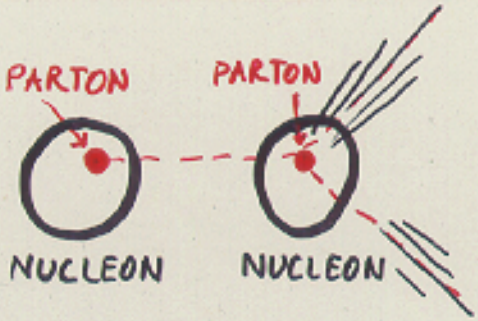
DARIUSZ MIŚKOWIEC

MEASURING JETS WITH ALICE

JETS



ALICE

Pb + Pb AT $\sqrt{s}/A = 5.5$ TeV

$45° < \theta < 135°$

$0° < \varphi < 360°$

THIS PRESENTATION

USE PYTHIA TO GENERATE JETS

USE HIJING OR SHAKER TO GENERATE THE REST, $dN_{CH}/dy \simeq 8000$

JETS IN $p\bar{p}$ AT $\sqrt{s} = 1.8$ TeV, CDF

HEP-PH/0102074
PRD64(2001)032001

FIGURES

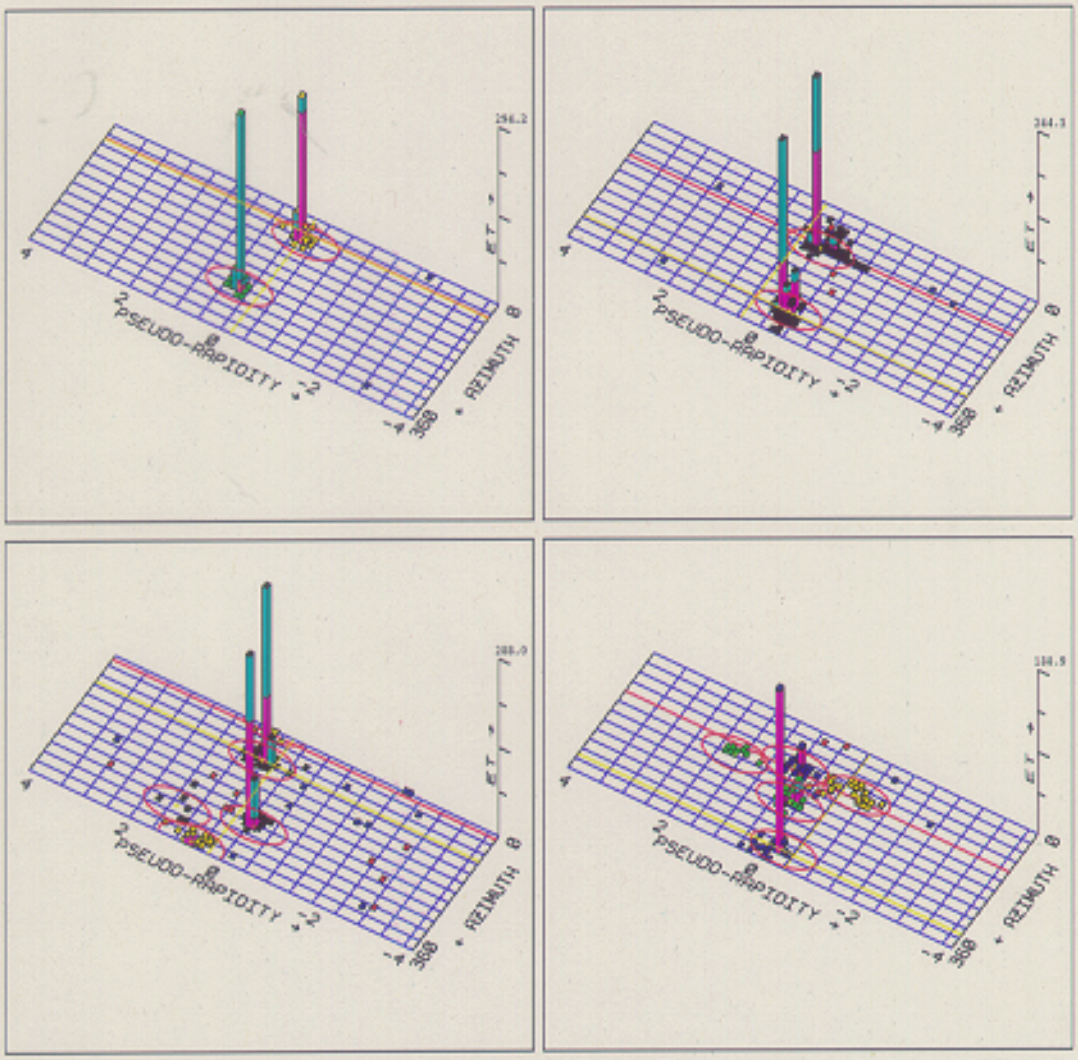
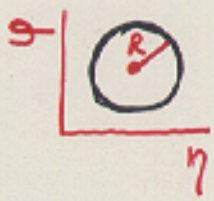


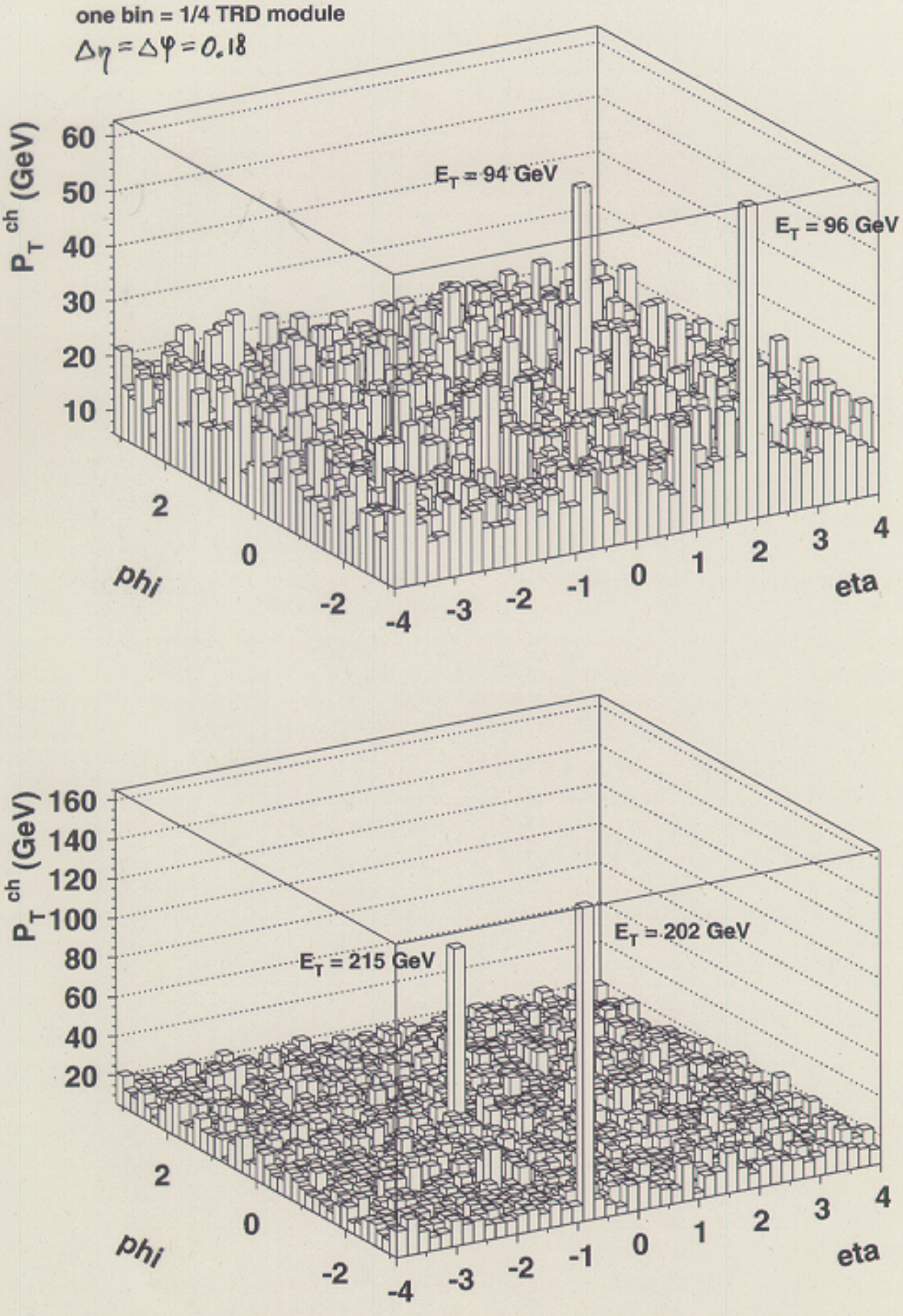
FIG. 1. Jet events in the CDF calorimeter. A jet clustering cone of radius 0.7 is shown around each jet. Clockwise from the upper left they are identified as two-jet, two-jet, five-jet and three-jet. Tracks for these events are shown in Figure 2.

JET RADIUS

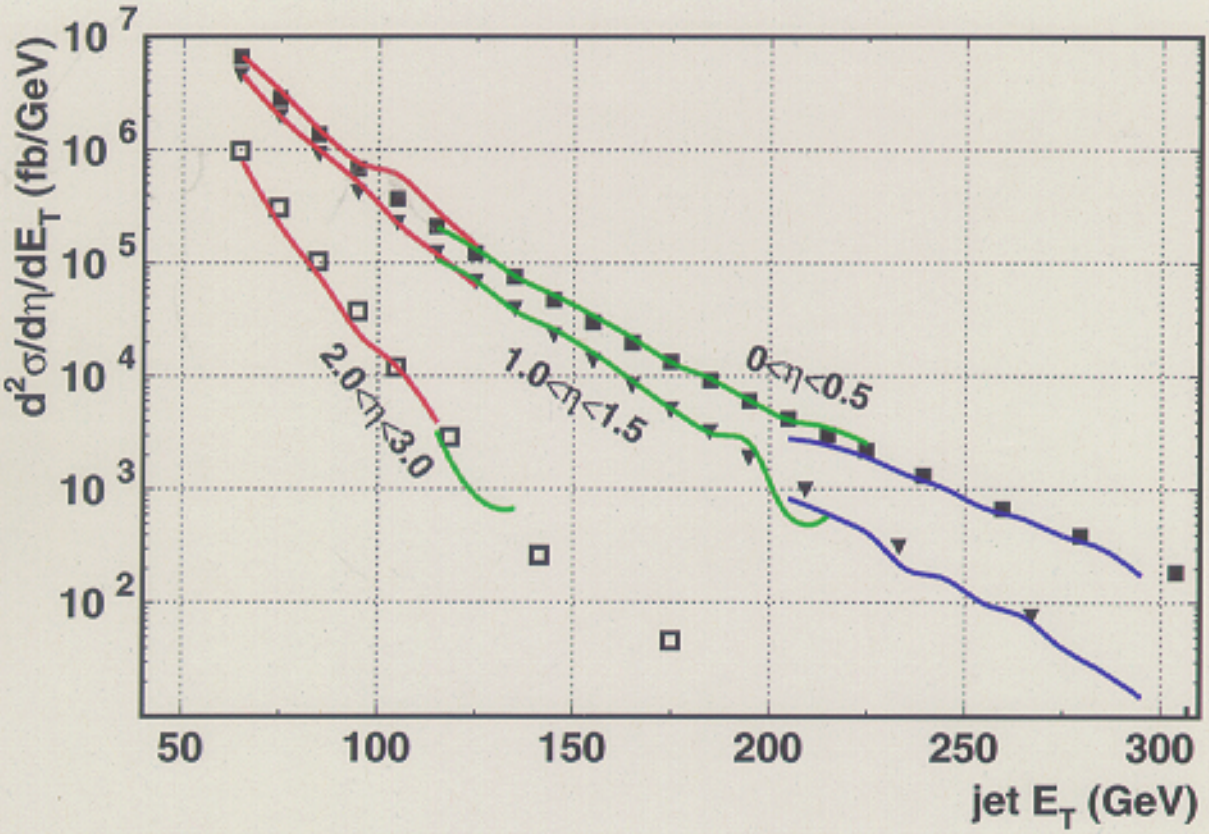


$R = 0.7$
(SNOWMASS CONVENTION)

Pythia jets sticking out of shaker background



Jet production in p-pbar at sqrt(s)=1.8 TeV



points: D0 PRL 86(2001)1707

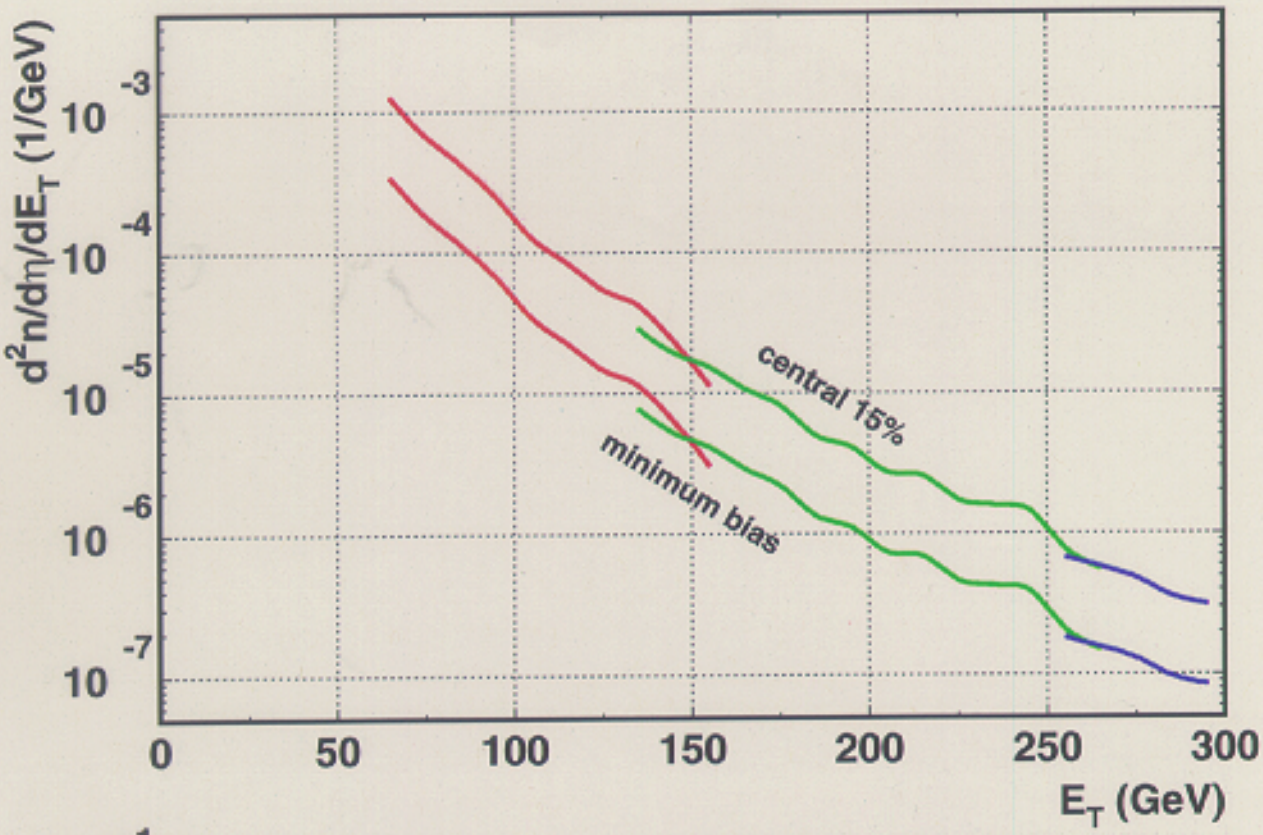
red line: 1.5 x PYTHIA with CTEQ4HJ, CKIN(3)=50

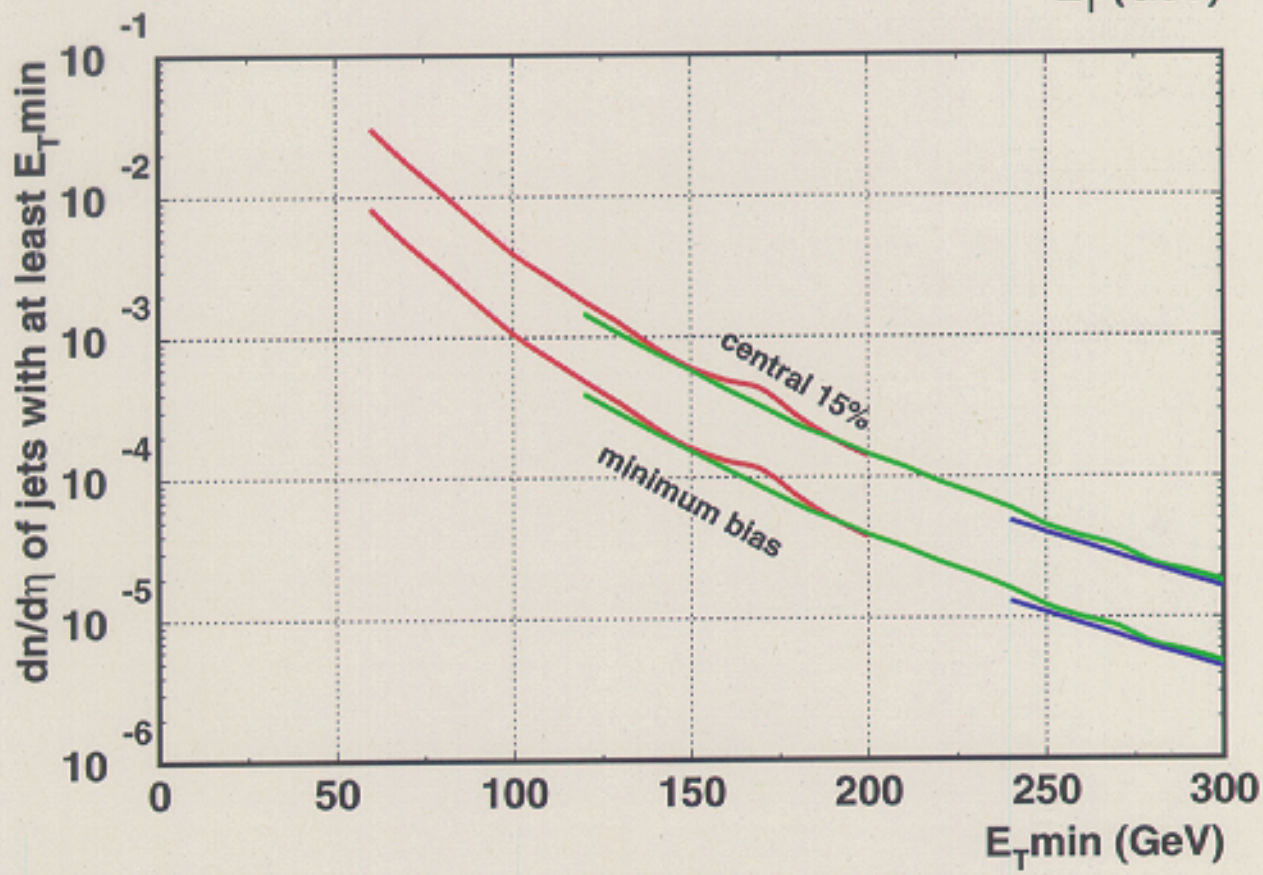
green line: 1.5 x PYTHIA with CTEQ4HJ, CKIN(3)=100

blue line: 1.5 x PYTHIA with CTEQ4HJ, CKIN(3)=200

K-FACTOR NEEDED TO REPRODUCE THE DØ DATA

Jet multiplicity in Pb+Pb at sqrt(s)=5.5 TeV



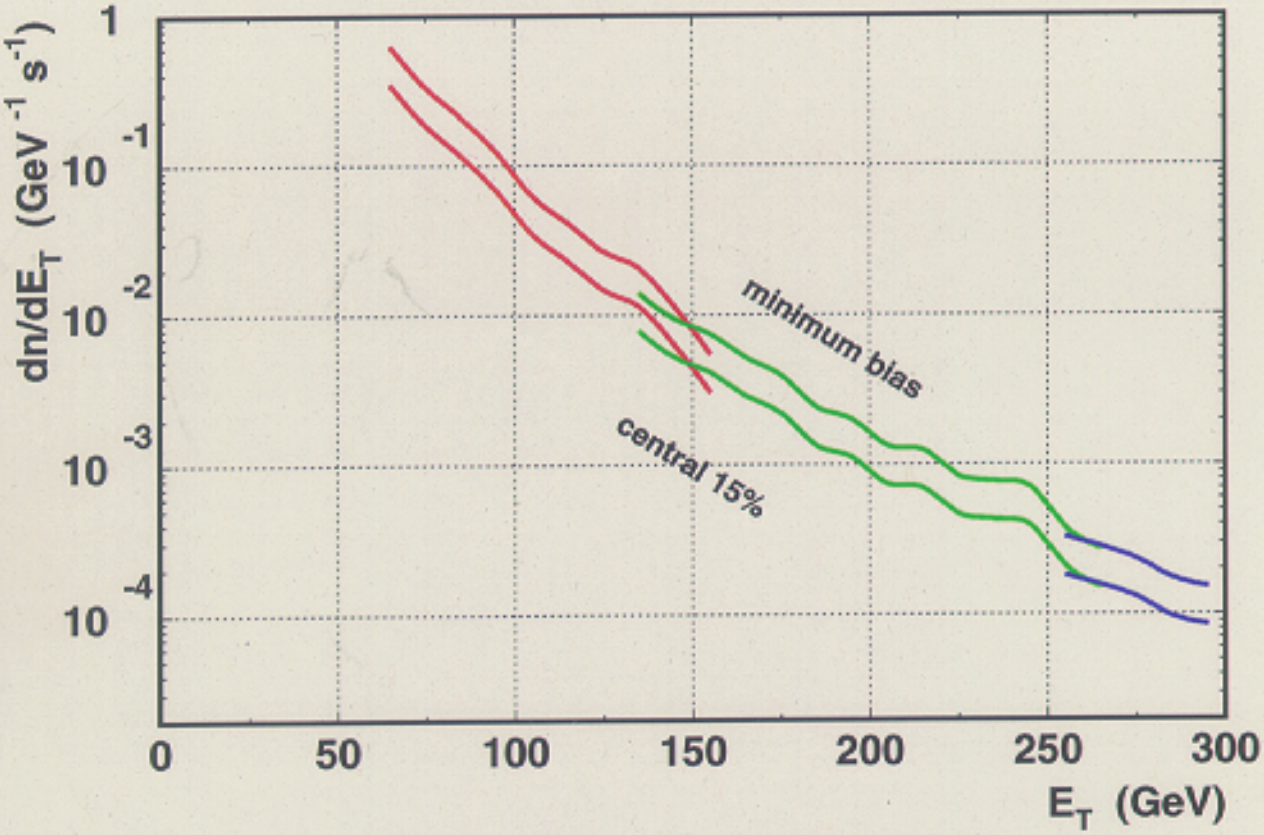


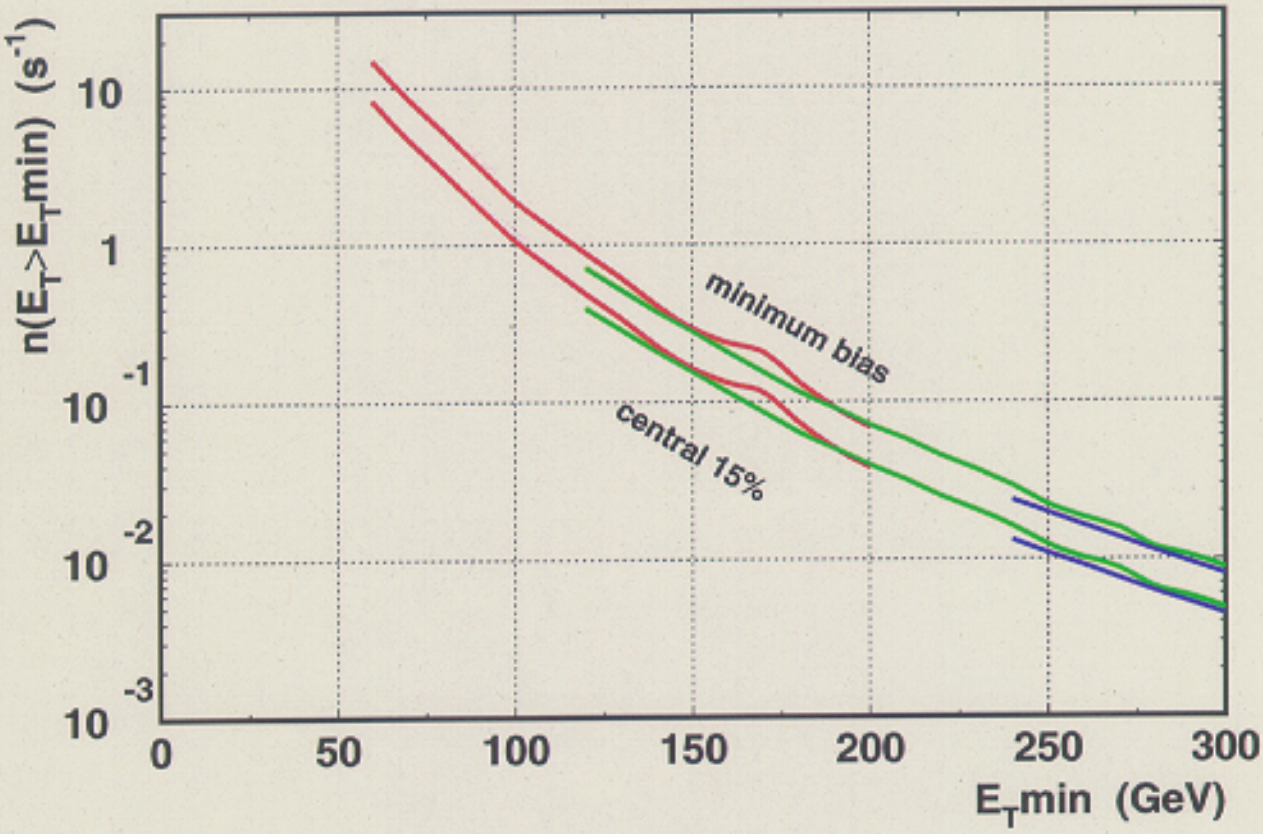
n (minimum bias PbPb) = 6 mb^{-1} * 1.5 * σ(pp)

n (central 15% PbPb) = 22 mb^{-1} * 1.5 * σ(pp)

nuclear overlap model — K-fac — Pythia

Jet into TPC rate in Pb+Pb at sqrt(s)=5.5 TeV



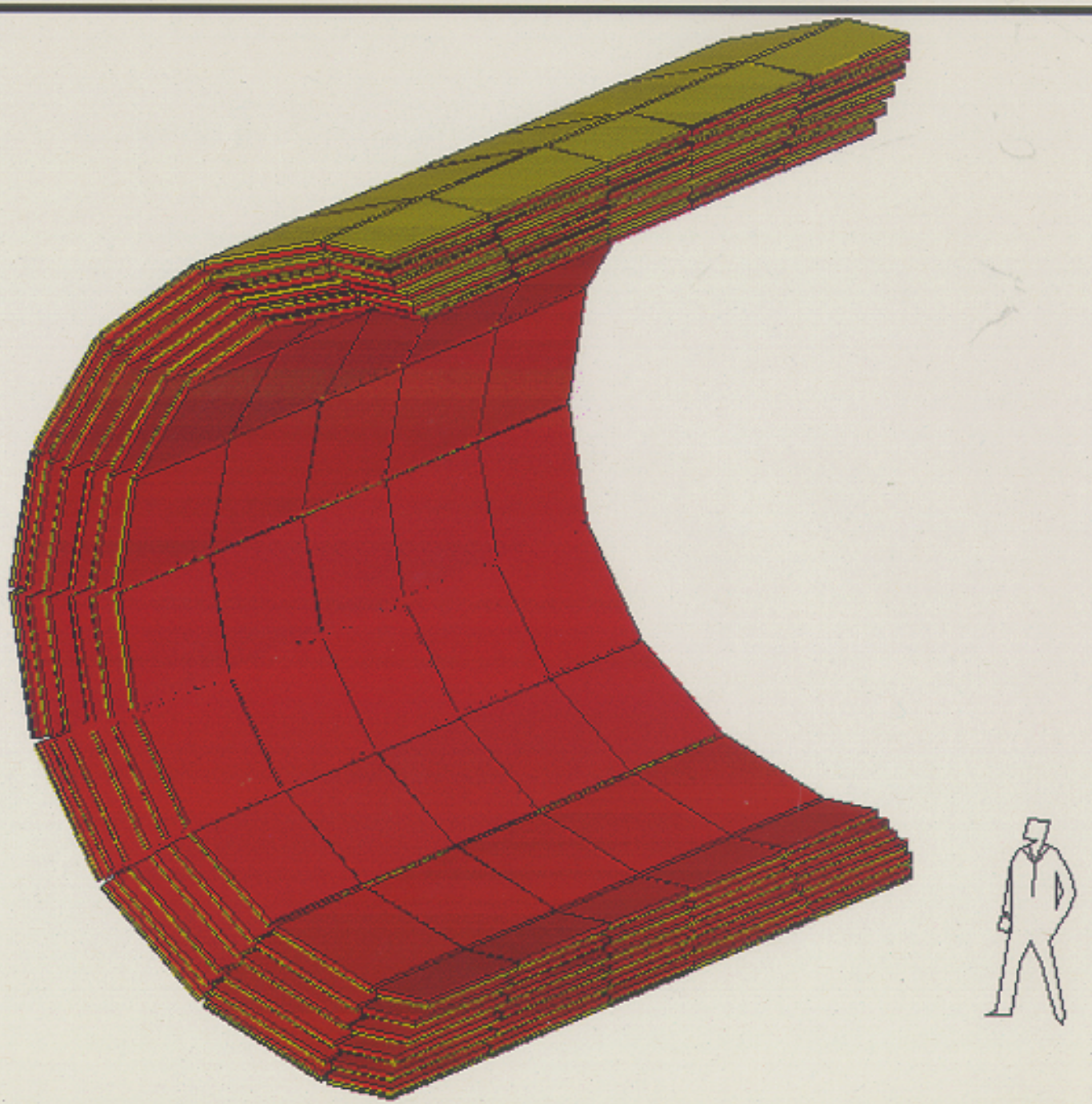


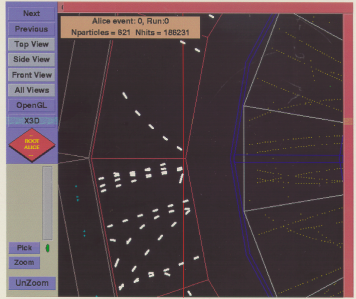
1000 minimum bias collisions per second assumed

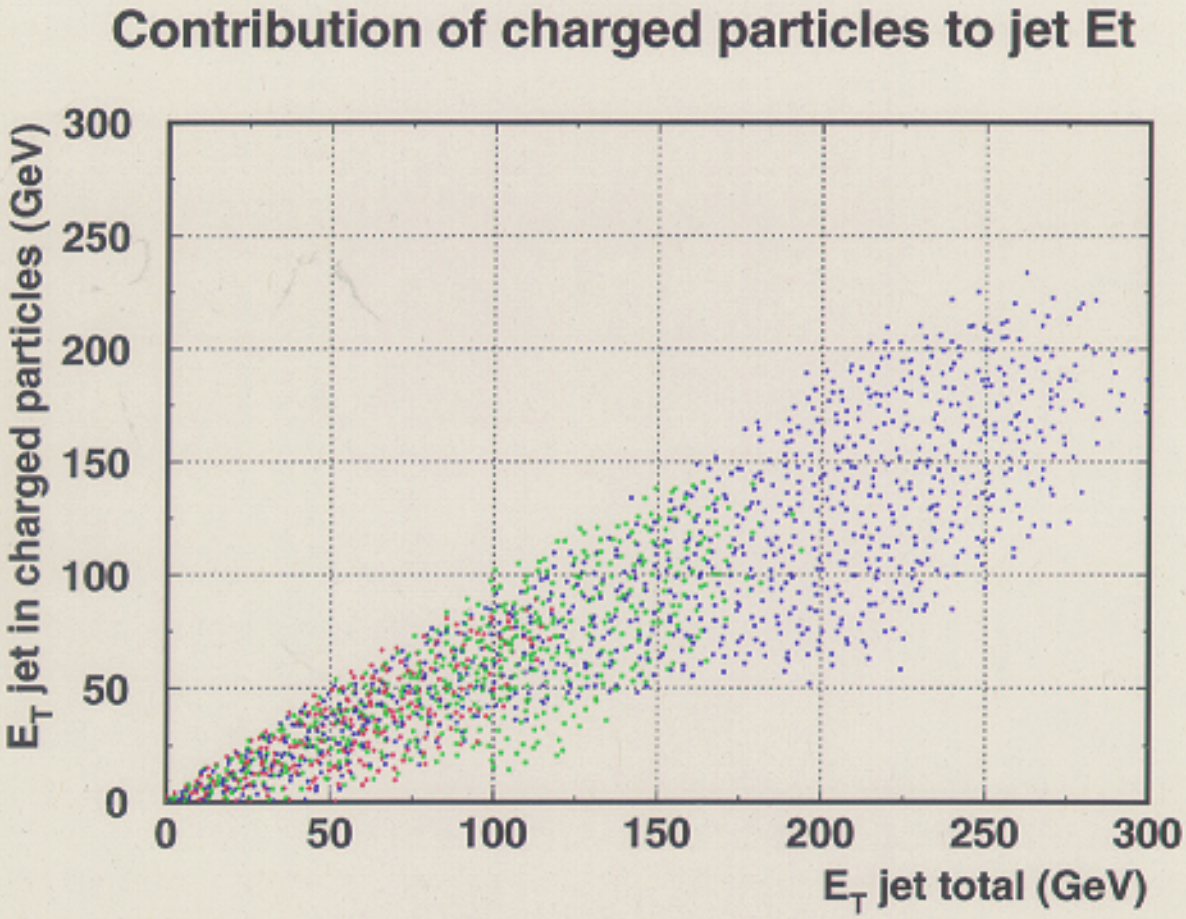
ALICE

Transition Radiation Detector

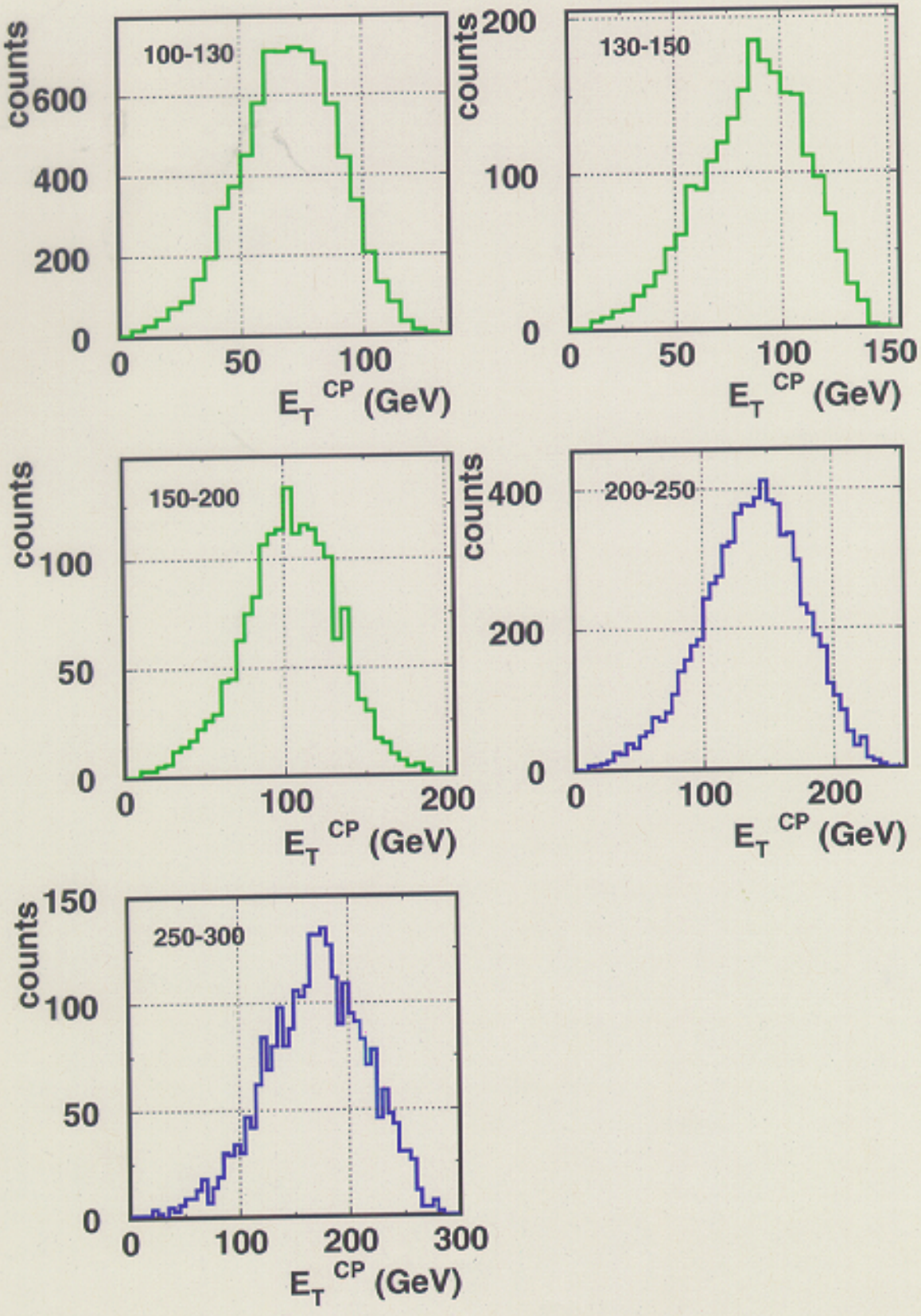
20/4/0




Next
Previous
Top View
Side View
Front View
All Views
OpenGL
X3D
ROOT
ALICE
Pick
Zoom
UnZoom
Alice event: 0, Run:0
Nparticles = 821 Nhits = 188231


Contribution of charged particles to jet Et
E_T jet in charged particles (GeV)
0
50
100
150
200
250
300
E_T jet total (GeV)

Contribution of charged particles to jet Et



CDF PRD64(2001)032001

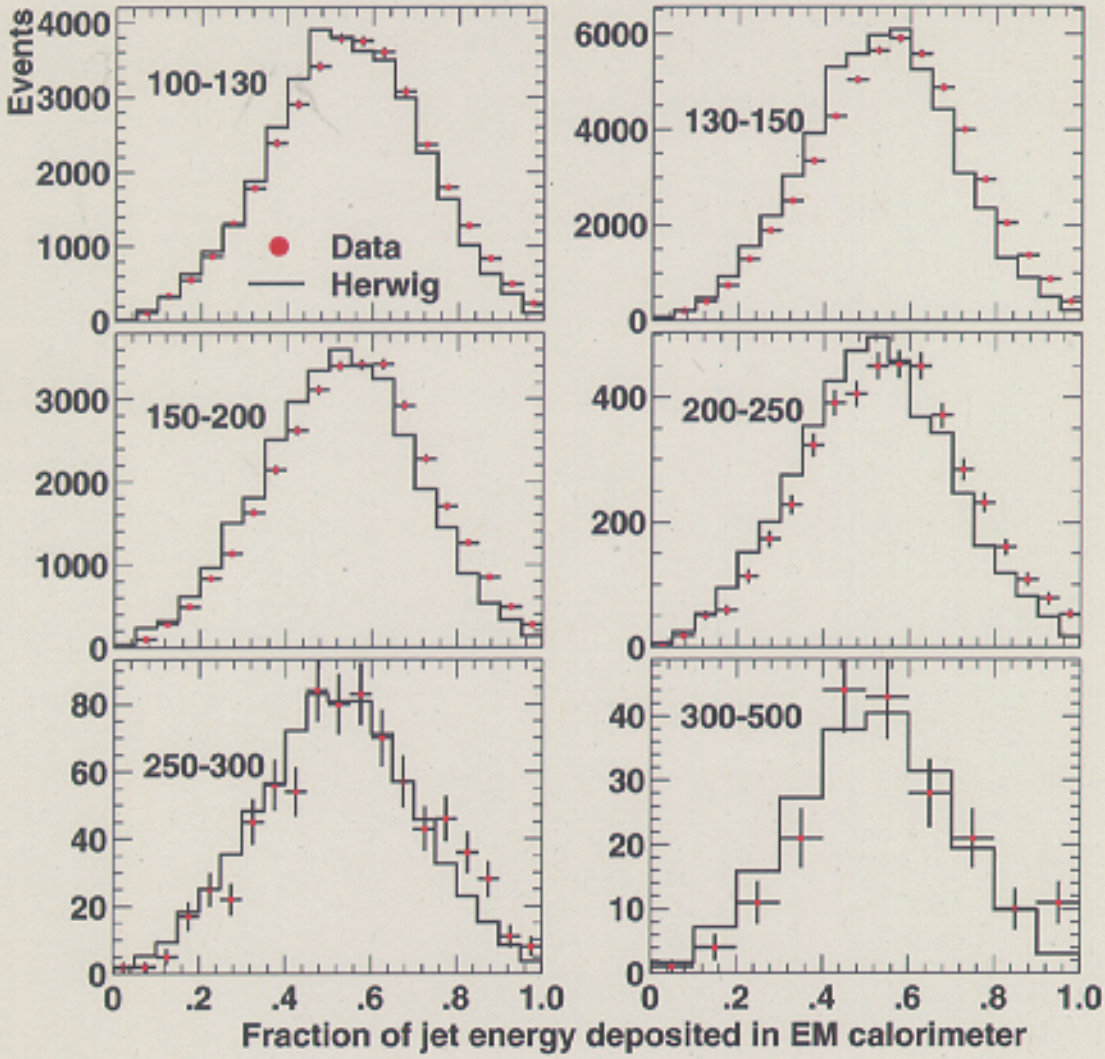
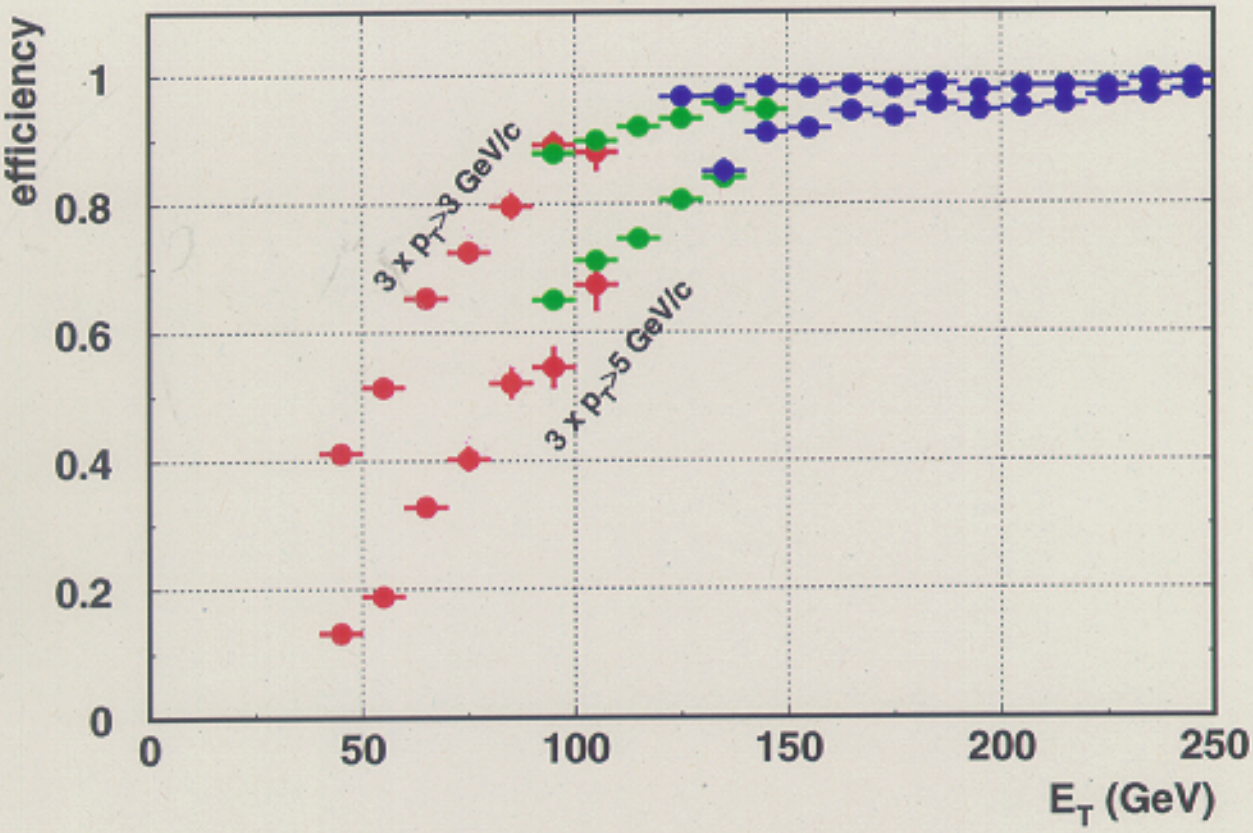


FIG. 15. Fraction of electromagnetic energy in jets for data (points) and simulation (histogram). The labels on the individual plots (e.g. 100-130 GeV) indicate the E_T range of the leading jet.

TRD jet trigger efficiency



trigger condition:
3 charged particles with $p_T > p_T$min in one TRD module

SUPRESSION OF EVENTS WITHOUT JETS

CENTRALITY	3× $p_\perp$>3	3 × $p_\perp$>5
0-15%	0.18	$2.3 \cdot 10^{-3}$
MINB	0.031	$4.0 \cdot 10^{-4}$

TRD jet trigger suppression factor for events without jets

1. Extract single particle multiplicities in central Pb+Pb from Hijing:
   0.192 charged particles with pt>3 GeV/c per TRD module
   0.0433 charged particles with pt>5 GeV/c per TRD module

2. From this, estimate mean multiplicities as a function of centrality:

centrality	<Ncoll>	<n(pt>3)>	<n(pt>5)>
0-15%	1320	0.192	4.3e-2
15-30%	619	9.0e-2	2.0e-2
30-45%	256	3.7e-2	8.4e-3
45-60%	90.0	1.3e-2	3.0e-3
60-75%	24.2	3.5e-3	7.9e-4
75-90%	5.2	7.6e-4	1.7e-4
90-100%	0.9	1.3e-4	3.0e-5

3. Use these mean multiplicities to calculate the probability of having at least 3 such particles. Assume independent production and use Poisson.

centrality	3 x pt>3	3 x pt>5
0-15%	1.0e-3	1.3e-5
15-30%	1.1e-4	1.3e-6
30-45%	8.2e-6	9.8e-8
45-60%	3.6e-7	4.5e-9
60-75%	7.1e-9	8.2e-11
75-90%	7.3e-11	8.2e-13
90-100%	3.7e-13	4.5e-15
minbias	1.7e-4	2.2e-6

How good is the assumption of independence? Not very good because the multiplicity distributions in Hijing are not exactly Poissonian. A direct valuation of the probability of having 1,2, and 3 particles with pt>3 GeV/c yields 0.17, 0.020, and 0.0022 respectively, compared to the Poissonian 0.18, 0.016, and 0.00102. Let us take care of this by multiplying all the obtained probabilities for n>=3 by 2.

4. Calculate the fake trigger probabilities. The trigger condition is to have at least 3 pt>ptmin particles in any of the TRD modules. For this, multiply the above values by 90 (number of TRD modules) and 2 (correction for non-Poissonian multiplicity distributions):

centrality	3 x pt>3	3 x pt>5
0-15%	0.18	2.3e-3
minbias	0.031	4.0e-4

5. Calculate event rates, assuming 1000 minbias/s. Notation:
   central - central 0-15%
   jet3 - at least 3 charged particles with pt>3 GeV/c in any TRD module
   jet5 - at least 3 charged particles with pt>5 GeV/c in any TRD module
   Assumed trigger efficiency for Et>100 GeV jets: 100% for central, 90% for jet3, and 66% for jet5.

trigger	events without jets	Et>100 GeV jet events
minbias	1000/s	2.0/s
jet3	31/s	1.8/s
jet5	0.40/s	1.3/s
central	150/s	1.0/s
central and jet3	27/s	0.9/s
central and jet5	0.35/s	0.7/s

****

EVENT RATES WITH TRD JET TRIGGER

TRIGGER	EVENTS WITHOUT JETS	EVENTS WITH $E_T > 100$ GeV JETS
MINBIAS	1000/s	2.0/s
JET3	31/s	1.8/s
JET5	0.46/s	1.3/s
CENTRAL	150/s	1.0/s
CENTRAL·JET3	2.7/s	0.9/s
CENTRAL·JET5	0.35/s	0.7/s

THESE NUMBERS MAY BE HIGHER IN REALITY; FULL SIMULATION IS NEEDED

EXPLANATION OF TERMS:

CENTRAL ≡ MOST CENTRAL 15%

JET3 ≡ $3 \times P_t > 3$ GeV/c IN ANY OF TRD MODULES

JET5 ≡ $3 \times P_t > 5$ GeV/c —" —

JETS WITH ALICE - SUMMARY

IN Pb + Pb

IN 10^7 CENTRAL EVENTS WE WILL HAVE

500 000 JETS WITH $E_\perp \geq 50$ GeV
50 000 JETS WITH $E_\perp \geq 100$ GeV
7000 JETS WITH $E_\perp \geq 150$ GeV

USING TRD TO TRIGGER ON JETS WE GET SIMILAR NUMBERS OF JETS PER DAY (ALL CENTRALITIES)

THIS NUMBER OF JETS IS COMPARABLE TO THE TOTAL JET STATISTICS OF DØ OR CDF.

TOTAL JET STATISTICS

DØ, CDF: $n^{jet} = 100\ pb^{-1} \cdot \sigma^{jet}_{1.8\,TeV}$

ALICE Pb Pb:

$$n^{jet} = \underbrace{10^{27}\ cm^{-2}\,s^{-1}}_{\mathcal{L}_{PbPb}} \cdot \underbrace{2.6\cdot 10^{6}\,s}_{month} \cdot \underbrace{1/8}_{\text{BEFORE/AFTER PROTECTION}} \cdot \underbrace{20^{2}}_{\frac{\sigma_{PbPb}}{\sigma_{NN}}} \cdot \underbrace{10}_{\frac{\sigma_{5.5\,TeV}}{\sigma_{1.8\,TeV}}} \cdot \sigma^{jet}_{1.8\,TeV}$$

$$n^{jet} = 150\ pb^{-1} \cdot \sigma^{jet}_{1.8\,TeV}$$

$1\ cm^{-2} = 10^{-36}\ pb^{-1}$