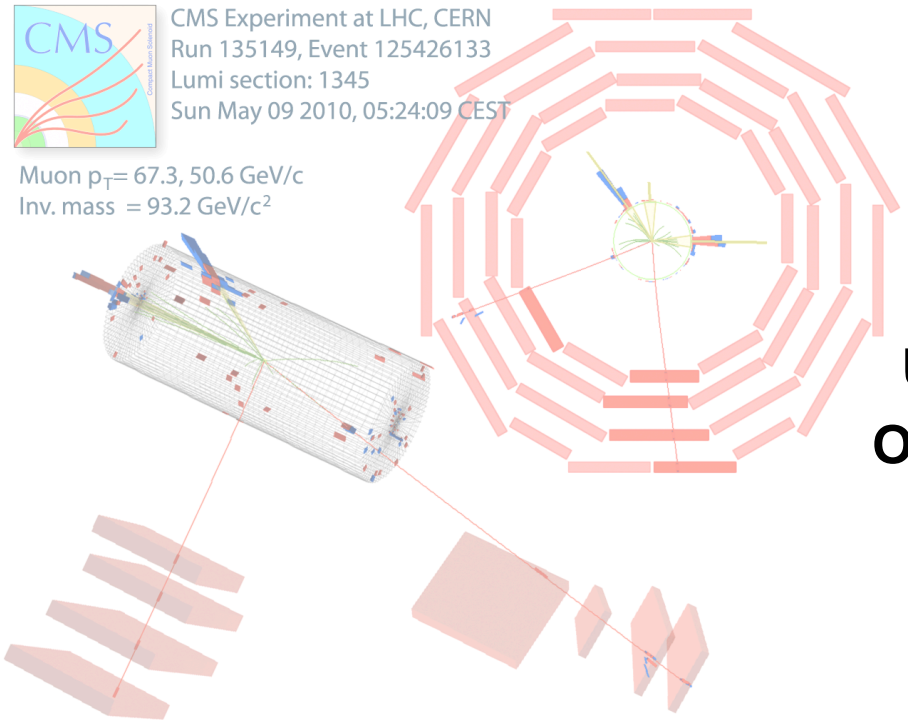
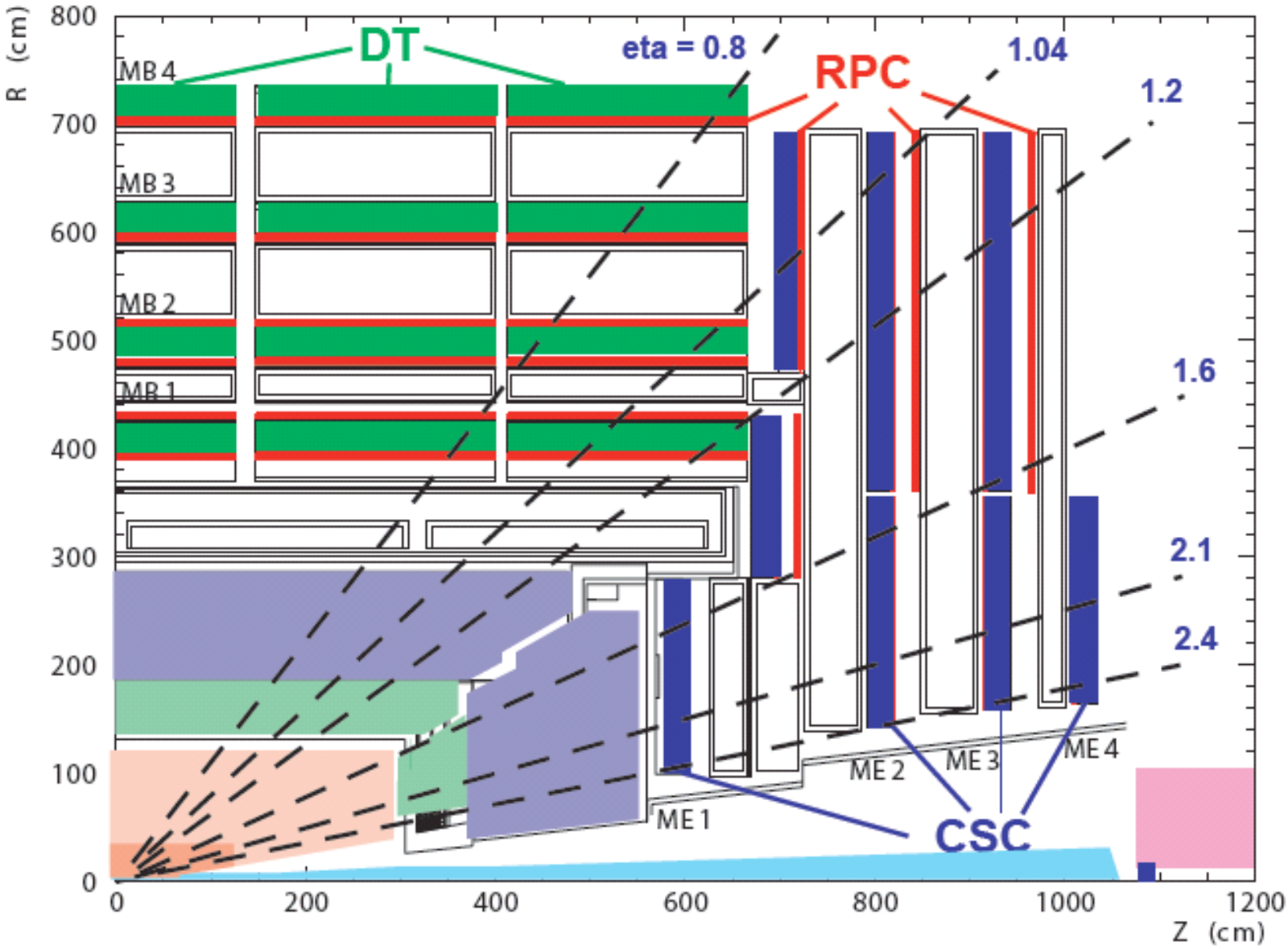
Muon Performance in the CMS Detector Using First 7 TeV Data



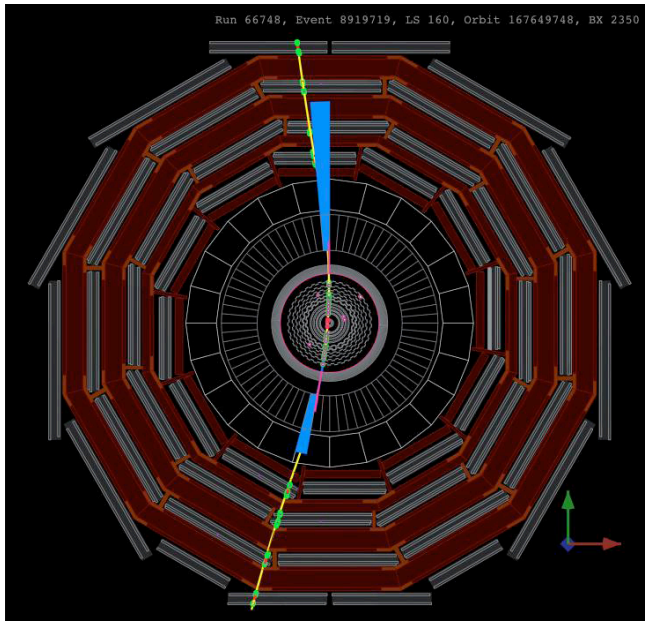
Rachel Wilken
University of California Riverside
On behalf of the CMS Collaboration

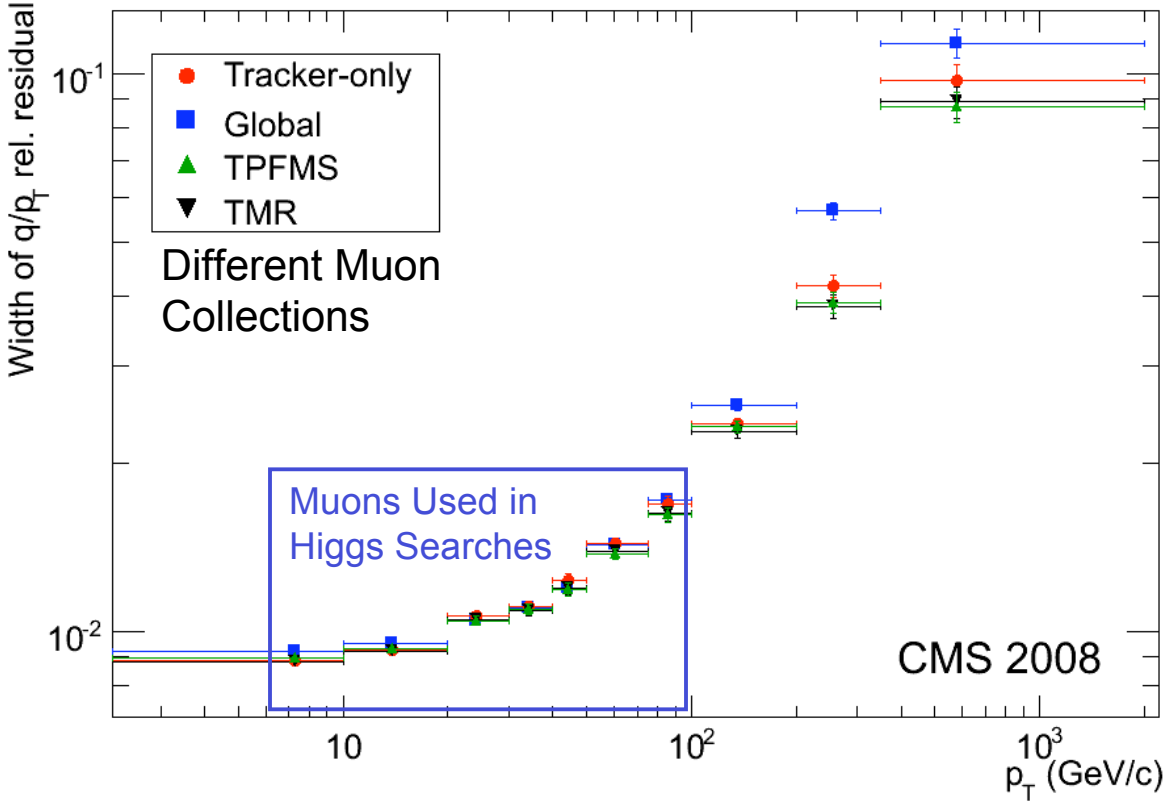
Muon Geometry



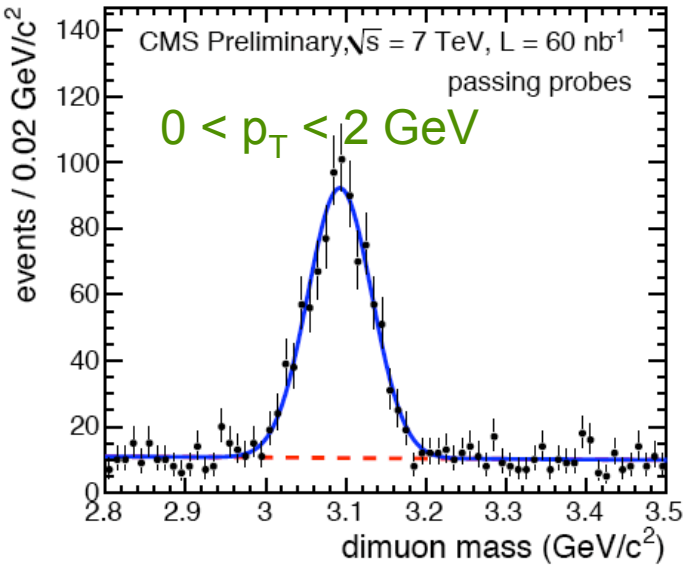
Momentum Resolution

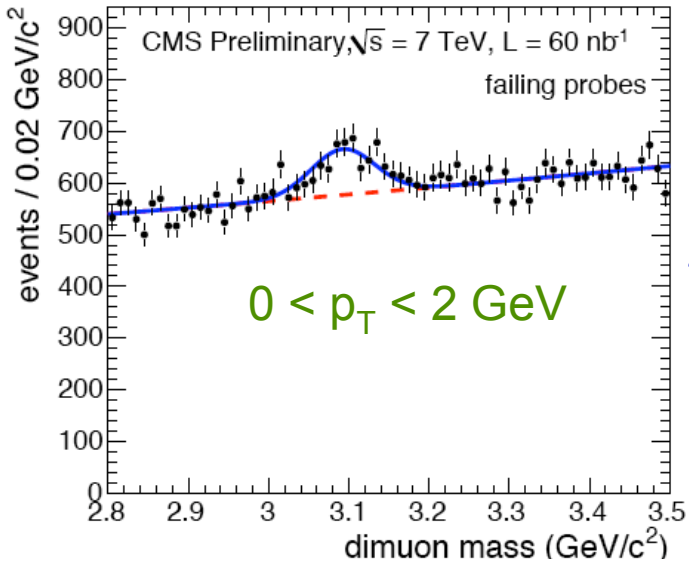
- 270 million cosmic events to make muons best understood reconstructed object in CMS
- Compare track p_T in upper and lower halves of detector
- 8% resolution at p_T = 500 GeV
- 1% at 10 GeV





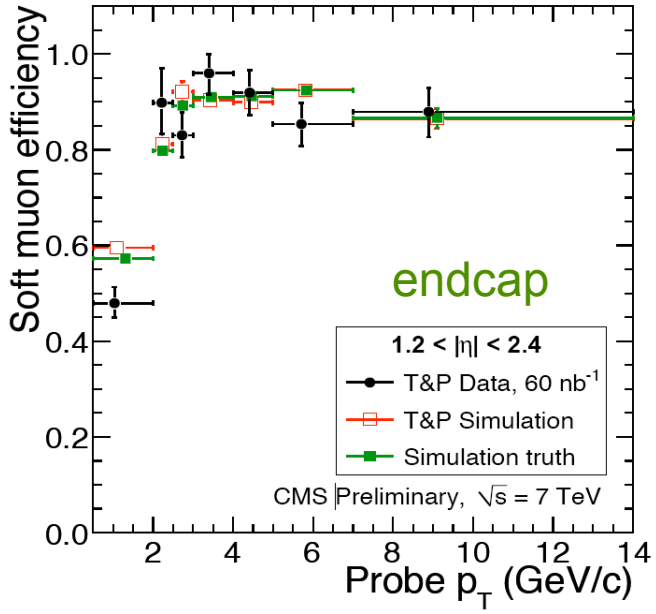
Tag and Probe



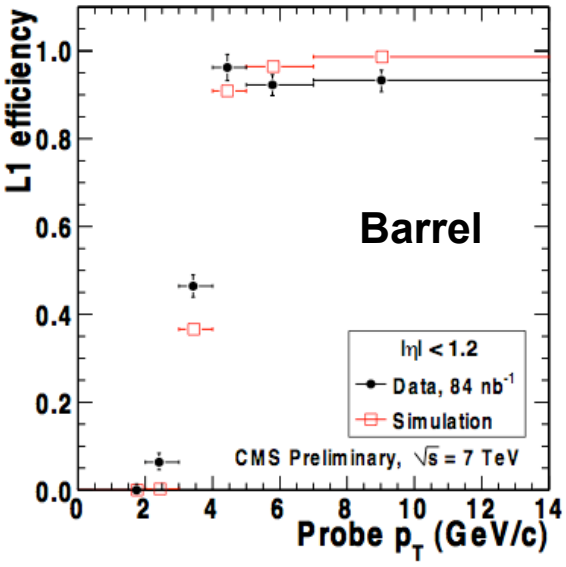


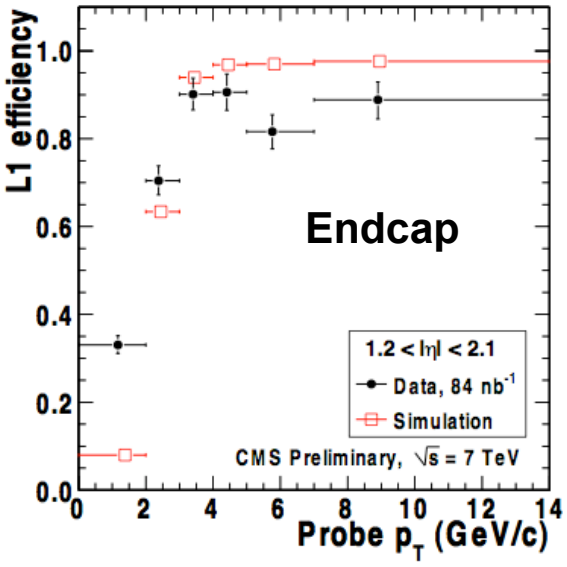
Using J/ψ→μμ resonance
2.8<$m_{\mu\mu}$<3.5 GeV

- Tight Selection on tag muon
- All probes required to have a tracker track
- Perform combined fit to “passing” and “failing” line shapes in order to subtract background

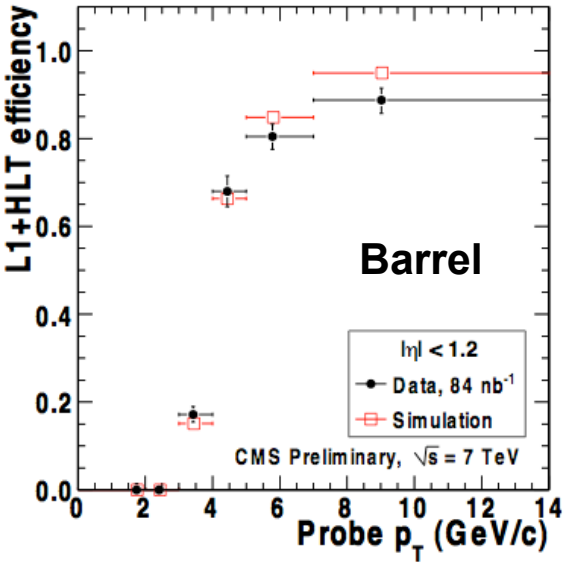


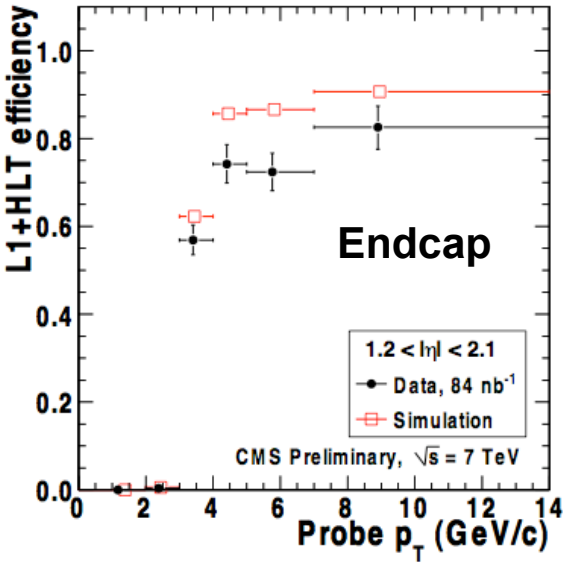
Trigger Efficiency





Level 1 Trigger

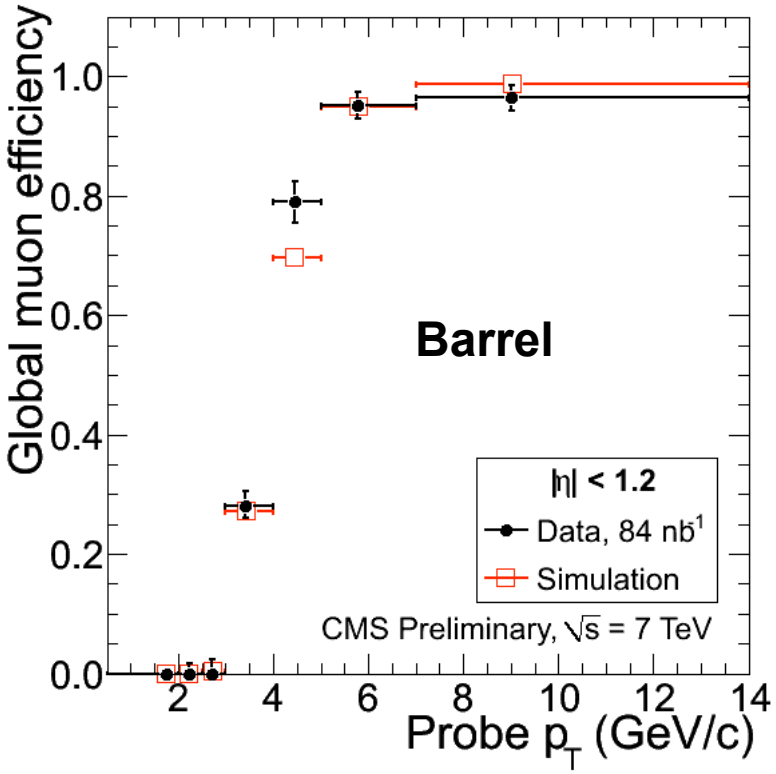


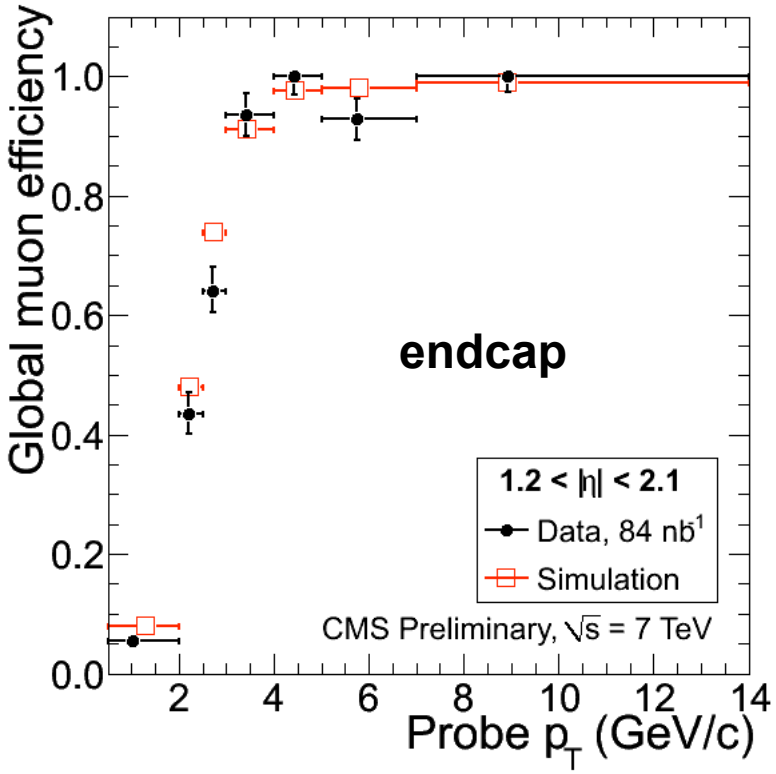


High Level Trigger + Level 1

Reconstruction Efficiency

- Tag and Probe study using $J/\psi \rightarrow \mu^+\mu^-$

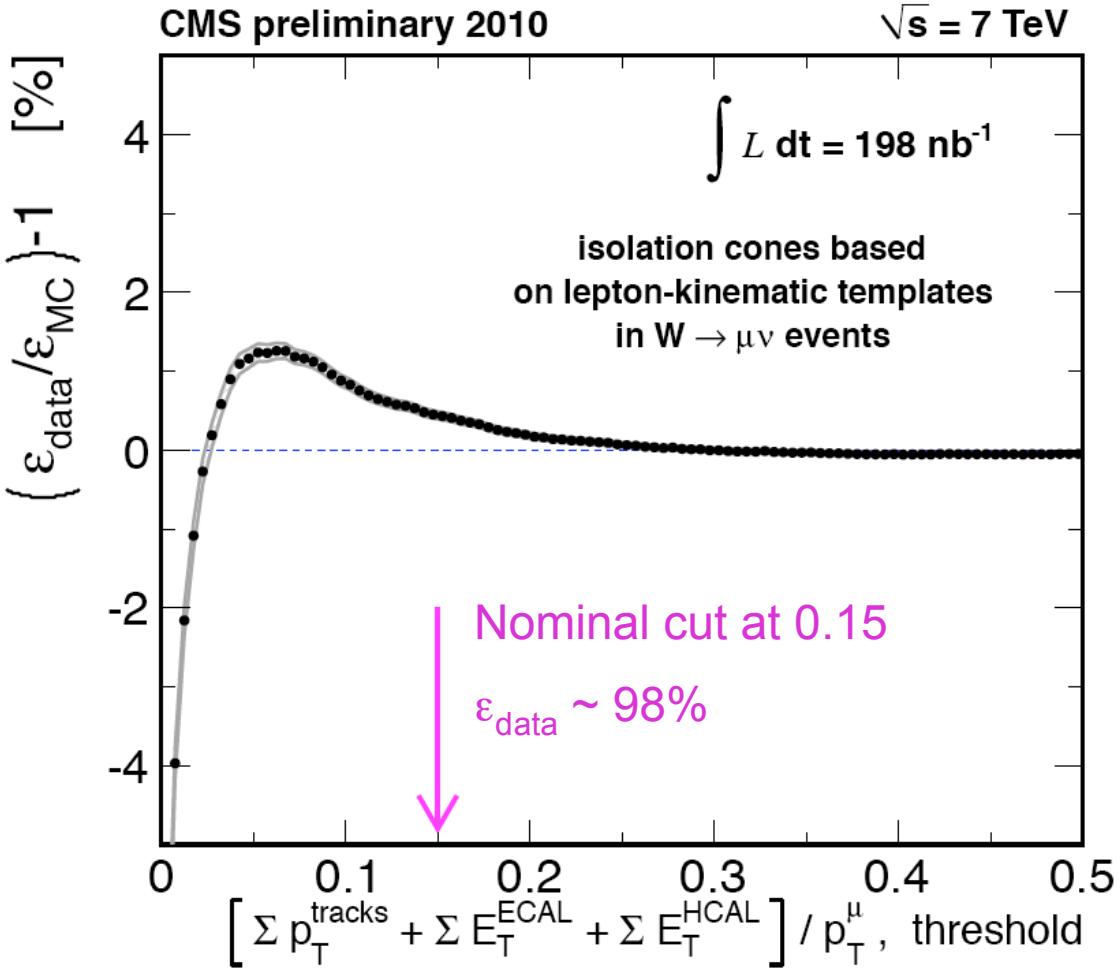




CMS fully efficient at ~5GeV

Muon Isolation

- Lepton-kinematic templates method used to calculate isolation efficiency

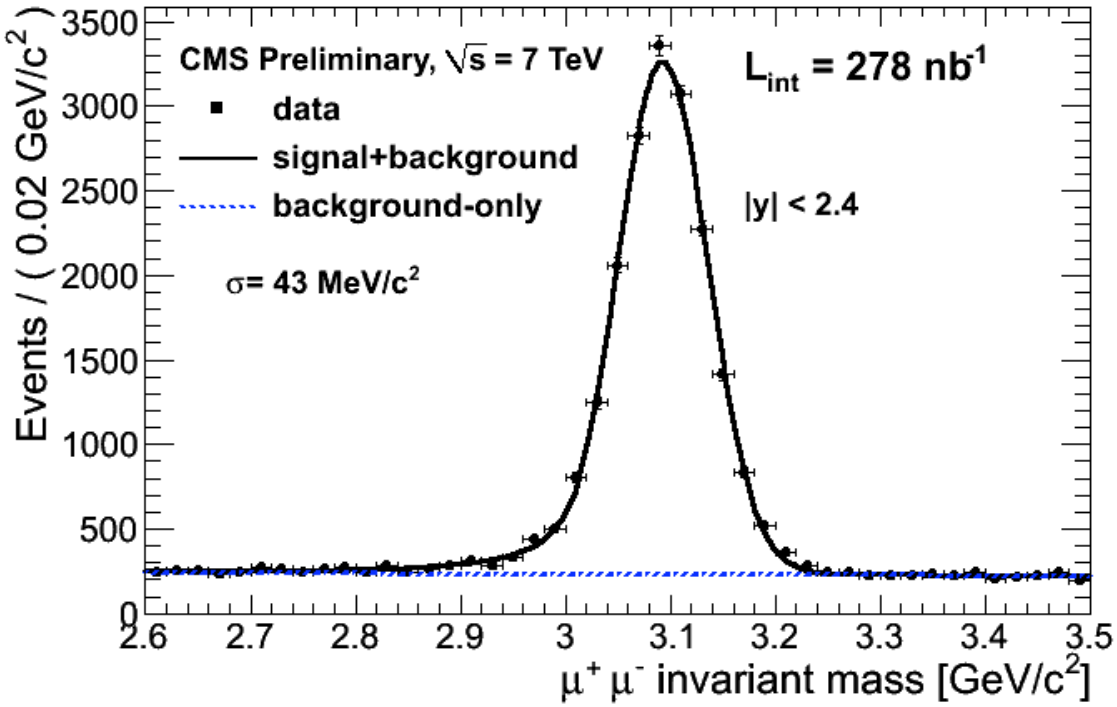


- Lepton-kinematic Templates use pre-defined directions from MC to estimate isolation in data
- Isolation calculated using 100 lepton-kinematic templates for each W->μν data event
- If template falls within 0.6 in eta and phi of muon then event thrown out

Momentum scale: $J/\psi \rightarrow \mu^+\mu^-$

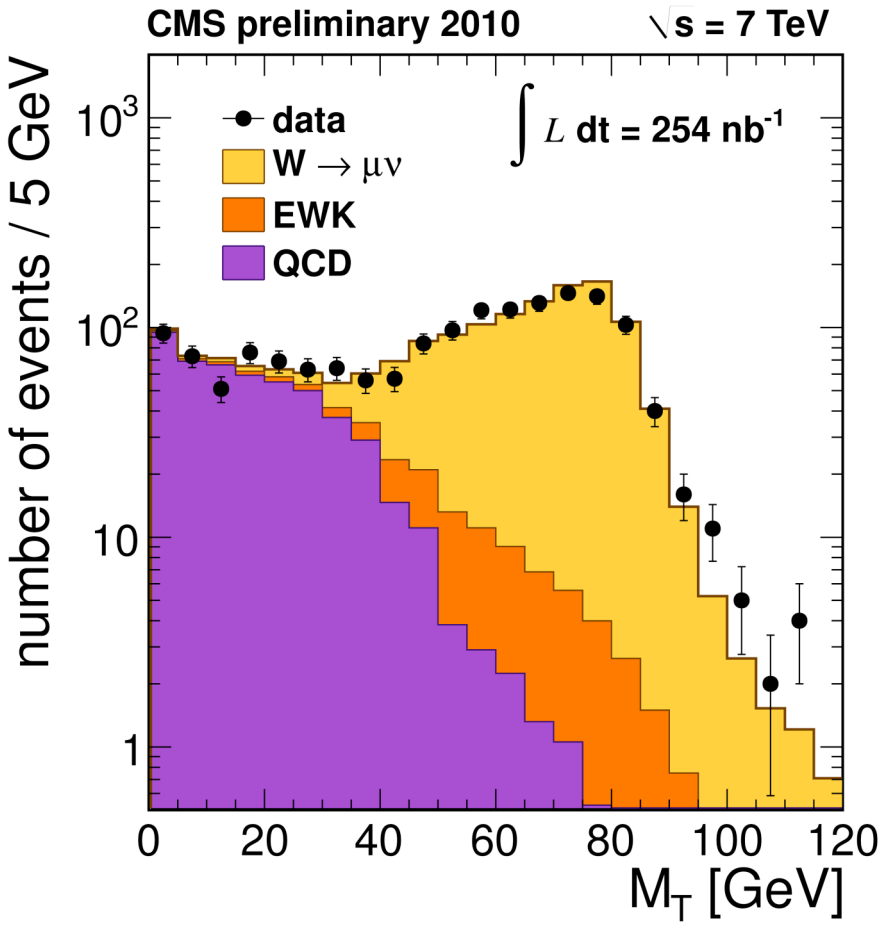
Mean from data = 3.0927±0.0005 GeV

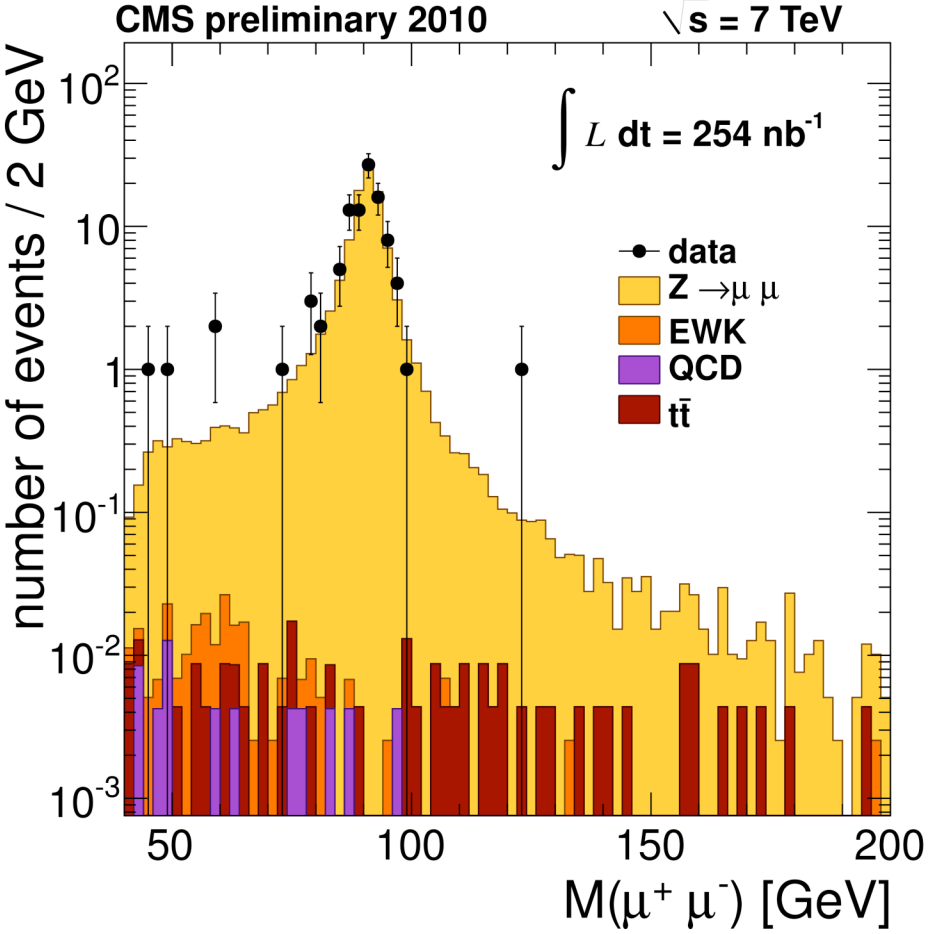
PDG mass = 3.0969±0.000011 GeV



- Use sample to further understanding of muons in CMS
  - Tag and Probe
  - Momentum scale corrections
    - Mass as a function of η and p_T
      - Material in the detector
  - Impact parameter and secondary vertices

W→μν and Z→μ⁺μ⁻





σ(pp→W+X→μν+X) =
9.14±0.33(stat)±0.58(syst)±1.00(lumi)nb

SM σ(pp→W+X→μν+X) = 10.44 nb

σ(pp→Z(γ*)+X→μ⁺μ⁻+X =
0.881±0.104(stat)±0.042(syst)±0.097(lumi)nb

SM σ(pp→Z(γ*)+X→μ⁺μ⁻+X = 0.97 nb

Conclusions

- Muons well understood using first 7 TeV data
  - Trigger
  - Reconstruction
  - Isolation
- Impressive agreement between simulation and data
- Understanding muons from W and Z is the first step to finding the Higgs in WW and ZZ channels

CMS is well on its way!