XEM Collaboration Meeting

Jlab Expt: E03-103 & E02-019

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Outline

- Electron efficiency of Cerenkov
- Pion rejection in Cerenkov
- Pion rejection in shower counter
- Calorimeter resolution
- Summary

Introduction

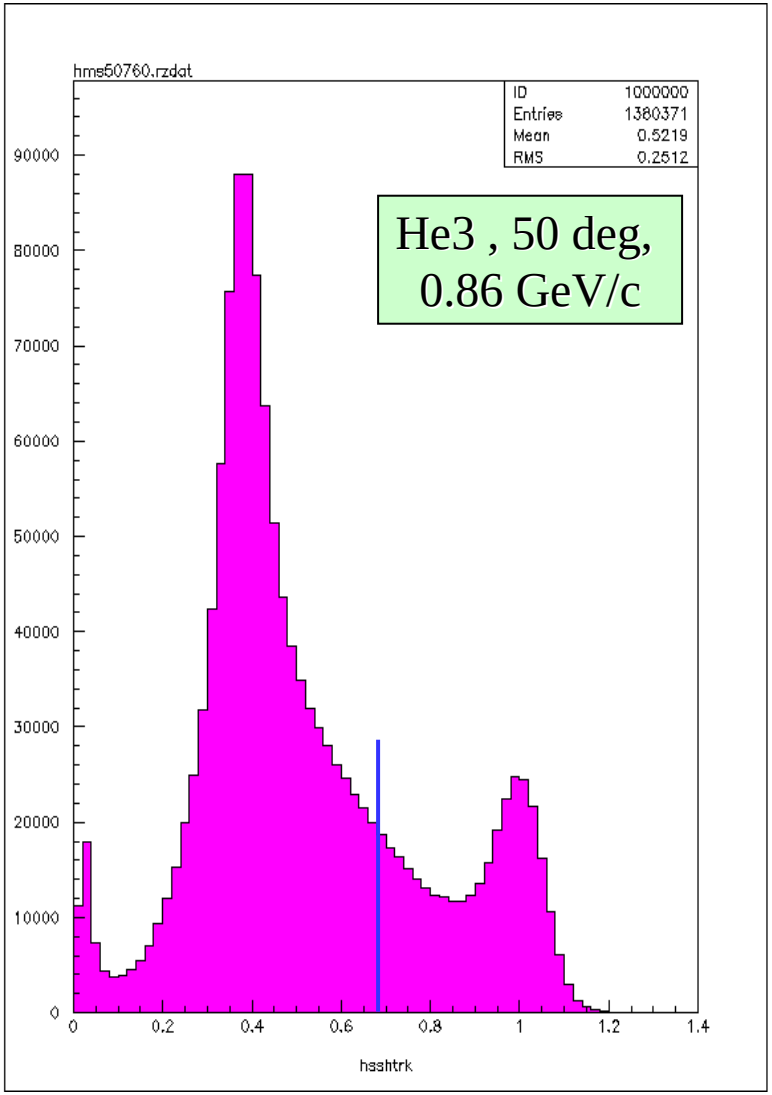
- In addition to electrons HMS detects negative hadrons also.
- Need clean electrons as efficiently as possible ⇨

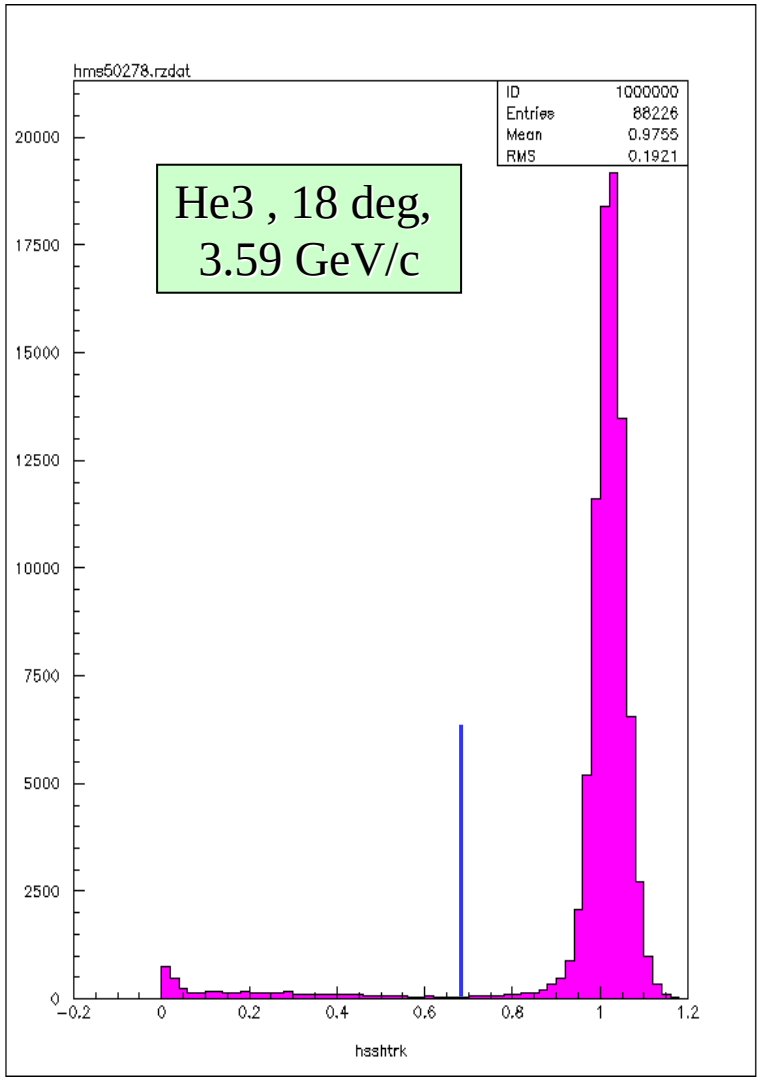
  pion contamination should be estimated.
- Two PID detectors Cerenkov and shower counter .

EFFICIENCY STUDIES
Lead Glass Calorimeter (shower counter)

- Used to discriminate between electrons and pions.
- Charged particles produce Cerenkov radiation which is detected by photomultiplier tubes.
- Electrons tend to deposit their entire energy, so a peak @ E_{cal}/E_{prime}~1
- Pions deposit 300MeV through ionization, so a peak can be observed @ 0.3GeV/E_{prime}.

EFFICIENCY STUDIES
Typical spectrum





EFFICIENCY STUDIES
Cerenkov

- Cerenkov detector provides particle identification by operating as a threshold detector.
- A pair of front reflecting mirrors focus the light on a pair of PMTs.
- Pion threshold ~ 4.4 GeV/c
- Electron threshold ~ 15MeV/c
- The detector is filled with C_4F_{10} (n=1.00143@1atm,300K)

EFFICIENCY STUDIES
Cerenkov Efficiency

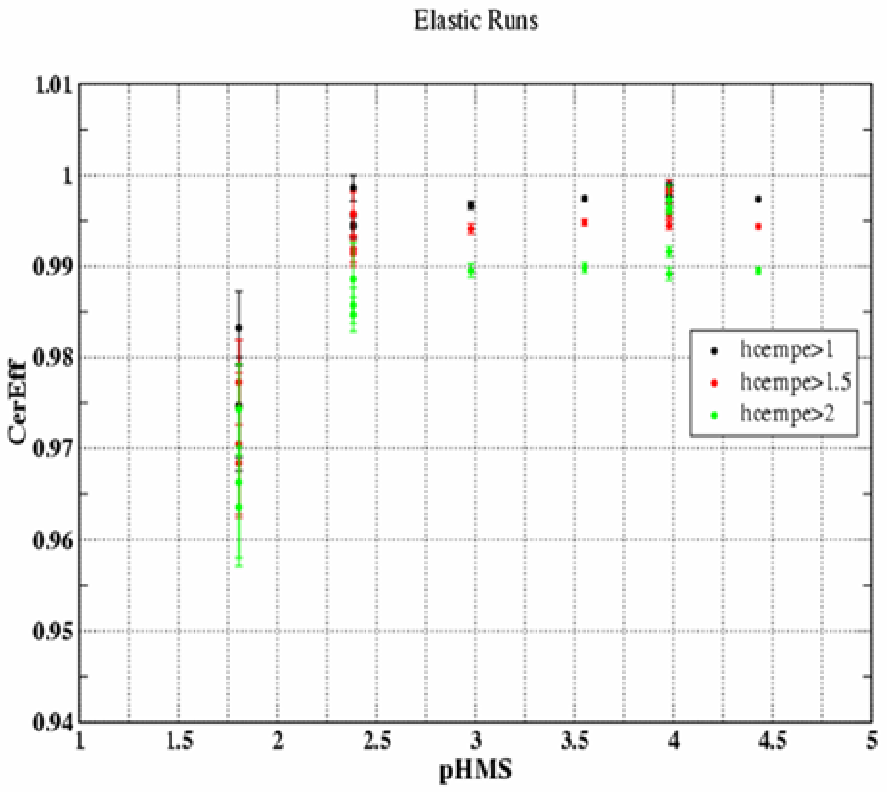
- But a pion can be misidentified as an electron when it produces a knock-on delta electron… and this pion will pass Cerenkov cut.
- Need to know how efficient is the cut that we apply to Cerenkov spectrum .

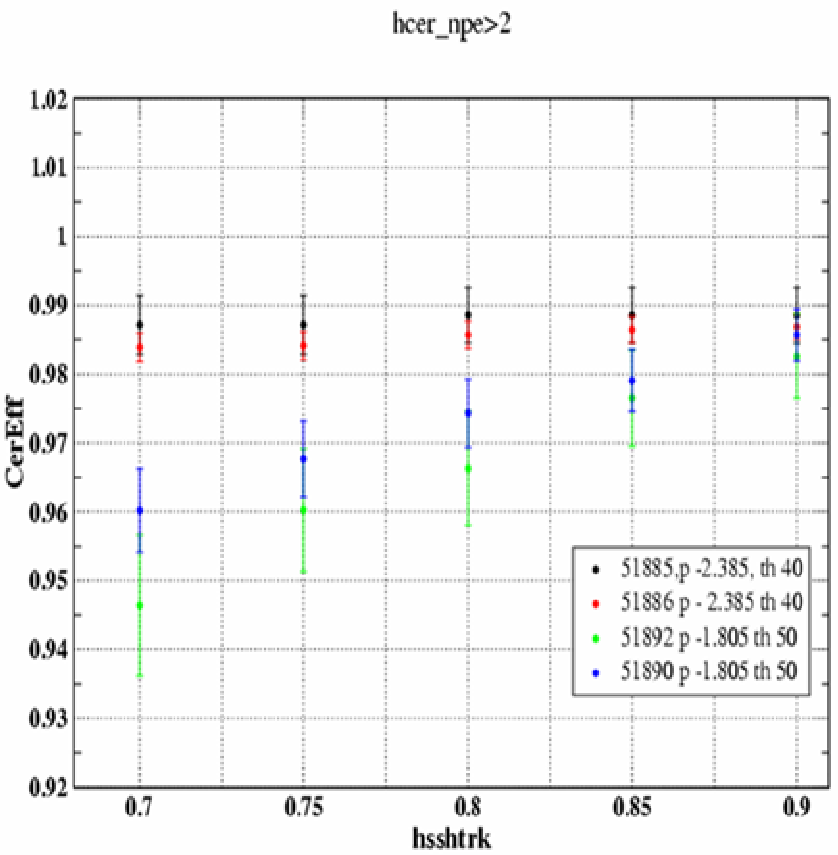
EFFICIENCY STUDIES
Cerenkov Efficiency

- We need a clean sample of electrons.
- Elastic scattering runs can be used for this since there is an additional constraint on W.
- Cuts used in the present analysis:-
- **Acceptance cuts:**
  - abs(hsdelta)<8 (percentage deviation from central momentum)
  - abs(hsxptar)<0.07 (out of plane angle)
  - abs(hsyptar)<0.03 (in plane angle)
- **Particle ID cuts:-**
  - hsshtrk >0.8 &&< 1.2 (Energy measured by calorimeter divided by central momentum)
- abs(w-0.938272)<0.03
- hselhi>100 (shower counter leg of trigger system)

Cer Eff = (Nevents live above cerenkov cut / total Nevents)

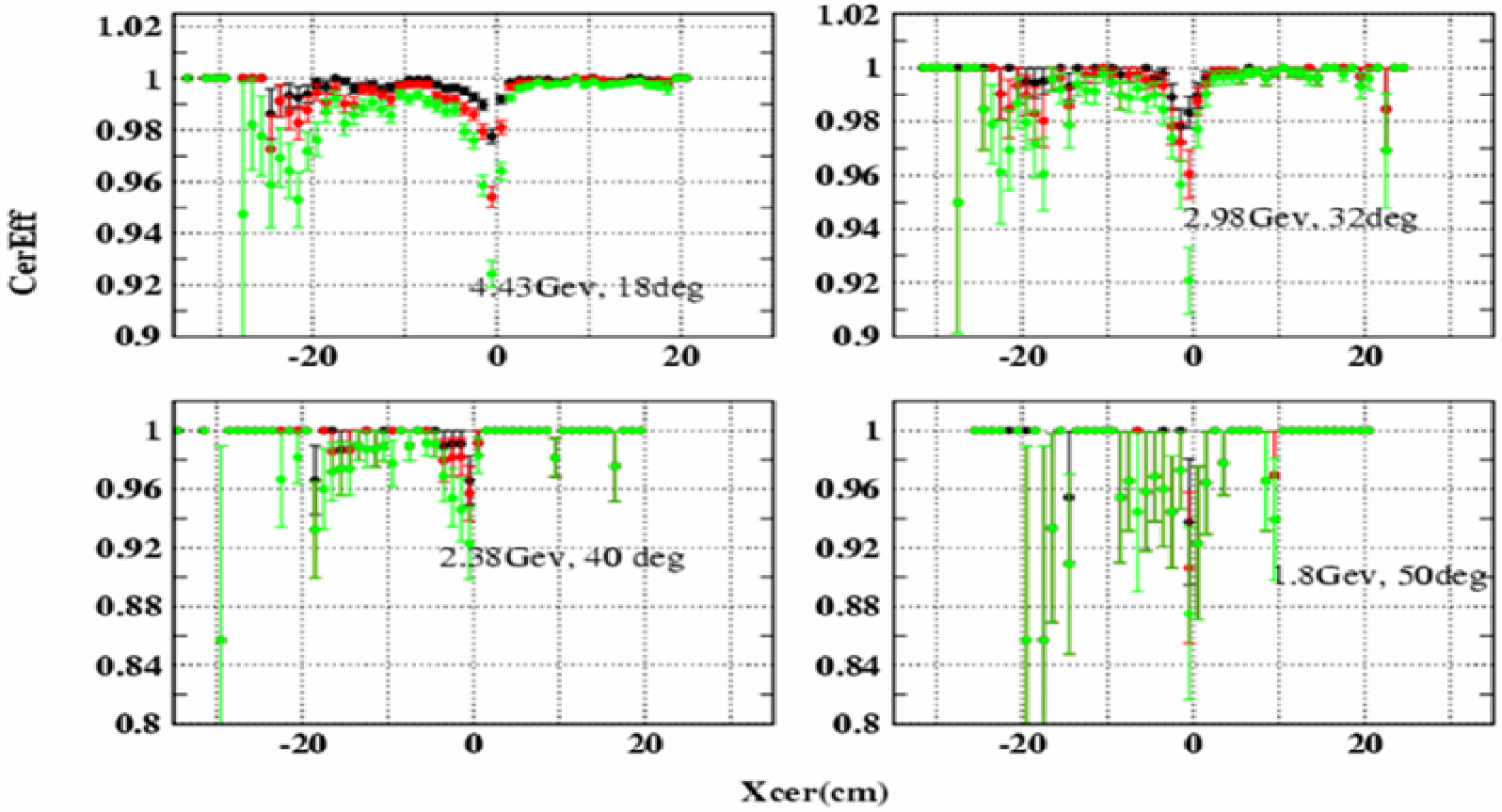
EFFICIENCY STUDIES
Cerenkov Efficiency:-elastic runs





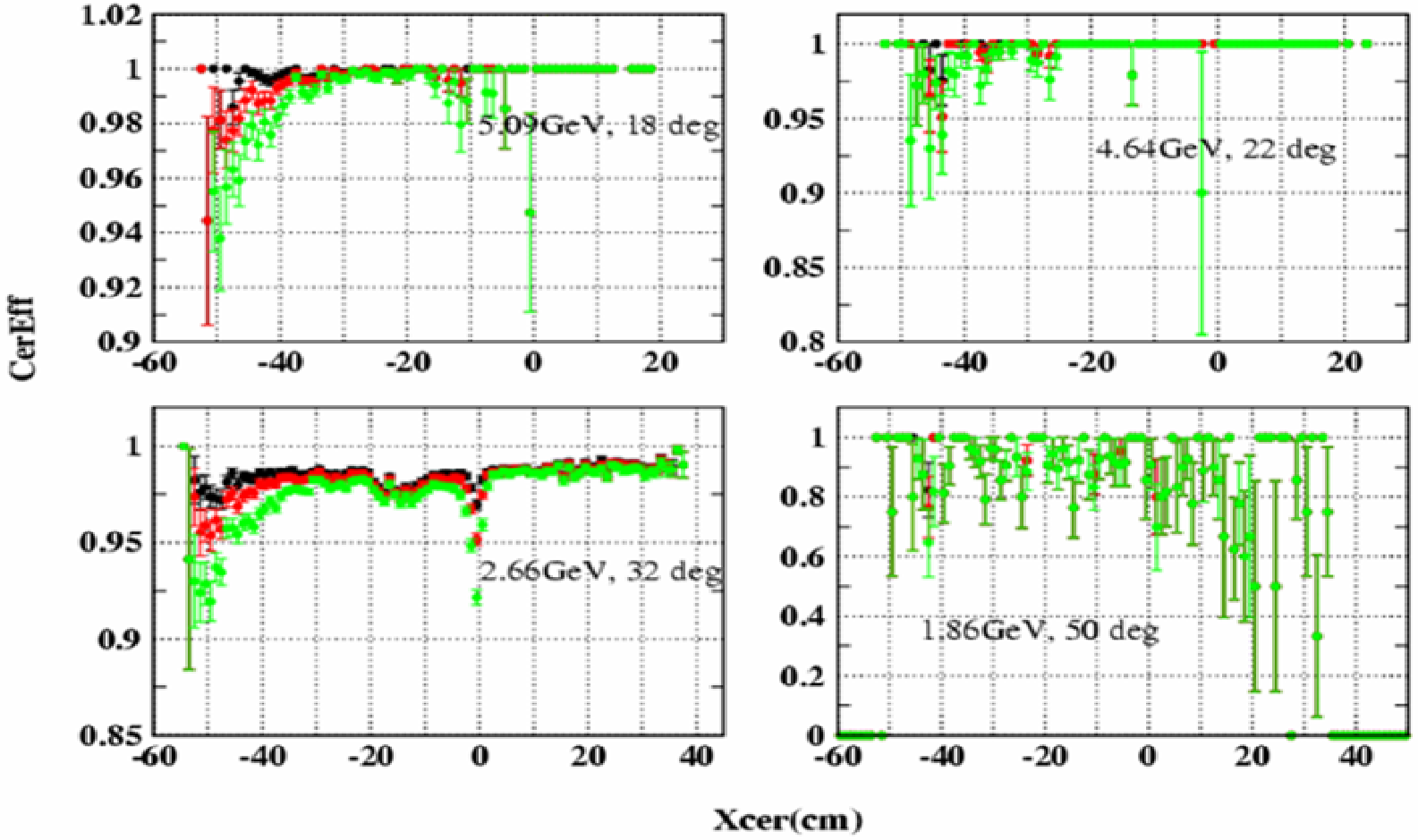
EFFICIENCY STUDIES
Cerenkov Efficiency:-across acceptance

Some elastic runs



EFFICIENCY STUDIES
Cerenkov Efficiency:-across acceptance

Few production runs

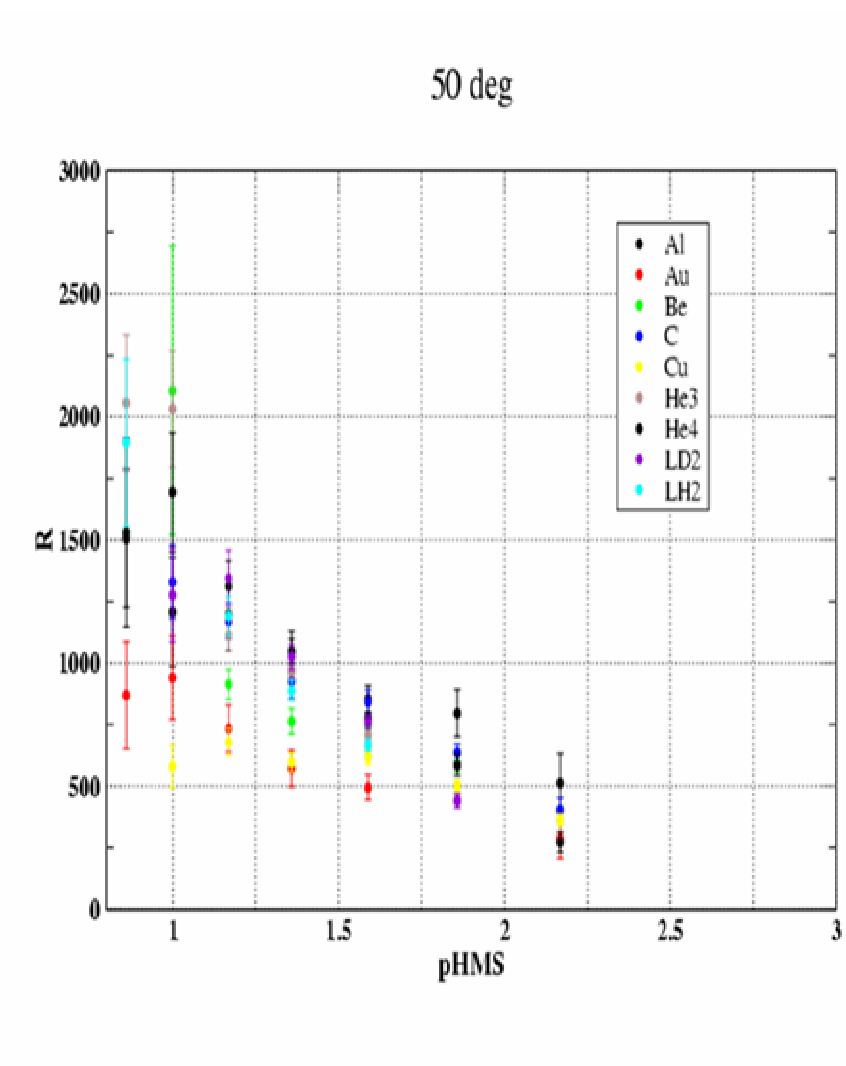


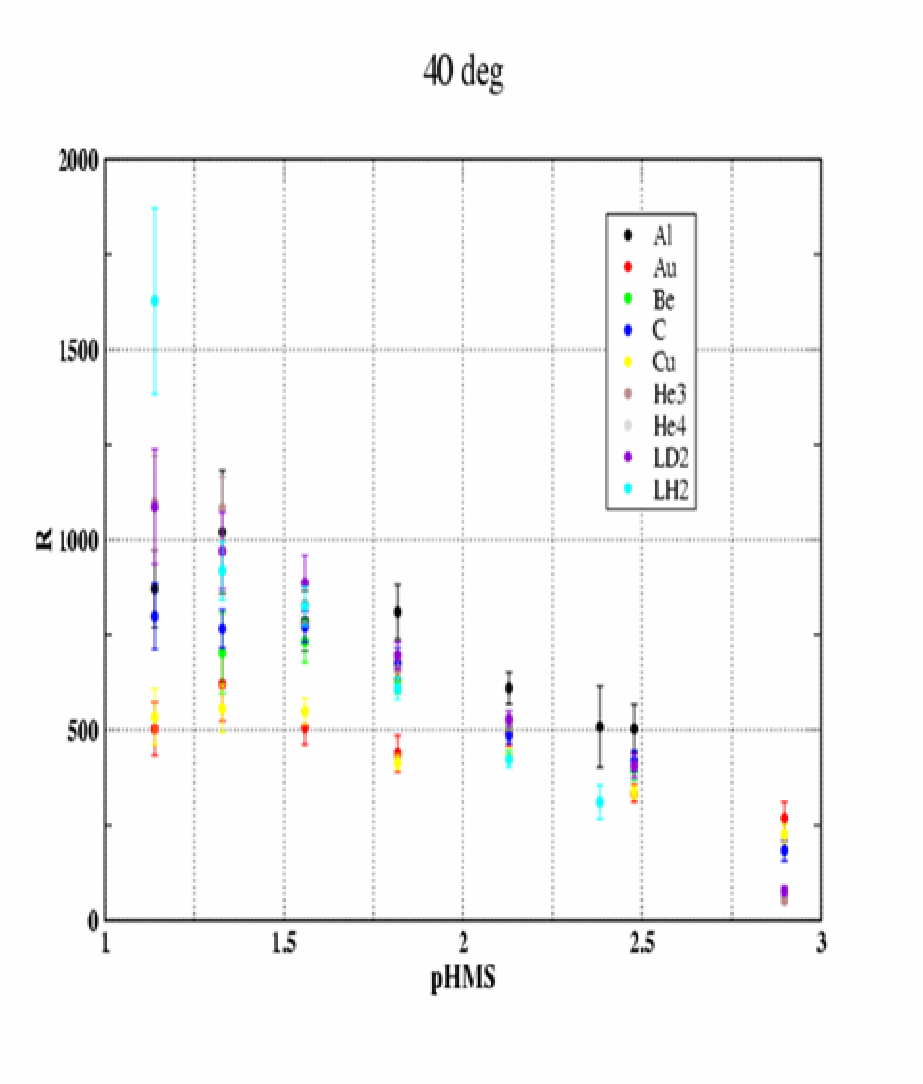
Pion rejection using Cerenkov

- We need a pure sample of pions.
- Cuts used:-
  - **Acceptance cuts:**
    - abs(hsdelta)<8
    - abs(hsxptar)<0.07
    - abs(hsyptar)<0.03
  - hspipre>10
  - hsbeta>0.9
  - **PID cut:-**
    - hsshtrk >0.05 &&< 0.4

Pion rejection R= (Nevents /Nevents live@cerenkov>2)

Pion rejection using Cerenkov





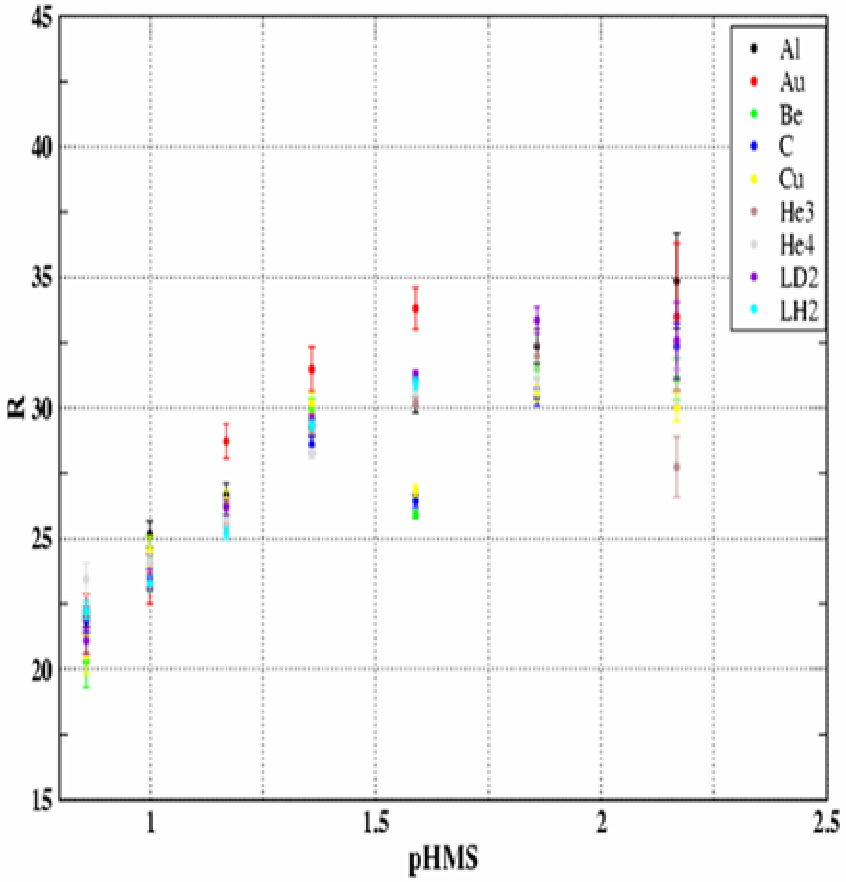
Pion rejection using shower counter

- We need a pure sample of pions.
- Cuts used:-
  - **Acceptance cuts:**
    - abs(hsdelta)<8
    - abs(hsxptar)<0.07
    - abs(hsyptar)<0.03
  - hspipre>10
  - hsbeta>0.9
  - **PID cut:-**
    - hcer_npe<0.5

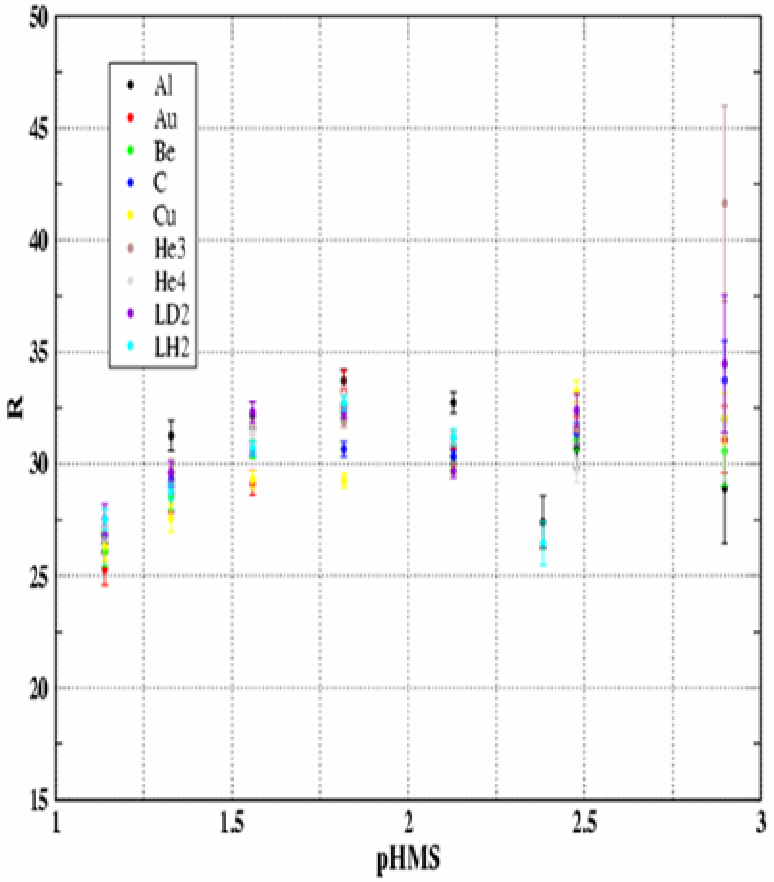
Pion rejection R= (Nevents /Nevents live@hsshtrk>7)

Pion rejection using shower counter

50 Deg



40 Deg



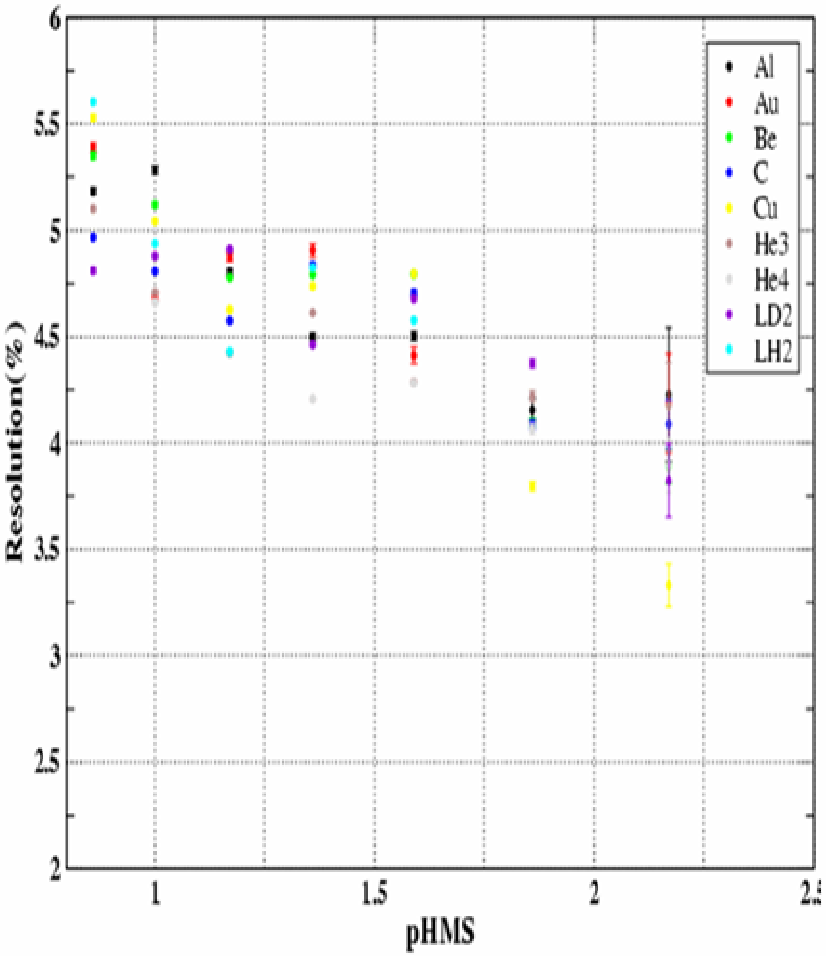
Pion rejection using shower counter

- From Pion CT expt (by Jason Seely)
- Normal acceptance cuts + tight timing cut on e/pi+ coincidence.

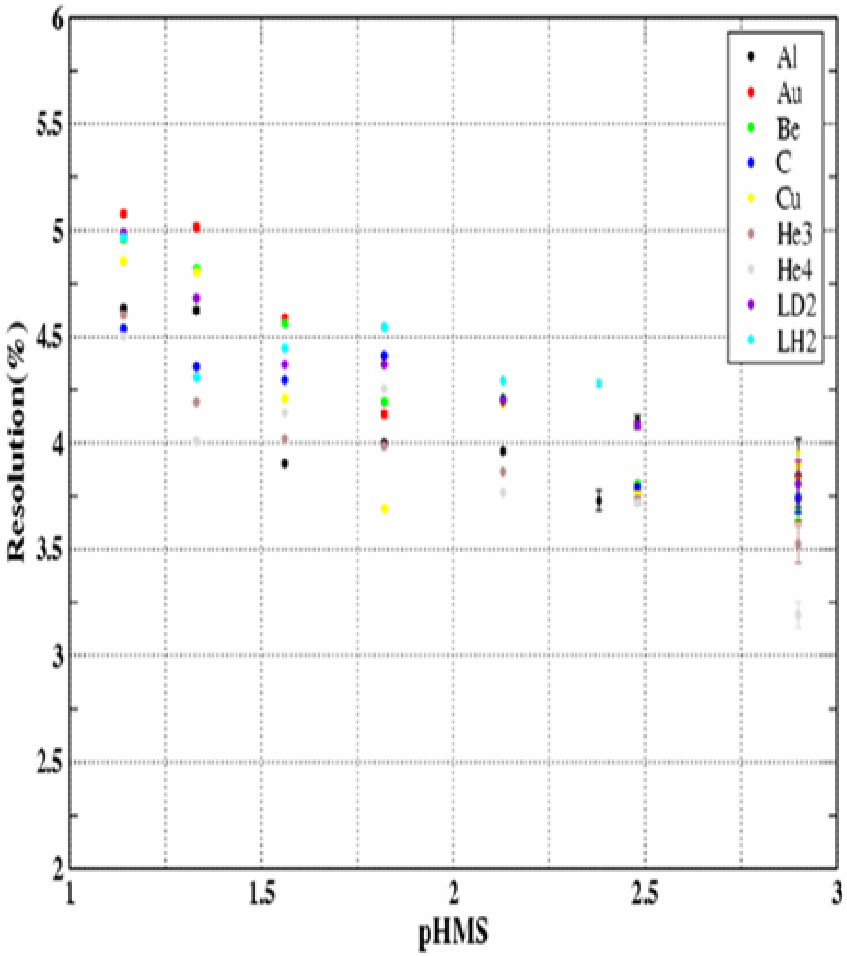
Beam energy(GeV)	Angle (deg)	R
4	10.6	27.6
4	10.6	31.6
4	20.0	29.2
5	13.5	37.5
5	10.6	36.2
5	10.7	34.1
5.8	10.7	33.0

Calorimeter Resolution

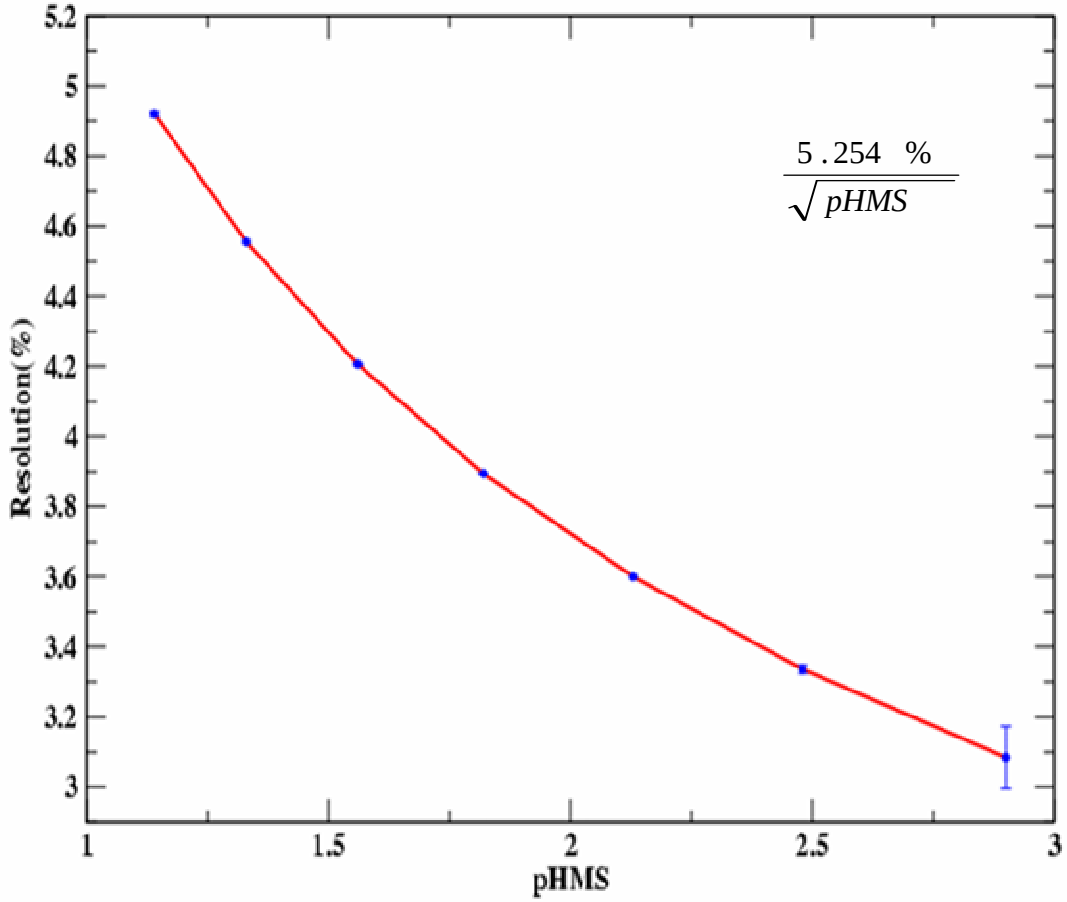
50 deg



40 deg



Calorimeter Resolution
Fit to data



Summary

- Cerenkov efficiency is found to be > 99 % .
- Cerenkov efficiency is acceptance dependent (~2%).
- Pion rejection using Cerenkov is > 500, except at large momenta.
- Pion rejection using shower counter ~30.
- Need to study calorimeter efficiency.