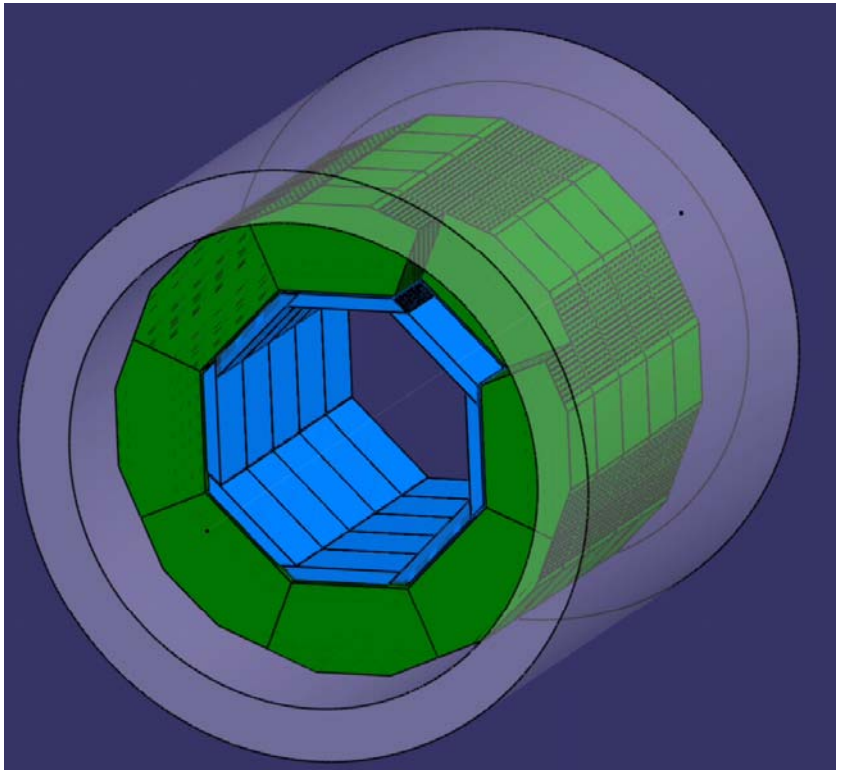


ILD tail catcher?

Felix Sefkow

Calorimeter for ILC

ILD MDI meeting
August 12, 2008

Discussion

- HCAL thickness
- Need for muon ID
- Usefulness of tail catcher

Depth

- The HCAL depth is rather low
  - 4th concept: 10 λ
  - Was always criticized
- PFLOW reduces the problem (for charged particles)
  - To what extent – at high E?
- Shower shape "extrapolation"?
  - test beam analysis ongoing
  - Can recover mean leakage, but not fluctuations
- How much does the tail catcher recover?
  - test beam
  - Pandora tools are there

Leakage – Calorimeter energy correlation

Number of neutral hadrons per parton $(200GeV)$

	K_L^0	n
b	0.966	0.885
c	0.910	0.990
d	0.838	1.101
u	0.819	1.045

Remark:

$e^{-4} = \frac{1}{54.6}$

$e^{-5} = \frac{1}{148.4}$

Percentage of events with a leakage more then 5% of energy

16-sectors

Energy [GeV]	200	100	50	25	10
b	25.9	17.3	10.4	7.6	3.0
c	29.4	17.5	12.5	10.3	4.1
d	26.4	19.9	11.5	9.7	5.6
u	26.5	19.9	12.4	10.5	4.2
in average	27.1	18.7	11.7	9.5	4.2

8-sectors

in average	45.4	31.8	22.1	13.7	5.7

16 sectors

Vasiliy Morgunov Padova, 5-8 May 2000

Muon identification

- Excellent muon ID in the calorimeters
- Yes, but…

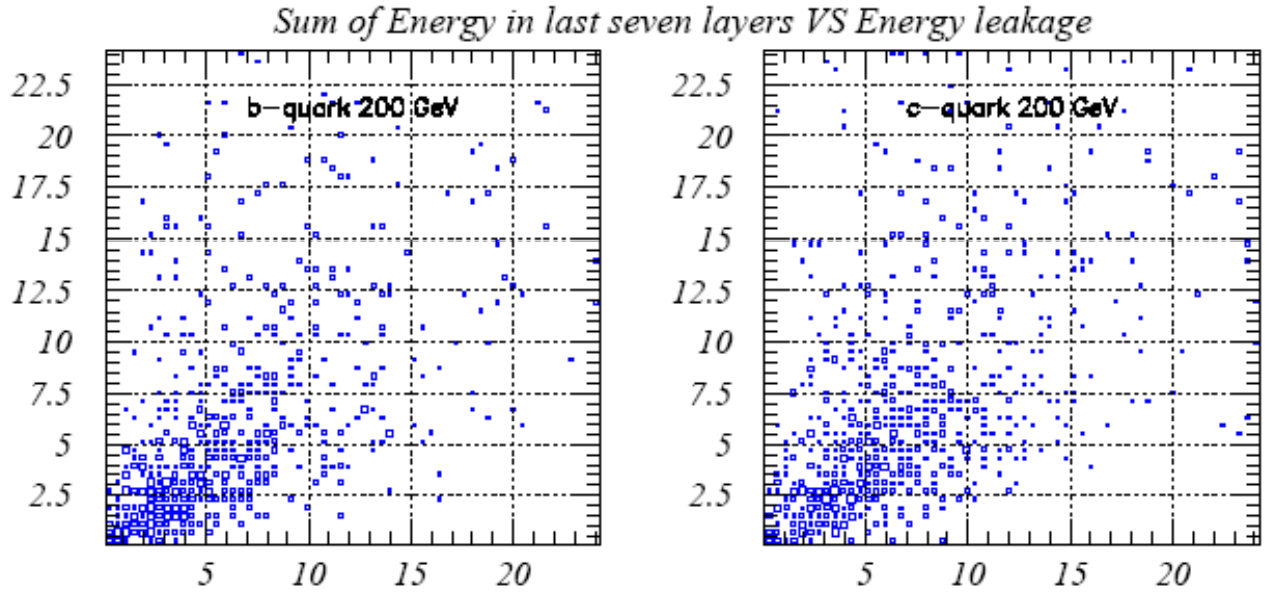
- What counts is hadron rejection
- Sail-through probability alone is $\exp(-n\lambda) = 0.7\%$ for $n=5$
  - In addition: punch-through, decay in flight

- Muon purity depends on likelihood ratio:
  - Hadron rejection
  - Hadron abundance
- Should be studied in physics channels (b-tag, isolated pions,..)

- Conclusion: some instrumentation of the iron yoke needed anyway.

Shower extrapolation?

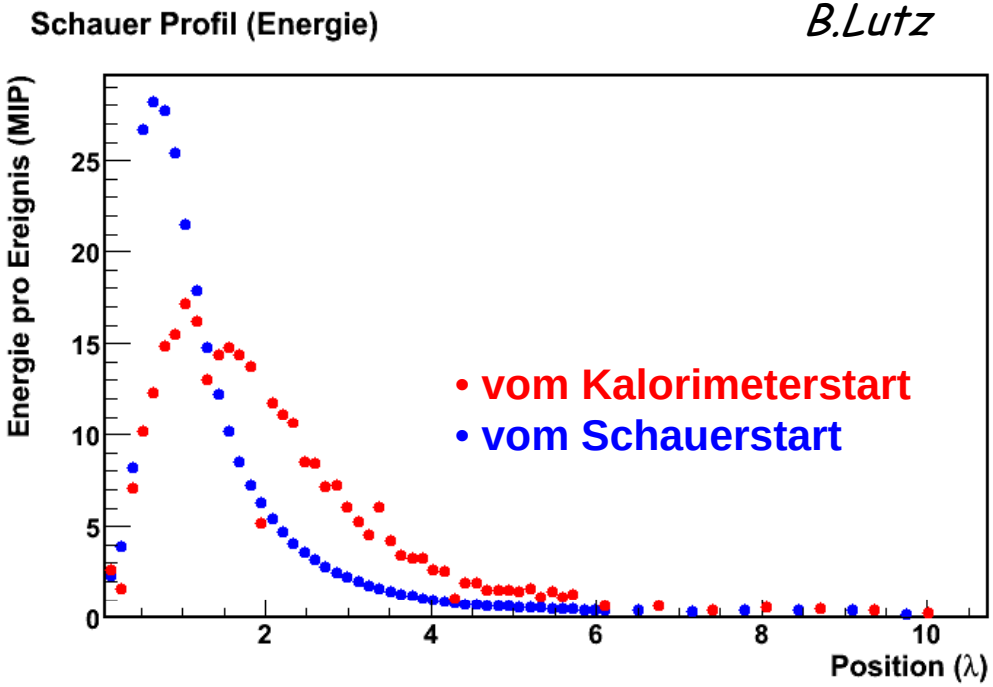
- Naively: check the rear section of HCAL whether shower "ended"
- Problem: large shape fluctuations and disconnected fragments
  - Does not work as well as for e.m. showers

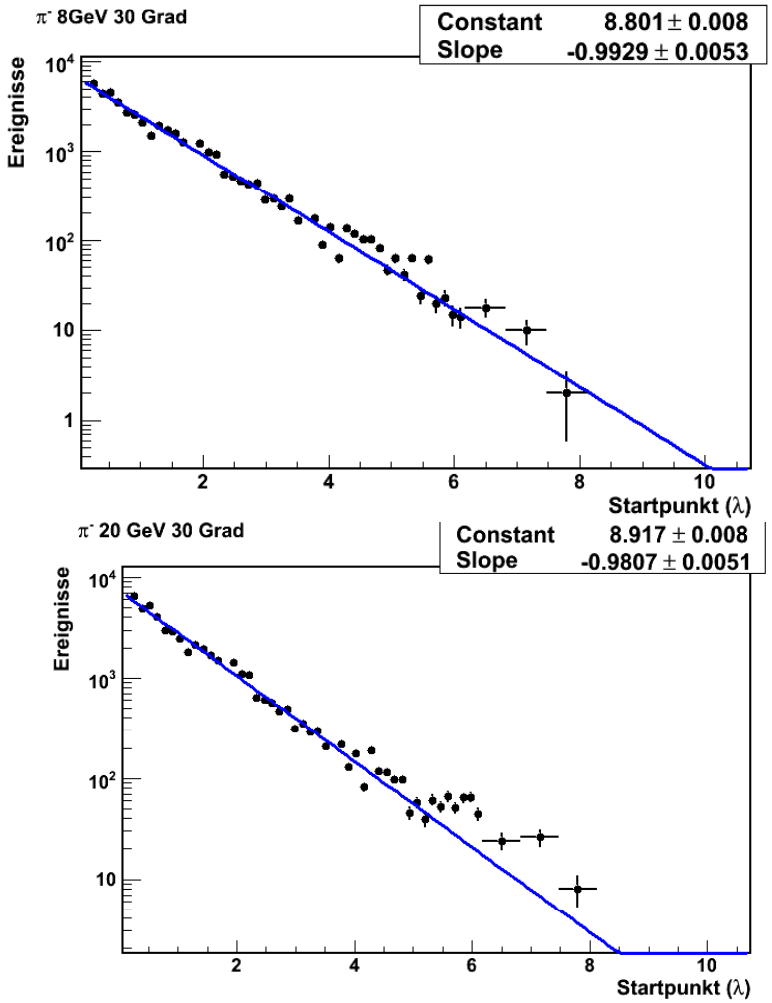


V.Morgunov

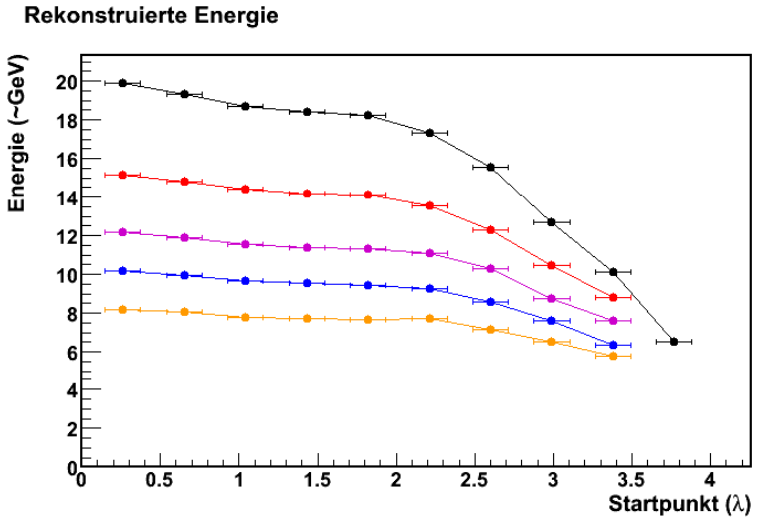
Shower starting point

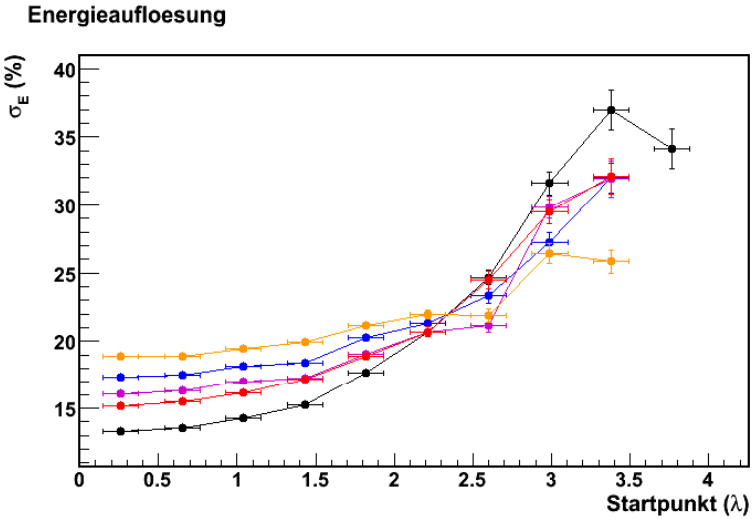
- Test beam data, HCAL + TCMT
- Reconstruct starting point
  - > 5 hits, 8 MIP in 3 consec, layers
- Shower profile:

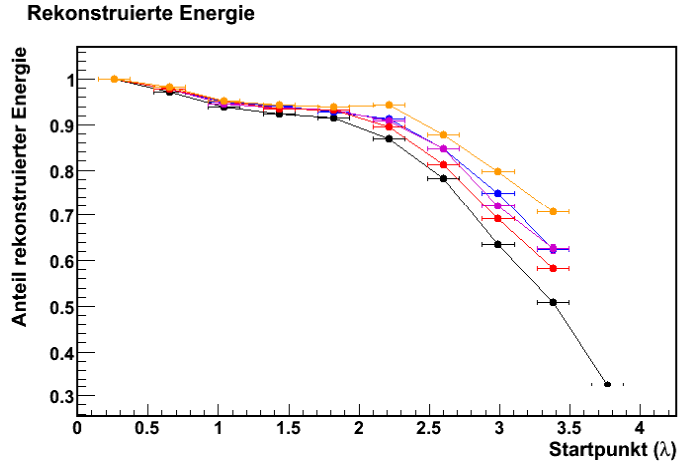




Reconstructed energy

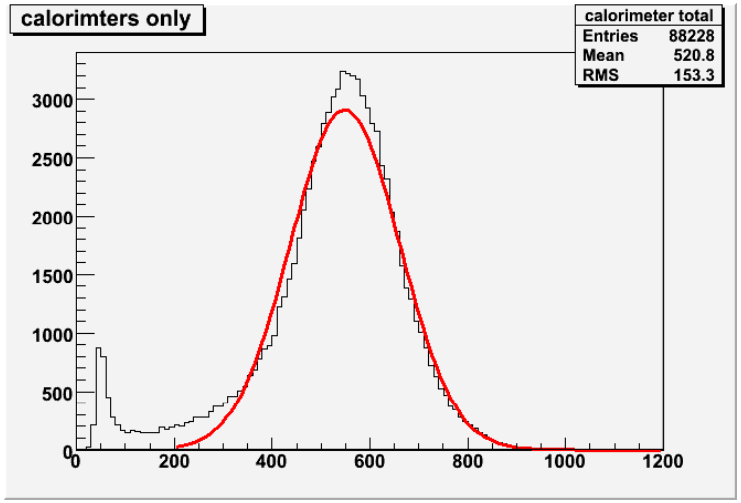


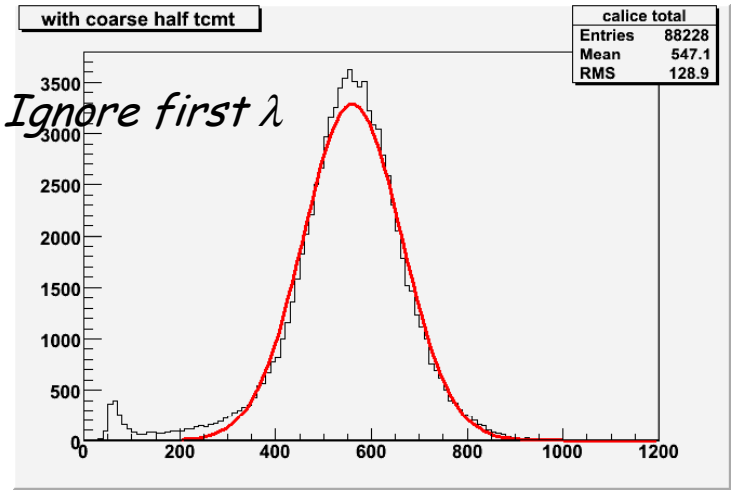




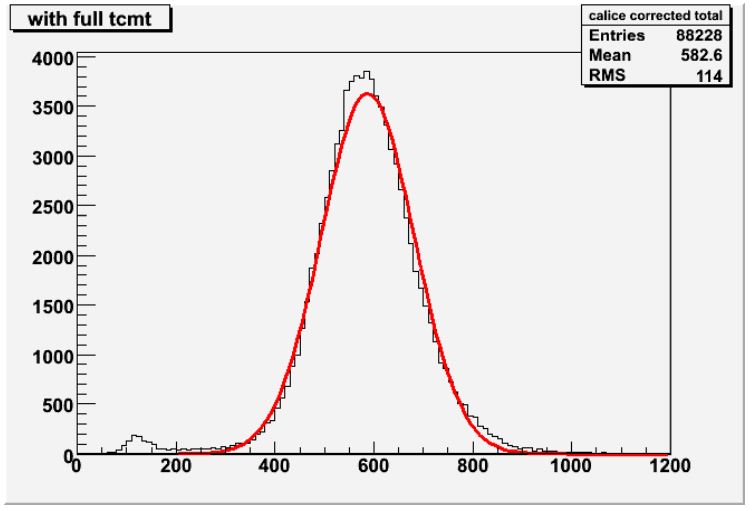
- "onset" of leakage when shower max moves out
  - Depends on energy
- Resolution degrades as energy is lost

Tail catcher





V.Zutshi

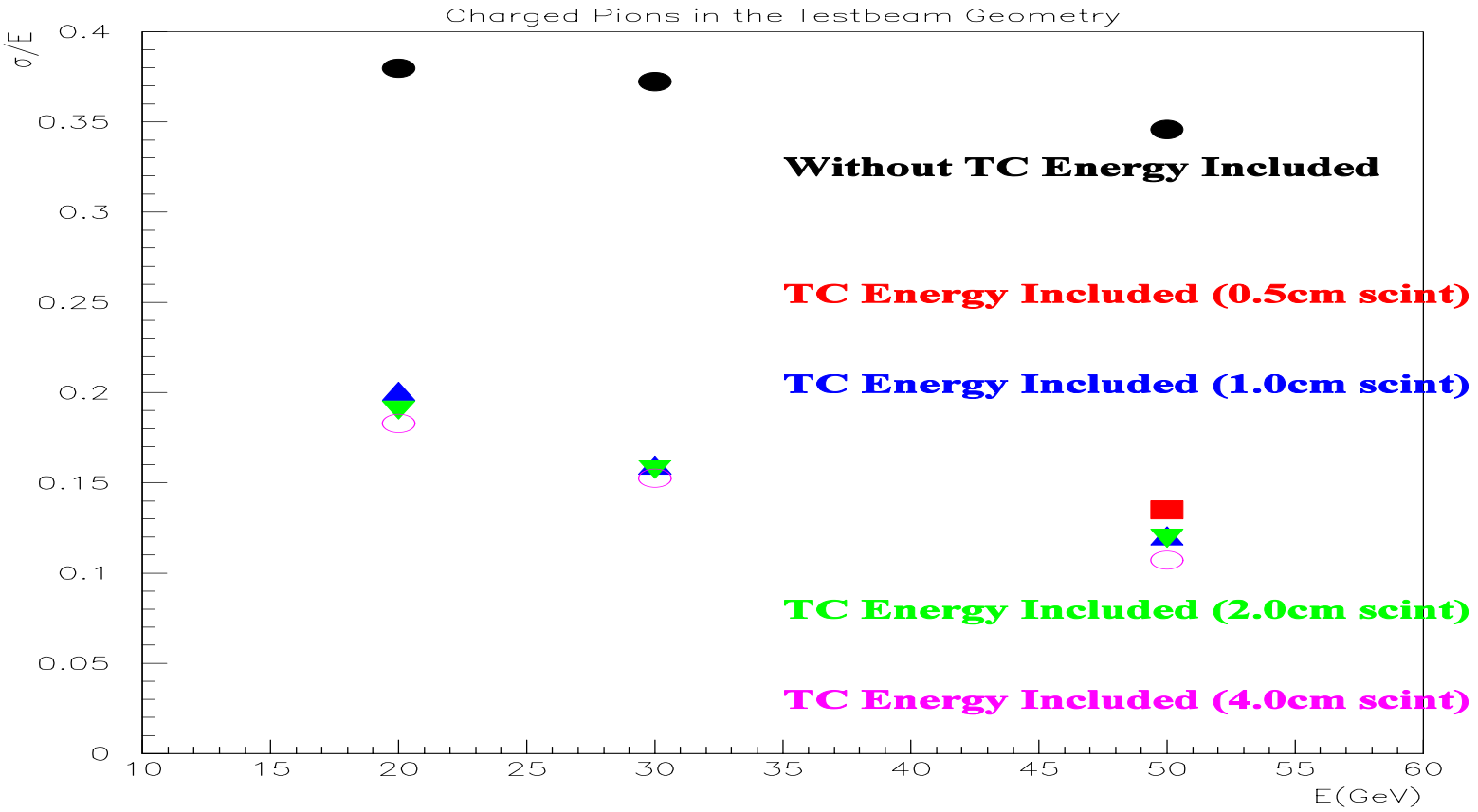


- Improvement also with incomplete measurement
- No weights applied
- Keep the coil thin!

For charged pions with >5% of E inside TC

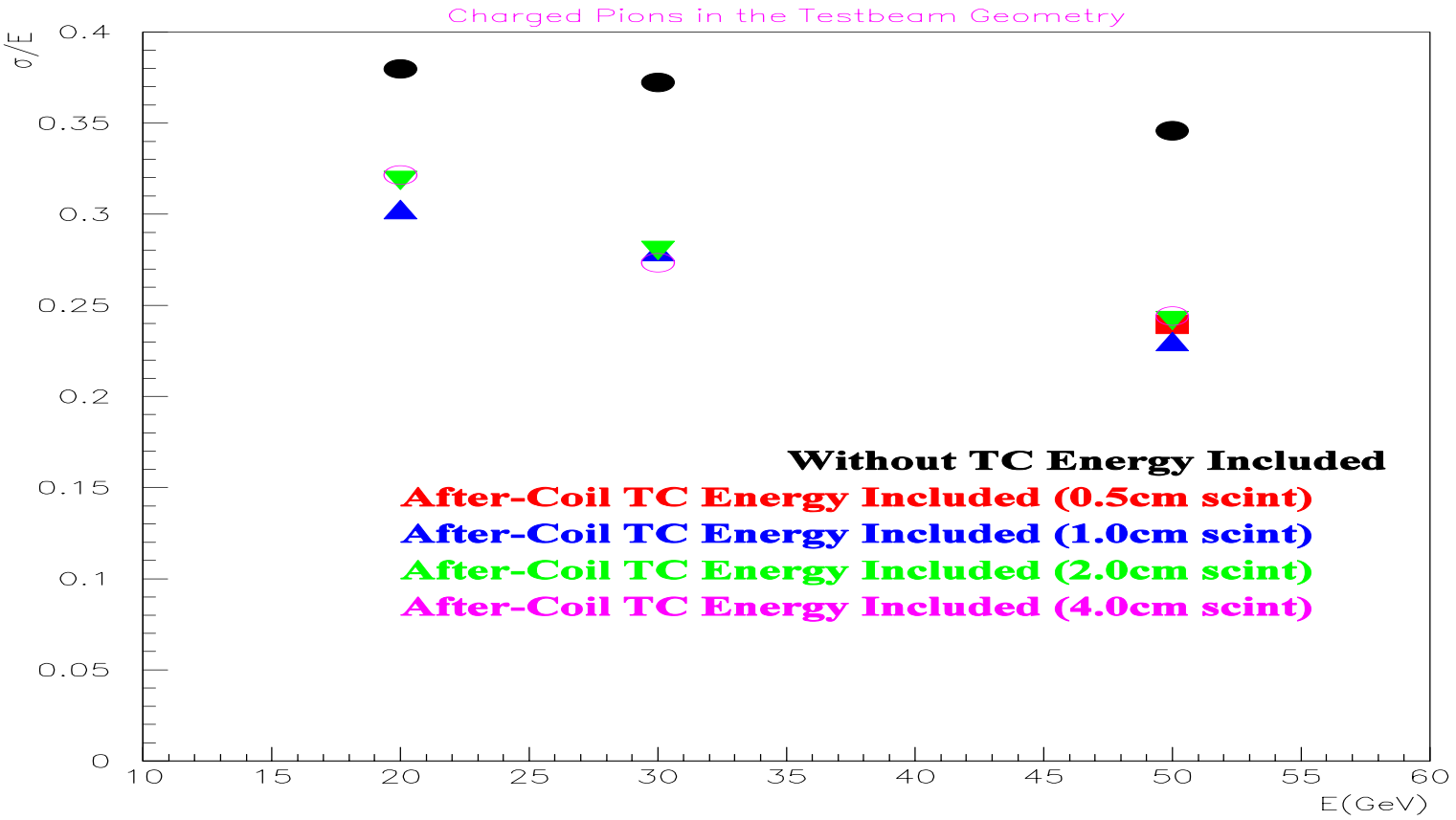
On tail-catching

From V.Zutshi, NIU, 2004



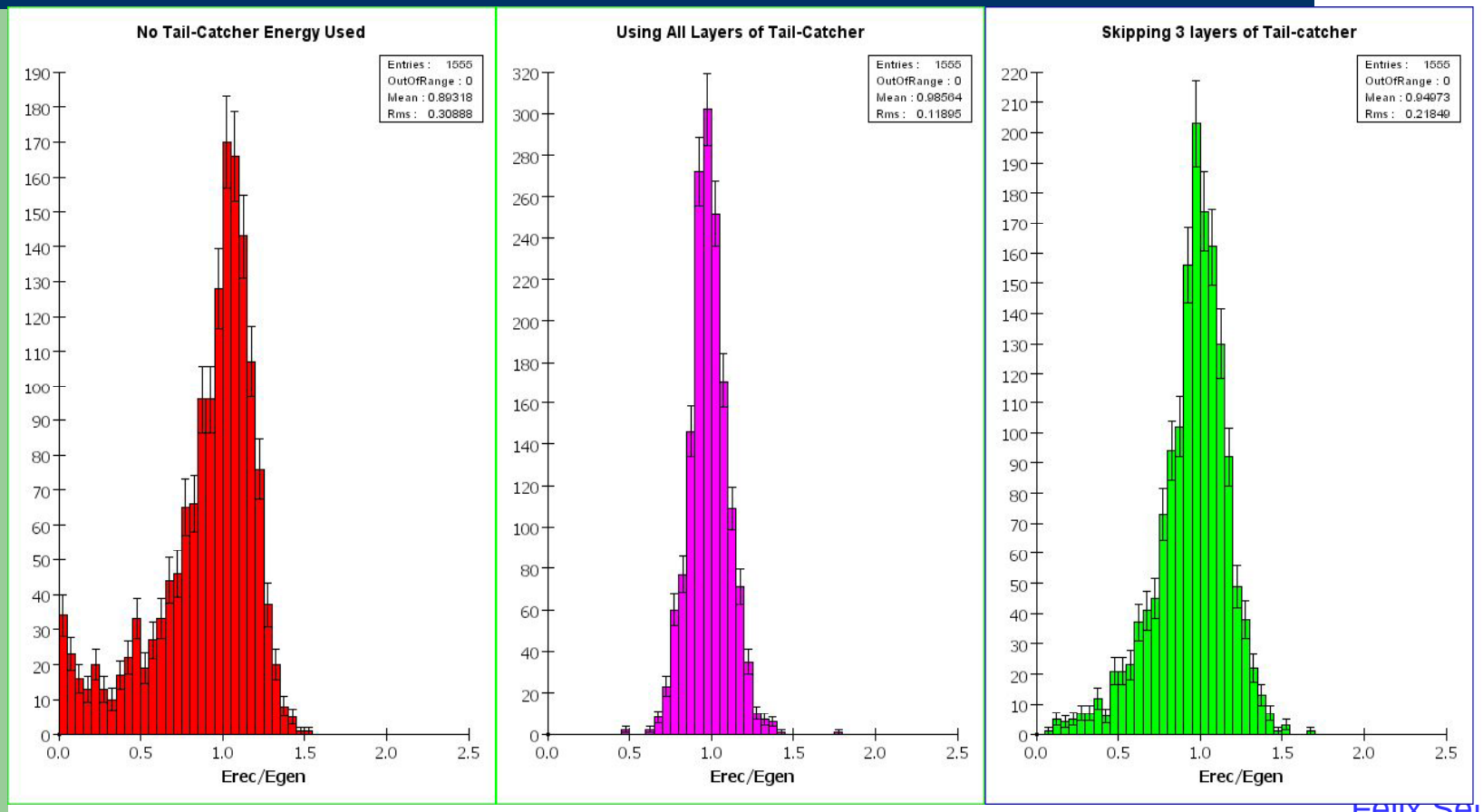
10cm absorber plates

Accounting for material in the coil...



135%/sqrt(E)

E_{rec}/E_{gen} 50 GeV $\pi^{\pm}$



Conclusion:

- Case for tail catcher based on gut feeling and fragmented information
- On this basis, it is too early to discard the option
- Needs to be addressed in more serious studies (PANDORA)
  - The need (in view of PFLOW tools)
  - The performance (seems to work even after coil!)
- Iron yoke instrumentation is needed anyway for muon hadron separation
  - Several layers for redundancy
  - Layers can be made as thin as HCAL layers: 0.6cm plus cassette
- Tail catcher
  - 10 cm absorber thickness only first guess