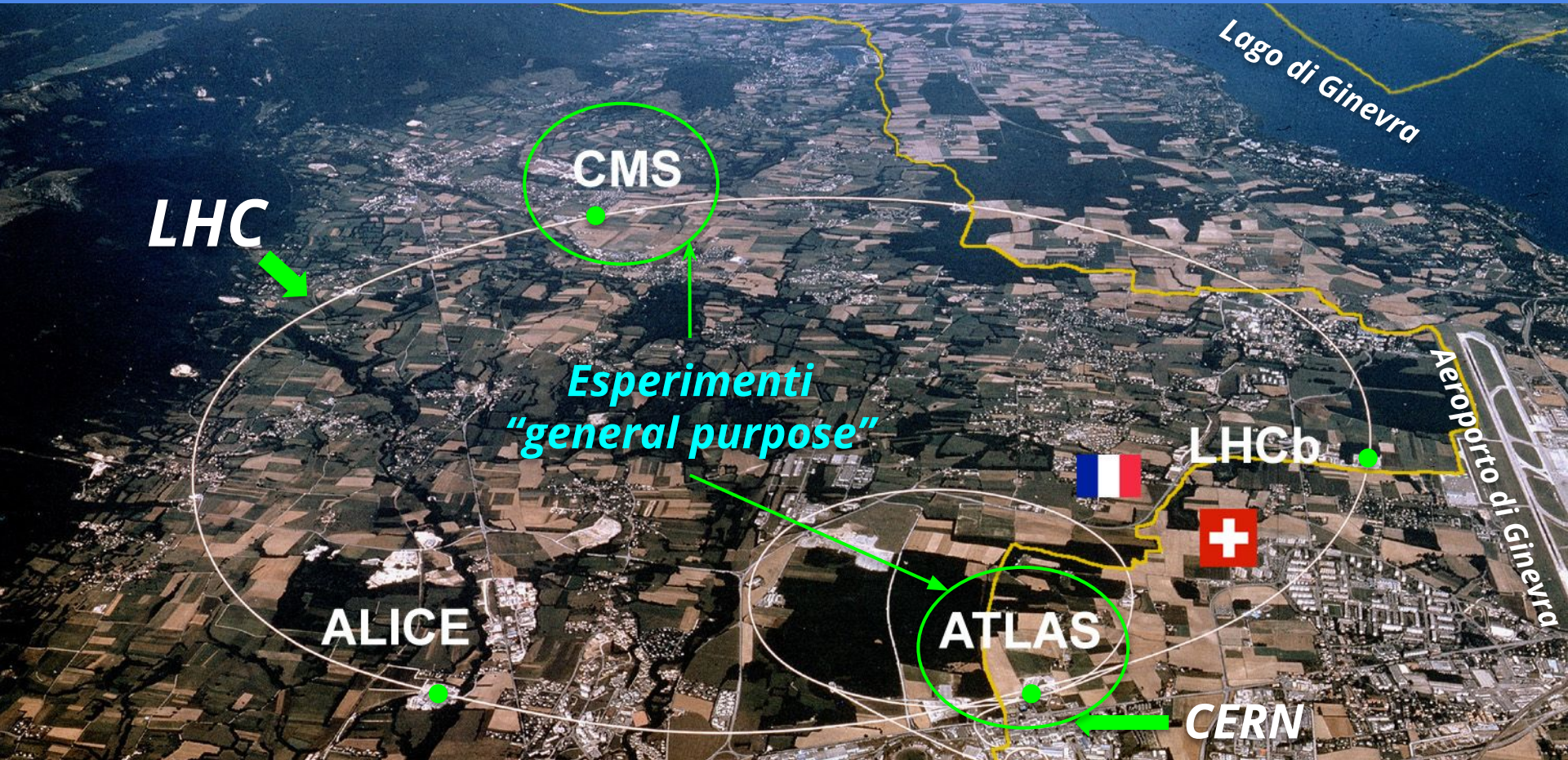




Michele Pinamonti (INFN Trieste)

UniTS / INFN Trieste CERN Virtual Visit | 14 Gennaio 2022

LHC e i suoi esperimenti

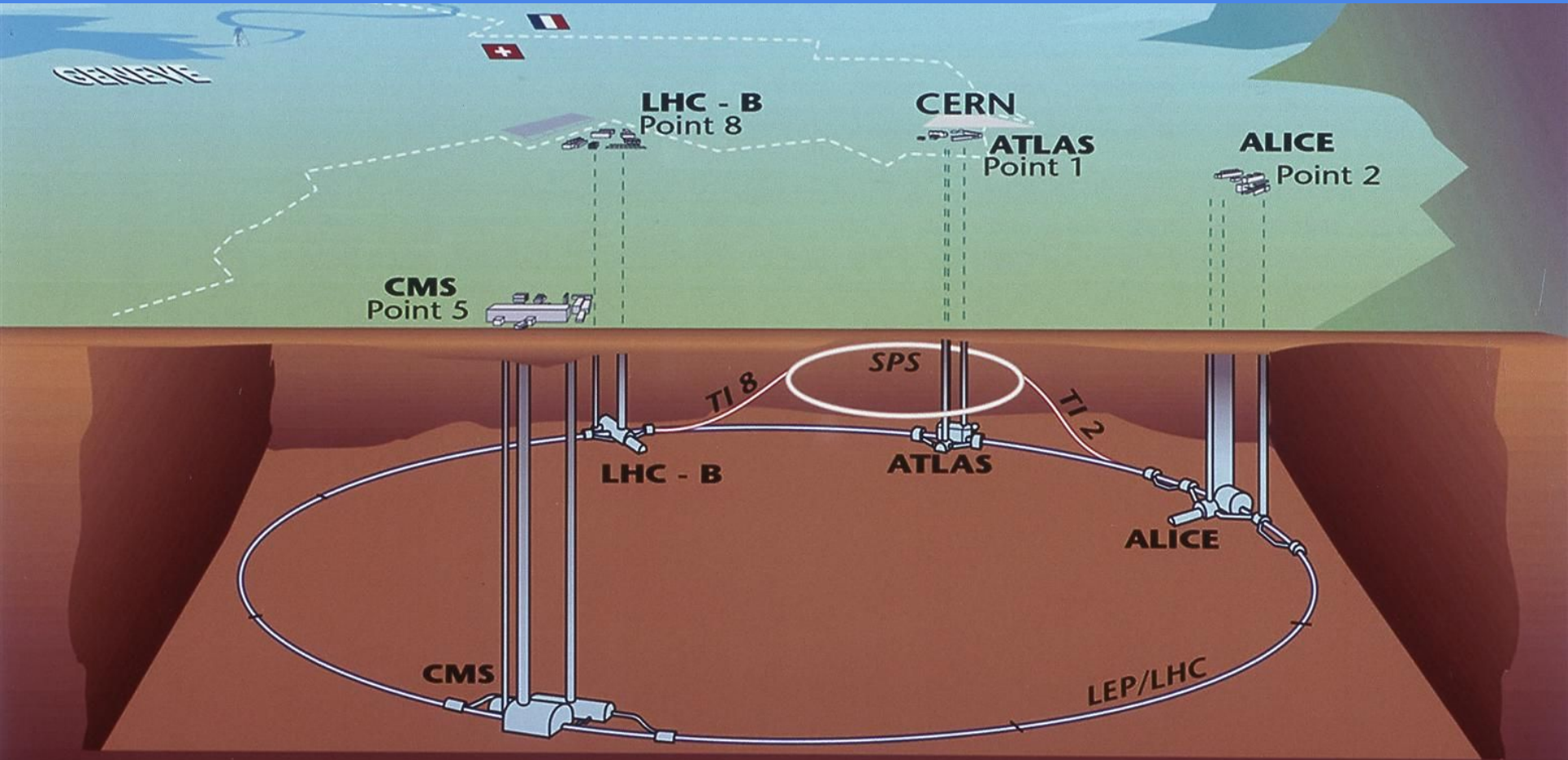


ATLAS @LHC

CMS @LHC


Lago di Ginevra
CMS
Sala controllo CMS
Rivelatore CMS...
Aeroporto di Ginevra
CERN

LHC underground

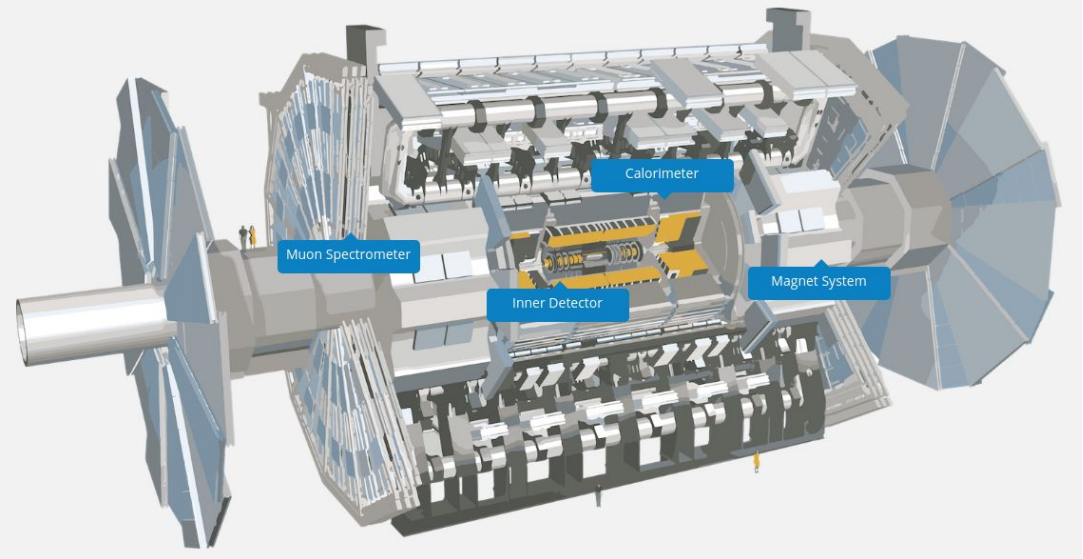


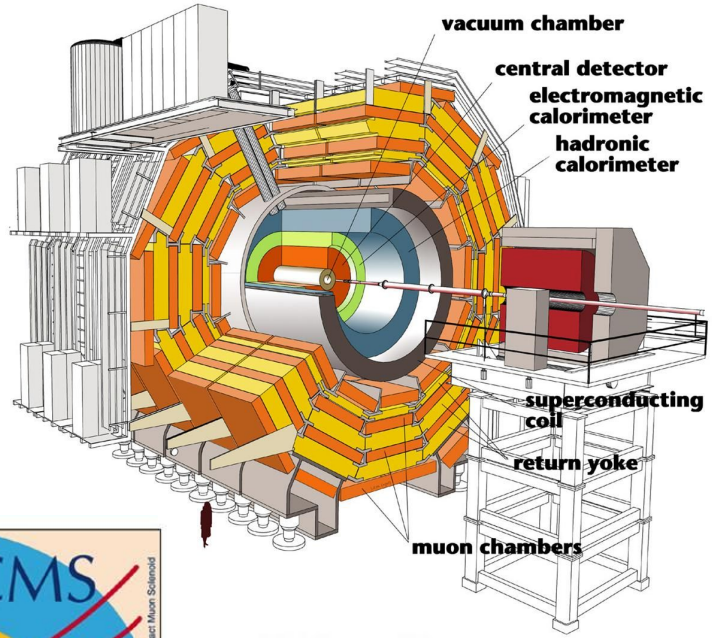
I rivelatori ATLAS e CMS

- Costruzione: 1995 - 2009
- Run 1: 2010 - 2012 → *pp* √s = 7 TeV, 8 TeV
- Upgrade Run 2: 2013 - 2014
- Run 2: 2015 - 2018 → *pp* √s = 13 TeV
- Upgrade Run 3: just finished
- Run 3: 2022 - 2025 → *pp* √s = 13.6 TeV

ATLAS EXPERIMENT

46	100	7000	1000000000
meters long & 25m of diameter	meters below ground	tonnes	collisions / second



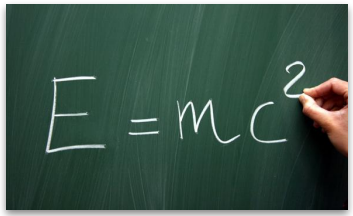


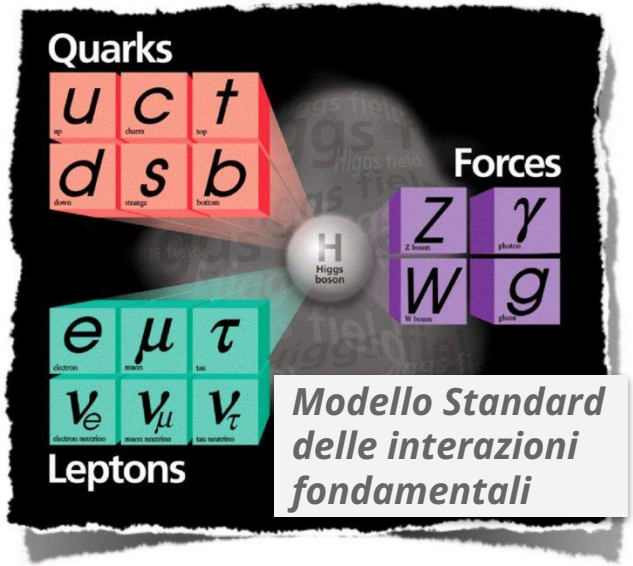
CMS Compact Muon Solenoid

Width: 22m
Diameter: 15m
Weight: 14'500t

Cosa vogliono studiare?

- ATLAS e CMS hanno un ampio range di obiettivi
- In generale quello che si vuole è:
  - **produrre particelle** *pesanti* (⇒ *instabili*) in collisioni *pp* a massima energia
    - bosoni *W* e *Z*
    - bosone di *Higgs*
    - quark *top*
    - particelle *nuove* (particelle “supersimmetriche”, quarta famiglia di quark e leptoni, eccitazioni “Kaluza-Klein” di particelle conosciute…)

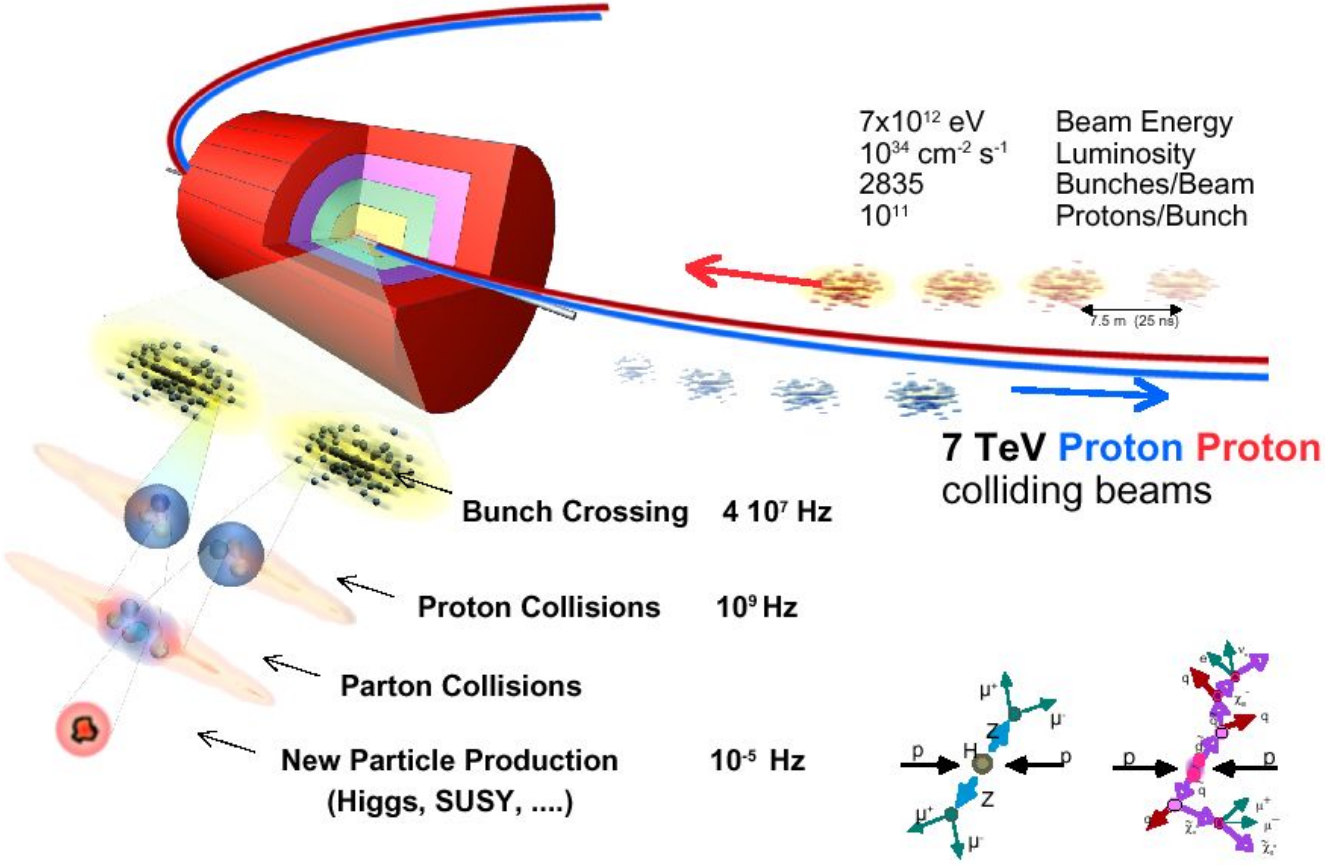


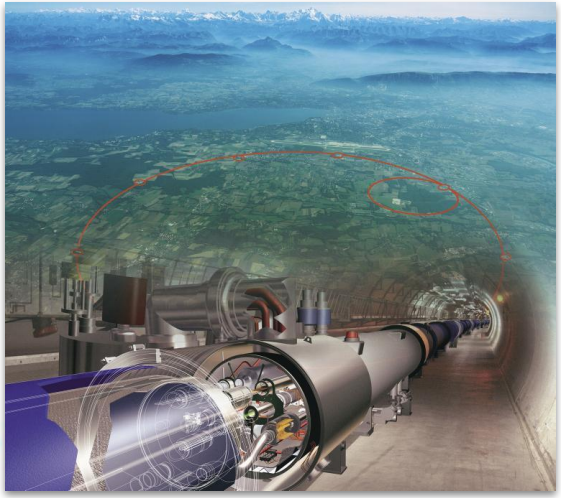


  - studiarle tramite i ***prodotti di decadimento***
    - massa
    - proprietà di spin / parità
    - forza di accoppiamento con altre particelle

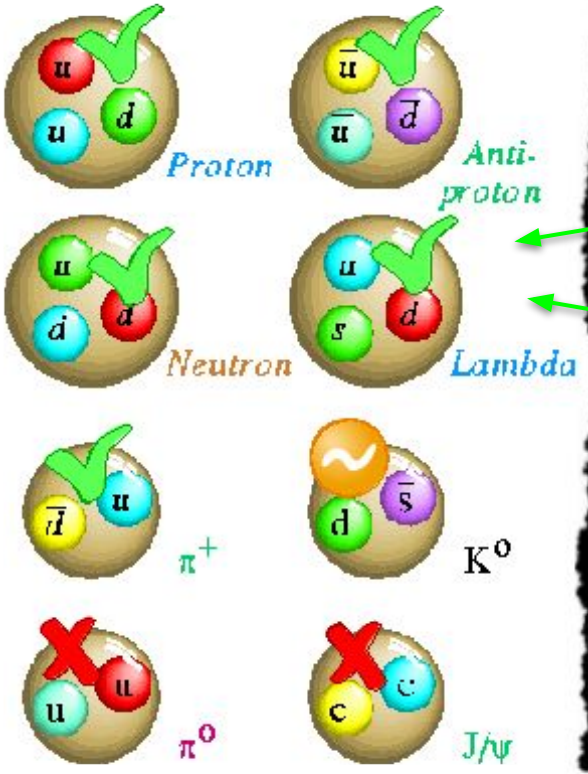
sia per particelle “nuove” che per quelle “vecchie”!

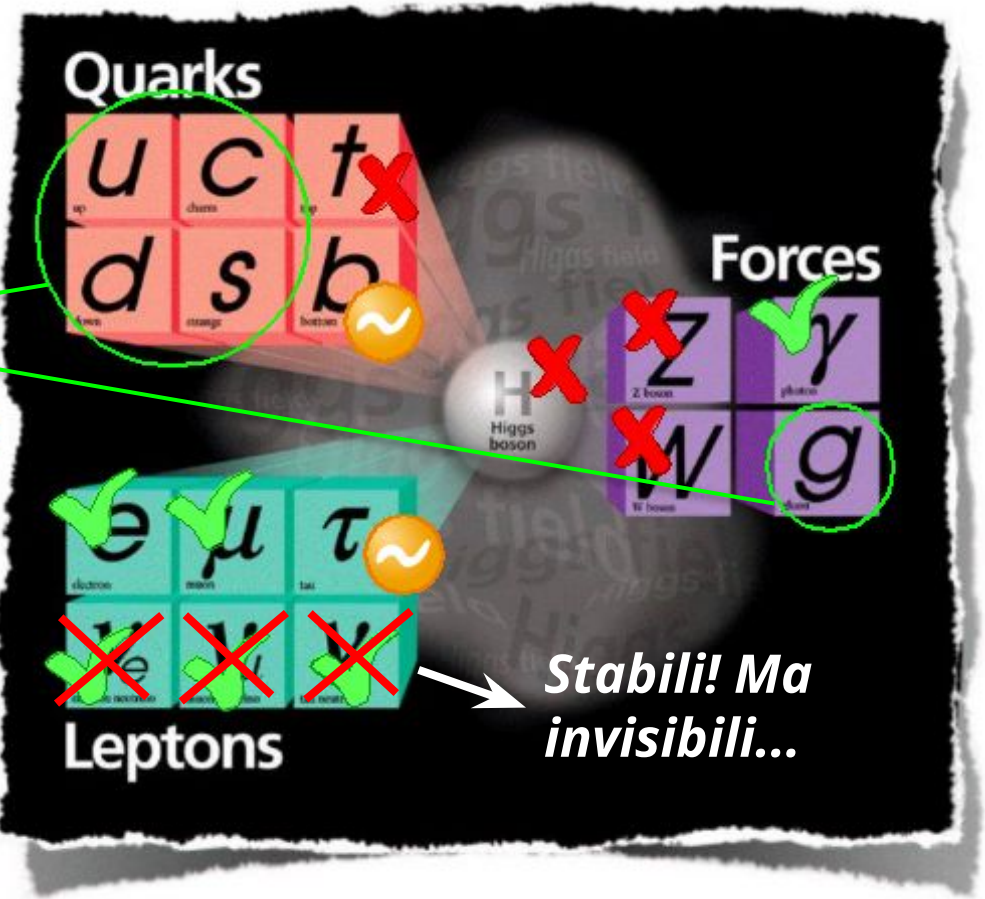
Collisioni protone-protone a LHC



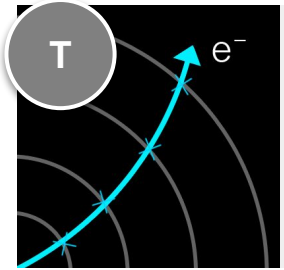


Che particelle possiamo “vedere” direttamente...



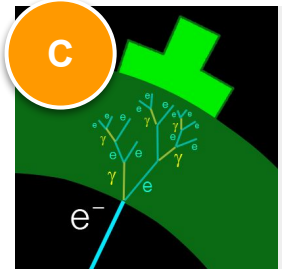


... e come?



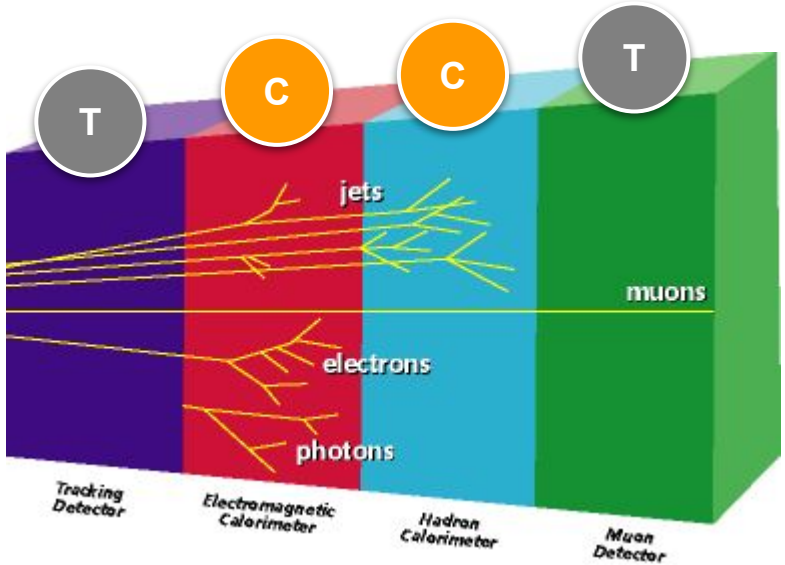
Tracciatori:

- idea = misurare la **traiettoria** (in campo magnetico) e estrarne ***quantità di moto***

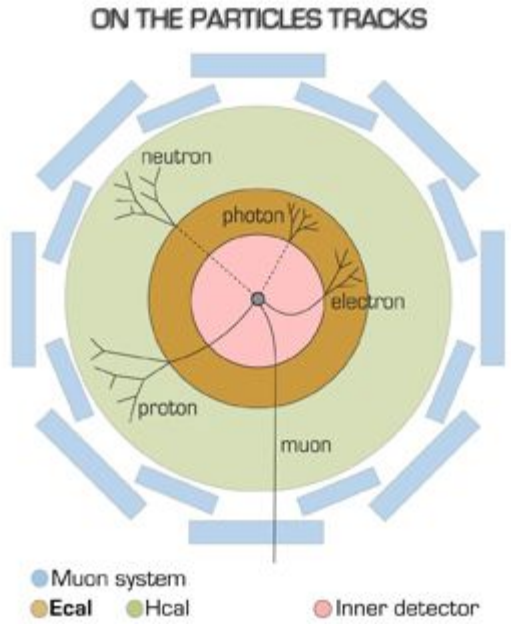


Calorimetri:

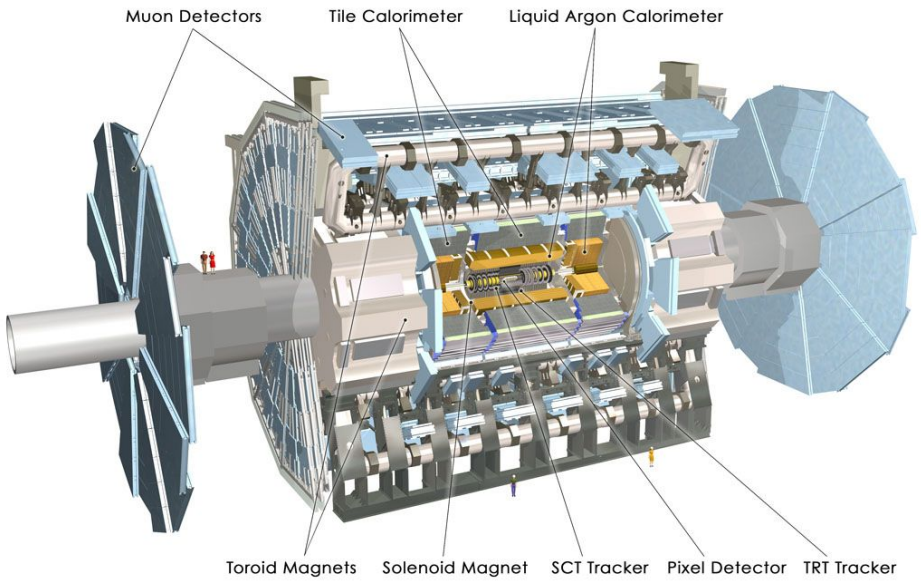
- idea = **fermare** particelle e misurarne l'***energia*** (cinetica)

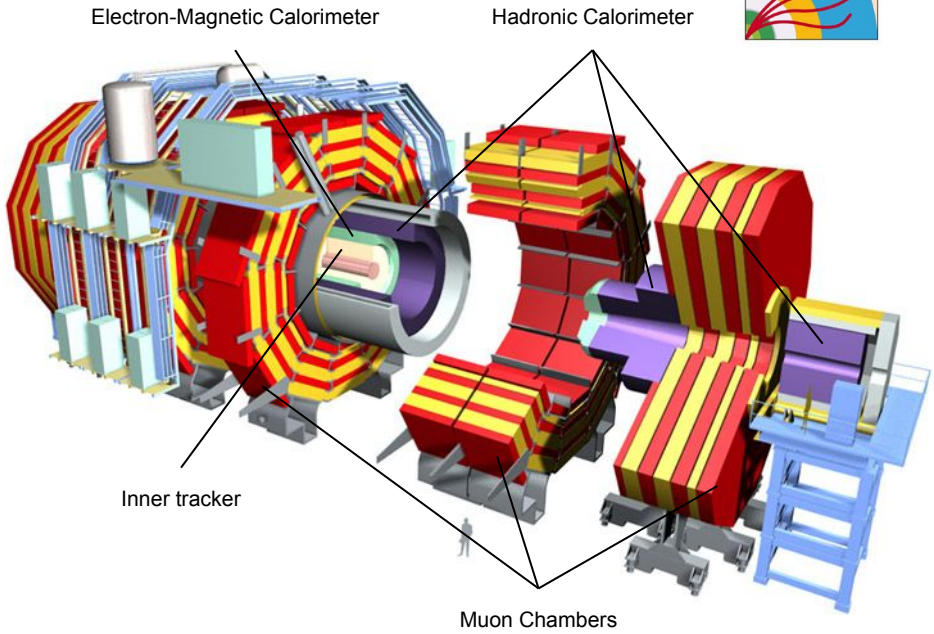


Struttura a cipolla!



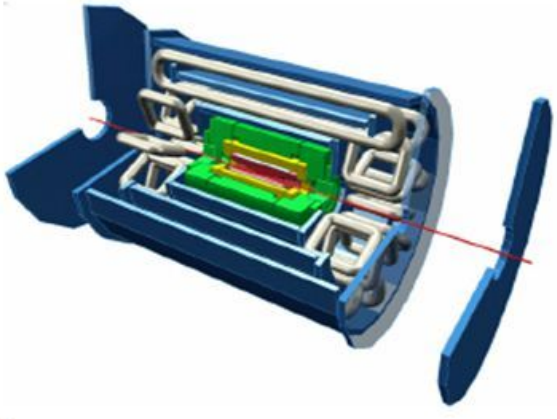
La struttura dei rivelatori

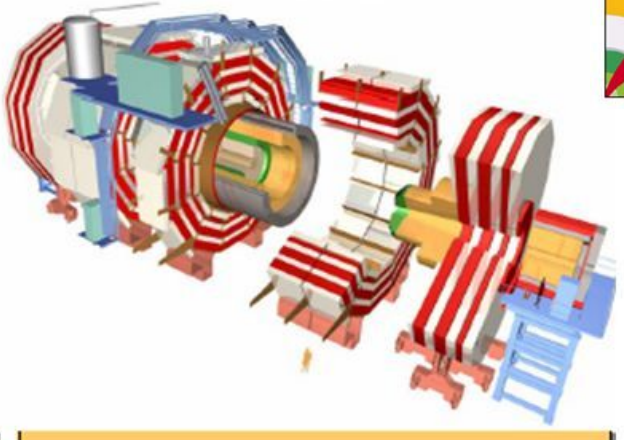




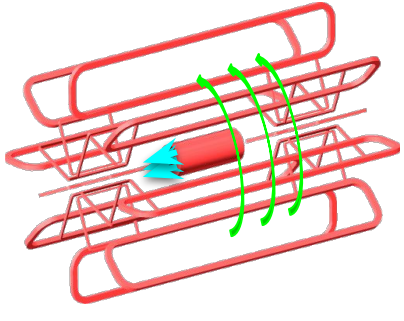
Sistema di Magneti

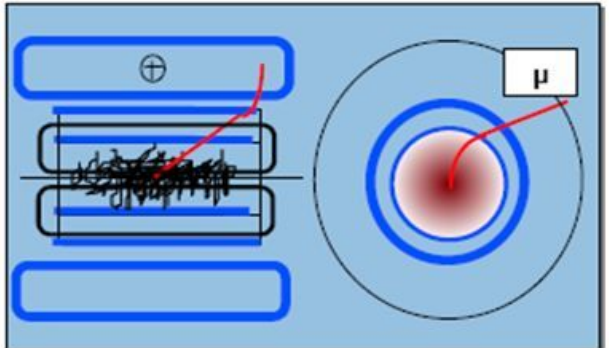
ATLAS EXPERIMENT

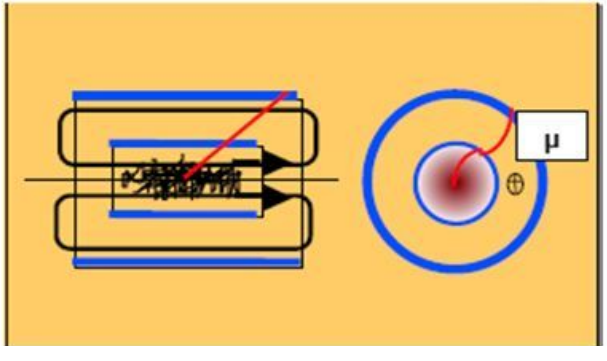




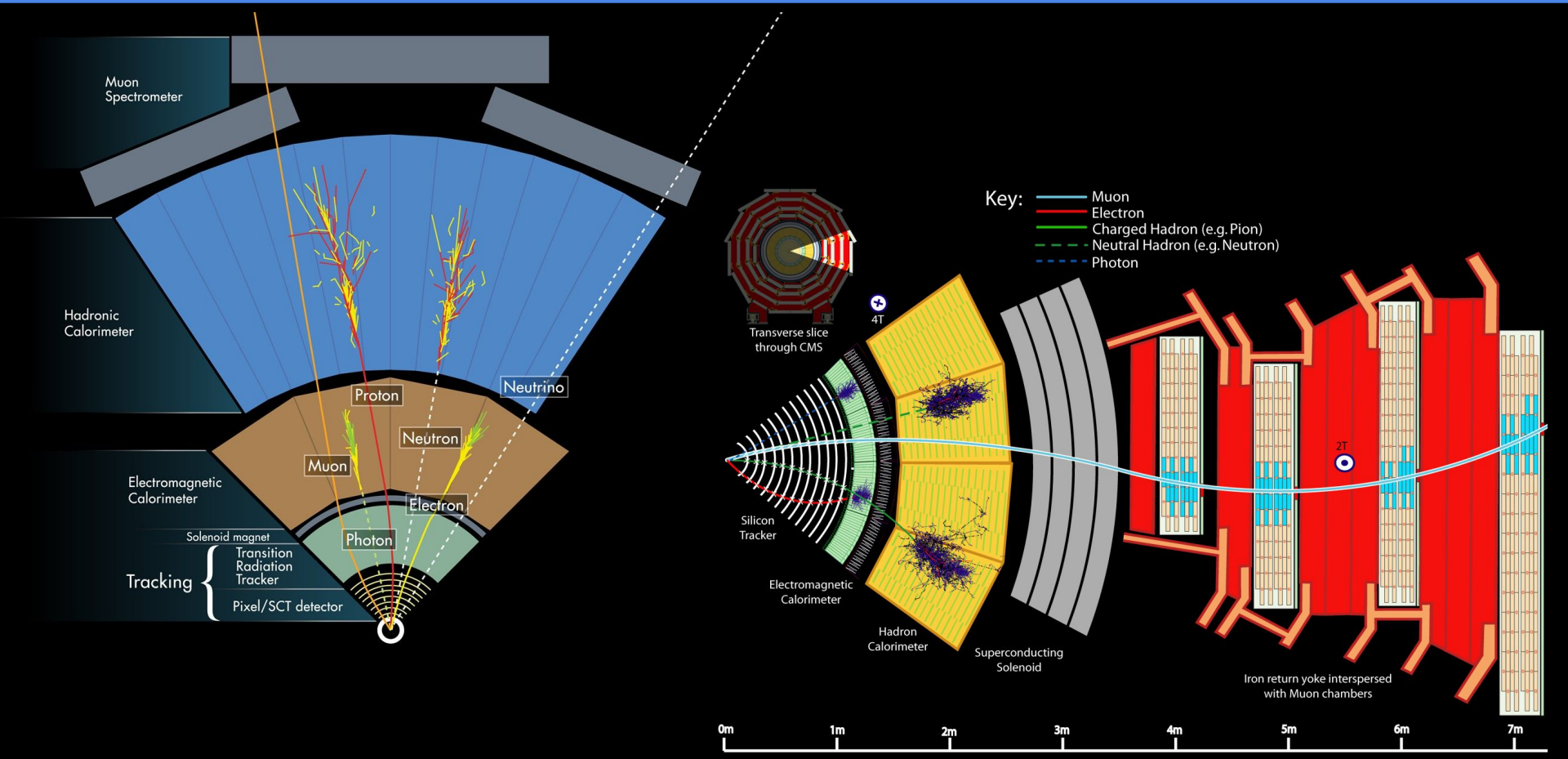
CMS
Compact Muon Solenoid



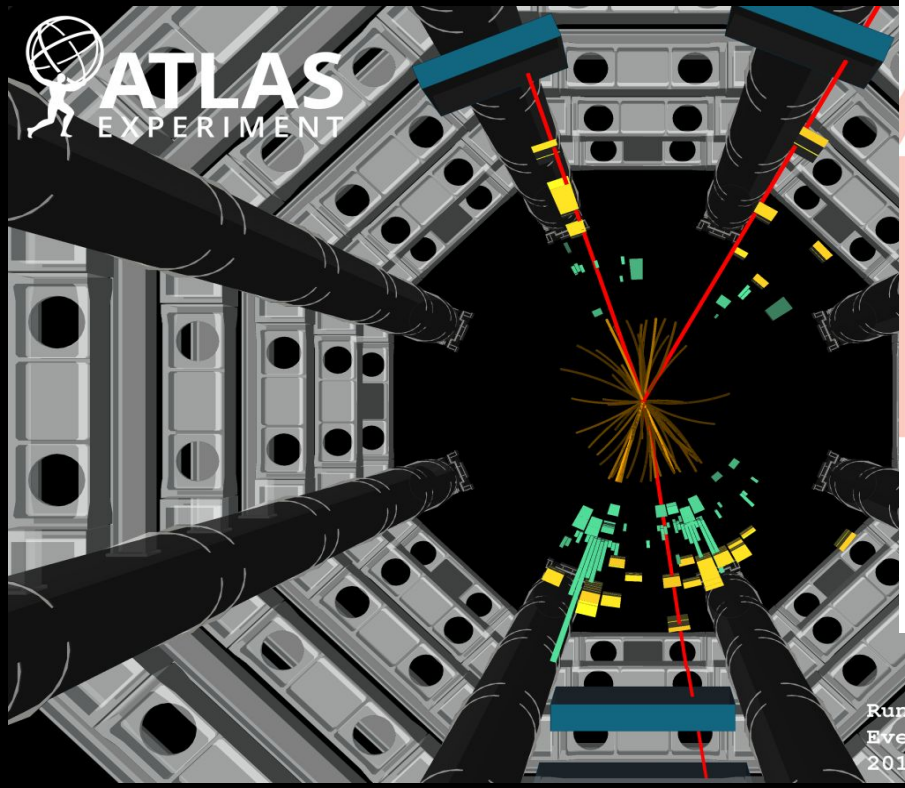


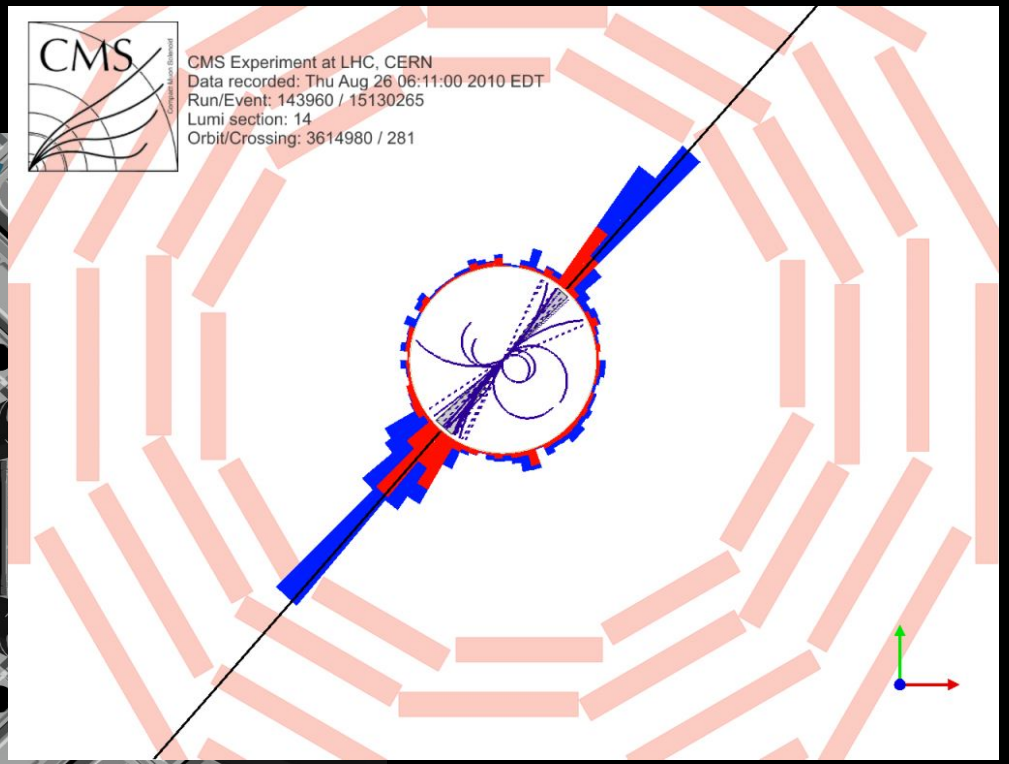


Identificazione delle particelle



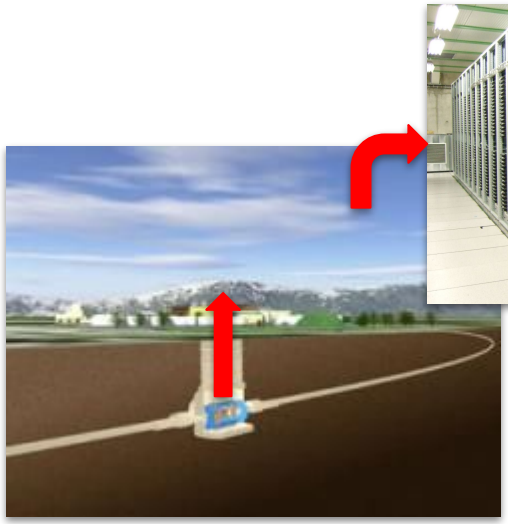
Eventi di collisione “ricostruiti”

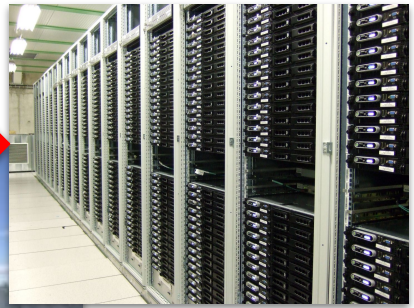


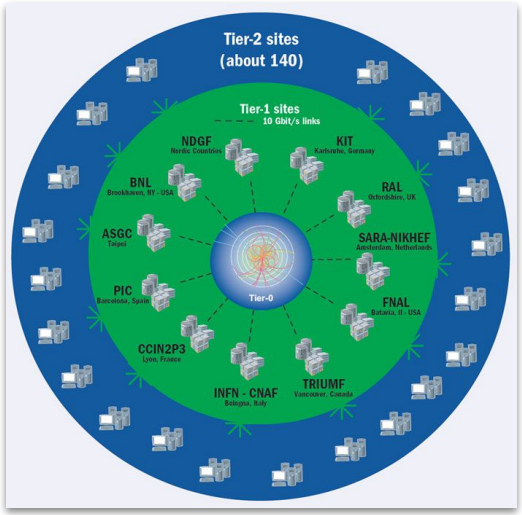


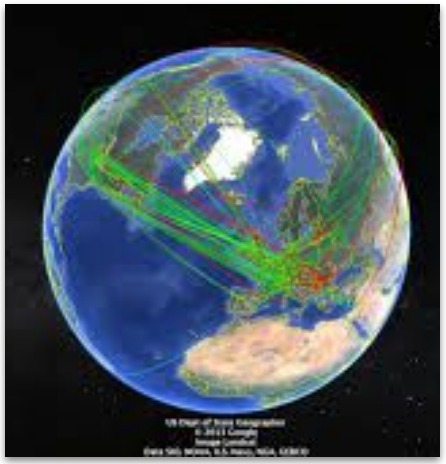
Trigger e flusso di dati

- Sistema di “**trigger**”:
  - seleziona in tempo reale solo i dati “**interessanti**”:
    ~1 miliardo di collisioni /sec (~60 TB/sec...) → ~1000 /sec
- Dati registrati e **distribuiti** tramite la “GRID”
  - per ricostruzione e analisi
    in > 130 centri di calcolo in tutto il mondo









Le collaborazioni Sperimentali

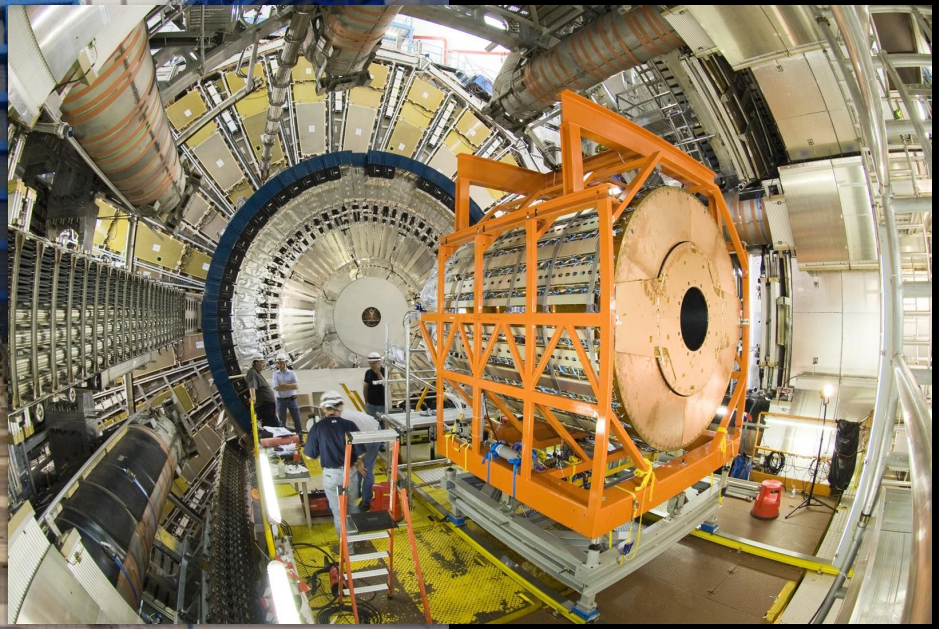
3000
Scientific authors

183
Institutions

38
Countries

1200
Doctoral students

ATLAS in costruzione



CMS in costruzione