Calibration of testbeam FEB - B0 results

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Plan of the presentation

1. Method of calibration
2. Cross check with Geant4 and simple formula
3. Absolute gain after injector calibration
4. Example of calibrated results

Calibration method

Using a simple single-channel injector, it was possible to inject same charge for each channel.

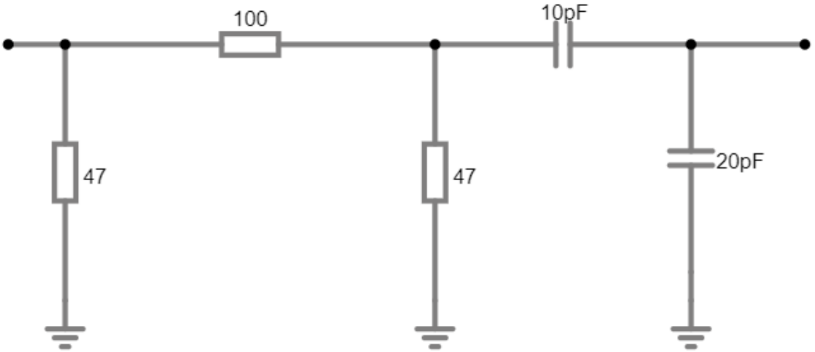

Fig. 1: Injector circuit

Injector calibration

Using an external measurement setup with known gain, it was possible to calibrate our injector.
Injector calibration: $Q_{in}[fC] = 0,4628 \cdot U[mV] + 0,5148[fC]$

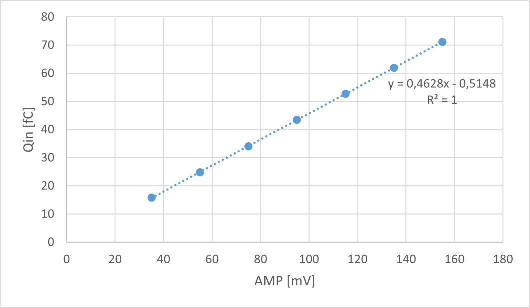

Fig. 2: Charge in function of generator amplitude - injector calibration

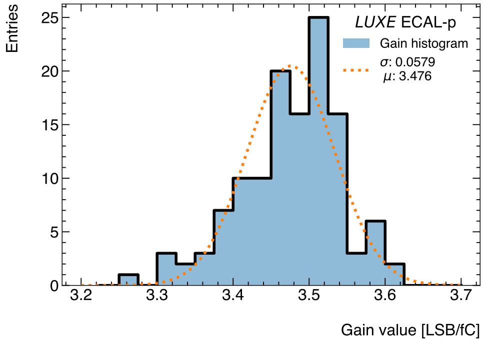

Fig. 3: Absolute gain value using calibrated injector

Cross check with simulations

Methods of estimating energy deposition

- Using simple equation for energy loss:
  $\Delta E(\text{keV}) = d\ (0.1791 + 0.01782\ \ln(d))$ with d in um
- Geant4 for 500 μm

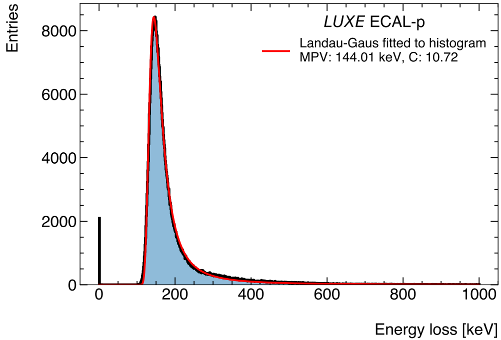

Fig. 4: Energy distribution Geant4 simulation

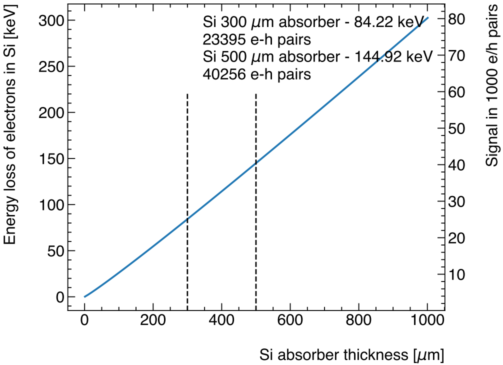

Fig. 5: Energy loss in function of thickness of Si absorber

Cross check with simulations

Methods of estimating energy deposition

- Using simple equation for energy loss:
  $\Delta E(\text{keV}) = d\ (0.1791 + 0.01782\ \ln(d))$ with d in um
- Geant4 for 500 μm Si

Thanks to MC simulations by Mihai, I was able to calculate the most probable energy deposition in a 500 μm Si sensor. Assuming 3.6 eV per e-h pair, I calculated the most probable e-h number. The gain was calculated as the Landu MPV using a fit to the raw data divided by the charge.

Table 1: Simulated parameters

	Geant4	formula	inj calib
E [keV]	144.01	144.9	-
e-h pairs	40002	40256	-
charge [fC]	6.41	6.45	-
estimated FLAME gain	**3.48**	**3.45**	**3.48**

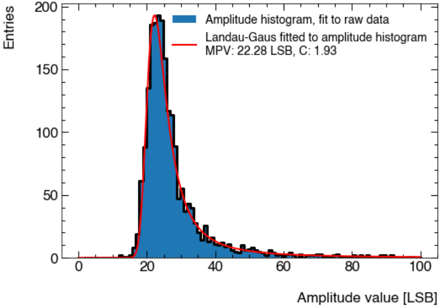

Fig. 6: Amplitude distribution run 4533 calice sensor ch 61

Linear regression

After calculating MPV for each channel and charge linear regression was applied (4 channels was classified as bad)

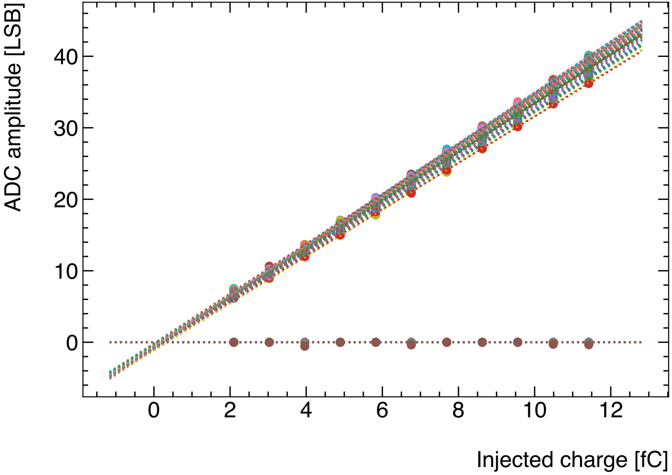

Fig. 7: Fit to raw data reconstruction with linear regression applied

Linear regression - gain

From linear regression we can read information about slope and after performing injector calibration we have absolute gain value.

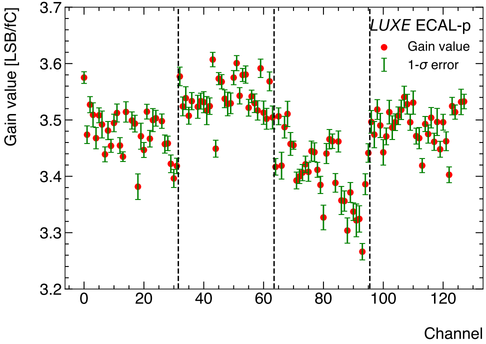

Fig. 8: Absolute gain

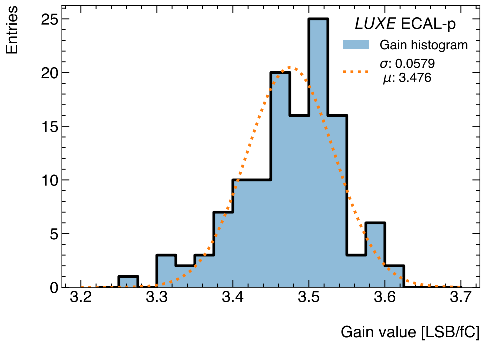

Fig. 9: Absolute gain - histogram

Linear regression - relative gain

From linear regression we can read information about slope and after normalisation to mean slope value we have relative gain values.

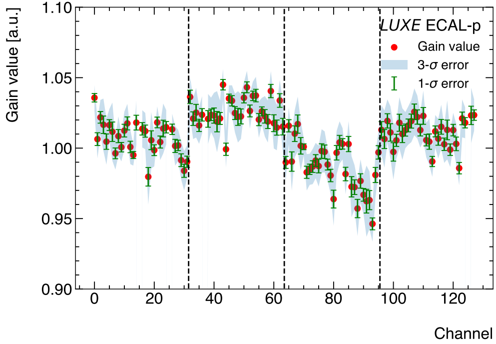

Fig. 10: Relative gain

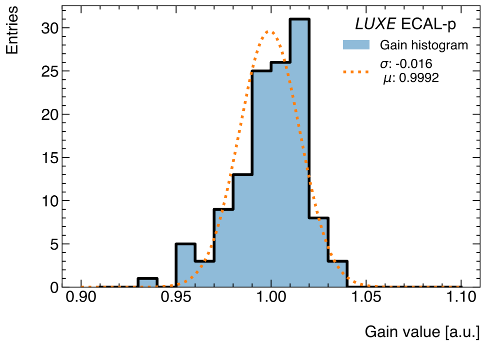

Fig. 11: Relative gain - histogram

Example of calibrated results Calice

Taking account relative gain for each channel we can perform gain correction for B0 board. As you can see gain difference has no significant influence on MPV position.

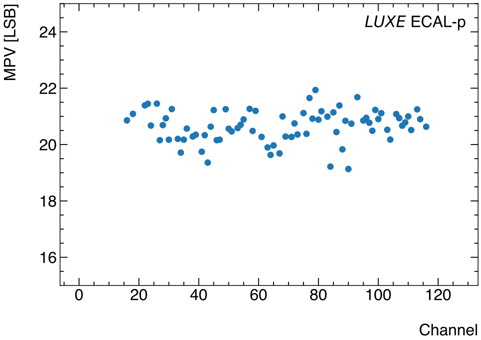

Fig. 12: Calice corrected MPV position - online reconstruction

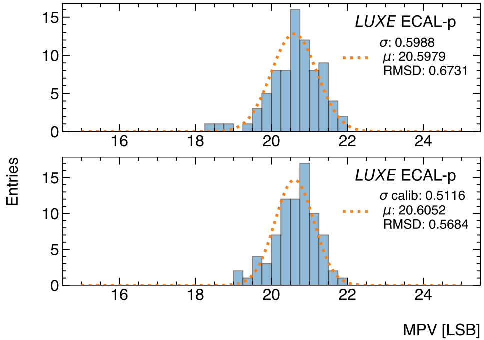

Fig. 13: Calice corrected MPV position histogram - online reconstruction

Example of calibrated results Yan

Taking account relative gain for each channel we can perform gain correction for B0 board. As you can see gain difference has no significant influence on MPV position.

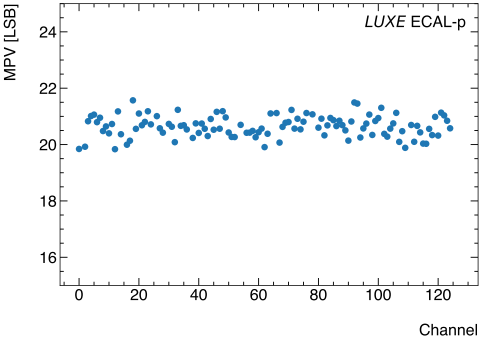

Fig. 14: Yan corrected MPV position - online reconstruction

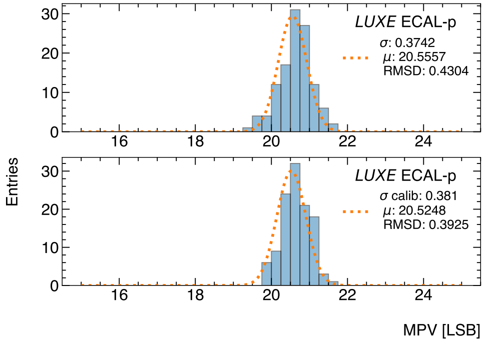

Fig. 15: Yan corrected MPV position histogram - online reconstruction

Conclusions

- Absolute μ_{gain} 3.47 $[\frac{LSB}{fC}]$ σ 0.0579
- MC simulation agree with laboratory measurements
- Applied gain correction slightly improve MPV distribution

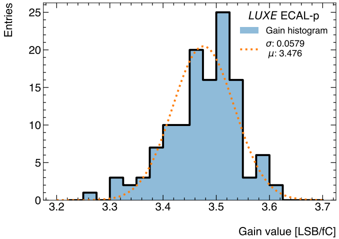

Fig. 16: Absolute gain histogram - fit from raw data

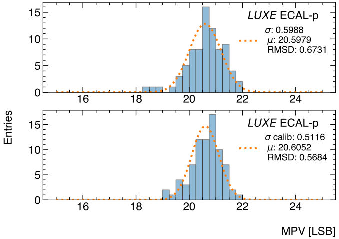

Fig. 17: Calice MPV position histogram - online reconstruction

Thank you for attention