The Plan on the 1st Period GDH Data analysis and PID results for 2nd Period Data

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He-3 collaboration meeting   07/22/2005

***The plan on the first period data of nGDH.**

***The recent results on the calibration for shower and cherenkov**

The plan on the first period data of nGDH.

Low beam energy data were taken during the first period of data taking.

Now data analysis for the second data got progress well by GDH group, which not only can get useful results ,but also provide valuable experience for the 1st period data analysis.

However, due to the kinematics and geometry are different for the experiments during the two periods, so, following work have to be done individually for the first period data:

spectrometer optics analysis;

target analysis;

scalar analysis (beam current, deadtime correction…);

particle identification and detector analysis;

acceptance study using carbon data;

elastic analysis;

background study and MC simulation;

extraction of the raw cross section and asymmetries;

radiative corrections;

extraction of physics quantities: the extend GDH integral, the spin structure functions g_1 and g_2.

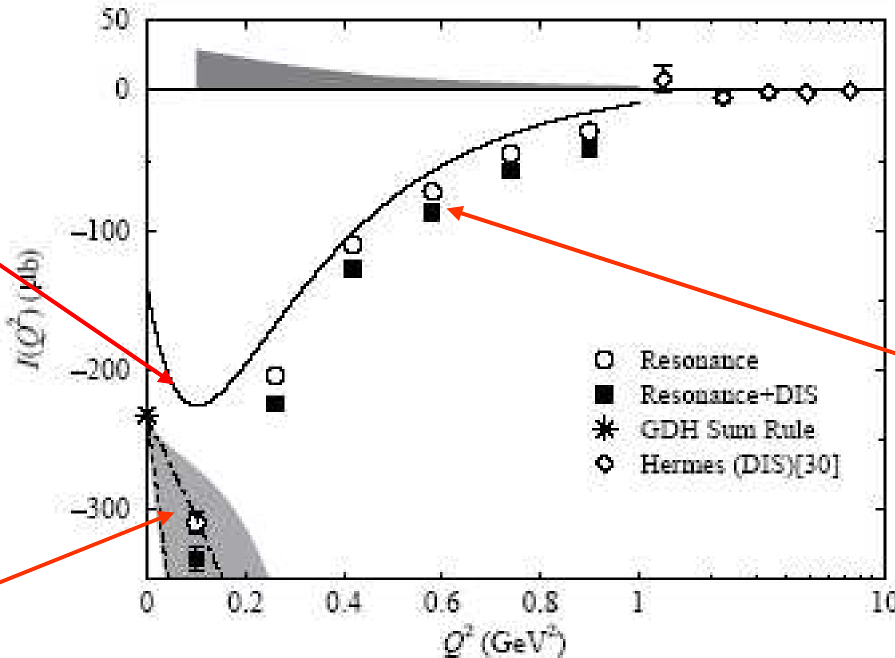
We knew that it is a hard task to analyse the first Period data, but We are interested in this subject because its importance and interest.

Because the data which we will analyse, are in the small

Q^2 **area.**

$$\int_{i\ \ n} \sigma_{1/2}(\ \ )\quad \sigma_{3/2}(\ \ )\ \frac{d}{\qquad} = -\frac{2\ \ ^{2}\ \ _{E}}{M^{2}}\ \ M2$$

Model



PT

Jlab Hall A, 15.5^0 measurement results.

FIG. 3. Our measurements for $I(Q^2)$ vs. Q^2, both with and without an estimate of the DIS contribution. Also shown with a dotted (dot-dashed) line are the χPT calculations of ref. [12] (refs. [13] and [14]). The calculation of ref. [11], based largely on the MAID model, is shown with a solid line.

How to go at small Q^2 region? Down lower? Turn around like the MAID model? A negative slop like PT calculation? goes to GDH point at Q^2 =0(extrapolation)?

It is lack of experimental data at small Q^2 of 0.02-0.2 GeV ^{2}

So it is very important and interesting to test the small Q^2 field .

The original purpose of data taken in the first period of small angle GDH experiment at Jlab, Hall A, exactly for checking the theories and add some important data points to this region.

Plan for 1st Period Data Analysis

USTC group will be responsible on the analysis as follows:

- particle identification and detector analysis
- acceptance study using carbon data
- data extraction of the raw cross section and asymmetries
- radiative corrections
- extraction of physics quantities

People of USTC group for this work:

Yi Jiang, (faculty, Associate Professor, work experience on D0, Fermilab)

Yunxiu Ye, (faculty, Professor, work experience, at HERMES and CERN)

Haijiang Lu, (postdoc, work experience on HERMES and BES)

Xinhu Yan (graduate student, available in Sep.)

Pei Zhang (undergraduate student)

Summary

It is very important to analyse the data in small Q^2 regime to have a benchmark test of χPT in this region where it is supposed to work, and verify the GDH sum rule at Q^2 =0.

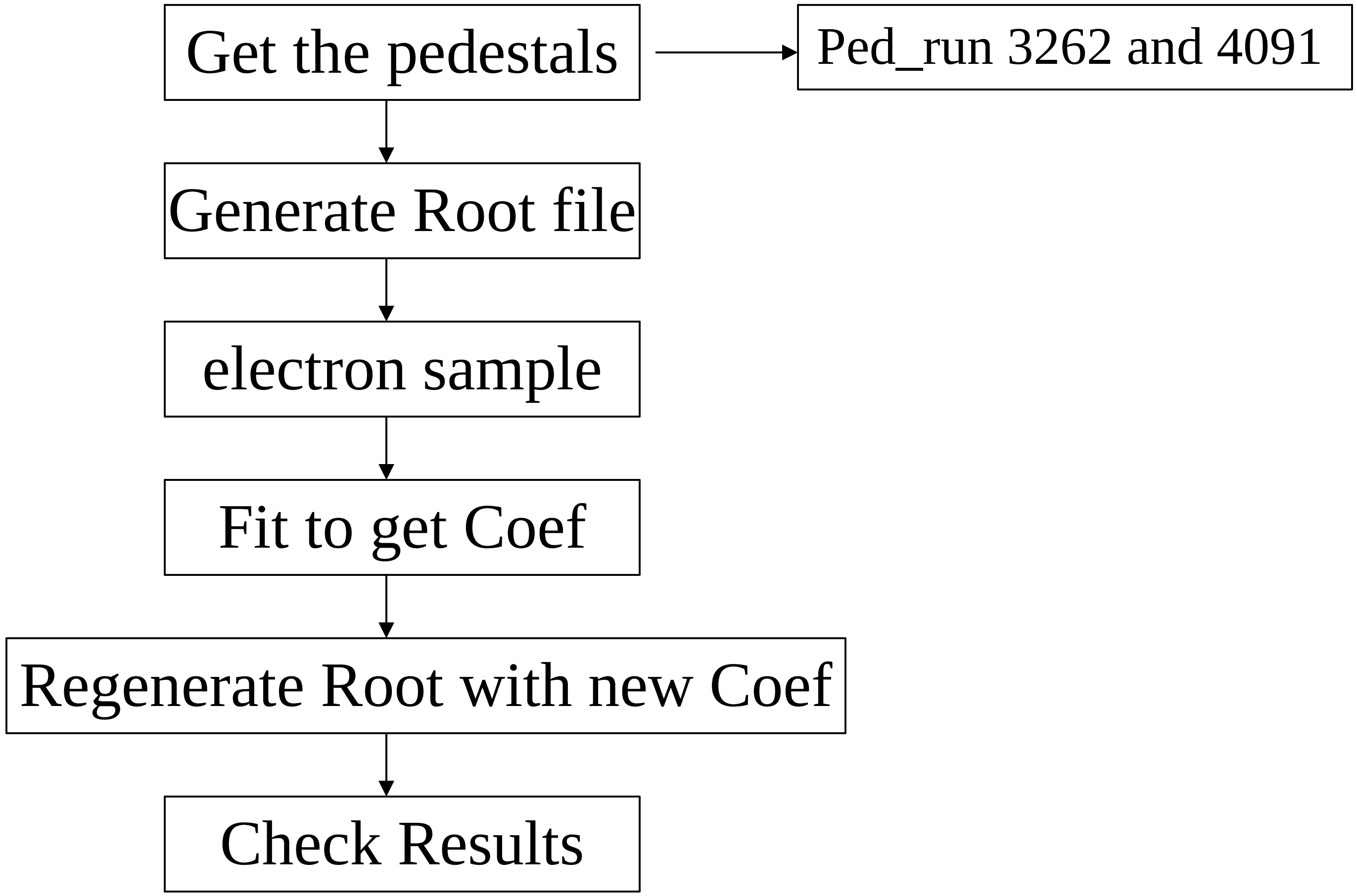
Now, we are working on the particle ID and the calibration for the preshower, shower and cherenkov detectors using second period data. Mainly, Haijiang(a postdoc) is doing this work.

The purpose of doing PID is for cross check of the results, required by the spokesperson of GDH, which have been done by another student(Jing) before we are doing; on the other hand, it is for preparation and getting some experience for analysing the first period data.

Shower and Cerenkov Calibration & Efficiency

- ❑Method & Data set
- ❑Sample election
- ❑Before && after calibration
- ❑Cut efficiency
- ❑Summary
- ❑Cherenkov Calibration

Method


Get the pedestals
Ped_run 3262 and 4091
Generate Root file
electron sample
Fit to get Coef
Regenerate Root with new Coef
Check Results

PID results

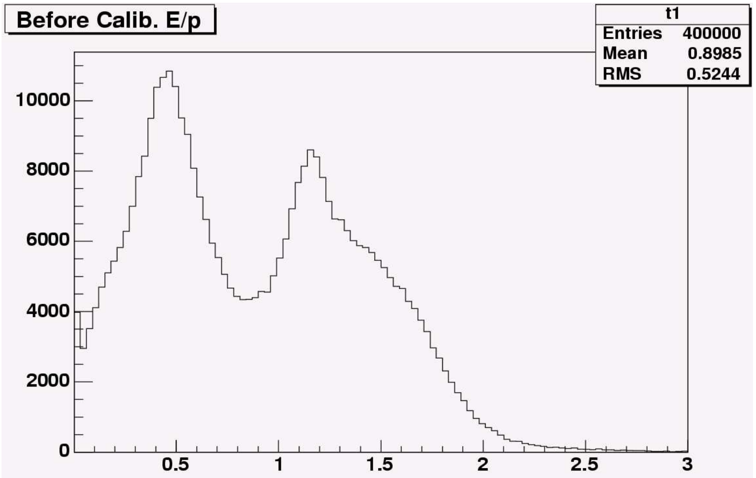
First, using the data in DIS region.

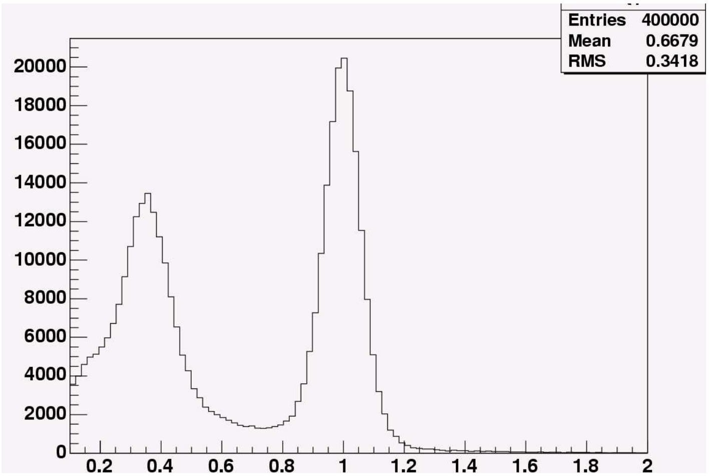
The coefficiencies of calibration for Shower and

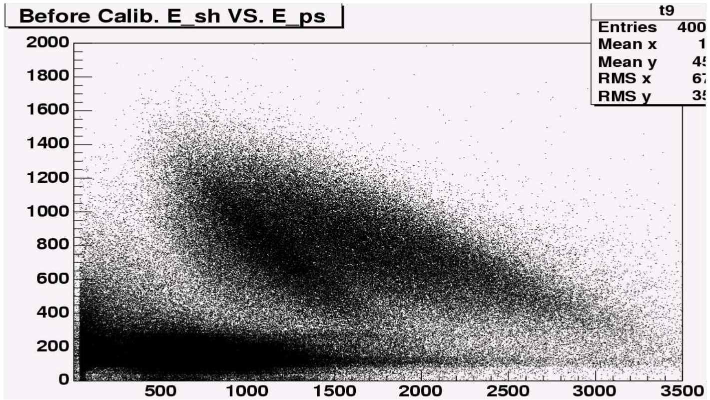
preShower counters have been obtained. The detection efficiencies of Shower and Cherenkov have been extracted.

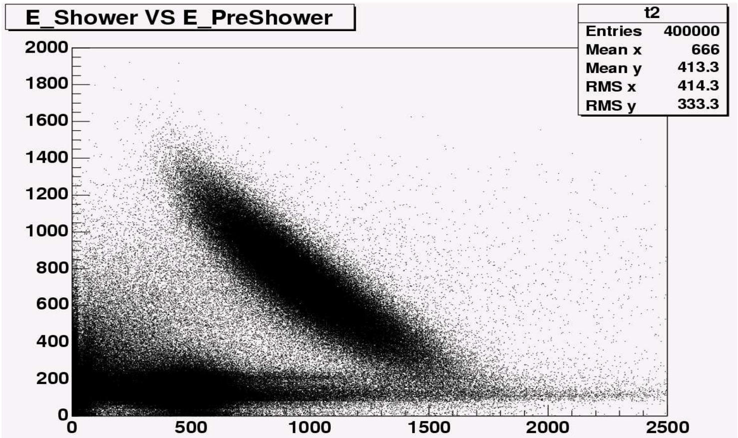
For example, the fig. are the before and after applying the calibration constants.

E_total/p and E_Sh VS E_Pre









Before calibration **After calibration**

the results shown last time using the data from DIS region.

In order to get more clean samples so that the results are more credible, according to J. P.'s suggestion, we used the runs from resonance regime.

We took the runs as follows:

Data Set:	9^o, **Target: He3,** **E_beam = 3.775, 1.147, 2.235, 4.404, 3.320GeV**

Run list

Run#	E_beam	p0_central
3320	3.775	3.100
3330	3.775	2.883
3370	3.775	2.493
3381	3.775	2.318
3390	3.775	2.156
3420	3.775	1.853
3476	3.775	1.001
3545	1.147	1.142
3570	1.147	0.995
* 3590	1.147	0.790
3634	1.147	0.461
3740	2.235	1.931
* 3771	2.235	1.788

Run#	E_beam	p0_central
3812	2.235	1.525
3836	2.235	1.129
* 3902	4.404	3.137
3940	4.404	2.704
3974	4.404	2.318
3994	4.404	2.146
4020	4.404	1.991
4056	4.404	1.585
4110	3.320	2.887
* 4173	3.320	2.131
4202	3.320	1.700

*** Calibration Runs**

Sample Selection

0. basic cuts
1. Only one track reconstructed in VDC
2. Only one track detected in S1 & S2
3. Only one cluster reconstructed in PreShower & Shower
4. Sum of corrected amplitudes of Gas Cherenkov

   >800 && < 3000

5. The cluster in cut 3 is coincident with Golden Track

6. The cluster doesn't cross the edge block of the shower.

Because we concentrate on the calibration for the non-edge blocks.

Sample Selection cuts

basic cuts: |R.gold.dp|<1.0, |R.gold.th|<0.5, |R.gold.ph|<0.5

VDC: R.vdc.u1.nclut==1&& R.vdc.v1.nclut==1

R.vdc.u2.nclut==1&& R.vdc.v2.nclut==1

S1,S2: R.s1.nthit==1&& R.s1.nlahit==1&&R.s1.nrahit==1
R.s2.nthit==1&& R.s2.nlahit==1&&R.s2.nrahit==1

(Pre)Shower: R.ps.nclust==1
R.sh.nclust==1

Chev: R.cer.asum_c>800&&R.cer.asum_c<3000

GoldTrack:

$$|R.ps.trx - R.ps.x| < 0.1, |R.ps.try - R.ps.y| < 0.2$$

$$|R.sh.trx - R.sh.x| < 0.15, |R.sh.try - R.sh.y| < 0.15$$

Fit to get Coef

Readout the pedestals for different (Pre)Shower channels P_j

Readout the momentum for the particle p_{kin}

Readout the amplitudes value in different channels of (Pre)Shower A_j

Initial the Coef for all channels. (Set to the default values)

Minimization the following function:

$$^{2}=\sum_{i=1}^{N}\left[\sum_{j\in M_{ps}^{i}} C_{j}\cdot\left(A_{j}^{i}-P_{j}\right)+\sum_{k\in M_{sh}^{i}} C_{k}\cdot\left(A_{k}^{i}-P_{k}\right)-p_{kin}^{i}\right]^{2}$$

M_{ps} : Channels of PreShower M_{sh} : Channels of Shower

Coef's for PreShower

E_beam=2.235. Cal Run# 3771

0.80300	0.99400	0.95312	0.92424	0.90532	0.89653	0.88402	1.04538	0.92794	0.87188	0.85953	0.89416
0.95349	0.93818	0.88233	0.96353	0.94581	0.85754	0.94360	1.05135	0.95294	0.90953	0.45309	0.46515
0.45423	0.47102	0.97456	0.92000	0.97229	1.01948	0.98640	0.88186	0.91775	0.92576	0.90014	0.89525
1.02552	0.95183	0.87147	0.80266	0.88629	0.82805	0.88252	0.88784	0.97302	0.89135	1.36337	0.62700

E_beam=4.404. Cal Run# 3902

0.80300	0.99400	0.94804	0.96248	0.93066	0.91259	0.93525	1.09994	0.96845	0.92062	0.91303	0.93861
1.00157	0.99453	0.93494	0.99711	0.97972	0.88838	0.98592	1.10320	0.99796	0.95930	0.45309	0.46515
0.45423	0.47102	1.02853	0.97471	1.02985	1.06219	1.03940	0.93169	0.95992	0.97315	0.94727	0.93851
1.07809	1.00563	0.91895	0.83062	0.91782	0.85464	0.91986	0.93203	1.02254	0.92108	0.92800	0.62700

All the numbers are very close and have differences of less than 6%.

Green numbers are ones on edge blocks.

Comparison of Coef's for PreShower

Ours :

7 points have the differences of more than 20%

E_beam=2.235. Cal Run# 3771

0.80300	0.99400	0.95312	0.92424	0.90532	0.89653	0.88402	1.04538	0.92794	0.87188	0.85953	0.89416
0.95349	0.93818	0.88233	0.96353	0.94581	0.85754	0.94360	1.05135	0.95294	0.90953	0.45309	0.46515
0.45423	0.47102	0.97456	0.92000	0.97229	1.01948	0.98640	0.88186	0.91775	0.92576	0.90014	0.89525
1.02552	0.95183	0.87147	0.80266	0.88629	0.82805	0.88252	0.88784	0.97302	0.89135	1.36337	0.62700

Jing's : Run# 3771

1.41646	1.23978	0.92208	1.11137	1.09055	0.86070	0.72266	0.76304	0.86693	0.63328	0.61329	0.79809
0.66683	0.71853	0.75877	0.87065	0.96089	0.79312	0.95600	1.10145	0.91135	0.82822	0.85699	3.75910
1.40567	1.13375	0.97345	1.04603	0.97184	1.01865	1.01215	0.84765	0.77401	0.97027	0.81112	0.89712
0.83972	0.86359	0.79559	0.63031	0.88836	0.78947	0.83847	0.85418	0.84365	0.78661	0.71126	0.62700

Coef's for Shower(The values on edge blocks are fixed)

E_beam=2.235. Cal Run# 3771

0.82000	1.08688	0.80317	0.85291	1.08581	0.82000	0.82000	1.08510	0.86102	0.85477	1.13164	1.49000
0.82000	0.82124	0.97673	0.90353	0.91614	0.58214	0.51549	0.53841	0.61542	0.94201	0.91503	0.73692
0.64983	0.66755	0.73350	0.56015	0.54837	0.59701	0.64045	0.86850	0.92773	0.42738	0.56066	1.14603
0.67345	0.44188	0.71947	0.73396	0.50126	0.58858	0.45182	0.45232	0.83906	1.01332	0.80140	1.24900
1.23600	0.31763	0.34188	0.79667	0.47337	0.41446	0.78542	0.45618	0.83324	0.66637	0.43084	0.45121
0.97178	0.82825	0.40759	1.09277	0.81744	1.09800	1.27900	0.92452	0.88351	1.25415	0.81698	1.27600
1.23700	1.05322	0.90122	0.72072	0.84246	1.35300	1.31700	0.79827				

E_beam=4.404. Cal Run# 3902

0.82000	1.08688	0.80317	0.85291	1.08581	0.82000	0.82000	1.08510	0.86102	0.85477	1.13164	1.49000
0.82000	0.82124	0.97673	0.90353	0.91614	0.77661	0.50006	0.54829	0.64216	0.99515	0.98595	0.75626
0.65640	0.65539	0.72500	0.55493	0.54139	0.58823	0.63726	0.86850	0.92773	0.40696	0.54727	1.14294
0.66530	0.43232	0.72152	0.73237	0.48387	0.57298	0.44424	0.45143	0.83202	1.02208	0.80365	1.24900
1.23600	0.36513	0.32117	0.80259	0.47177	0.41169	0.77661	0.45171	0.83587	0.65054	0.42910	0.45436
0.97372	0.76101	0.42265	1.09277	0.81744	1.09800	1.27900	0.92452	0.88351	1.25415	0.81698	1.27600
1.23700	1.05322	0.90122	0.72072	0.84246	1.35300	1.31700	0.79827				

There is one point having difference with 30%, another two has ~10%; others have less than 5%

Our calibration constants for shower, Run # 3771

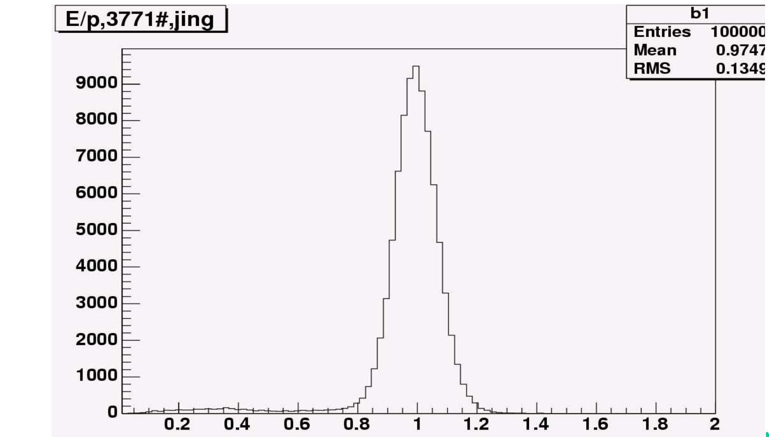
0.82000	1.08688	0.80317	0.85291	1.08581	0.82000	0.82000	1.08510	0.86102	0.85477	1.13164	1.49000
0.82000	0.82124	0.97673	0.90353	0.91614	0.58214	0.51549	0.53841	0.61542	0.94201	0.91503	0.73692
0.64983	0.66755	0.73350	0.56015	0.54837	0.59701	0.64045	0.86850	0.92773	0.42738	0.56066	1.14603
0.67345	0.44188	0.71947	0.73396	0.50126	0.58858	0.45182	0.45232	0.83906	1.01332	0.80140	1.24900
1.23600	0.31763	0.34188	0.79667	0.47337	0.41446	0.78542	0.45618	0.83324	0.66637	0.43084	0.45121
0.97178	0.82825	0.40759	1.09277	0.81744	1.09800	1.27900	0.92452	0.88351	1.25415	0.81698	1.27600
1.23700	1.05322	0.90122	0.72072	0.84246	1.35300	1.31700	0.79827				

Jing's calibration constants for Shower, Run #3771

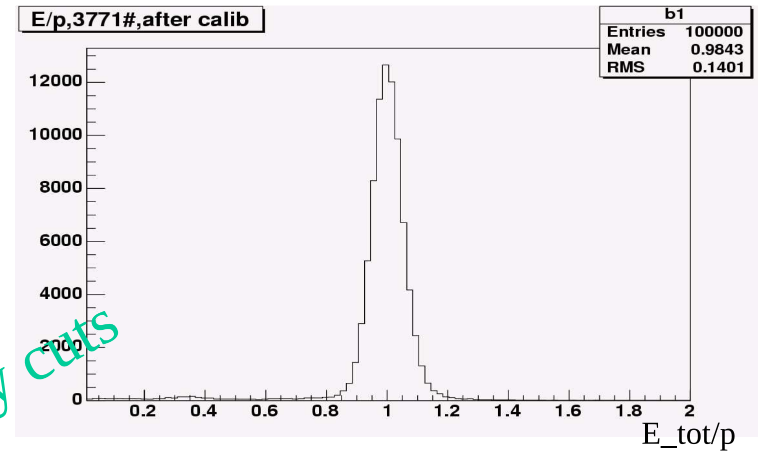
0.73786	0.31162	0.50474	1.19800	0.46493	1.99035	1.32966	2.26303	0.59227	0.90941	0.86816	0.92221
0.13256	0.29395	0.79786	0.07015	0.49744	0.43021	0.49208	0.50056	0.55501	0.39977	0.74831	0.29661
0.63075	0.50459	0.72831	0.54989	0.52355	0.57477	0.60310	0.35407	0.29907	0.44171	0.55525	1.07358
0.63413	0.37776	0.63644	0.64337	0.42698	0.54391	0.42506	0.42425	0.77722	0.97130	0.74831	0.48899
0.14677	0.33910	0.34526	0.98678	0.51708	0.40043	0.80513	0.46997	0.88340	0.68082	0.42011	0.45735
0.81517	0.73499	0.38599	0.13097	0.19062	1.74123	0.21929	0.88286	1.18410	0.90880	0.06997	0.29441
0.60349	0.50324	0.25264	1.86346	0.77286	0.41467	0.11235	0.23909				

There are two points(red) have differences of about 2-3times, 6 points have diffrences of ~30% .

Comparison with Jing's 3771

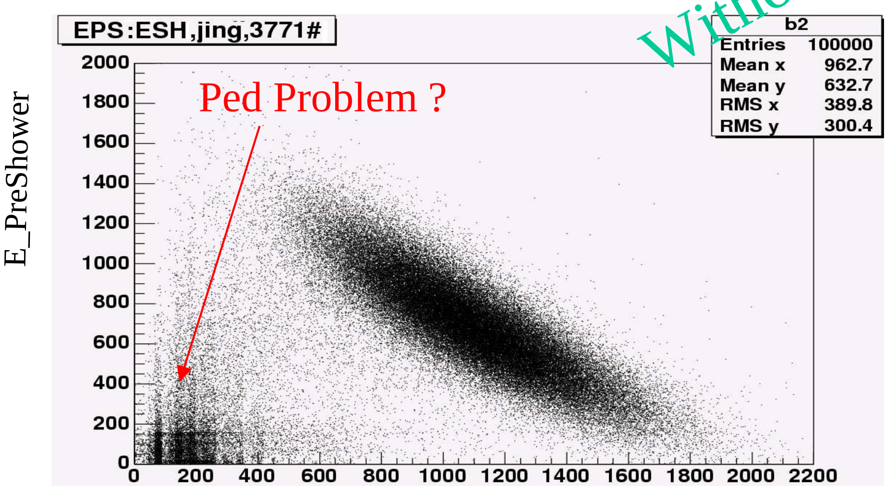


E_tot/p

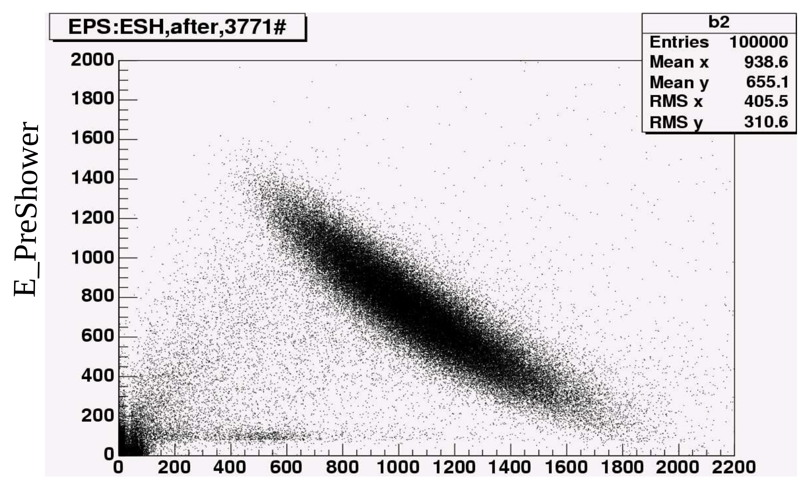


E_tot/p

Without any cuts



E_Shower

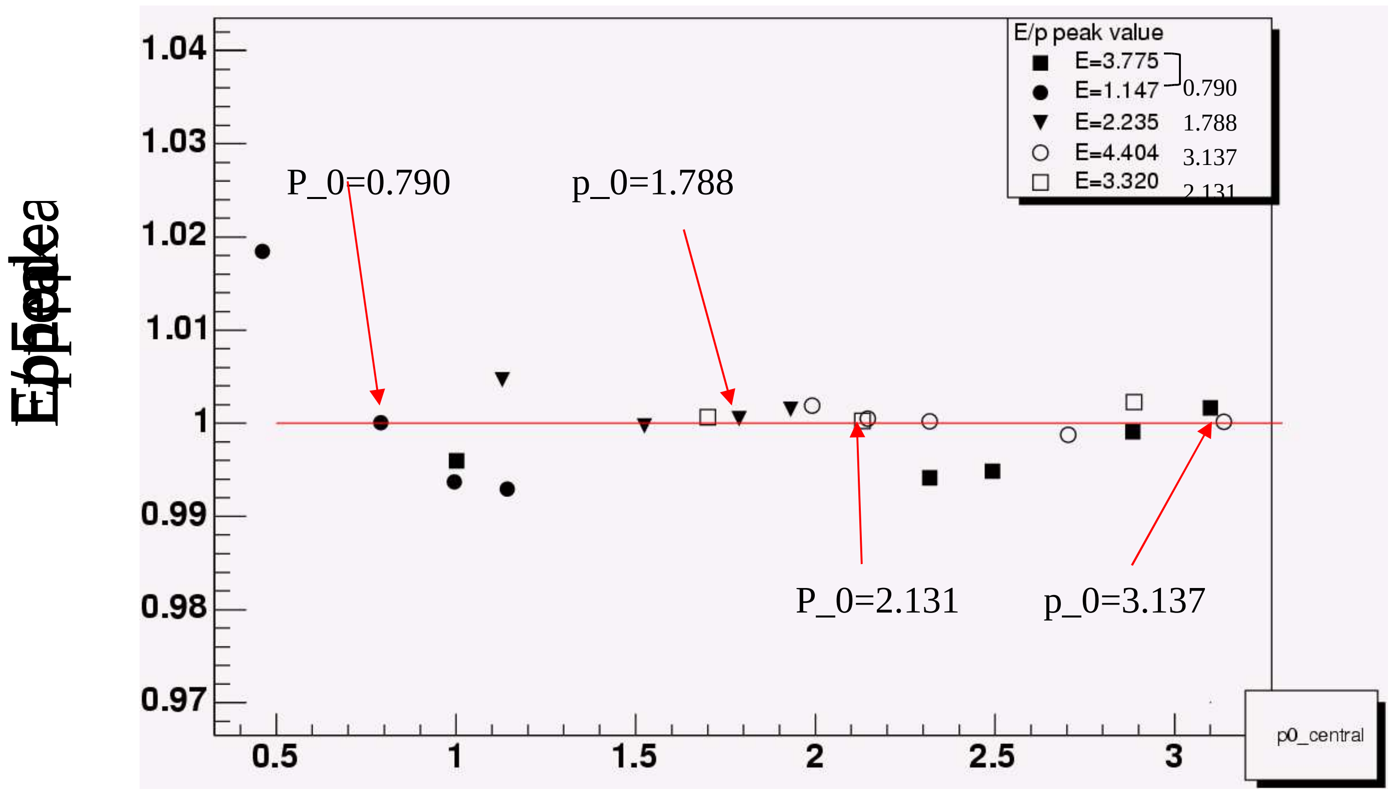


E_Shower

Jing's Coef's && ped's

Our Coef's &&ped's

E_tot/p Peak VS. p0



4 sets of calibration constants are used to 5 sets of beam energies with variable momenta to get their E/P peaks.

Shower detection efficiency for diff. Kin.

Sample selection:

1200<R.cer.asum_c<2500 → N_cer

Triggered Shower and Preshower

N_sh

$$_{det\_sh} = \frac{N_{sh}}{N_{cer}}$$

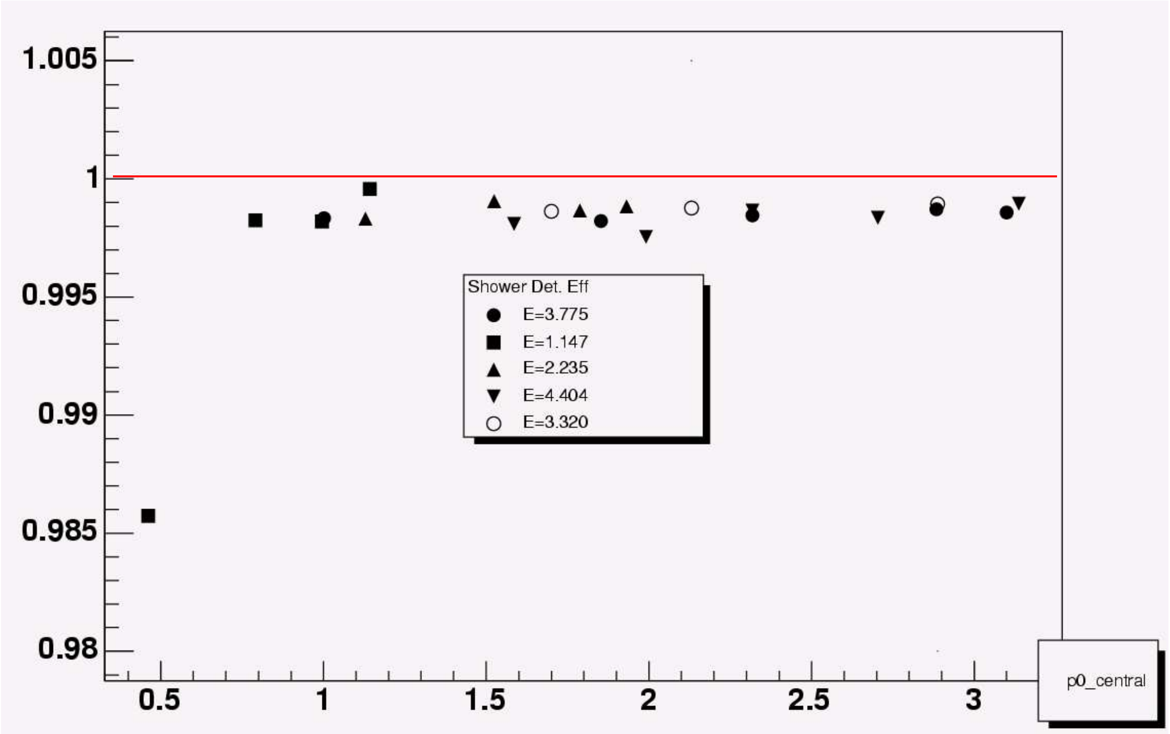
= 99.8%

for each run

exept run#=3634

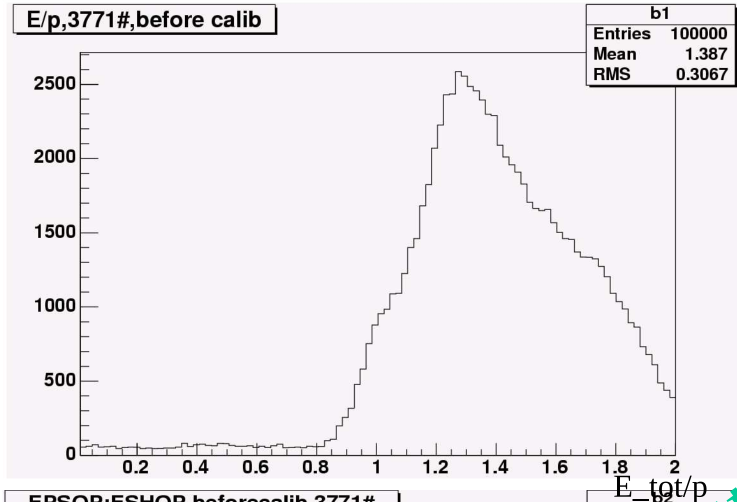
with momentum

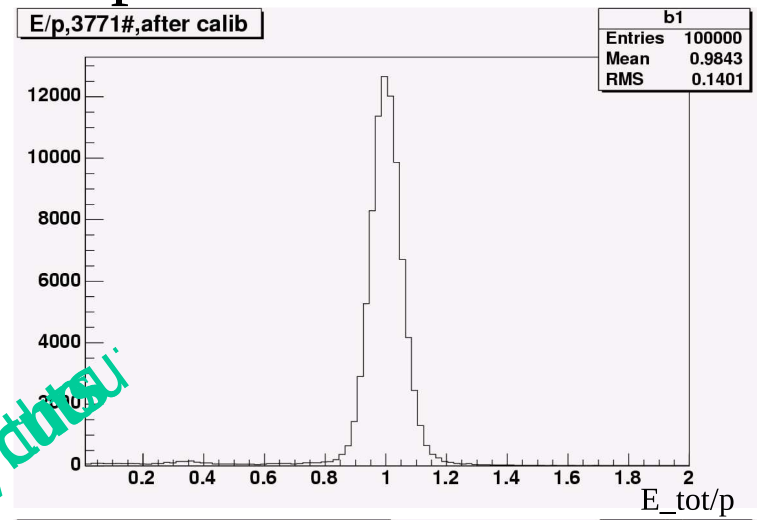
P_0= 0.461 GeV/c

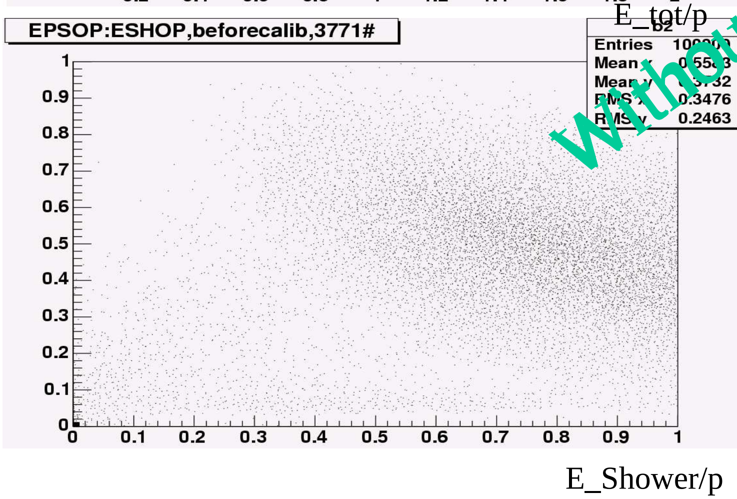


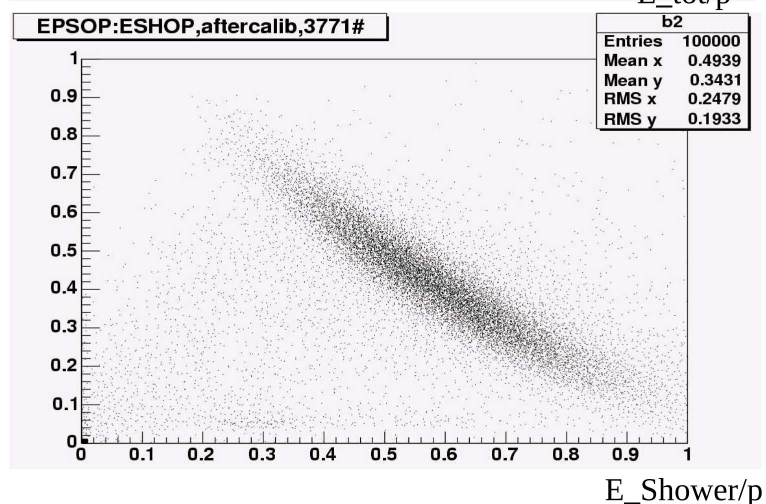
About cut efficiency

E_total/p and E_Sh/p VS E_Pre/p





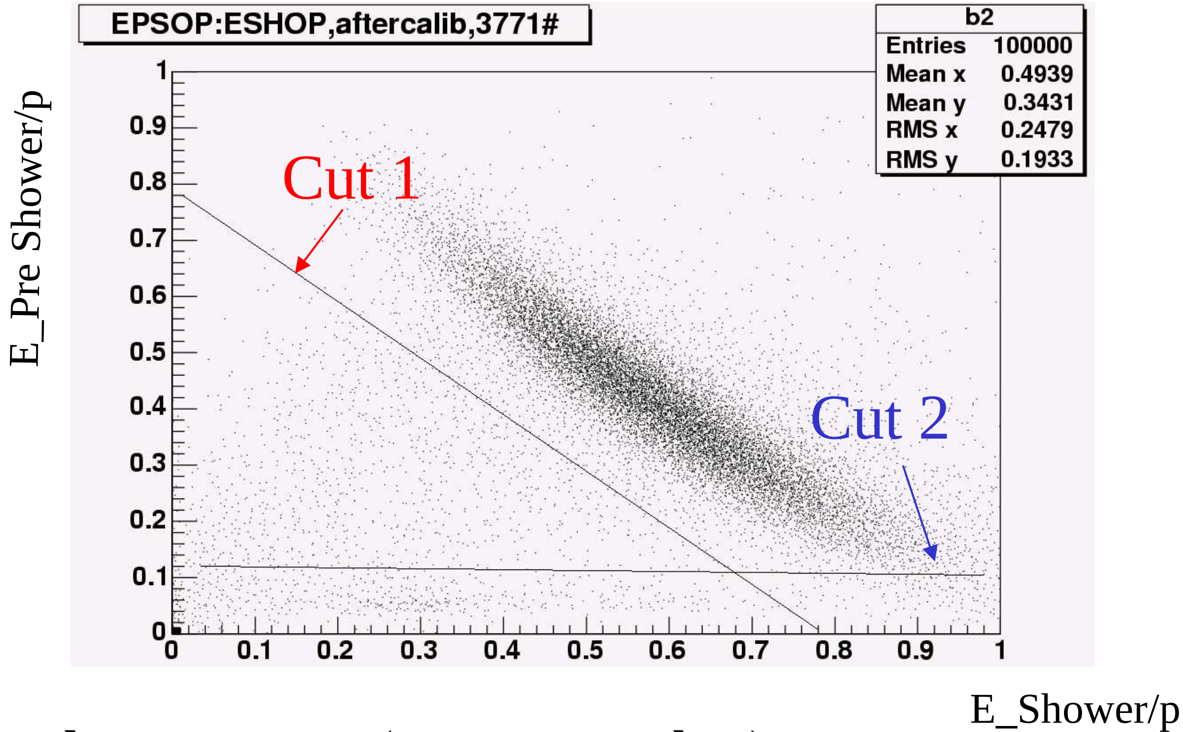




Before Calibration(all Coef's =1.)

After Calibration

Shower Cut efficiency



Cut 1: E_total/p cut : (R.ps.e+R.sh.e)/p

Cut 2: E_Pre/p cut : R.ps.e/p

p=P_central*(1+CorR.dp)=CorR.p

Cut 1: E_total / p

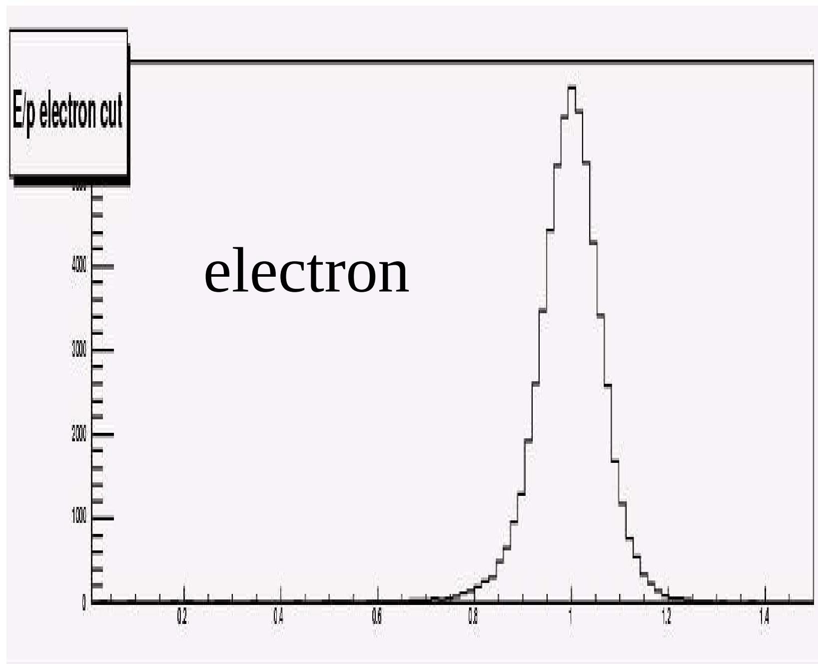
electron sample selection:

a. basic Cuts

b. Golden Track matched

c. 1200<R.cer.asum_c<2500

long tail in both sides!!!



E_tot/p

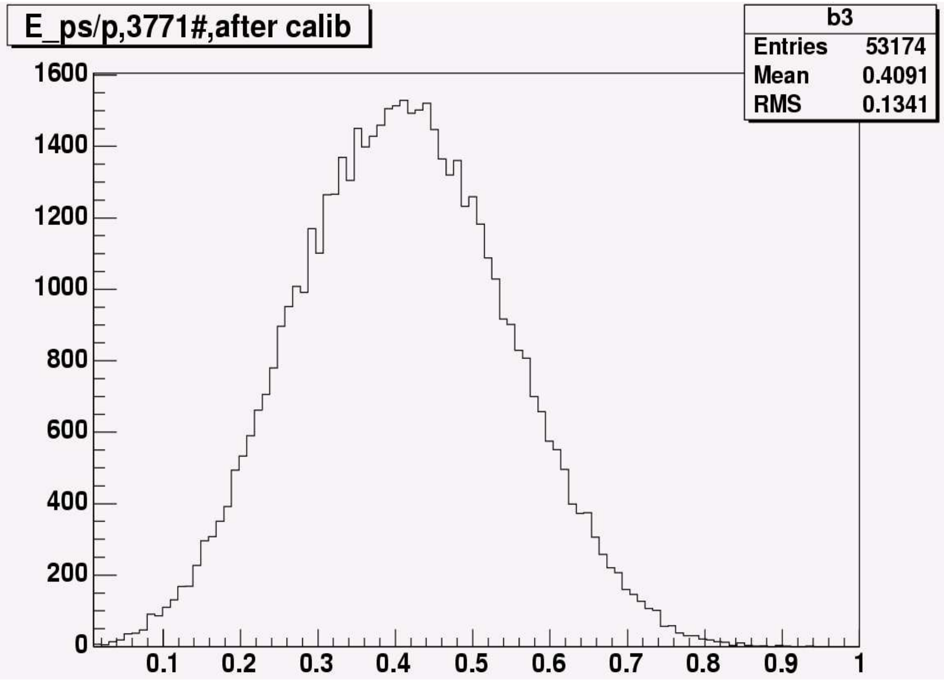
Cut 2: E_Pre / p

electron sample selection:

a. basic Cuts

b. Golden Track matched

c. 1200<R.cer.asum_c<2500

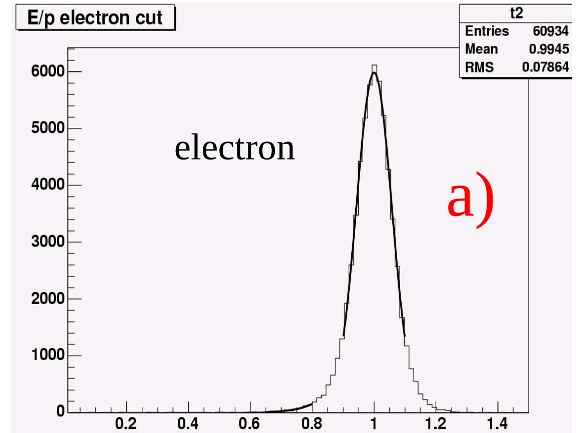


E_PreSh/p

Cuts selection

Note: the tail in both sides of the E_total /p for the electron is asymmetry !!!

Total number of good electron events (N_tot) :



Step 1: Fit region 0.9—1.1 of a) with gaussian

Step 2: Fit region 0.75—0.85 of a) with func_defined

Step 3: Get the N_tot.

N_tot=N_c(E/p>0.8) +N_func(0:0.8)

Calculate the good events rejected by cut1>x0 (N_rej_c1)

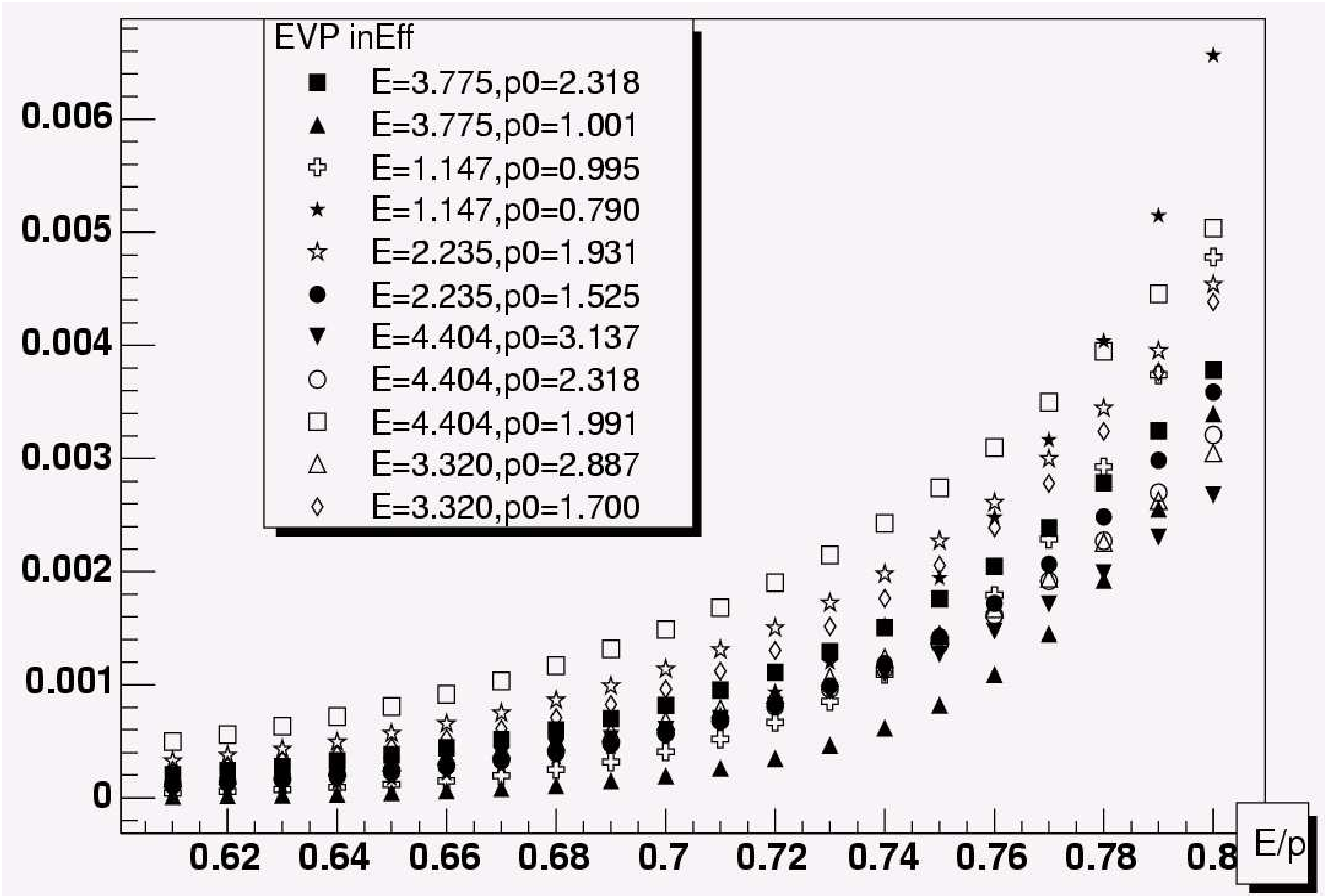
Inefficiency for Cut 1: $_e^{cut1} = \frac{N_{rej_{c1}}}{N_{tot}}$

Calculate the good events rejected by cut2>x1 (N_rej_c2) while E/p>x0

Cut1,2 efficiency: $_e = 1 - \frac{N_{rej_{c1}} + N_{rej_{c2}}}{N_{tot}}$

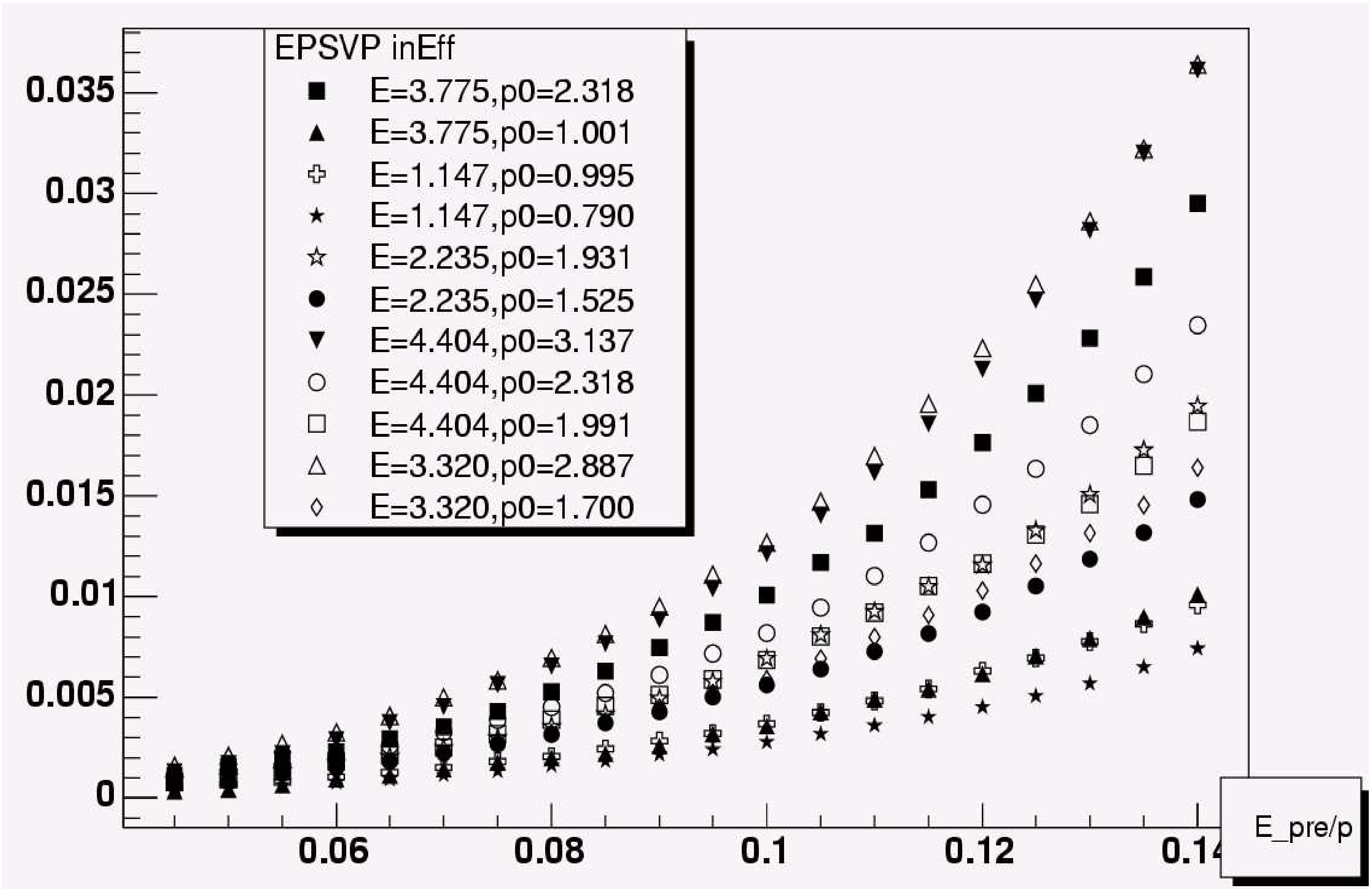
Adjust x0,x1 to let $_e > 99.$

Cut1 inefficiency for diff. Kin.



Cut2 “inefficiency”

$$e_{cut2} = \frac{N_{rej_{c2}}}{N_{tot}}$$



Summary

Shower Calibration:

9^o , He3, E_beam = 3.775,1.147,2.235,4.404,3.320 GeV,

And get the calibration constants.

Shower detection efficiency: 99.8%

Shower Cut: E_tot/p > x0

E_Pre/p >x1

Cut efficiency:

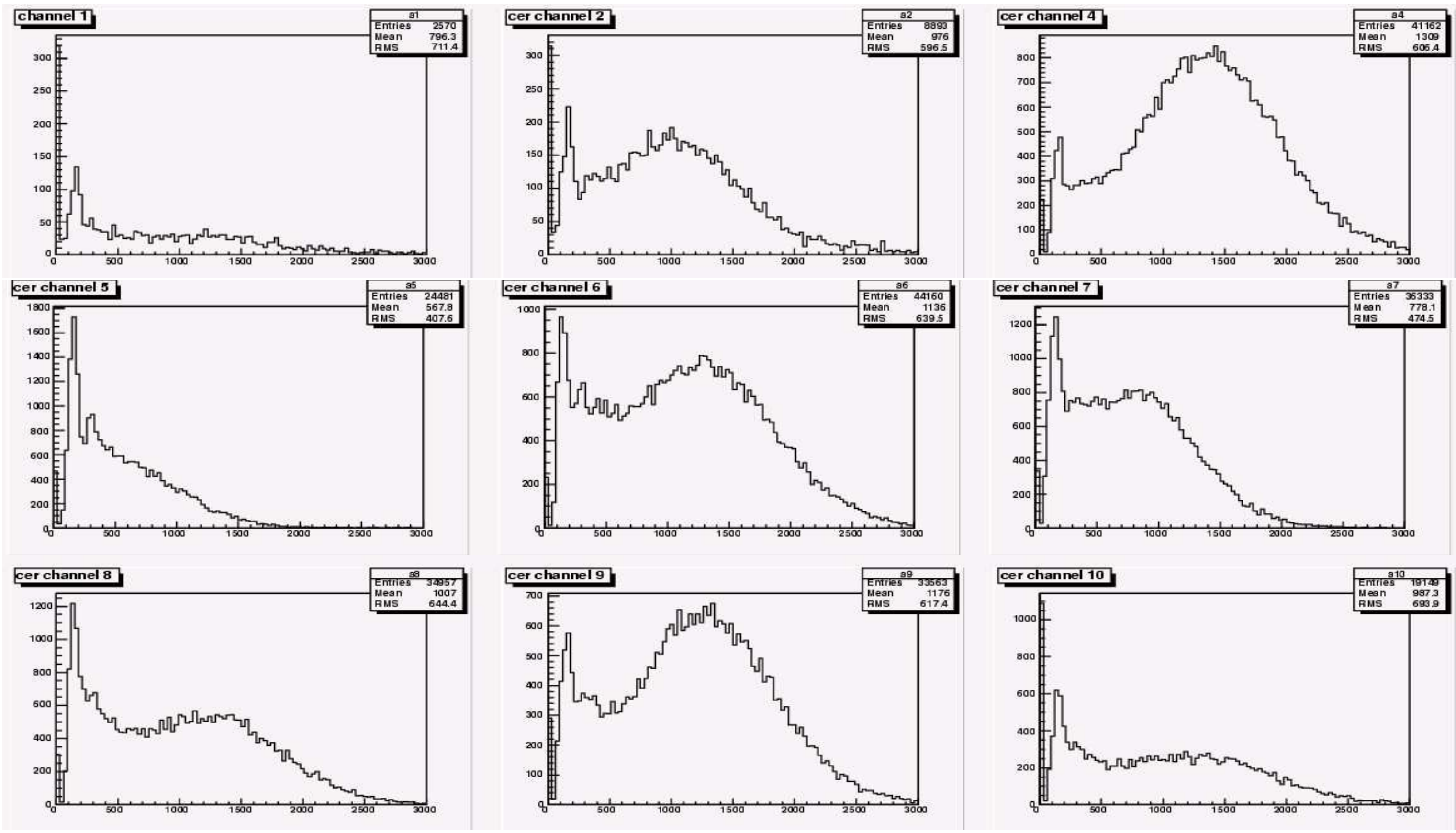
electron acceptance: adjust x0,x1 to let >99.0%

Cerenkov Calibration & efficiency

- Method
- Sample election
- Cut efficiency

Calibration

Align the single photon electron peak to 200



Cerenkov detection efficiency for diff. Kin.

Sample selection:

0.95 < E_tot/p < 1.05

0.2 < R.ps.e/p <0.8

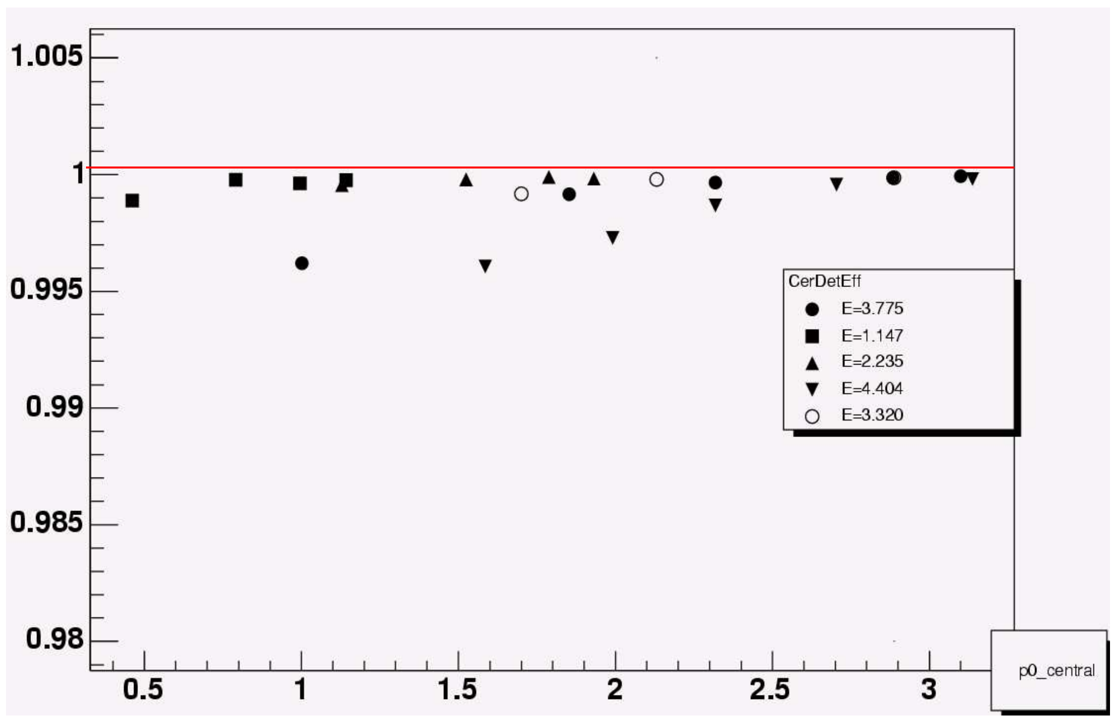
→ N_sh

Triggered Cerenkov

N_cer ←

$$_{det\_cer} = \frac{N_{cer}}{N_{sh}}$$

= 99.99%



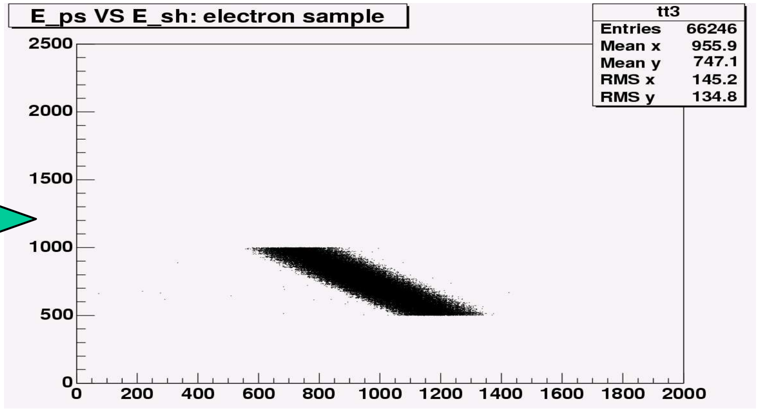
Cut efficiency 1: sample selection

Electron sample selection:

$0.95 < E\_tot/p < 1.05.$

$500 < R.ps.e < 1000$

$E\_tot = R.sh.e + R.ps.e$

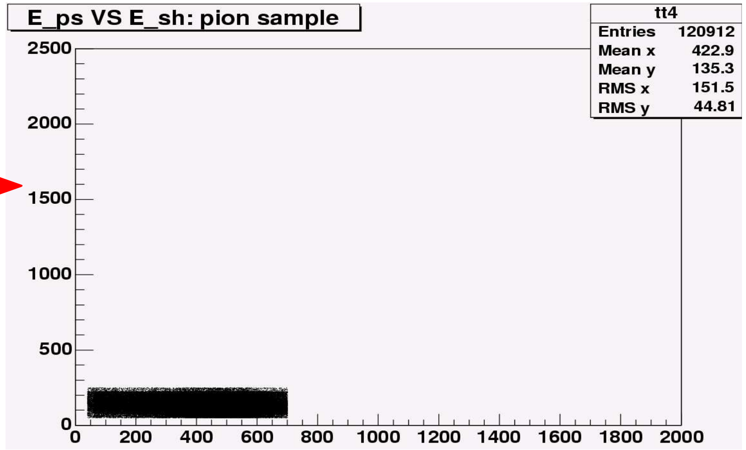


pion sample selection:

$20 < R.sh.e < 700.$

$20 < R.ps.e < 220.$

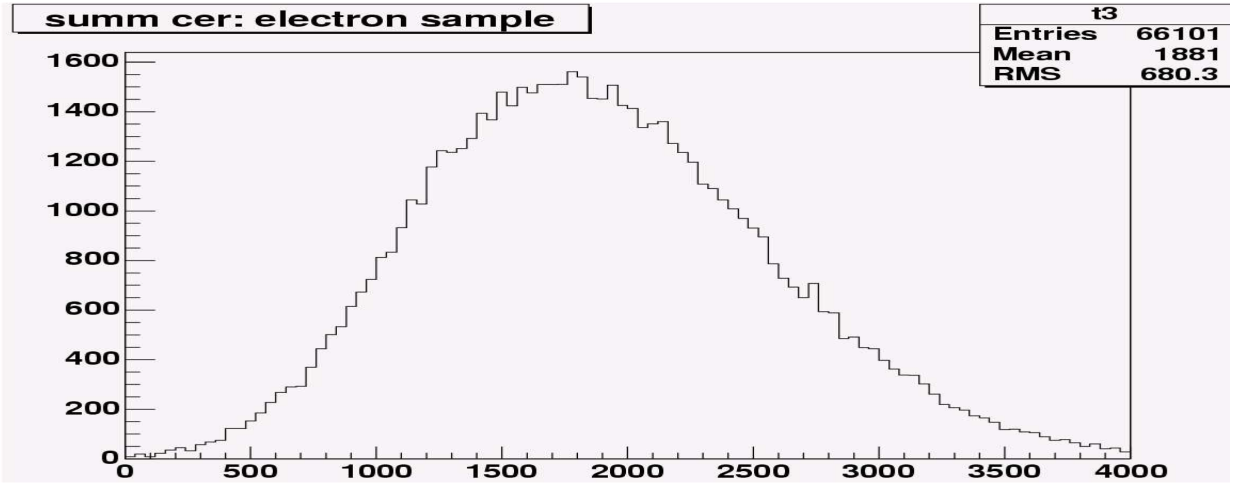
E_Preshower



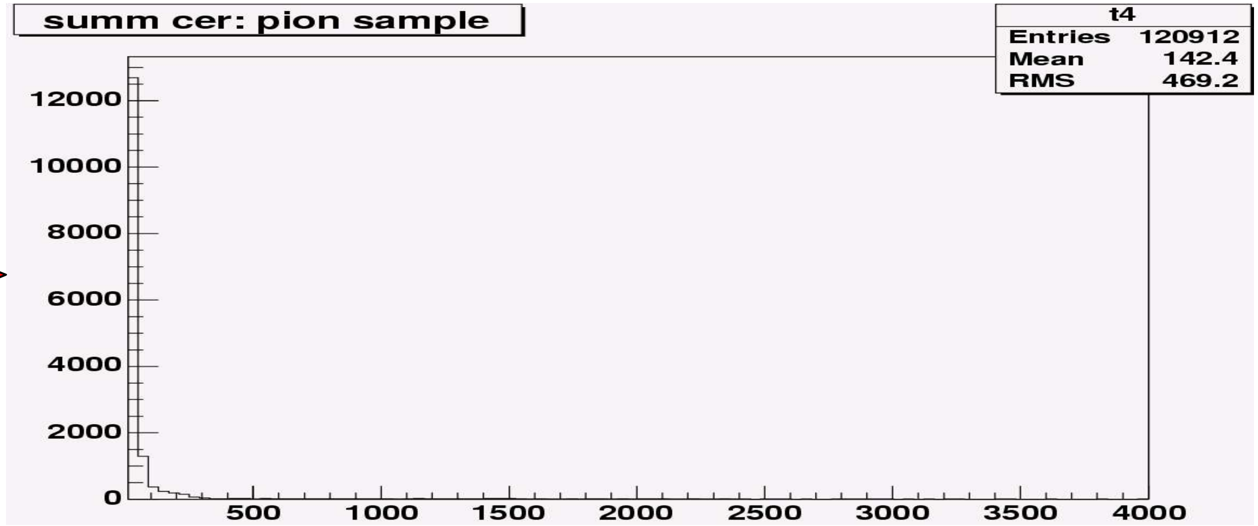
E_shower

Cut efficiency 2: Sum_a_c distribution

Electron

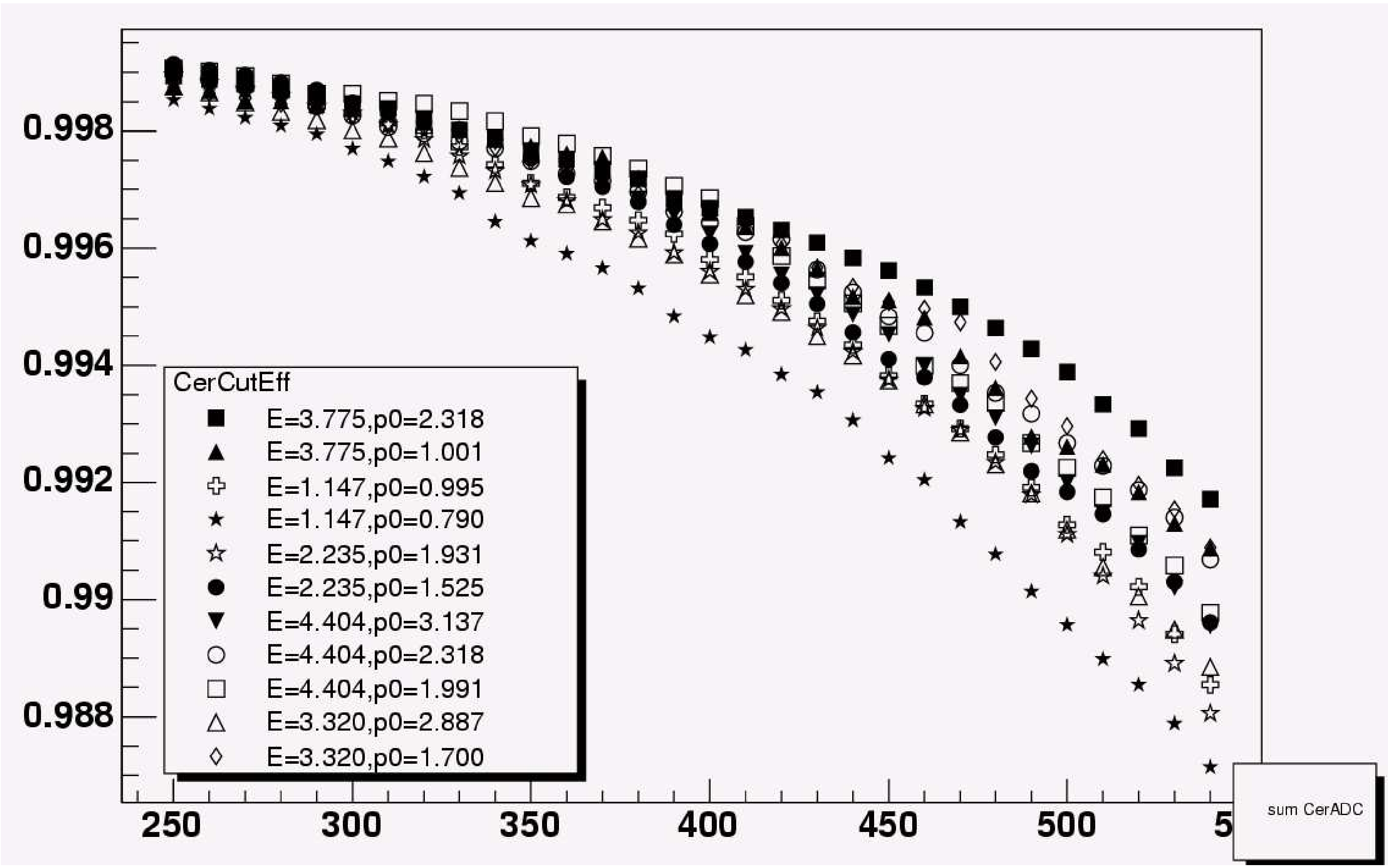


pion

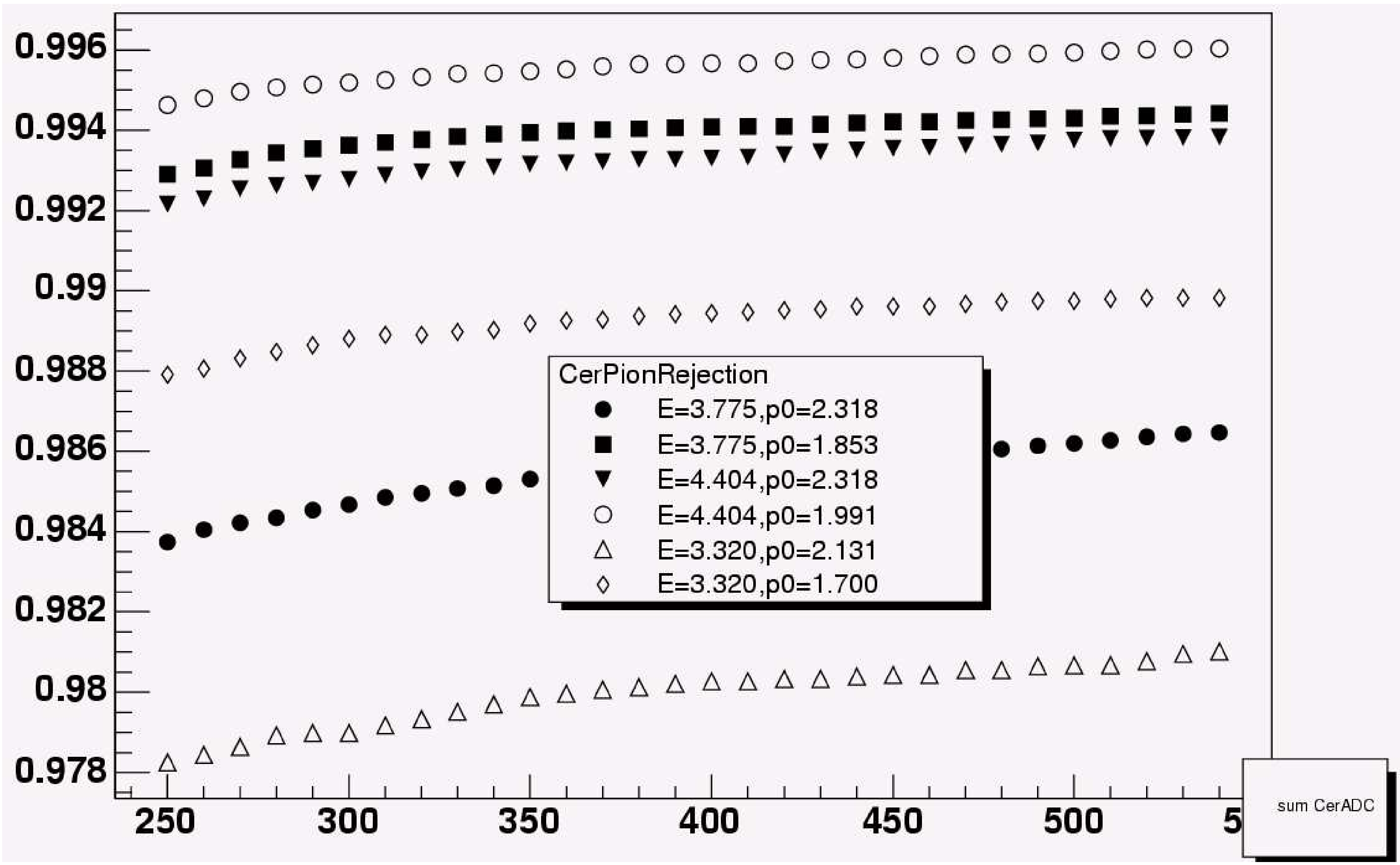


Sum_a_c

Cut efficiency



Pion Rejection



PID efficiency

E_total / p > x0

E_PreShower / p > x1

→ Electron acceptance:99.0%,pion rejection: 98.0%

Σa_c > 350 → Electron acceptance: 99.7%, pion rejection: 99.0%

PID cut efficiency:

Electron acceptance: 98.70%

pion rejection: 99.99%

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