Jet studies for QCD physics

DØ New Phenomena Workshop : December 13-14, 2001

Alexander Kupčo[1], *Marek Zieliński*[2]

[1] *Institute of Physics, Academy of Sciences of the Czech Republic Center for Particle Physics, Prague*

[2] *University of Rochester*

Physics priorities of QCD group

- ▷ inclusive pT and dijet mass cross sections
  - – direct impact on pdfs, test of pQCD, compositeness
- ▷ dijet angular distributions (compositeness)
- ▷ diffractive physics
  - – test of various diffraction models

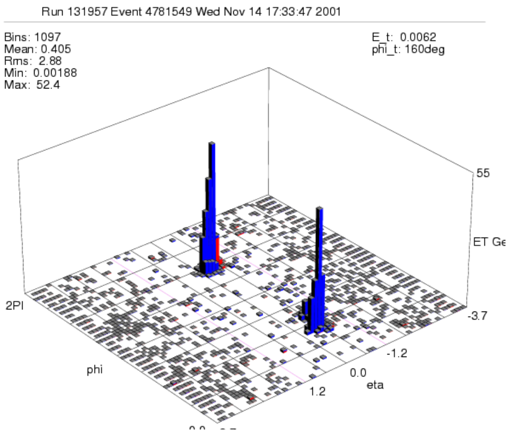
Needs

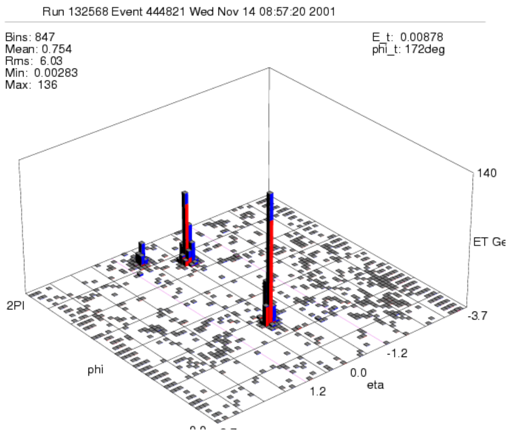
- stable and quiet calorimeter
  - suppression of hot cells
  - reasonble measurement of MET
- efficient triggering
  - selection of L1 terms
- event selection criteria
  - cut on MET (removing 'one jet' events)
  - cut on calorimeter occupancy (E_{100} variable)
- jet selection criteria
  - EMF
  - HotF
  - CHF
  - n90
- efficiencies for the above cuts
  - understanding of jets in data *vs.* MC
- energy scale corrections
- jet energy resolution
- luminosity per trigger

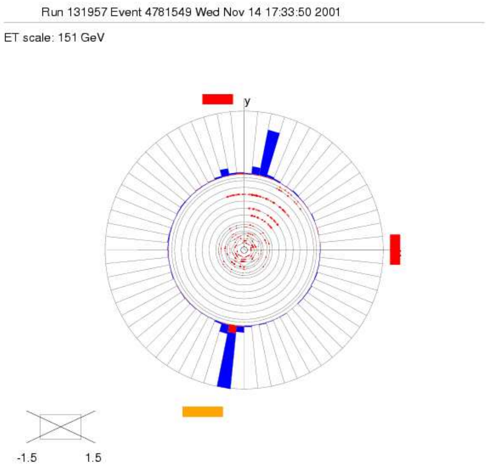
Studies of pre-shutdown data

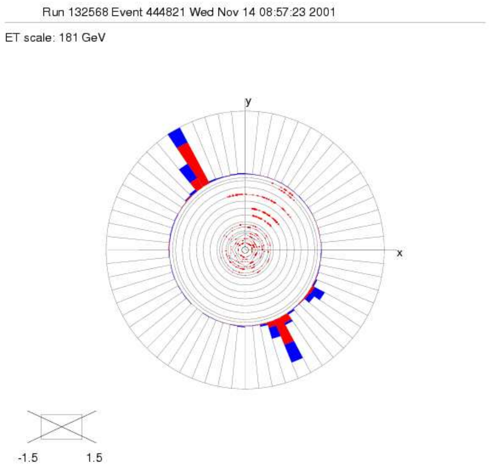
- ▷ event display samples of nice and bad events
- ▷ event selection criteria
  - MET distribution
  - MET versus HT
  - removing busy events (E_{100} variable)
- ▷ studies of jet quality cuts
- ▷ NADA influence on jets

Nice events

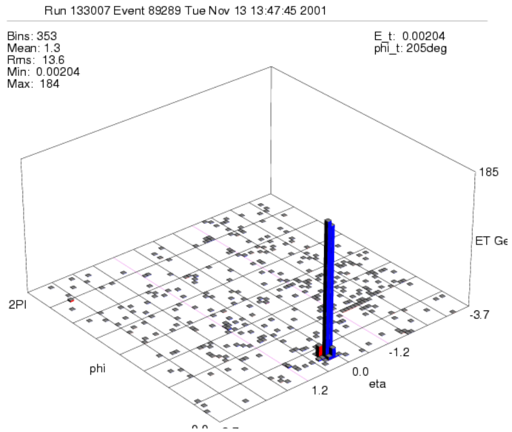

Run 131957 Event 4781549 Wed Nov 14 17:33:47 2001
Bins: 1097
Mean: 0.405
Rms: 2.88
Min: 0.00188
Max: 52.4
E_t: 0.0062
phi_t: 160deg
55
ET Ge
-3.7
2PI
-1.2
phi
0.0
eta
1.2

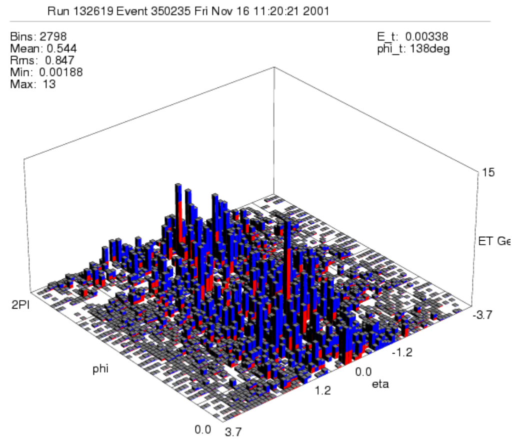

Run 132568 Event 444821 Wed Nov 14 08:57:20 2001
Bins: 847
Mean: 0.754
Rms: 6.03
Min: 0.00283
Max: 136
E_t: 0.00878
phi_t: 172deg
140
ET Ge
-3.7
2PI
-1.2
phi
0.0
eta
1.2

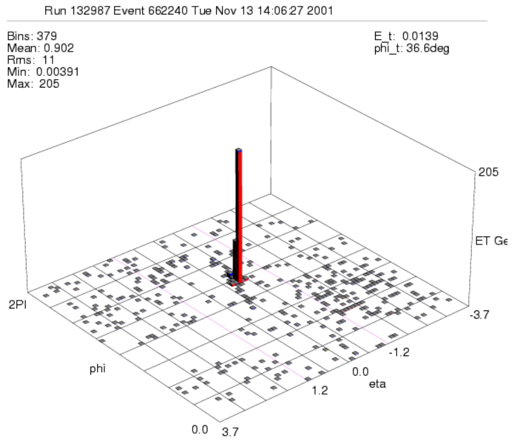

Run 131957 Event 4781549 Wed Nov 14 17:33:50 2001
ET scale: 151 GeV
y
-1.5
1.5


Run 132568 Event 444821 Wed Nov 14 08:57:23 2001
ET scale: 181 GeV
y
x
-1.5
1.5

Not that nice events





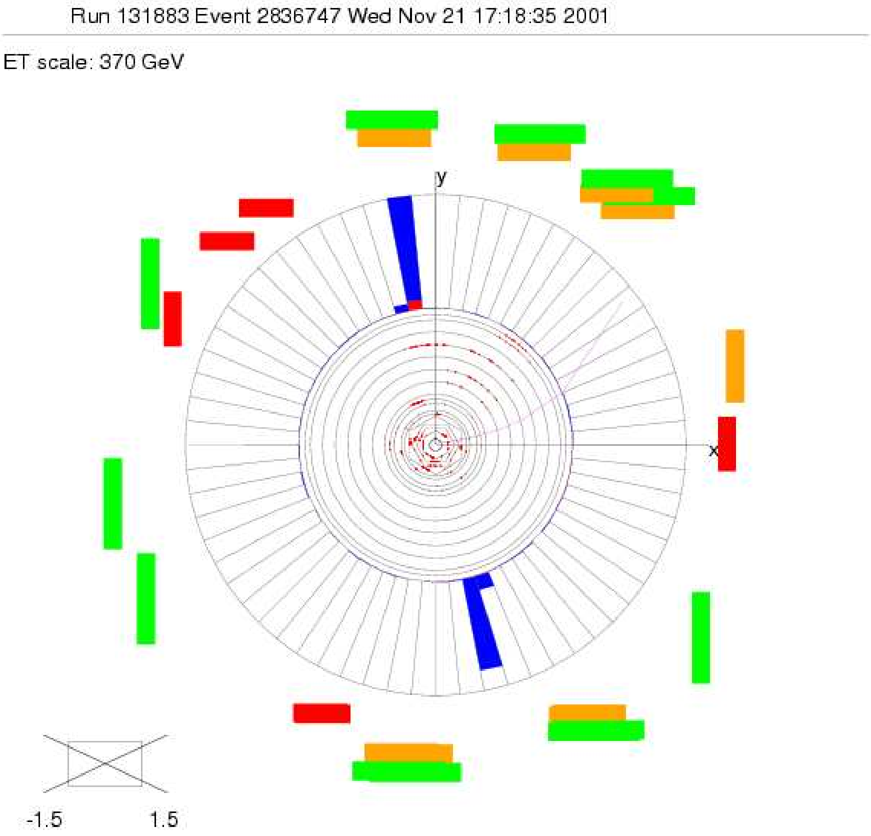


- ▷ *all jets passed jet quality cuts*
- ▷ *event quality criteria are needed*

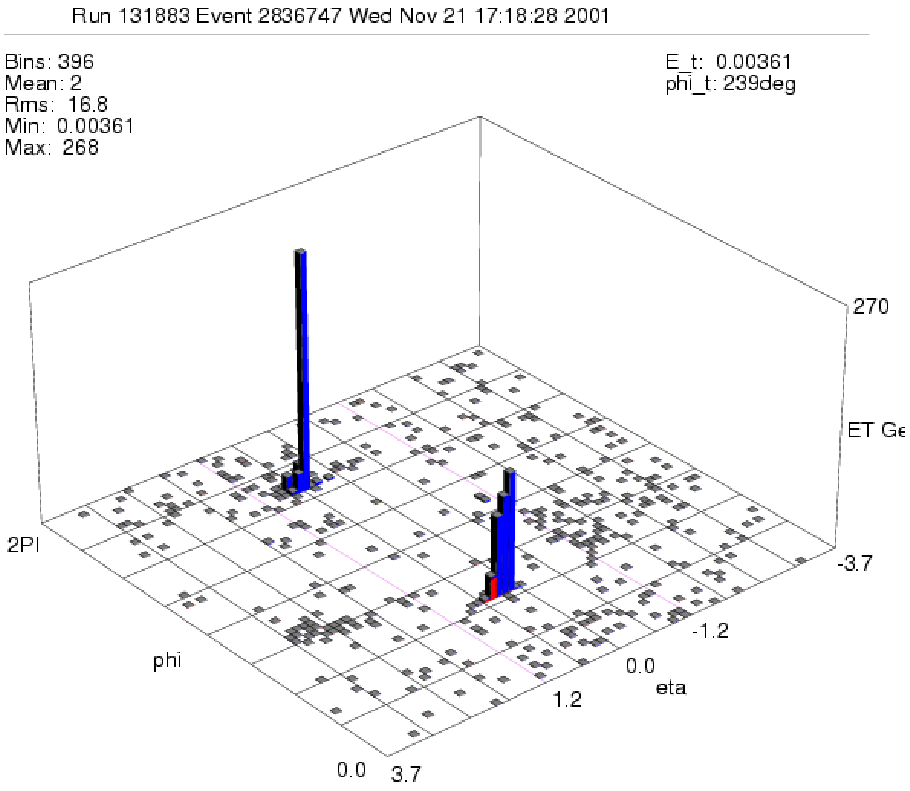
$$MET < 0.7\, p_T^{leading\ jet}$$

$$E_{100} \equiv \sum_{E_{cell} > 0.1\, GeV} E_{cell} < 2\,\mathrm{TeV}$$

Ugly event



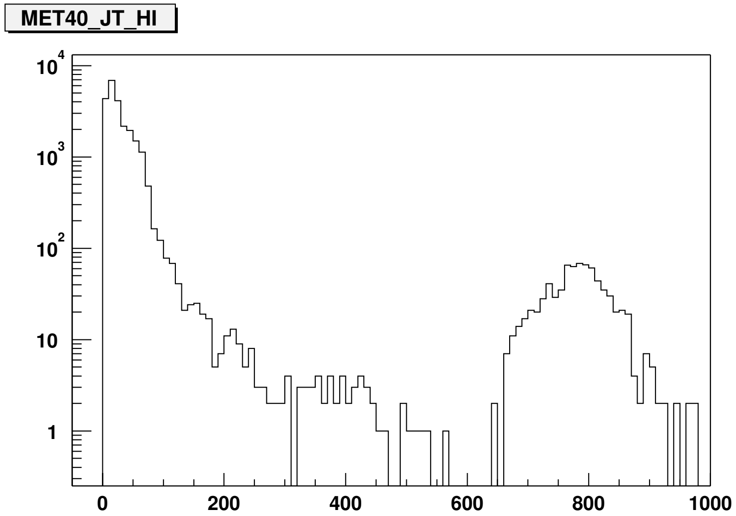
Run 131883 Event 2836747 Wed Nov 21 17:18:35 2001
ET scale: 370 GeV
y
x
-1.5
1.5

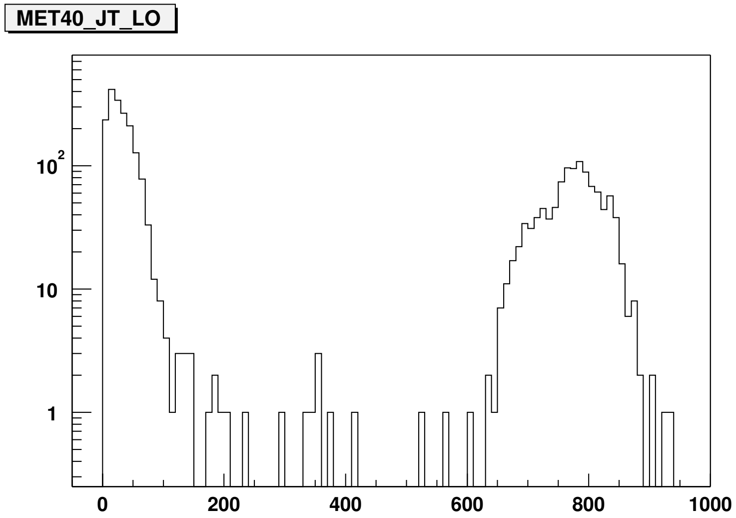


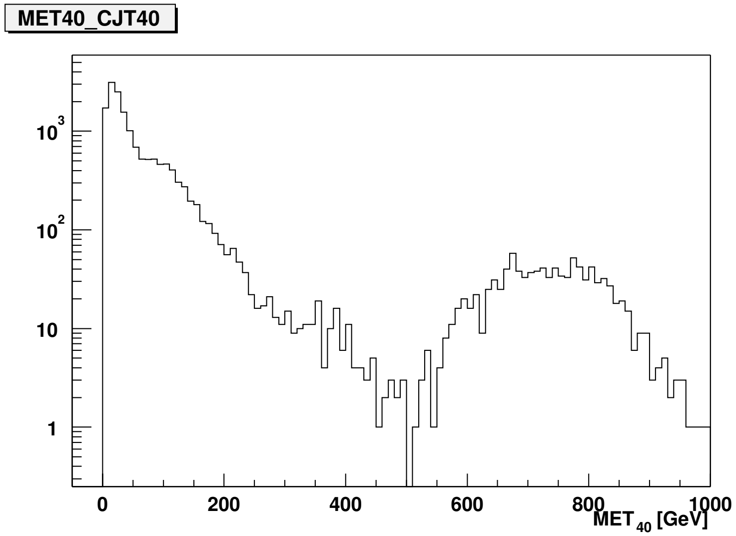
Run 131883 Event 2836747 Wed Nov 21 17:18:28 2001
Bins: 396
Mean: 2
Rms: 16.8
Min: 0.00361
Max: 268
E_t: 0.00361
phi_t: 239deg
270
ET Ge
2PI
-3.7
-1.2
0.0
eta
1.2
phi
0.0
3.7

MET

- only runs with all three jet triggers
- runs before 131263 not used
- only events with p_T of the leading jet grater then 40 GeV





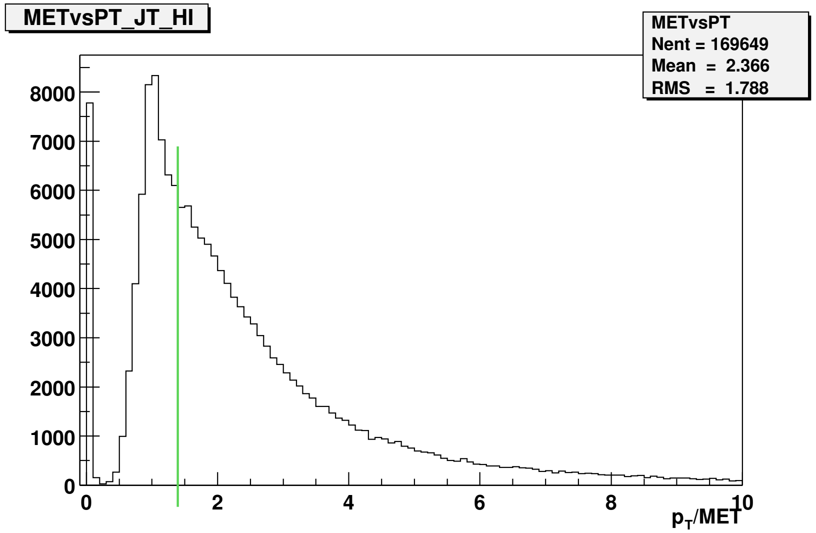


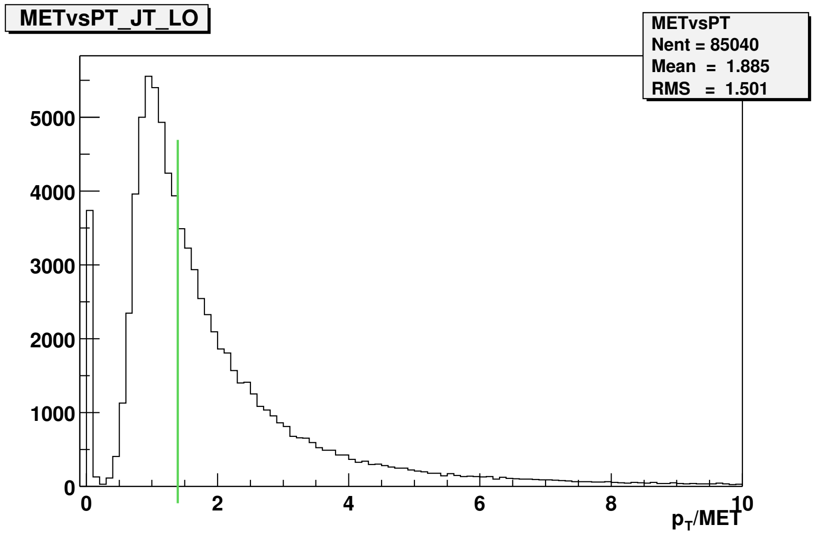
MET over PT

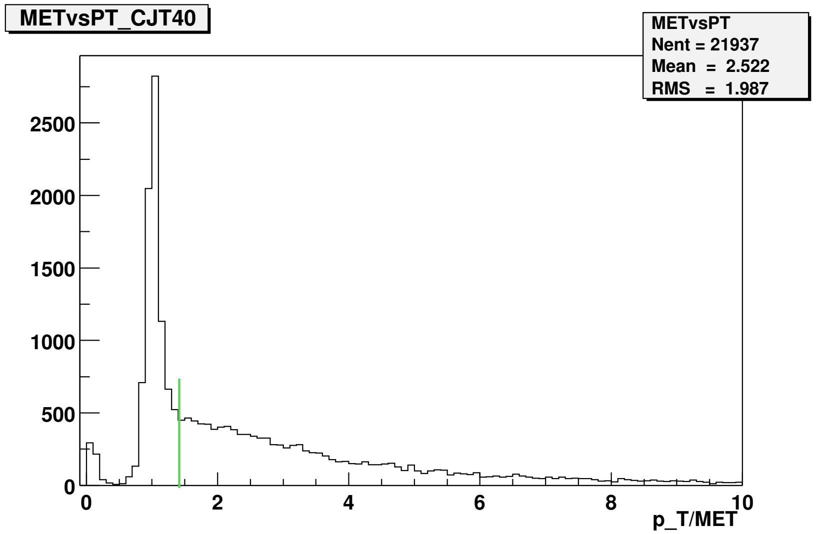
- are we really sure about the event selection criterium

$$MET < 0.7\, p_T^{leading\ jet}$$

- how to obtain cut efficiency?



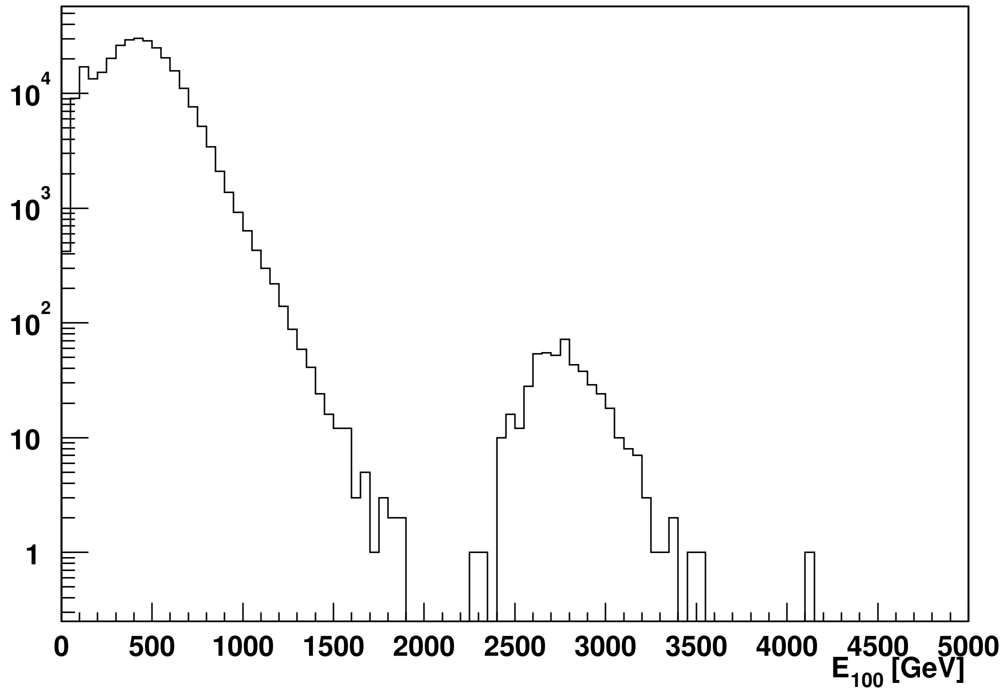




Busy events

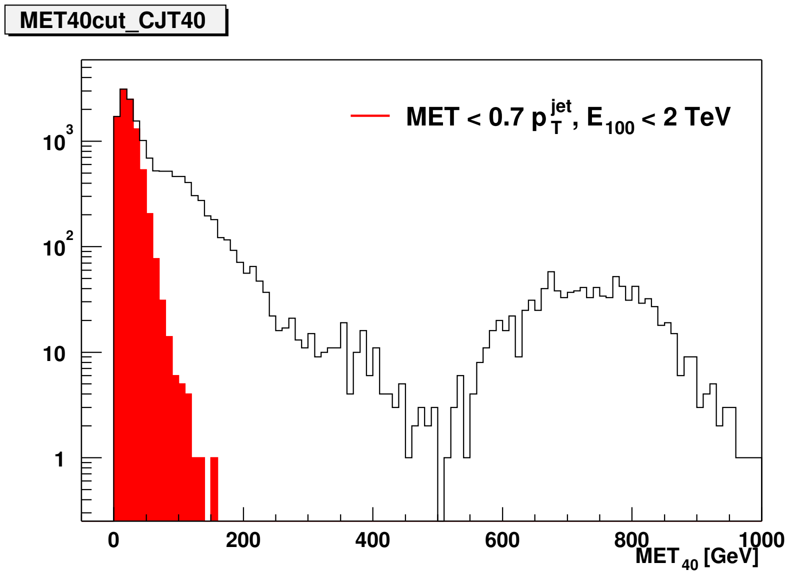
▷ *remove busy events with unrealistic energies*

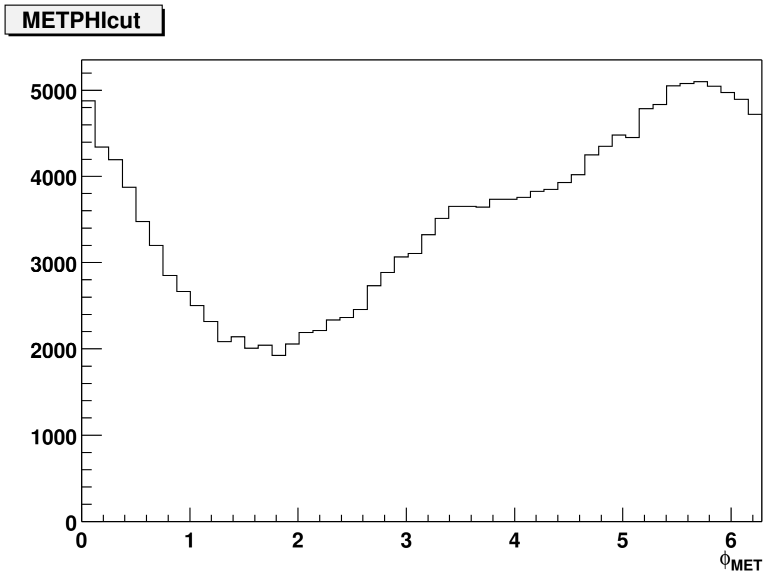
$$E_{100} \equiv \sum_{E_{cell} > 0.1\,GeV} E_{cell} < 2\,\mathrm{TeV}$$



MET after event selection cuts

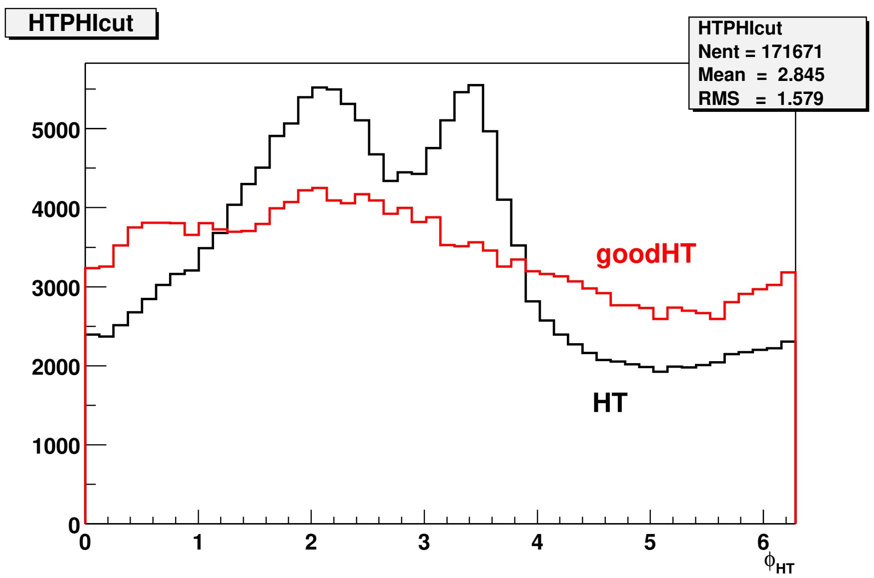
- MET distribution looks much more better
  - bump around 800 GeV dissapeared (not big surprise)
  - events from the bump look like normal low p_T events
  - the bump is probably formed by negative hot cells
- the distribution of the direction of MET is not flat
  - possible bias from calorimeter warm region

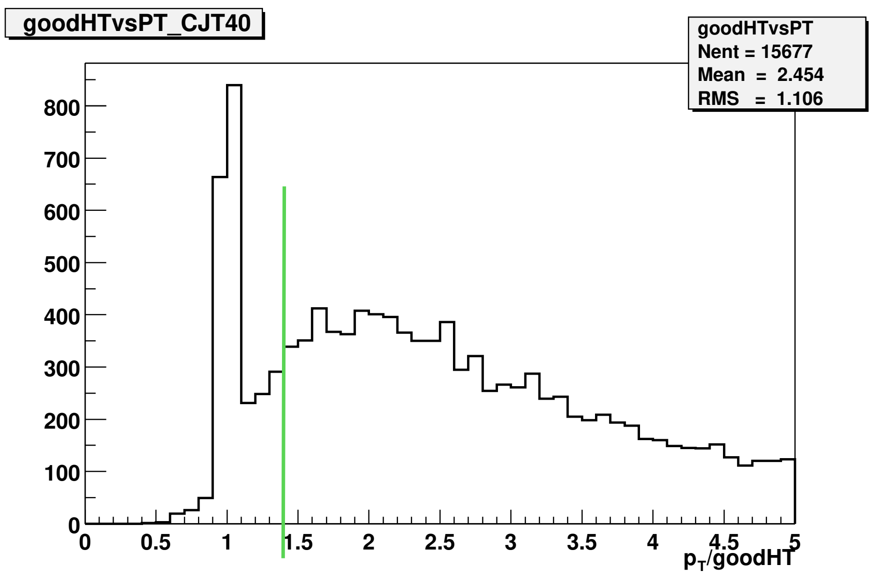




using HT instead of MET

- using $|\vec{H}_T|$ calculated from good jets instead of MET
- the direction of $\vec{H}_T$ is much more randomly distributed
- *much more clear separation of wierd events*
- cutting on $|\vec{H}_T| < 0.7 p_T^{leading\ jet}$ *will not remove all the events with MET around* $800\,\mathrm{GeV}$

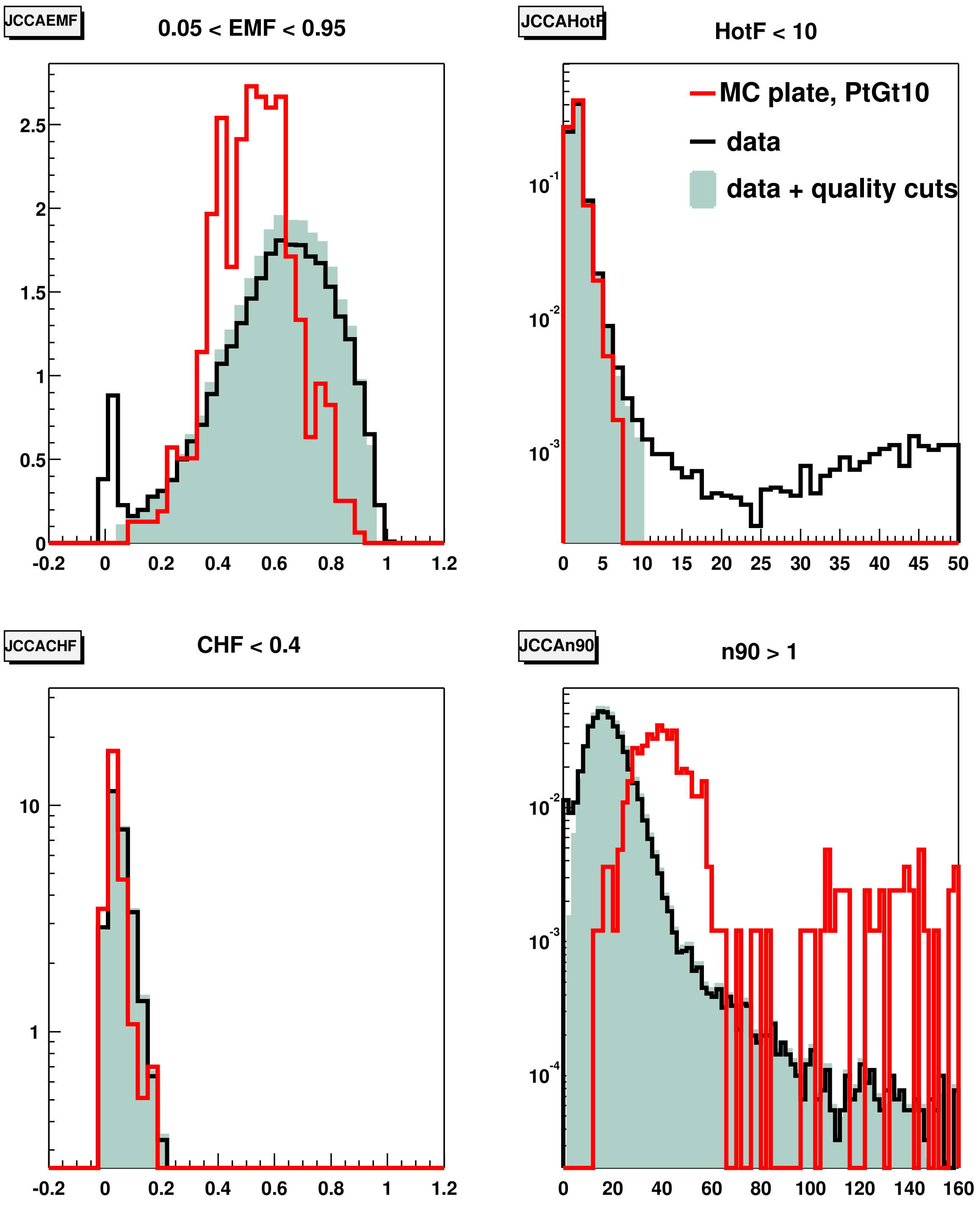




Jet quality cuts

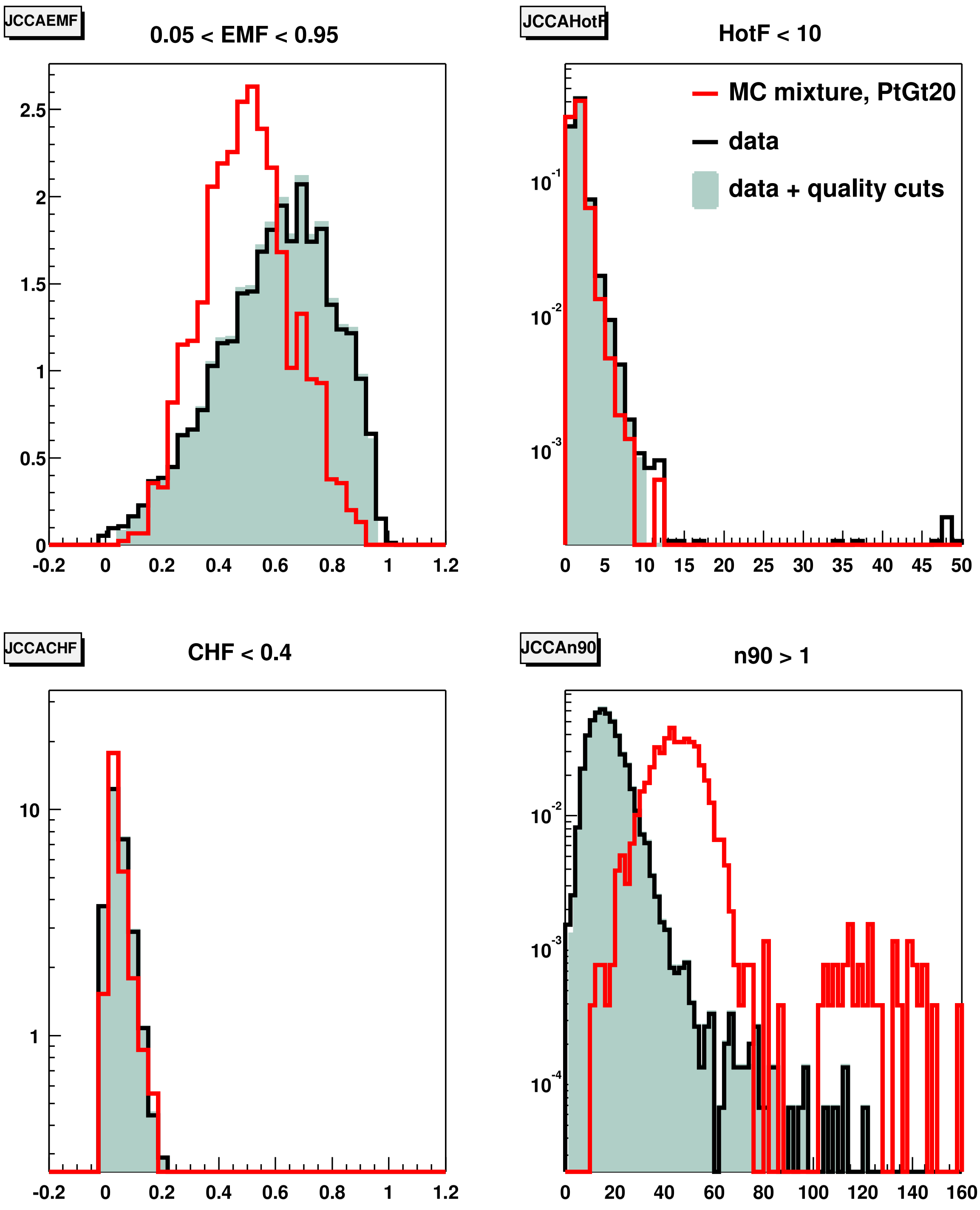
no event selection, just jet triggers

$25\,\mathrm{GeV} < p_T < 35\,\mathrm{GeV}$ *and* $|\eta| < 0.5$



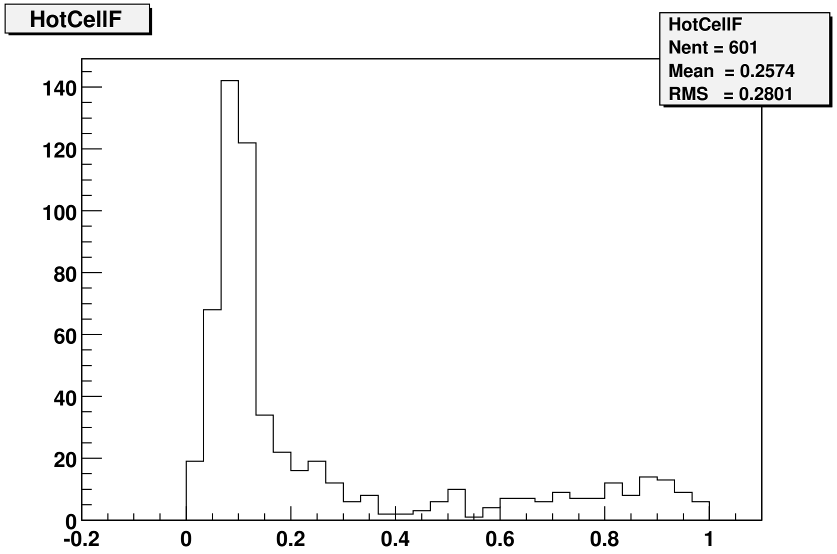
Quality cuts in nice dijet events

$$25\,\mathrm{GeV} < p_T < 35\,\mathrm{GeV} \quad \textit{and} \quad |\eta| < 0.5$$



NADA hot cells and jets

- old NADA (p10.08.01) *with* static cut *does not help too much to clean up* jets
- *only about* 3% *percent of jets are affected by* hot cells *identified by* NADA
  - *just few of them are formed by* hot cells



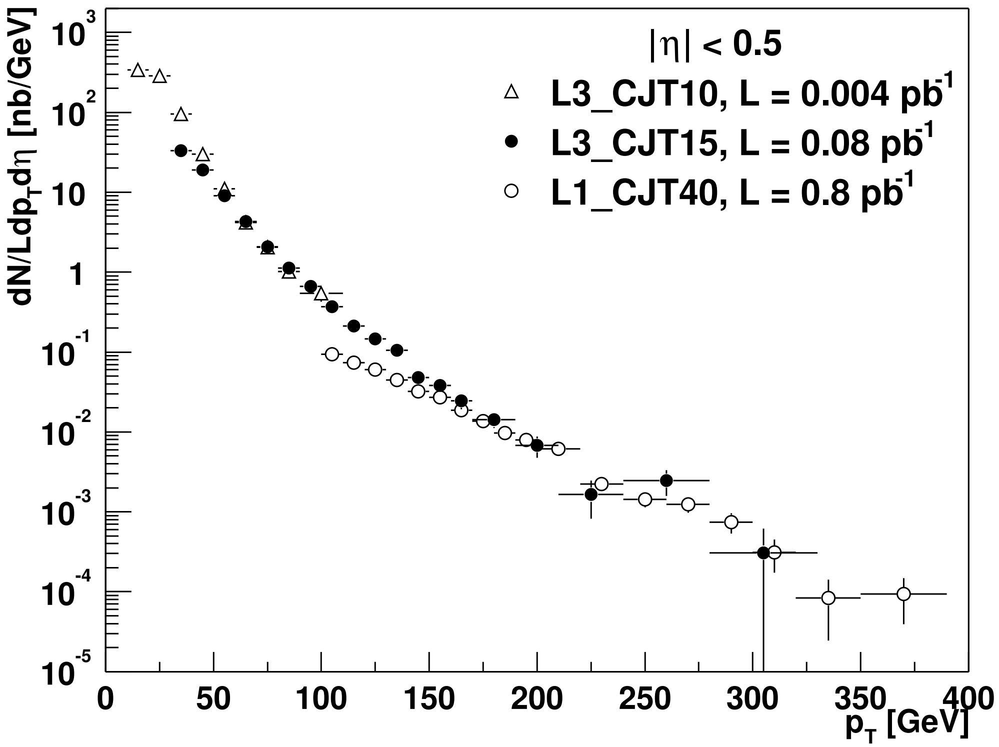
- *more important issues for jets (could be solved by* NADA *with dynamic* cut)
  - *negative* cells
  - hot *or warm regions*

Results from pre-shutdown data

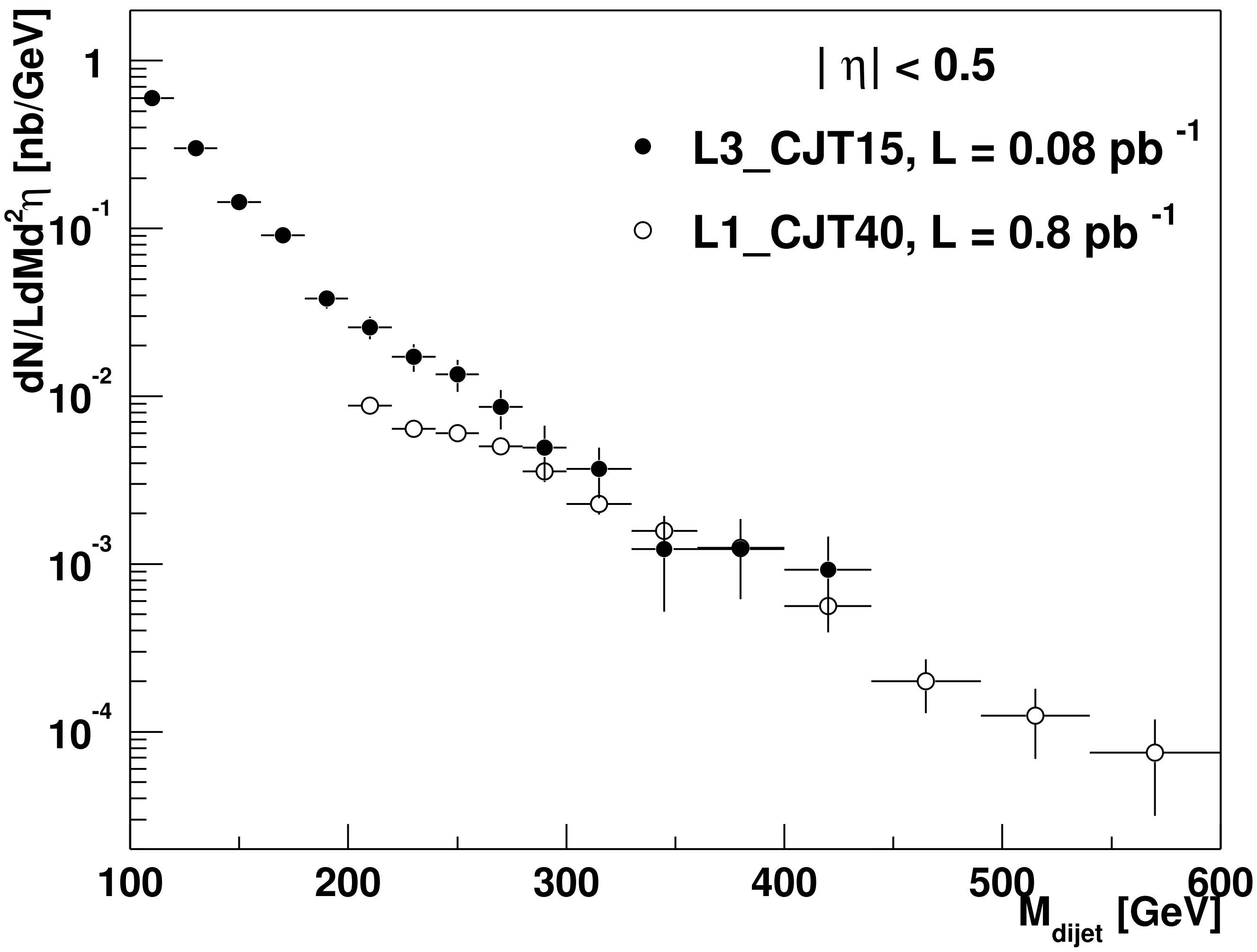
- p_T inclusive spectrum
- dijet mass spectrum
- jet resolutions

Jet rates for Cone R=0.7

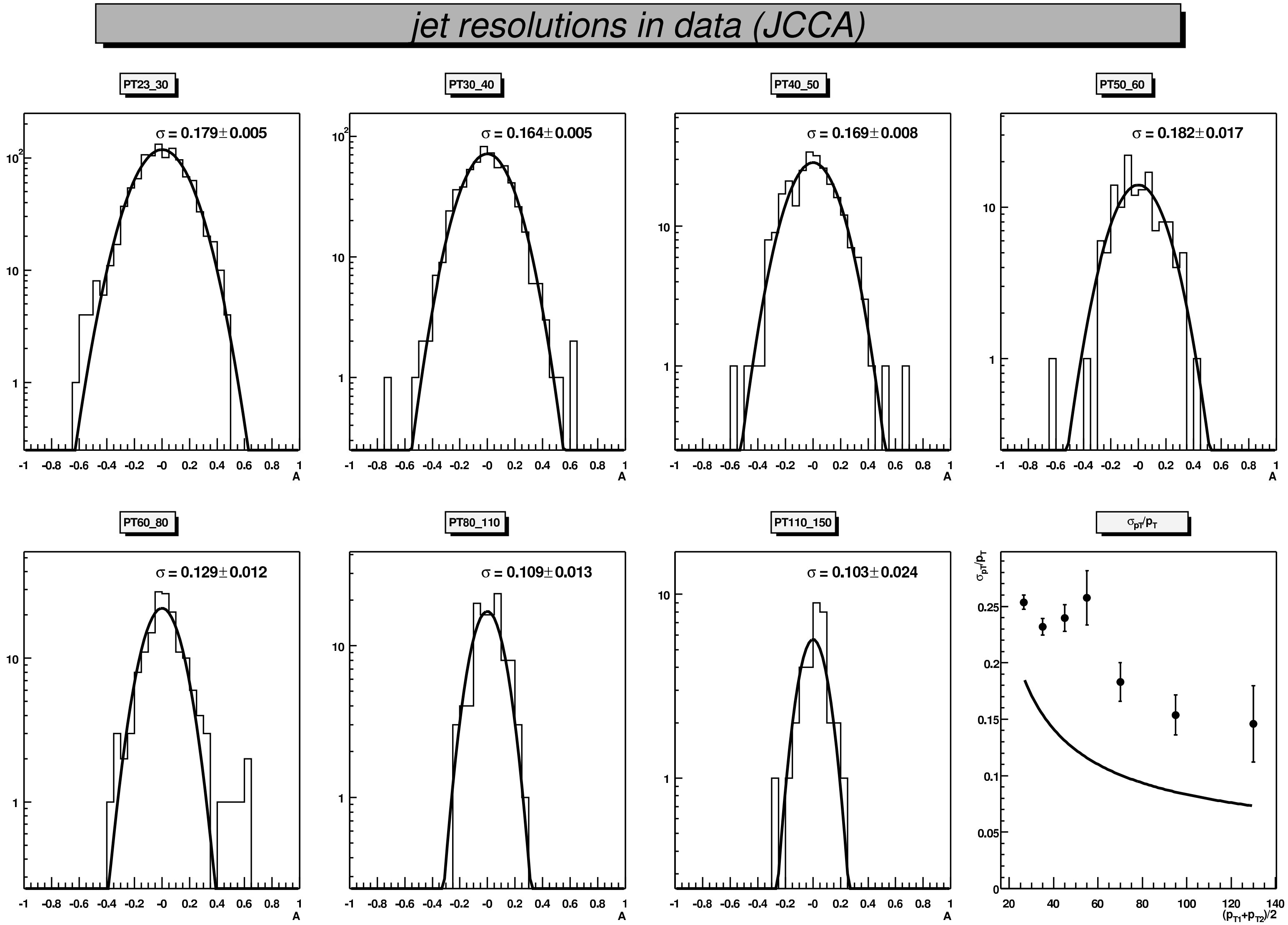
- ▷ *event selection + jet quality cuts*
- ▷ *very crude jet energy scale corrections*
- ▷ *luminosity only at L1*
- ▷ *no corrections for cut efficiencies*



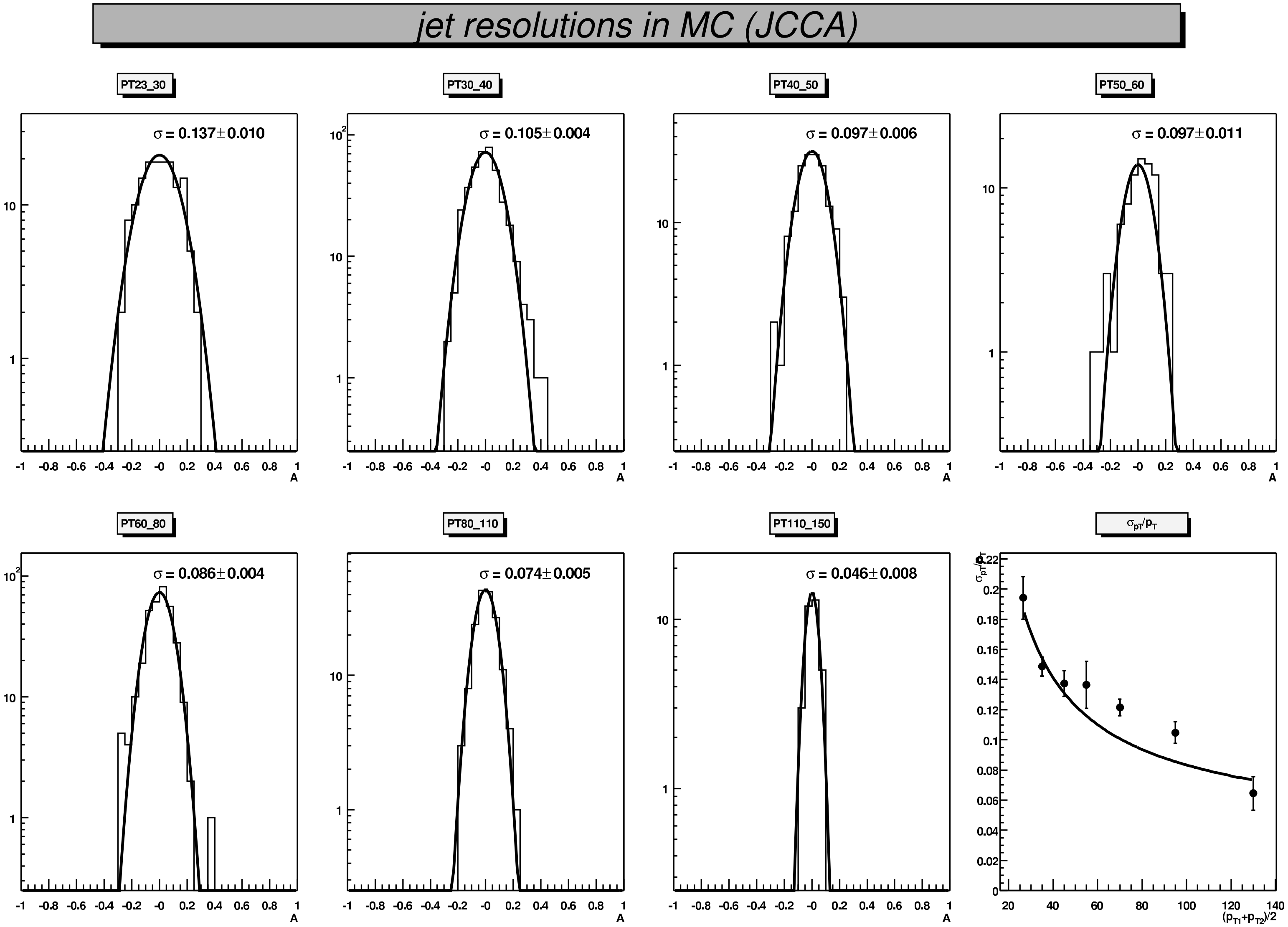
Dijet mass for Cone R=0.7



jet resolutions for cone R=0.7

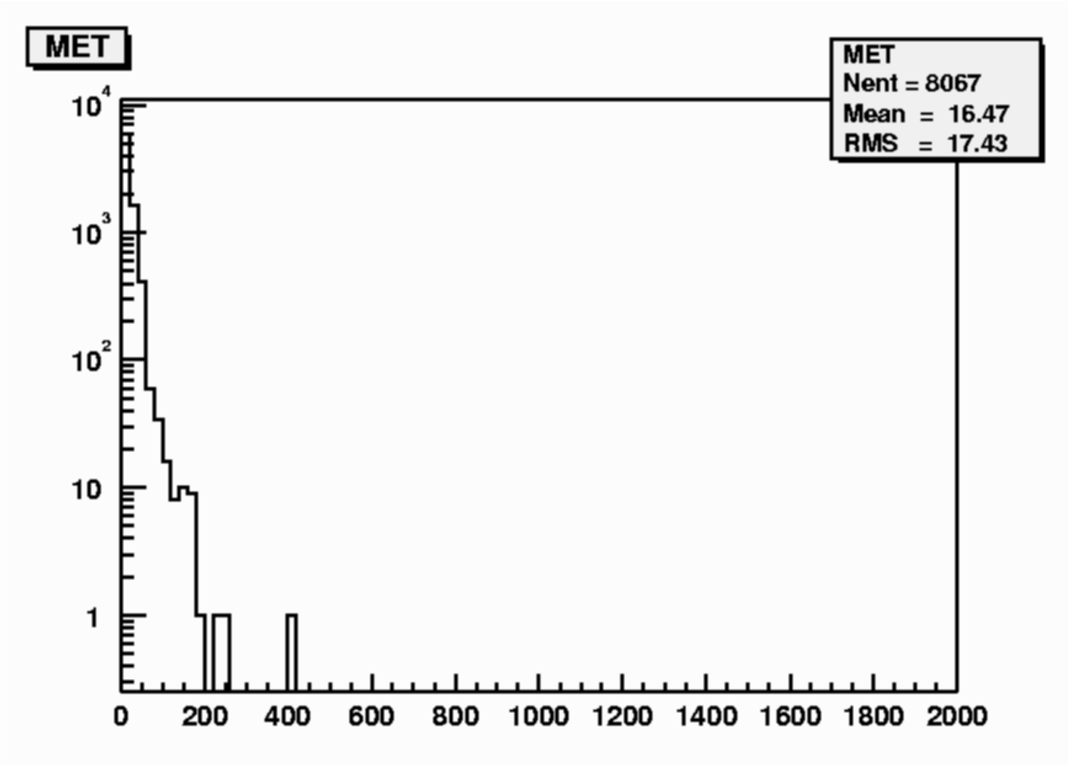


MC jet resolutions for cone R=0.7



Studies of post-shutdown data

- just starting
- MET distribution more promising



MET in post-shutdown data for JT_HI trigger (runs between 139893–140149)

- still, MET is shifted in some runs

Sorting out L1 jet triggers

- CJT40 trigger not effective (slow turn on)
- list of proposed jet triggers

L1 triggers	L3 triggers
CJT(2,3)	CJT(1,9)
CJT(1,5)CJT(2,3)	CJT(1,15)
CJT(1,7)CJT(2,3)	CJT(1,21)
CJT(1,10)CJT(2,3)	CJT(1,30)
CJT(2,7)	CJT(1,42)
CJT(3,5)	CJT(1,42)
CJT(3,7)	CJT(1,60)
CJT(4,5)	CJT(1,60)
CJT(4,7)	CJT(1,84)

- needs to narrow down

Hot things to do

- ▷ understand calorimeter in post-shutdown data
- ▷ study hot cells (NADA) and MET
- ▷ L1 trigger turn-ons
- ▷ trigger efficiencies
- ▷ estimate efficiencies of event selection and jet quality cuts
- ▷ understand jet energy resolution
- ▷ understand data versus MC