Monte Carlo study of a Micromegas SDHCAL

Optimisation of thresholds by parametrisation of weight

Iro and Max, 13/03/2013

Overview

- TB data affected by (lot of) systematics → Monte Carlo first

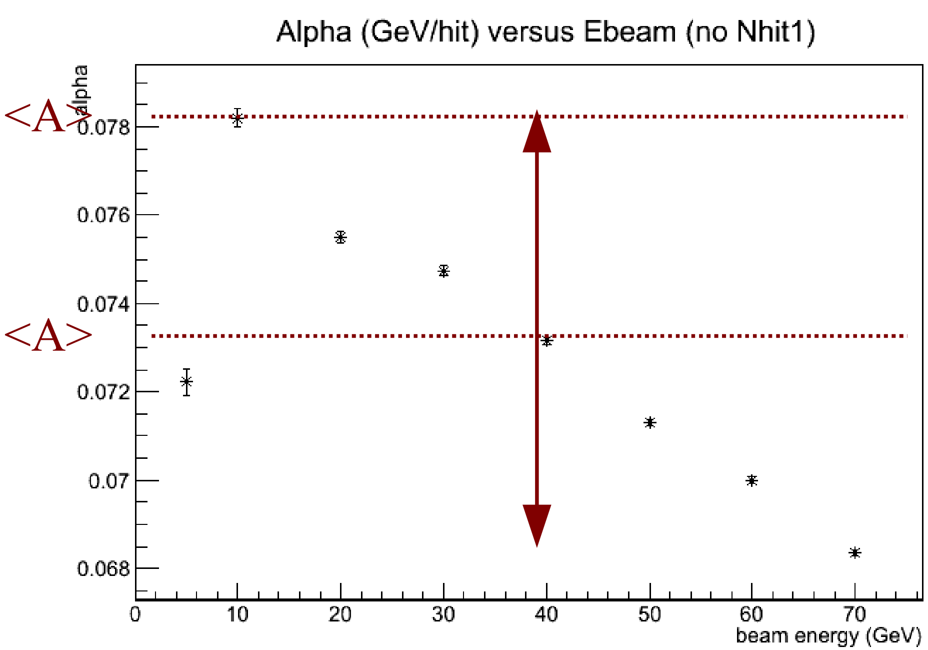
- Energy reconstruction with weights
  - Ereco = A (N0 + B.N1 + C.N2)
    N0, N1, N2 can be defined in an exclusive or inclusive way
  - The trick is that B and C are energy dependent
    → can be parametrised as a function of N0, N1 or N2

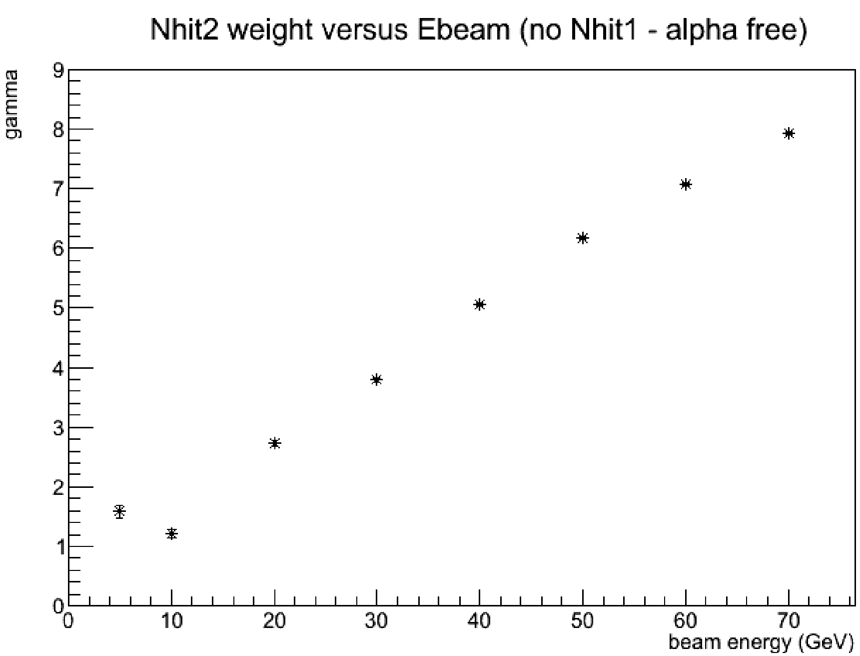
- Motivation of this study
  - Understand the parametrisation
    how many parameters are necessary, why this function...

- Simulated data
  - 10 k pions at 5-70 GeV
  - thr0 ~ 0, thr1 = 5 MIP, = 15 MIP
  - Deep SDHCAL: 100 layers of 100x100 cm2

Method with 2 thresholds (1/2)

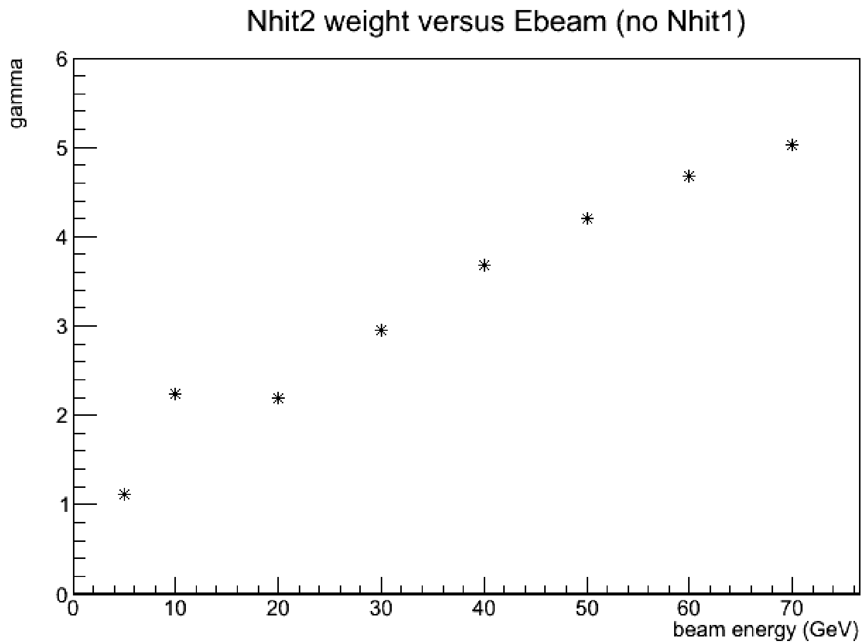
- First start with 2 thresholds: low (~0) and high (15 MIP)
- Energy reconstruction: Ereco = A(E) . (N0 + C(E).N2)
- Determination of A(E) and C(E) by minimisation of X2 = (Ereco – Ebeam)2
- Except at 5 GeV, trends make sense
- "A" should be a constant (GeV/hit) → take mean/max A value & only C is a parameter

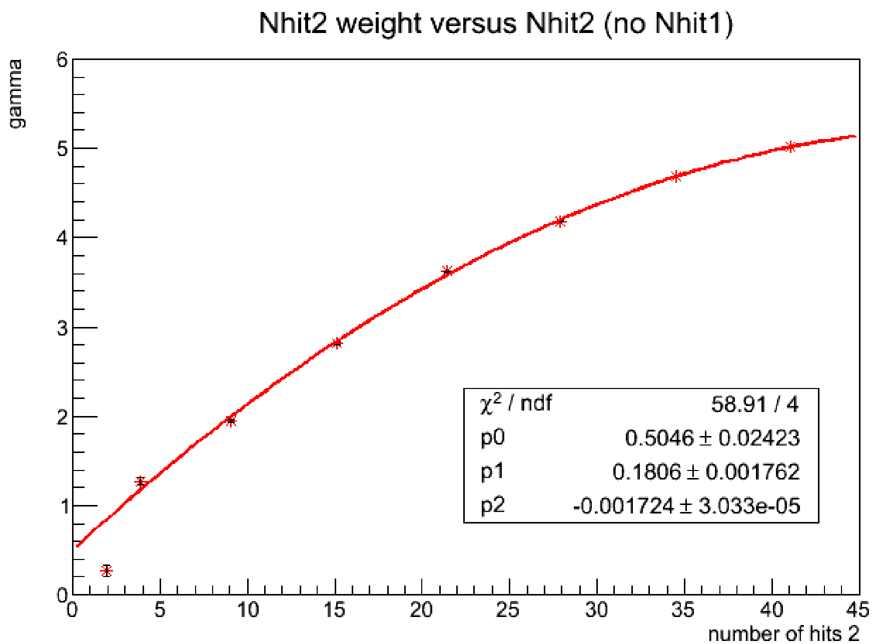




Method with 2 thresholds (2/2)

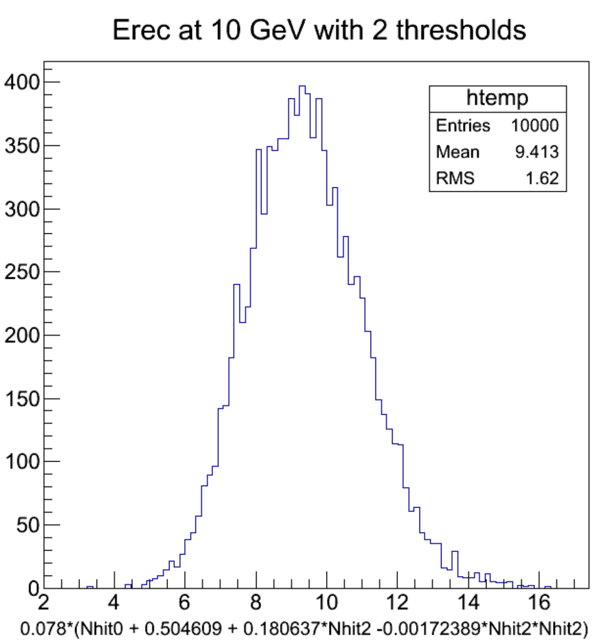
- First start with 2 thresholds: low (~0) and high (15 MIP)
- Energy reconstruction: Ereco = A . (N0 + C(E).N2) with A = 0.078 GeV/hit
- No fit, simply: B = (Ebeam – A.N0) / A.N2
- Seems to be a problem at 10 GeV
  - C(5 GeV) ~ C(10 GeV)
  - Less obvious for C(N2) trend, which is the one used "at ILC"
- Fit pol2 to C(N2), excluding the 5 GeV point...

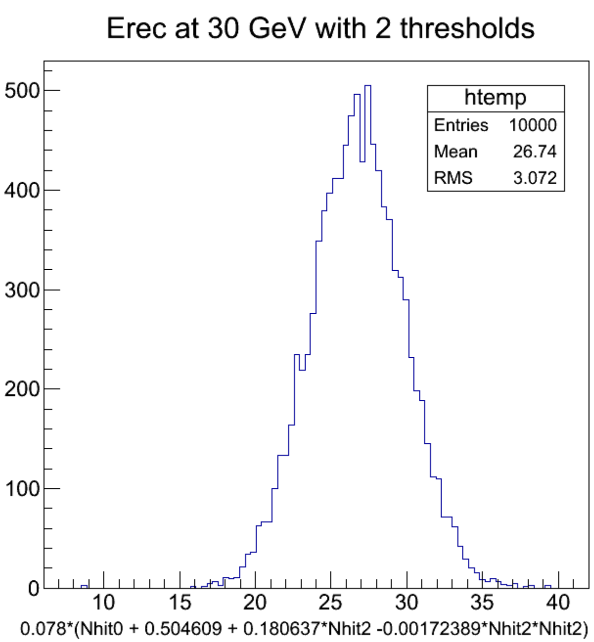


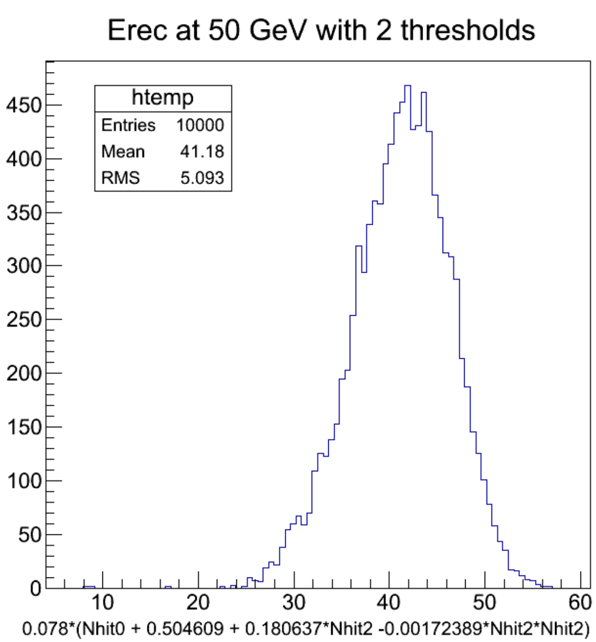


Method with 2 thresholds (2/2)

- Re-loop over data (or best take different data set) and use A, B(N), C(N) to reconstruct the energy without knowing the beam energy
  - Erec = A . (N0 + C(N).N2)
- Calculate <E> and R (resolution) from mean and sigma of Erec distributions







Energy under-estimated → 2 thresholds do not seem to work (to be re-checked)

Method with 3 thresholds (1/5)

- Find A and parametrisations of B(N) and C(N) using knowledge of beam energy
  - Take “A” equal to the response at 0 GeV from the Ntot(E) trend
  - Minimisation of X2 = (Erec-Ebeam)2

    PS: this could be done in a testbeam

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  - Erec = A . (N0 + B(N).N1 + C(N).N2)

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- Find A and parametrisations of B(N) and C(N) using knowledge of beam energy
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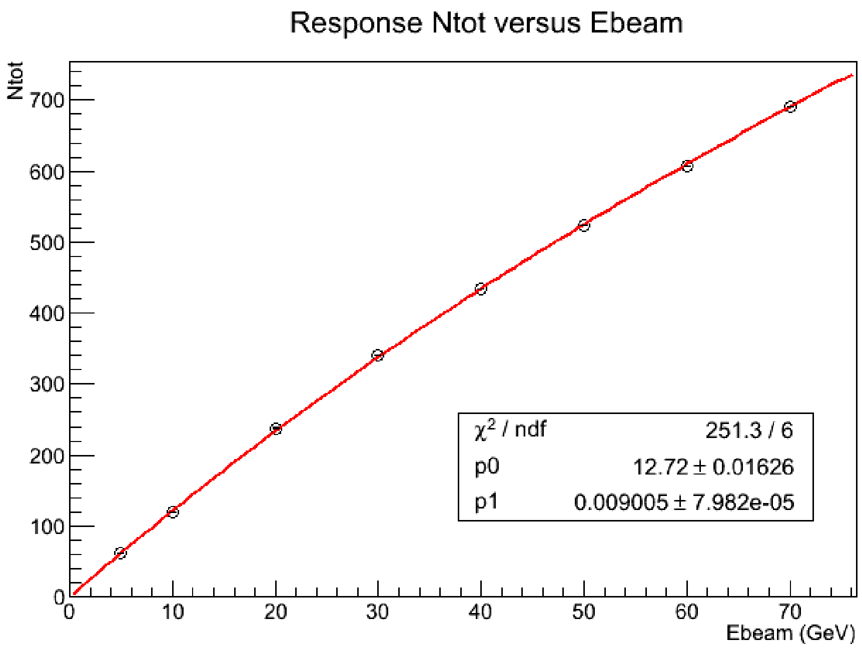


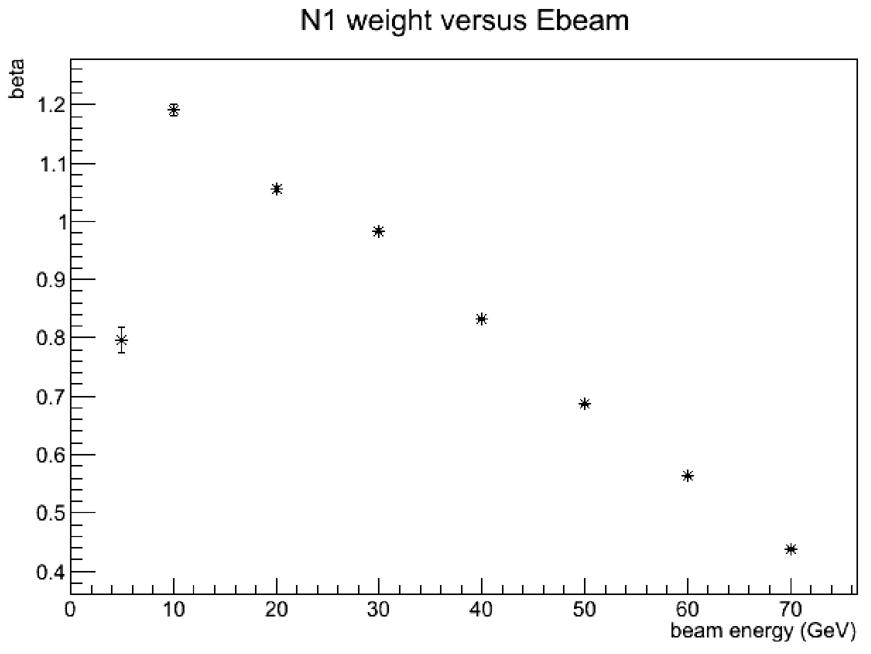
1/A = 12.472 hit/GeV

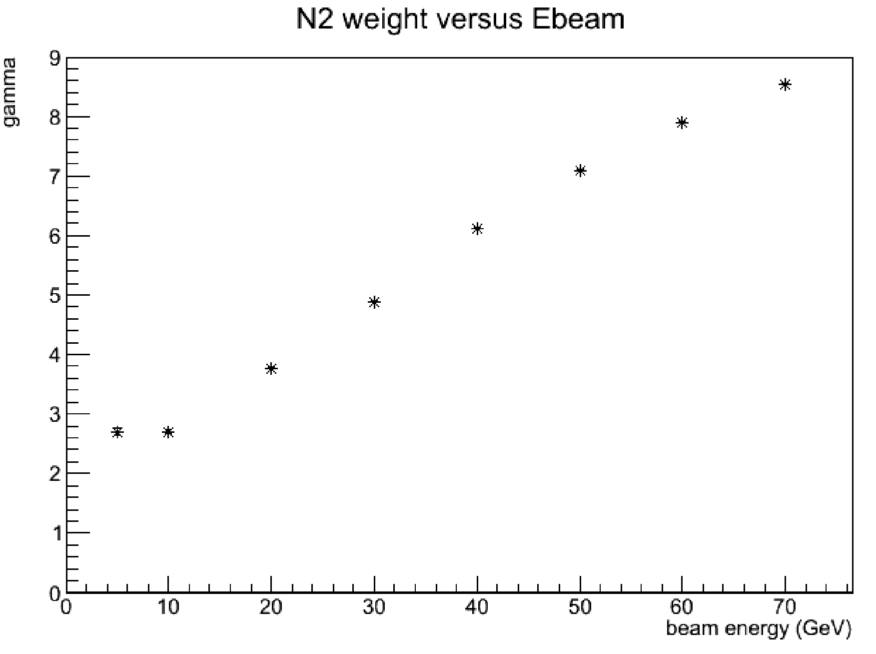
A = 0.0786 GeV/hit

Method with 3 thresholds (3/5)

- Find A and parametrisations of B(N) and C(N) using knowledge of beam energy
  - Take “A” equal to the response at 0 GeV from the Ntot(E) trend
  - Minimisation of X2 = (Erec-Ebeam)2
    PS: this could be done in a testbeam

Problem with 5 GeV points in E-trends



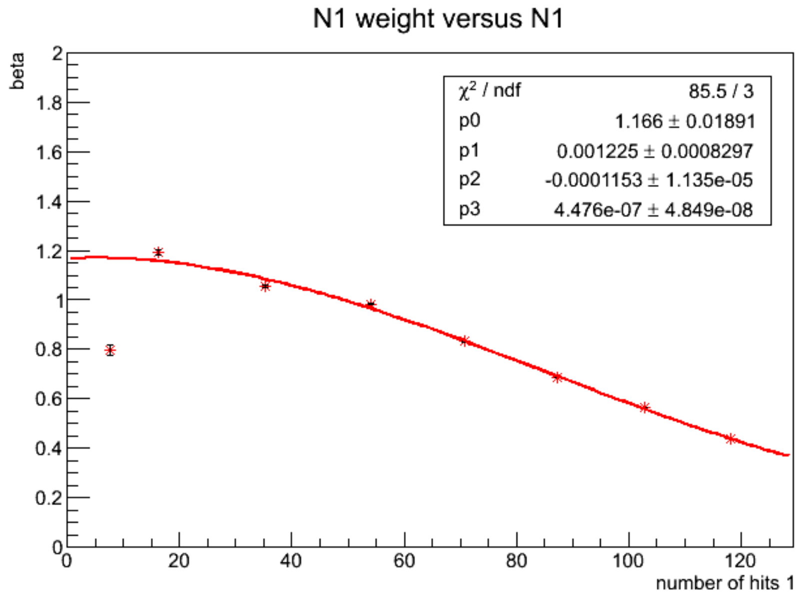


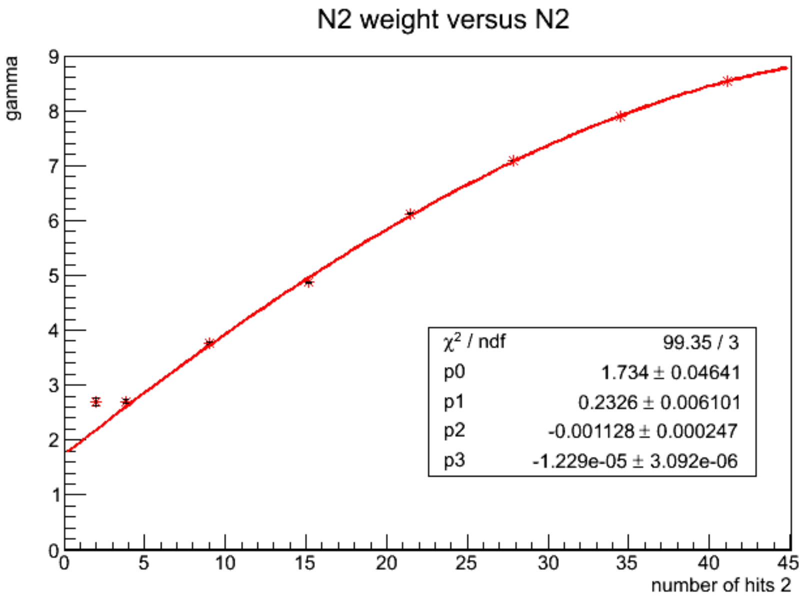
Method with 3 thresholds (4/5)

- Find A and parametrisations of B(N) and C(N) using knowledge of beam energy
  - Take “A” equal to the response at 0 GeV from the Ntot(E) trend
  - Minimisation of X2 = (Erec-Ebeam)2

    PS: this could be done in a testbeam

Problem with 5 GeV points in Nhit-trends, exclude from pol3 fit

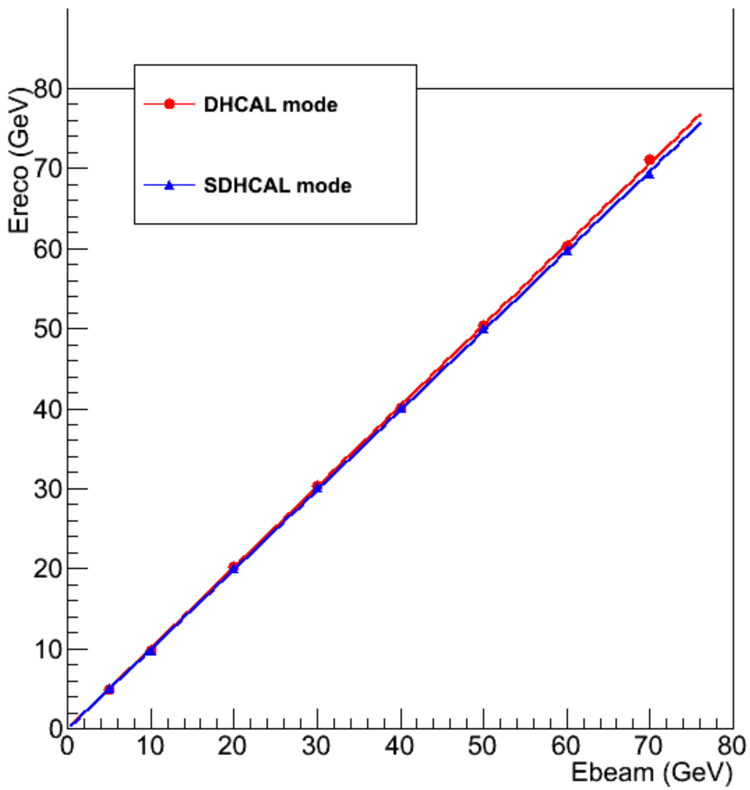


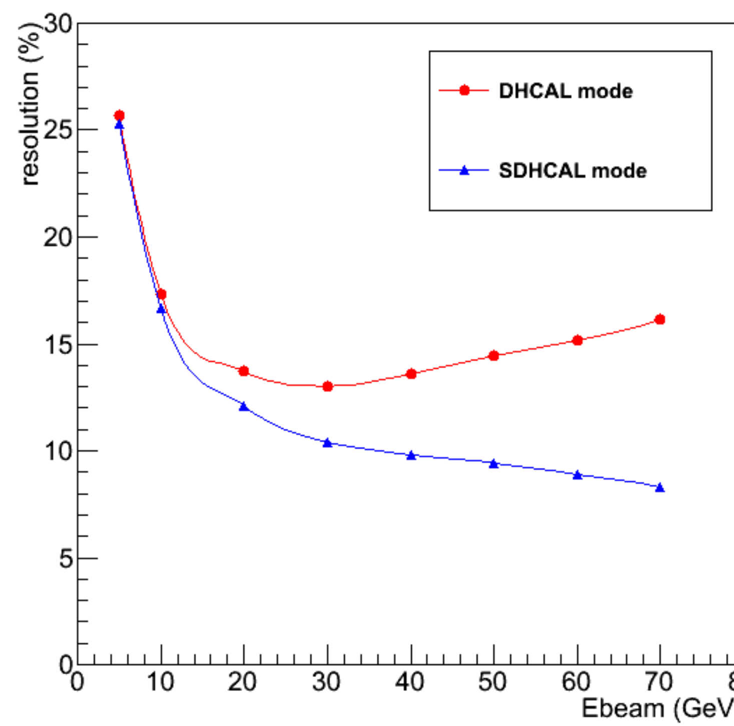


Method with 3 thresholds (5/5)

- Re-loop over data (or best take different data set) and use A, B(N), C(N) to reconstruct the energy without knowing the beam energy
  - Erec = A . (N0 + B(N).N1 + C(N).N2)

- Calculate <E> and R (resolution) from mean and sigma of Erec distributions





Status

- Results are preliminary
- Why is the 5 GeV point off?
- Compensation method with 2 thresholds
  - Seem not to work, but I think there is a bug
  - Find the bug and get performance (today)
- Compensation method with 3 thresholds look powerful
  - Should be applied to a new set of data 5-50 GeV
  - First look at new data → Nhit distributions are similar...
  - Get performance with new set of data (today)

- For CALICE
  - Show performance with 2 and 3 thresholds (local fit energy per energy)
  - Compare with the results from the Lyon paper (global fit over all energies)