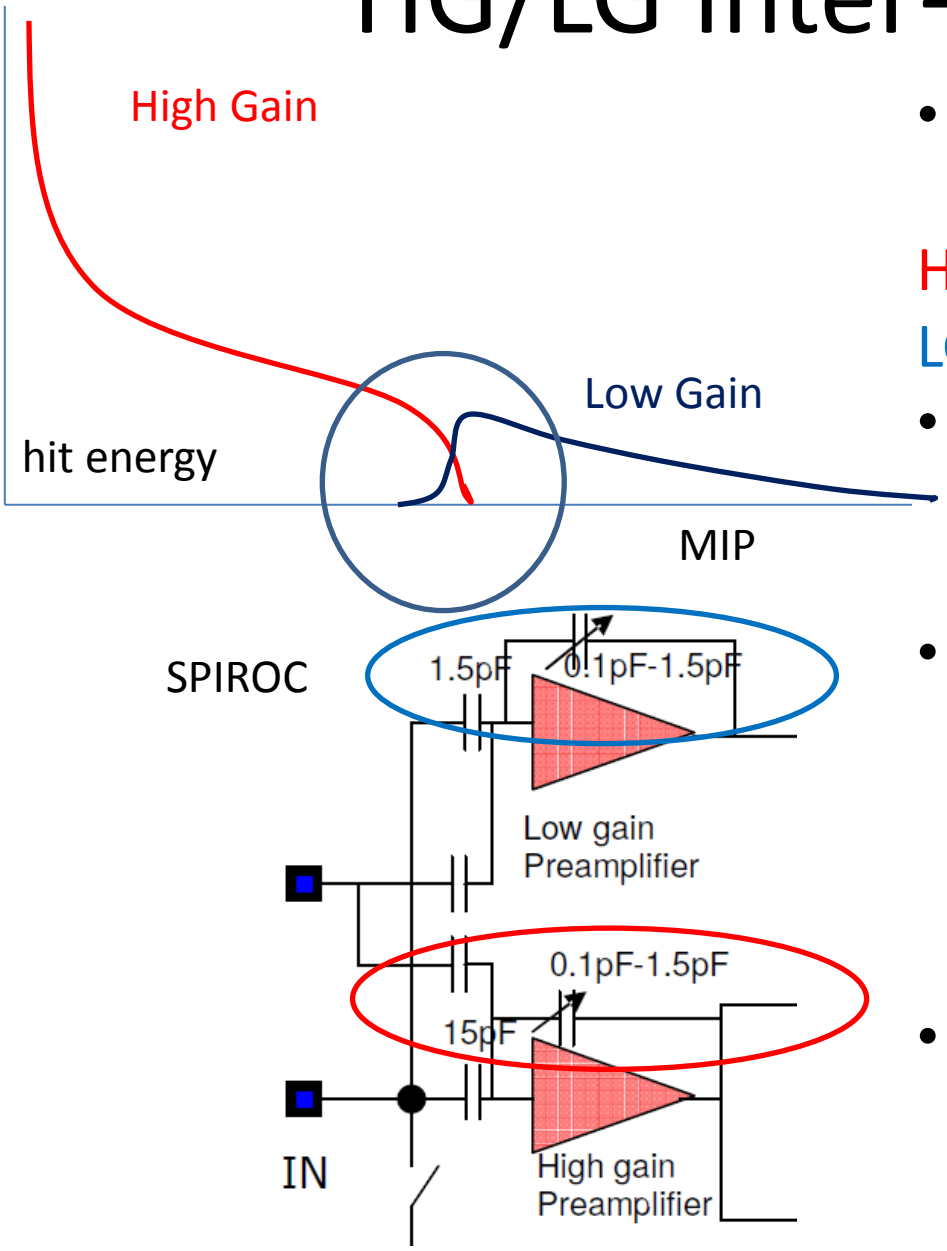
HG/LG Inter-Calibration
and
LG Pedestal position with Hit

18.12.2018

AHCAL Analysis Workshop at DESY

Yuji Sudo (DESY)

HG/LG Inter-Calibration



- SPIROC2B/2E has 2 signal output lines. High Gain and Low Gain

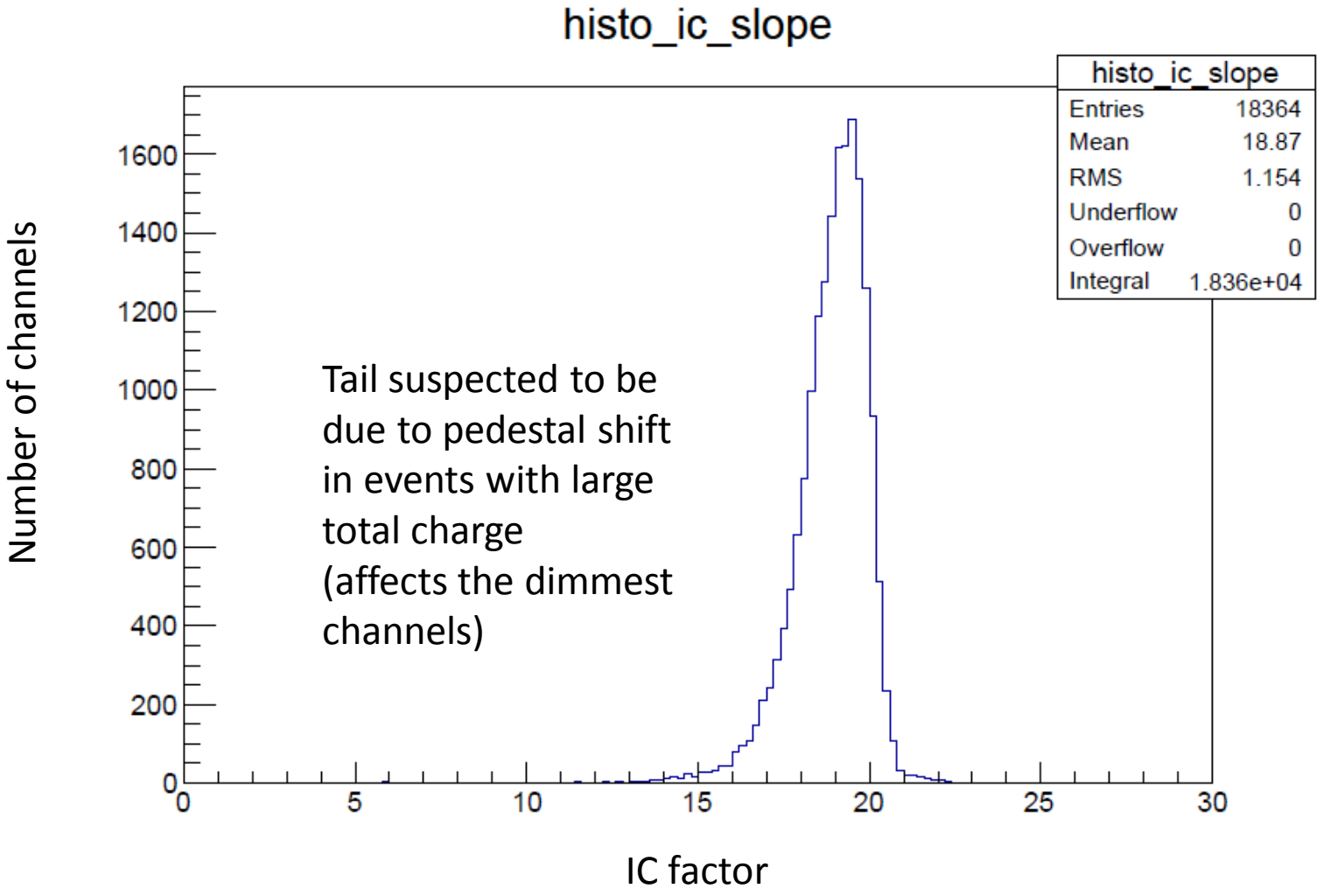
HG -- small deposited energy hits

LG -- large deposited energy hits

- In principle, IC factor is constant and just depends on ratio of capacitors. (IC ~20 for TB 2018)
- But IC factor is different for each channel due to an uneven quality of capacitance and parasitic capacitance.
  →measurement is important
- After inter-calibration, HG and LG output of hit energy should be connected smoothly

Slope of HG vs LG without correction

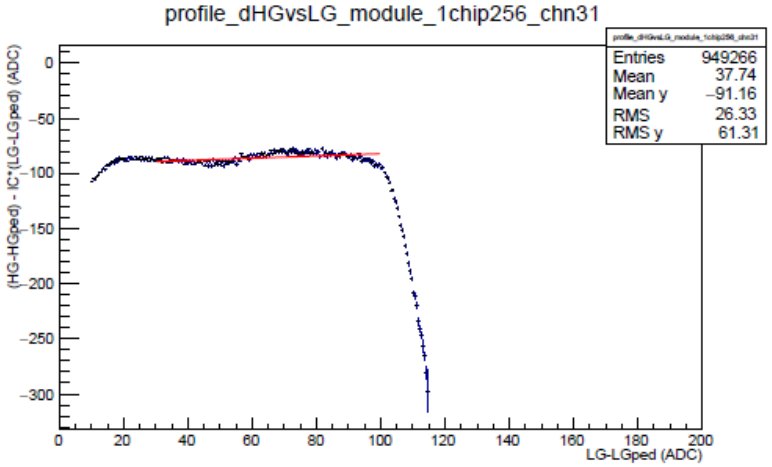
- need to apply higher order correction for slope

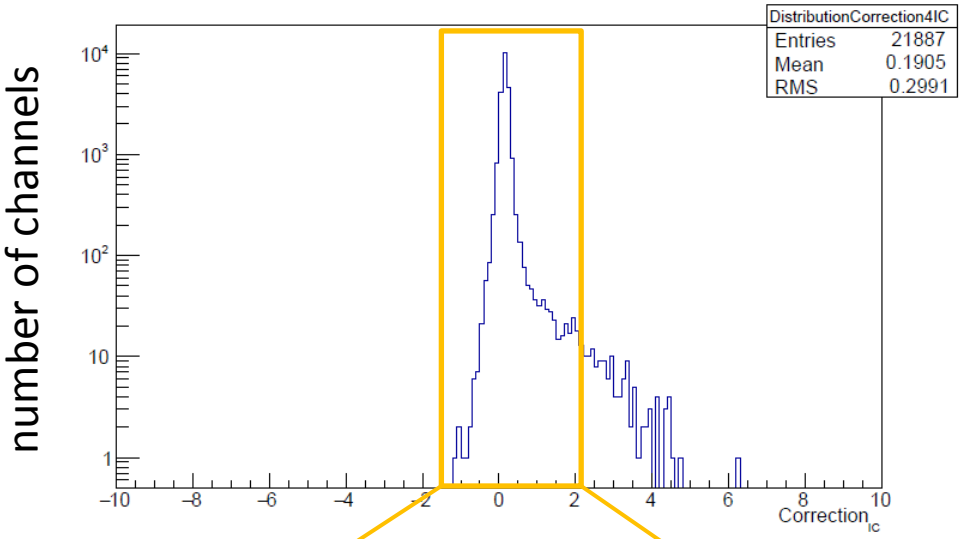


correction value

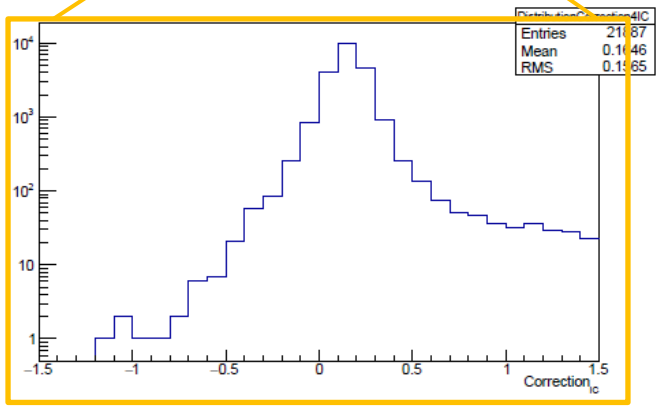
- higher order correction for slope

fit profile of dHGvsLG
30 < LG ADC < 100



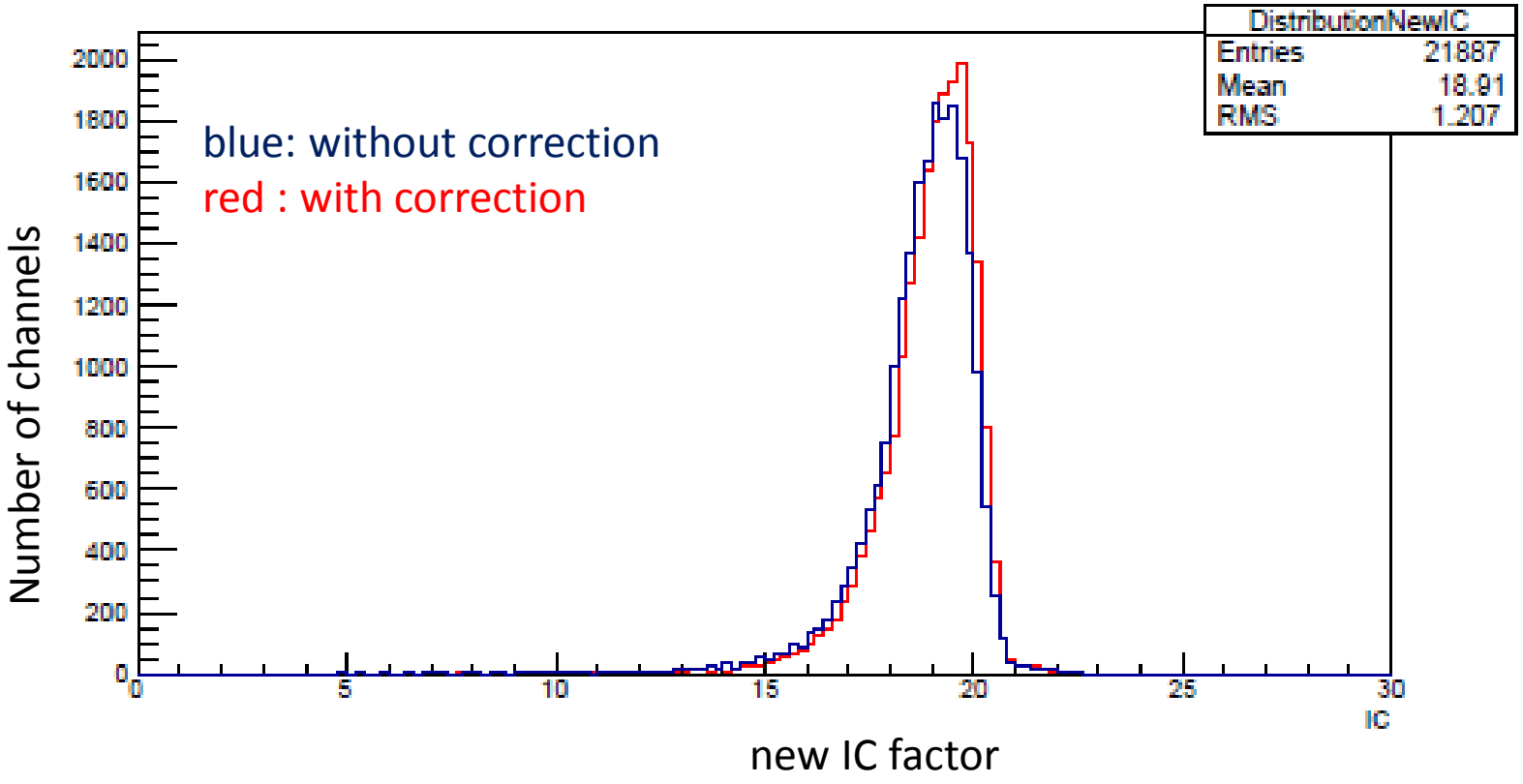


correction for IC factor



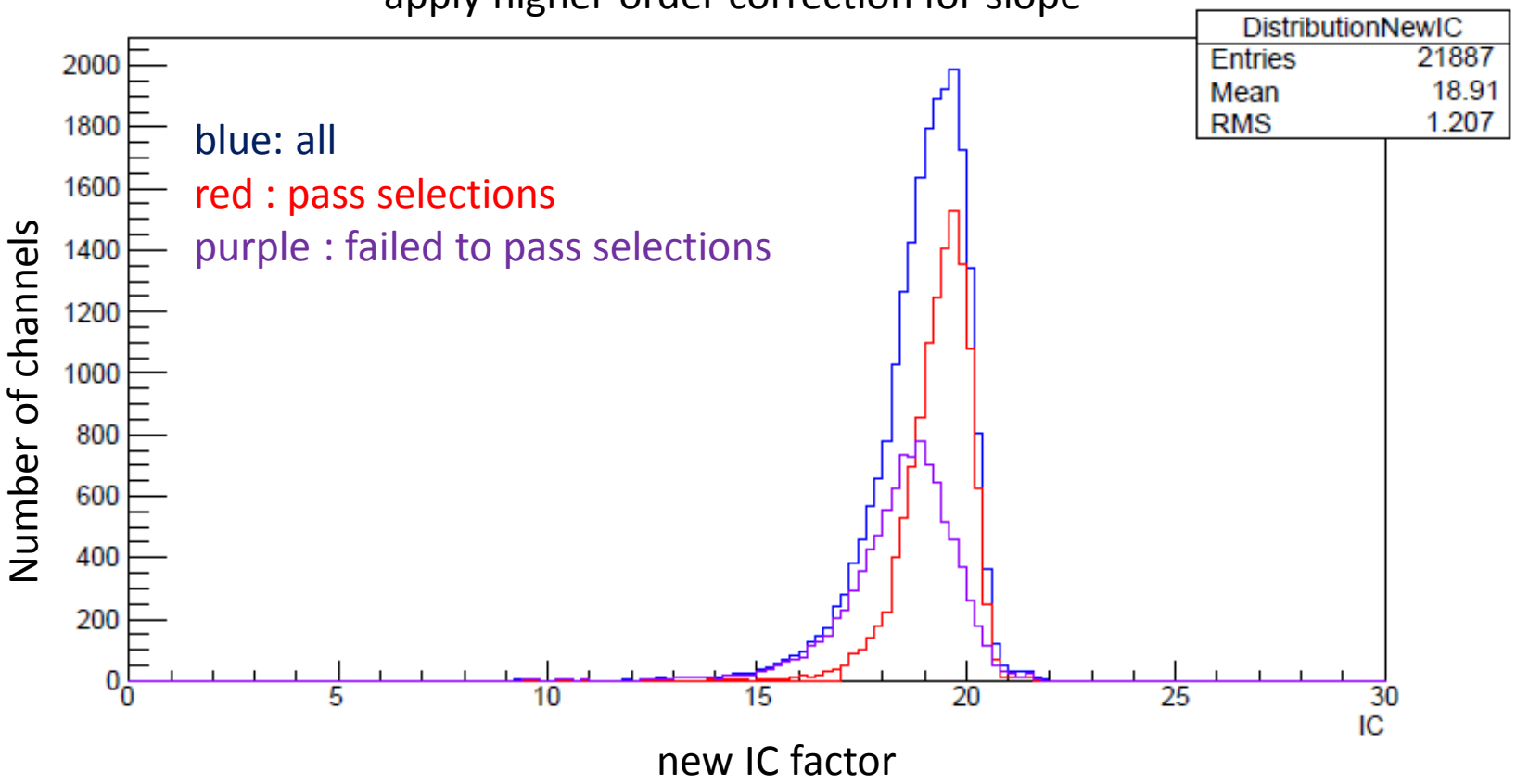
Slope of HG vs LG with correction

- apply higher order correction for slope



Slope of HG vs LG with correction

- apply higher order correction for slope



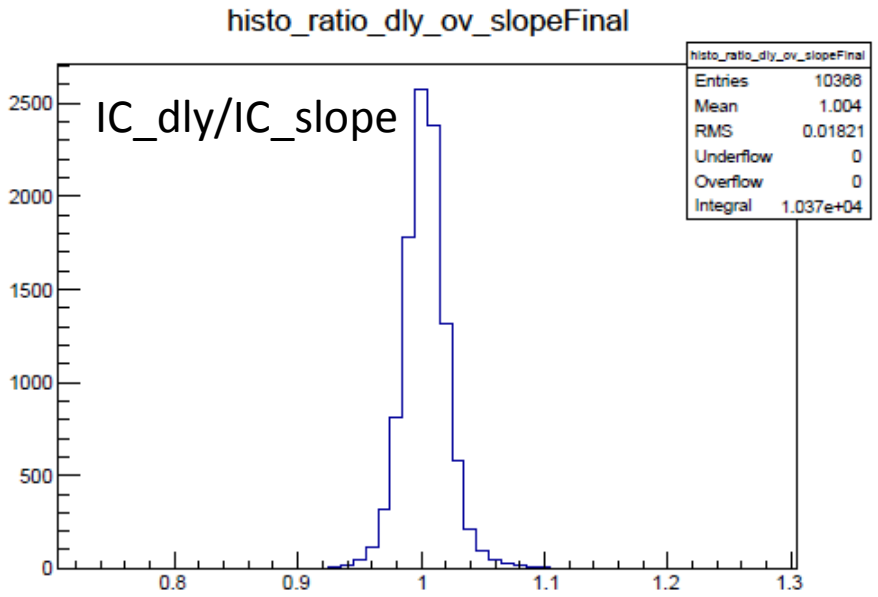
selection

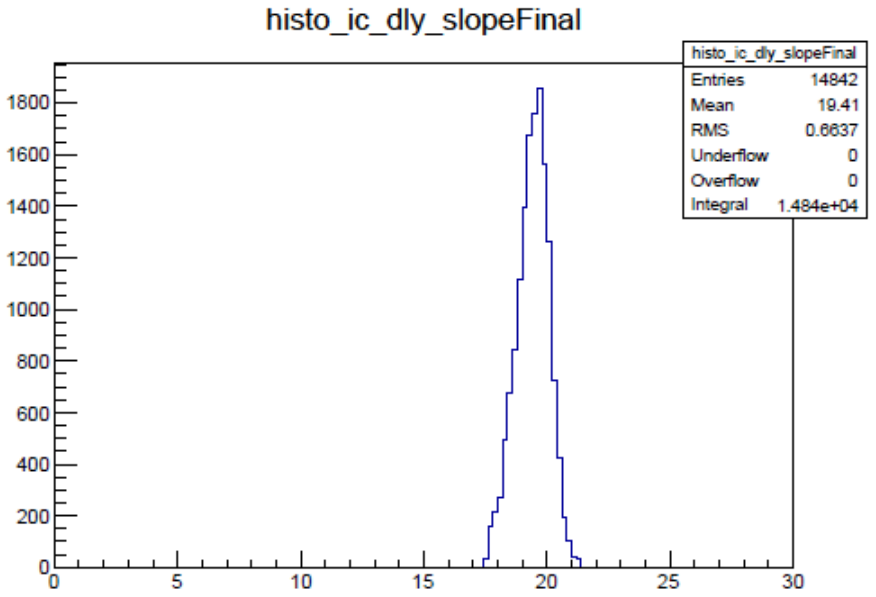
no measured point with a total amount of charge in a chip >60000 in fitting region

IC > 15 and get RMS

mean $\pm$ 3*RMS

Inter-Calibration Factor

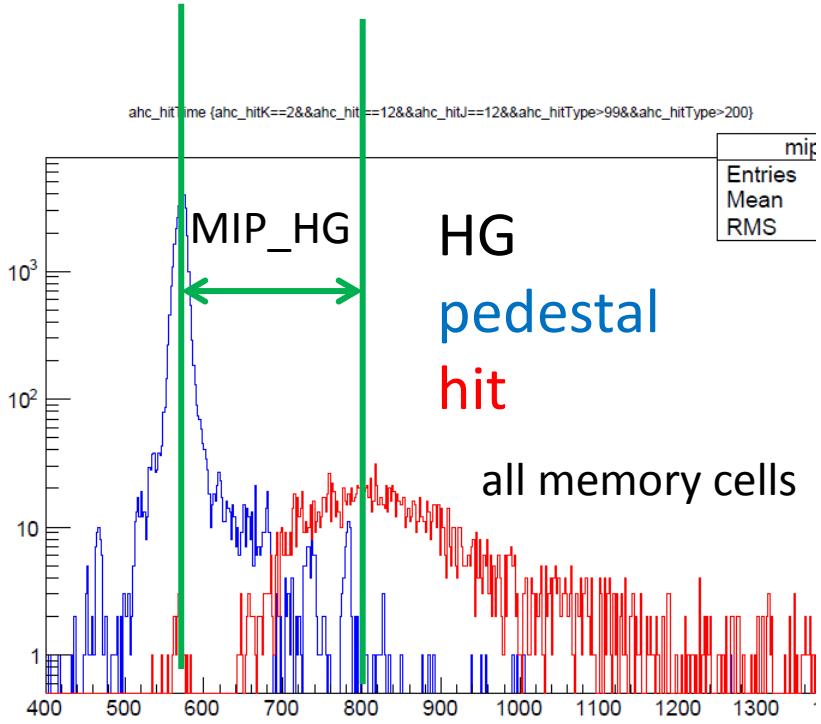


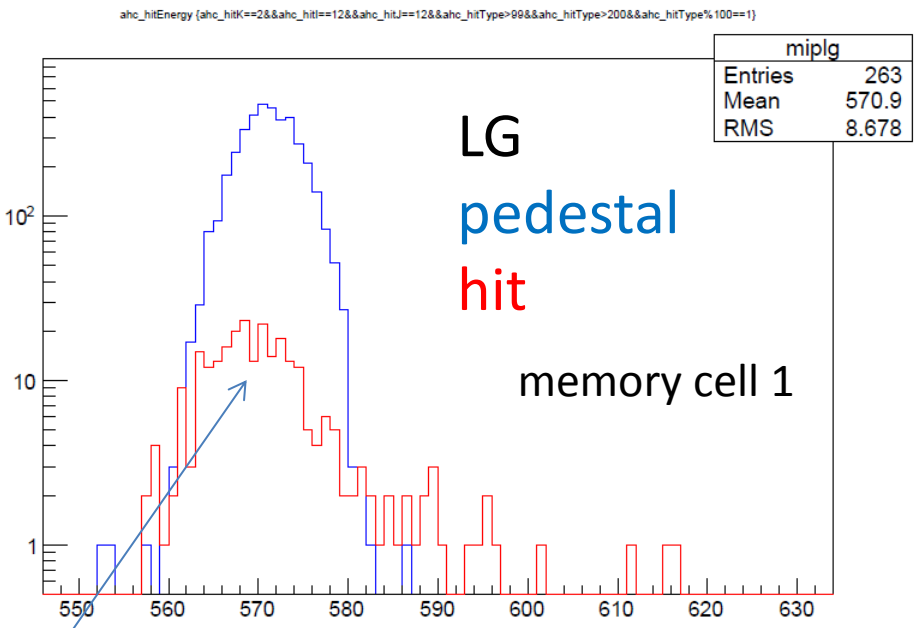


0.4% systematic shift
RMS = 0.018 (previous result 0.022)

loose selection :17665, mean=19.22
tight selection :14842, mean=19.44 (new)

Muon Run with IC mode (HG/LG)
Pedestal shift with hit?





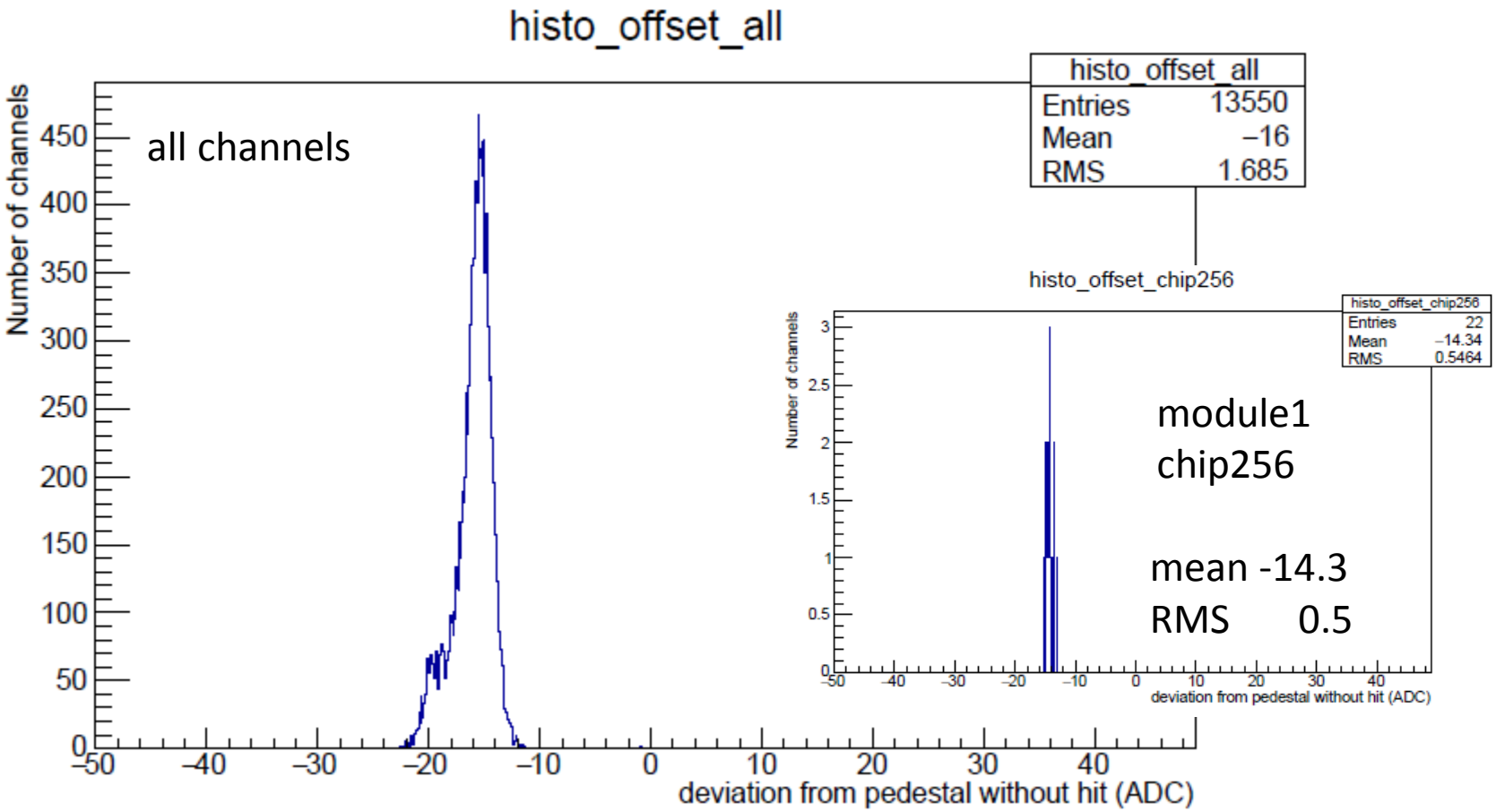
AT run is not available to extract the IC factor due to a pedestal shift.
But this information is useful to correct the low gain pedestal.

- IC factor is obtained from LED runs (ETIC)

→ Pedestal_LG = (Peak_LG with hit) – (expected MIP_LG)

(expected MIP_LG) = MIP_HG/F_{IC}

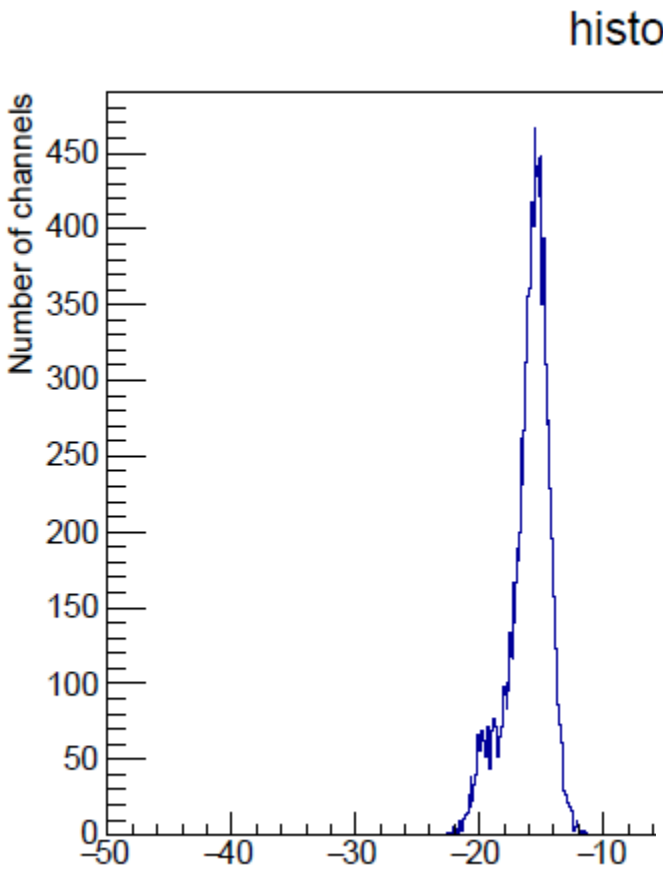
LG Pedestal Offset for hitbit1

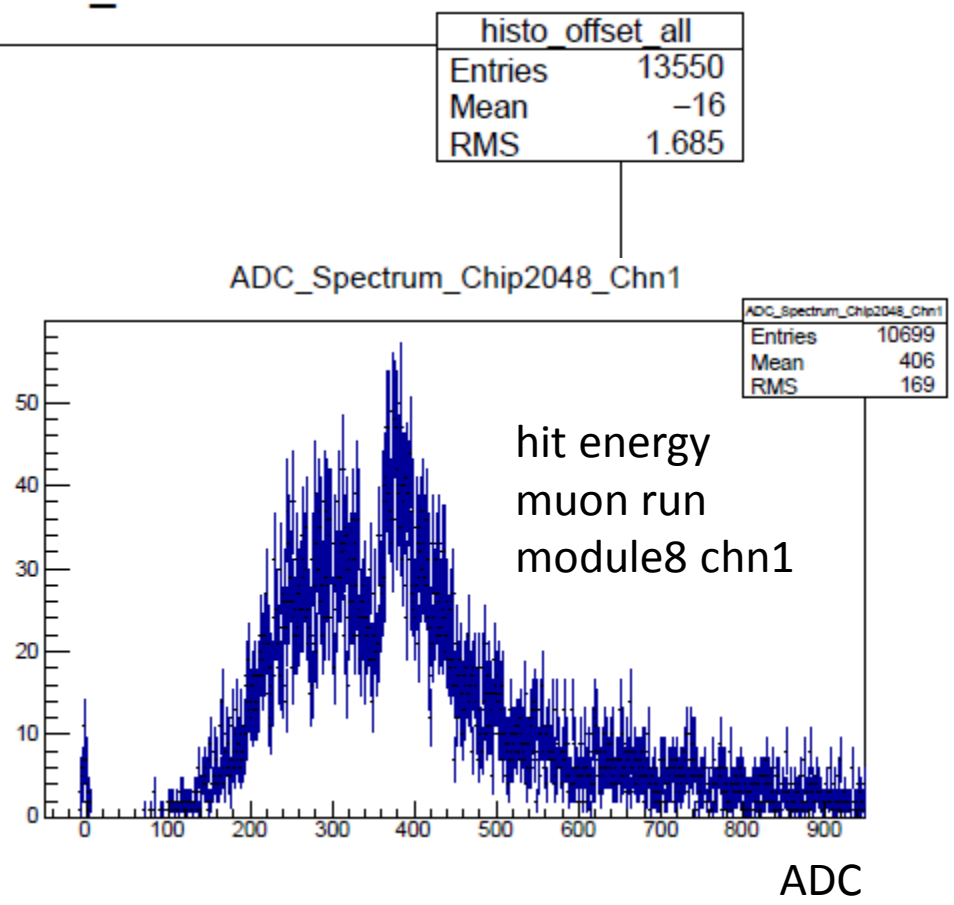


offset = LG_Pedestal_wHit - LG_Pedestal_woHit

LG_Pedestal_wHit = LG_MIP_MPV – HG_MIP_MPV/ICfactor

LG Pedestal Offset for hitbit1



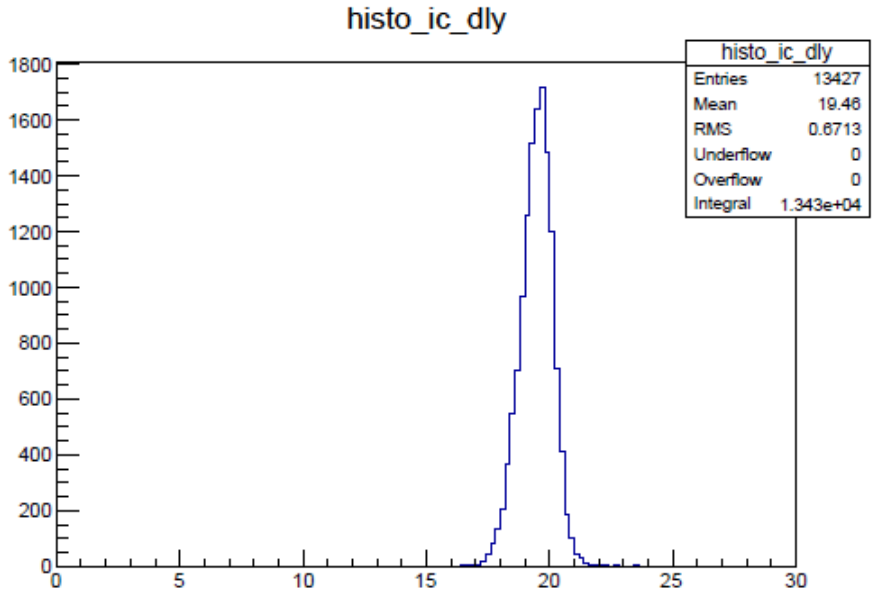


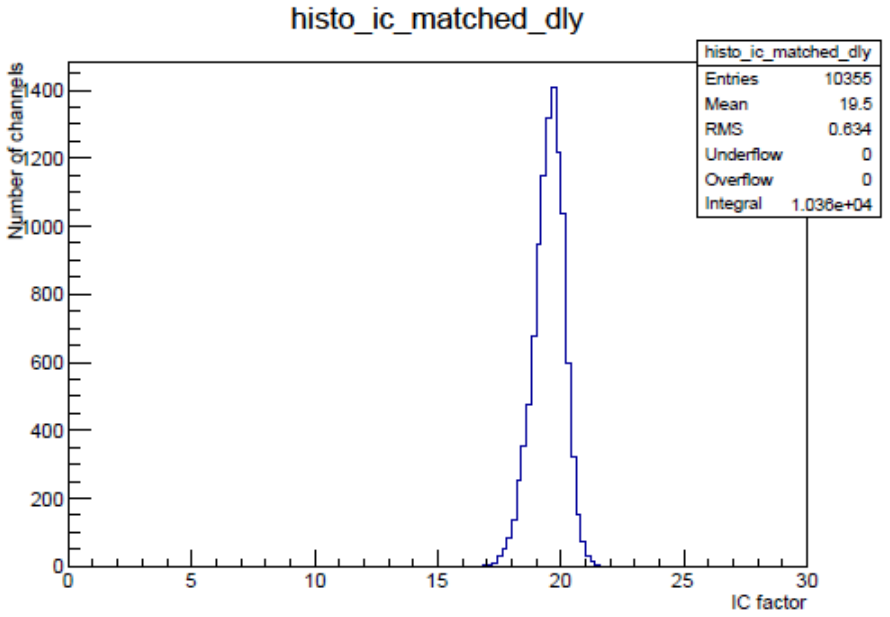
Summary

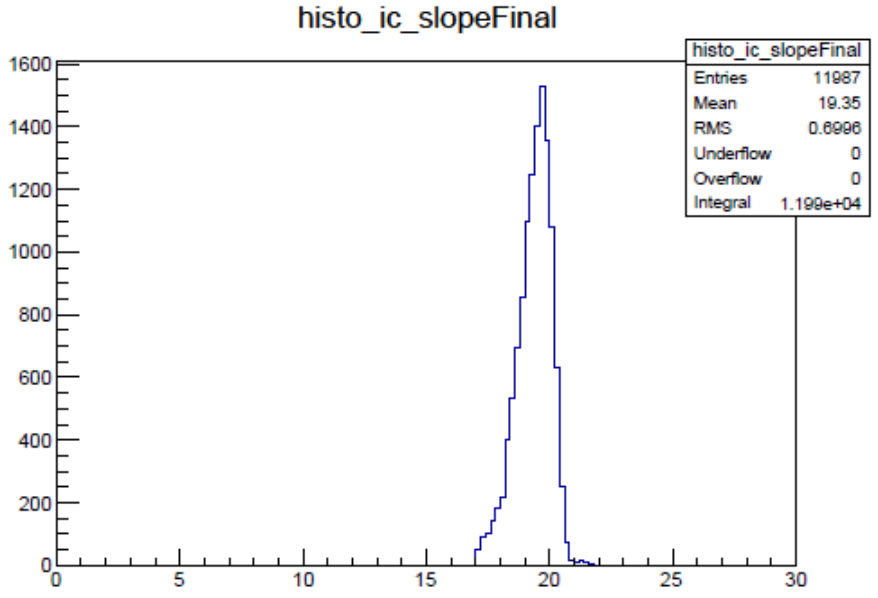
IC factor: higher order correction is applied to IC factor extracted from slope of HG vs LG output

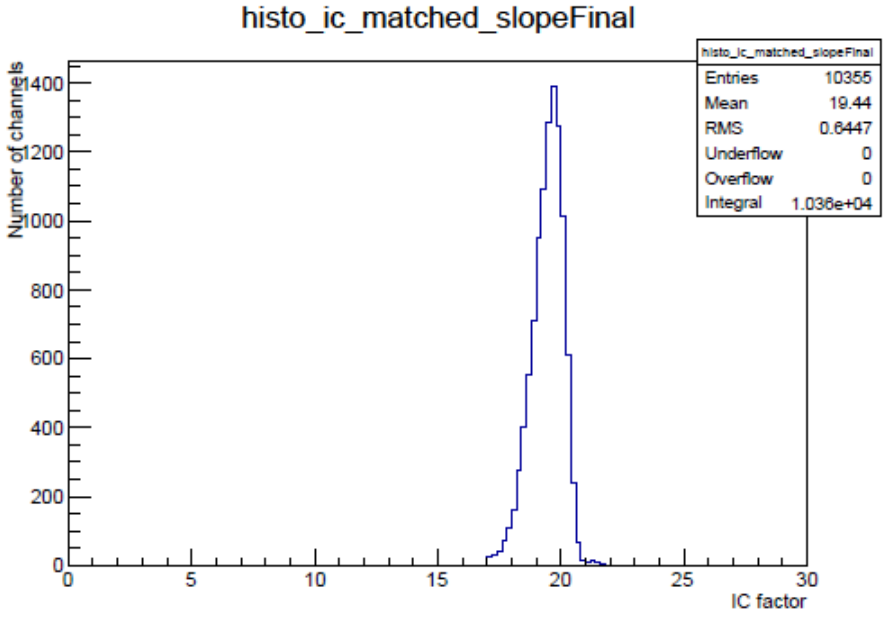
LG pedestal: need to figure out the strange peak on MIP spectrum

Backup


histo_ic_dly
histo_ic_dly
Entries 13427
Mean 19.46
RMS 0.6713
Underflow 0
Overflow 0
Integral 1.343e+04


histo_ic_matched_dly
histo_ic_matched_dly
Entries 10355
Mean 19.5
RMS 0.634
Underflow 0
Overflow 0
Integral 1.036e+04
Number of channels
IC factor


histo_ic_slopeFinal
histo_ic_slopeFinal
Entries 11987
Mean 19.35
RMS 0.6996
Underflow 0
Overflow 0
Integral 1.199e+04


histo_ic_matched_slopeFinal
histo_ic_matched_slopeFinal
Entries 10355
Mean 19.44
RMS 0.6447
Underflow 0
Overflow 0
Integral 1.036e+04
Number of channels
IC factor

IC factor from LED runs dHG_ADC/dLG_ADC

- Small LED V step is required to cancel out or reduce impact of pedestal shift.

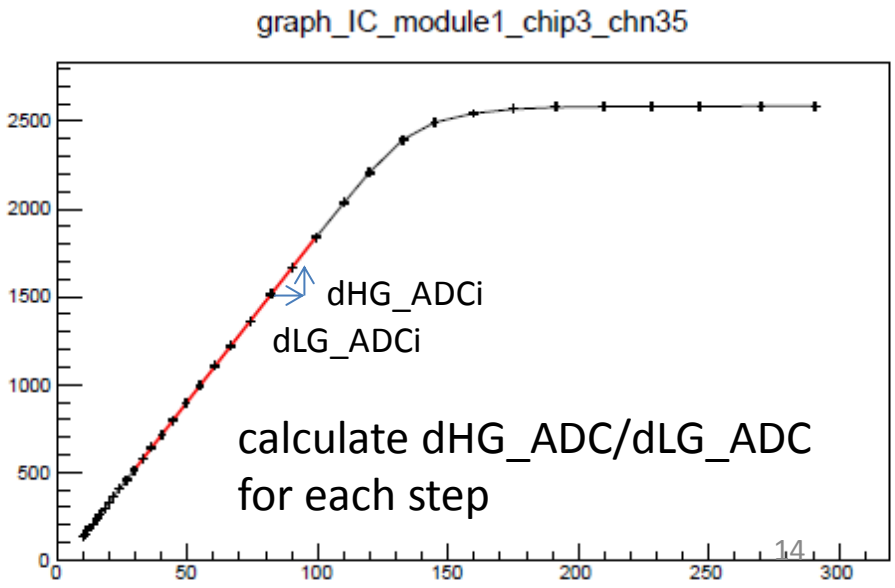
ΔLight yield * HG = $(HG\_ADC_{i+1} - HG\_ADC_i)$

ΔLight yield * LG = $(LG\_ADC_{i+1} - LG\_ADC_i)$

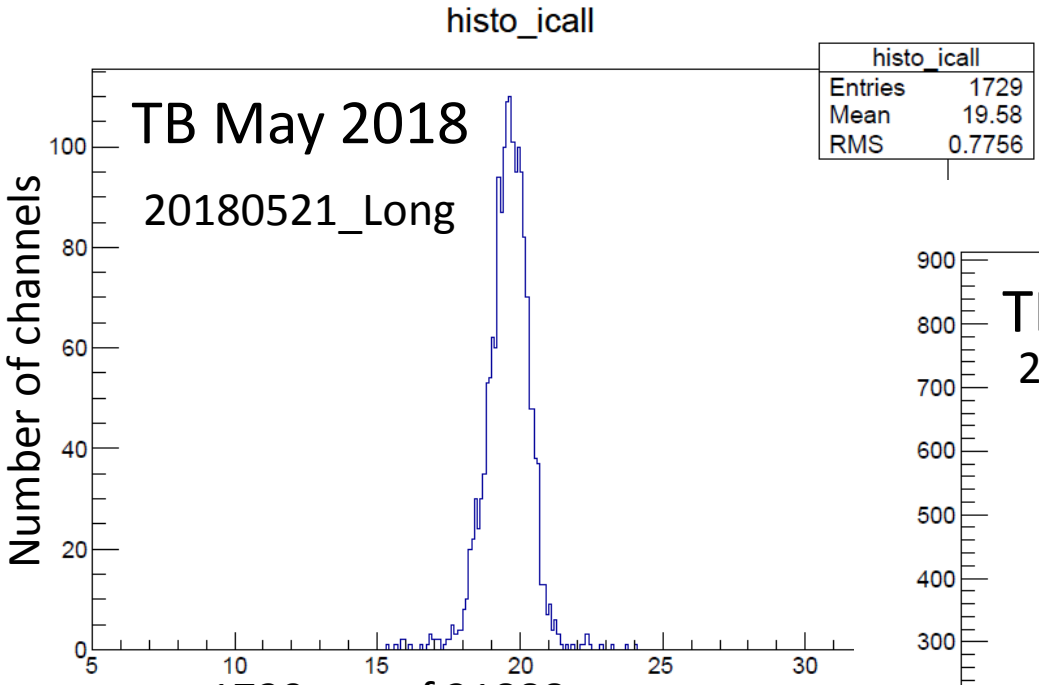
IC = HG/LG = $(HG\_ADC_{i+1} - HG\_ADC_i)/(LG\_ADC_{i+1} - LG\_ADC_i)$

constraints

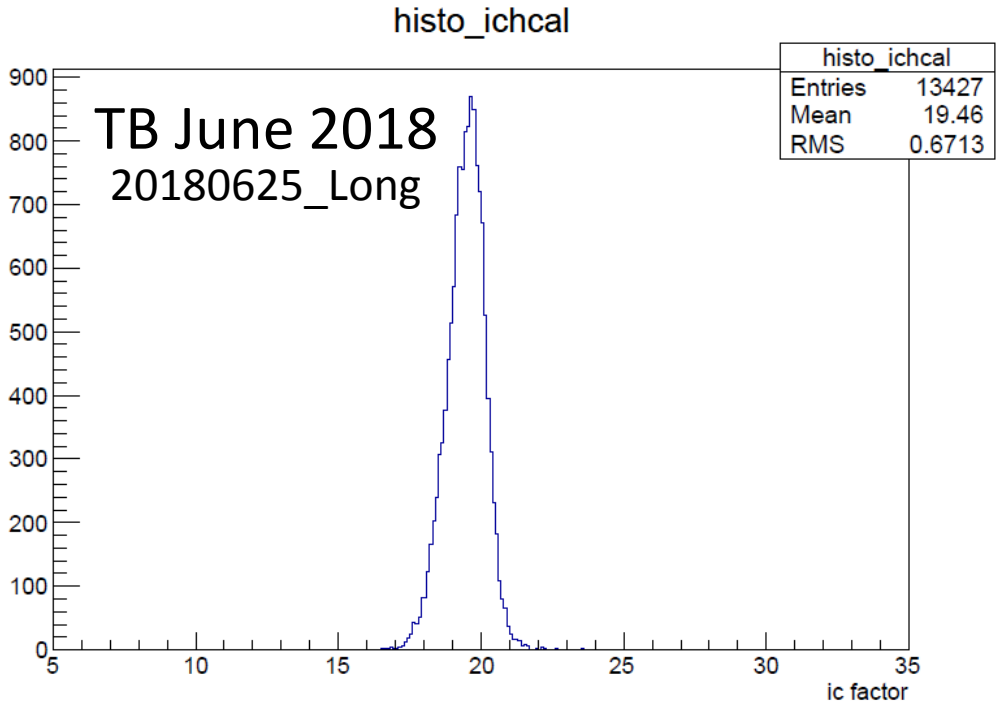
- reasonably large signal
- $HG\_ADC_{i+1} - HG\_ADC_i > 100$
- $30 < LG\_ADC_{i+1} - LG\_ADC_{ped} < 100$
- total amount of charge in a chip < 60000



LED Run May and June 2018 LG1200



1729 out of 21888
5 sets of LED run for IC
(10+1 runs)
Average of slopes and
memory cells per channel

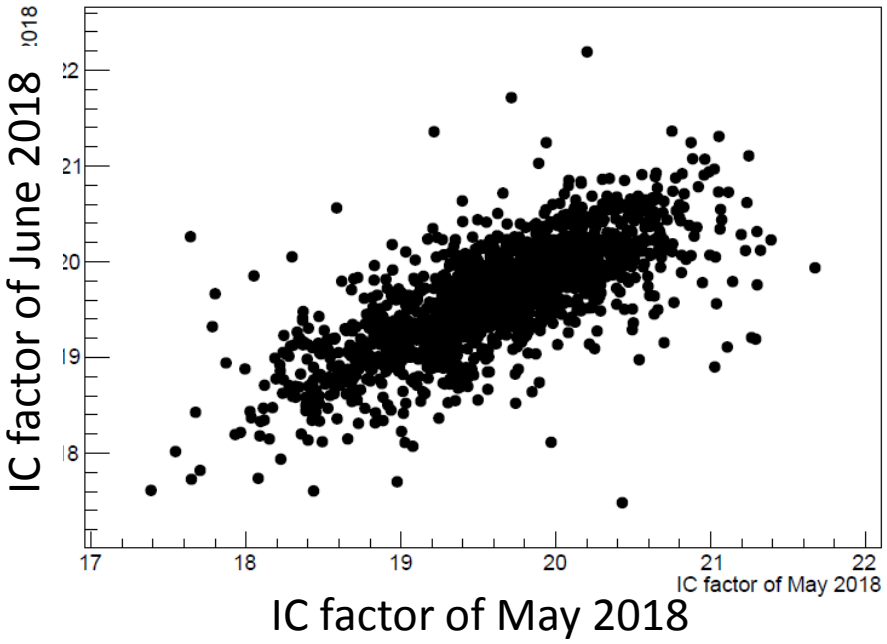


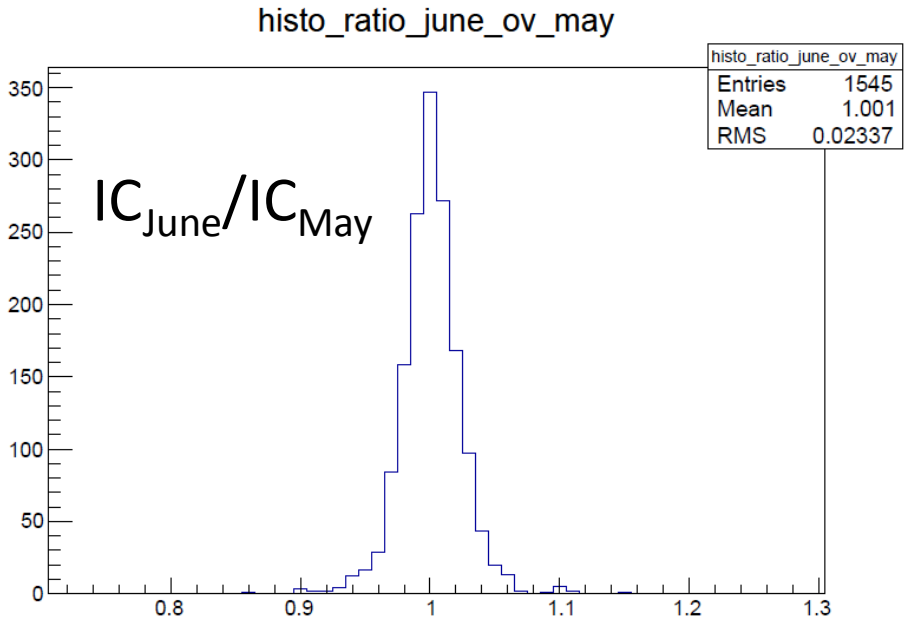
13427 out of 21888
101+1 runs

Channel-to-channel spread 3.5-4%

Comparing IC factor of June and May 2018

after reject outliers: range of plots is mean $\pm$ 3xRMS of IC histogram

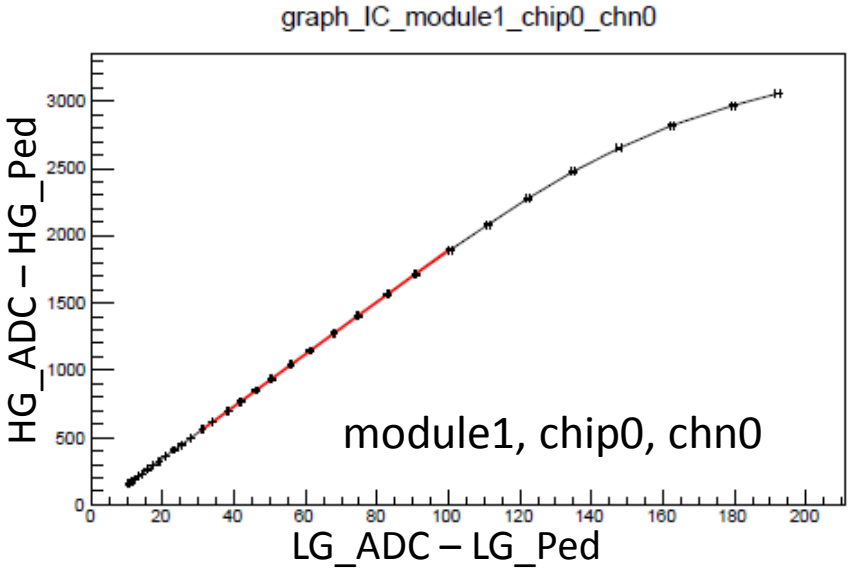


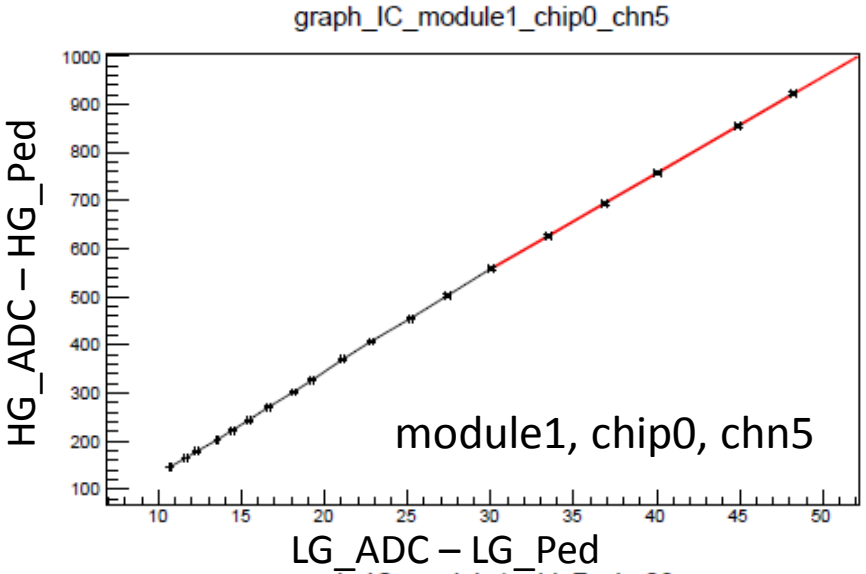


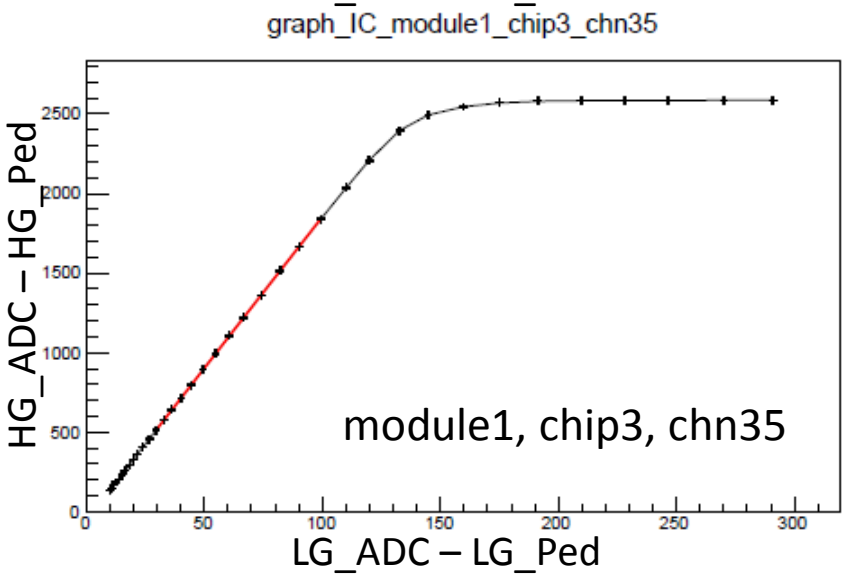
RMS of IC_{June}/IC_{May} is 2.3%, mean is 1.001 $\pm$ 0.0006

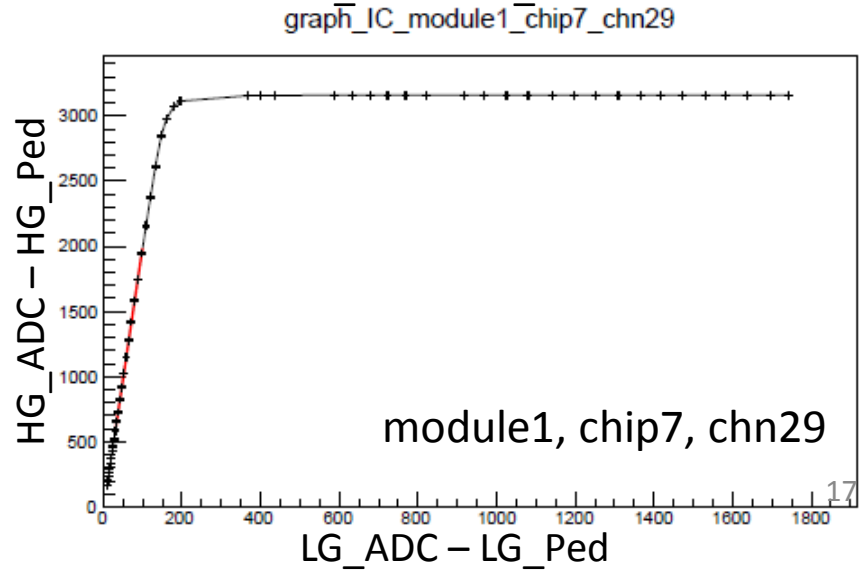
Slope of HG vs LG

- after pedestal subtraction
- fitting range 30 < LG < 100
- total amount of charge in a chip < 60000 ADC (HG)
- at least 5 points in the fitting range



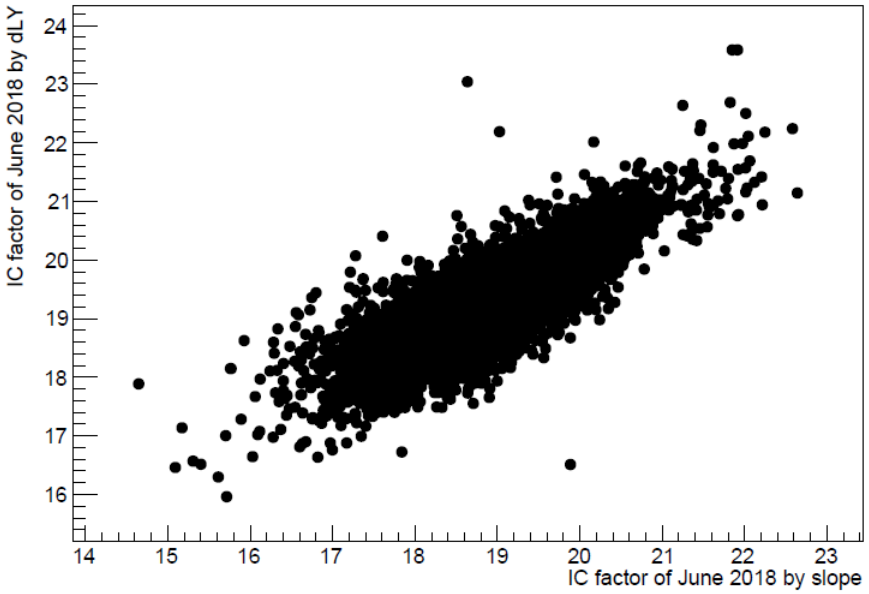




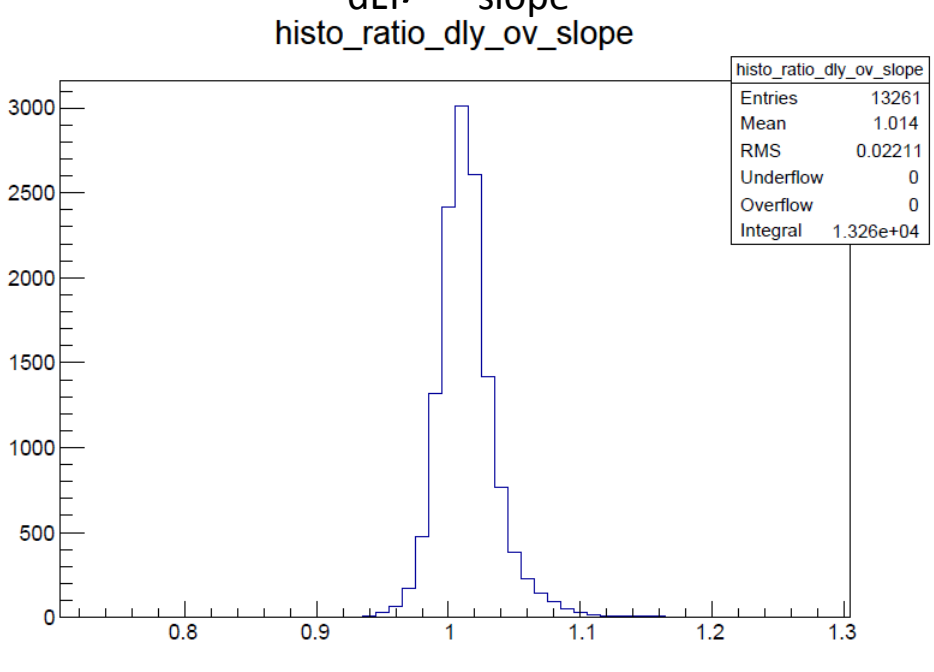


IC factor dLY vs Slope and IC_{dLY}/IC_{slope}

dLY vs Slope



IC_{dLY}/IC_{slope}



- Mean of IC_{dLY}/IC_{slope} 1.014 → 1.4% systematic shift
- RMS = 0.022

IC factor extracted by dLY and slope

1. fill IC values extracted by dLY within mean +/- 3*rms of IC histogram of dLY
2. fill IC values extracted by slope within mean +/- 3*rms of IC histogram of slope, if the IC values are not filled by first step.