



HCAL Performance Studies for Jets & MET

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8-June-2000**

**Jet Energy Correction
Fake Jets at $10E34$
MET resolution**

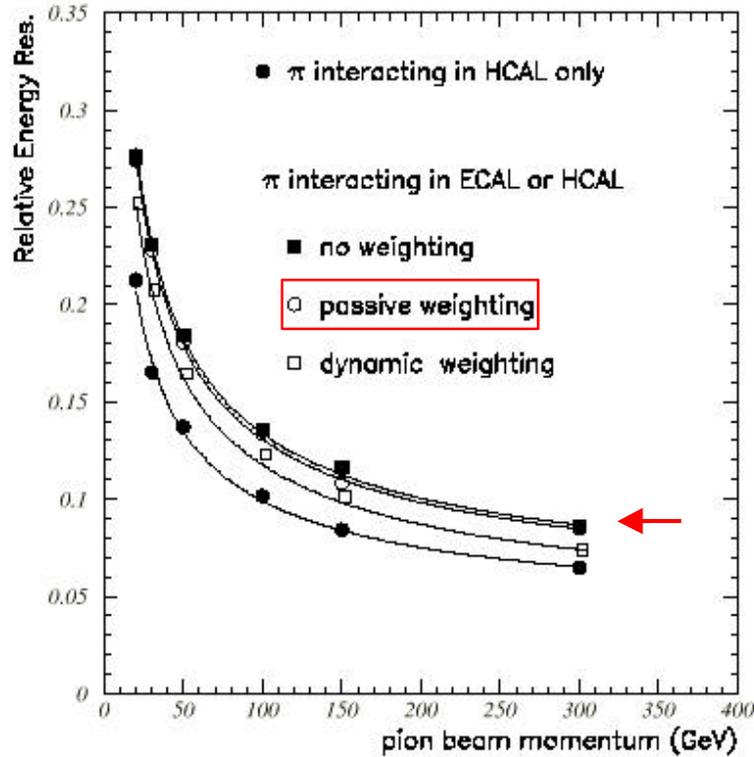


96'H2 Test Beam Data (pions)

Passive weigh:

$$E_{TOT} = E_{EC} + \alpha \times E_{H1} + E_{H2} + E_{HO} \quad (\alpha=1.4)$$

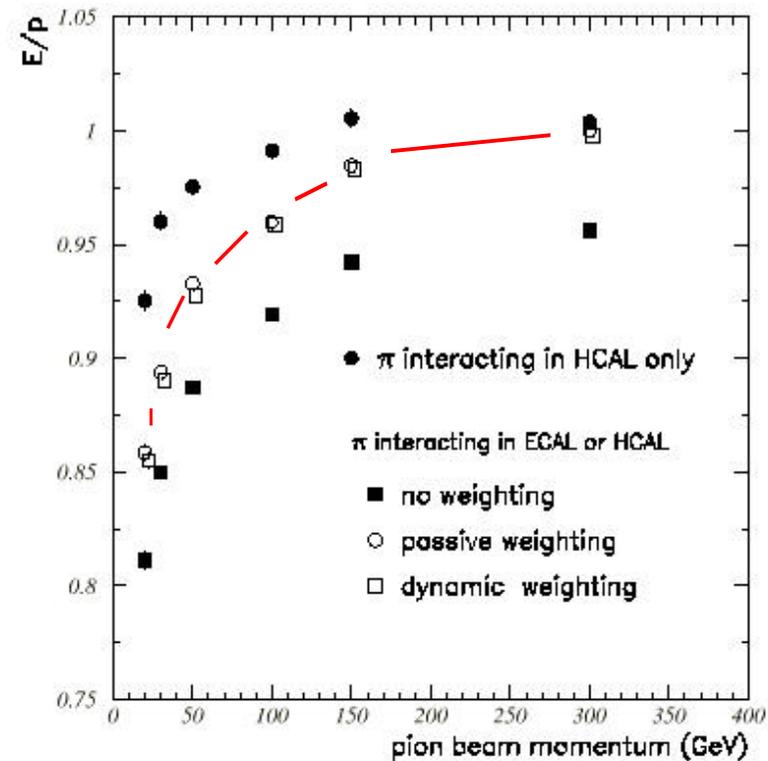
Resolution



$$\sigma_E/E = 122\% / \sqrt{E} + 5\%$$

122% --> ~100% w/o coherent noise (?)

Linearity



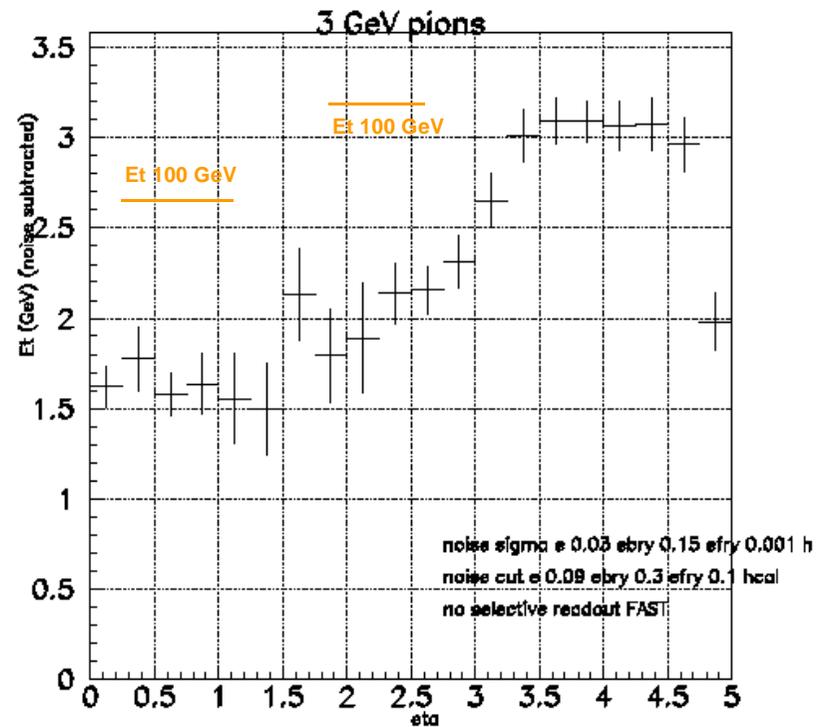
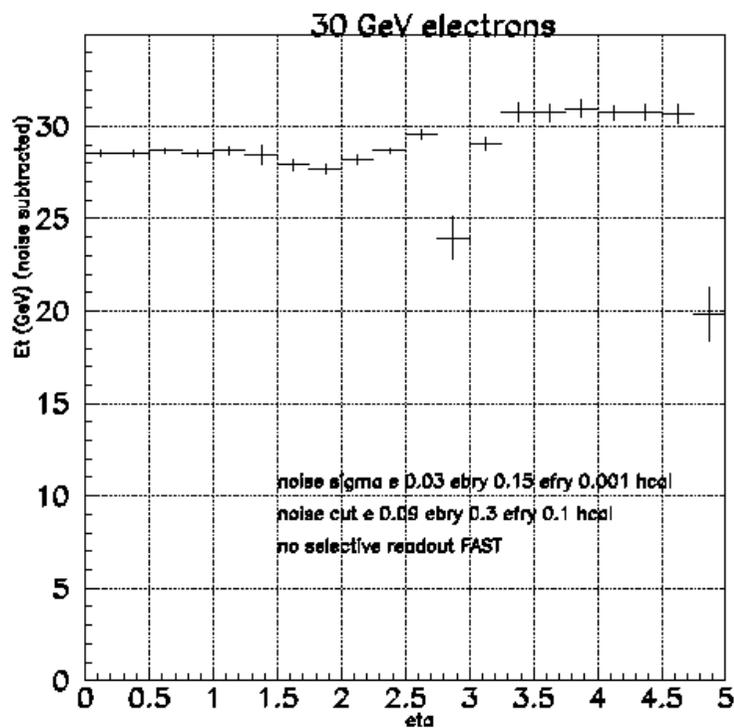
Lowest data point = 20 GeV



Single Particle Response

Energy Scale

- HB,HE with $E_t = 50\text{GeV}$ pions into HCAL
- HF with $E = 1\text{TeV}$ jet



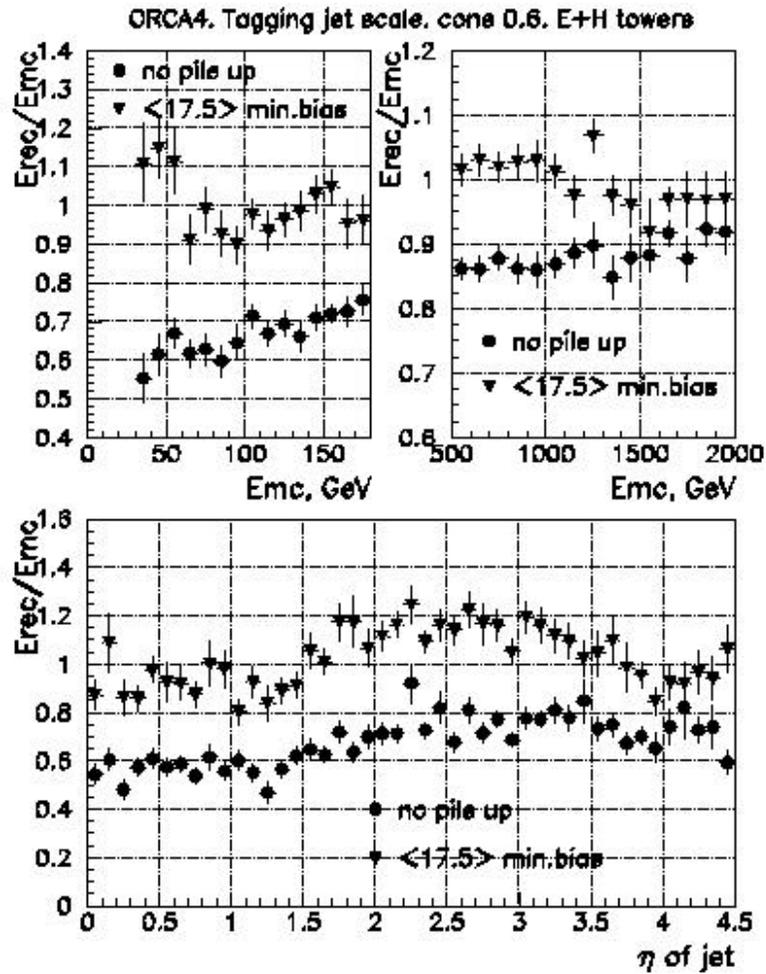
E= 3 7 30 82 227 GeV

(S.Eno)

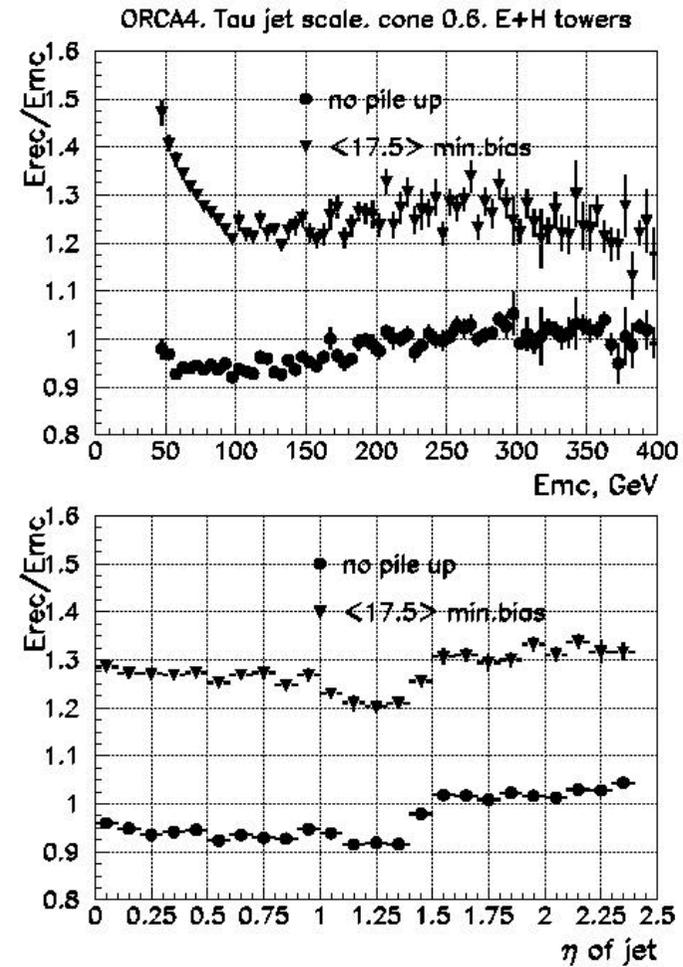


ORCA4: Jet Finder (simple cone)

Tagging jets



Tau jets

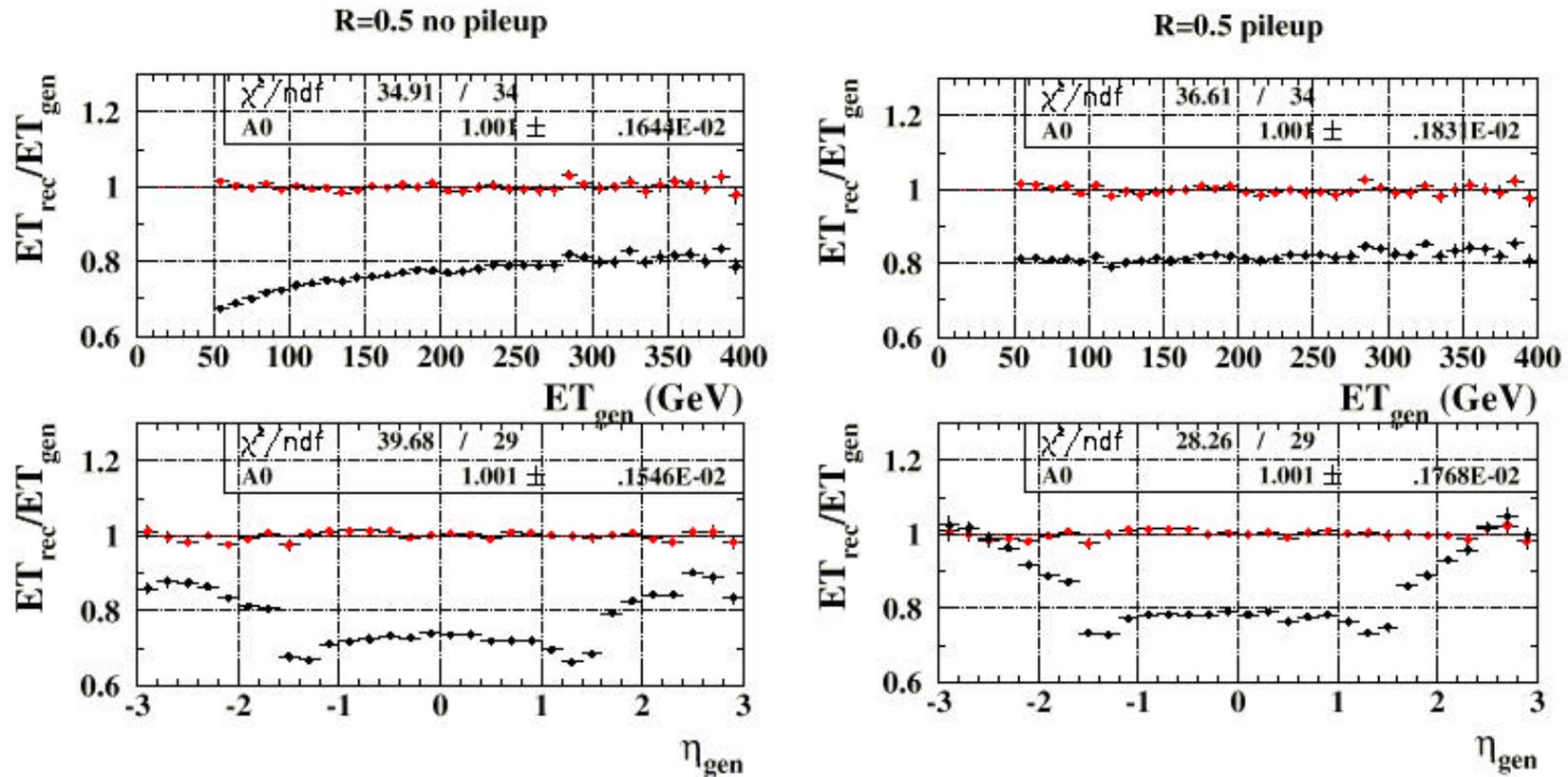


(A.Nikitenko)



Jet Energy Correction

Et-eta dependent correction for QCD jets

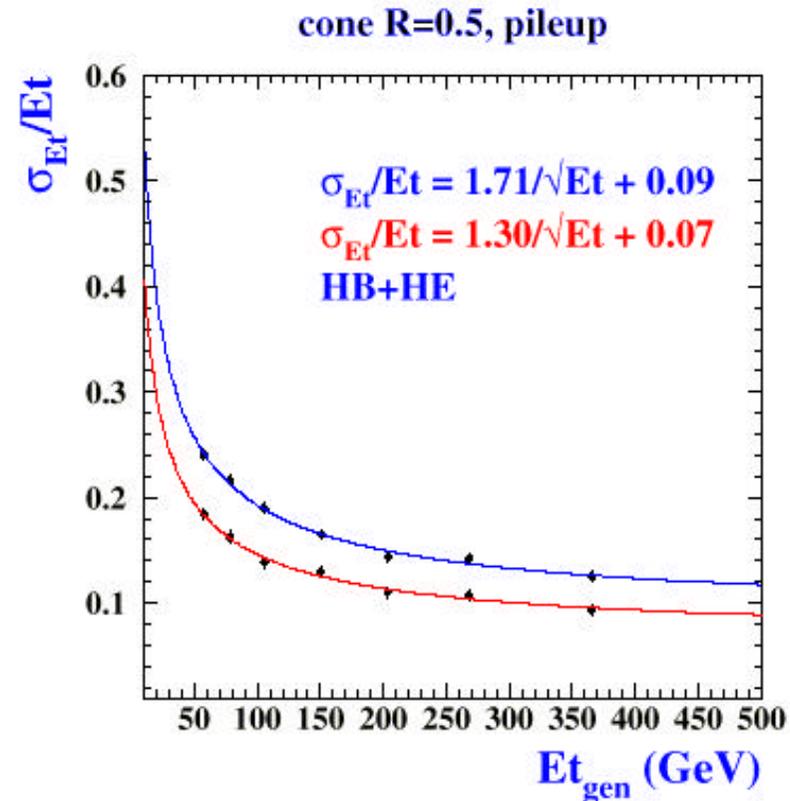
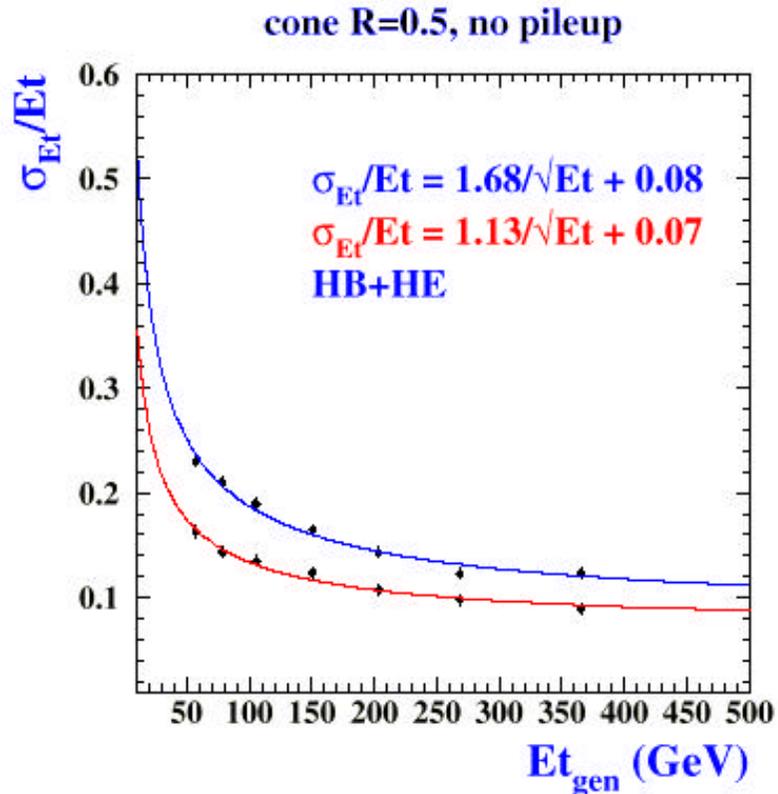


(S.Arcelli) => Need additional maps for L1 jets, tau-jets and b-jets.



Jets Resolution Before/after energy correction

(Average over eta range < 3.0)



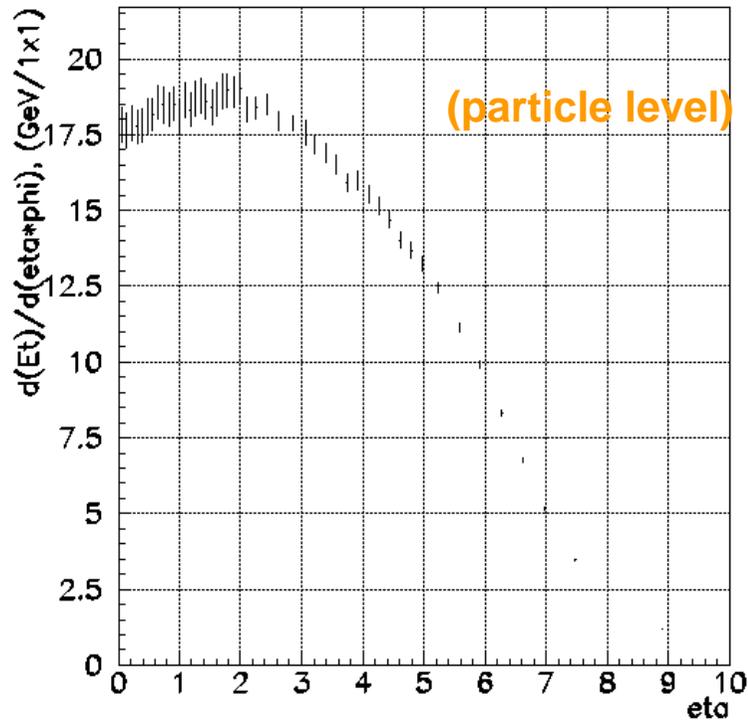
(S.Arcelli)



Minimum Bias Event Overlap (in-time pile-up)

X-sec = 55mb >>> 17.3 min-bias/crossing at 10E34

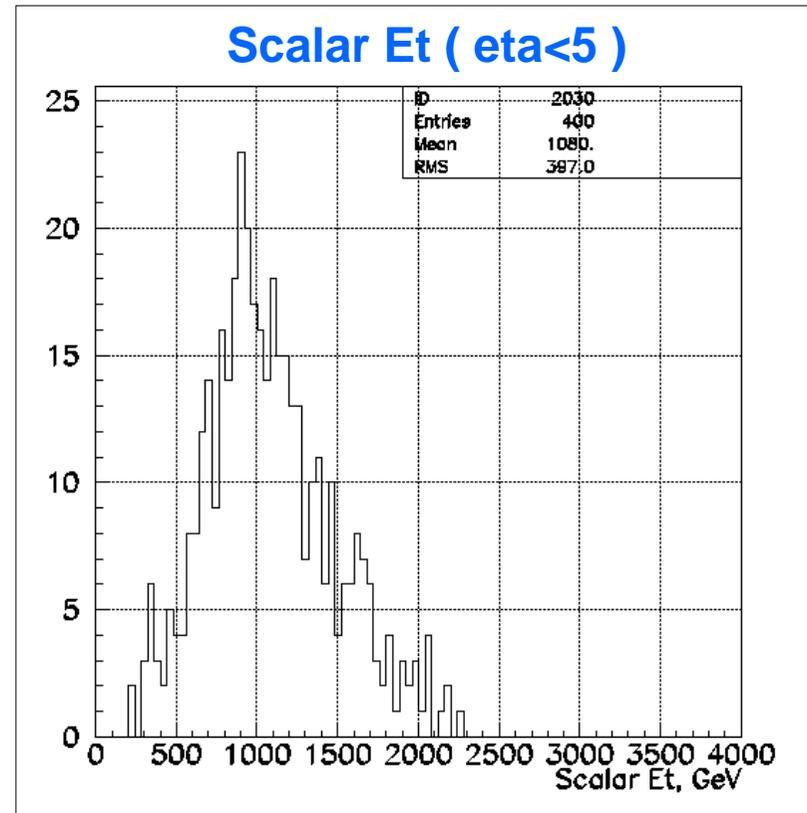
Et Flow



~17 GeV in unit (eta x phi) !

(equiv. cone radius 0.56)

Scalar Et (eta<5)



<Scalar Et> = 1080 GeV

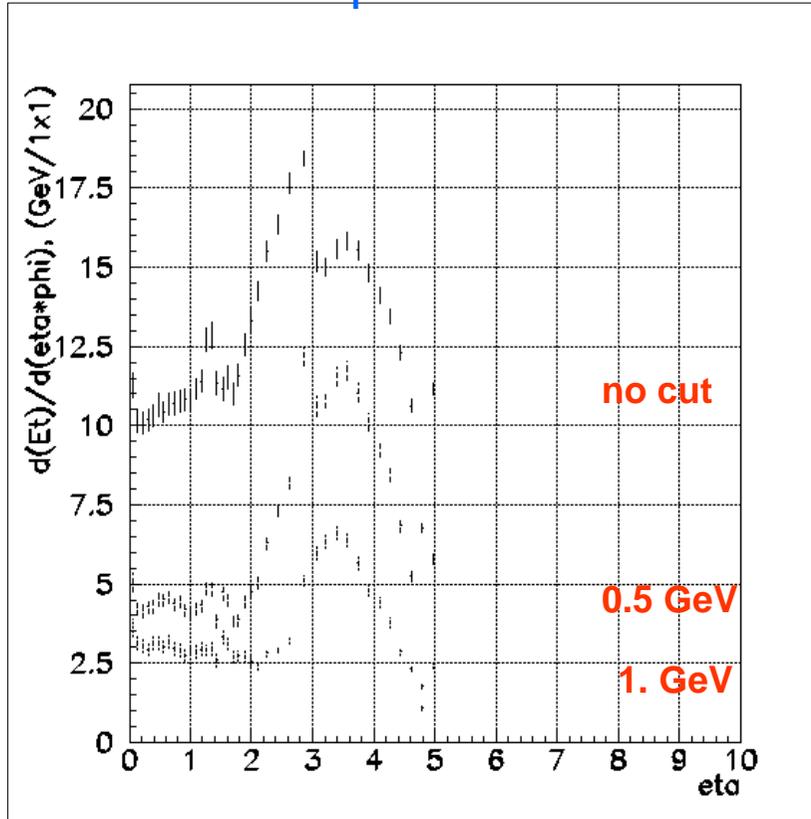
Note: <Scalar Et> = 750 GeV for ttH



E_T in Calorimeter

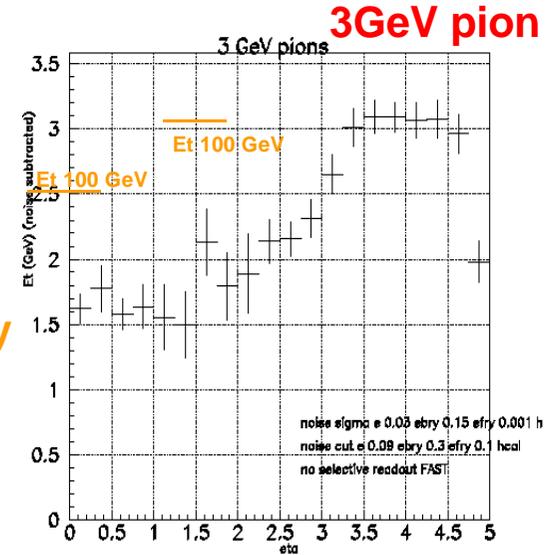
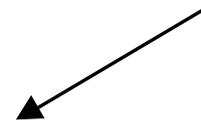
17.3 min-bias/crossing at 10E34

E_T Flow

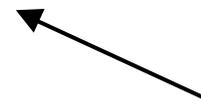


(Cuts: on Tower)

Non-linearity

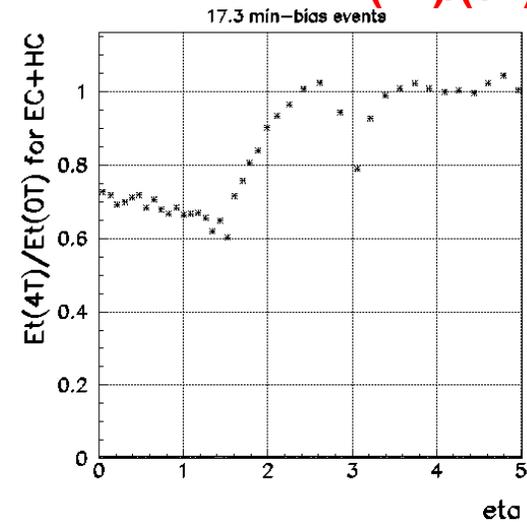


(4T)/(0T)



B-field

Charged particle $P_T < 0.8$ does not reach EB

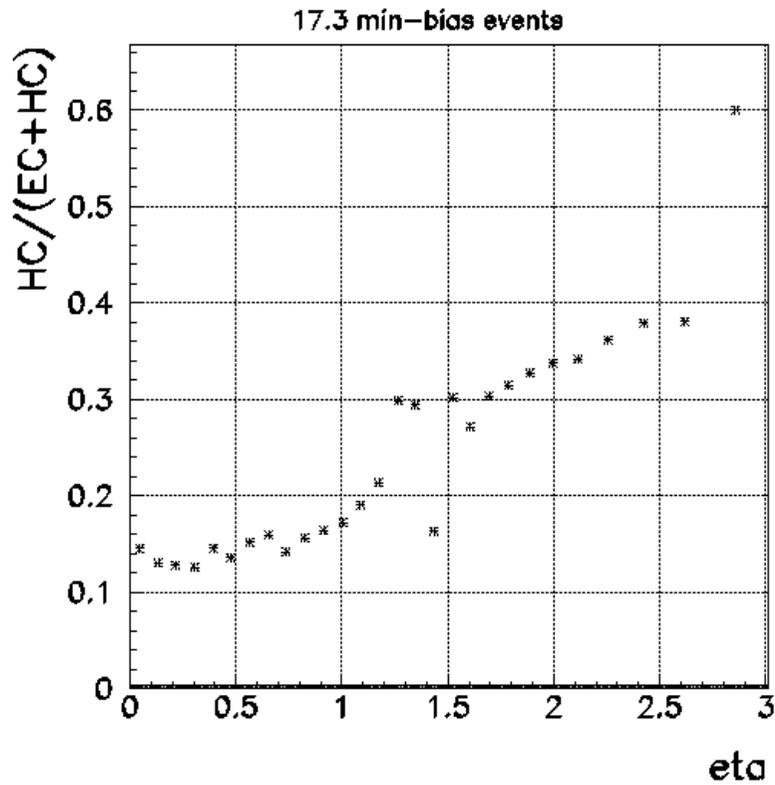




E_T in HCAL

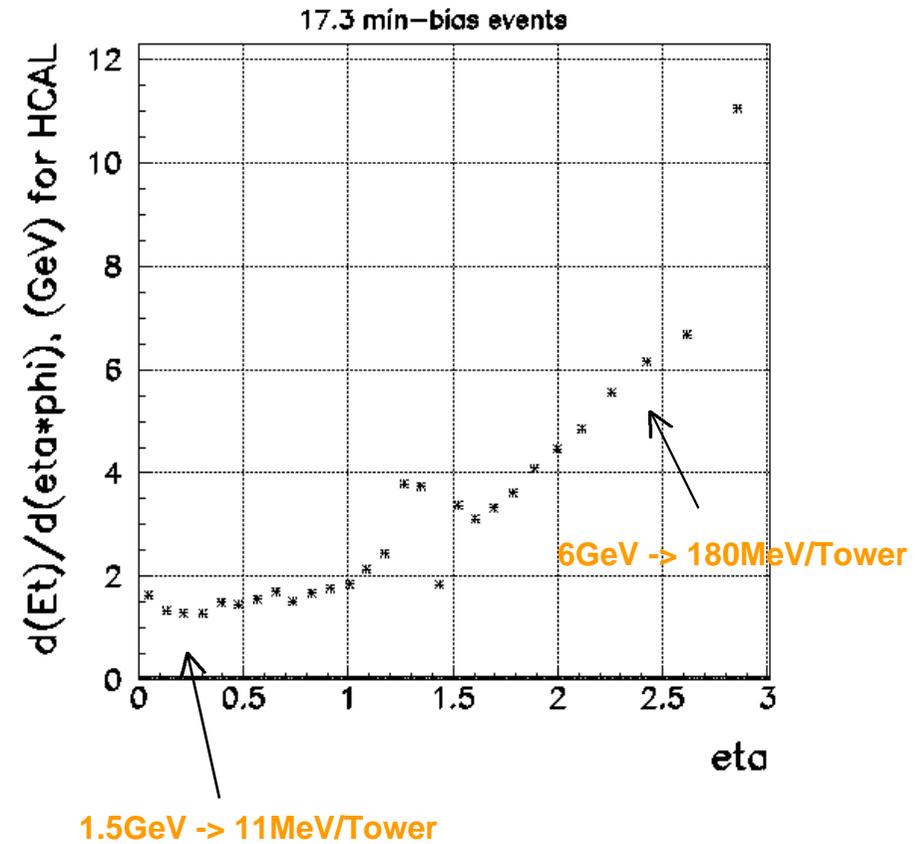
(17.3 min-bias events)

Fraction in HCAL



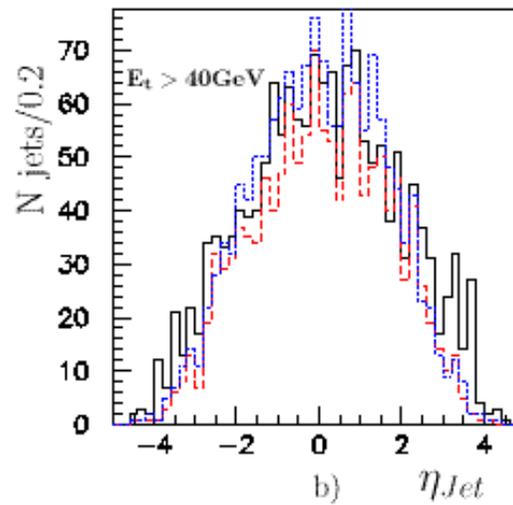
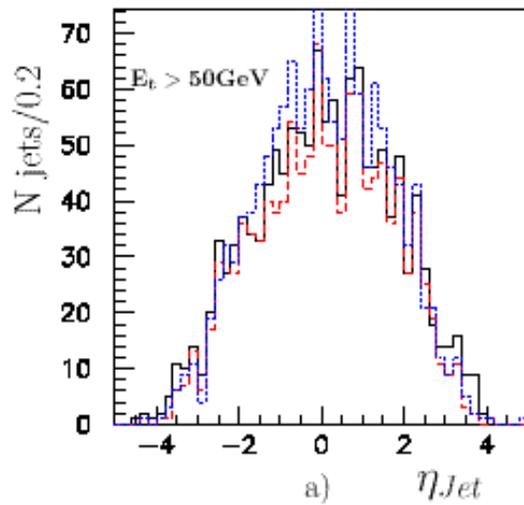
Much energy stays in ECAL!

Et Flow



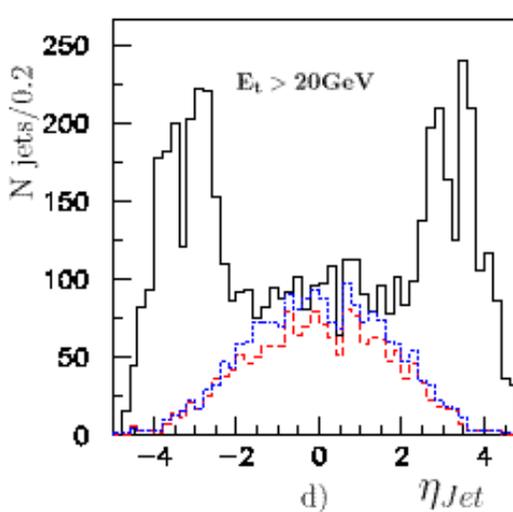
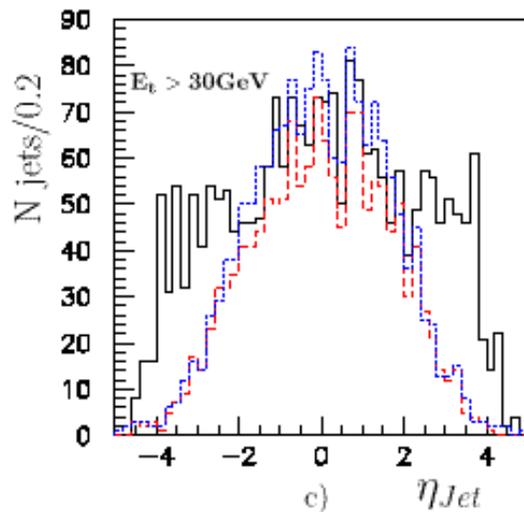


Low Et Jets and Pile-up



— Reco with pile-up
- - - Reco w/o pile-up
... Generated

($R < 0.7$)



Fake jets < 40GeV

=> core of jets
=> smaller cone

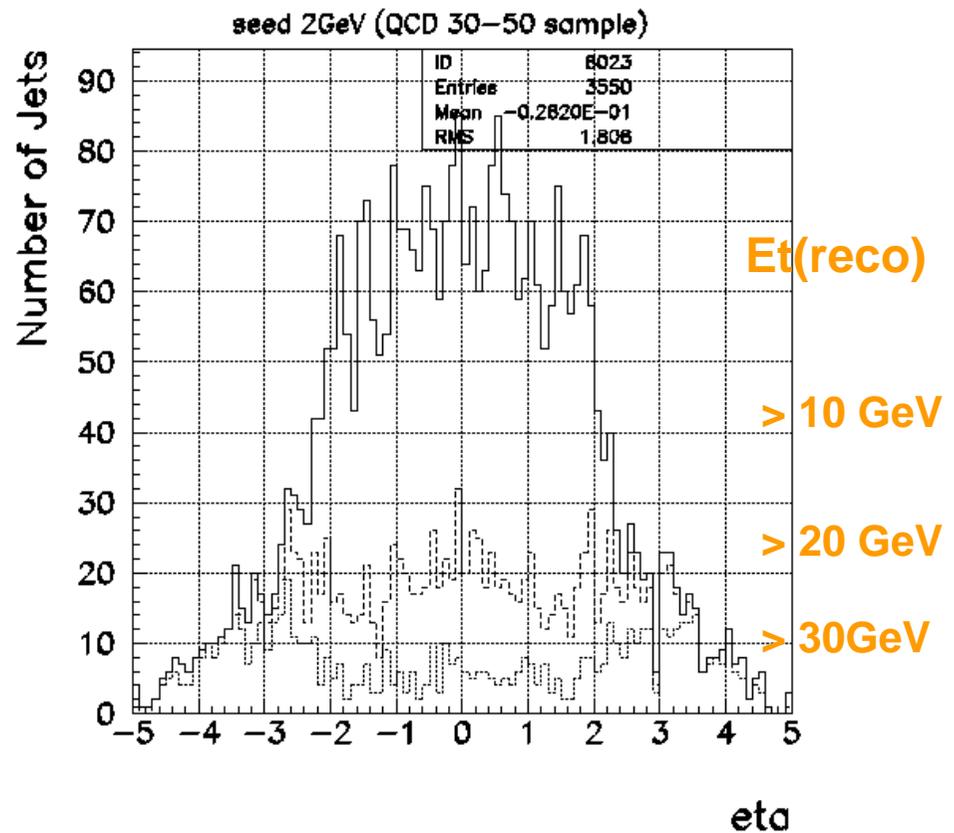
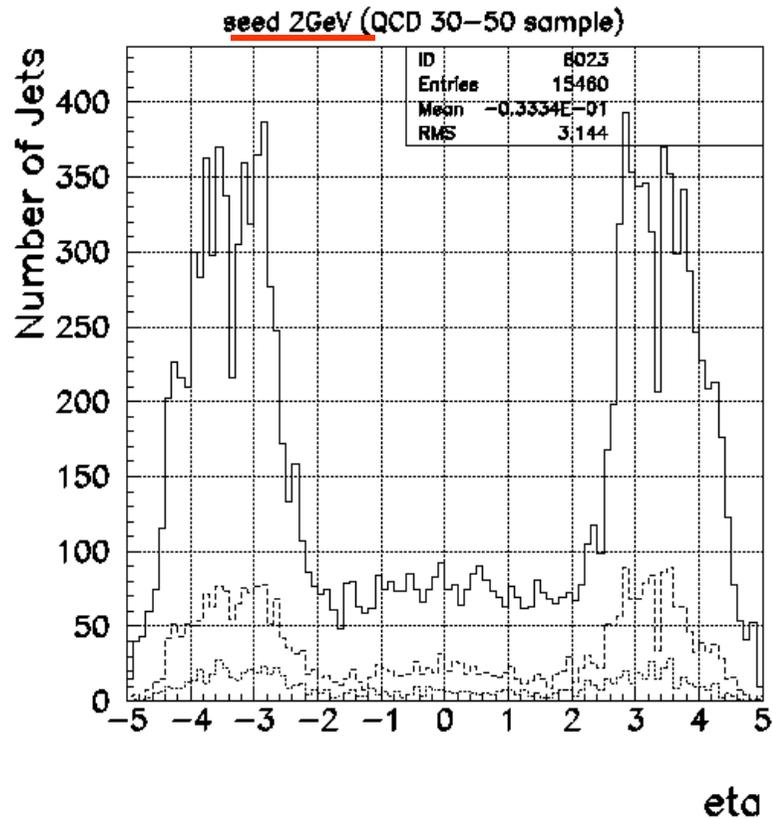
(A.Krokhotine)



Seed Cut

No cut

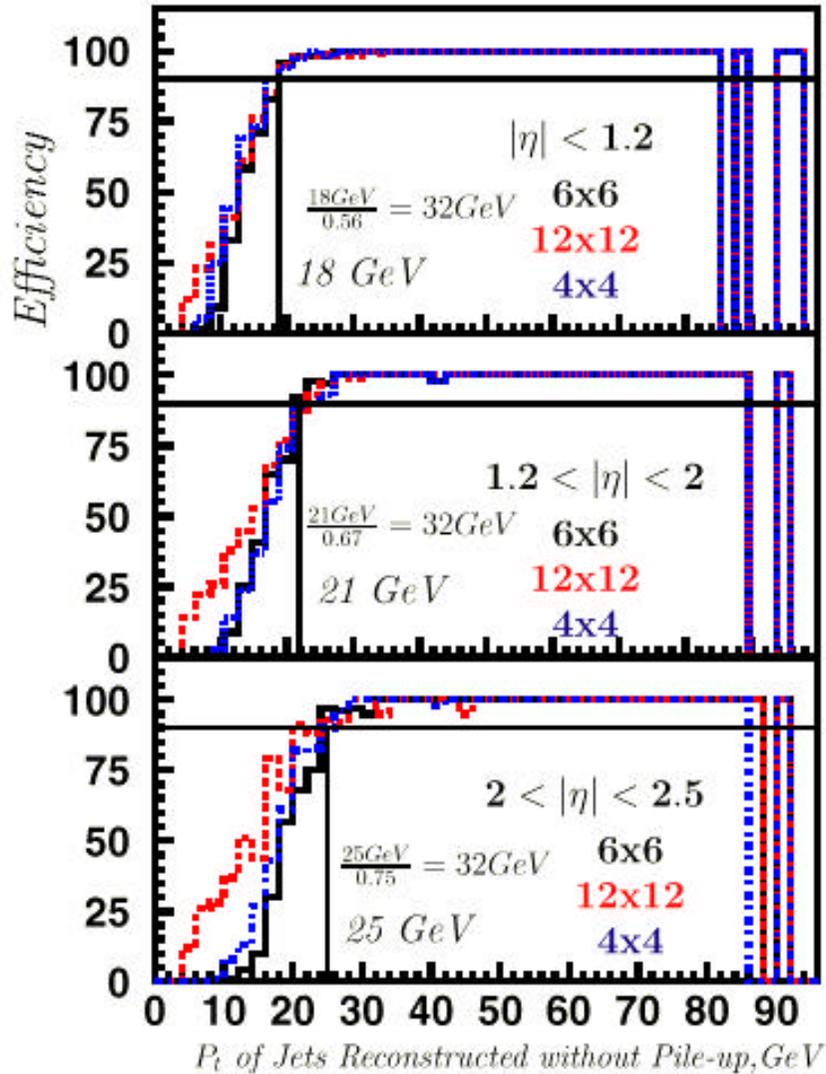
2 GeV / (0.087x0.087)



Suppression of fake jets!
... but still many fakes remaining.



Window Size Dependence



Tower = 0.087x0.087

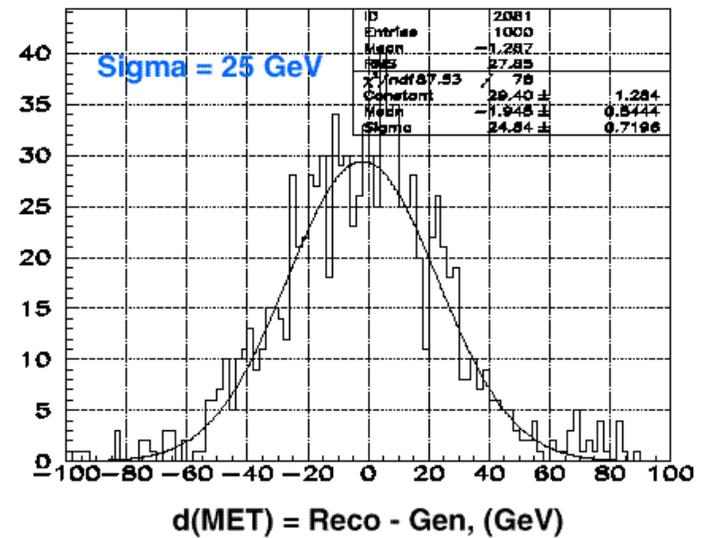
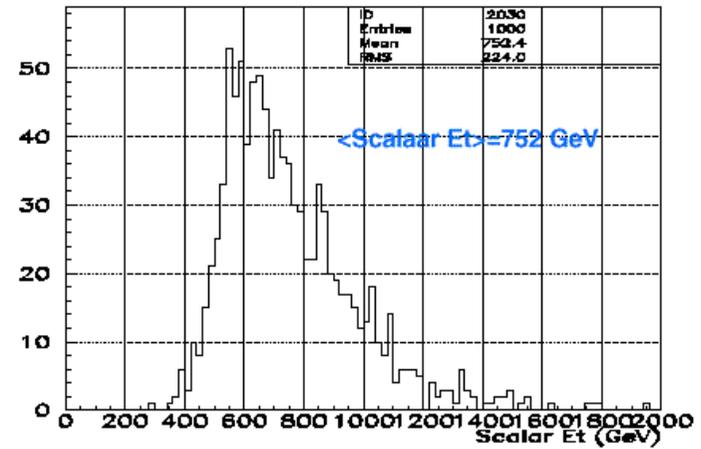
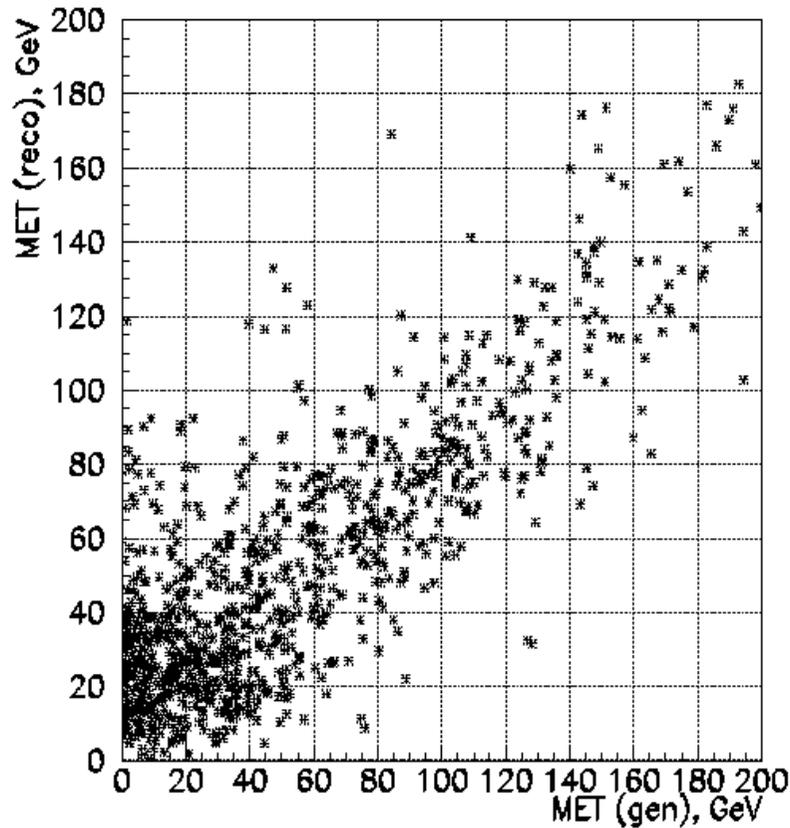
equ
 cone
 size rejection
 for fake
 2 jets

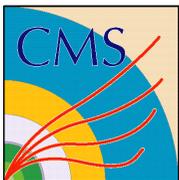
12x12	(0.59)	2.68
6x6	(0.29)	7.19
4x4	(0.20)	6.90



MET Response

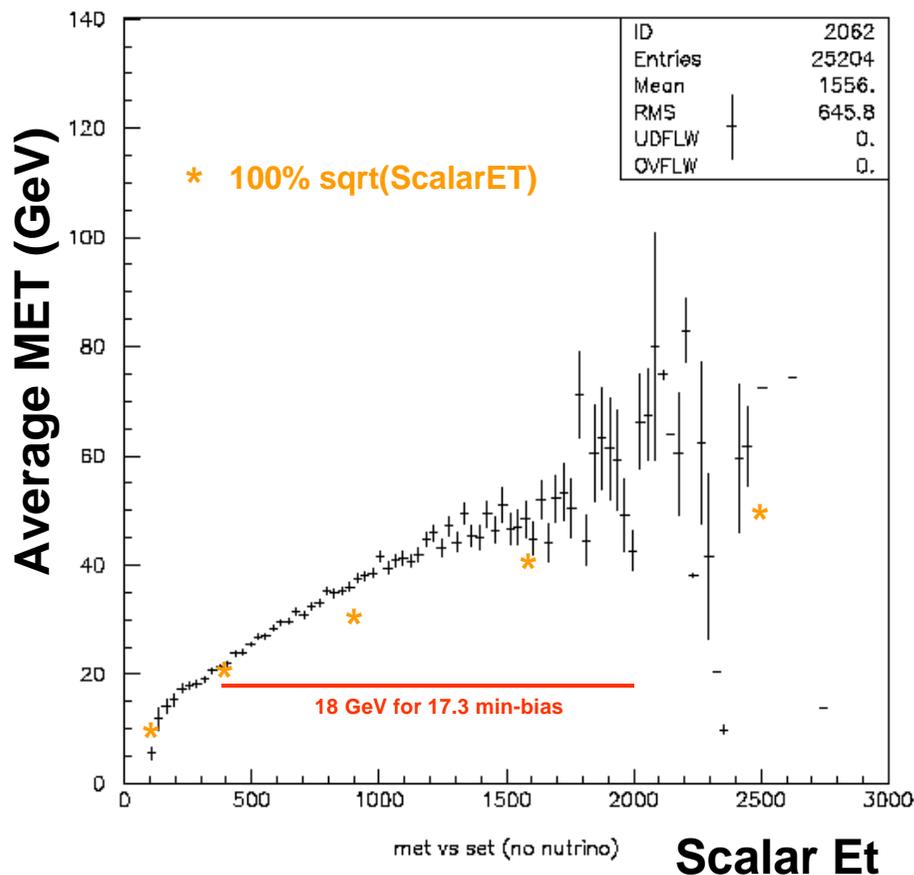
ttH(110) no min-bias overlap
(H->bb)





MET Resolution

QCD Jets with no neutrino/muon
(no pile-up)



$$E_x = \sum (E_{x\text{-tower}})$$

$$E_y = \sum (E_{y\text{-tower}})$$

Any way to improve this?

e.g.

$$E_x' = E_x + \sum (\Delta(E_{x\text{-jet}}))$$

$$E_y' = E_y + \sum (\Delta(E_{y\text{-jet}}))$$

Does this work?

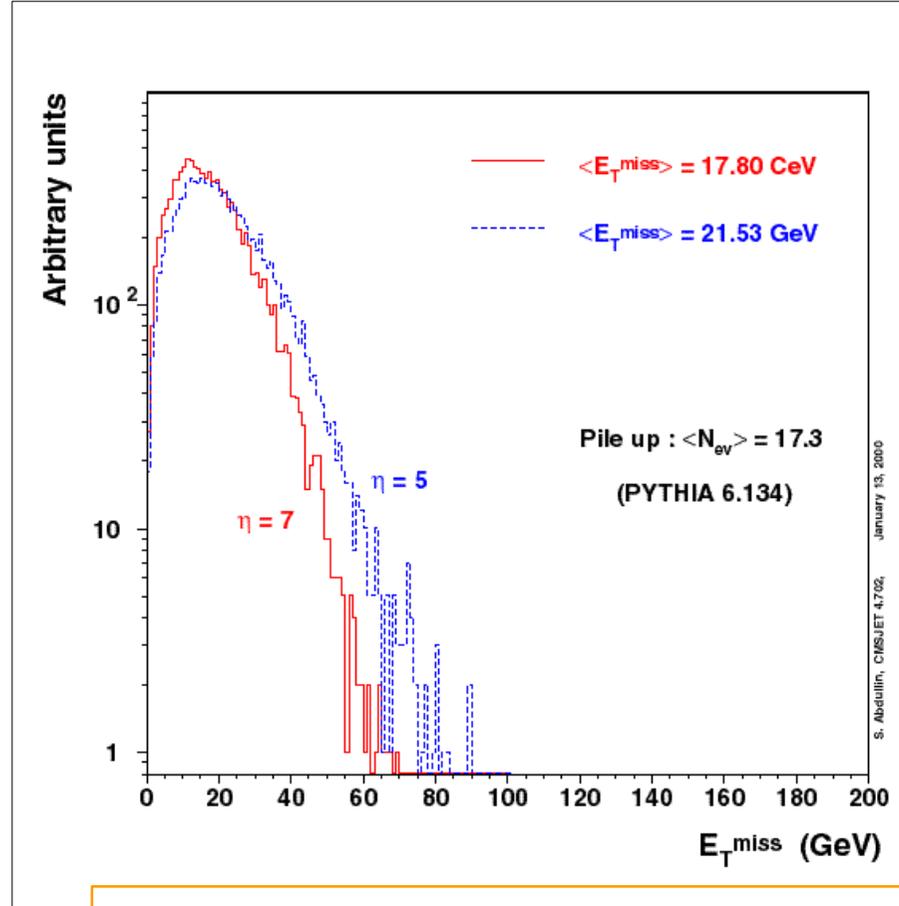
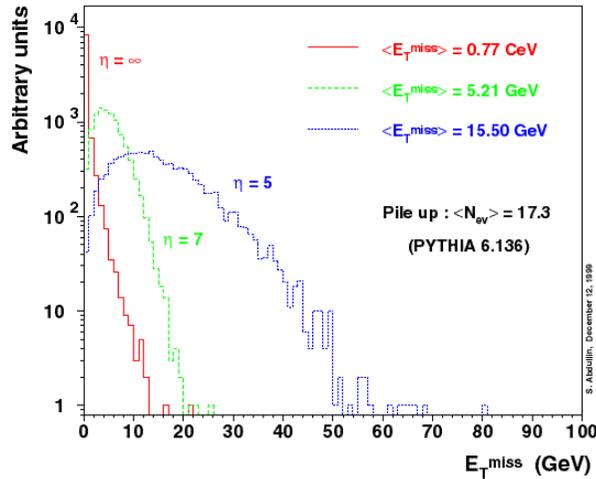


MET with Pile-up (eta 5 vs 7)

(CMSJET simulation)

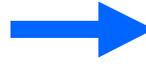
(S.Abdullin)

Particle level $E_{T,miss}$ calculation for various η coverage



MET (GeV)			
eta	gen.	cmsjet res.	all(*)
5	15.49	19.36	21.53
7	5.21	12.92	17.80

(all = res. & B-field & vtx smearing)

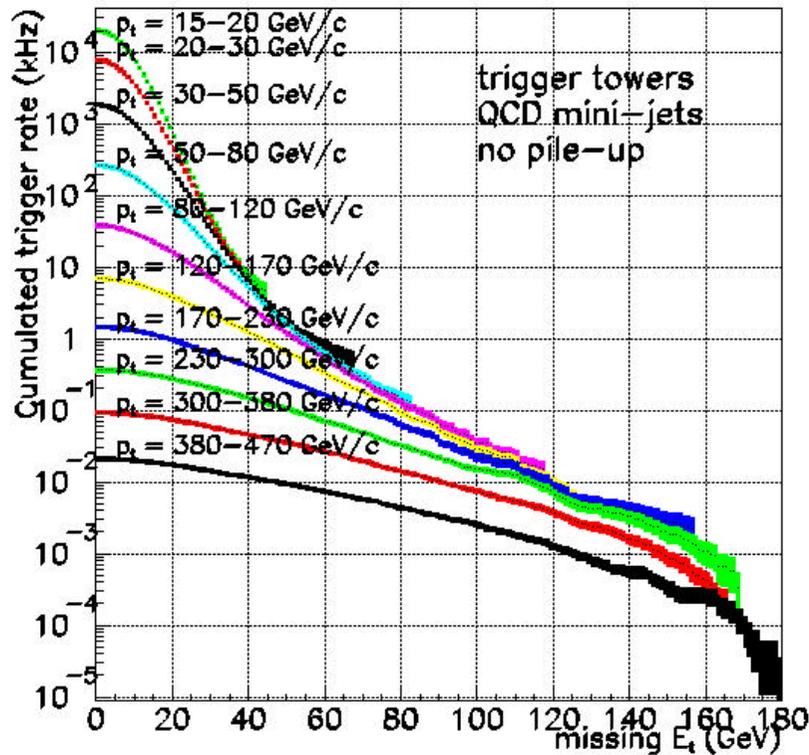


~ Equal contribution from
eta 5-7, resolution and B-field
(15GeV) (12GeV) (9-12GeV)

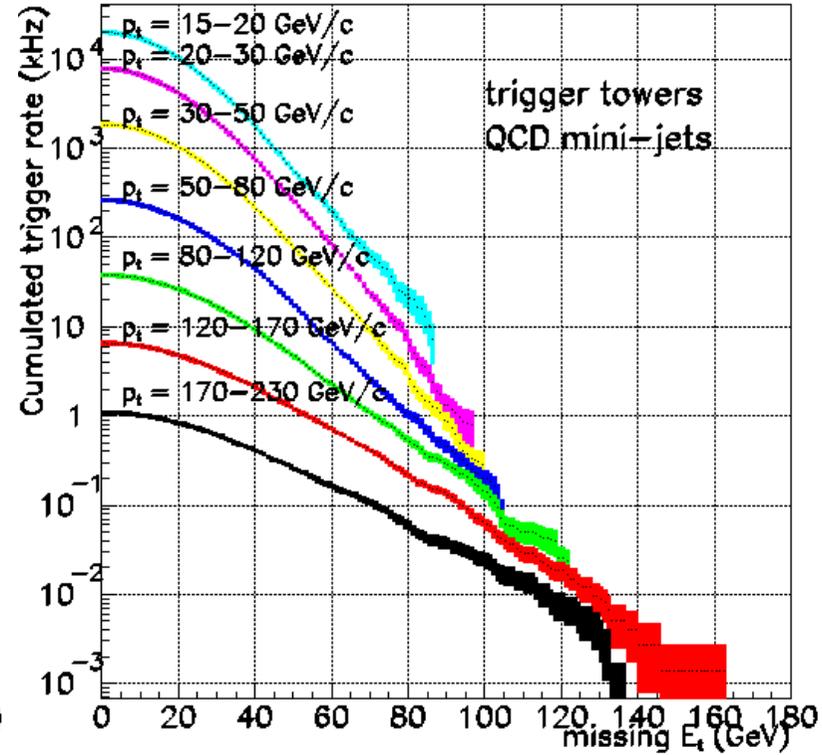


Rates with Pile-up

No pile-up



In-time pile-up



Huge rate below MET < 100 GeV due to min-bias at 10E34.

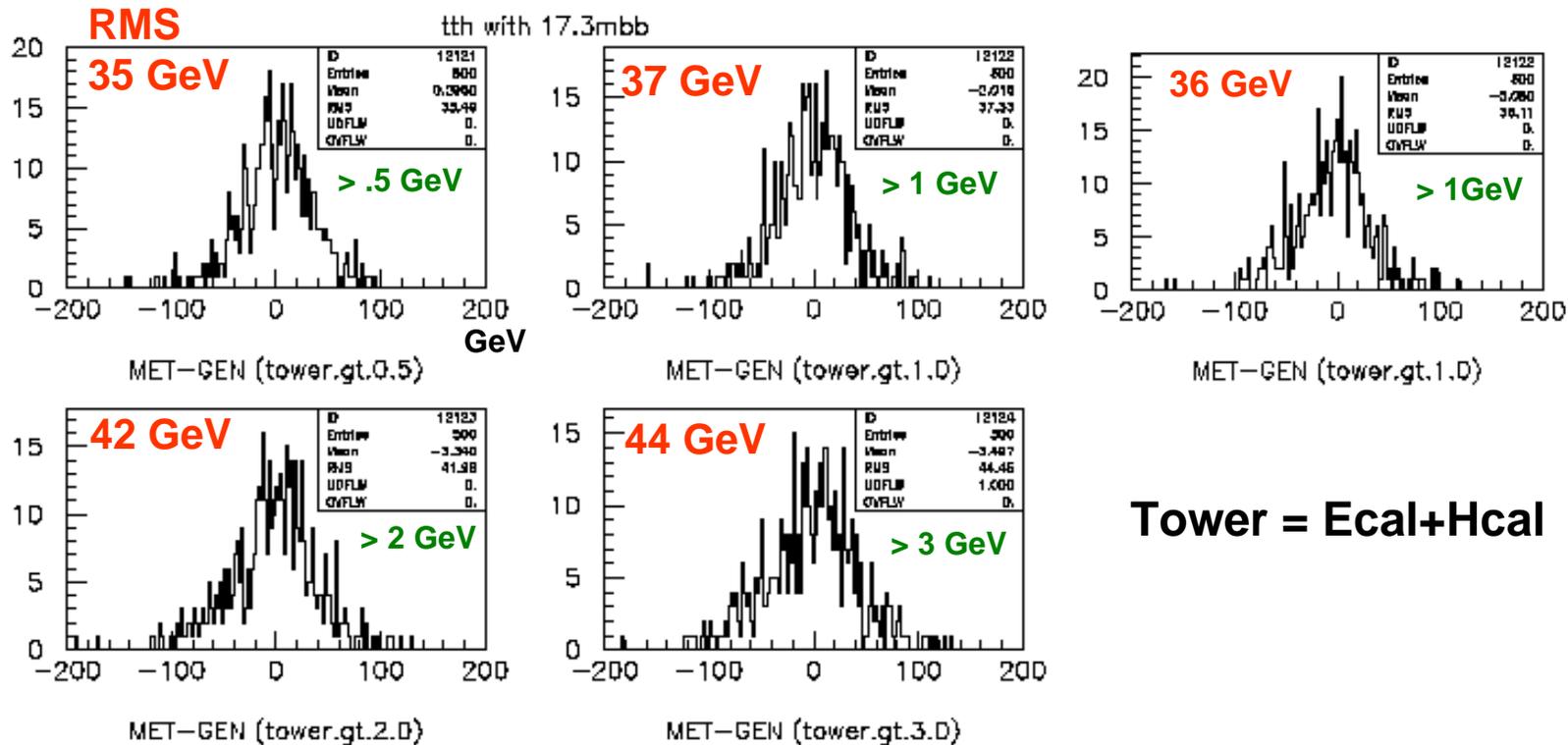
(P.Hidas)



MET for Signal Events with Pile-up and Tower Threshold

With 17.3 min-bias events

No min-bias



- >> Not much pile-up effect with this resolution!
- >> Resolution gets worse as threshold increase.



Summary

Jets:

- **Energy scale: strong E_T -eta dependence**
 - A first energy scale correction table has been made.
 - **Improvement for QCD jets (w/o and w/ pile-up)**
 $\sigma_{E_T}/E_T = 1.68/\sqrt{E_T} + 0.08$, $= 1.71/\sqrt{E_T} + 0.09$ (before)
 $\sigma_{E_T}/E_T = 1.13/\sqrt{E_T} + 0.07$, $= 1.30/\sqrt{E_T} + 0.07$ (after)
 - **Extend the correction to tau-jets, b-jets, etc.**
 - Development of pile-up energy subtraction is in progress.
- **Fake jets at low E_T at 10E34**
 - Development of rejection algorithm is in progress

MET:

- **Energy scale and resolution improvement:**
 - Start developing algorithm following the jets energy correction. --> **probably physics process dependent.**