Observing the production of the jets in association with vector boson in pp collisions at $\sqrt{s}$=7TeV with CMS detector at LHC

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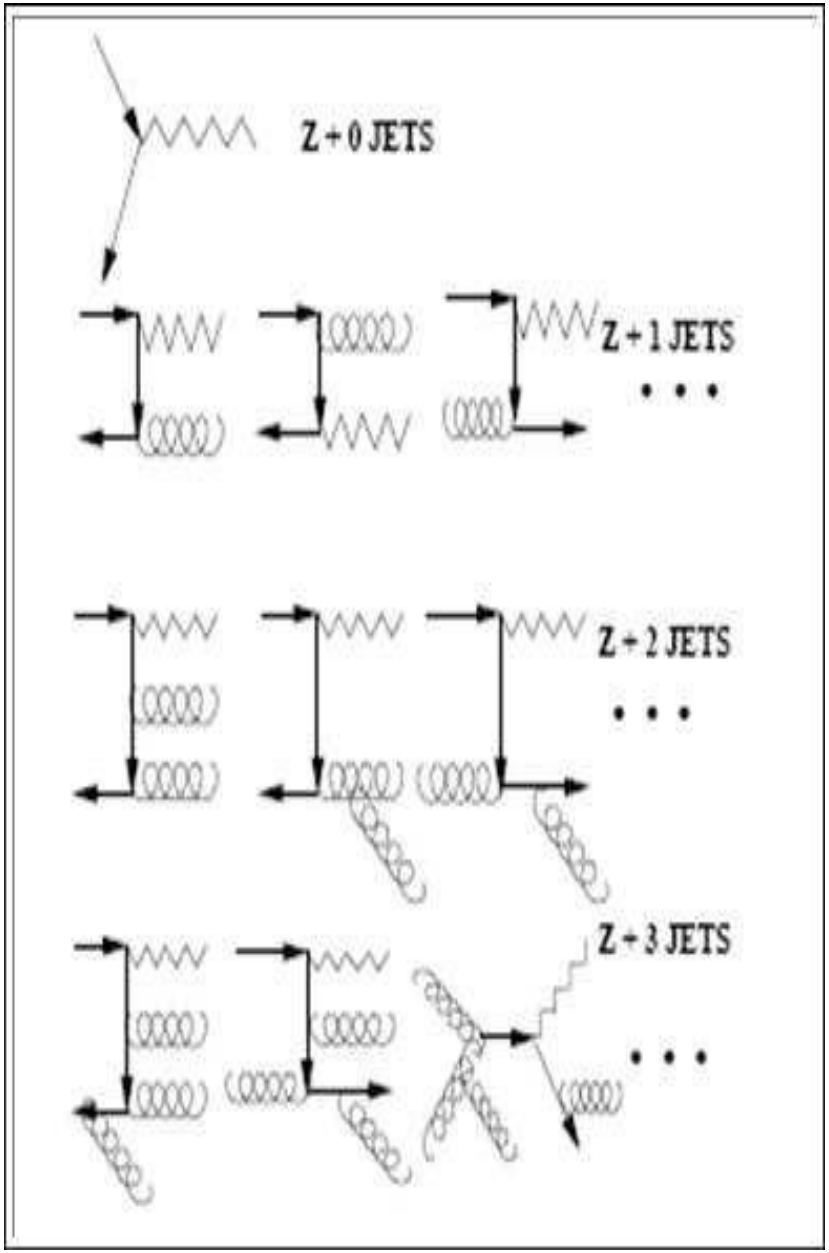
Outlook

- Why V+Jets?
- LHC & CMS
- Selections in muon/electron mode
- W/Z reconstruction
- Jet Multiplicity Analysis

Why V+Jets?

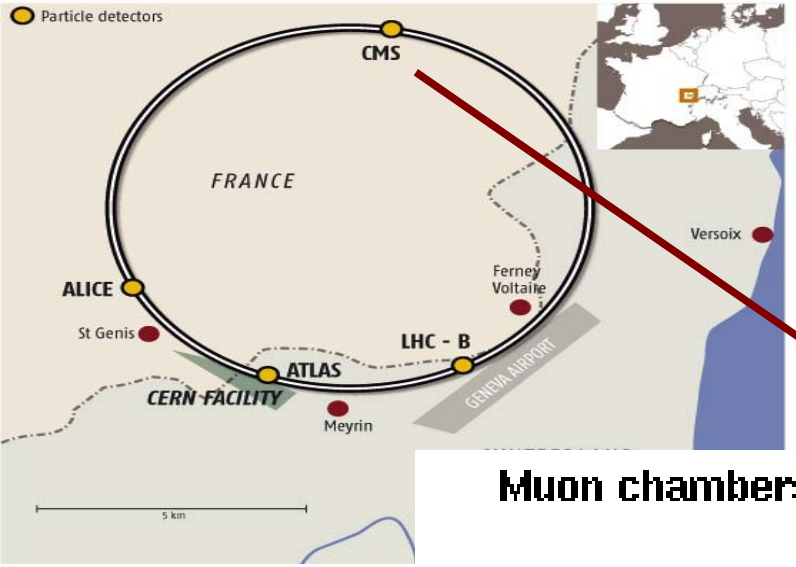
The observation of W and Z bosons produced in association with jets (V+Jets), where the vector boson decays to lepton final states is of vital physics interest to:

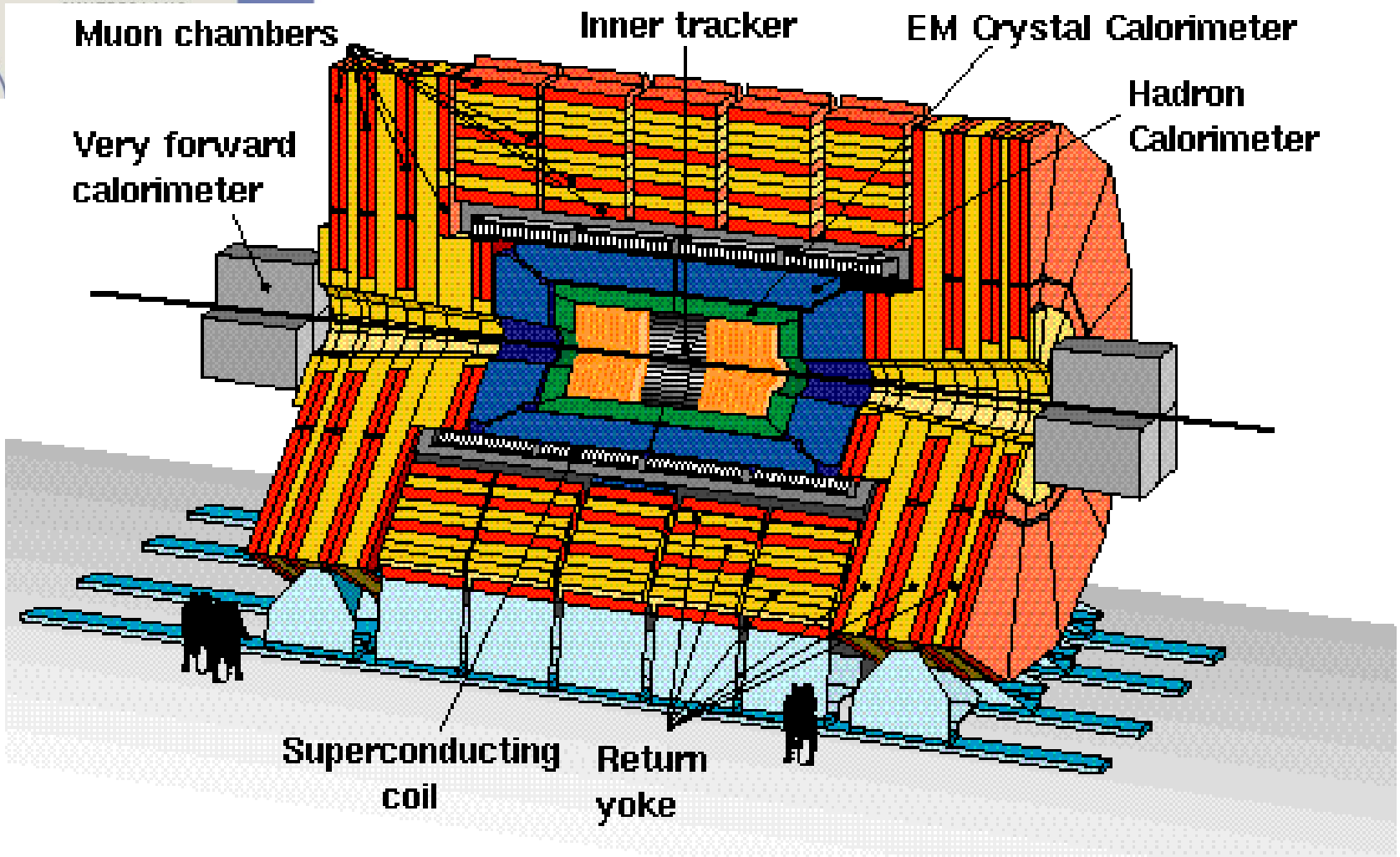
- Test the Standard Model (SM) predictions
- Test the perturbative QCD calculations
- V+Jets have very large cross-section so are significant background to other physics processes like seraches for Higgs, Top, SUSY etc.
- Important tool for detector commmissioning
  - they are used to calibrate the Jet Energy Scale.



LARGE HADRON COLLIDER

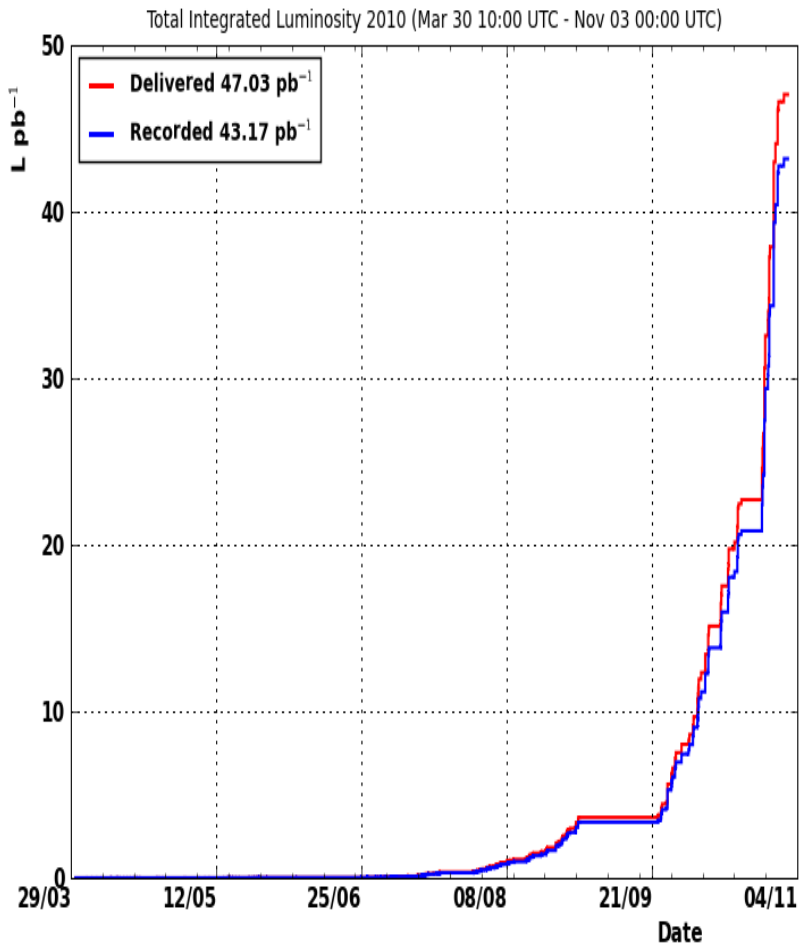
Four detectors around the 27-km-long accelerator will hunt for new particles, including the Higgs boson or "God particle"





CMS Commissioning: 2010

- Total Luminosity Integrated since March-2010: ~43 pb^{-1}
- Certified for physics analyses: 36 pb^{-1}
- Currently: We present only results obtained with very early data (198nb^{-1}).
- Studies with higher lumi. are yet to be approved.



Muon Identification and Selection

- Event Trigger
  - Level-1 (L1) and High Level Trigger (HLT) single muon trigger with an HLT threshold of pT>9GeV in |eta|<2.1
- Muon Reconstruction
  - Inner tracker information: “tracker muons”
  - Segments in muon chambers: “standalone muons”
  - *Finally we do a global fit combining tracker and muon chamber hits: “global muons”*
- Muon Identification
  - A cut on χ^2 / *ndof* <10 on a global fit containing tracker and muon hits
  - Tracks must have more than 10 hits and at least one hit in the pixel detector
  - Cosmic veto
    - transverse impact parameter < 2mm
- Muon Isolation
  - I^{rel}_{comb} = { ∑(pT(tracks)+ET(em)+ET(had)) } / pT(mu)
    - Where sums are defined in a cone of dR=0.3 around muon direction, ∑(pT(tracks): sum of all transverse track momenta, ∑(ET(em)+ET(had): sum of all transverse energies of electromagnetic and hadronic deposits.
    - Muon track and associated deposits are excluded from these sums.

Electron Identification and Selection

- Event Trigger
  - L1 (ECAL cluster Et>5GeV)+ HLT (ECAL cluster Et>15GeV)
- Offline Selection:
  - Require an ECAL cluster with Et>20GeV and |η|<1.4442 (Barrel) and 1.566<|η|<2.500 (Endcaps)
    - ECAL cluster matched to tracks using gaussian sum fit track algorithm (GSF) which accounts for the possible energy loss due to bremsstrahlung in the trcaker layers.
  - Electron Identification
    - Require eta-phi match between track and ECAL cluster
    - Limit the HCAL energy measured in a cone of dR<0.15 about ECAL cluster direction
    - Require ECAL cluster to have narrow width in eta.
  - Photon Conversion Rejection:
    - Require electron to have no missing hits before the first in the assigned track.
    - Reject the electron candidate, if a parallel partner track is found (x-y distance<0.02cm) and both form a small opening angle.
  - Isolation:
    - Impose limits on sums of HCAL Et, ECAL Et and track pT in a cone of dR<0.3 around the electron candidate direction.

W Boson Identification

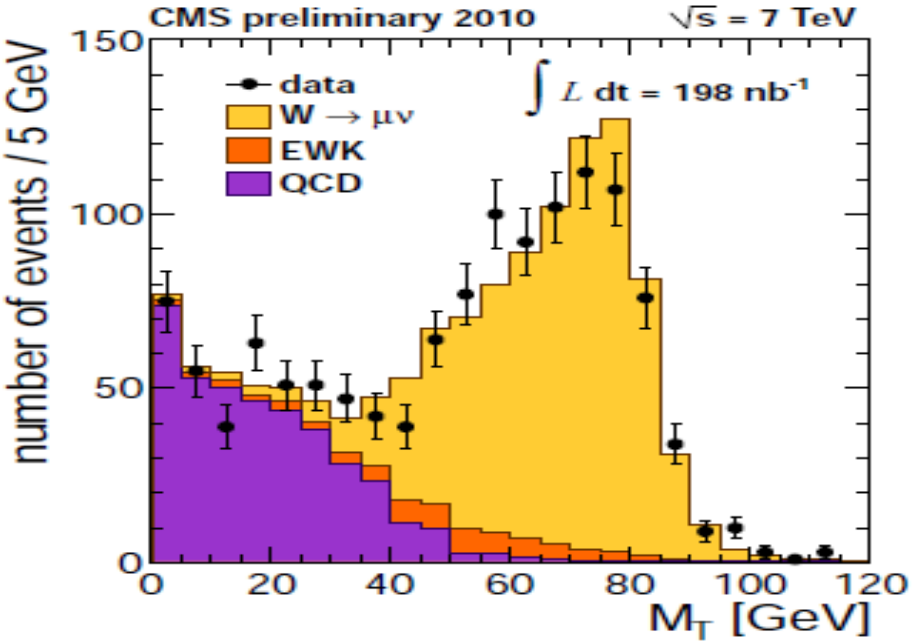
- Require one high pT isolated lepton with pT>20GeV/c and in detector acceptance region
- Significant amount of missing transverse energy (MET: depicts the presence of neutrino in final state that escapes undetected)
- Drell-Yan event rejection: reject events having a second lepton with pT>20GeV

Z Boson Identification

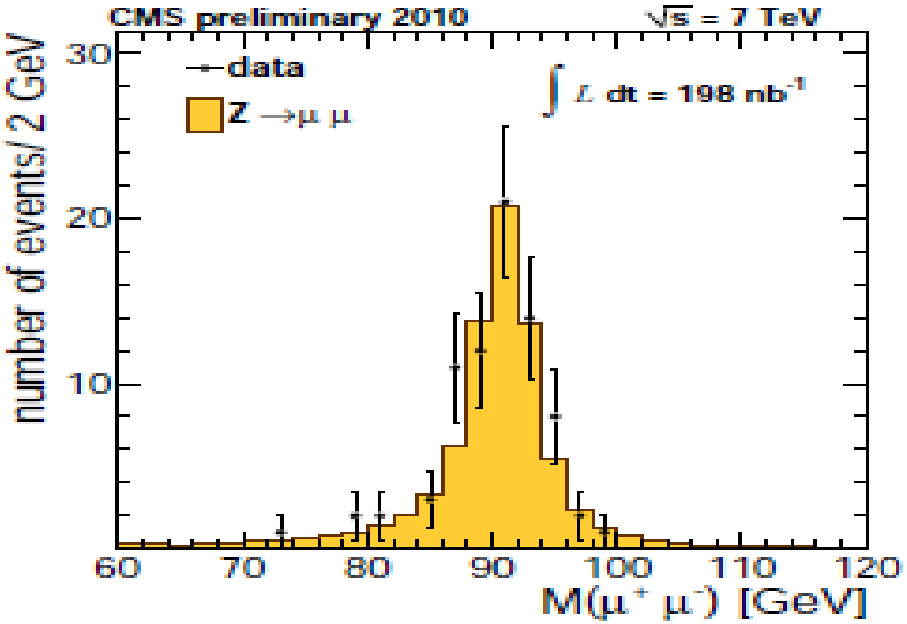
- Require presence of two high pT isolated leptons with pT>20GeV forming a di-lepton system with high reconstructed invariant mass, consistent with Z boson mass.
- Take opposite charge leptons with pT >20GeV/c with invariant mass between 60-120

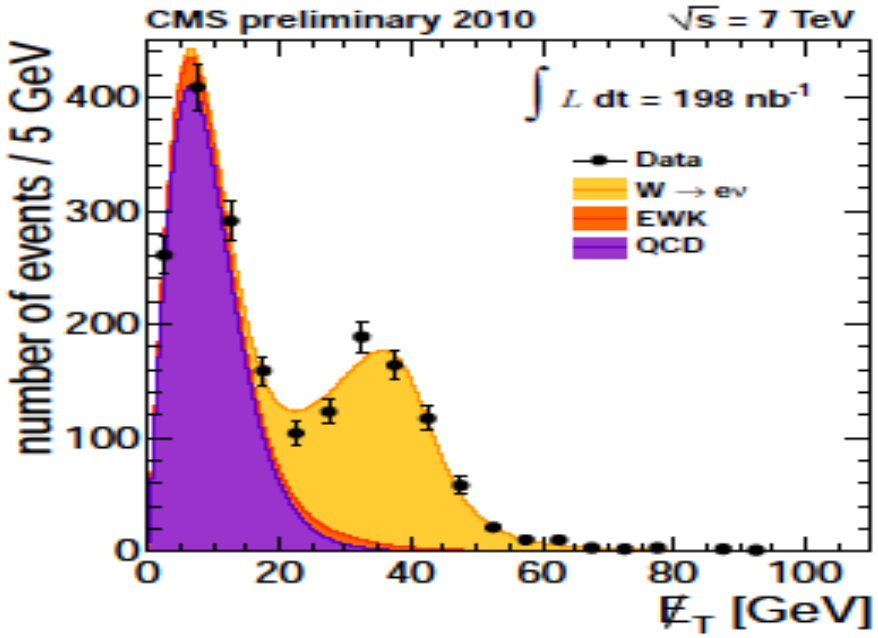
Mass Distributions

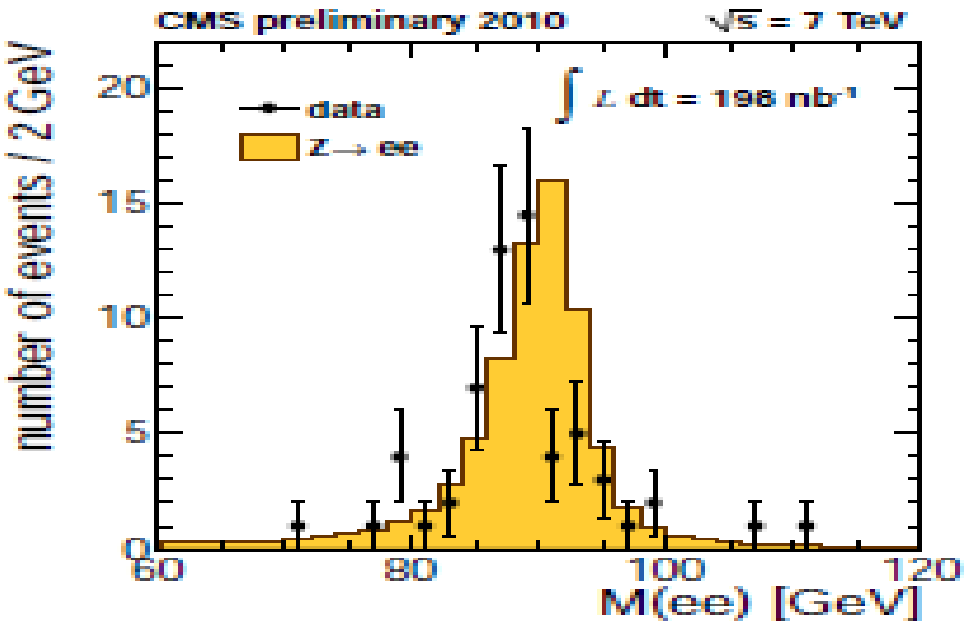
- W transverse mass



- Z invariant mass peaks







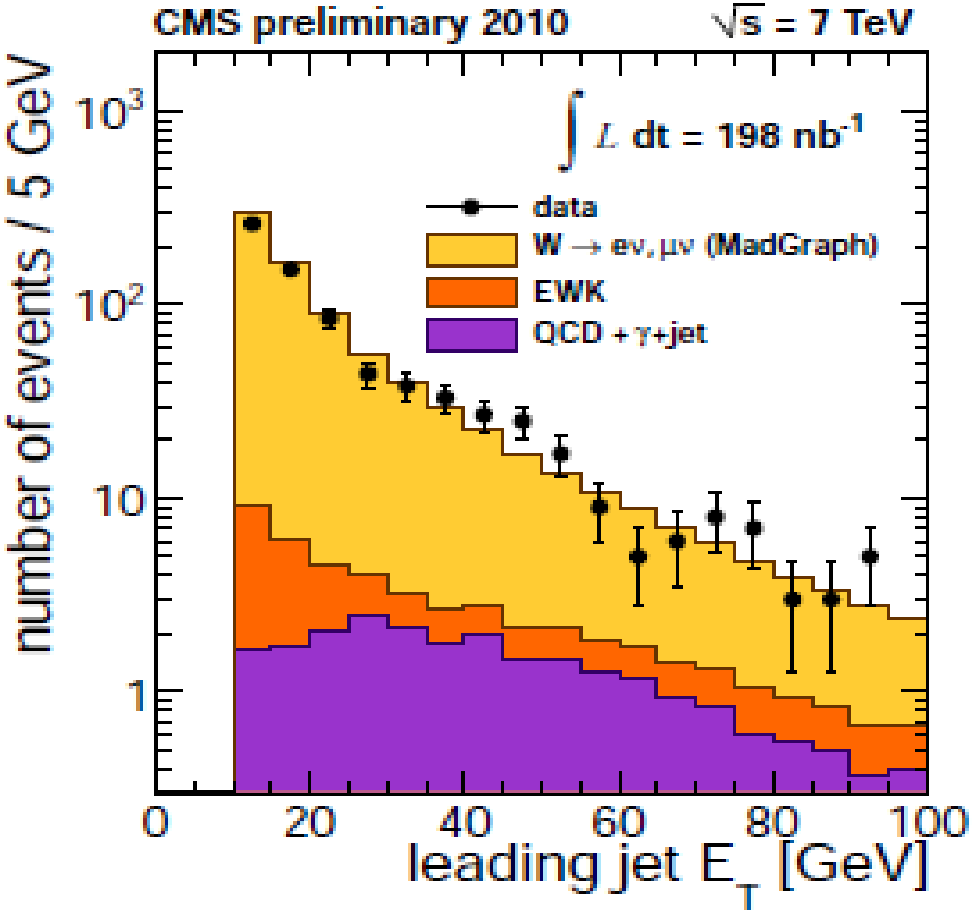
Jet Reconstruction at CMS

- Hadronic jets are reconstructed by clustering (using ak5 algorithm with dR=0.5) charged and neutral hadrons and photons identified by particle flow (PF) method.
- PF Jets are reconstructed with very good resolution.
  - JEC used are:
    - Offset removing noise and pileup
    - Relative removing variations versus η
    - Absolute removing variations versus pT
- Jets must be separated from the closest lepton identified as coming from boson decay by more than jet clustering cone radius (dR>0.5)
- Current study used the jets within tracker acceptance, for multiplicity analysis. Two different thresholds were used: Et>15GeV and Et>30GeV

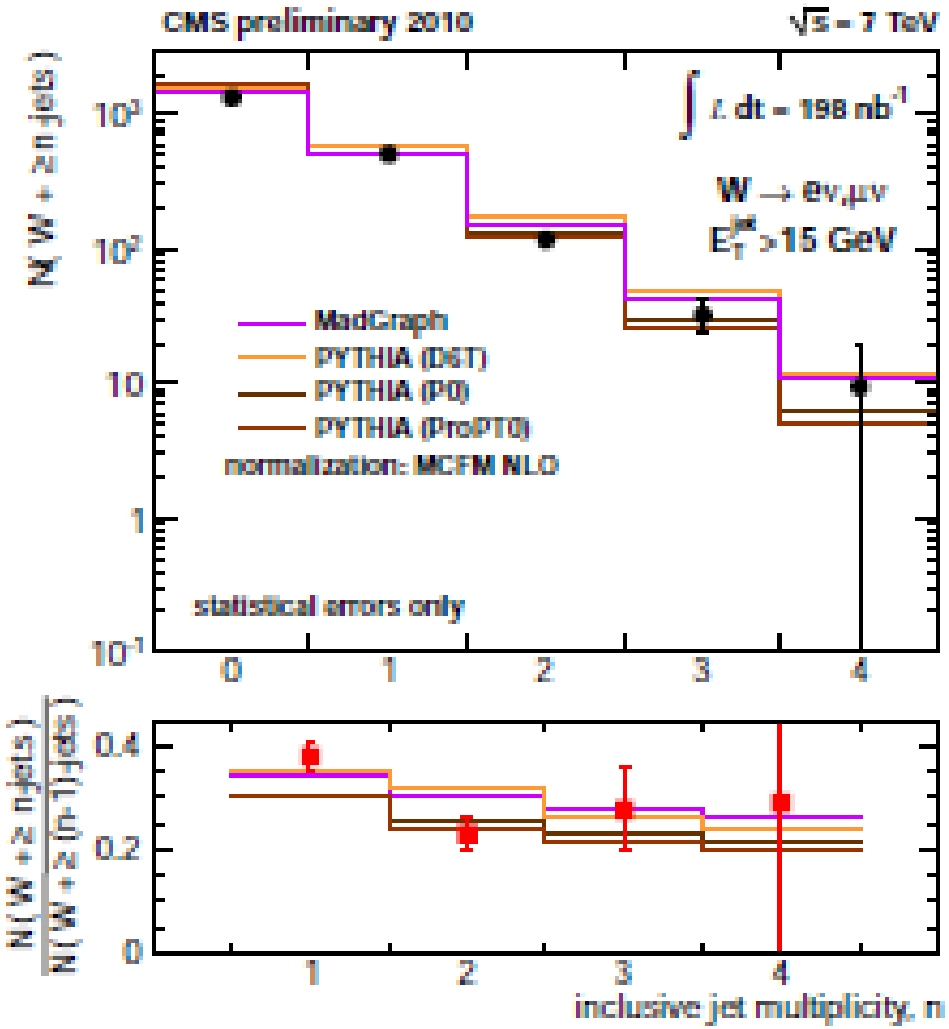
Inclusive Jet Multiplicity

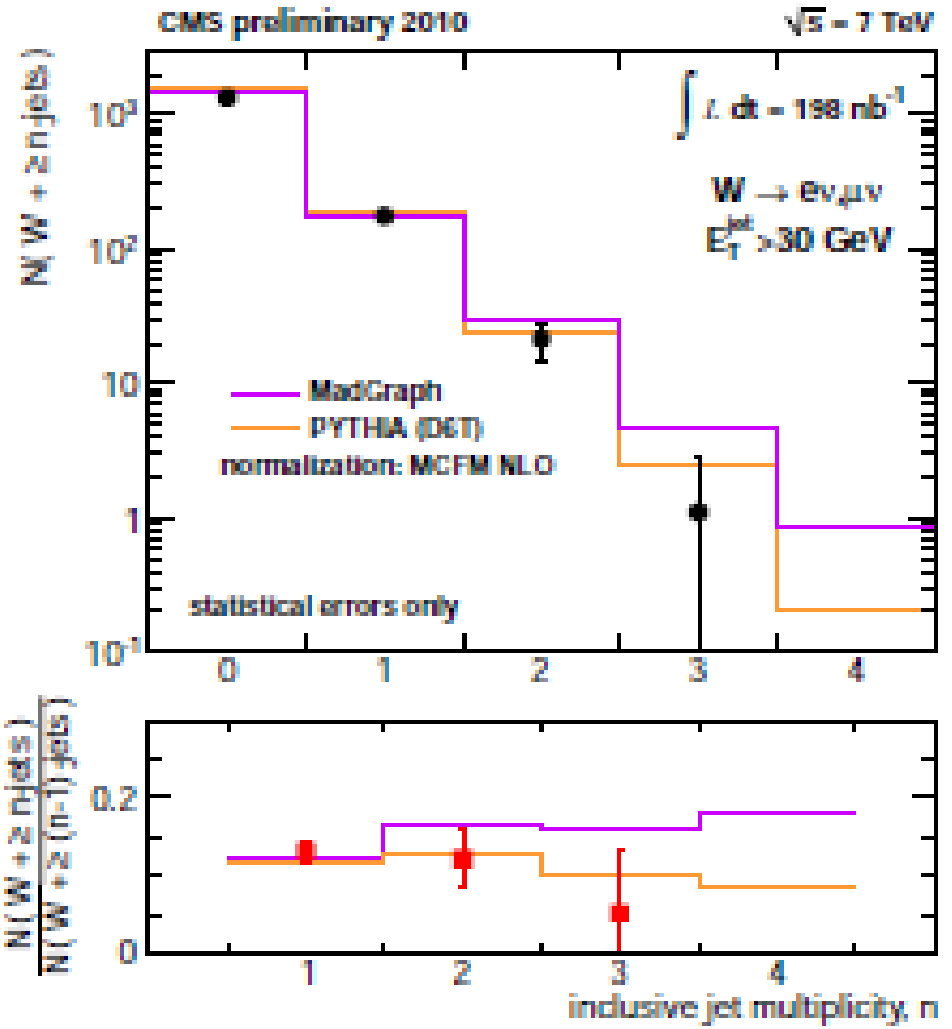
- Events having an identified vector boson are classified into the bins of jet multiplicity. Here we show results for W+Jets channel only.

- pT spectrum for the hardest jet in W+>0Jet events where W has Mt>50GeV and Jet Et>10GeV
- Electron and muon modes of W decay are combined here
- Errors are statistical only
- Other systematic uncertainties are being investigated



W+Jets multiplicity





- In MC:
  - Low Et jet rate sensitive to tuning of parton shower generator
  - High Et jet rate sensitive to matrix element of the hard scattering at the parton level

Summary

- First measurements of W+Jets done using early 198/nb of data collected at CMS
- W/Z+Jet measurements from fully certified 36/pb data are in approval process.