Status of Jet Simulations

Sightly modified version of transparancies
shown during the MPI-HEC group meeting

A. Kiryunin

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- **Status**

- **Jet energy resolution**

- **Maximal expected signal**

Jet Simulations

A.Kiryunin, R.Mekhdiyev, Z.Metreveli, D.Salihagić

- **Events with $q\overline{q}$ jets of fixed energy and at fixed pseudo-rapidity**
- **Generation of events with ATGEN: 250 events per point**
- **Simulation with DICE/SLUG:**
  - **all calorimeters are active, with magnetic field inside**
  - **inner tracker is present as passive medium**
  - **no muon system**
  - **GCALOR — code for hadronic shower development**
- **Number of simulated events:**

η	Institute	Version	Jet energy, GeV				
			100	200	500	1000	2000
1.85	Dubna/CERN	96_9	250	200	229	250	215
2.15	Dubna/CERN	96_11	250	250	250	221	227
2.45	MPI Munich	96_7	250	250	250	250	250
2.75	MPI Munich	96_9	250	250	250	250	250
3.05	MPI Munich	96_9	250	250	250	250	250

- **Used computer resources (at MPI)**

CPU Resources, used at MPI for Jet Simulations

Dsik space

File with data: `/at/hec/jets/data/*.data`

File size, MBytes

Jet energy, GeV	Eta=2.45	Eta=2.75	Eta=3.05
100	36.6	41.2	43.6
200	48.5	56.6	61.9
500	72.2	85.3	105.2
1000	97.4	121.6	159.2
2000	133.7	178.8	235.0

CPU time

T - CPU time per one GeV of the total energy in an event,
<*T*> - average time for a group,
R - relative time between different groups of computers

		Jets at Eta=2.45			Jets at Eta=2.75			Jets at Eta=3.05		
Group	**Computer**	***T*, sec**	**<*T*>, sec**	***R***	***T*, sec**	**<*T*>, sec**	***R***	***T*, sec**	**<*T*>, sec**	***R***
1	iws182	2.12	2.12	0.81	2.05	2.05	0.83	1.93	1.93	0.83
2	comps1	2.63	2.62	1.0	2.43	2.46	1.0	2.26	2.32	1.0
	iws144a	2.59			2.56			2.36		
3	iws186	3.20	3.20	1.22	3.46	3.46	1.40	2.90	2.90	1.25
4	afmp07	-	-	-	-	-	-	4.37	4.37	1.88
5	iws172	6.27	6.35	2.4	5.67	5.85	2.4	4.72	5.35	2.3
	iws174	6.10			-			-		
	iws174a	6.33			5.67			5.61		
	iws179	6.24			5.88			5.25		
	iws180	6.52			6.00			5.66		
6	afmp08	-	-	-	-	-	-	7.45	7.45	3.2
7	afmp02	-	-	-	-	-	-	10.39	10.91	4.7
	afmp04	-			-			11.94		
	afmp06	-			-			10.90		

Jet Energy Resolution

- **Calibration of calorimeters: "electro-magnetic scale"**
- **Additional corrections: by minimizing resolution for the total calorimeter volume**

$$E_i = \sum_{j=1}^{M} C_j \cdot E_{ij}$$

$$F = \sum_{i=1}^{N} (E_i - E_{0i})^2$$

- **11-13 correction parameters for each energy separately:**

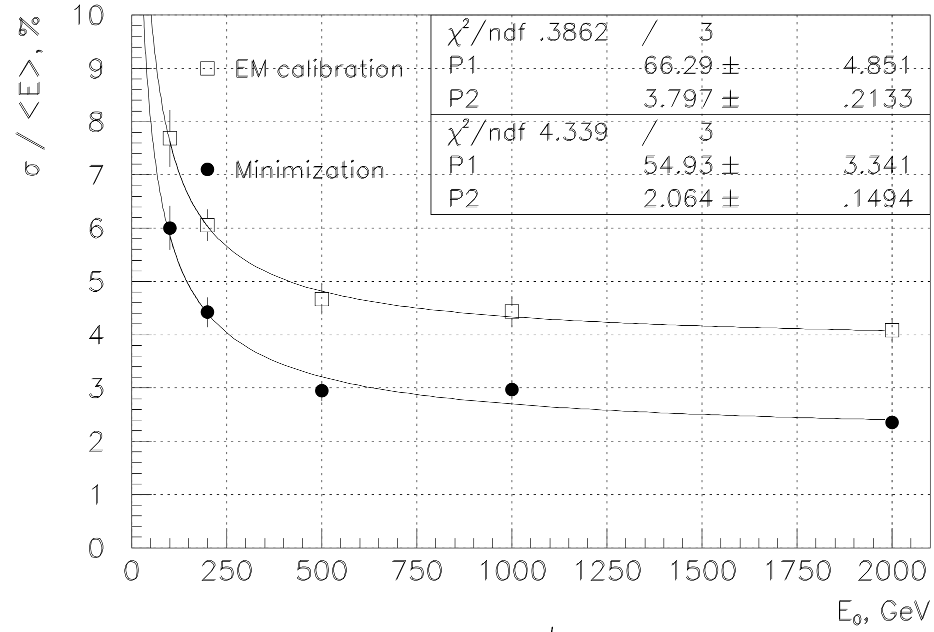
  3 longitudinal layers of HEC
  3 longitudinal layers of outer EM EC (or less)
  2 longitudinal layers of inner EM EC (or less)
  EM barrel and presampler
  Tile calorimeter as a whole (or more — for a crack)
  Forward calorimeter as a whole (or more — for a crack)

- **Gaussian curves are fitted to energy distributions in an interval of $\pm 3\sigma$ around the peak value**

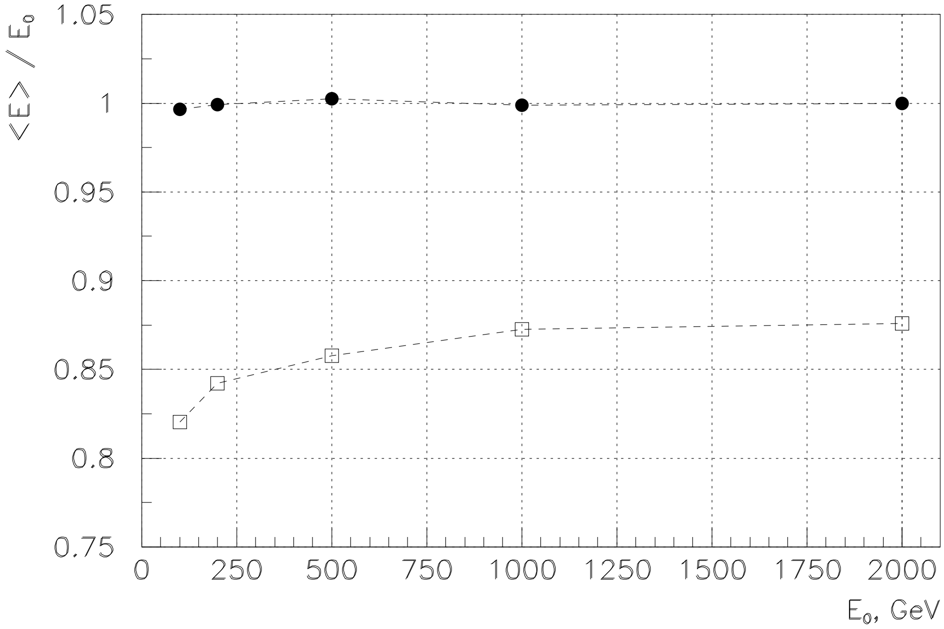
- **Resulting $< E >$ and σ — resolution $\sigma / < E >$**
- $(\sigma/E)_{TOT} \rightarrow (\sigma/E)_{JET}$
  $\sigma_{JET} = \sigma_{TOT}/\sqrt{2}, E_{JET} = E_{TOT}/2$
- **Energy dependence of the resolution:**

$$\frac{\sigma}{E}(E_0) = \frac{P_1}{\sqrt{E_0}} \oplus P_2$$

Jets at η*=2.45*



$\sigma/E = P1/\sqrt{E} \oplus P2$

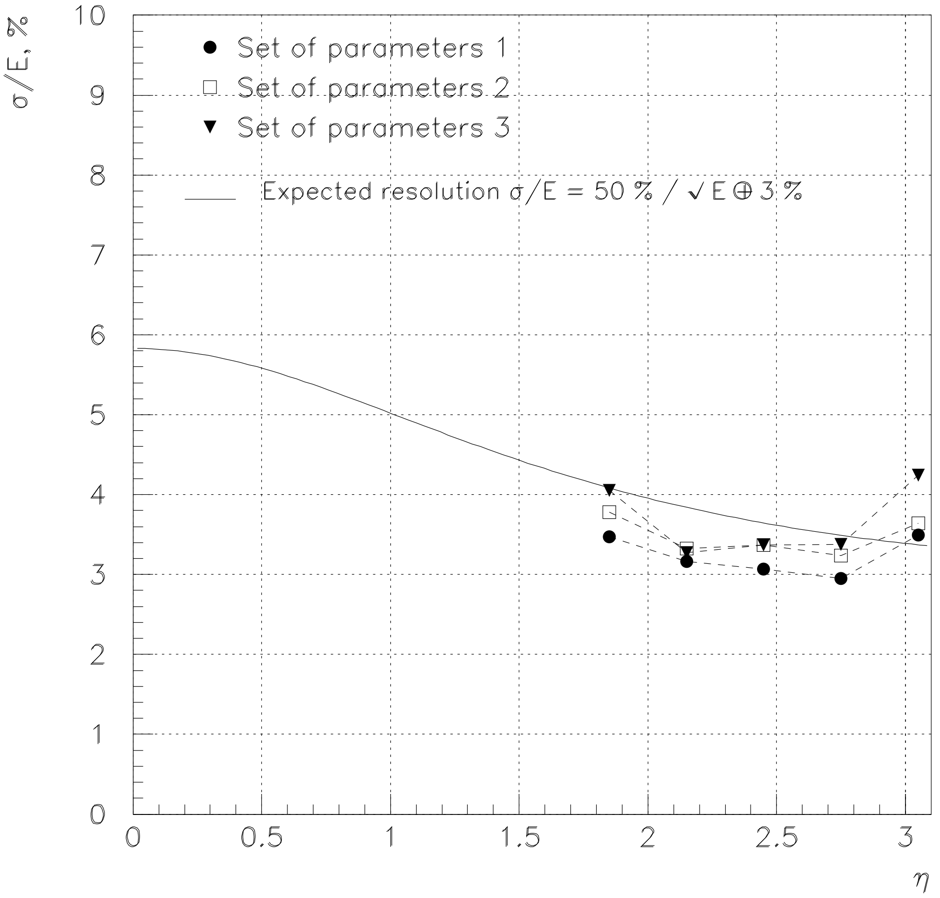


- **η-dependence of resolution for jets of E_T=100 GeV**
  Three sets of correction parameters:

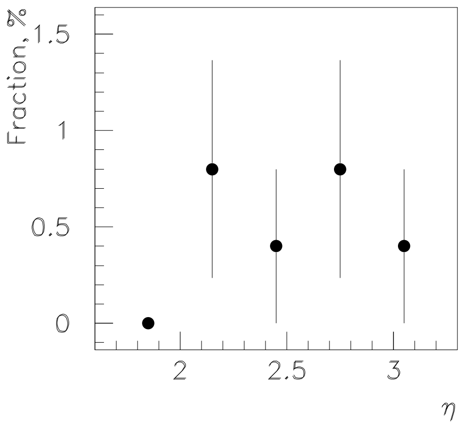
  1. **The one, used for the total volume (11-13 parameters)**
  2. **The "intermediate" one (6-8 parameters)**
  3. **The minimal one (6 parameters):**
     HEC front wheel
     HEC rear wheel
     EM EC
     EM barrel and presampler
     Tile
     Forward

- **Fraction of events in tails**
- **Study of energy resolution for different cone sizes**
- **Jets reconstruction (with ATRECON)**
- **Selection of events:**
  Two jets with maximal energies with
  $2.2 < |\eta| < 2.7$, $\pi - 0.25 < |\varphi_1 - \varphi_2| < \pi + 0.25$
  Energy cut
- **Used variables:**
  E_{KIN} — **energy in the cone, calculated on the particle level**
  E_{REC} — **reconstructed energy in the cone, using:**
  - **"electro-magnetic scale" calibration**
  - **correction parameters, obtained for the total volume**
  - **re-minimisation**
- **Gaussian curves are fitted to distributions on E_{REC}/E_{KIN}:**
  Mean value — response
  Standard deviation — resolution

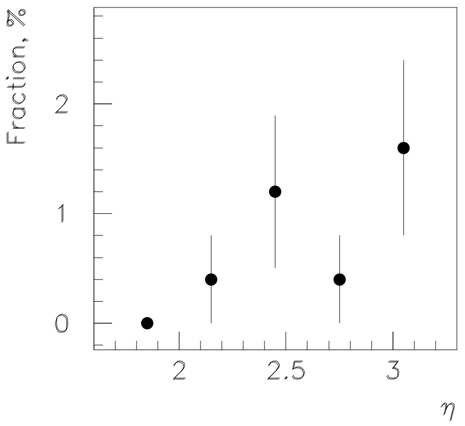
Resolution for Jets of E_T=100 GeV



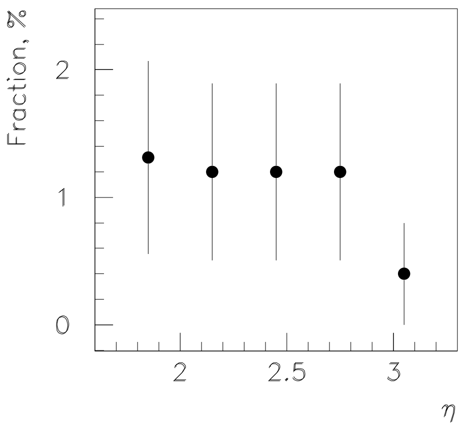
Fraction of Events in Tails (below <E>-3σ)



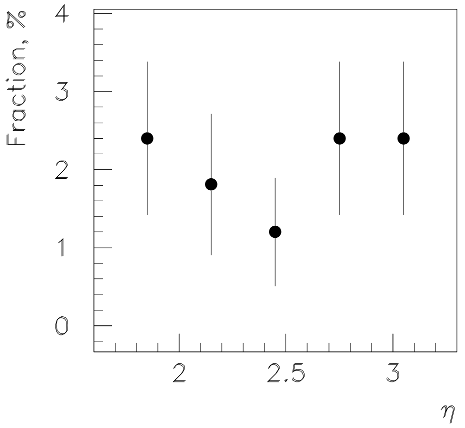
100 GeV jets



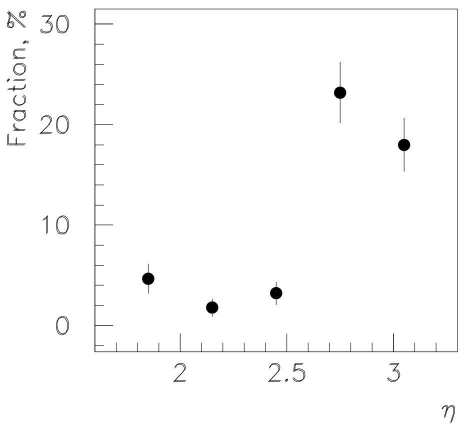
200 GeV jets



500 GeV jets

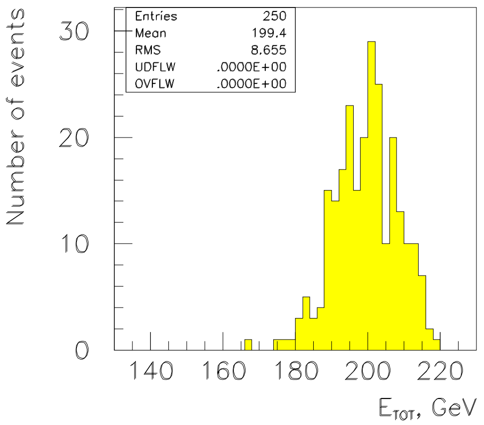


1000 GeV jets

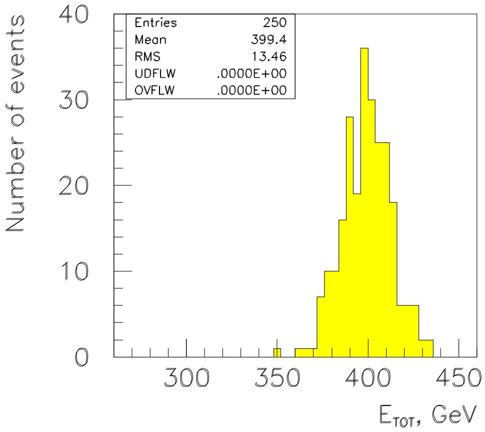


2000 GeV jets

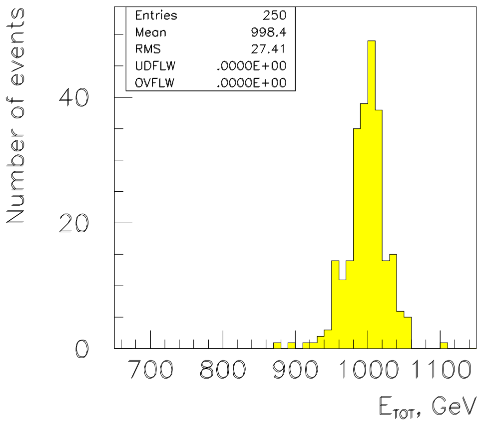
Events with Two Jets at |η|=2.75 (after Minimization)



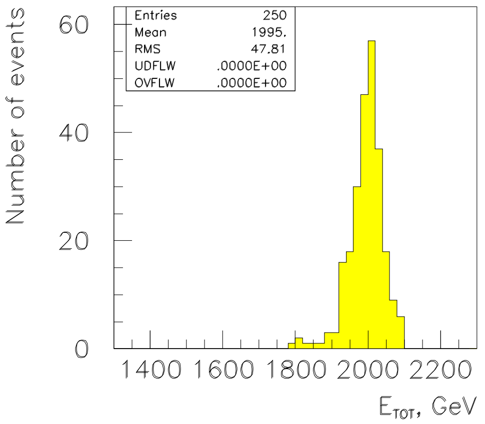
E_0=200 GeV



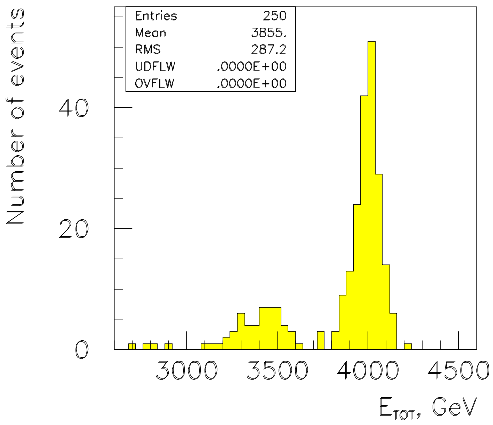
E_0=400 GeV



E_0=1000 GeV

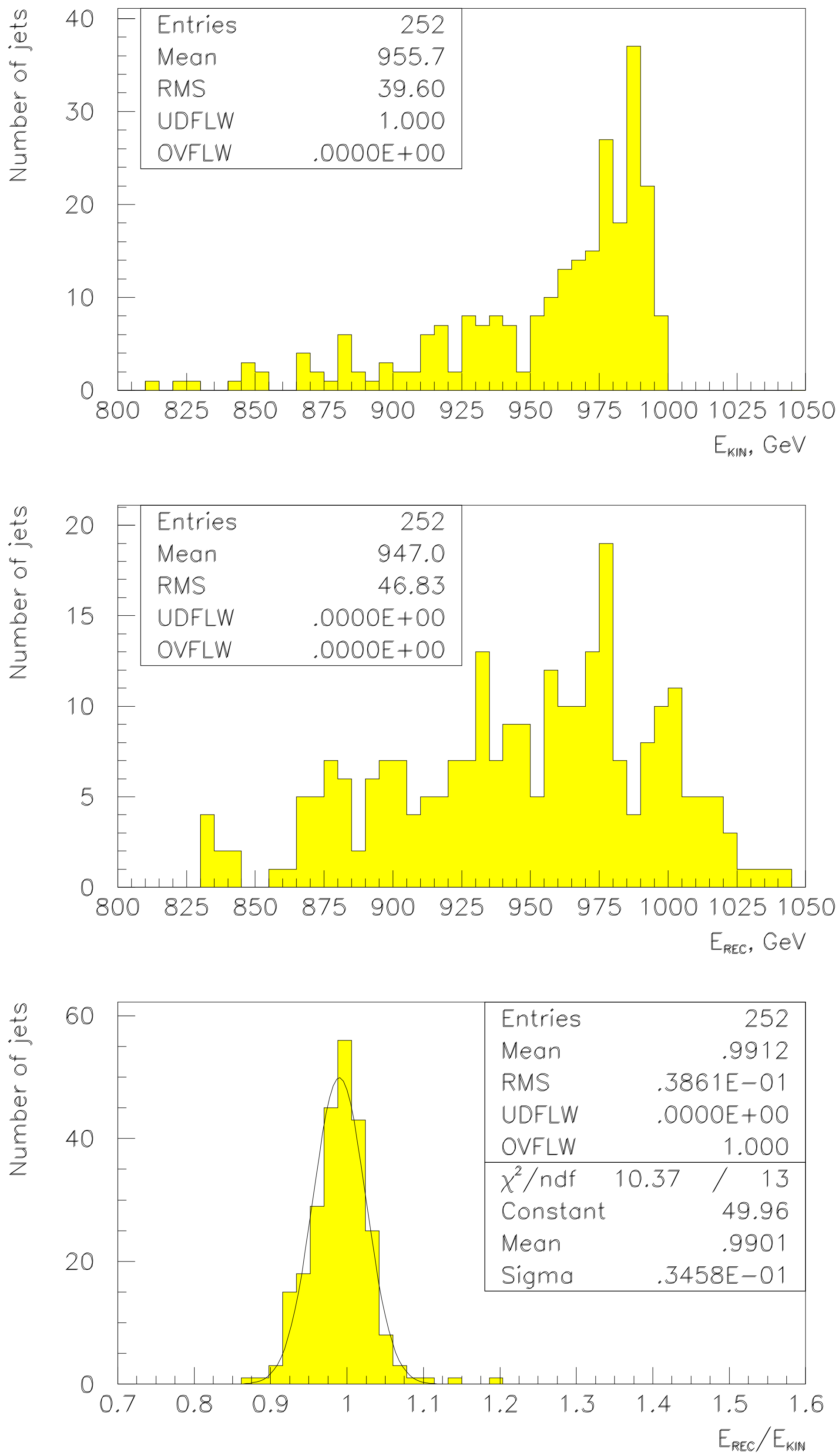


E_0=2000 GeV

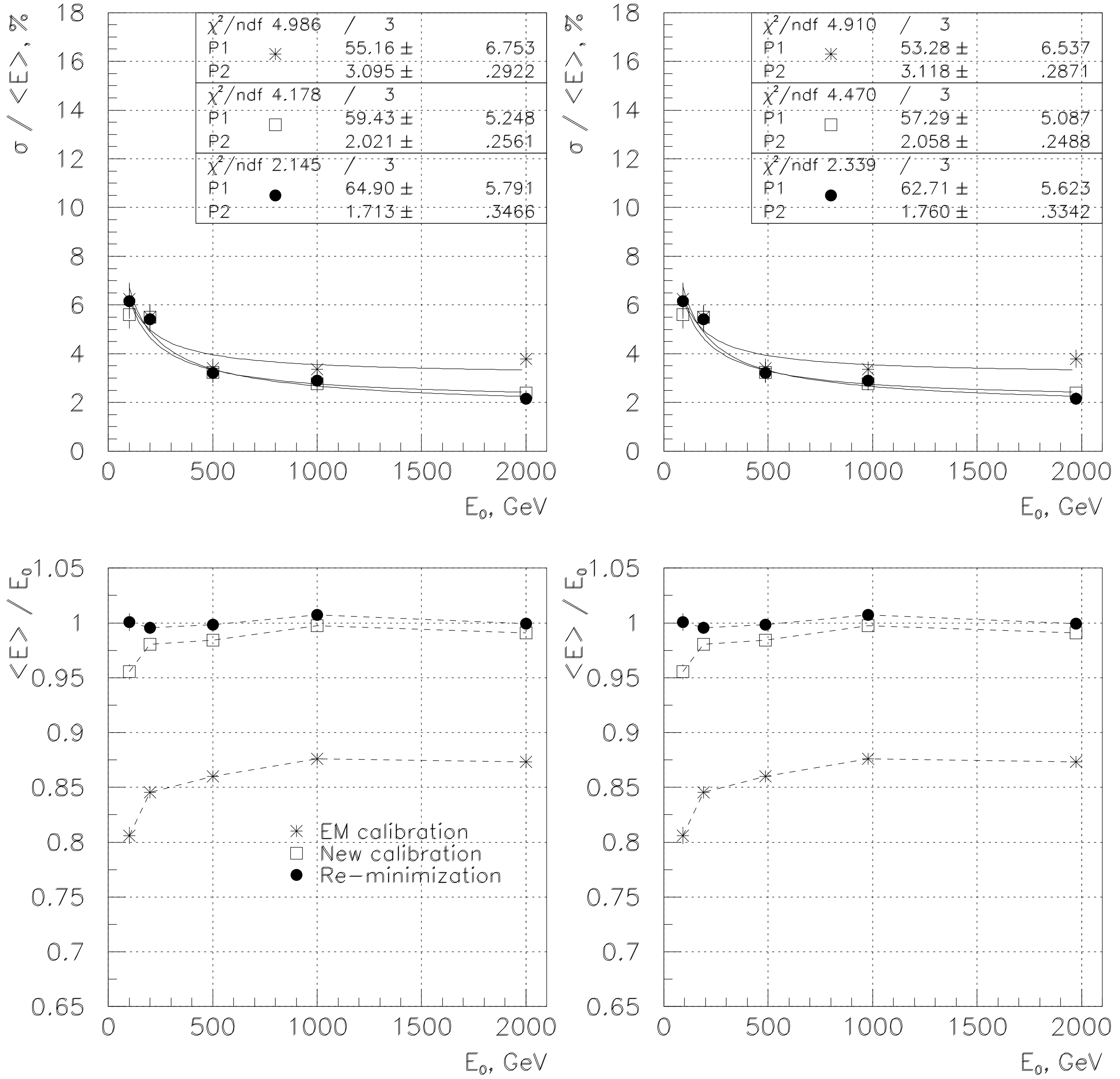


E_0=4000 GeV

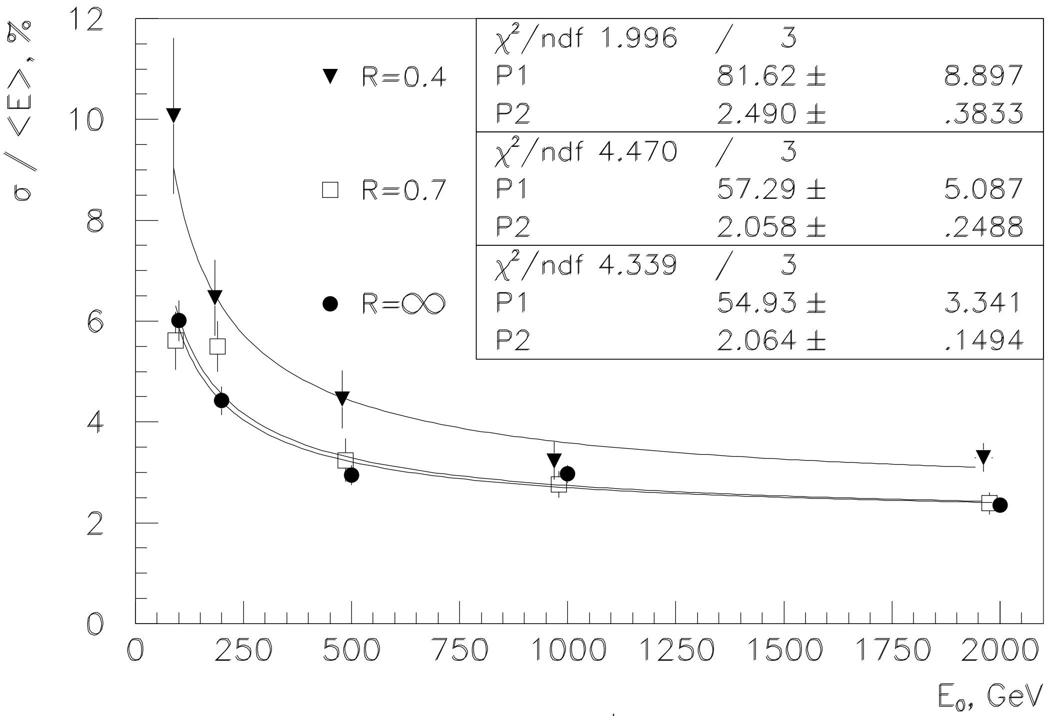
1000 GeV Jets of R=0.7 at η=2.45



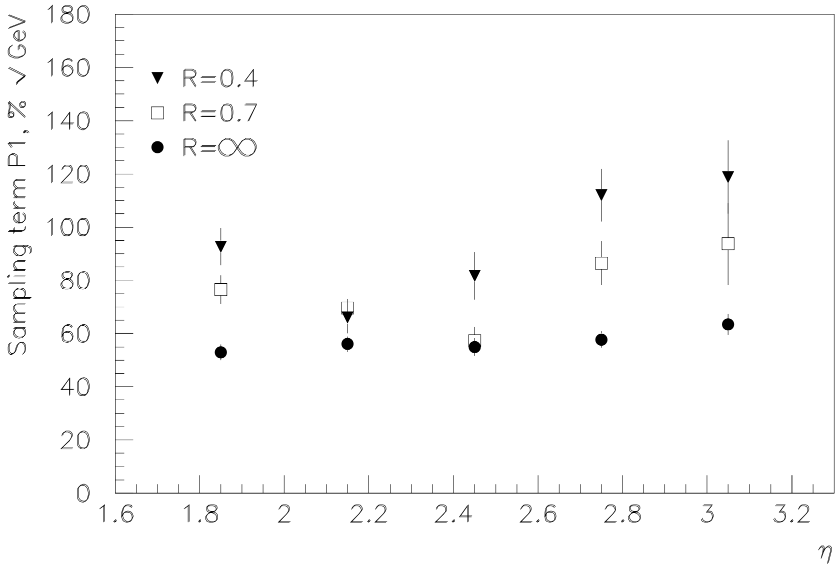
Jets of R=0.7 at η*=2.45*



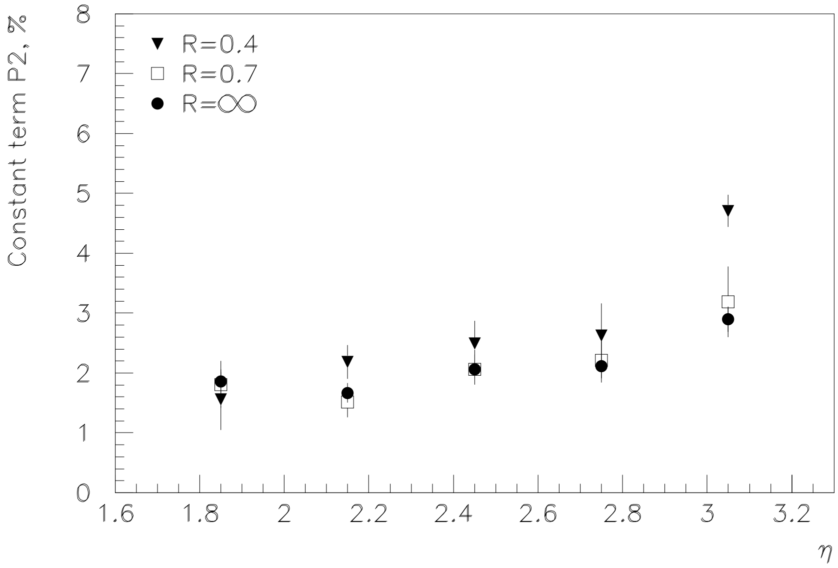
Jets at η*=2.45*



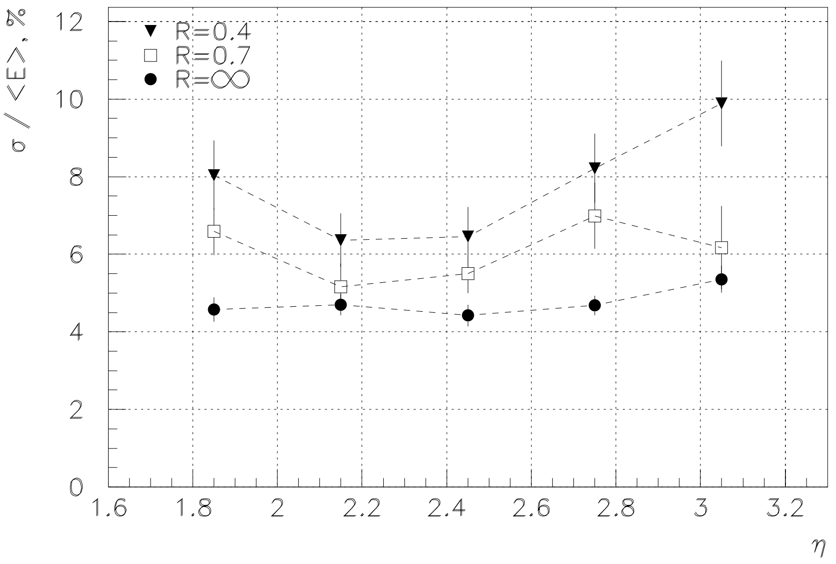
$\sigma/E = P1/\sqrt{E} \oplus P2$



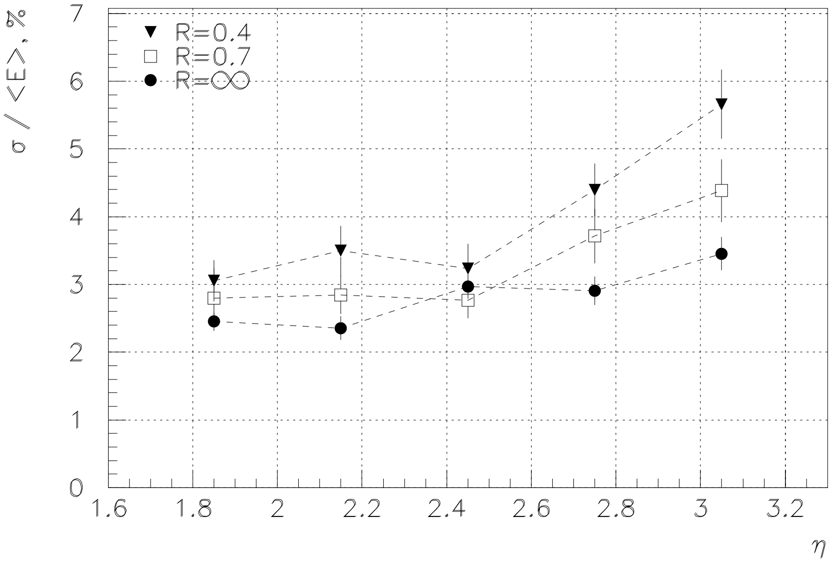
Sampling term P1, % √GeV
R=0.4
R=0.7
R=∞
η



Constant term P2, %
R=0.4
R=0.7
R=∞
η



200 GeV jets



1000 GeV jets

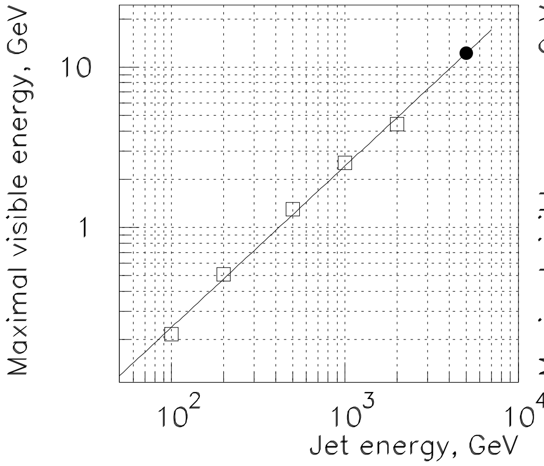
Maximal Expected Energy in the HEC

- **Maximal energy in a readout cell, readout channel or trigger tower**
- $E_{MAX}(E_0)$ — **99 % of events below this cut**
- **Extrapolation** $E_{MAX}(E_0)$ **up to 5000 GeV**
- $E_{MAX}(5\ TeV)$ — **"electro-magnetic scale" calibration**
- $Q = log_2(E_{MAX}/E_{MIP})$ — **energy range**

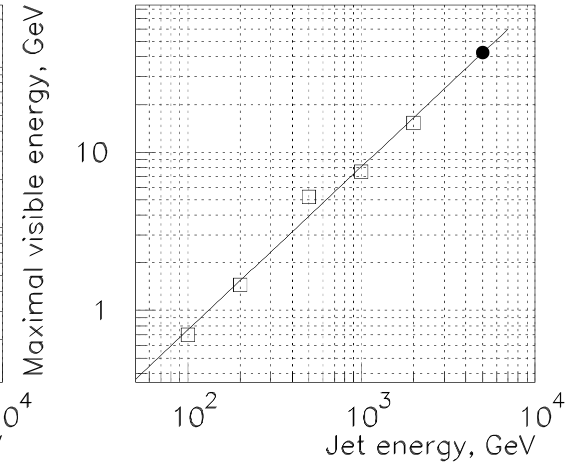
Longitudinal compartment	Readout cell		Readout channel	
	E_{MAX}, GeV	Q_{cell}	E_{MAX}, GeV	$Q_{channel}$
1st (4 cells)	440	12.2	1310	11.8
2nd (8 cells)	400	12.1	2040	11.4
3rd (8 cells)	575	11.2	1950	10.0

- **Trigger tower:**
  E_{MAX} = **2640 GeV**
  Q=**10.2**

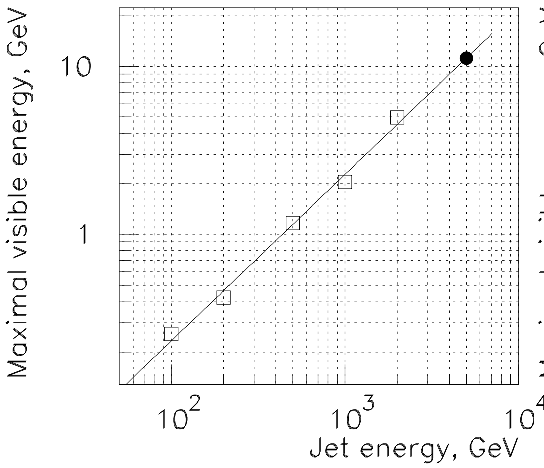
Jets at η=2.45, Cut - 99 %



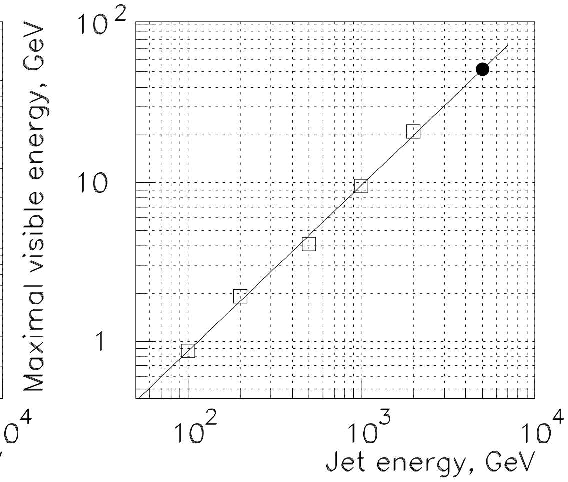
Double gap 4



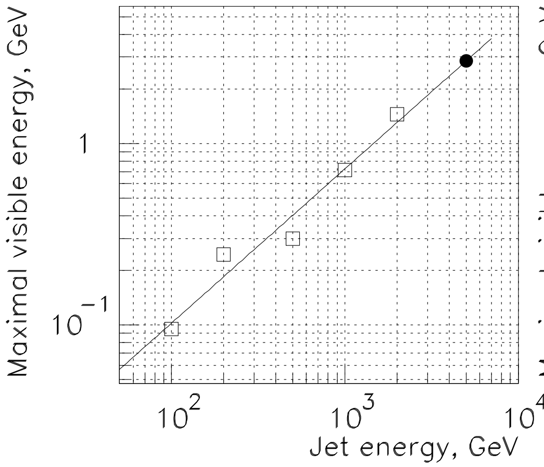
Layer 1 with 8 gaps



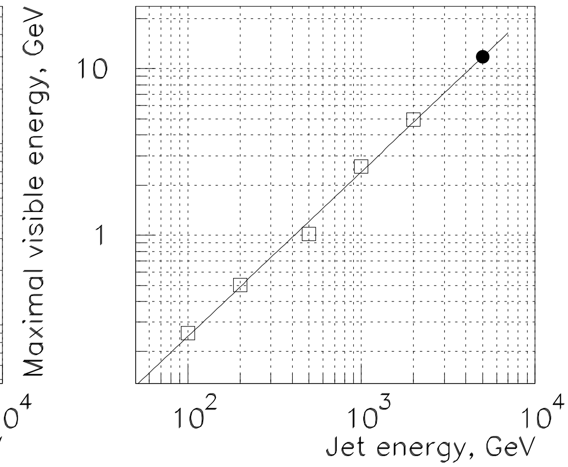
Double gap 5



Layer 2 with 16 gaps

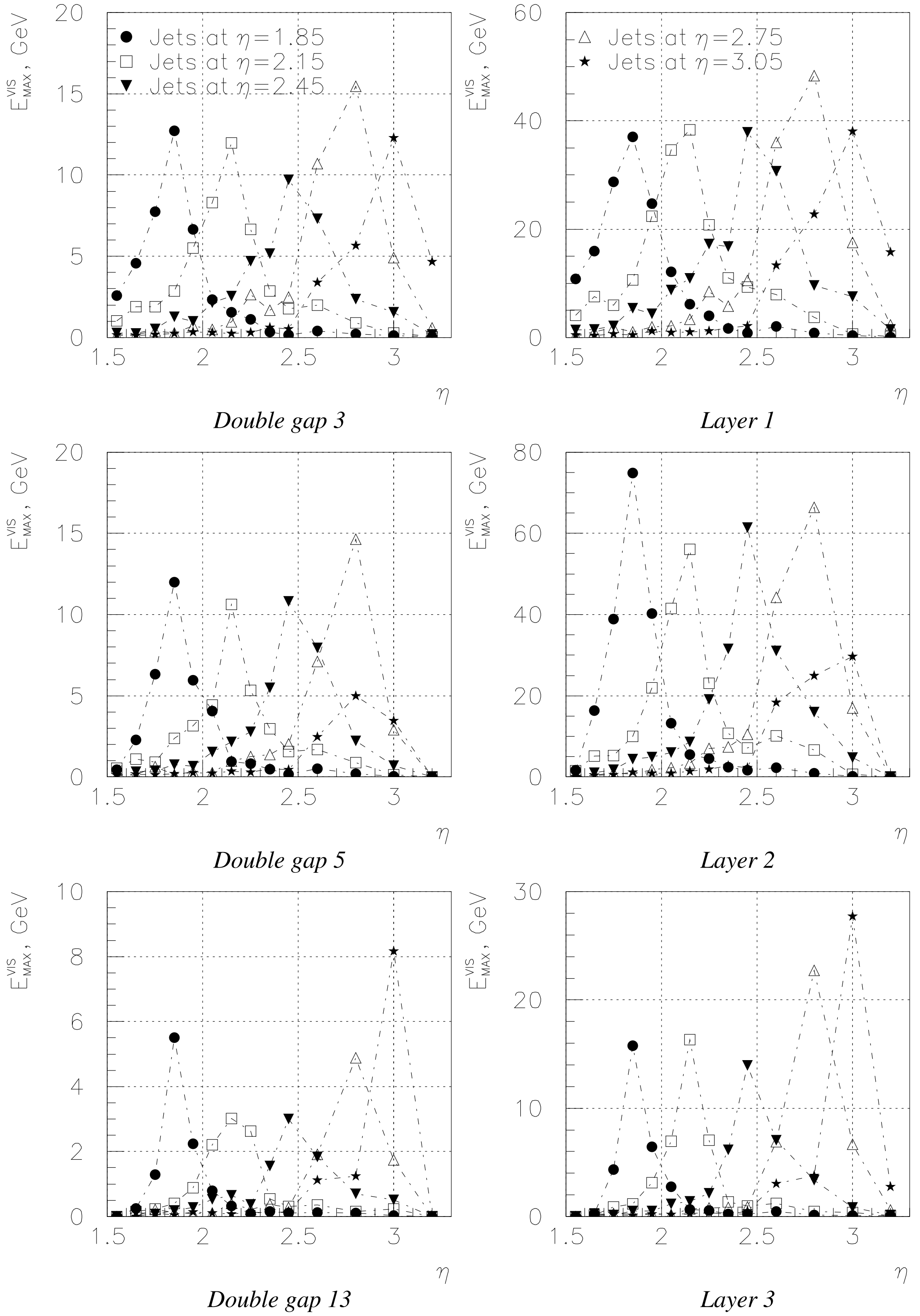


Double gap 13

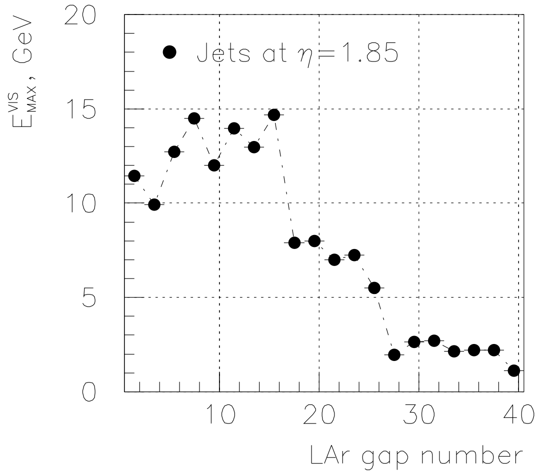


Layer 3 with 16 gaps

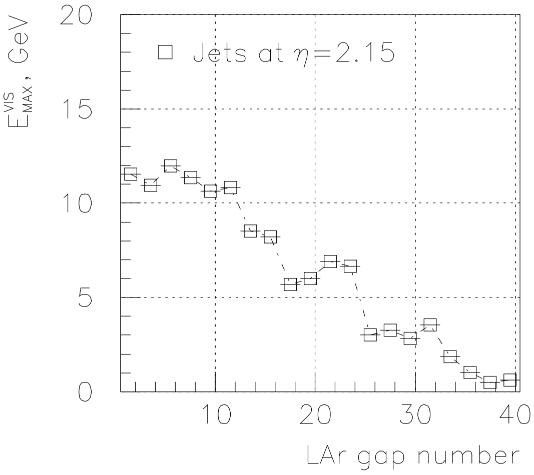
Maximal Visible Energy for 5 TeV Jets at 99 % Cut



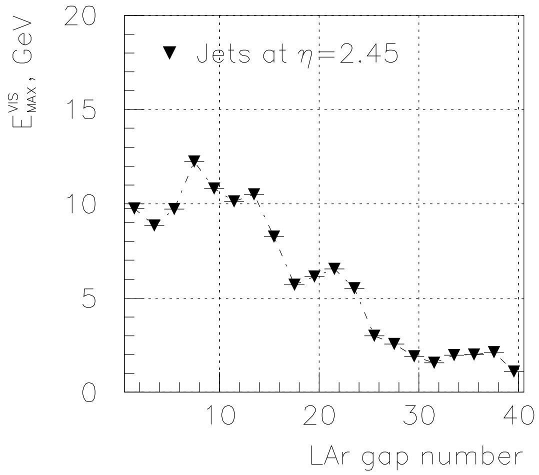
Maximal Visible Energy for 5 TeV Jets at 99 % Cut



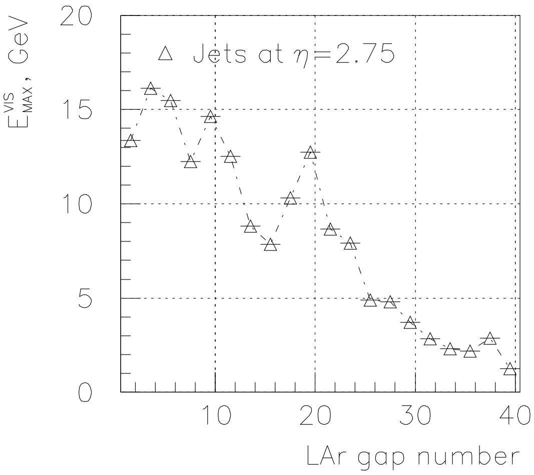
Tower at η*=1.85*



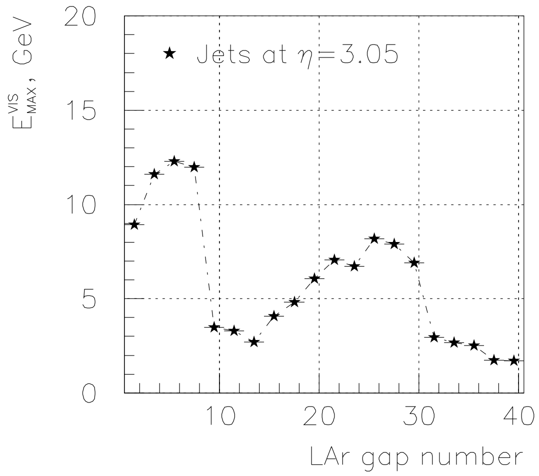
Tower at η*=2.15*



Tower at η*=2.45*

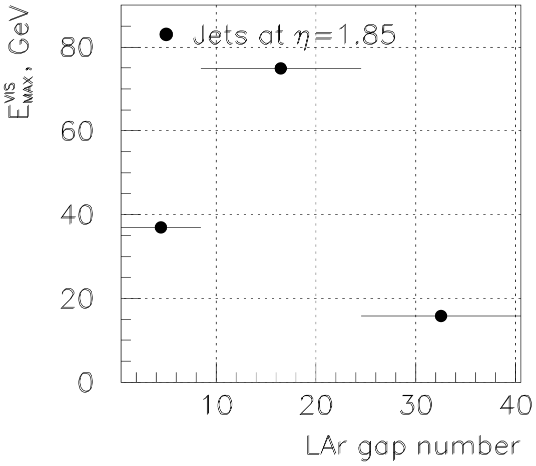


Tower at η*=2.8*

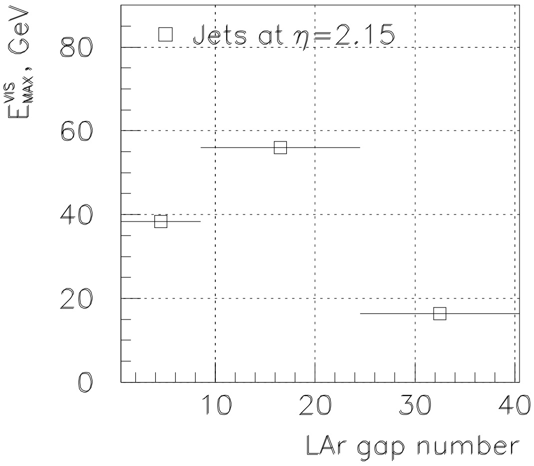


Tower at η*=3*

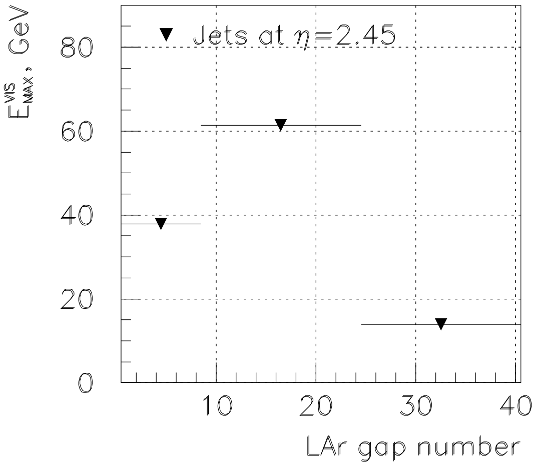
Maximal Visible Energy for 5 TeV Jets at 99 % Cut



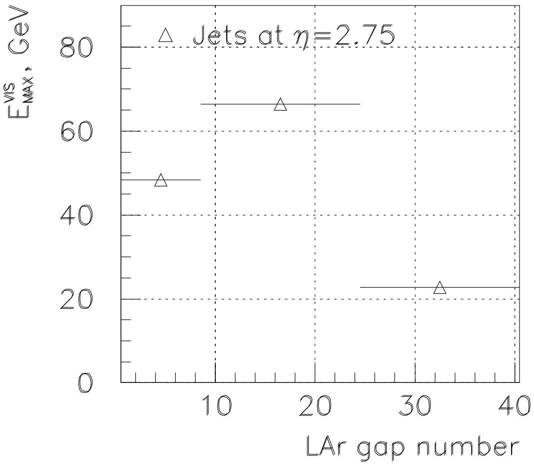
Tower at η=*1.85*



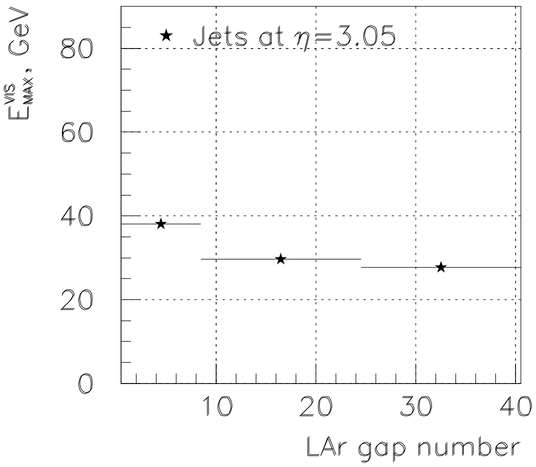
Tower at η=*2.15*



Tower at η=*2.45*



Tower at η=*2.8*



Tower at η=*3*