the ZEUS Detector

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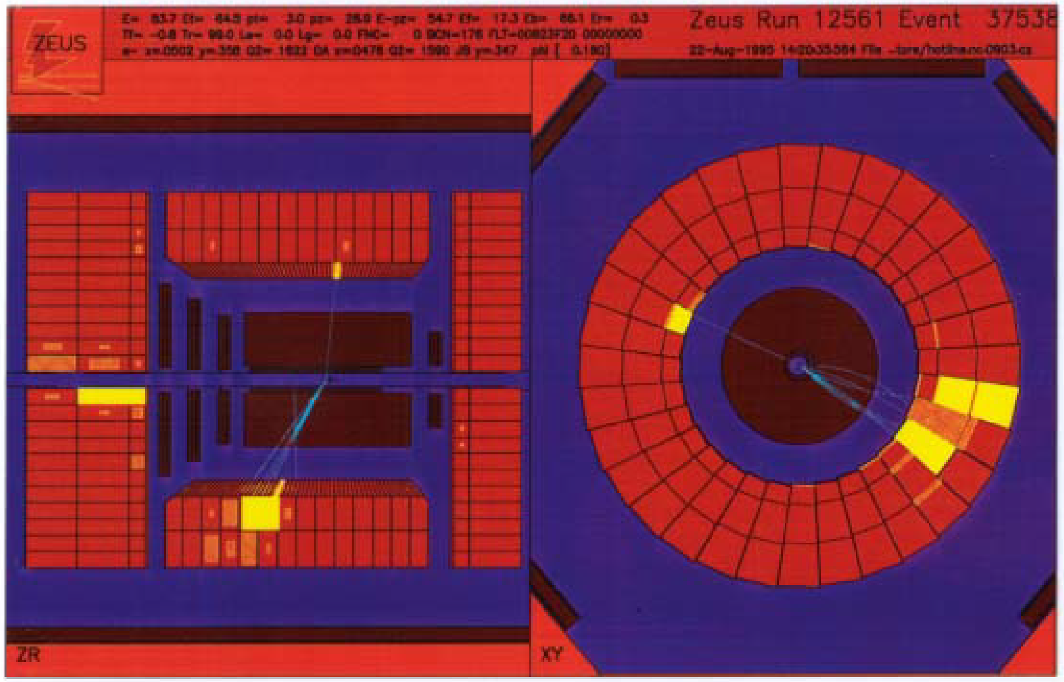
On behalf of the ZEUS Collaboration

- Introduction.
- Method for correction.
  - Reconstructed objects; Energy flow-objects (EFOs).
  - Correction procedure; momentum conservation in DIS events.
- Results.
- Conclusions.

CALOR2000, LAPP, Annecy 12 October 2000

$$e + p \to e + X$$



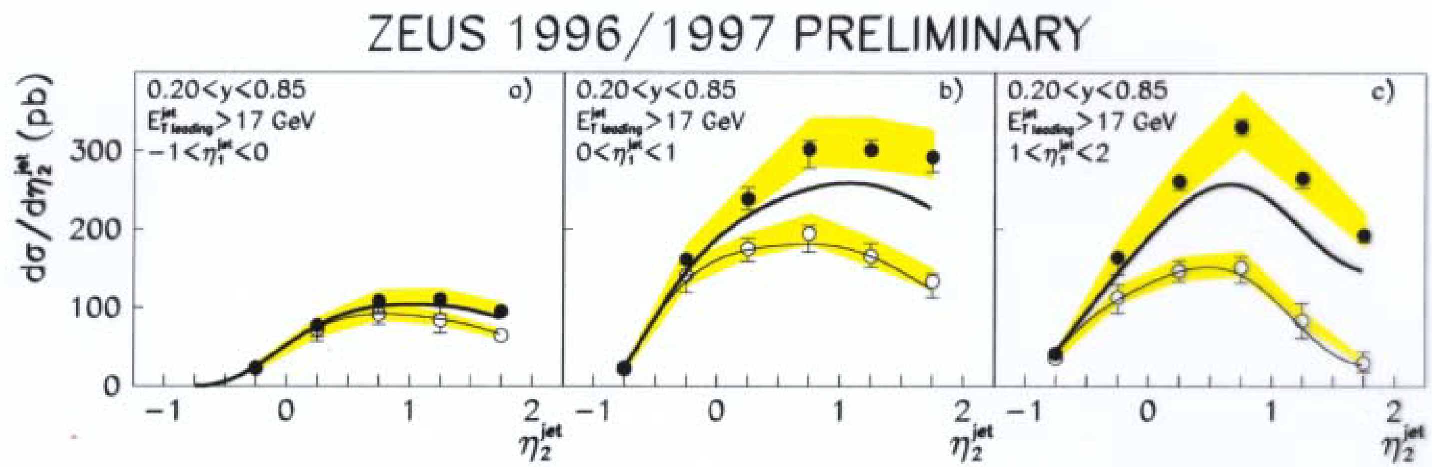
- **HERA (in 1996) collided 27.5 GeV e with 820 GeV p**
- **In neutral current events, can balance p_T of electron with hadronic system.**
- **Consider double angle reconstruction:**
  - **Angles more accurately measured than energies.**
  - **Independent of calorimeter energy scale.**

Consider transverse and longitudinal momentum:

$$p_T^{\mathrm{DA}} = 2E_e \frac{\sin\gamma \cdot \sin\theta'_e}{\sin\gamma + \sin\theta'_e - \sin(\theta'_e + \gamma)}, \quad y^{\mathrm{DA}} = \frac{\sin\theta'_e(1 - \cos\gamma)}{\sin\gamma + \sin\theta'_e - \sin(\theta'_e + \gamma)}$$

θ'_e and γ are the scattering angle of the electron and current jet.

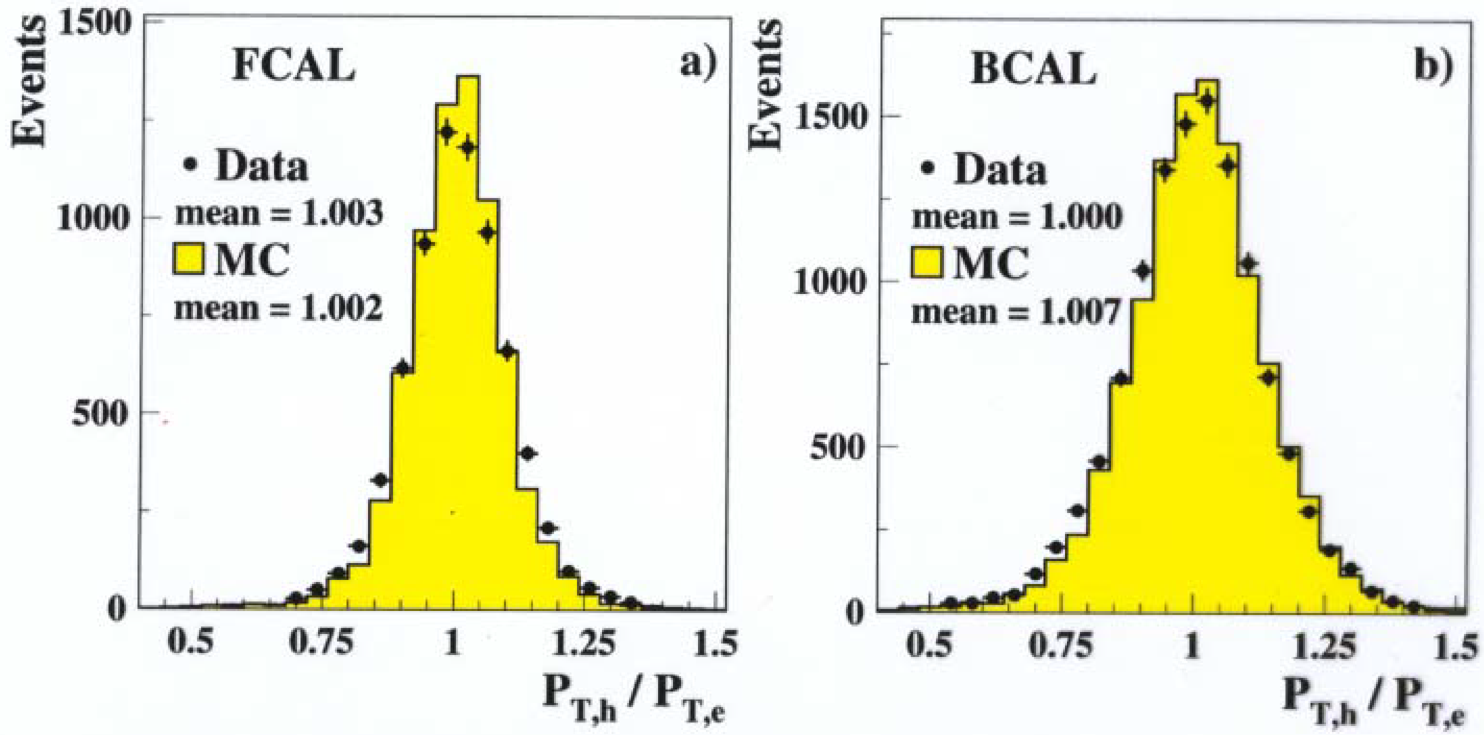
Hadronic CAL scale uncertainty between data and MC and E_T^{jet} resolution are dominant systematics in jet measurements, $E_T^{\text{jet}} \sim 10 - 100$ GeV.



- **Current uncertainty on hadronic energy scale (with jets) is ± 3%.**
- **Uncertainty of ± 3% ⇒ ± 15% error on cross section measurement.**
- **Precise measurements of jet physics (photon structure, α_s, etc.) need smaller uncertainty.**

$\eta = -\ln[\tan(\theta/2)]$, θ is measured from proton beam direction.

- Electron energy scale uncertainty is $\sim\ \pm\ 1\%$.
- Hadronic energy scale uncertainty is $\pm\ 2\%$ (1% from electron uncertainty)

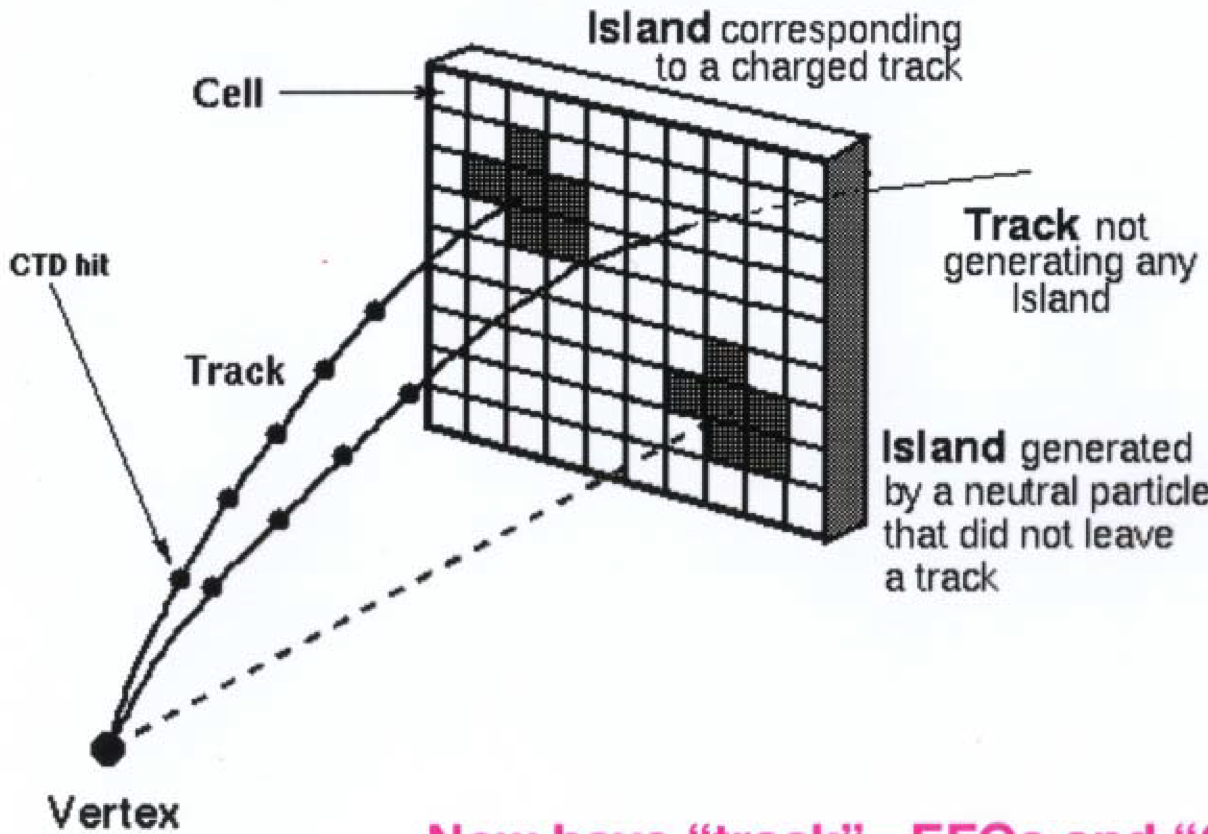


- But this is global hadronic energies at high$-Q^2$.
- Jet energy scale is different (modelling, algorithm, etc.).
- Can we achieve similar value for jet reconstruction?

EFOs use a combination of track and CAL cluster (island) information.

Where possible, use tracking information.

Energy corrections determined for CAL information for data and MC separately.



- **Form clusters of cells and** *combine* **with tracks.**
- **For low/medium charged particles, want to use tracking.**
- **For neutral particles, those outside tracking acceptance or high momenta, want to use CAL information.**

Now have "track"−EFOs and "CAL"−EFOs.

Select two samples of clean neutral current DIS events.

Momentum transfer, $Q^2 > 100 \text{ GeV}^2$.

Sample 1, "p_T":

$$E^{\text{DA}} > 25 \text{ GeV}$$

$$p_T^{\text{DA}} > 10 \text{ GeV}$$

Hadronic flow mainly forward

Sample 2, "high$-y$":

$$15 < E^{\text{DA}} < 25 \text{ GeV}$$

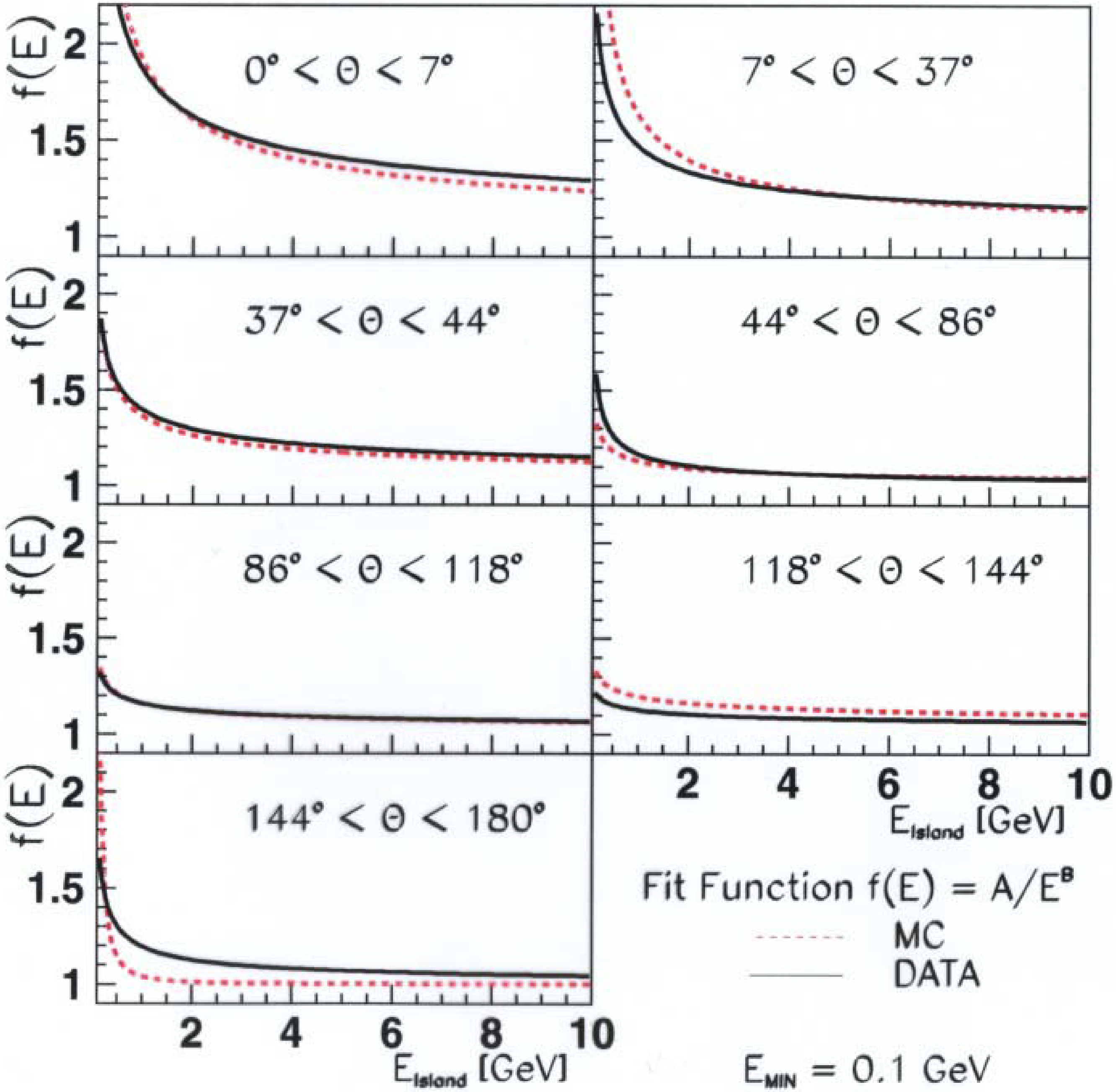
$$y^{\text{DA}} > 0.3$$

$$\gamma > 60^\circ$$

Minimise:

$$\sum_{\text{sample 1}} min\left[\left(\frac{p_T^{\text{DA}} - p_T^{\text{had}}}{p_T^{\text{DA}}}\right)^2, 0.2^2\right] + \sum_{\text{sample 2}} min\left[\left(\frac{y^{\text{DA}} - y^{\text{had}}}{y^{\text{DA}}}\right)^2, 0.2^2\right]$$

in bins of polar angle, reflecting detector geometry.

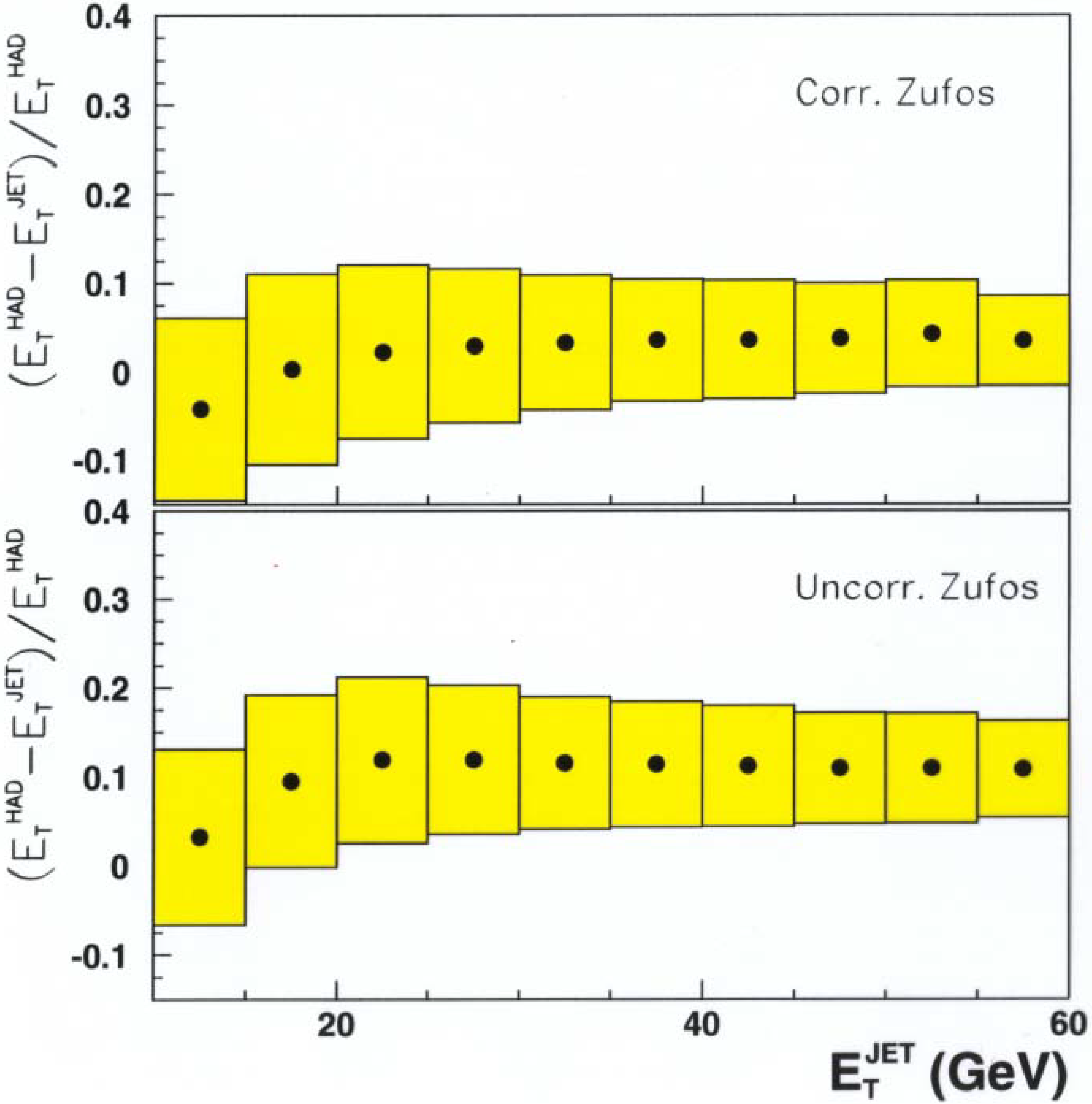


- **Correction functions similar between data and MC.**

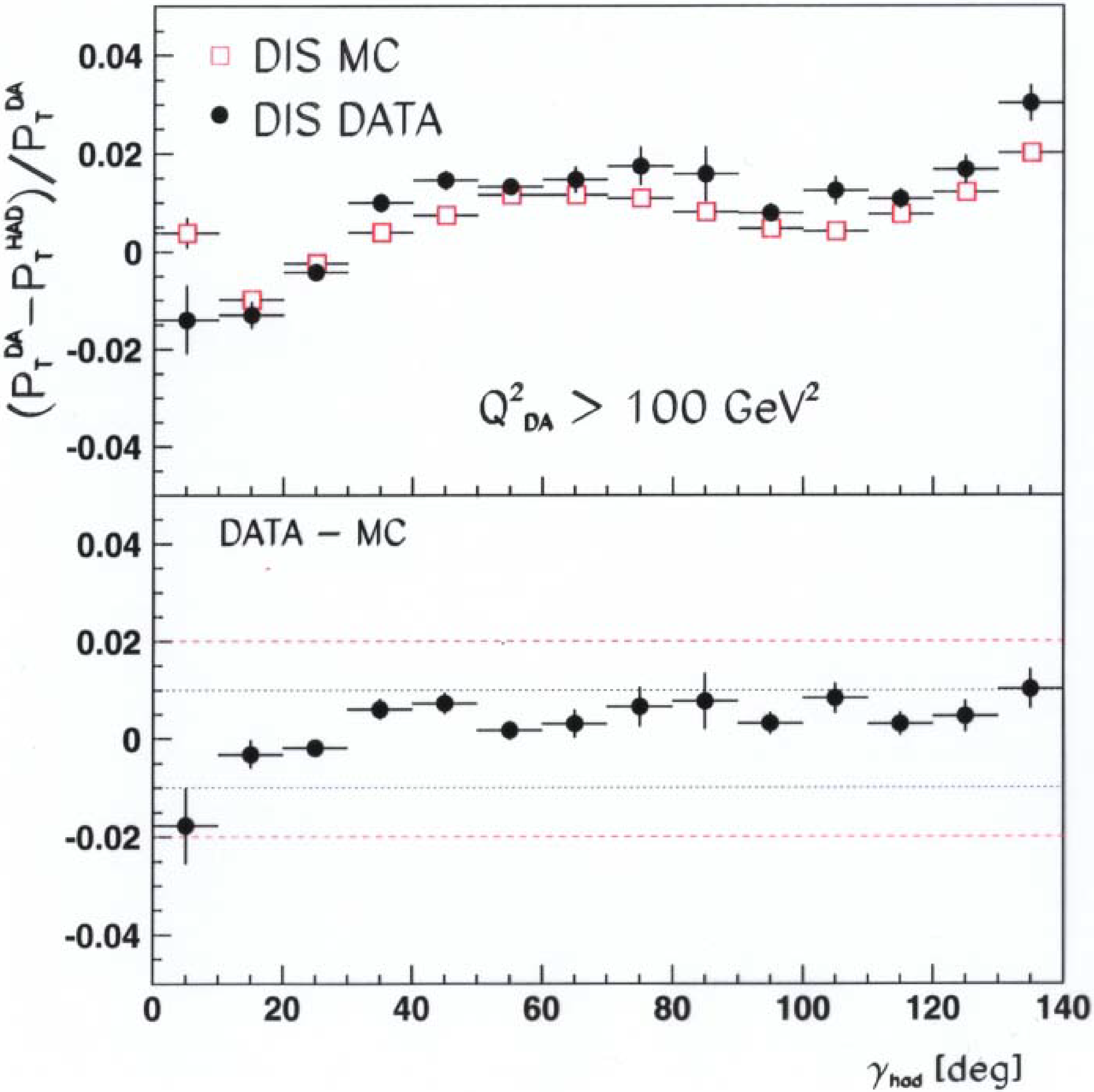
  ⇒ Data is reasonably well modelled.

- **But correction functions do differ between data and MC.**

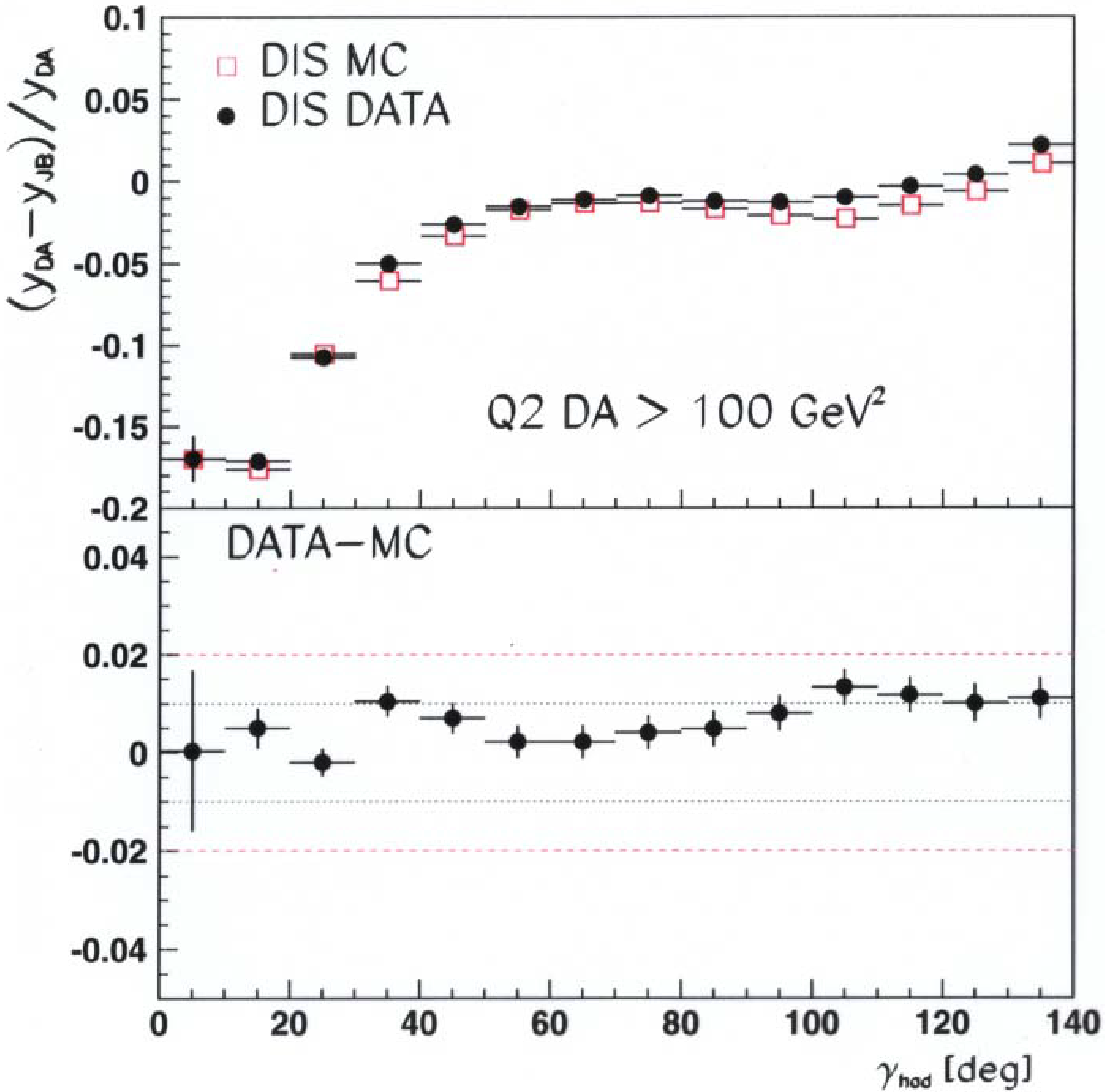
  ⇒ Necessary to be treated separately.



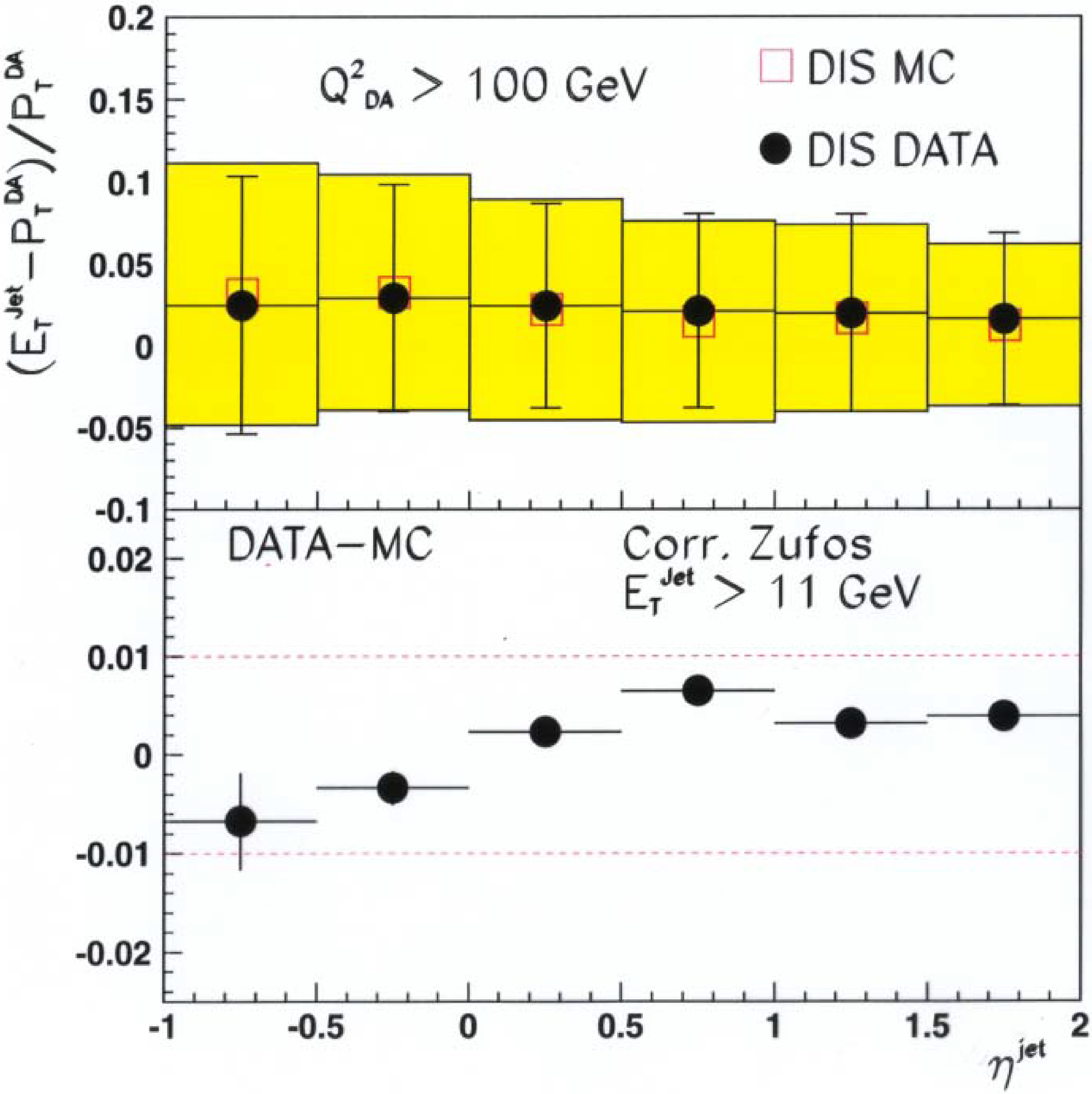
- **Applying to an independent (photoproduction) MC.**
- **The true jet quantities are well reproduced by the correction.**
- **Works for MC; how does it do for data and MC?**



- **Hadronic p_T well reconstructed.**
- **Within 3% of "true" value, p_T^{DA}**
- **Data and MC show same trend.**
- **Agreement between data and MC is to within 2%.**



- **Quantity y_{JB} also well reconstructed with corrected EFO's**
- **"Dip" at low$-\gamma$ is well modelled.**
- **Data and MC again follow each other to within 2%.**



- Consider jet in DIS event as a function of η^{jet}.
- Correlated with p_T^{HAD} but would not necessarily balance.
- Good check for reconstruction of jets as well as global energies.
- Jet reconstruction also to well within 2%; as good as global quantities.

Conclusions

Dead material correction routine developed for jet events in the ZEUS calorimeter.

Procedure relies on combination of tracking and calorimeter infromation; the calorimeter information corrected by considering p_T-balanced neutral current events.

Applying the correction to a different MC sample recovers the true level.

Better reproduction of hadronic final state for jet measurements.

Indications are seen that the difference between the data and MC is within $\pm 2\%$.