EM scale in forward calorimeters.

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- Electron identification in the forward calorimeters
- Insitu Calibration with $Z->ee$ and $J/\psi->ee$

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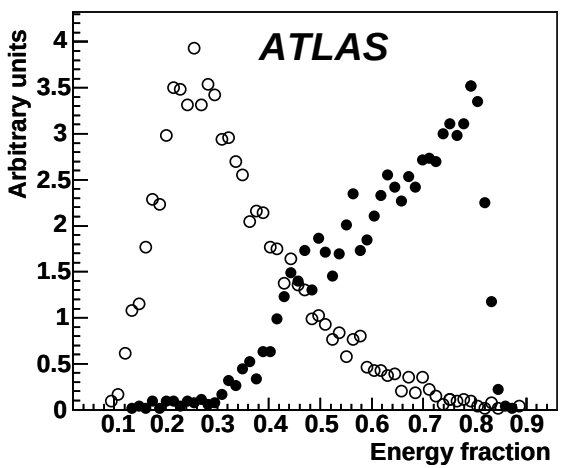
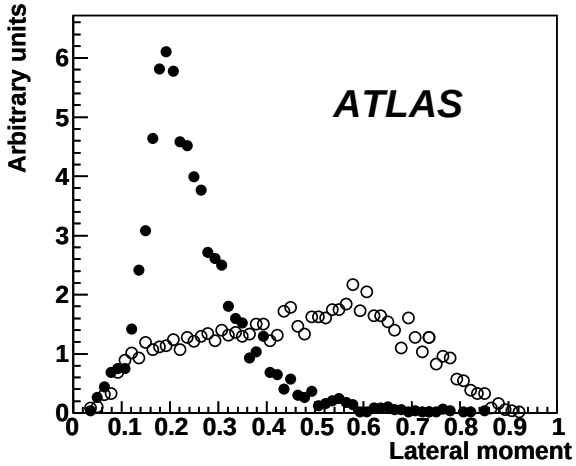
Forward Electron ID

- What are differences with fiducial electrons
  - You do not have charge
    - We cannot distinguish between photon, electron and positron
  - The clustering
    - We are using the topological clustering algorithm (in principle we can also use SW but does not cover that region)
  - We cannot trigger on (there is possibility to use the jet trigger for these electrons if they are energetic), you have to look for one reference: for $Z \rightarrow ee$ you should trigger for at least one electron in the central region.

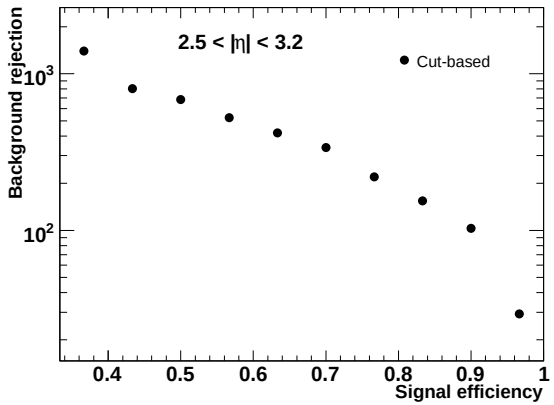
- 7 variables are used for the electron ID. Most of the variables are the topological cluster moments
  - Energy fraction in the most energetic cell
  - Longitudinal and lateral moments
  - Energy density
  - Distance of each cell to the Shower center
- Two eta bins: EMEC IW and FCal

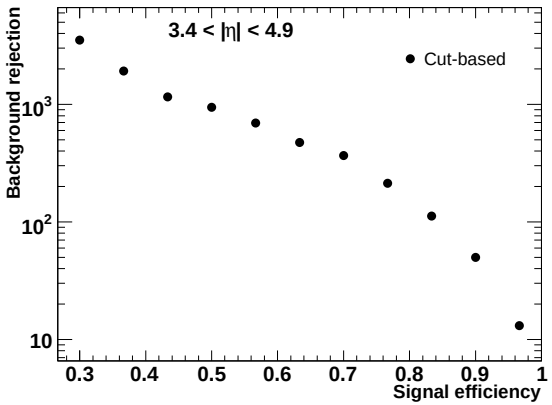
Forward ID (suite)





- Plots show two cluster moments for the signal electrons (full circles) and the QCD di-jet background (open circles) in the FCal.



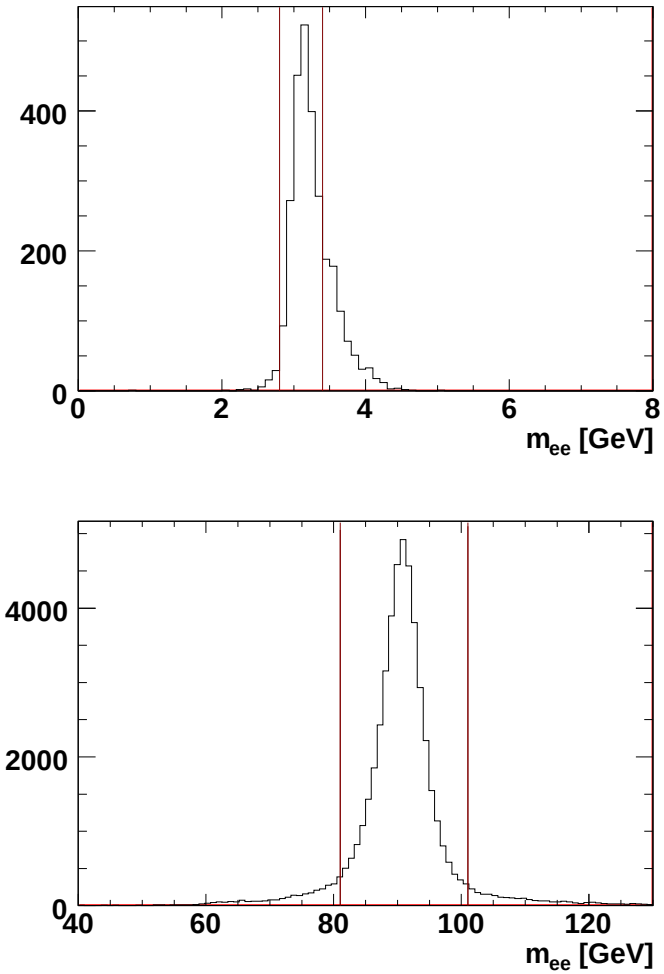


- plots show jet background rejection versus signal electron (from Z) efficiency using the cut-based methods in the inner wheel of the EMEC (left) and in the FCal (right).

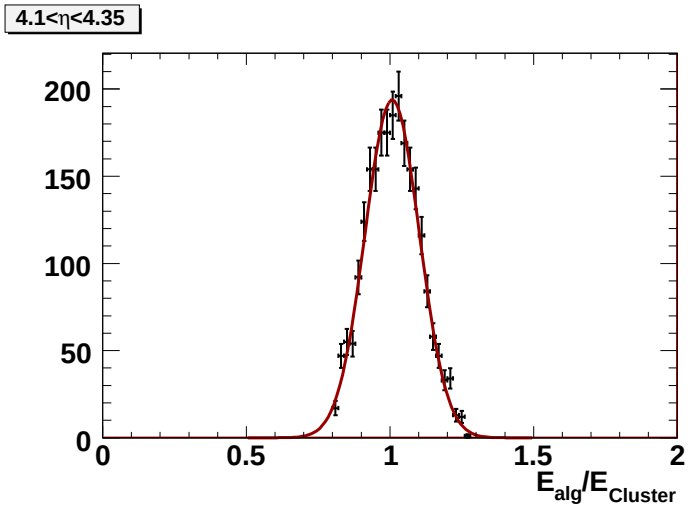
Calibration - Calculation

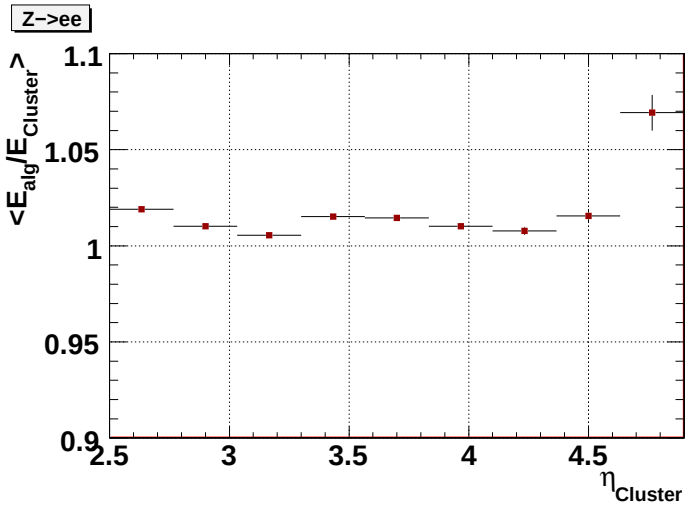
- Calculate energy of cluster $E_2 = E_{alg}$ starting with ${m_{Res}}^2 = (p_1 + p_2)^2$, $Res = J/\psi$ or Z
- Determination of E_2 yields $E_2 = \frac{-b}{2 \cdot a} + \sqrt{\frac{b^2}{4 \cdot a^2} - \frac{c}{a}}$ with
  - $a = {E_1}^2 + \left({m_e}^2 - E_1^2\right) \cdot \cos^2\left(\sphericalangle\left(\tilde{\mathrm{p}_1}, \tilde{\mathrm{p}_2}\right)\right)$
  - $b = -2 \cdot M^2 \cdot E_1$
  - $c = M^4 + {m_e}^2 \cdot \left({E_1}^2 - {m_e}^2\right) \cdot \cos^2\left(\sphericalangle\left(\tilde{\mathrm{p}_1}, \tilde{\mathrm{p}_2}\right)\right)$
  - $M^2 = \frac{{m_{Res}}^2}{2} - {m_e}^2$

- Tag'n'Probe
  - Tag
    - *Good* electron in the central region ($|\eta| < 2.5$)
  - Probe
    - One forward electron
  - Tag and probe electron around $m_{J/\psi}$ or m_Z

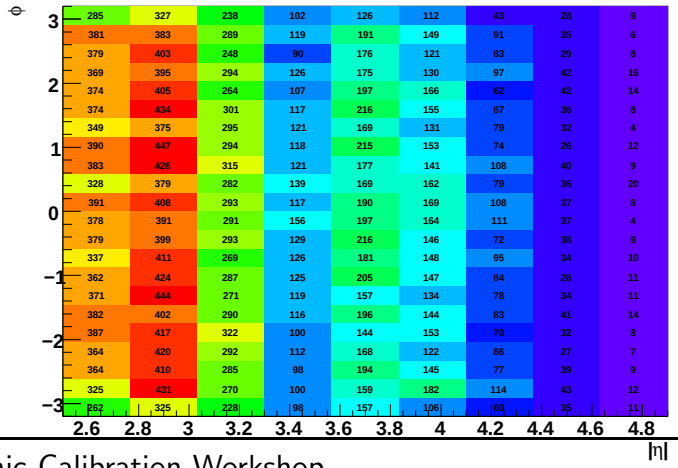


Energy scale with $Z->ee$



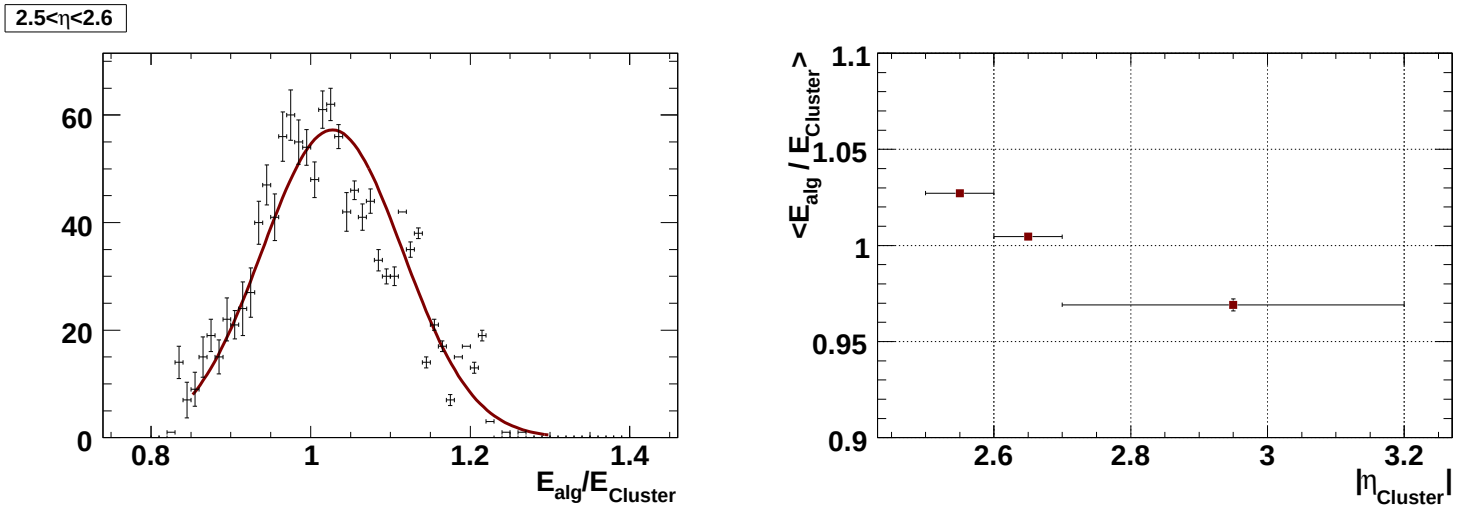


- right plot shows the scale factor calculated for different eta bins in the forward calorimeters. We fit a gaussian to the distribution of the scale in each bin.
- population per η-ϕ zone.

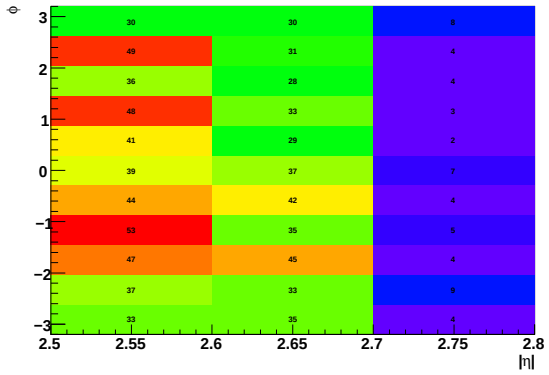


400k events	L=330 pb^{-1}
$\|\eta_{e1}\| < 2.5$ (crack removed for e1) $\|\eta_{e2}\| > 2.5$ $p_{T_{e1}} > 25GeV$ $p_{T_{e2}} > 15GeV$ Tight ID $\|M_{ee} - M_Z\| < 10GeV$	CMS=10TeV σ=1.4nb ϵ_{filter}=0.86
35524 events	

Energy scale with $J/\psi -> ee$

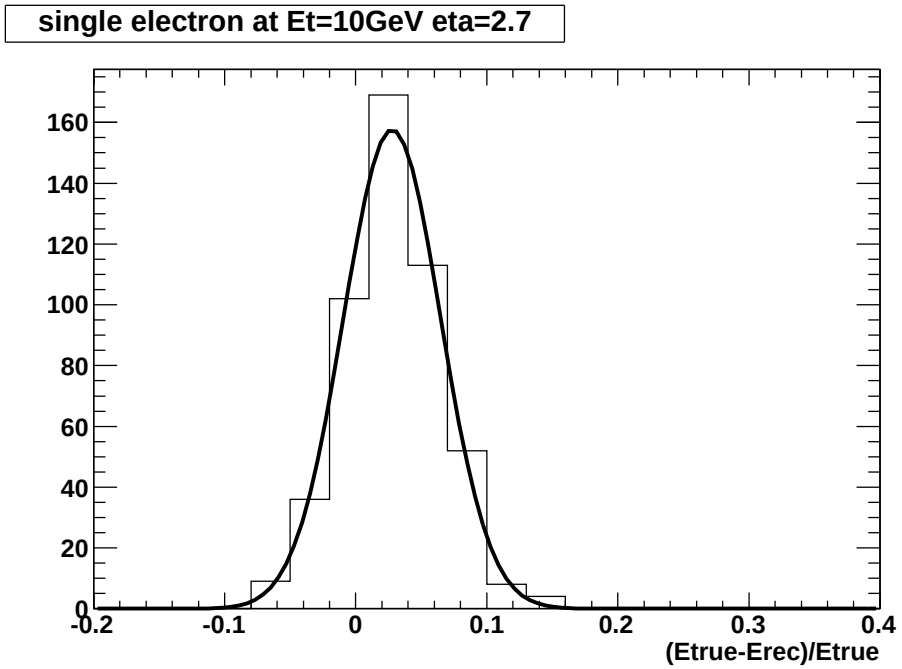


- Here we fit Crystal Ball function to the distribution of the scale in each bin.
- we are limited in statistics. Also since the openning angle of the two electrons is too small compared to Zee events, most of the forward electrons are concentrated in EMEC IW



100k events	L=50 pb^{-1}
$\|\eta_{e1}\| < 2.5$ (crack removed for e1) $\|\eta_{e2}\| > 2.5$ $p_{T_{e1}} > 5GeV$ $p_{T_{e2}} > 5GeV$ Tight ID $\|M_{ee} - M_{J/\psi}\| < 500MeV$	CMS=10TeV σ=115nb 'default' PS=60
962 events	

Backup


single electron at Et=10GeV eta=2.7
160
140
120
100
80
60
40
20
0
-0.2
-0.1
0
0.1
0.2
0.3
0.4
(Etrue-Erec)/Etrue