Egamma Meeting
25. Sep. 2007

Electron Trigger efficiencies from Z→ee in data

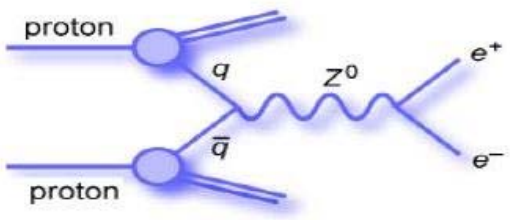
Wolfgang Ehrenfeld, Johannes Haller,
Stefan Mättig

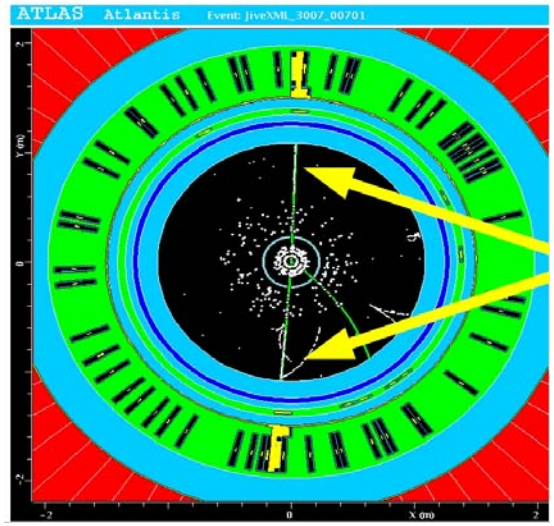
Outline

- **Introduction:**
  - Trigger efficiencies from data (Tag & Probe)
- **Results without background**
  - Comparing Tag & Probe with MC truth
  - Application to other physics processes
- **Including background (first approach…)**
- **Summary**

Background Information

- In general: trigger efficiencies should be **extracted from data**, not from MC!
- One method to do this is the so called **tag & probe** method:





  - In an offline analysis require:
    two reconstructed electrons with $M_{inv} = M_Z$ +/- 20GeV
  - Require that event has been triggered by "Tag" electron (e25i)
  - Determine trigger efficiency with "Probe" electron (2e25i)

Does this method introduce a bias?
Compare with truth matched electrons:

Electron Selection

Ntuples produced with HighPtView
Dataset used: trig1_misal1_csc11.005144.PythiaZee.recon.AOD.v12000601_tid00599

- selection offline:
  - isEM==0, tight
  - 1.37 < | η| < 1.52 (Barrel/endcap crack excluded)
  - |η| < 2.4 (electrons in inner detector acceptance)
  - 70GeV <|M_{inv}|< 110GeV
- selection MC gen ("truth"):
  - 2 offline reconstructed electrons matched to a truth electron

$$\varepsilon_{MC} = \frac{\#\text{ triggered truth matched reco electrons}}{\#\text{all truth matched reco electrons}}$$

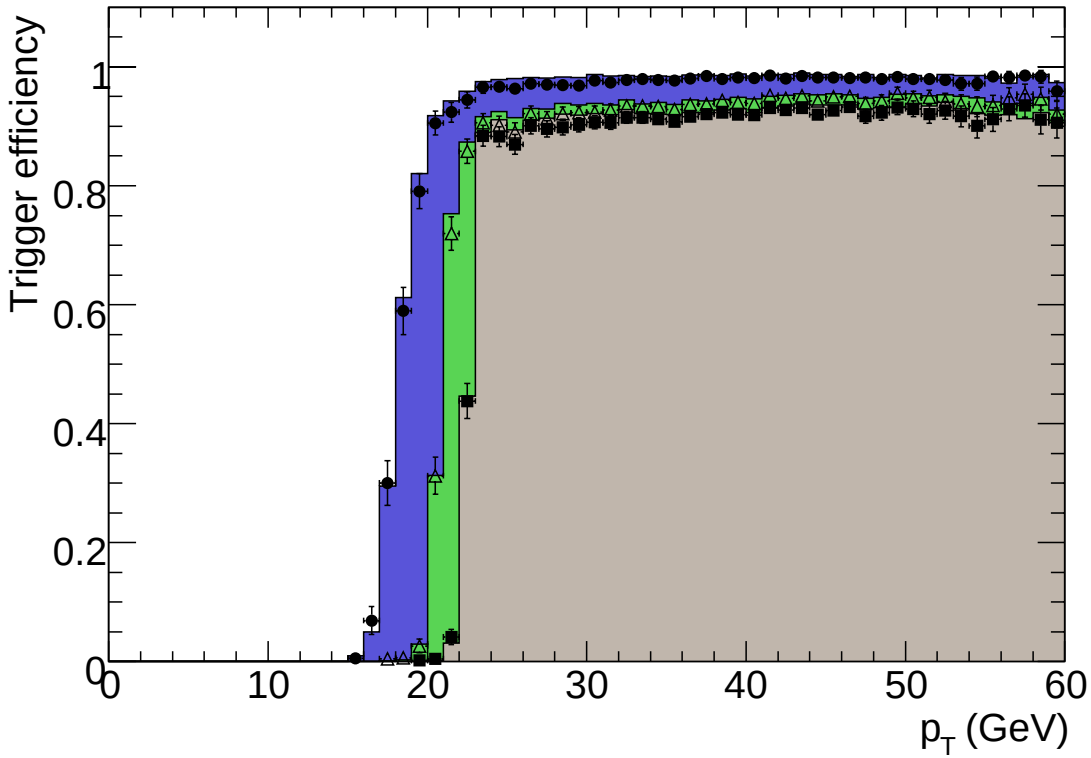
...if event is triggered by the 'tag' electron:

$$\varepsilon_{T\&P} = \frac{\#\text{ triggered reco 'probe' electrons}}{\#\text{all reco 'probe' electrons}}$$

Comparison Tag & Probe to MC

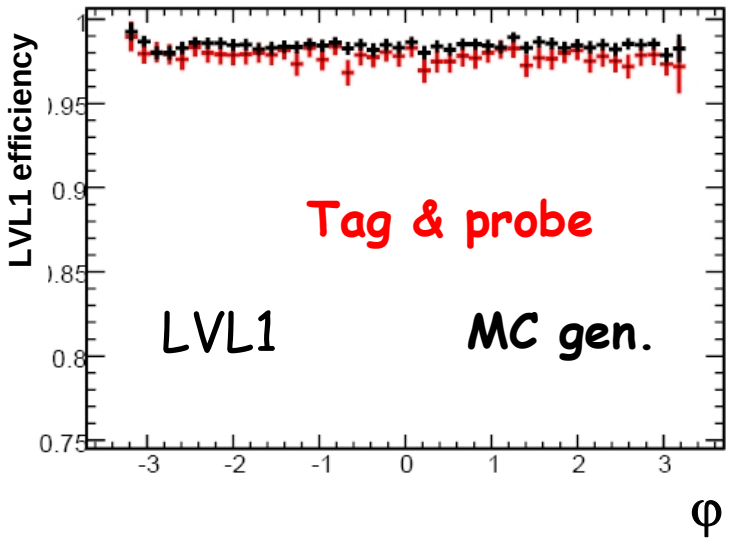
- Normalized to offline selection.
- plotted: $P_{T,REC}$
- Histograms: MC
- Dots: Tag & Probe
- e25i efficiency for
  - L1
  - L1 + L2
  - L1 + L2 + EF
- loss in L2 due to L2 tracking bug in Rel 12. (fixed in Rel 13)

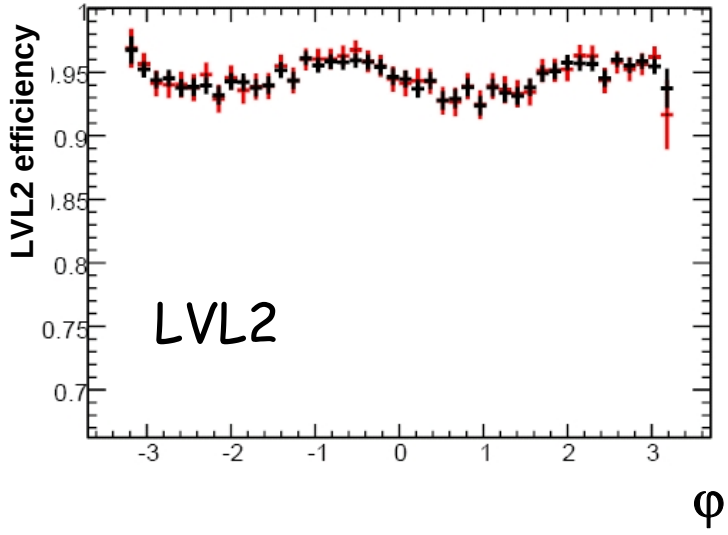
Our contribution to the detector paper:

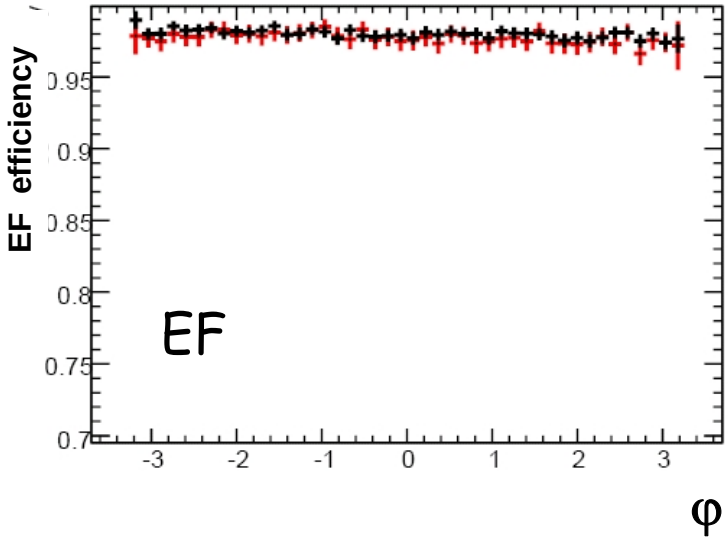


....Method seems to work fine!

Efficiencies in φ

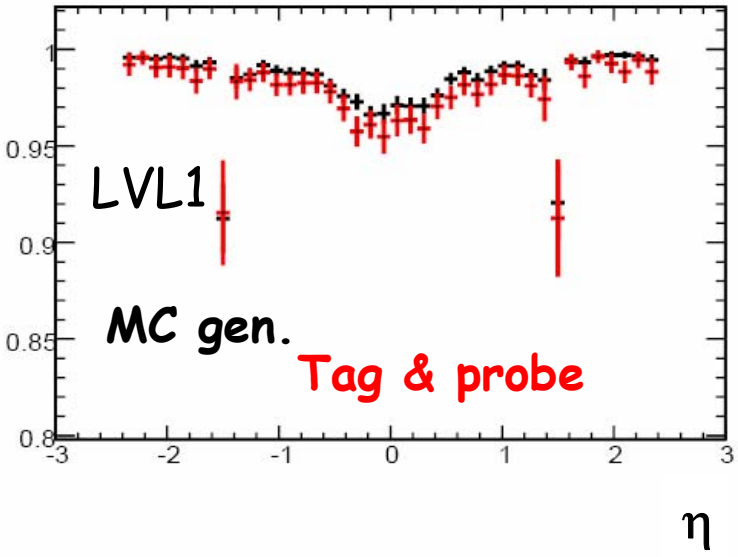


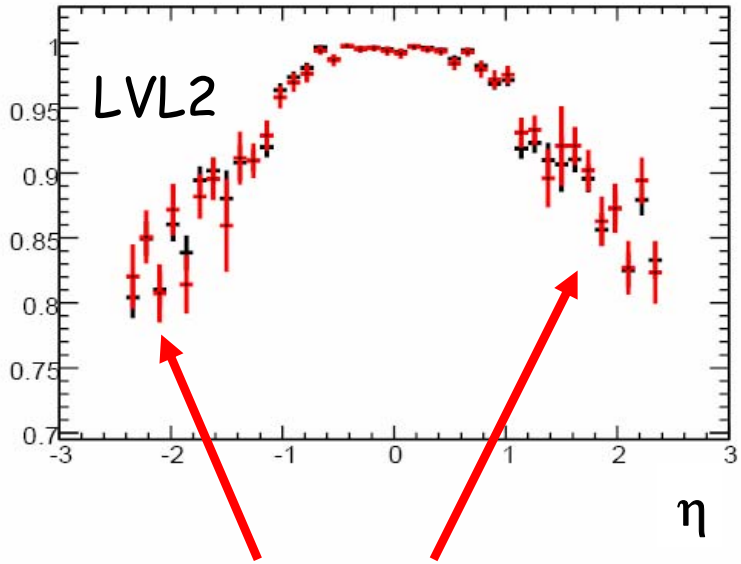


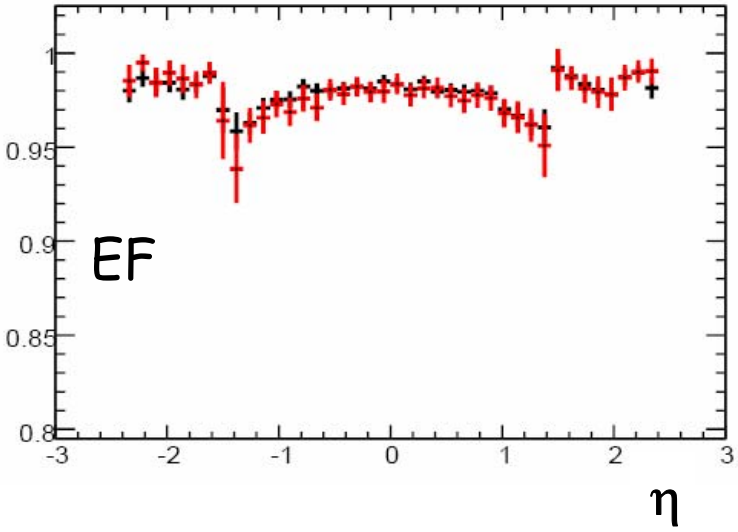


- Efficiencies with respect to previous trigger Level output P_T > 25 GeV in plateau.
- small differences (0.5% level) in LVL1 to be investigated.

Efficiencies in η







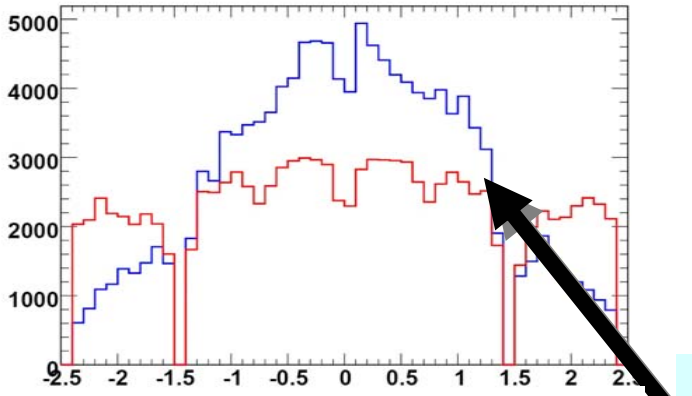
L2 Tracking bug in Rel 12 clearly visible
(efficiency loss in end-cap region)

→ Efficiencies obviously η dependent!

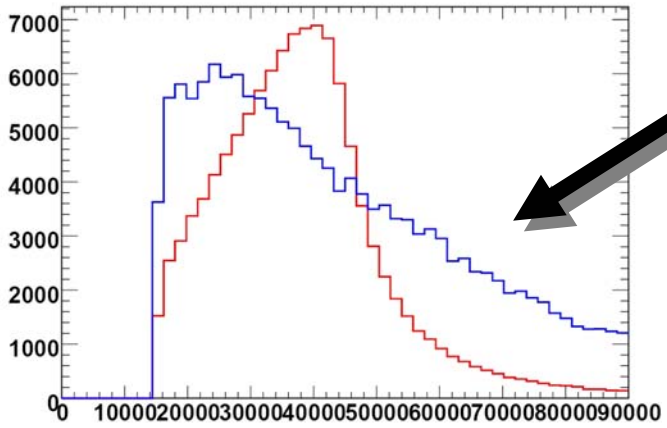
Good agreement of both methods on all Trigger levels!

Application to other physics processes

Compare Distributions of ttbar events to Zee



η



P_T

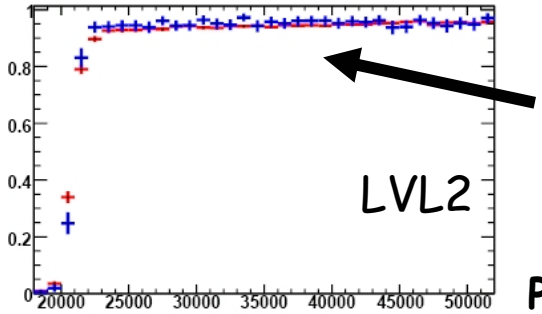
electrons from ttbar:

- Less isolated
- more central
- tail to higher P_T
- Considerably amount of electrons have low Pt.

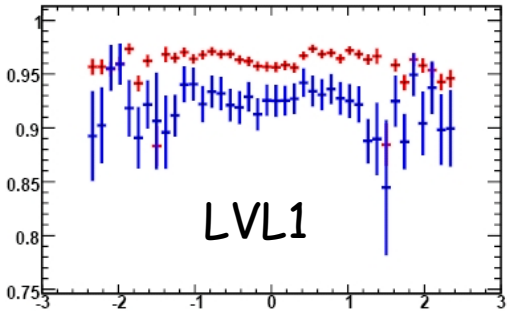
First step towards parameterisation

Idea: If the electron efficiency is properly parametrised as a function of the correct variables, then it should be independent of the physics process.

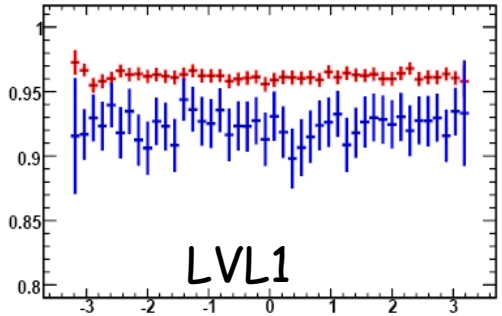
Inclusive efficiencies:



P_T



η

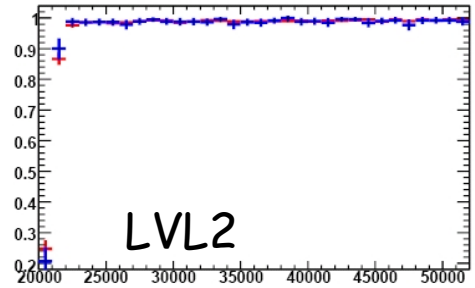


φ

Small, but clearly visible differences cancel out, when **restricting**:

$|\eta| < 1$

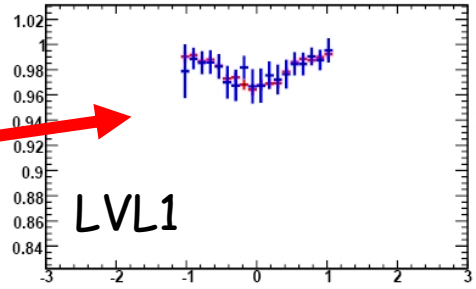
After first parameterisation:



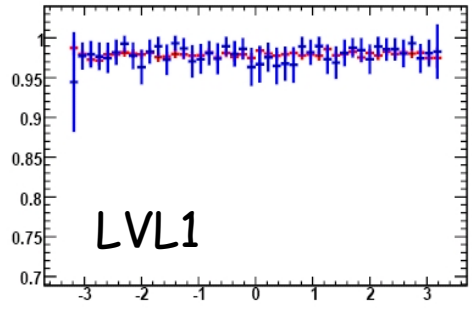
P_T

Further restricting:

$|\eta| < 1$ and
$25.\ GeV < P_T < 70.\ GeV$



η

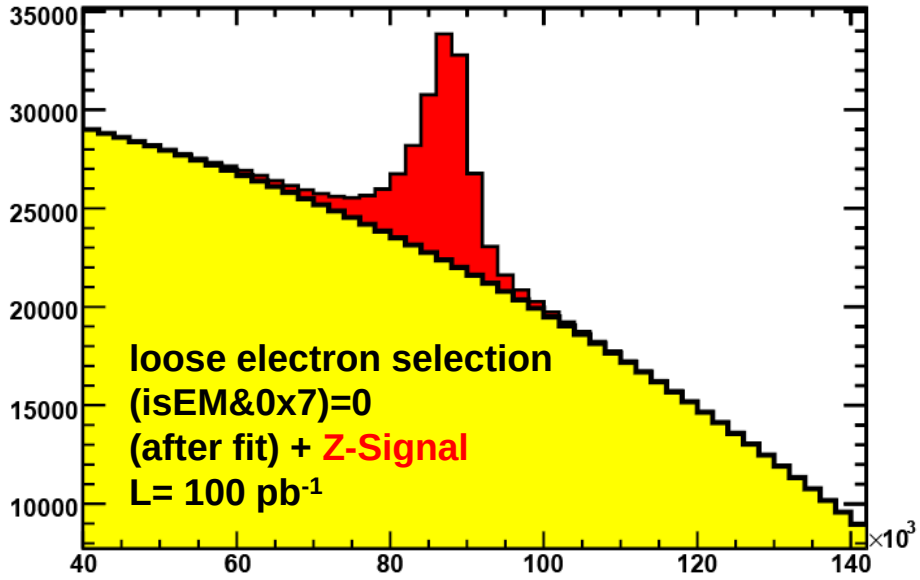


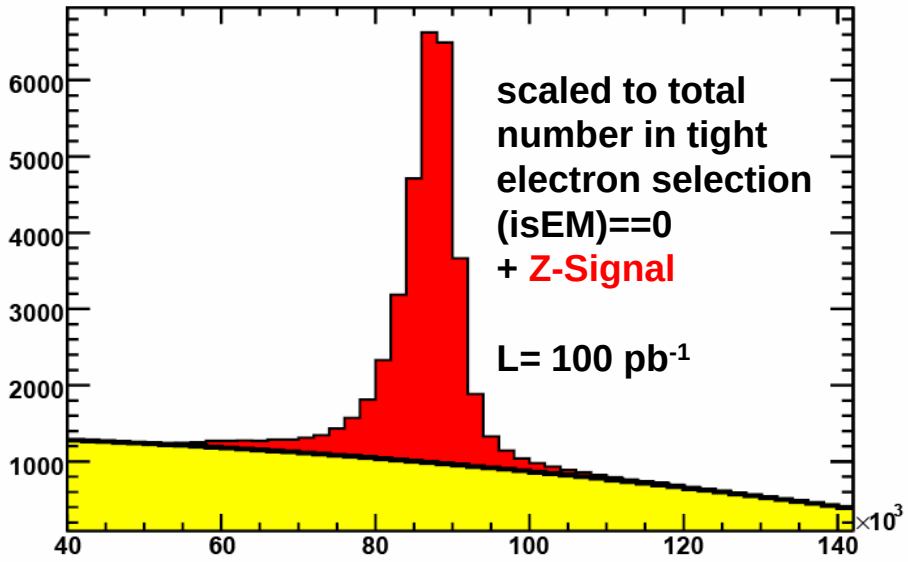
φ

... differential efficiencies from Zee and ttbar are in agreement!

Including background

- Main source of background: misidentified di-jets.
- Available simulated di-jet sample is by far not big enough for an estimate.
- a *rough* estimation of the background under the Z-peak is sufficient since we won't have this problem in data.
- Our method:
  - Use the invariant (jet-jet) mass spectrum of inclusive di-jets for the shape.
  - fit the spectrum
  - Scale it to the the invariant mass spectrum of di-jet objects in the HighPtView electron container (passing tight electron selection).





Signal: trig1_misal1_csc11.005144.PythiaZee.recon.AOD.v12000601_tid00599

Bkgr: trig1_misal1_mc12.005802.JF17_pythia_jet_filter.recon.AOD.v12000601_tid006302

Next step: sideband subtraction of the background -> First results look promising!

Conclusion/Outlook

Summary:

- Results using the 'Tag & Probe' method (without background) are in good agreement with efficiency from generator matched electrons.
- Comparing 'inclusive' efficiencies of ttbar events shows deviations !
- A first step towards parameterization in one (η -pT) bin shows that efficiency gained from Z->ee events is applicable to other processes.

Next Steps:

- Include background.
- Extend parameterization to full phase space (e.g. endcaps).
- Test method with SUSY events.