Single Cell Corrections in the AHCAL Reconstruction

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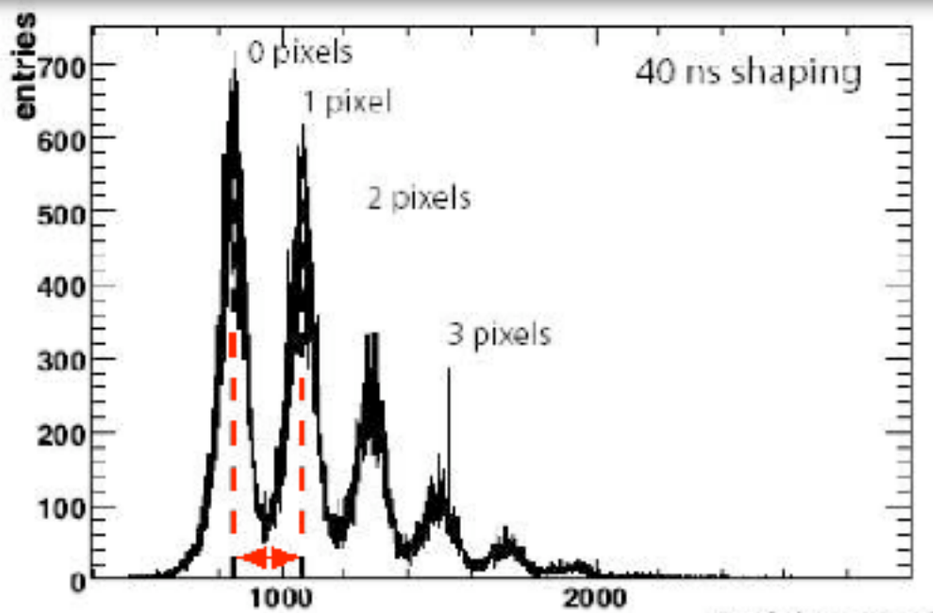
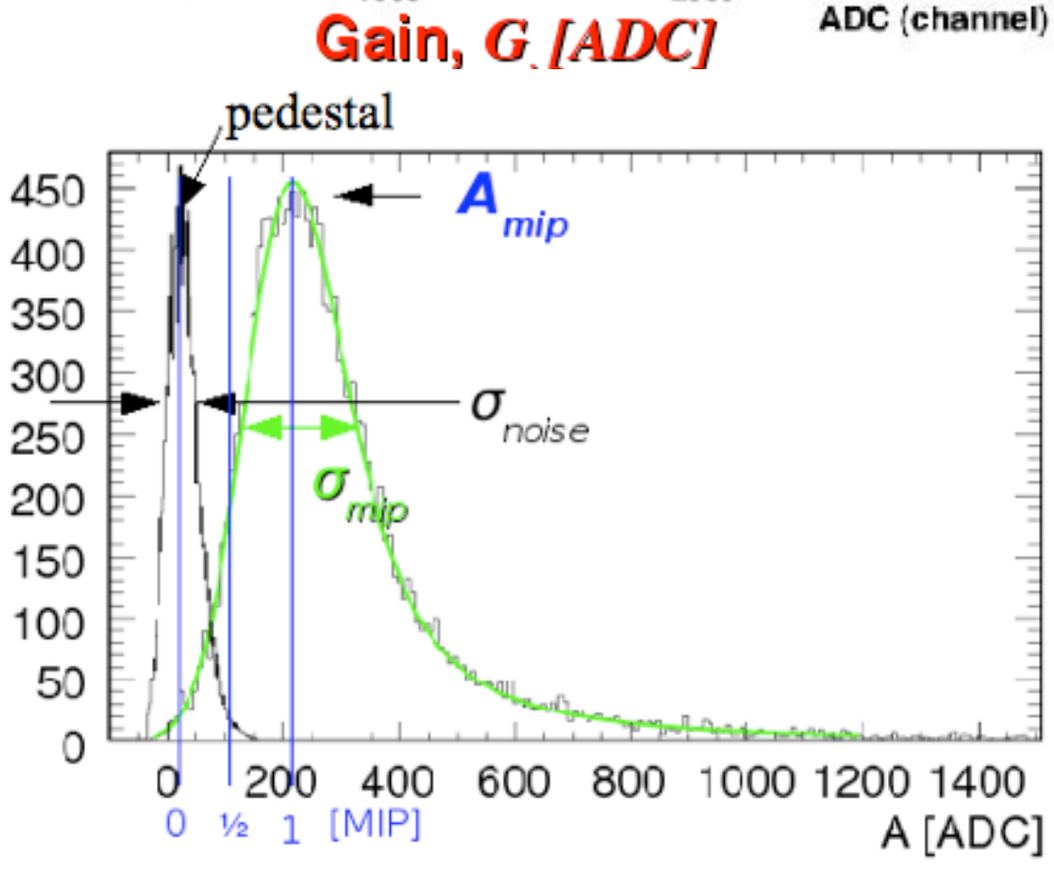
AHCAL Calibration

- 7608 tiles read out individually with SiPMs
- Calibration using as μ^- MIPs
- Two factors: A^{MIP} and G

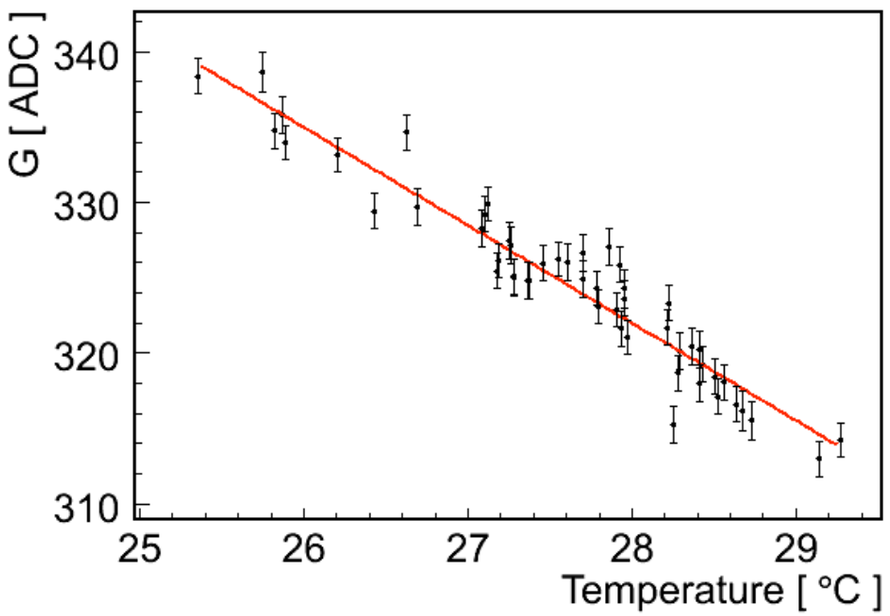


$$E[MIP] = \frac{A[\mathrm{ADC}]}{A^{\mathrm{MIP}}[\mathrm{ADC}]} \cdot f\left(A[\mathrm{pix}]\right)$$

$$A[\mathrm{pix}] = \frac{A[ADC]}{G[\mathrm{ADC}]}$$

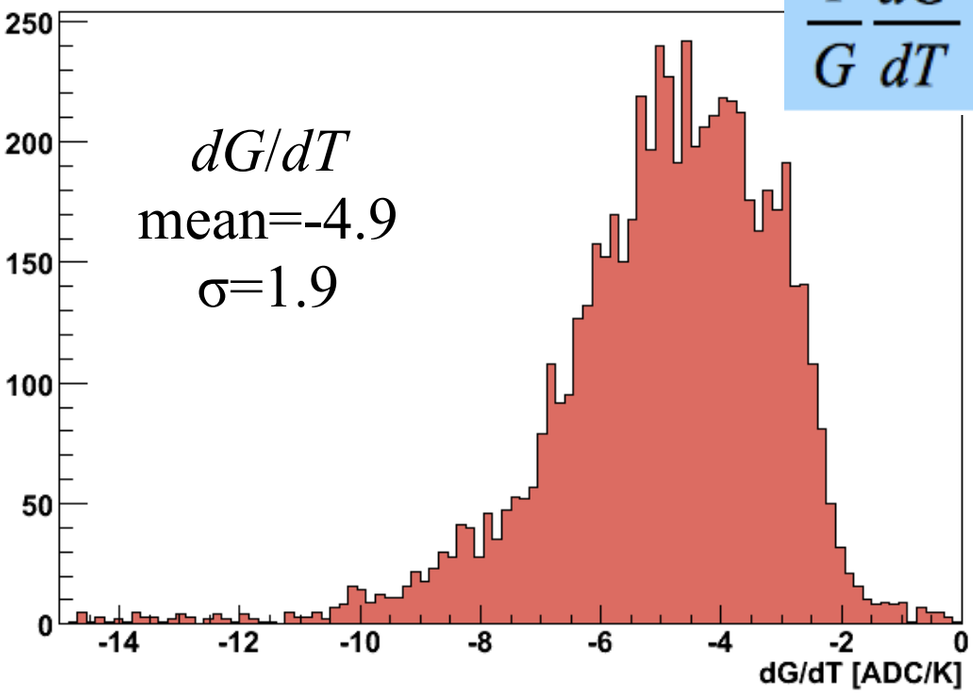


Temperature Dependencies

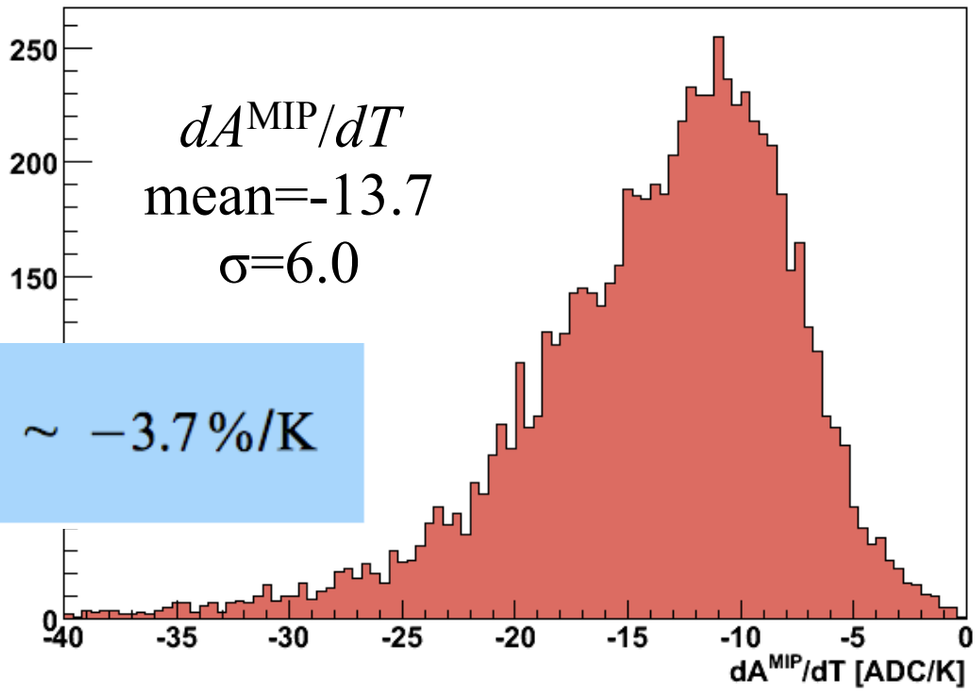


- Linear fits to determine slopes
- Big spread of slopes → is taking the average sufficient enough?

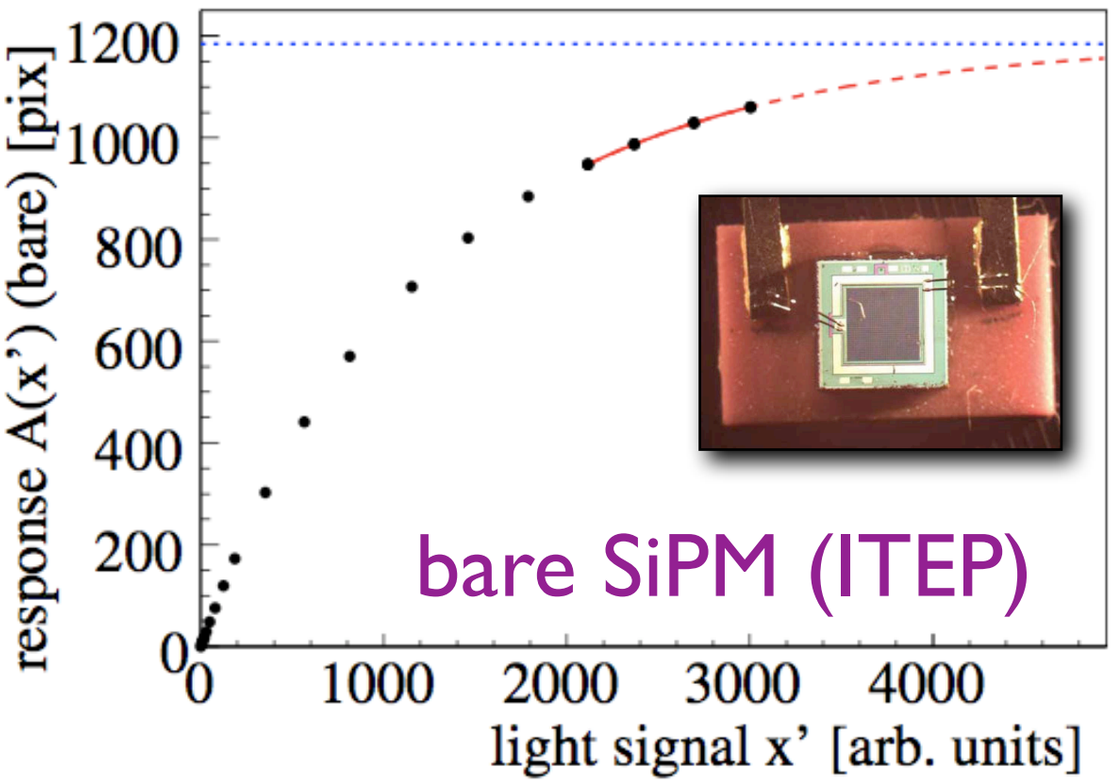
$$\frac{1}{G}\frac{dG}{dT} \sim -1.7\%/K$$

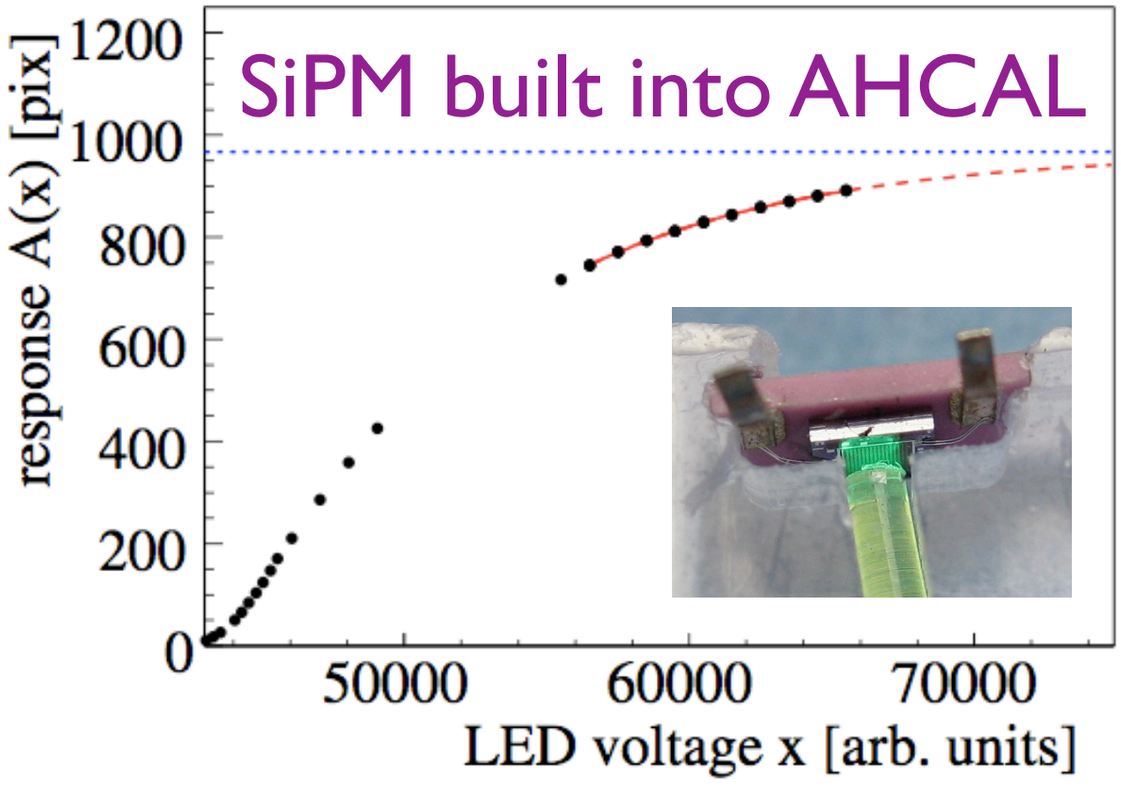


$$\frac{1}{A^{\mathrm{MIP}}}\frac{dA^{\mathrm{MIP}}}{dT} \sim -3.7\%/\mathrm{K}$$



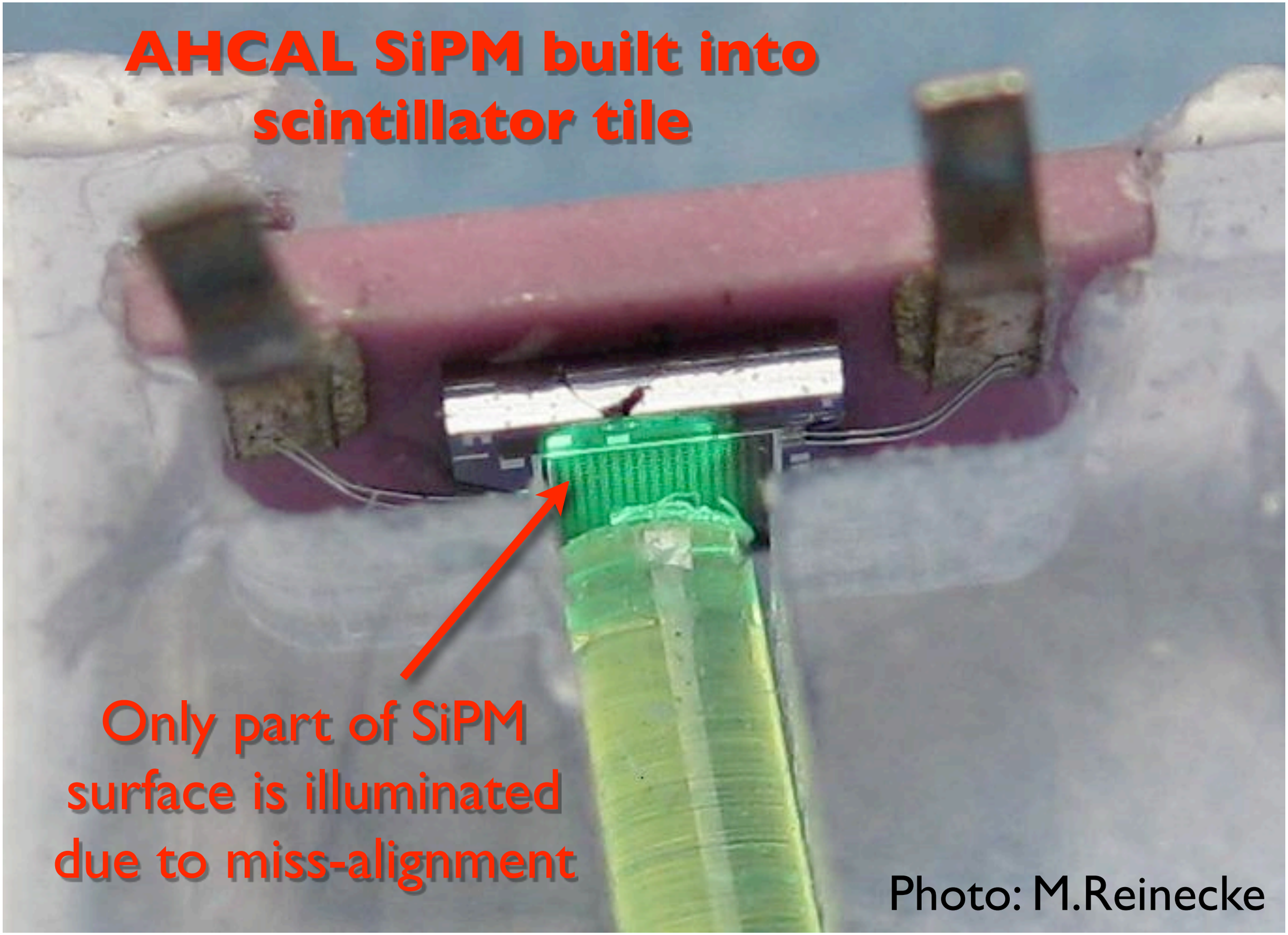
SiPM Saturation



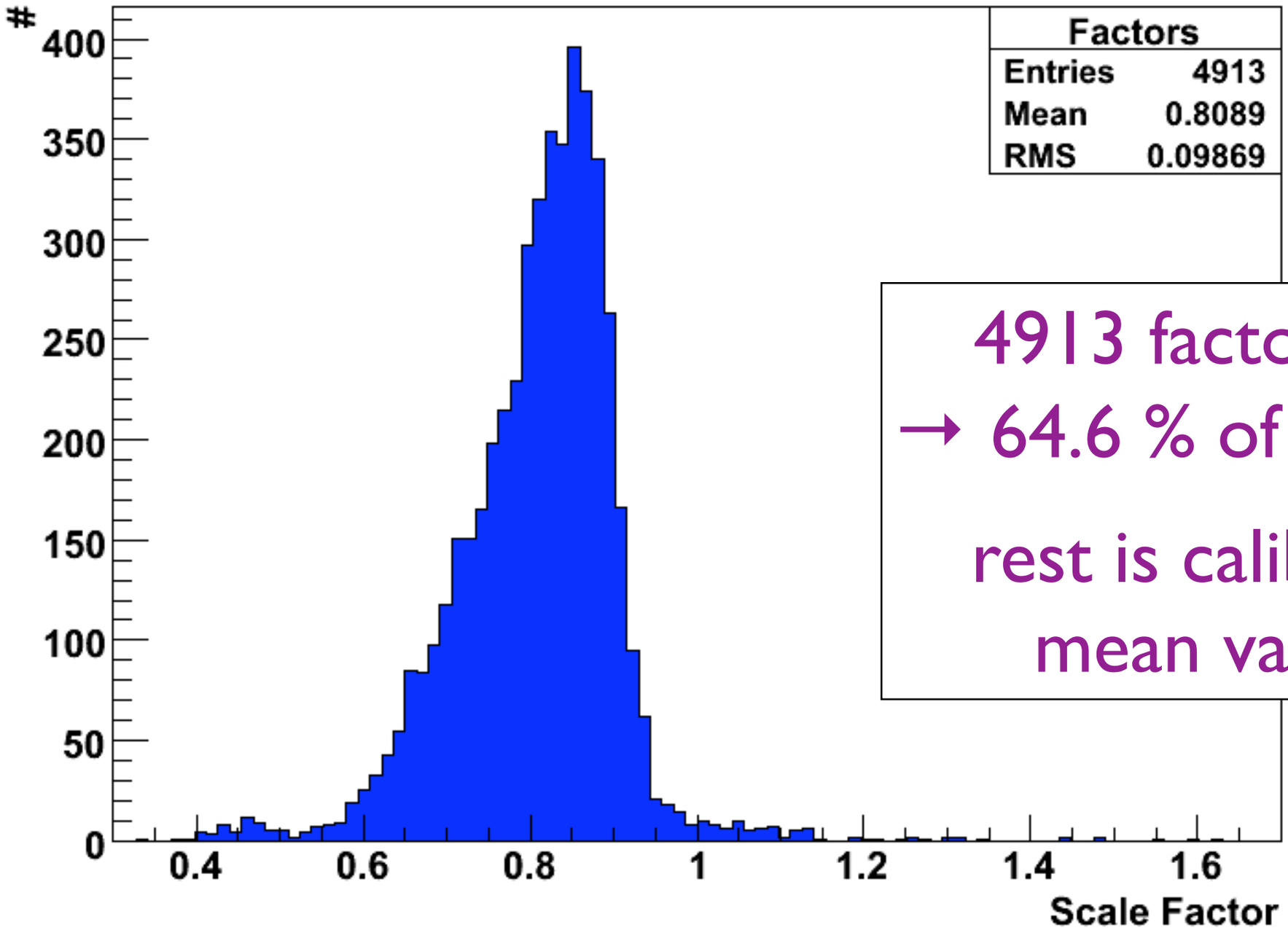


- Saturation due to limited number of pixels (1156)
- Bare SiPM: illumination of full surface
- Built-in SiPM: only part of surface illuminated via fiber
  → saturates earlier
- Rescaling necessary for Correction

AHCAL SiPM built into scintillator tile



Saturation Rescaling Factors



4913 factors available

→ 64.6 % of AHCAL cells

rest is calibrated with mean value of 0.8

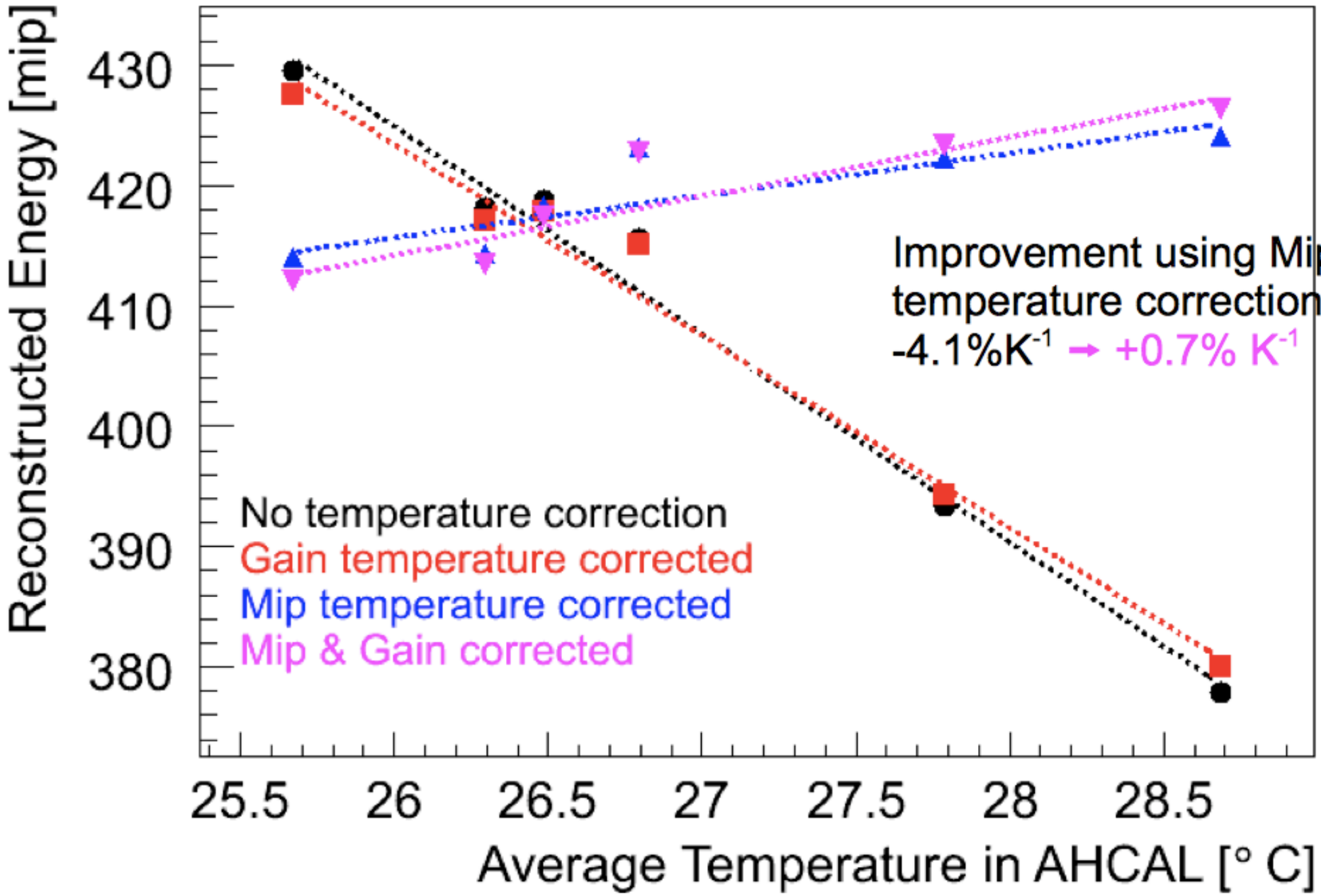
e+ Run Set 1

Run#	Beam [GeV]	T [°C]	x [cm]	y [cm]	Rot [°]
350118	10	28.7	-8.8	6.2	0
350144	10	27.8	0	0	0
350225	10	26.5	39	47	10
350278	10	26.8	-6	0	20
350320	10	26.3	0	0	30
350246	10	25.7	-6	0	30

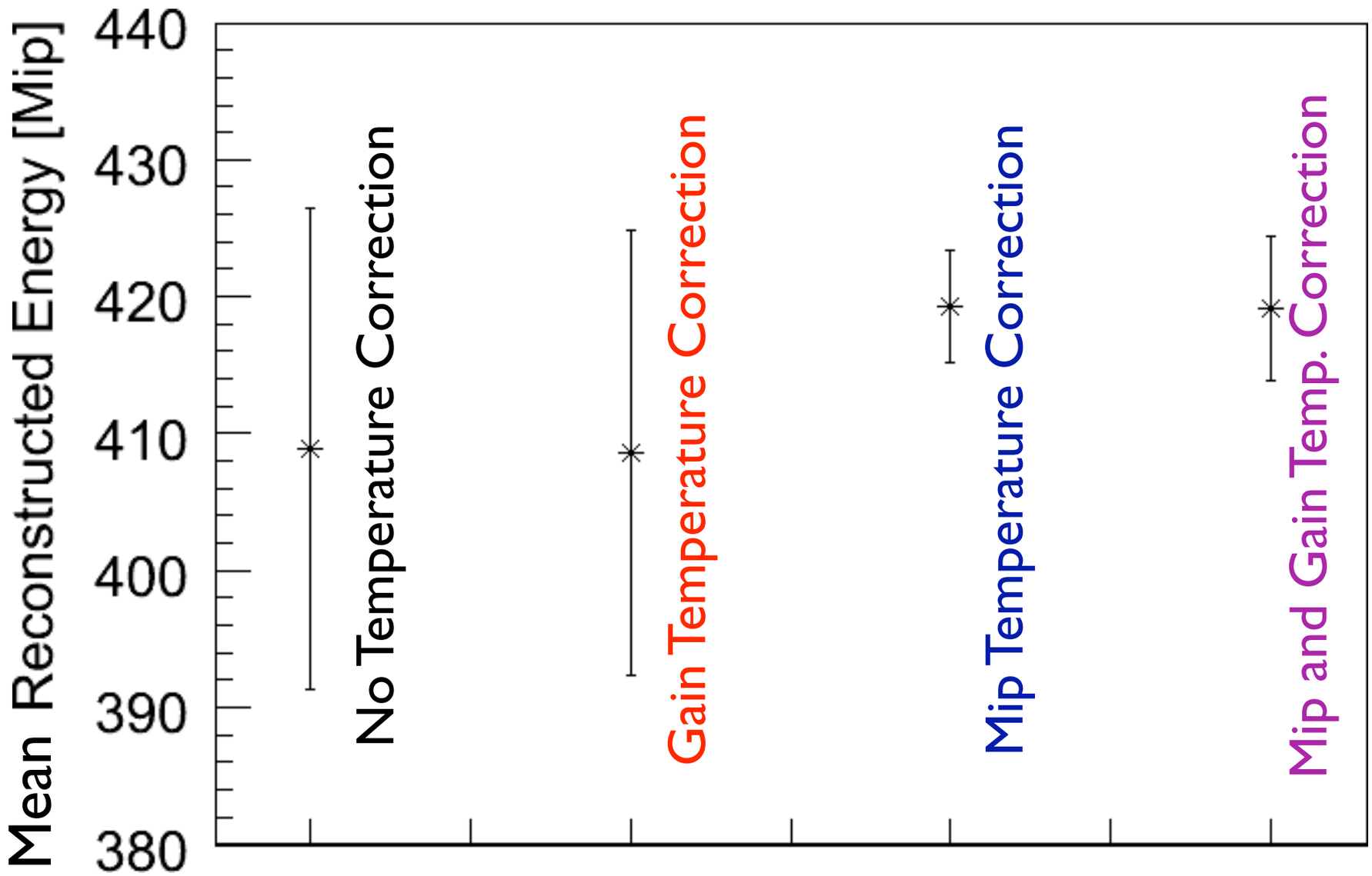
AHCAL only runs taken 2007 at CERN.

Different stage positions: affects reconstructed energy

Energy vs. Temperature



Spread of Energy in Runs



Error bars: RMS of reconstructed energy in 10 GeV e+ run set 1

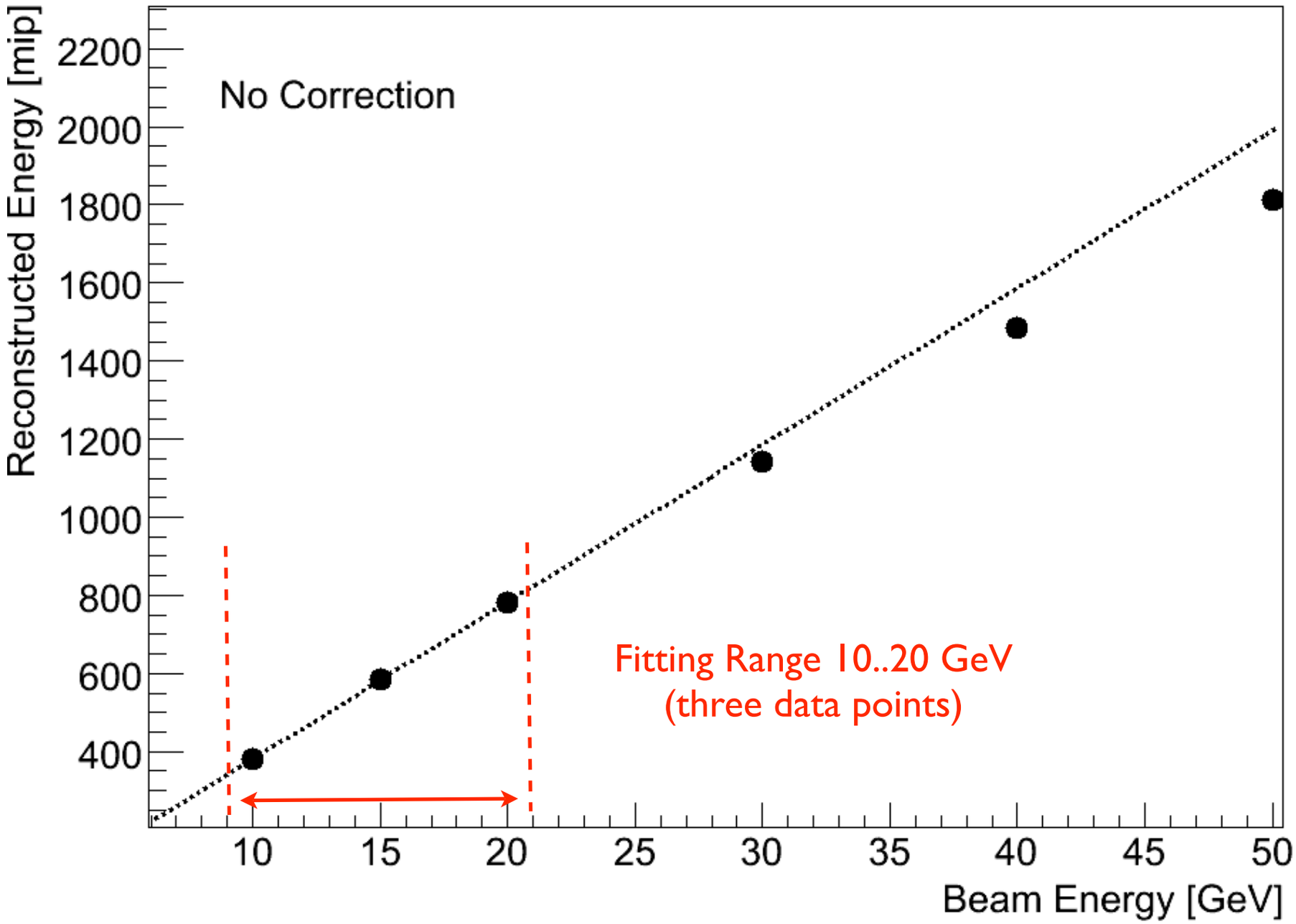
e+ Run Set 2

Run#	Beam [GeV]	T [°C]	x [cm]	y [cm]	Rot [°]
350128	50	28.5	-8.8	6.2	0
350129	40	28.4	-8.8	6.2	0
350132	30	28.2	-8.8	6.2	0
350137	20	27.8	-8.8	6.2	0
350134	15	28.0	-8.8	6.2	0
350118	10	28.7	-8.8	6.2	0

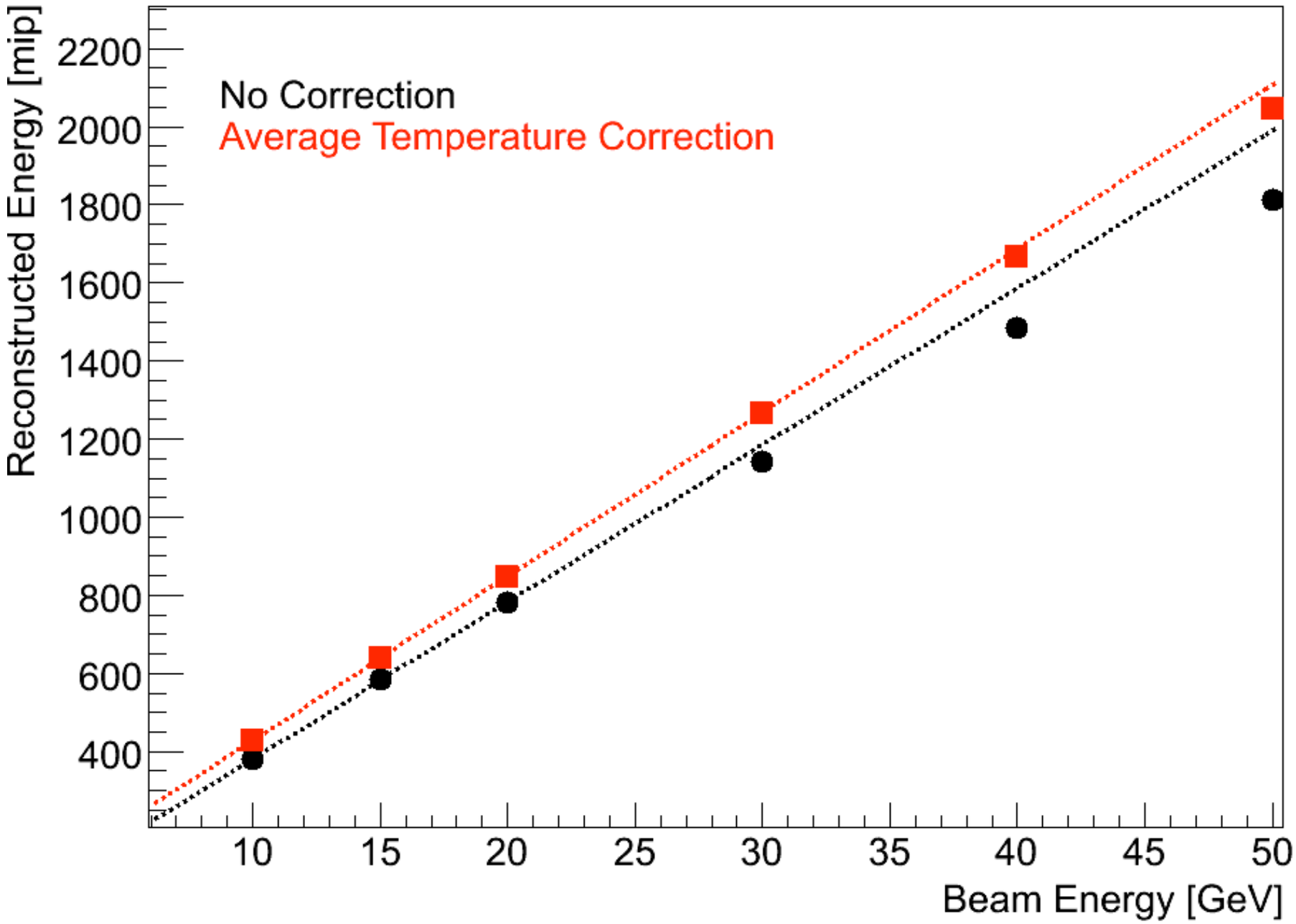
AHCAL only runs taken 2007 at CERN.

All have the same stage position.

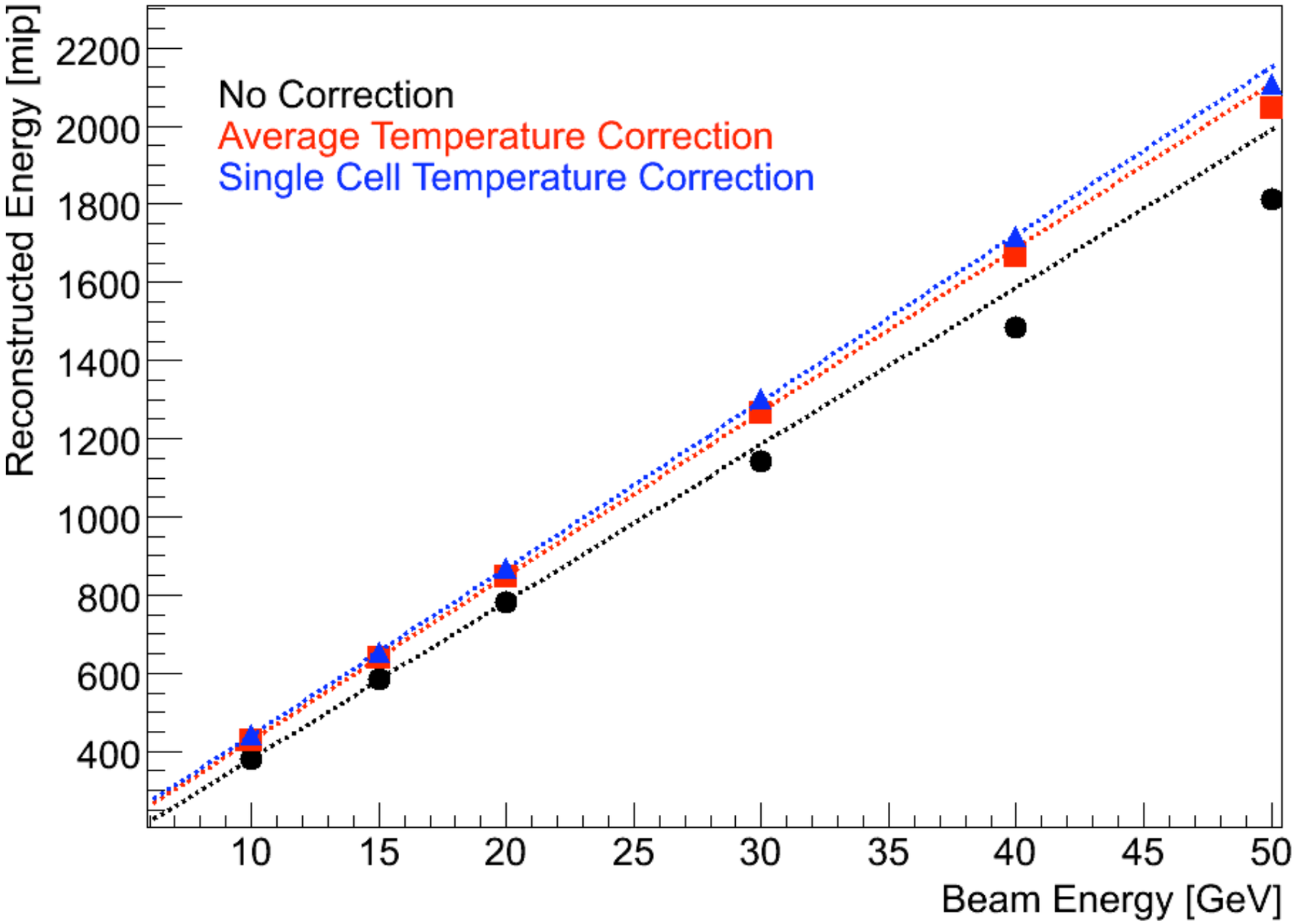
e+ Set 2: Linearity



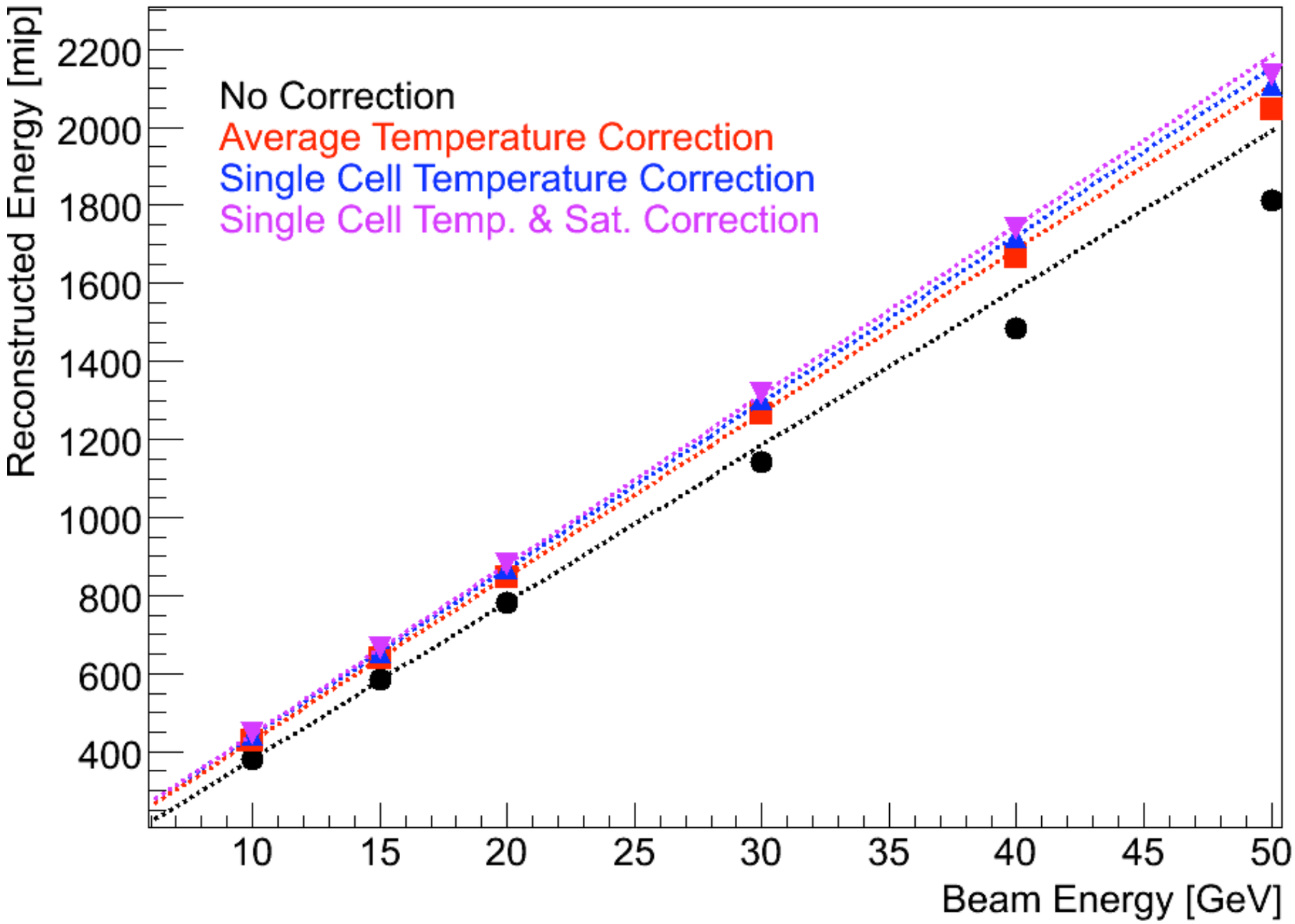
e+ Set 2: Linearity



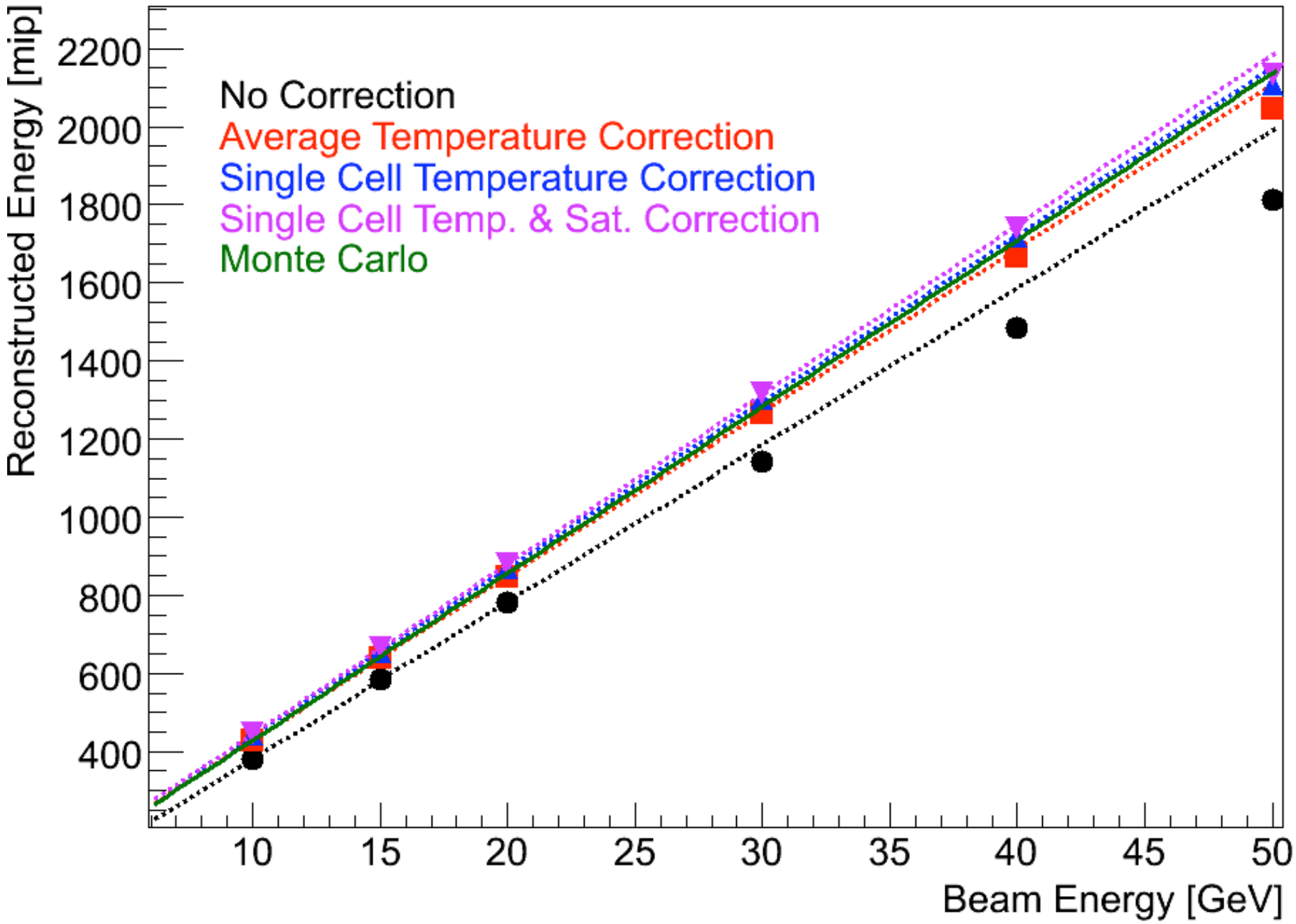
e+ Set 2: Linearity



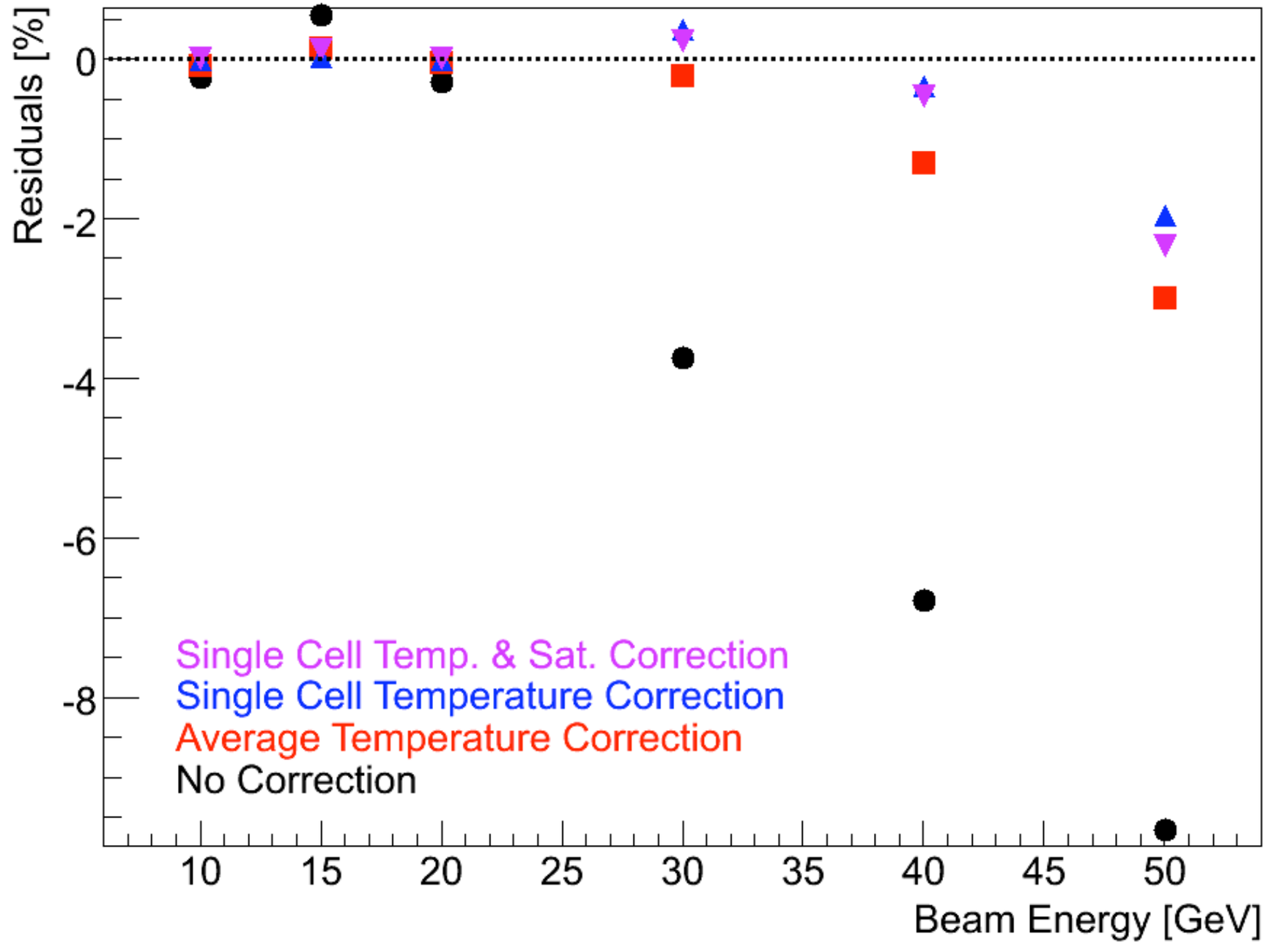
e+ Set 2: Linearity



e+ Set 2: Linearity



Residuals to Linearity



Summary & Conclusion

- Temperature corrections implemented in AHCAL Marlin Reconstruction (no official released yet).
- Corrections for temperature improve linearity - Single cell correction gives further improvement.
- Scaling of saturation factors for single cells shows only little effect compare to average scaling.
- TODO:
  - Monte Carlo comparision.
  - Revise temperature correction slopes and scaling factors for single cells.

backup slides...

Current Status

- Slopes and offsets for MIP(T) and Gain(T) are now in (preliminary) database folders:

  `/test_sr/mip_linear_fits` and `/test_sr/gain_linear_fits`

- Some numbers:

  - 6720 good (slope,offset) MIP pairs → 88.3%
    750 (slope,offset) MIP pairs calculated using 'old official' MIP values and average slope of -3.8%
    → 98.2 % cells can be MIP calibrated with temperature correction
  - 6422 good (slope, offset) Gain pairs → 84.4%