TB data analysis with SDHCAL

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CALICE Collaboration meeting
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Status

- Addendum to the CAN-037 note on the first results of the SDHCAL technological prototype: resolution improved by 15% (for E<30 GeV)
- New steps
  - ✔ HT hits added
  - ✔ Ordering in time, reducing noise
  - ✔ Using the time information: spill calibration
  - ✔ September & November data are reanalyzed

CAN-037 addendum summary

Pion Selection :

$$N_{hit} / N_{layer} > 2.2$$

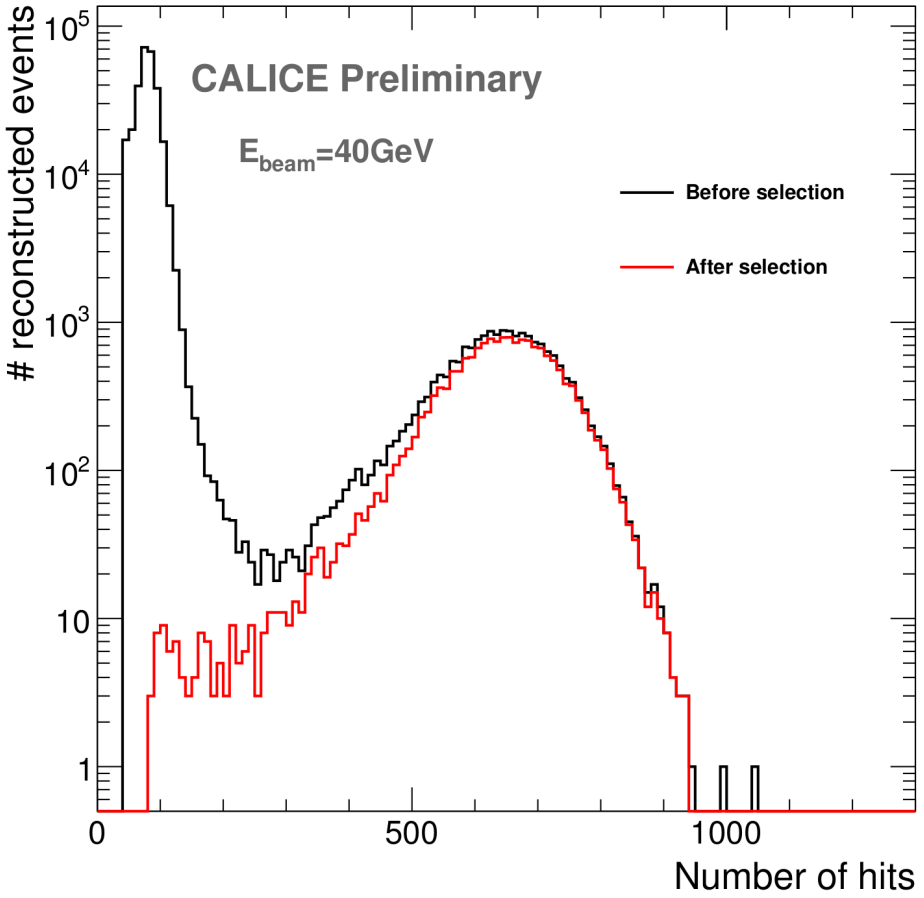
$$N_{hit} \in First\,5\,layers \geq 4$$

$$\frac{N_{layer} \setminus RMS > 5\text{cm}}{N_{layer}}$$

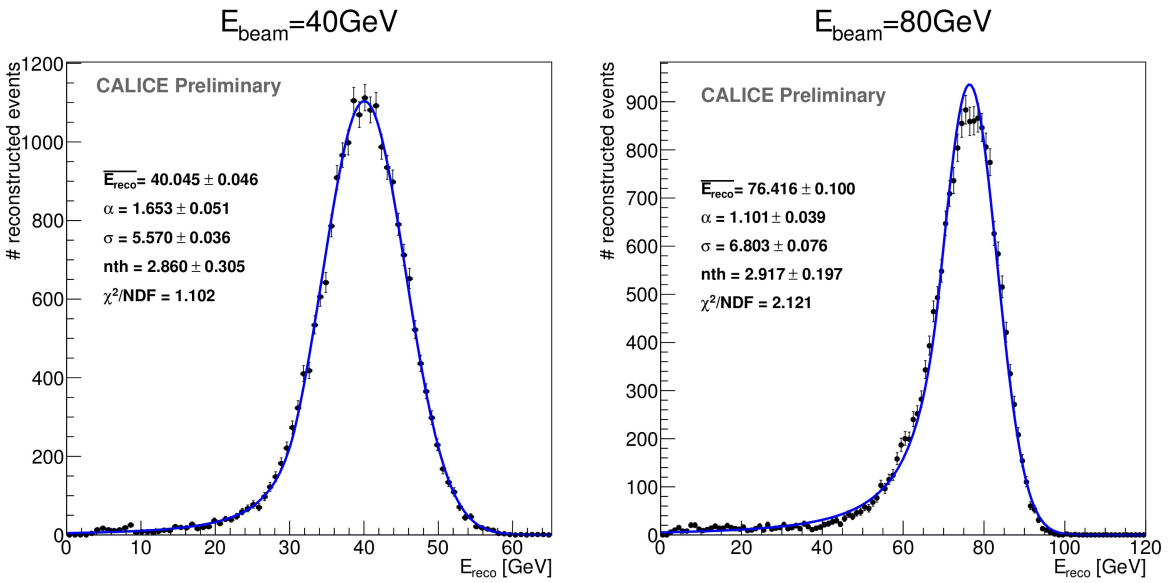
$$Z_{begin} \geq 5 \vee N_{layer} \geq 30$$

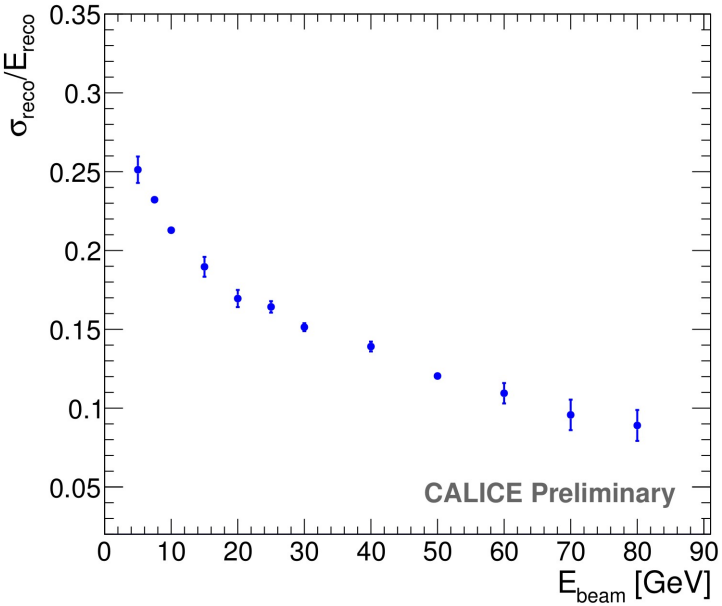
Energy reconstruction :

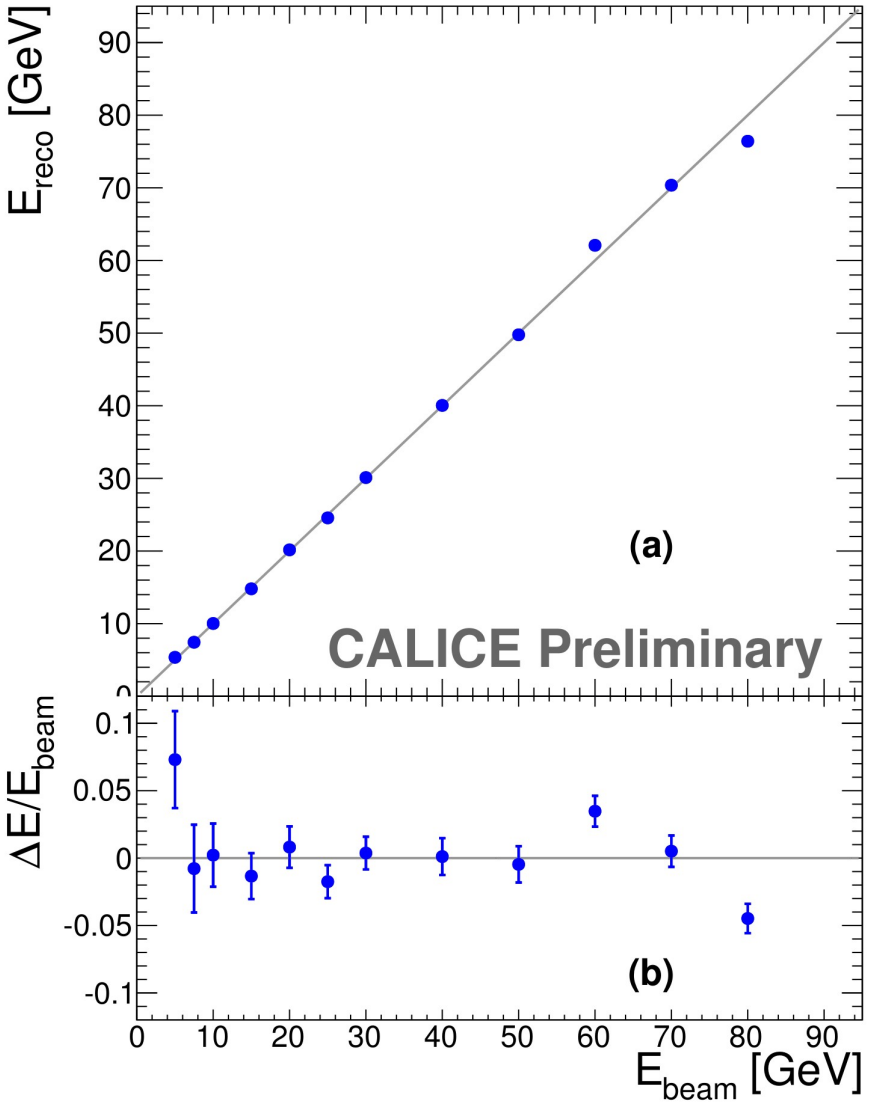
$$E_{reco} = \alpha(N_{hit})\,N_1 + \beta(N_{hit})\,N_2 + \gamma(N_{hit})\,N_3$$



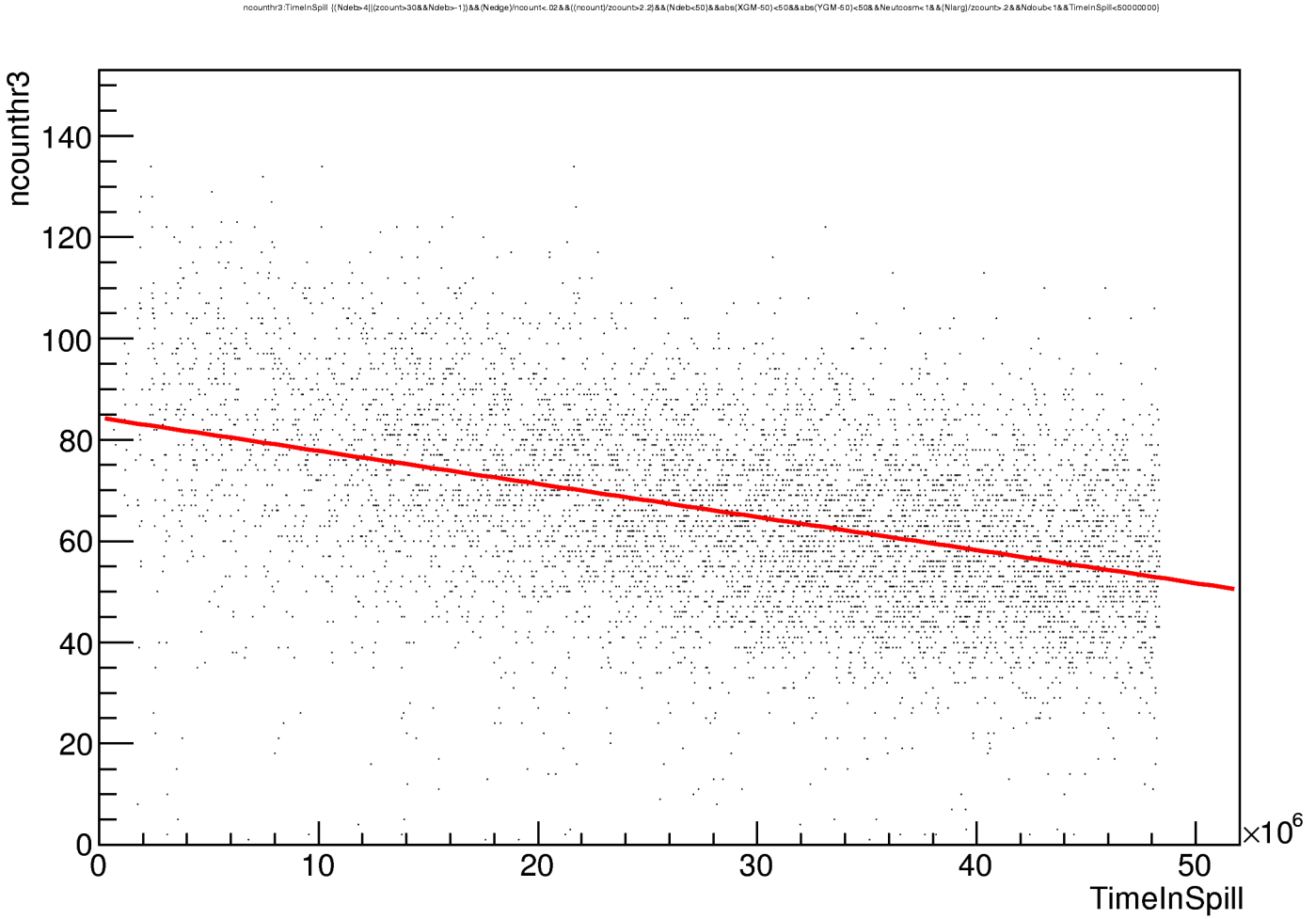
CAN-037 addendum summary





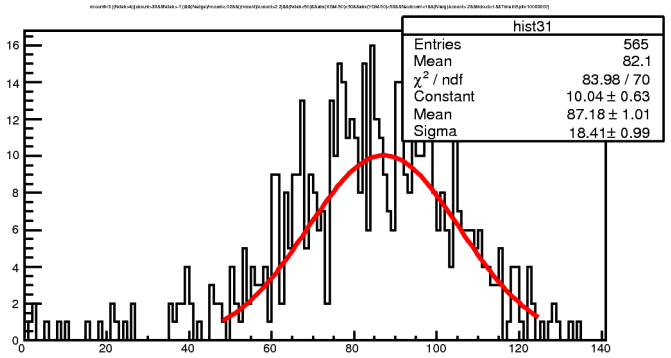


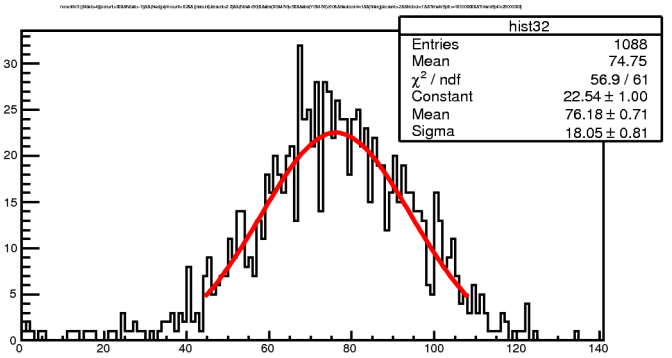
Spill in time

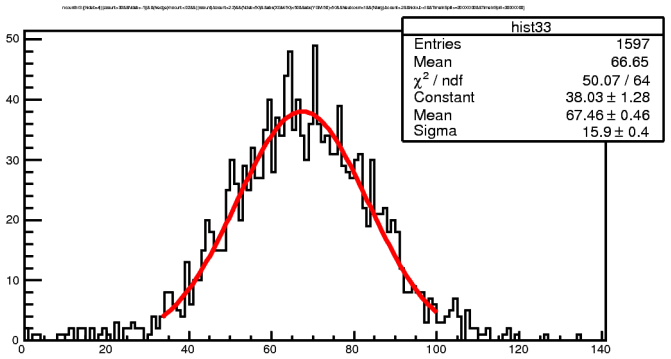


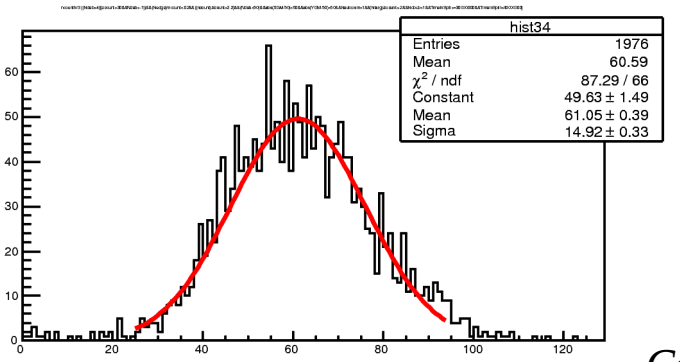
- No calibration applied
- Number of hits reduced with time: brings resolution worse

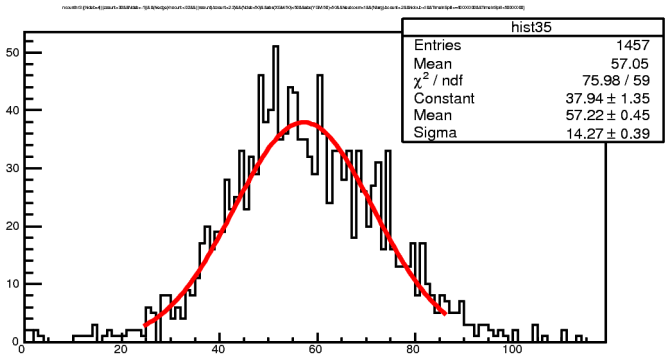
Spill calibration









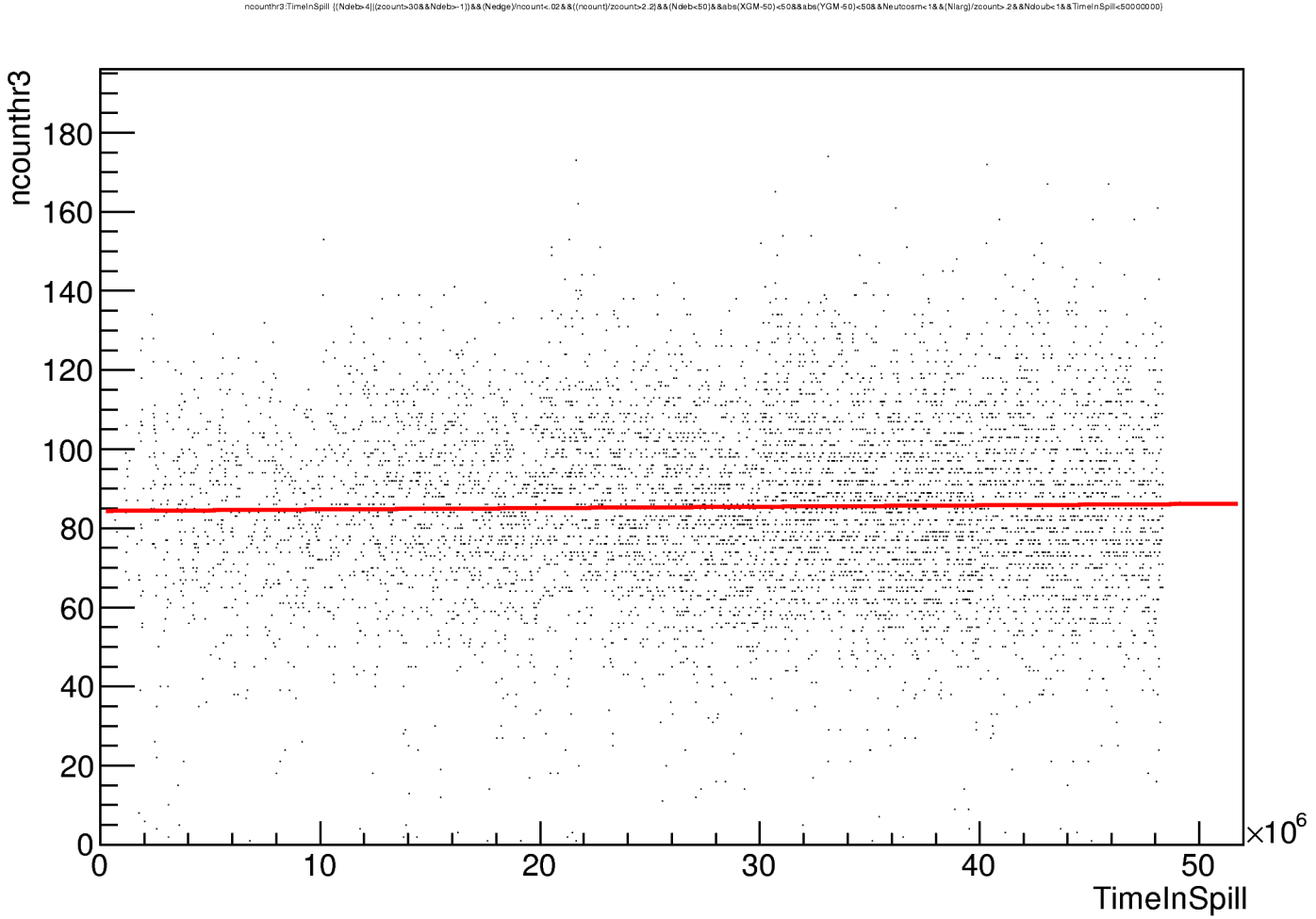


$$Coeff_i = \frac{Mean_I}{Mean_i}$$

Procedure:

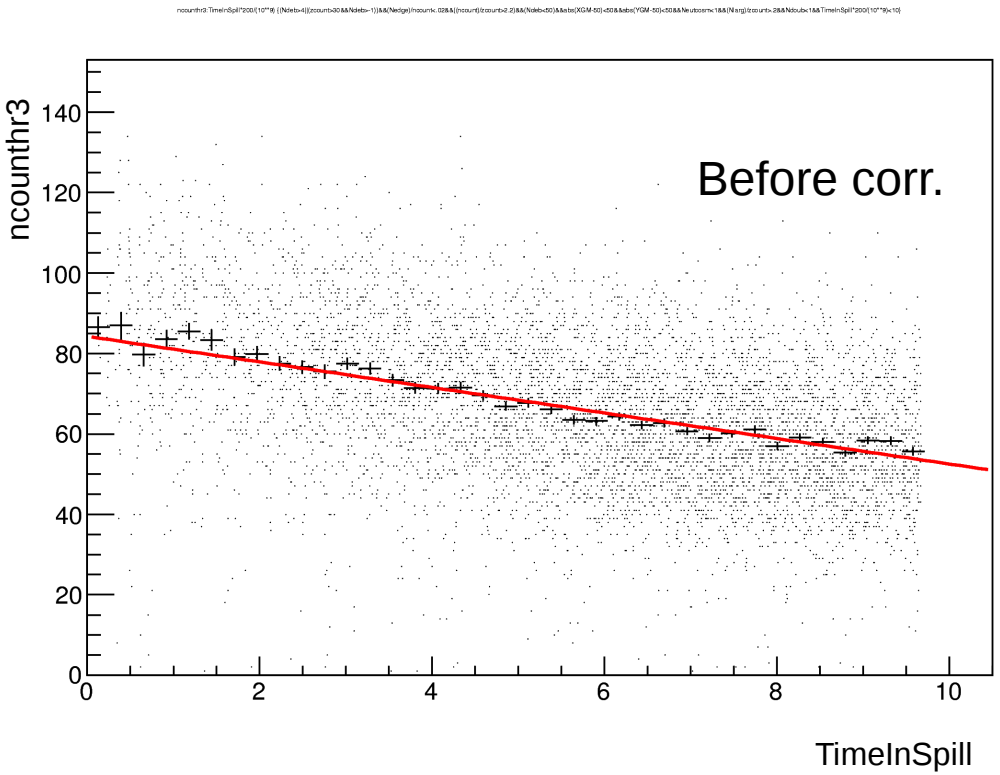
- Define 5 time slots in spill for every run
- Fit each $Nhit_i$ and derive parameters for 3 thr. (mean of first distr. is a reference)
- Apply calibration const to analysis job for each thr. j: $Ncorr_j = \sum_{i=I}^{V} Nhit_i \cdot Coeff_i$

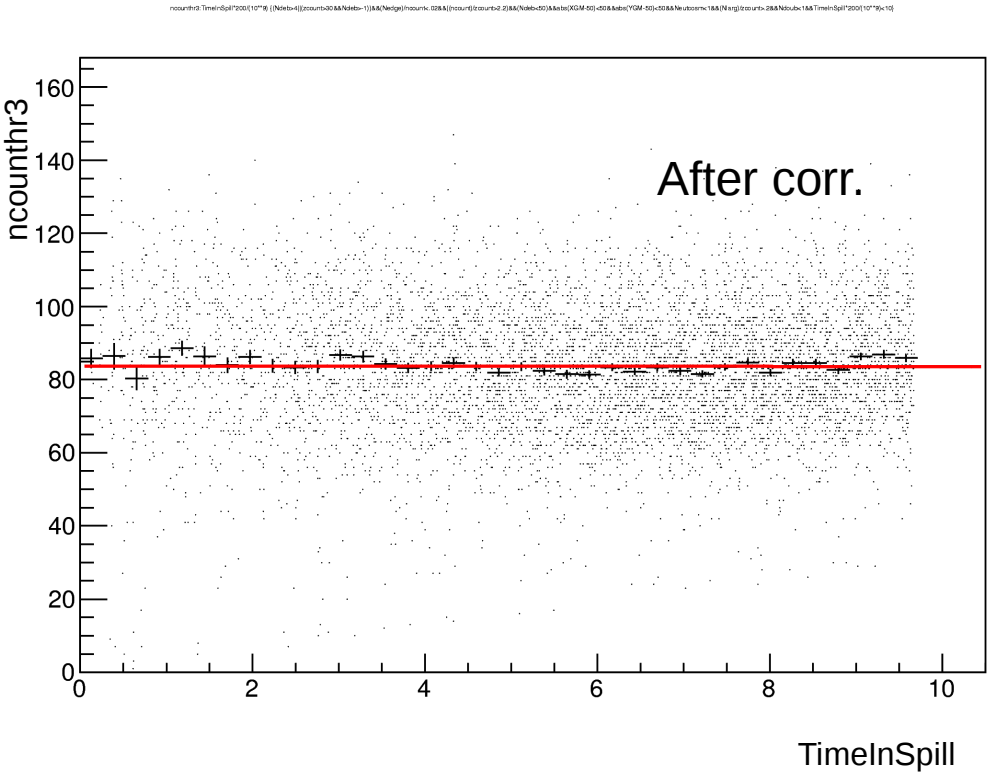
Spill calibration



Spill calibration applied

Alternative method

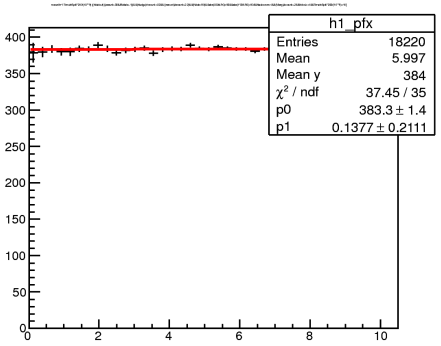


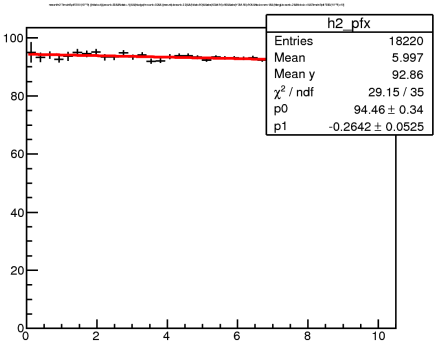


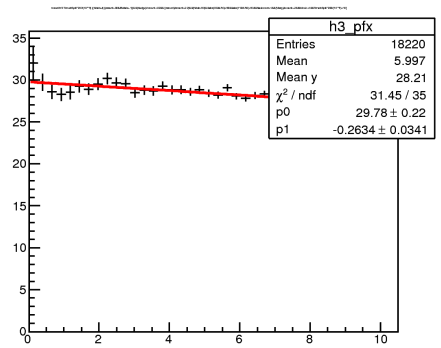
- Fit by straight line the time evolution in spill, extract 'slope'
- Correct Nhit for each threshold, each run: $Ncorr = \sum_{i=I}^{III} Nhit_i - slope_i \cdot TimeInSpill$

Two 30 GeV Sept. runs

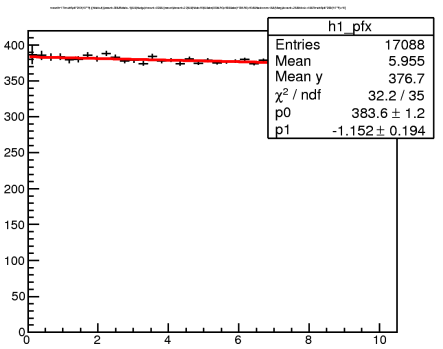
Run 715671 (40M)

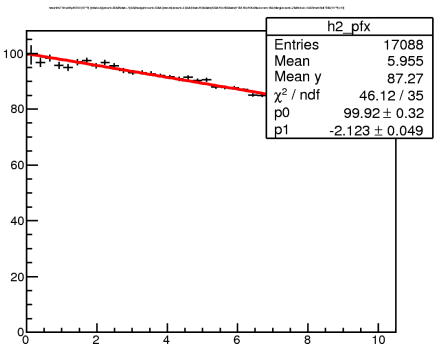


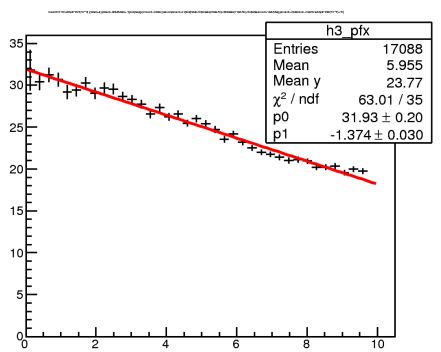




Run 715747 (16M)

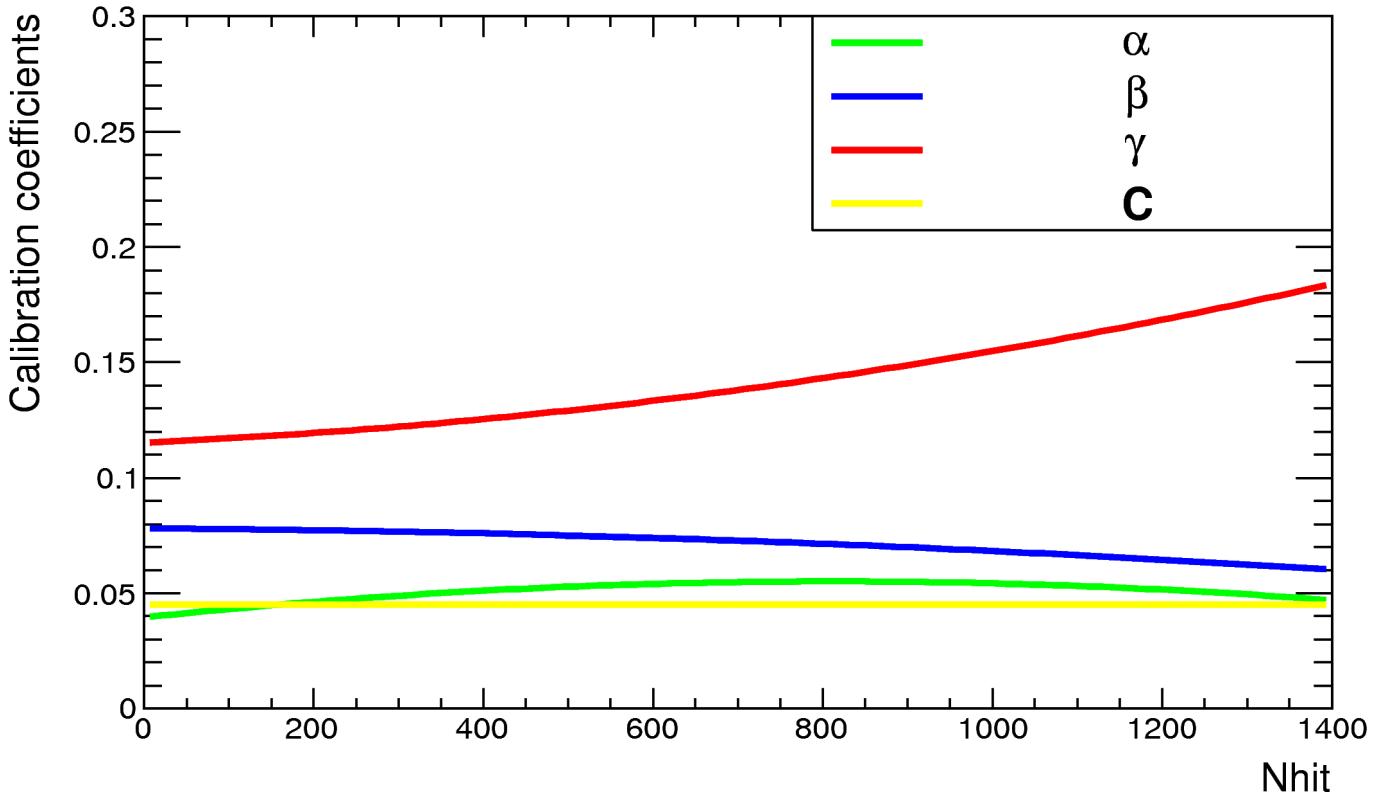






- Very different beam conditions, intensity
- Can be corrected with spill calibration

Coefficients

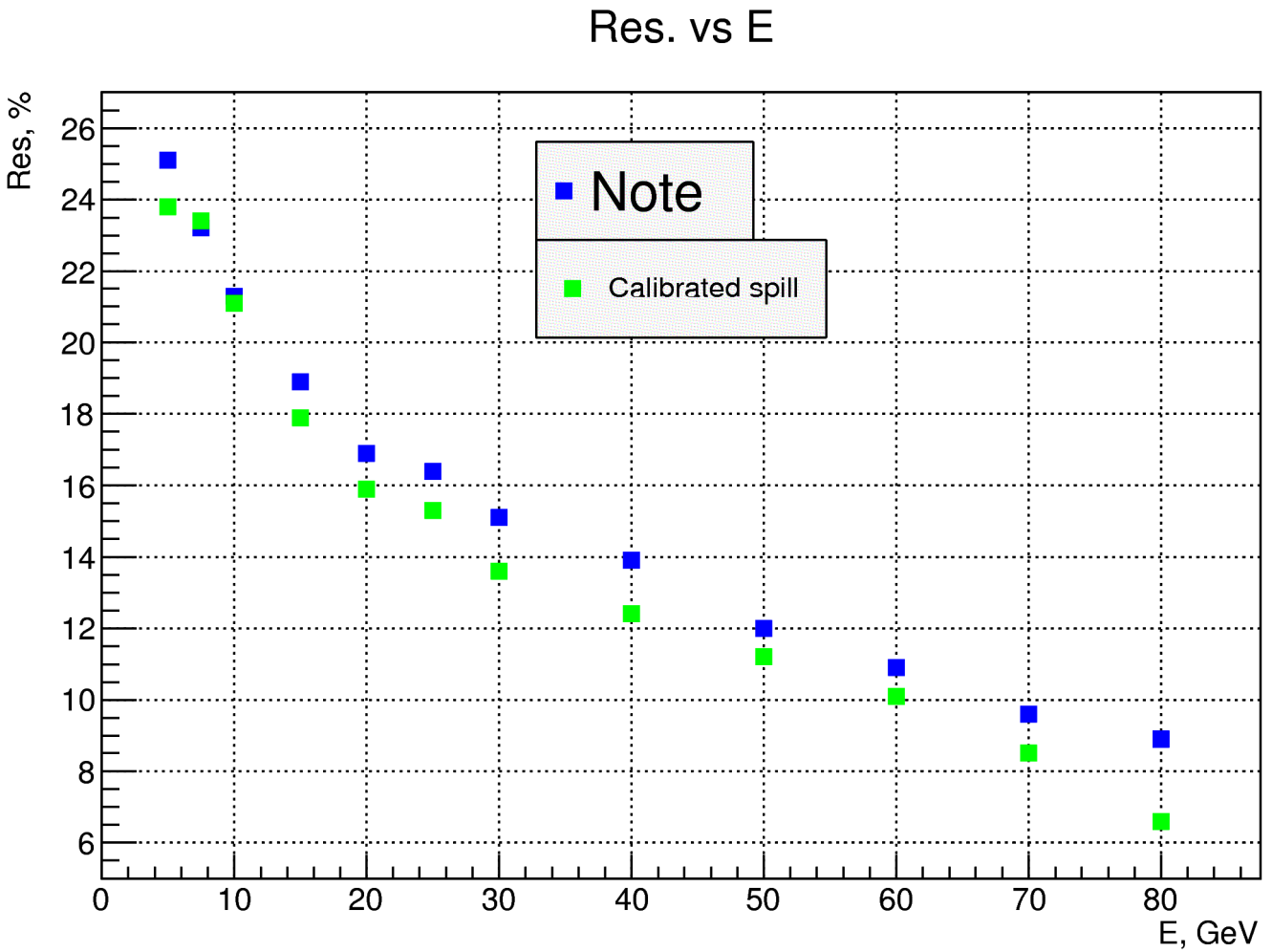


$$E_{rec} = \alpha(N_{tot})(N_1 - N_{HT1}) + \beta(N_{tot})(N_2 - N_{HT2}) + \gamma(N_{tot})(N_3 - N_{HT3}) + CN_{HT}$$

Sept. & Nov. TB data

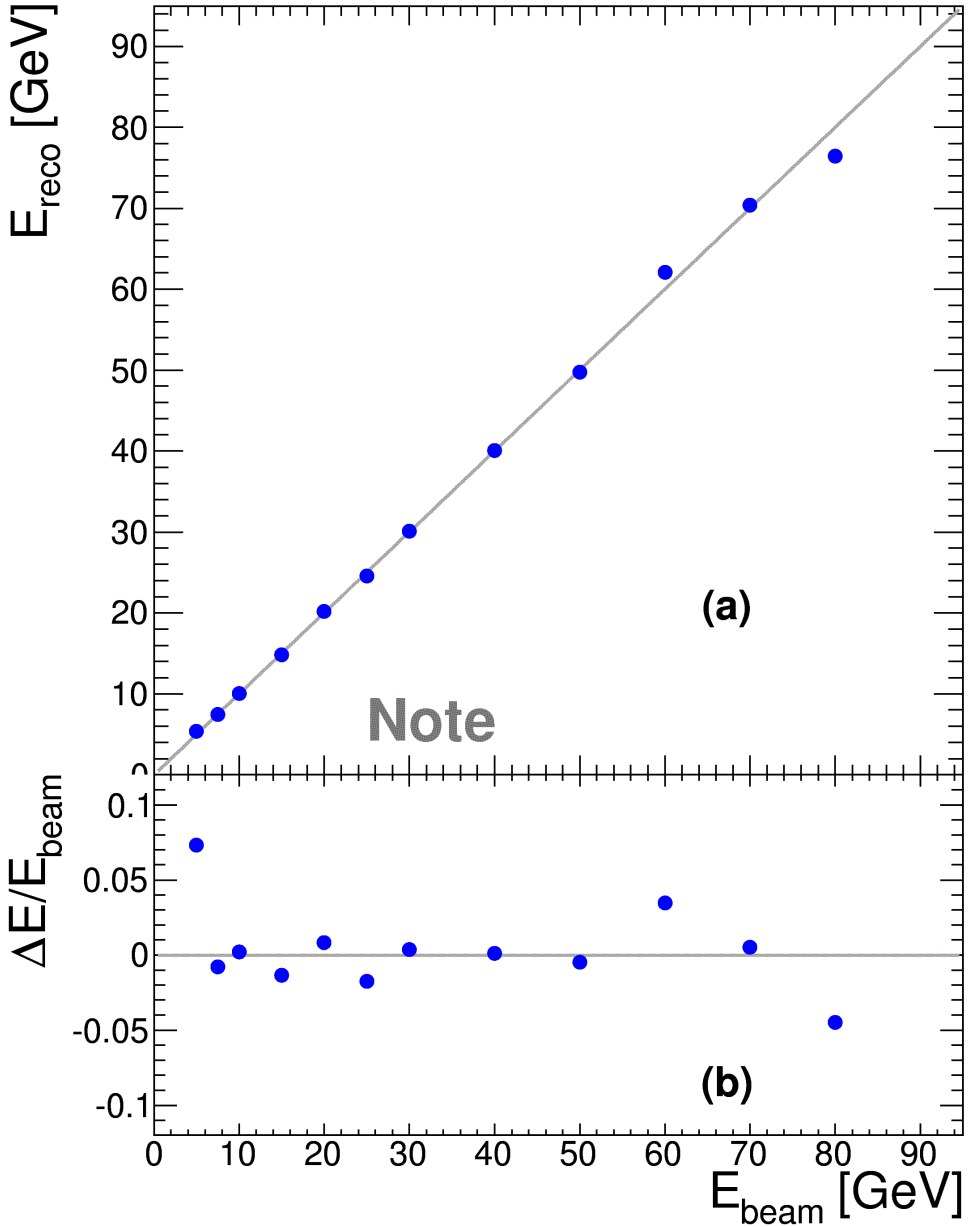
Note Sept.		Calibrated Sept.		Calibrated Nov.	
E, GeV	Res, %	E, GeV	Res, %	E, GeV	Res, %
5.4	25.1	5.3	23.8		
7.4	23.2	7.4	23.4		
10.0	21.3	9.9	21.1	10.0	20.6
14.8	18.9	14.8	17.9		
20.2	16.9	20.7	15.9	19.8	14.9
24.6	16.4	25.1	15.3		
30.1	15.1	31.0	13.6	30.1	13.5
40.1	13.9	40.9	12.4	40.6	12.2
49.8	12.0	48.7	11.2	51.6	11.1
62.1	10.9	60.1	10.1	60.5	10.5
70.4	9.6	69.7	8.5	67.4	9.8
76.4	8.9	77.5	6.6	76.7	7.6

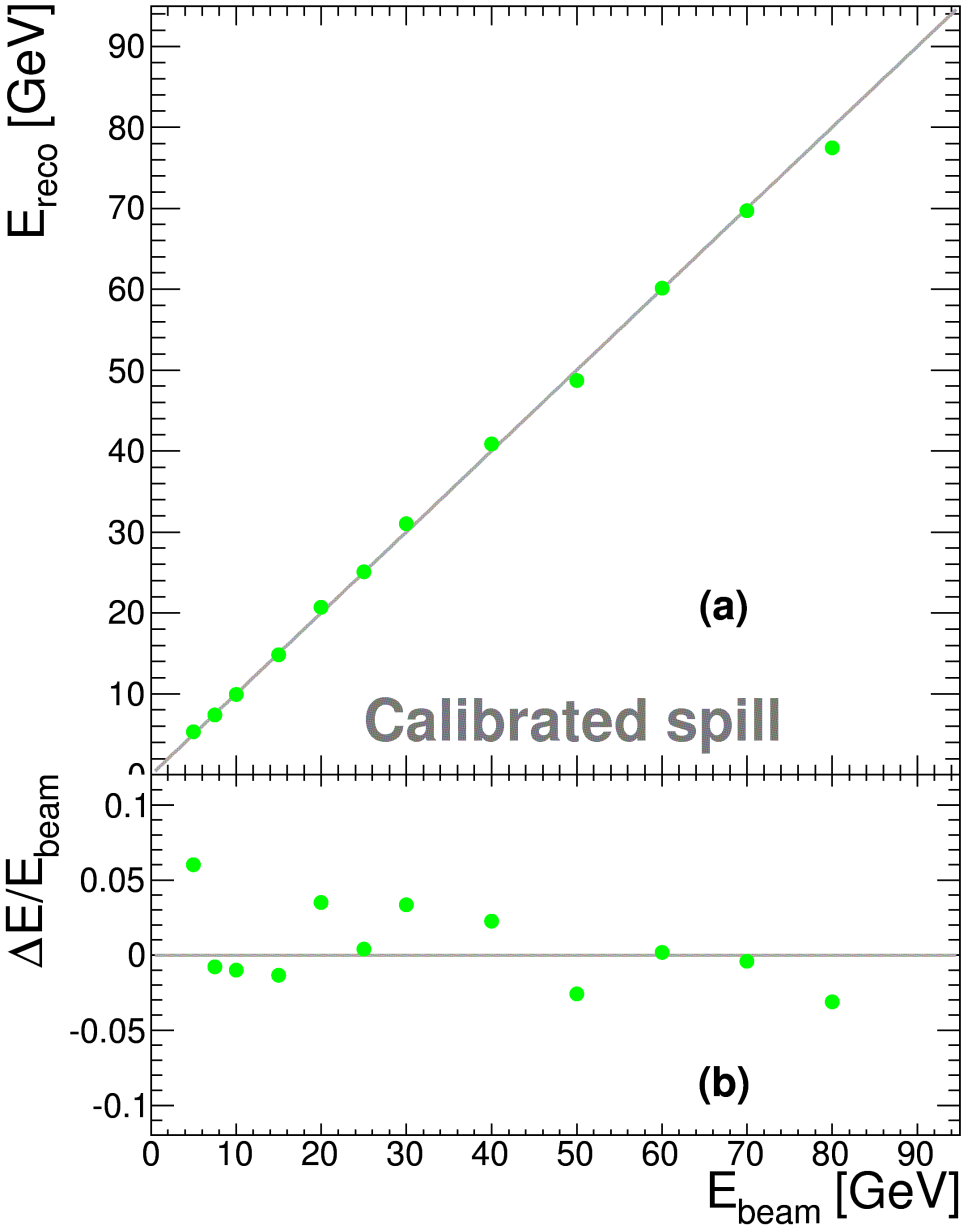
Results on Resolution 1



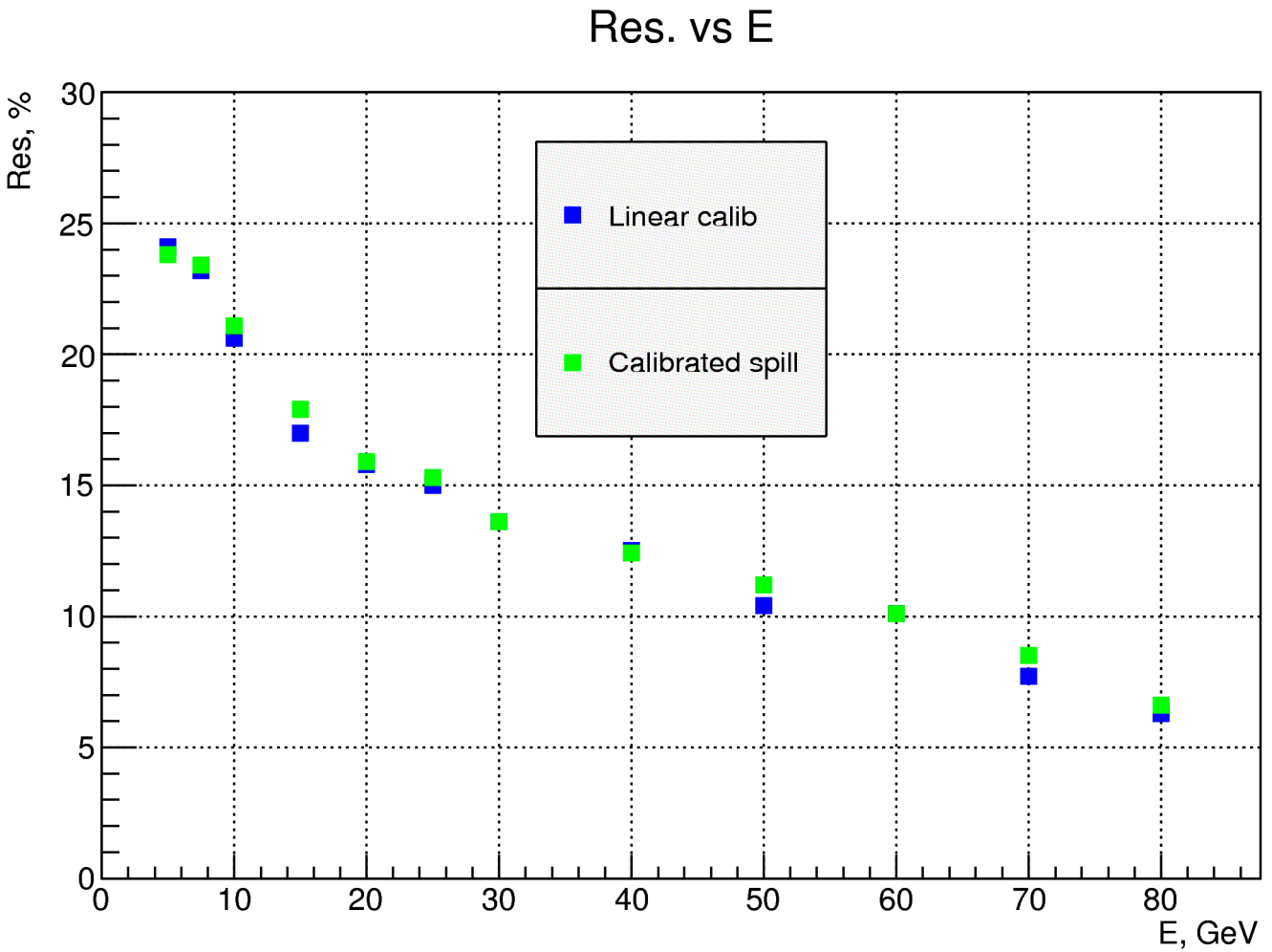
- Sept. data, 1.5σ fit
- Better resolution after the spill calibration

Results on Linearity



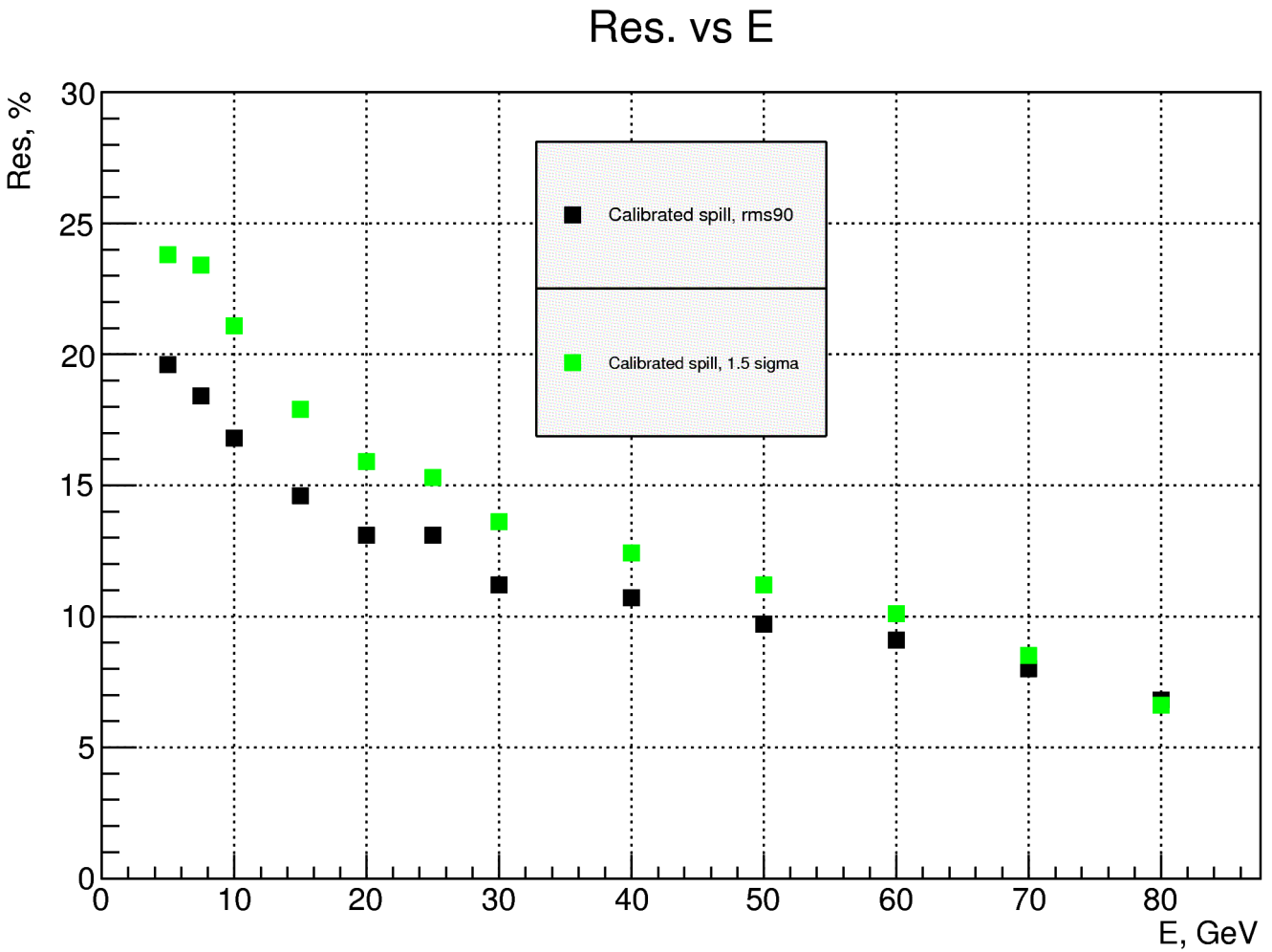


Results on Resolution 2



The straight line calibration is better here (but a little worse in linearity)

Results on Resolution 3



Rms90: code from Pandora, used for ILD simulation

Outlook

- ~7% of improvement in resolution after all changes applied

- Work in progress:
  - Separate dense and non-dense parts of the shower, make new parametrization (19 parameters)
  - Use the parametrization as Neural Network input