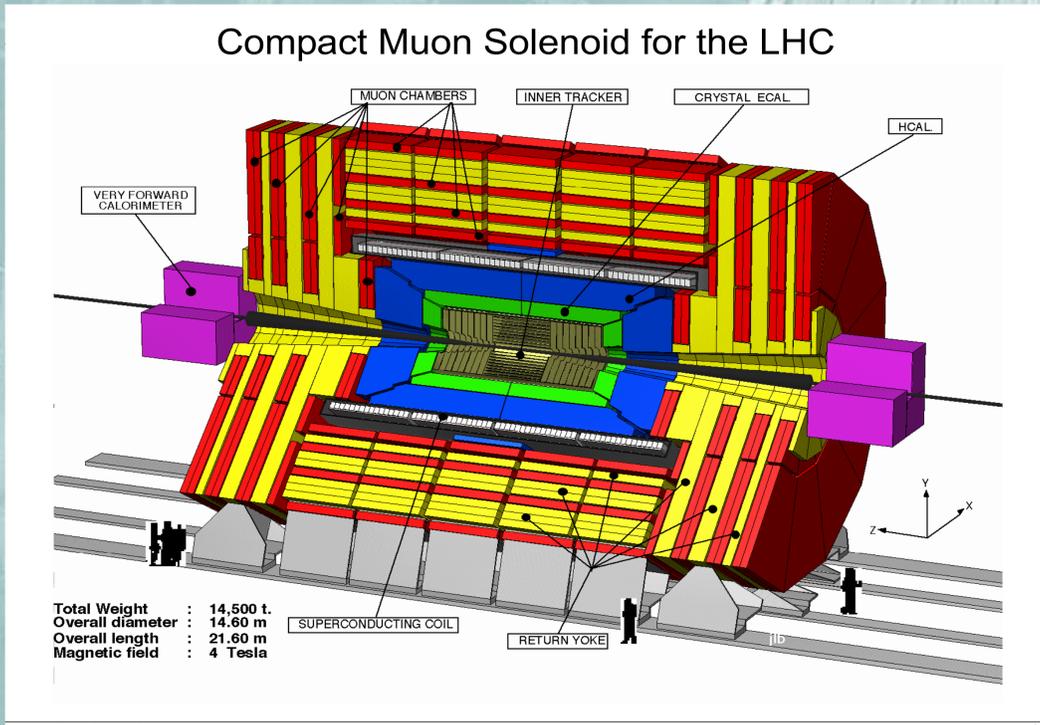


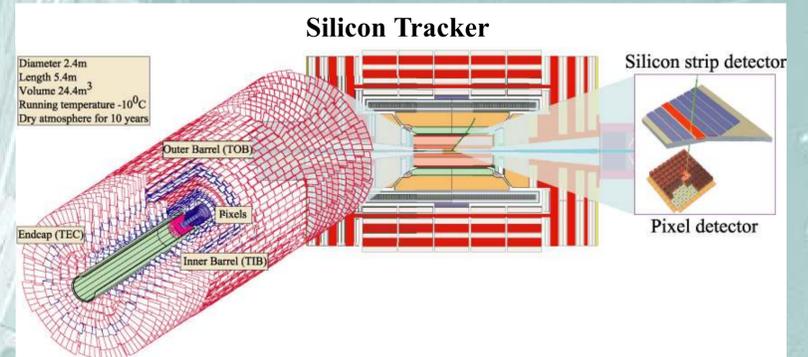
# QuarkNet Teachers Work on CMS Tracker

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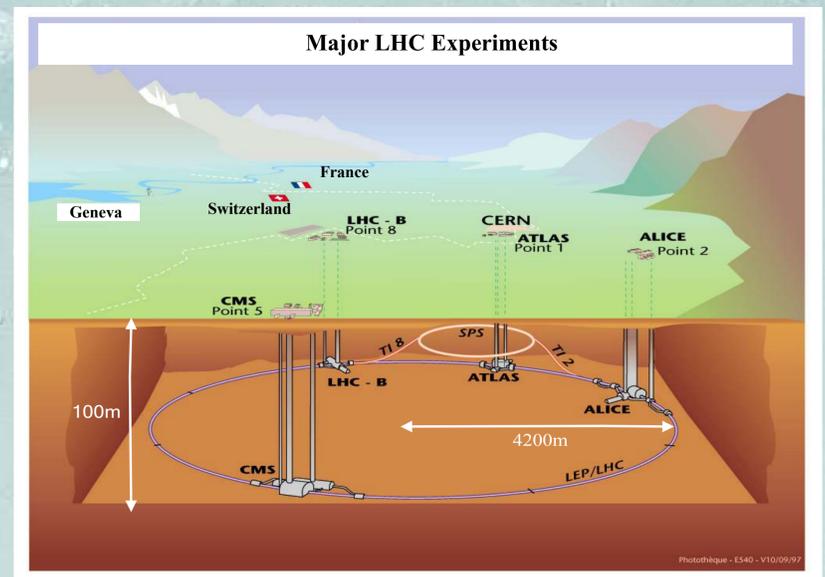
University at Buffalo-The State University of New York at Buffalo



CMS is one of the two major detectors currently being installed along the LHC or Large Hadron Collider at CERN near Geneva, Switzerland (right). The Compact Muon Solenoid detector is a collaboration of more than 2000 scientists about 40 countries. CMS has three major components (above). The tracker, which is closest to the beam pipe, is used to reconstruct the momentum of the particles created in the 14 TeV proton-proton collisions. Next, the Calorimeters find the energy of the particles produced. The Tracker and Calorimeters are surrounded by a solenoid generating a 4 T magnetic field. Finally, the Muon System aids in identifying muons and measuring their momentum. Searches for the Higgs boson and Supersymmetry form a central part of the CMS physics program.

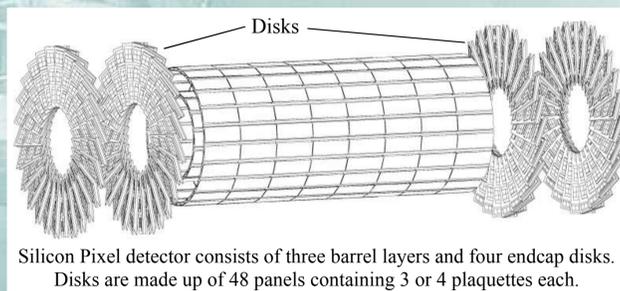


CMS uses an all-silicon tracker. silicon pixel detectors are situated closest to the beam pipe, while silicon microstrip detectors are used in the outer layers. This versatile tracking system allows charged particle reconstruction with high efficiency and precision. In addition, the silicon pixel detectors bring the capability of identifying tracks from secondary vertices. Such vertices arise from decays of b quarks, and are very useful signatures over a broad spectrum of physics, including the Higgs boson and Supersymmetry searches. The choice of all silicon technology for the tracker should ensure functionality for a 10 year life span in the high radiation environment of LHC.



## Forward Pixel Detector Testing at Fermilab

### Silicon Pixel Components



Plaquettes are tested Fermilab's SiDet facility using the test station shown on the right. Individual plaquettes are placed into the cold box and connected to the interface as shown below. Once the plaquette is cooled to operating temperature, a high-voltage power supply and the computer-controlled LabVIEW interface calibrate and test each channel on the connected plaquette.

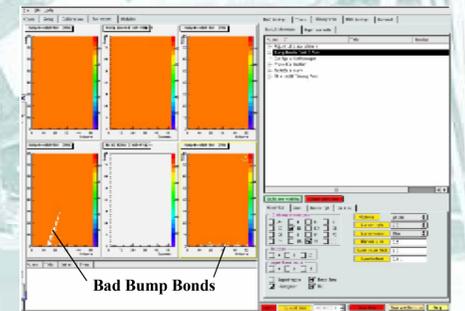
### SiDet Test Station



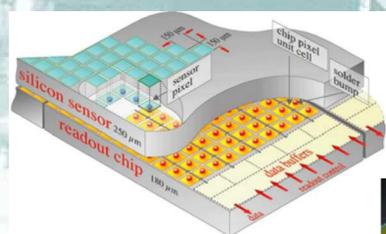
### Inside the Cold Box



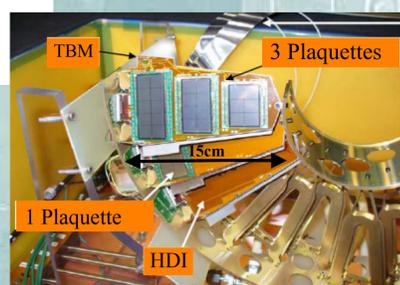
### LabVIEW Interface Screen Shot



Here is an example of a test to measure the connection between the sensor and the ROC. White areas represent broken or failed bump bonds.



When a charged particle passes through the silicon sensor, it produces secondary charged particles via ionisation mechanism. Resulting electric signal is sent to the Readout Chip (ROC) which is bump bonded to the sensor. Each pixel is 150 μm x 100 μm to minimize occupancy and optimise resolution. With this configuration the forward pixel detector has about 66 million channels.



The background is an image of Dr. Darin Acosta from the University of Florida standing next to the 16-meter-tall endcap.

Images and content provided by the CMS outreach website Dr. Avto Kharchilava and Dr. Ia Iashvili of the University at Buffalo and Dr. Sudhir Malik of University of Nebraska - Lincoln. For more information visit USCMS at [www.uscms.org](http://www.uscms.org).