



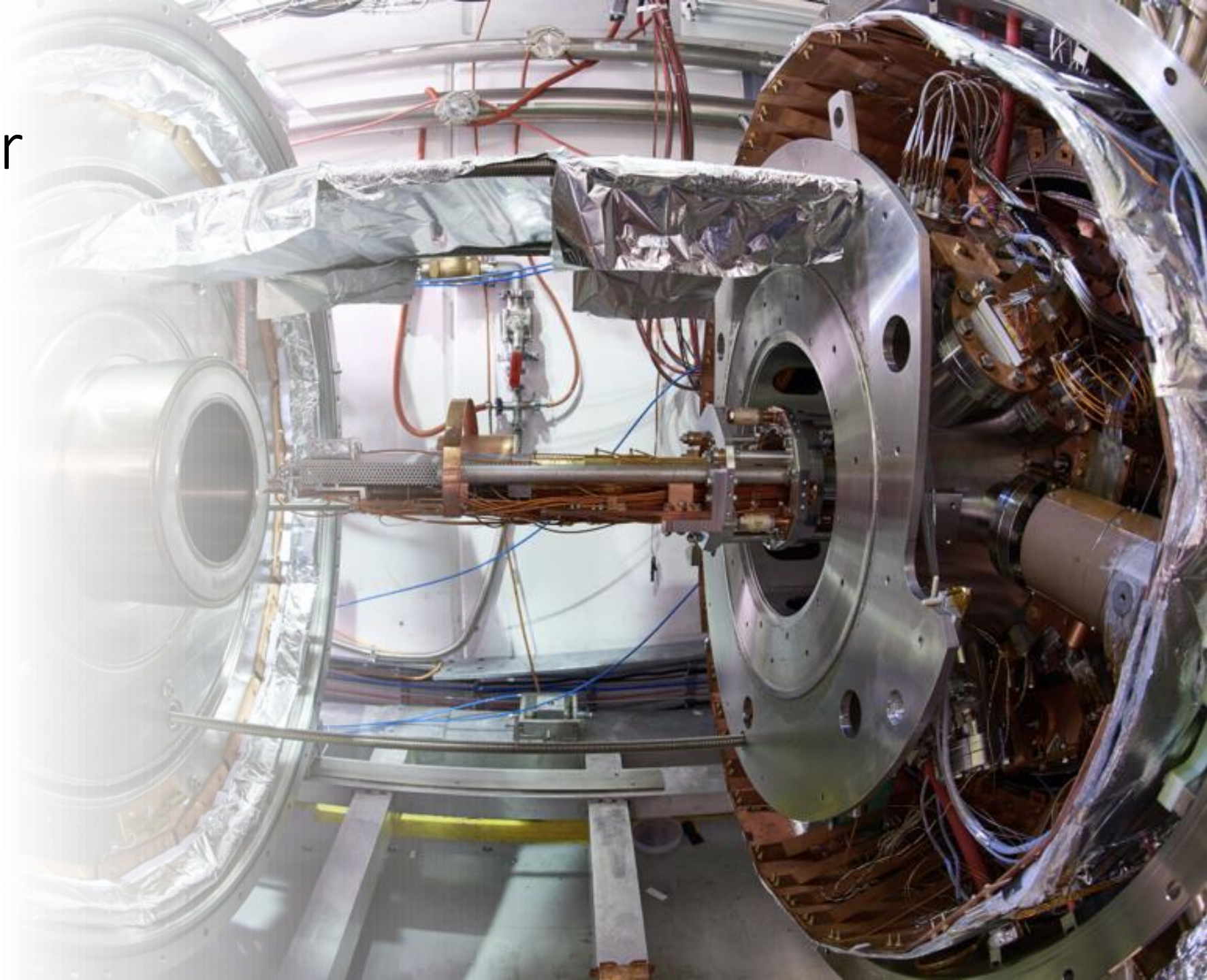
Antimatter and the WEX summary

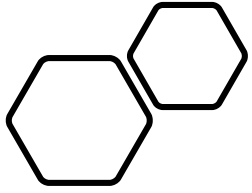
Ioannis KARATZIAS, Mauricio ESPINOZA MAYZER, Adam EXNER

EEB3

Content of our presentation

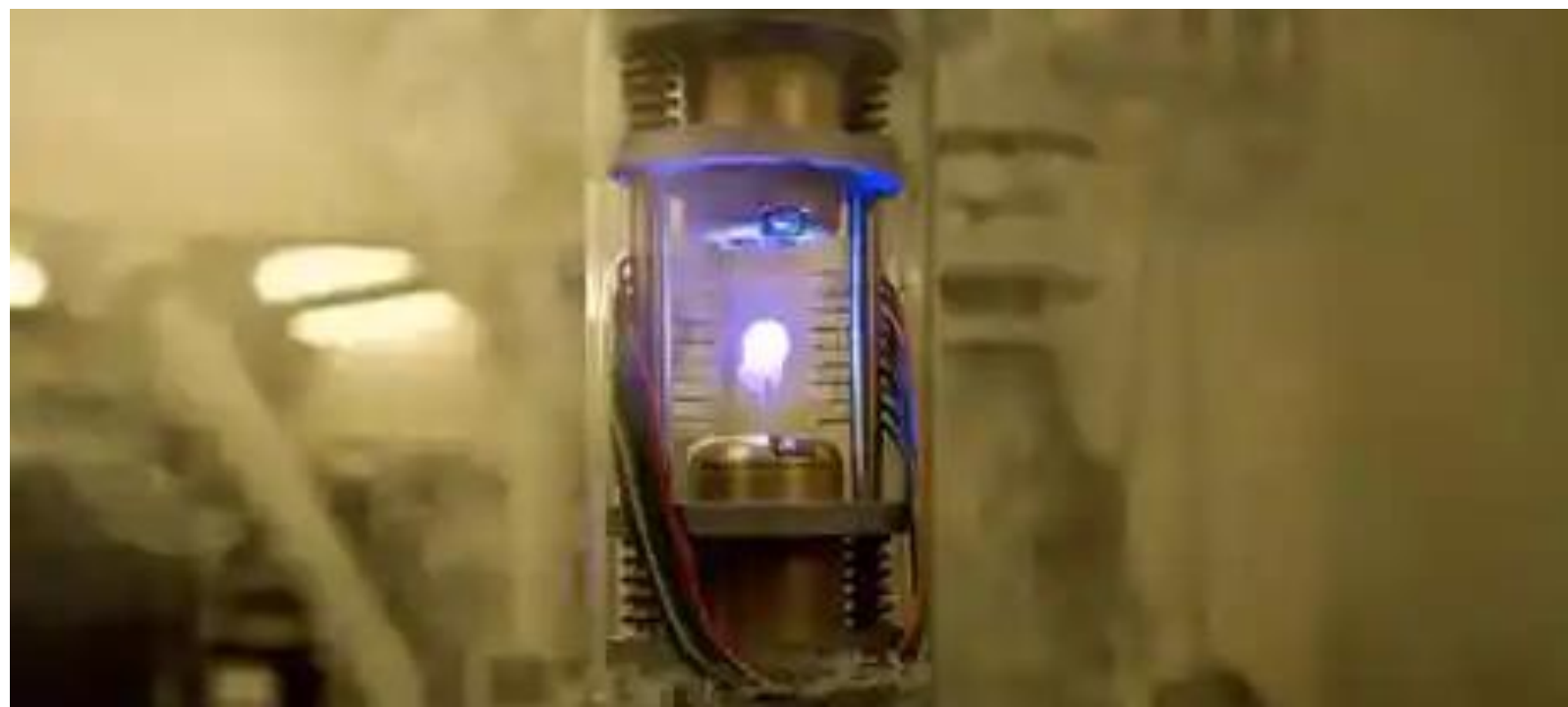
- Antimatter
 - What is antimatter
 - Detecting antimatter
 - Missing antimatter
 - AMS
 - Applications
- Our WEX summary
 - Particle physics
 - The accelerators
 - FCC
 - Data management
 - The ALICE
 - Virtual visits





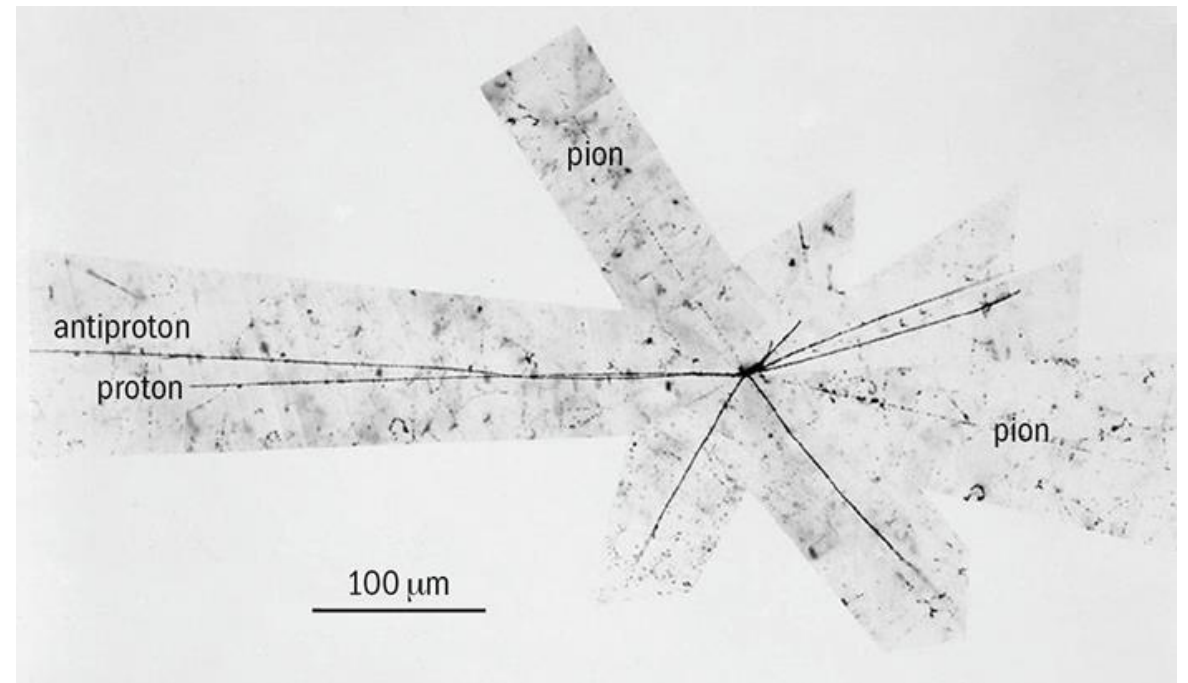
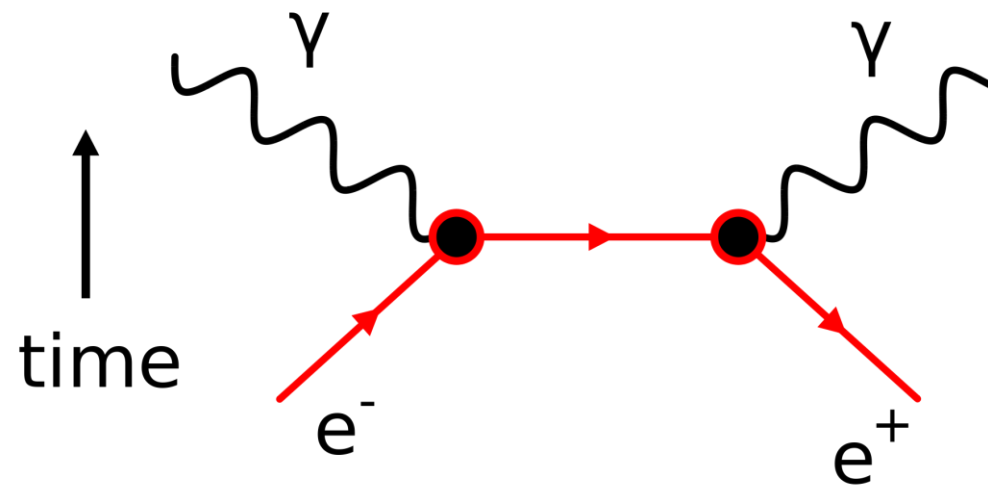
What is anti-matter

- Material composed of anti-particles
- Has same properties as particles but opposite charges
- Can be regarded as the perfect counterpart of matter



Detecting anti-matter

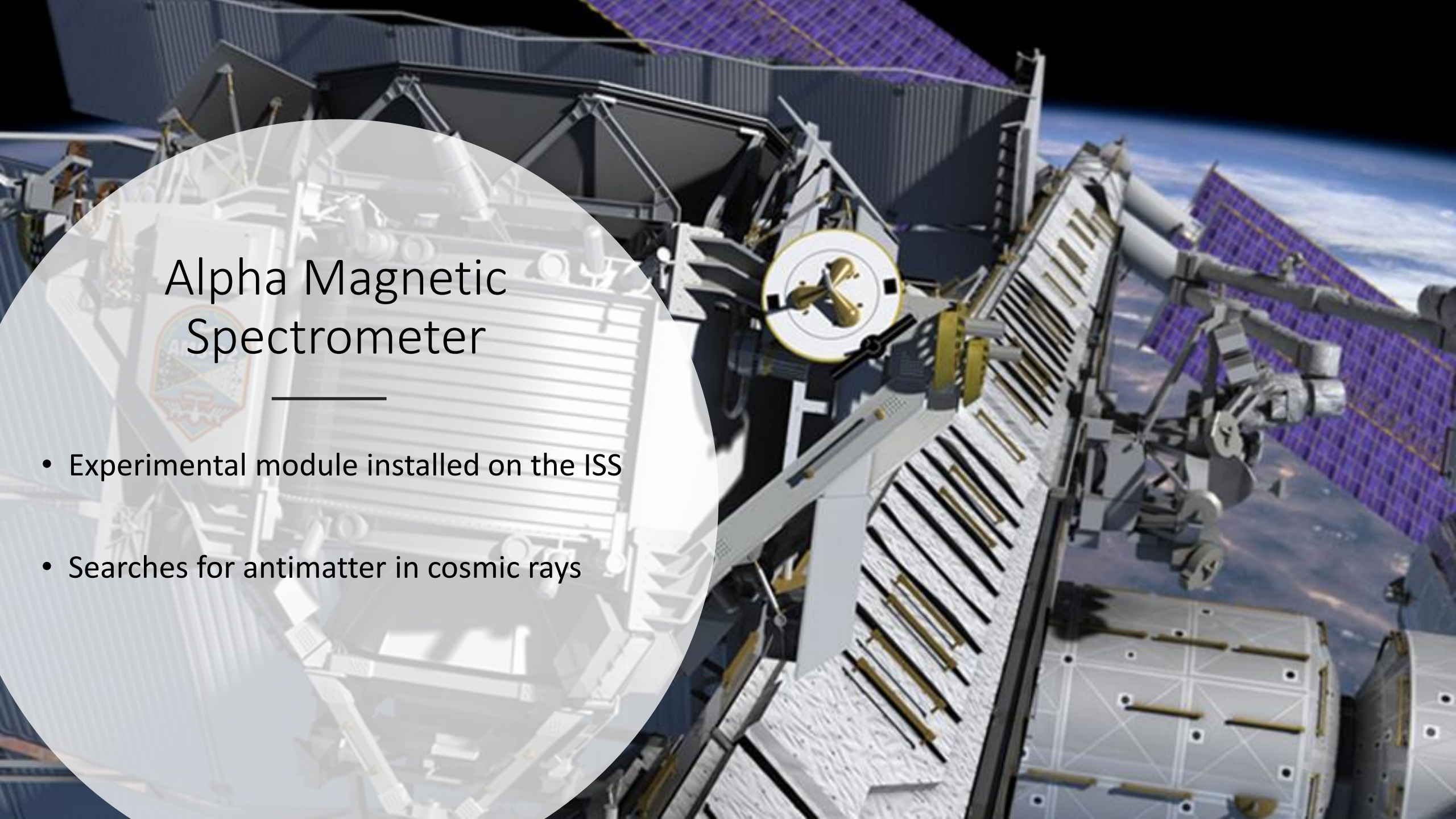
- Matter and anti-matter have the same properties
- If we collide an electron and a positron, the result will be 2 photons with 511KeV
- There is antimatter at the center of the galaxy



Missing antimatter

- There should be equal amounts of matter and antimatter
- But universe isn't 50-50
- Production is asymmetric
- Energy produces more matter than antimatter
- The universe started with small preference for matter



The background image shows the Alpha Magnetic Spectrometer (AMS) installed on the International Space Station (ISS). The AMS is a large, white, rectangular experimental module with a complex internal structure. It is mounted on the station's exterior, with various cables and support structures visible. The Earth's blue and white atmosphere is visible in the background, along with the station's solar panels and other components.

Alpha Magnetic Spectrometer

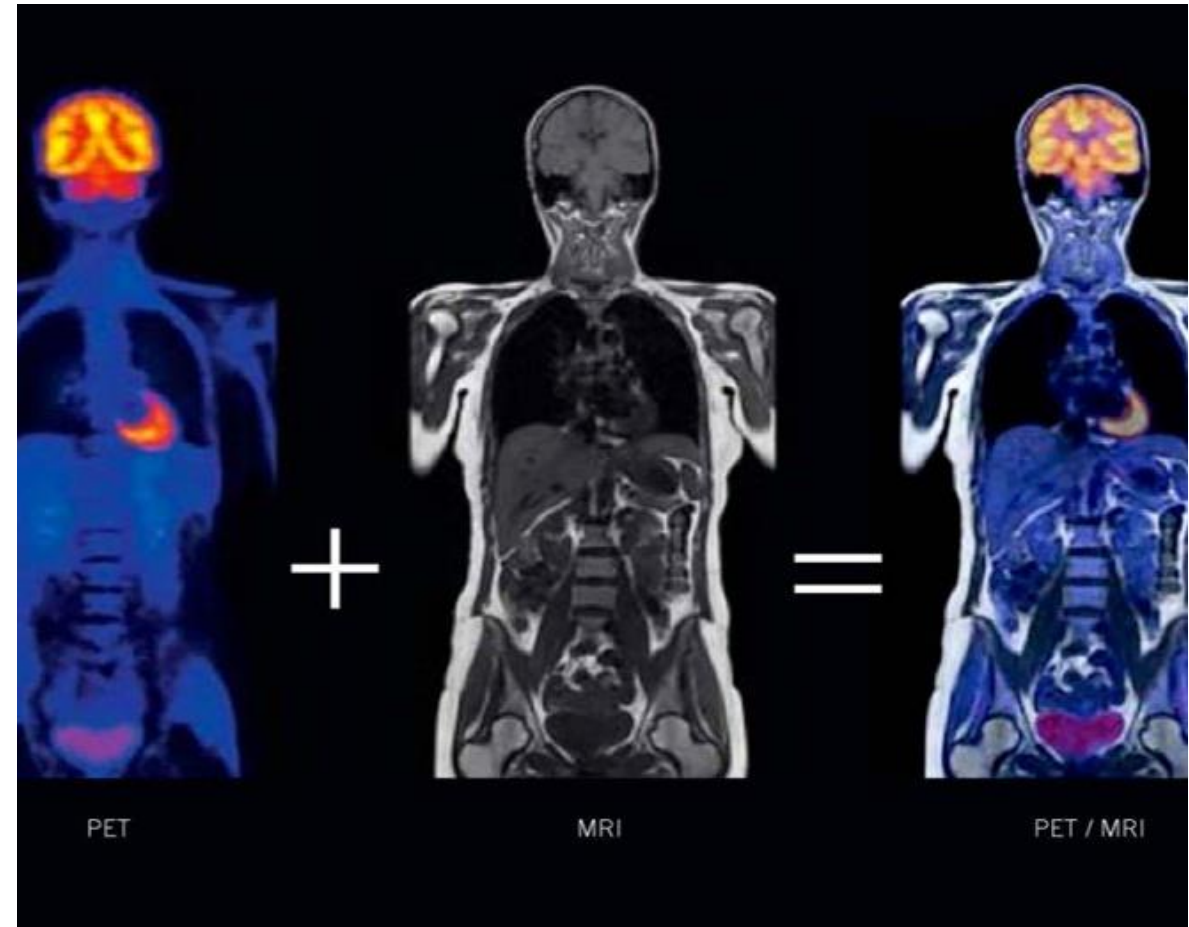
- Experimental module installed on the ISS
- Searches for antimatter in cosmic rays

Application of anti-matter

PET(Positron-emission tomography)

Radiotherapy

Energy production



WEX Summary



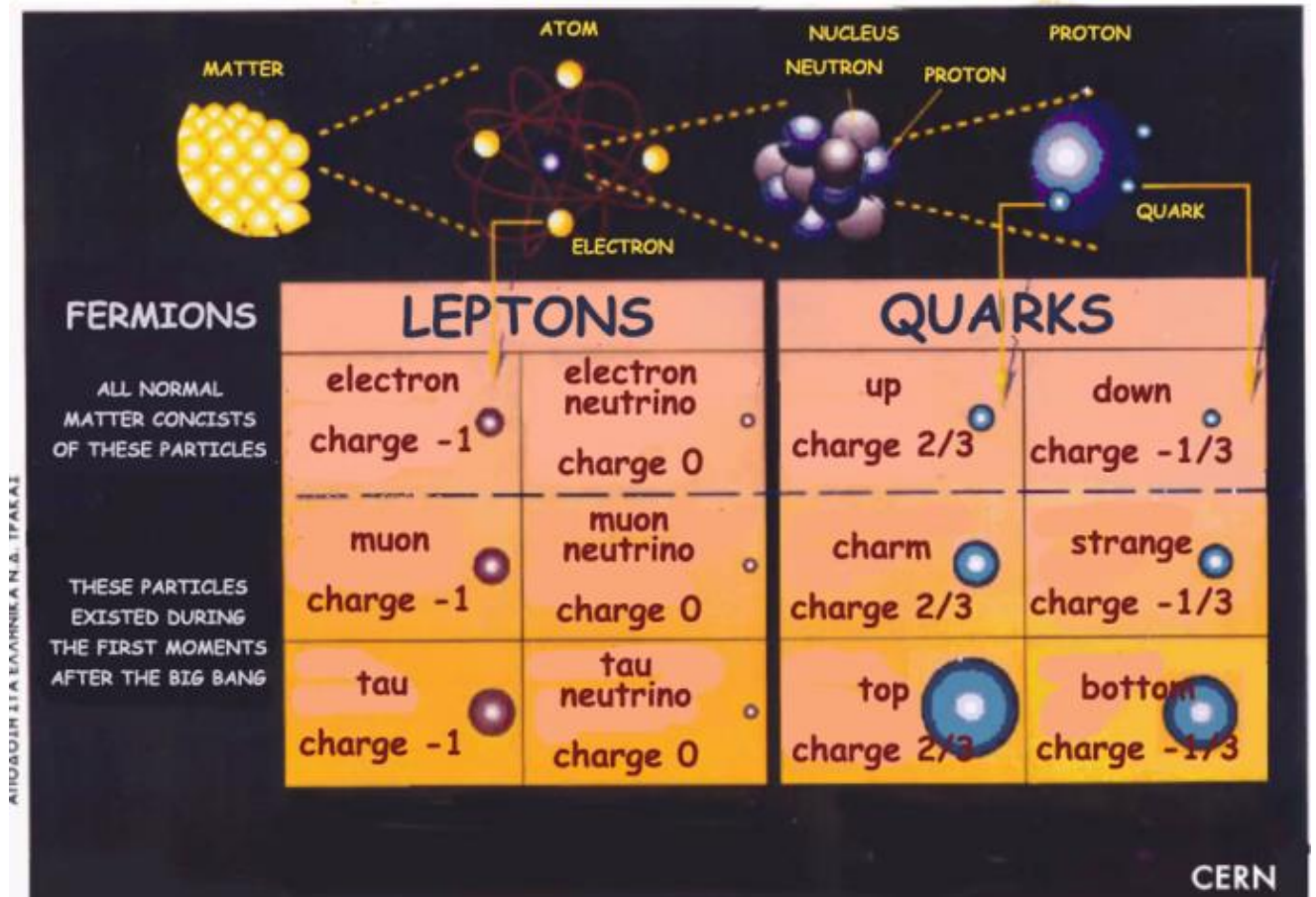
CERN

- Conseil Européen pour la Recherche Nucléaire
- Located in Geneva
- Has 23 members states
- Receives about 1 billion euros funding
- Those working at CERN are either employed or users of it, meaning that they are employed elsewhere



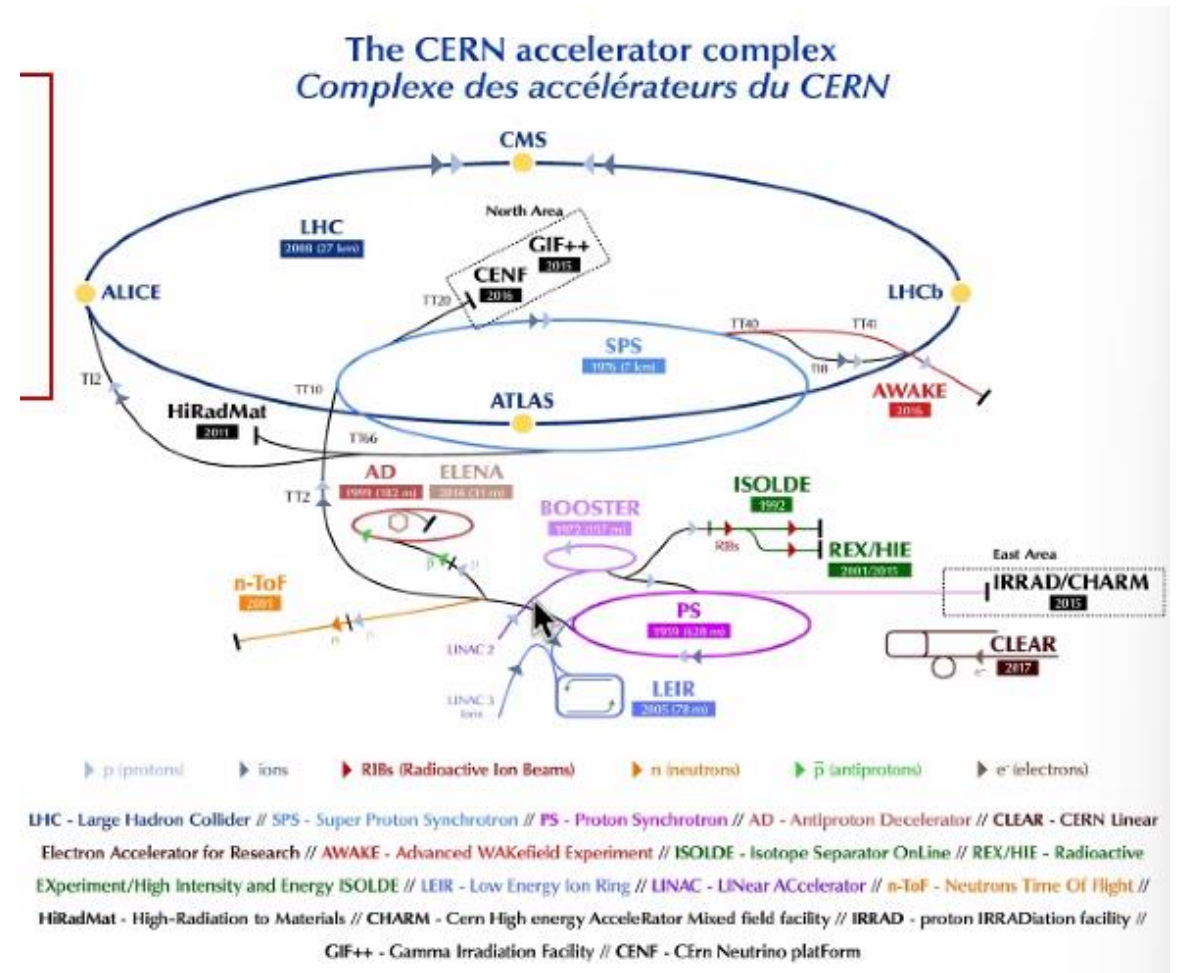
Particle Physics

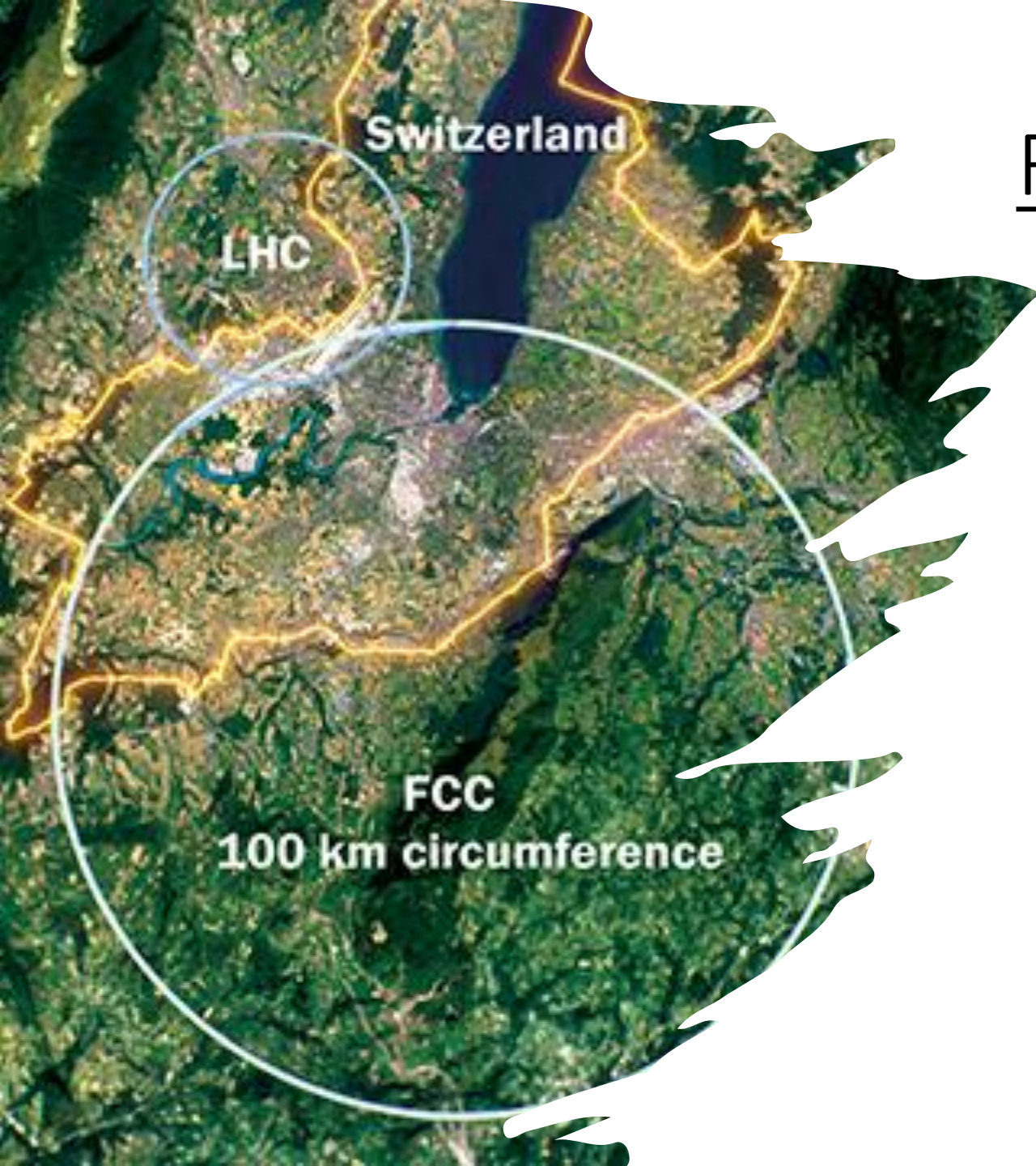
- Matter -> Atoms -> Nucleuses, Electrons
- Nucleus -> Neutrons, Protons -> Quarks
- 1ST FAMILY: electron, electron neutrino, up, down
- 2ND FAMILY: muon, muon neutrino, charm, strange
- 3RD FAMILY: tau, tau neutrino, top, bottom
- Quantum physics: in microworld, not same laws as macroworld
- Four forces: strong nuclear force, weak nuclear force, electromagnetic force, gravity



The Accelerators

- Three types:
linear, circular fixed target, circular colliding beams
- CERN → circular colliding beams LHC largest
length 27km
average depth 100m underground
- Why underground?
- Consist of beampipe + superconductive electromagnets
- How do they work?
 1. protons or heavy-ions ejected in as beams
 2. 20min acceleration → speed of light
 3. Collision (specific point)



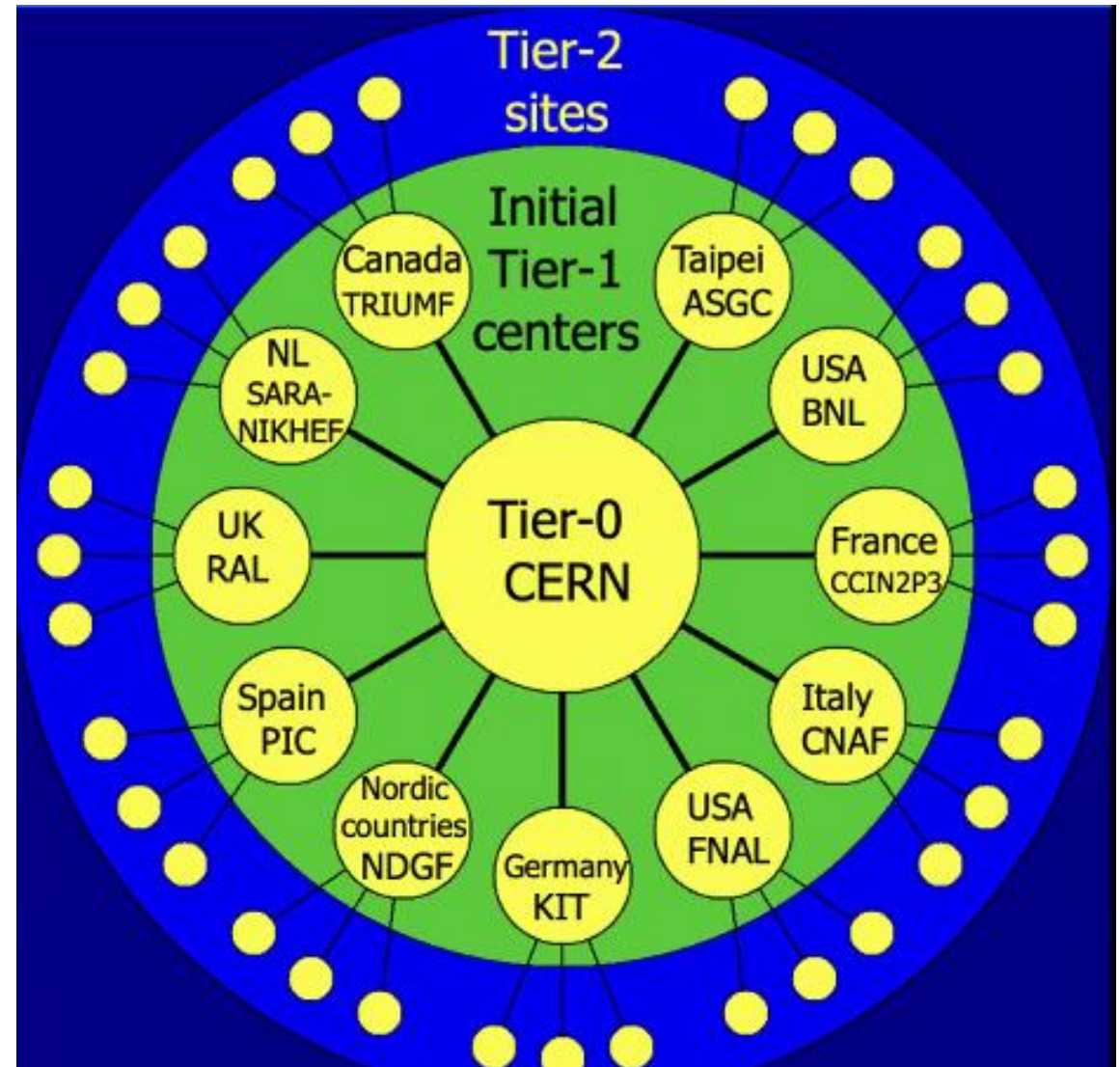


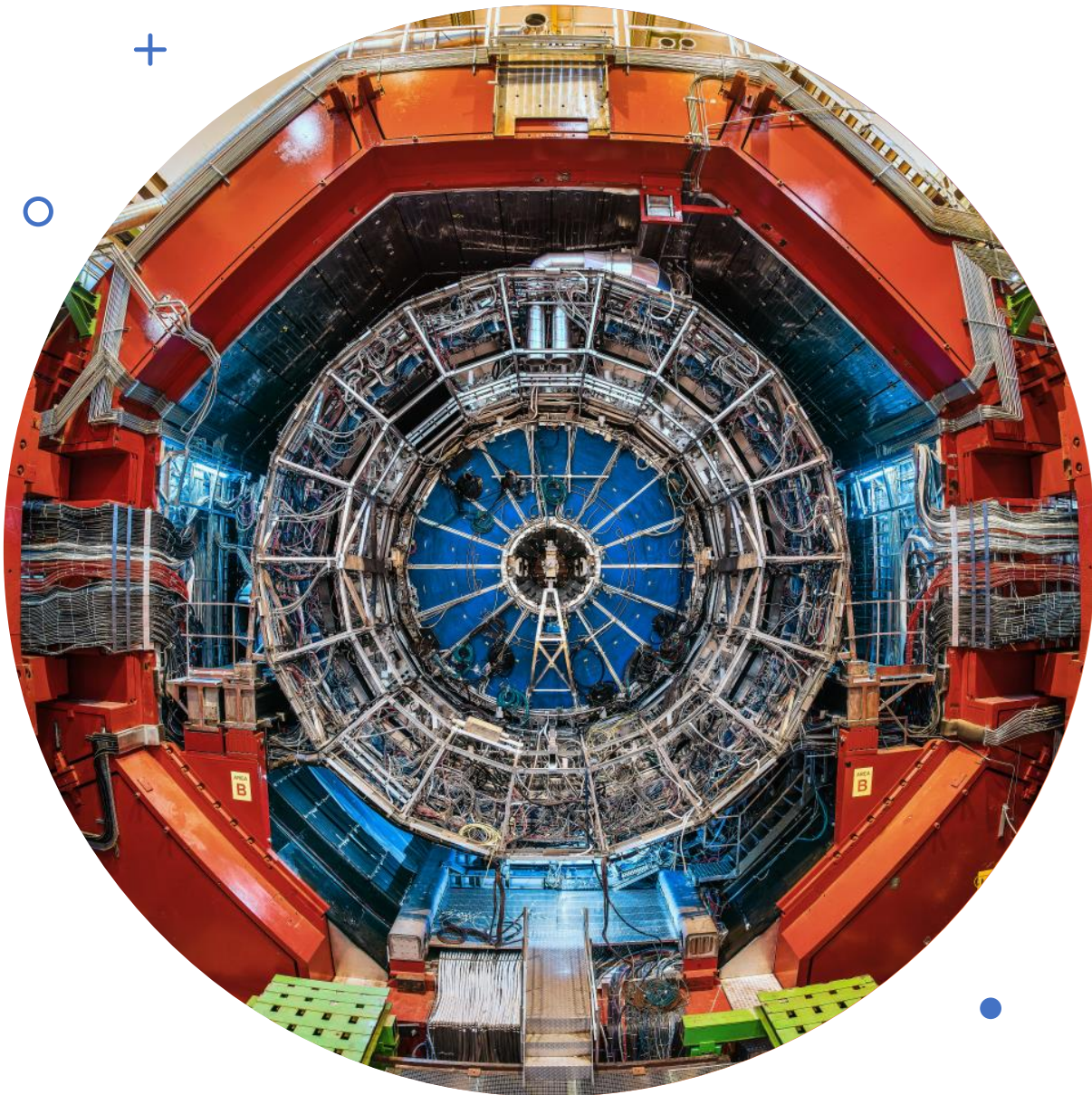
Future Circular Collider

- Since 2011 Higgs boson discovery → plans for new bigger and more precise collider
- 100k length, most under France
- Electron-positron collider; advantages + disadvantages
- 7-year construction
- Philosophy
→ no theory guidance, no discoveries, search for anything exotic

Data Management

- 100+ petabytes from all events/year
- 1.3+ Exabytes total
- 900k+ typical processors and huge storage required
- CERN can provide up to 25% of those
- Data cannot be overwritten
- Grid: international connection of hundreds of thousands of computers, safe access to download and analyze data from anywhere in the world
- Based on logic of distributed computing
- Worldwide LHC Computing Grid



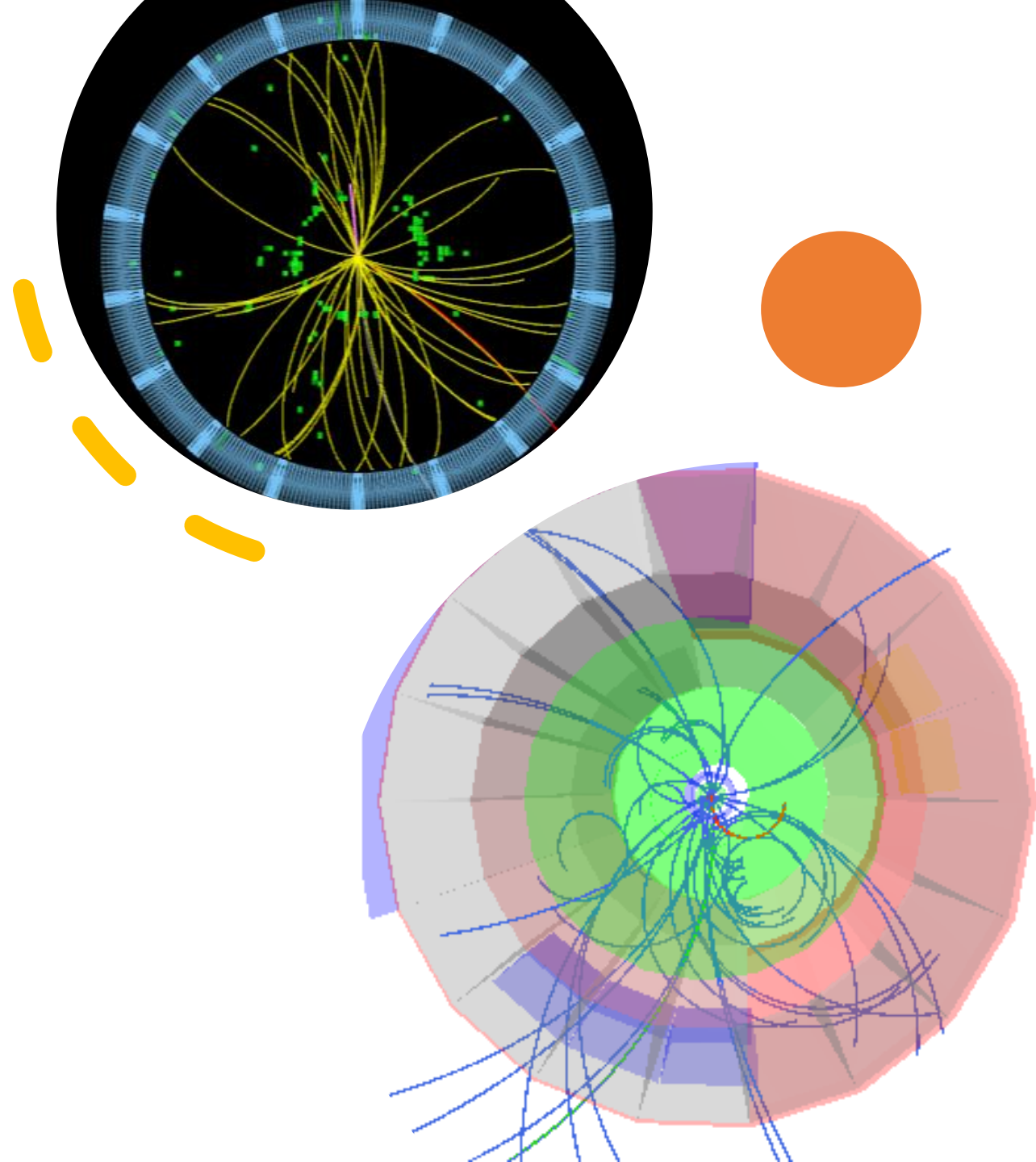


ALICE

- A detector dedicated to the heavy ion physics
- Create the "Little Bang" to study the aftermath
- It tracks the collision of Pb and P to study the particles generated
- ALICE collaborates with all the continents: 40 countries, 172 institutes and 1964 members
- ALICE new upgrades: ITS(inner tracking system), TPC(time projection chamber), FIT(fast interaction trigger)

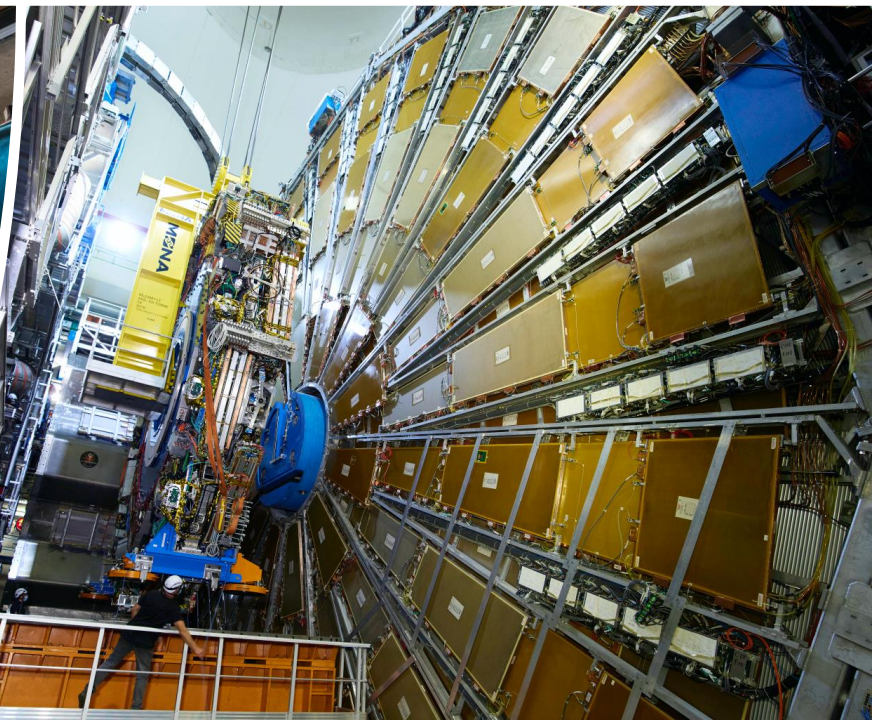
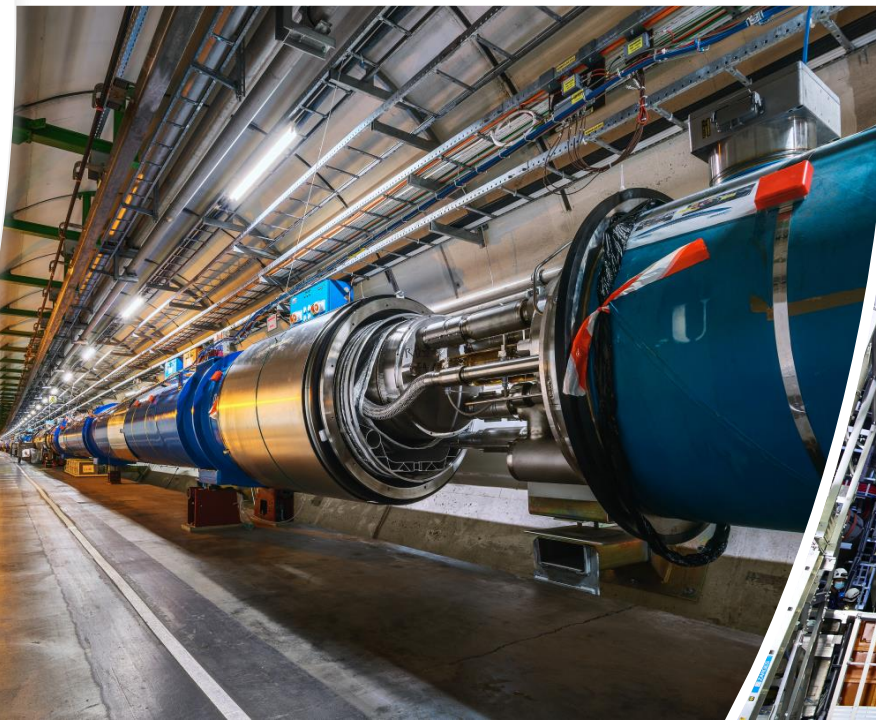
Activities

- Analysis of ALICE data
 - From proton collision
 - From lead collision
 - From strangeness enhancement
- Discovery of the rules of particle transformations
- Identification of particles with real proton-proton collisions



Virtual Visits

- The LHC and their components(super conducting magnets, focusing magnets, RF cavities...)
- The CERN data center
- ALICE control room and cavern
- ATLAS virtual visit



Sources

- <https://home.cern/news/news/physics/live-inside-cerns-antimatter-factory>
- <https://home.cern/science/physics/matter-antimatter-asymmetry-problem#:~:text=Matter%20and%20antimatter%20particles%20are,in%20and%20out%20of%20existence.>
- <https://ams.nasa.gov/>
- <https://home.cern/science/experiments/alice>
- <https://wlcg.web.cern.ch/>



SOURCES



Thank You
For Your Attention