Jet Identification and Energy Scale

Physics Workshop
February 23rd , 2004, Fermilab

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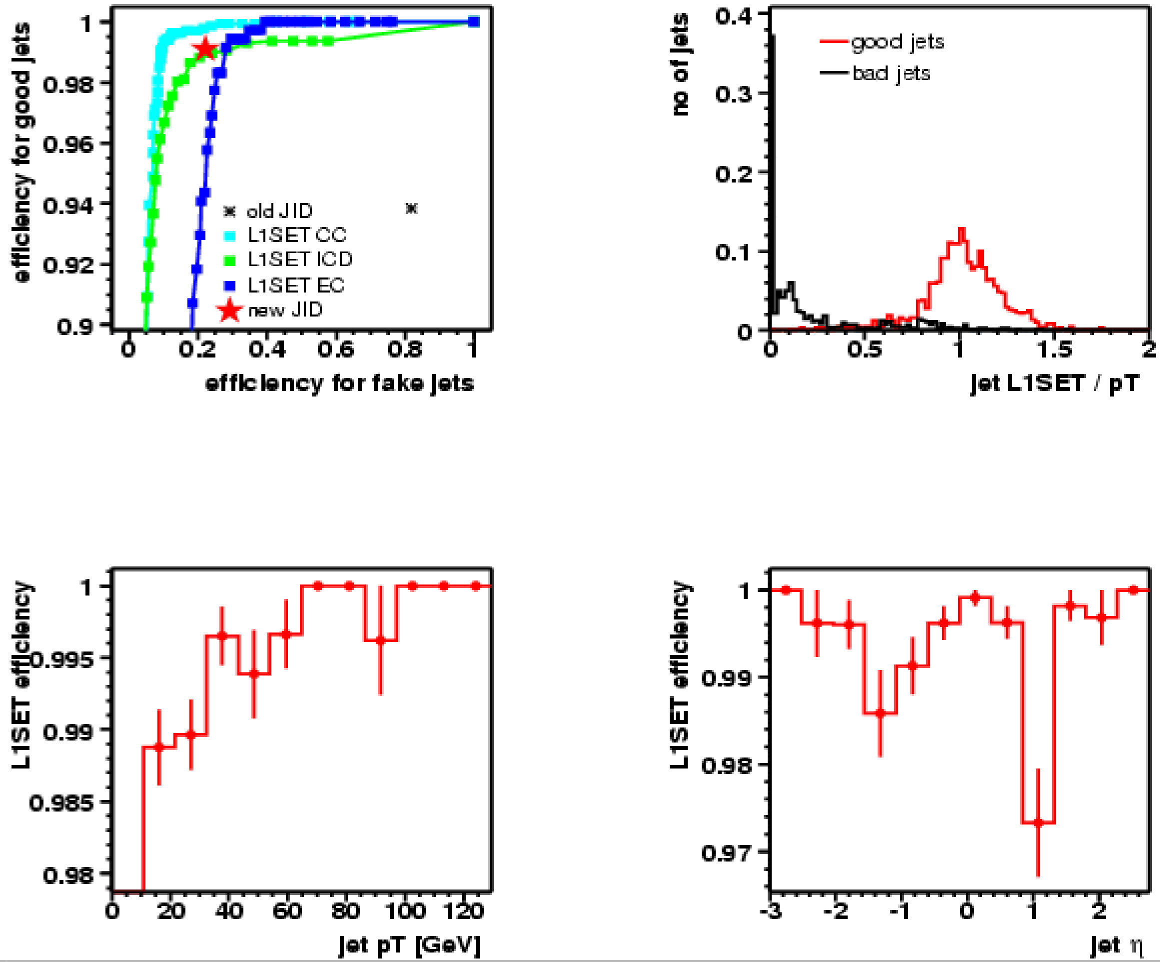
For Jet-Id and JES groups

Jet Id cuts

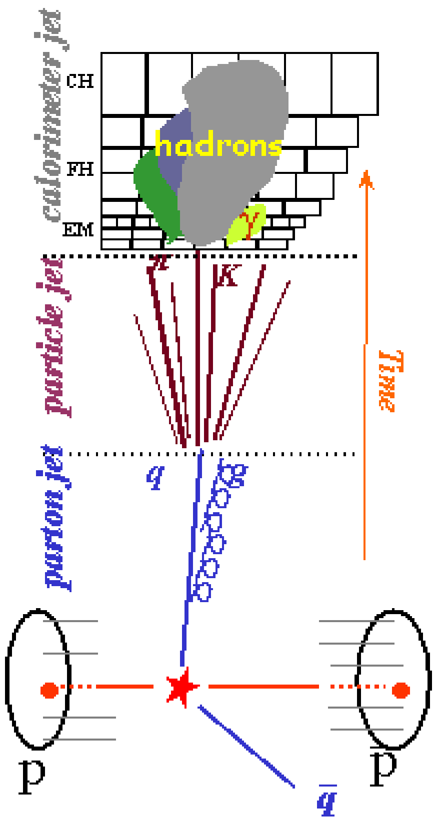
- ID cuts:
  0.05<EMF<0.95, CHF<0.4, HotF<10, n90>1 and
  L1 confirmation: L1set/(pT*(1-CHF) > 0.4 (CC,EC) or > 0.2 (ICR)
- L1 confirmation has replaced older f90<0.5 or CHF<0.15 cut from the previous certification
- Performance study/optimization using good and fake jet samples
- Good jets:
  - dijet events
  - two jets with $\Delta\phi > 2.7$
  - $\not{E}_T < 5$ GeV
  - one jet passes all good jet criteria (including L1 confirmation)
  - other jet is assumed to be a good jet
  - jet $P_T > 15$ GeV
- Bad jets:
  - events with more than 4 jets
  - fake jet passes L1 confirmation but has no tracks matched to it.

Jet Identification



- L1 confirmation efficiency is about 99% (98% in the ICD).
- Total JetID efficiency is $97.4 \pm 0.5\%$
- Rejection rate is 70-80%.

Jet Energy Scale



True particle level jet energy Ejet^ptcl is obtained from measured on Ejet^meas using the following formula:

$$E_{jet}^{ptcl} = \frac{E_{jet}^{meas} - E_O(R,\eta,\mathcal{L})}{R_{jet}(R,\eta,\mathcal{L})\, Rcone(R,\eta,\mathcal{L})}$$

Where,

E0 is an energy offset from electronics and Uranium noise, energy pile-up from previous crossings, additional ppabr inetraction and underlying events.

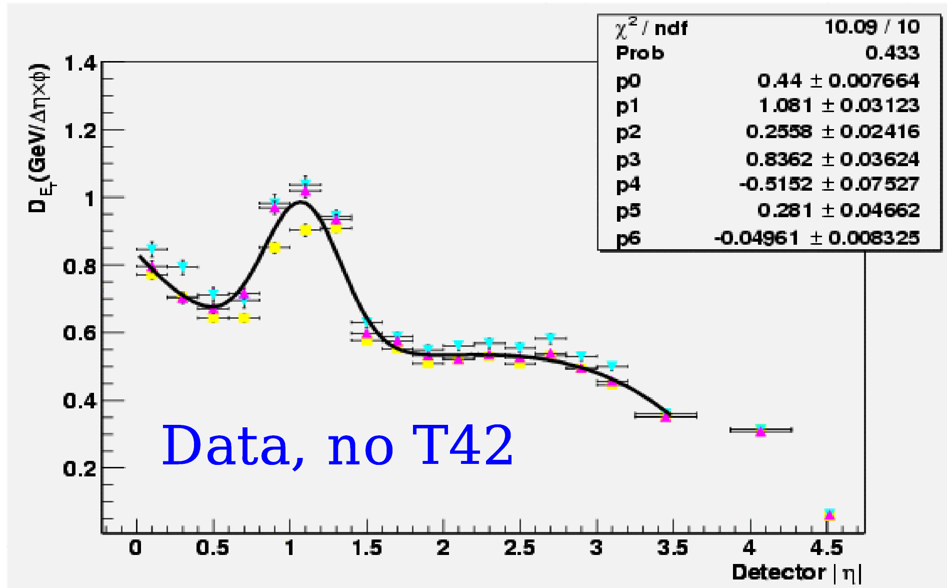
Rjet is calorimeter response

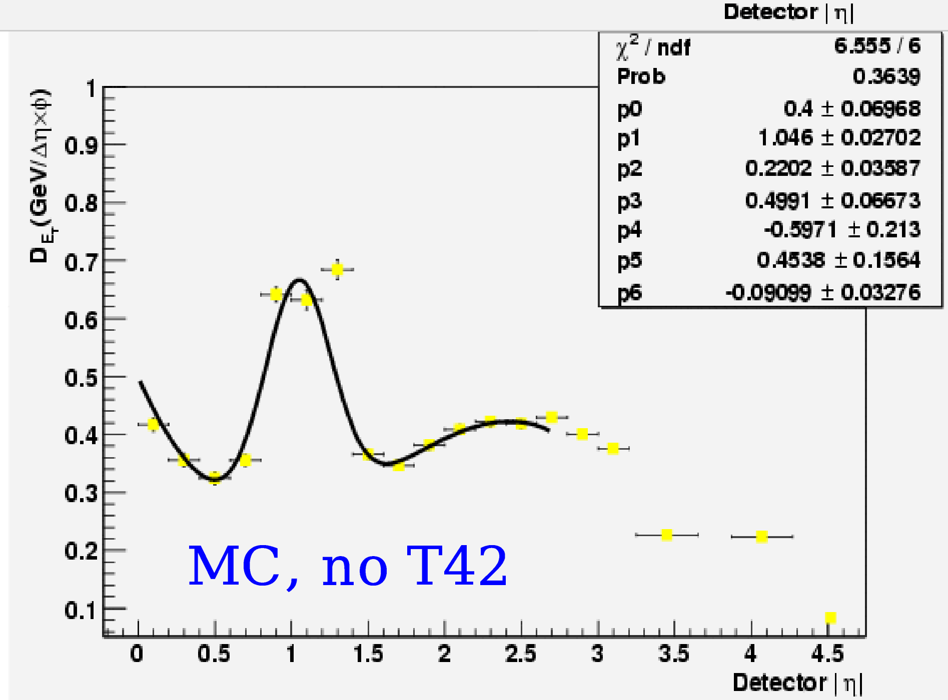
Rcone is the fraction of the jet calorimeter shower contained in the algorithm cone

calorimeter jet ⇒ particle jet

Offset measurement

- $$\mathcal{D}_{E_T} = \frac{\sum_{All\phi} E_T(\eta)}{2\pi \times \omega_\eta \times N_{events}}$$
- Currently derived using special Minbias runs taken at vrious luminosities
  L=11.5E30/cm^2/s
  L=19.5E30/cm^2/s
  L=32.5E30/cm^2/s
- MC offset derived using Pythia minbias events (*underlying event contribution*) superimposed with <mb>=0.8 (*multiple ppbar interaction contribution*)
- Overall sys. uncertainty of 40% includes variations in the densities at different luminosities, plus possible differences due to jet vs. Minbias data



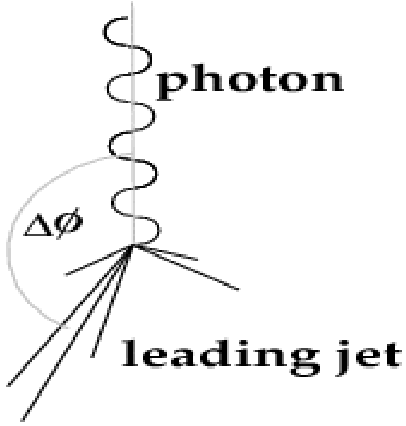


Response

Jet Respone is typically < 1.

- $h/e \neq 1$
- Uninstrumented regions
- Module to module fluctuations

Missing E_T Projection Fraction Method



Based on event energy balance in the transverse plane

In an ideal calorimeter:

$$\vec{E}_{T\gamma} + \vec{E}_T^{had} = 0$$

In the DØ calorimeter:

$$R_{em}\vec{E}_{T\gamma} + R_{had}\vec{E}_T^{had} = -\vec{\not{E}}_T$$

Once photons are calibrated, $R_{em} = 1$: $R_{had} = 1 + \frac{\vec{\not{E}}_T \cdot \hat{n}_{T\gamma}}{E_{T\gamma}}$

For a γ-jet two body process: $R_{jet} = R_{had}$

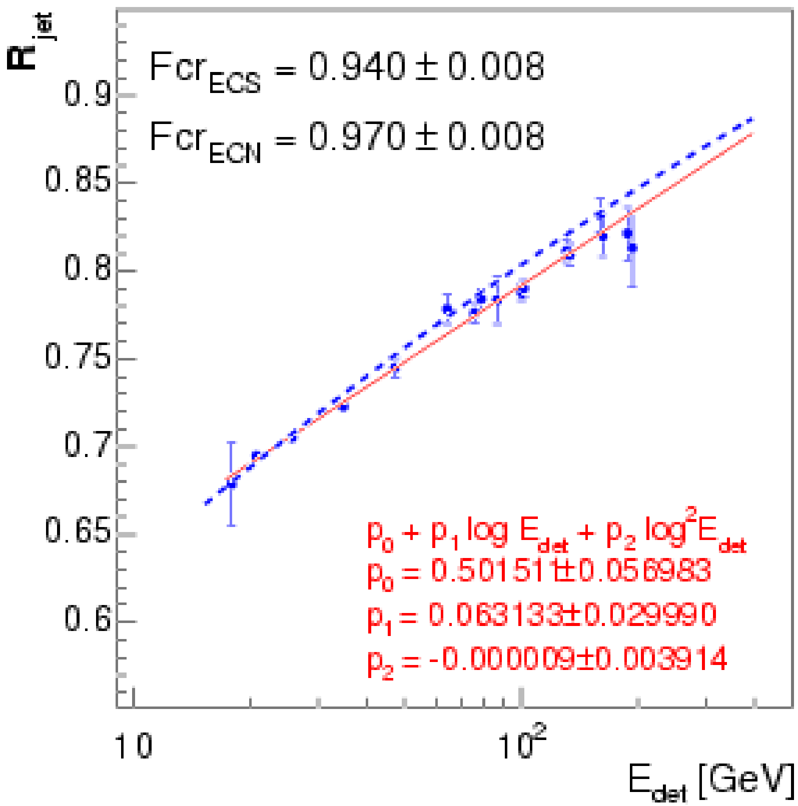
To avoid resolution bias and effect of a steeply falling γ cross section:

R_{jet}versus E' with $E' = E_{T\gamma}\cosh(\eta_{jet})$

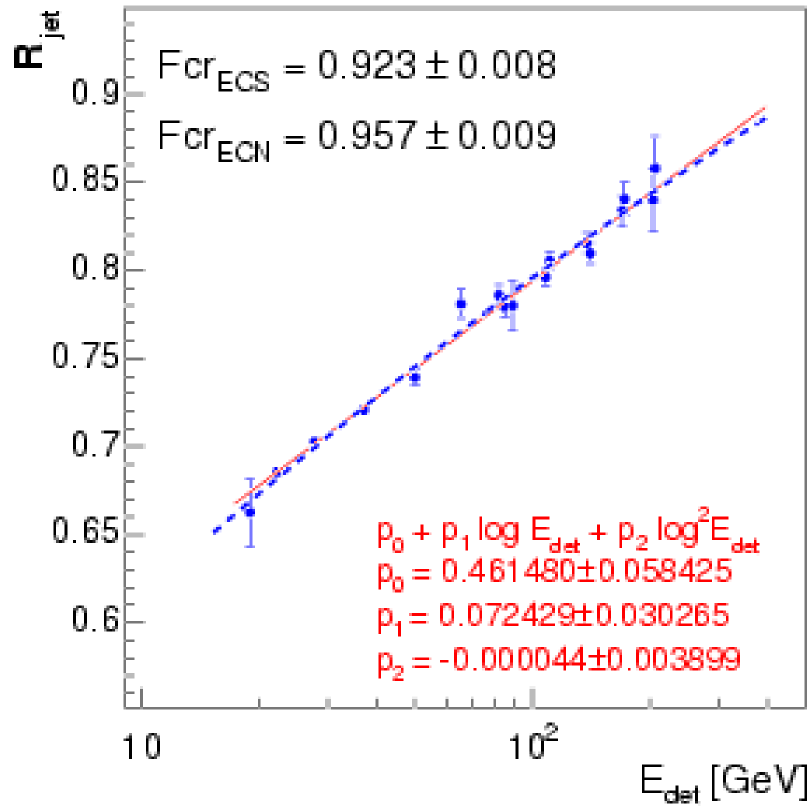
$E' \rightarrow E_{jet}^{meas}$ and R_{jet} versus E_{jet}^{meas}

p14 Response -- data

R=0.5 cone



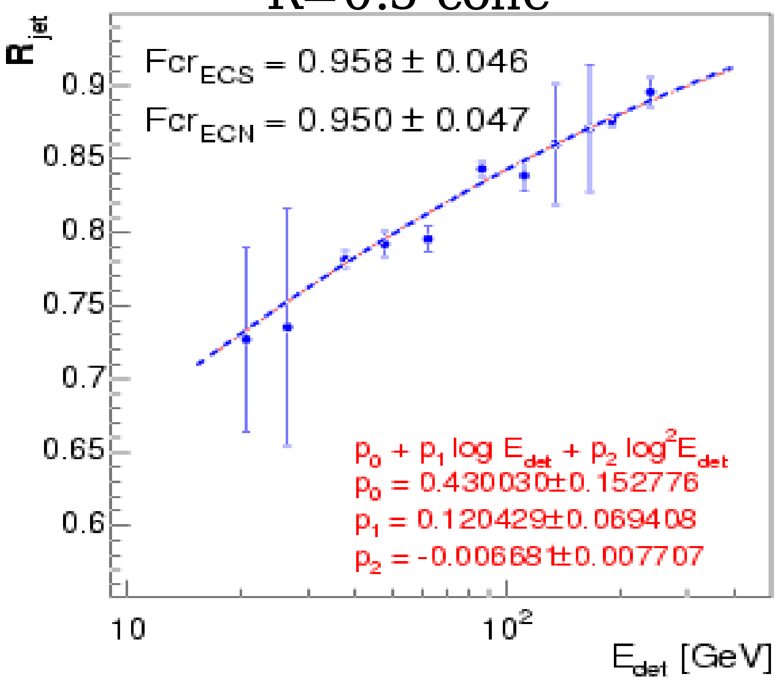
R=0.7 cone



Red – response with T42
blue – response without T42

p14 Response -- MC

R=0.5 cone



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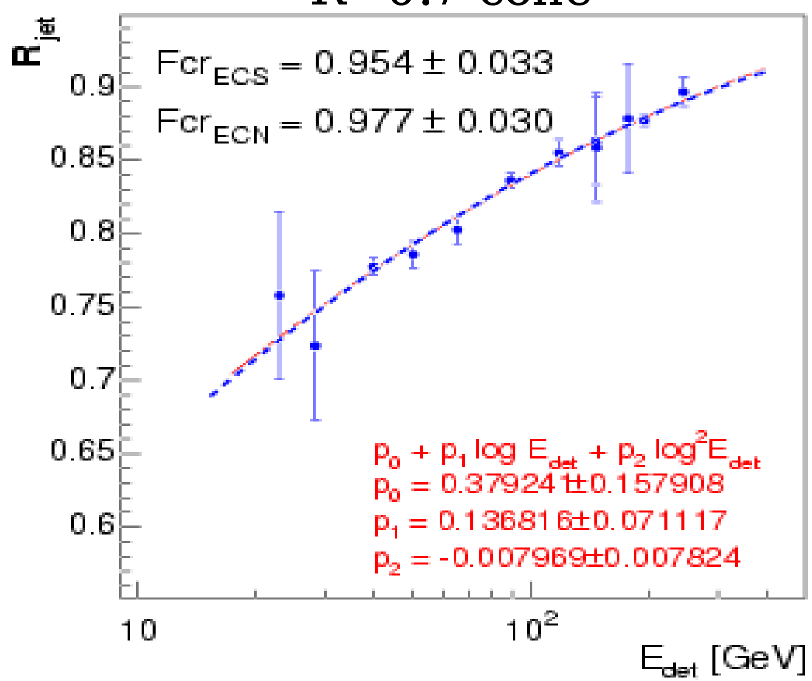
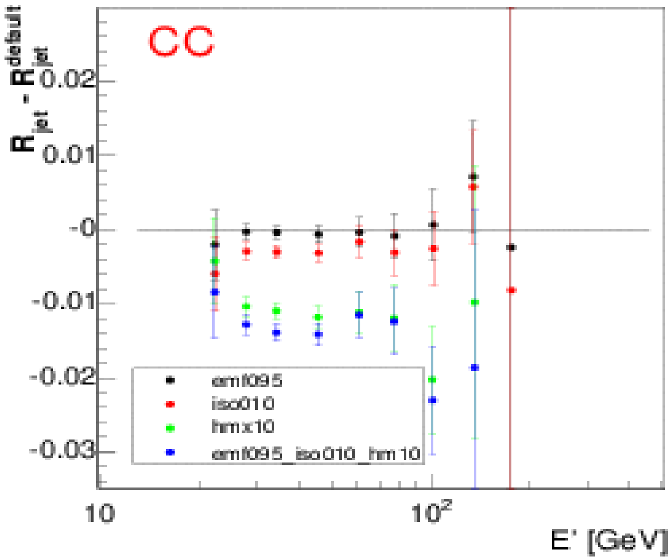


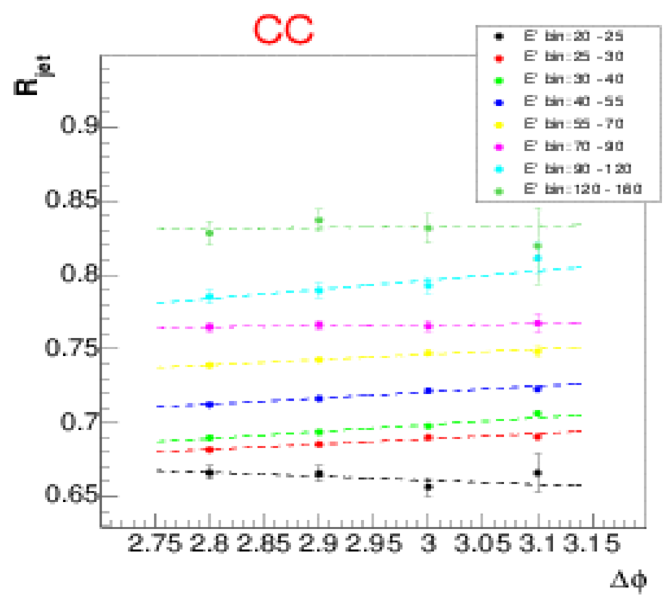
Red – response with T42
blue – response without T42

MC response is lower by ~0.05 compared to data.
The shapes are simmilar.

Response systematics

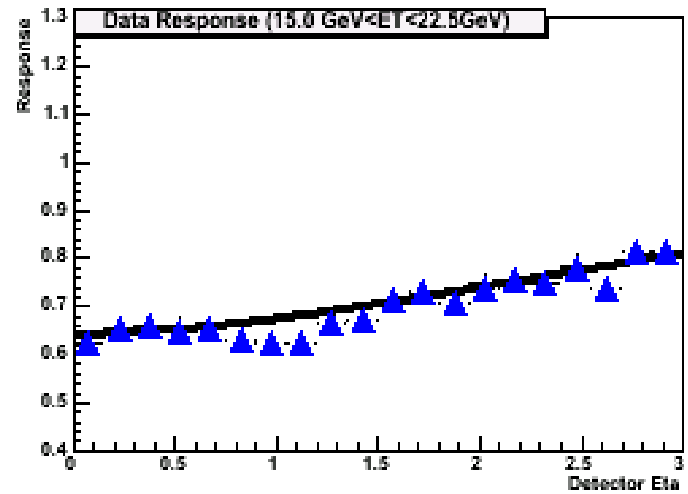
- Number of systematic uncertainties:
  - Variation of EM id cuts, i.e. QCD bkgd fraction -- ~2% in data.
  - Topology systematics ~0.5% (3%) for dphi>2.8(3.1)
  - Vertex cut variation -- ~1%
  - MET systematics -- 0.5%
- Additional systematics from fitting and EM scale.
- At low energies, E<20 GeV main systematic due to low ET bias
- At high energies E>250 GeV large systematic error from response extrapolation

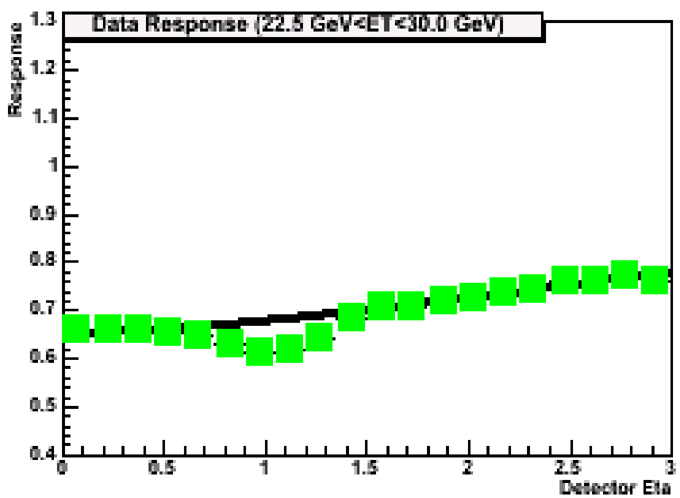


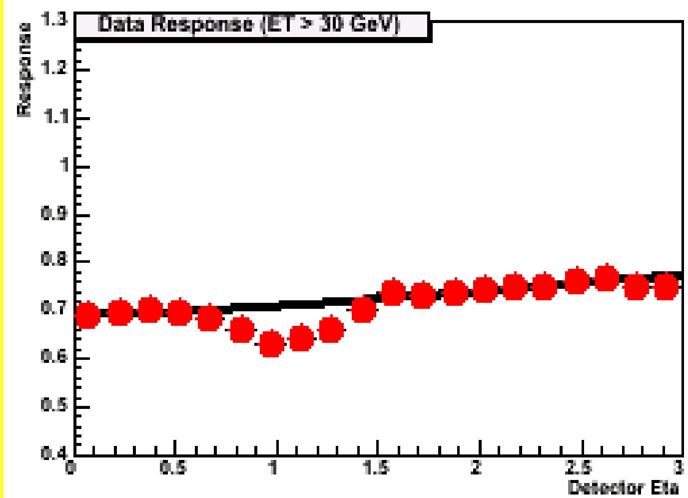


p14 ICR correction -- data

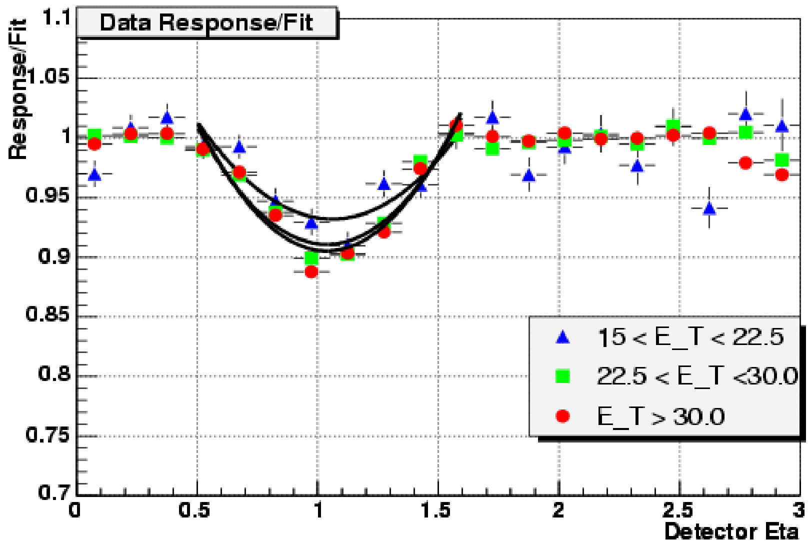
- Response as a function of detector eta -- nonuniformity of the detector in the ICR region
- Use a+bxlog(eta) fits to take out energy dependence

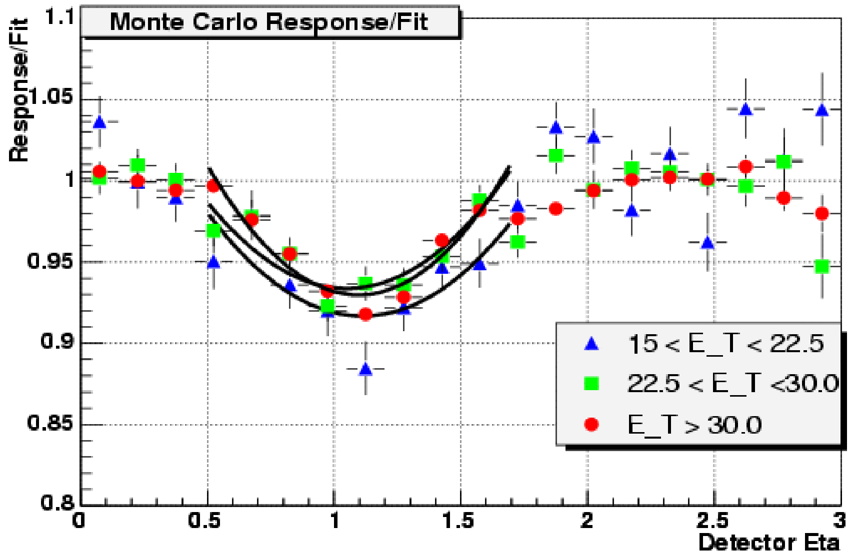


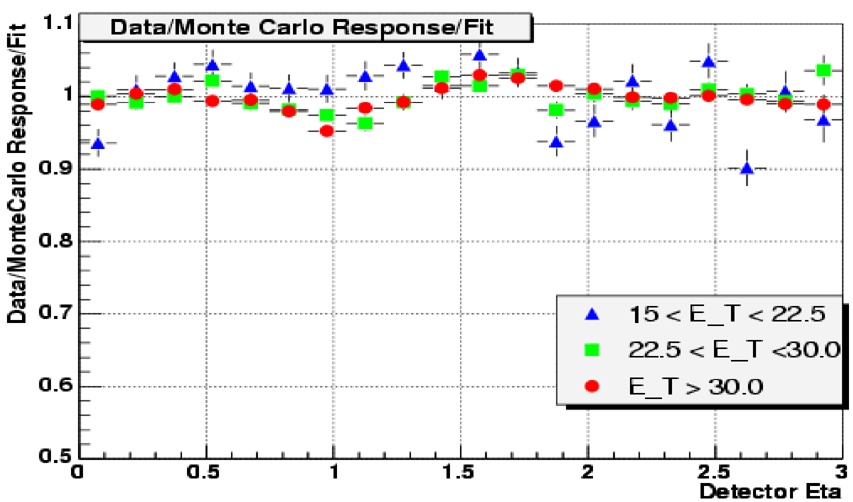




p14 ICR correction -- data vs. MC





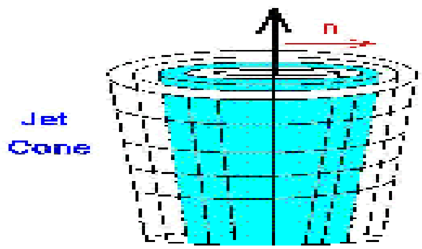


30% systematic error to accout for possible ET dependence

much smaller 'dip' in p14 data (~9%) compared to p13 (~25%)

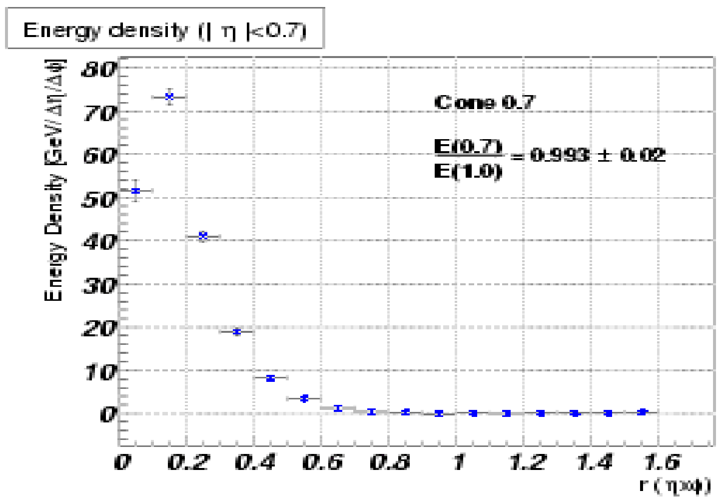
Showering

- Use back-to-back photon+jet events
- Method: measure ET densities in ring around jet axis



$$r = \sqrt{(\eta - \eta_o)^2 + (\phi - \phi_o)^2}$$

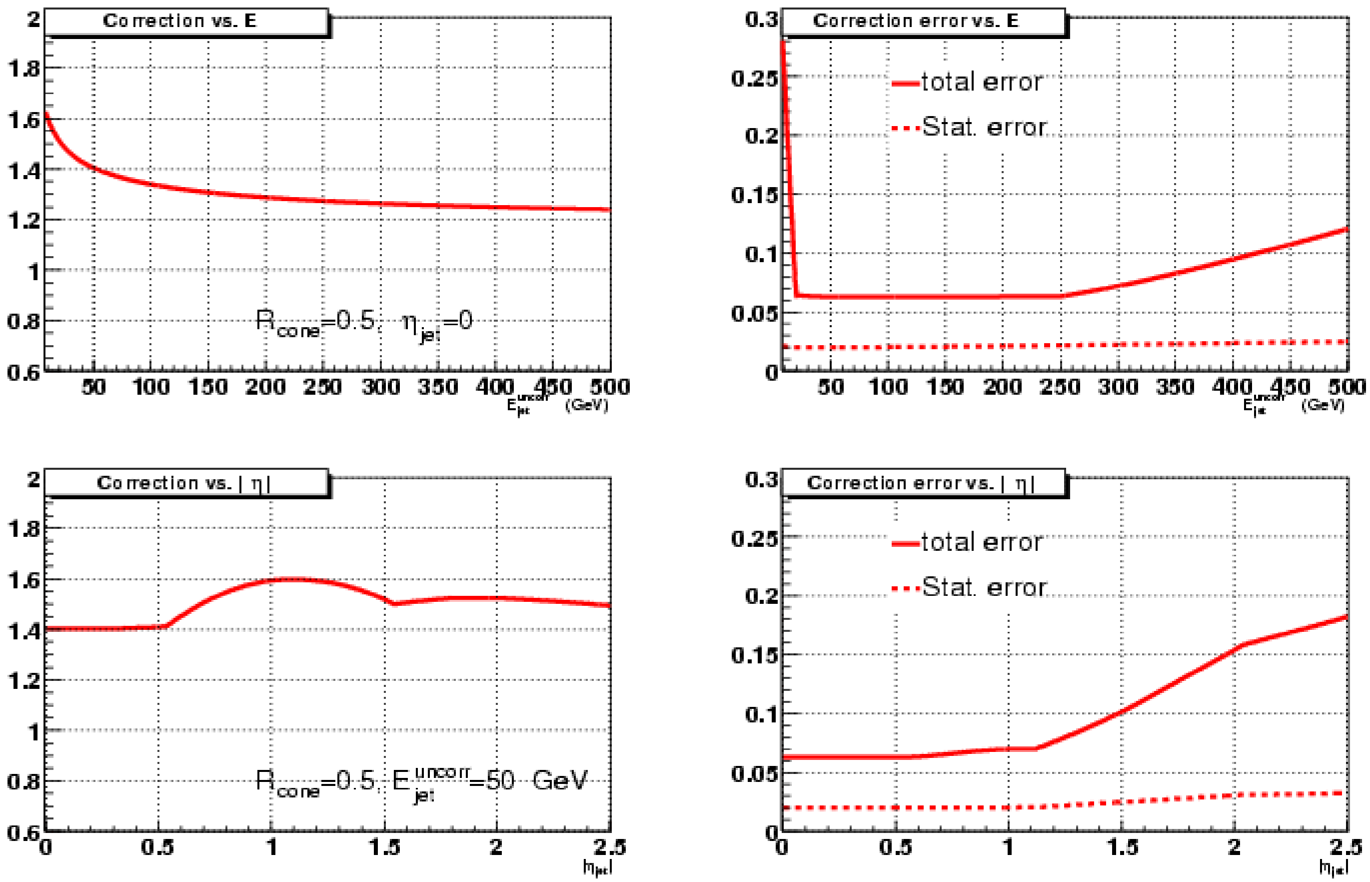
$$S_{cone} = \frac{E_{cone}}{E_{jetlimit}}$$



	$r = 0.7$	$r = 0.5$
Central	0.99	0.92
ICR	0.96	0.89
Forward	0.94	0.85

- 5 (20)% syst. error in Central (End) Calorimeter

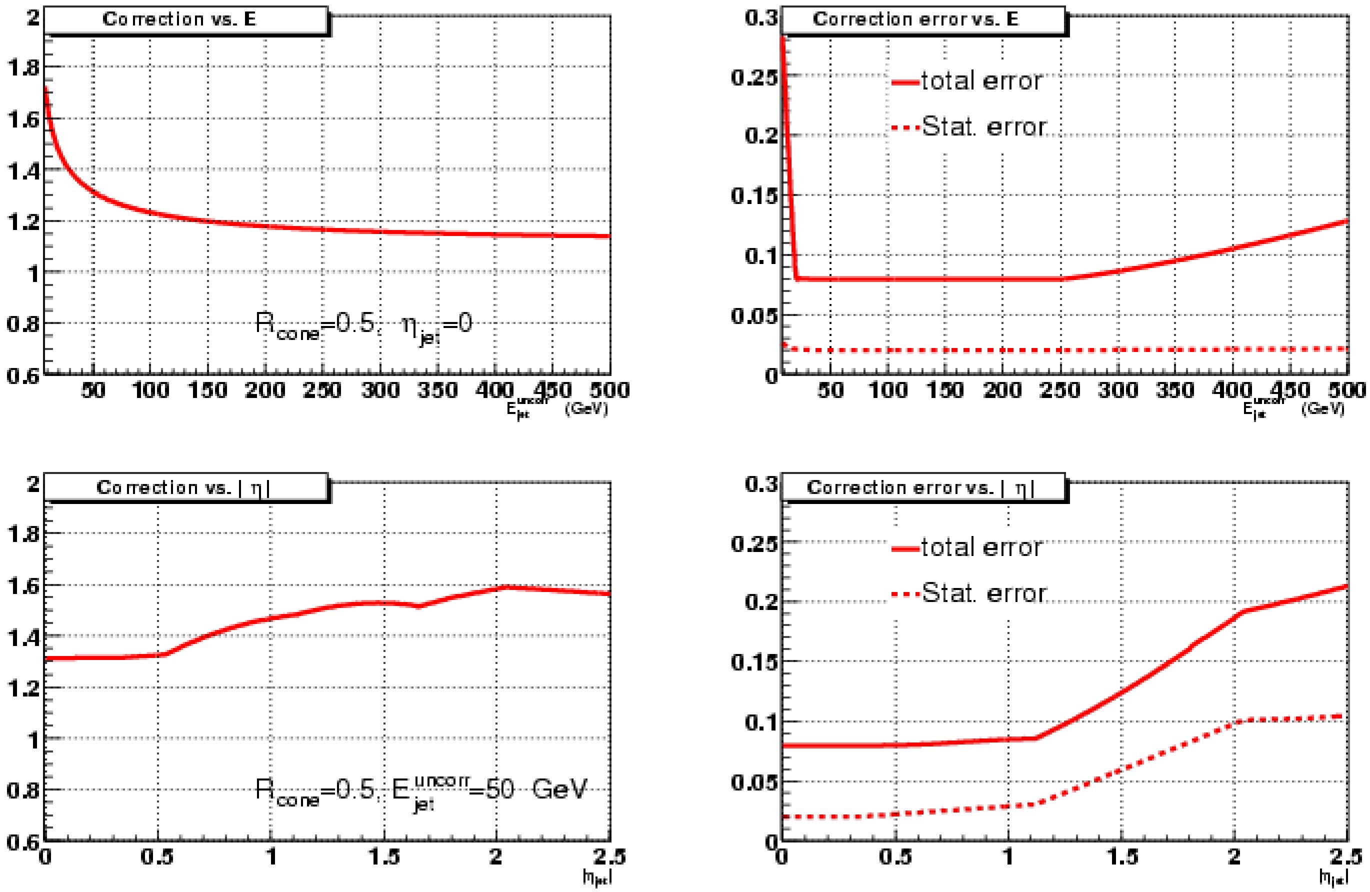
Overall JES correction and error for data



Around 7% error for the jets with |eta|<0.5 and uncorrected energy of 20-250 GeV

The error dominated by systematic uncertainties

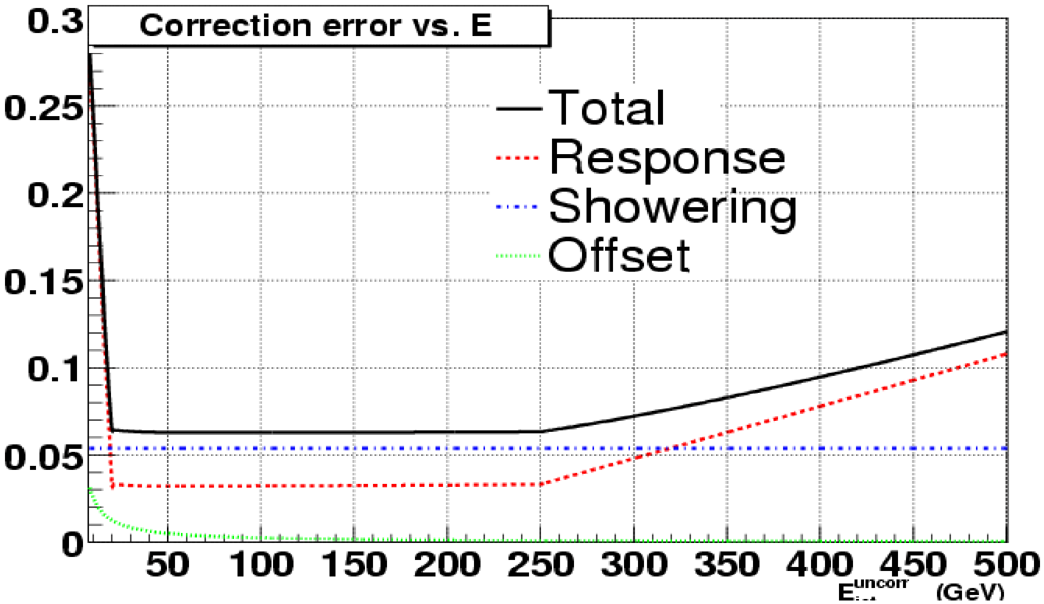
Overall JES correction and error for MC

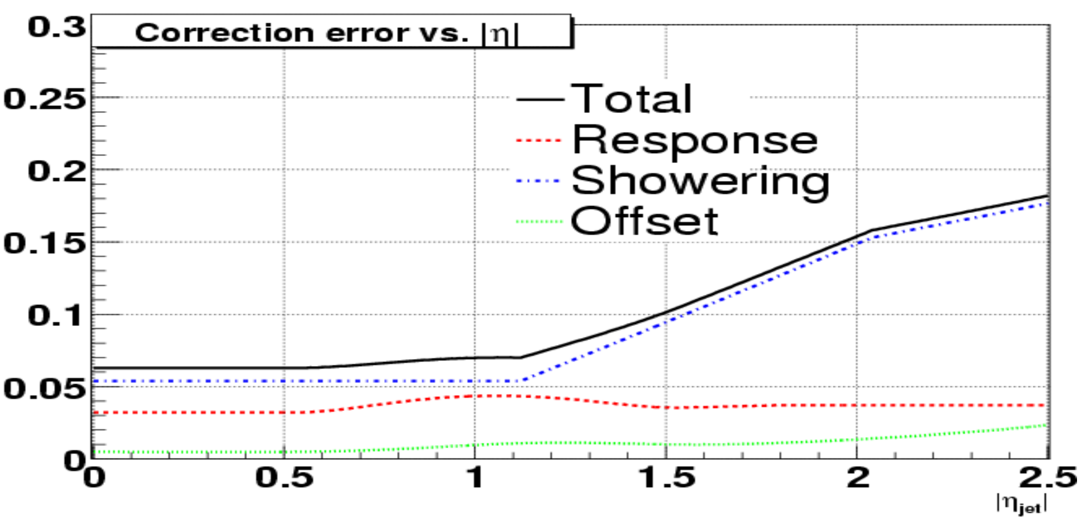


Around 8% error for the jets with |eta|<0.5 and uncorrected energy of 20-250 GeV

The error dominated by systematic uncertainties

JES error for data -- various contributions

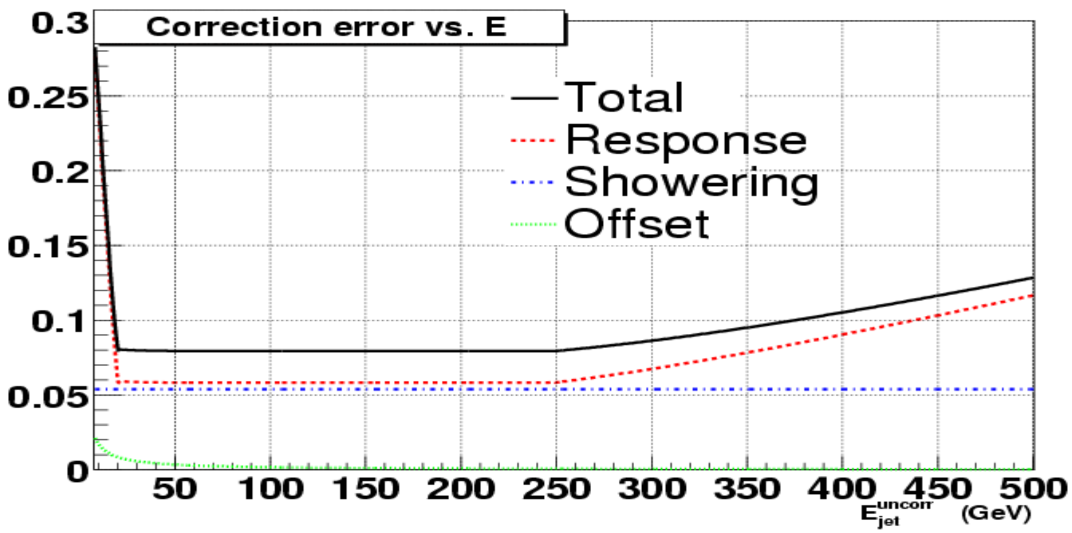


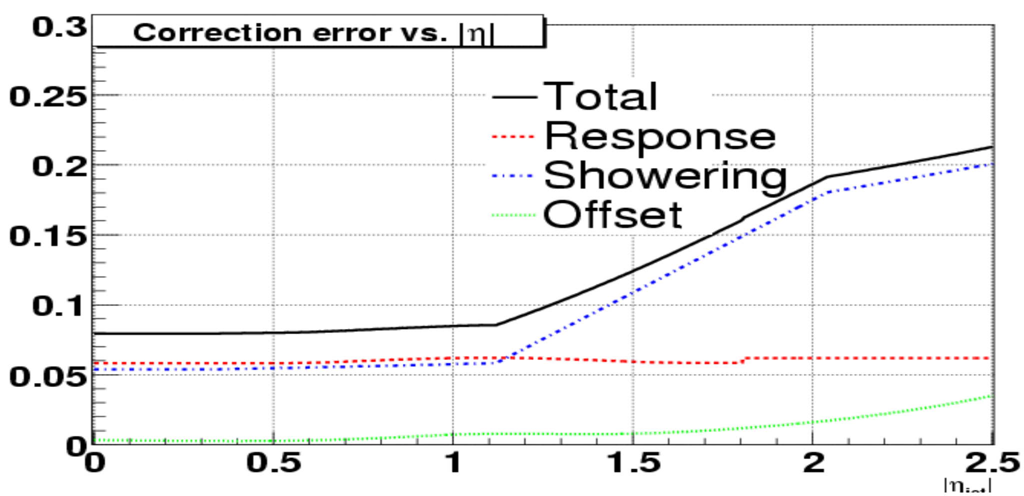


Response error dominant uncertainty at low (E<20 GeV) and high (E>300-350 GeV)

Showering uncertainty dominant for 20<E<300GeV jets at all etas

JES error for MC -- various contributions



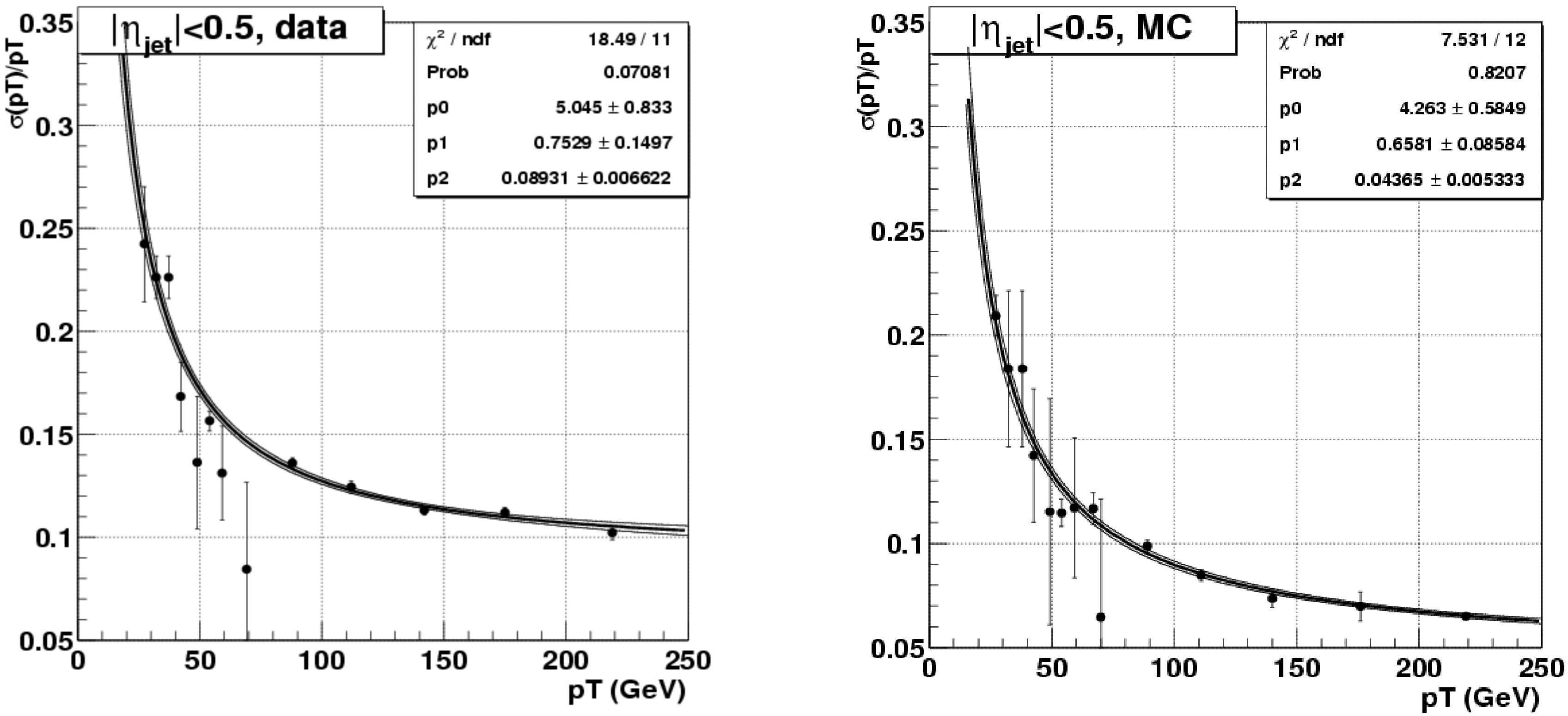


Response error dominant uncertainty at low (E<20 GeV) and high (E>300-350 GeV)

Showering and response uncertainties comparable and dominant for 20<E<300GeV jets in |eta|<1.2. Beyond |eta|>1.2 showering error becomes dominant

Jet resolutions

R=0.5 cone, w/ T42



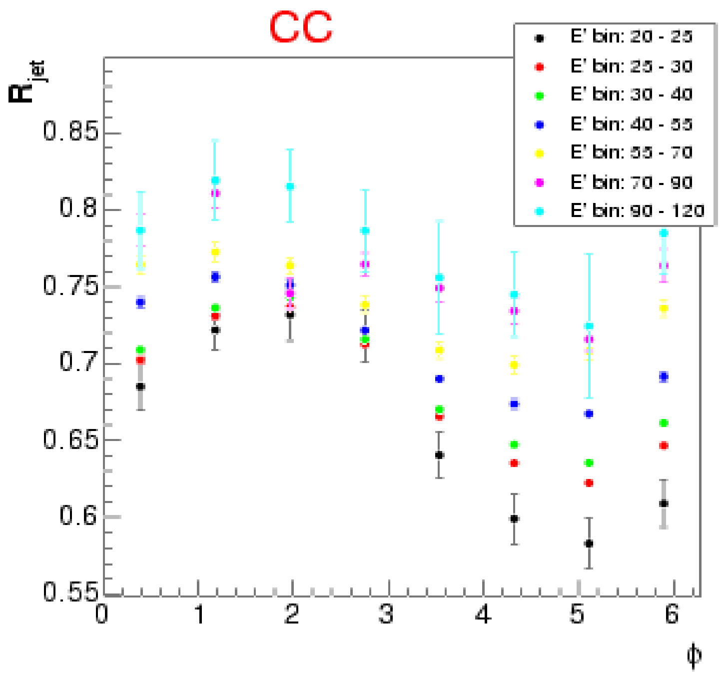
Low pT region (<50GeV) – measurement from photon+jet data

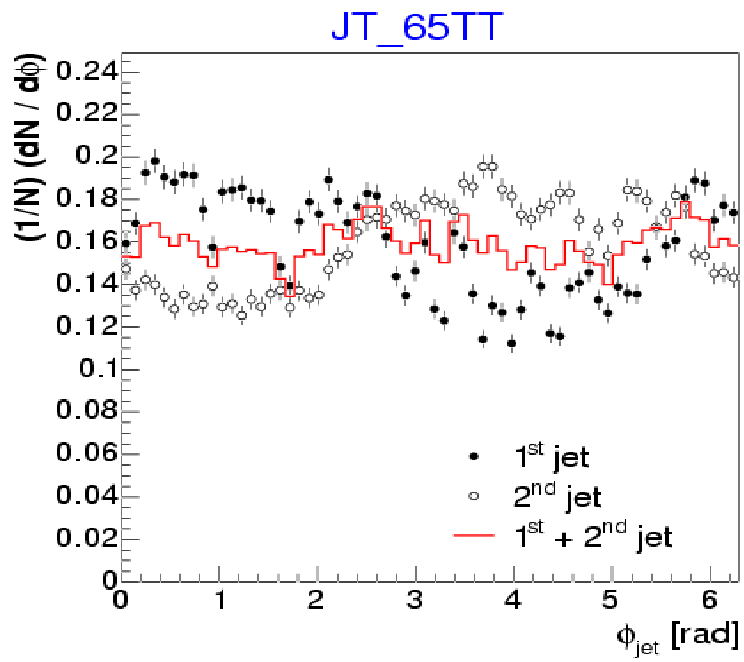
high pT region (>50 GeV)– dijet data

Plans

- Better understanding of OOC showring is of crucial importance -- derive showering correction using both data and MC methods. Separate physics OOC showering contribution from instrumental showering
- Improve on low energy jet calibration – low ET bias studies
- Offset – study density dependance on “jettness” of events.
- Response: investigate other degrees of freedom: phi dependence, run range dependance, …
- Goal is to decrease error down to 3% by summer -- challenging:
  - Need more person power and stable data-sets

Φ dependence of response





- Possible sources:
  calorimeter misalignement
  "warm" region
  φ nonuniformity
- Under investigation
- Can (at least partially) explain poor jet resolutions