A. Nikitenko CERN EP / ITEP Moscow
jetmet group

Status of missing E_t

- problems with not corrected off-line MET.
- energy scales for MET
- status of off-line / L1 MET with energy corrections
- <MET> from pileup
- on usage of tracker for JETMET

Not corrected off-line MET with calorimeter

$$MET_X = \sum E_t^{\,x}(tower)$$
$$MET_Y = \sum E_t^{\,y}(tower)$$
$$MET = sqrt(MET_X^2 + MET_Y^2)$$

HCAL is calibrated in cms116 with pions of p_t = 50 GeV

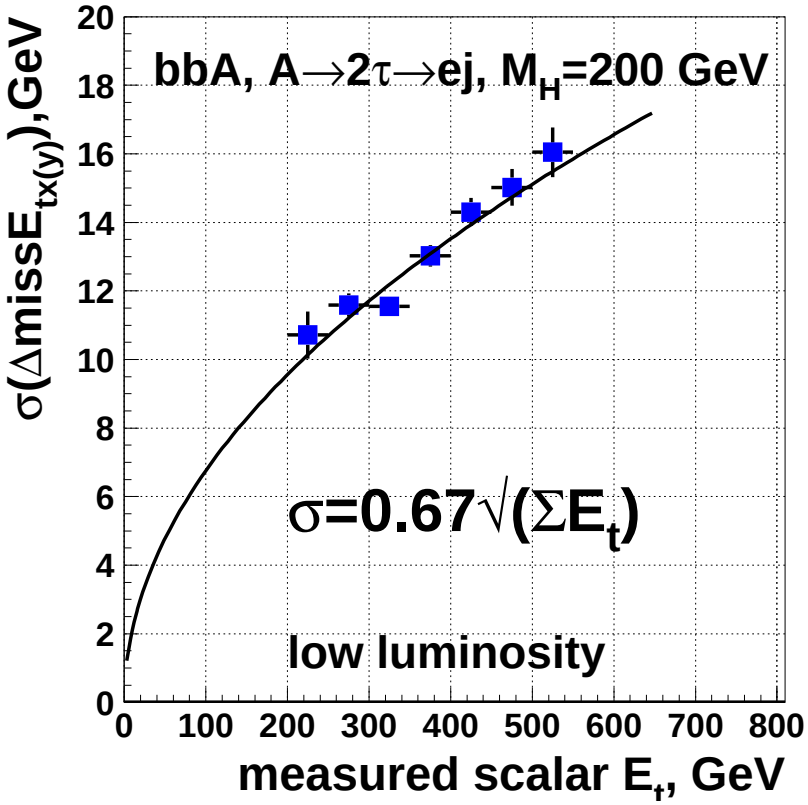
No weight for ECAL is applied - e/γ measurement

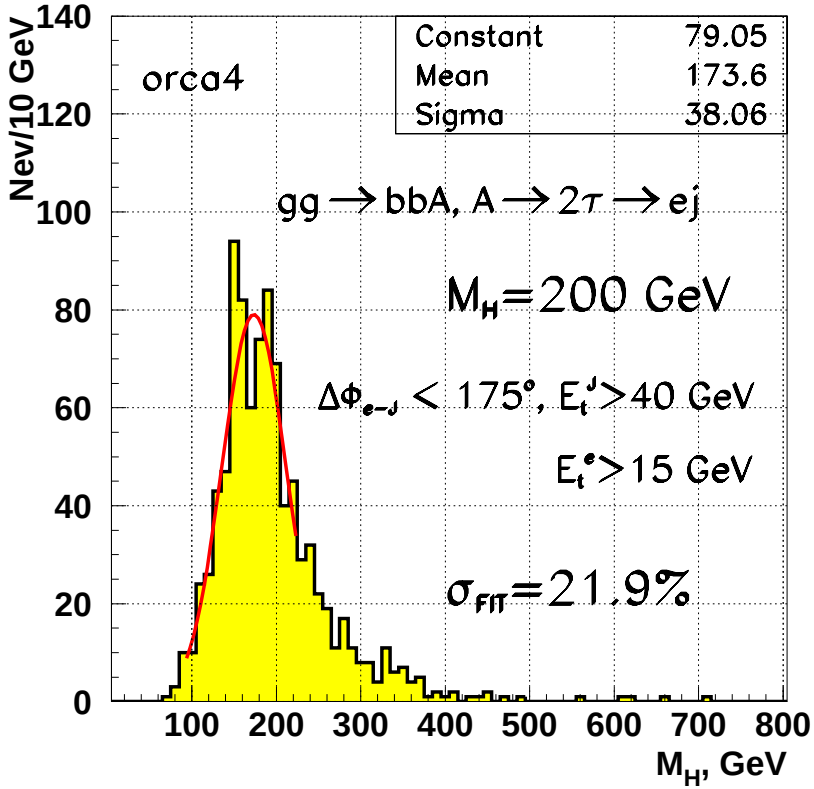
Cufoff on digi : 2 σ noise in ecal; 300 MeV, > 2σ noise in hcal (noise 43, 88, 142 MeV)

As a benchmark channels we use

- **mSUGRA Jets+MET events, $M_{squark/gluino}$ ~ 500 GeV**
- **A/H->2τ-> e Jet / 2Jets M_A=200, 500 GeV**

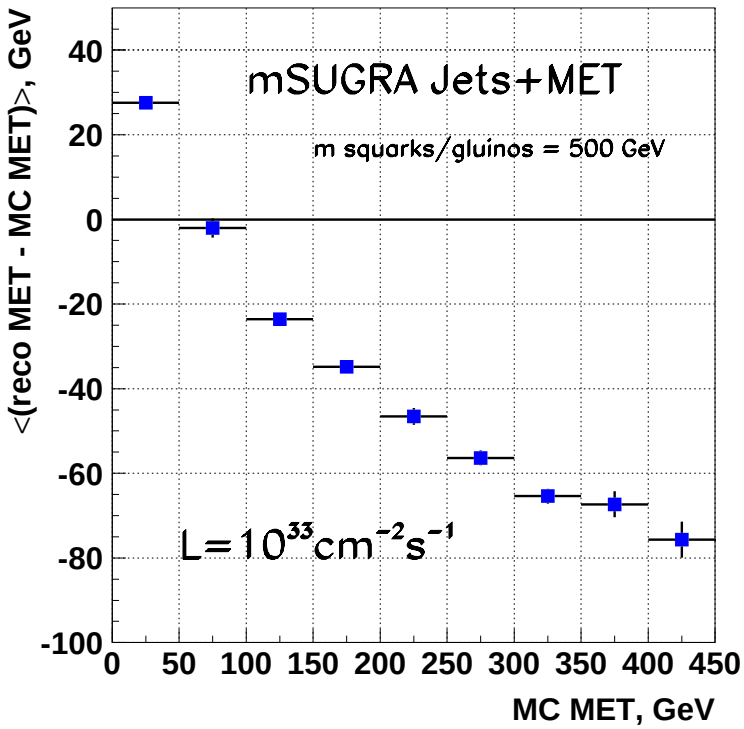
MET v.s. scalar E_t

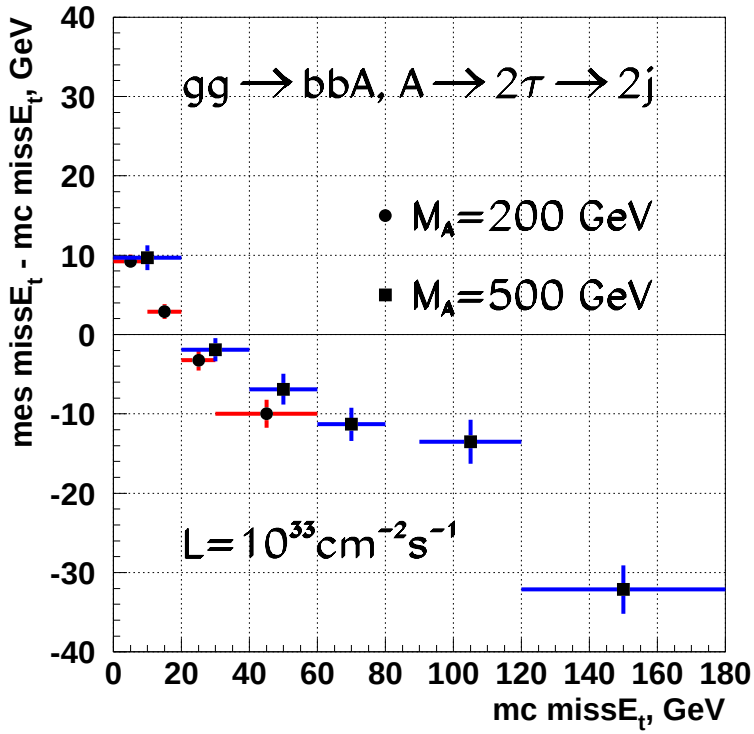




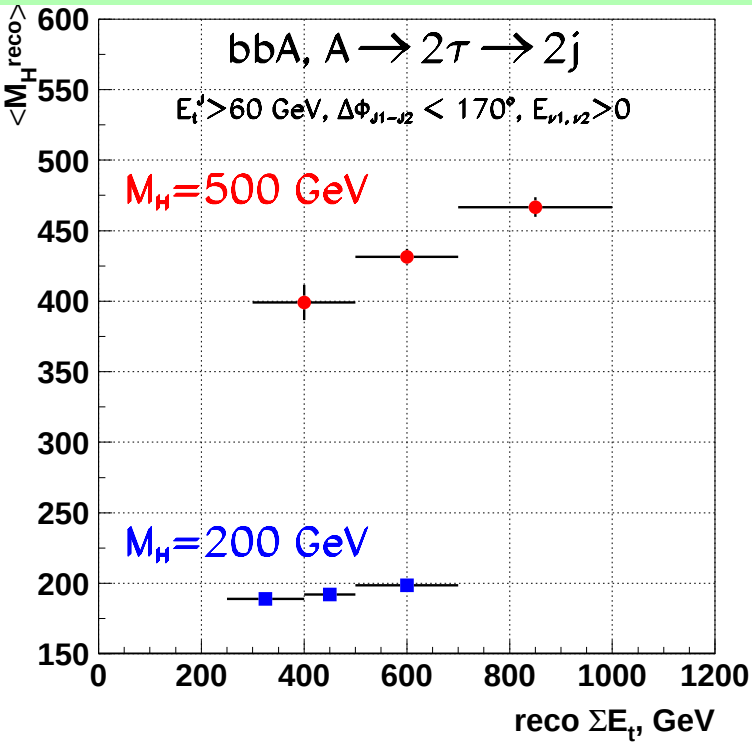
gg->bbA, A->2τ -> e j	ORCA	CMSJET	ATLAS
$\sigma(M_H)$ / <M_H>, M_H=200 GeV	22 %	18%	~17 % (M_H=150 GeV)

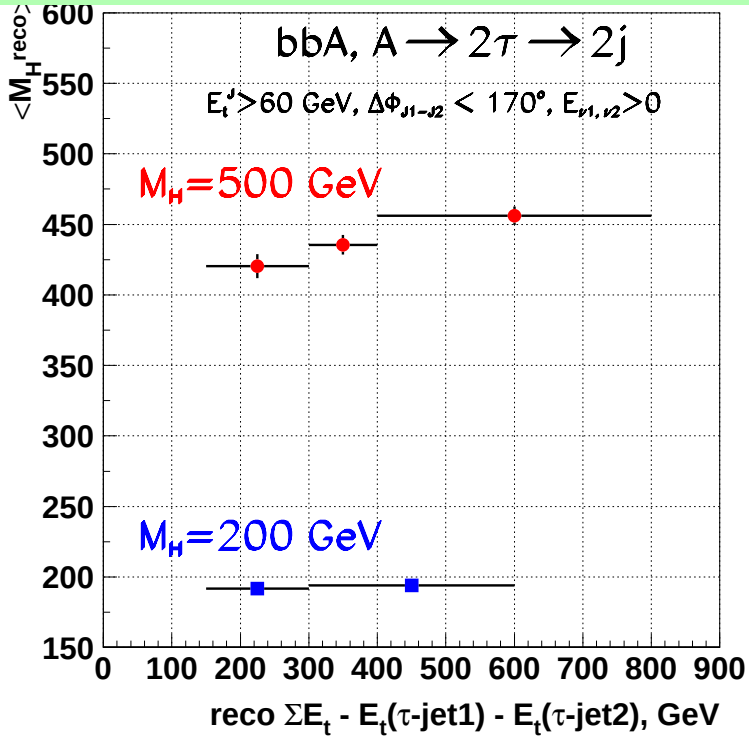
offset of measured MET





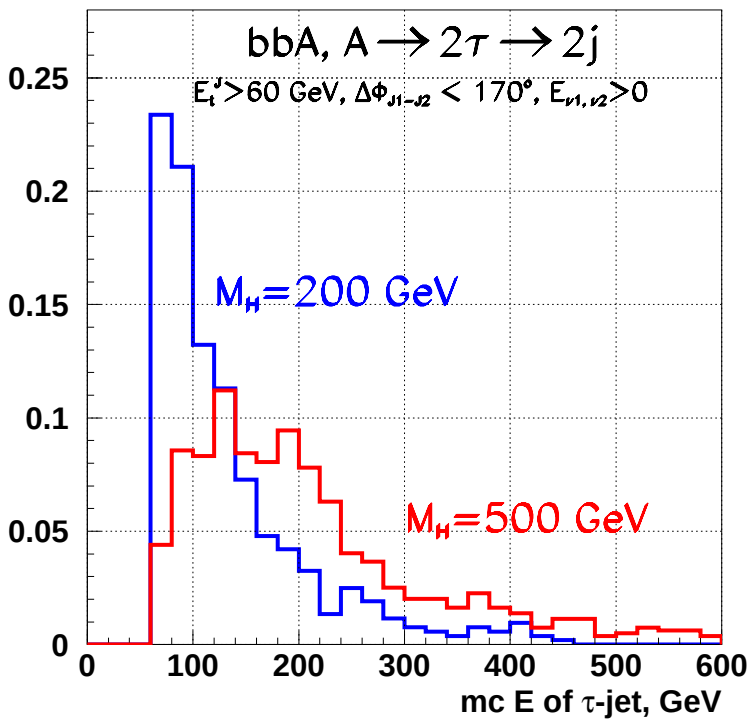
non linearity in MET measurement

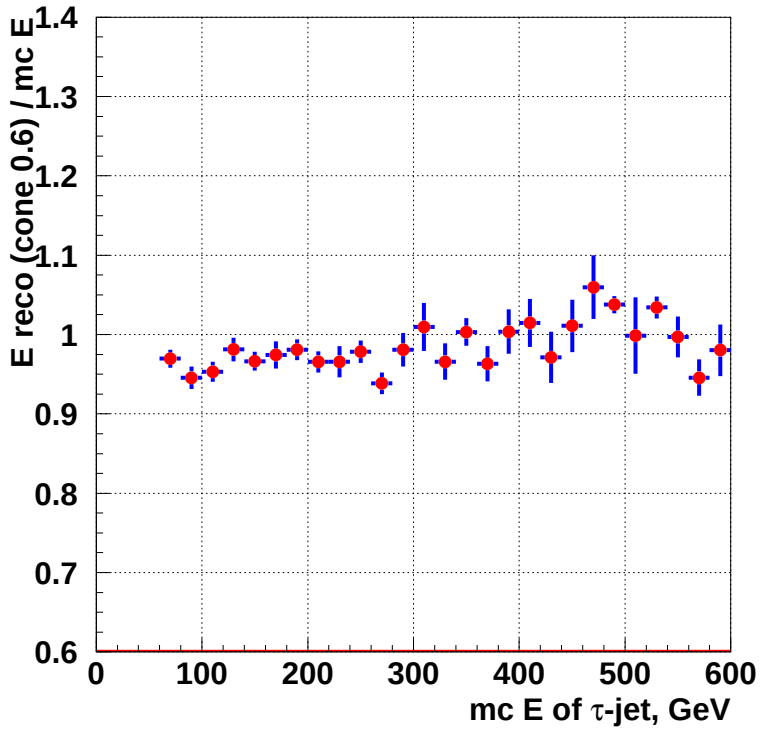




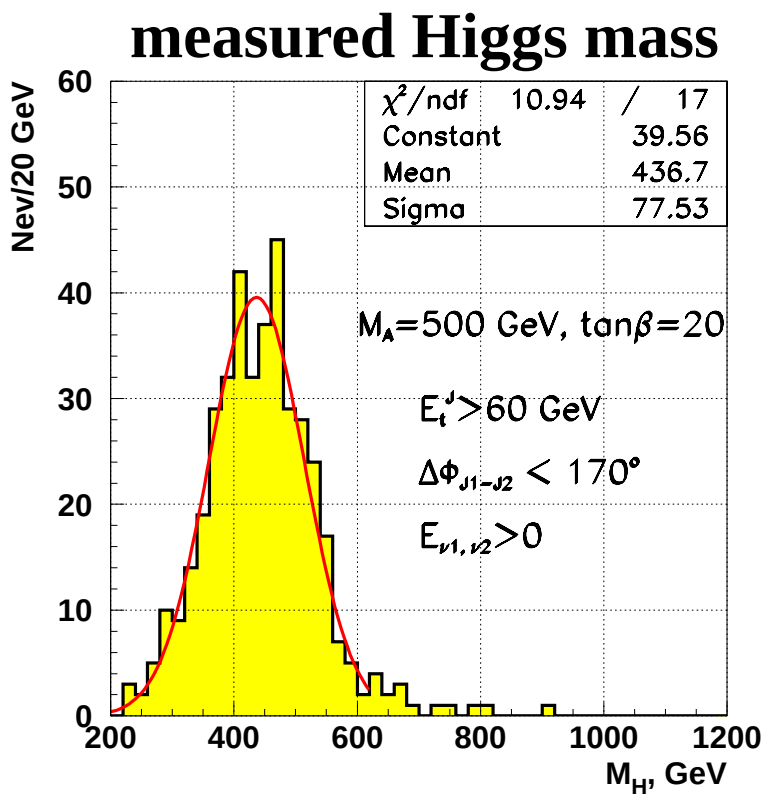
gg->bbA, A->2τ -> 2 jet	ORCA	CMSJET
$\sigma(M_H)$ /<M_H>, M_H=200 GeV	14.0 %	13.0 %
$\sigma(M_H)$ /<M_H>, M_H=500 GeV	19.7 %	13.4 %

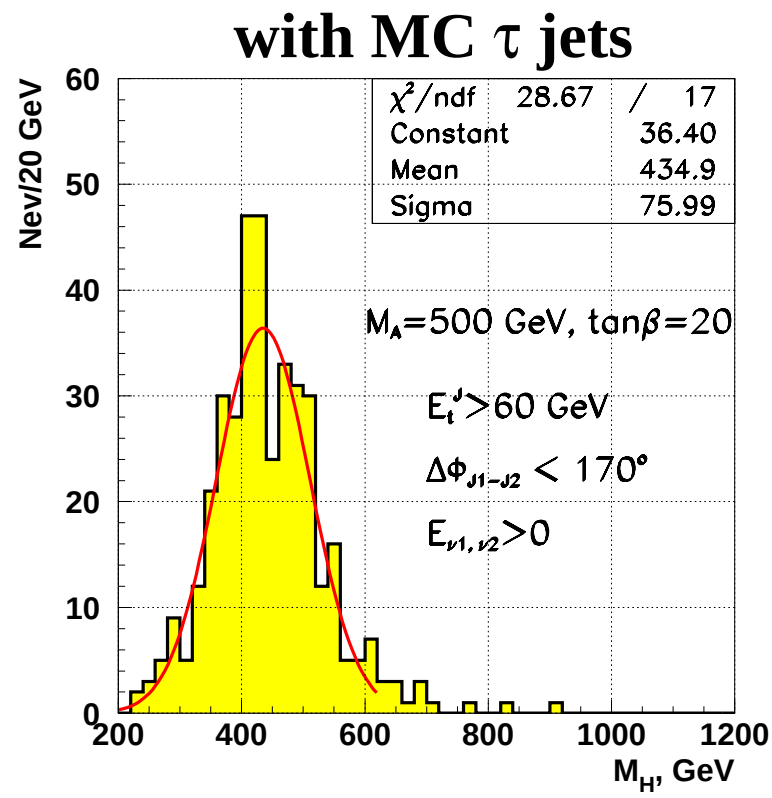
variation of τ jet scale < 5 %



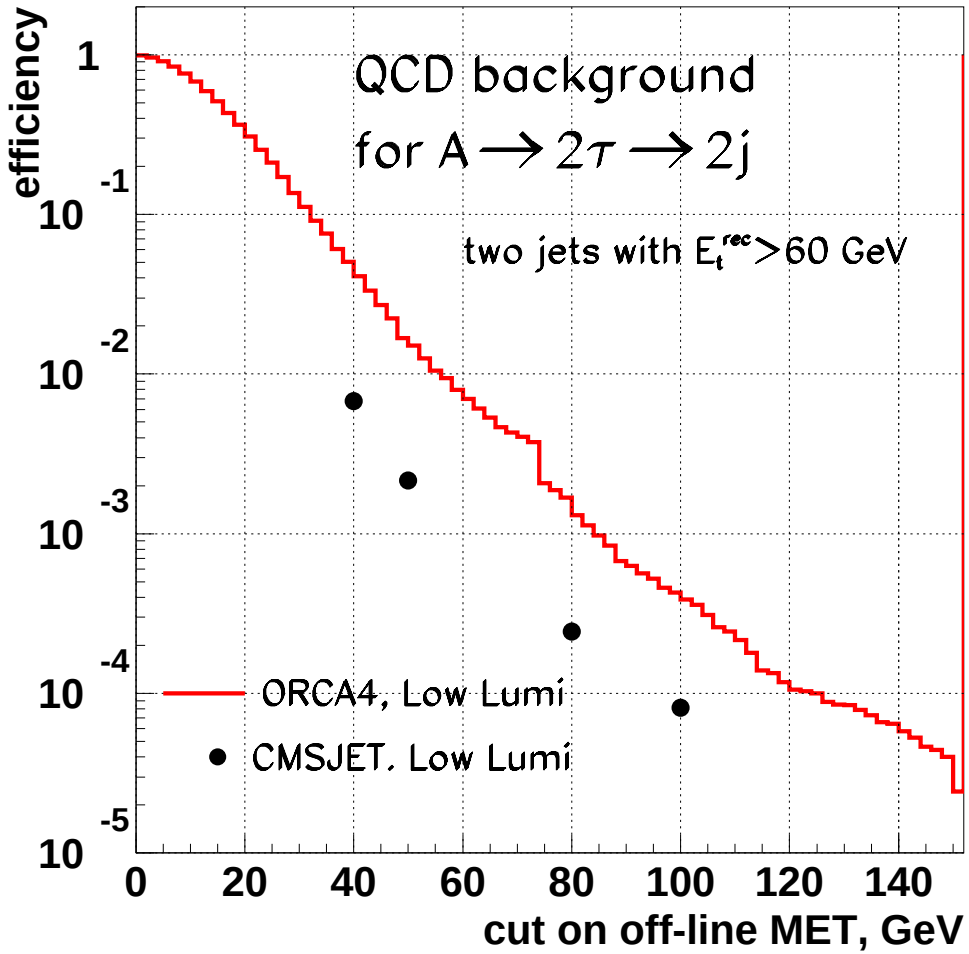


resolution is dominated by not τ jets

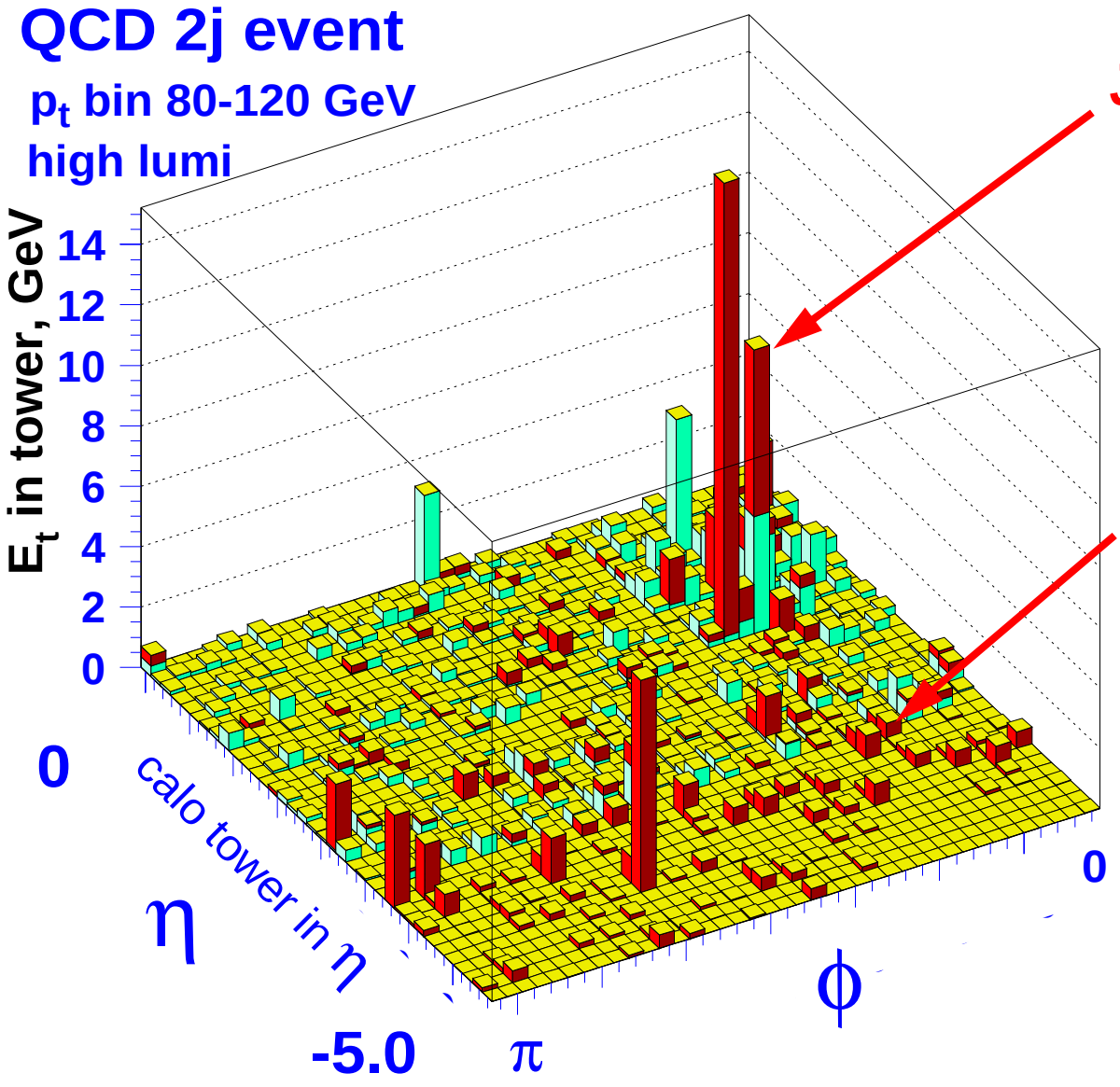




less rejection with MET than expected



Energy scales for MET



Jet energy scale

out of cone energy scales :

- physics (FSR)
- 4T field
- pile up
- underying event

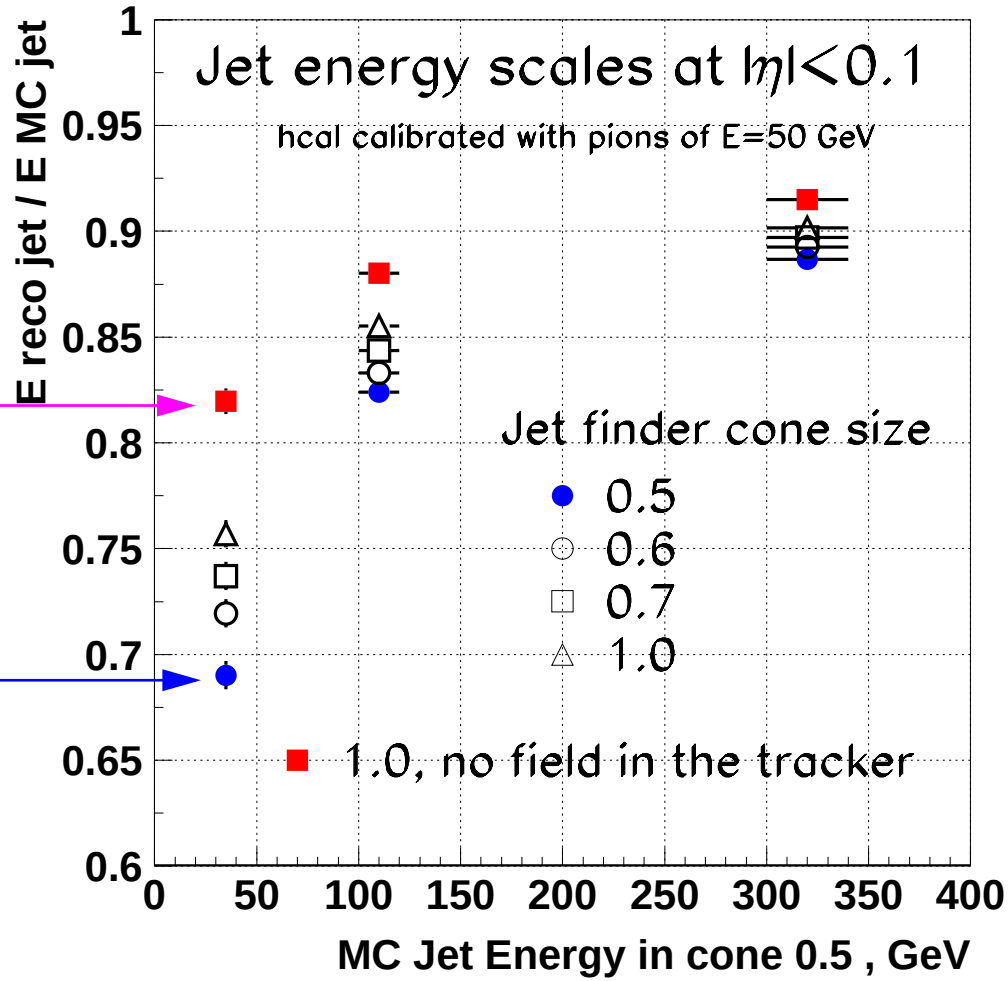
Jet energy scales

"D0's" Jet responce R

(to be found from γ + j events)

"D0's" jet corrections C

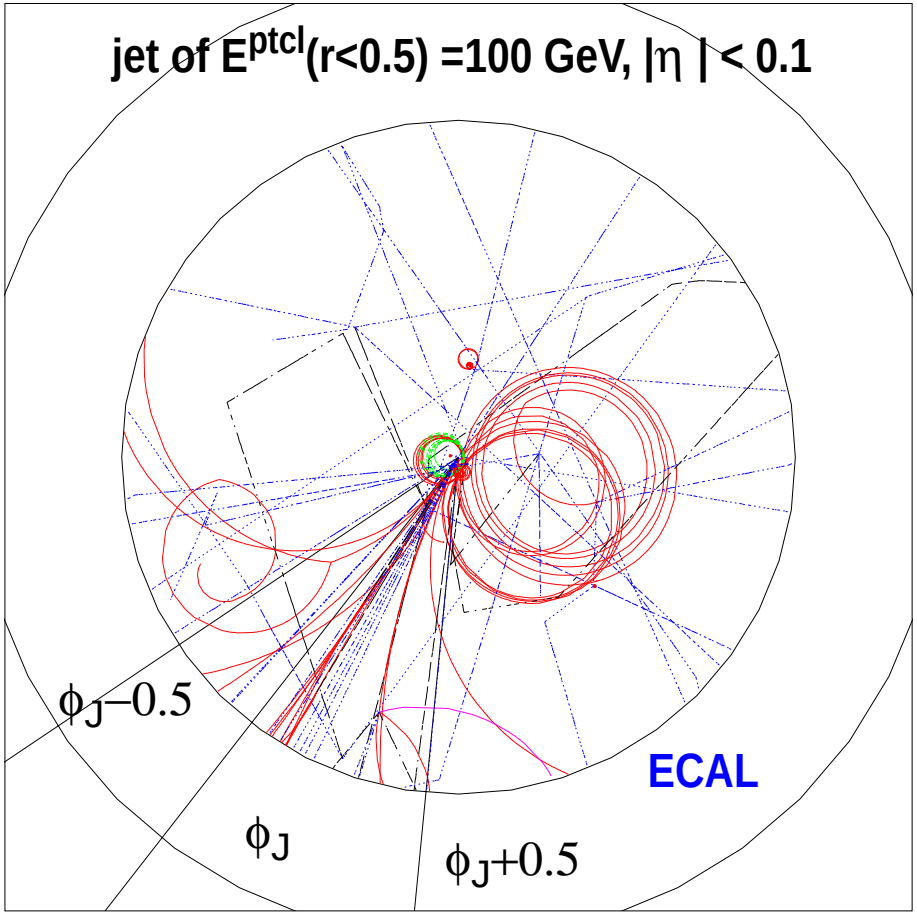
to evaluate $E_{jet}^{ptcl}(r<0.5)$

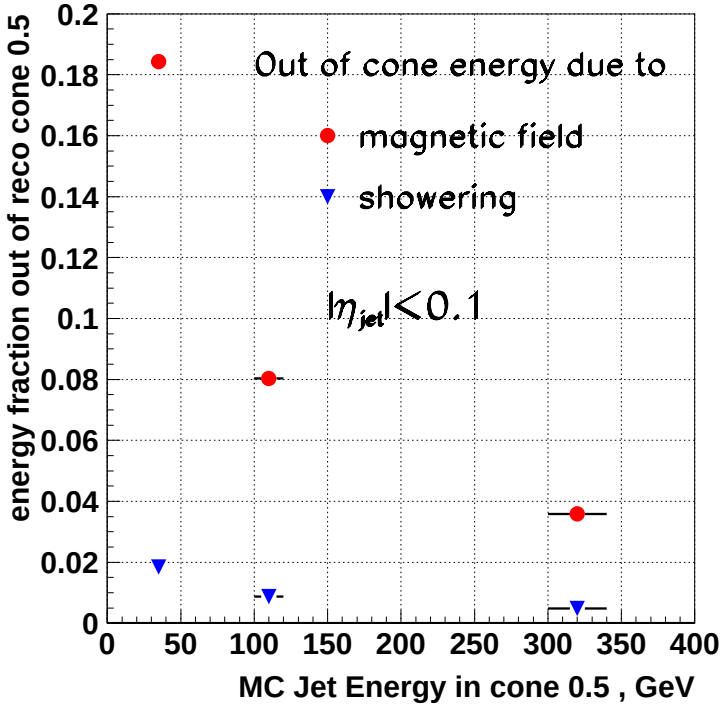


MET must use jet energy corrections, but C or R ?

usage of C may lead to double counting for low energy jets

Fraction of out of cone energy due to 4T field and showering





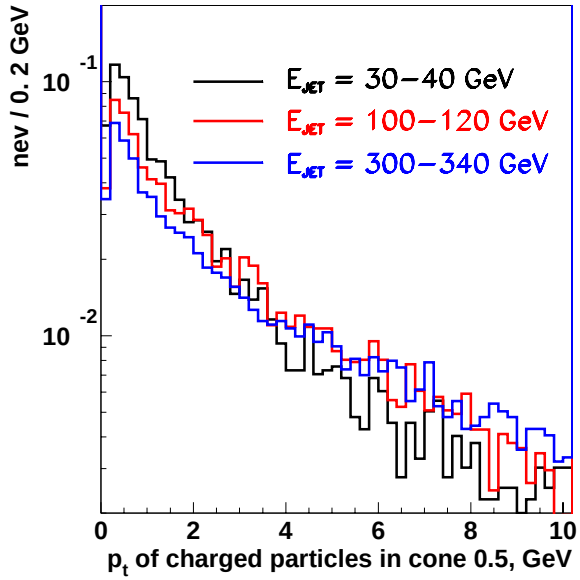
Usage of jet energy corrections (C) instead of jet responce corrections (R) may lead to double counting for low energy jets

Out of cone scale due to 4T field:

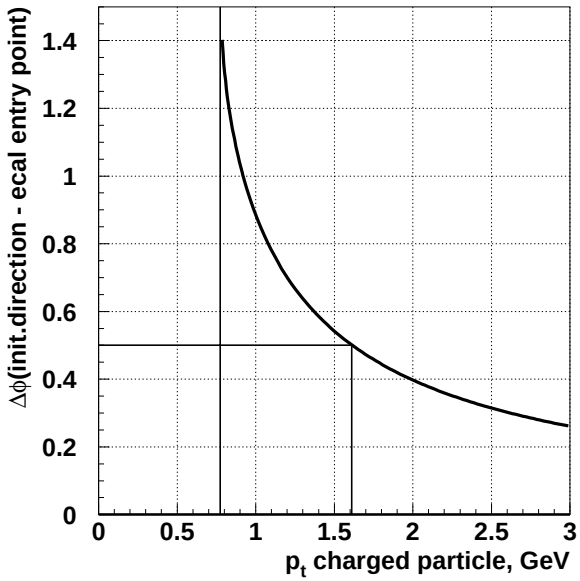
low p_t jet particels don't enter reconstruction cone

Jets with MC energy 30-40, 100-120, 300-340 GeV in cone 0.5 , η = 0.1

spectra of jet charged particles



$\Delta\phi$ deviation due to 4T field



E_J=30 - 40 GeV - $\langle p_t^{ch} \rangle$ = 2.4 GeV, $\langle n^{ch} \rangle$ = 8.4

E_J=100 -120 GeV - $\langle p_t^{ch} \rangle$ = 5.1 GeV, $\langle n^{ch} \rangle$=12.7

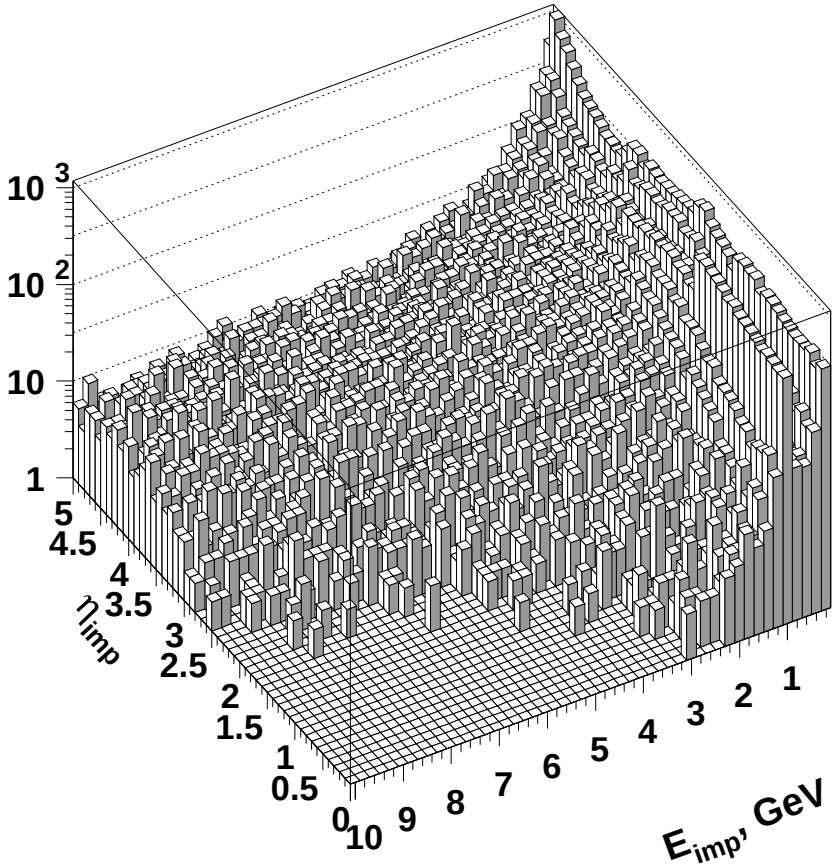
E_J=300 -340 GeV - $\langle p_t^{ch} \rangle$ = 9.6 GeV, $\langle n^{ch} \rangle$=17.0

charged particles of p^{ch}_t < 1.5 GeV do not enter reco cone 0.5

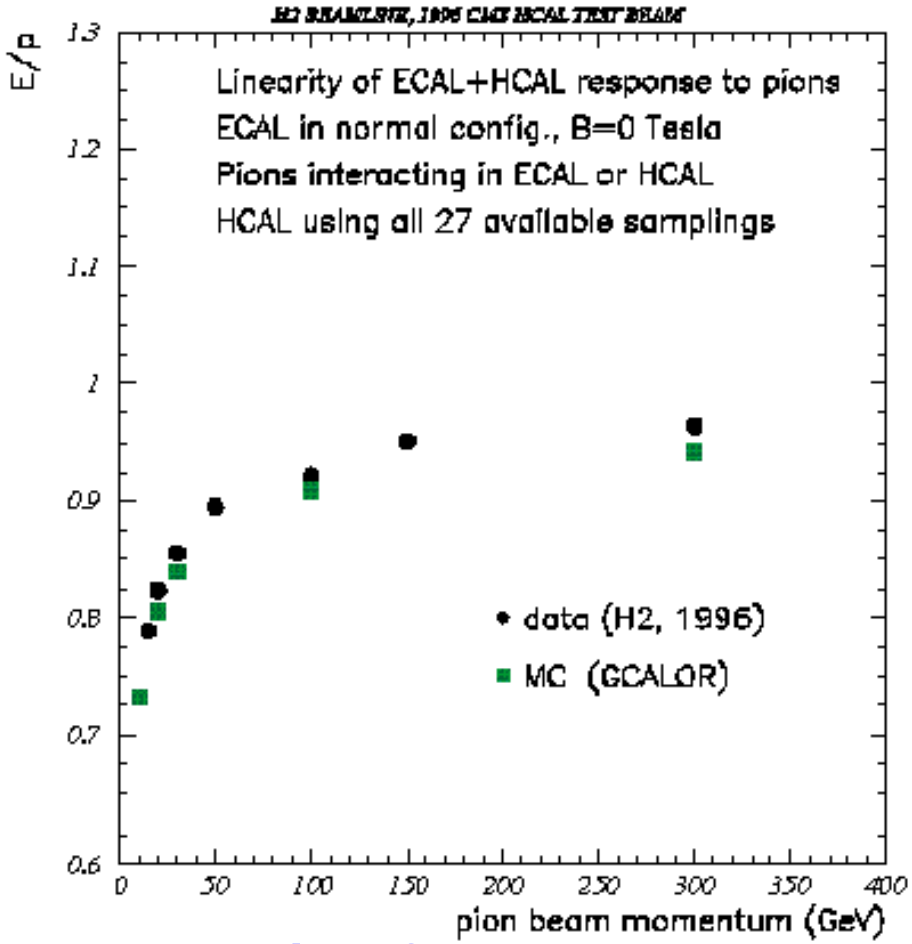
Out of cone scale due to pileup

$\langle p_t^{ch} \rangle \sim 0.6$ GeV, $\langle n_{ch} \rangle / \Delta\eta \sim 7.2$ at $\eta=0$

min.bias particle energy at the entry face of calorimetry



ECAL+HCAL non linearity from test beam

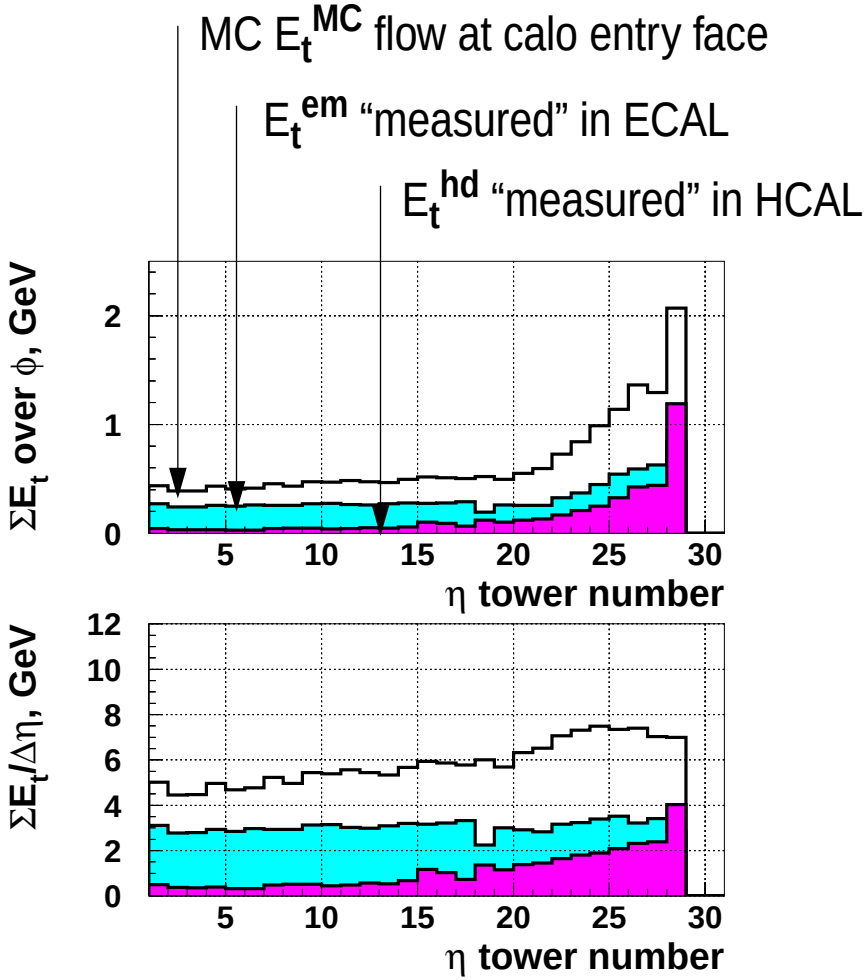


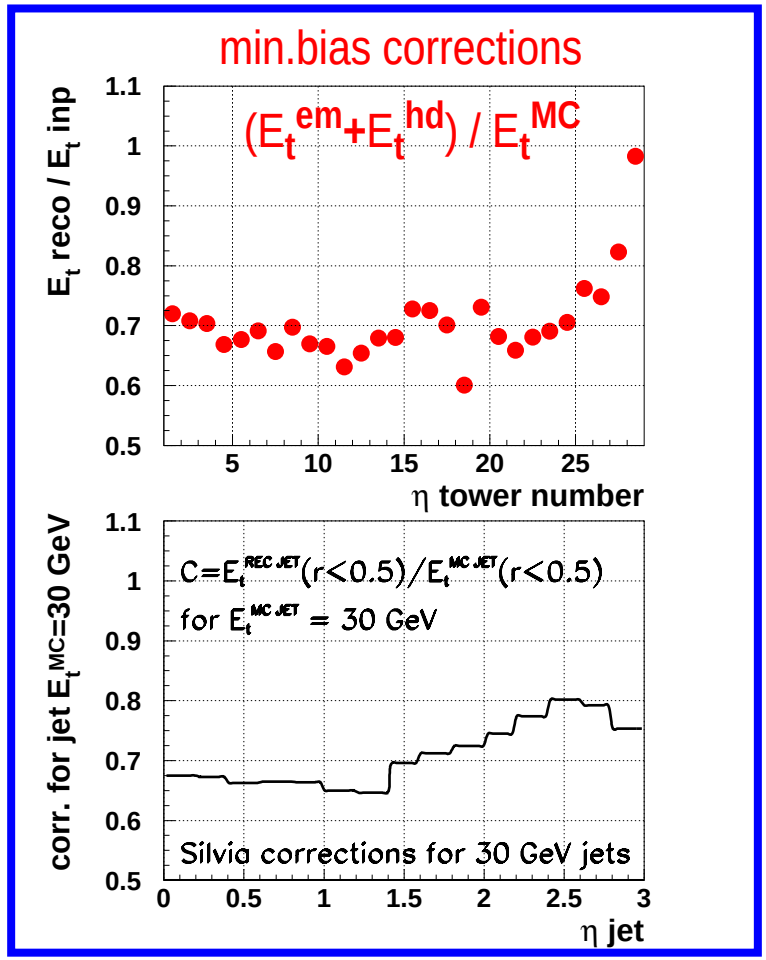
no data for $E_\pi < 10$ GeV

“calo response” to min.bias from geisha MC

cms120, hcal calibration on p_t^{π} = 50 GeV, no noise, no threshold

1 min.bias event per crossing





MET calculation with corrections

Type1 corrections* :

correct jets of E_t^{jet} > 30 GeV on $E_{t\ jet}^{ptcl}$ in cone 0.5
not correct out of cone towers

Type2 corrections* :

correct jets of E_t^{jet} > 30 GeV on $E_{t\ jet}^{ptcl}$ in cone 0.5
correct towers with corrections for E_t^{jet} = 30 GeV

Type3 corrections (will be evaluated) :

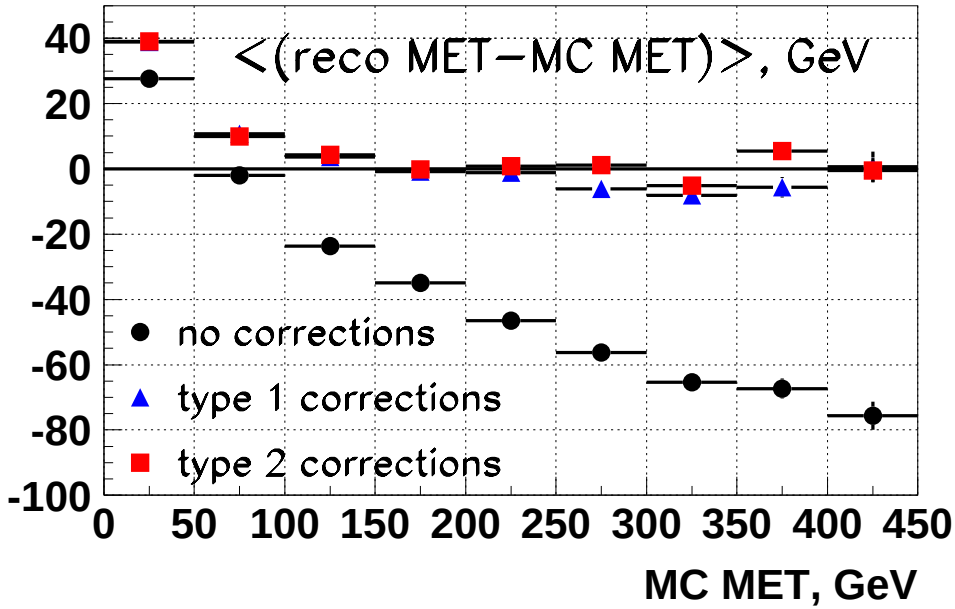
correct jets of E_t^{jet} > 30 GeV on Jet responce (R)
correct towers on responce for jets of E_t^{jet} = 30 GeV

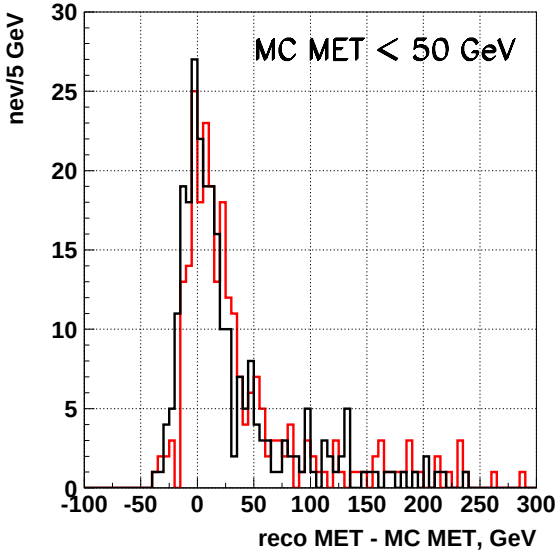
responce = reco E_t^{jet} / MC E_t^{jet}(on calo surface)

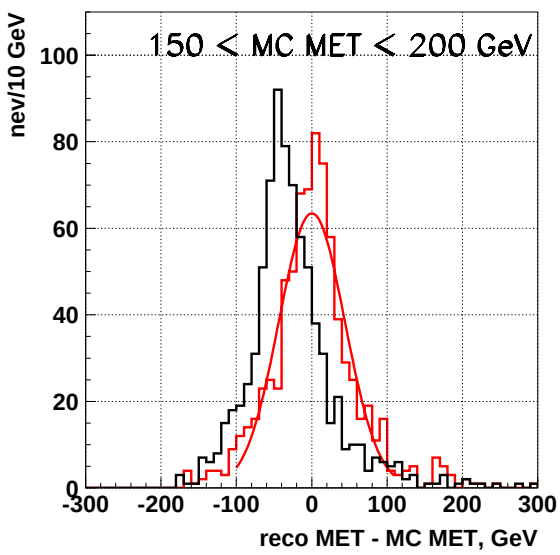
**** Silvia's Jet corrections from***

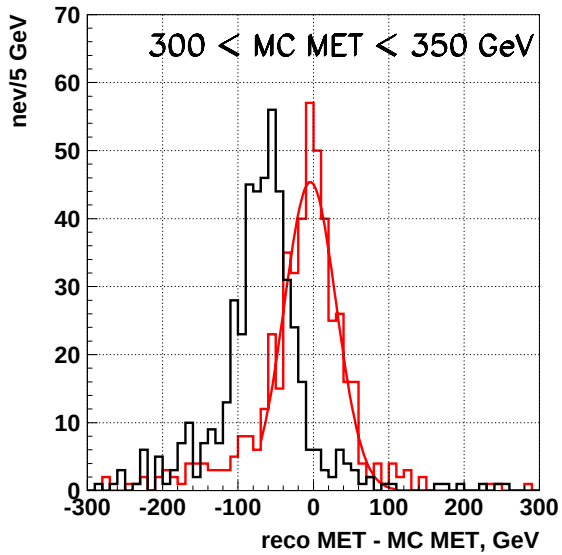
CMS IN 2001/001 S. Abdullin, S. Arcelli, S. Eno, S. Kunori, A. Krokhotine

corrected off line MET for mSUGRA Jets+MET at low lumi

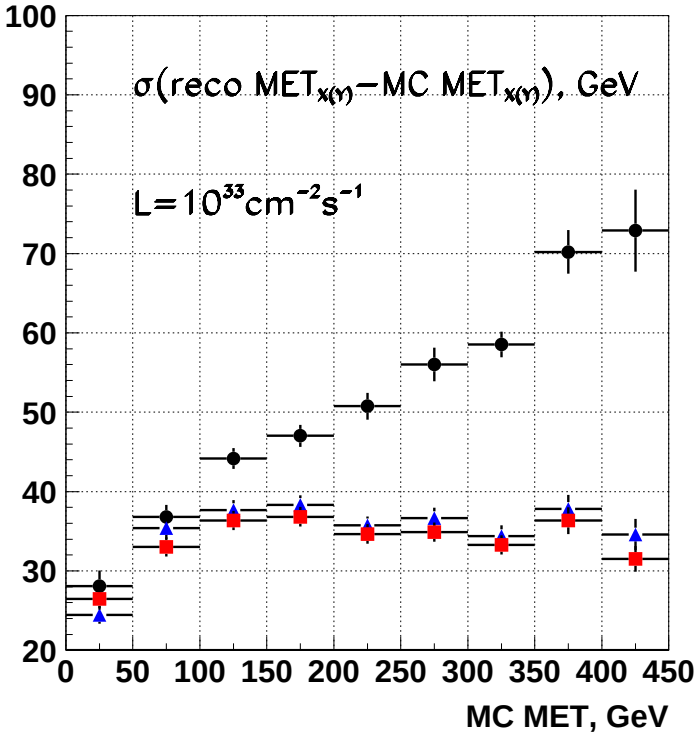


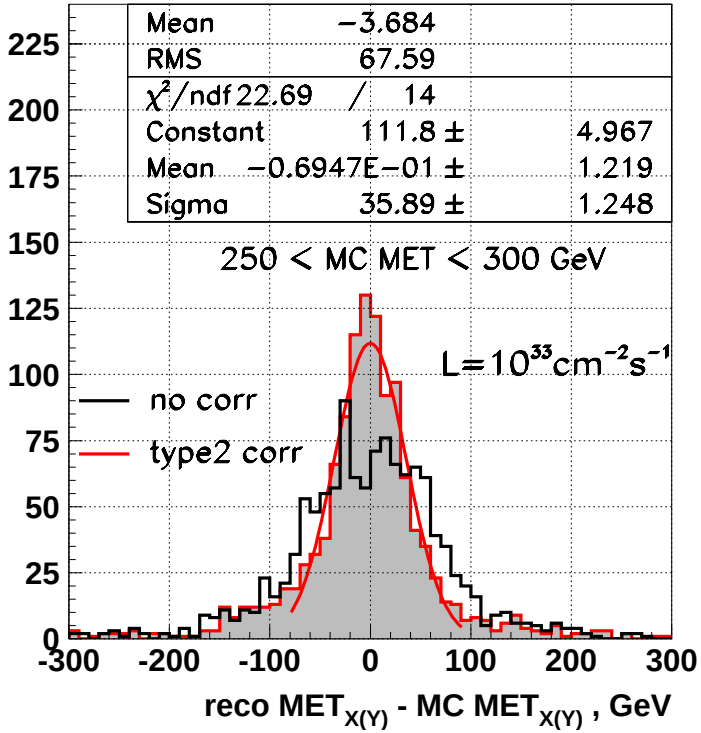




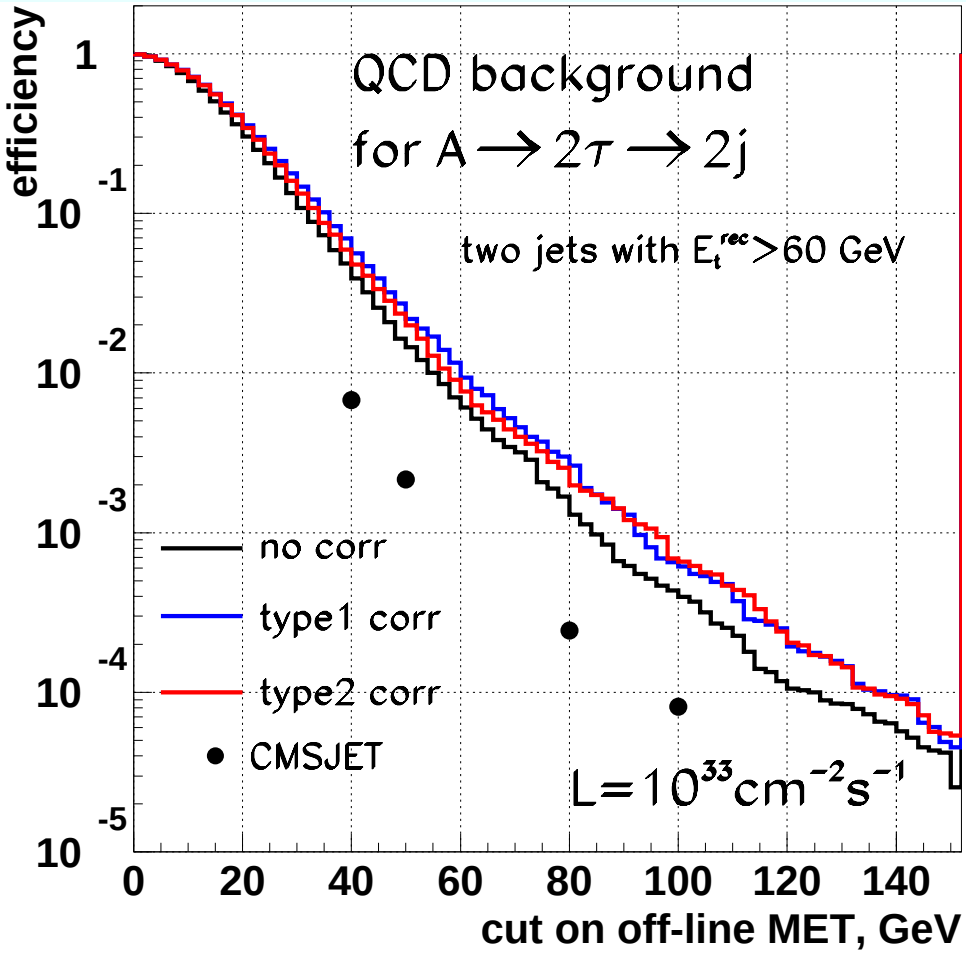


corrected off line MET resolution for mSUGRA events



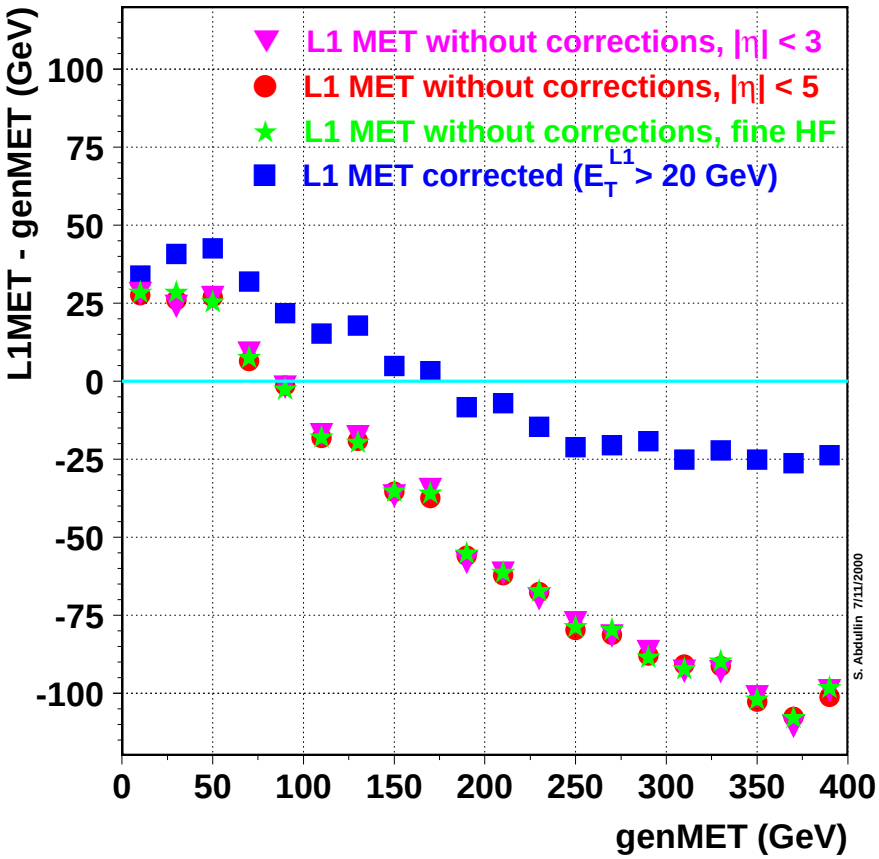


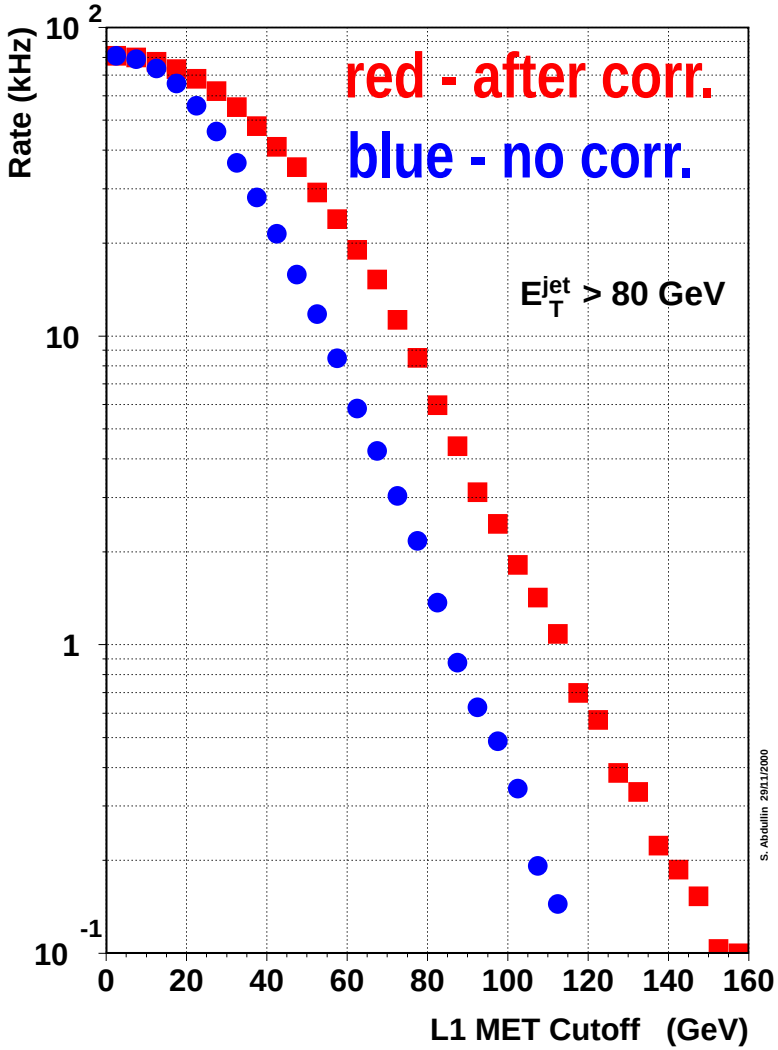
A/H->2τ->2J : MET rejection factor for QCD bkg with full simulation



- "true" rejection factor of MET>40 GeV is between ~ 20 and 100
- b tagging provides enough rejection factor even without MET cut

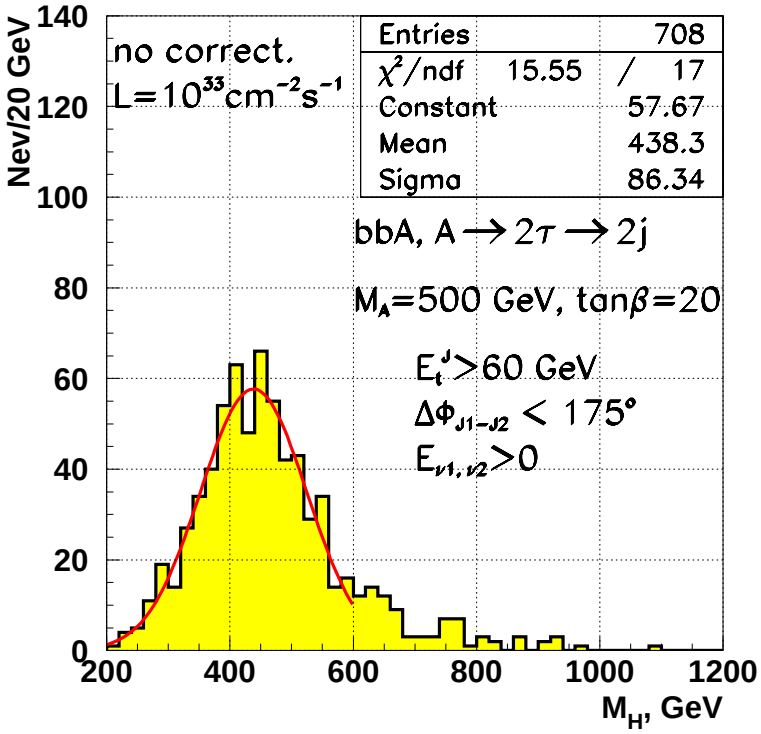
type1 corrected L1 MET for mSUGRA at high lumi

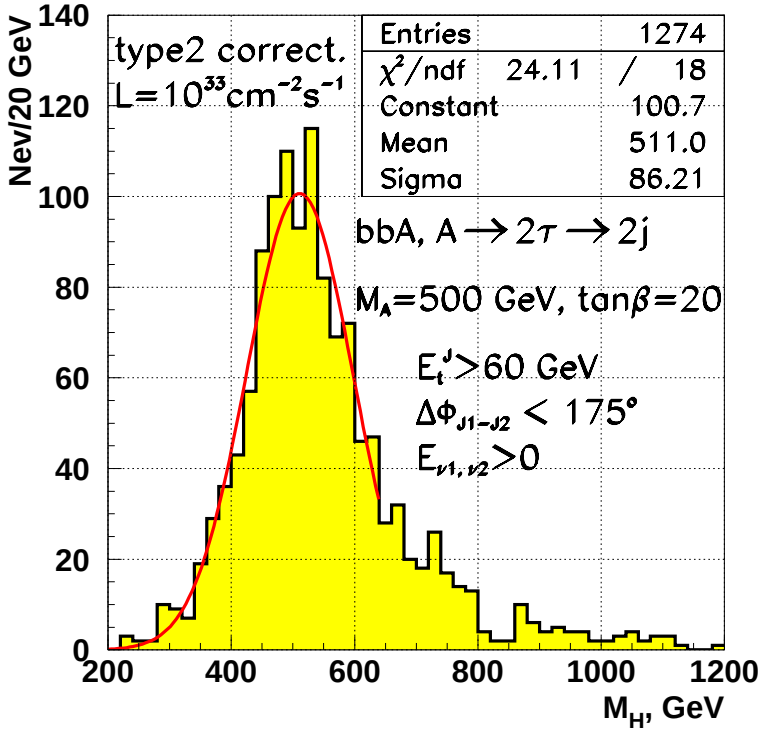




CMS IN 2000/60 by
S. Abdullin and S. Eno

Higgs mass in bbA, A->2τ ->2j with corrected MET





bbA, A->2τ->2j	no corrections	type1 corrections	type2 corrections	CMSJET
$\langle M_H \rangle$	438.3 GeV	500.3 GeV	511.0 GeV	500.0 GeV
$\sigma / \langle M_H \rangle$	19.7 %	18.9 %	16.8 %	13.4 %
ε_{reco} (corr.) / (no corr)	1	1.53	1.80	

contributions to pileup <MET> at $L=10^{34}cm^{-2}s^{-1}$

cumulative contributions	<MET>, GeV		
	$\eta < 5$	$\eta < 7$	full coverage
particle level*	13.1	5.0	0.78
+ 4T magnetic field*	14.3	7.3	
+ detector resolution (CMSJET)*	16.3	13.6	
+ noise and thresholds (ORCA4)	18.3		

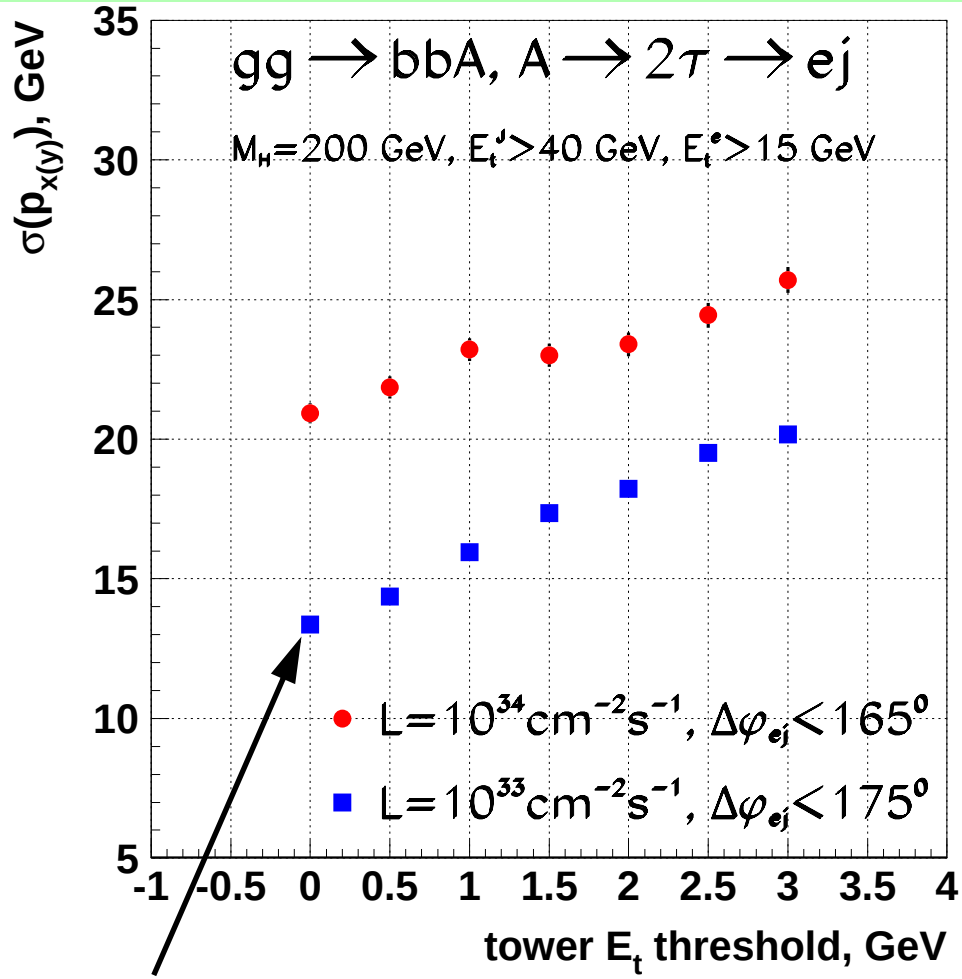
* from CMS Note 2001/005 P. Hidas, S. Abdullin, S.C. Eno

Sources of tails in missing E_t due to :

- physics (heavy quarks)
- detector (cracks, resolution)

will be studied in details

MET resolution v.s. off line tower E_t threshold



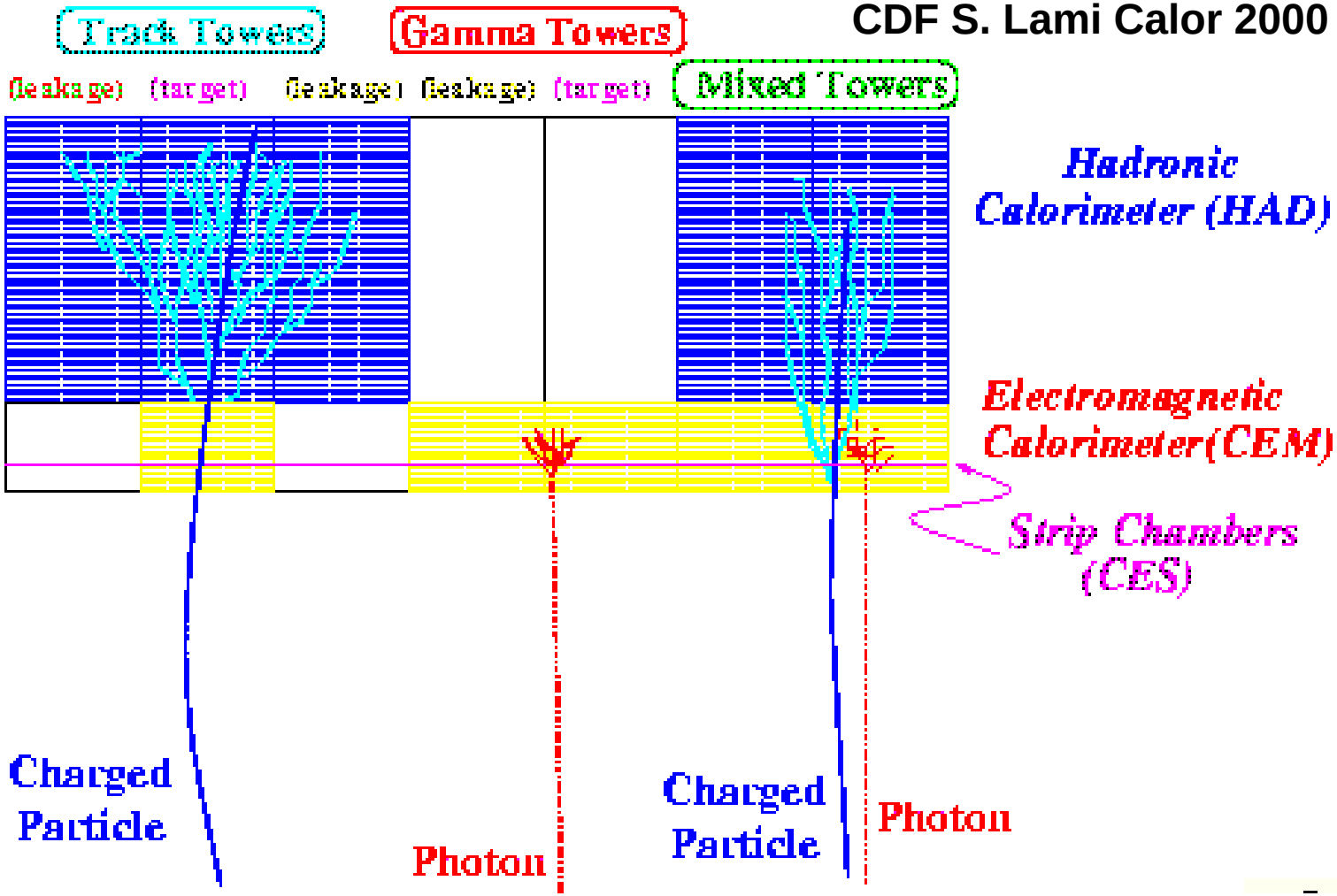
Cufoff on digi : 2 σ noise in ecal; 300 MeV, > 2σ noise in hcal (noise 43, 88, 142 MeV)

ATLAS without pileup : $\sigma(p_{x(y)})$=5 GeV with 1.5 σ noise cutoff on digi, with 2.5 σ ~ 7 GeV

Usage of tracks.

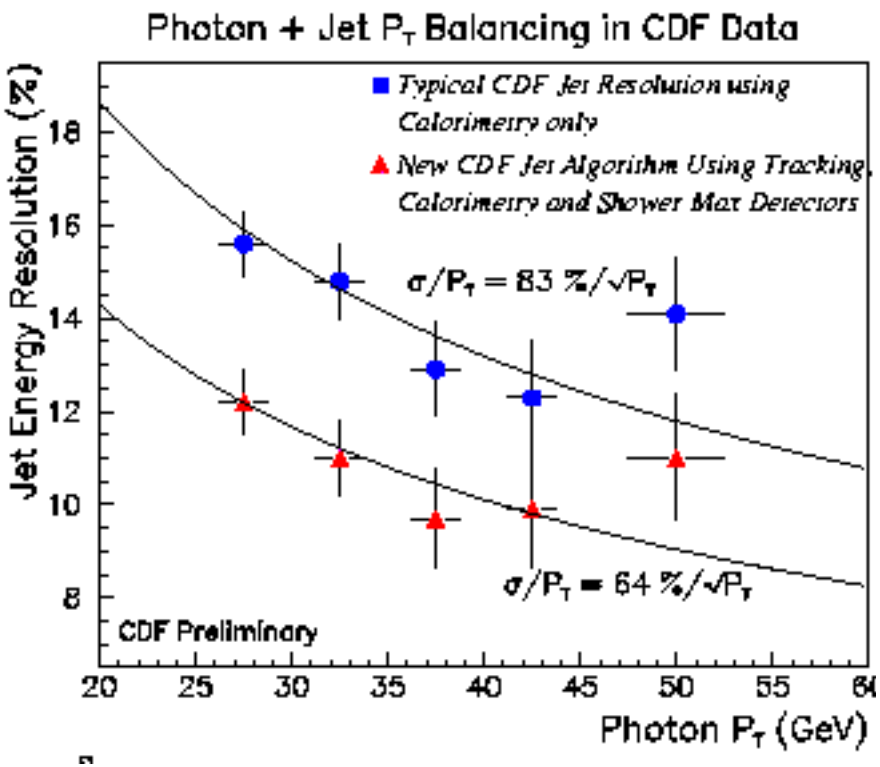
CDF and LEP use tracks to improve Jet resolution

CDF S. Lami Calor 2000

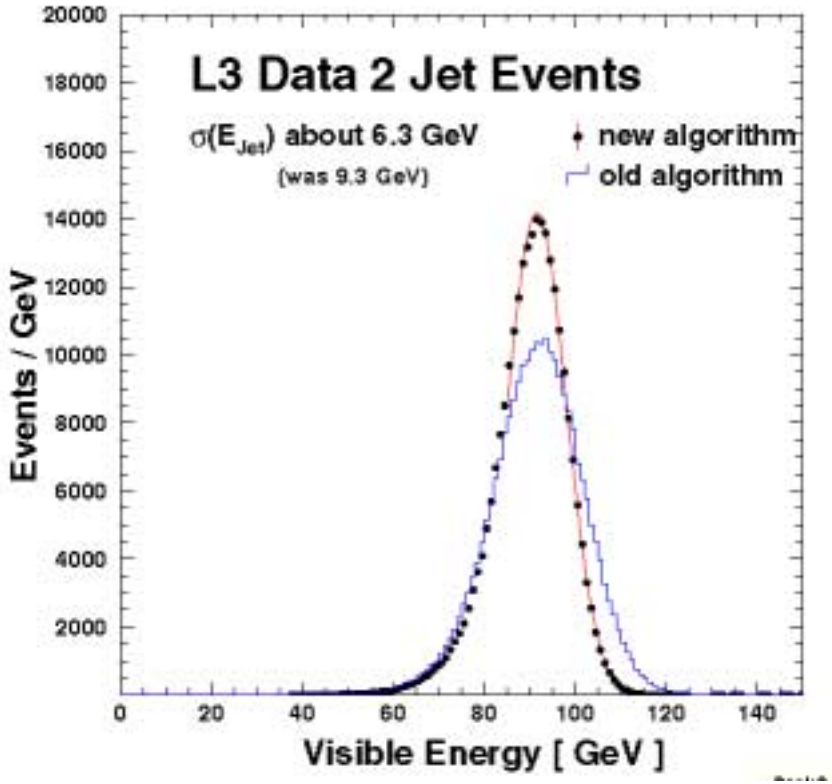


Improvement of Jet energy resolution with tracks

CDF



L3



initial work has been started in jetmet by Dan Green

Conclusion and next steps

- MET is improved with current Jet energy corrections for phys. channels with real MET
- no “improvement” for MET from QCD background; We will try responce corrections
- study on the sources of tailes in MET
- study of impact of electronics and selective readout on MET
- usage of tracks to improve Jet and MET resolution