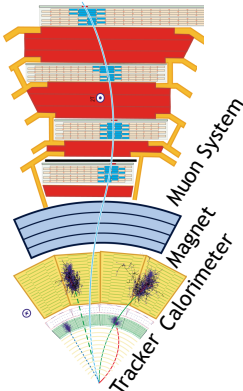


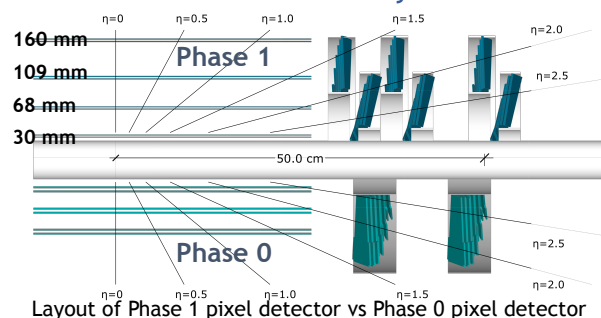
CMS Detector and its radial cross-section



LHC and the CMS detector

The Compact Muon Solenoid (CMS) is a general purpose detector at the Large Hadron Collider (LHC) at CERN. The LHC accelerates bunches of protons which collide in four Interaction Points (IPs) at an energy of $\sqrt{s} = 13\text{-}14$ TeV. CMS is located at one of these IP where the bunches collide every 25 ns. The core of the detector is the tracking system, comprised of the silicon strip detector and the pixel detector, which provide spatial information with high resolution closest to the IP. The CMS pixel detector is a hybrid silicon pixel detector. In order to maintain the excellent tracking capability of the CMS detector at the increased luminosity that LHC is delivering, an upgraded pixel detector (Phase 1) has been installed this year.

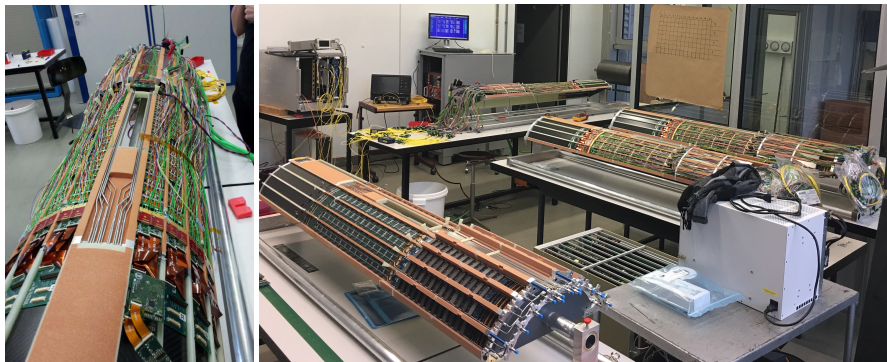
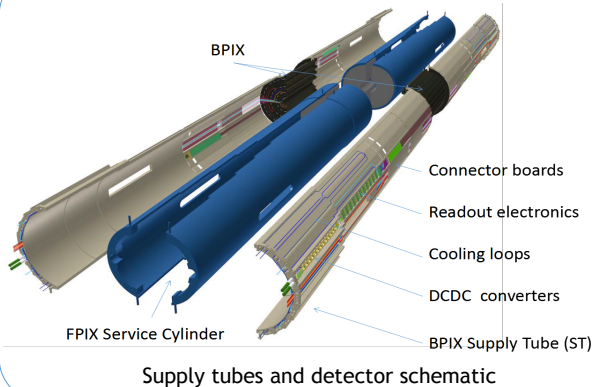
Pixel detector layout



Summary of improvements

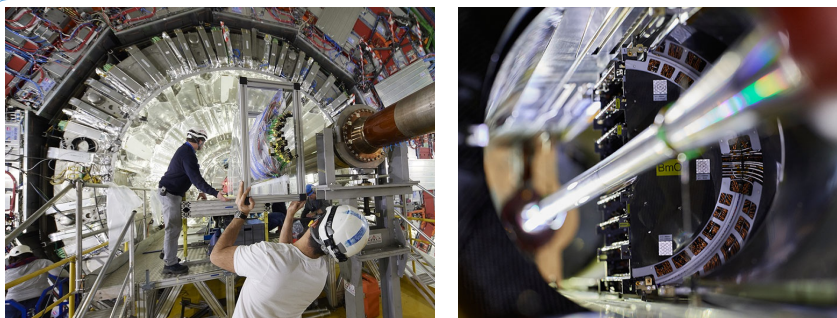
- New readout chip
- Larger readout bandwidth
- Addition of a fourth layer and two disks
- Doubled the number of channels (124 M)
- First layer closer to the new beam pipe
- Fourth layer further away
- Ultralight mechanics
- New CO₂ cooling system
- Readout electronics moved to higher η
- Reduced dead time
- Improved track seeding
- Robust vertex tagging at high PU
- Reduced multiple scattering
- Reduced photon conversions

The readout electronics and the supply tube



The Supply Tubes (STs) host the Barrel Pixel (BPix) detector readout electronics, the cooling and power connections, and transmit control signals to the detector. All the electronic components have been thoroughly tested before and during the assembly of the four supply tubes. After the assembly, the data transmission in each sector is tested using a set of detector modules. Furthermore, the ST functionality is tested during and after 20 thermal cycles between 15 °C and -20 °C before the final merging with the pixel detector.

Installation and performance



Pixel detector insertion inside CMS

The pixel detector insertion was completed on March 7, 2017. The first collisions with stable beams were delivered from the LHC accelerator on the 23rd of May, 2017. After a period of calibration and commissioning, the pixel detector has reached and exceeded the performance of the Phase 0 detector in a harsher environment, with a mean Pile Up (PU) which exceeds the nominal by a factor of 2. The data quality is monitored both online and offline to guarantee the best possible performance. The pixel Phase I detector will be the core of CMS until the year 2023, when a major upgrade for both LHC and the entire experiment is foreseen. During this year the detector has recorded 44 fb⁻¹ of data.

