CMS at LHC

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Synopsis For experimental particle physicist it is crucial to understand how an experiment like the LHC is carried out, in order to know how and where to search for new physics. This seminar is focused in explaining how the LHC and in particular the CMS experiment works, we are going to describe the proton - proton collisions process, from the acceleration chain to the detectors in the Compact Muon Solenoid (CMS) in order to reconstruct the byproducts of those collisions and the trajectories of the resulting particles. We are also going to describe the limitations of the CMS detector and how radiation damage involves constant recalibration of the systems.

After the Superconducting Super Collider was canceled, the 16 of December of 1994 the Large Hadron Collider (LHC) was approved and thus turned into the biggest and most important particle physics experiment. LHC uses the same 27 km tunnel that was caved for LEP (Large Electron-Positron Collider) , the LHC depth ranges from 50 to 175 m and is capable of accelerating protons and lead ions to an energy of 7 TeV per beam, actually 6.5TeV so far.

Collisions in this particle accelerator occur in four points, at each one, one of the four principal experiments conducted by CERN is located: ATLAS, CMS, ALICE and LHCb. We are going to put our efforts into explaining the Compact Muon Solenoid (CMS) experiment, that is the second largest experiment on LHC. The Universidad de Antioquia is part of this collaboration with te participation of 4 people.

CMS is a detector located at point 5 of LHC ring, the detector has a diameter of 15m and a longitude of 21m. It weights 14000 Tons. Its called "Compact Solenoid" because some of the detections systems are inside of his 367.5 m^3 solenoid capable of producing a 3.8T magnetic field and "Muon" due to its systems designed to efficiently reconstruct muon trajectories with very high precision [1,2,3].

The main subsystems of the CMS detector are: the tracker system, the superconducting solenoid, the electromagnetic calorimeter (ECAL), the hadronic calorimeter (HCAL) and the muon chambers (a 3-D representation is shown in Figure 1). All these systems produce an extraordinary amount of data (1 PB/s) and not all events are interesting, so an intelligent filter must be applied. The CMS detector has a system called the trigger that does this job in two stages and achieve a huge reduction of the data, by making the already mentioned selection [4].

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The motivation of this talk is to present the LHC and CMS functioning, this is important because when an analysis of some particle physics model is going to be done, particle physicist have to know well what they can measure and how precise it is. As a really simple example, neutrinos escape from the detector, so you cannot look for its trajectory, another important task where one has to know very well how CMS operates, is making an accurate simulation of the detector, this has to be done every time before performing a realistic search in the detector.

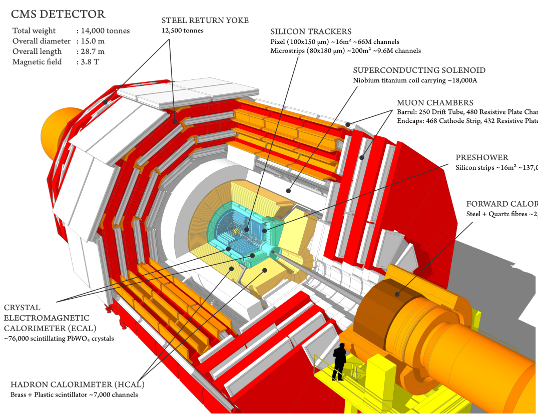

Figure 1. CMS detector 3-D representation showing each of its subsystems.

References

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[3] Werner Herr and Bruno Muratori,Concept of luminosity.

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