

L'esperimento ATLAS @LHC



Michele Pinamonti (INFN Trieste)



- 2002 – 2008: Fisica @UniTS
- 2009 – 2011: PhD @UniTS, esperimento ATLAS
- 2012 – 2016: Post-doc @SISSA, Trieste
- 2016 – 2019: RTDa @UniRomaTorVergata
- 2010 & 2018-'19: Fellow @CERN
- 2019 – oggi: Ricercatore a tempo indeterminato @INFN, Trieste

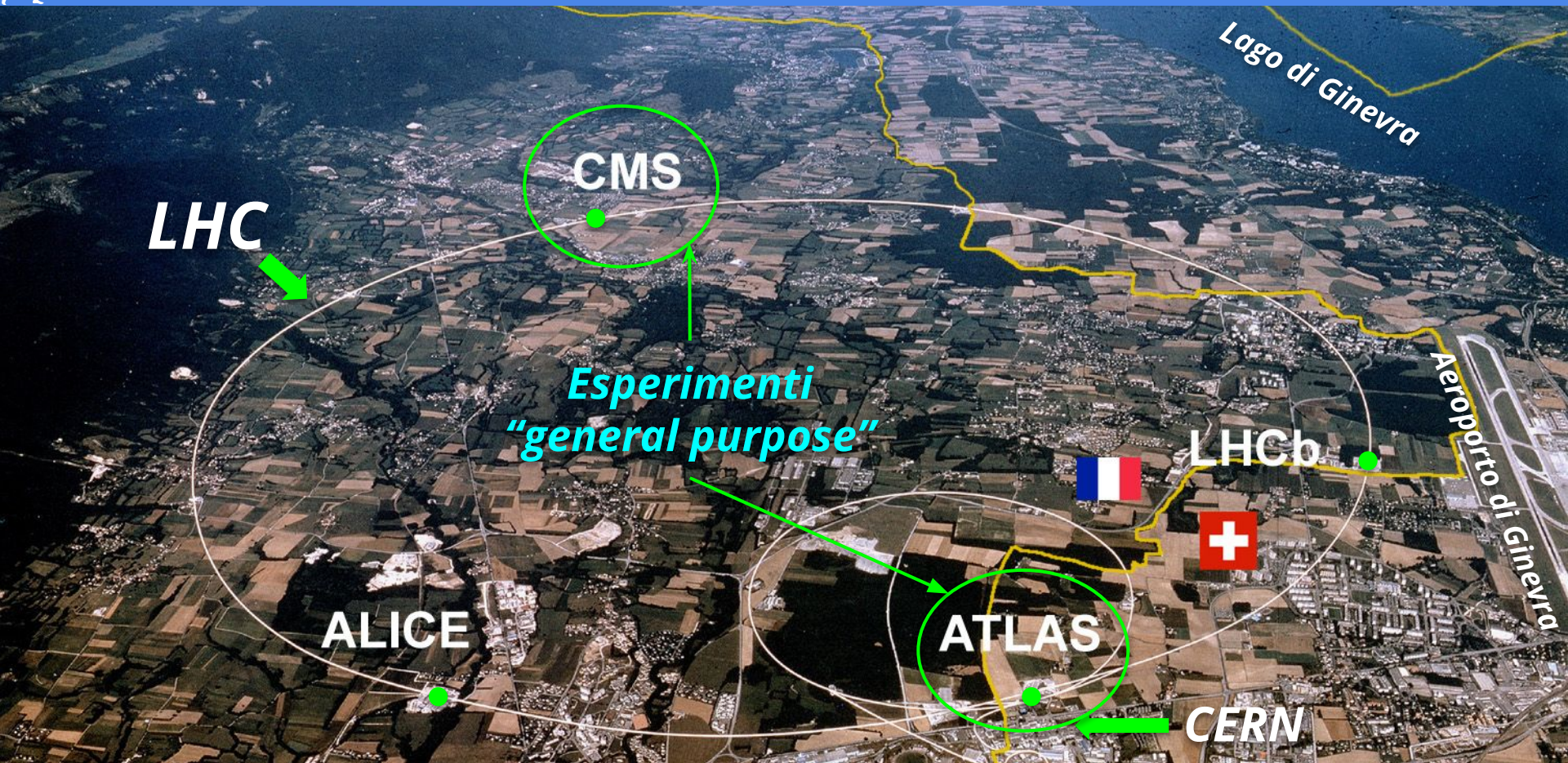


- Membro della Collaborazione ATLAS dal 2008
- Principale attività in ATLAS:
 - analisi dati per lo studio del quark top e ricerca di nuova fisica
 - coordinamento gruppi di analisi dati
 - comitato interno di analisi statistica



LHC e i suoi esperimenti

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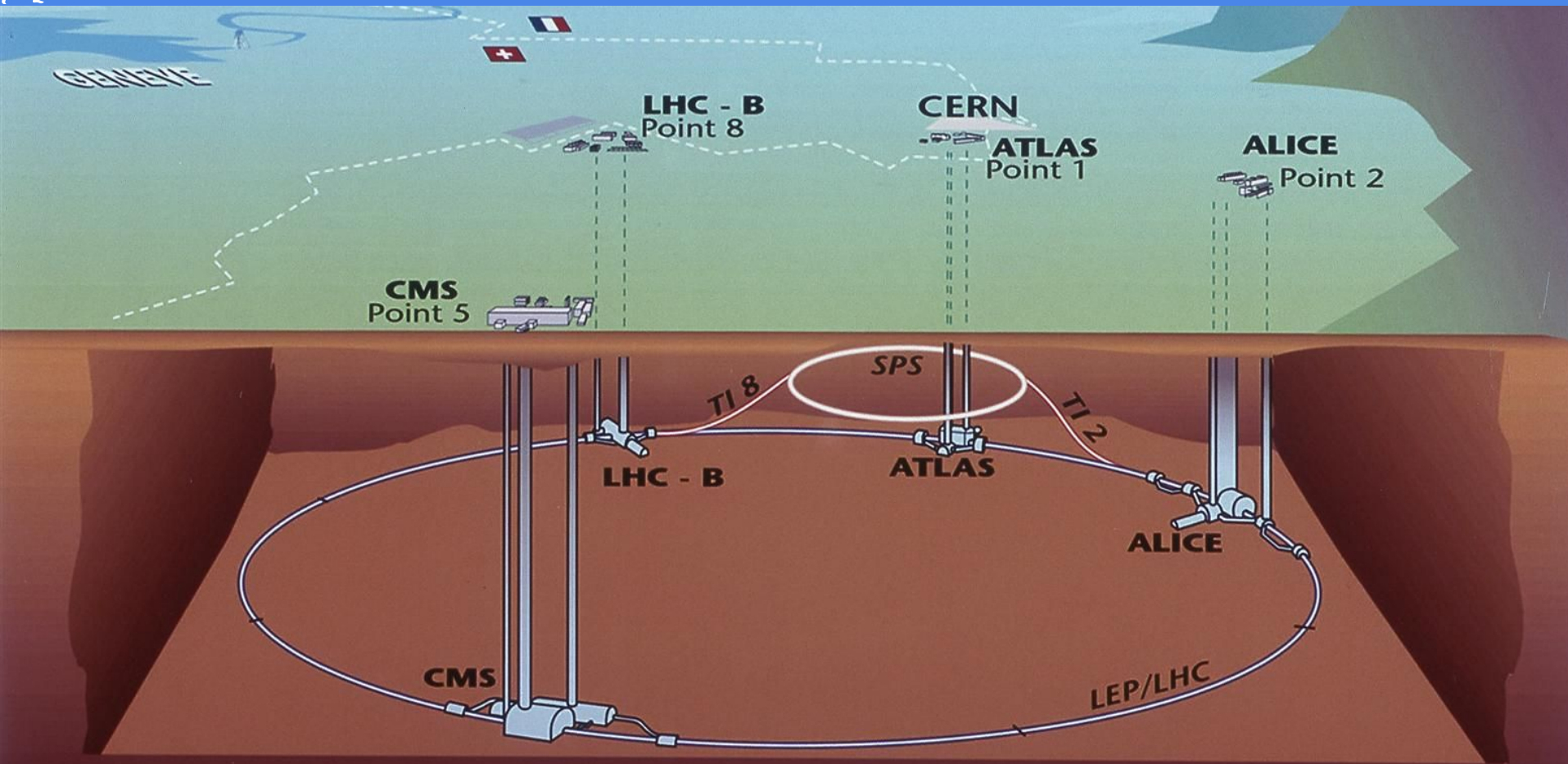
Porto di Ginevra

CERN



LHC underground

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Il rivelatore ATLAS

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- Costruzione: 1995 - 2009
- Run 1: 2010 - 2012
 - $pp \sqrt{s} = 7 \text{ TeV}, 8 \text{ TeV}$
- Upgrade Run 2: 2013 - 2014
- Run 2: 2015 - 2018
 - $pp \sqrt{s} = 13 \text{ TeV}$
- Upgrade Run 3: ongoing
- Run 3: 2022 - ?
 - $pp \sqrt{s} = 14 \text{ TeV} (?)$



46

meters long & 25m of diameter



100

meters below ground



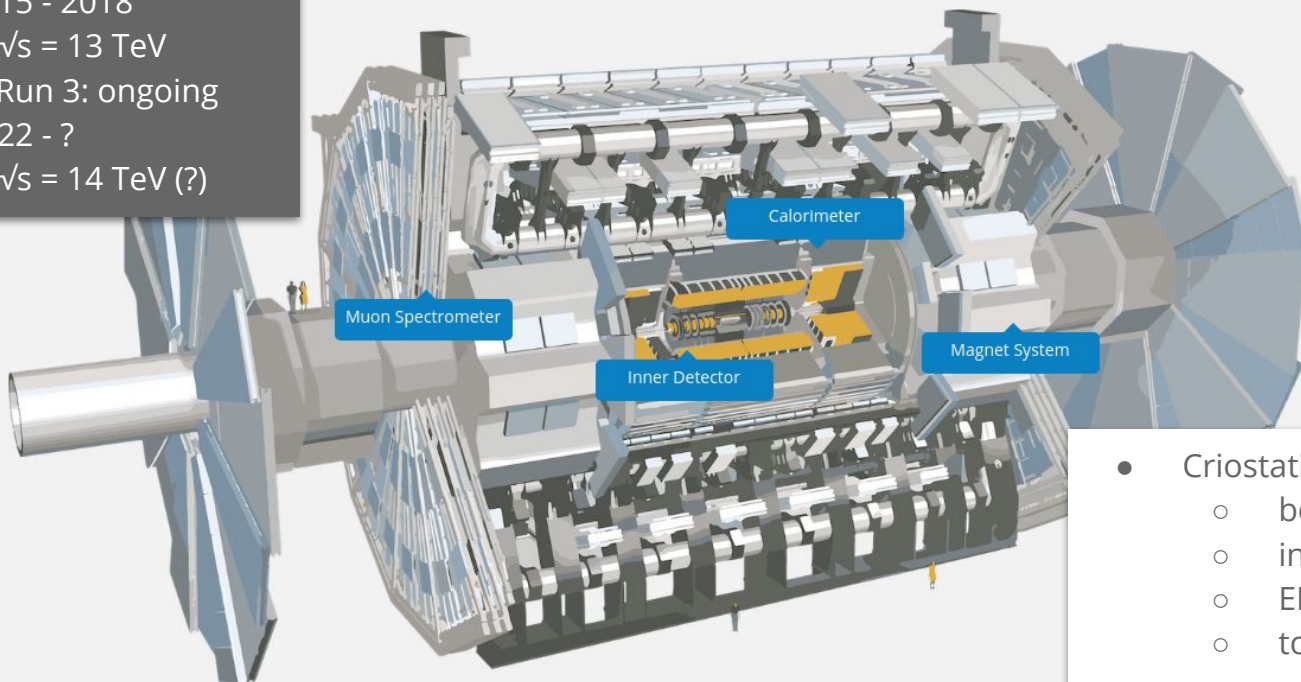
7000

tonnes



1000000000

collisions / second



**3000 km
di cavi!**

- Criostati:
 - beam-pipe: 1.9 K
 - inner detector: -15 °C
 - EM calorimeter: 87 K
 - toroid magnets: 4.7 K



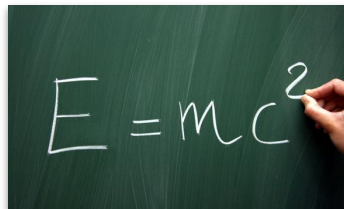
Cosa vuole studiare ATLAS?

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- ATLAS e CMS hanno un ampio range di obiettivi
- In generale quello che si vuole è:

- **produrre particelle pesanti** ($\Rightarrow$ instabili)
in collisioni pp a massima energia

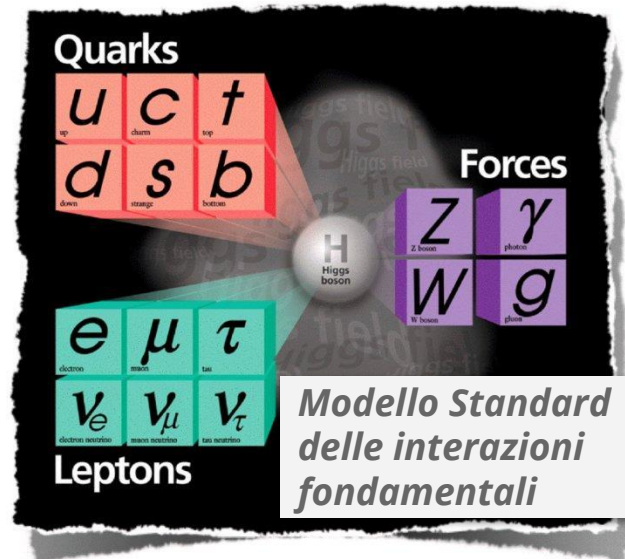
- bosoni W e Z
- bosone di *Higgs*
- quark *top*
- particelle *nuove*



(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

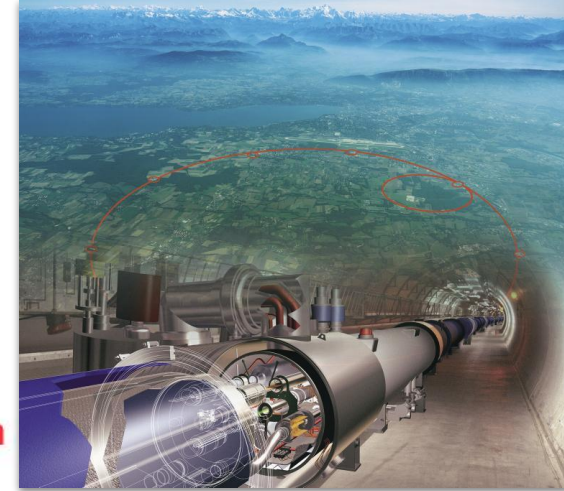
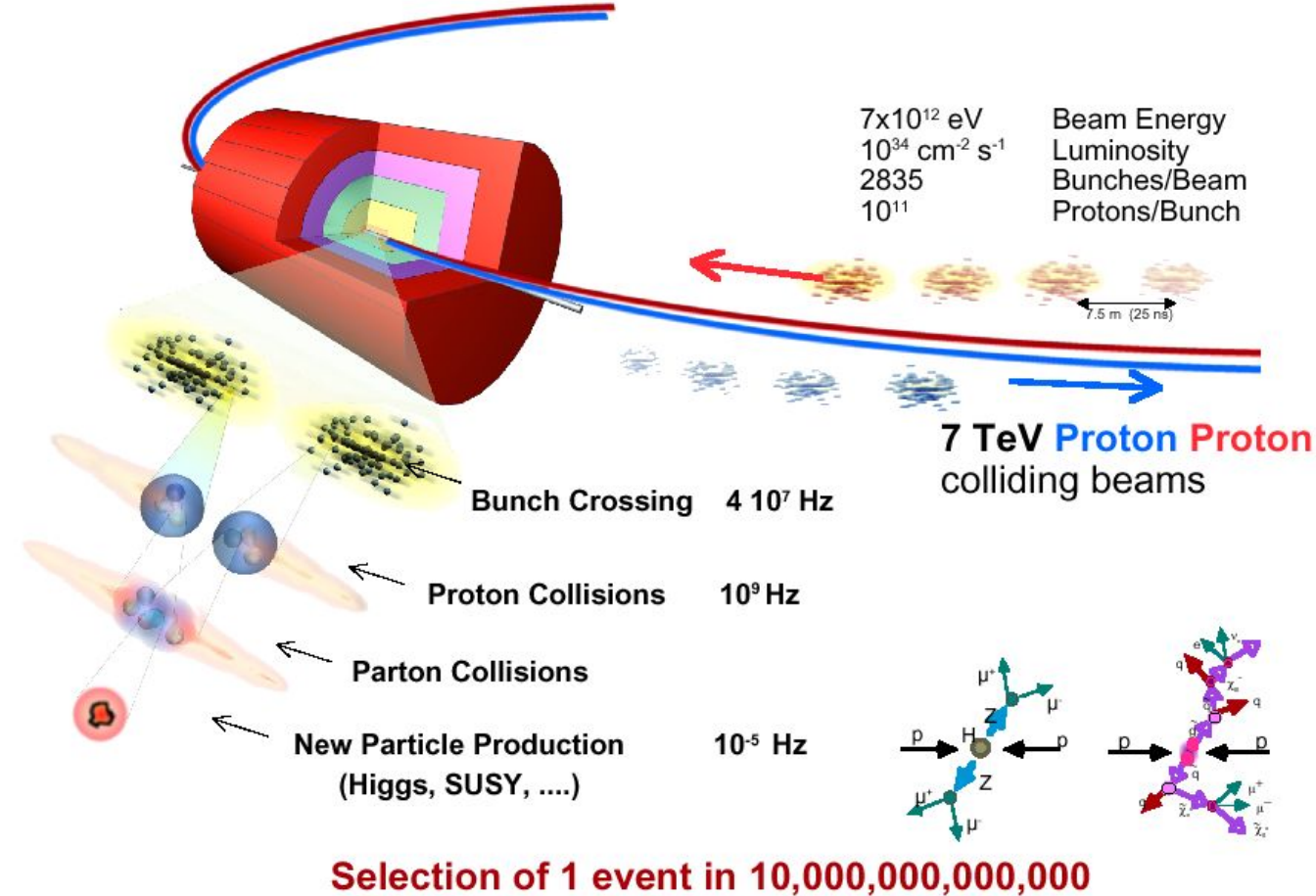


sia per particelle
“nuove” che per quelle
“vecchie”!



Collisioni protone-protone a LHC

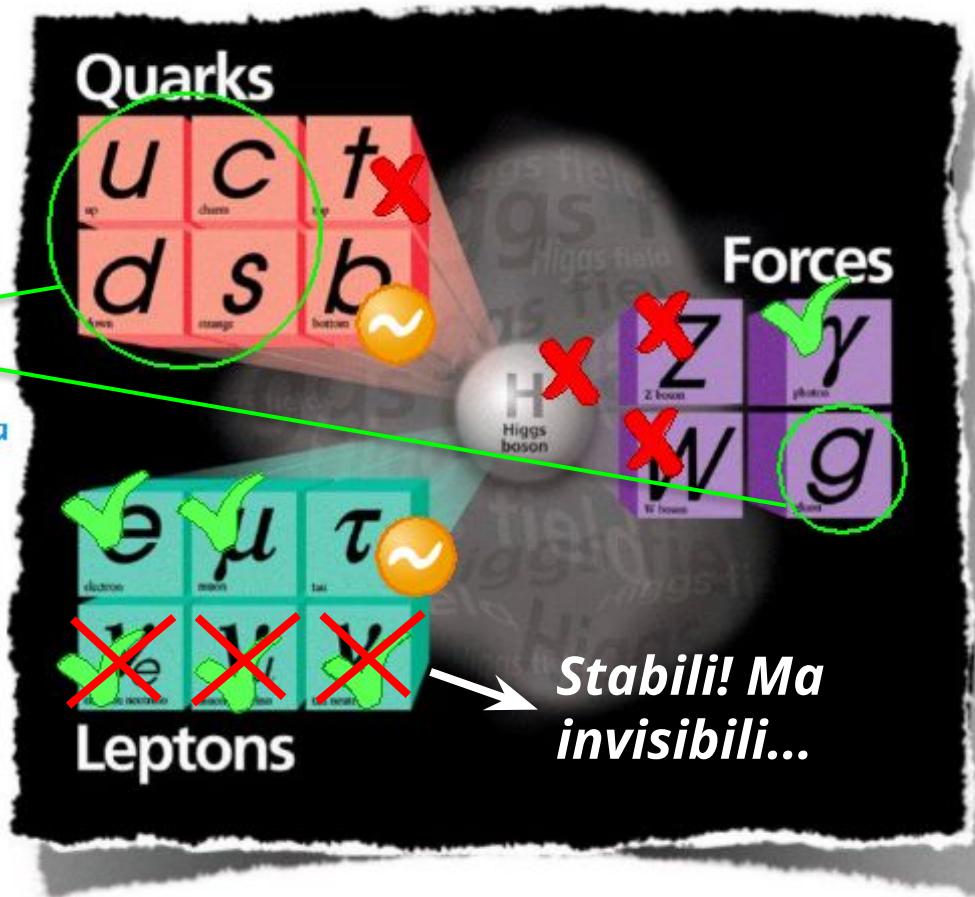
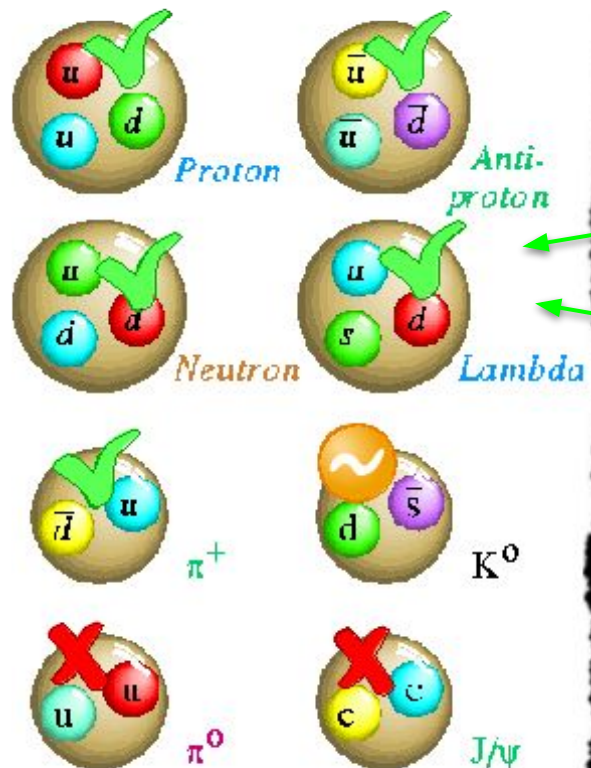
8





Che particelle possiamo “vedere” direttamente...

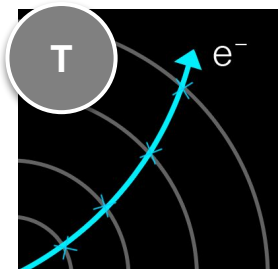
9





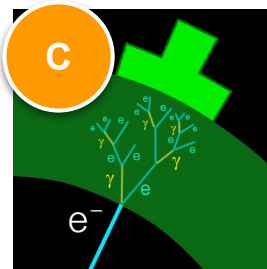
... e come?

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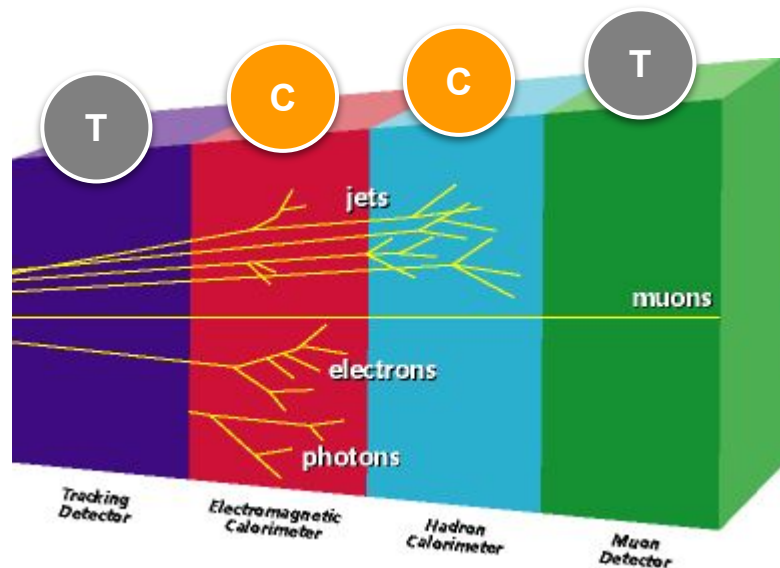
Tracciatori:

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

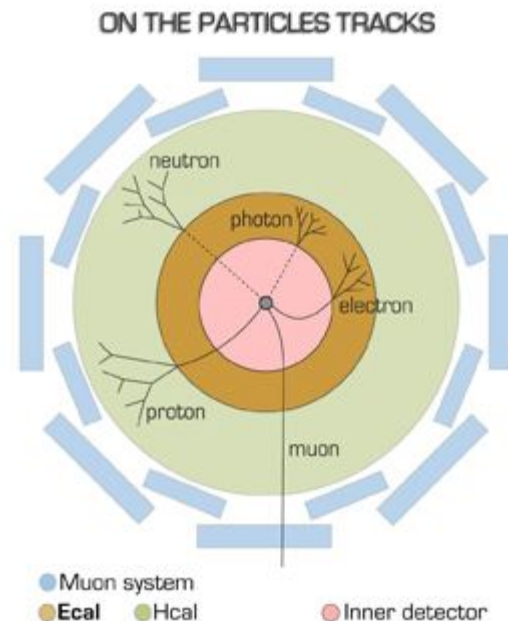


Calorimetri:

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



Struttura a cipolla!

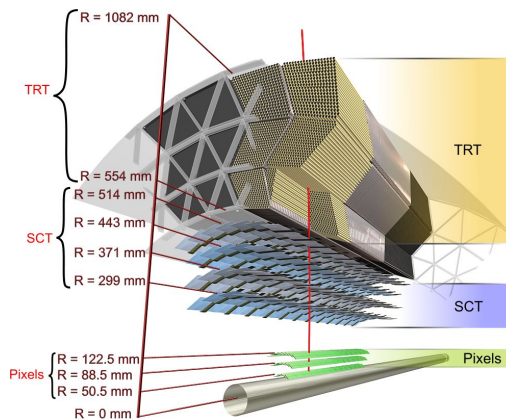




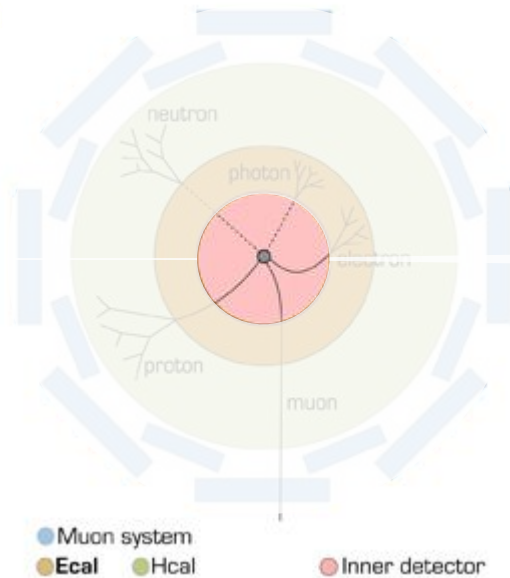
Inner Detector

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T



ON THE PARTICLES TRACKS



Muon Detectors

Tile Calorimeter

Liquid Argon Calorimeter

Toroid Magnets

Solenoid Magnet

SCT Tracker

Pixel Detector

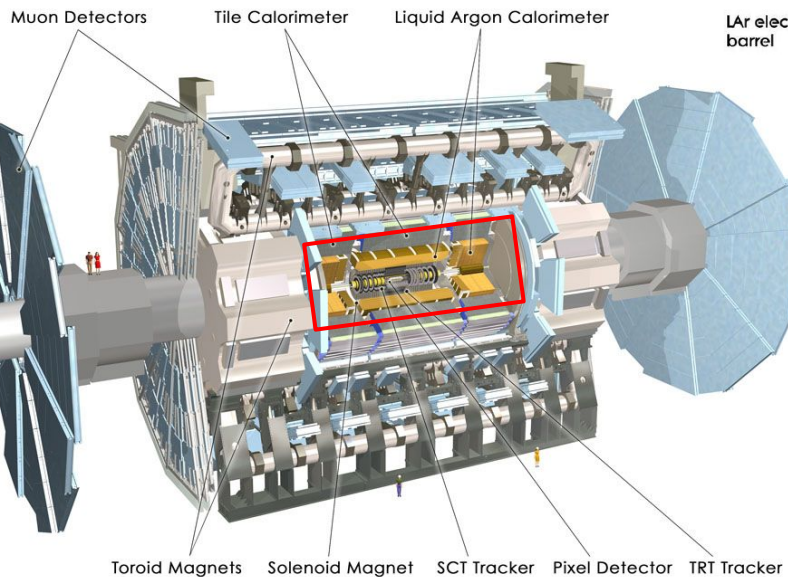
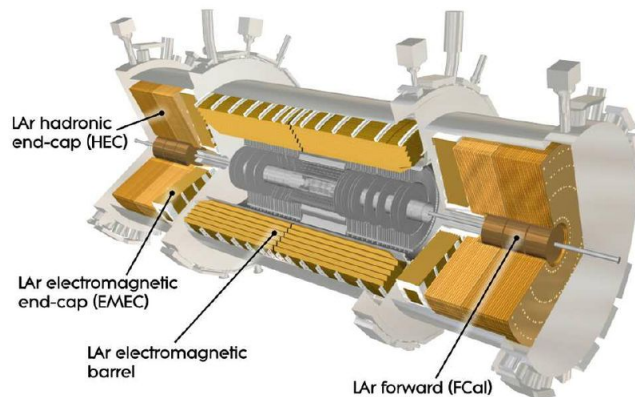
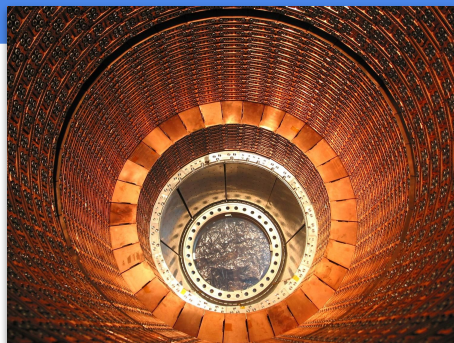
TRT Tracker



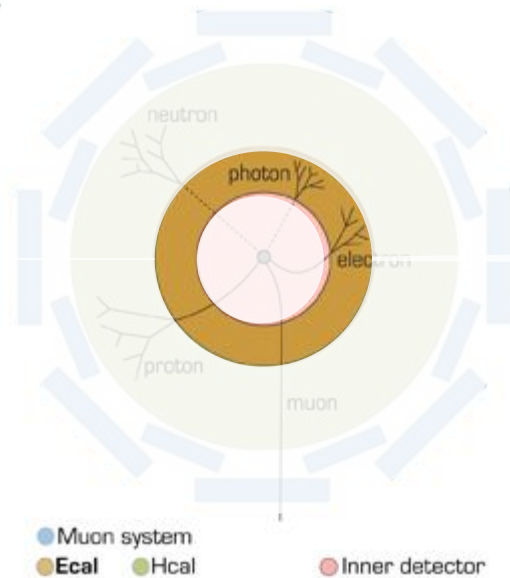
Calorimetro Elettromagnetico

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C



ON THE PARTICLES TRACKS

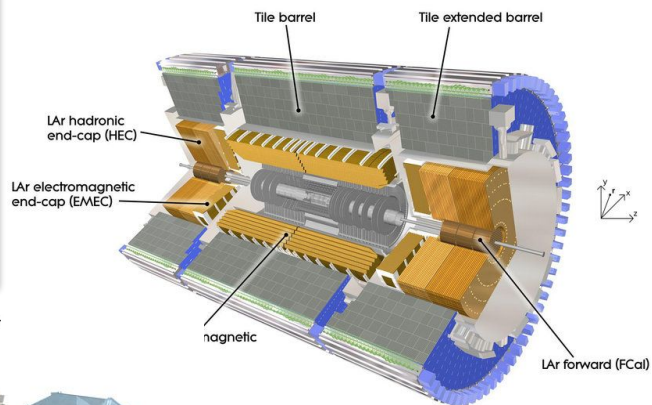
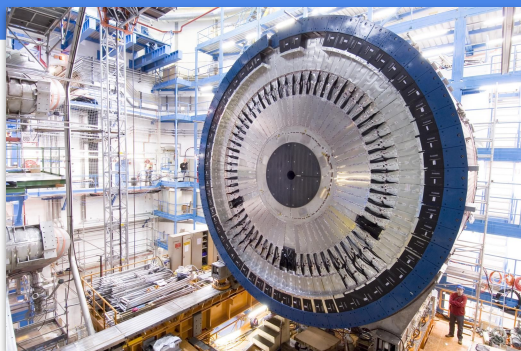




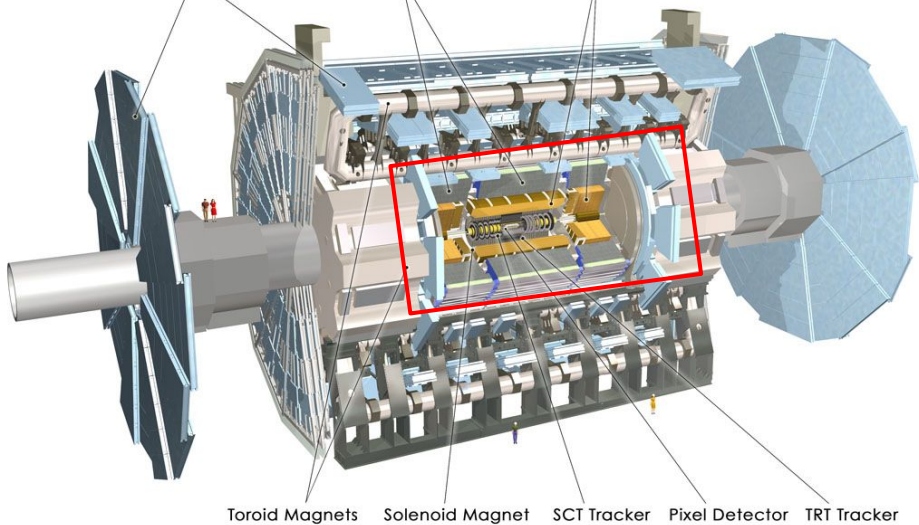
Calorimetro Adronico

13

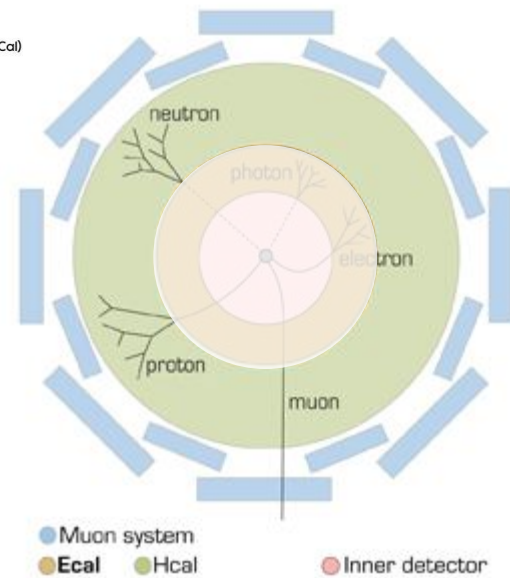
C



Muon Detectors Tile Calorimeter Liquid Argon Calorimeter



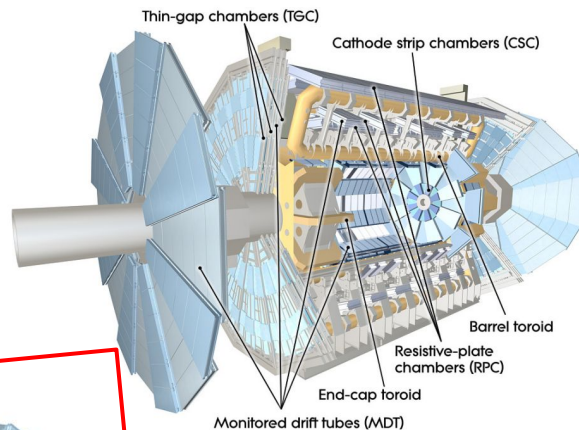
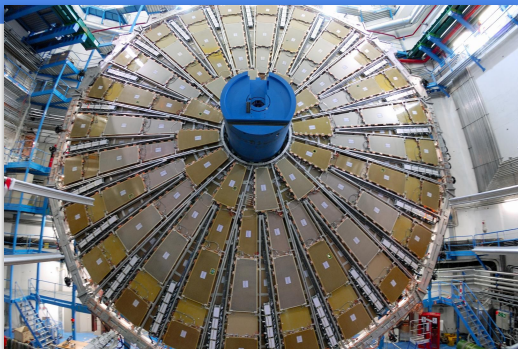
ON THE PARTICLES TRACKS



Spettrometro per Muoni

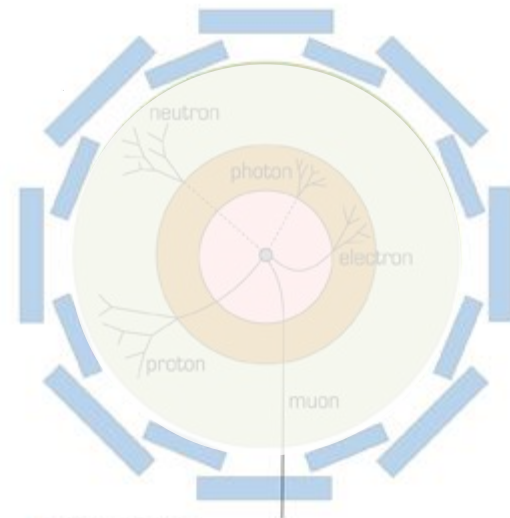
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T



Muon Detectors Tile Calorimeter Liquid Argon Calorimeter

ON THE PARTICLES TRACKS



● Muon system

● Ecal

● Hcal

● Inner detector

Toroid Magnets Solenoid Magnet SCT Tracker Pixel Detector TRT Tracker

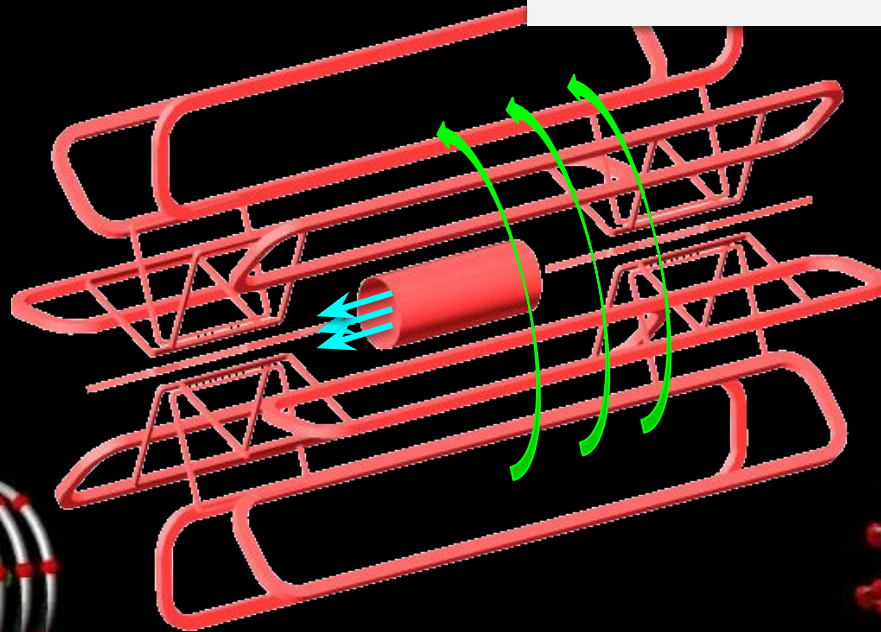
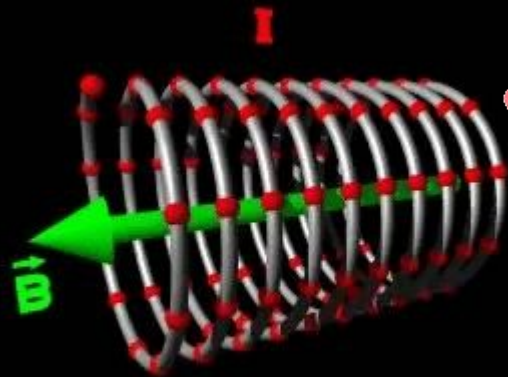


Sistema di Magneti

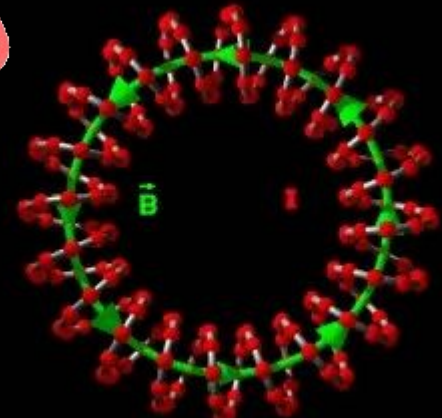
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ATLAS = A Toroidal Lhc Apparatus

*Campo magnetico
solenoidale*



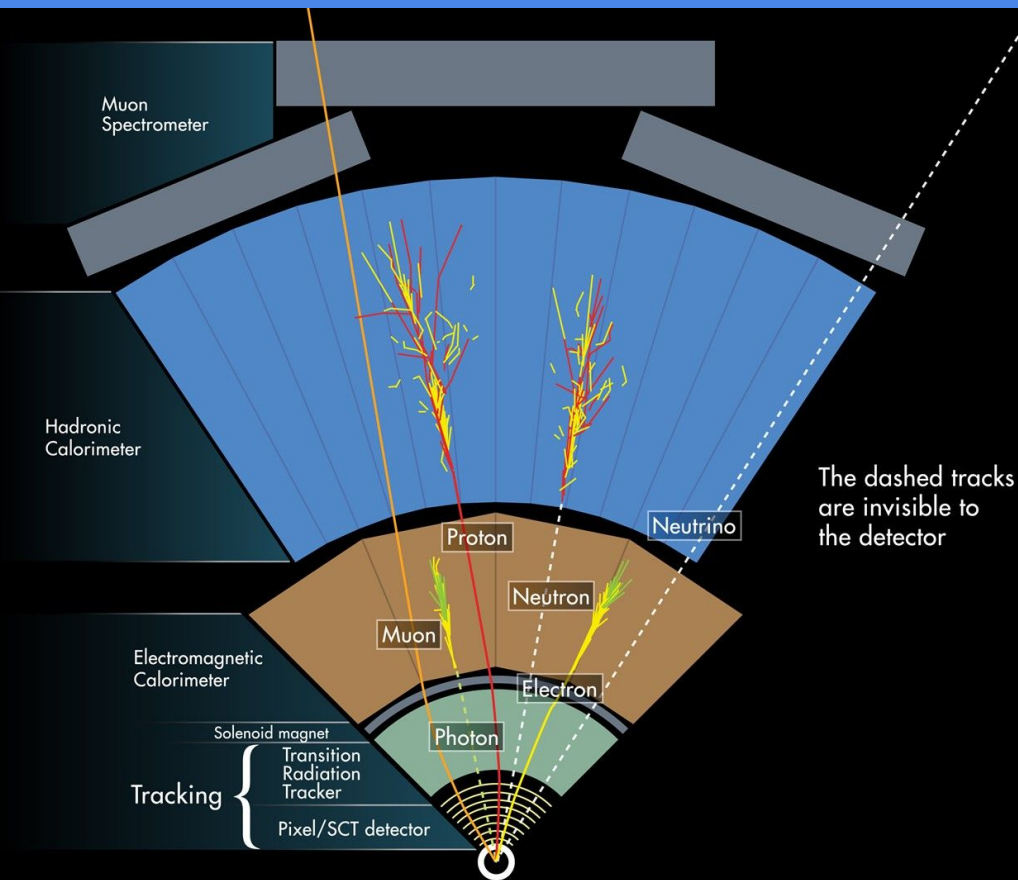
*Campo magnetico
toroidale*





Identificazione delle particelle in ATLAS

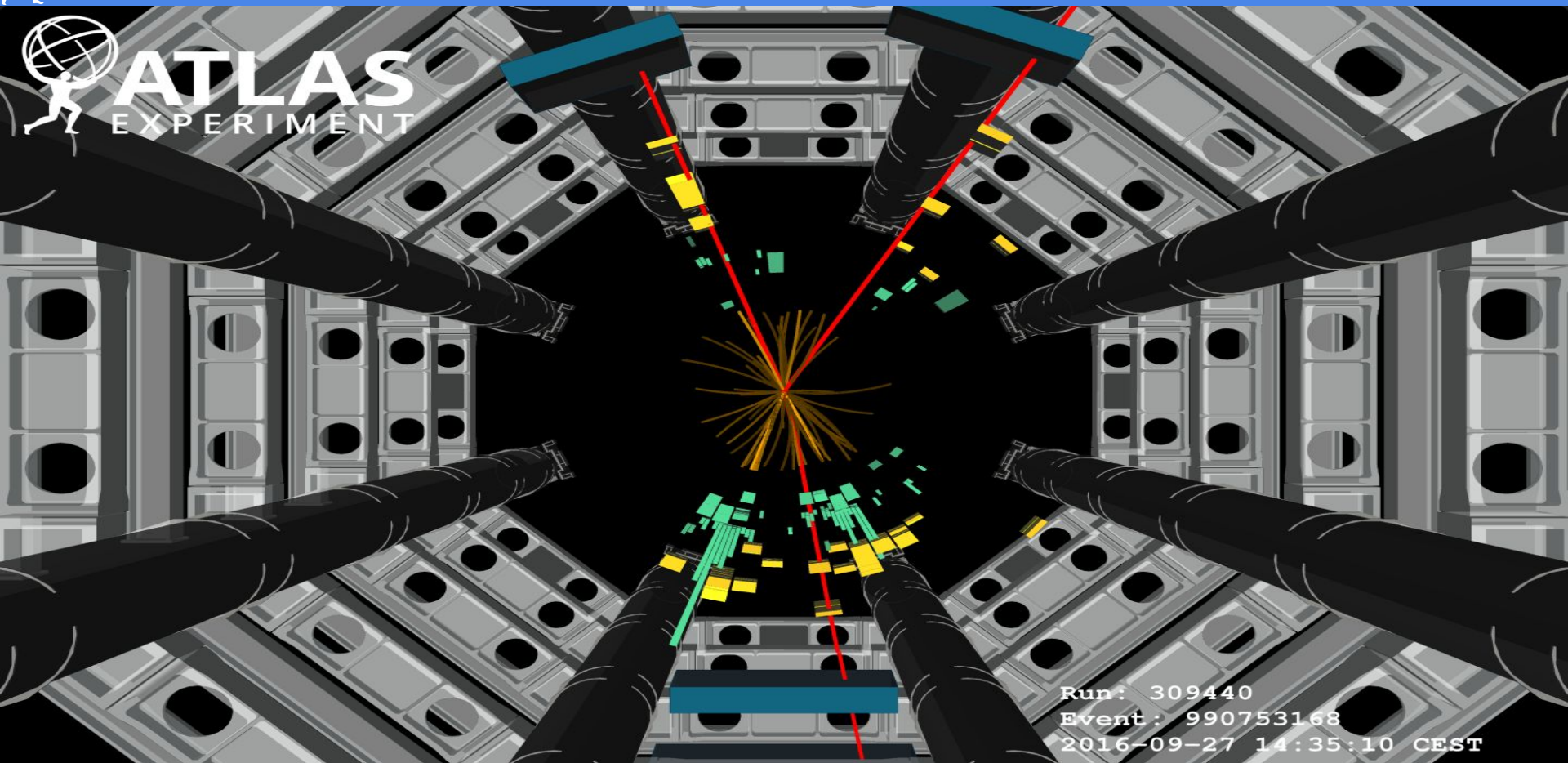
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Un evento di collisione “ricostruito”

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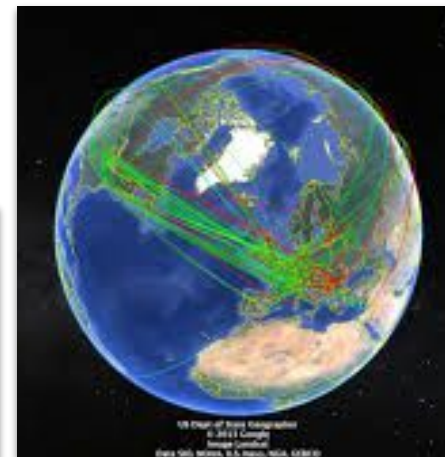
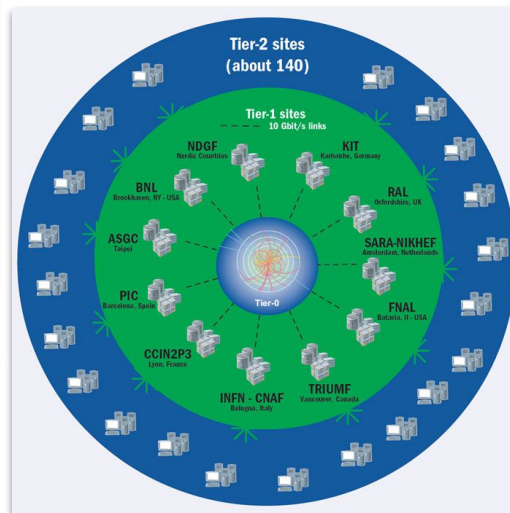
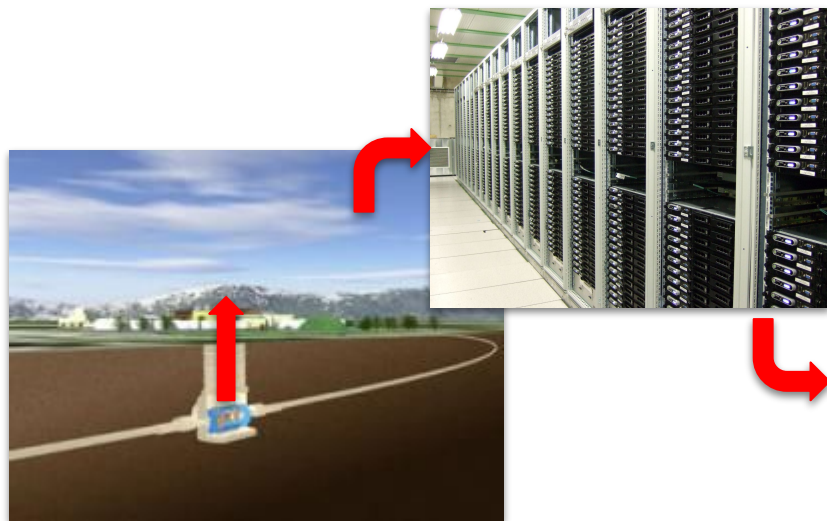
Run: 309440
Event: 990753168
2016-09-27 14:35:10 CEST

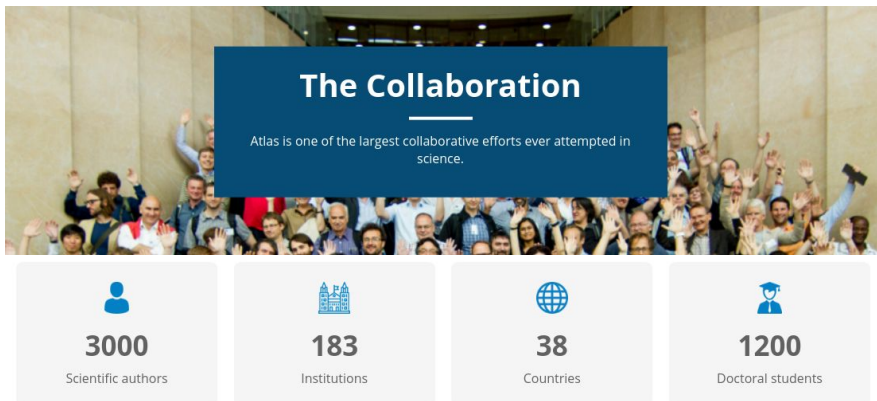


Trigger e flusso di dati

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- 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





- Sito web ATLAS:
<https://atlas.cern/>
- Gruppo ATLAS Udine / ICTP-Trieste:
<https://atlasud.uniud.it/>





La scoperta del Bosone di Higgs

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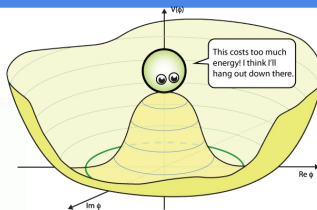
● Il Bosone di Higgs:

ONE OF THE THINGS PEOPLE
PREDICT WILL COME OUT IS

THE
HIGGS
BOSON



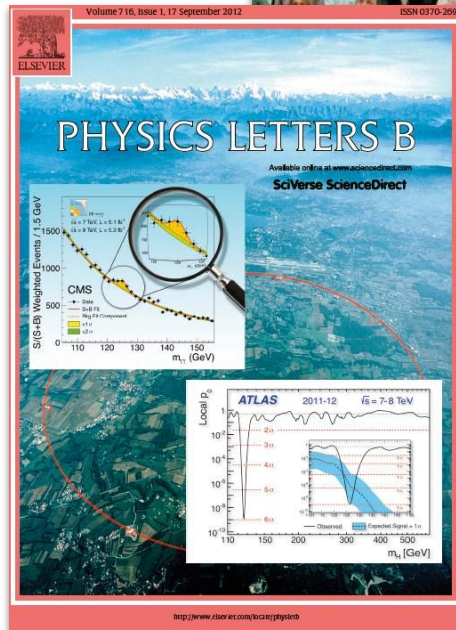
THE HIGGS IS THE
PARTICLE RESPONSIBLE
FOR GIVING MASS TO
OTHER PARTICLES.



● 4 Luglio 2012:



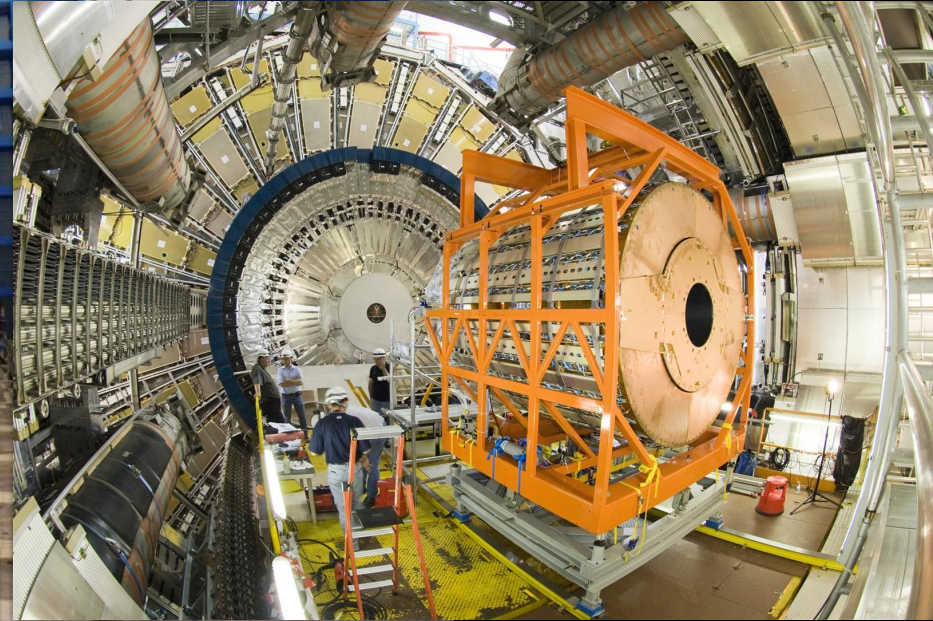
- dati 2010-2012
- diversi analisi combinate
- scoperta statisticamente
validata da parte di
ATLAS e CMS
indipendentemente





ATLAS in costruzione

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ATLAS in costruzione

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Buona visita!

