Recent results with High-Pt leptons from CMS

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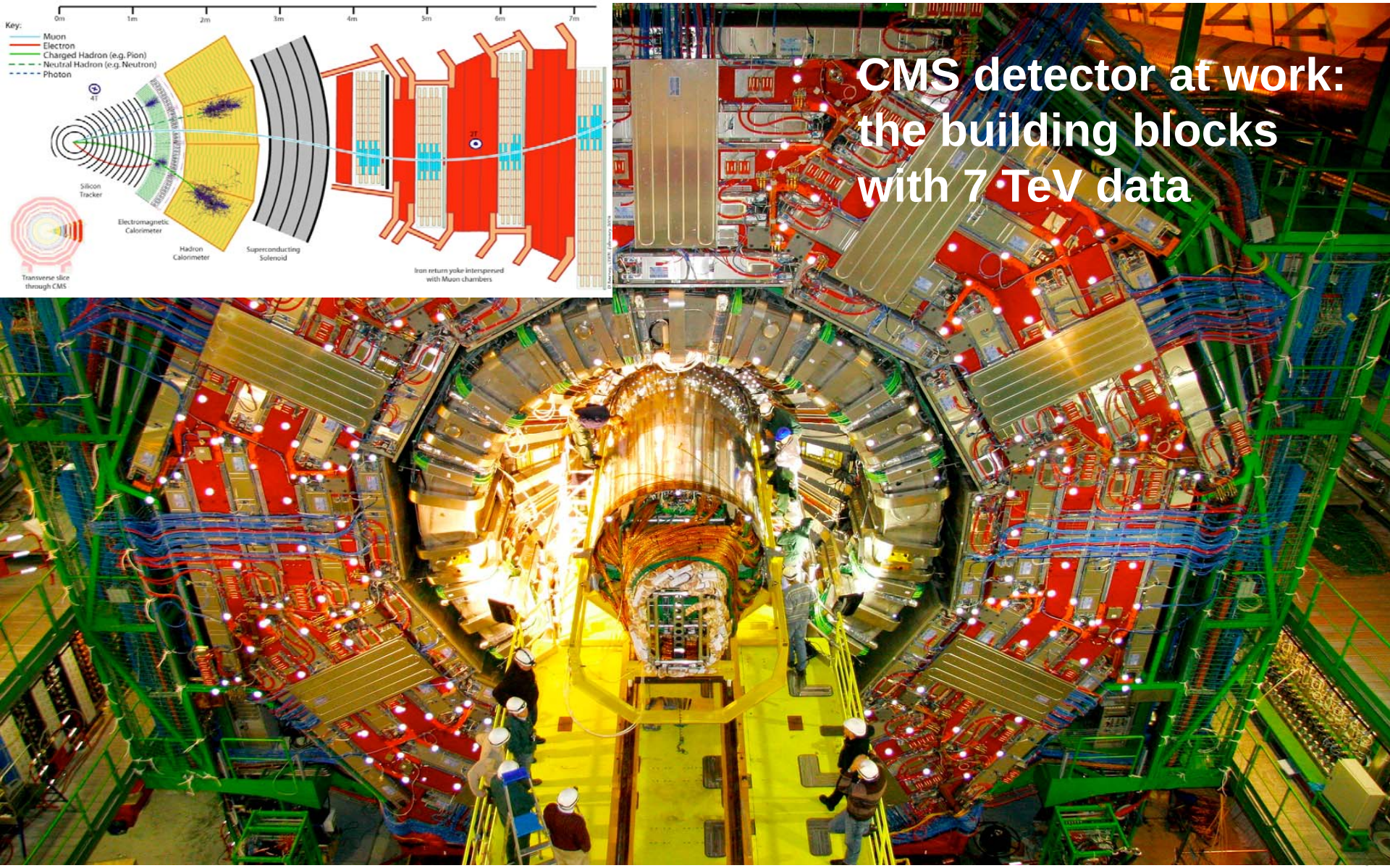
on behalf of
The CMS Collaboration

Outline

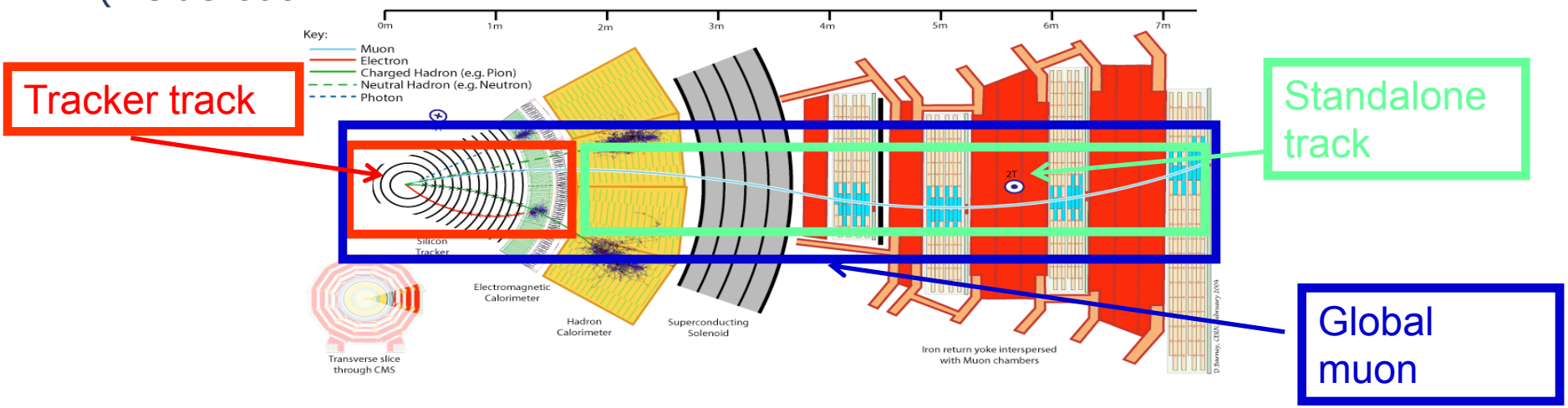
- Muons
- Electrons
- Missing energy (neutrinos)
- Taus
- W and Z bosons

CMS overview

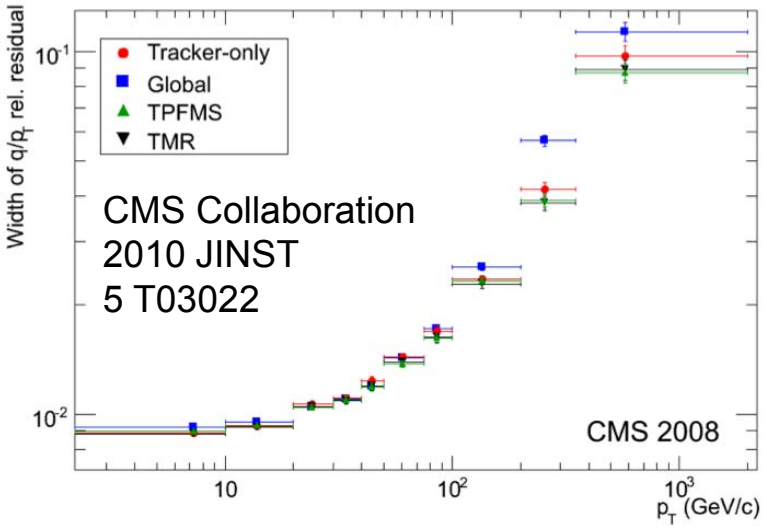


Muon reconstruction

- Three different subsystems to detect muons: Drift Tubes ($|\eta|<1.2$), Cathode Strip Chambers ($0.9<|\eta|<2.4$) and Resistive Plate Chambers ($|\eta|<1.6$)
- two complementary approaches: "standalone" (outside-in) and "tracker" (inside-out)

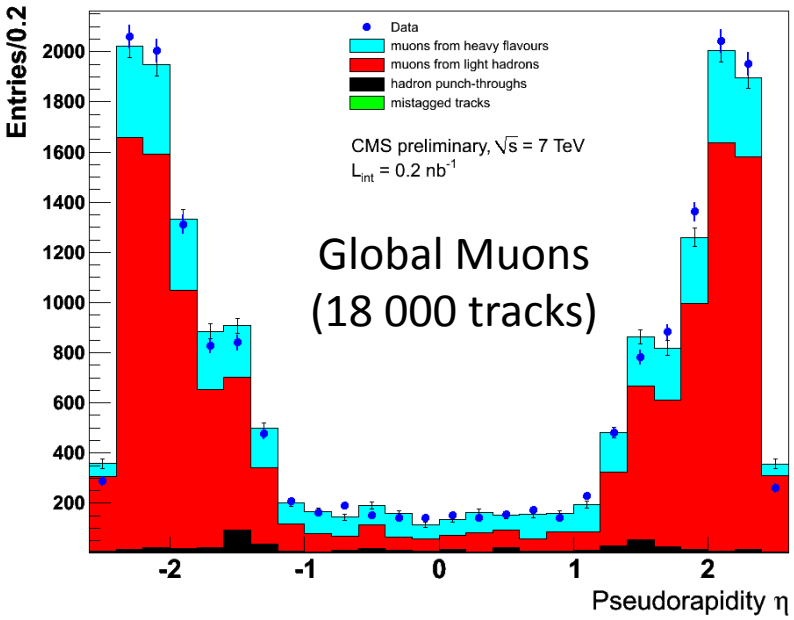


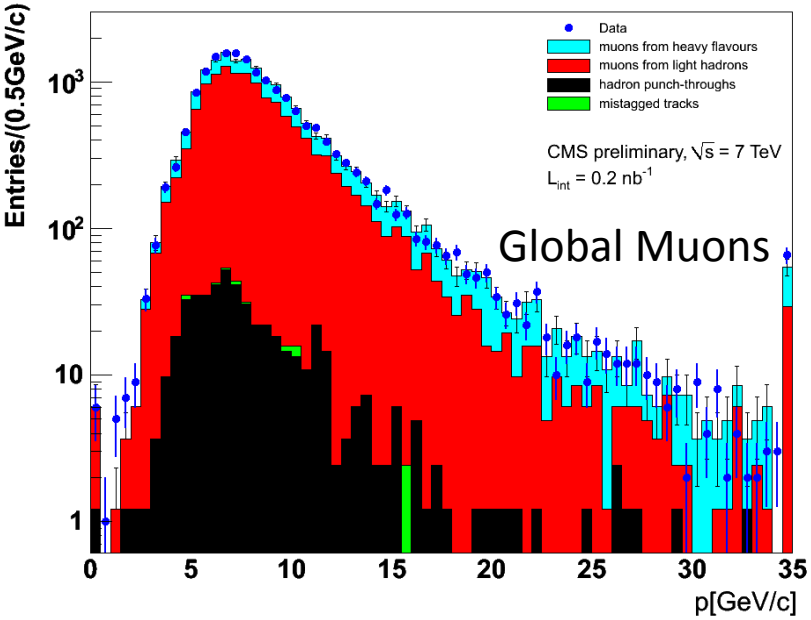
- goals: momentum measurement:
  - 1% for $p_T \approx 100$ GeV, 10% for $p_T \approx 1$ TeV
- cosmic rays runs allowed calibration and alignment at the level expected with $0(pb^{-1})$ of collisions



Muon distribution

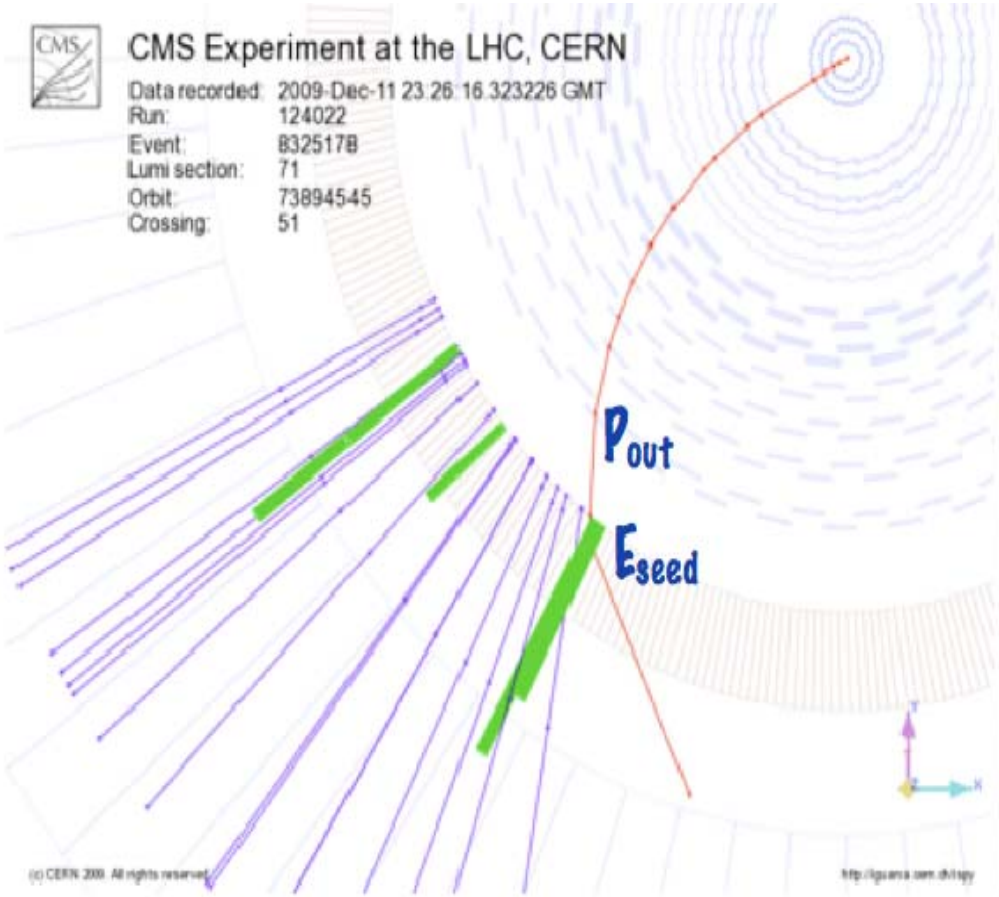
"Global Muons": matched tracks from Muon system and Tracker

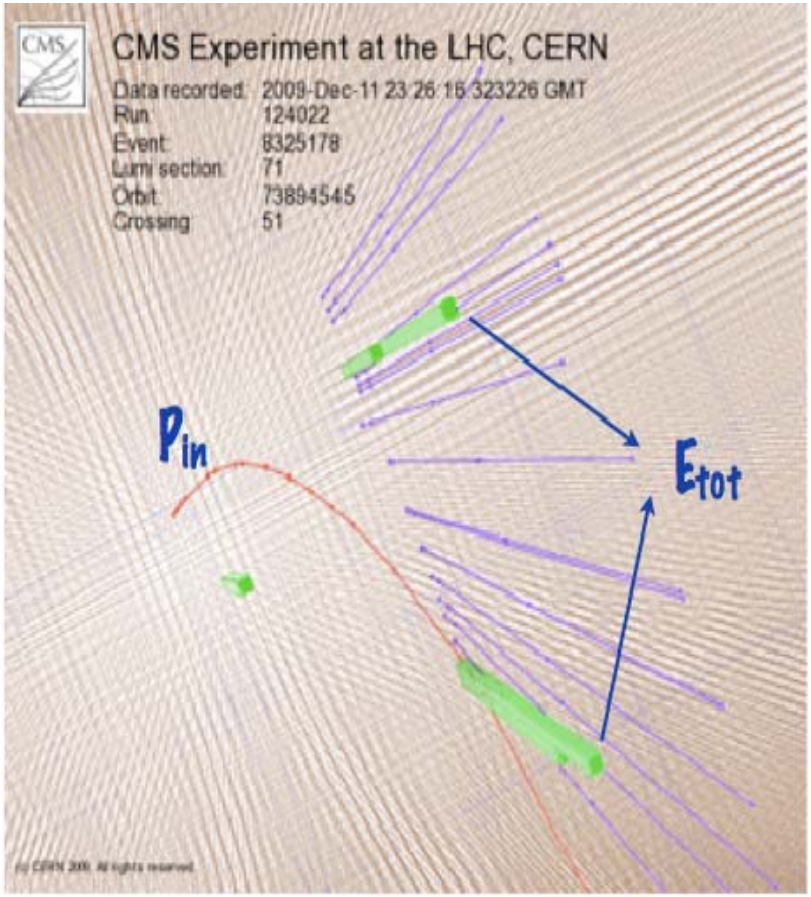




- η and p_T distributions dominated by light hadron decay muons (red)
- good agreement with MC prediction, including
  - heavy flavor decays (blue)
  - punch-through (black)
  - fakes (green)

Electrons

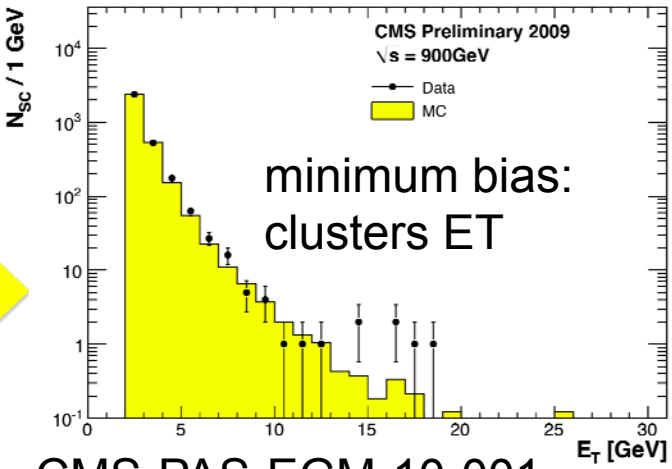




Electrons deposit their energy in several crystals in the ECAL. The presence of material in front of the calorimeter results in bremsstrahlung and photon conversions.

Electron reconstruction

- High granular and precise e.m. calorimetry allows:
  - electron energy measurement through dynamic clustering (collection of bremsstrahlung radiation along Φ)
  - electron-jet separation through cluster shape in η
  - track seeding from clean ECAL clusters
- high granular pixel + Si strips tracking system allows:
  - track pattern modeling with "Gaussian Sum Filter"
  - track seeding, complementary to ECAL seeding
  - precise track-ECAL matching
- 900 GeV→2.36 TeV→7 TeV data commissioning:
  - from low pT electrons (mainly from γ conversions) to the prompt high pT ones



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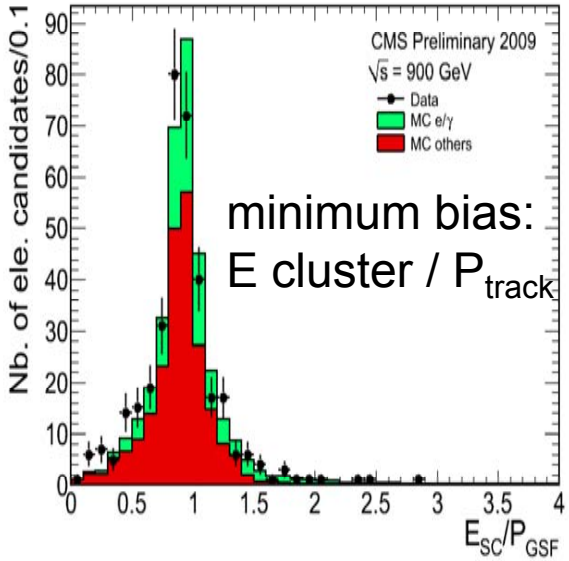


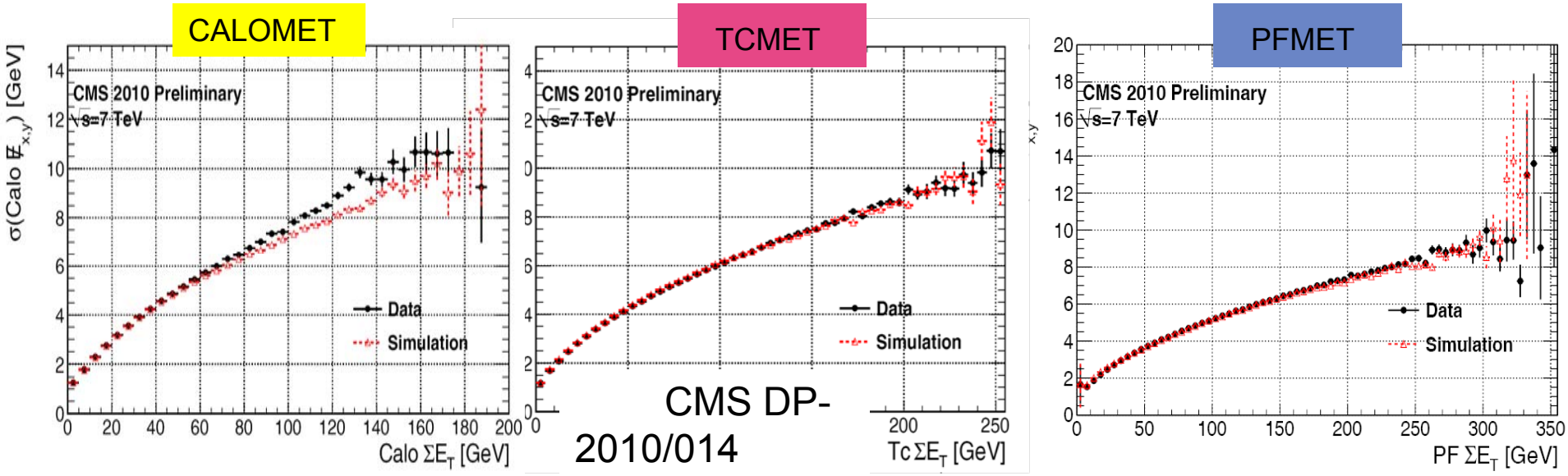
Particle Flow

- Particle Flow: Full Event reconstruction
  - Topological matching between charged particle momenta measured with tracker with clusters in calorimeter
  - Corrects for energy loss along trajectories
  - Better precision, full event info

- High-level object: requires holistic detector view
  - Excellent tracker
  - High E/M calorimeter granularity (0.017 × 0.017)
  - Strong magnetic field to separate tracks
- CMS very well suited for P-Flow reconstruction

$\not{E}_T$ commissioning

- V momentum estimated from energy imbalance in the transverse plane
- Main rejection of QCD di-jets and Drell-Yan (no real $\not{E}_T$)
- Necessary for M_W measurement (definition of $M_T(W)$) and search for new physics
- Three methods exploit increasing number of informations:
  - pure calorimetric, track-corrected, full particle flow
- First 7 TeV collision runs allowed commissioning of $\not{E}_T$:
  - Effort to reduce calorimetric noise

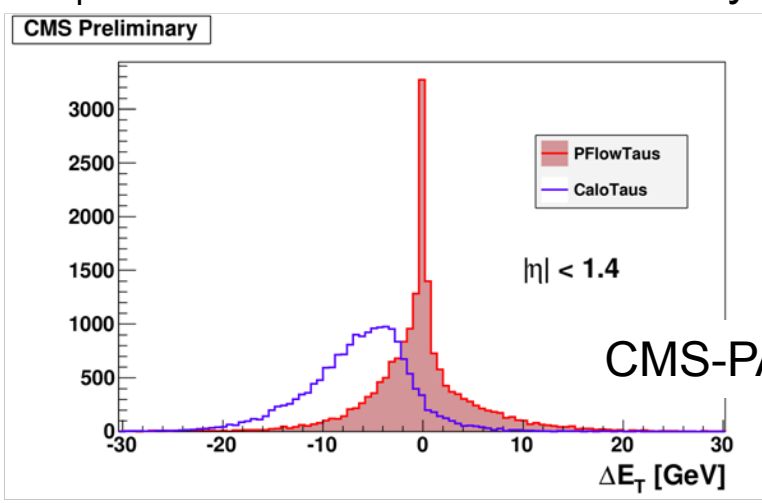


CMS DP-2010/014

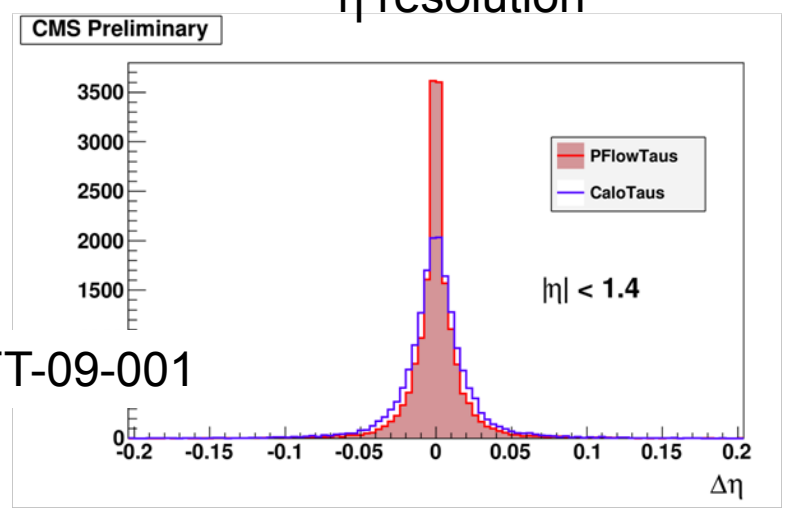
Tau prospects

- Important role for SM and Higgs.
  - About 2/3 of the taus decay hadronically, most often in 1 or 3 H^{+-}, possibly with $\pi^0 \rightarrow \gamma\gamma$
- particle-flow event reconstruction provides an excellent accuracy for the measurement of the energies and directions of all the visible tau decay products

E_T resolution for hadronic τ decay



η resolution



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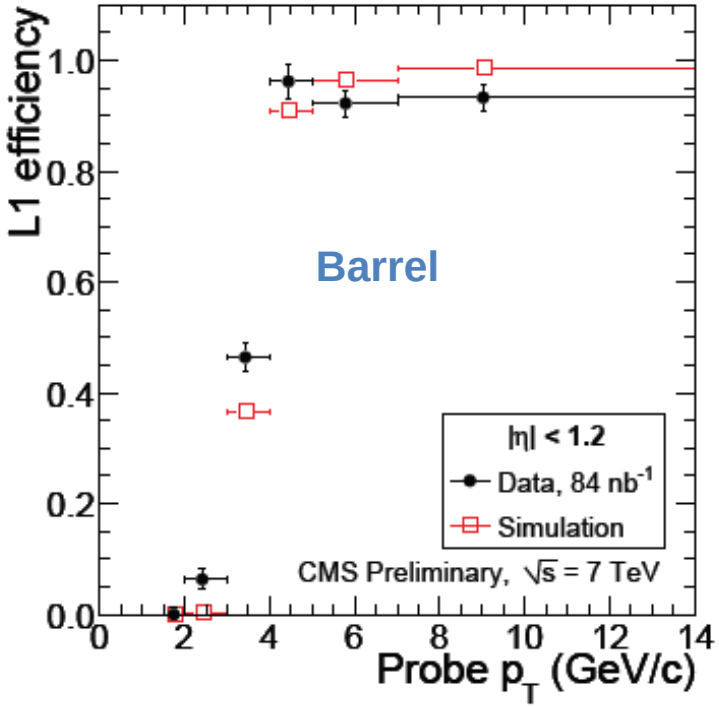
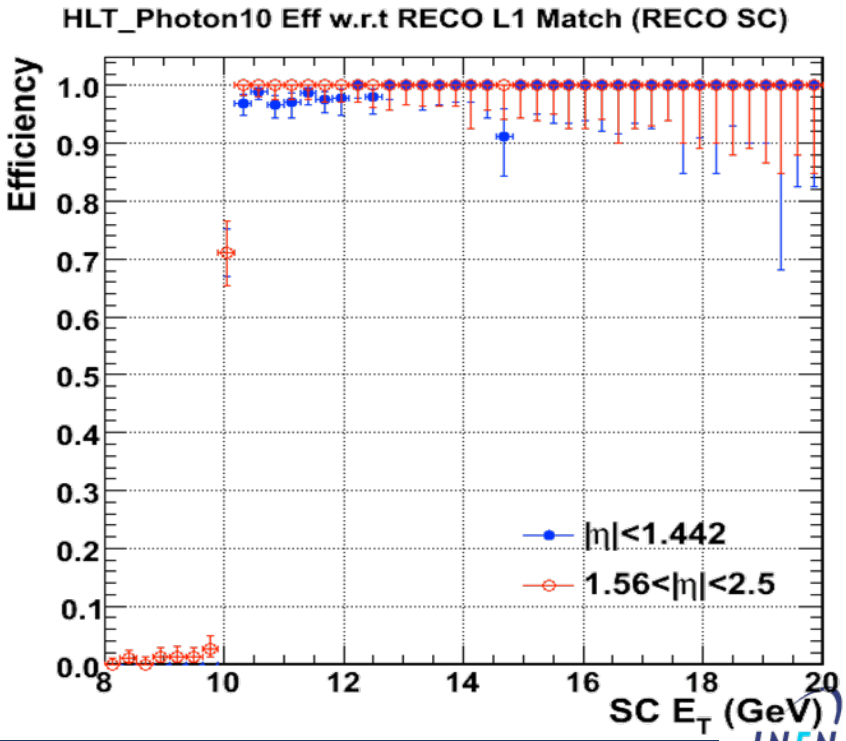
Trigger Performance



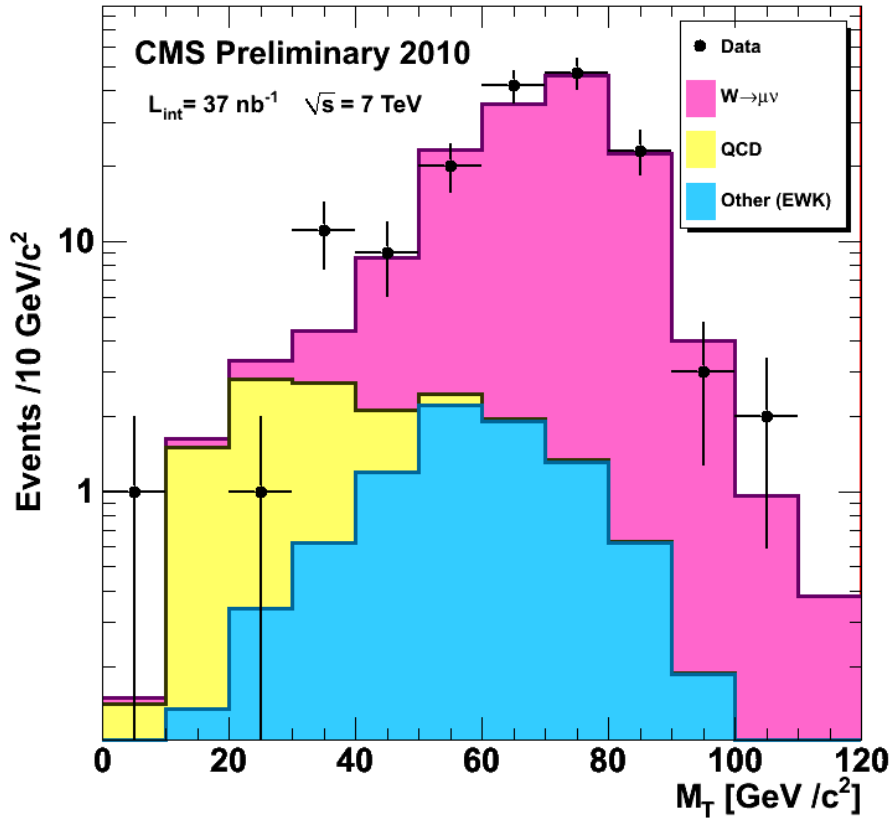
- HLT muon efficiency wrt L1
- L1 objects matched to offline objects
- ~90% efficiency at the plateau

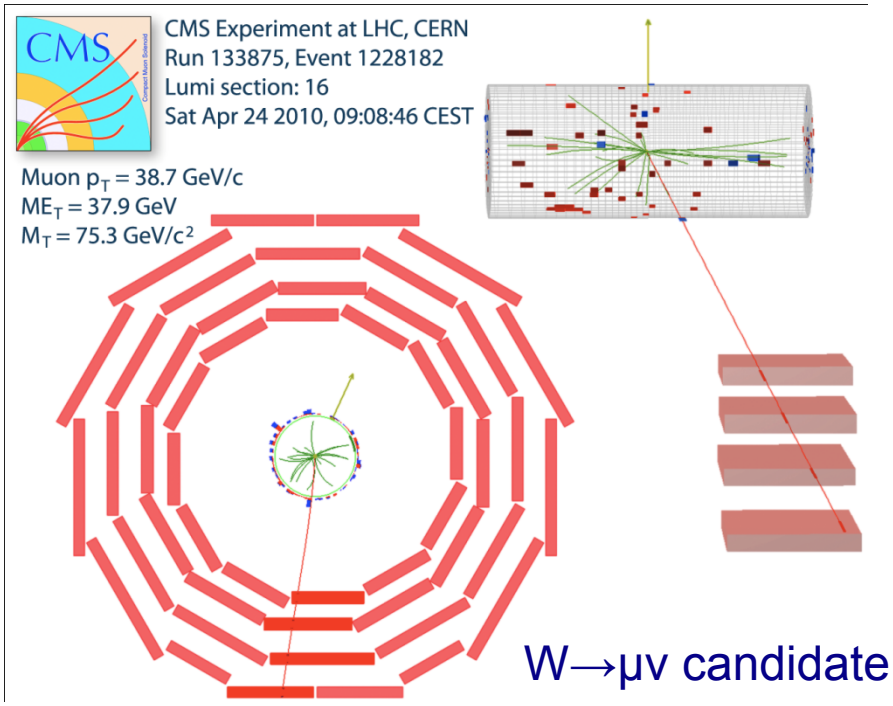


- Photon efficiency wrt offline "super clusters"
- For barrel & endcaps
- Nearly 100% efficient

$W^{\pm} \rightarrow \mu^{\pm}\nu$ observation

- Event selection:
  - Muon id cuts + trigger
  - Isolation, p_T and MET cuts
- Monte Carlo: Event count normalized to integrated luminosity



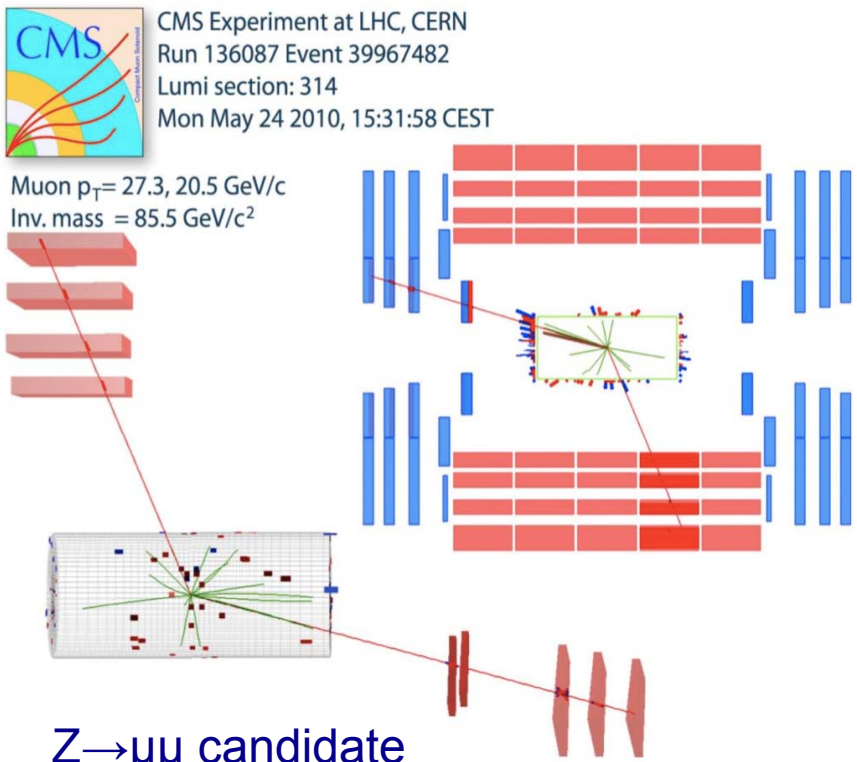


# of candidate (M_T > 50 GeV) = 137
# of expected signal (M_T > 50 GeV) = 128
# of expected background (M_T > 50 GeV) = 7

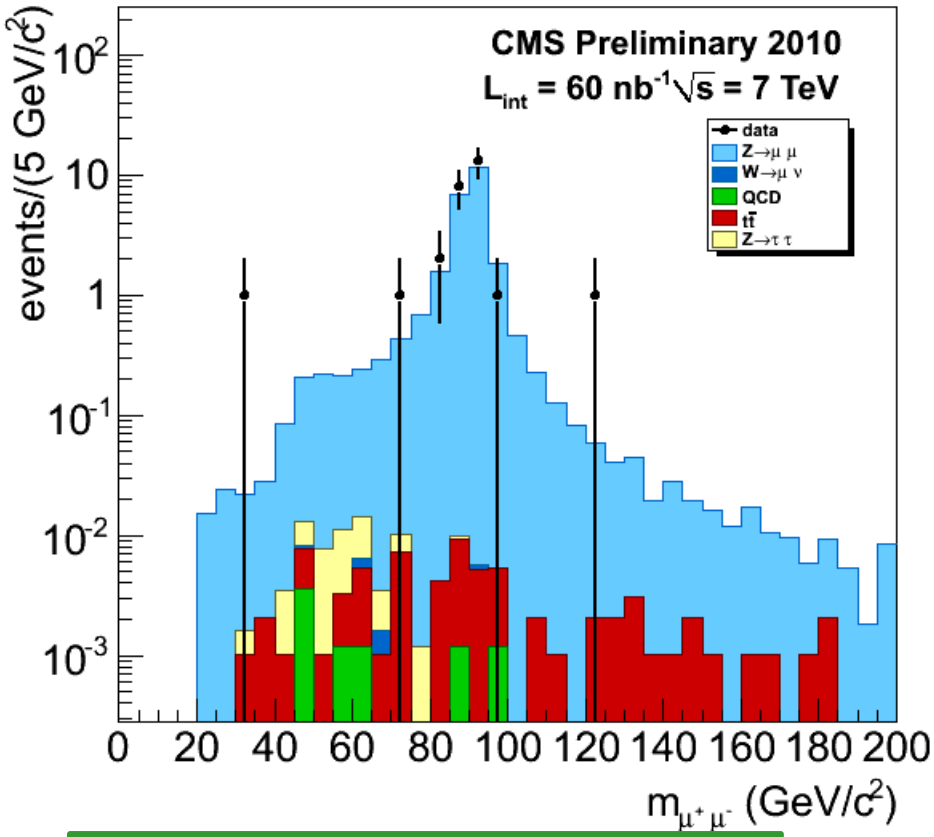
37 nb^{-1}

$Z \rightarrow \mu^+\mu^-$ observation

- Event selection:
  - Muon id cuts + trigger
  - isolation, p_T cuts
- Monte Carlo: Event count normalized to integrated luminosity



Z→μμ candidate

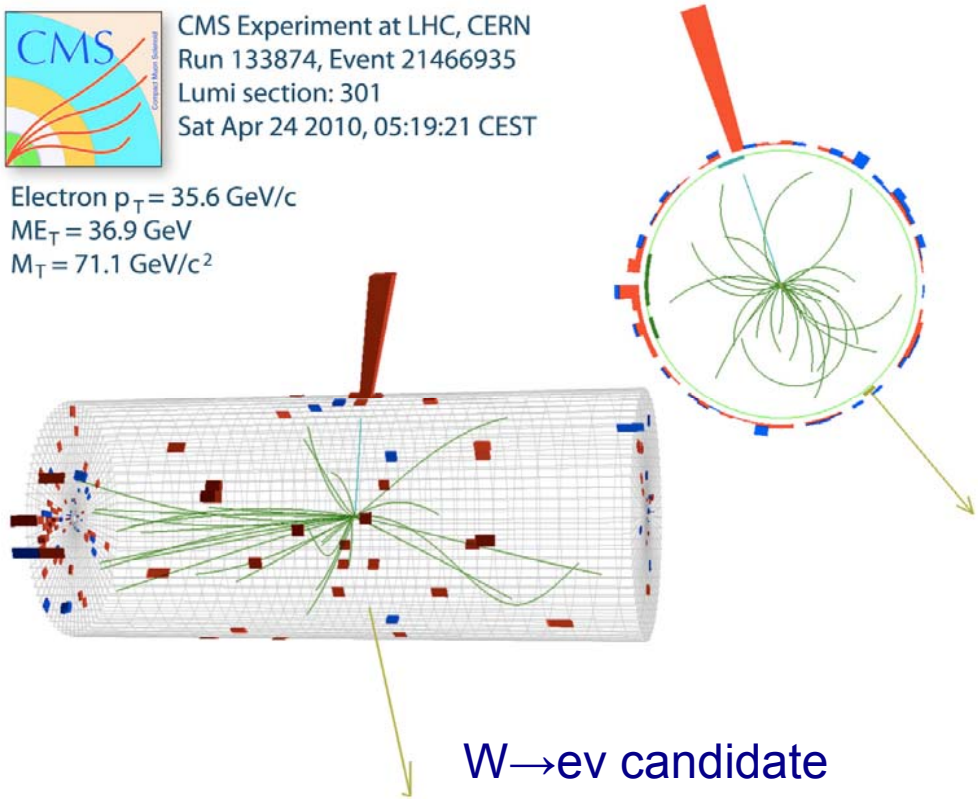


#of candidate = 25
#of expected signal = 24.7
#of expected background = 0.08

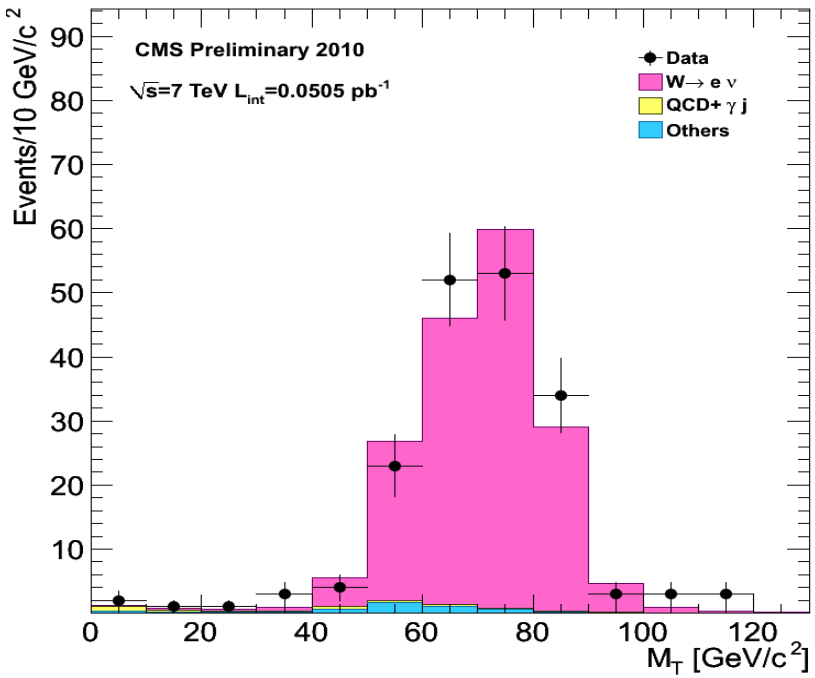
60 nb^{-1}

$W^{\pm} \rightarrow e^{\pm}\nu$ observation

Event selections:
-electron ID, cuts on E_T, MET, ΣE_T



W→eν candidate

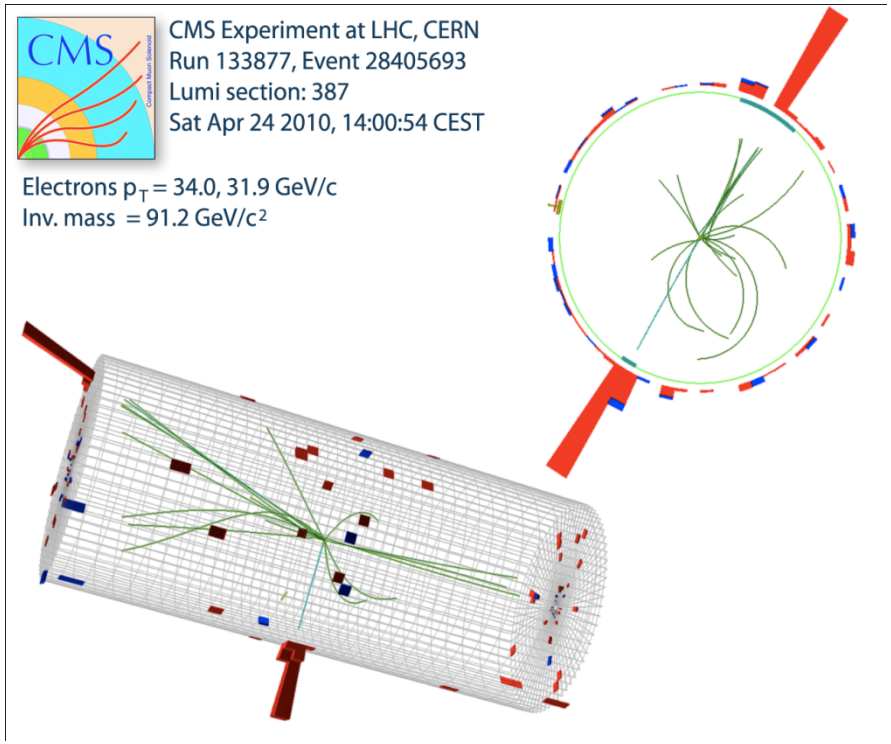


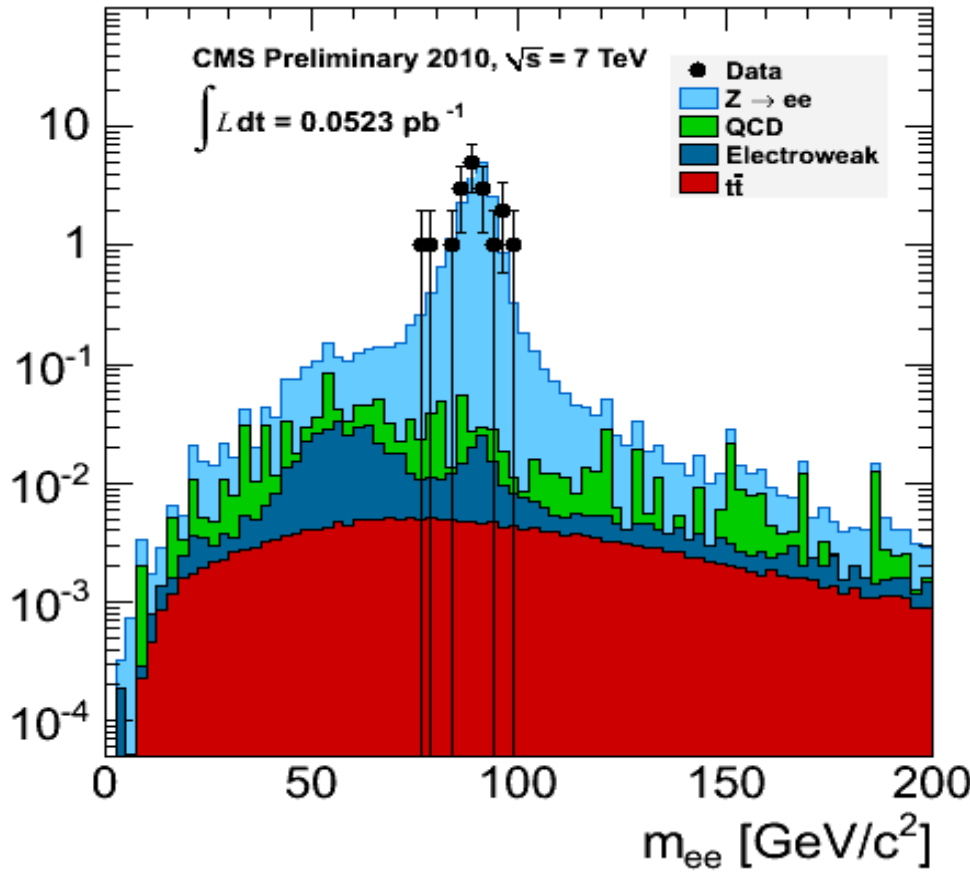
173 candidates with M_T > 50 GeV
MC: Sig=163, Bkg=5

51 nb^{-1}

$Z \rightarrow e^+e^-$ observation

- Event selection:
  - Two electrons with $E_T > 20$ GeV
- Monte Carlo: Event count normalized to integrated luminosity





#of candidate = 18
#of expected signal = 19
#of expected background = 0.8

52 nb^{-1}

Z→ee candidate

Conclusions

- CMS high-p_T lepton triggering, identification and reconstruction behaved smoothly with the first tens nb^{-1} of LHC 7 TeV operation
- Muons and electrons ewk channel already shows agreement with simulation
- MET commissioning is ongoing and already gives appreciable results
- We are ready to measure tau decay
  - Great challenge for the experiment !
- Stay tuned with iCHEP next week
  - Plenty of results from CMS
- With leptons and MET we are ready for the unknown!!!