From ADC to GeV

On the Cell Level Reconstruction
for the DØ Calorimeter in Run II

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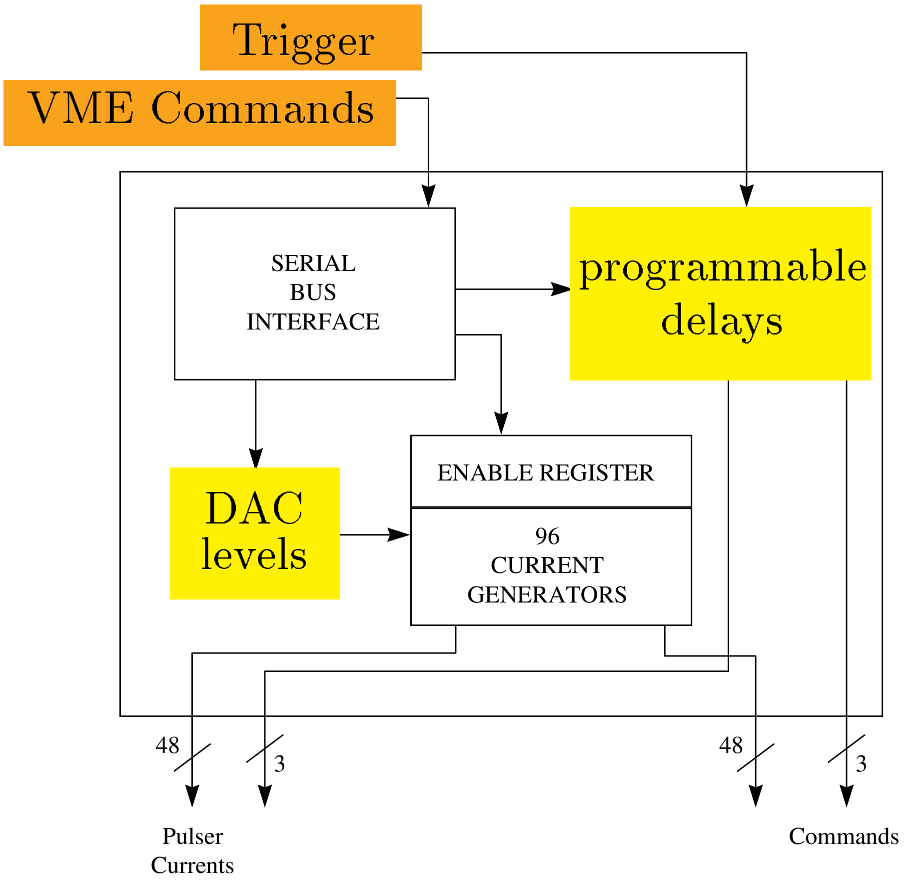
- Using the Electronic Calibration
- Tasks for Recontruction Code
- Corrections to the Cell Energies

DØ Workshop / Calibration and Alignement,
Fermilab, 10^{th} of July 1998

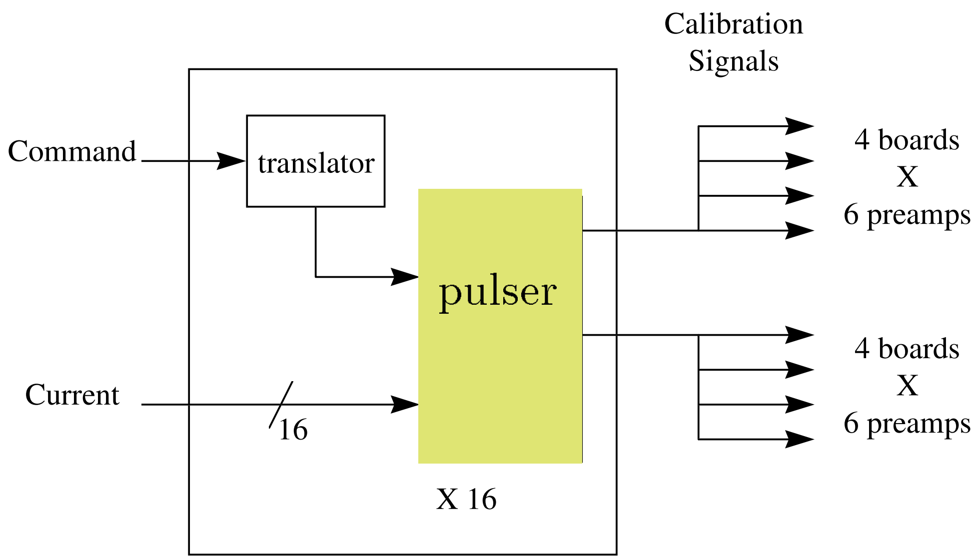
Electronic Calibration



Pulser Control Board

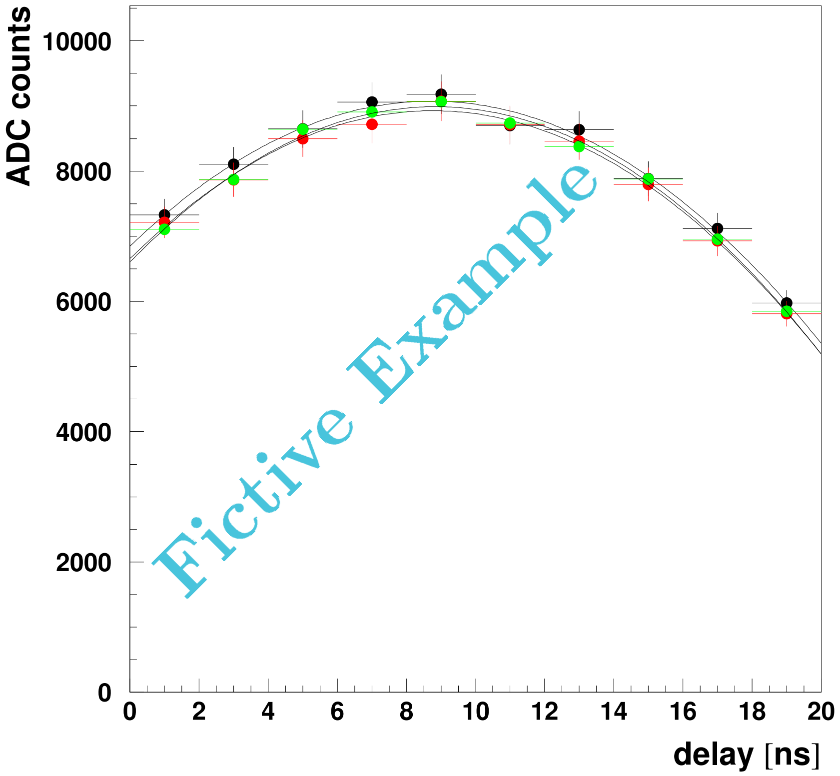
- → **delay ramps:** initialisation
- → **level ramps:** standard calibration
- → **special tests**

Active Fanout



Delay Ramps

• adjusts the delay for each pulser
to the maximum response in the read-out branch
for the pulsed channels



• precision: 2 ns

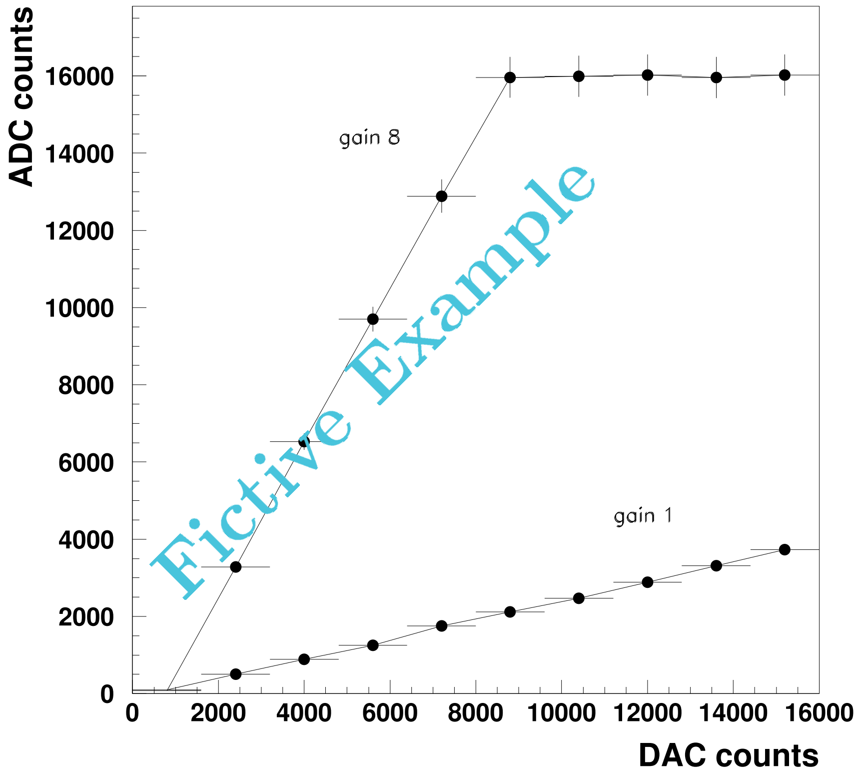
• values to be stored on the DataBase

• to be downloaded to the pulsers before calibration

Level Ramps

standard calibration procedure

for intercalibration between • channels
• gain1/gain8



- determine calibration constants from polinomial fits

→ with an automatic validation procedure if possible

- execution inteval: every 2 days
  (together with pedestal runs)
  ⇒ monitoring in time important!
- execution time: 20”-30” (goal!)

→ 1000 events per pulseheight
  max. pulser frequency: ∼ 10 kHz (10 times faster!)

→ 5 points per ramp
  time for downloading constants: ??
  DAQ-frequency: ??

Special Tests

- cabling and mapping checks

$\rightarrow$ check with different pulser patterns
 responding channels

- cross-talk measurements
- noisy channel detection
- dead channel detection
- check trigger response (?)
 (mapping and intercalibration)

$\rightarrow$ adjust pulse height to different trigger levels
 and check outcoming trigger bits

Possible Ramp Mechanism

Database

Pulsers

Calorimeter

Host:

2) fetch initialisation constans from DB → delays

- **download constants for initialisation and 1^{st} ramp-step to pulsers**
- **send "RunStart" signal to L3**
- **send N_{evnt} trigger signals to pulser**

4) download constants for new ramp-step to pulser

- **send N_{evnt} trigger signals to pulser**

... *iterate* $N_{step}-1$ *times*

6) validate calibration

→ check validity range, compares with old values...

- **write new constants to the DataBase**

L3:

1) user interface to start test procedure

standard programs and menu for special configurations

- **send configuration parameters to HOST**

→ N_{evnt} number of events per ramp-step

→ N_{step} number of step per ramp

→ DAC and delay values, pulser pattern...

3) read N_{evnt} events

- **fills histogramms**
- **send acknoledgment signal to HOST**

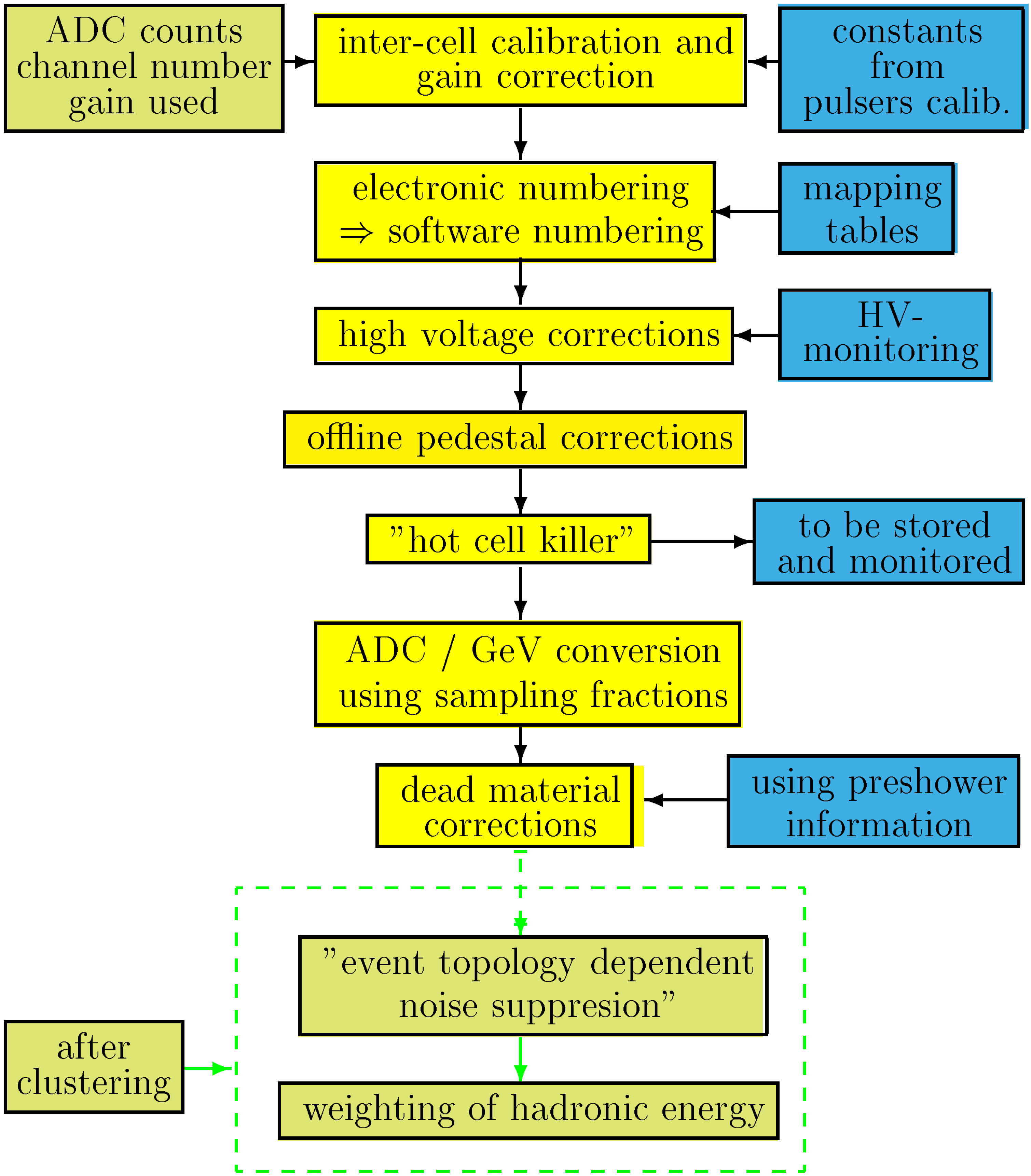
...*iterate* N_{step} *times*

5) compute calibration constants

- **sends calibration constants to HOST**
- **sends "RunStop" signal**

→ **discussions with Mrinmoy**

Reconstruction Tasks



Sampling Weights

ADC/GeV conversion in Run I

e.m. section:

$$E_{tot} = \alpha \sum_{i=1,5} \beta_i E_i + \delta$$

α : ADC/GeV conversion factor

E_i : energy per layer

β_i : weighting factor

δ : offset for energy losses

LAYER	dE/dX		DATA	MONTE CARLO
	SF	SF(3)/SF(j)	β_i	β_j
EM1	0.049	1.83	1.47 ± 0.03	1.13 ± 0.03
EM2	0.088	1.01	1.00 ± 0.01	0.98 ± 0.01
EM3	0.089	1.00	(1.00)	(1.00)
EM4	0.081	1.10	1.10 ± 0.01	1.04 ± 0.01
IH1	0.053	1.67	(1.67)	(1.67)

H. Aihara et al, NIM **A325** 393.

biggest difference to SF in layer 1
$\Rightarrow$ **dead material corrections**

had. section:

sampling fractions from dE/dx

Dead Material in Run II

Increased dead material
from presence of solenoid:

without solenoid and PreShower

with solenoid and PreShower

DØ-Note 2666, H. da Motta

- energy losses in dead material more important
- difficult region at solenoide border

$\Rightarrow$ necessary corrections more complicated

- include Pre-Shower Detectors
- η and energy dependend?
- depending on shower type?

Our Proposal:

- split sampling fractions and dead material corrections
- if possible: store "e0"-energy scale after ADC/GeV conversion
- run independent "module" for dead material correction

Advantages:

- **more detector oriented:**

→ sampling fractions have a different physical origine than dead material corrections and should be thefore treated seperately

- **stable "e0"-scale:**

→ sampling fraction are determined once and not supposed to vary in time

- **more flexiblity for dead material corrections:**

→ different approaches can be tried without going to all calorimeter corrections again

→ could be applied later in the reconstruction, after "shower-classification" for example

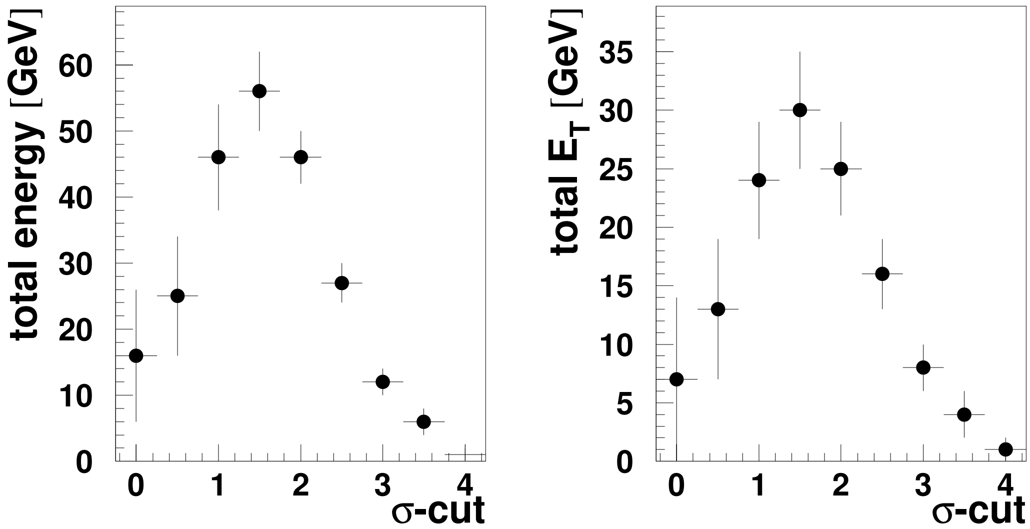
Noise Suppression

3 levels of noise suppression in Run I:

1. online zero-suppression: BLS at $\pm 2\sigma$

$\rightarrow$ determined from pedestal runs

- suppression of "sick channels"
  if pedestal or gain deviates from value expected from the capacitance of the channel



Energy and E_T in the calorimeter for random triggers as function of different BLS-cuts

D0-Note 3112 J. Guida, D. Schamberger, J. Guida

$\Rightarrow$ still significant amount of energy from electronic and uranium noise in the detector

BUT: harsher cut would cut into physics signal!

Possiblity for offline "Topological Noise Suppression"

$\Rightarrow$ suppresses cells between 2 and 4σ if they don't have a neighbour cell with more than 4σ energy

Offline Noise Suppression

2. Run-dependent noise suppression:

flags single noisy cells or searches for noise patterns

Run I: flagging cells using Φ-isotropie criterias
D0-Note 2379 S. Fahey et al.

→ determined before the offline reconstruction
→ stored in Run-Summary

3. Event-dependent noise suppression:

Run I: AIDA - suppressing energetic isolated cells
D0-Software Documentation

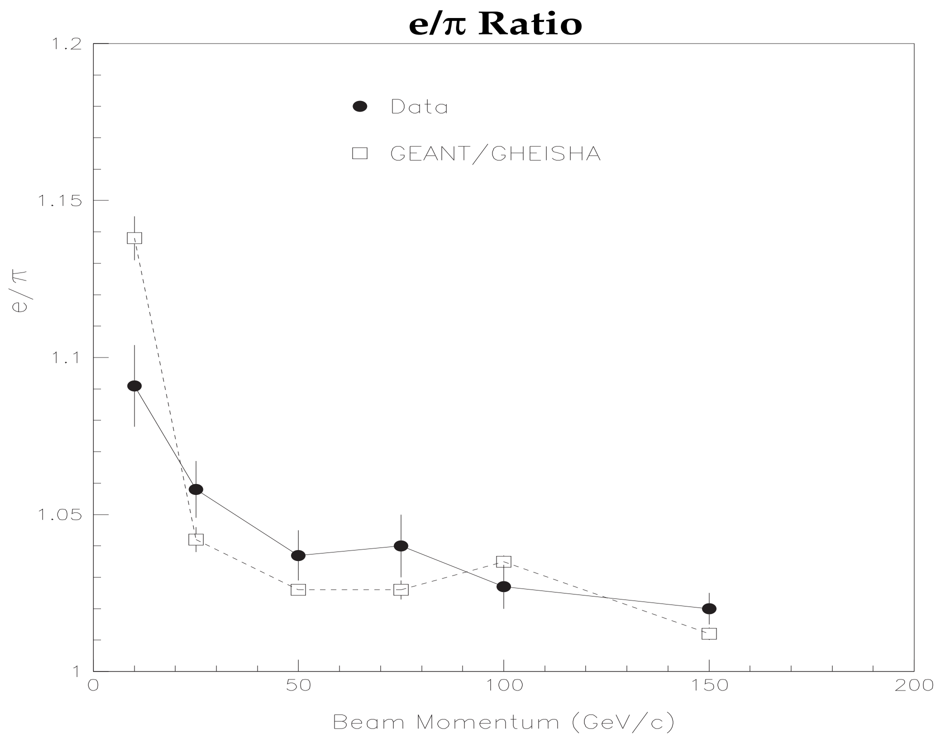
→ suppression criteria:
E_T-cell$>$ 10 GeV
E_T of neighbour cell $<$ 5 % of E_T-cell

Problem: too much energy suppressed!!
(cf. mail from Bob and John)

More restrictive algorithmes:

→ defining regions in calorimeter with clear activity (jets, e.m. clusters, muon tracks)
→ flagging isolated cells only in "empty" regions

Weighting for hadrons?



DØ Calorimeter is nearly compensated!

but: losses for π of 10% -15% at low energy

$\Rightarrow$ weighting of low energy hadrons could improve the resolution!

- clear distinction between e/γ and hadrons at low energy necessary
- unprecise MC description of final state may bias the results

$\Rightarrow$ MC studies should be done first showing the gain in resolution and the feasability!

Conclusions

- Project on online/offline cell-calibration getting started in Paris
- Dedicated studies will be necessary to keep/improve the high performance of the Run I calorimeter reconstruction
- On-line Procedures could be rather similar as in Run I but with higher performances.
- Off-line Strategies have to be developped for new "features":
  - presence of the solenoid
  - different noise behaviour
  - additional pile-up due to the high lumi?
- Higher Statistics will allow a more detailed calibration (in ϕ for instance) *in situ*
- New techniques are envisaged (software weighting)
- Next Steps:
  - more discussions with Run I experts necessary
  - work on the software design