GEM TN-93-300

GEM Physics Simulation Meeting - SSCL

February 23, 1993

Abstract:

Agenda, attendees, and presentations of the GEM Physics Simulation Meeting held at the SSC Laboratory on February 23, 1993.

GEM PHYSICS GROUP --- TDR MEMORANDUM #8
KENNETH LANE --- FEBRUARY 18, 1993
(internet: lane@buphyc.bu.edu, lane@weyl.bu.edu)

AGENDA FOR GEM PHYSICS MEETING -- TUESDAY, FEBRUARY 23

1 PM until finished -- GEM Conference Room at SSCL

(a) Status of gemfast, esp. muon simulations -- Tomasz S., ~~Tomasz Wenaus~~, Andrei Golutvin (on pattern recognition).

(b) Trigger issues -- Henk Uijterwaal

Higgs physics --

Zhu on WW->H->\gamma\gamma; Do we need a GEANT study of gamma gamma signal and background (Daniel F.)

Shevchenko on 800 GerV H -> l^+ l^- jet jet

Yamamoto on CTEQ structure functions.

Top physics -- Chiaki Yanagisawa

Jet physics -- Rob Carey

~~10^34 physics -- TBA~~

Missing E_T physics -- ~~Frank Paige~~ Vangashine, Smakov

VERY IMPORTANT! A list of what remains to be done and a timetable for
npletion -- K. Lane and Bing Zhou. (This may be moved earlier in the
hedule if time becomes a factor. We will consider continuing on Wednesday
rning if necessary.)

EASE LET ME KNOW NOW IF YOU ARE SCHEDULED TO SPEAK HERE, BUT BE
NABLE TO MAKE IT.

est regards,

Ken Lane

Physics Simulation Meeting 2/23/93

Name	Inst.	Email
HENK UijtERWAAL	SSCL	HENK@PDSF.SSC.GOV.
Xiaorong Shi	Caltech	shi@cithex.bitnet
Robert Carey	BU	CAREY@BUPHYC.BU.EDU
Barry Barish	Caltech	BARISH@CITHEX
Harvey Newman	Caltech	newman@cithex
VLADIMIR GLEBOV	SSCL	GLEBOV@SSCVX1
Konstantin Shmakov	ORNL	SHMAKOV@ORPHOI
Yu. Fisyak	SSCL	SSCVX1::FISYAK
S. Shevchenko	Caltech	VXCERN::SHEVCHEN
Vladimir Gavrilov	SSCL/ITEP	SSCVX1::GAVRILOV
Andrey Golutvin	ITEP/SSCL	SSCVX1::Golutvin
Vladik Balagura	ITEP/SSCL	SSCVX1@Balagura
Peter Dingus	SSCL	SSCVX1::Dingus
JENNY THOMAS	SSCL	SSCVX1::JTHOMAS
Sroan McKee	U of Mich	TARLEB::MCKEE
Chiaki Yanagisawa	Stony Brook	SBHEP::CHIAKI
Hong Ma	BNL	hma@bnl.gov
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KM McFarlane	SSCL	mcfarlane@SSCVX1
Ren-yuan Zhu	~~CALT~~ CALTECH	ZHU@CITHEX.
Bing Zhou	Boston U.	ZHOU@BUPHYC
Tomasz Skwarnicki	SMU	TOMASZ@SSCVX1
KEN LANE	B.U.	
S. Vangashine	SSCL	

Presentation by:

Ken Lane

GEM PHYSICS GROUP --- TDR MEMORANDUM #8
KENNETH LANE --- FEBRUARY 18, 1993
(internet: lane@buphyc.bu.edu, lane@weyl.bu.edu)

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Ken Lane

GEM PHYSICS GROUP --- TDR MEMORANDUM #7
KENNETH LANE --- FEBRUARY 7, 1993
(internet: lane@buphyc.bu.edu, lane@weyl.bu.edu)

PRELIMINARY ANNOUNCEMENT OF PRE-TDR PHYSICS SIMULATION MEETINGS AT SSCL

1.) Tuesday, February 23 at 1 PM.
This meeting is midway between the 2/5 and 3/5 dates for submission of simulation results.

2.) Wednesday, March 17 at 1 PM.
Discussion, critique of nearly final simulation results, figures, etc.
Collaboration Council meeting is on March 18;
FINAL simulation results are due March 26.

3.) Tuesday, April 6 at 1 PM.
Wrap-up of very specific, final details for the TDR;
TDR work will continue on April 7 as needed;
Finished text and figures for the TDR are due April 9.

Please let me know ASAP if any of these dates are impossible for you.
Agendas and meeting places will be distributed as the dates approach.
Make your reservations now and save money!

Best regards,

Ken Lane

ı: BUPHYC::LANE 21-FEB-1993 10:21:31.29
@TDR2.DIS,STEVE
LANE
i: Draft # 2 of TDR Chapter 2 is in the CMS library

GEM PHYSICS GROUP --- TDR MEMORANDUM #9
KENNETH LANE --- FEBRUARY 21, 1993
(internet: lane@buphyc.bu.edu, lane@weyl.bu.edu)

: physics simulators and Chapter 2 referees:

:he 2nd draft of Chapter 2 is now in the CMS library on SSCVX1. The
›nd draft of section 2.3, "Higgs Physics", is still in preparation; it
. be available in the CMS library by Thursday, Feb. 25.

Revisions to the Chapter 2 sections will appear as soon as significant
material is available. It is hoped that we will meet or beat the March
deadline for the final draft.

It is important that ALL physics simulators read at least the section of
›ter 2 relevant to their activities. These sections summarize the work
ı of you are responsible for and, in many cases, contain comments in
d-face requesting more information or back-up support, references to
ıils, and so on. WITHIN ONE WEEK (February 28), you MUST provide this
›rmation to me OR tell me exactly when it will be provided. Also in one
:, please send a COMPLETE LIST OF TABLES AND FIGURES that you intend to
ear in the TDR. These are NOT casual requests. They are necessary for
:ime preparation of the TDR.

Referees should read the draft chapter 2 and send comments to me ASAP.
erstand that, at present, the draft is little more than a detailed
.ine, with physics discussions. Simulators are responsible for providing
work that will allow the details to be filled in. Referees should read
draft with an eye for what elements of the simulations analysis are
ing, what important functions of the TDR physics chapter do not appear
›e well-served, etc. (Please don't suggest new physics topics that ought
›e simulated unless you can provide the manpower to do them!)

Many thanks and best regards,

Ken Lane

1) WITHIN ONE WEEK (March 1), please provide the information you are responsible for **OR** let me know exactly when it will be provided. Also provide a COMPLETE LIST OF FIGURES AND TABLES that you intend will appear in the TDR. (NOTE: This is NOT a demand that all work be finished in one week. You have a little longer than that -- we are keeping to the original timetable in my memo of December 15. The nearly final results are due March 5, in time for me to prepare the "Final Draft for Review", due at SSCL on March 15.)

2) Everyone must read the section of the SDC TDR that deals with his own work. Make sure we are not missing something important. Critique methods, results of SDC.

3) All simulators should present results in the following format:

a) Statement of the signals to be sought, generator used, number of events generated, other special information (e.g., dist'n functions).

b) List all physics backgrounds studied; describe methods for elimination. State sample sizes generated.

c) List all detector-induced backgrounds studied; describe remedies, if any.

d) Describe selection criteria:
-- justify cuts with plots.
-- determine the signal efficiency of the cuts.
-- determine the background rejection power of the cuts.
-- where descriptions, plots, etc. are lengthy, prepare and refer to a GEM Note, or refer to detailed discussions in other TDR chapters.

e) Present final results: Signal rate; background rate; signal significance (suitably defined); plots; tables. Be sure to INCLUDE ALL EFFICIENCIES (trigger, geometrical, ID and reconstruction, etc.) in the final rate numbers and plots.

f) Discuss what features of the GEM detector were most important for doing the physics, extracting the signal from the background, etc.

g) Be prepared to compare with the corresponding analysis in the SDC TDR. If possible, explain how GEM is superior.

:ION 2.2 (MODELING THE GEM DETECTOR):

ıdd a subsection on electron, photon, muon ID and reconstruction .ciency; geometric efficiency; trigger efficiency. As appropriate, this :o be done as a function of energy and luminosity. Bing Zhou will .ect the information for this from subsystem simulators.

ıdd a subsection discussing jet definition (jet-finding algorithm, ;tering issues, etc.), angular resolution, jet-energy resolution, and, ;ibly, a summary of jet-energy correction (both as done for TDR ılations and in the actual experiment). Rob Carey will collect (and in ɜ cases provide) the information for this.

)iscuss the capabilities of ALL the subsystems at L = 10^34. What ıbilities of the central tracker (CT) survive AND are useful at 10^34? ., etc.

E: Shawn McKee should respond to this for the CT; Hong Ma and Rob Carey the calorimeters, Torre Wenaus and Bing Zhou for the muon system.

TION 2.3 (MINIMAL STANDARD MODEL HIGGS PHYSICS): Renyuan Zhu, et al.

Everything needs to be done. Draft will be submitted by Caltech group on ruary 22.

Be sure to discuss jet issues with Rob Carey, missing-E_T with Frank ge, CT issues with Shawn McKee, EM calorimetry with Hong Ma, muons with re Wenaus and Bing Zhou, etc.

SECTION 2.4 (HEAVY FLAVOR PHYSICS): Chiaki Yanagisawa and Mohammad Mohammadi
---

1) Check whether W-bosons from t-quarks can be used to calibrate jet energies, as claimed in the SDC TDR (end of section 3.3.2). -- Carey.

2) IF the eta_T studies are not done, be sure that top-discovery and mass measurement simulations are provided for m_t = 140 GeV.

3) Discuss background studies. Consider Z (-> tau^+ tau^-) + jets background as well WZ, Zb bbar (or Z+jets), Wb bbar. Bing Zhou says that backgrounds are expected to be O(10%) and must be shown in figures.

4) Carefully describe jet-definition / finding algorithm, and effect of jet energy resolution and jet energy correction on W -> 2 jets, H^+ -> 2 jets and t -> 3 jets. Discuss this with Rob Carey!!

5) See the extensive discussion on H^+ -> tau^+ nu_tau in the SDC TDR. They use the one-prong decays, tau^+ -> pi^+ nu or K^+ nu. It is important to properly account for the tau polarization resulting from W and H^+ decays. This makes the pi^+ from H^+ -> tau^+ -> pi^+ harder than the one from W^+ -> tau^+ -> pi^+. Hence, a cut on charged-hadron p_T is useful -- so SDC claims.

6) Does GEM have an advantage over SDC in that it can tag b-quarks by inclusive muons? Can SDC do this as well? Can GEM tag b's by the displaced vertex as SDC prefers to do. Compare the efficiency of b -> inclusive-mu tag by GEM with b-tagging via displaced vertex by SDC.

ION 2.5 (JET PHYSICS): Rob Carey
---

here in the TDR is measurement of the luminosity discussed? Refer to it
e appropriate in section 2.5.

ustify statement of ~ 100% jet triggering efficiency. Refer to
opriate chapter and (?) section 2.2.

iscuss (with Womersley) TDCs to reject cosmics.

lean up discussion of calorimeter nonlinearity, jet energy corrections.
t be repetitious with section 2.2.

omplete high-p_T jet analysis, providing all numbers ASAP.

iscuss effects of parton distribution functions.

ecide if we want to provide a discussion of the Lambda-reach at 10^34
fb^{-1}).

ecide if we will discuss "Other Jet Studies" -- as SDC does. If so, on
timetable?

:ECTION 2.6 (PHYSICS AT 10^34): M. Golden, M. Mohammadi, E. Simmons
---

.) Determine the (jet -> electron) rejection factor.

:) Discuss the status of the CT at 10^34: What is left? What are its :apabilities? (Get from Shawn McKee.) This should appear in section 2.2.

.) Avoid repetitious discussion of electron and muon capabilities at 10^34 trigger, ID, reconstruction, resolution, acceptance, etc.) between this ;ection and 2.2.

:) Determine and justify the criterion for well-measured muon charges.

;) Discuss (here or 2.2?) vertex resolution from EC or from CT.

;) Are jets a serious background to Z' -> e^+e^-? (cf. GEM TN 92-131.)

') Does initial state radiation in Z' -> e^+e^- degrade the electron energy ıeasurement? (cf. GEM TN 92-131.)

') Prepare discussion for q' qbar -> mu nu; W' -> e nu and mu nu.
- K. Lane

) Prepare discussion for rho_T^\pm -> W^\pm Z -> l+ l+ l- + missing E_T.
- K. Lane

:ECTION 2.7 (MISSING E_T; SUPERSYMMETRY): Frank Paige

) State GEM's SUSY (and other missing E_T) goals and summarize its SUSY ·each in the introduction.

) Expand on / complete the discussions of gluino (and other) mass .etermination, mass reach and likesign-lepton signatures.

Presentation by:

Henk Uijterwaal

TRIGGER SIMULATION ISSUES.

Henri Wijtenburg
SSC 1, 3/23/93.

1) CAL L2 Trigger improvements.

2) μ L2 Trigger improvements.

3) Trigger Efficiencies Update.

4) What has to be done for the TDR.

CAL L1 Trigger.

- The TDR will give 2 options for the CAL L1 trigger.

  A) A digital processor based design. D. Crossetto / SSCL.

  B) An Analog design. B. Cleland / Pitt.

- The L1 CAL Algo's currently in libtrf / Gemfast can run on the digital CAL L1 but not on the analog CAL L1.

  - Main differences are:
    - Different trigger towers
    - Absolute energy thresholds instead of fractions
    - Different isolation criteria.

  Unfortunately All simulations for this scheme used a Baseline I cal.

- These Analog algo's have been added to lib trf and are currently being tested. 1st results show:
  1) No difference for e, γ with $P_T \gtrsim 20$ GeV.
     Efficiency for $P_T = 10$ GeV considerably worse
  2) Jets better for low P_T's, worse for high P_T's
  3) π^- at high P_T often identified as e, γ.

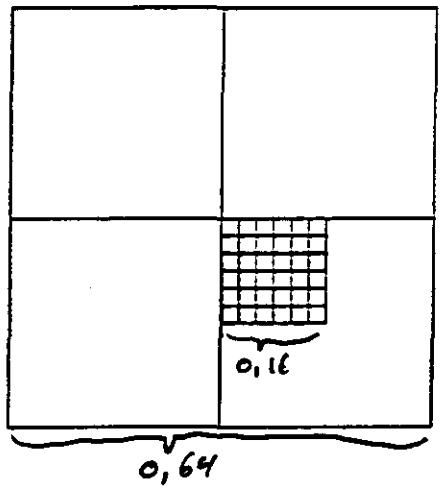
  But these results still have to be checked.

- This code will be added to libtrf, with a switch, soon.

GEM Isolated Gamma Trigger

EM with hadronic veto

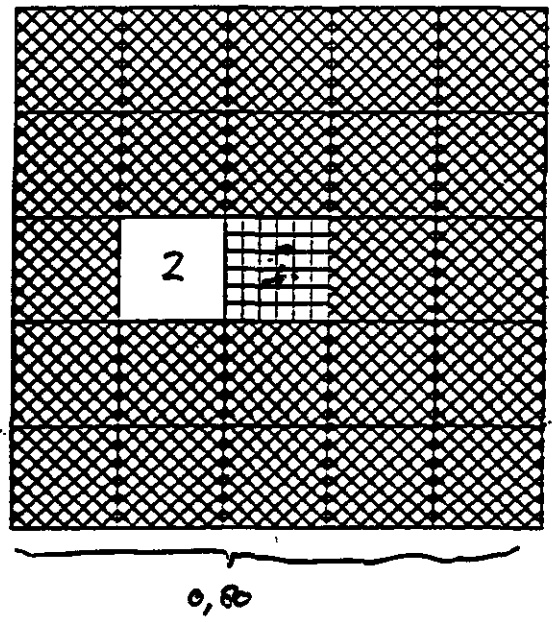
(Level 1)



$E_{hadronic} \leq 5$ GeV

EM with EM veto

(Level 1)



$(E_{EC} \geq Thr$

OR

$E_{EC1+2} \geq Thr)$

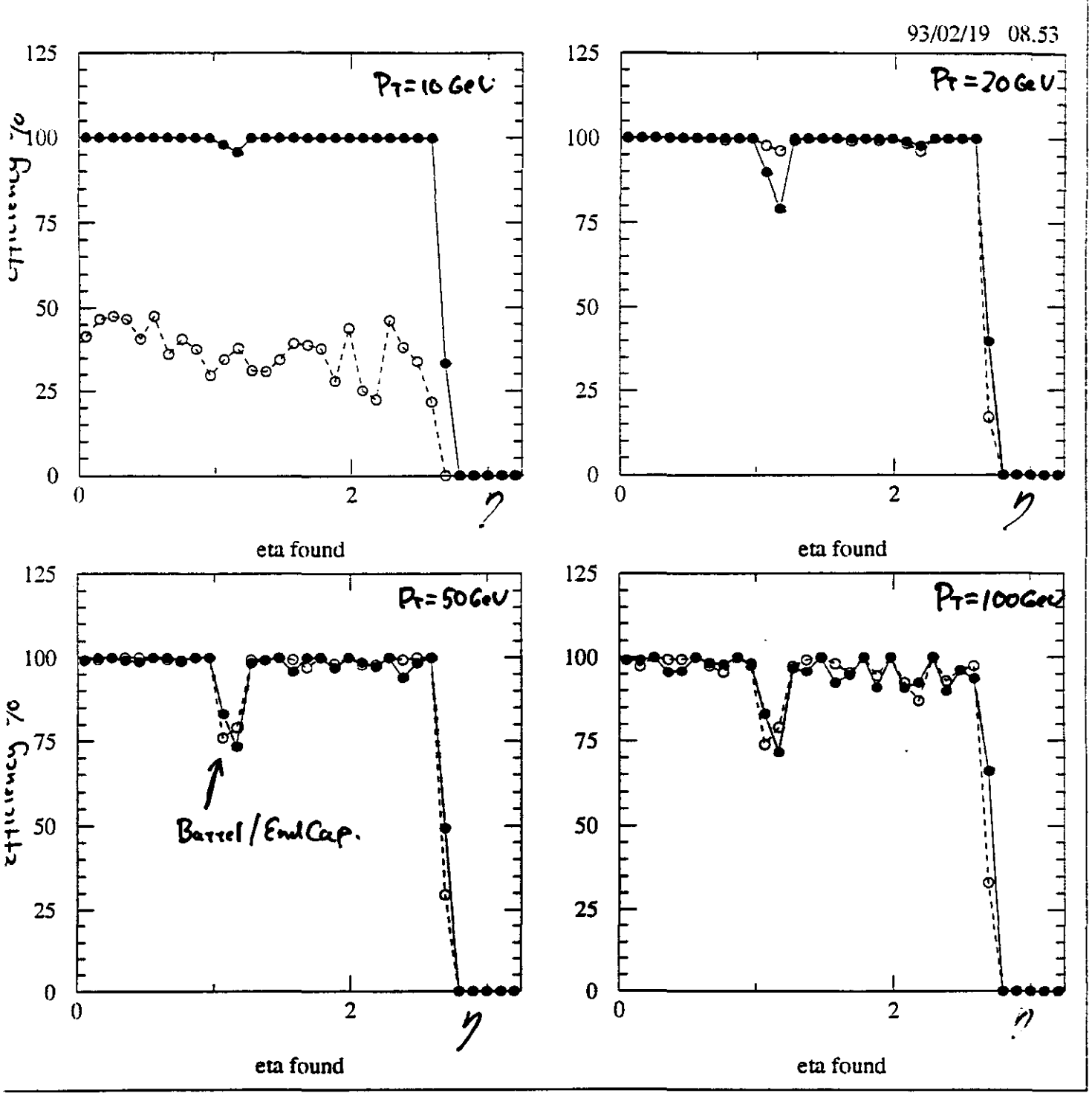
AND

$\sum E_{24(23)} \leq Thr.$

● Digital

○ Analog

Trigger efficiency for γ as a function of η

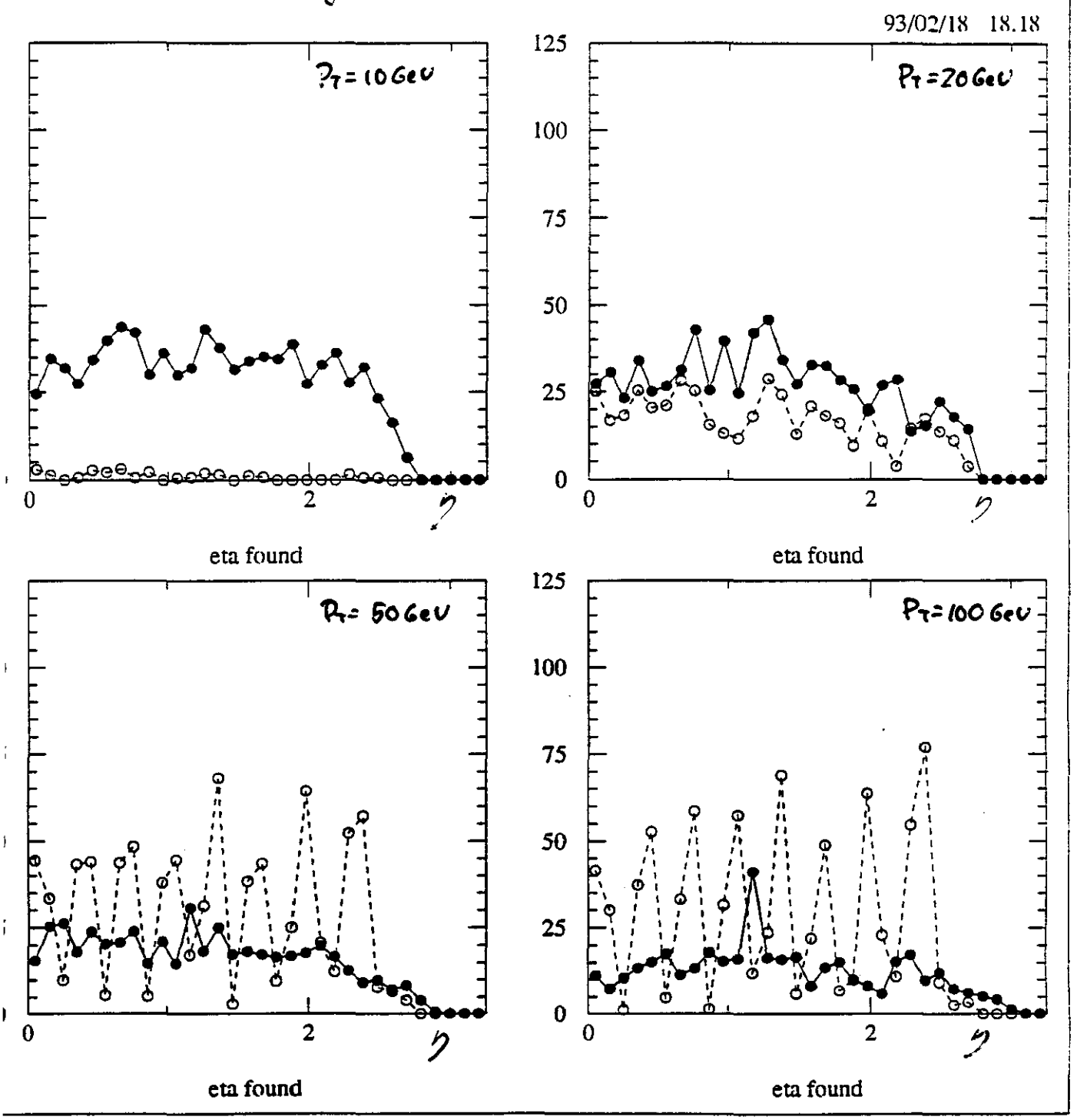


$$\text{efficiency} = \frac{\#\ \gamma(\eta)\ \text{found by L2}}{\#\ \gamma(\eta)}$$

Electrons almost the same.

1l identified as a γ/e by L1.

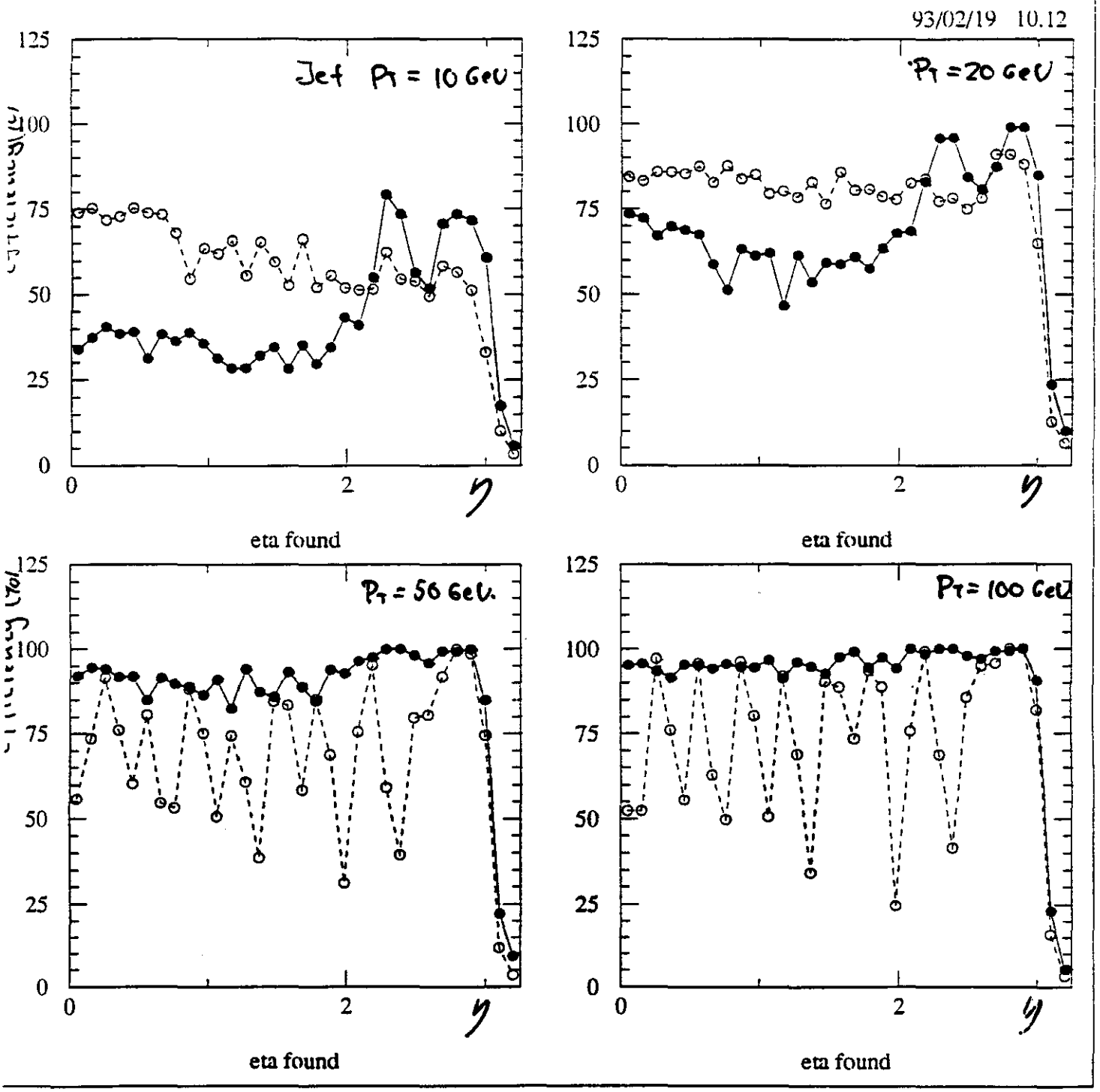
● Digital ○ Analog



also shows that L2 should do some e/π separation.

(SINGLE) JETS FOUND BY L1.

● Digital ○ Analog [illegible]



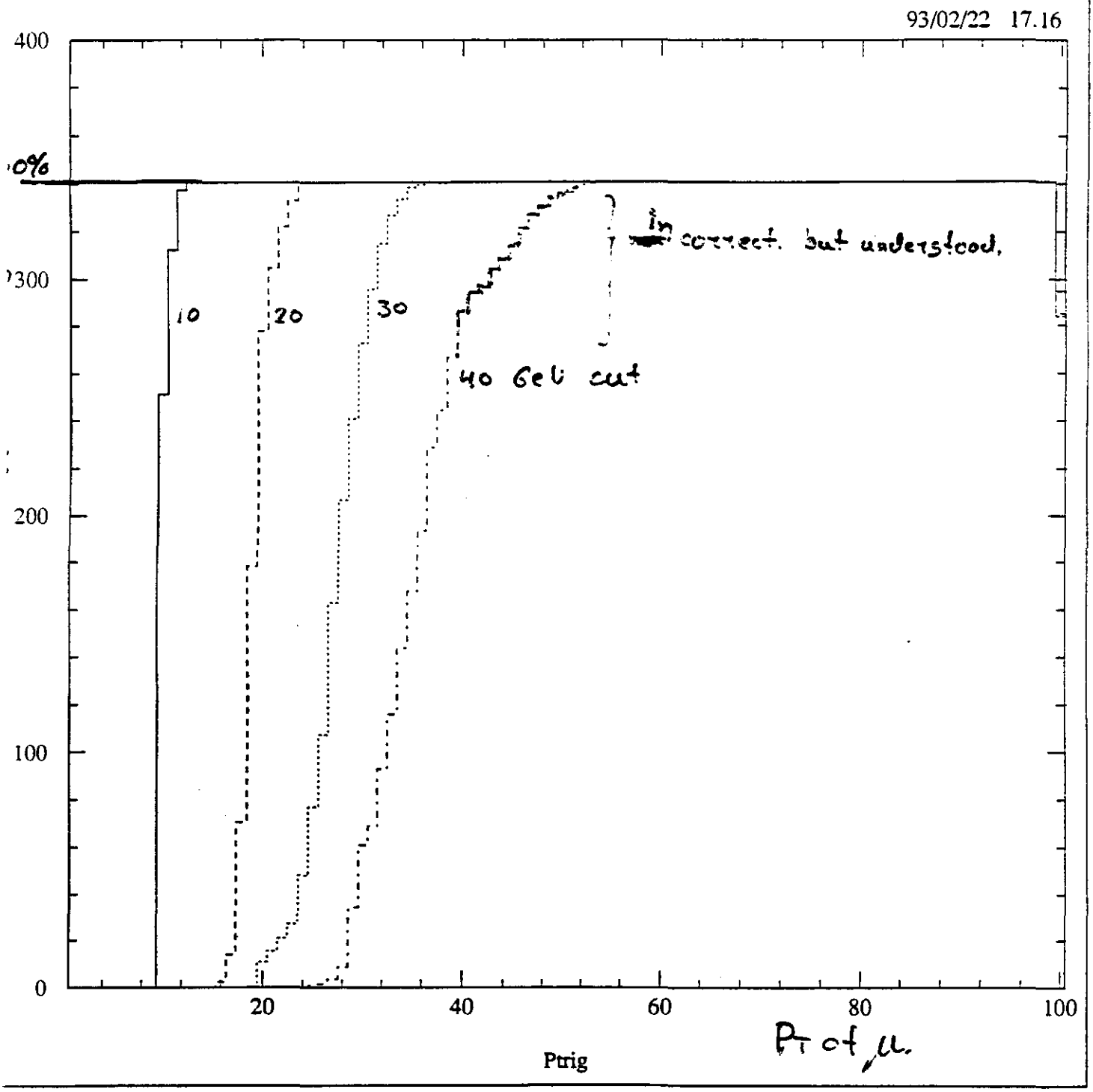
[illegible] : high P_T jets often identified as e, γ's ??

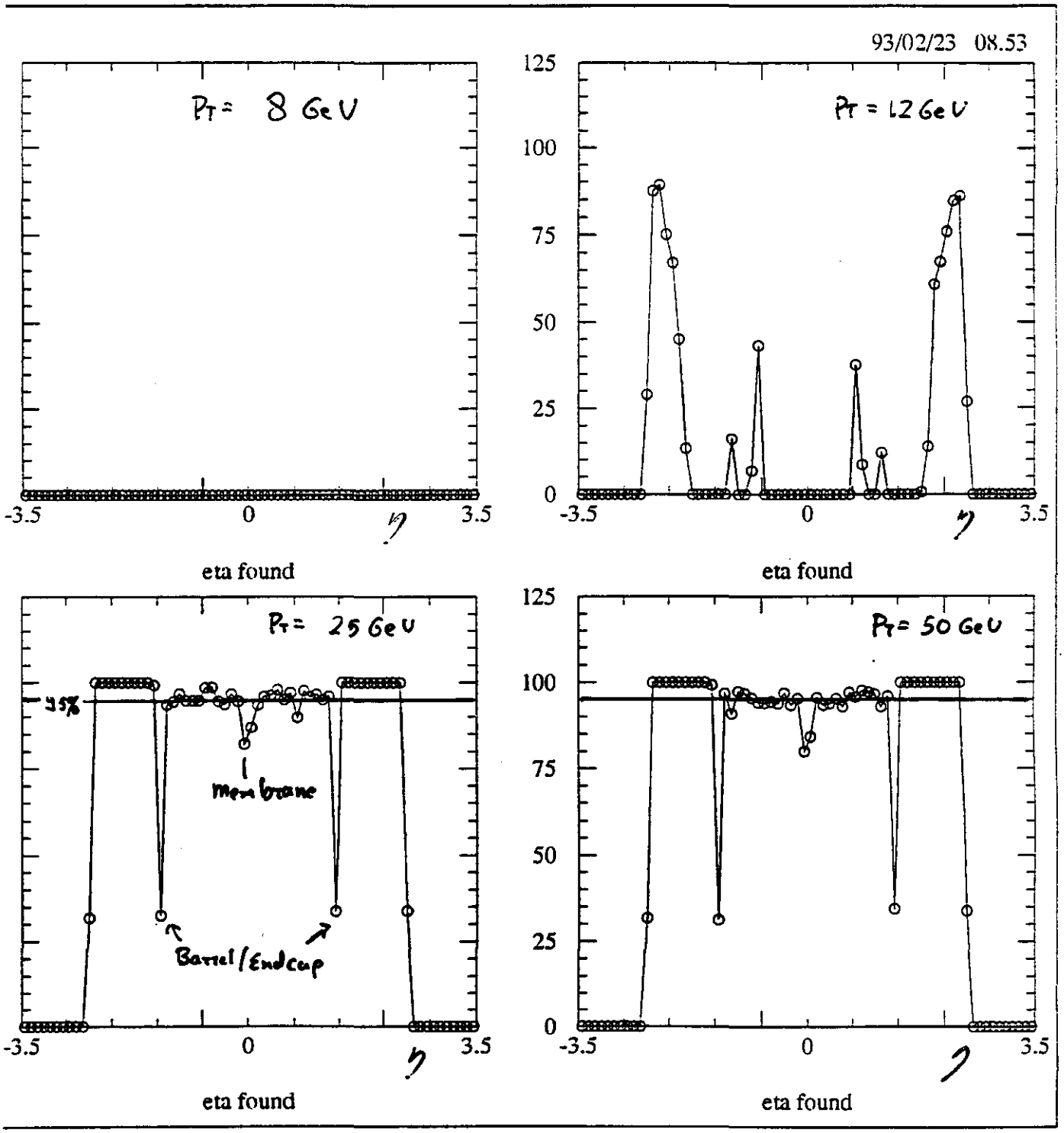
Muon L1 Trigger.

- New code by Peter Dingus:
  - Baseline II CSC
  - 0.5 cm strips in end caps, 1.2 cm in Barrel
  - All dead regions in ϕ, θ included.
  - Calculates trigger probability as a function of P_T, θ, ϕ and a cut.
- A few details have to be changed before it can be added to libtrf.
- The algorithm is described in the minutes of the Tuscon meeting.

Trigger Efficiency as a function of P_T

$\phi = 0 \ldots 360°$, $\Theta = 45°$ (Barrel).





→ μ, P_T fixed

⇒ Efficiency = $\frac{\#\mu \text{ found}}{\#\mu \text{ [illegible]}}$

Trigger Efficiency Update

The trigger simulation was run for 3 more processes.

Process	Generator	Constraints	Efficiency	Triggers.
$H \to \tau\tau$	Pythia	$m_H = 140$ GeV $\lvert\eta_H\rvert \leq 3$.	34 ... 37 %	10 : $\tau \to$ Hadr 1 : Jet 4 : μ 3 : e
$\tilde{g}\tilde{g} \to \tilde{\gamma}\tilde{\gamma}$ + jets	Isajet	$M_{\tilde{g}} = 500$ GeV	100 %	10 : $\not{E}_t$+Jet 7 : $\not{E}_t$
$t\bar{t} \to$ $t \to Wb$ $\bar{t} \to Wb$	Pythia	$M_t = 140$ GeV $\lvert\eta_{t,\bar{t}}\rvert \leq 3$	77 %	1 : Jet 10 : $\not{E}_t$+Jet 8 : $\not{E}_t$+e.

⇒ We have to improve the τ-trigger.

⇒ Efficiencies for $t\bar{t}$ and $\tilde{g}\tilde{g}$ look ok.

The 12 L1 Triggers.

No.	Trigger	Comment
1	H_{80}	High P_T-jet.
2	(4 of H_{50})	Multi jet event.
3	E_{50}	High P_T electron or γ.
4	M_{30}	High P_T μ.
5	(2 of E_{16})	Two electrons or γ's.
6	(2 of M_{10})	Two μ's.
7	P_{100}	$\not{E}_T$
8	$E_{16} \wedge P_{50}$	Electron and $\not{E}_T$ ($W^{\pm}$, τ)
9	$M_{10} \wedge P_{50}$	Muon and $\not{E}_T$ ($W^{\pm}$, τ)
10	$H_{16} \wedge P_{50}$	Tau and $\not{E}_T$
11	$M_{10} \wedge$ (3 of H_{50})	Muon and 3 jets.
12	$E_{16} \wedge$ (3 of H_{50})	Electron and 3 jets.

Table 2: Reduced list of suggested Level 1 trigger criteria. A logical "OR" of these criteria will accept all physics processes listed in section 2. The same notation as in table 1 has been

To Be Done for the TDR.

1) Finalize [illegible] Analysis [illegible] and [illegible] μ case.

2) Rerun jobs with the best simulation available

$H \to \gamma\gamma$	80, 110, 140	GeV
$H \to ee\mu\mu$	400	GeV
$H \to eejj$	800	GeV
$H \to \tau\tau$	140	GeV
$t\bar{t}$	140	GeV
$\tilde{g}\tilde{g}$	500	GeV
min·bias		

3) Analysis of Output

4) Produce text and plots for sections

2.1.5 . Trigger Simulation
7.3.3 Level 2 Strategies
7.3.4 Level 1 Rates and Efficiencies

Presentation by:

Tomasz Skwarnicki

Jemfast status
T. Skwarnicki 2/23/93

'ES

l

y significant changes compared to vII102:

effecting /gem/demo/gemfast Makefile and execution scripts only:)
use new new gemgen v110

;ammas now convert in CT with explicit generation of e+e-.
o disable conversions set EGCONV in fsi_fasopt.inc to a very
large energy.
hotons which convert will have IGTOEC(1-2,)=0. You must follow
daughter electrons pointed to by JDAHEP.
ew large input file needed: fsi_ctinfo.dat.
Jenny Thomas/Shawn McKee (code)
and Shawn McKee (material data)
Tomasz S. (generation of secondaries)

'si_addpile is not dummy any more and contains preliminary
ile-up files for 10**33 (works on pdsf only)
Sasha Vanyashin

ıew SC segmentation, coarser than HC.
C enregy added to CA proportionally to the HC tower energy.

Molliere Radius scaled down by 25%. Showers got narrower.
.esolution recalibrated for EC.

Worsering of hadronic resolution by a factor of 2 in the crack region
for IHCRACK=0)

EV25_EC automatically corrected for average transverse (5x5) and
ongitudinal leakage (EC->HC).
y default EV25_xx(4) energy does not include unfolding of
verlapping bumps (previously did) - controlled by IXBxxUN flag.

ıegative EC energies added to CA (previously only positive)

ıpdated fsi_fcsmear
Mike Shupe

'si_ctsmear contains parametrization for high luminosity
sing IPCs alone. Activated by setting ALUM33 in fsi_fasopt.inc
) >3.0
Shawn McKee, Melynda Brooks, Scott Nutter

updated fsi_ctrecon (producing EFFCT). Previous version
'as wrong.
Shawn McKee, Melynda Brooks

parametrization of number of spots per shower changed in fsi_gflash

geometry of CT layers changed (only in calculation of ICLCT,EFFCT)
Shawn McKee

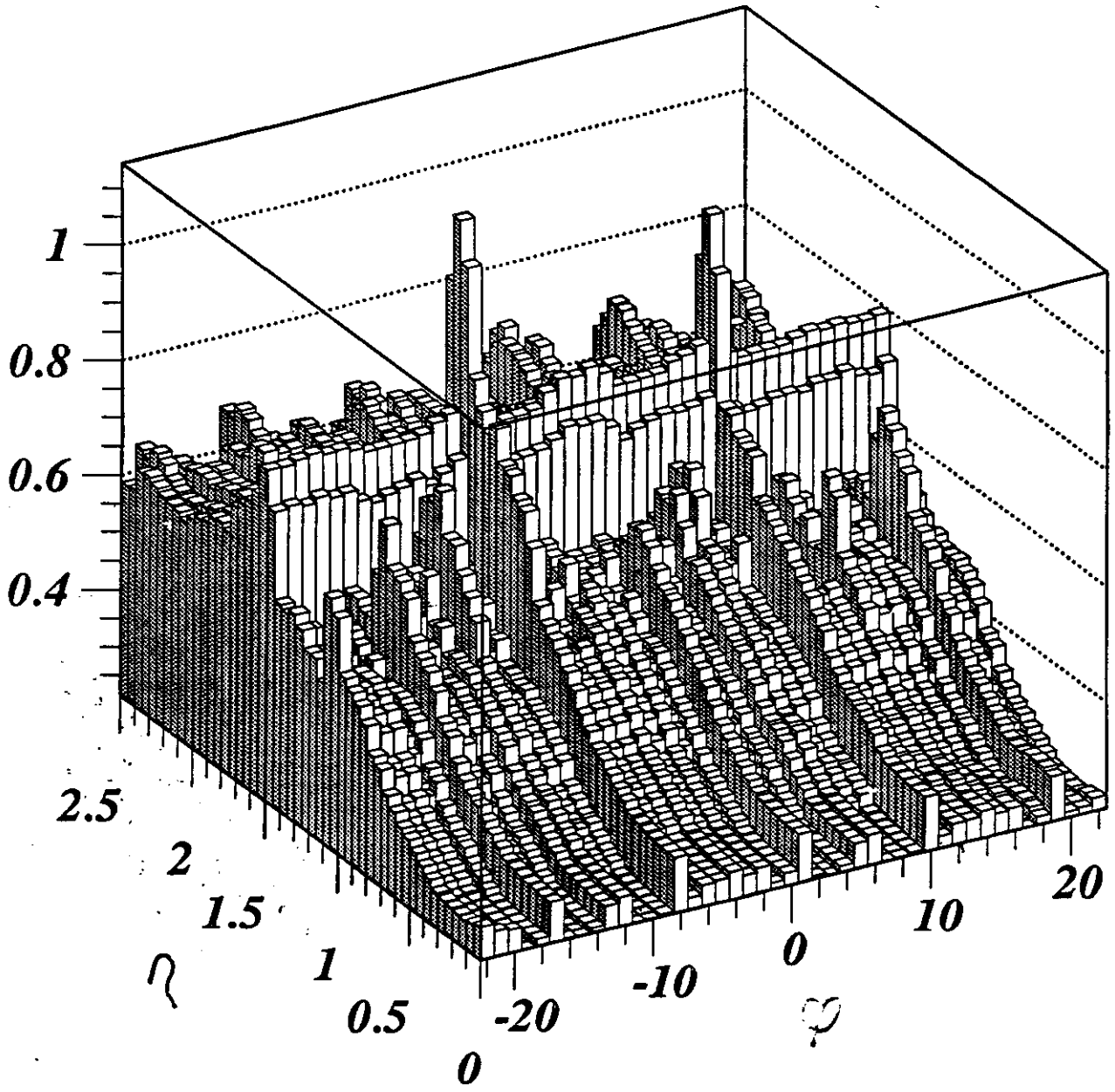
new user callable parametrizations for
si_ecangle:
smearing of generated direction according to resolution in EC
si_mphorej
gamma/multi-photon rejection
Hong Ma

fsi_XXsum,fsi_XXcone routines effected by INEGCONE flag
ı fsi_fasopt.inc

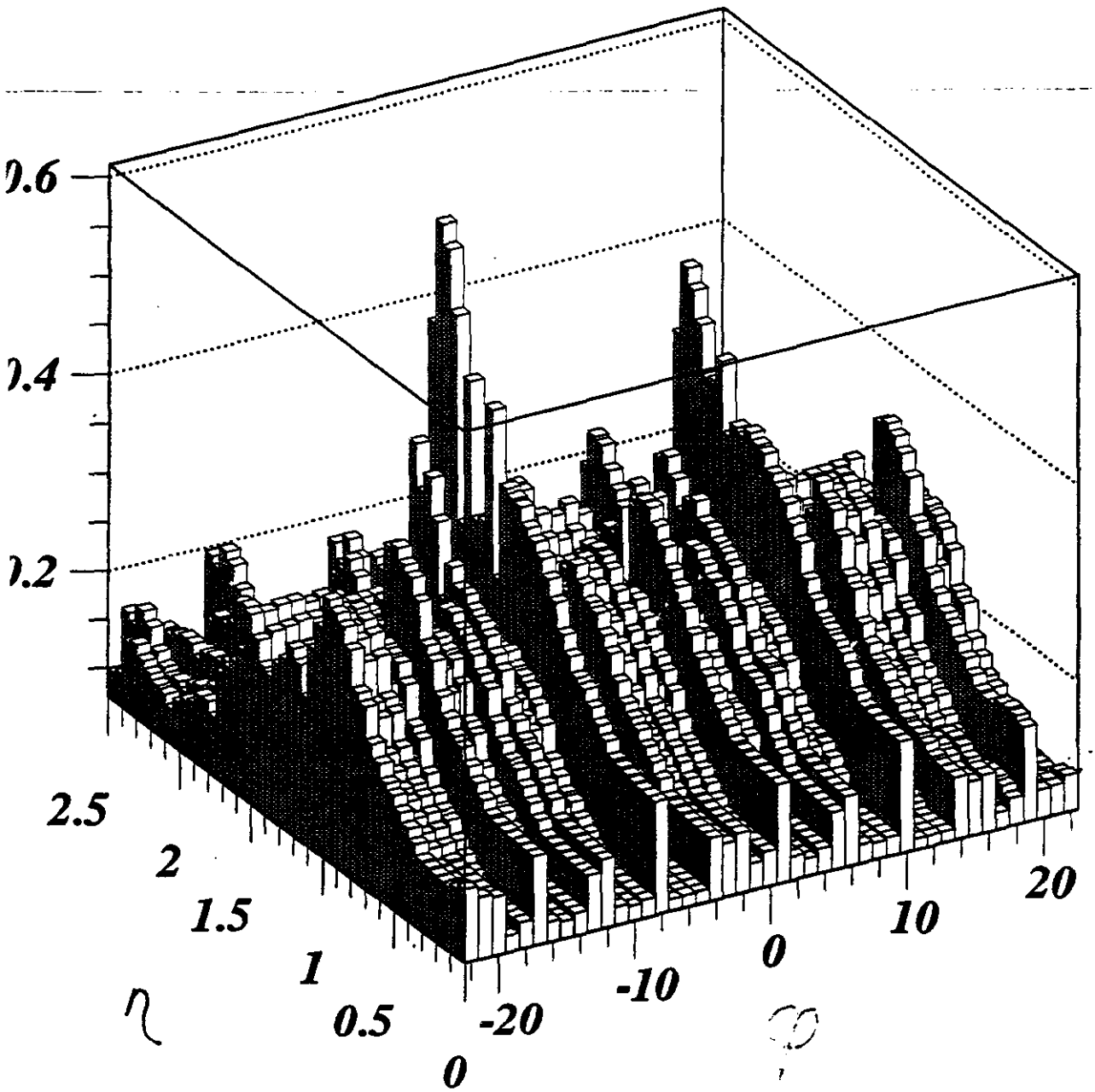
ıany bug fixes (mostly in muon code) which were implemented in
.sions of vII102, but not included in the original release

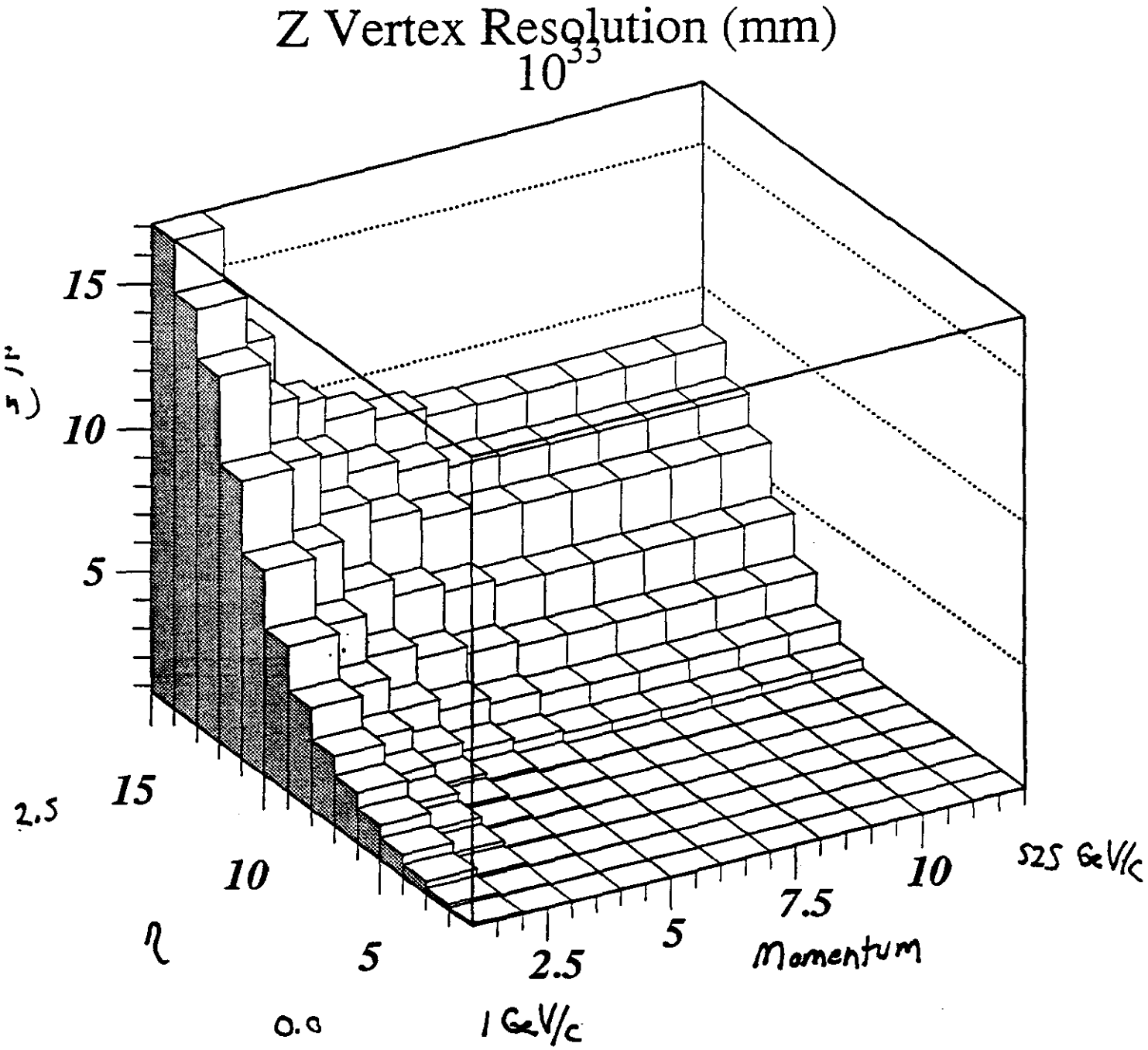
rce: /gem/cvs/gemfast/gemfast/gemfast.5,v $
:: 1993/01/21 07:45:50 $
hor: gemadm $, $Locker: $, $State: Exp $
: gemfast.5,v $

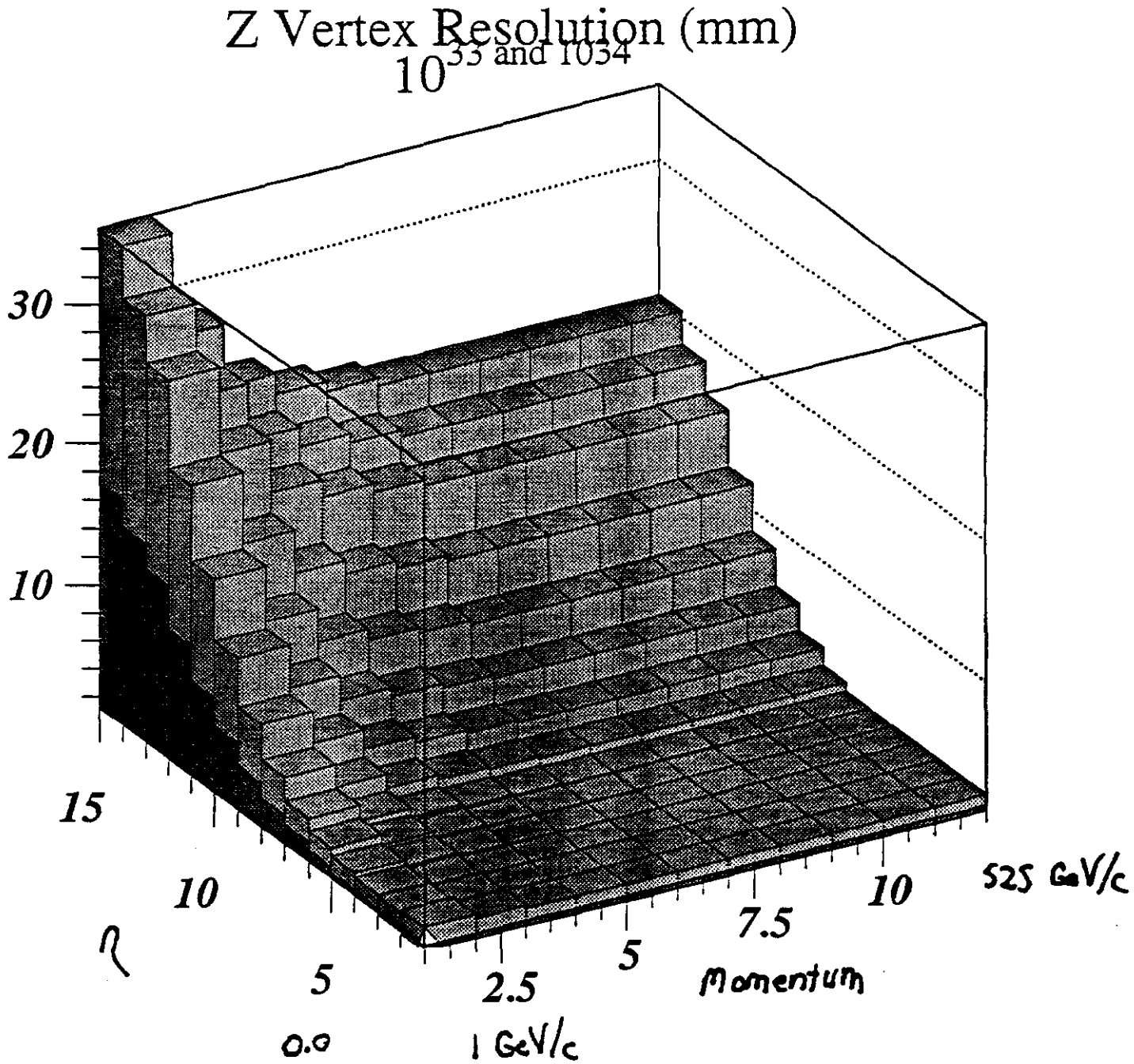
Radiation Lengths Exiting Tracker



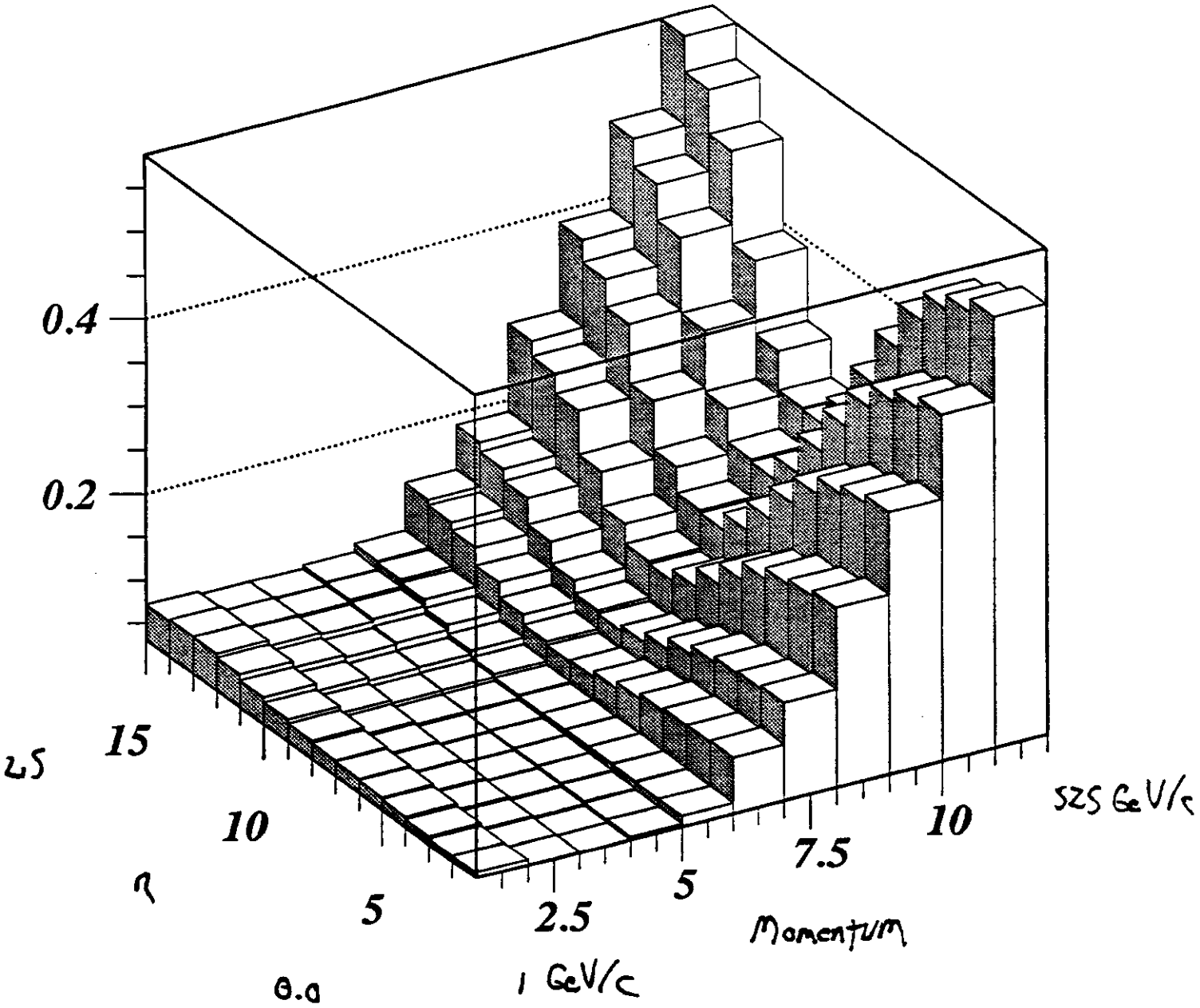
Radiation Lengths Before Last Layer



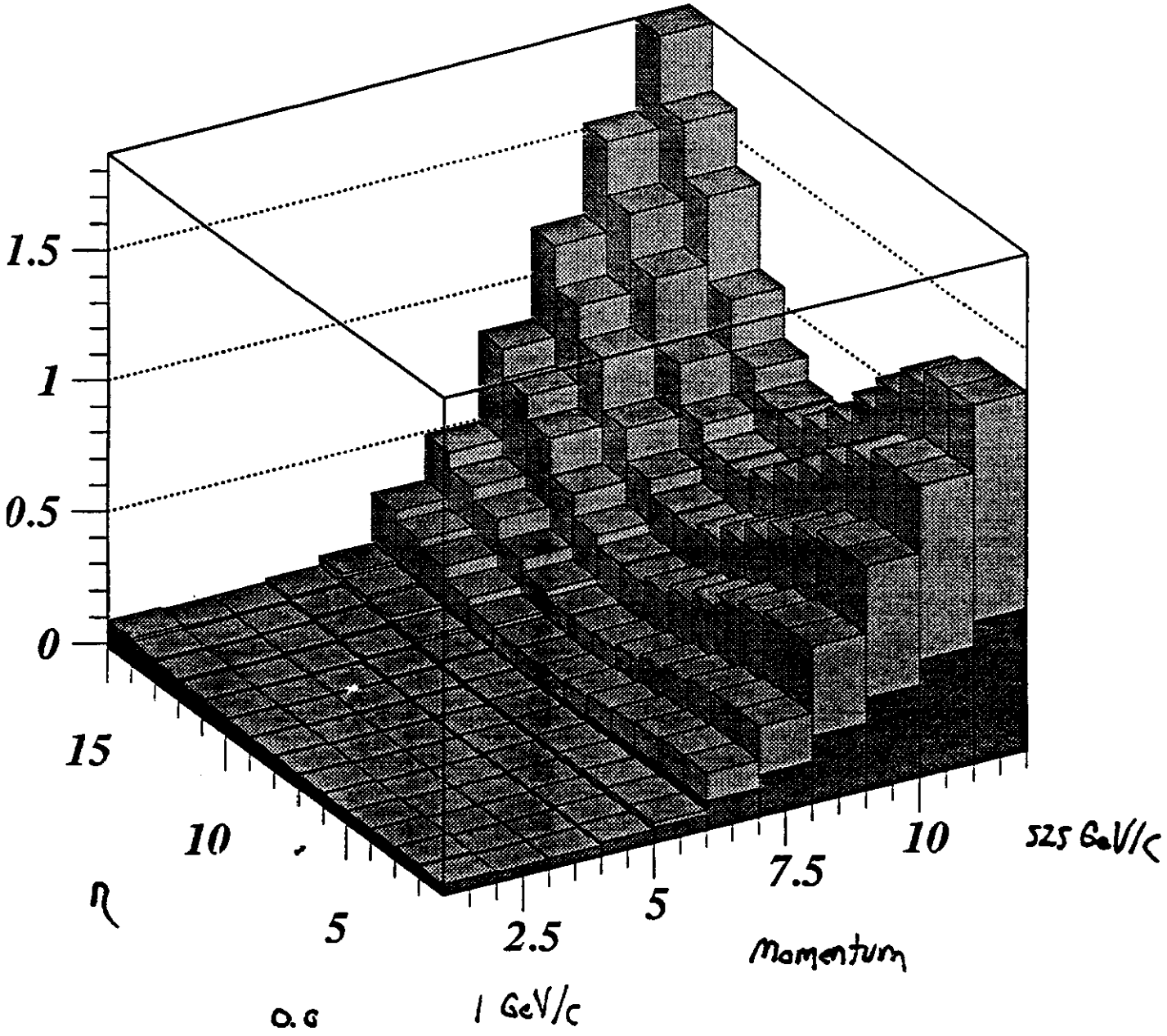

Z Vertex Resolution (mm)
10^{33}
15
10
5
15
10
5
2.5
0.0
η
2.5
5
7.5
10
Momentum
1 GeV/c
525 GeV/c

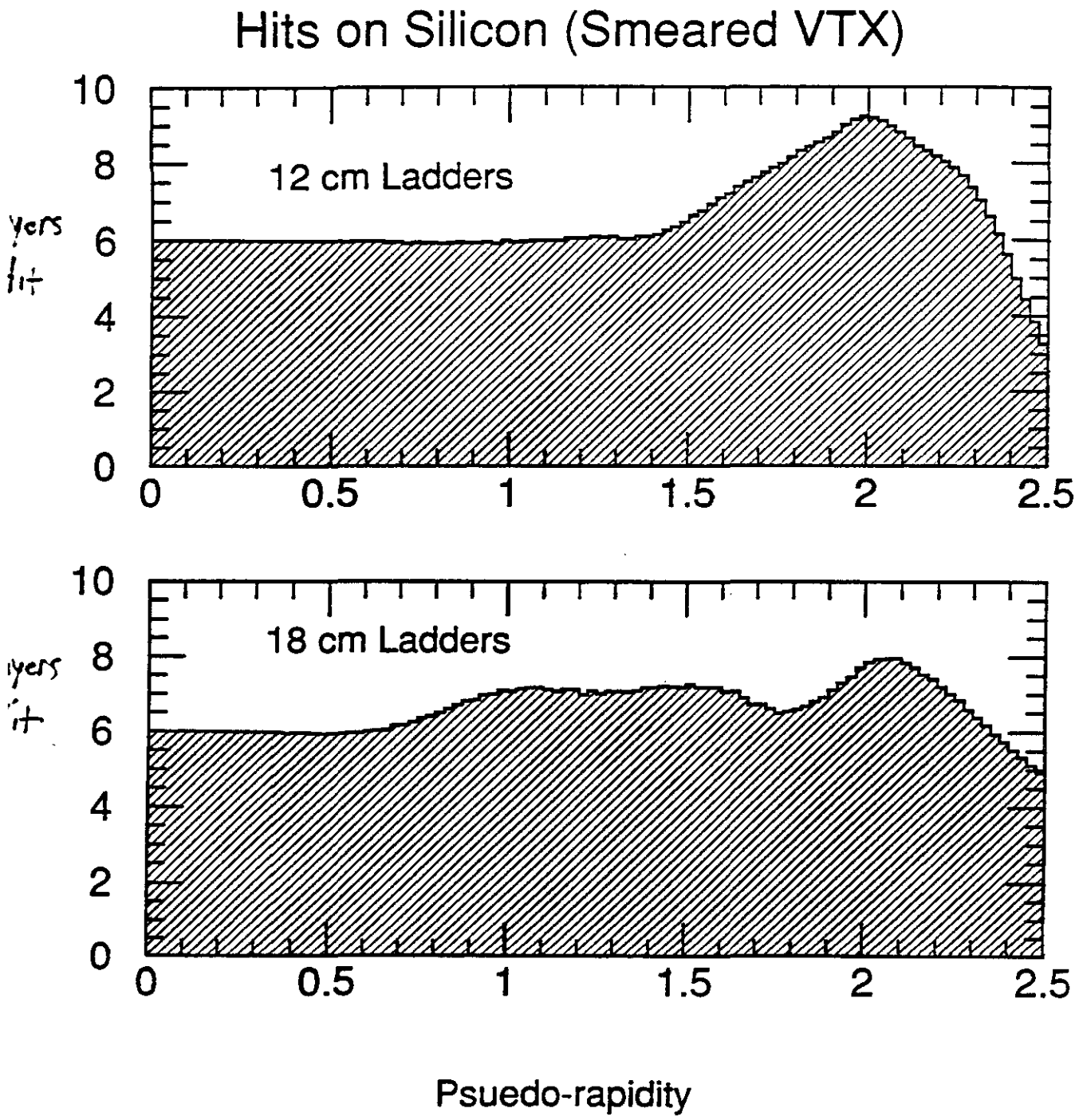

Z Vertex Resolution (mm)
10^{33} and 10^{34}
30
20
10
15
10
5
0.0
η
2.5
5
7.5
10
1 GeV/c
Momentum
525 GeV/c

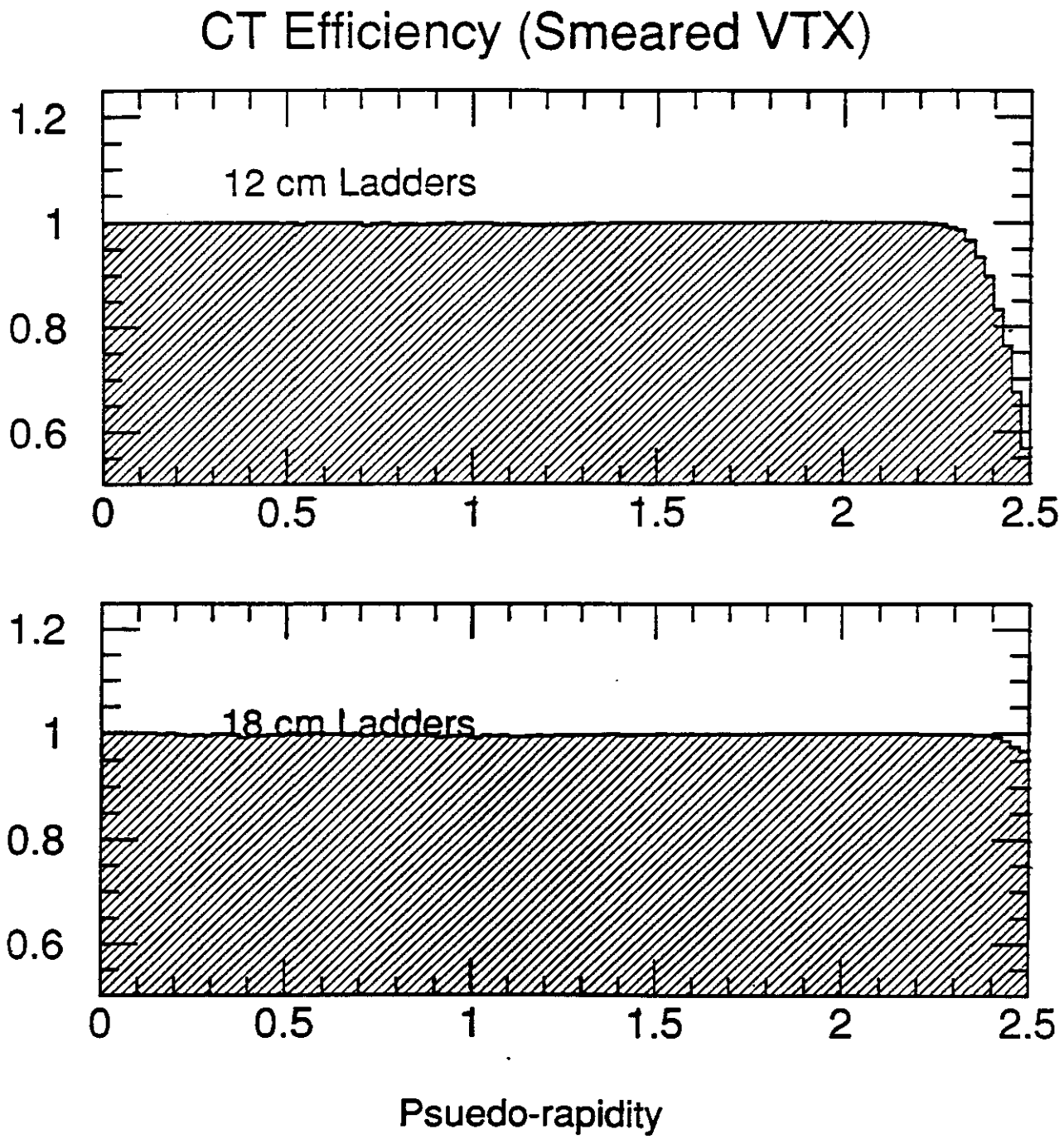
Momentum Resolution 10^{33}



Momentum Resolution $10^{33/1034}$




Hits on Silicon (Smeared VTX)
12 cm Ladders
18 cm Ladders
yers
hit
10
8
6
4
2
0
0
0.5
1
1.5
2
2.5
Psuedo-rapidity


CT Efficiency (Smeared VTX)
12 cm Ladders
18 cm Ladders
1.2
1
0.8
0.6
0
0.5
1
1.5
2
2.5
Psuedo-rapidity

Presentation by:

Renyuan Zhu

H$\rightarrow \gamma\gamma$ Studies

Renyuan Zhu
Caltech

Physics Group Meeting

February 23, 1993

- H$\rightarrow \gamma\gamma$ Signal & Background;
- Higgs Mass Resolution;
- GEANT Simulation for H$\rightarrow \gamma\gamma$?

Caltech Team

- S. Mrenna: $H \to \ell\ell\ell\ell$;
- ✓ S. Shevchenko: $H \to \ell\ell jj$
- X. Shi: $H \to \ell\ell\nu\nu$;
- ✓ H. Yamamoto: $H \to \gamma\gamma$;
- ✓ R. Zhu: Coordinate Higgs Section and $H \to \gamma\gamma$.

Strategy

- Calculate x-section right, taking into account uncertainties of structure function and high order corrections;

- Use NLL calculation from Bailey and Owens for irreducible background, which includes:
  - Born and $O(\alpha_s)$ corrections;
  - Box diagram;
  - Single and double Bremsstrahlung;
  - The exact 2→3 kinematics for $q\bar{q} \to \gamma\gamma g$, $qg \to \gamma\gamma q$ and $g\bar{q} \to \gamma\gamma\bar{q}$.

- Calculate requested jet rejection for γ-jet and 2jets final states.

Event Selection Cuts

1. $E_T^\gamma > 20$ GeV;

2. $|\eta^\gamma| < 2.5$;

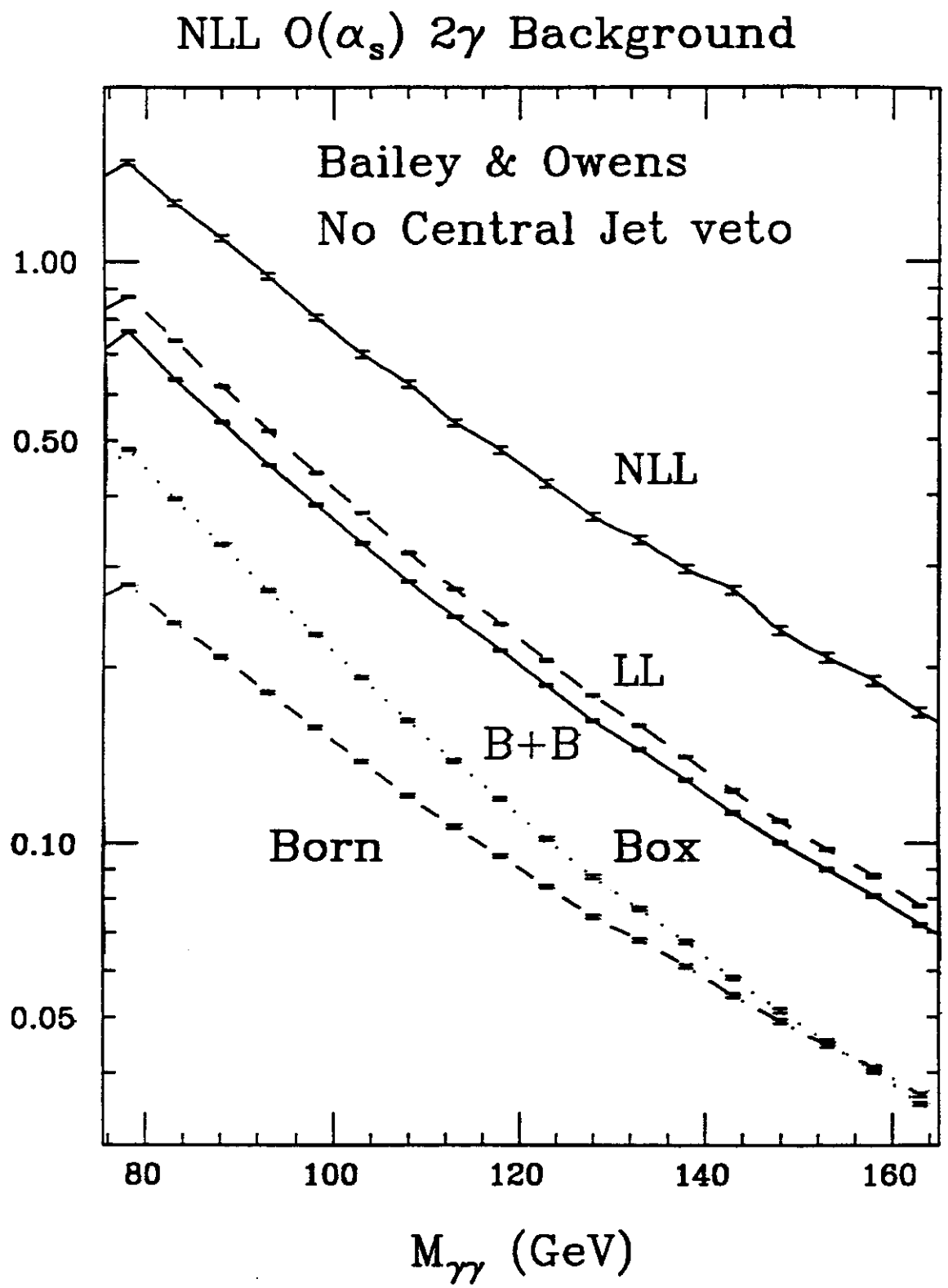
3. Isolation:

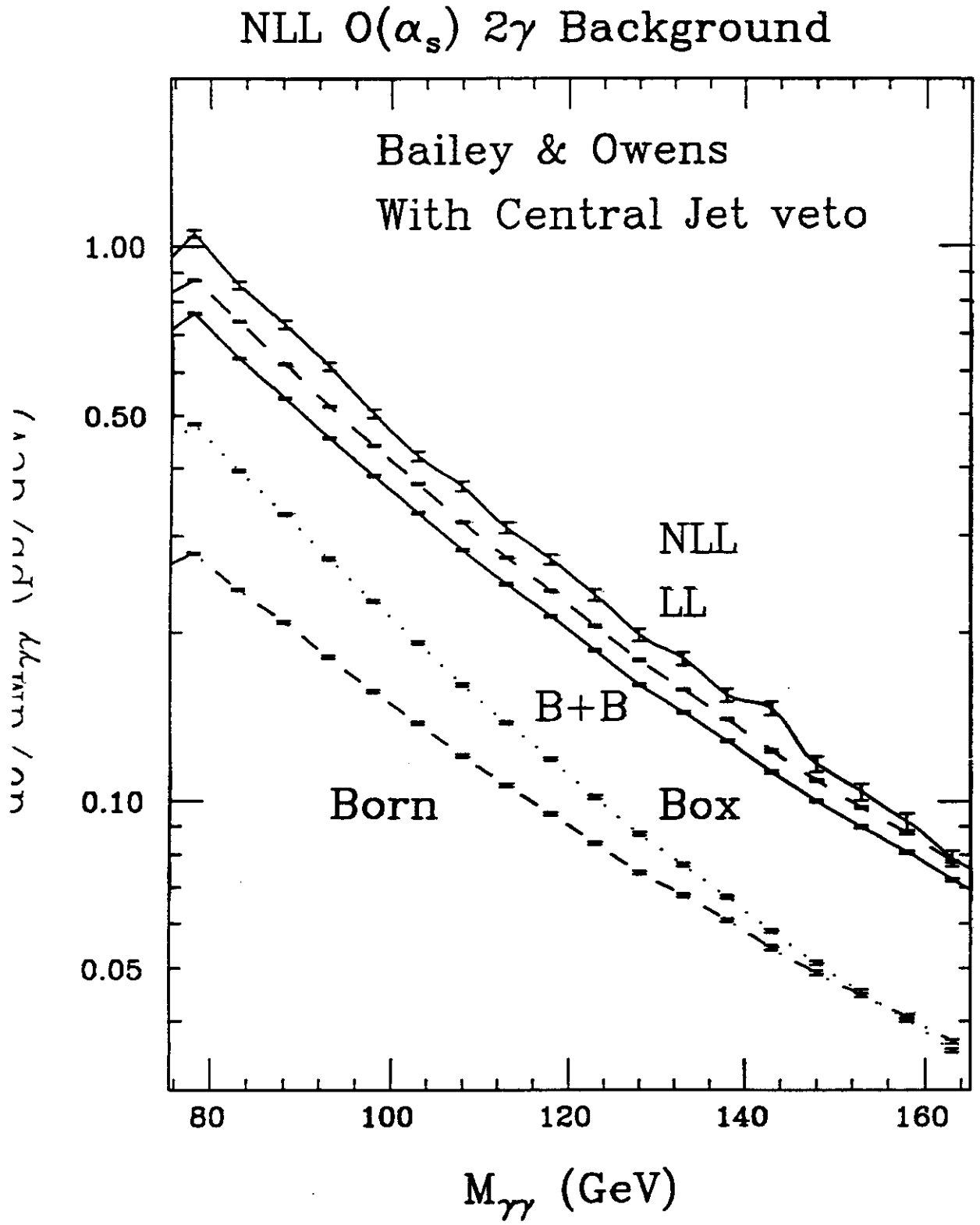
$$\sum_{r<0.45} E_T - gE_T^{5\times5} < 5GeV$$

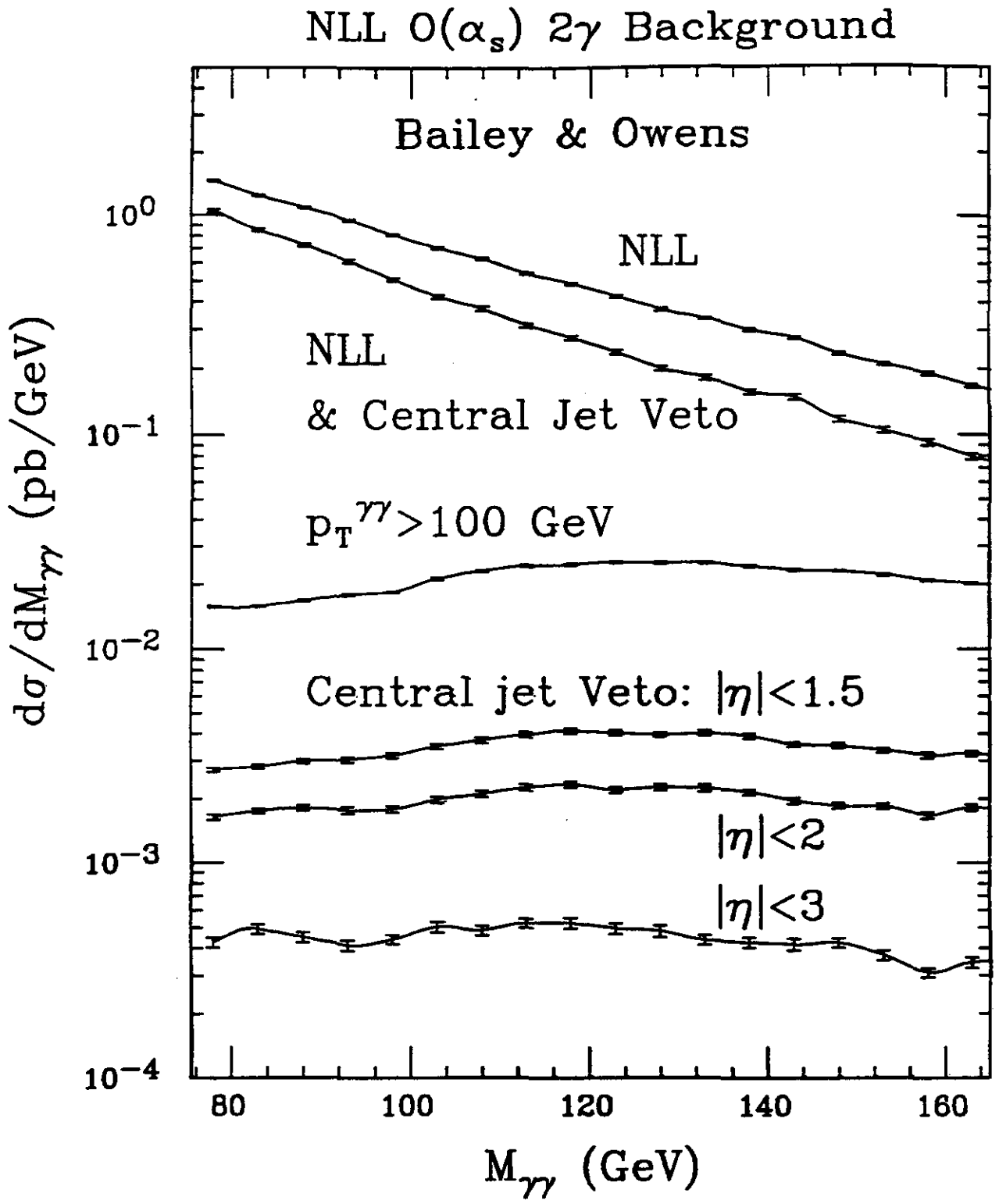
   where g = 1.013 for GEMFAST.

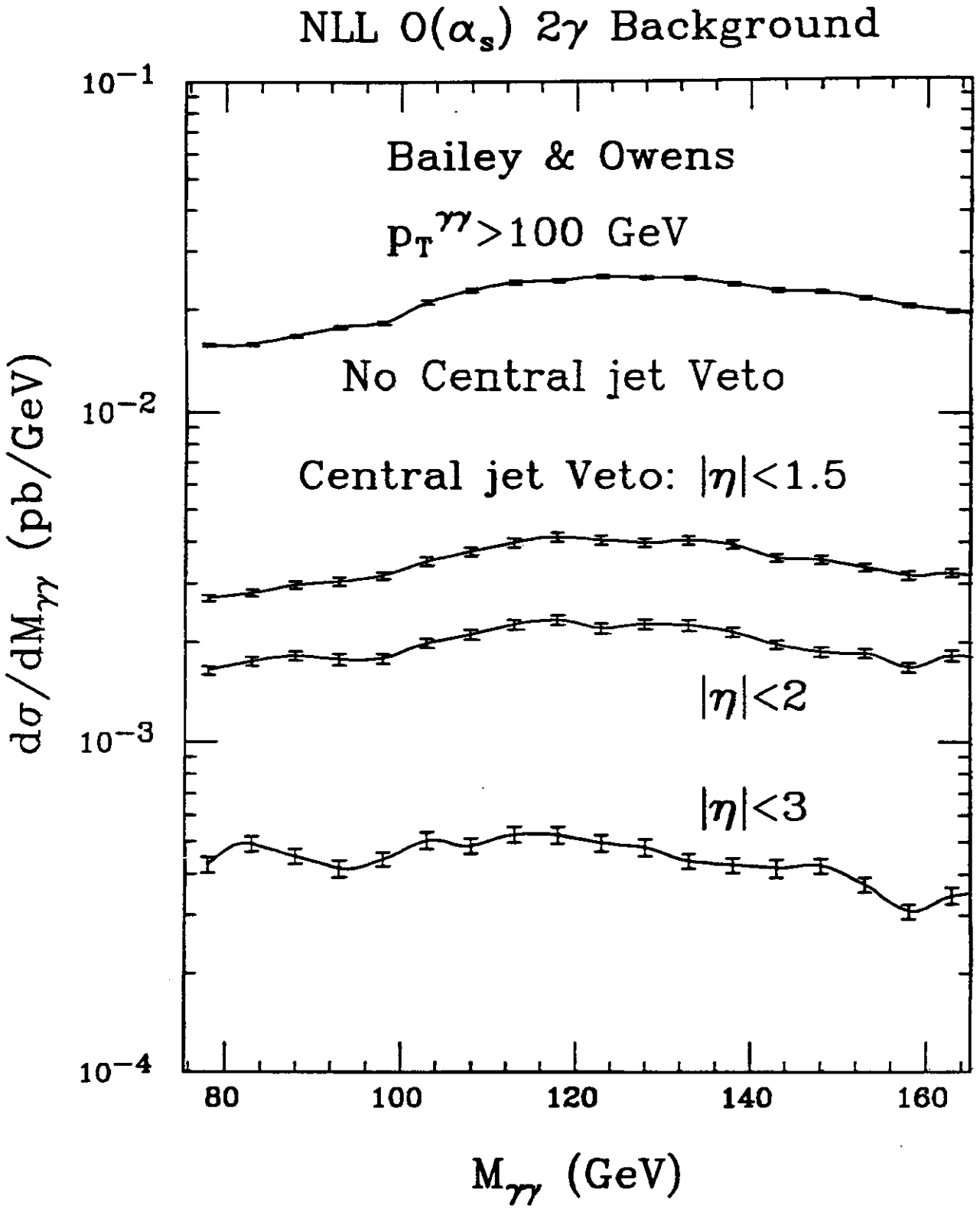
4. $p_T^{\gamma\gamma} > 50$, 80 or 100 GeV $\Rightarrow$ select VV.

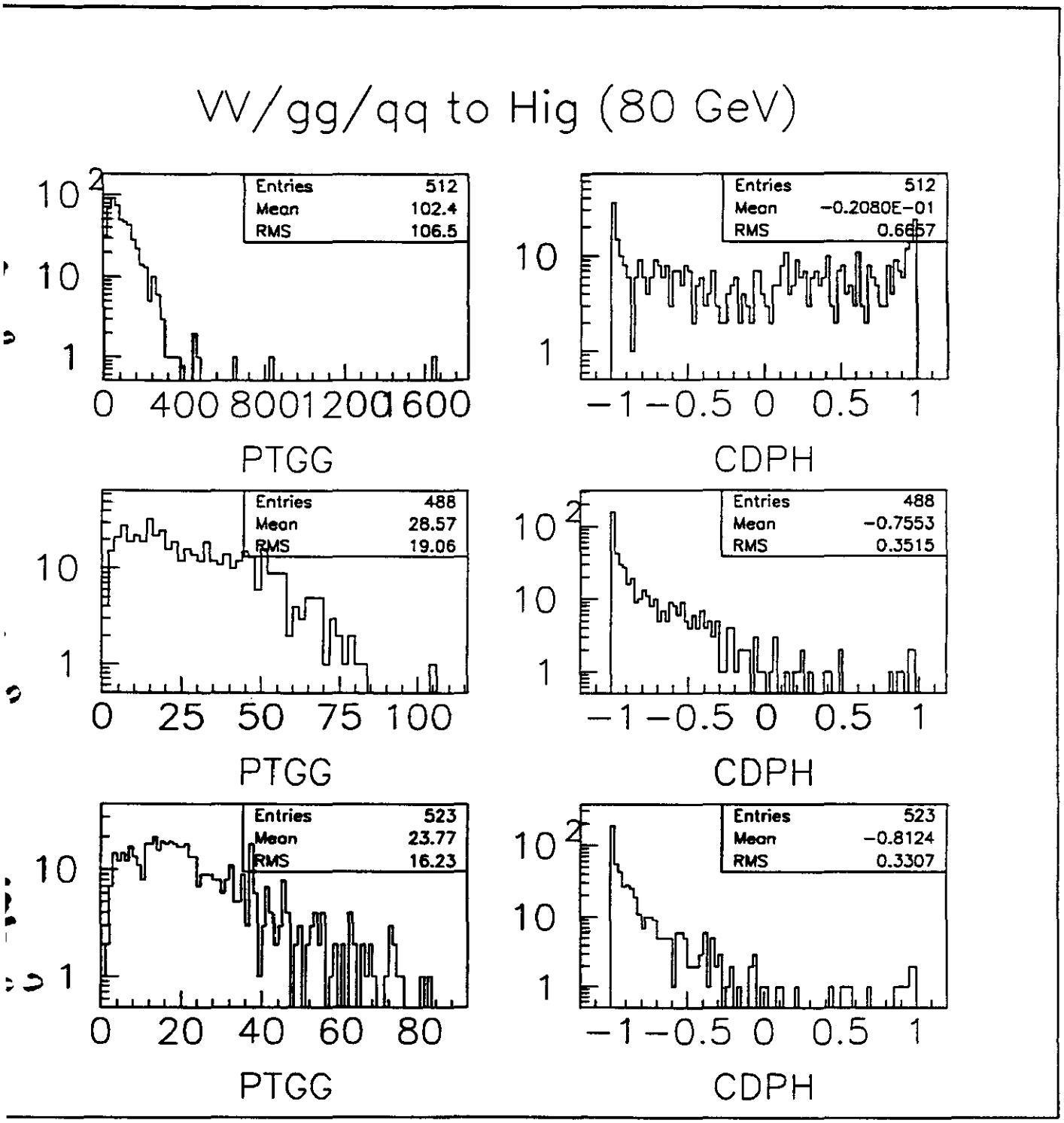
5. Central Jet veto: No jet with P_T >20 GeV in $|\eta|$ <1.5, 2 or 3.

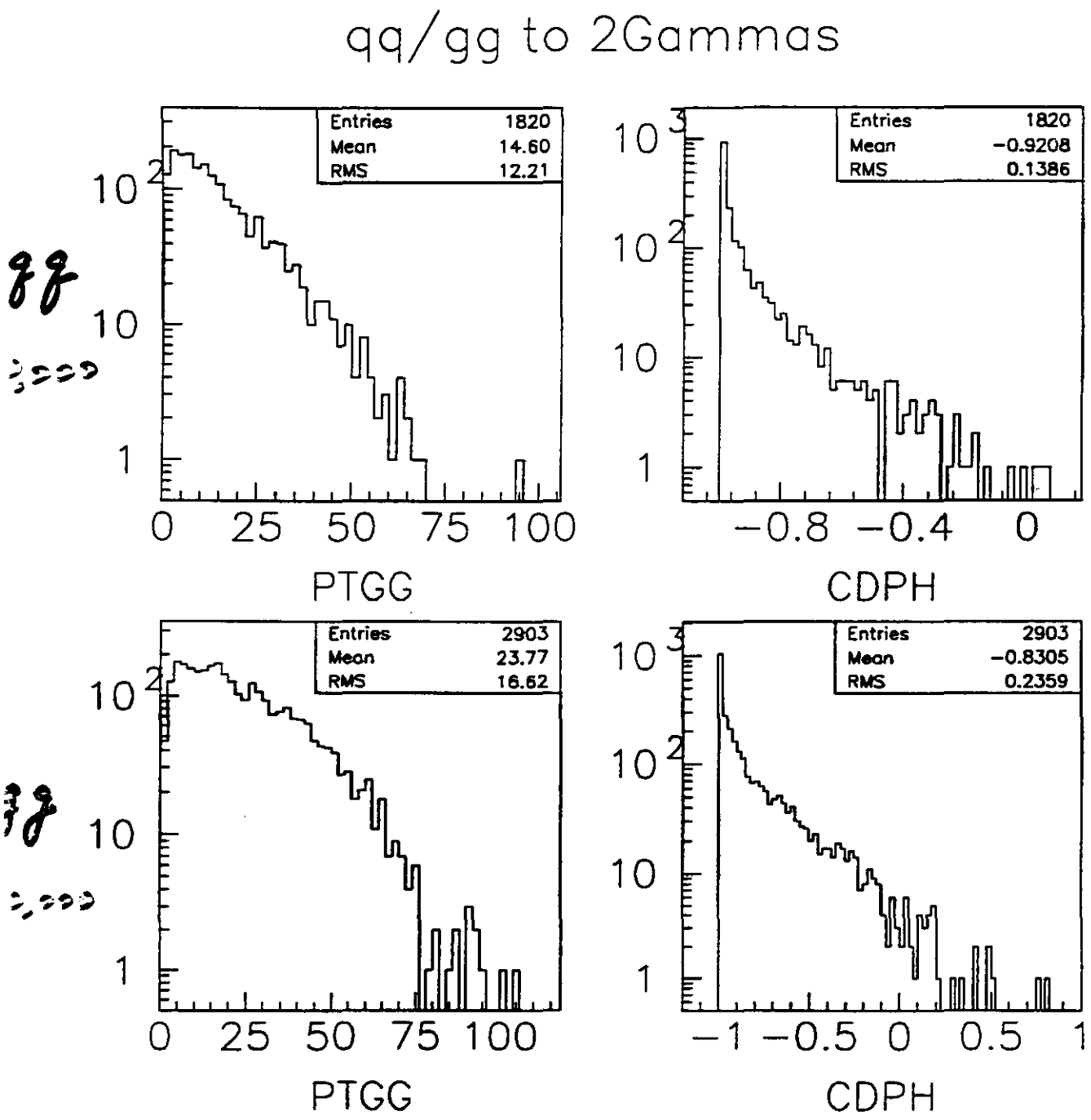

NLL O(α_s) 2γ Background
Bailey & Owens
No Central Jet veto
1.00
0.50
0.10
0.05
NLL
LL
B+B
Born
Box
80
100
120
140
160
$M_{\gamma\gamma}$ (GeV)

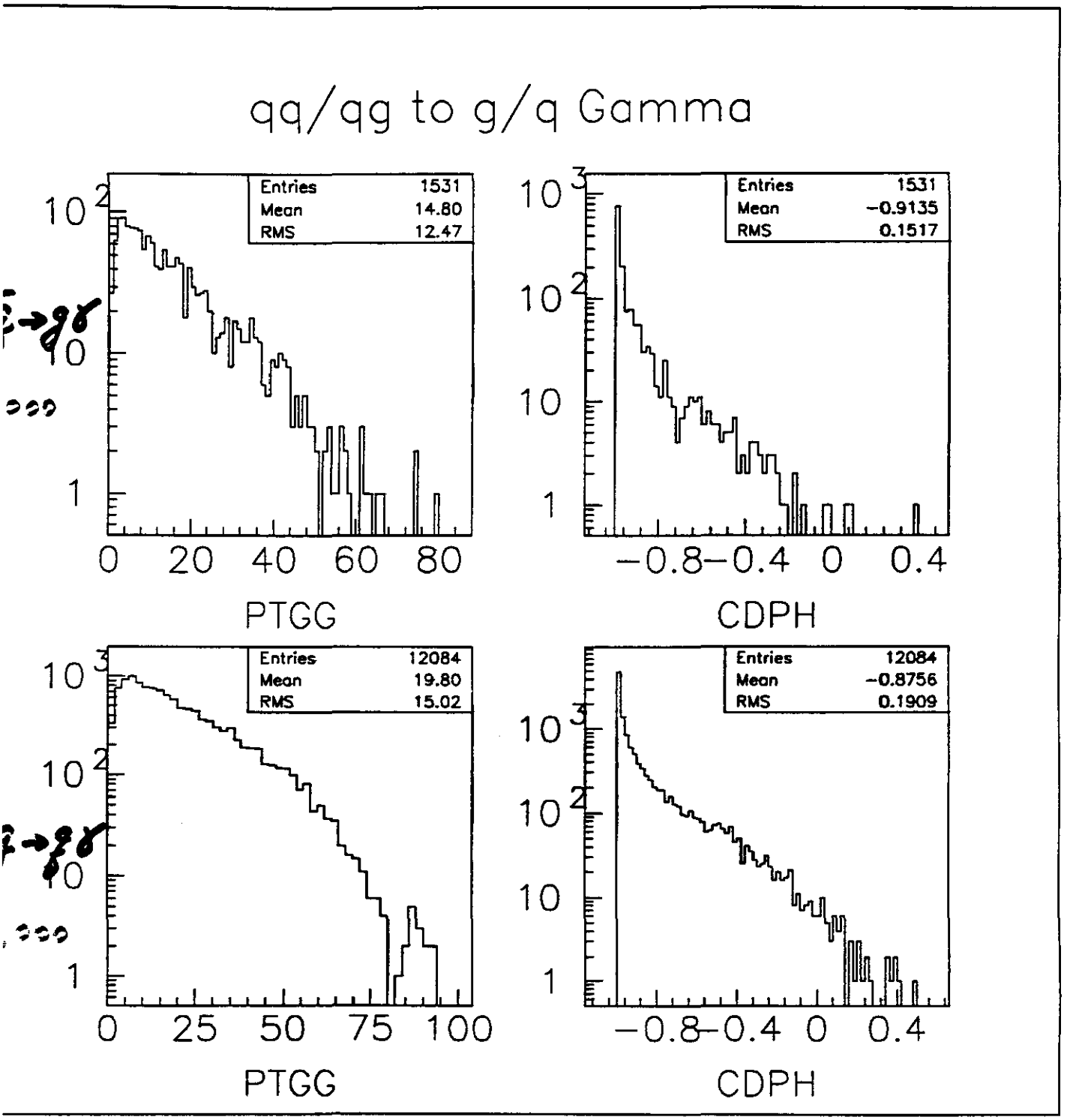

NLL O(α_s) 2γ Background
Bailey & Owens
With Central Jet veto
1.00
0.50
0.10
0.05
NLL
LL
B+B
Born
Box
80
100
120
140
160
$M_{\gamma\gamma}$ (GeV)

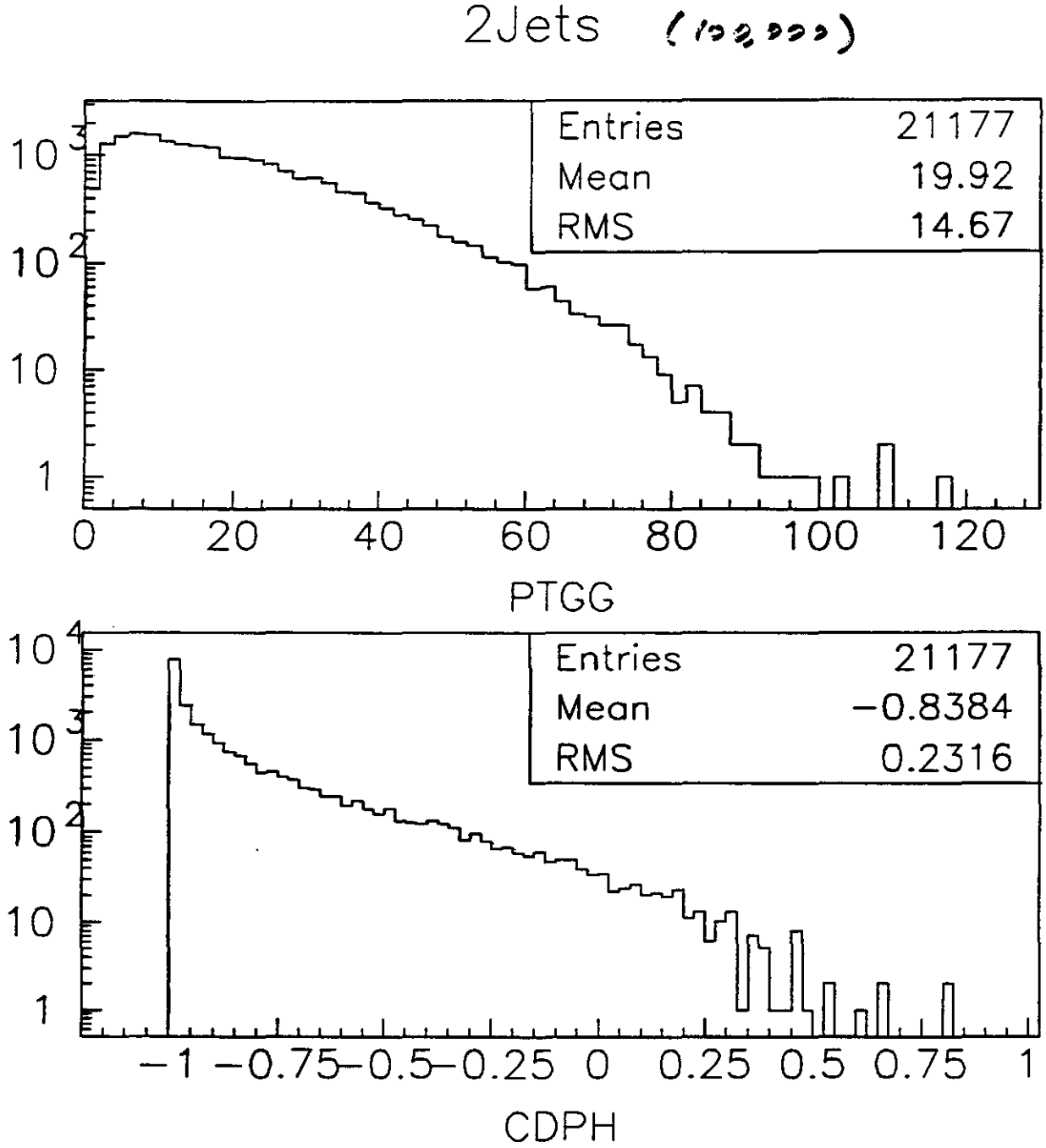

NLL O(αs) 2γ Background
Bailey & Owens
NLL
NLL
& Central Jet Veto
pT^γγ>100 GeV
Central jet Veto: |η|<1.5
|η|<2
|η|<3
dσ/dMγγ (pb/GeV)
Mγγ (GeV)
10^0
10^-1
10^-2
10^-3
10^-4
80
100
120
140
160


NLL O(α_s) 2γ Background
Bailey & Owens
$p_T^{\gamma\gamma}$>100 GeV
No Central jet Veto
Central jet Veto: $|\eta|$<1.5
$|\eta|$<2
$|\eta|$<3
$d\sigma/dM_{\gamma\gamma}$ (pb/GeV)
$M_{\gamma\gamma}$ (GeV)
10^{-1}
10^{-2}
10^{-3}
10^{-4}
80
100
120
140
160


VV/gg/qq to Hig (80 GeV)
Entries 512
Mean 102.4
RMS 106.5
PTGG
Entries 512
Mean −0.2080E−01
RMS 0.6657
CDPH
Entries 488
Mean 28.57
RMS 19.06
PTGG
Entries 488
Mean −0.7553
RMS 0.3515
CDPH
Entries 523
Mean 23.77
RMS 16.23
PTGG
Entries 523
Mean −0.8124
RMS 0.3307
CDPH


qq/gg to 2Gammas
Entries 1820
Mean 14.60
RMS 12.21
PTGG
Entries 1820
Mean −0.9208
RMS 0.1386
CDPH
Entries 2903
Mean 23.77
RMS 16.62
PTGG
Entries 2903
Mean −0.8305
RMS 0.2359
CDPH


qq/qg to g/q Gamma
Entries 1531
Mean 14.80
RMS 12.47
PTGG
Entries 1531
Mean −0.9135
RMS 0.1517
CDPH
Entries 12084
Mean 19.80
RMS 15.02
PTGG
Entries 12084
Mean −0.8756
RMS 0.1909
CDPH


2Jets (102,000)
Entries 21177
Mean 19.92
RMS 14.67
PTGG
Entries 21177
Mean −0.8384
RMS 0.2316
CDPH

80 GeV Higgs$\rightarrow \gamma\gamma$ Signal (fb)
Irreducible Background (fb/GeV)

Process	σ_{prod}	c1-3/c5(1.5/2/3)	c1-4(50/80/100)	c1-5 (1.5/3
VV$\rightarrow$H	17	8.0/4.7/3.7/2.0	5.8/3.8/3.0	1.7/0.43
gg$\rightarrow$H	96	44/39/38/35	7.2/0.3/0.1	0.0/0.0
$f\bar{f} \rightarrow$H	10	4.8/4.4/4.2/4.0	0.4/.02/0.0	0.0/0.0
Sum	123	57/48/46/41	13/4.1/3.1	1.7/0.43
$q\bar{q} \rightarrow \gamma\gamma$	1350	235/-	4.0/0.1/0.0	
gg$\rightarrow \gamma\gamma$	2800	770/-	61/3.4/0.3	
Sum	4150	1000/-	65/3.5/0.3	
NLL	-	1.36/1.0/.98/.95	-/-/16	2.7/0.45
S/$\sqrt{B}$	-	2.6/2.6/2.5/2.3	-/-/1.2	2.1/1.3
"K" factor	-	3.7/3.7/3.5/3.2	-/-/1.2	2.1/1.3

lote, the S/$\sqrt{B}$ includes 6% ($\delta\eta$=0.15) acceptance loss and 90%

fficiency of γ identification and 0.6 GeV σ_{M_H}.

lso note NLL x-section using HMRS(B) structure function has

)% lower x-section @80 GeV, comparing ELHQ-1 for signal.

Jet Background (pb/GeV)

Process	σ_{prod}	c1-2	c4 (50/80/100 GeV)
$q\bar{q} \rightarrow \gamma g$	235	36	0.6/<0.024/<0.024
$qg \rightarrow \gamma q$	3330	800	42/1.0/<0.1
Sum	3600	840	43/1/<0.13
Rejection to NLL	-	620	-/-/8
2jets (nb/GeV)	28,300	6,000	270/9/1.2
Rejection to NLL	-	4.4×10^6	-/-/7.5×10^4

Requested rejection, if jet background is 100%(10%) of NLL/JV:

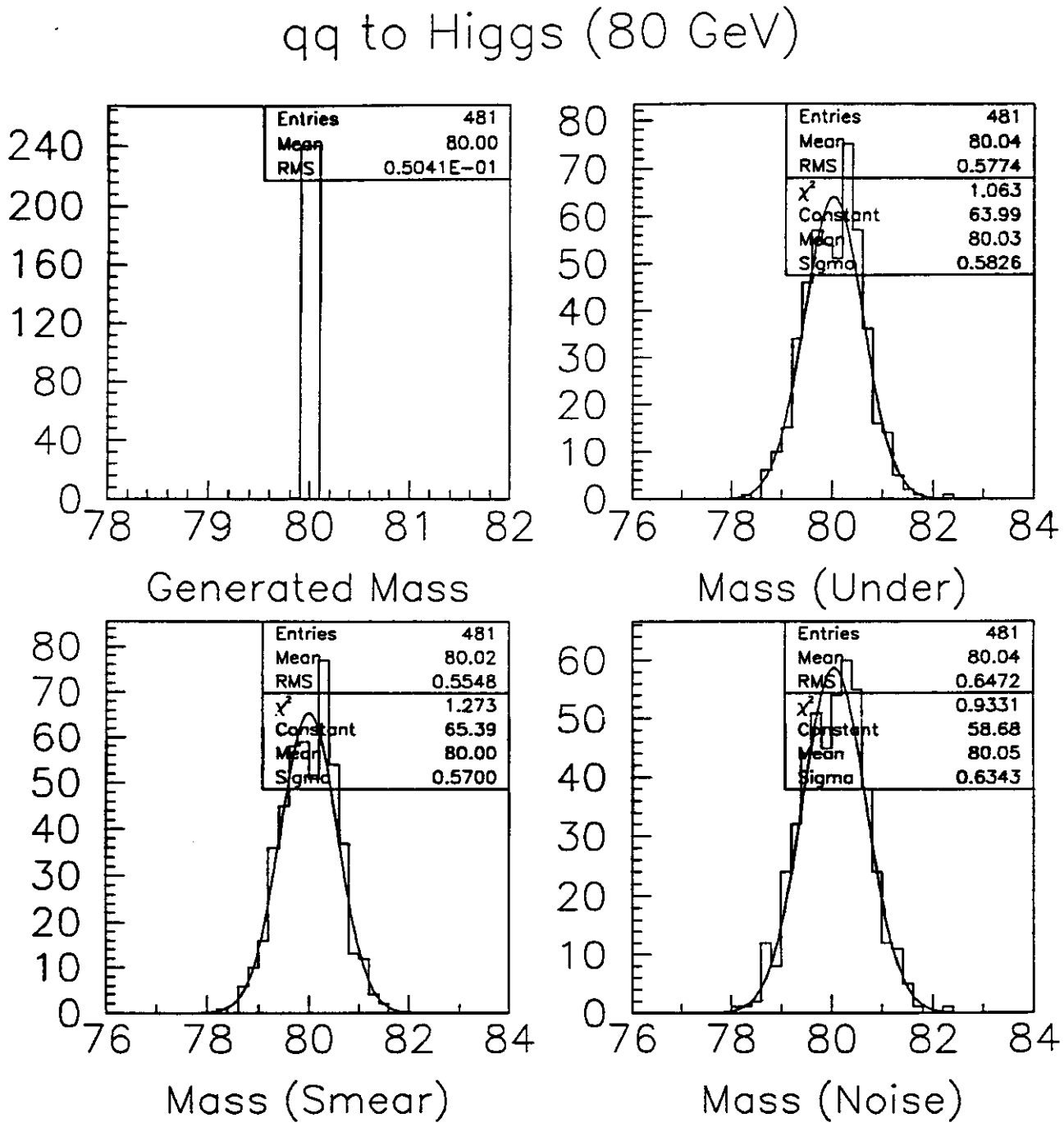
620 (6200) for quark jet and 2100 (6600) for gluon jet.

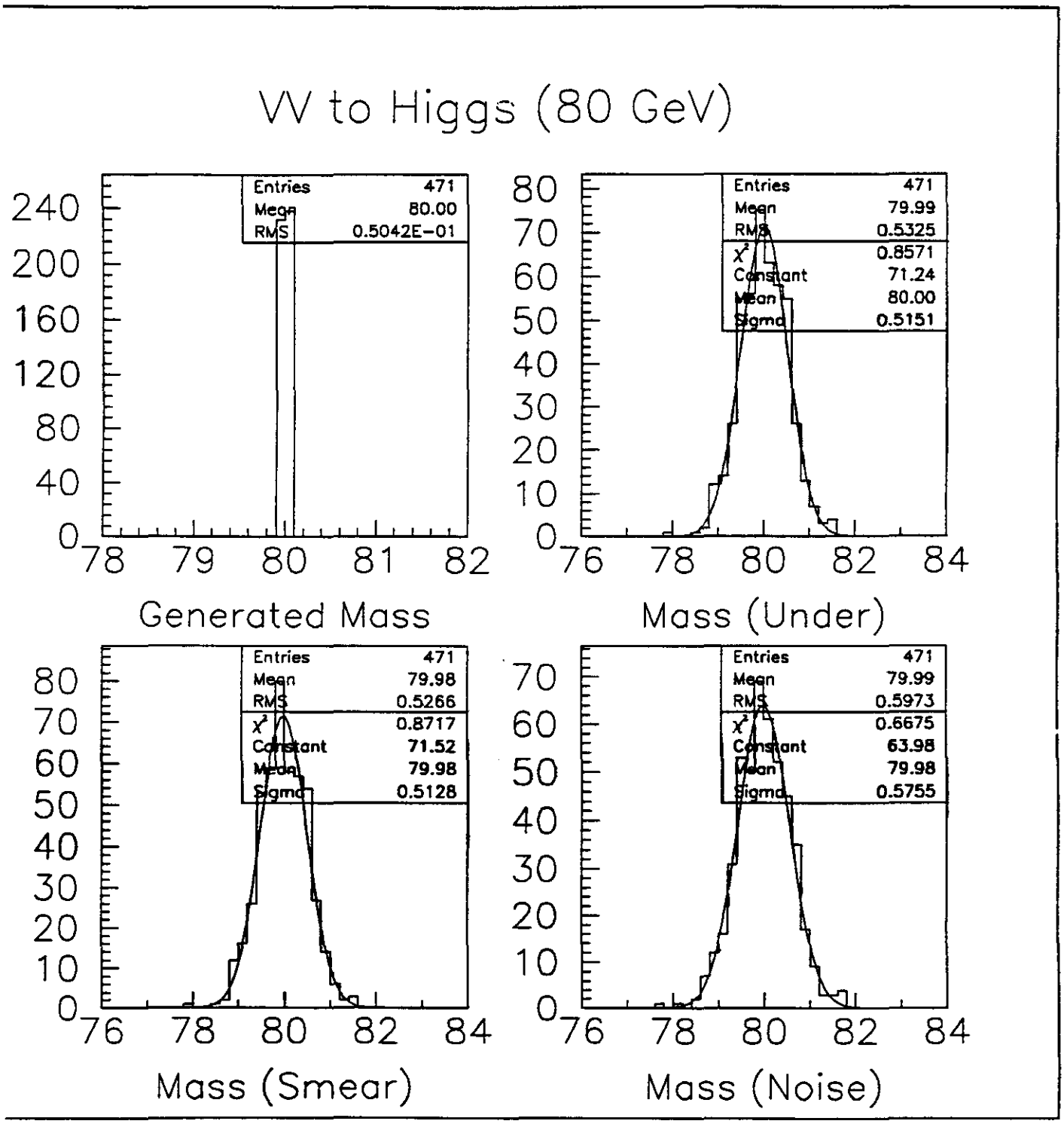
GEANT Simulation with 10,000 jets?

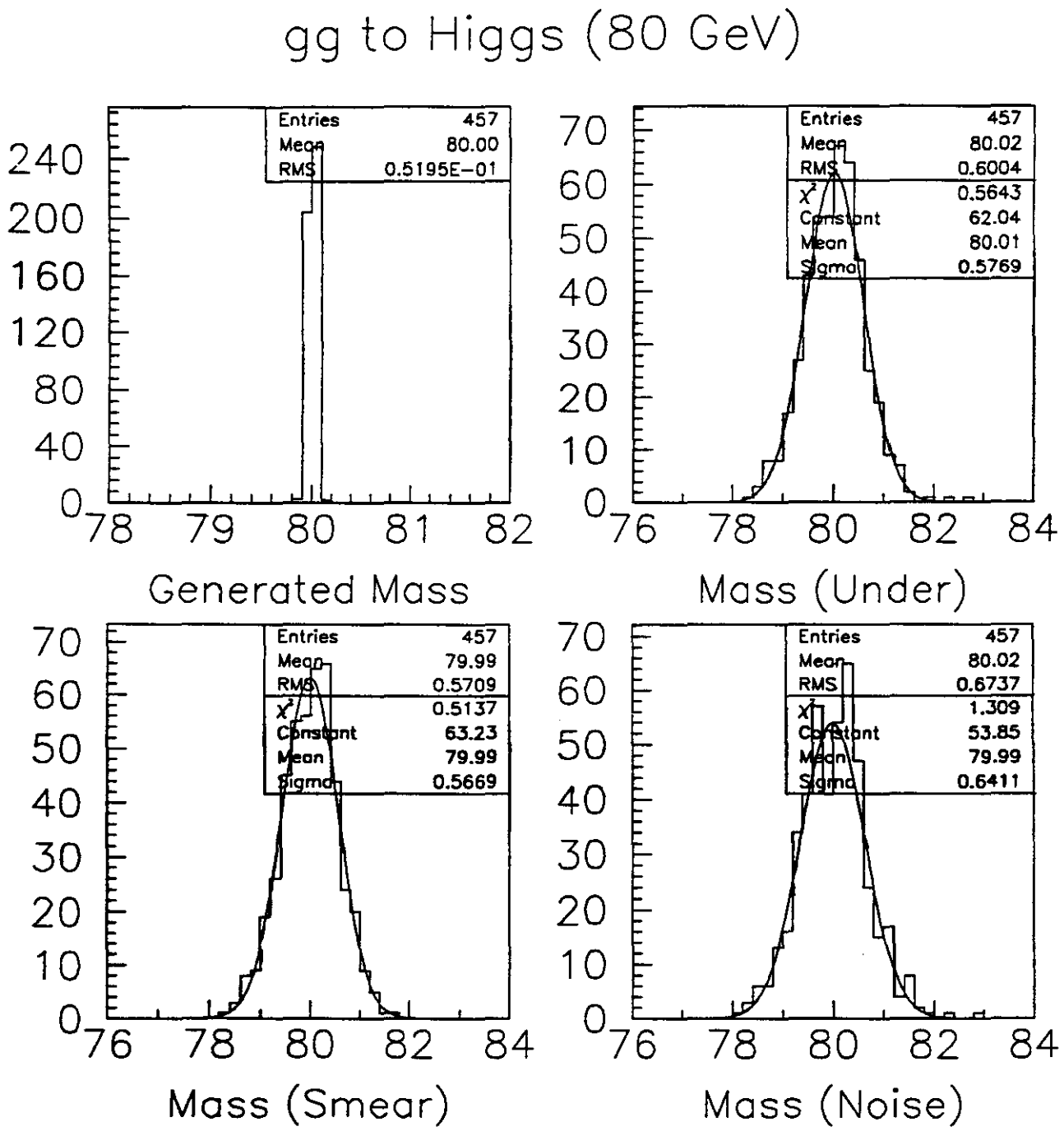
Higgs Mass Resolution

- Mass Generated from PYTHIA;
- Mass reconstructed with two photons smearing:
  - Barrel: a = 6%, b=0.4%;
  - Endcaps: a = 8%, b=0.4%;
  - position resolution & vertex resolution: 1 mm.
- Mass reconstructed with underlying events + smearing;
- Mass reconstructed with underlying events + smearing + noise (thermal & pileup):
  - Barrel: σ_{E_T} = 150 MeV;
  - Endcaps: σ_{E_T} = 220 MeV.

80 GeV Higgs resolution is 600 MeV.


qq to Higgs (80 GeV)
Entries 481
Mean 80.00
RMS 0.5041E-01
Generated Mass
Entries 481
Mean 80.04
RMS 0.5774
χ² 1.063
Constant 63.99
Mean 80.03
Sigma 0.5826
Mass (Under)
Entries 481
Mean 80.02
RMS 0.5548
χ² 1.273
Constant 65.39
Mean 80.00
Sigma 0.5700
Mass (Smear)
Entries 481
Mean 80.04
RMS 0.6472
χ² 0.9331
Constant 58.68
Mean 80.05
Sigma 0.6343
Mass (Noise)


VV to Higgs (80 GeV)
Entries 471
Mean 80.00
RMS 0.5042E-01
Generated Mass
Entries 471
Mean 79.99
RMS 0.5325
χ² 0.8571
Constant 71.24
Mean 80.00
Sigma 0.5151
Mass (Under)
Entries 471
Mean 79.98
RMS 0.5266
χ² 0.8717
Constant 71.52
Mean 79.98
Sigma 0.5128
Mass (Smear)
Entries 471
Mean 79.99
RMS 0.5973
χ² 0.6675
Constant 63.98
Mean 79.98
Sigma 0.5755
Mass (Noise)


gg to Higgs (80 GeV)
Entries 457
Mean 80.00
RMS 0.5195E-01
Generated Mass
Entries 457
Mean 80.02
RMS 0.6004
χ² 0.5643
Constant 62.04
Mean 80.01
Sigma 0.5769
Mass (Under)
Entries 457
Mean 79.99
RMS 0.5709
χ² 0.5137
Constant 63.23
Mean 79.99
Sigma 0.5669
Mass (Smear)
Entries 457
Mean 80.02
RMS 0.6737
χ² 1.309
Constant 53.85
Mean 79.99
Sigma 0.6411
Mass (Noise)

GEANT Simulation?

- γ/Jet Rejection: (also e/jet)
  - Large uncertainty with GEMFAST $\Rightarrow$ GEANT;
  - Approach: calculate jet rejection with GEANT simulation as function of p_T and η, as done for π^0's. To calculate jet rejection to 10^{-4} level.
- γ/e rejection:
  - Need Hit level GEANT simulation in CT.
- Pointing:
  - Can not be done with GEMFAST $\Rightarrow$ GEANT;
  - It is done by Hong Ma.

gem

γeμ

Presentation by:

Hong Ma

Summary of multi-photon rejection in GEM EM calorimeter.

Using the EM calorimeter baseline for TDR, as modeled by ichal Seman, multi-photon rejection for isolated EM showers is simulated in ull GEANT. The noise in the strips as well as the towers are taken nto account. The rejection is parameterized as a function of and the mass of the photons cluster that make the shower. The eta ependence is scaled with the distance from the calorimeter to the nteraction point, because the opening distance between the photons s proportional to the distance.

Three mass points are simulated, at 135, 250 and 550 MeV. he first is pizero, the last is eta, the second is just something n between. The multiplicity is assumed to be 2 for pizero, (55%) and 6 (45%) for eta, and 3 for the 250MeV object. his is compared to the jet background, and found to be close to the hoton multiplicity of the neutral EM showers after isolation cuts.

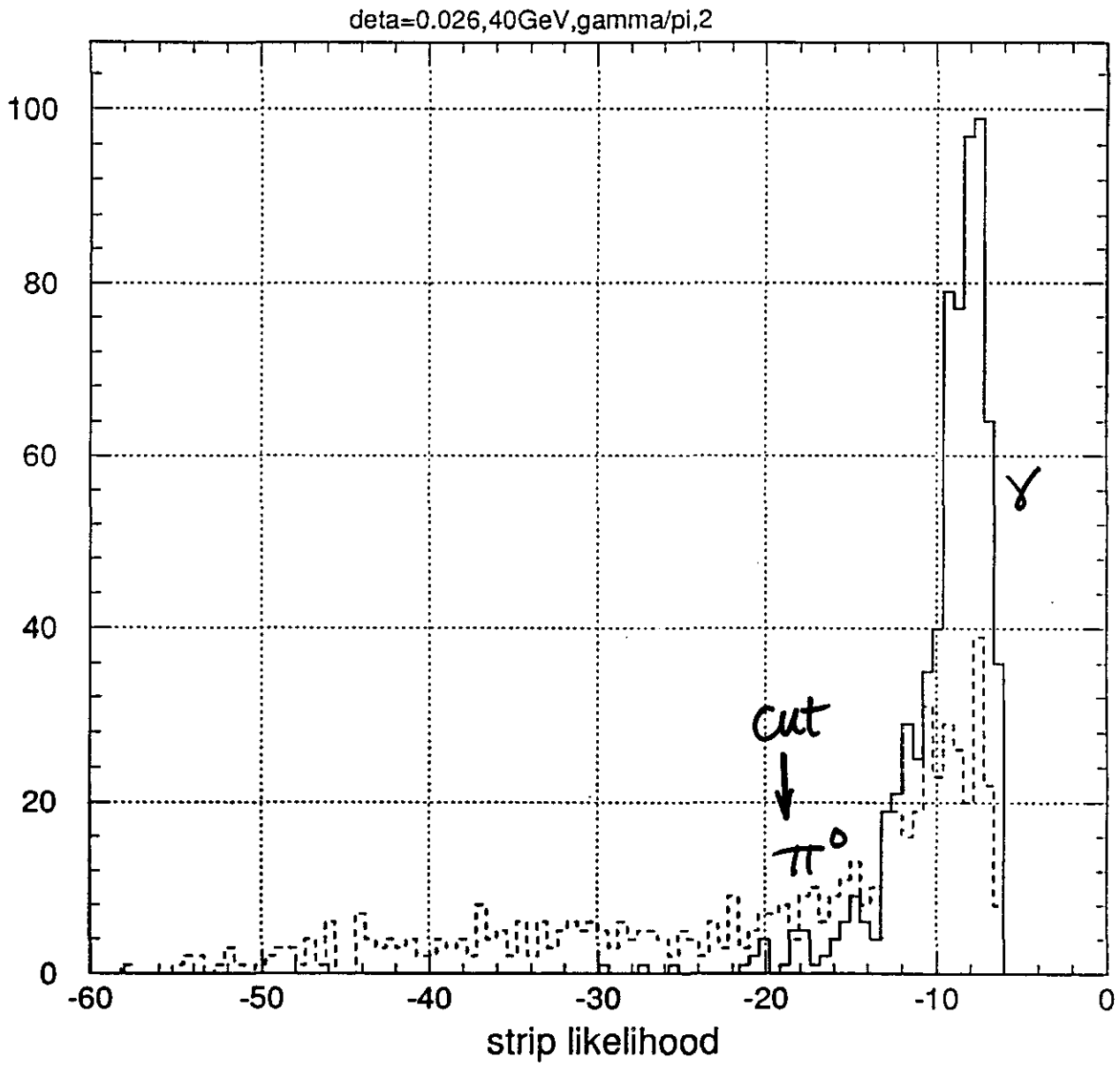
A subroutine is provided in GEMFAST for rejecting multiphotons, ased on the following results.

nergy	THETA	MASS (GEV)	REJECTION
)	90	.135	85%
5	90	.135	80%
)	90	.135	60%
)	90	.135	40%
)	90	.250	85%
)	90	.250	70%
30	90	.250	50%
)	45	.135	52%
)	45	.135	70%
)	90	.550	92%
30	90	.550	90%

The effect of noise at 10 MeV/strip level is small, ie rejection at 40 GeV for pi0s increase to 50% if the noise increases) 30 MeV/strip.

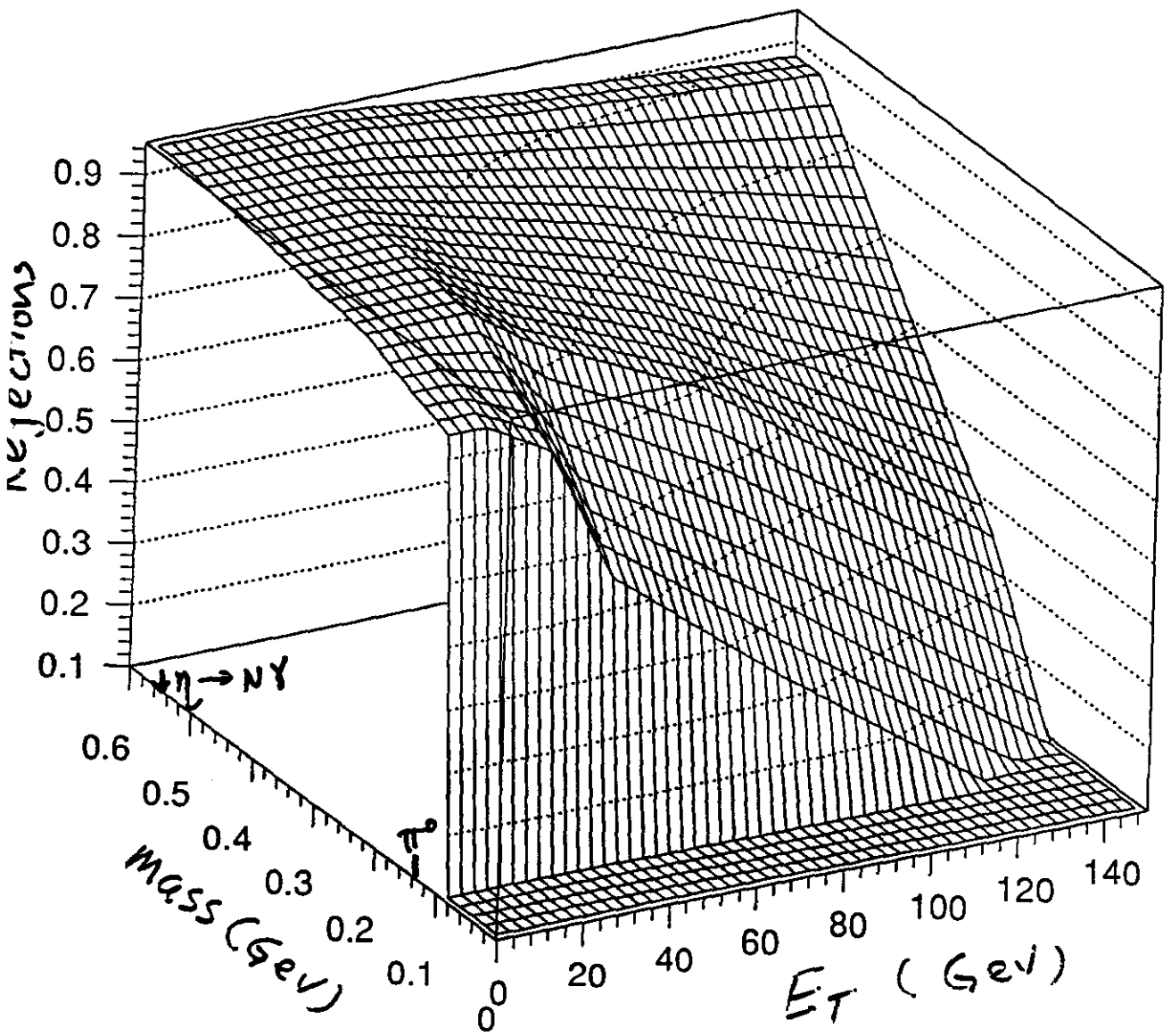
Combined likelihood function
$\beta/\gamma = 4$, massless gap

93/02/19 16.47



93/02/22 09.02

HISTOUT



Jet (multiphoton) Rejection with Full GEANT Simulation Compared to parametrization

Jets are generated with pythia single particle gun. Isolation cut ($E_T < 5$ GeV in a cone of $R = 0.45$) is applied at generator level. Surviving EM Clusters are simulated in EM Calorimeter with GEANT.

Rejection is obtained with the photon likelihood function.

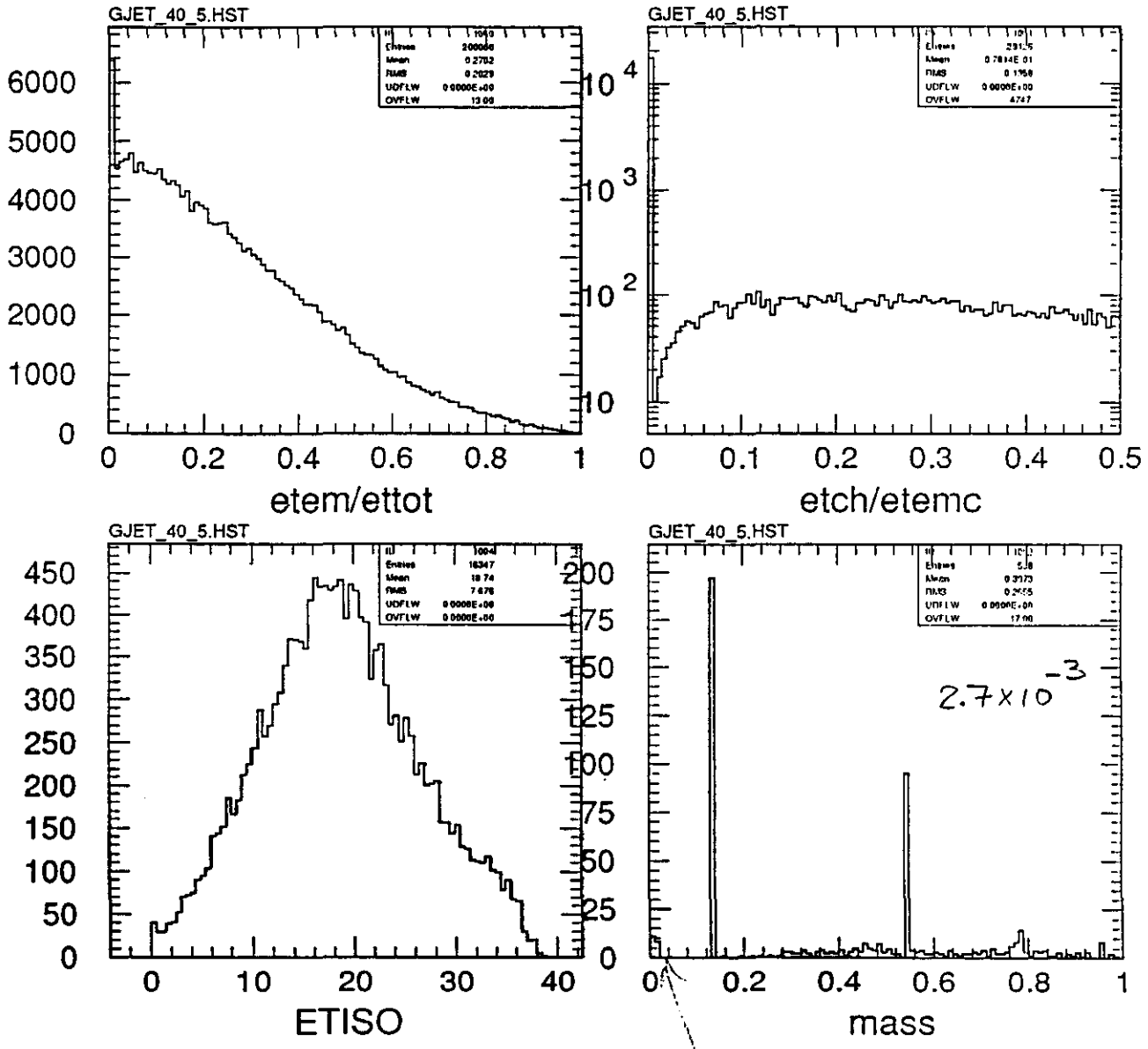
This is compared to the rejection given by the parametrized rejection function for the same events.

They both give rejection of a factor of 5 for 40 GeV jets.

$g \to N\gamma$

40GeV

93/02/19 16.57

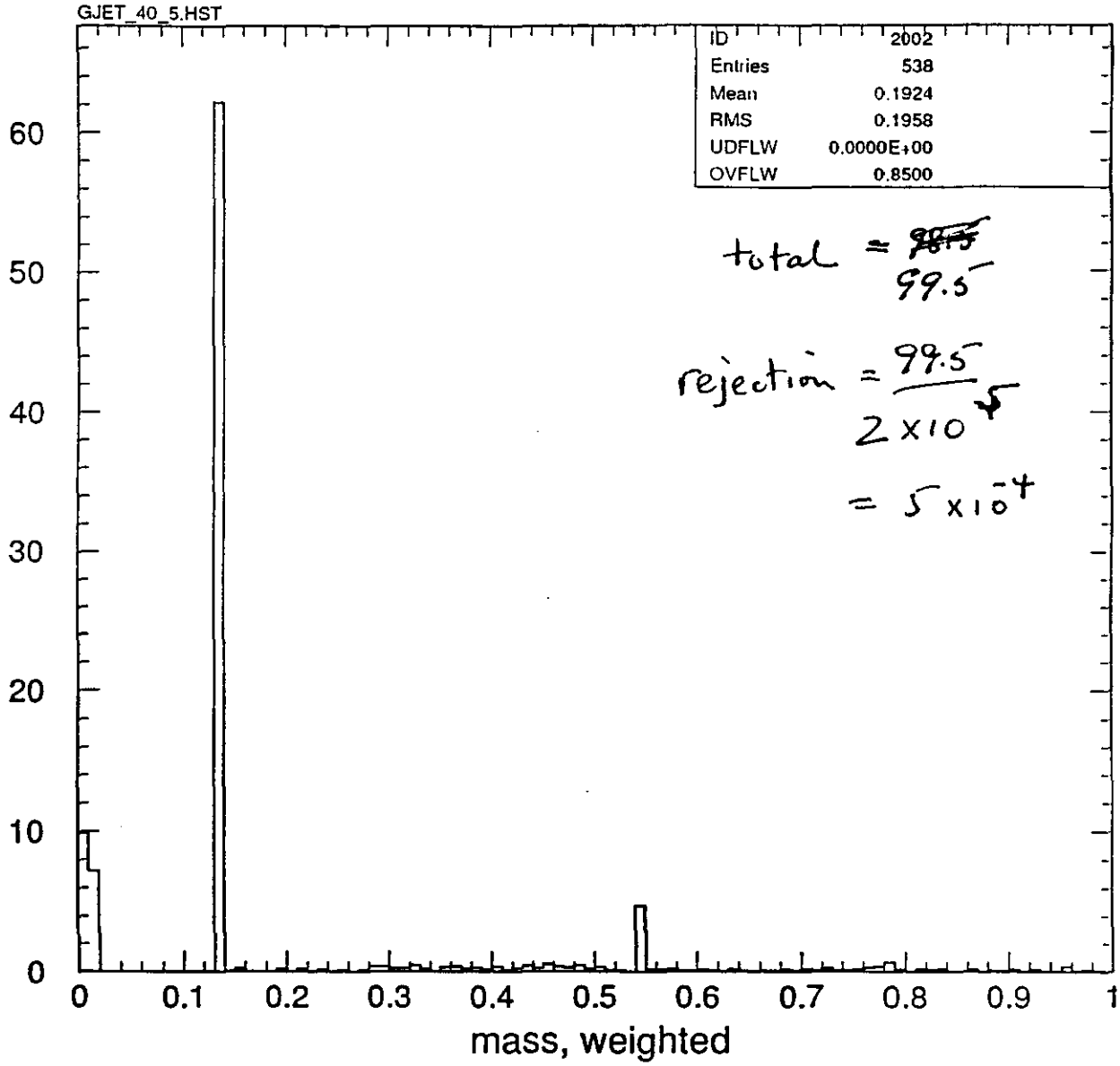


$20/200{,}000$

$= 1\times10^{-4}$

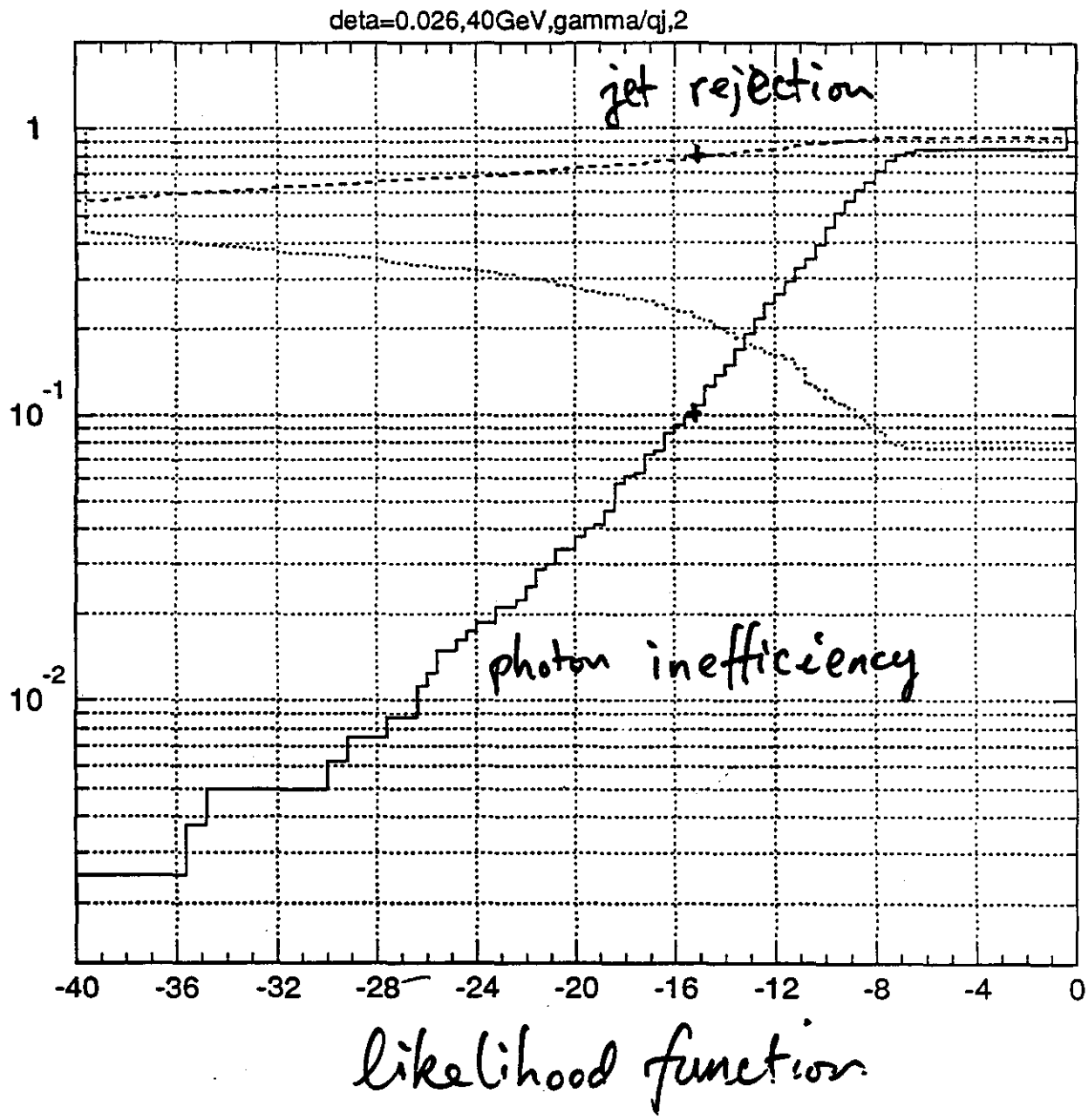
$g \to N\gamma$

93/02/19 16.58



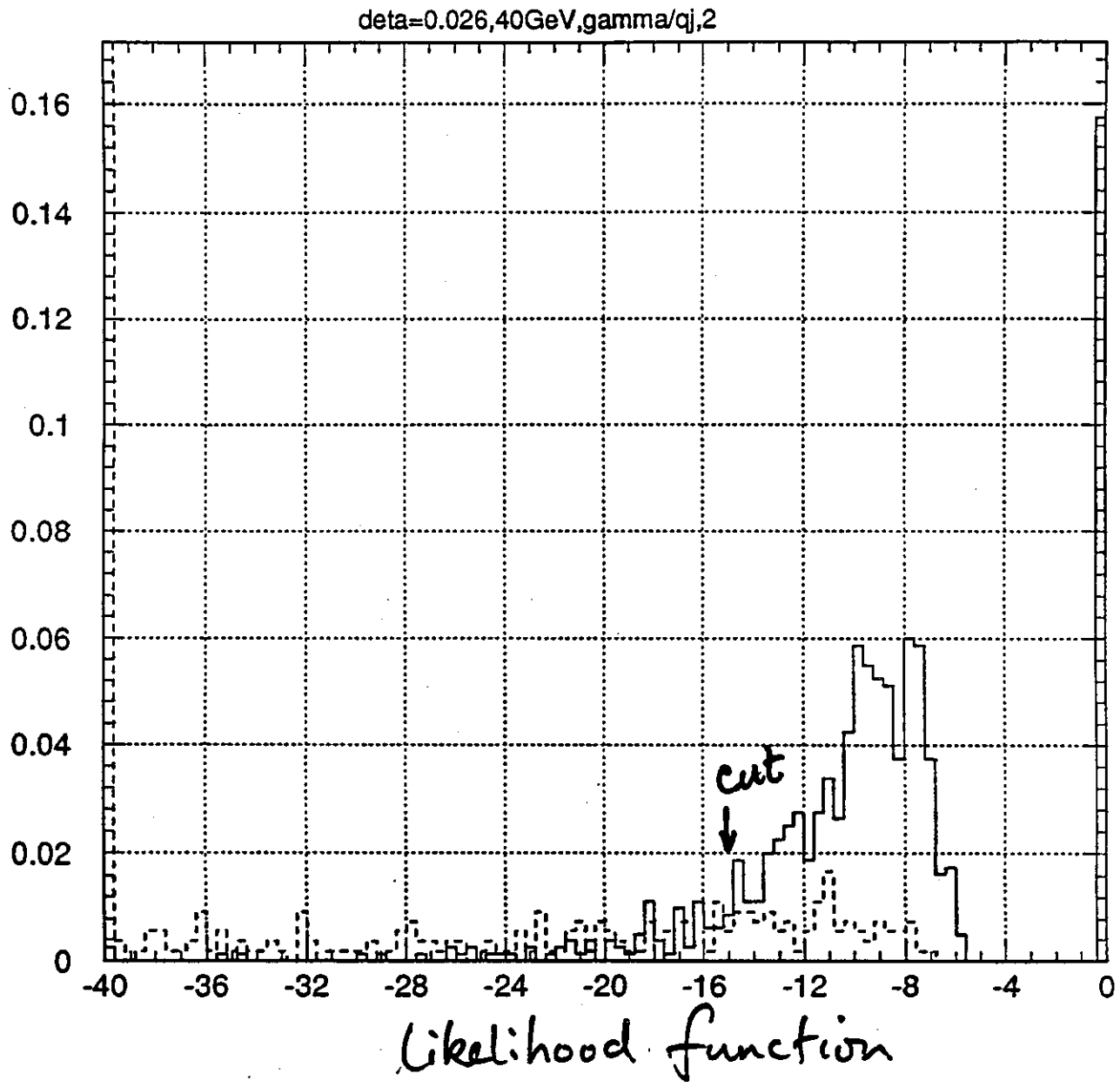
$q \rightarrow N\gamma$

93/02/22 13.24



$\underline{q} \to N\gamma$

93/02/22 13.24



Jet Rejection

Parton	isolation	strip + Shower shape	~~Kinematic Acceptance (23%)~~ *
q	1×10^{-2}	2×10^{-3}	~~4×10^{-4}~~
g	2.7×10^{-3}	5.4×10^{-4}	~~1.1×10^{-4}~~
q	5.7×10^{-3}	1.03×10^{-3}	
g	1×10^{-3}	1.6×10^{-4}	

ed for	q (γ-jet)	1.6×10^{-4}
- Irr. γγ	g (2jet)	1.5×10^{-4}
ted for	q	1.6×10^{-3}
Irr. γγ	g	5×10^{-4}

R.Y. Zhu. TM-126

to be compared to the number in Table 9.

At 80 GeV, isolation cut is more effective (if E_T^{iso} kept at 5 GeV). EM Cluster has larger multiplicity (or mass). strip + shower shape rejection is about 5–6.

Presentation by:

Hiro Yamamoto

Hiroaki Yamamoto @ CIT
February 23, 1993

Structure Functions

- short story behind the sceen -

1. EHLQ - good old boy @ 1984
   vs
   (H/K)MRS - European favoriate @ 1988 - 1992
   vs
   CTEQ - New American Hero @ 1992 -

2. New vs Old

• Signal

	H + x	tt/W + H + x
(H/K)MRS / EHLQ	0.85	0.90
CTEQ / EHLQ	1 ± 0.1	1.1

• $\gamma\gamma$ background $d\sigma / dm(\gamma\gamma) = A\ (pb) \times \exp(-Bm)$

	A	B
EHLQ ~~HELQ~~	0.91 ± 0.03	0.030 ± 0.002
CTEQ	1.04 ± 0.04	0.030 ± 0.002
HMRSB	0.81 ± 0.03	0.029 ± 0.002
MRS S0	0.94 ± 0.03	0.030 ± 0.002

3. Significance uncertainty ($S / \sqrt{B}$) for low mass Higgs
   ~ 15 to 20 %

4. Which one to use ?

gem

γeμ

Presentation by:

S. Shevchenko

Search for High mass Higgs Boson $H^0 \to ZZ \to \ell\ell + 2$ jets at SSC with GEM

Feb. 23 1993

S. Shevchenko

Caltech

Higgs production ($M_H = 800$ GeV)

Two mechanisms dominate:

- $gg \to H^0$ (gluon fusion) $\sim 60\%$
- $qq \to qq H^0$ via the exchange of two W or Z bosons (vector boson fusion) $\sim 40\%$

$$\Gamma_{H^0} \sim M_{H^0}^3$$

For $M_{H^0} = 800$ GeV $\quad \Gamma_{H^0} \simeq 270$ GeV

- NO easily recognizable peak in mass spectrum
- Understanding of background uncertainty is a crucial issue

Signal and Backgrounds Rates

1 SSC year $= 10^4 pb^{-1}$

	Cross section (pb)	Rate/year (number of events)
$H^0 \to ZZ$ with $Z \to ee$ or $\mu\mu$ and $Z \to qq$		
M_{H^0}=800 GeV	0.11	1100
$pp \to tt$ with $t \to bW$ and $W \to e\nu$ or $\mu\nu$		
No P_t cut	780.	7.8×10^6
$pp \to Z + jets$ with $Z \to ee$ or $\mu\mu$		
$P_{tZ} > 50$ GeV	5.7×10^2	5.7×10^6
$P_{tZ} > 200$ GeV	27.	2.7×10^5
$pp \to ZW, ZZ$ with one $Z \to ee$ or $\mu\mu$		
$P_{tZ} > 50$ GeV	2.6	2.6×10^4
$P_{tZ} > 200$ GeV	0.13	1.3×10^3

Cross sections calculated with PYTHIA 5.6 Monte Carlo. EHLQ 1 structure functions

Tools

- **Pythia**

  with energy resolution smearing:

  - Electromagnetic resolution

    $7.5\%/\sqrt{E} + 0.4\%$

  - Hadronic resolution

    $70\%/\sqrt{E} + 4.5\%$

- **GEMFAST** VII102

  - Electromagnetic resolution

    Barrel – $6\%/\sqrt{E} + 0.4\%$

    Endcap – $8.5\%/\sqrt{E} + 0.4\%$

  - Hadronic resolution

    $57\%/\sqrt{E} + 3.4\%$

    (A. Savin for barrel)

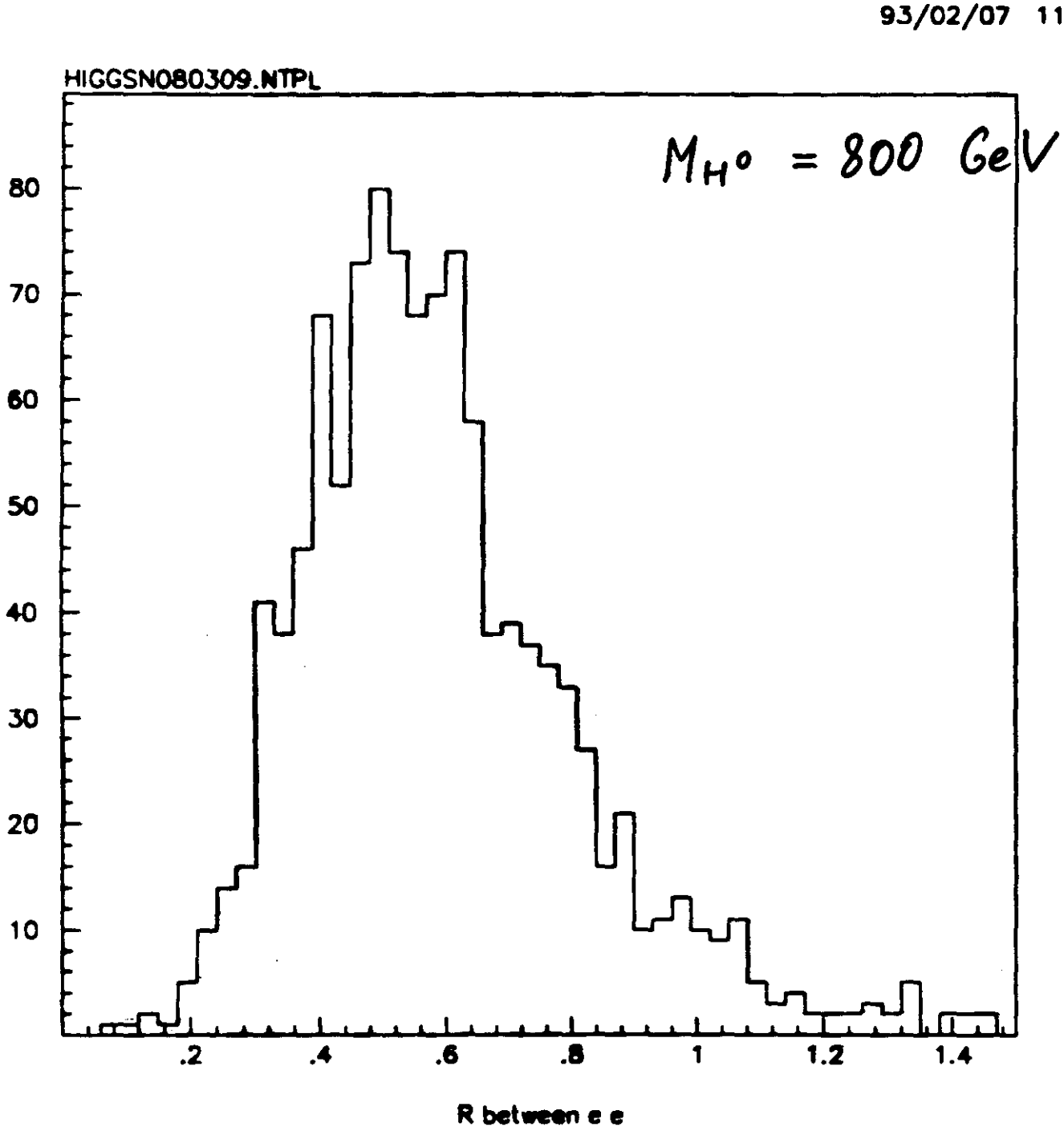
Number of generated event for backgrounds

- **$t\bar{t}$ background** $\sim 3 \cdot 10^6$
  - $W^{\pm}$ forced to decay into leptons
  - $P_{te} > 50$ GeV
  - $|\eta_e| < 2.5$
  - $M_Z - 15$ GeV $< M_{ee} < M_Z + 15$ GeV

- **Z + jets, ZW, ZZ background** 1 SSC year
  - Z forced to decay into leptons
  - $P_{te} > 50$ GeV
  - $|\eta_e| < 2.5$
  - $P_{tZ} > 200$ GeV

$H^0 \to ZZ \to e^+e^-$ jet jet was analyzed

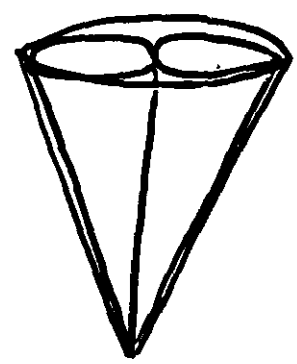
Minimum distance in ΔR
(the distance in (η, φ) space)
between two leptons.



Two methods to reconstruct Z boson from jet pair:

- Sort out all possible jet pairs and choose one, which gives the closest invariant mass to Z boson mass
  Jet cone — 0.3

- - Find the jet, which has highest transverse energy $|\eta_{jet}| < 2.5$
  Jet cone = 0.9
  - Match two narrow jets (jet cone = 0.3) with larger jet cone



$P_t > 250$ GeV
wide jet

Second method gives better suppression of background

Variables to reject background

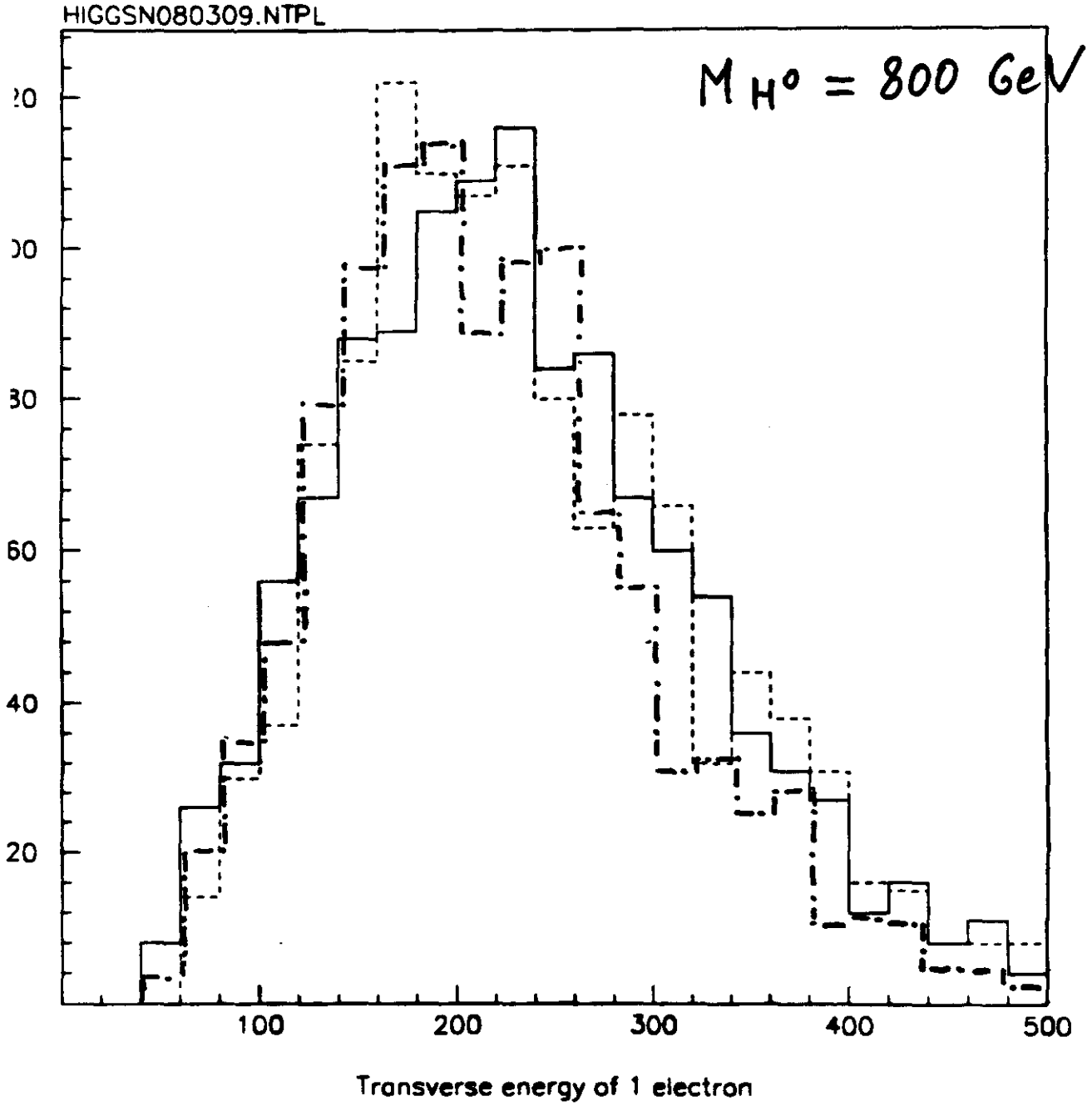
- Transverse energies of leptons and jets
- Reconstructed invarant mass from pairs of leptons and jets
- Transverse energy of reconstructed Z bosons from lepton and jet pairs
- "Forward jet tagging" technique
- "Central jet veto" technique

TRANSVERSE energy of the most energetic

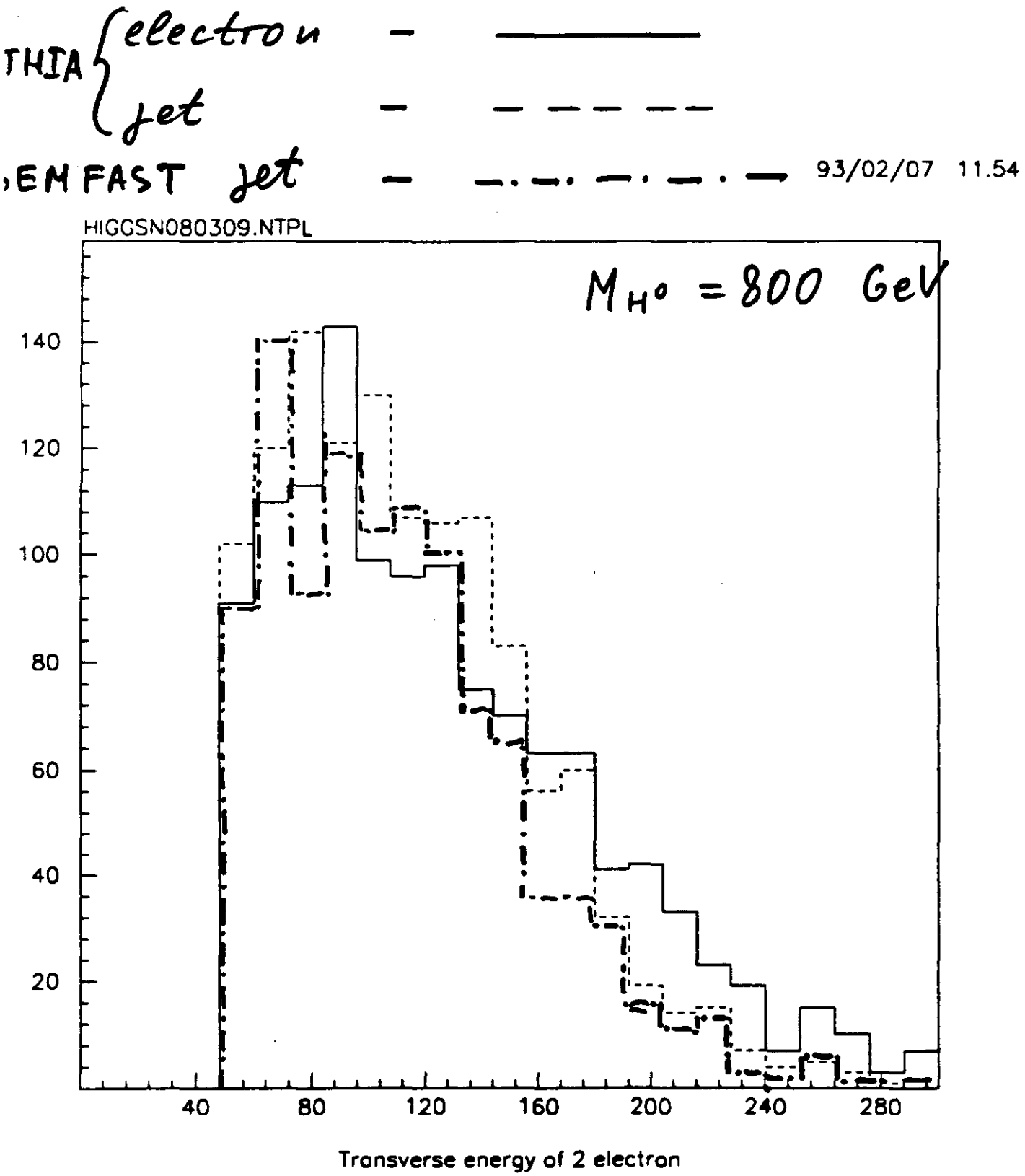
IA { electron — ———
jet — - - - - -

FAST jet — —·—·—·—·—

93/02/07 11.53



TRANSVERSE energy of the less energetic

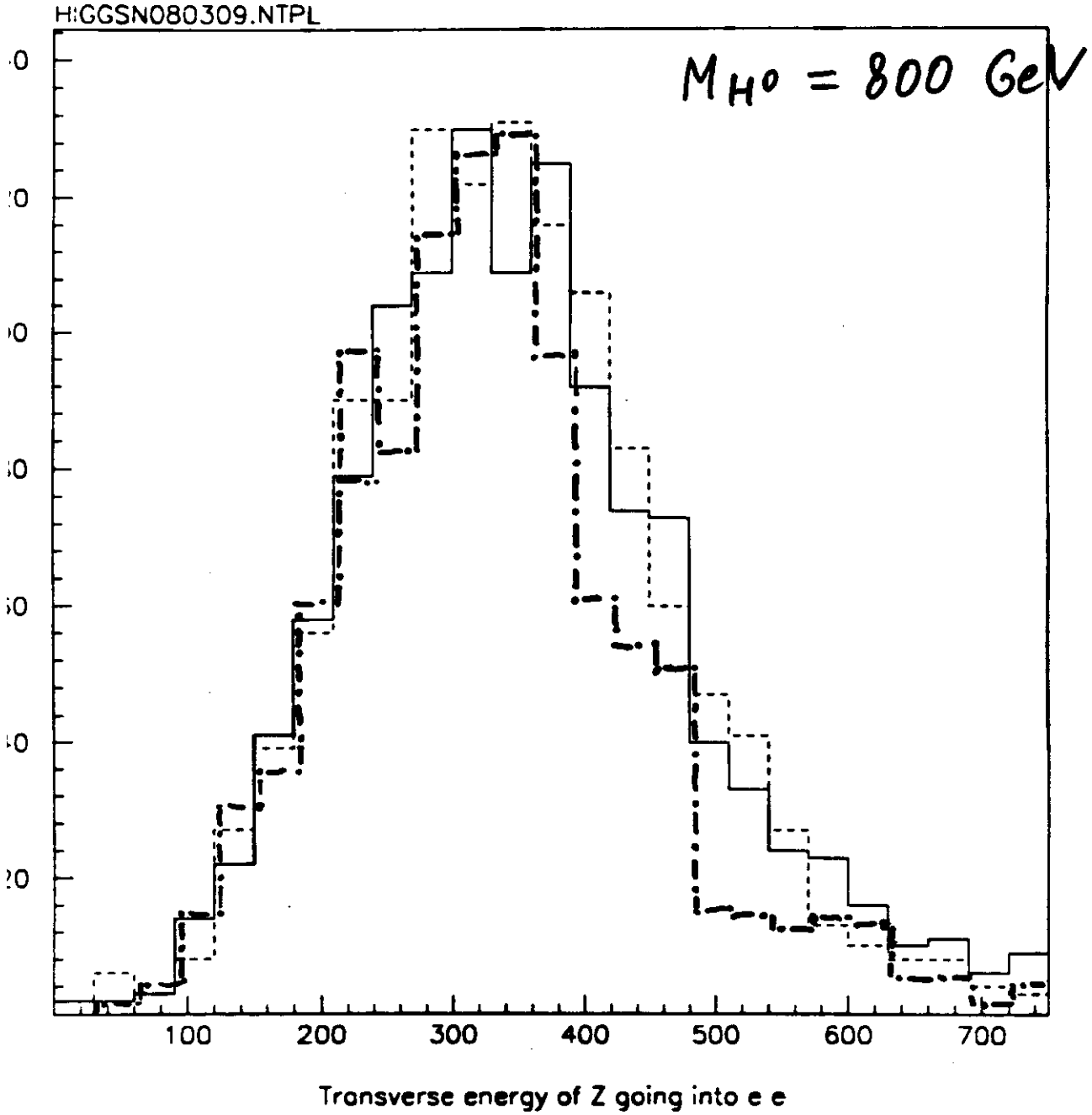


Transverse energy of Z-boson reconstructed from:

iA { electrons — ———
jets — - - - - -

:MFAST jets — —·—·—·—·—

93/02/07 11.55

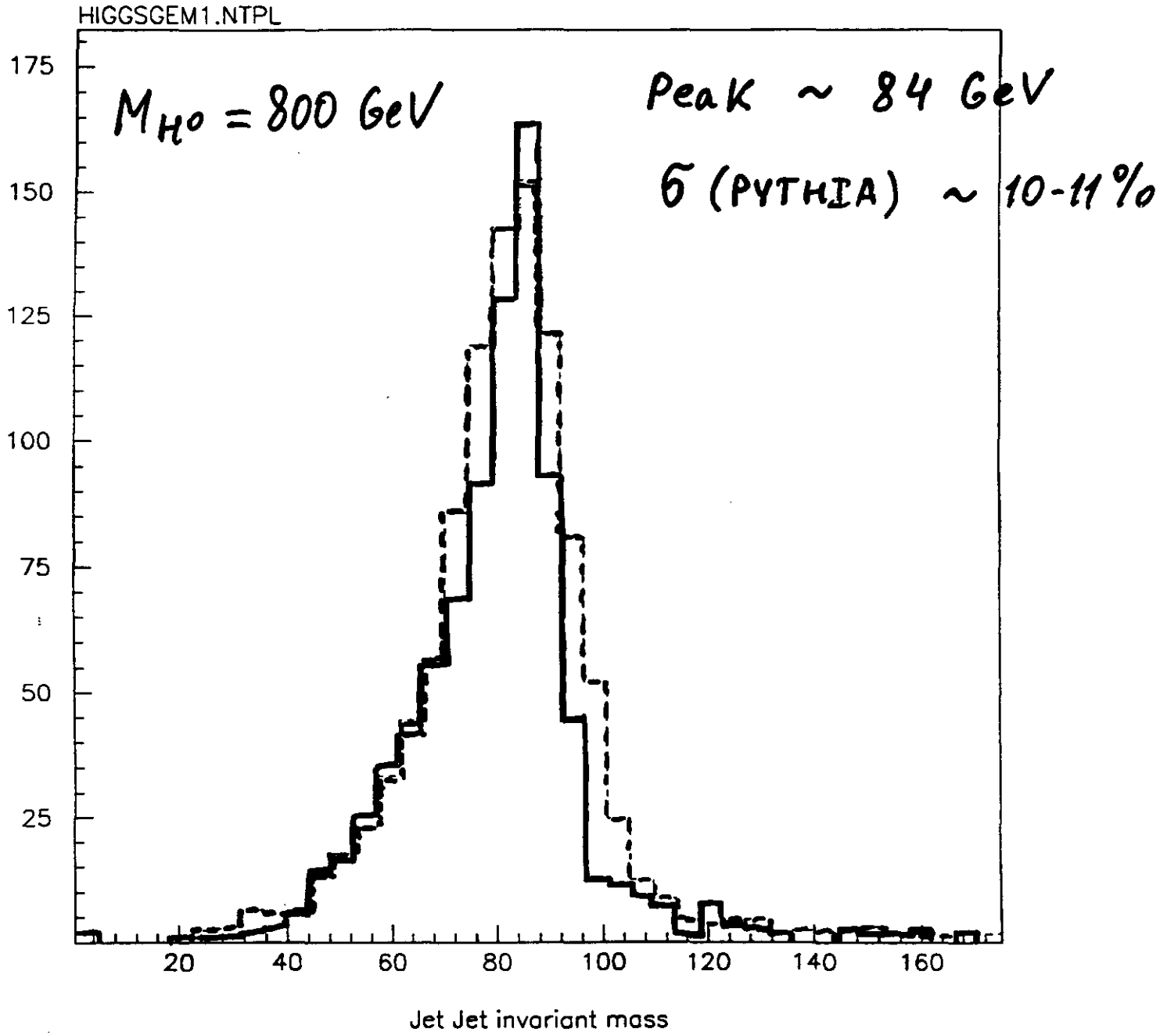


Z-boson mass reconstructed from jets

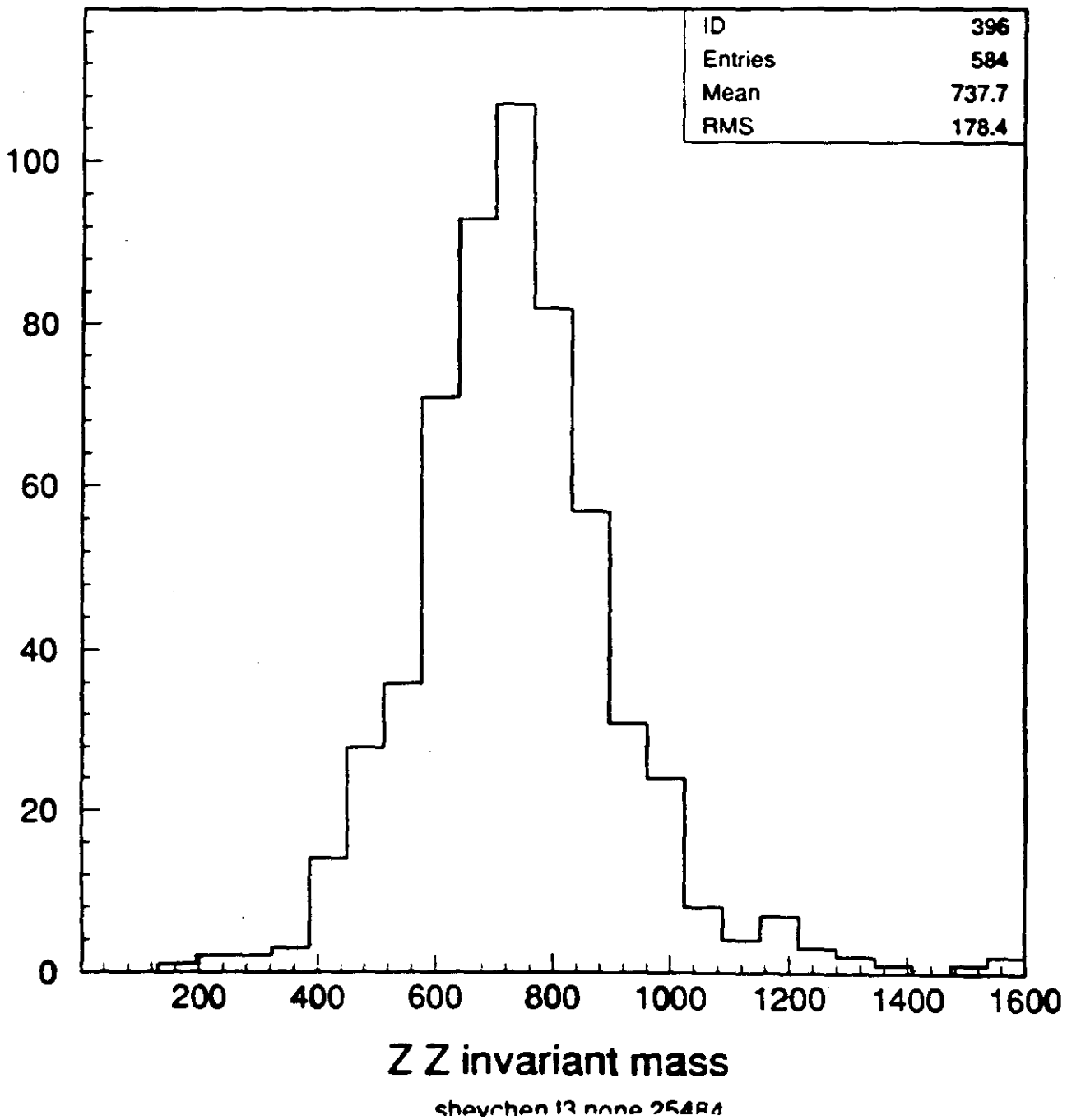
- - - - PYTHIA
hadronic resolution $70\%/\sqrt{E} + 4.5\%$

——— GEMFAST
hadronic resolution $57\%/\sqrt{E} + 3.4\%$

93/02/21 09.54



Higgs signal, reconstructed from leptons and jets



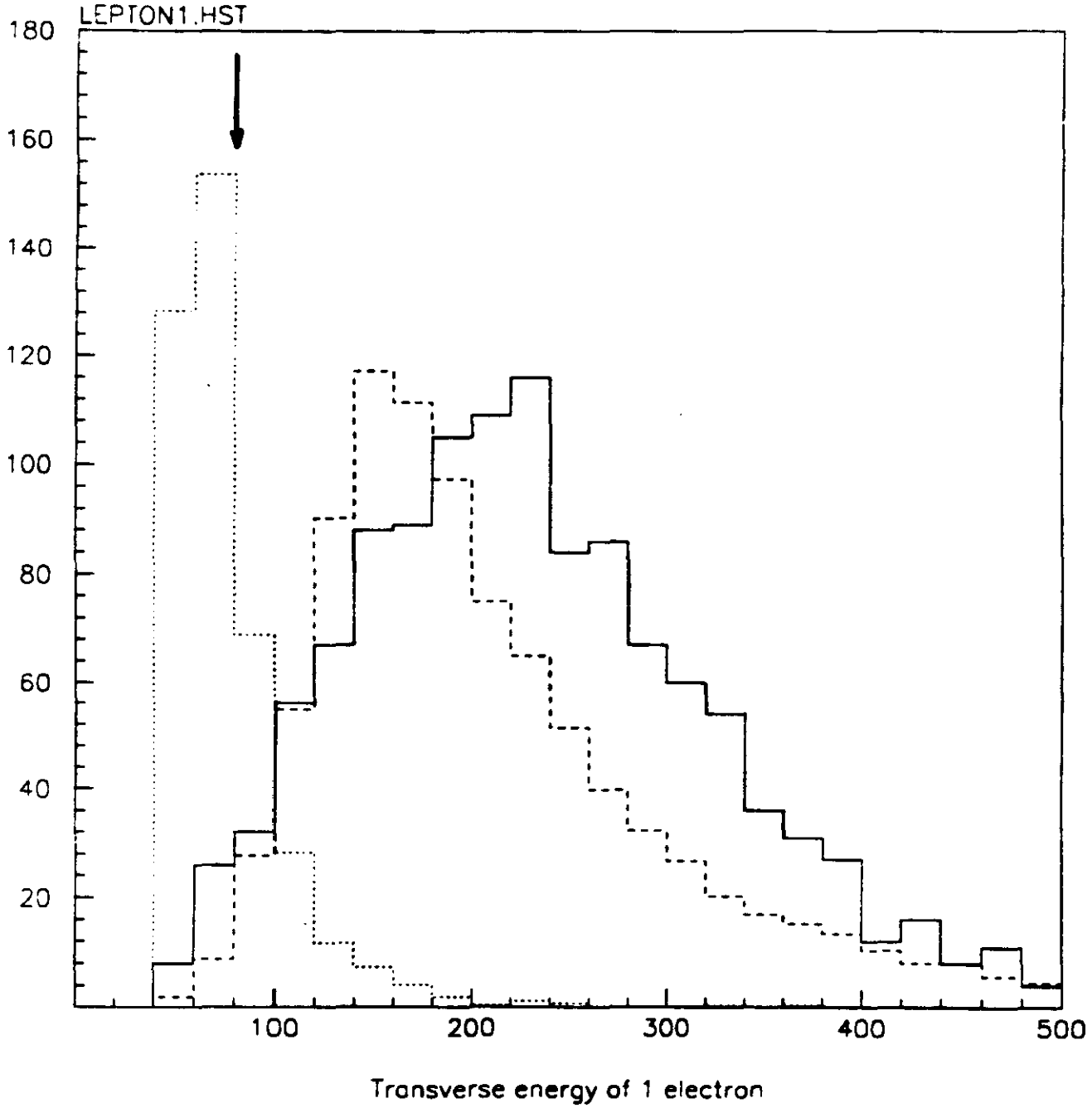
Transverse energy of the most energetic electron

signal — ————

Z+jets, ZW, ZZ — - - - - - -

$t\bar{t}$ — .....

93/02/07 12.55

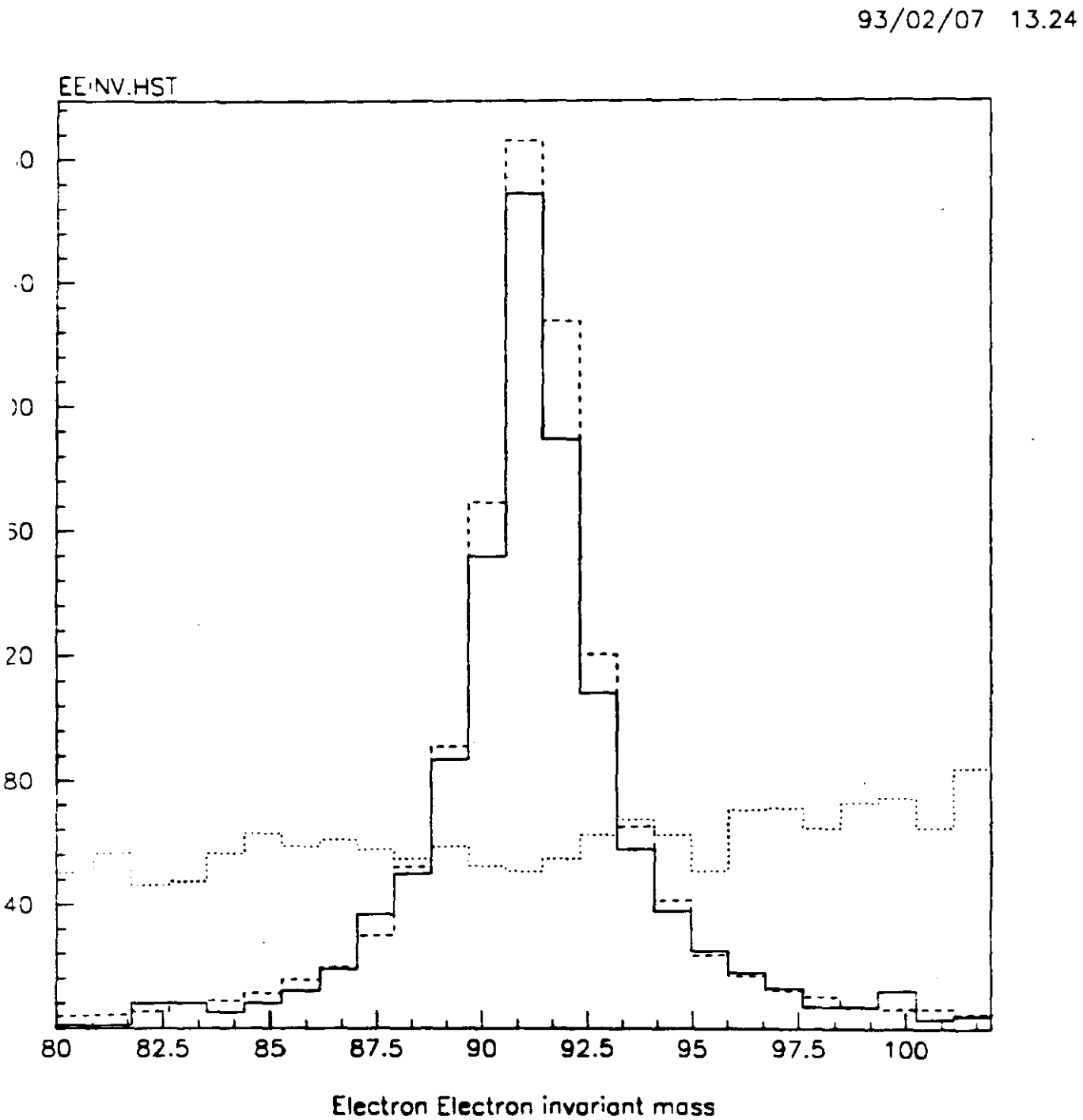


Lepton - lepton invariant mass

signal - ————————

Z+jets, ZW, ZZ - - - - - - -

tt - ·····

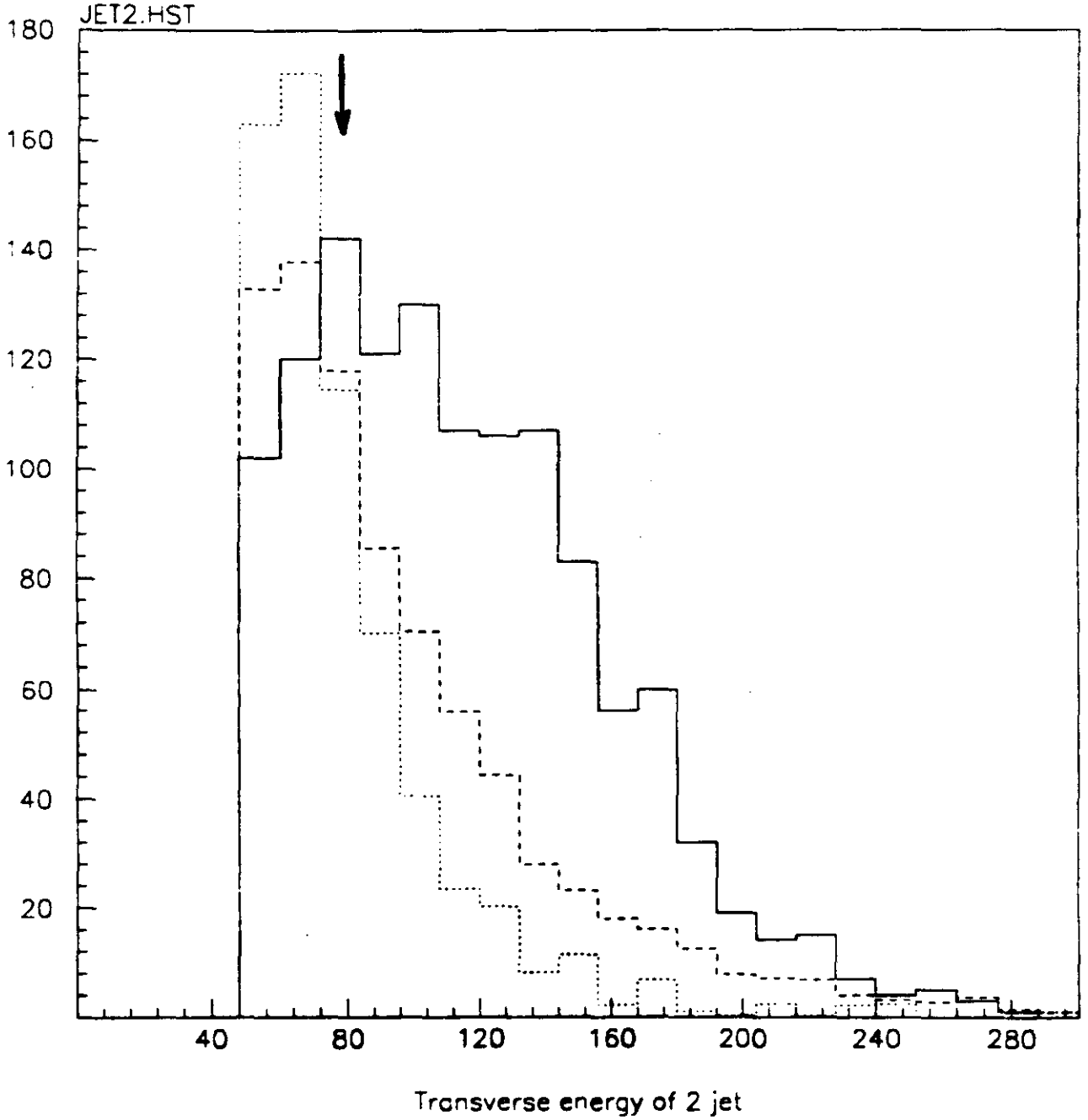


Transverse energy of the less energetic jet

signal - ————

z jet, zw, zz - - - - - -

tt - ····· 93/02/07 13.14



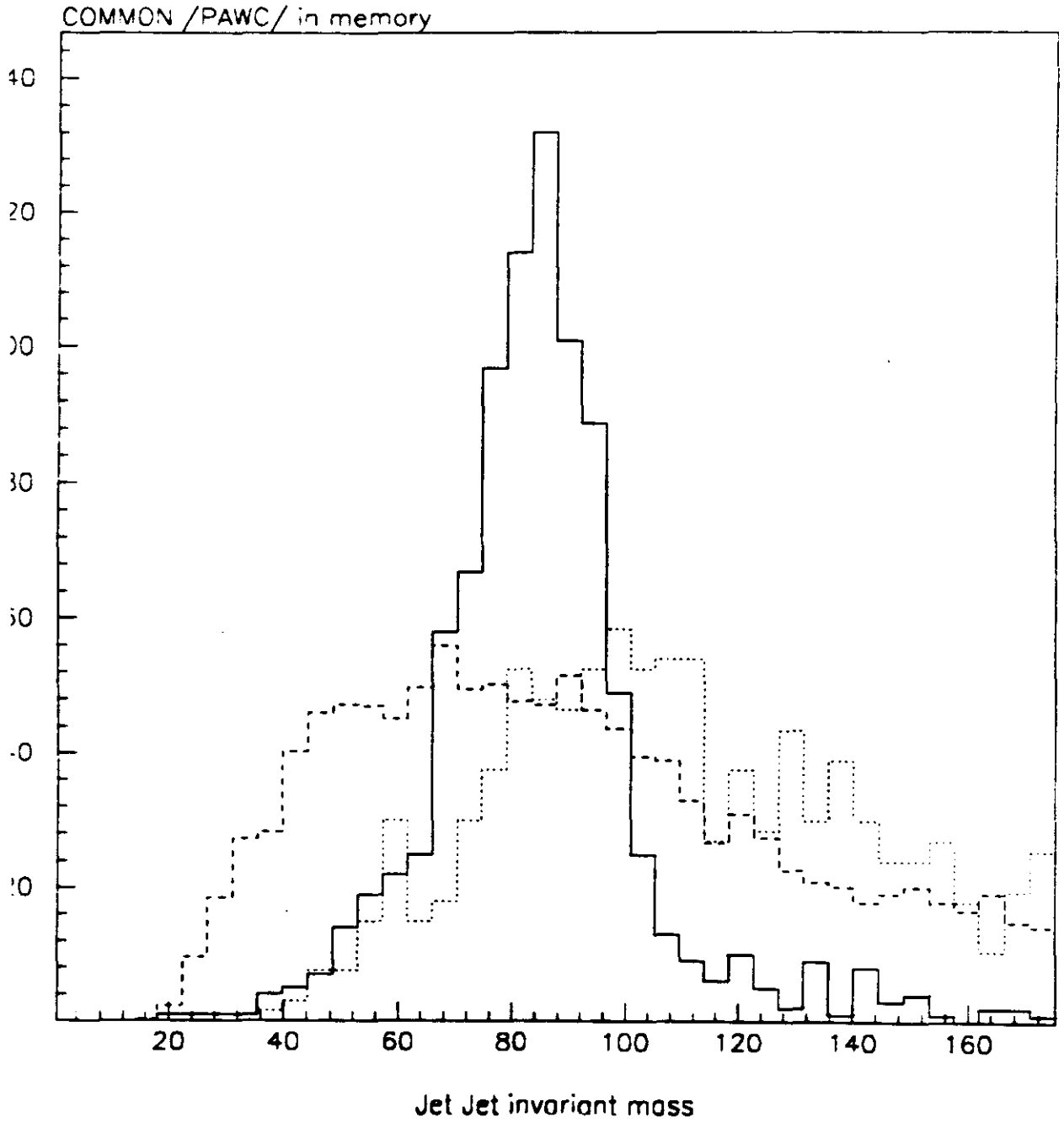
Jet-jet invariant mass

signal — ————————

Z+jets, ZW, ZZ — — — — —

tt — · · · · · · · · · ·

93/02/07 13.28



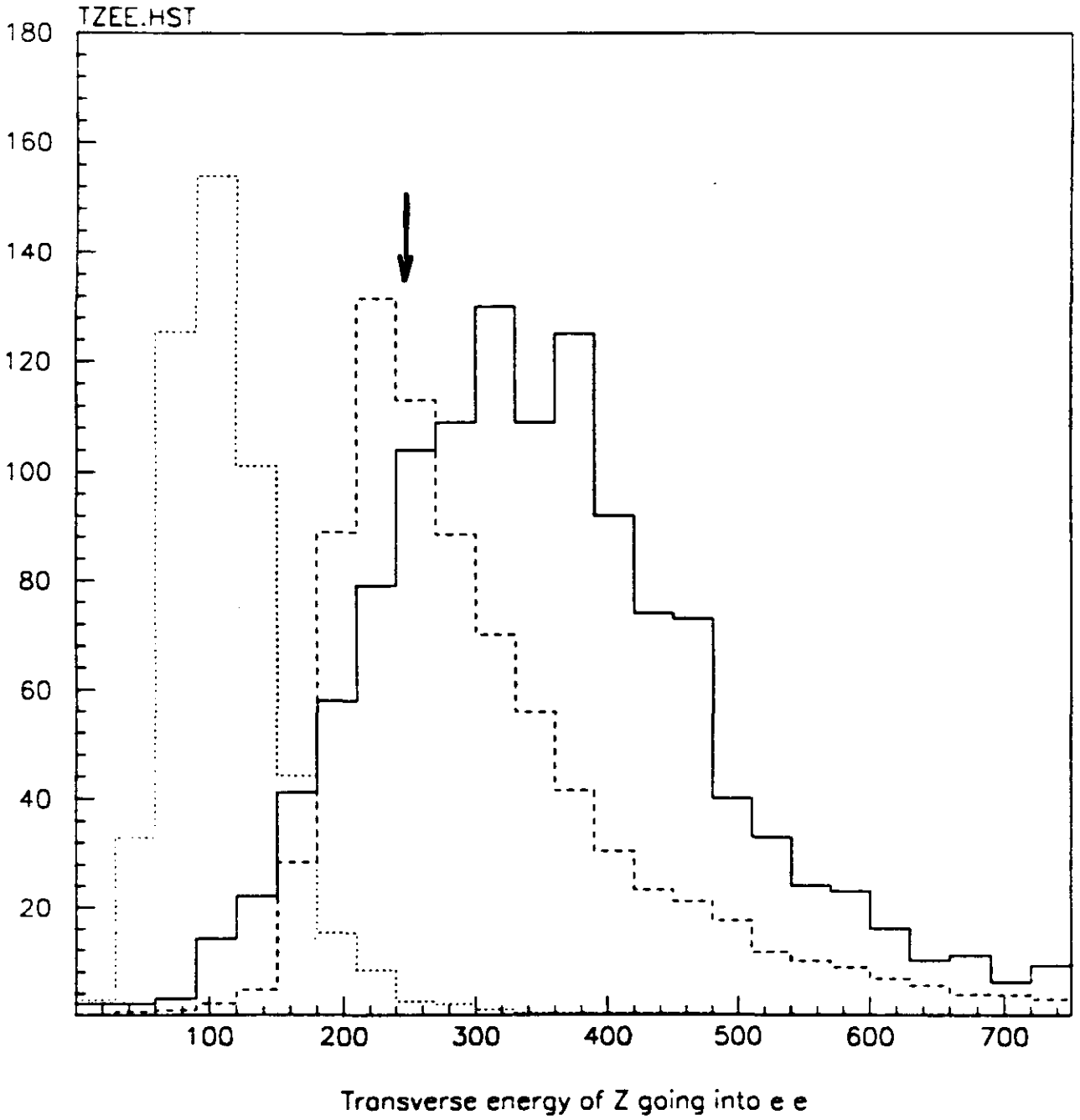
Transverse energy of the Z-boson reconstructed from two leptons

signal — ————————

Z+jets, ZW, ZZ — — — — —

tt — ·····

93/02/07 13.17



Analysis steps

1. - $P_{te} > 50$ GeV , $|\eta_e| < 2.5$
   - leptons should be isolated
   (X. Shi, Caltech , GEM TN-93-284)

Signal - 57% Background - 26%

! All numbers are preliminary

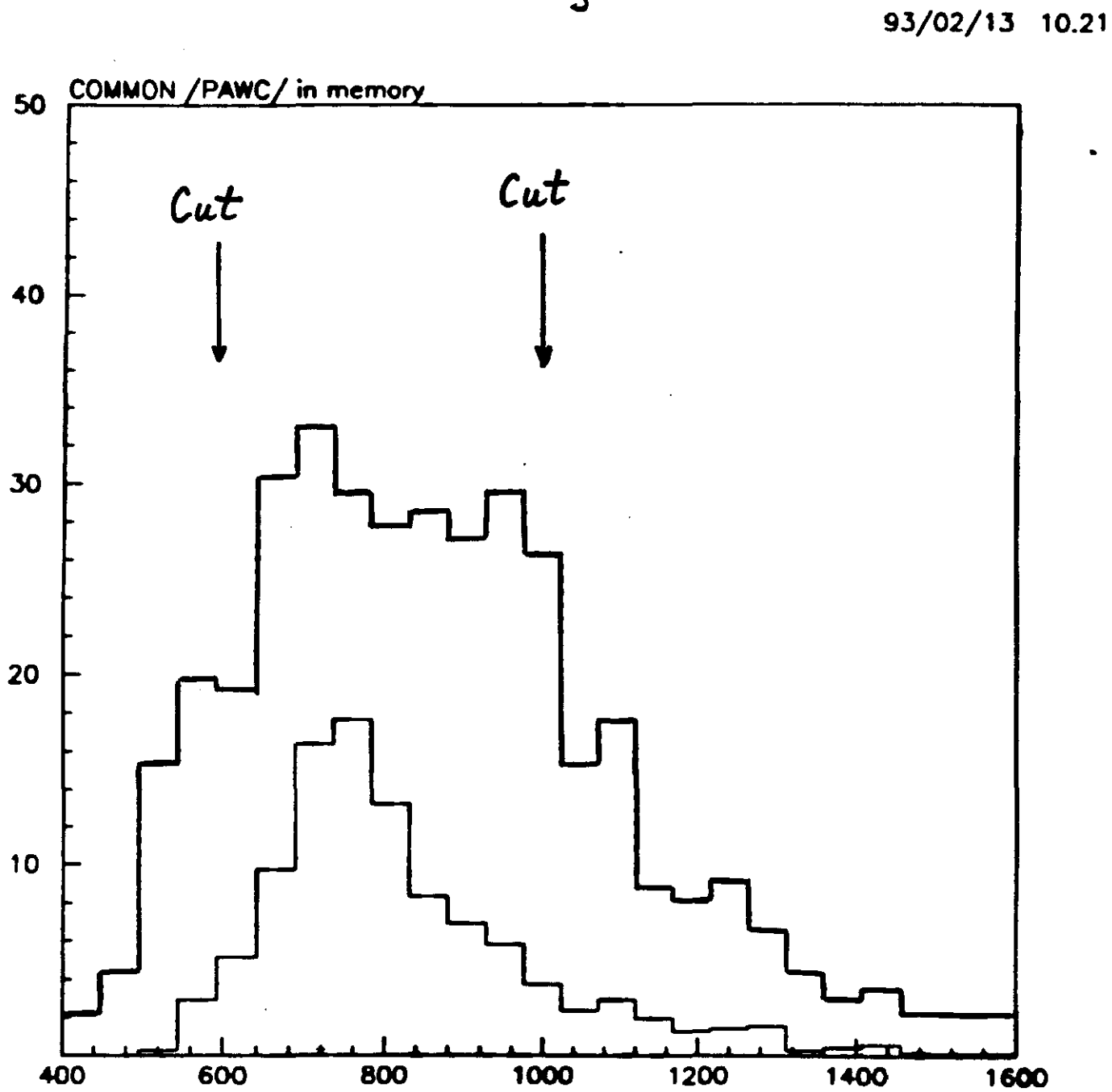
- ΔR between leptons < 1.2
- $M_Z - 10$ GeV $< M_{ee} < M_Z + 10$ GeV

Signal - 90% Background - 90%

- $P_{t\,wide\,jet} > 250$ GeV and $|\eta| < 2.5$
- two narrow jets match with wide jet
- invariant mass reconstructed from two narrow jets should be
  $M_Z - 20$ GeV $< M_{\gamma\gamma} < M_Z + 15$ GeV

Signal - 47% Background - 4%

Higgs mass,
reconstructed from two Z bosons



E. - $P_{t_{leptons,\ jets}} > 80$ GeV

- $P_{t\ Z_{\mu\mu},\ Z_{ee}} > 250$ GeV

Signal - 68% Background - 33%

D. - 600 GeV $< M_{ZZ} <$ 1000 GeV

Signal - 82% Background - 65%

<u>Total</u>

Signal - 13.5% Background - 0.2%

<u>1 SSC year</u> ($\mu\mu$ + ee channels)

Signal - ~ 150 events

Background - ~ 540 events

$\Uparrow$ EHLQ 1 set

These numbers suppose same efficiency for $H^0 \to ZZ \to \mu\mu$ jet jet, as for ee jet jet

Preliminary

Significance

EHLQ1 Set

- **Perfect knowledge of background**

Signal – ~150
Background – ~540 } 690

$S = 6.5$

- **5% uncertainty in background**

Signal – 123
Background – 567

$S = 5.2$

- **10% uncertainty in background**

Signal – 96
Background – 594

$S = 3.9$

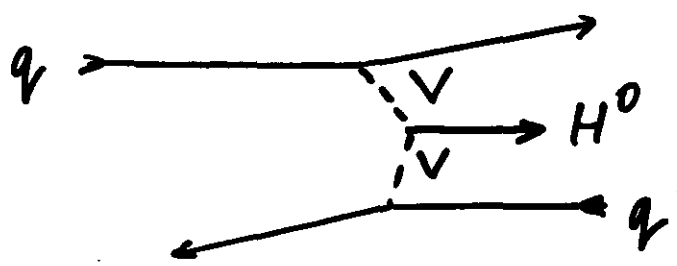
! Significance for heavy Higgs should be impoved by combining analysis result from three independent channels :

$H^0 \rightarrow ll$ jet jet ; $H_0 \rightarrow llll$
$H^0 \rightarrow ll\ \nu\nu$;

"Forward jet tagging" and "central rapidity jet veto" techniques.

expected for Higgs production through VV fusion
40% of total cross section
for $M_{H^0} = 800$ GeV

- "forward jet tagging"



expected high energetic jets in forward direction

- "centrall rapidity jet veto"

  - No exchange of color between high-pt jets and incident proton remnants for the signal
    less jets in central region
  - Exchange of colour between high-p_t jets and incident proton remnants for the background
    more jets in central region

Number of jets in rapidity region
$|\eta| < 1.7$

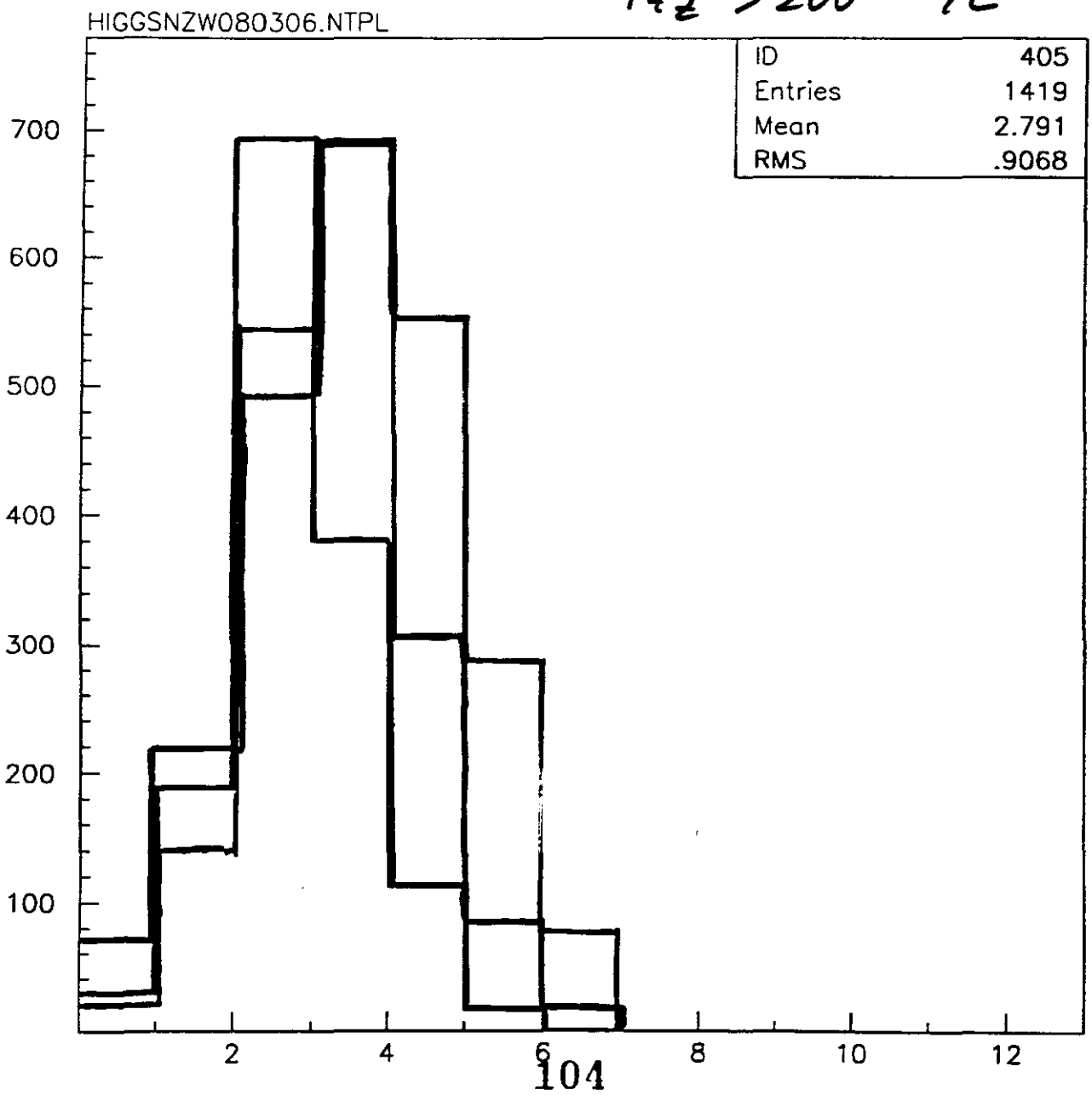
P_t jet > 50 GeV jet cone = 0.6

——— $WW \to H^0$ (VV fusion)

——— $gg \to H^0$ (gluon fusion)

——— Z + jets, $P_{tZ} > 200$ GeV/c

93/02/15 17.33



Wide jets in rapidity gap 1.7

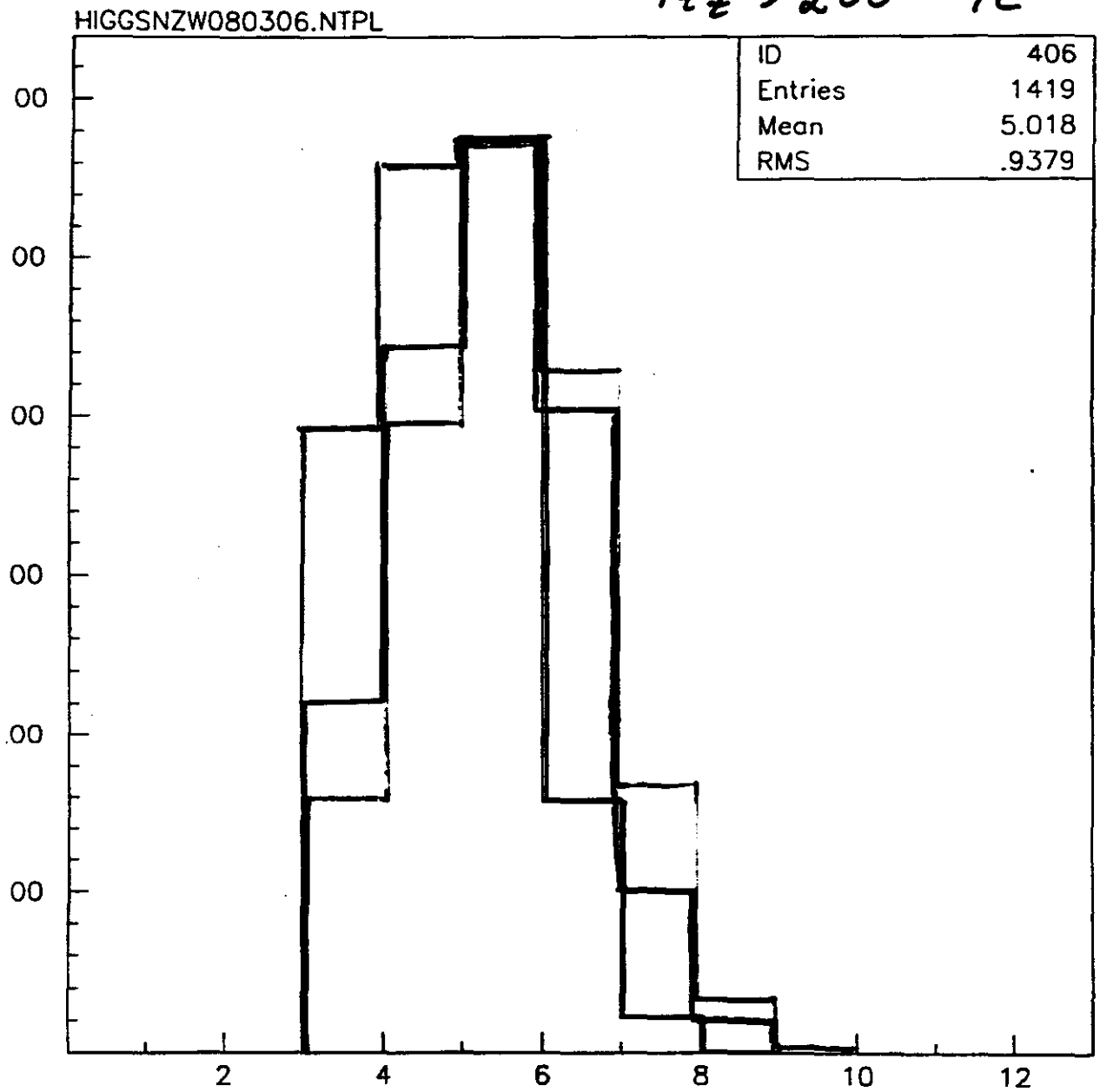
Number of jets in rapidity region
$|\eta| < 2.5$
P_t jet > 50 GeV/c ; jet cone = 0.6

——— $VV \rightarrow H^0$ (VV fusion)

——— $gg \rightarrow H^0$ (gluon fusion)

——— Z + jets, $P_{tZ} > 200$ GeV/c

93/02/15 17.34



Wide jets in rapidity gap 2.5

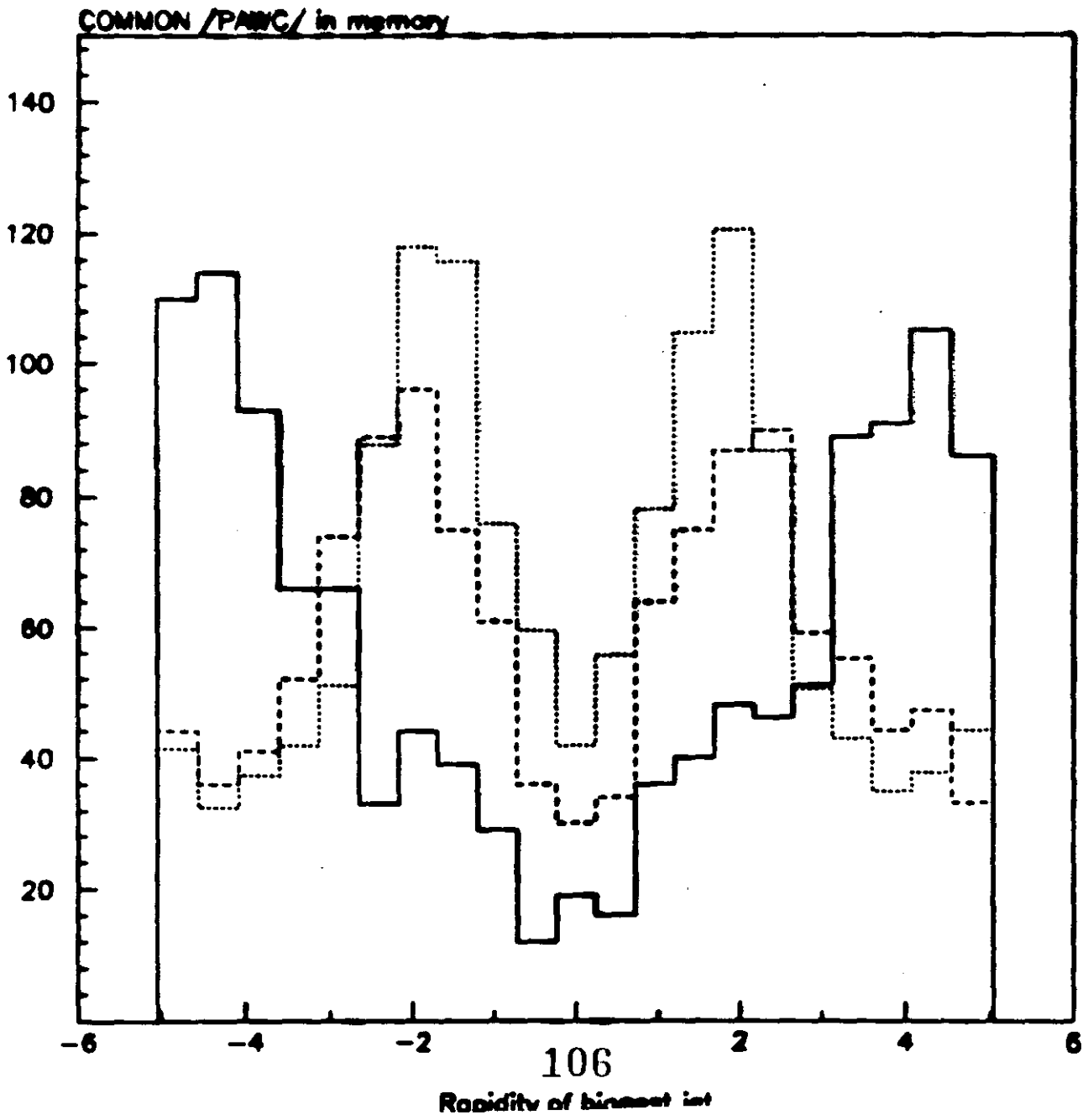
Rapidity of the highest jet

H^0 VV fusion — ————

H^0 gg fusion — - - - - -

Zjet background — .....

93/02/07 18.24



Assumption for forward calorimeter

- $3 < |\eta| < 5$
- segmentation in η, φ – 0.3
- energy resolution – $100\%/\sqrt{E} + 5\%$
- jet cone size – 0.6

Results after kinematical and topological cuts + "jet tagging"

one jet tagging in $2.5 < |\eta| < 4.5$

- $E_{jet} > 2000$ GeV, $P_{t_{jet}} > 50$ GeV

Events after cuts (1 SSC year)

Signal – ~24 eff = 2.1%

Background – ~32 eff = 1.3×10^{-4}

$S = 4.2$

(3.6) EHLQ1 Set

assuming 10% uncertainty in background

Preliminary

Conclusions

- Background
  - $t\bar{t}$ background – not a problem
  - Z+jets background is very important
- If the knowledge of background uncertainty is $\lesssim 10\%$ one does not need to apply "forward jet tagging" technique. With only kinematical and topological cuts one can achive the same significance.
- It could be important to apply "forward jet tagging" technique, If background uncertainty $> 10\%$.
- "central rapidity jet veto" seems doesn't help

gem

γeμ

Presentation by:

Chiaki Yanagisawa

Top Physics

Chicki Yanagisawa
at SSCL

$m_t = 250\,\mathrm{GeV}$ $\quad \sigma_{t\bar{t}} = 1.5\,\mathrm{nb} \rightarrow 1.5 \times 10^7\, t\bar{t}/\mathrm{SSCY}$
@ $10^{33}\,\mathrm{cm}^{-2}\mathrm{s}^{-1}$

$t\bar{t} \rightarrow W^-\bar{b}$, $W^- \rightarrow \ell^-\bar{\nu}$, $W^- \rightarrow q\bar{q}'$

$t\bar{t} \rightarrow W^+ b$, $W^+ \rightarrow \ell^+\nu$, $W^+ \rightarrow q\bar{q}'$: $cW^* \rightarrow cq\bar{q}'$

$W^+ \rightarrow \ell^+\nu$: $cW^* \rightarrow c\mu^-\nu$

ℓ + jets

(1) An isolated μ with the highest $p_T > 20\,\mathrm{GeV}/c$

(2) Jets defined with cone size 0.5, $p_T^{jet} > 50\,\mathrm{GeV}/c$

(3) $\phi_{\mu\text{-jet}} > 90°$

(4) Pick up up to 4 highest p_T jets

(5) One of di-jet mass within 20 GeV of m_W.

(6) $p_T(3\,\mathrm{jets}) \geq 300\,\mathrm{GeV}/c$

Expected # of events

$$1.5 \times 10^7 \times \frac{220}{10{,}000} \times \overset{\text{w/e } t/\bar{t}}{2} \times \overset{B(W\to\ell)}{2} \times \overset{B(W\to q\bar{q}')}{0.1} \times 0.7 \simeq 92\,k/\mathrm{SSCY}$$

$e^{\pm} + \mu^{\mp} +$ "μ" with jet

(1) One isolated μ ($p_T > 20$ GeV/c)
one isolated $e^{\pm}$ ($p_T > 20$ GeV/c)
one non-isolated μ ($p_T > 10$ GeV/c)

(2) $e^{+}\mu^{-}$"μ^{-}" or $e^{-}\mu^{+}$"μ^{-}"
$m_{e\mu}$ $m_{\mu\mu}$

(3) $p_T(e\mu) > 120$ GeV/c ?

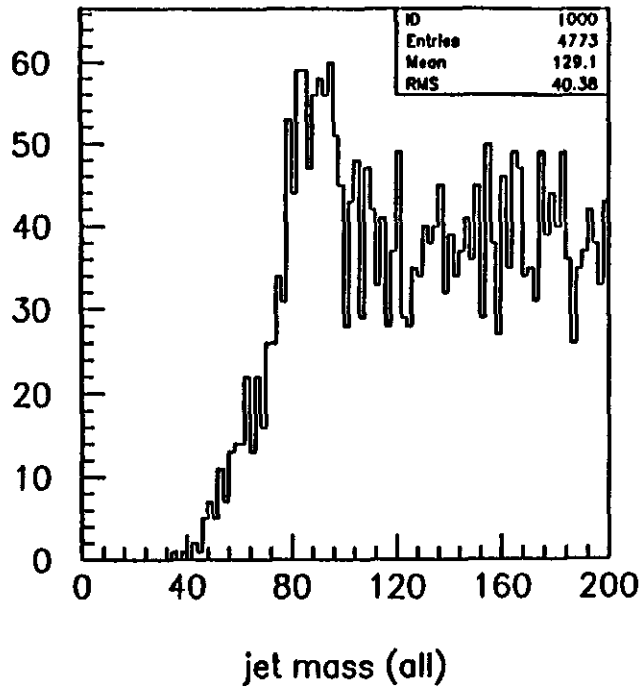
(4) $\phi_{e\mu} < 90°$

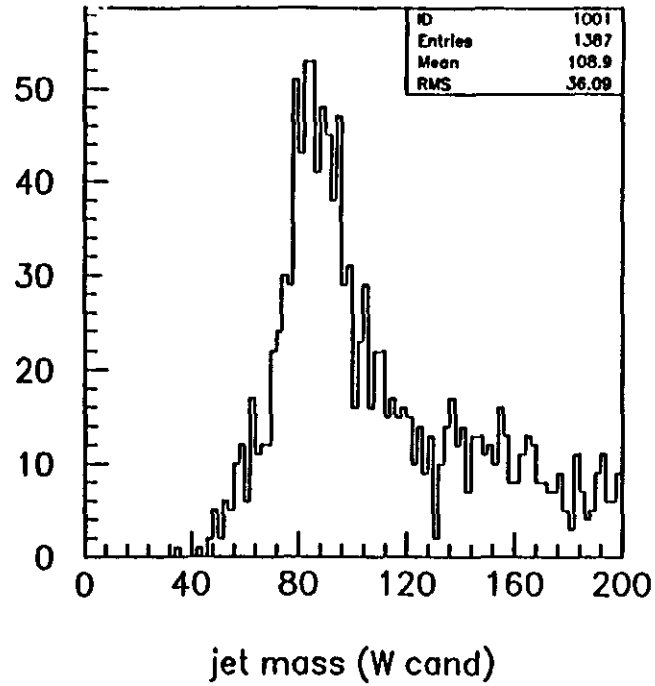
Expected # of events

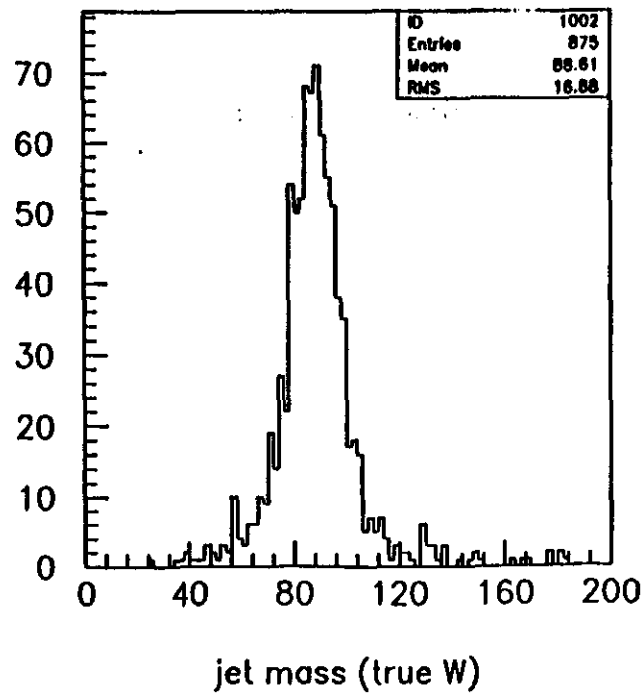
$$1.5\times10^{7} \times \frac{806}{10{,}000} \times 2 \times (0.1)^2 \times 2 \times 0.1 = 4836 \text{ ev/sscy}$$

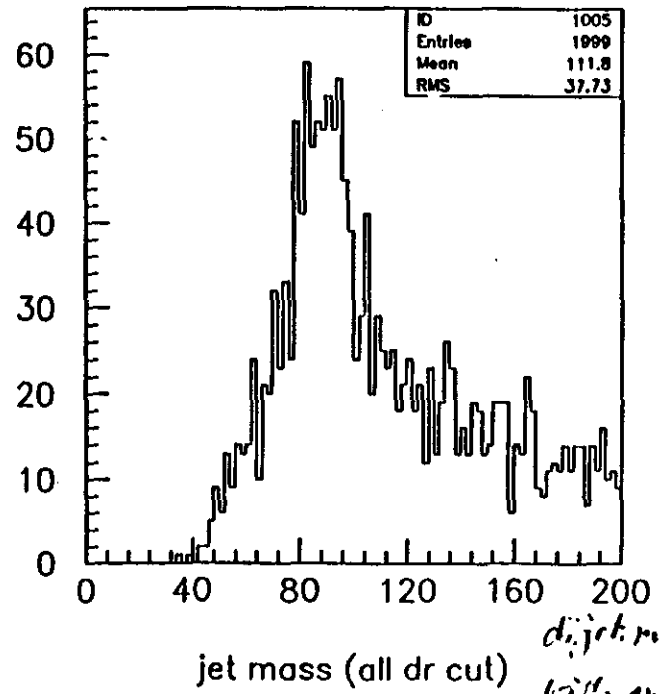
μ/e $B(b\to e)$ b/b $B(b\to\mu)$

$$\frac{96}{10{,}000} = 576!$$

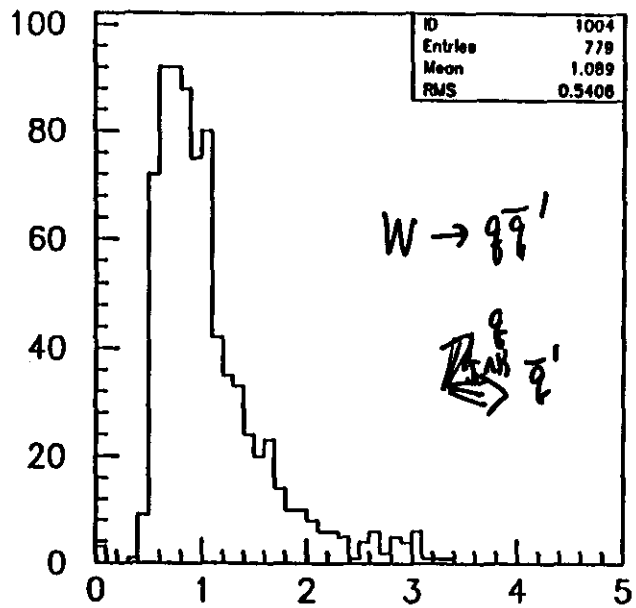


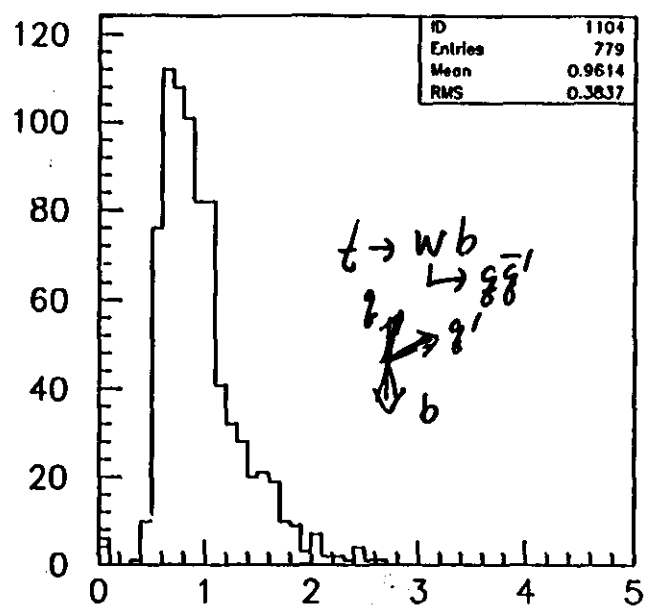


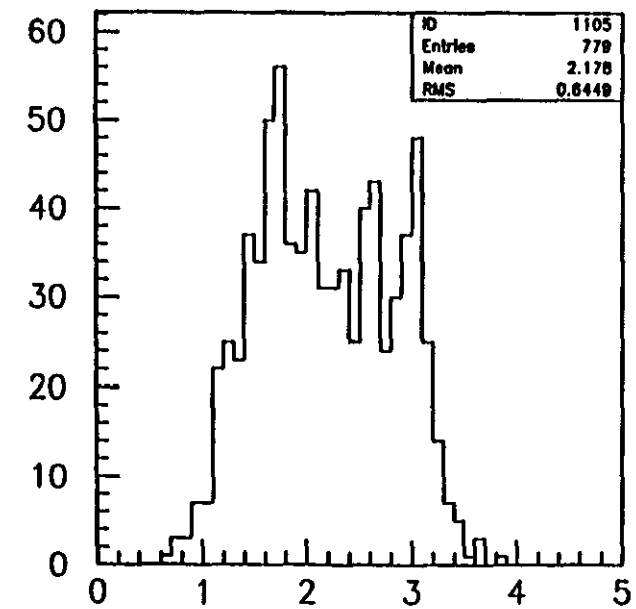


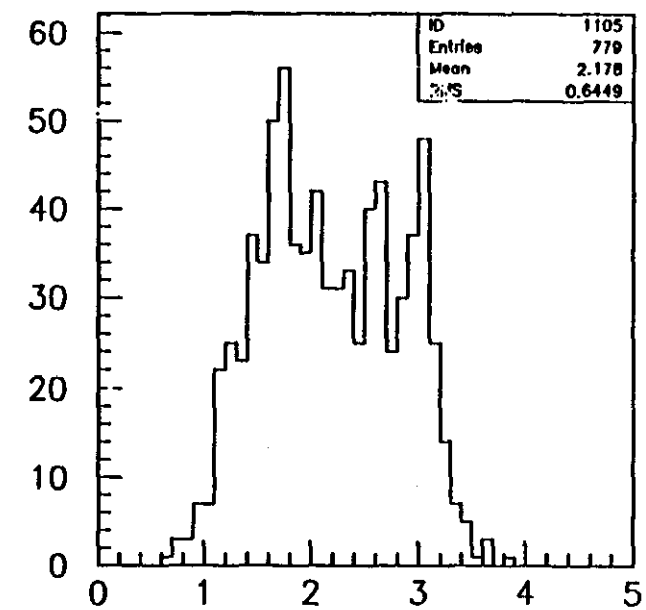


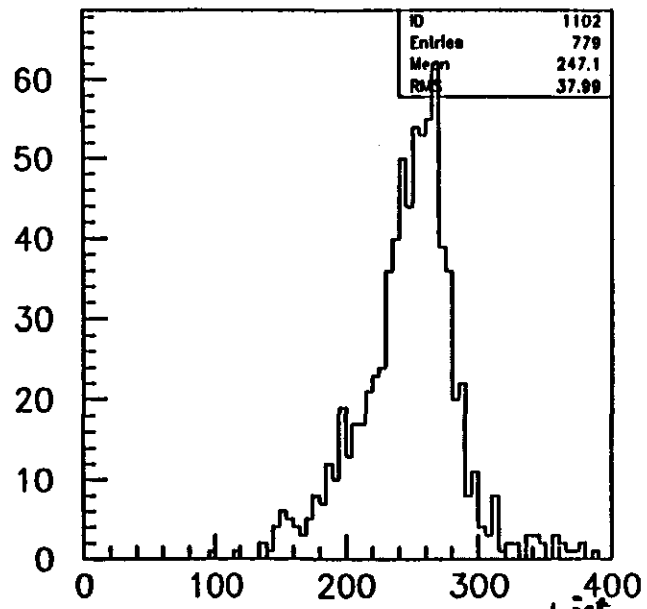
dijet mass of [illegible] pair with smallest ΔR.


ID 1004
Entries 779
Mean 1.089
RMS 0.5406
W → qq̄'
delta R of two jets from W

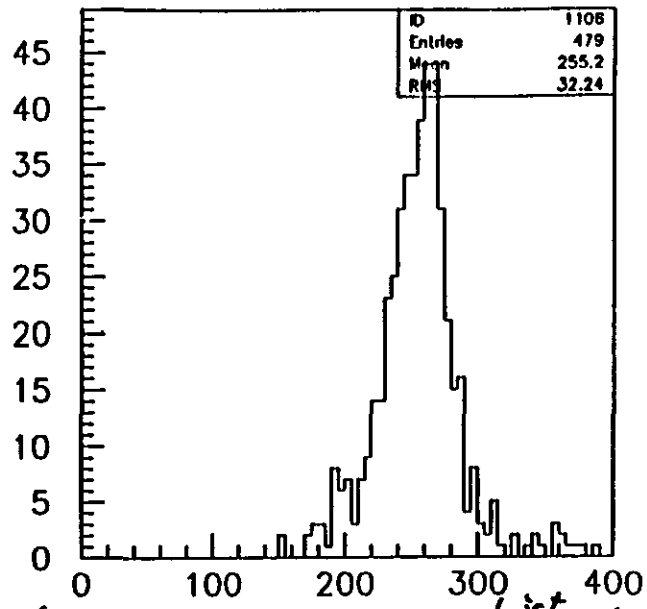

ID 1104
Entries 779
Mean 0.9614
RMS 0.3837
t → Wb
delta R min among three jets


ID 1105
Entries 779
Mean 2.178
RMS 0.6449
delta R max among three jets

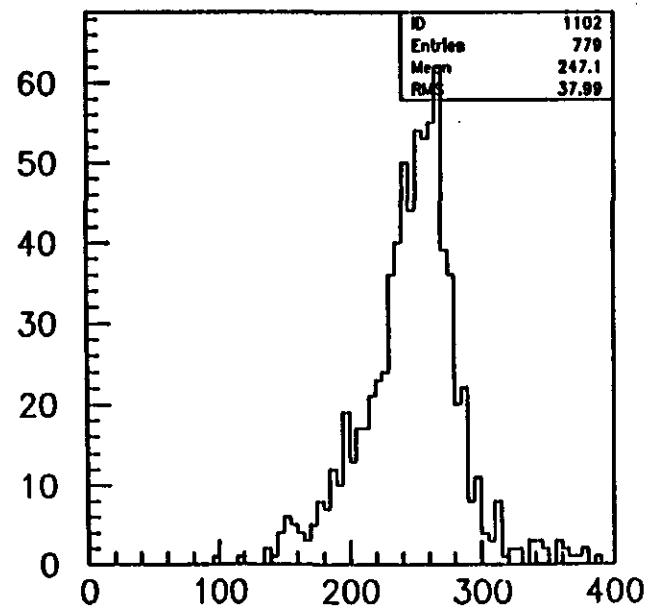

ID 1105
Entries 779
Mean 2.178
0.6449
delta R max among three jets

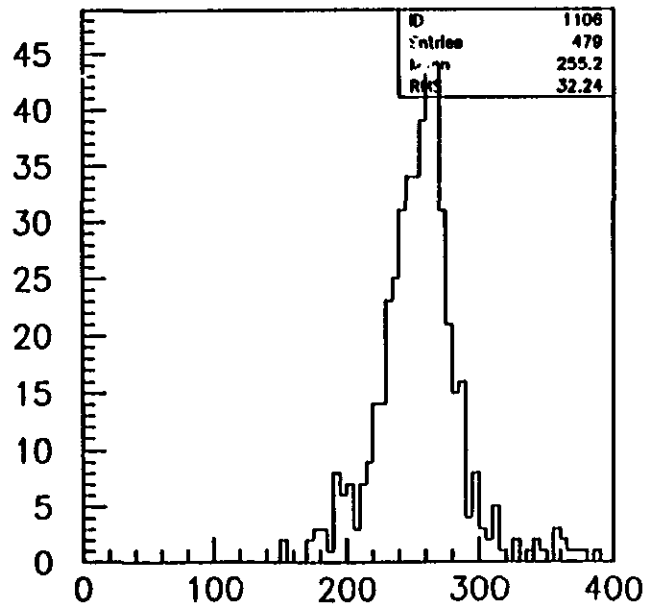


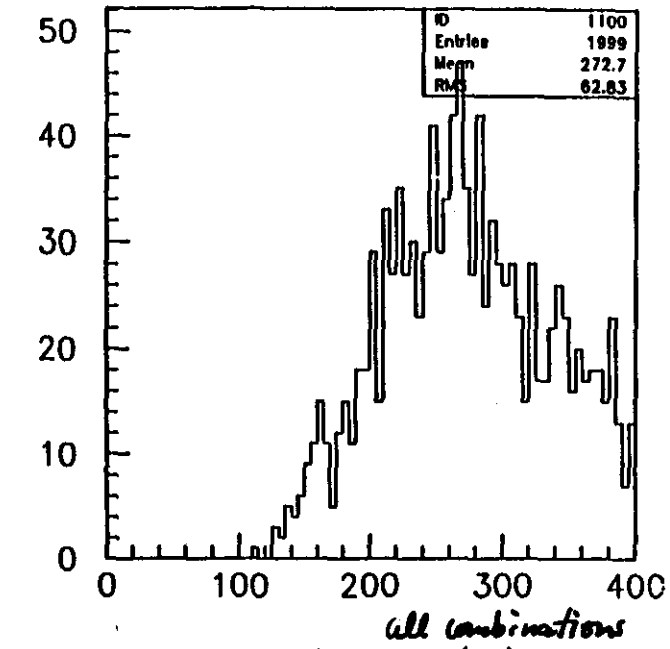
$p_T^{jet} > 20$ GeV/c



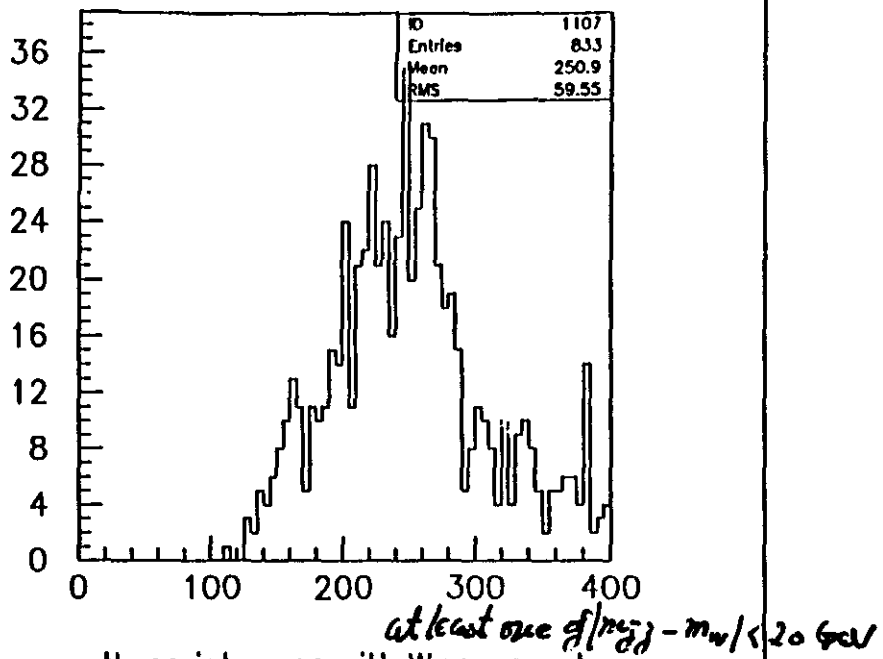
$p_T^{jet} > 50$ GeV/c



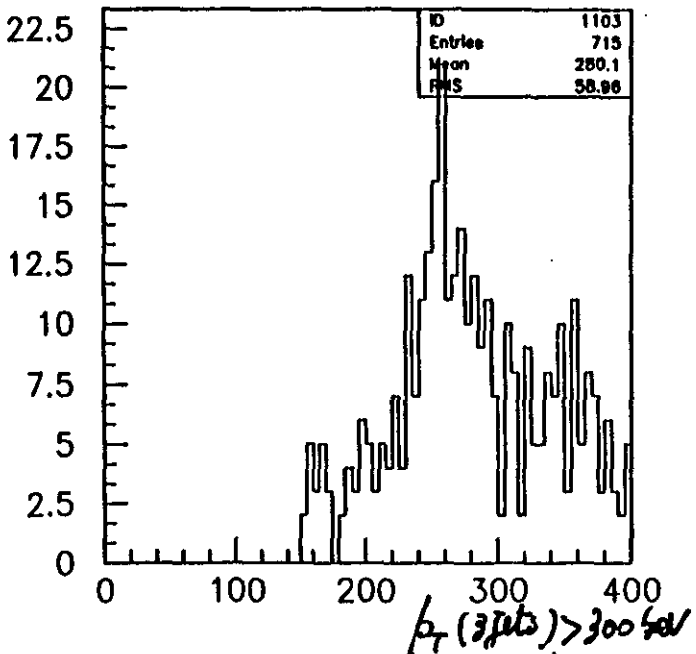




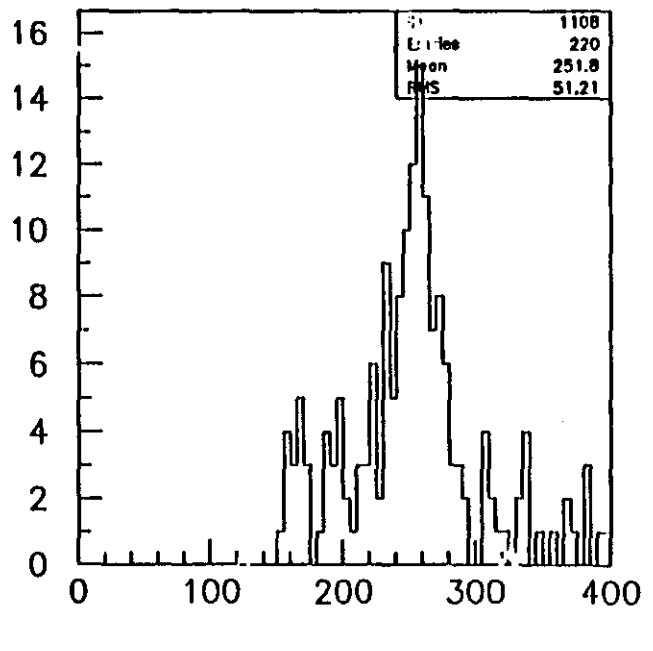
three jet mass (all)



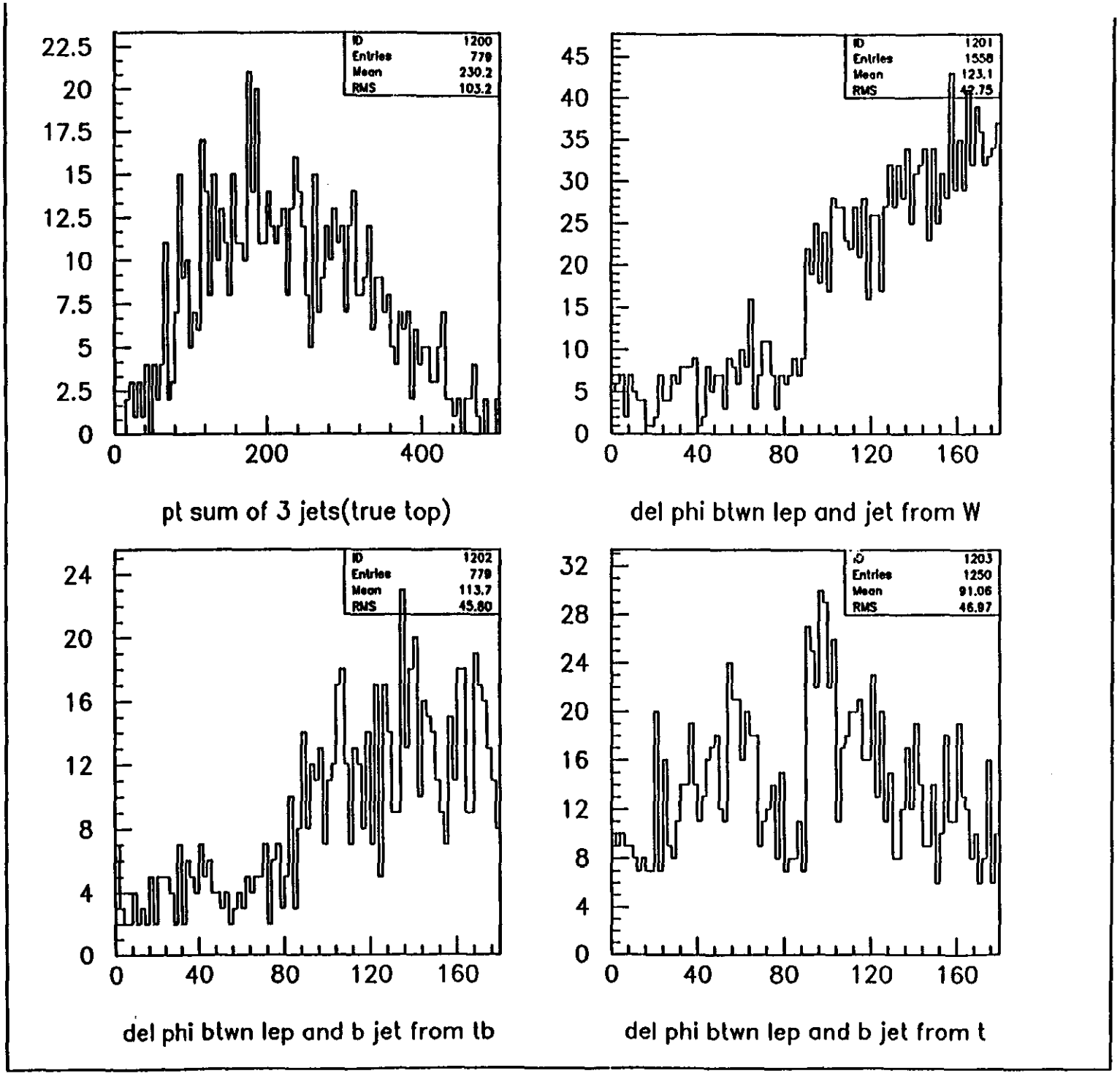
three jet mass with W mass cut

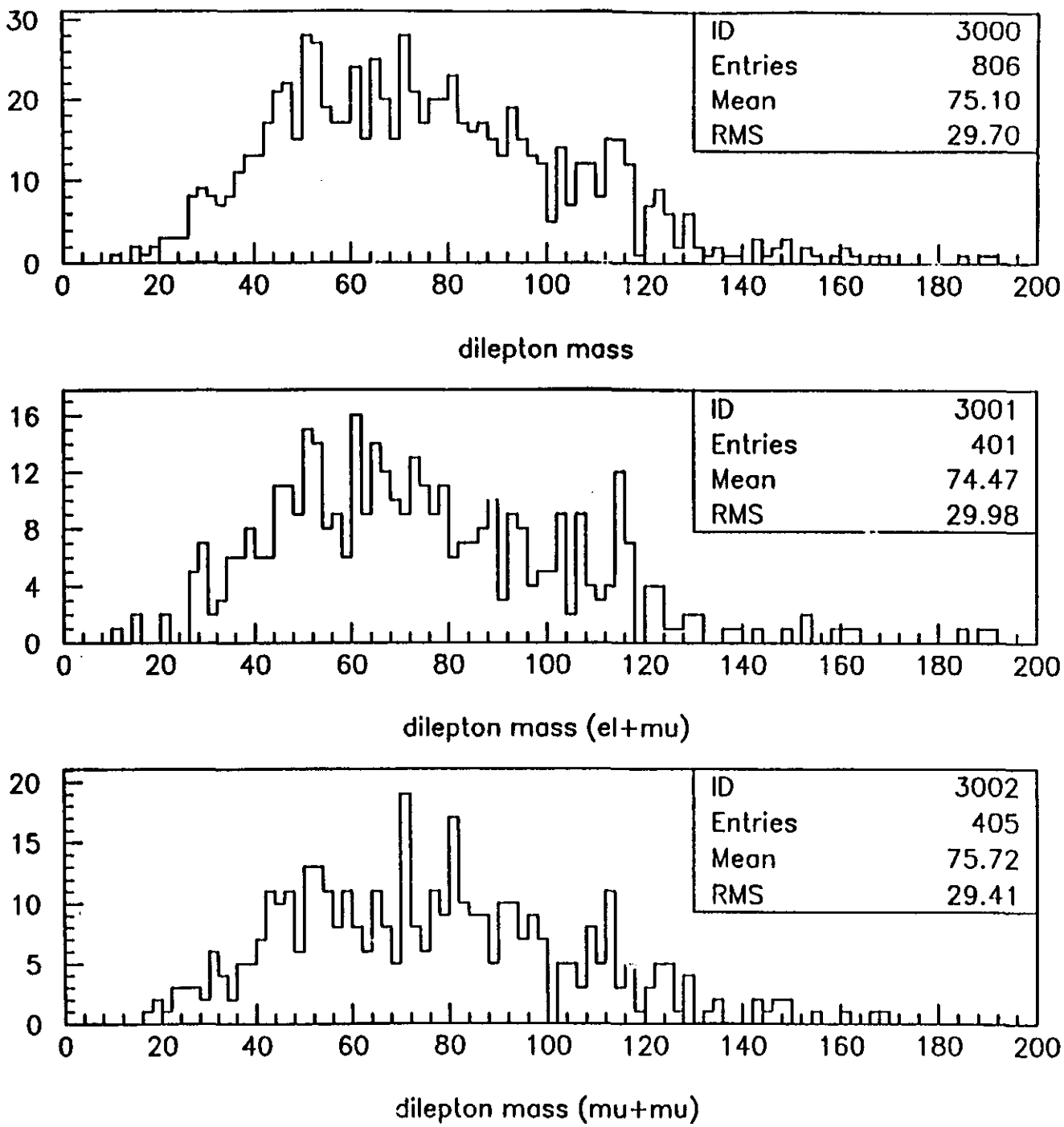


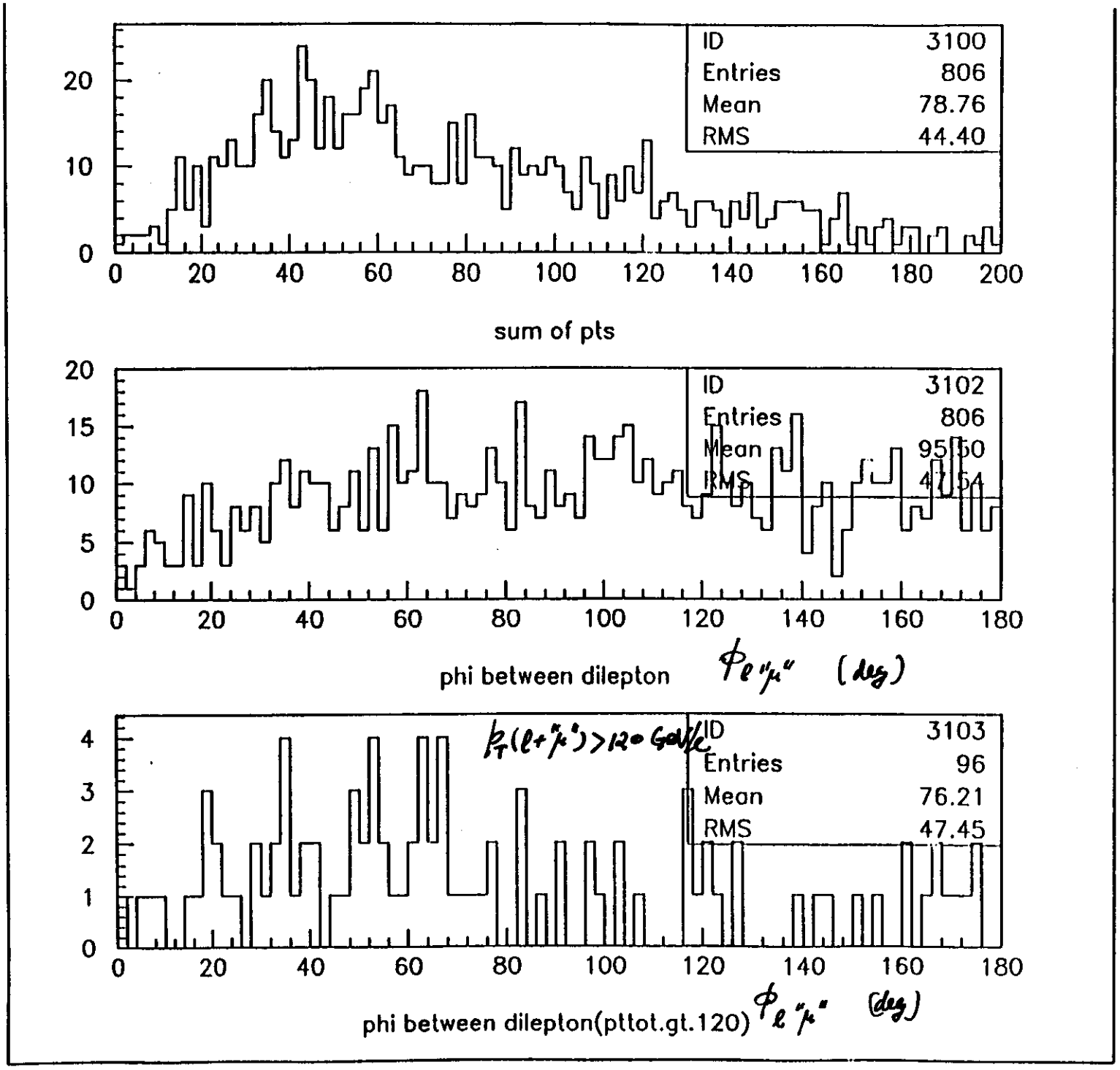
three jet mass (pttot cut)

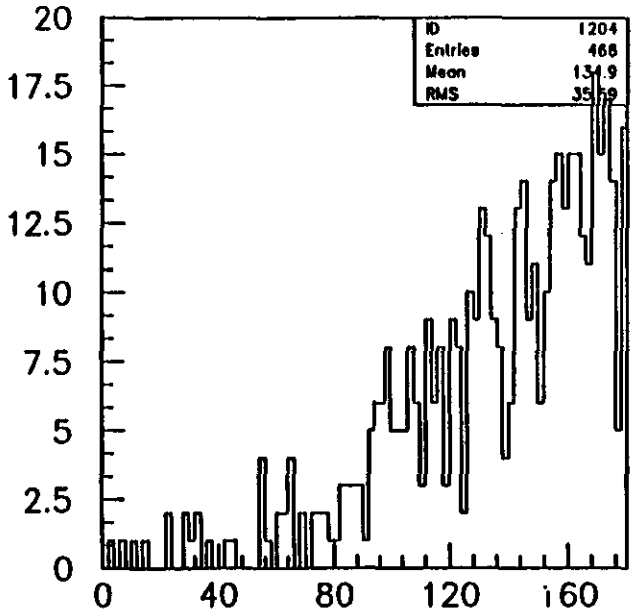


three jet mass with W mass e pttot cuts

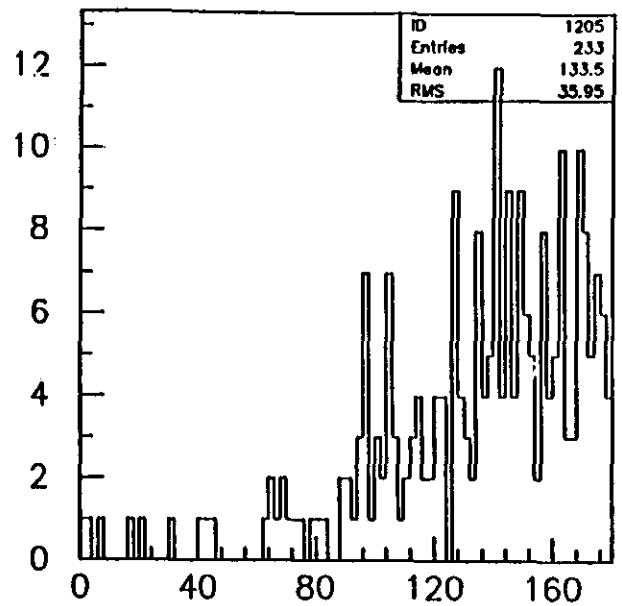

ID 1200
Entries 779
Mean 230.2
RMS 103.2
pt sum of 3 jets(true top)
ID 1201
Entries 1558
Mean 123.1
RMS 42.75
del phi btwn lep and jet from W
ID 1202
Entries 779
Mean 113.7
RMS 45.80
del phi btwn lep and b jet from tb
ID 1203
Entries 1250
Mean 91.06
RMS 46.97
del phi btwn lep and b jet from t


ID 3000
Entries 806
Mean 75.10
RMS 29.70
dilepton mass
ID 3001
Entries 401
Mean 74.47
RMS 29.98
dilepton mass (el+mu)
ID 3002
Entries 405
Mean 75.72
RMS 29.41
dilepton mass (mu+mu)

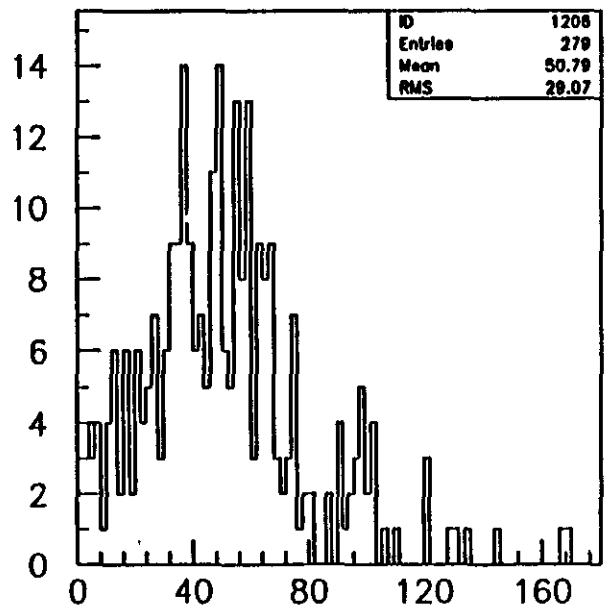

ID 3100
Entries 806
Mean 78.76
RMS 44.40
sum of pts
ID 3102
Entries 806
Mean 95.50
RMS 47.54
phi between dilepton
$\phi_{\ell\text{"}\mu\text{"}}$ (deg)
$p_T(\ell+\text{"}\mu\text{"}) > 120$ GeV/c
ID 3103
Entries 96
Mean 76.21
RMS 47.45
phi between dilepton(pttot.gt.120)
$\phi_{\ell\text{"}\mu\text{"}}$ (deg)



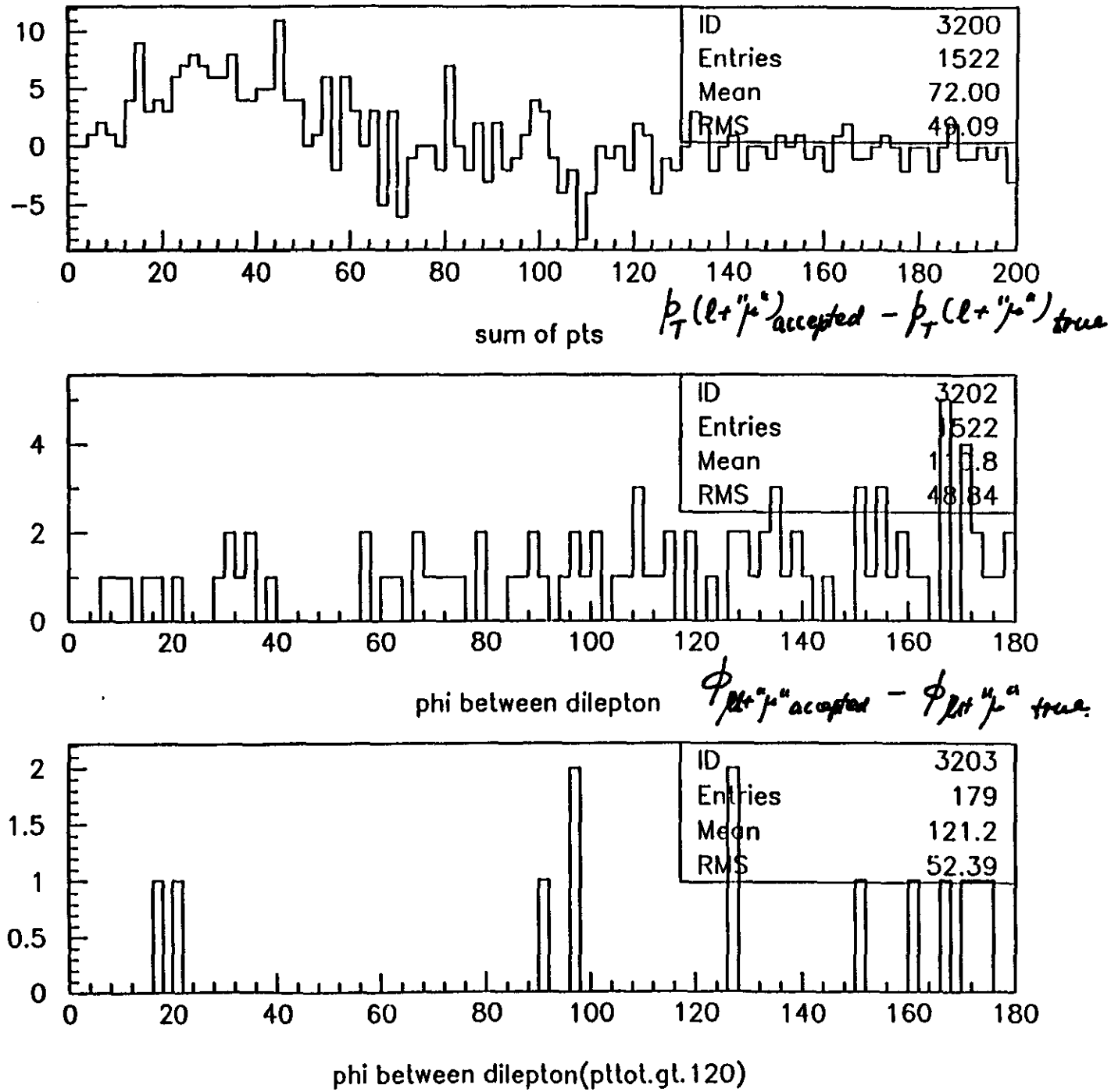
del phi btwn lep and jet from W (pttot)



del phi btwn lep and b jet from tb(pttot)



del phi btwn lep and b jet from t(pttot)


ID 3200
Entries 1522
Mean 72.00
RMS 49.09
sum of pts
$p_T(\ell^+ \text{"}\mu^-\text{"})_{accepted} - p_T(\ell^+ \text{"}\mu^-\text{"})_{true}$
ID 3202
Entries 1522
Mean 1[illegible].8
RMS 48.84
phi between dilepton
$\phi_{\ell\ell^+ \text{"}\mu^-\text{"} accepted} - \phi_{\ell\ell^+ \text{"}\mu^-\text{"} true}$
ID 3203
Entries 179
Mean 121.2
RMS 52.39
phi between dilepton(pttot.gt.120)

Presentation by:

Rob Carey

Rob Carey

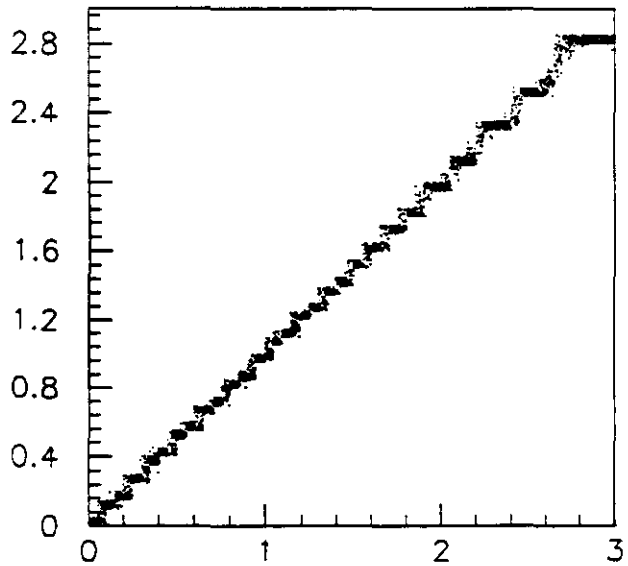
Jets Update

1) Single Particle Tests
2) Clustering Tests
   a) Efficiency: generator vs. Gemfast
   b) Angular resolution
   c) Effect of magnetic field
   d) Measure underlying event
   e) Jet response vs.
      eta
      P_t
      Clustering cone size

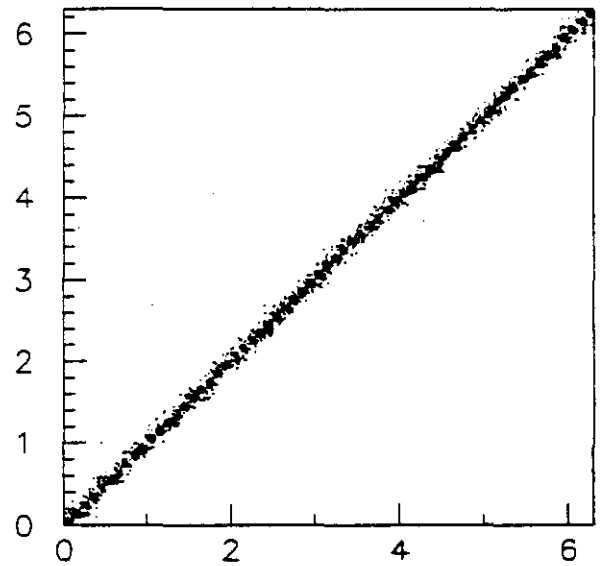
      ⟹ naive jet correction function

Single Particle Tests

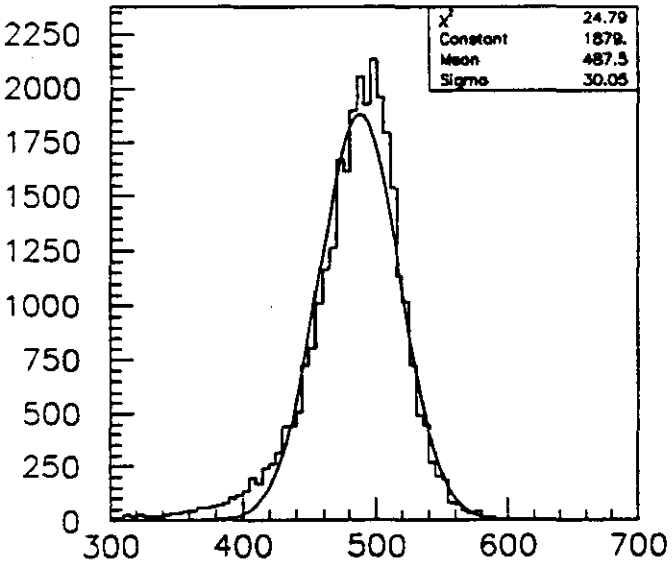
$E_\pi = 500$ GeV



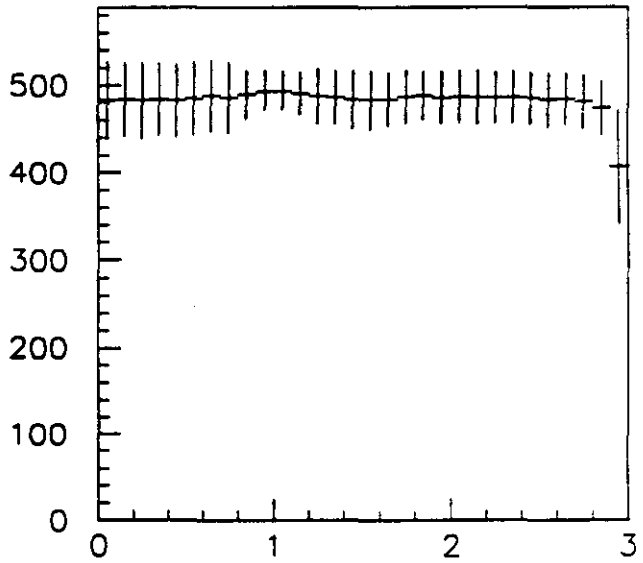
Eta measured vs Eta True



Phi measured vs. Phi True



Overall Energy Resolution



Res vs. eta

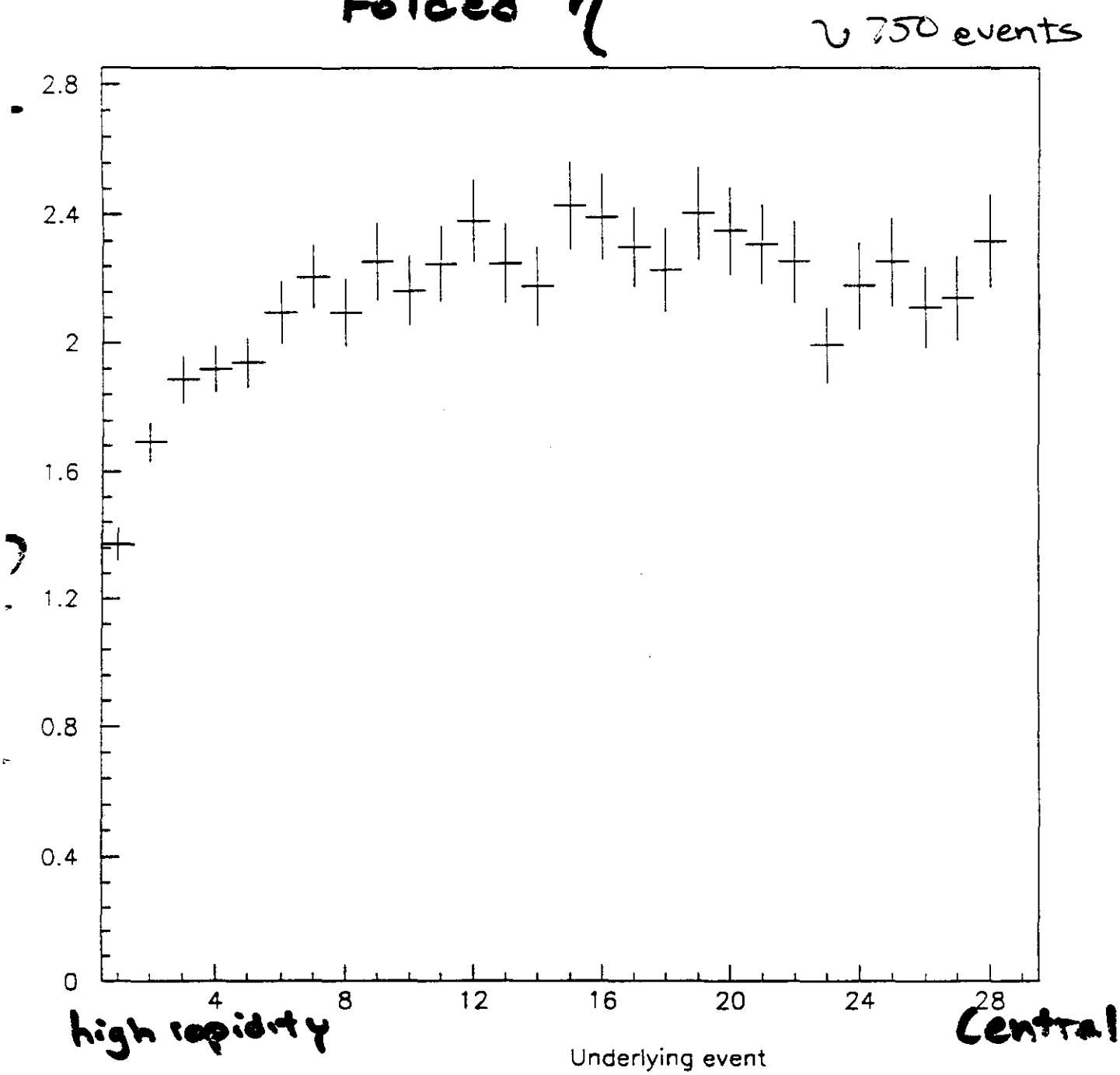
Naive Jet Correction Function

1. Calculate P_t response vs η, R, P_t
2. Calculate Underlying event vs η
3. Correct jet energy by

$$P_{t(corr)} = (P_{t\,raw} - \underset{\text{noise + true}}{U}) \cdot \text{Scale}$$

4. Make Superfast Monte Carlo
   (for when you don't need the very best)
   for QCD studies

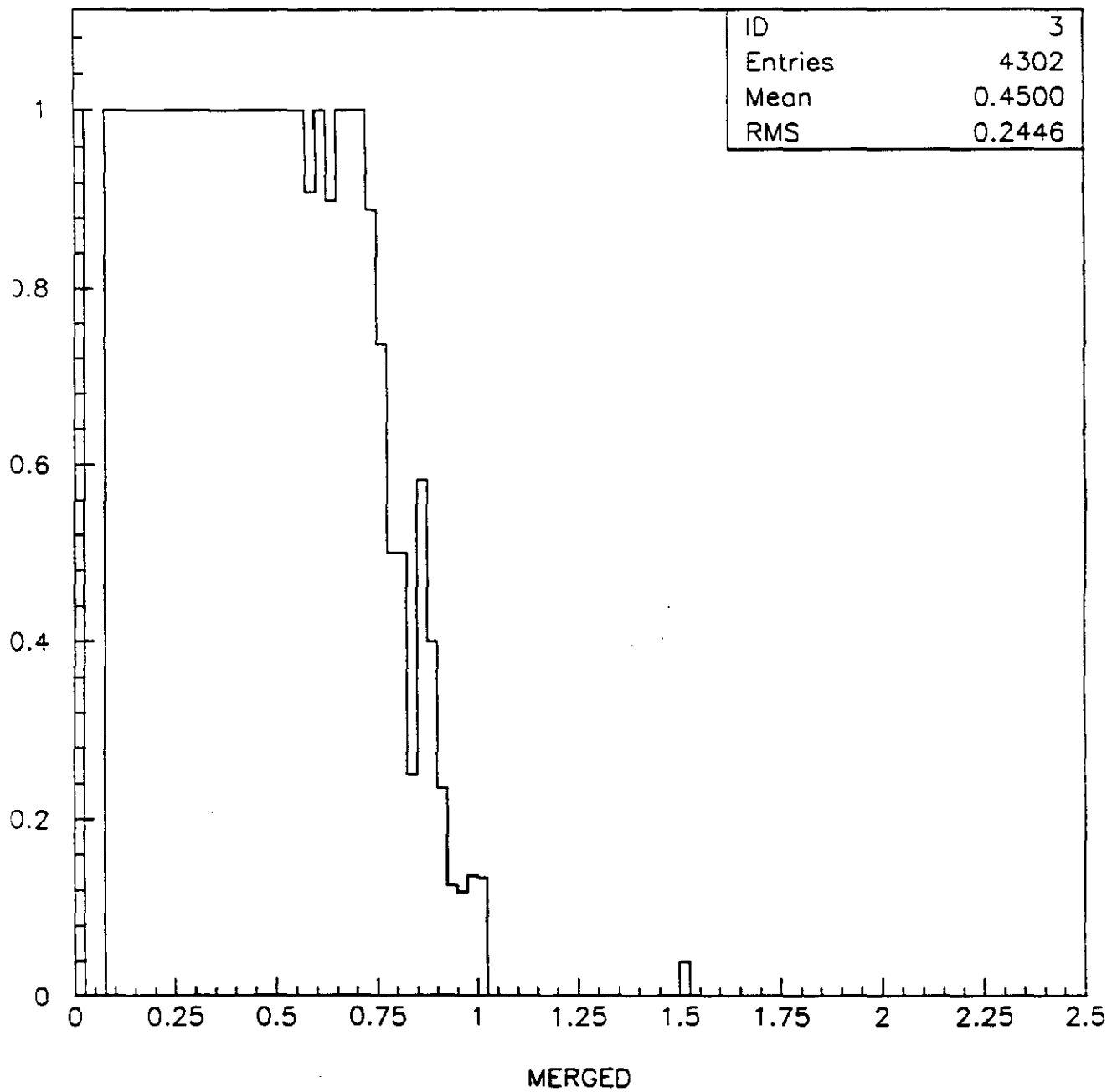
Underlying Event vs Folded η



Two jets $P_t > 100$ GeV. No other jets > 10 GeV

(no noise, no pileup)

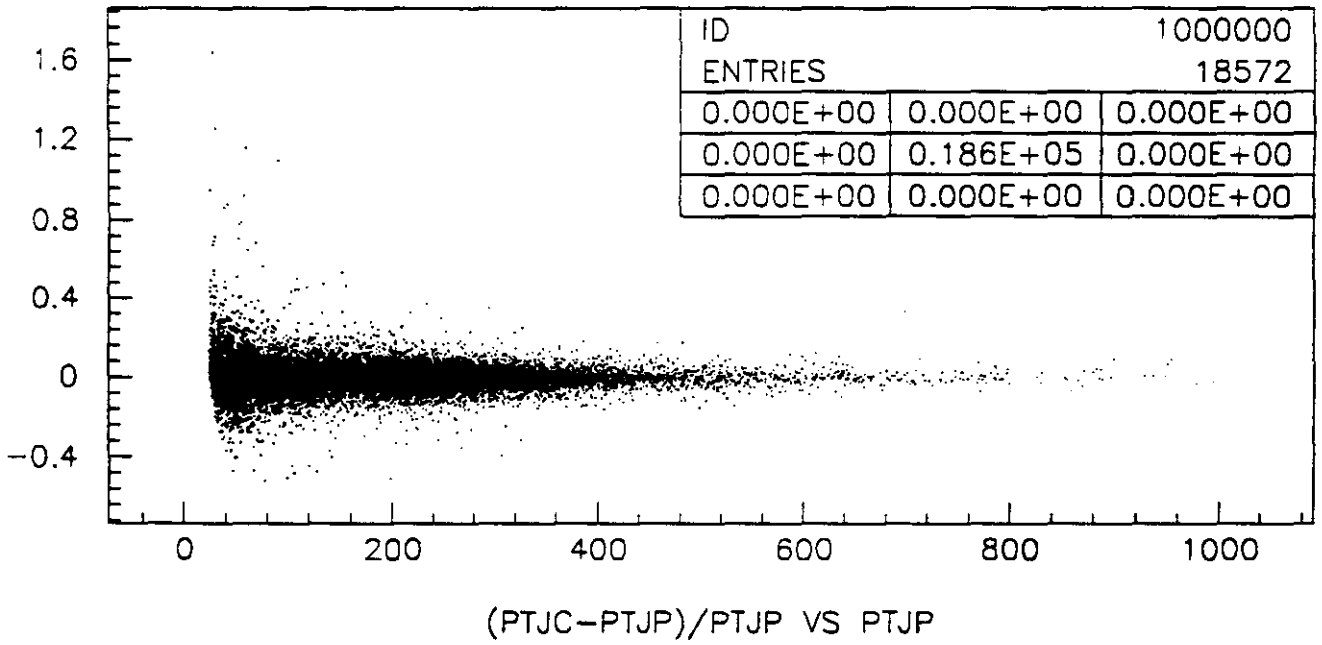
Jet Angular Resolution

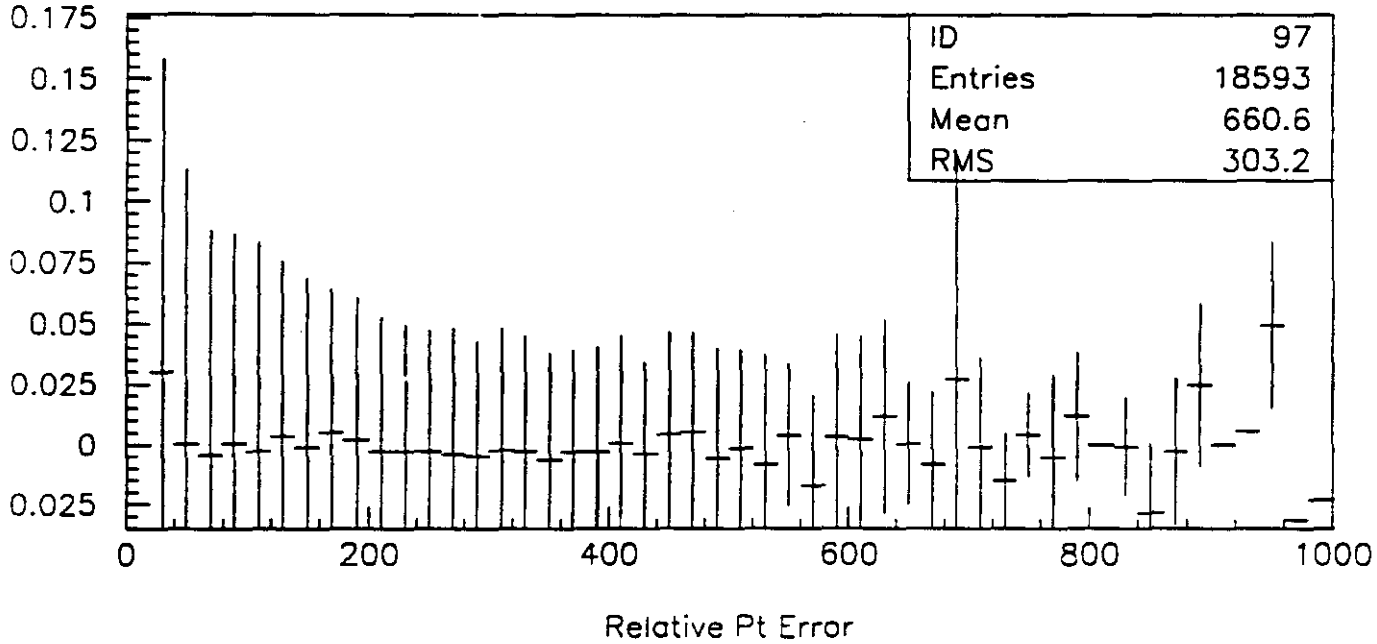


eta-phi distance

Jet Test Cluster $P_t > 100$ GeV

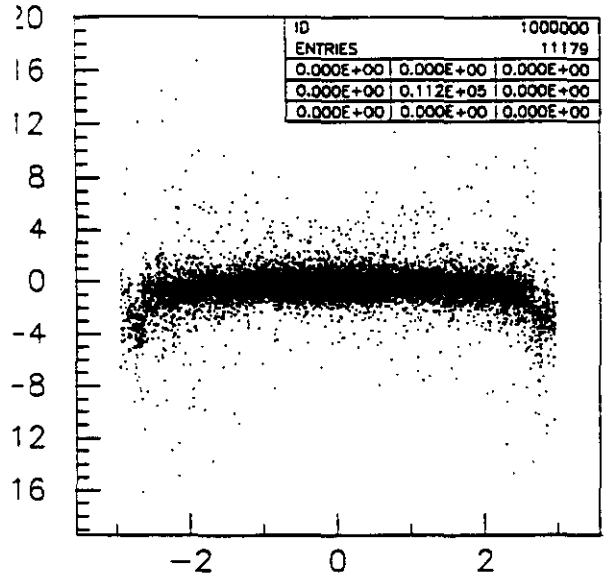
With + Without the Magnetic Field

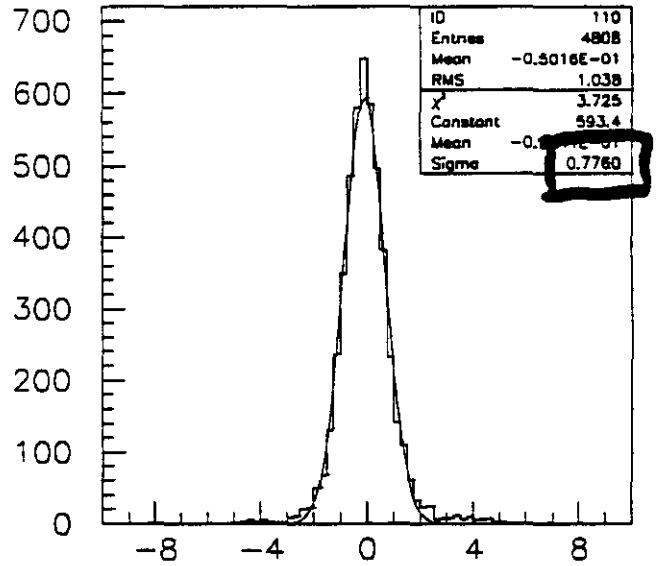




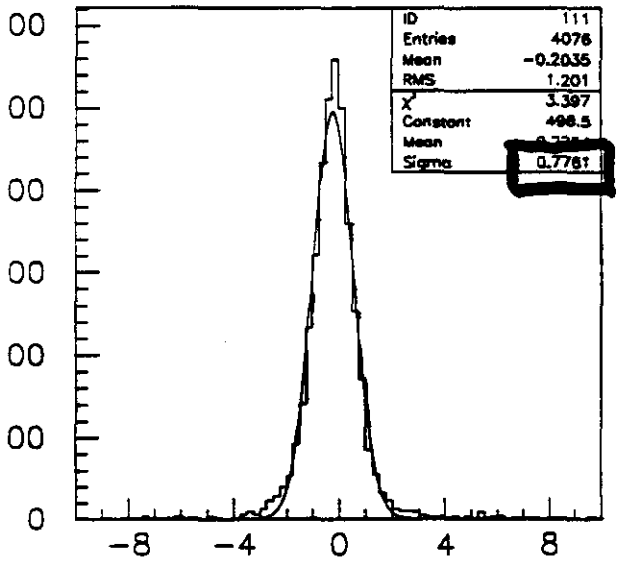
Normalized "Resolutions"

$0 < |\eta| < 1$

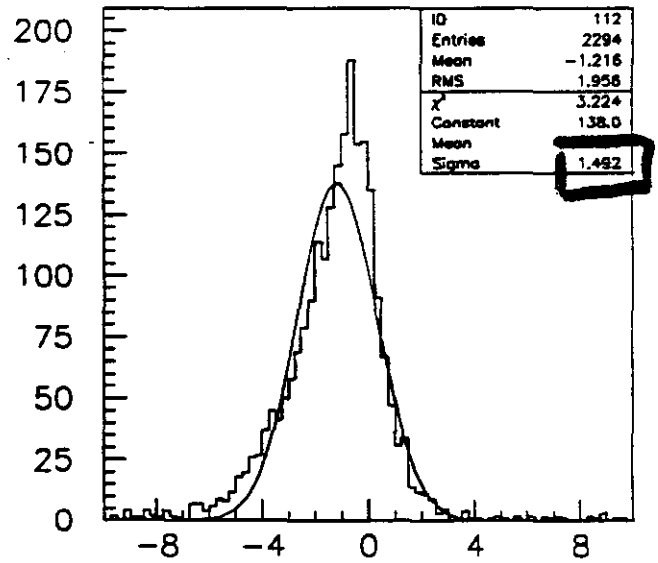




*((1+EXP(2*ETAP))/(2*EXP(ETAP)*PTJP))**.5 VS ETAPCentral Resolution



Transition Resolution

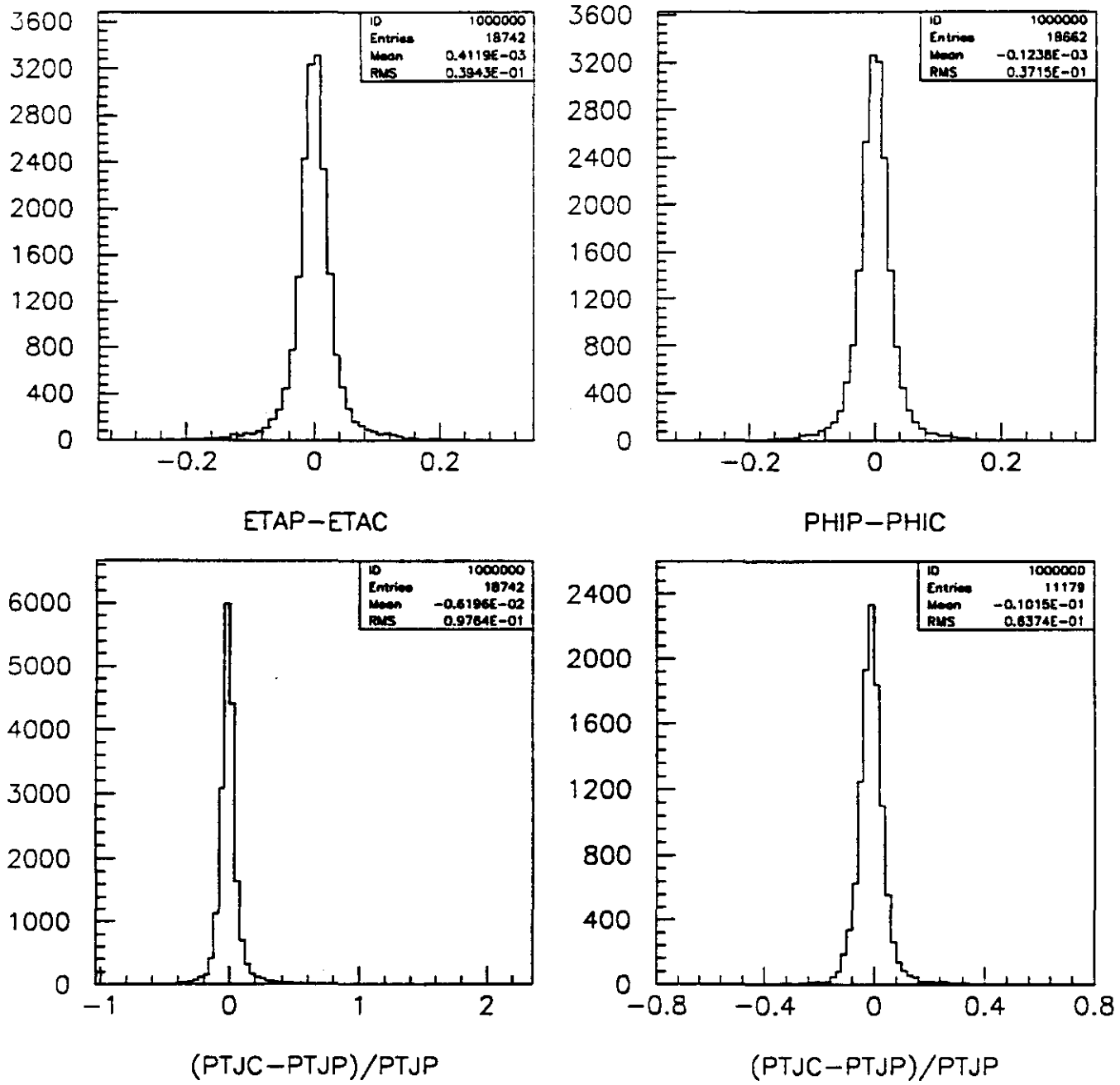


Endcap Resolution

$1 < |\eta| < 2$

$2 < |\eta| < 3$

Pythia vs Gemfast clustering



big jets only $\frac{P_t}{P_{t\,leading}} > .25$

jets taken from Compositeness generation

Next

1. Study jet overlap for top and heavy Higgs
2. Interface CTEQ structure functions with Pythia
3. Develop standard jet correction function
4. $R/h \neq 1$ in GemFast?
5. Free advice

Presentation by:

Sasha Vanyashin

A. Vinogradov
Feb. 23 1993

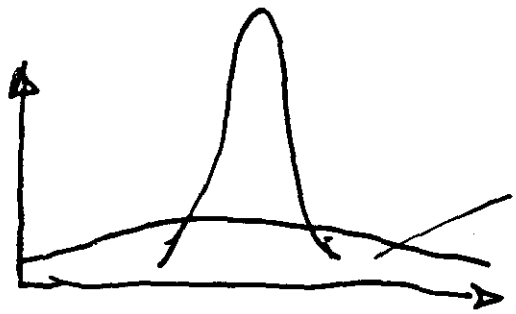
$\not{E}_T$ progress report

since Feb. 3

1. New version of FSI_FCSMEAR
(not in gemfast yet)

a) more dead material → worse resolution

b) gaussian non-gaussian tails



1% level
twice wider (DØ)

⇓

no significant degradation of $\not{E}_T$ performance (since Feb. 3)

2. Lepton veto now using reconstructed μ & e from GEMFAST

a) muons - OK

b) e - needs to be optimized for VETO

* bump $E_T > 20$ GeV
* 1 track in 0.05 cone
* $|E/p - 1| < 0.5$ or $3 * \sigma_{p_T}$

TO DO :

mass determination (m_T)

mass reach (high PT QCD, W, Z bkg

likesign dilepton

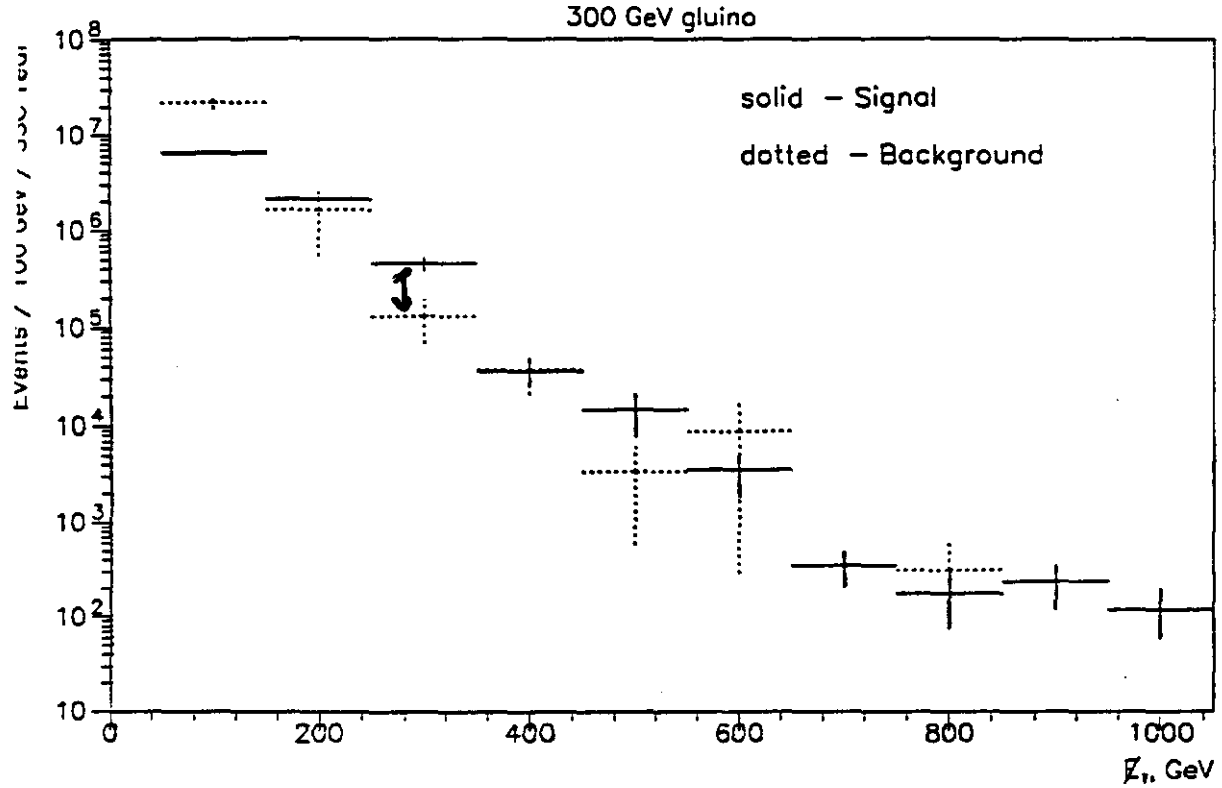
THIS week - new ISAJET version

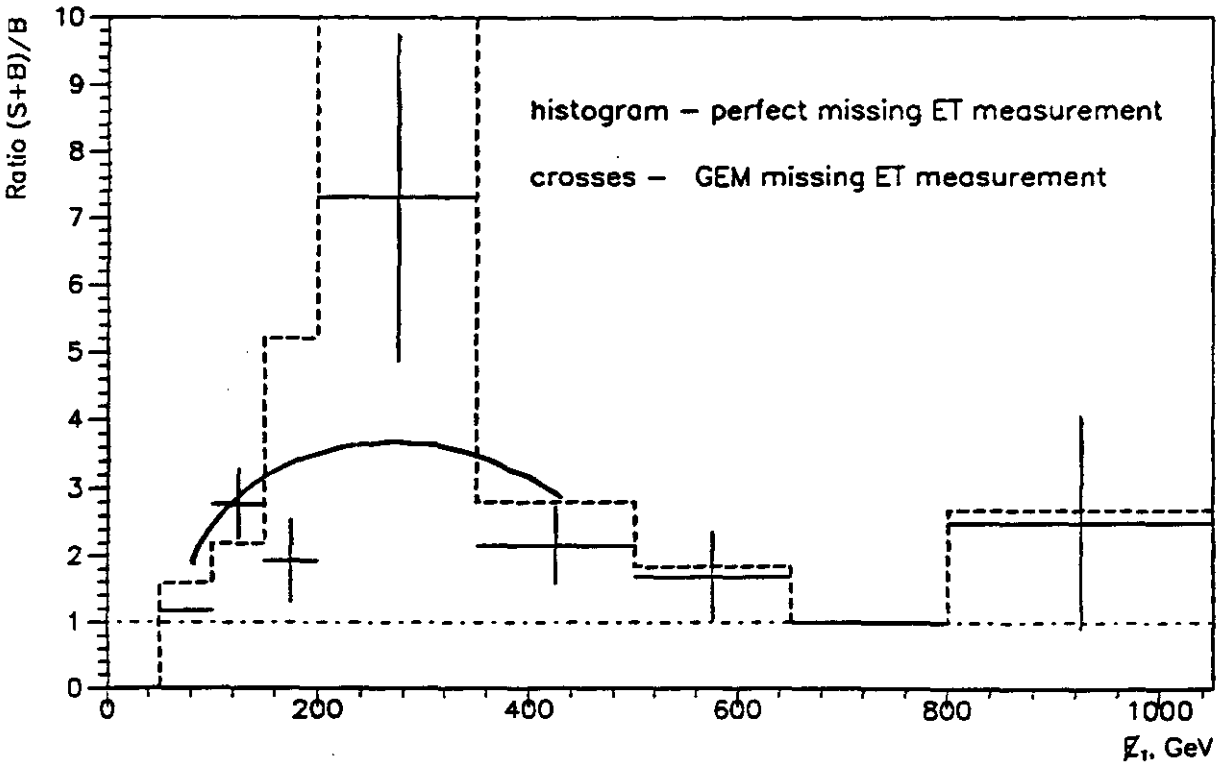
---

large run 2M events = 10 days on 16 hp

70 K Twojet events

93/02/23 13.58





gem

γeμ

Presentation by:

K. Shmakov

Missing E_T in Jets due to leakages into Scintillating Calorimeter

Konstantin Shmakov
Oak Ridge National Laboratory

February 4, 1993

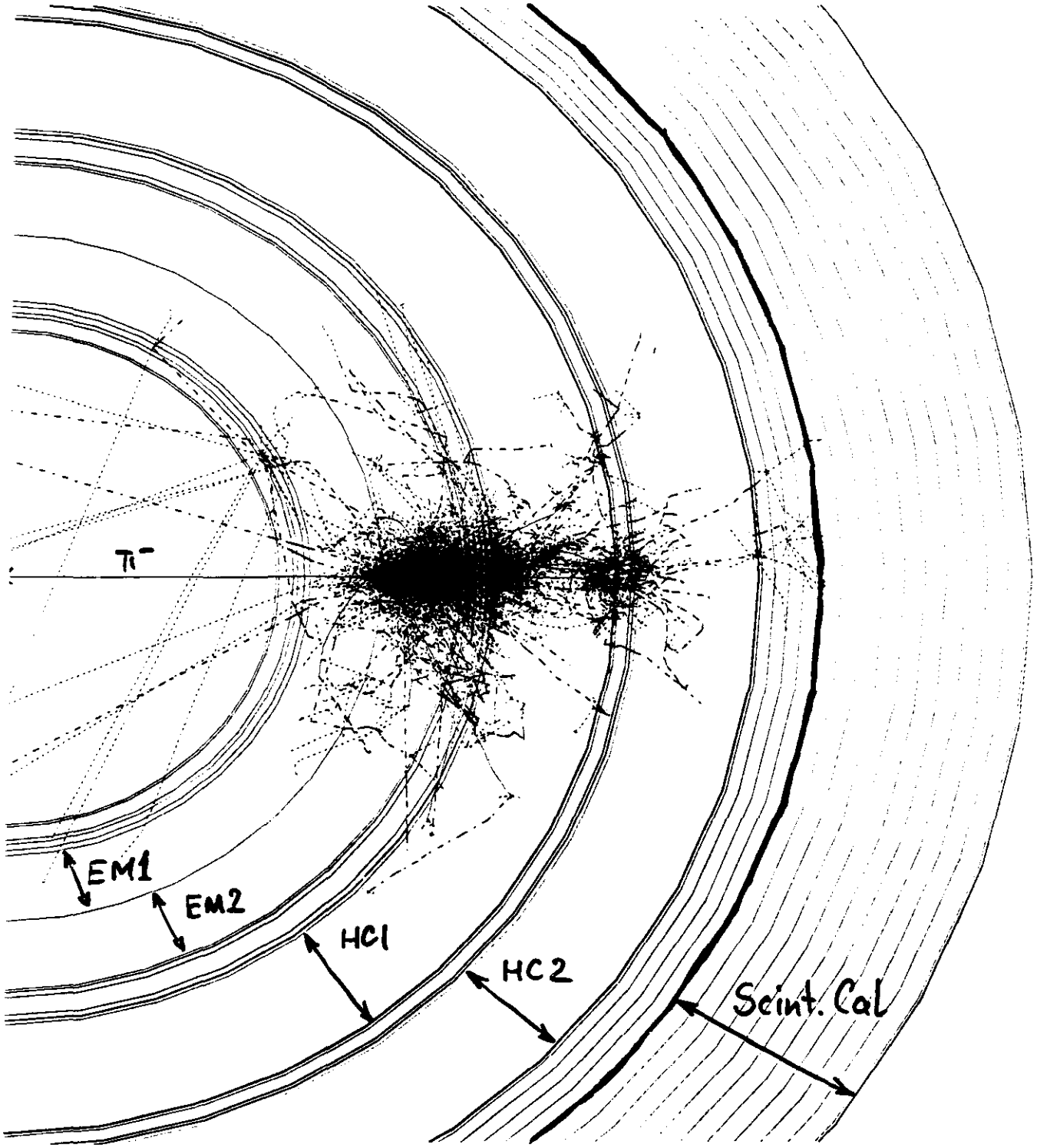
1 **Parametrisation of the tails of hadronic showers in Scint.Calorimeter** (GEANT)
vs energy, λ

2 **Standard Model missing E_T backgrounds**
PYTHIA 5.6 in 12 p_T bins

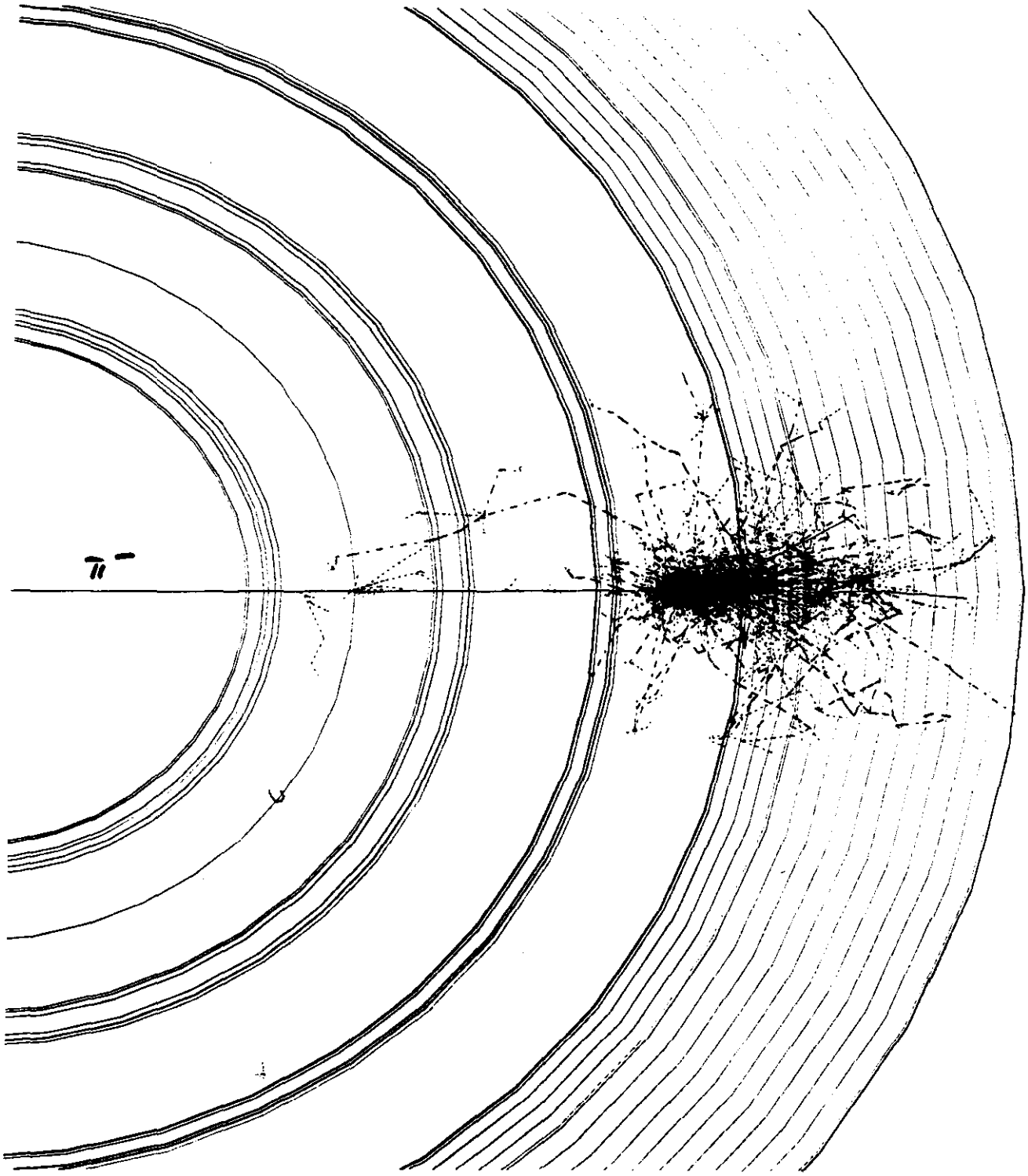
3 **Missing E_T due to SC (if non-instrumented)**
$|\eta| < 1.28$, the same events + parametrisation.

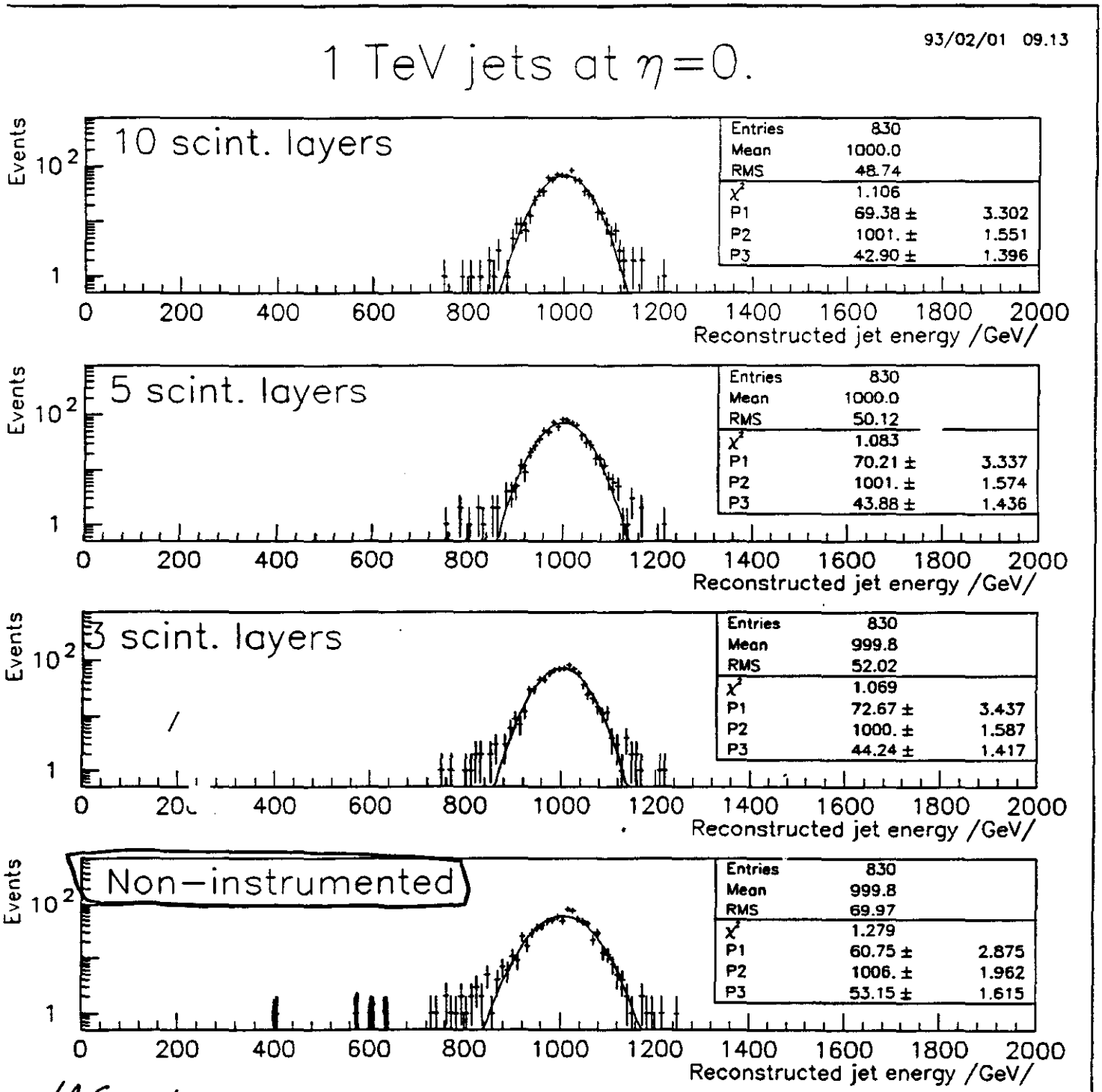
4 **Attemts to reduce Standard Model background. What is the impact on missing E_T from SC?**

100 GeV π^-

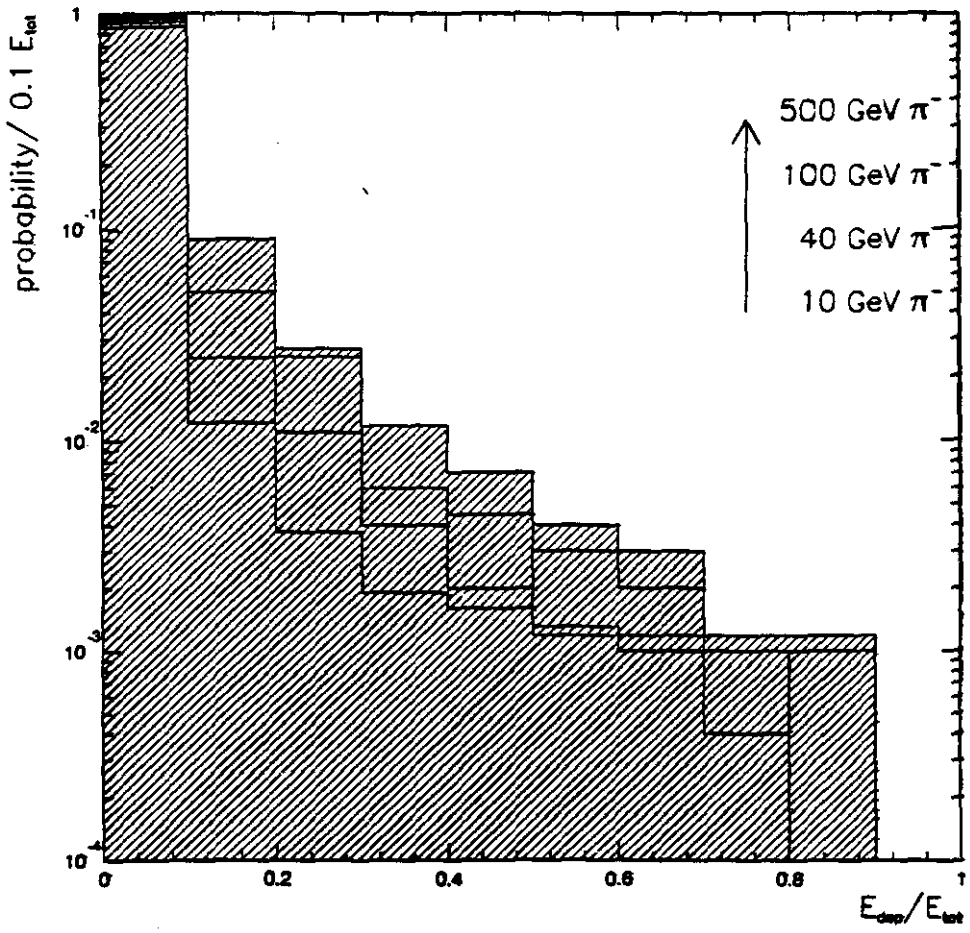


100 GeV π^-

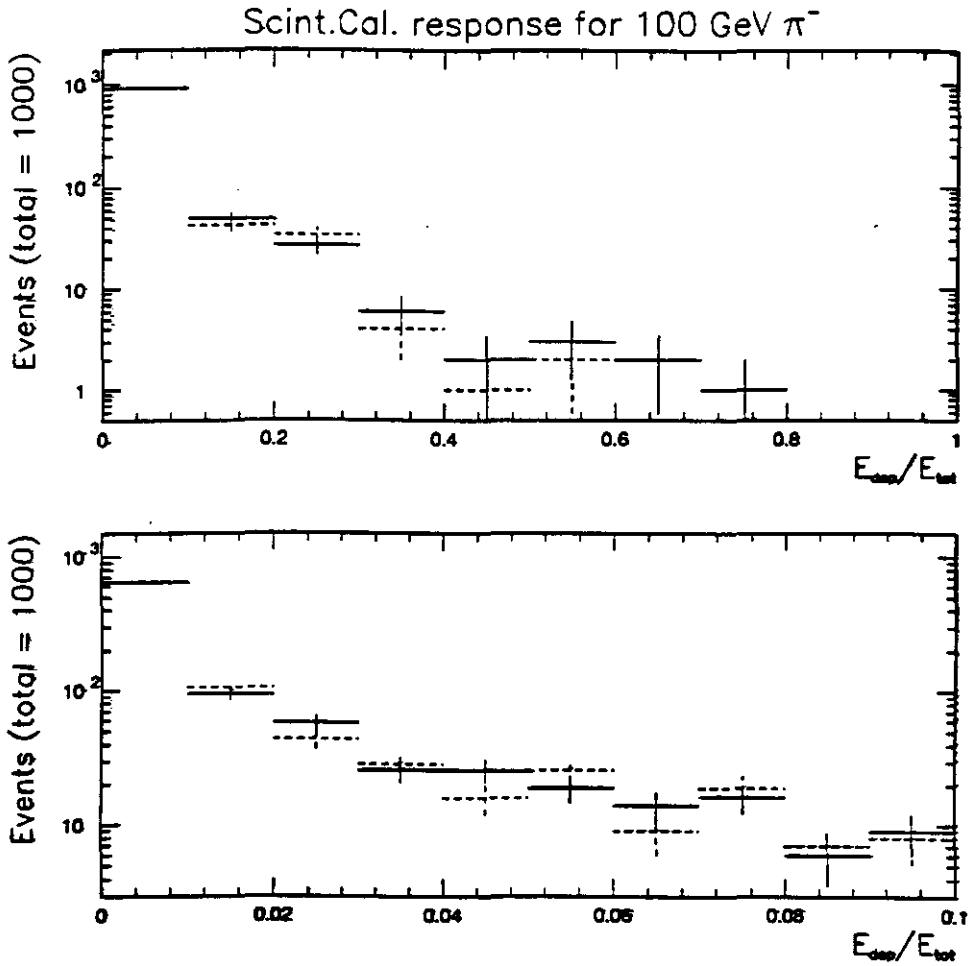



93/02/01 09.13
1 TeV jets at η=0.
10 scint. layers
Entries 830
Mean 1000.0
RMS 48.74
χ² 1.106
P1 69.38 ± 3.302
P2 1001. ± 1.551
P3 42.90 ± 1.396
5 scint. layers
Entries 830
Mean 1000.0
RMS 50.12
χ² 1.083
P1 70.21 ± 3.337
P2 1001. ± 1.574
P3 43.88 ± 1.436
3 scint. layers
Entries 830
Mean 999.8
RMS 52.02
χ² 1.069
P1 72.67 ± 3.437
P2 1000. ± 1.587
P3 44.24 ± 1.417
Non−instrumented
Entries 830
Mean 999.8
RMS 69.97
χ² 1.279
P1 60.75 ± 2.875
P2 1006. ± 1.962
P3 53.15 ± 1.615
Events
Reconstructed jet energy /GeV/

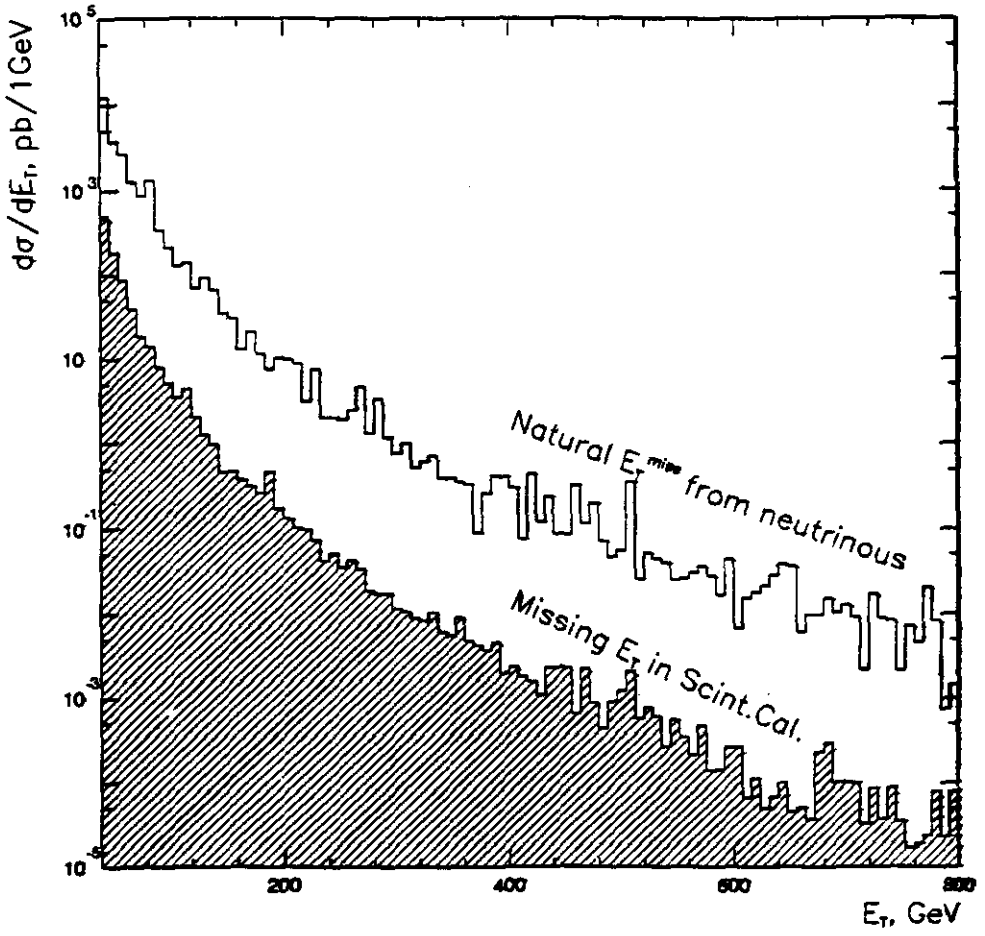
/A. Savin/



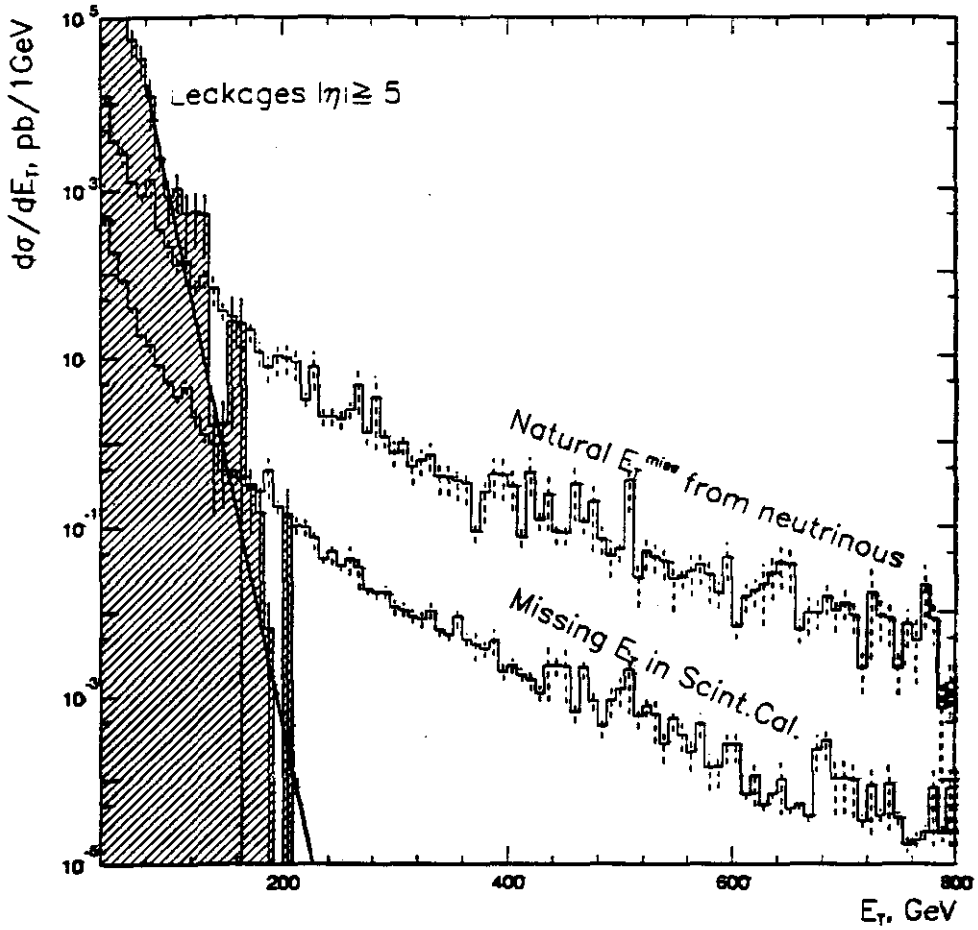
Parameterization of the hadron energy deposition in Scint.Cal. at 90° (6 λ). Probability is plotted for the $0.1E_{tot}$ bin as a function of the ratio E_{dep}/E_{tot} – fraction of the total energy deposited in Scint.Cal., (0.-1.)E_{tot} scale. One can see that all histograms looks similar and differs only by factor 2-3 in a tail.



Parameterization versus GEANT full Monte-Carlo for 100 GeV π^- in two scales a) 0.-1. E_{tot}, b) 0.0-0.1 E_{tot}. Solid points - GEANT3.15, dashed points - parameterization. Total number of events - 1000.



Natural E_T^{miss} spectrum from neutrinous (Standard Model Background) and E_T^{miss} spectrum originated in Scint.Cal. in case of no measurements there. This plots were generated as a sum of 12 distributions of 100,000 PYTHIA events with different p_T^q with corresponding cross-sections.



The effect of limited calorimeter coverage $|\eta| < 5$ versus E_T^{miss} spectrum from neutrinous (Standard Model background) and E_T^{miss} spectrum originated in Scint.Cal. in case of no measurements there.

Missing $\not{E}_T$

Standard Model Background:

$Z_0 \to \nu\bar{\nu}$ ($\sim 40\%$)

$W \to \mu\nu, e\nu$ ($\sim 30\%$)

$W \to \tau\nu$ ($\sim 20\%$)

t-quark ($\sim 10\%$)

- a few jets (2, 3)
- Low jet activity

Supersymmetric particles:

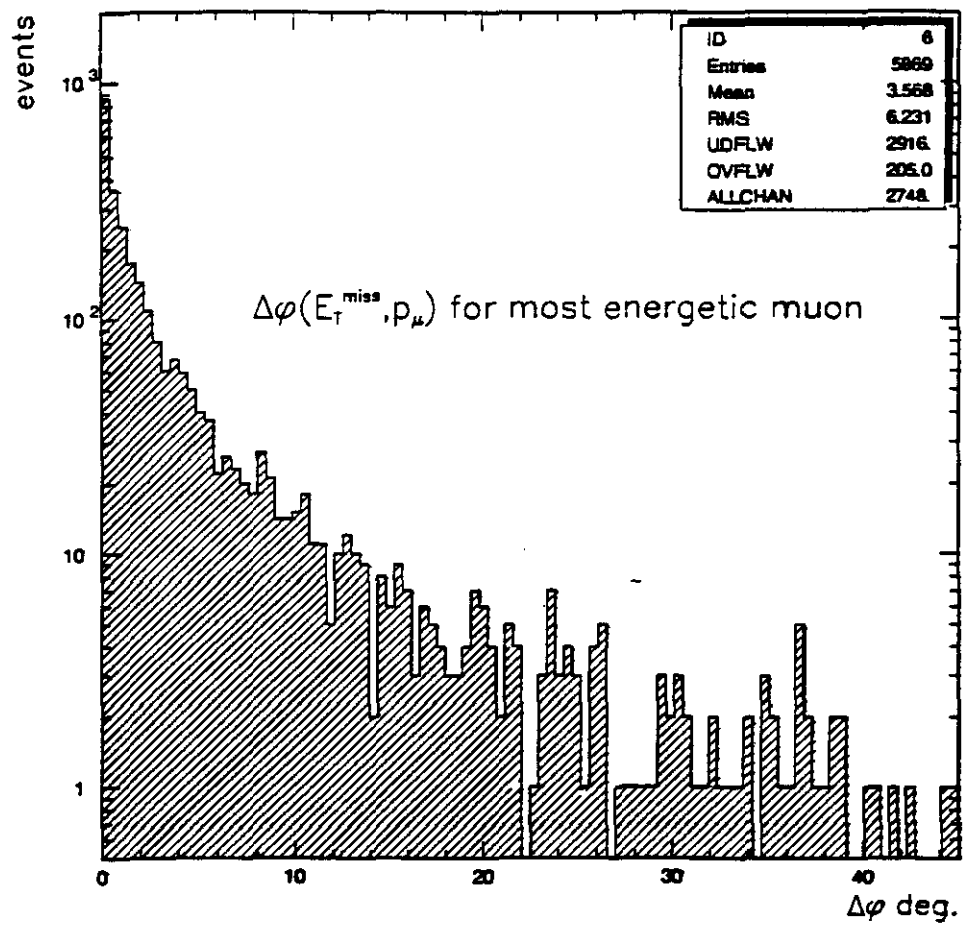
$\tilde{g} \to q\bar{q} + \tilde{\chi}_i^0$ (neutralino)

$\tilde{g} \to q\bar{q}' + \tilde{\chi}_i^{\pm}$ (chargino)

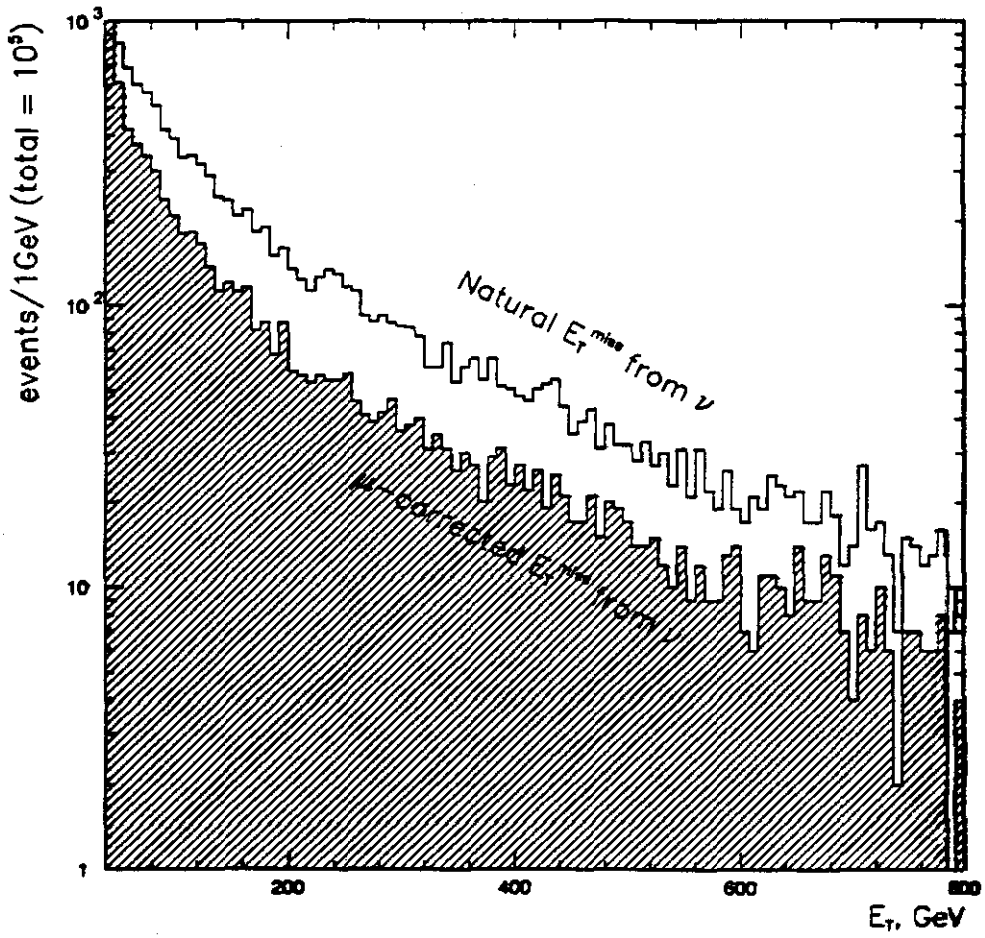
$\tilde{g} \to g + \tilde{\chi}_i^0$ (neutralino)

- many jets (>3)
- high jet activity

[1] Originally 1-2 orders of magn. below the Standard Model Background.



The angle $\Delta\phi$ between missing E_T vector and the most energetic muon in the event. E_T^{miss} includes leakages into region $|\eta| > 5$. Only events with $E_T^{miss} > 20GeV$ and $p_T^\mu > 20$ GeV in the region $|\eta_\mu| < 2.5$ are included in the analysis.



Correction of natural E_T^{miss} spectrum from neutrinous by μ-cut — no muons $p_T > 20$ GeV in the region $|\eta_\mu| < 2.5$ with $\Delta\phi(p_\mu, E_T^{miss}) < 0.1$. This plot is for PYTHIA events generated with 2 TeV $< p_T^q <$ 3 TeV.

Conclusion

1. $\not{E}_T$ due to non-instumented Scint. Cal. ($|\eta| < 1.28$) is factor <u>20 less</u> than the Standard Model background.

2. Though if GEANT is not correct for high energy dep. in a tail? Factor 2 can be.

3. Attempts to reduce SM background can give factor > 2.

4. Factor ~10 is not safe enough to conclude that SC is not needed to be instrumented.

H1 test beam

NIM (A290, 1990, p469)

GEANT vs DATA

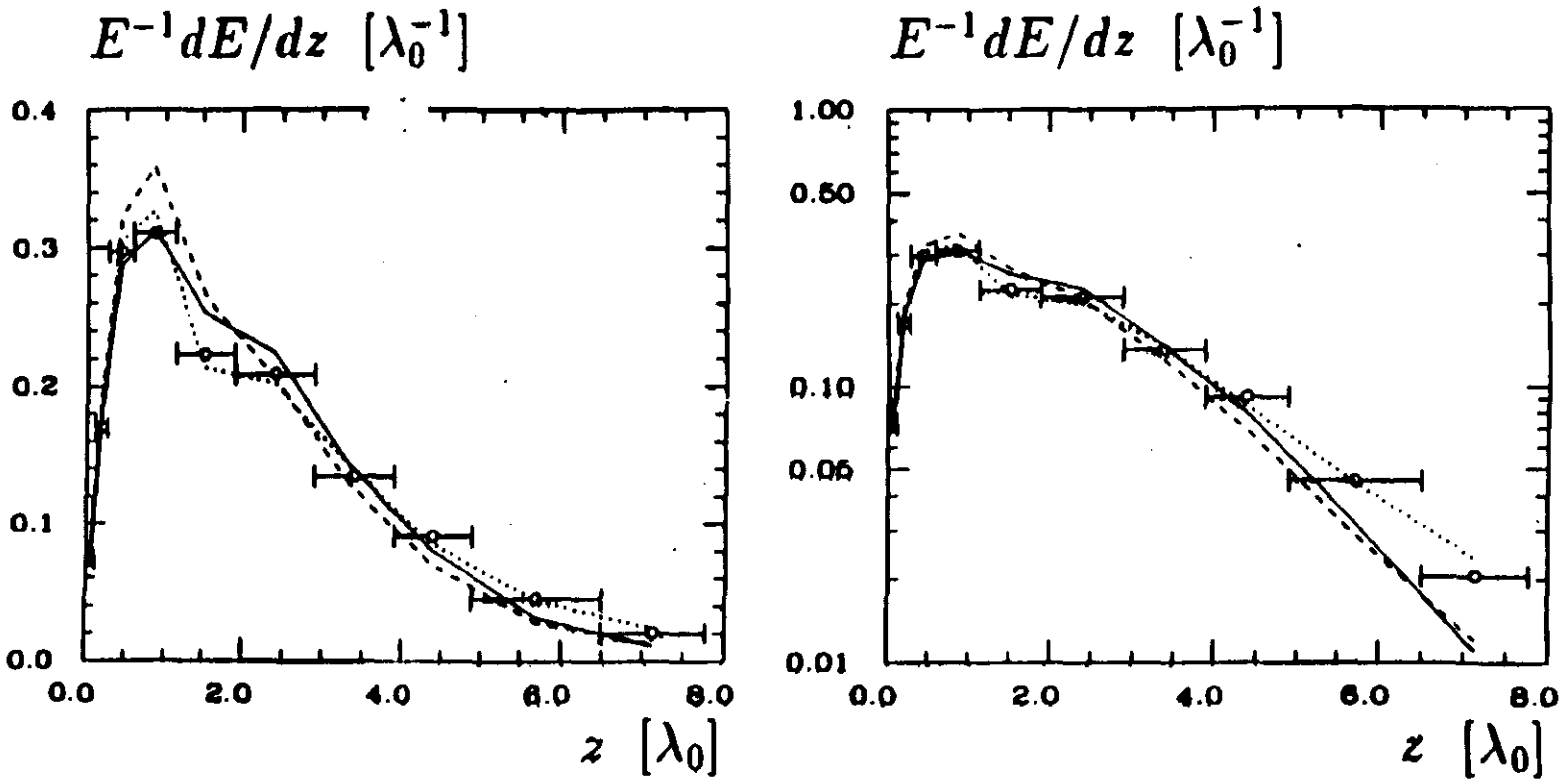


Fig. 9. Mean longitudinal energy profile for 30 GeV π^- showers: experiment (○), GFLASH (·····), GEANT311 (— — —), and GHEISHA8 (———).

H1 Test Beam

(From NIM A290, 1990, p469)

GEANT vs DATA in TailCatcher

TC – After ≈ 5. λ

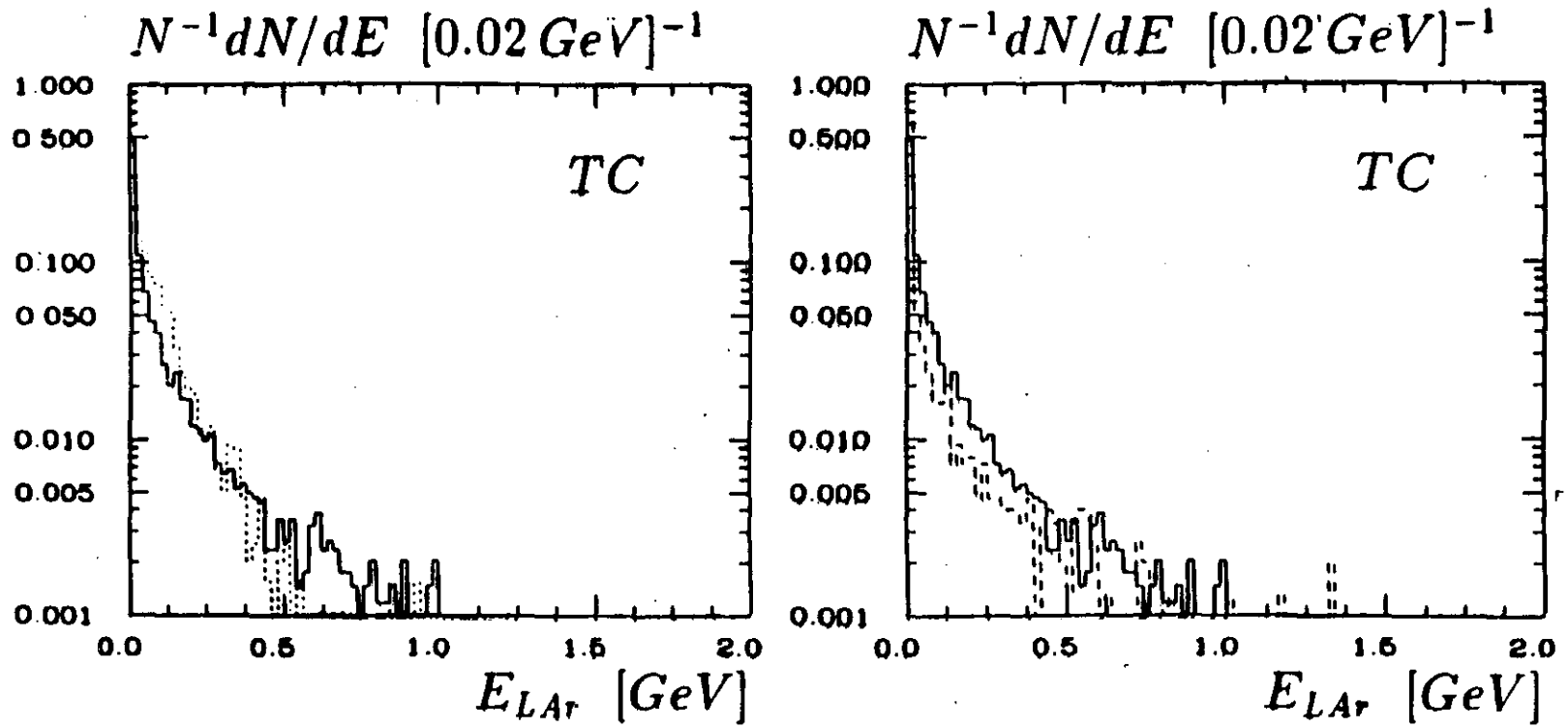


Fig. 15. Energy distributions in the modules EC, HC, and TC for 30 GeV π^- showers: experiment (———), GFLASH (· · · · · ·), and GEANT (— — —).