

SCECAL 2009 @ FNAL



CALICE MEETING AT LYON

SEP/2009



TOHRU TAKESHITA

SHINSHU, KOBE, TSUKUBA & KNU

STATUS REPORT

FNAL BEAM TEST ON MAY 2009

COMBINED WITH HACAL & TC

CALICE FNAL BEAM TEST 2009

□ SCECAL+AHCAL+TC

□ MAY 2009

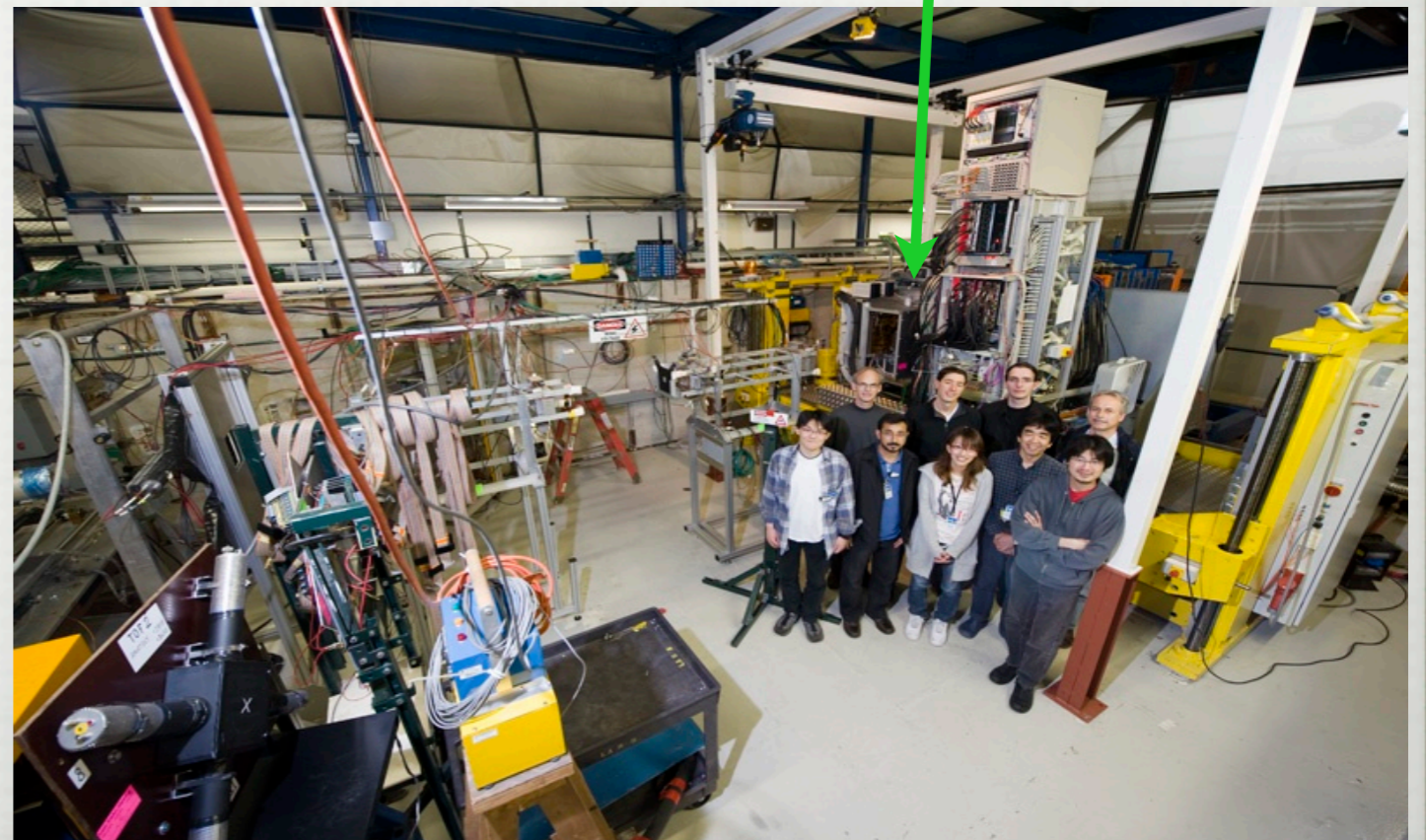
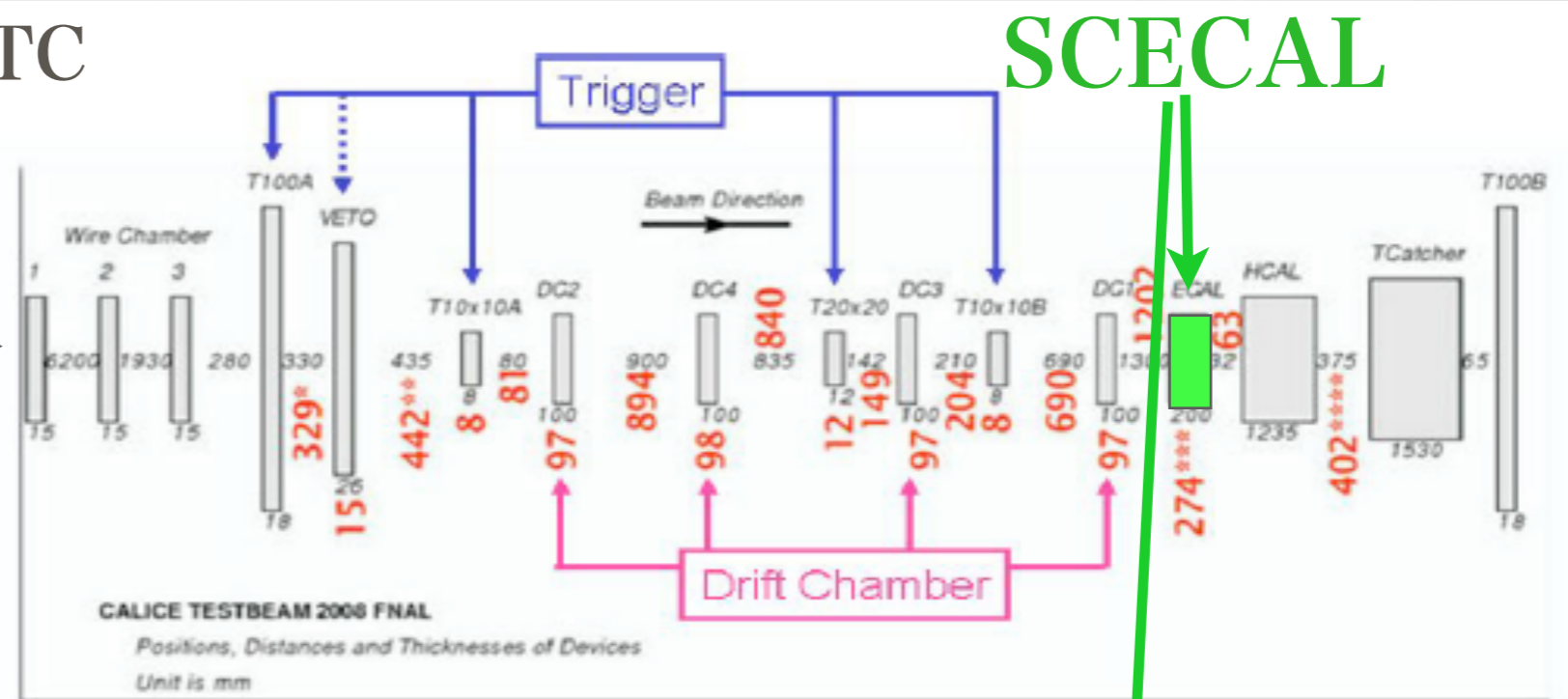
□ SEP 2008 BEAMS

□ SAME DETECTOR

□ WITH YOUNGERS

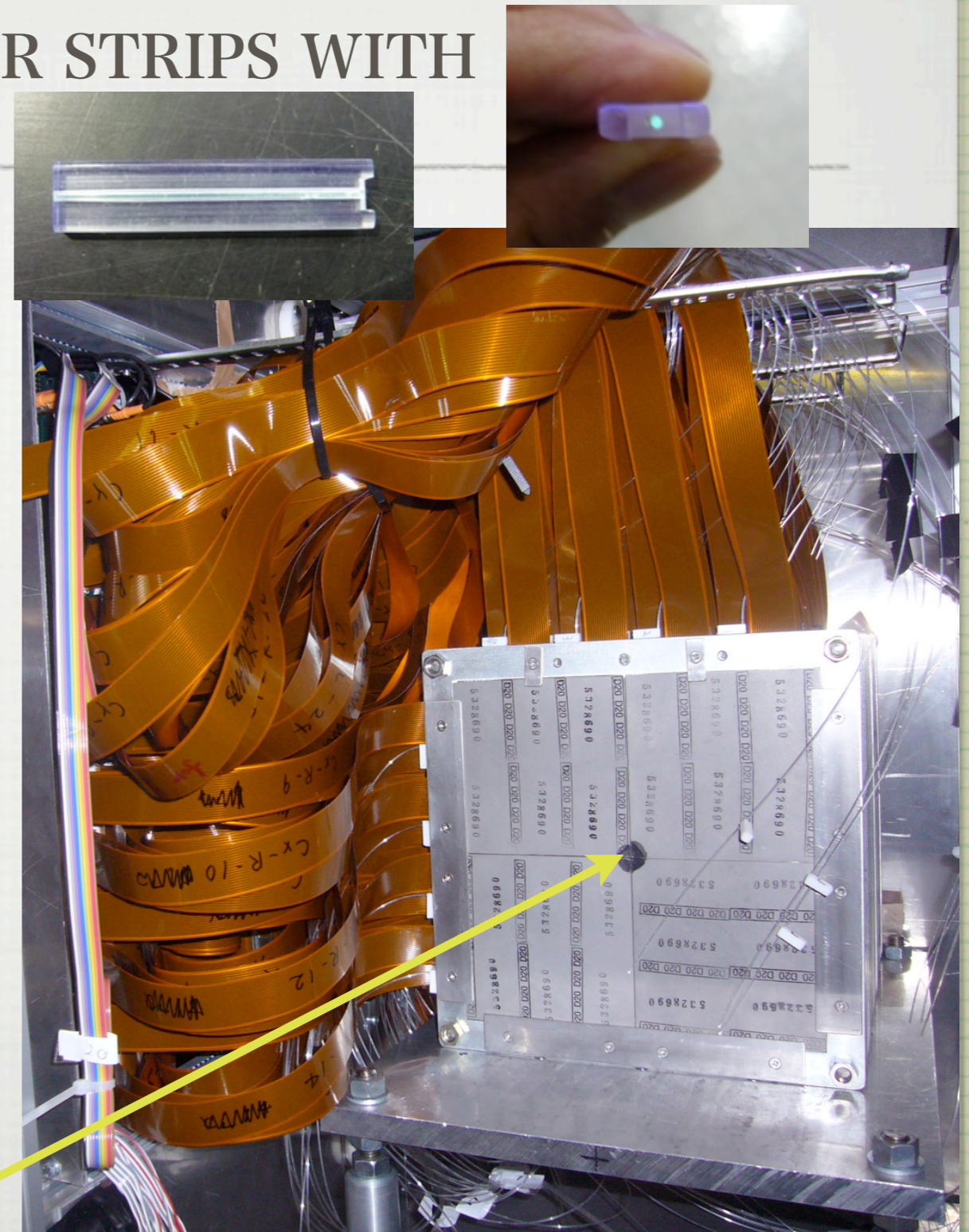
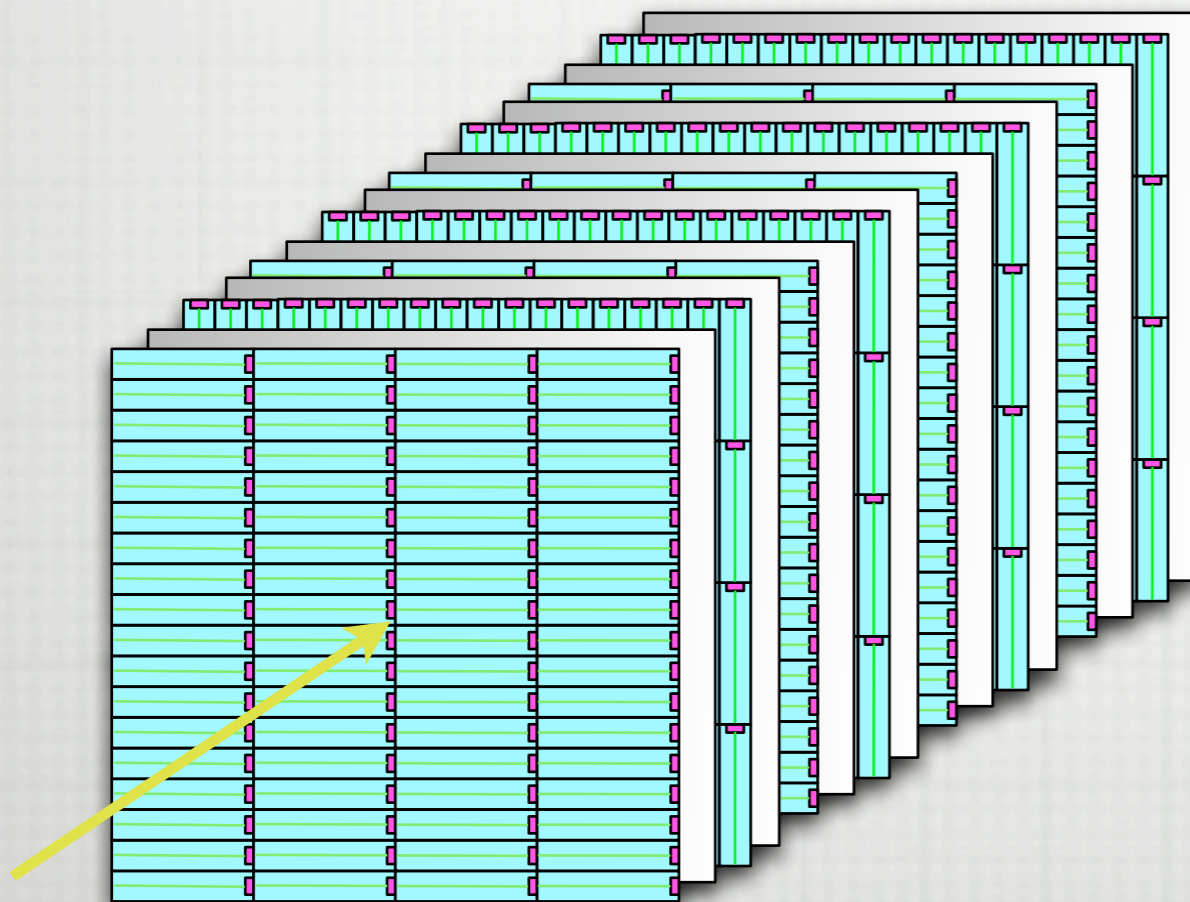
□ ONE PHD STUDENT FROM KNU AND ONE FROM SHINSHU

□ TWO MASTER STUDENTS FROM SHINSHU



SCECAL 2008-2009

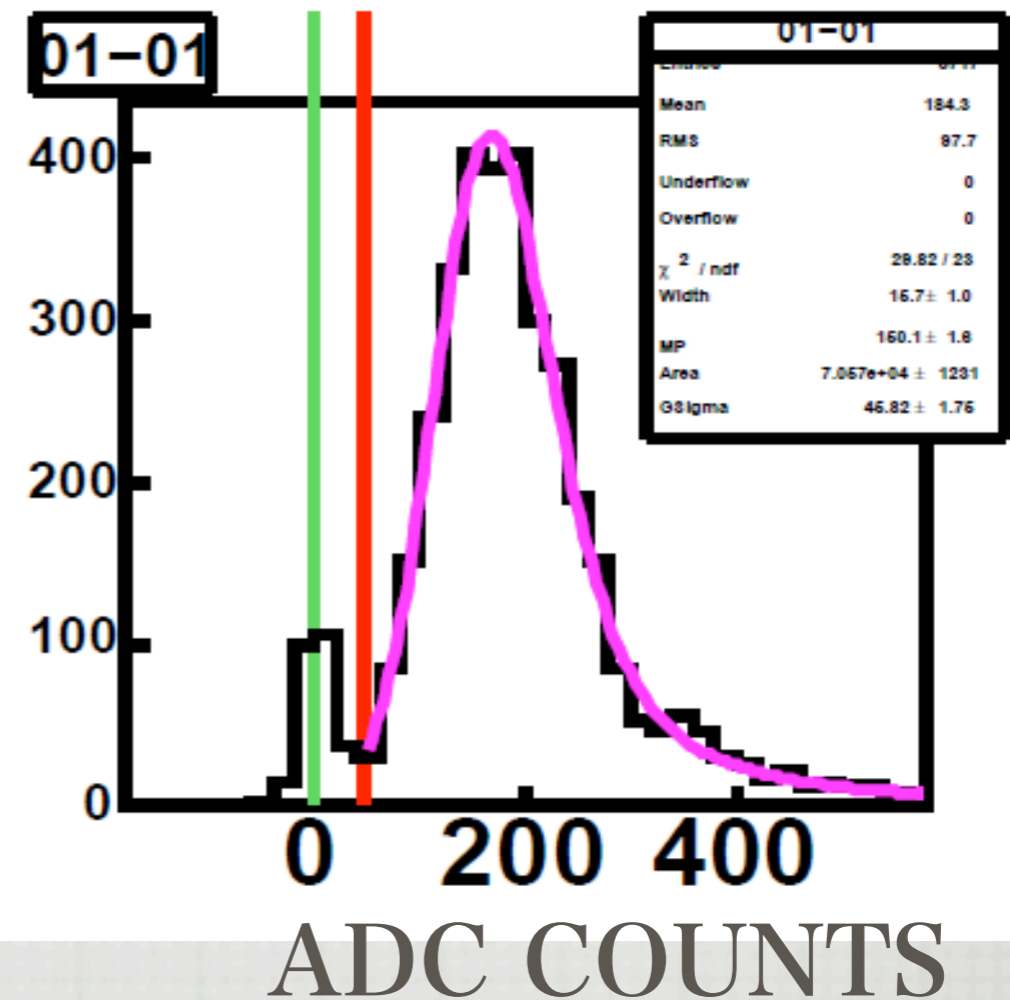
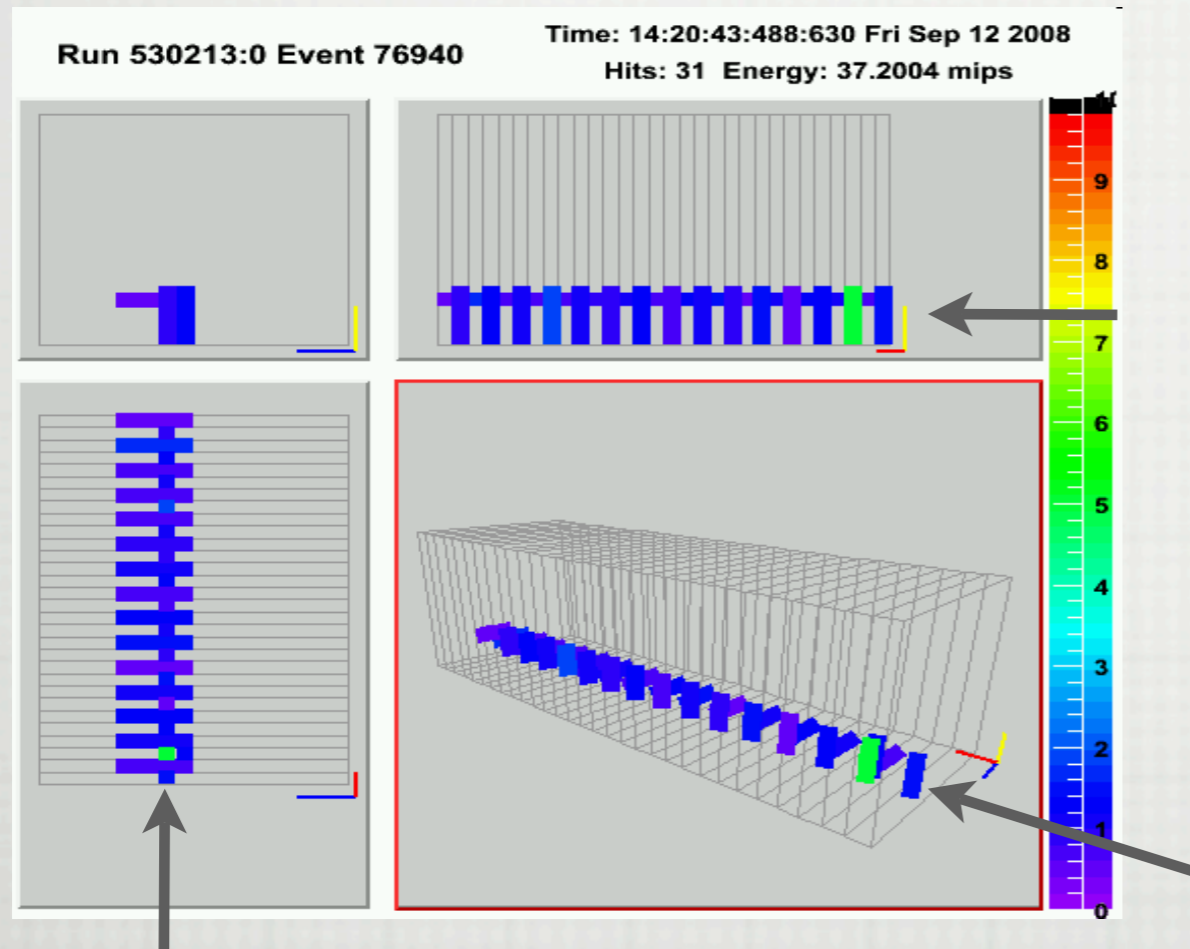
- 10X45X3 MM³ SCINTILLATOR STRIPS WITH A MPPC
- 72 X 30 LAYERS = 2160CH
- X-Y STRIP STRUCTURE
- TUNGSTEN 3.5 MM



MIP CALIBRATION

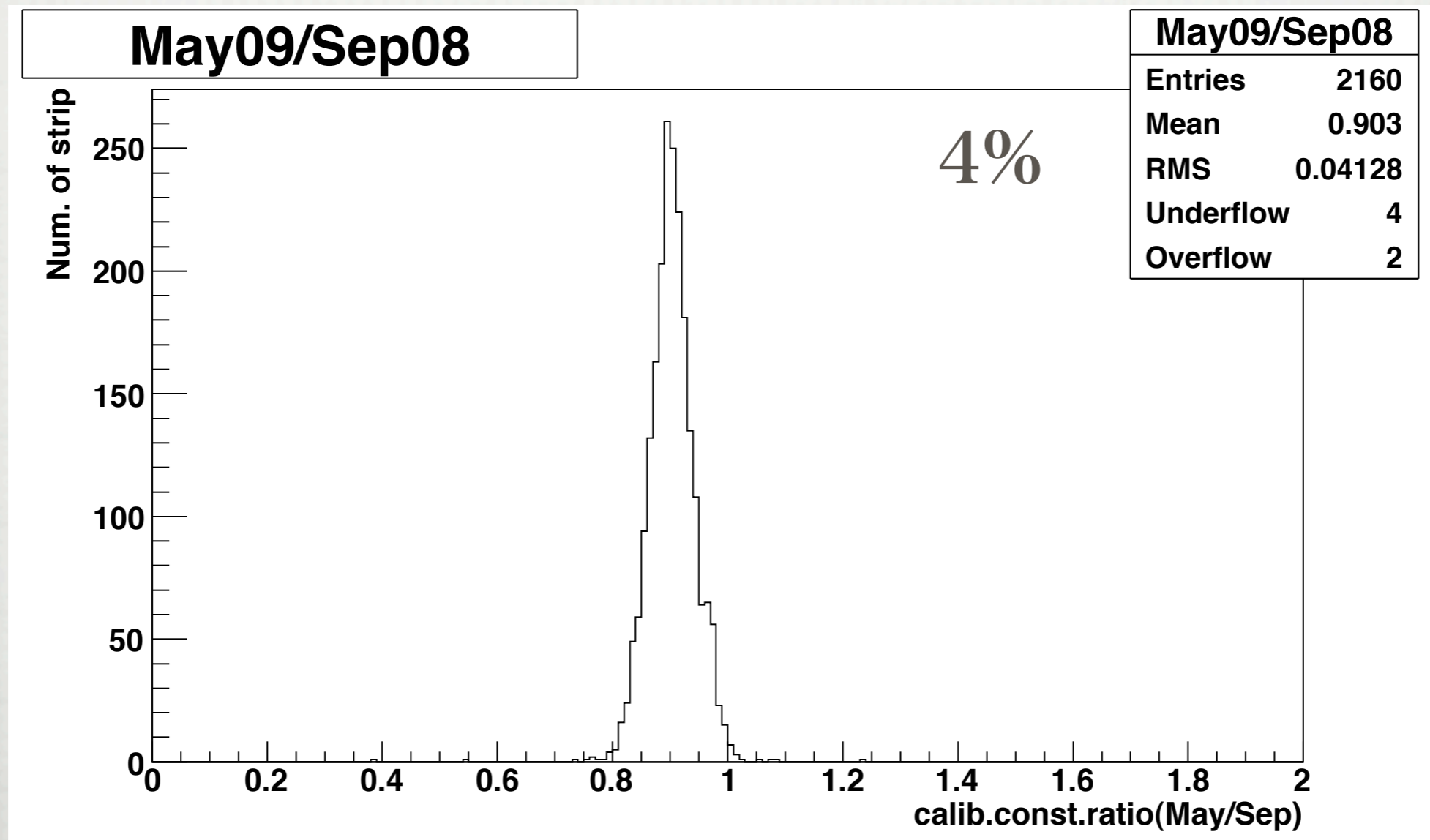
- BY 32 GEV MUONS
- TRIGGERED BY 20X20 CM²
- LANDAU CONVOLUTED GAUSSIAN

MIP RESPONSE



COMPARISON 2008 VS 2009

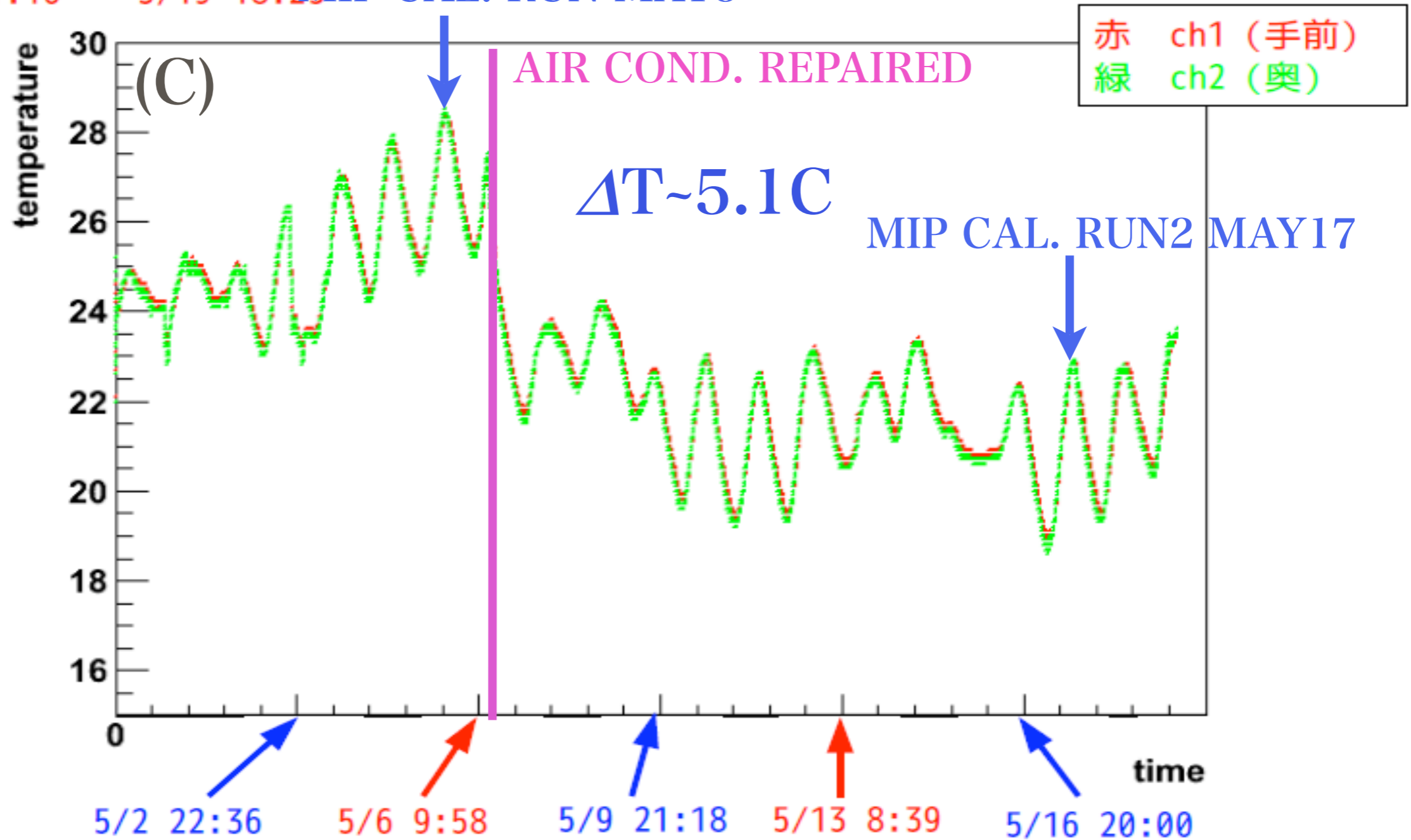
- RATIO OF MIP CALIBRATION CONST.
- THE SAME DETECTOR IN 2008 AND 2009
- SHIFT DUE TO TEMPERATURE



MAY 2009 AT MT6

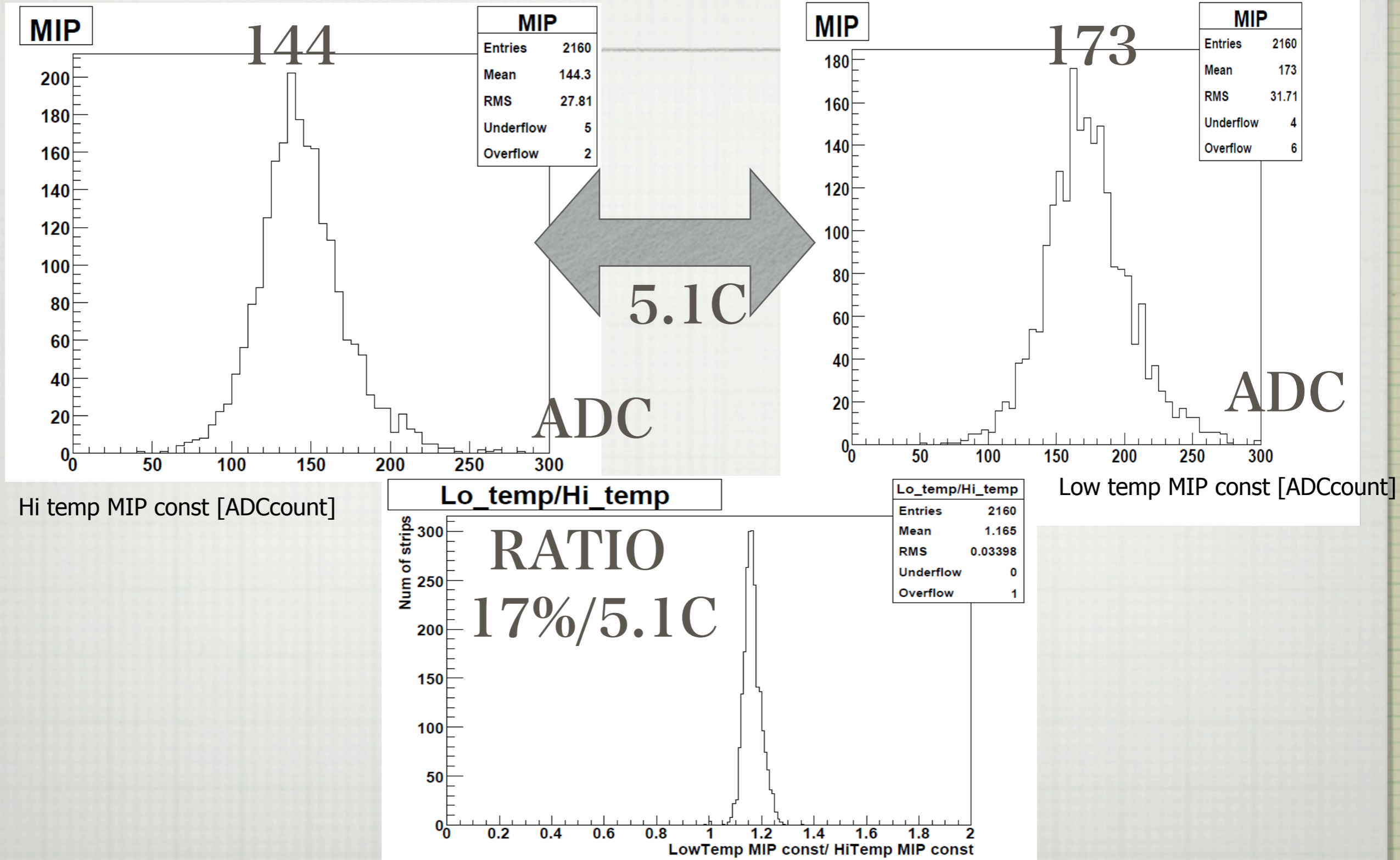
Temperature

4/29 11:16 ~ 5/19 18:23 MIP CAL. RUN MAY5



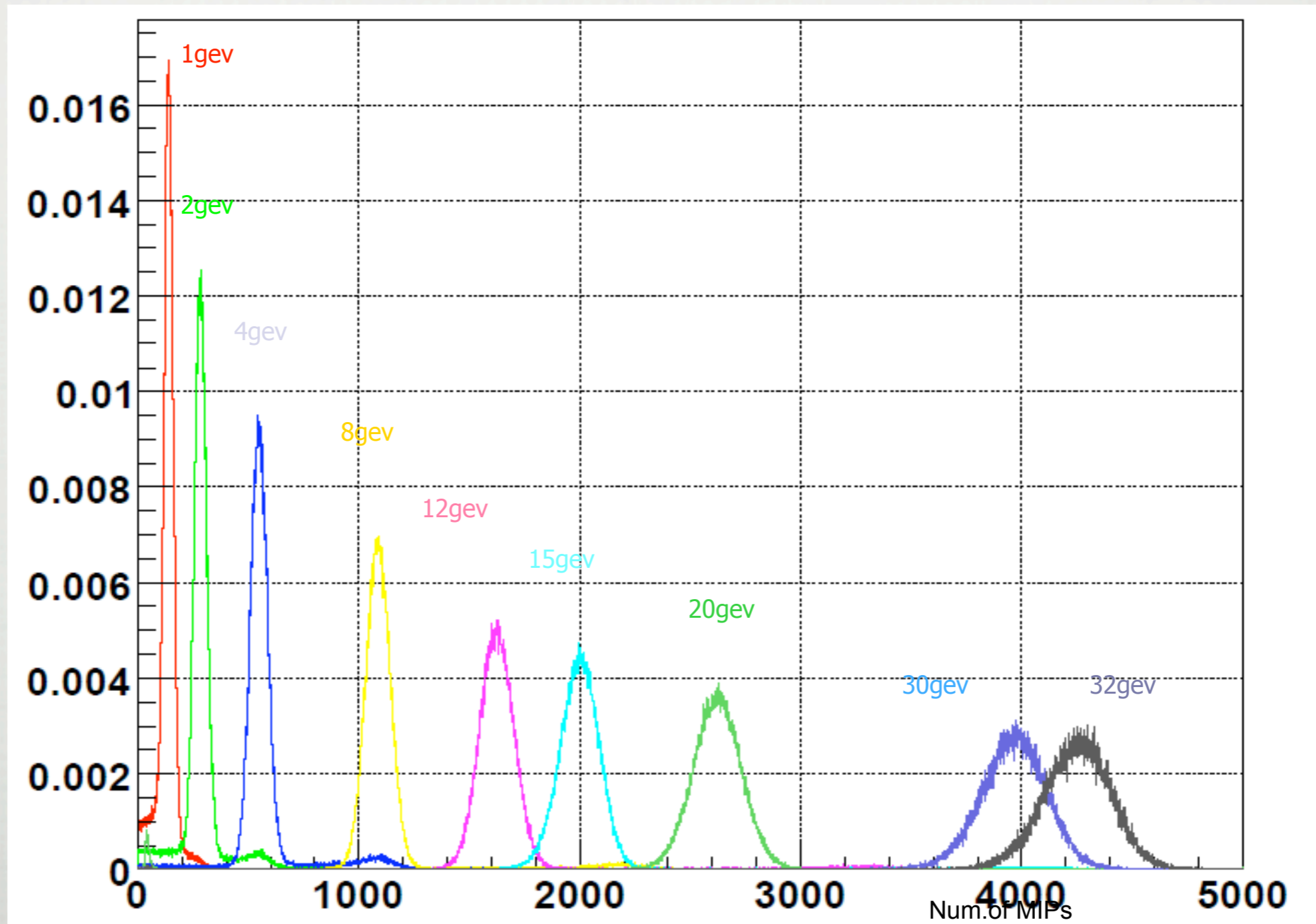
TWO MIP CALIB. RUNS

□ LOW AND HIGH TEMPERATURE



ENERGY MEASUREMENT

- 1,2,4,8,12,15,20,30,32 GEV ELECTRONS



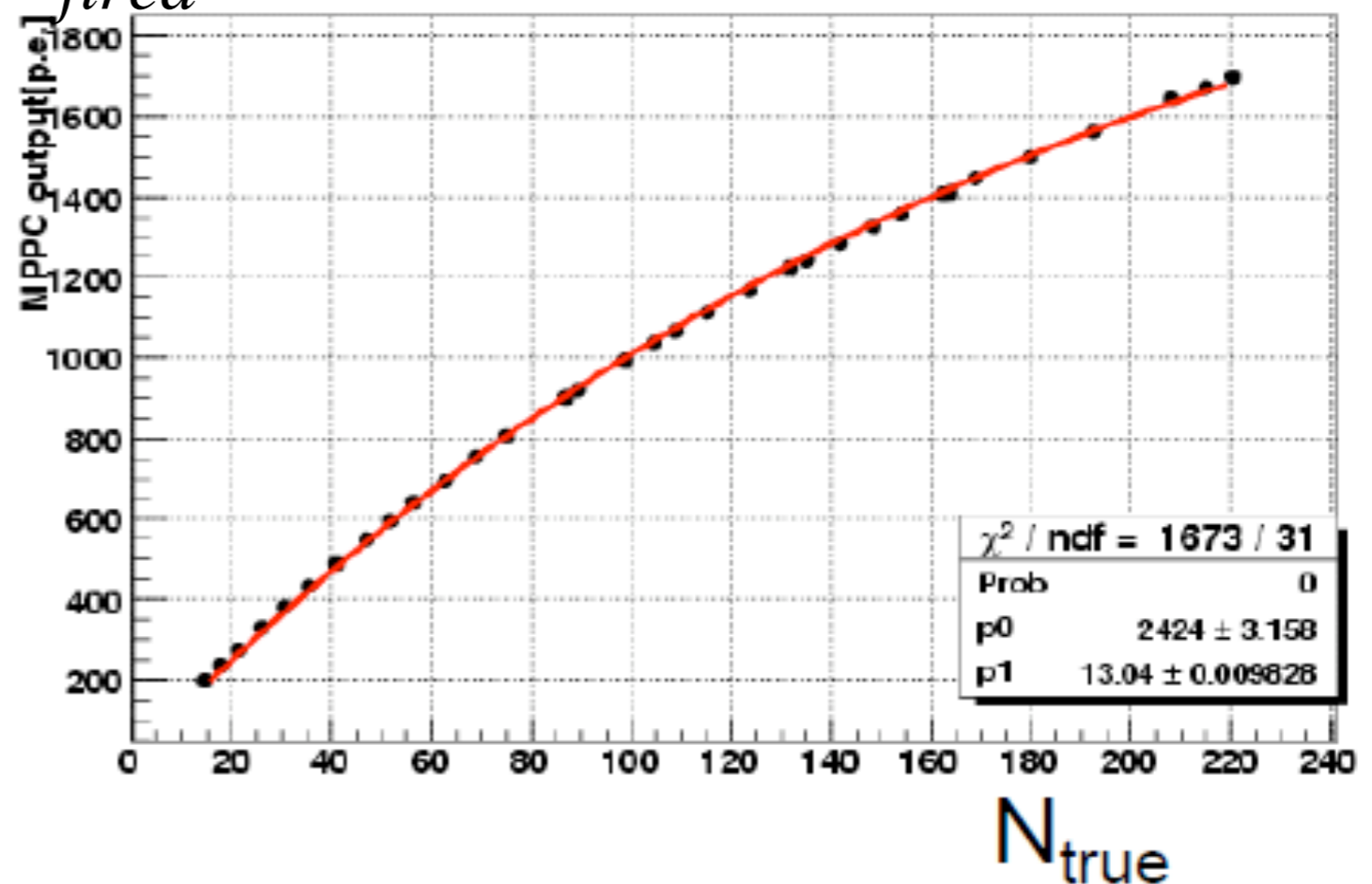
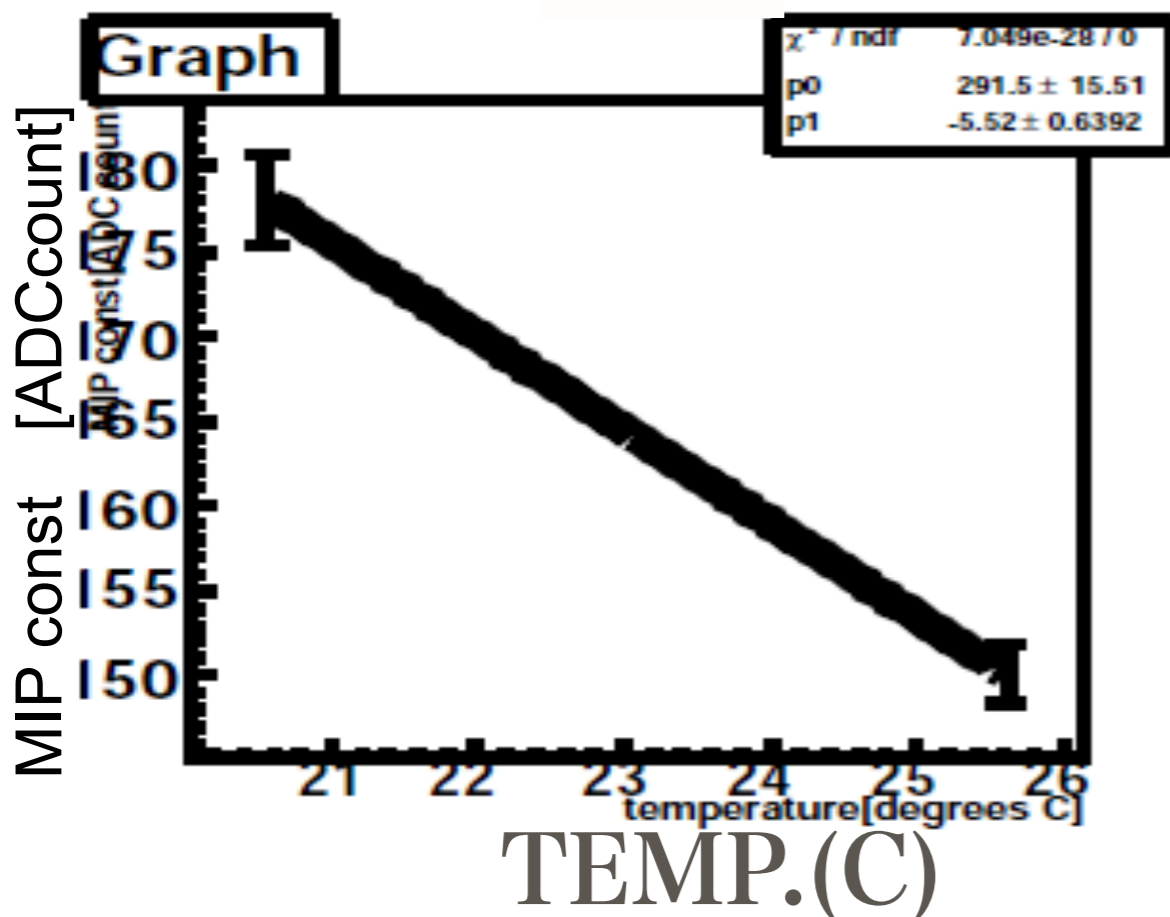
CORRECTIONS

- TEMPERATURE : FOR EACH CH., BY TWO MIP CALIB.
- SATURATION : A FUNCTION

$$N_{fired} = N_{p0} \left(1 - \exp\left(\frac{-p1 N_{true}}{N_{p0}}\right) \right)$$

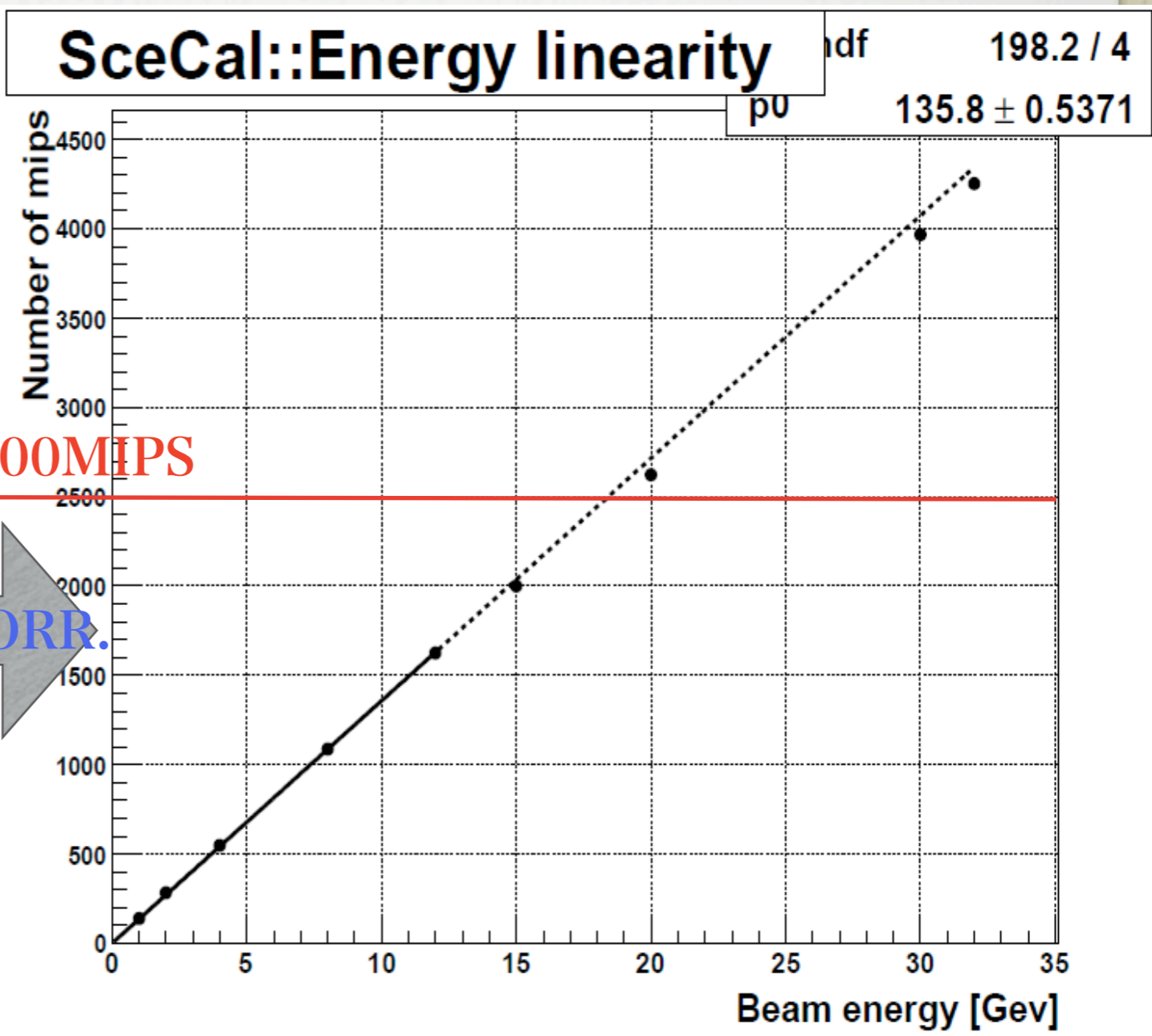
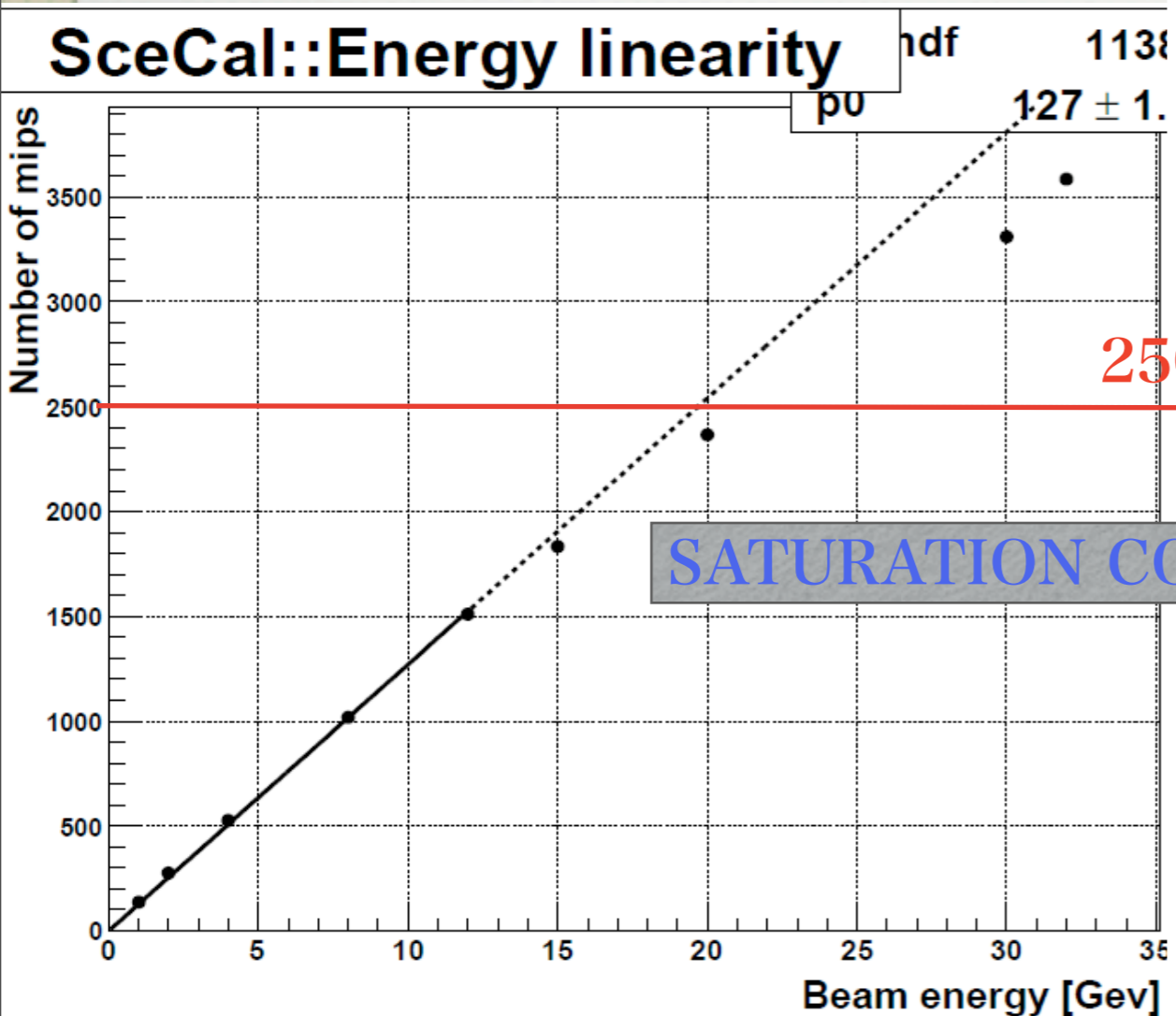
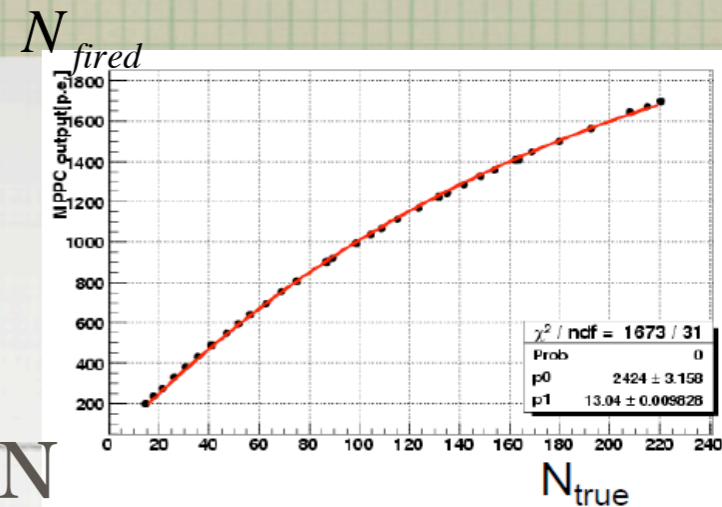
2 MIP RUNS

5.1C



LINEARITY

- SATURATION CORRECTION EFFECT
- BEFORE CORRECTION > AFTER CORRECTION
- N MIP VS EBEAM

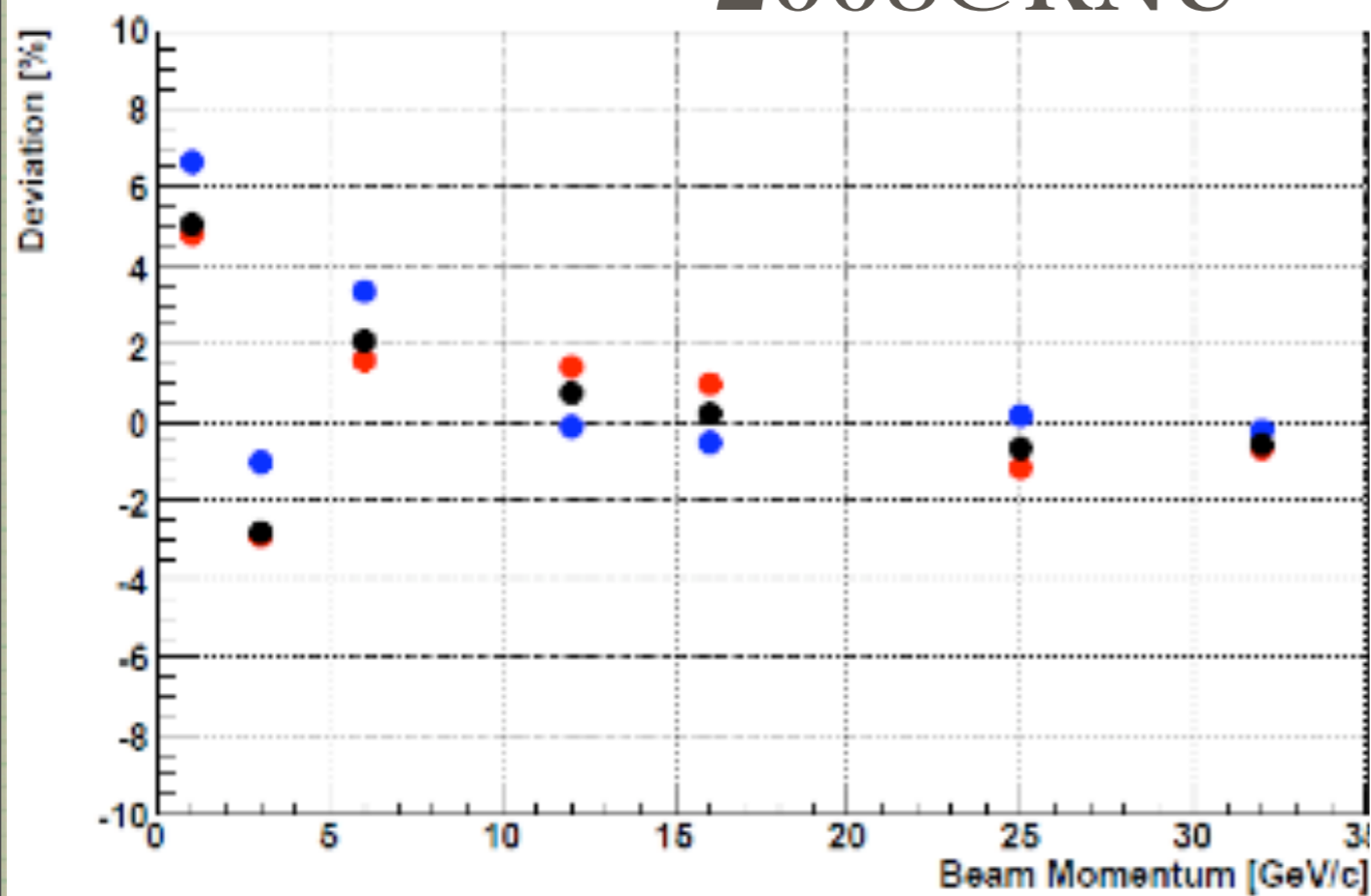


DEVIATION FROM LINEAR

- 2008 VS 2009
- SAME $\pm 10\%$ SCALE WITHIN 2-32GEV
- VERY SIMILAR STRUCTURE

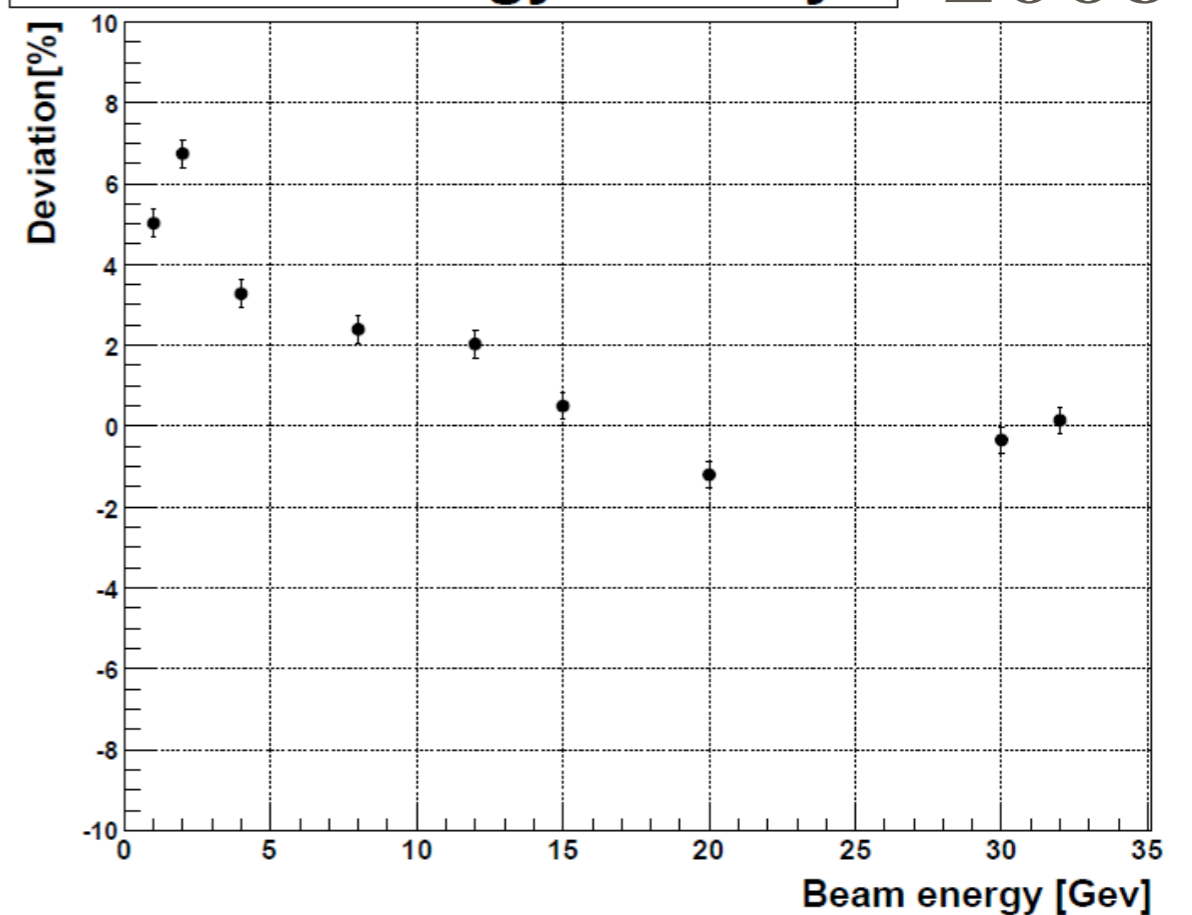
Deviation from linear fitting

2008@KNU



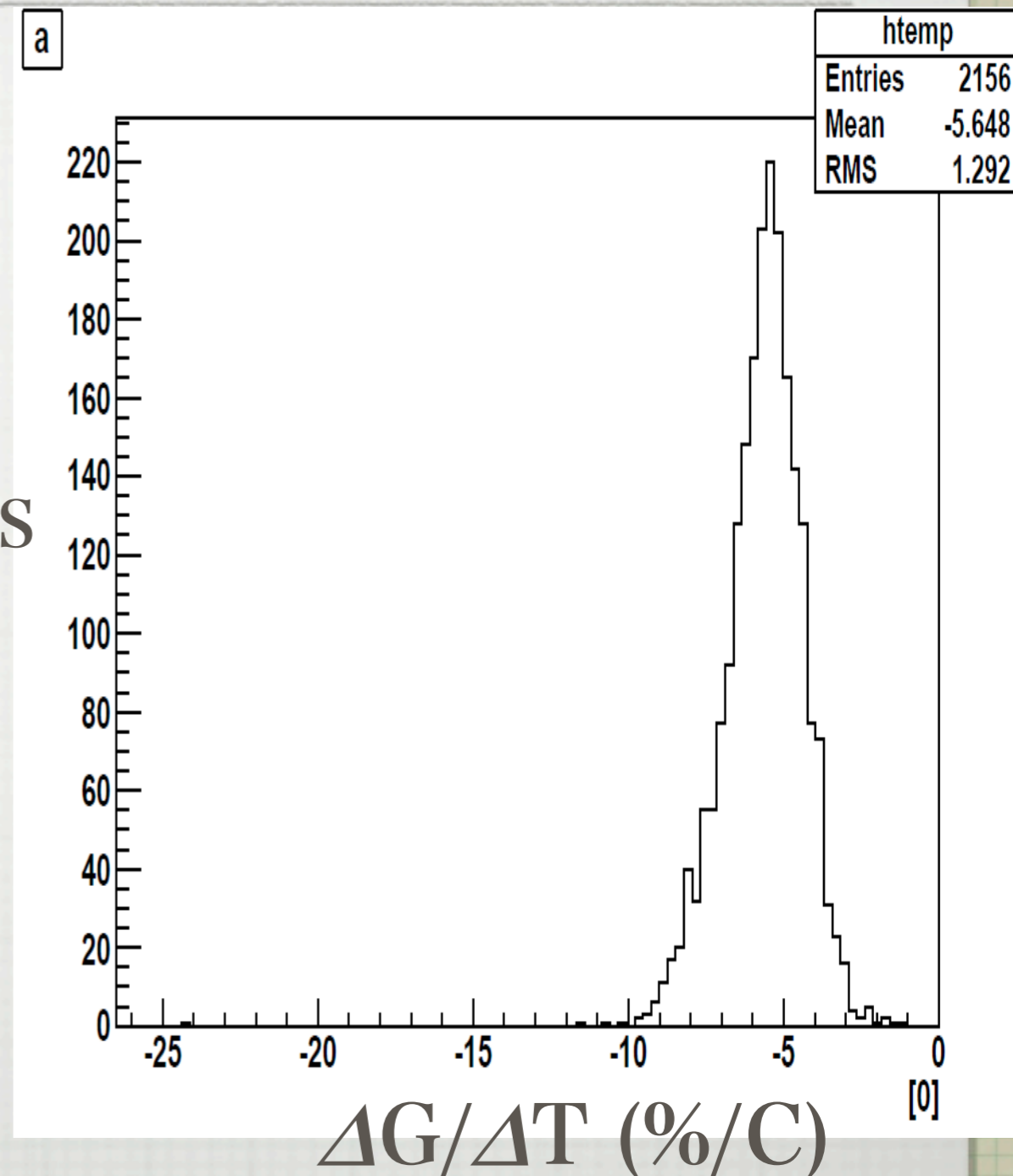
SceCal::Energy linearity

2009



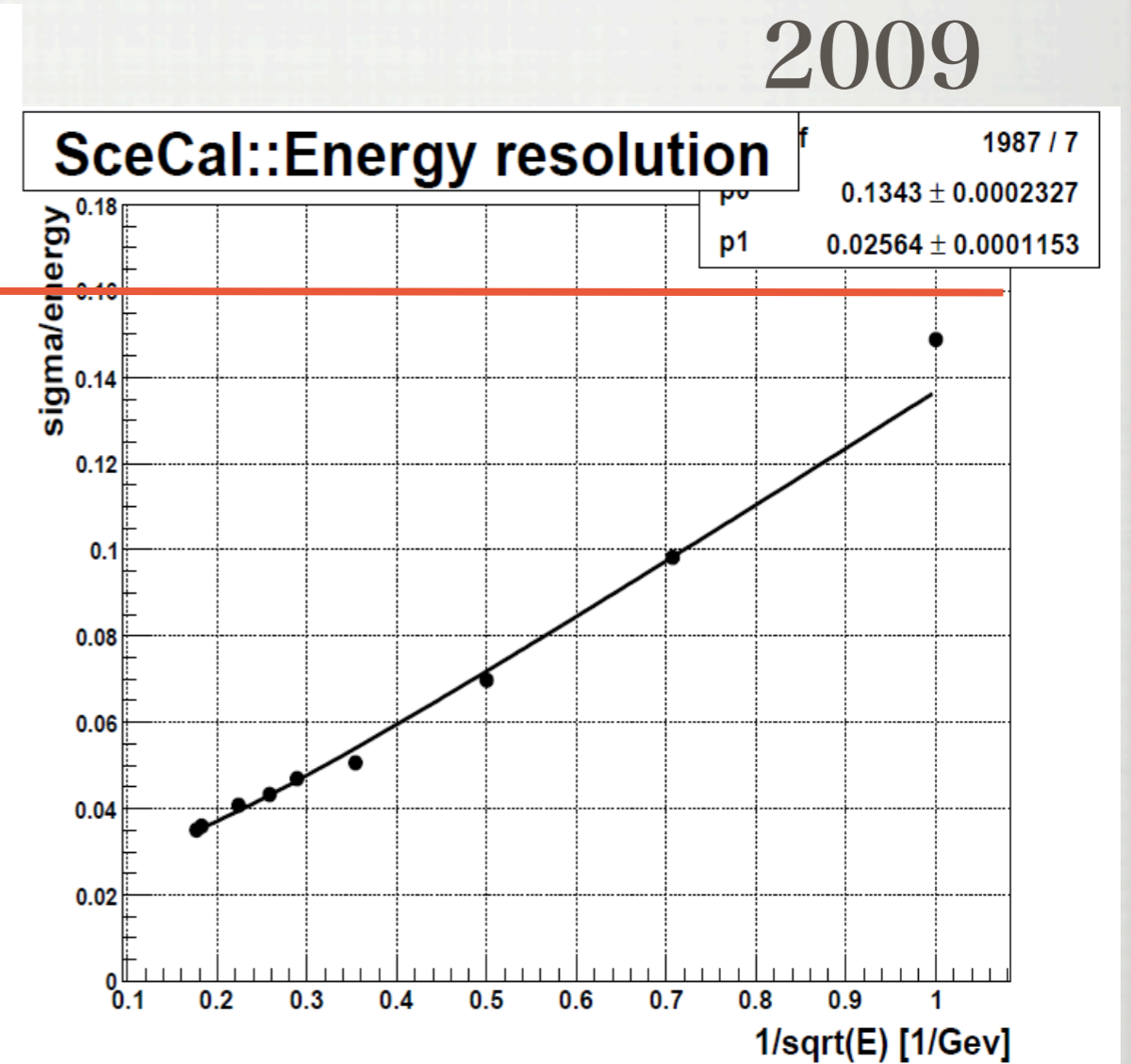
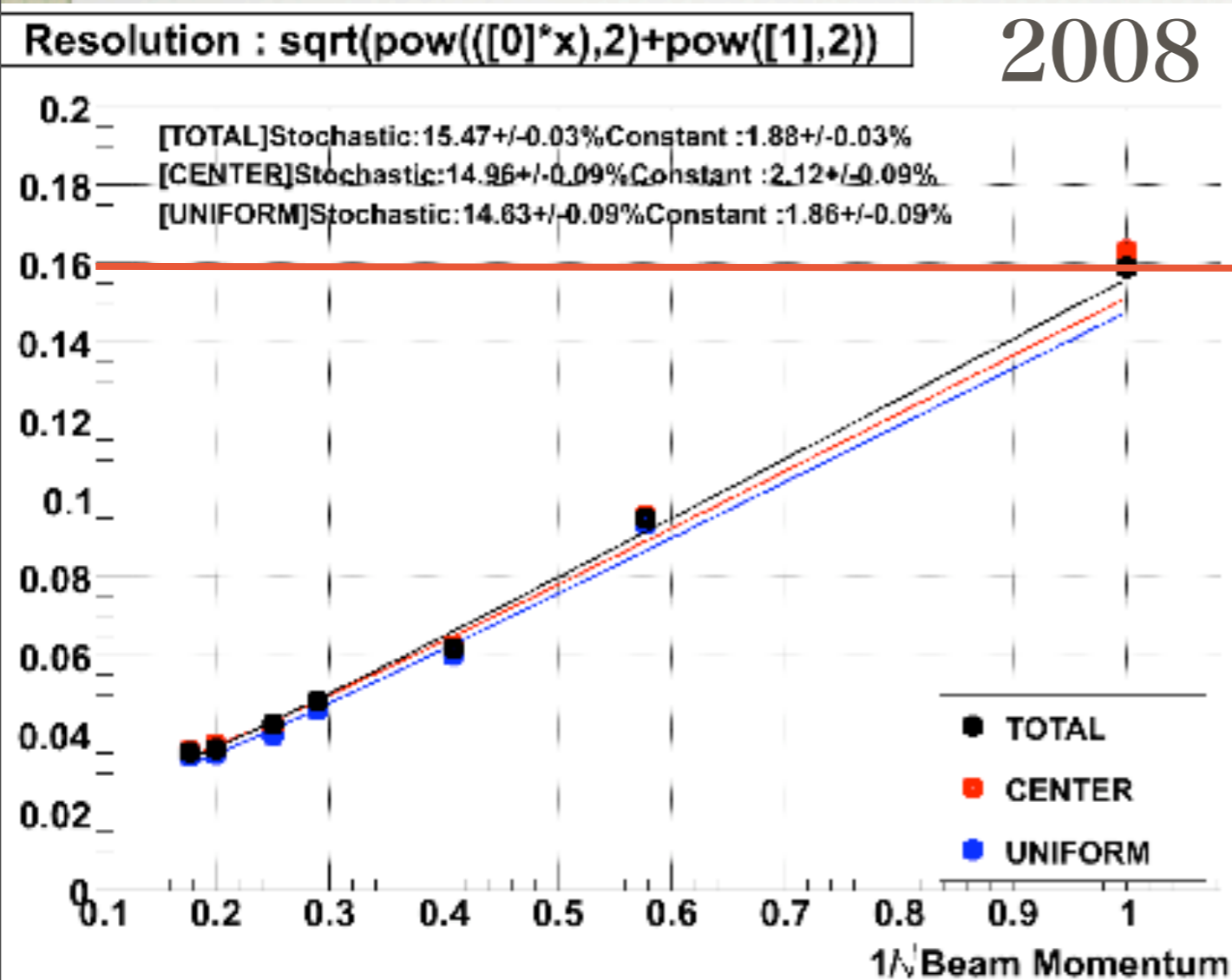
TEMPERATURE COEF.

- TEMPERATURE COEFFICIENTS
- $\sim -5.6 \text{ \%/C}$
- MAINLY DUE TO MPPC
- INCLUDING FIBRE AND SCINTILLATOR CONTRIBUTIONS



RESOLUTION

□ 2008 VS 2009



$$\frac{\sigma}{E} = \frac{14.86\%}{\sqrt{E}} \oplus 1.86\%$$

$$\frac{\sigma}{E} = \frac{13.43\%}{\sqrt{E}} \oplus 2.56\%$$

SUMMARY

- DATA ANALYSIS 2009
 - DONE BY STAND ALONE MODE
 - CALICE FRAME WORK ANALYSIS ON GOING
- STILL MANY THINGS TO BE CARRIED OUT
TO DO LIST

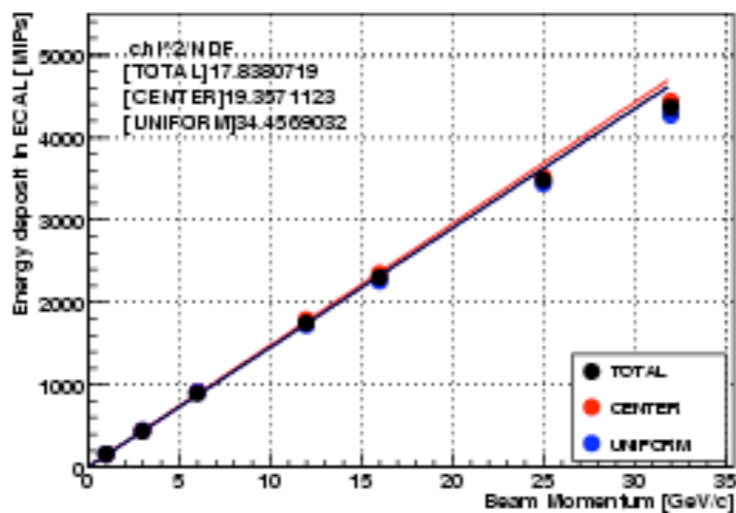
TO DO ON FNAL DATA

- BASIC TESTS (PEDESTALS, GAINS, TEMP.,,,)

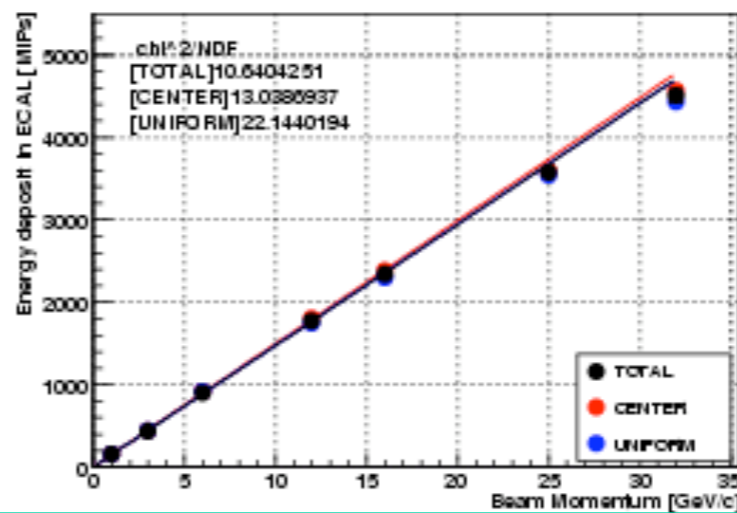
- IMPROVE PION REJECTION CUTS
- VERIFICATION OF LED GAIN MONITORING SYSTEM
- ANALYSIS
 - PI-ZERO
 - ANGLED BEAM
 - COMBINED WITH AHCAL AND TC (E/PI)
- PUBLICATION

$N_{pix}=2424$

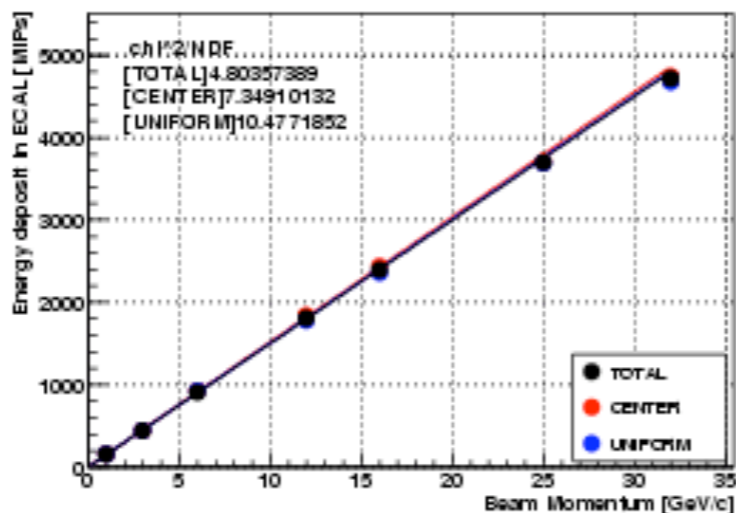
Linearity (4000 pix correction)



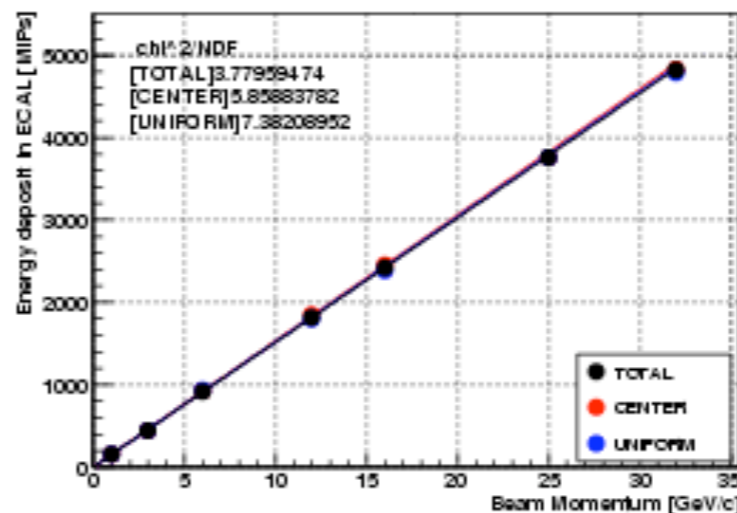
Linearity (3200 pix correction)



Linearity (2600 pix correction)



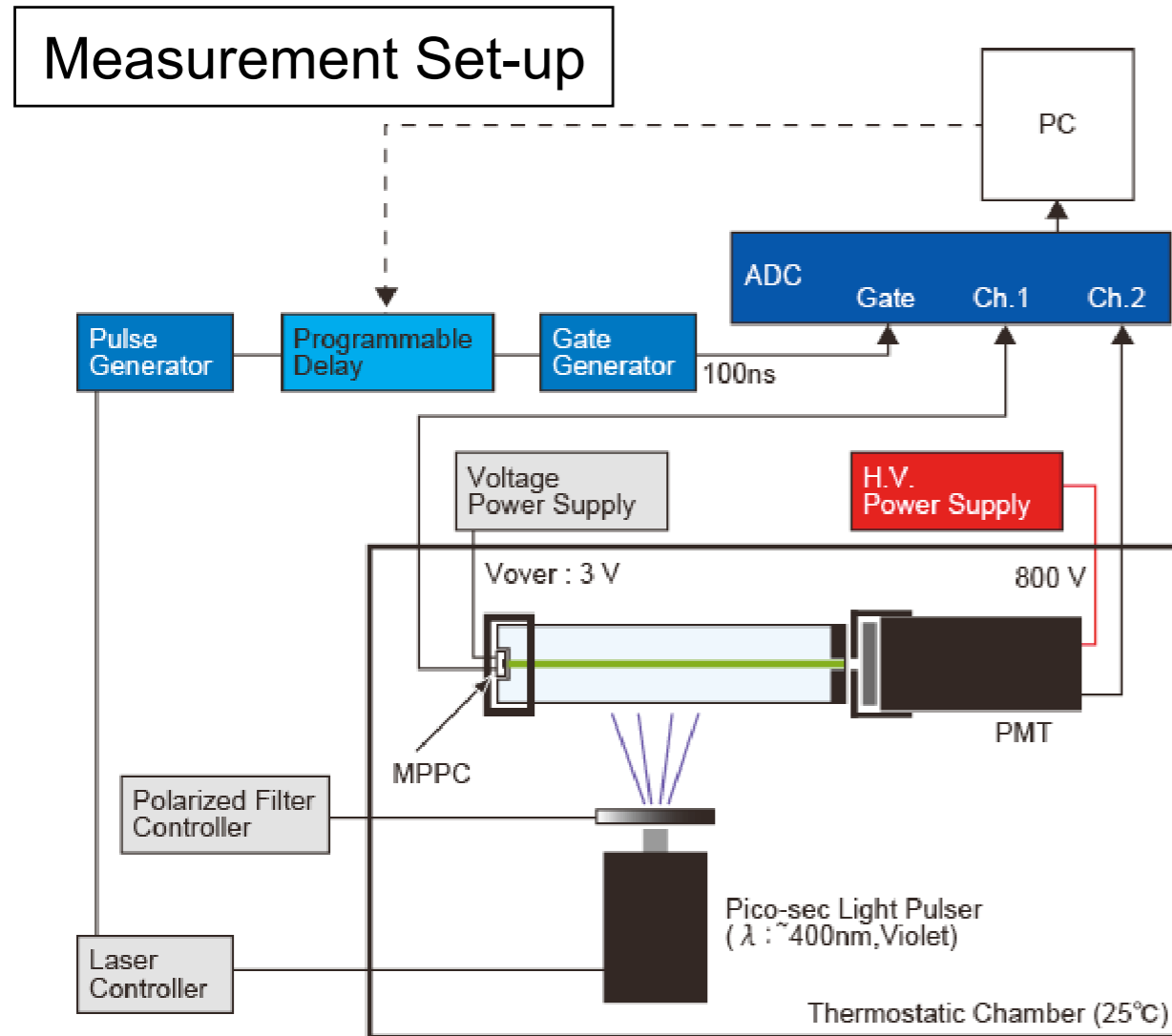
Linearity (2424 pix correction)



N_{pix}	全体		中心領域		均一領域	
	MIPs/GeV	χ^2/NDF	MIPs/GeV	χ^2/NDF	MIPs/GeV	χ^2/NDF
4000	144.76 ± 0.55	17.84	147.25 ± 0.56	19.36	144.65 ± 0.55	34.46
3200	146.86 ± 0.56	10.64	149.12 ± 0.57	13.04	146.97 ± 0.56	22.14
2600	149.71 ± 0.57	4.80	151.60 ± 0.58	7.35	150.17 ± 0.57	10.48
2424	150.99 ± 0.57	3.78	152.68 ± 0.58	5.86	151.61 ± 0.58	7.38
2000	154.95 ± 0.59	7.68	155.41 ± 0.61	5.09	156.23 ± 0.61	7.54
1600	160.63 ± 0.61	18.90	161.78 ± 0.61	14.79	161.61 ± 0.61	15.80

表 4.1: 様々な実効ピクセル数を用いた MPPC 応答補正により評価した応答線形性の結果

The response curve measurement

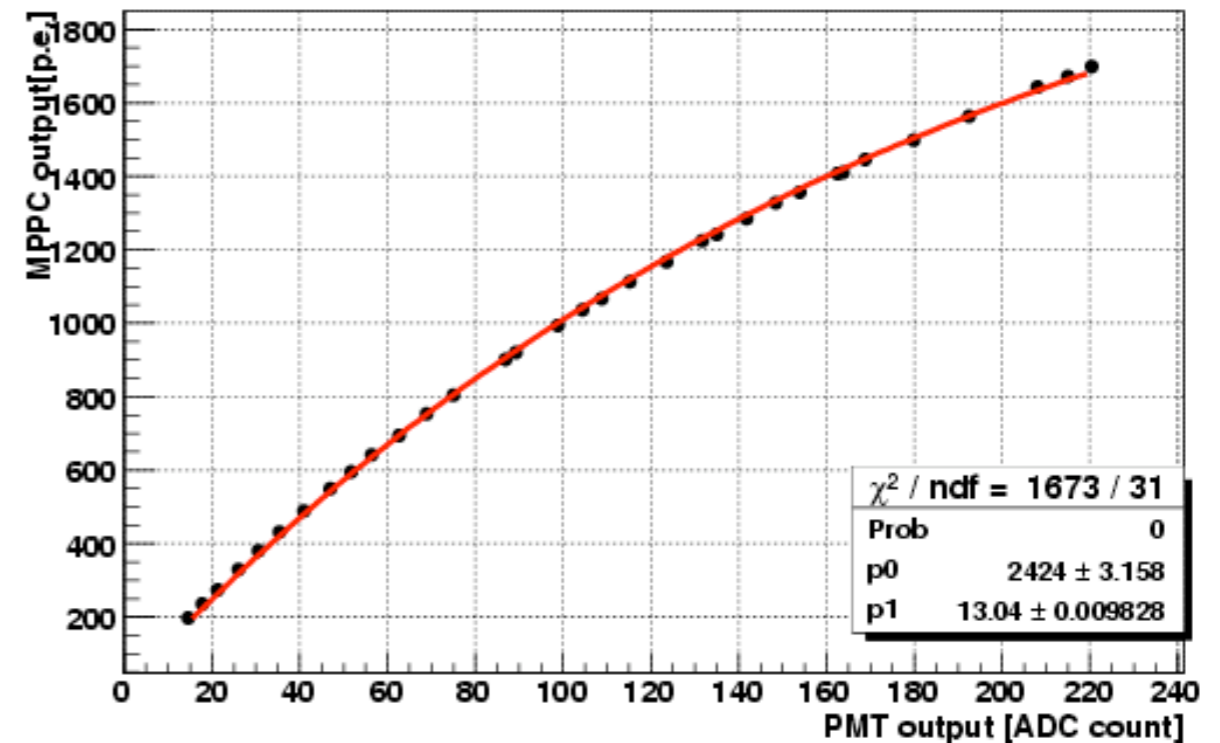


$$N_{fired} = N_{pix} \left(1 - \exp\left(-\frac{N_{true}}{N_{pix}}\right) \right)$$

Fit function

$$Output_{MPPC} = p0 \left(1 - \exp\left(-\frac{p1 \times Output_{PMT}}{p0}\right) \right)$$

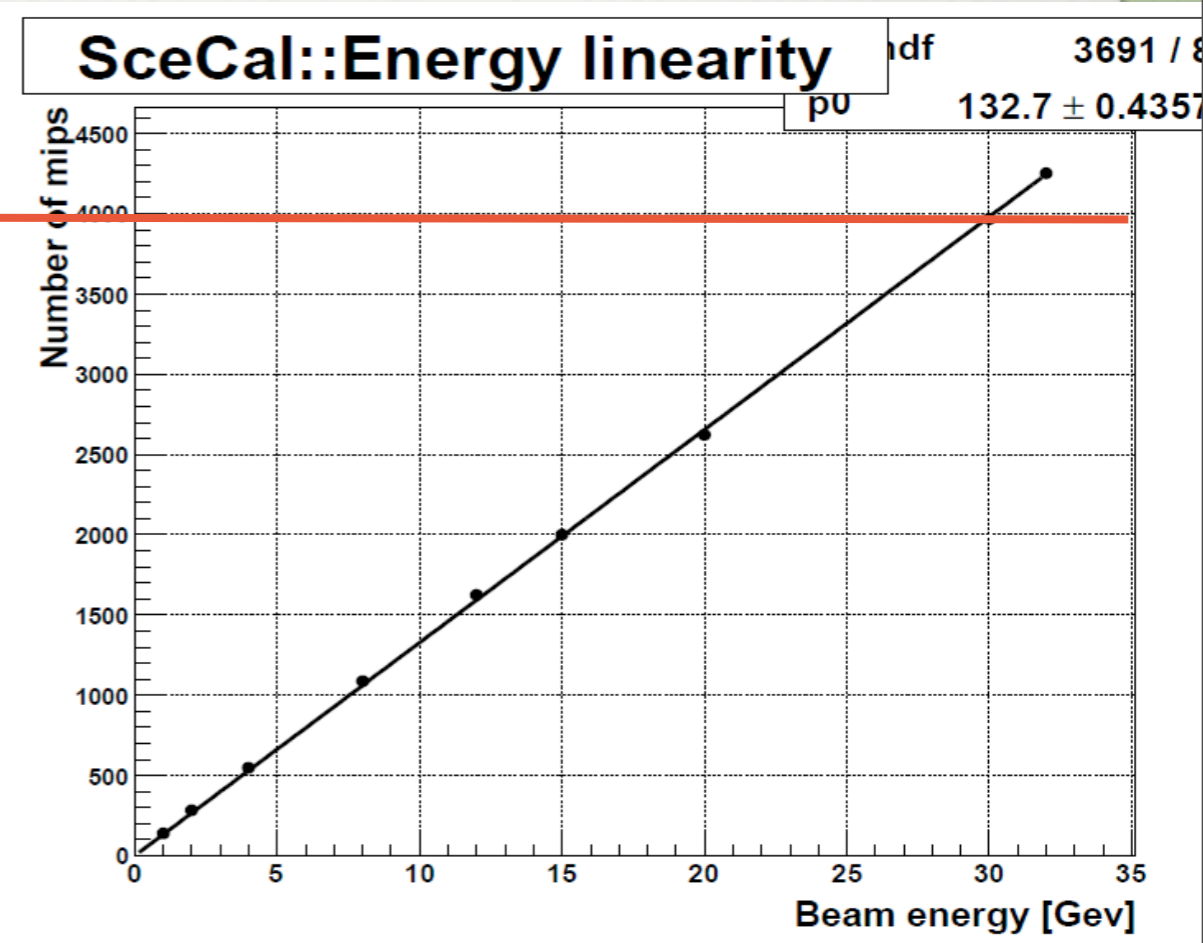
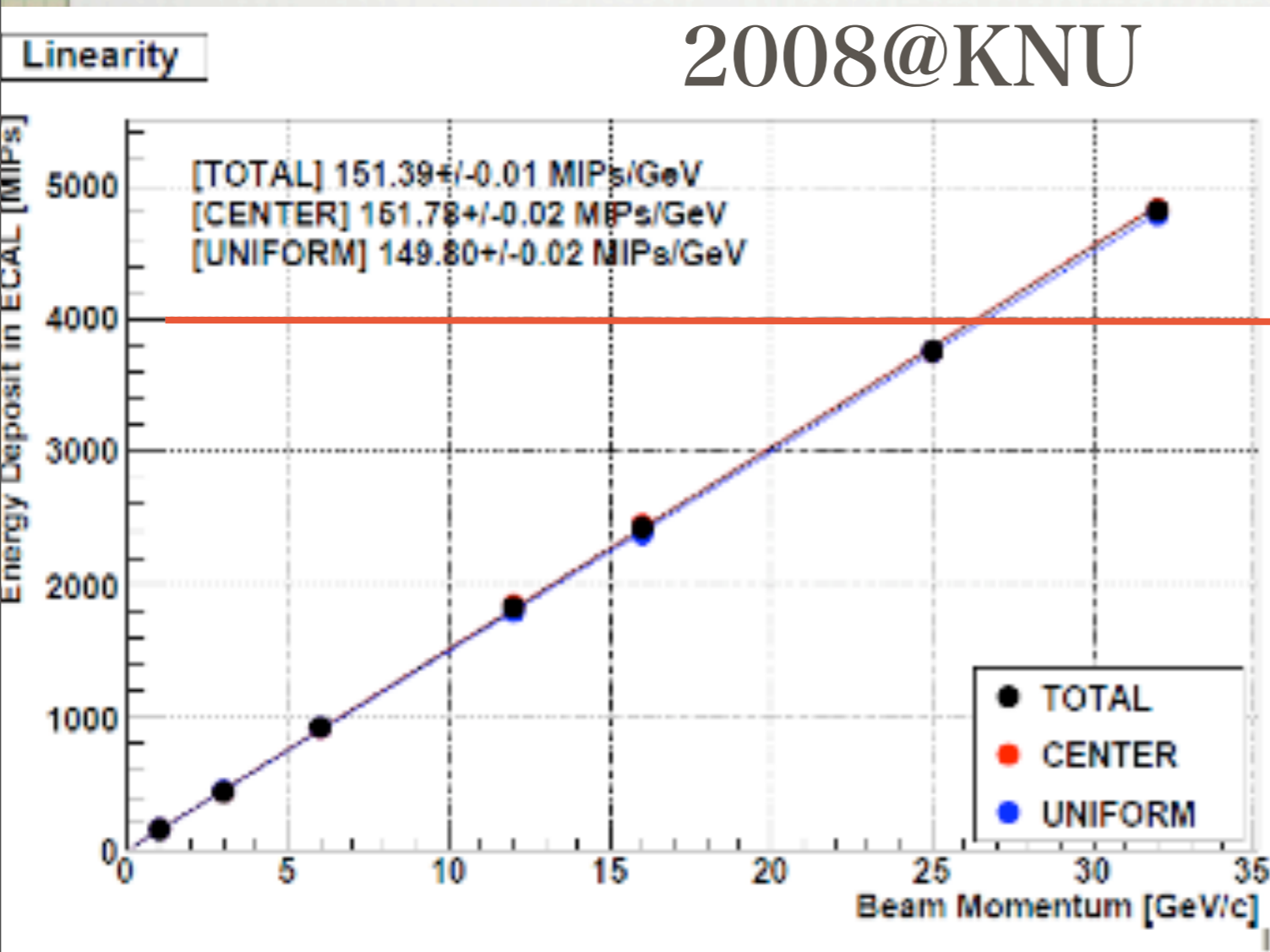
ResponseCurve



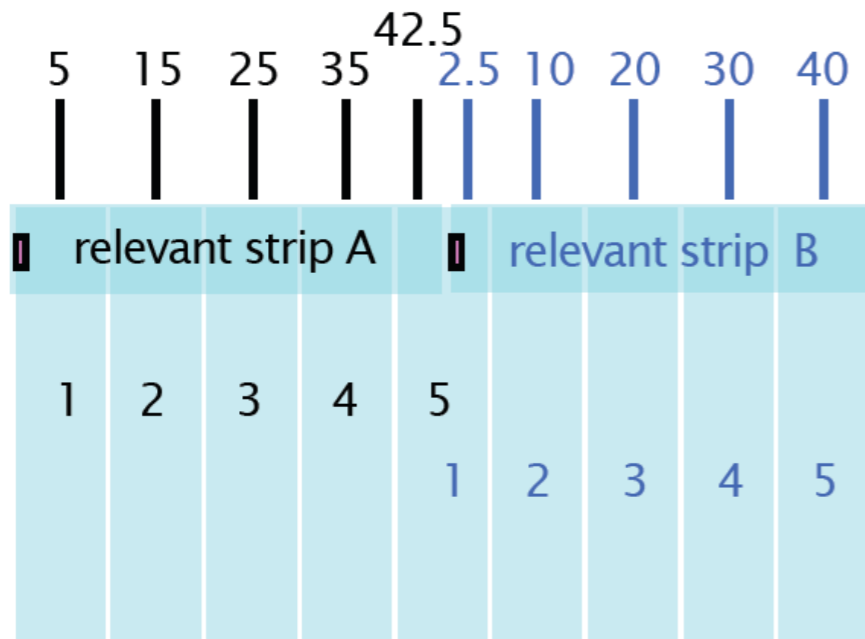
Result : $N_{pix} = 2424 \pm 3$

LINEARITY

- 2008 VS 2009
- 2008 155 MIPS/GEV
- 2009 133 MIPS/GEV

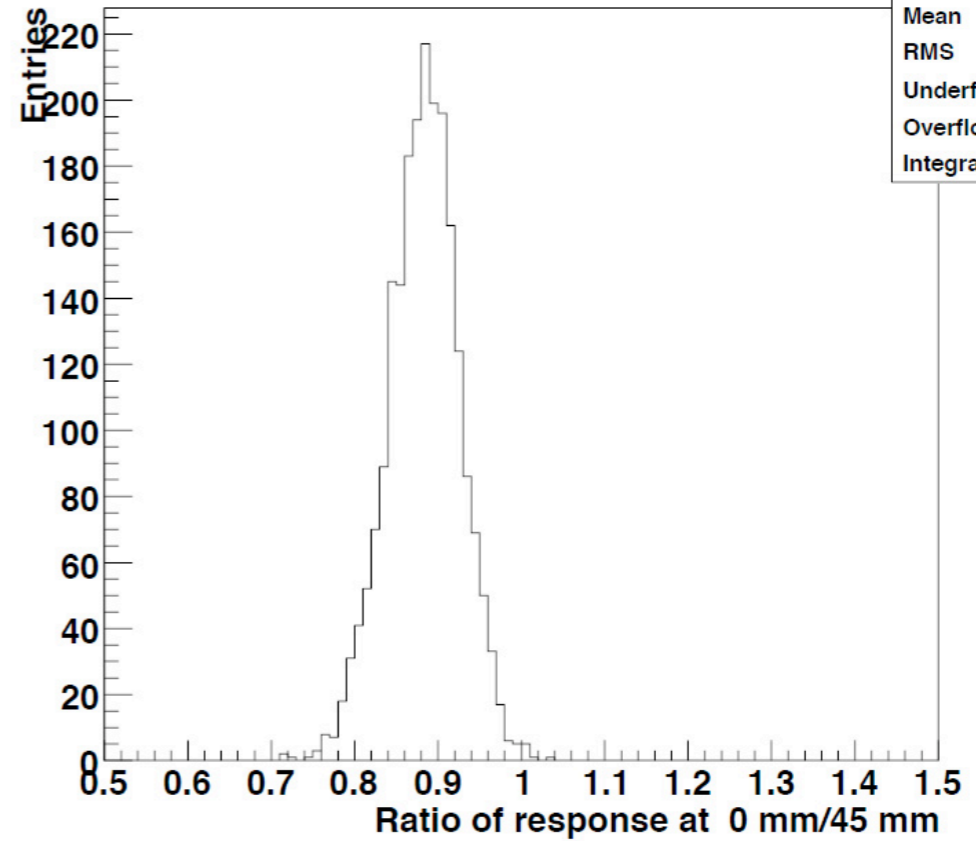


Scintillator non-uniformity

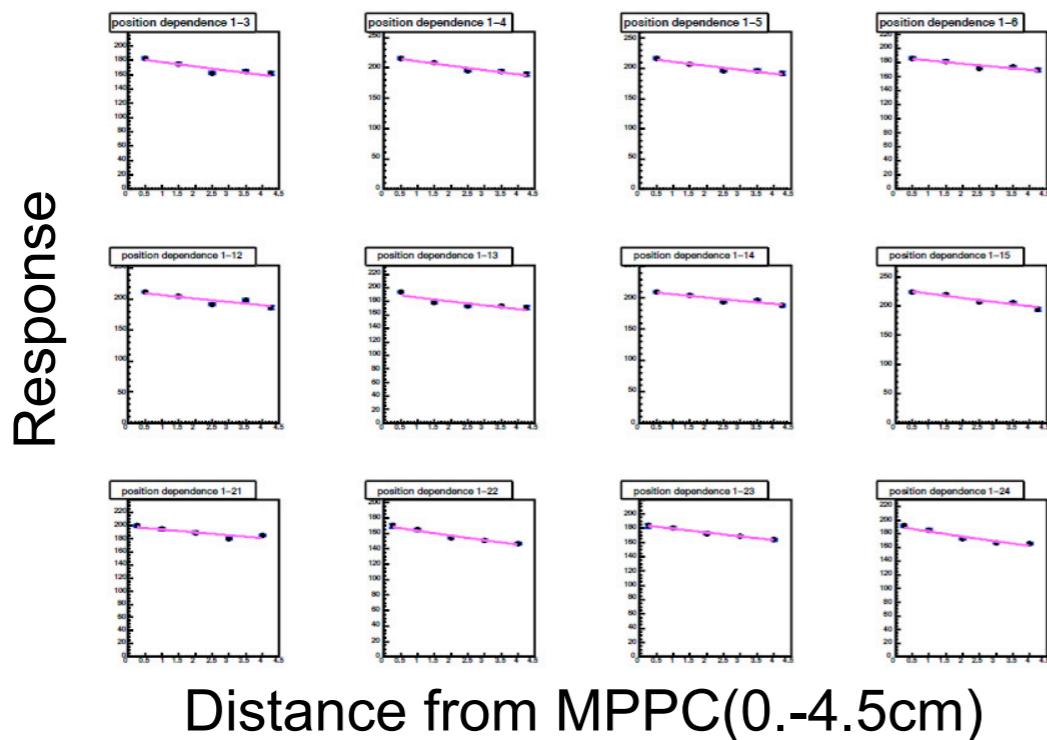


$\frac{\text{Response@45mm from MPPC}}{\text{Response@0mm from MPPC}}$

uniformity



uniformity	
Entries	2160
Mean	0.8828
RMS	0.04274
Underflow	0
Overflow	0
Integral	2160



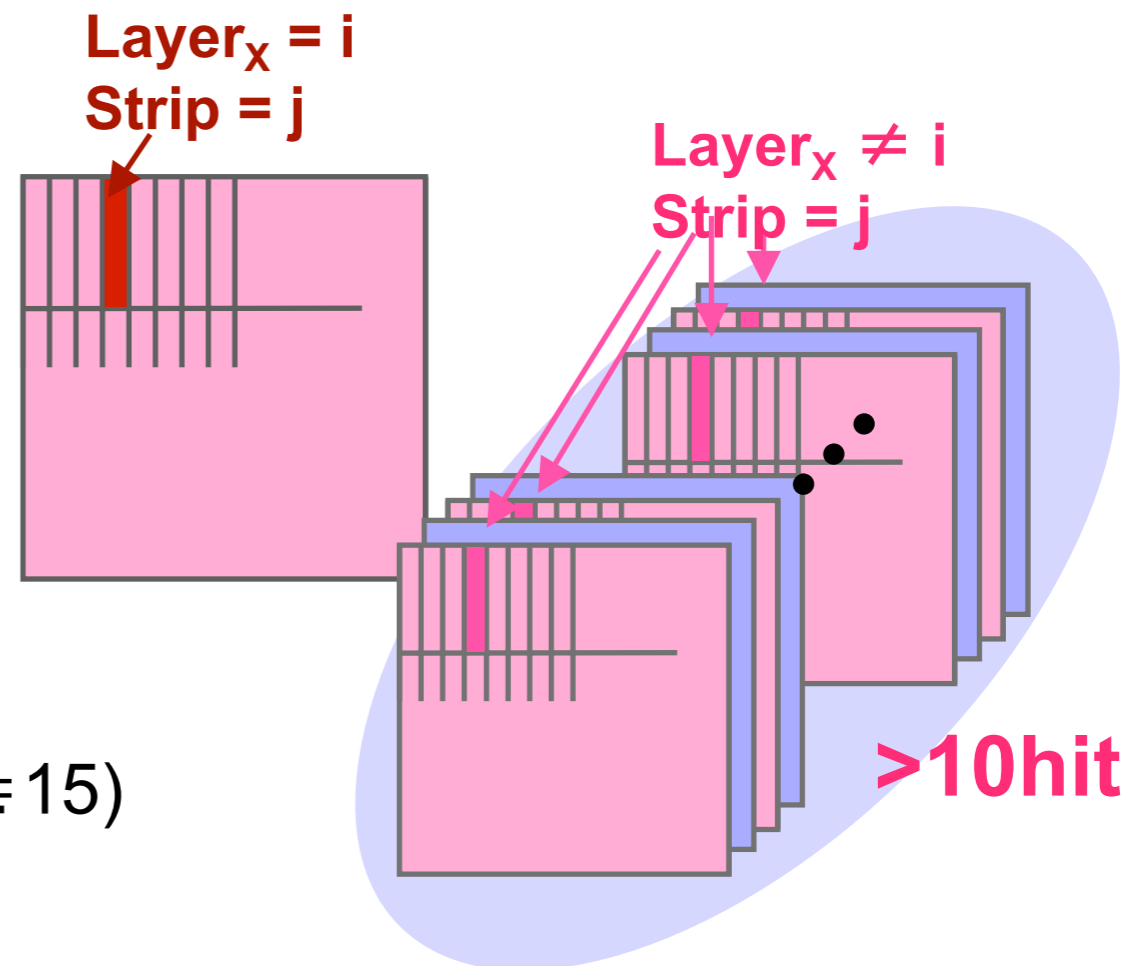
(Results from Shinshu Univ.)

MIP selection

● Event selection

Example: For X-Layer i , Strip j
→ Check a hit of the strip j on other X-layers excepting i . (total 14 layers)
If there are more than 10 hits,
it is presumed that a muon passed through the channel i - j . (MIP event)

Hit def. : $ADC > ADC_{ped} + 3\sigma_{ped}$ ($\sigma_{ped} \doteq 15$)

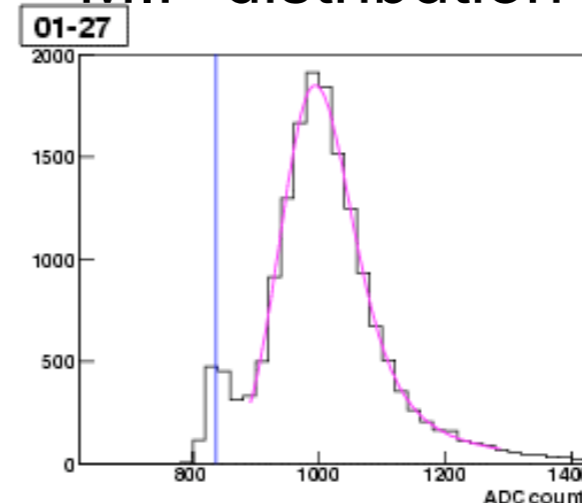


● Fitting MIP distribution

The fitting function:

Gaussian convoluted landau distribution
(4 parameters : mean , norm ,
landau-width , gaussian-width)

MIP distribution



Dead channels

2009

The dead channels of scECAL:

layer-strip

11-58(too noisy)

12-64(no signal)

19-11(too noisy)

26-65(no signal)

29-48(too noisy)

The channels that have problems:

11-22(low gain)

25-06(low gain)

26-67(low gain)

30-66(sometimes no signal)

2008

19-11 (too noisy)

21-71 (too noisy)

29-48 (too noisy)

25-06 (low gain)

**5 dead channels
(+ 4 NG channels)**