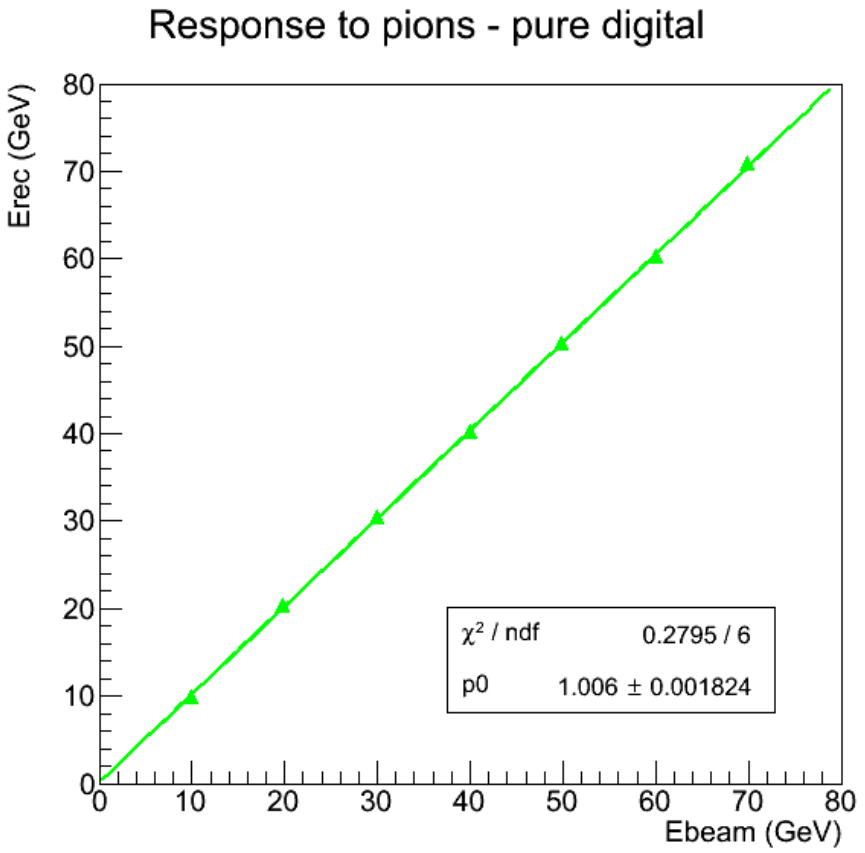
Monte Carlo study of a Micromegas SDHCAL

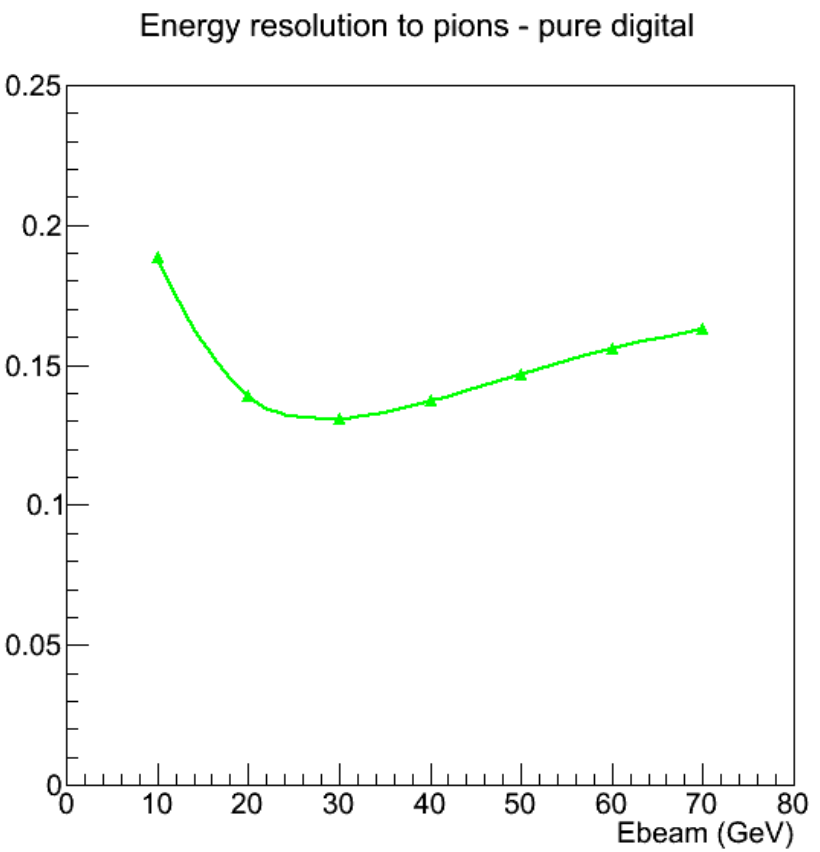
Optimisation of thresholds by a likelihood method

Iro and Max, 13/03/2013

Performance for pure digital

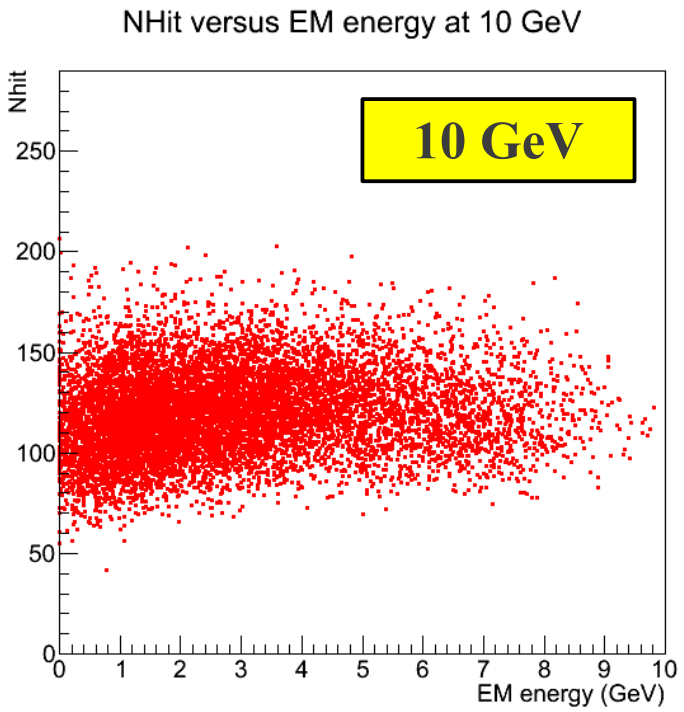
Linearity almost perfect (no surprise, we used the inverse of the response)
However, corrections degrade the energy resolution above at 30 GeV

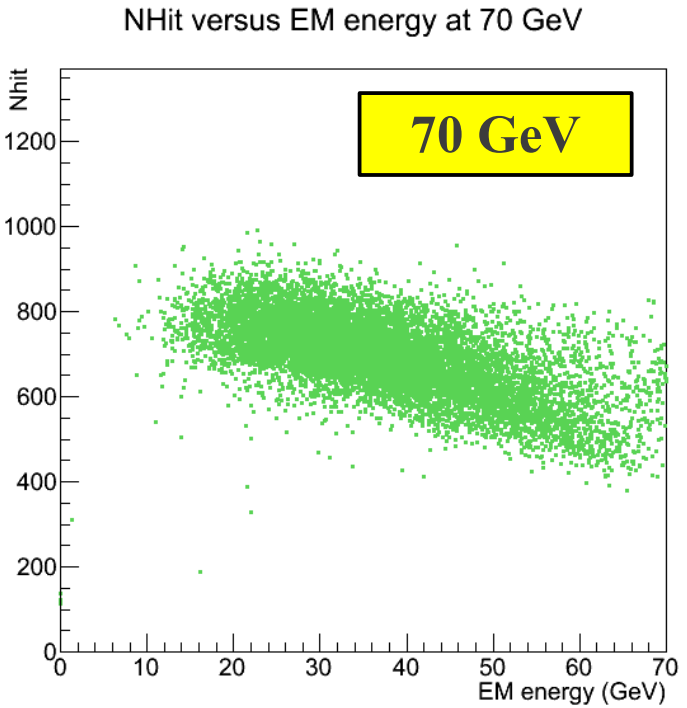




Degradation of the resolution

The EM fraction of hadron showers increases with energy.
With a digital readout → saturation of Nhit → worse resolution.





Energy reconstruction - semi-digital

Maximum likelihood method

Calculate at each energy, the probability to observe (N0,N1,N2)
The best estimate of the energy is then the one for which the probability is maximum

Hypothesis

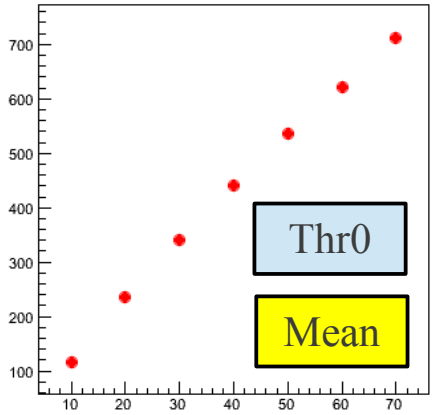
N0, N1, N2 are not correlated
(verified in 2D plots and with correlation coef. centred at 0)

→ p(N0,N1,N2) = p(N0) * p(N1) * p(N2)

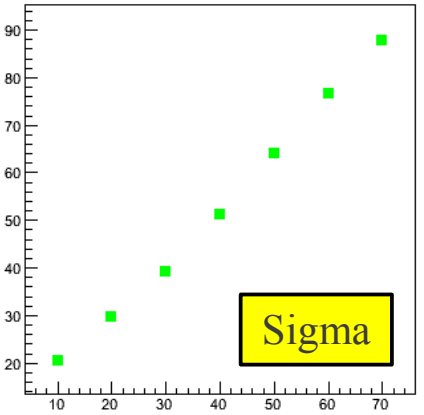
Calculation of probability

Parametrise the energy dependence of Novosibirsk fit parameters (mu,sig,tail,norm)
Normalised distributions → p(Ni,E) at any energy in the parametrisation range

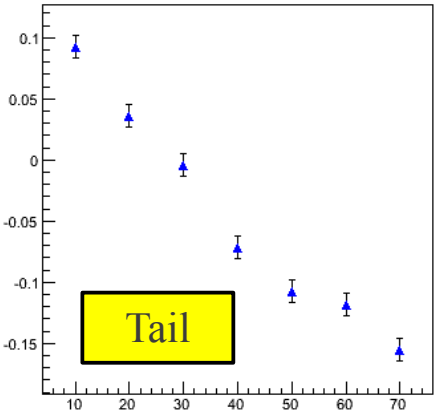
Novo mean - thr0



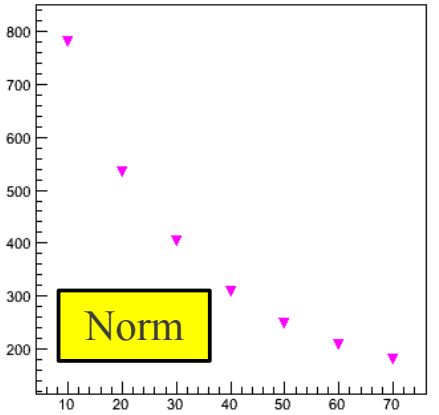
Novo sigma - thr0



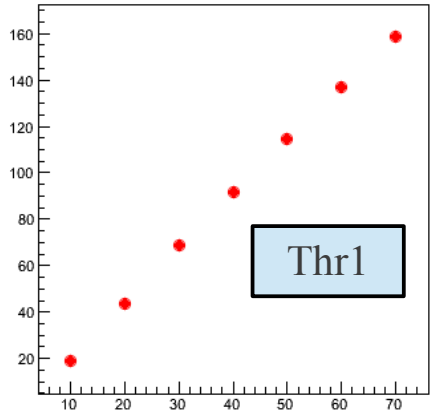
Novo tail - thr0



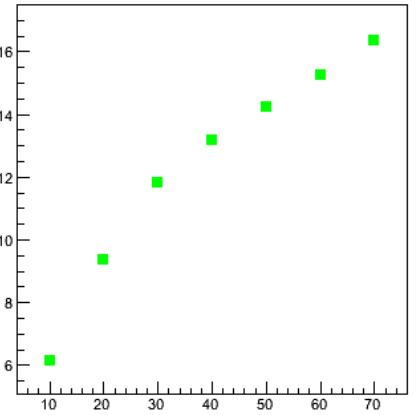
Novo norm - thr0



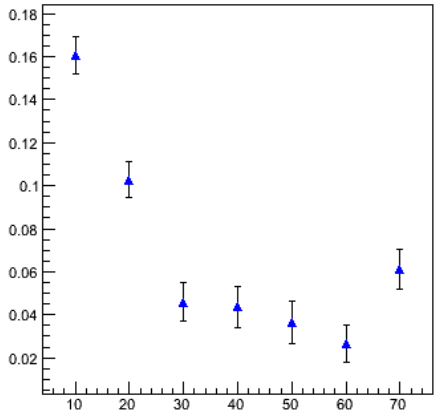
Novo mean - thr1



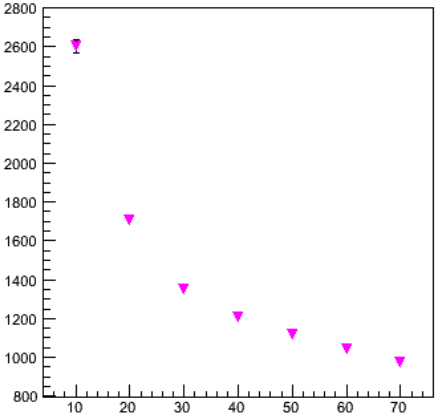
Novo sigma - thr1



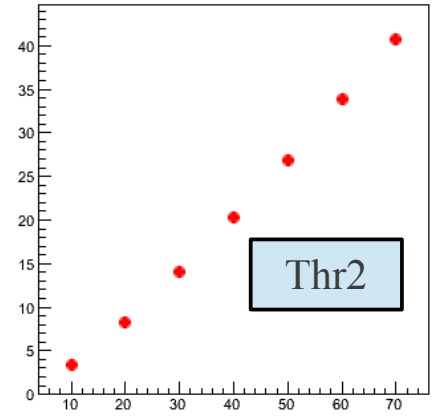
Novo tail - thr1



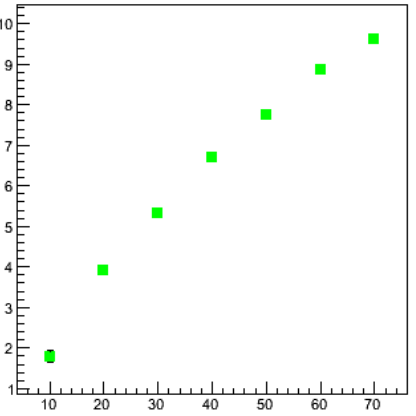
Novo norm - thr1



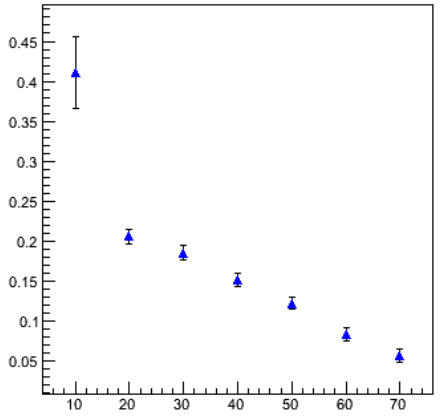
Novo mean - thr2



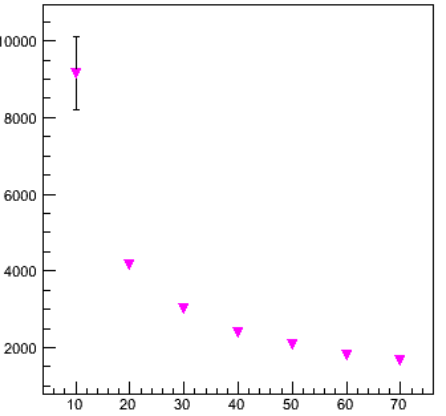
Novo sigma - thr2



Novo tail - thr2



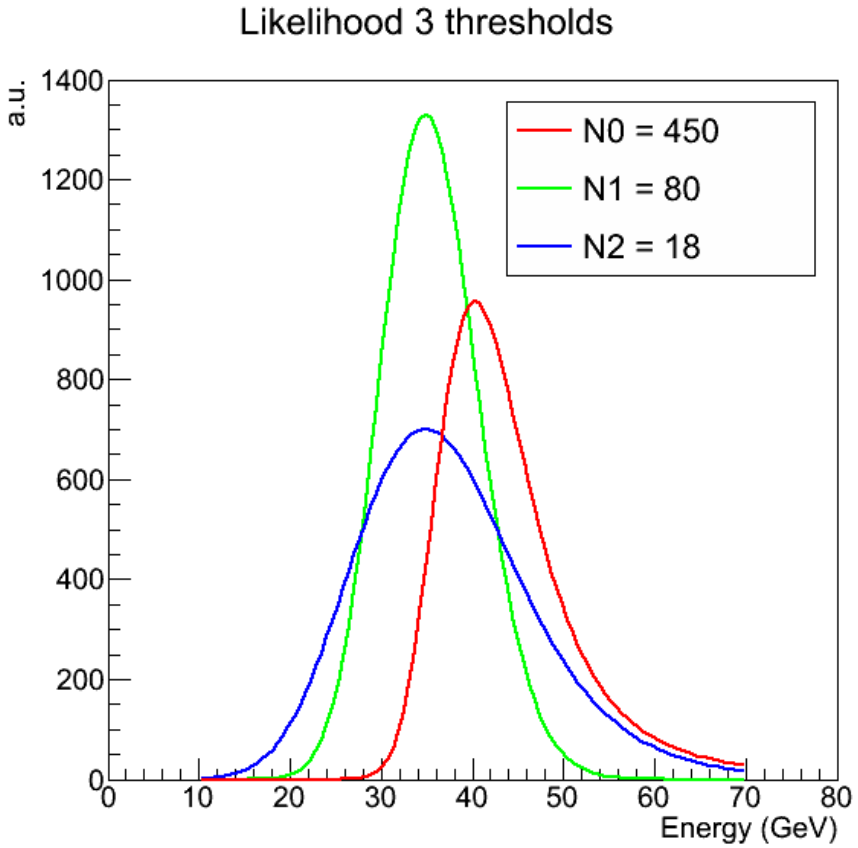
Novo norm - thr2



Energy parametrisation - thr0

Calculation of probability

Parametrise the energy dependence of Novosibirsk fit parameters (mu,sig,tail,norm)
Normalised distributions → p(Ni,E) at any energy in the parametrisation range



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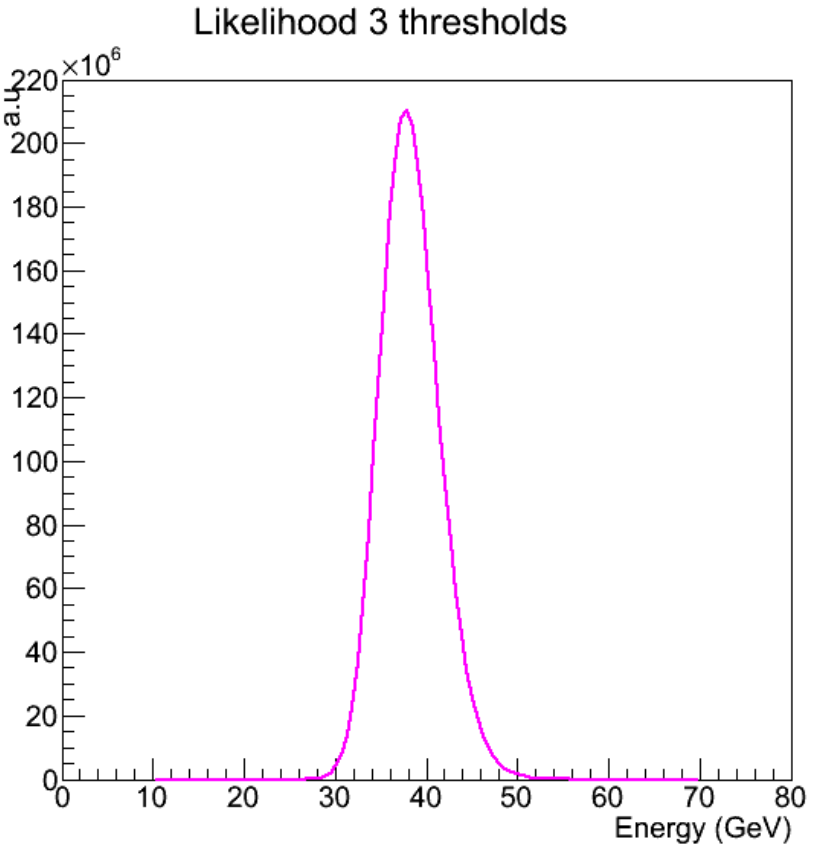
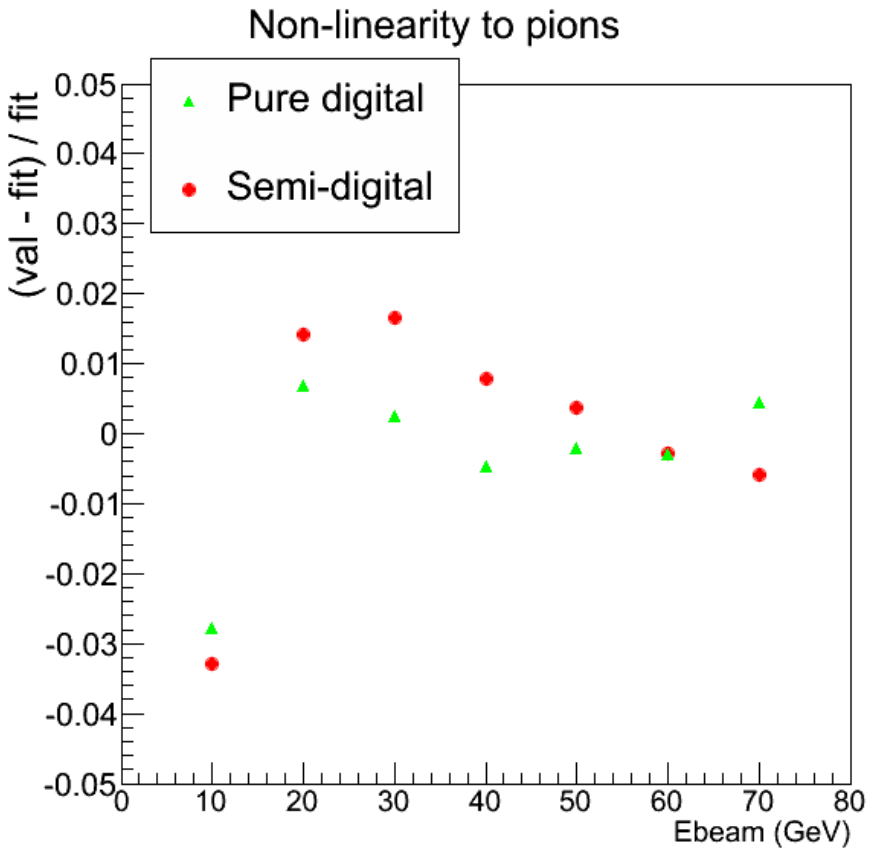
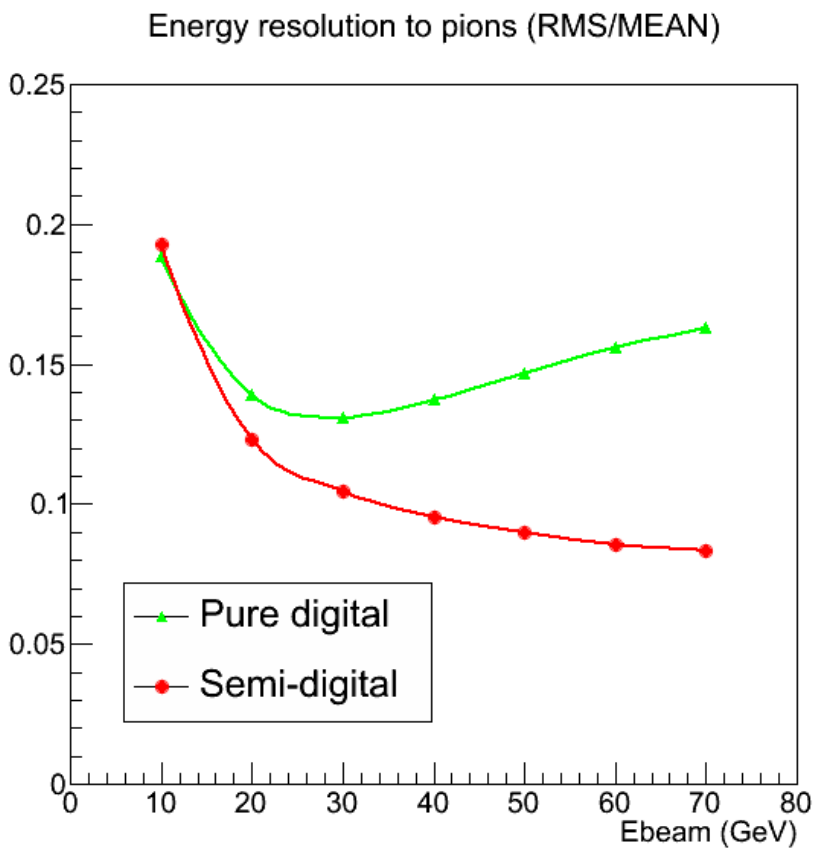


Comparison pure/semi digital

Semi-digital non linearity below 4% at 10 GeV, below 2% in 20-70 GeV
Energy resolution: improvement already at 20 GeV





Status

- Results are preliminary

- Compensation method with likelihood look powerful
  - Additional information can be added
  - But: how to deal with correlations?
  - Get performance with new set of data (today)

- For CALICE
  - Show performance with 1 and 3 thresholds, if it works on new data
  - Just mention it if not