GEANT4/3 control parameter optimisation

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Outline

- introduction
- conclusions
- highlights
- summary

Introduction - calorimeter simulation

► .

: work with G3-BRAHMS(v3.01) and G4-MOKKA(v2.0)
porting calorimeter geometry from G4 to G3

: analysis code in ROOT and C++

► .

: study with TESLA-TDR D08 calorimeters (W/Si ECAL + Fe/Scint HCAL)

: perform control parameter / particle / energy scan with G3 and G4

: identify regions where testbeam should focus to give answers

Conclusions

- **from G3-G4 calorimeter simulation**
  - : GEANT4 is reasonably stable with respect to its control parameter
  - : GEANT3 is in general agreement with GEANT4 provided
    - ▷ δ rays generation is turned on
    - ▷ GHEISHA bugs in G3 are fixed
    - ▷ energy cuts are sufficiently low (how much low?)
- **control parameter optimisation**
  - : GEANT3 is not reliable for energy cuts below 10 keV
  - : highlight plots wrt calorimeter response follow
  - : similar studies for energy resolution, shower size etc
    same conclusions apply

G3-G4 comparison

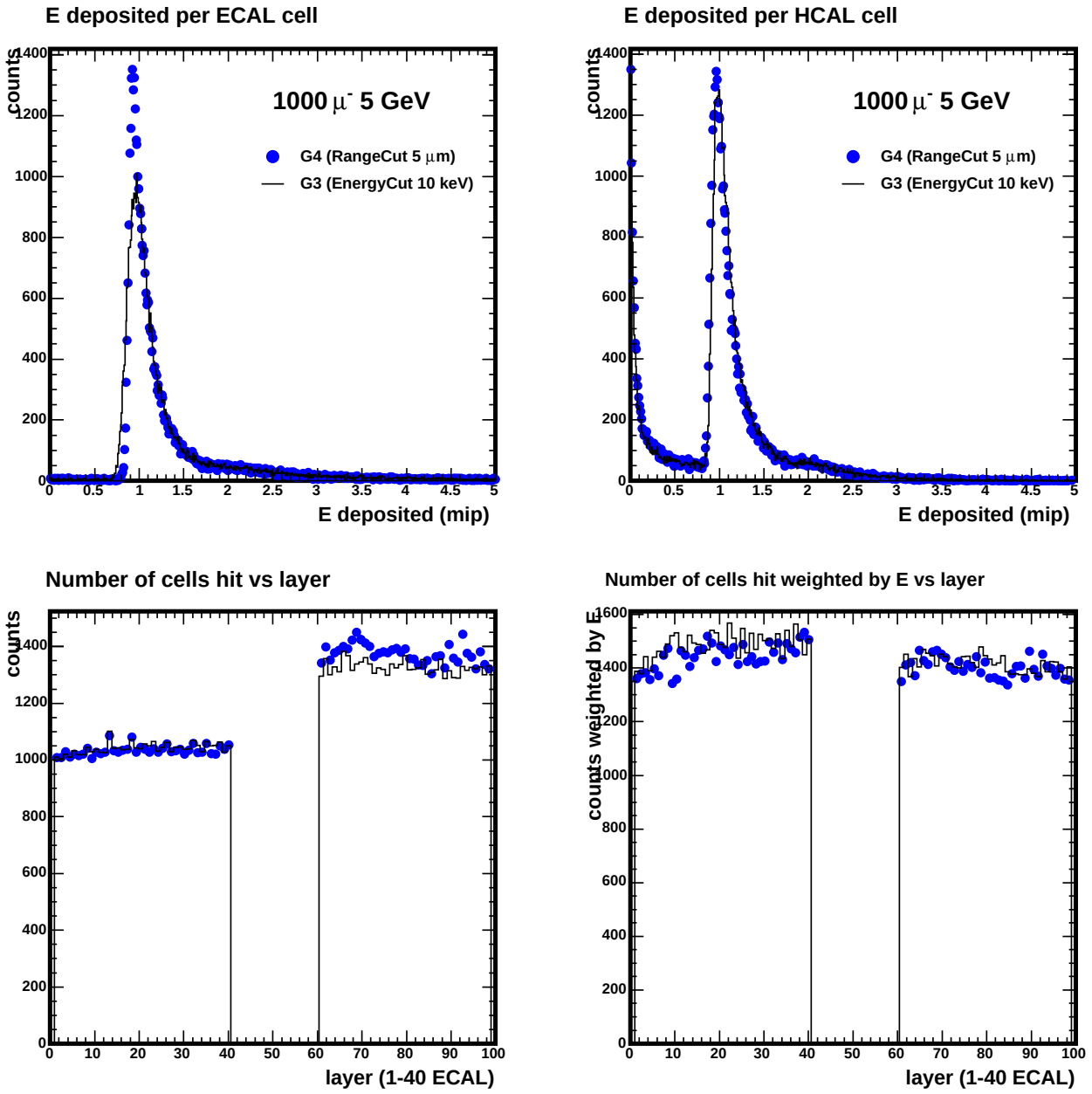
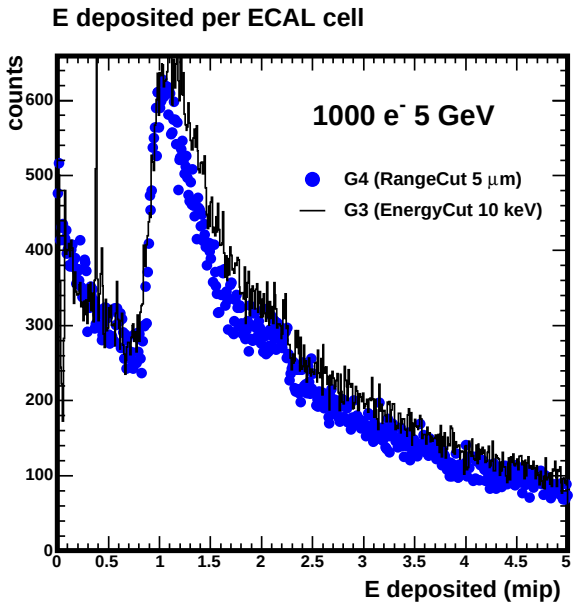
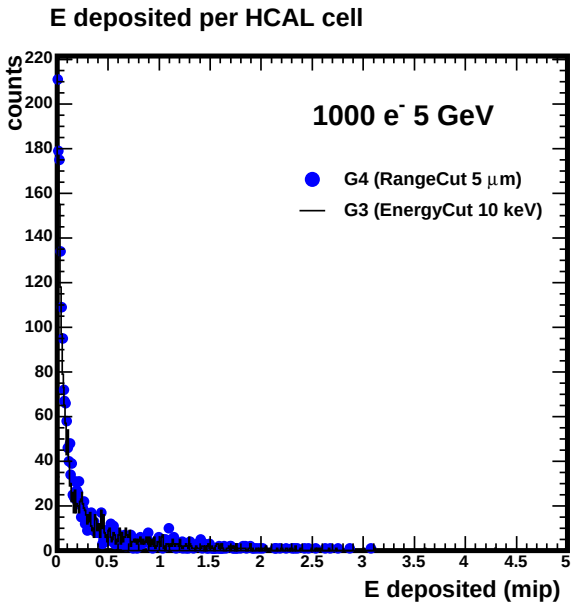
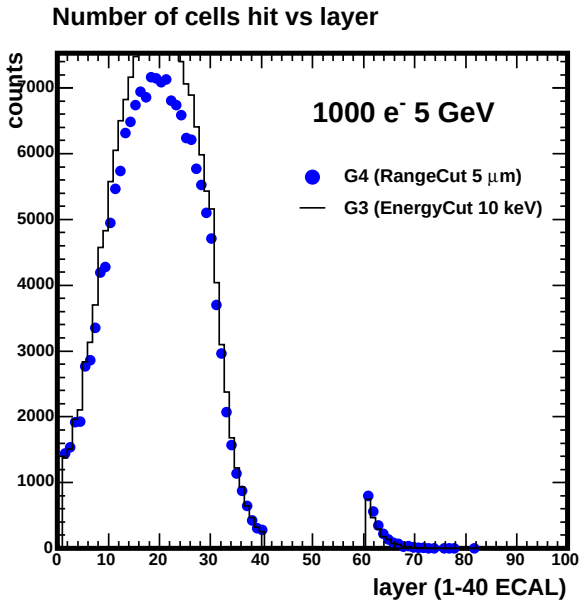


fig.1

G3-G4 comparison







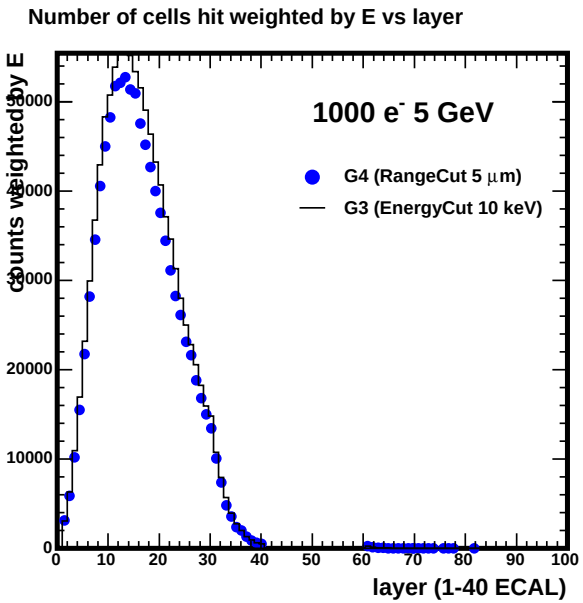


fig.2

response vs G3 control parameter

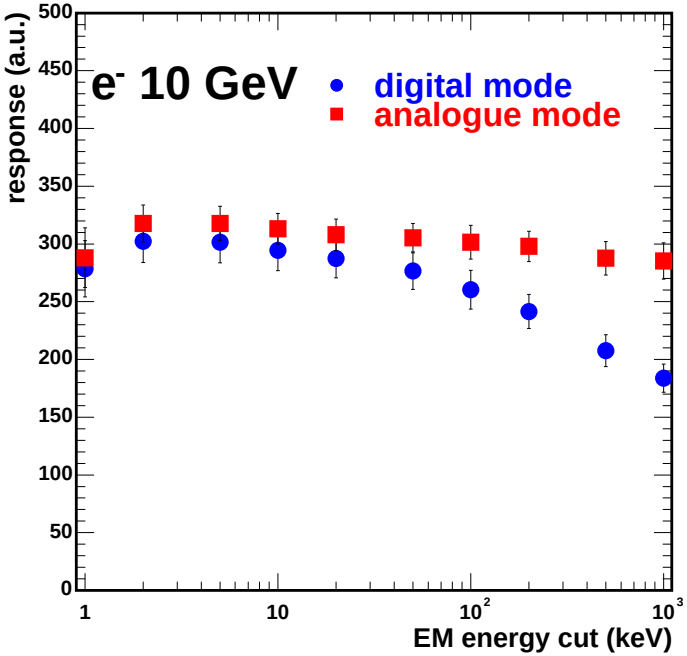


fig.3

response vs G4 control parameter

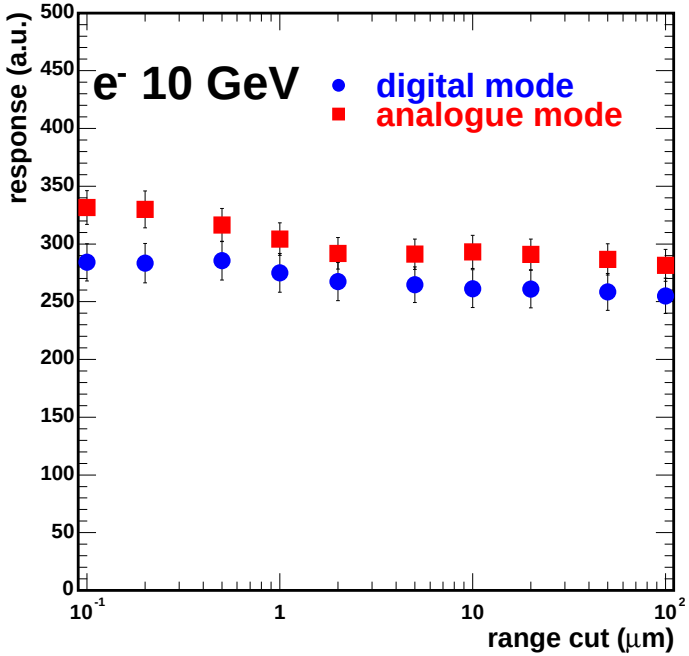


fig.4

digital mode : count hit cells (no threshold)
analogue mode : sum energy deposited in cells

response vs G3 control parameter

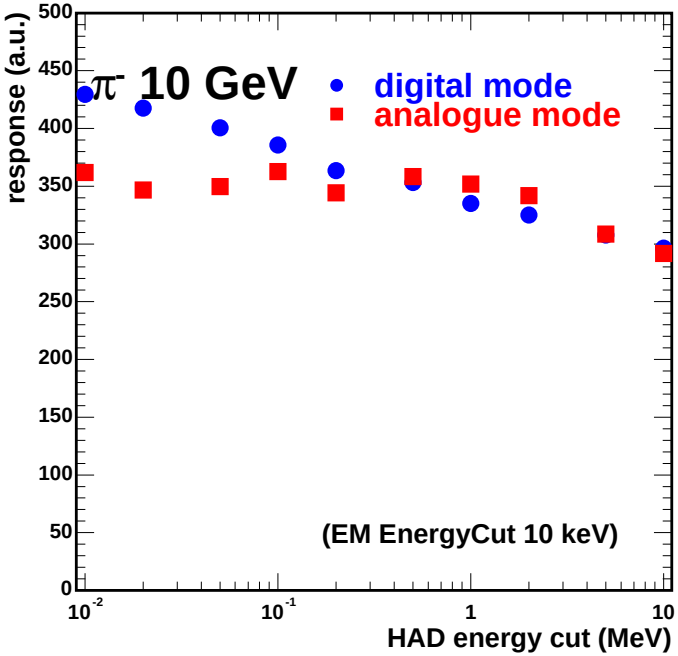


fig.5

response vs G4 control parameter

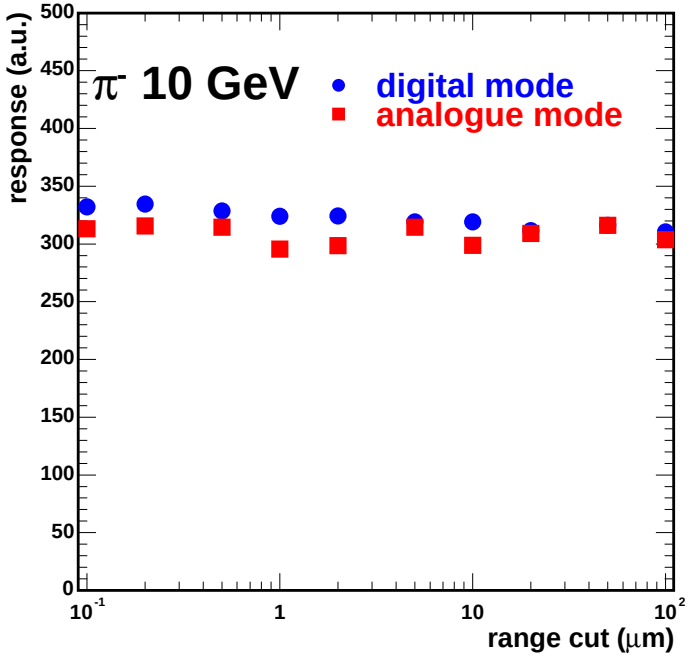
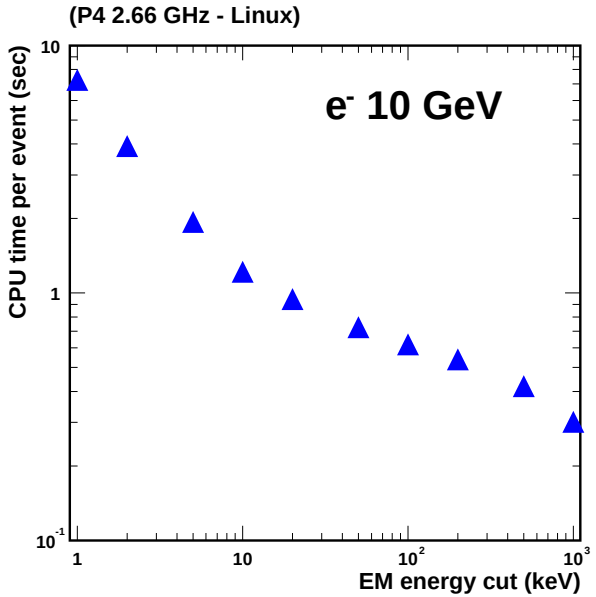


fig.6

digital mode : count hit cells (no threshold)
analogue mode : sum energy deposited in cells

CPU time vs G3 control parameter



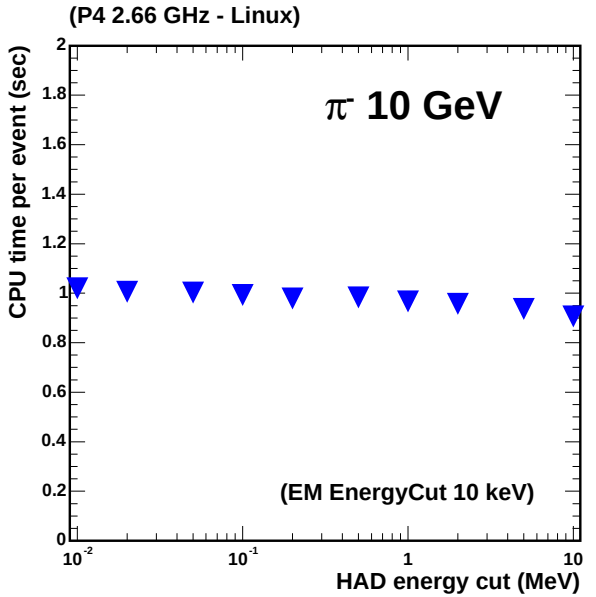
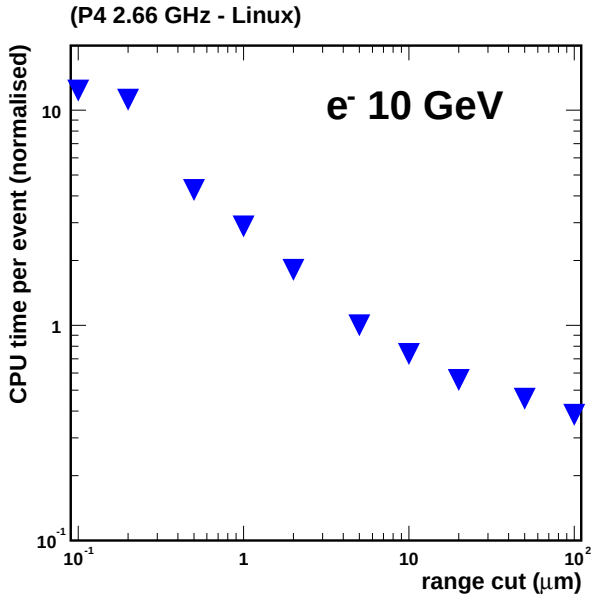


fig.7

CPU time vs G4 control parameter



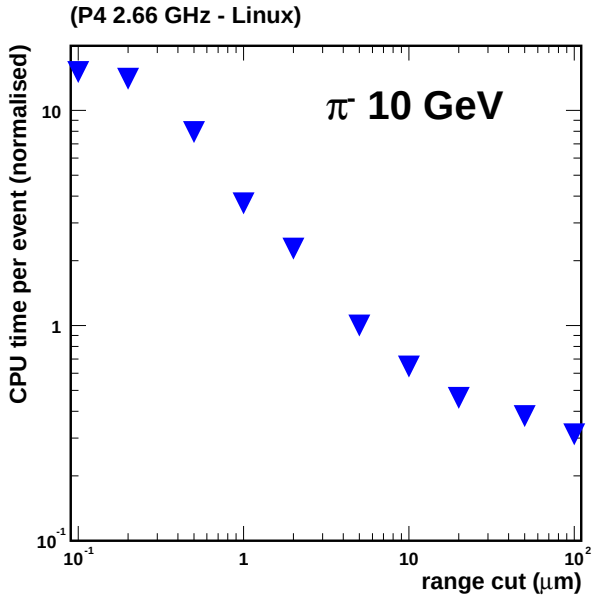


fig.8

problem with energy cuts below 10 keV

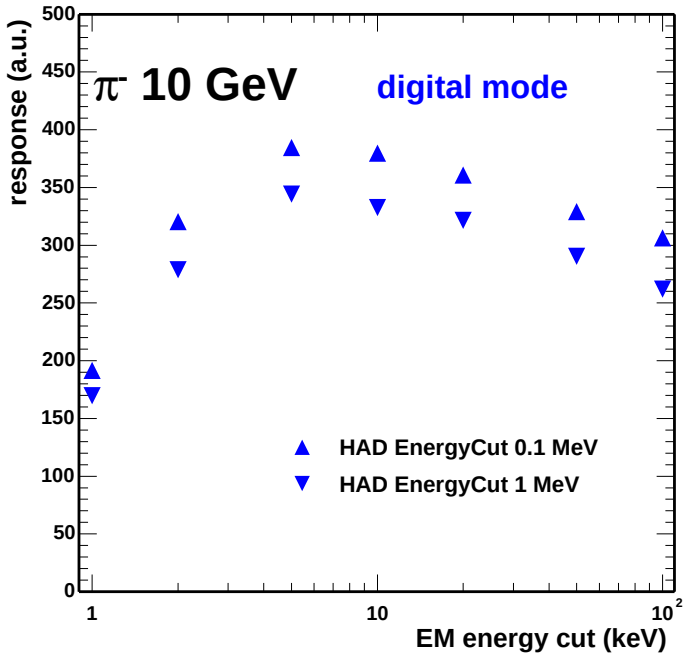


fig.9

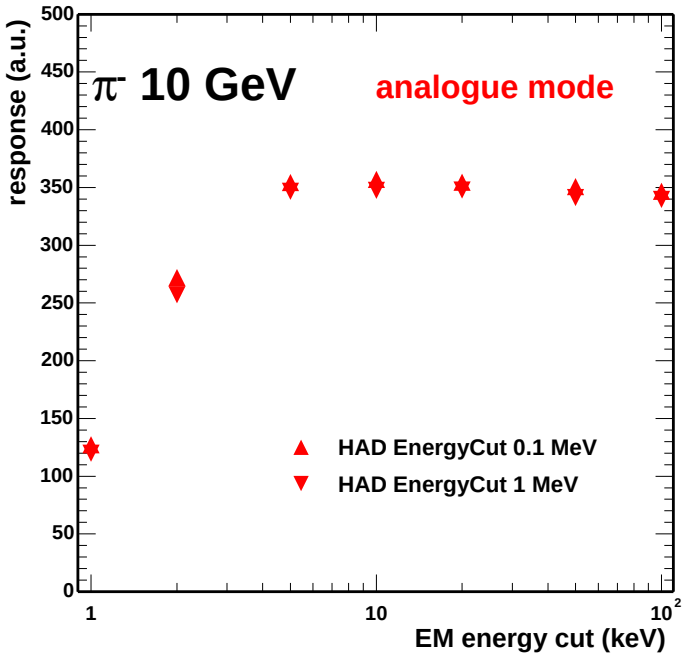


fig.10

- *problem* : non-physical drop of response, particles die "early"
- *solution* : increase default cut on number of steps allowed
  AND
  force G3 to calculate cross-sections down to 1 keV

unfolding fig.10

in general for GEANT3

► .

: no significant change by altering HAD energy cut

(see also CPU time consumption)

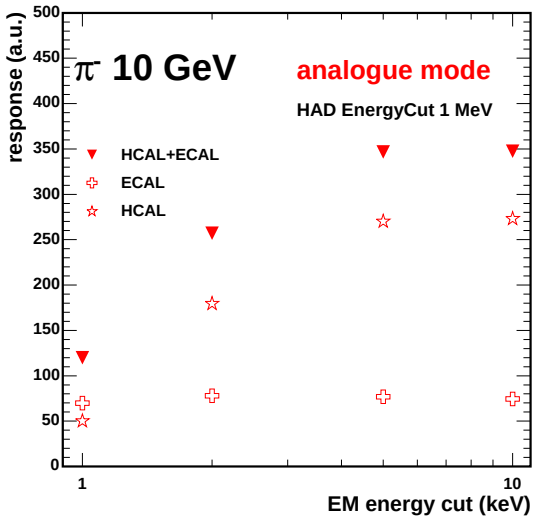
► .

: EM energy cut is the crucial control parameter

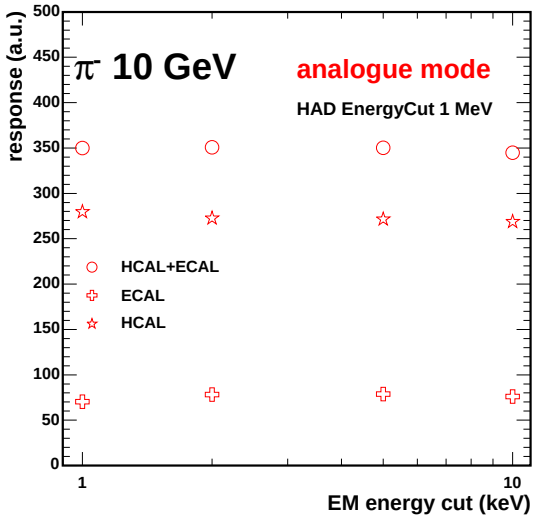
► .

: G3 is not reliable with energy cuts below 10 keV

: G3 can be pushed to very low cuts (1 keV),
simple changes needed to restore "normal" behavior
BUT
no reason to pay for more CPU time



"push" G3 cross-section tables down to 1 keV



Conclusions continued

► .

: GEANT3 technically works with as low cuts as we like
(simple tuning of basic parameters is needed)

: **B U T** results for energy cuts much below 10 keV are not reliable since energy deposition rates are calculated by extrapolation

► .

: GEANT3 energy cuts around EM = 10 - 100 keV, HAD = 0.1 - 1 MeV recommended for detailed calorimetric simulations
A N D do not forget to switch on δ rays generation

: GEANT3 in reasonable agreement with GEANT4 provided above conditions