Update on the Linearity of the TPOL Calorimeter in Geant Simulation

in Comparison to Data

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Linearity of the Calorimeter - In current Geant Setup

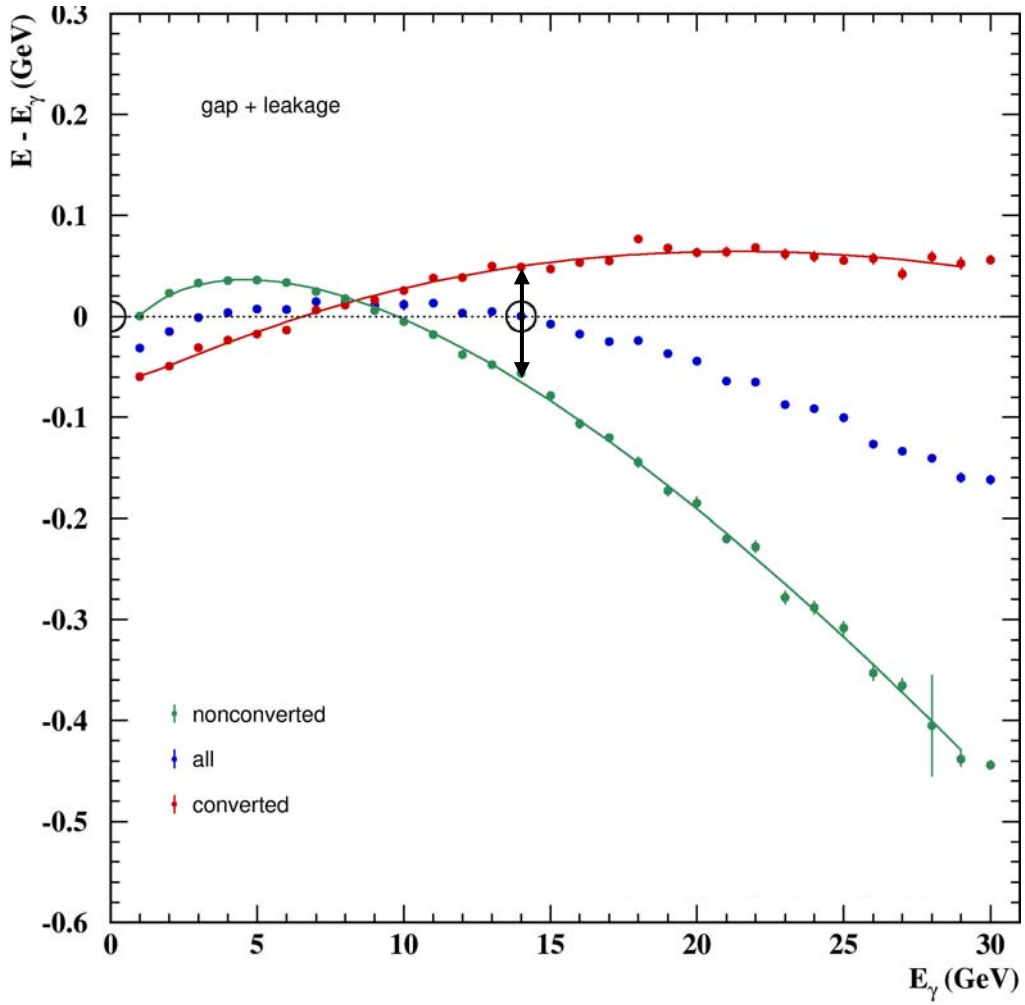
- Linearity of the calorimeter in Geant MC as shown last time

  → With calibration such to reproduce 14GeV for class ‚all' at a photon energy of 14GeV

  → Difference of Compton edges between converted and nonconverted photons has been subject to the tuning of the Geant setups

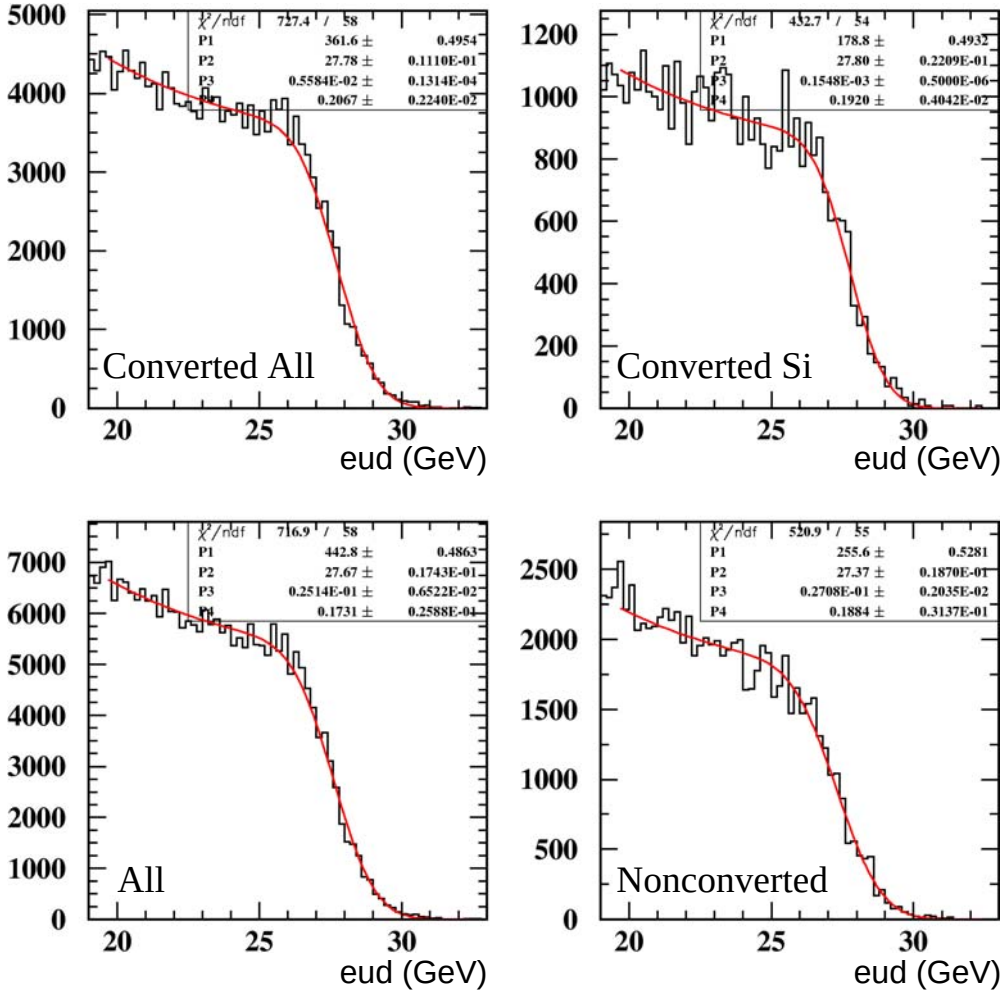
  → Predicts the position of higher markers, such as bremsstrahlung edges at HERA energy 27.5GeV for the different classes

  ➢ The idea was to fit bremsstrahlung edges in data to compare with Geant and eventually calibrate the linearity



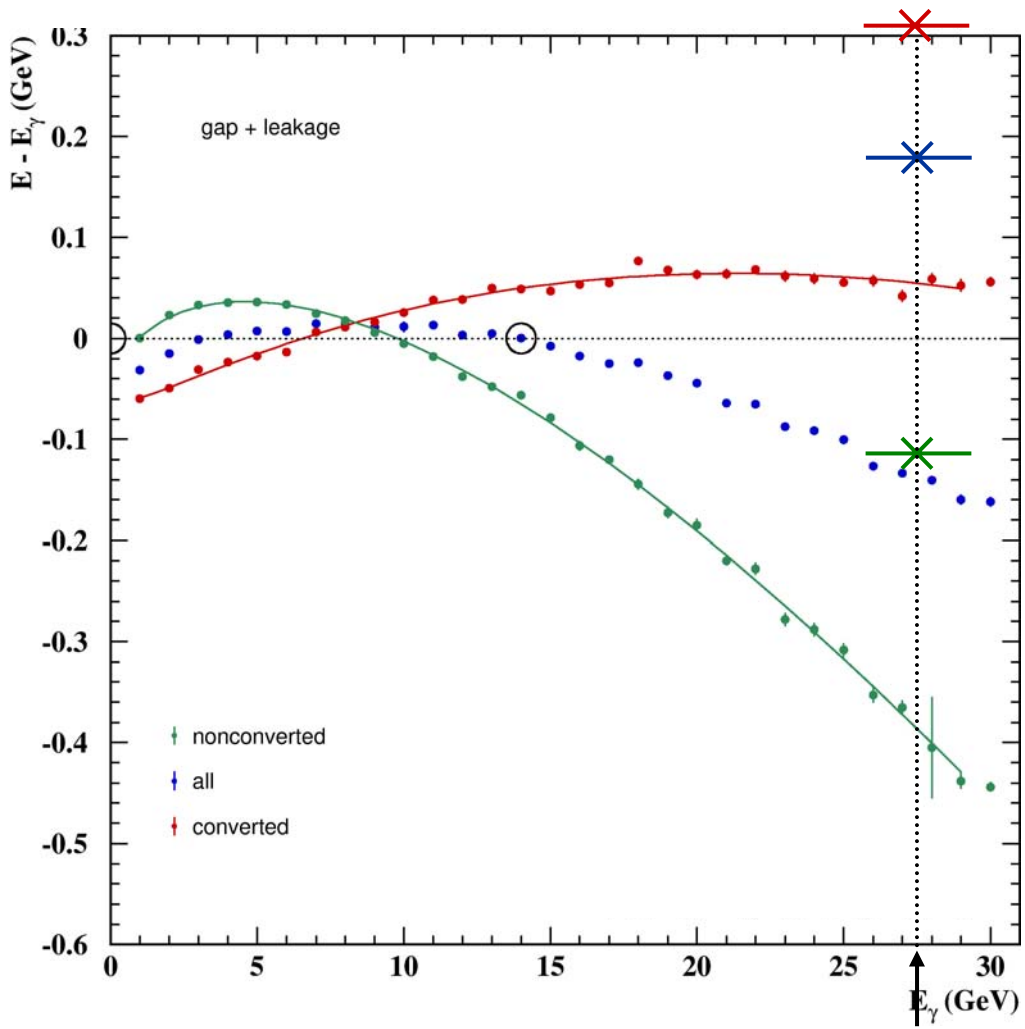
Bremsstrahlung Edges - In centered Si-Calorimeter Data

- Bremsstrahlung edges in combined Silicon calorimeter data
  - → 8 central runs with 100k events each
  - → Gain factors set such, that Compton edge of class ‚All' corresponds to a beam energy of 27.5GeV
- Cuts for classes in data
  - → converted all (any clusters): ncx+ncy>0.
  - → converted Si (one y cluster with significant charge): ncy=1 ∧ cychg(1) > 35.
  - → all: No cuts
  - → nonconverted (no clusters): ncx+ncy=0
- Fit with bremsstrahlung spectrum folded with resolution (statistical and/or constant term) and with bremsstrahlung spectrum x Fermi function
  - → Results for edge position are all consistent with each other
- Results
  - → converted all: 27.775 ± 0.011 GeV
  - → converted Si: 27.814 ± 0.023 GeV
  - → all: 27.683 ± 0.015 GeV
  - → nonconverted: 27.386 ± 0.018 GeV



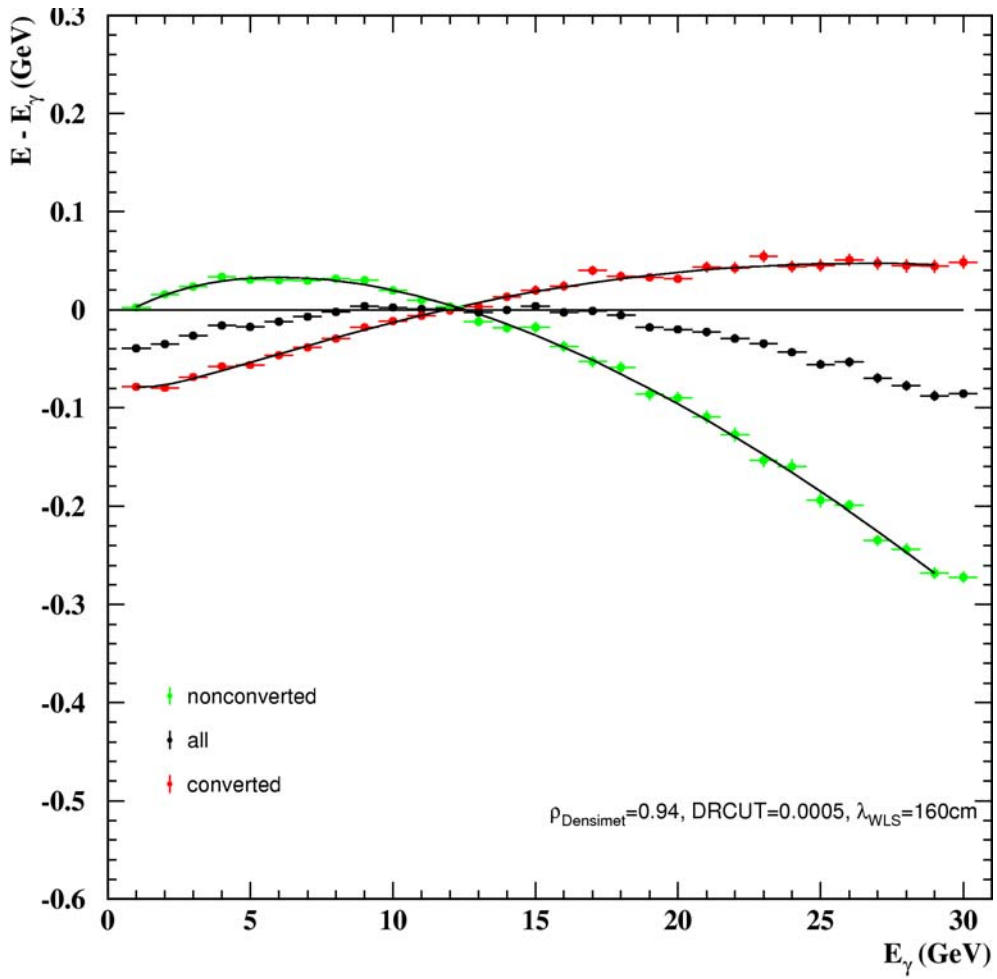
Bremsstrahlung Edges - In Comparison to Geant MC

- Results
  - → converted all: 27.775 ± 0.011 GeV
  - → converted Si: 27.814 ± 0.023 GeV
  - → all: 27.683 ± 0.015 GeV
  - → nonconverted: 27.386 ± 0.018 GeV
- ‚Ordering' of edges is correct
- Distances between edges are remarkably similar to those in Geant
- But: the overall offset to linearity for given calibration is completely different: edges are too high!!!
- How can this be?
  - → Attenuation in the WLS?



Linearity of the Calorimeter - Geant with WLS Attenuation

- Modified the current Geant setup to incorporate exponential attenuation in the WLS
  - → Read-out is from behind, so light from deeper scintillator layers has a shorter way to the PMs
  - → Light from deeper layers will be less attenuated, corresponding signal of them is higher compared to layers less deep
  - → Chose two attenuation lengths for comparison:
    - ➢ λ = 160cm and 80cm
    - ➢ Chosen according to numbers given by ZEUS for this kind of WLS or similar…
  - → Overall signal height changes (will be larger or smaller depending on the normalization point for the attenuation)
  - → But: it does not help!
    - ➢ Distance of Compton edges shrinks, even can get inverted
    - ➢ Distance of Bremsstrahlung edges shrinks, and could get inverted for very short lengths



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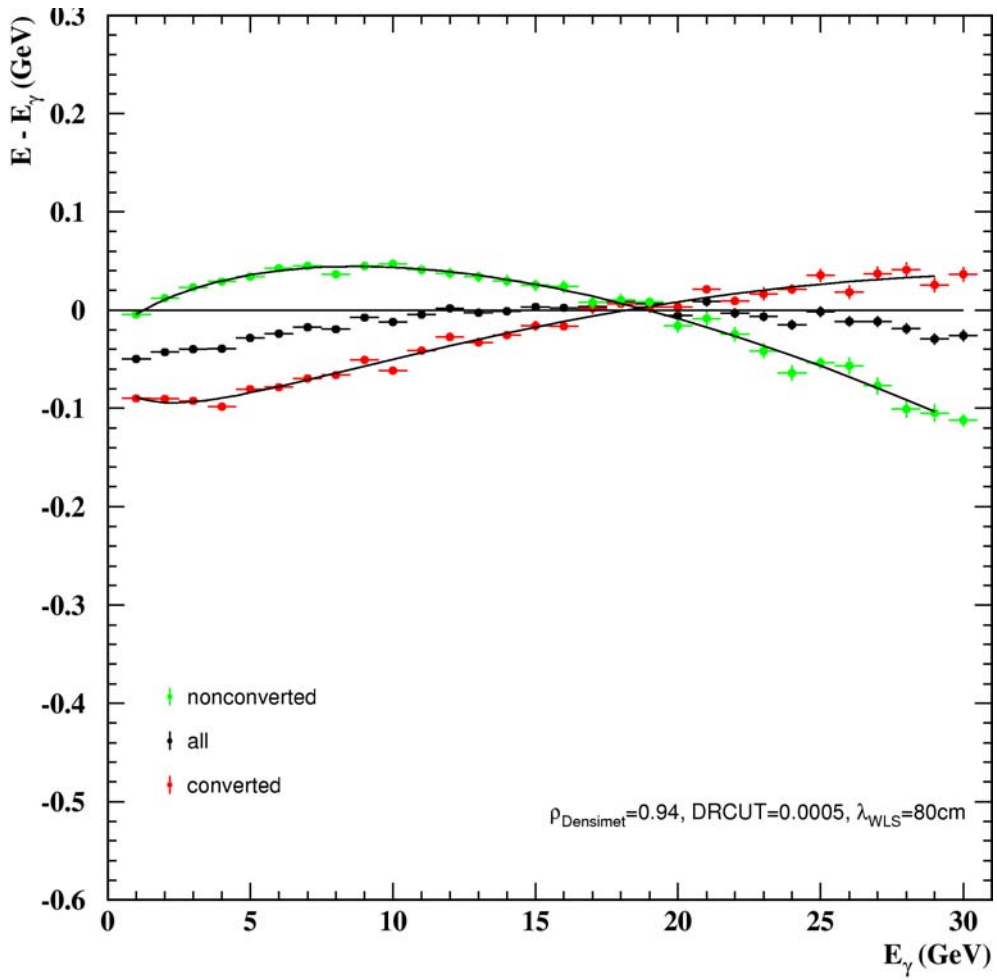
  - → But: it does not help!
    - ➢ Distance of Compton edges shrinks, even can get inverted
    - ➢ Distance of Bremsstrahlung edges shrinks, and could get inverted for very short lengths
    - ➢ Bremsstrahlung edges cannot become higher with this!



Summary - Linearity in Geant MC and in Data

- Bremsstrahlung edges in data appear to be higher than would be expected by perfect linearity
  - → If dominated by leakage they should be lower w.r. to linearity when calibrating on the Compton edges
  - → Odering is ok, approximate distance of edges of different classes too
  - → But all edges are too high
  - → Attenuation in WLS can be excluded, results are consistent with a very large attenuation length
    - ➢ Will stick with length=∞ (no attenuation)
- Linearity f the calorimeter is not understood
  - → How to implement it in MC when only to hook points are known but no effect to describe the ‚inbetween'?
  - → Cannot just add a linear hypothesis: effect would be large, becoming sizeable with respect to the binning in data
  - → Any ideas?