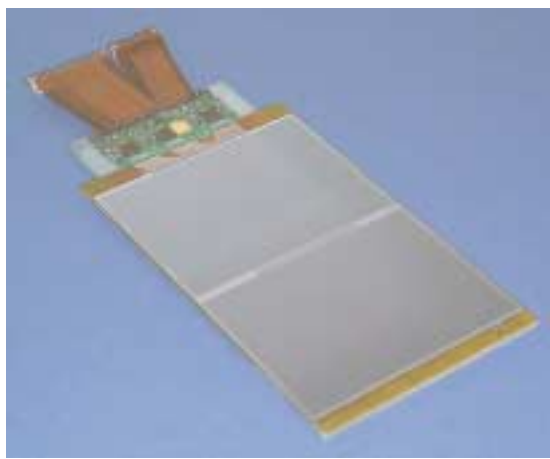


CMS is a worldwide collaboration comprising 1870 scientists and engineers from 151 institutions in 31 countries

CMS is a general purpose proton-proton detector designed to run at the highest luminosity at the LHC. It is also well adapted for studies at the initially lower luminosities. The main design goals of CMS are:

- i) a high performance muon system
- ii) a high resolution electromagnetic calorimeter
- iii) high quality central tracking
- iv) a hermetic hadron calorimeter

## Silicon Tracker



Two silicon detectors cut from 6" wafers bonded together to form 512 long strips. Four APV25 chips (radiation hard 0.25μm technology) are incorporated for pre-amplification, shaping, voltage-sampling into an analogue pipeline and subsequent multiplexing output.

The tracking volume is given by a cylinder of length 6m and a diameter of 2.6m. 250 m<sup>2</sup> of fine-pitch silicon detectors provide precise hits. Pixel detectors placed close to the interaction region improve measurement of the track impact parameter and reconstruction of secondary vertices, as well as aiding electron identification. In the central region ( $|\eta| < 1.5$ ) the  $\Delta p_T/p_T$  is 0.005 + 0.15  $p_T$  ( $p_T$  in TeV)

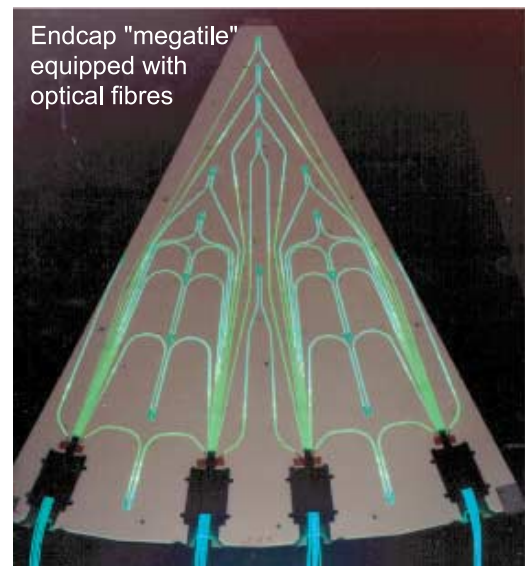
## Electromagnetic Calorimeter



"Alveolar" structures contain the crystals, and are cantilevered from the rear. Shown is an endcap "SuperCrystal" - carbon-fibre alveolar containing 5x5 crystals+VPTs. The typical energy resolution of the ECAL is 0.6% for incident 100 GeV electrons. The endcap ECAL also includes a two-layer preshower detector, incorporating ~16m<sup>2</sup> of silicon sensors, for enhanced  $\gamma/\pi^0$  separation.

Approximately 80000 lead tungstate (PbWO<sub>4</sub>) crystals will be used to construct the homogeneous ECAL. Avalanche photodiodes (APDs) and vacuum phototriodes (VPTs) will detect the light in the barrel and endcap sections respectively. The ECAL is both compact and finely segmented, due to the small  $X_0$  (0.89cm) and  $R_M$  (2.2cm) of PbWO<sub>4</sub>.

## Hadronic Calorimeter



The barrel and endcap parts of the HCAL are formed from 50mm-thick brass segments interleaved with 4mm-thick scintillating tiles equipped with wavelength-shifting optical fibres. The average thickness of the HCAL is 10λ up to  $|\eta| < 3.0$ . A forward calorimeter completes the hermetic coverage up to  $|\eta| < 5$ , using radiation-resistant quartz fibres inserted into steel plates.

## Magnet



CMS is built around a long superconducting solenoid (length = 13m) with a free inner diameter of 5.9 m and a uniform magnetic field of 4T. The magnetic flux is returned via a 1.5 m thick saturated iron yoke instrumented with muon chambers. Shown are the first two barrel yoke rings (from five) built on the surface at LHC Point 5 in Cessy, France.

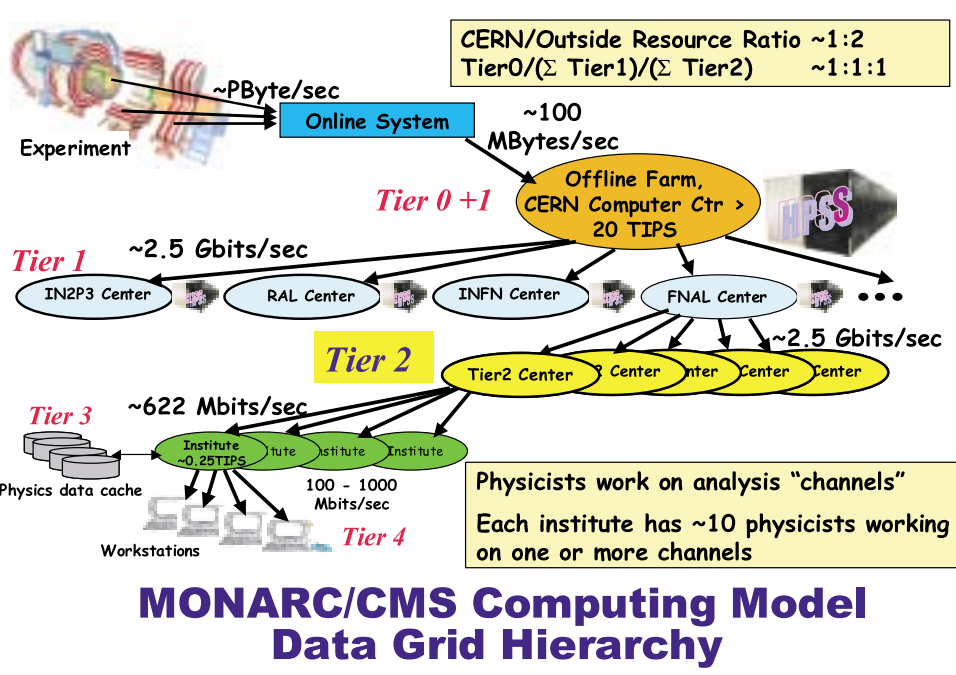
## Infrastructure



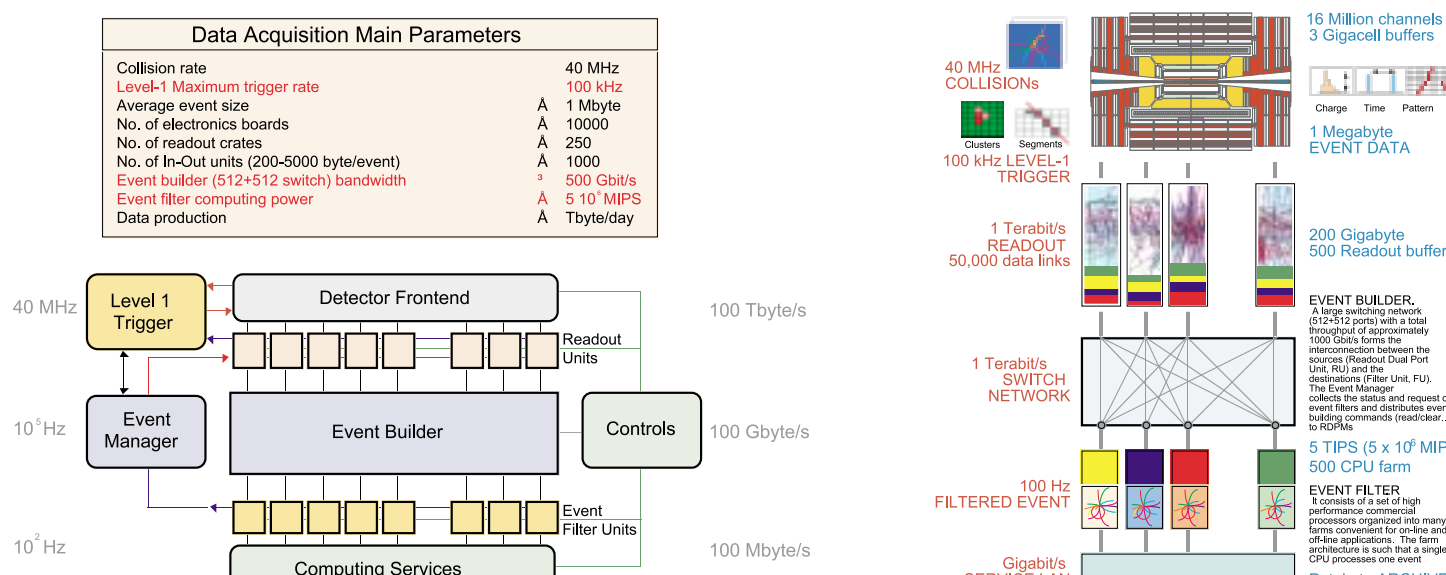
The assembly and testing of most of CMS will take place in a large surface hall before lowering it into the underground experimental cavern. The choice of using a surface hall rather than the underground area, allows the construction of the magnet and detectors in parallel with the civil engineering works. During the construction phase the main assembly hall will have a length of 140 m, a width and height of 23.5 m. After installation of CMS in the underground cavern, these dimensions will be reduced to a length of about 100 m and a height of 16 m, thus having no major impact on the environment.

Total weight : 12500 tonnes  
Overall length : 21.5 metres  
Overall diameter : 15.0 metres  
Field strength : 4 Tesla

## Computing

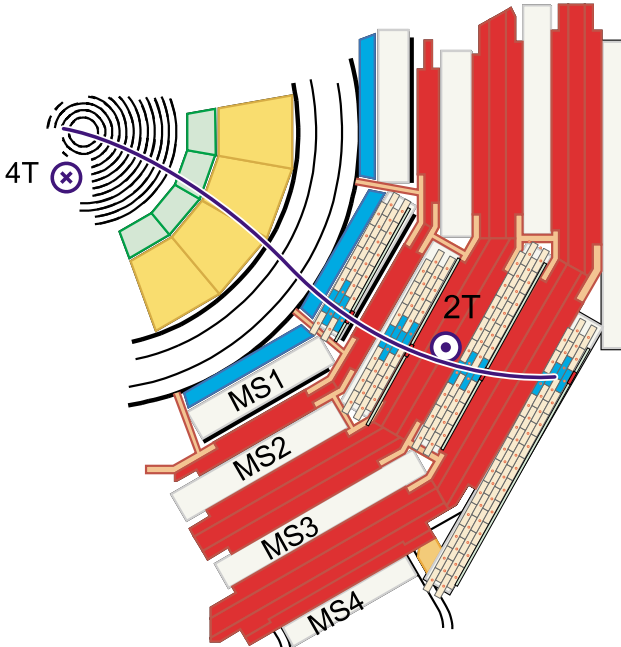


## Trigger and Data Acquisition



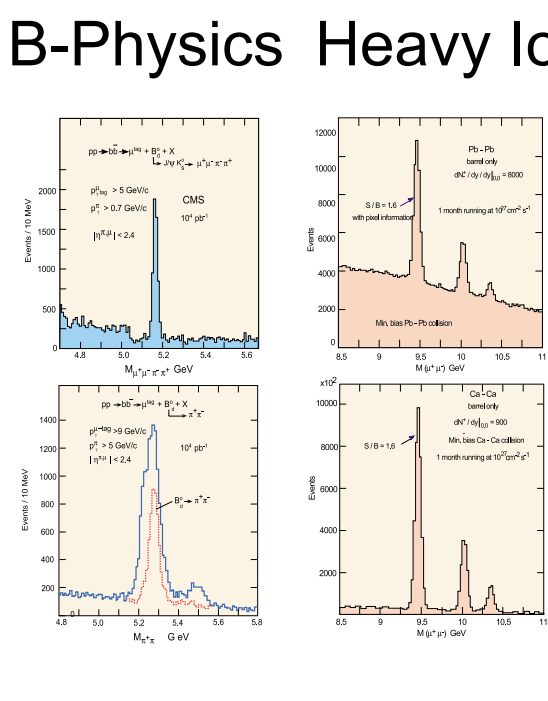
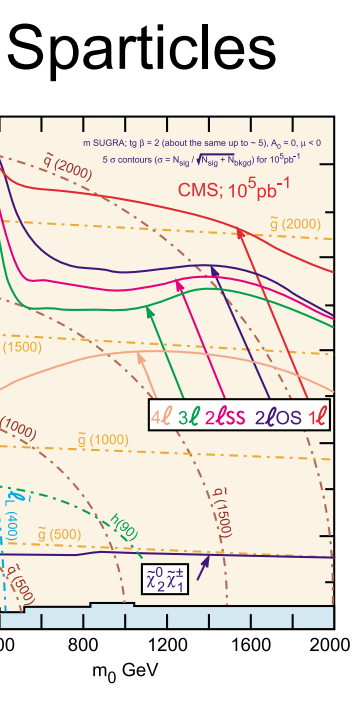
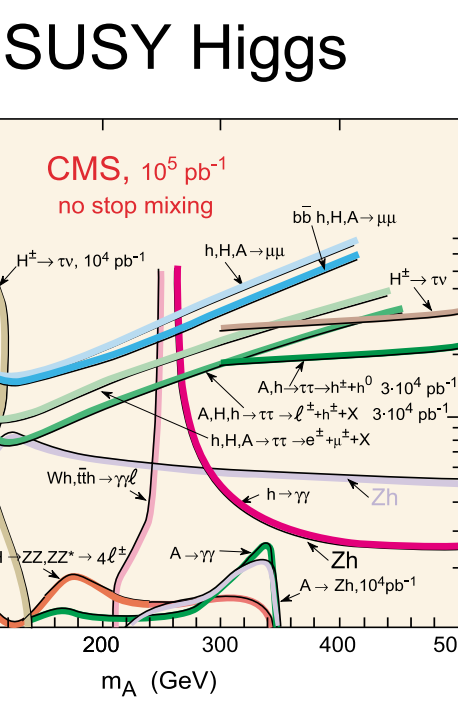
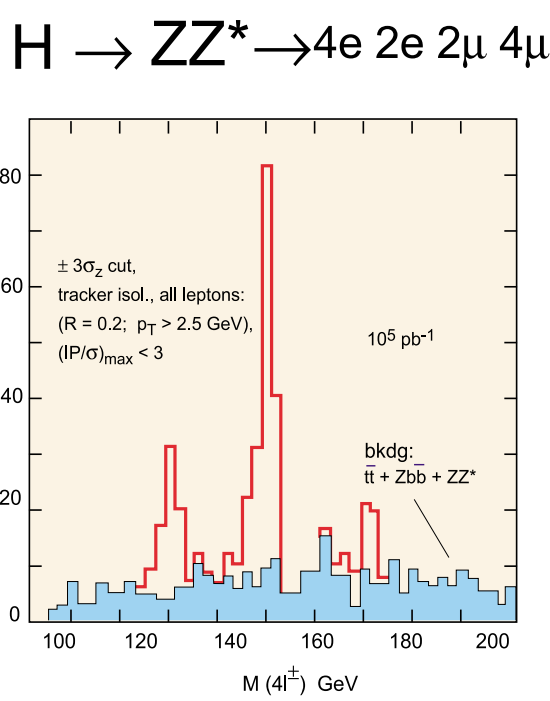
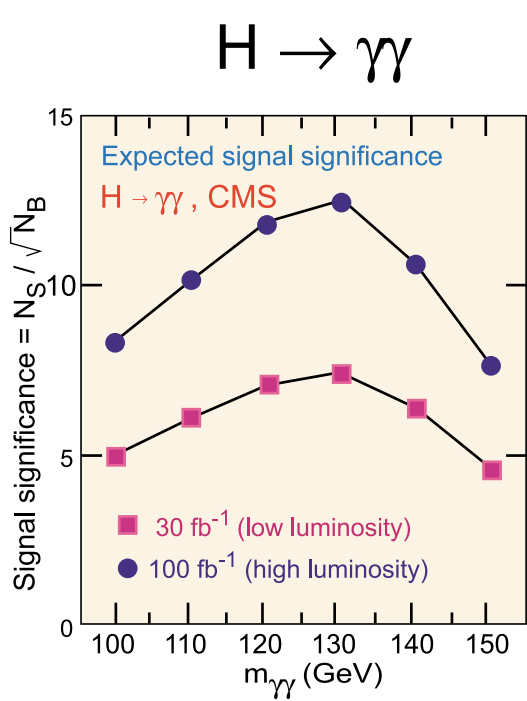
## Muon Spectrometer

Centrally produced muons are measured 3 times: in the inner tracker, after the coil, and in the return yoke. They are identified and measured in four identical muon stations using drift chambers in the barrel, cathode strip chambers in the endcaps and resistive-plate chambers in both the barrel and endcaps to ensure redundancy in triggering.



Testing a full-size cathode strip chamber

## Physics Performance



Hadrons in the Inner Tracker	
$\sigma(B_c \rightarrow \pi^+ \pi^-)$	$\approx 27$ MeV
$\sigma(B_c \rightarrow \mu^+ \mu^-)$	$\approx 26$ MeV
$\sigma(Y \rightarrow \mu^+ \mu^-)$	$\approx 37$ MeV
$\sigma(H \rightarrow 4\mu^+)$	$\approx 1.0$ GeV
Muons in the Tracker and Muon System	
$\sigma(B_c \rightarrow \mu^+ \mu^-)$	$\approx 26$ MeV
$\sigma(Y \rightarrow \mu^+ \mu^-)$	$\approx 37$ MeV
$\sigma(H \rightarrow 4\mu^+)$	$\approx 1.0$ GeV
Electrons/Photons in the Electromagnetic Calorimeter	
$\sigma(H \rightarrow 4e^+)$	$\approx 0.9$ GeV
$\sigma(H \rightarrow \gamma\gamma)_{\text{low LHC}}$	$\approx 0.6$ GeV
$\sigma(H \rightarrow \gamma\gamma)_{\text{high LHC}}$	$\approx 0.8$ GeV