# *CMS: Physics with electrons and photons*

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# *Introduction*

- The LHC
- CMS detector
- CMS ECAL
- $H \rightarrow \Upsilon\Upsilon$ channel
- $Z \rightarrow ee$ Acceptance Study
- Conclusions


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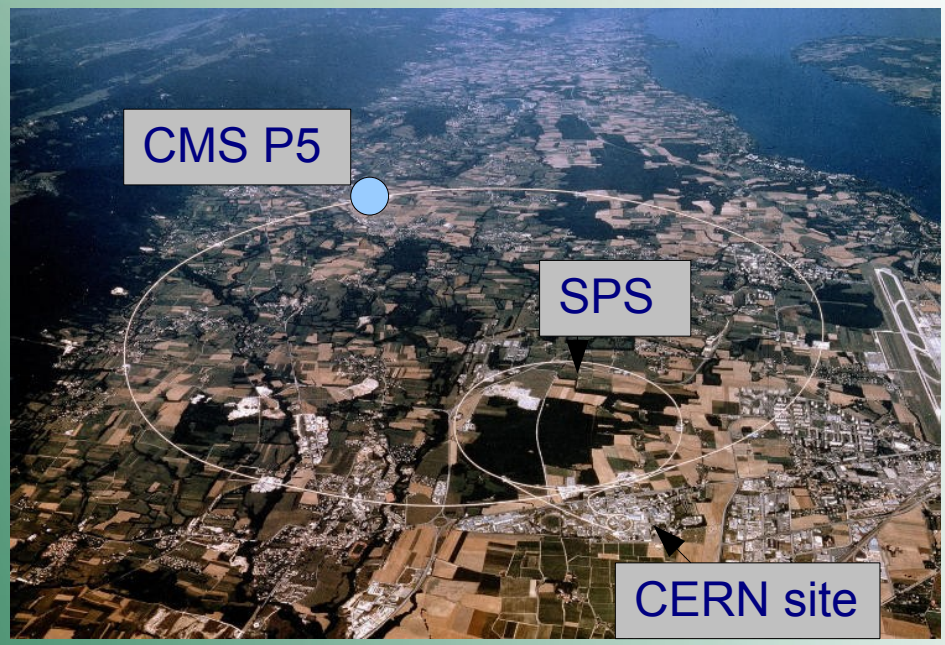
# *The LHC*

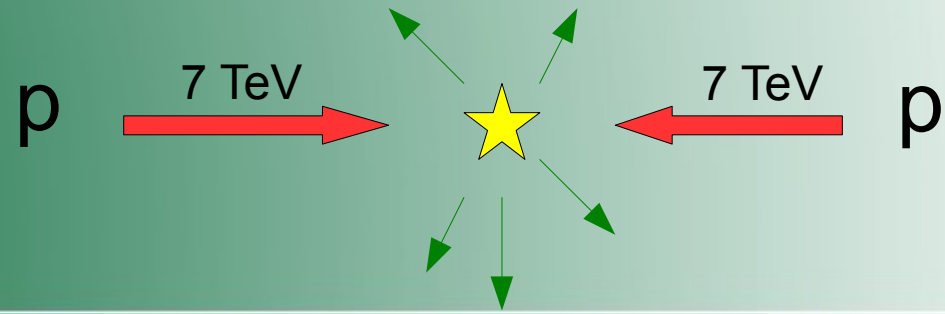
- World's largest and highest energy particle collider.
- 14TeV com energy; $10^{34}cm^{-2}s^{-1}$ luminosity.
- 27km circumference

Goals of the LHC:

- Find the Higgs (if it exists)
- Look for Supersymmetry
- Any other new physics




http://est-div-lea-at.web.cern.ch/est-div-lea-at/atlas_lhcpicturesAERIAL.htm





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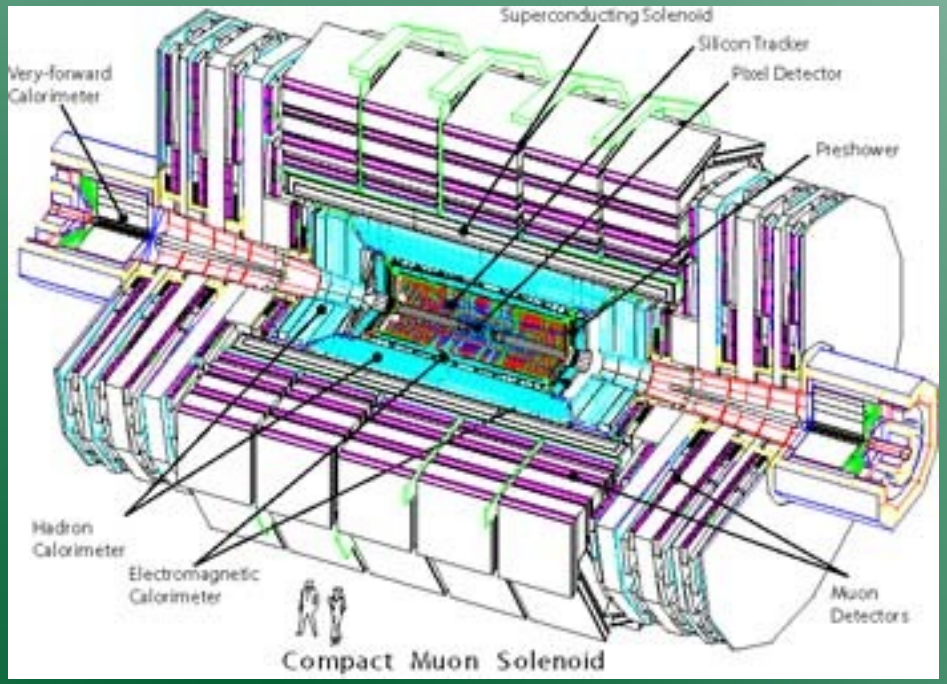
# *The CMS detector*




- General purpose detector
- Tracker
- ECAL
- HCAL
- Solenoid
- Muon chambers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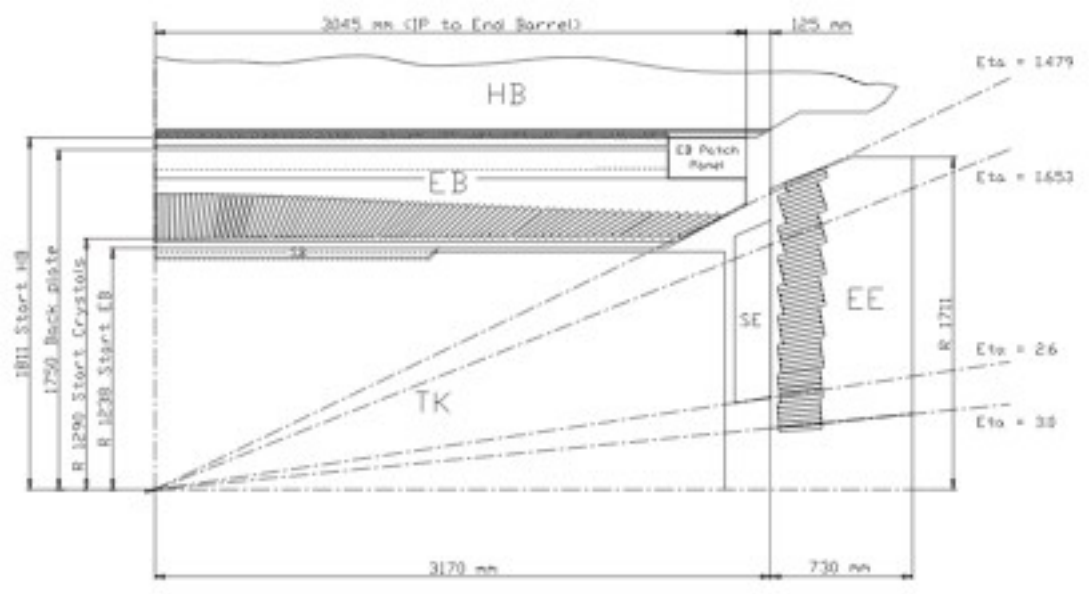
# *CMS ECAL I*

- $PbW0_4$ crystals: length 23cm (26 $X_0$), rm = 2.1cm.
- Area 22mmx22mm: $\Delta\eta \times \Delta\Phi = 0.0175 \times 0.0175$ (1°).
- Pseudorapidity coverage $|\eta| < 3$.





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# *CMS ECAL II*

- e/ϒ cause EM showers: bremsstrahlung, pair production. Collisions → Excitations → Scintilation light.
- Photodetectors: APDs (barrel) and VPTs (endcaps).
- Amplified and digitised → L1 trigger, DAQ.
- Energy Resolution: s = 2.7%, c = 0.55%, n = 155MeV.

$$\left(\frac{\sigma_E}{E}\right)^2 = \frac{s^2}{E} + c^2 + \frac{n^2}{E^2}$$

- ~1% for a 45GeV electron; ~0.6% for a 100GeV electron


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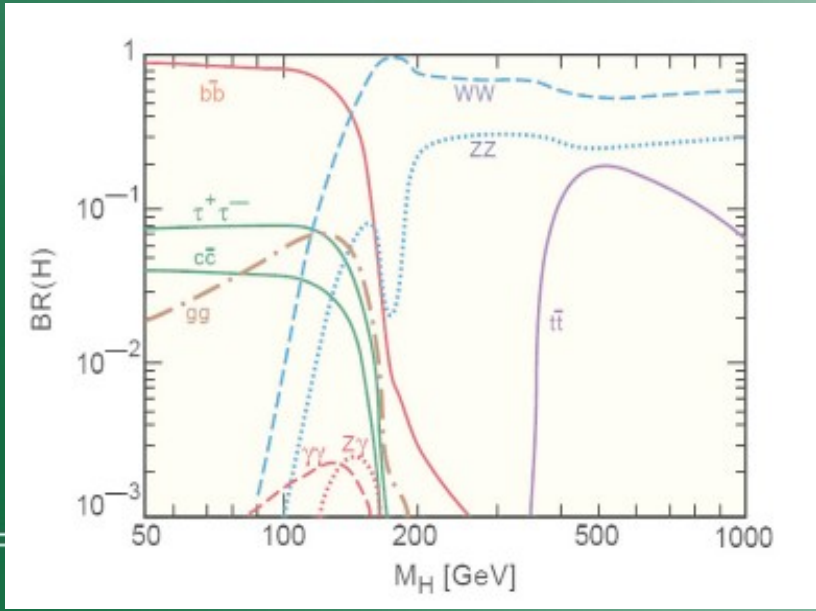
# $H \rightarrow \gamma\gamma$ decay mode

- Benchmark channel for design of the ECAL.
- Suitable for a low mass Higgs (114-150GeV).
- Low BR but it has a characteristic signature.
- Main background is $\pi^0$ looking like $\gamma$.





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# *Z → ee Acceptance Study*

- Need to understand every detail of how our detector works (as far as possible).
- Show that we can produce W's and Z's and other known Standard Model Physics.
- Z → ee acceptance: proportion of events lying within cuts.
- Correction due to detector resolution.
- Acceptance: #observed → #generated.


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# *Cuts*

- Cuts are made in $\eta$ and in pt.
- $-3 < \eta < -1.5$; $-1.4 < \eta < 1.4$; $1.5 < \eta < 3$.
- pt > 5 GeV/c


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# *The Monte Carlo*

- I used Pythia 8 (the new C++ version) with Root.
- pp collisions at 10 TeV.
- ff2gmZ
- $70 < m < 110$ GeV
- $Z \rightarrow ee$ only decay on.
- Produce plots of the Z and electron distributions.
- Determine the acceptance and the correction.


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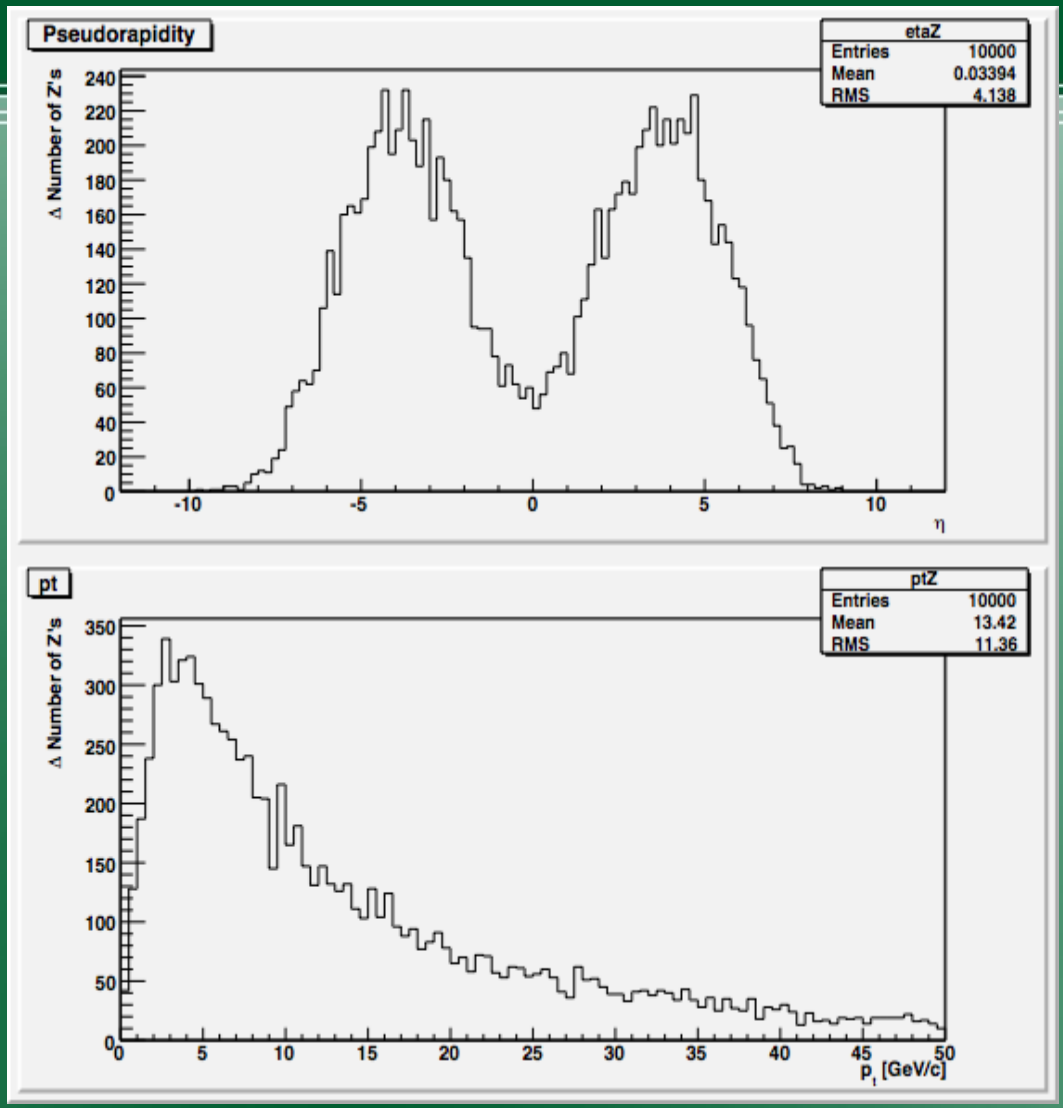
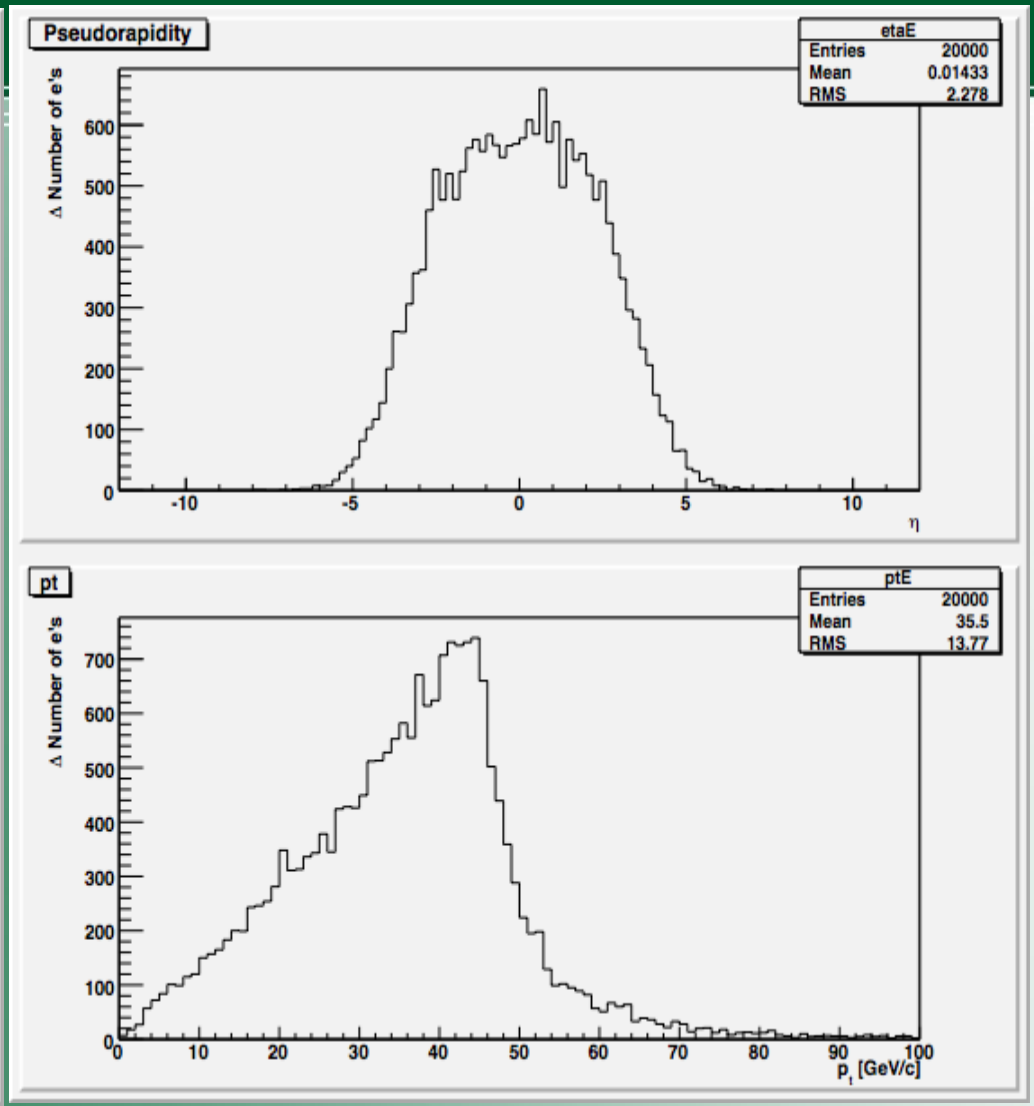
# Z and e distributions




Histograms of Z eta and pt distributions




Histograms of e eta and pt distributions



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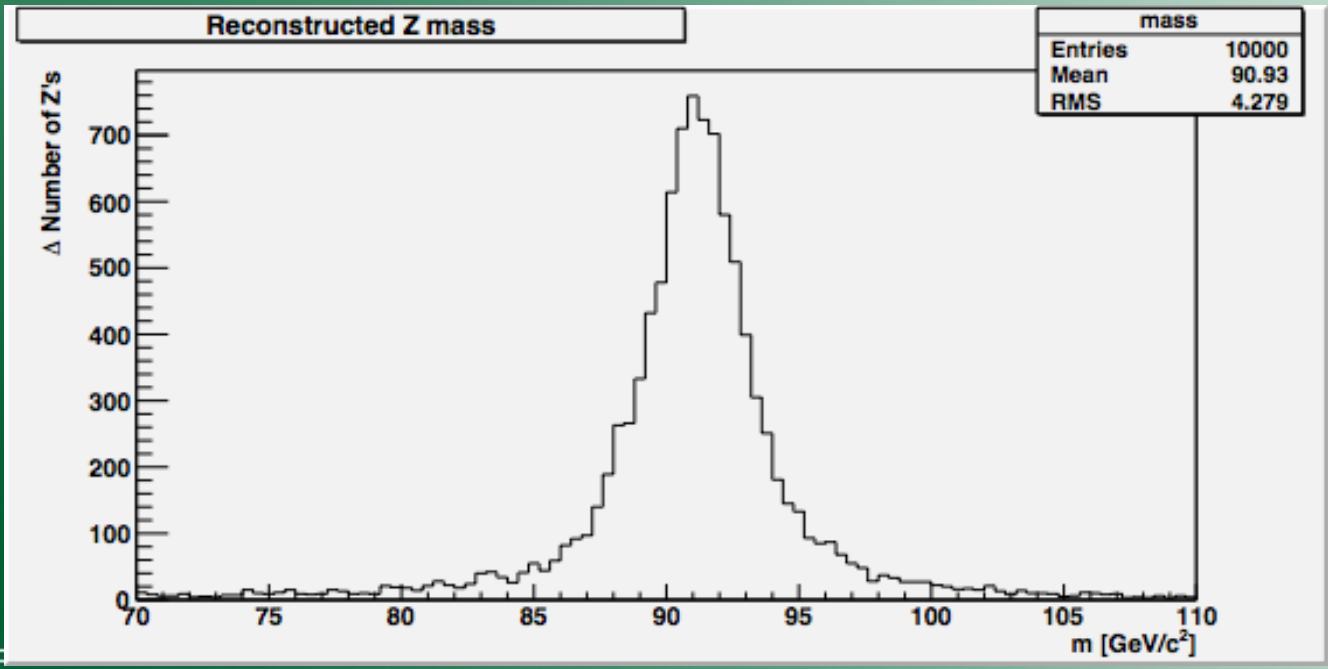
# *The Results*

- # generated = 10 000
- # in range = 5984
- # observed = 6003

Acceptance = 0.5984

Correction = 0.318%



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# *Conclusions*

- Search for new physics with CMS detector at LHC.
- We have a very good ECAL.
- $H \rightarrow \gamma\gamma$ channel is promising for a low mass Higgs.
- I wrote a Monte Carlo to determine the acceptance of $Z \rightarrow ee$ events.
- The acceptance was found to be about 0.6.


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Thank you

Any Questions?


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