Chapter 1

The Compact Muon Solenoid Experiment

The Compact Muon Solenoid (CMS) detector sits at point 5 of the LHC ring, diametrically opposite the ATLAS detector at point 1. It is a 4π hermetic general purpose detector, meaning that it has the capability to detect charged and neutral hadrons, photons, electrons, muons, taus, neutrinos, and non-Standard-Model particles predicted to escape the detector with good efficiency over the range $0 \leq \eta \leq 5$. Its main distinguishing feature is a superconducting solenoid that provides a 3.8T magnetic field parallel to the beam line. This strong magnetic field allows precise determination of the momentum and charge of muons and electrons up to a momentum of $\sim$1 TeV.

The CMS sub-detectors are arranged in concentric cylindrical layers, plus "endcaps," around the beam line, as shown in Figure 1.1. Closest to the beam line are three layers of silicon pixel detectors, with the innermost at radius 4.4 cm and outermost at radius 10.2 cm [**?**]. Including the pixel endcaps, the total pixel coverage extends to $\eta = 2.5$. The pixel detector plays in important role in determining the proton-proton interaction position (*beam spot*) and the impact parameters of charged particle trajectories, and is critical for the measurement of decay positions some dis-

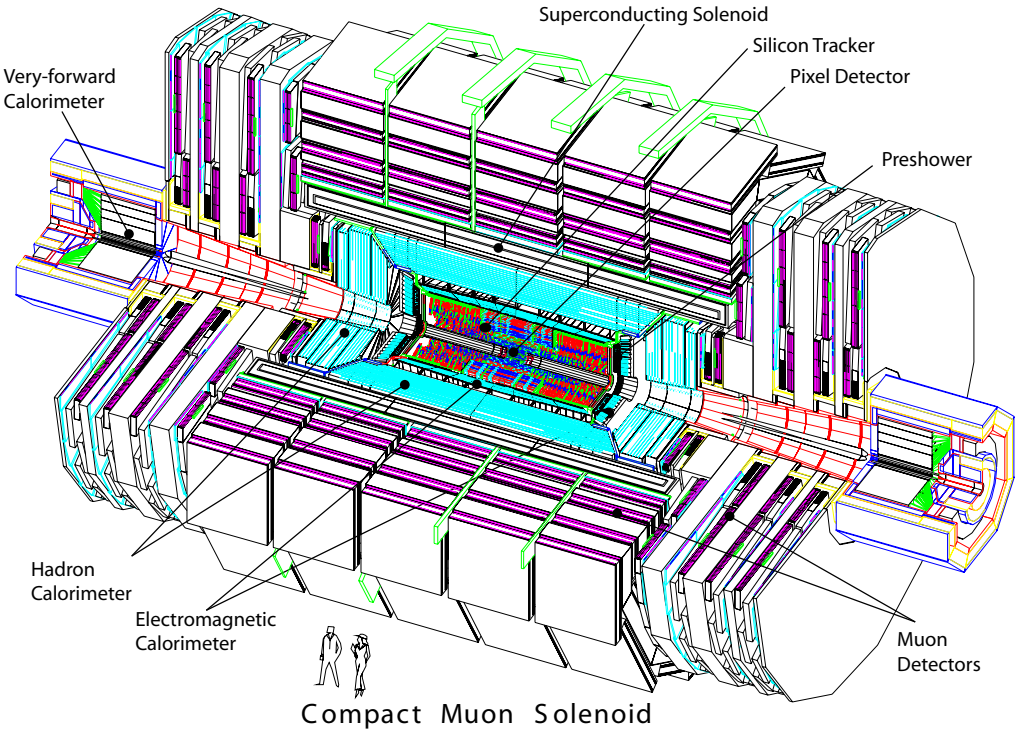

Figure 1.1: Cutaway view of CMS. Reprinted from Fig. 1.1 of ref. [**?**].

tance from the beam spot (*displaced vertices*), such as those due to the showering and hadronization of a b quark.

For a thorough description of CMS, see ref. [**?**], from which much of the information in the section was culled.

1.1 The Detectors and Their Operating Principles

1.1.1 Tracking System

Pixel Detector

Silicon Strip Tracker

1.1.2 Electromagnetic Calorimeter

1.1.3 Hadronic Calorimeter

1.1.4 Muon System

1.1.5 Far Forward Calorimetry

1.2 Triggering, Data Acquisition, and Data Transfer

1.2.1 Level 1 and High Level Trigger Systems

1.2.2 Data Acquisition System

1.2.3 Data Processing and Transfer to Computing Centers

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