

# Status

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**GSI-CERN data, atmospheric muons:**

**different  $L(\Delta E, E)$  functions observed for different particles.**

**L: light amount,  $\Delta E$ : deposited energy, E: incident energy**

**Current calibration based on energy deposited by atmospheric muons**

**Leads to an overestimate of the energy of gamma-ray/electrons of about 7%.**

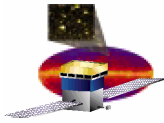
**Situation must be dealt with before launch so as to meet two requirements:**

- Energy calibration is correct for EM showers (to the largest possible extent)**
- MC data match real ones.**

**Proposal:**

- get the calibration « right » for EM showers**
- adjust the Monte-Carlo code accordingly**

**Impact on energy reconstruction, background rejection, on-orbit calibration...**



## Quenching factors ( $\equiv$ light yield ratios)

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One observes:  $L_{\mu}(\Delta E, E) = L_{\pi}(\Delta E, E) = L_p(\Delta E, E)$

Assuming a negligible dependence of  $L(\Delta E, E)$  on  $E$  over the energy ranges considered by GLAST, one defines ( $E_0 = E_{\text{MIPS}}$  ;  $\Delta E_0 = 11.2$  MeV):

$$Q_{i/\mu}(\Delta E) = \frac{L_i(\Delta E)}{\Delta E} \frac{\Delta E_0}{L_{\mu}(\Delta E_0)}$$

If  $L(\Delta E)$  is a linear function of  $\Delta E$ ,  $Q_{i/\mu}$  is independent of  $\Delta E$  (*more below*)

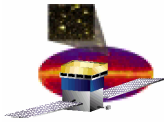
One has:  $Q_{C/\mu} = 1.23$ ,  $Q_{\text{He}/\mu} = 1.09$ ,  $Q_{e/\mu} = Q_{\gamma/\mu} \sim 1.07$

for the energy ranges explored in the different experiments performed.

**No understanding** of these values (even on a qualitative basis).

If  $Q_{e/\mu}$  is not constant as a function of energy, this effect is *only* due to either:

- discrepancy between MC and data for electrons;
- non-linearity of the calorimeter response.



## New scheme

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In the current scheme, the measured energy is:

$$E_{\gamma,e}^{meas} = Q_{e/\mu} \times E_{\gamma,e}^{true}$$

and doesn't match the predicted (« true ») energy. **That's not acceptable.**

### « Minimal » modified scheme

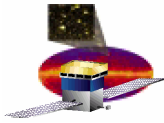
1) Rescale the calibration coefficients by:

$$1/Q_{e/\mu} = Q_{\mu/e}$$

The relevant correction factors are now:  $Q_{i/e} (= Q_{i/\mu} \times Q_{\mu/e})$

The MIP Landau distribution now peaks at:  $Q_{\mu/e} \times \Delta E_0$ .

Is that a problem? No, if one realizes that the parameter is not « deposited energy », but « **apparent deposited energy** » (which is what the CAL measures). The unit is **MeVee** (« MeV equivalent electron »), commonly used in scintillator technic.



## Handling of Monte-Carlo code

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**2) Modify the Monte-Carlo code in the « digi » stage.**

**Currently the MC energy is divided by « MeV/DAC » in the « digi » stage, then is multiplied back by the same factor in the « recon » stage to retrieve the true energy.**

**One needs to multiply the deposited energy by  $Q_{i/e}$  in the « digi » stage to get agreement between MC data and real ones.**

**Complication arises when dealing with nuclear reactions (several particles involved). Single  $Q_{i/e}$  or one per particle? I lend toward using a single one.**

**The on-orbit calibration with protons, H1, will be relative to the initial (pre-launch) calibration, so no action is necessary (although we might want to do it anyway ) to correct the apparent deposited energy for quenching effects, once the particle nature is clearly identified .**