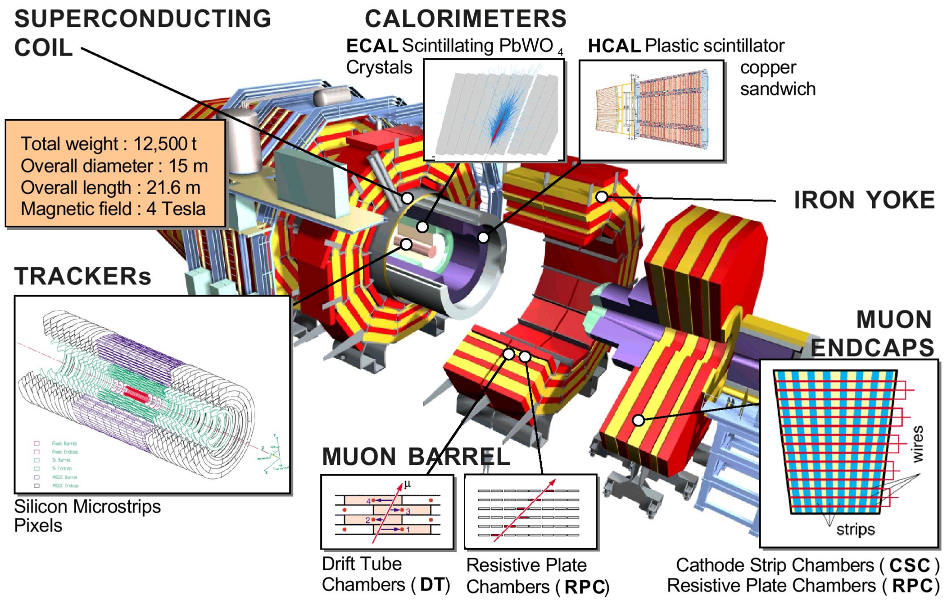
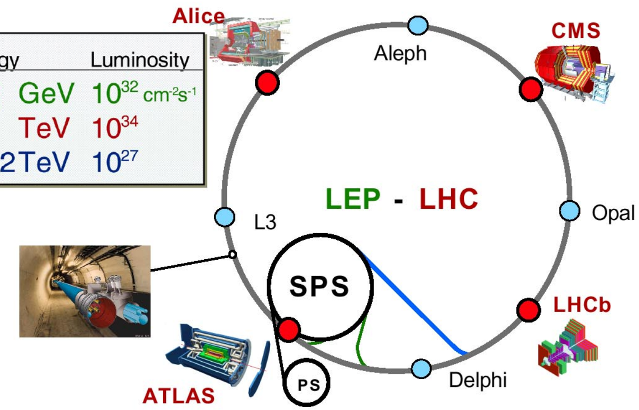
The CMS experiment at LHC

The Compact Muon Solenoid (CMS)



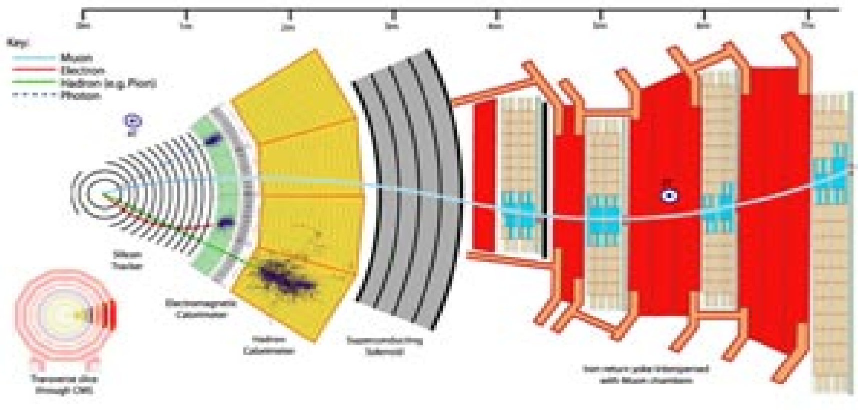
	Beams	Energy	Luminosity
LEP	e^+e^-	200 GeV	10^{32} $cm^{-2}s^{-1}$
LHC	p p	14 TeV	10^{34}
	$P_b P_b$	1312TeV	10^{27}

Two superconducting magnet rings in the LEP tunnel.



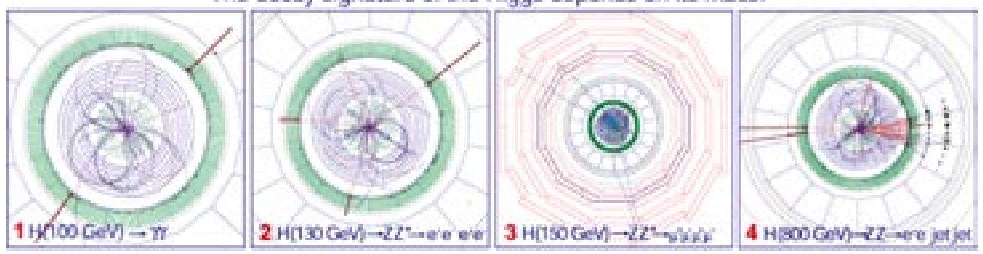
Experiments at LHC

ATLAS A Toroidal LHC ApparatuS. (Study of Proton-Proton collisions)
CMS Compact Muon Solenoid. (Study of Proton-Proton collisions)
ALICE A Large Ion Collider Experiment. (Study of Ion-Ion collisions)
LHCb (Study of CP violation in B-meson decays at the LHC collider)



CMS has been optimized to discover the Higgs in the full expected mass range 0.08 TeV < MH < 1 TeV

The decay signature of the Higgs depends on its mass:



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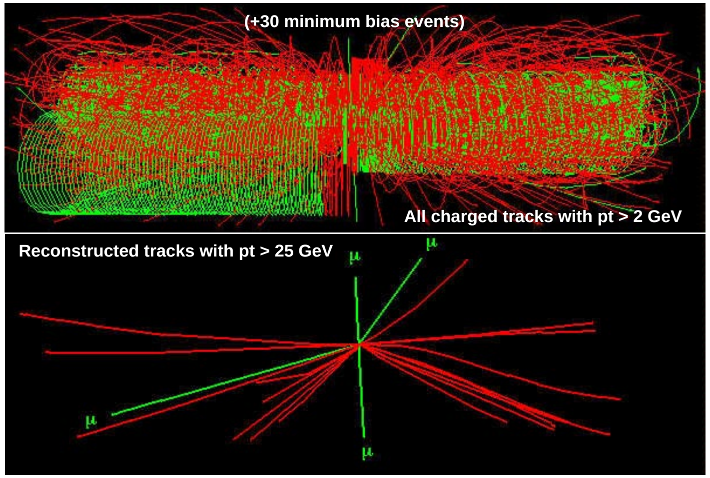
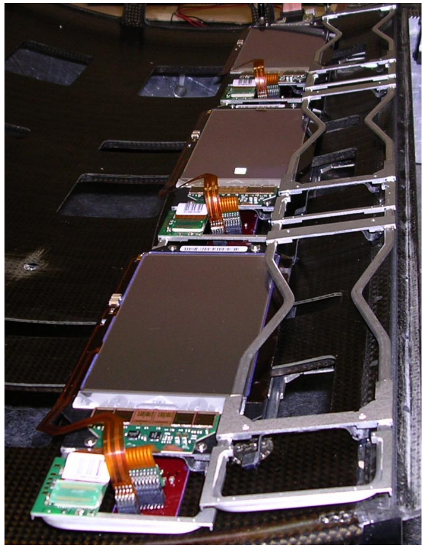
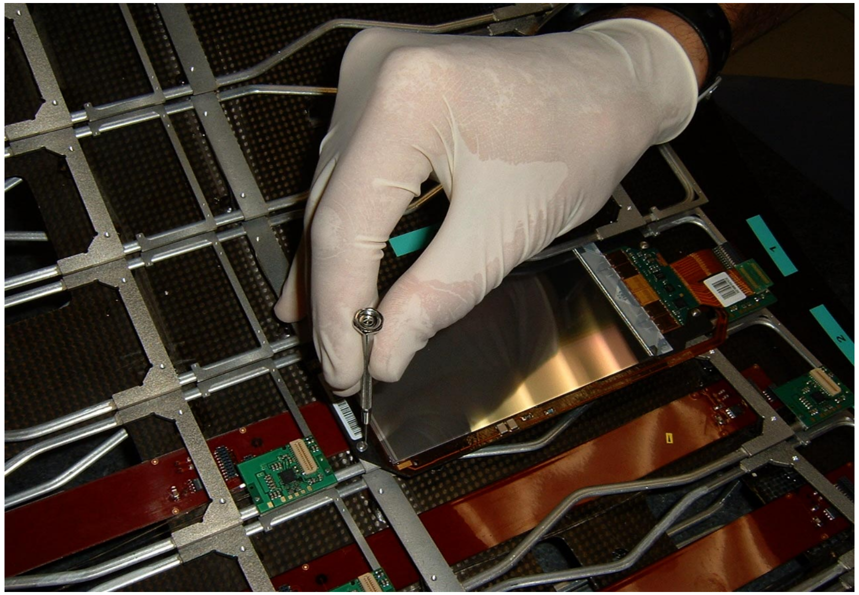
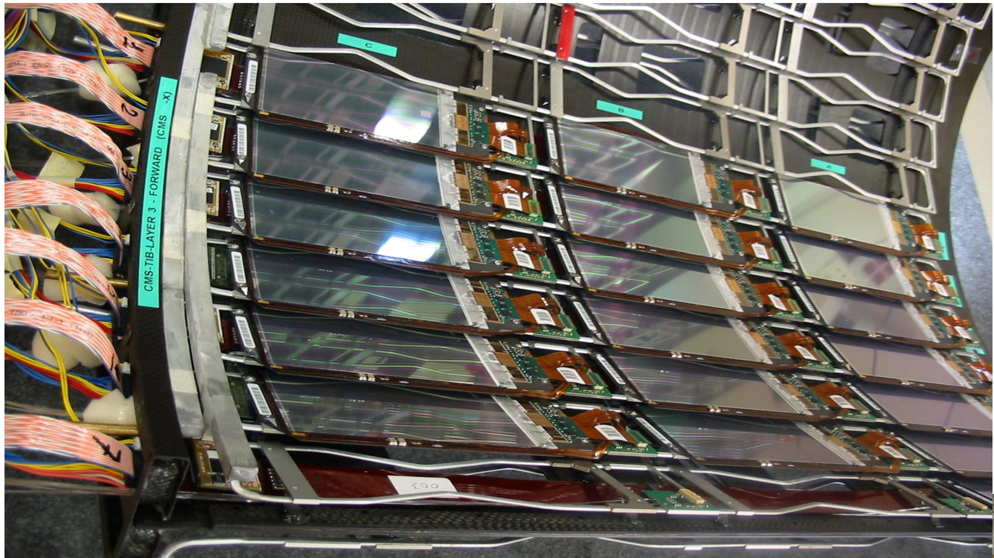
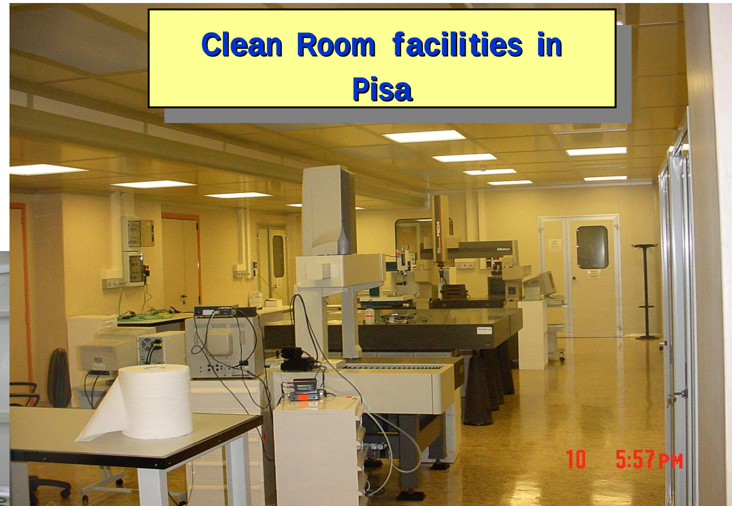
The CMS Tracker



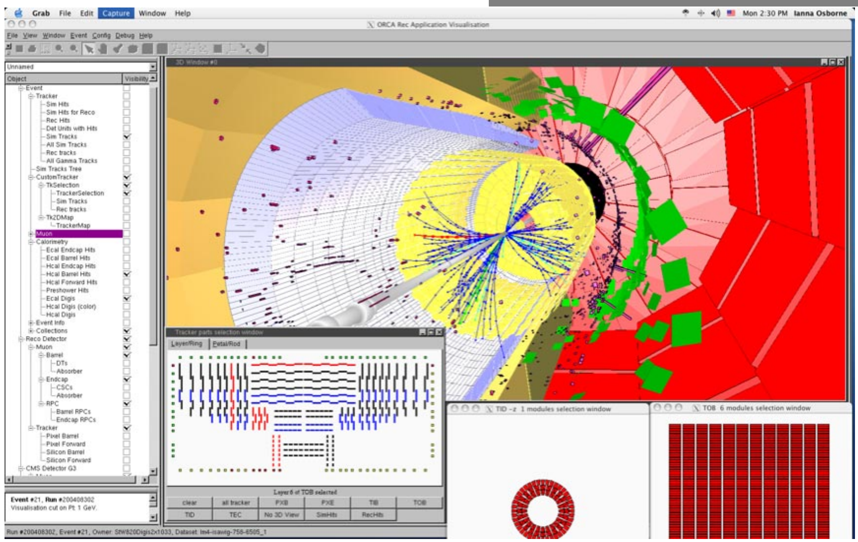


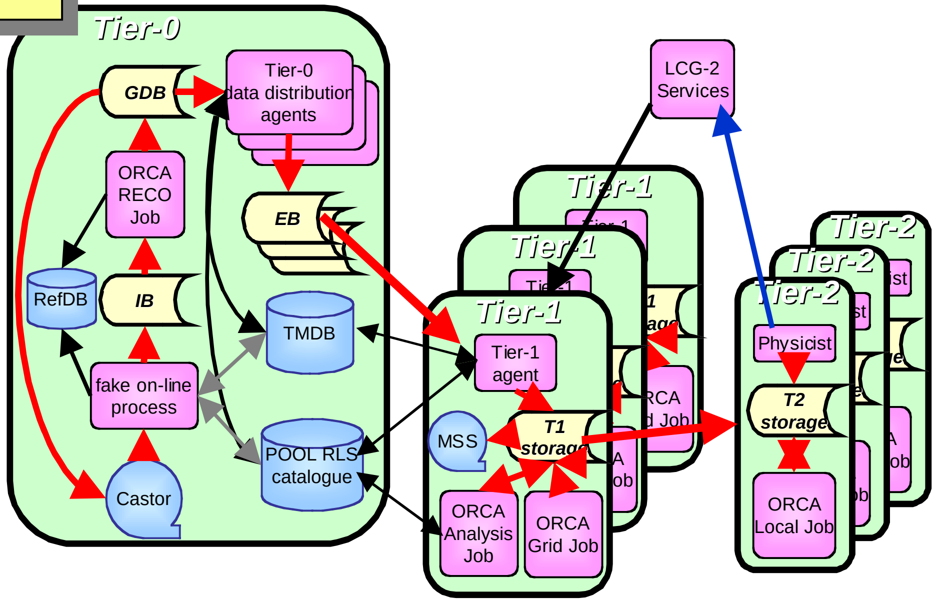




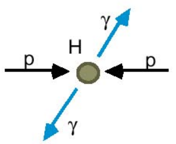


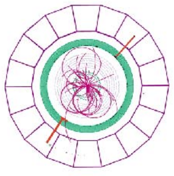
LHC Computing GRID (LCG)



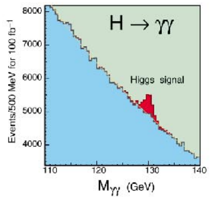


CMS physics: Higgs

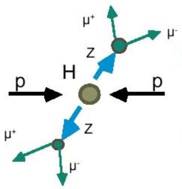


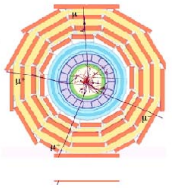


M_{Higgs} = 100 GeV

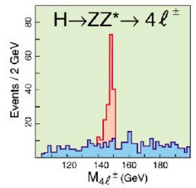


Higgs to 2 photons (M_H< 140 GeV) . $H^0 \to \gamma\gamma$ is the most promising channel if M_H is in the range 80 – 140 GeV. The high performance $PbWO_4$ crystal electromagnetic calorimeter in CMS has been optimized for this search. The $\gamma\gamma$ mass resolution at $M\gamma\gamma \sim 100$ GeV is better than 1%, resulting in a S/B of ≈1/20

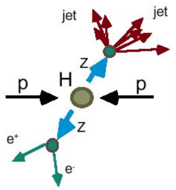


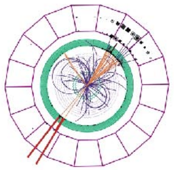


M_{Higgs} = 150 GeV

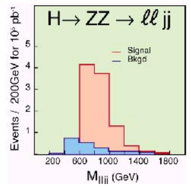


Higgs to 4 leptons (140 < M_H< 700 GeV). In the M_H range 130 - 700 GeV the most promising channel is $H^0 \to ZZ^* \to 2\ell^+ 2\ell^-$ or $H^0 \to ZZ \to 2\ell^+ 2\ell^-$. The detection relies on the excellent performance of the muon chambers, the tracker and the electromagnetic calorimeter. For $M_H \leq 170$ GeV a mass resolution of ~1 GeV should be achieved with the combination of the 4 Tesla magnetic field and the high resolution of the crystal calorimeter





M_{Higgs} = 800 GeV



Higgs to 2 leptons+2 jets (M_H > 500 GeV). For the highest M_H, in the range 0.5 - 1 TeV, the promising channels for one year at high luminosity are $H^0 \to ZZ \to \ell^+\ell^- \nu\nu$, $H^0 \to ZZ \to \ell^+\ell^-$ jj and $H^0 \to W^+W^- \to \ell^\pm \nu$ jj . Detection relies on leptons, jets and missing transverse energy (E_t^{miss}), for which the hadronic calorimeter (HCAL) performance is very important

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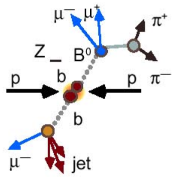
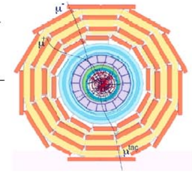
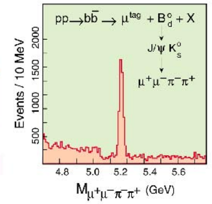
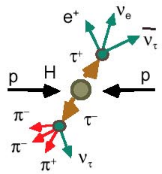
CMS physics: B & Supersymmetry

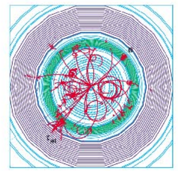




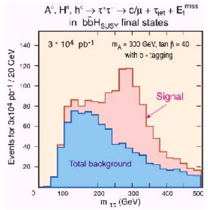


The decay B^0 or $\bar{B}^0 \to J/\psi\ K^0_S$ presents a very clean experimental signature. The particle content (B^0 or $\bar{B}^0$ meson) that gave the decay can be determined from a muon from the second b-flavored hadron in the event. An asymmetry in the two rates (B^0 vs $\bar{B}^0$) would signal CP violation. This would be the first time that CP violation is observed outside the neutral kaon system

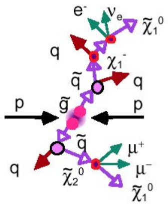


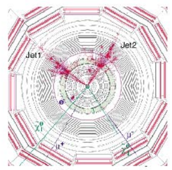


H → τ τ → e+ τ_{jet}("3-prong")

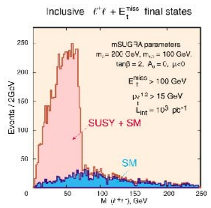


SUSY Higgs bosons. In the MSSM there are 5 Higgs bosons: h^0, H^0, A^0 and $H^\pm$ decaying through a variety of decay modes to γ, $e^\pm$, $\mu^\pm$, $\tau^\pm$ and jets in final states. Above: an example of a SUSY Higgs decay to $\tau\tau$ in CMS. On the right is the reconstructed $\tau\tau$ mass spectrum





SUSY event with 3 leptons + 2 Jets signature



Sparticles. Production of sparticles may reveal itself though some spectacular kinematical spectra, with a pronounced "edge" in the $\ell^+\ell^-$ mass spectrum reflecting $\chi_2^0 \to \ell^+\ell^- \chi_1^0$ production and decay. An example of such a spectrum in inclusive $\ell^+\ell^-$ + E_t^{miss} and of a 3 $\ell^\pm$ production event are shown below