

Characterisation of the new Hamamatsu MPPC25 SiPMs

Marco Szalay

DESY Hamburg - 9 December 2013



Max-Planck-Institut für Physik
(Werner-Heisenberg-Institut)

Table Of Content

- Noise measurement for the new MPPC25
- Comparison with older MPPC revision
- Noise vs bias voltage correlation
- Signal vs bias voltage correlation
- Uniformity scans for the new Hamburg tiles
- Noise measurement for the Ketek SiPM

The measurement setup

Noise measurements

SiPM → 1st preamp ($\sim x9$) → 2nd preamp ($\sim x5$) → counter

- Scan over several SiPM bias voltages
- simple threshold scan in 5 mV steps on the counter
- 1 s integration time for each bias voltage and counter threshold

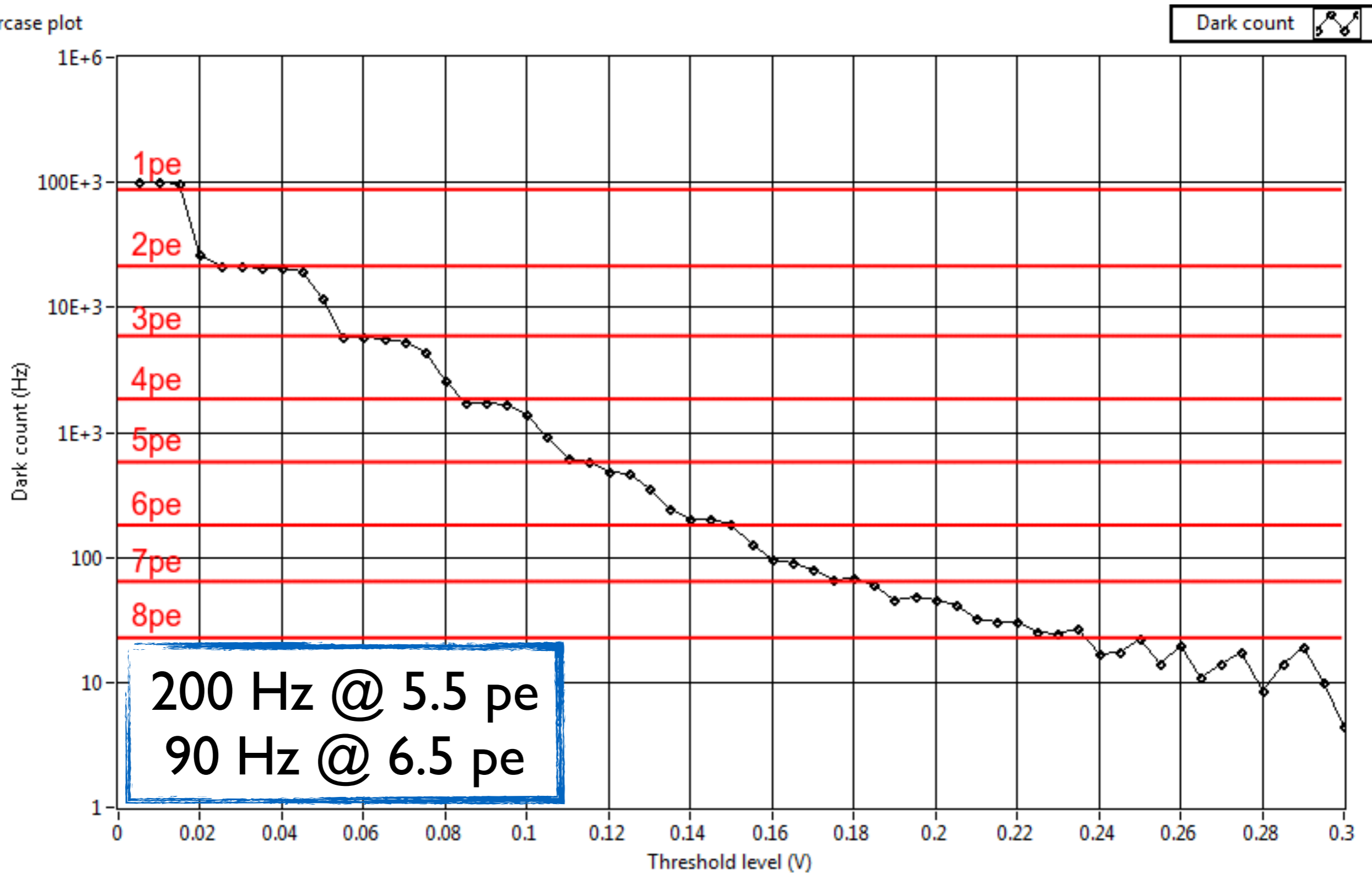
Signal measurements

 source → scinti tile + SiPM → preamp → picoscope

- 9.6ns integration window to avoid recording afterpulses
- 3.5 kHz Sr90 e^- source (conversion factor to MIP = 0.8)
- Triggered on a 2nd scintillator, below the tile under investigation

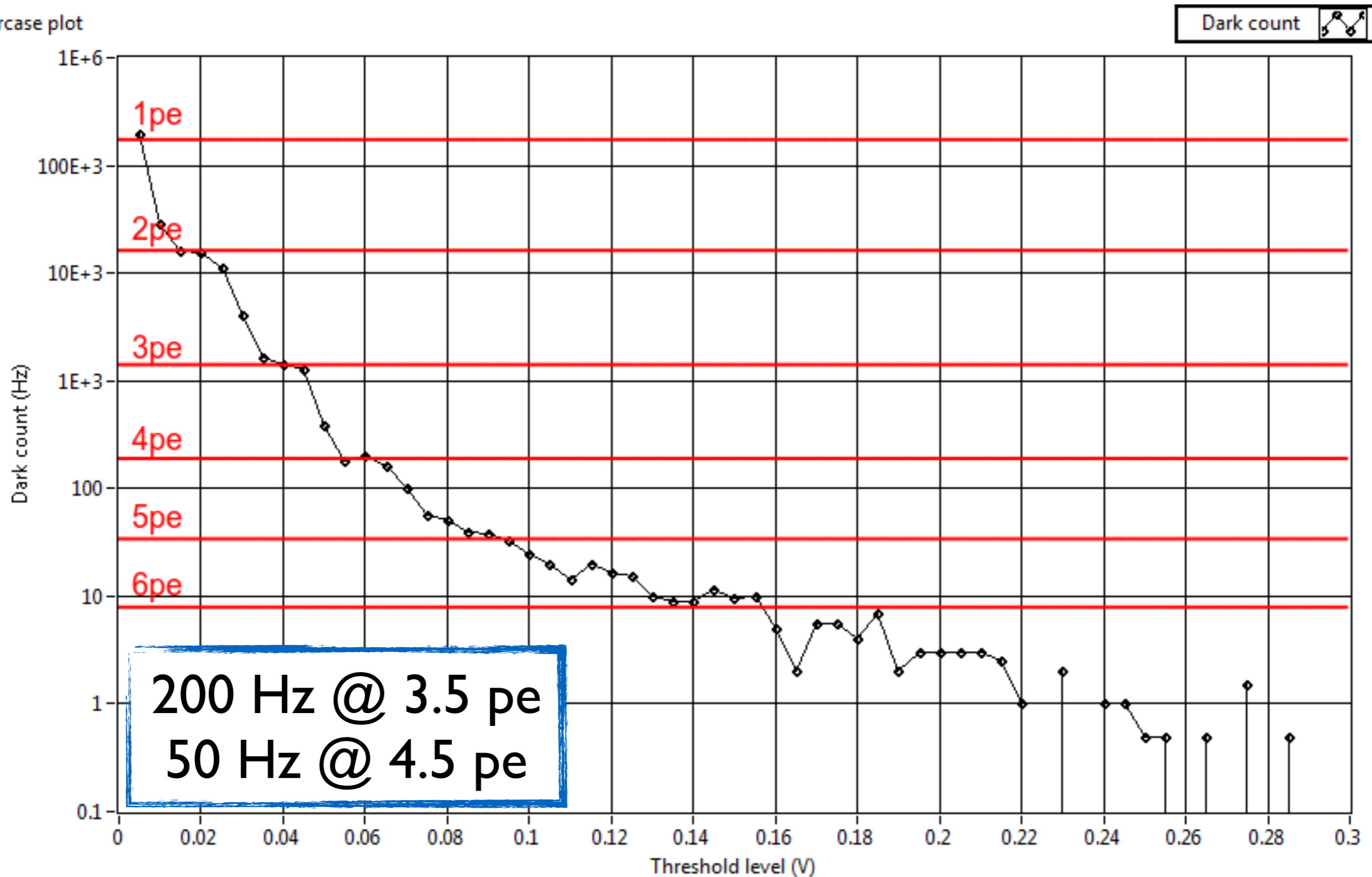
New MPPC25 - Noise rate @ reference VBias

Staircase plot



Old MPPC25 - Noise rate @ reference VBias

Staircase plot



Light yield with several Tiles

Results of 9-point scans with 90-Sr source
(1 cm² with evenly placed points in the middle of the tile.)

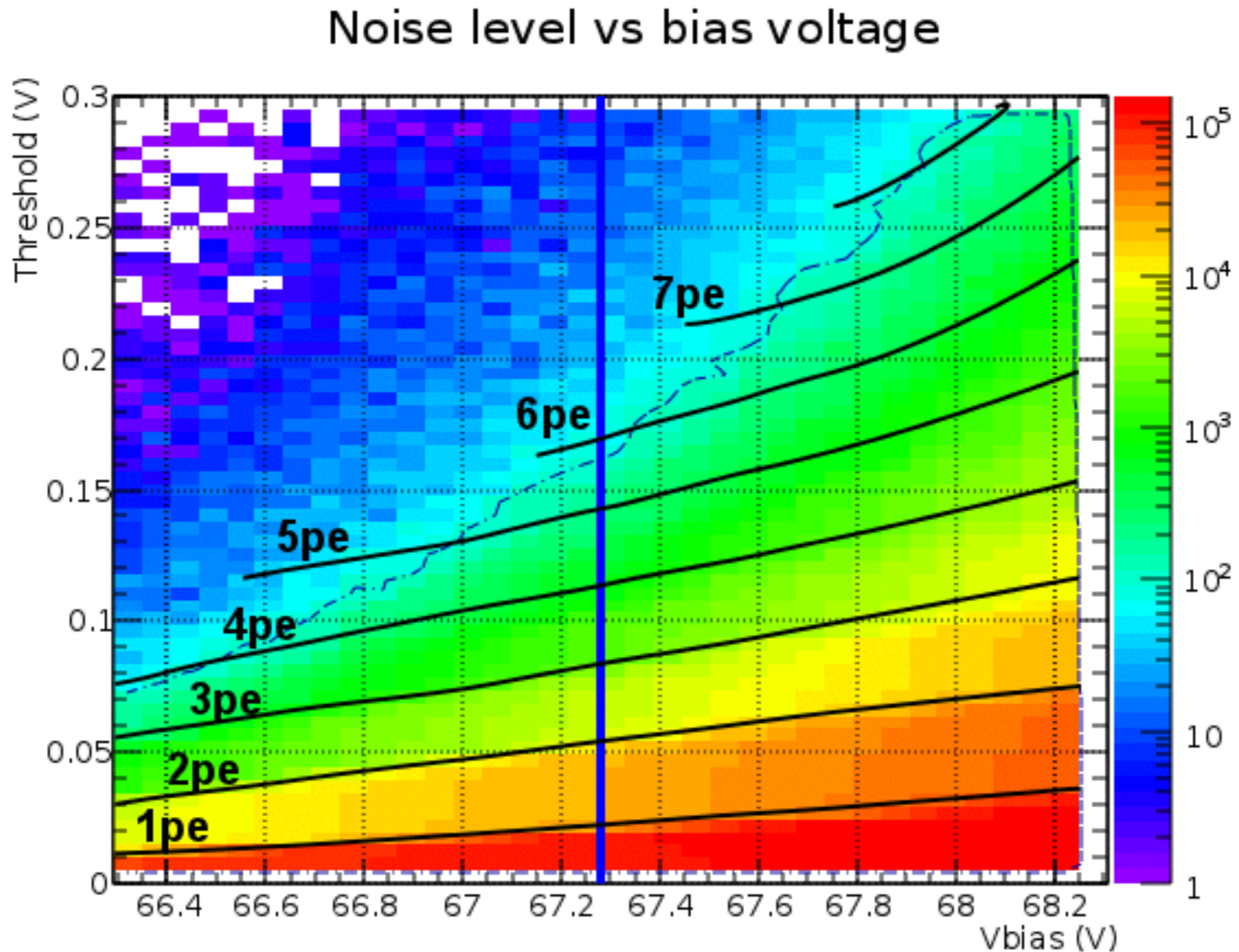
new MPPC25

old MPPC25

Tile	E (MPV) [p.e.]	E (mean) [p.e.]	uniformity [p.e.]	E (MPV) [p.e.]	E (mean) [p.e.]	uniformity [p.e.]
T3B	13	14.3	1.1	7.5	8.3	1.1
ITEP	8	9.2	3.0	4.5	5.6	1.6
HH	15	16.4	1.0	8.5	9.5	0.7

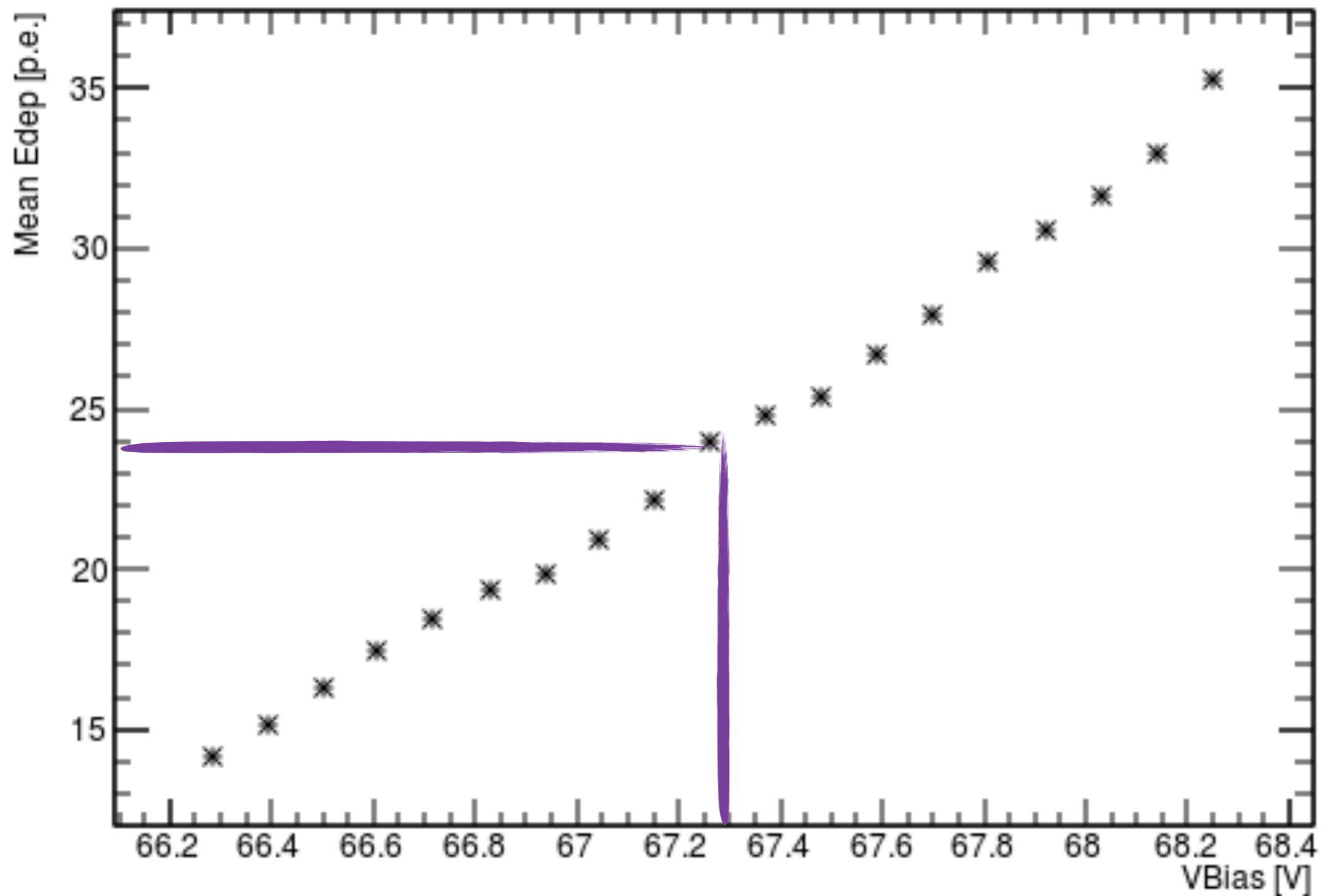
The relative yield between tiles should be correct BUT, after investigating the new MPPC25 active area, we found a big dust spot that must have affected the absolute yield. The next measurements have been taken after thorough cleaning.

New MPPC25 - Noise rate vs VBias



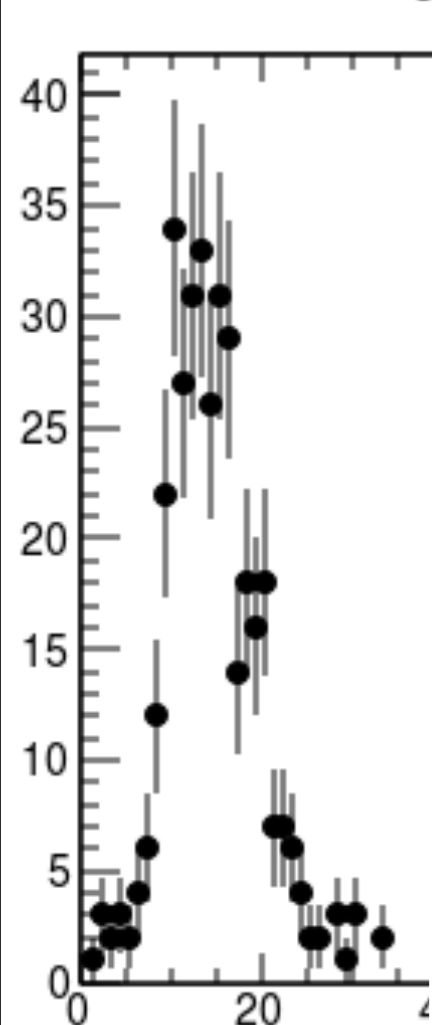
New MPPC25 - Mean Signal vs VBias

Averaged Energy Deposition vs. VBias



New MPPC25 - Signal distribution vs VBias

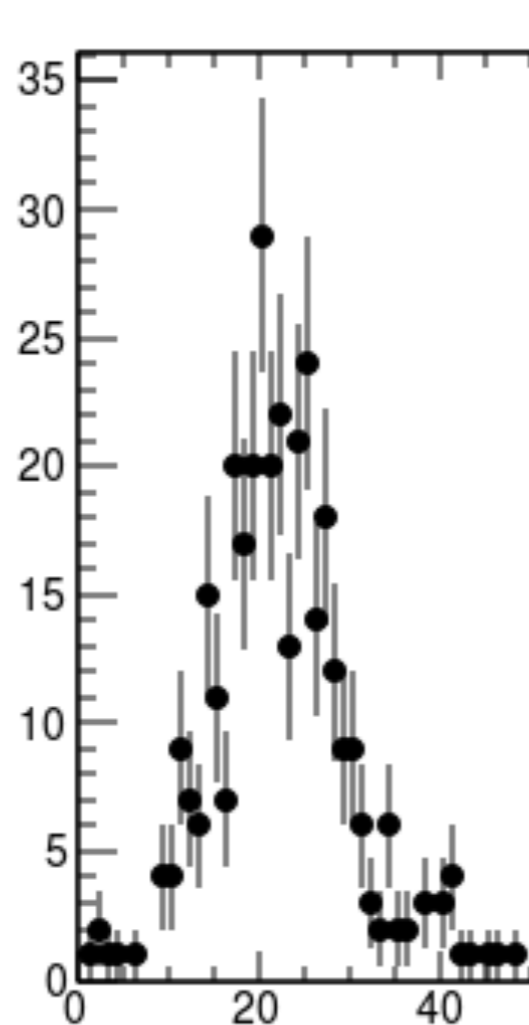
Total Energy Distribution for TilePosition: 0 - VBias:66.3928



Total Energy Distribution for TilePosition: 0 - VBias:66.3928	
Entries	369

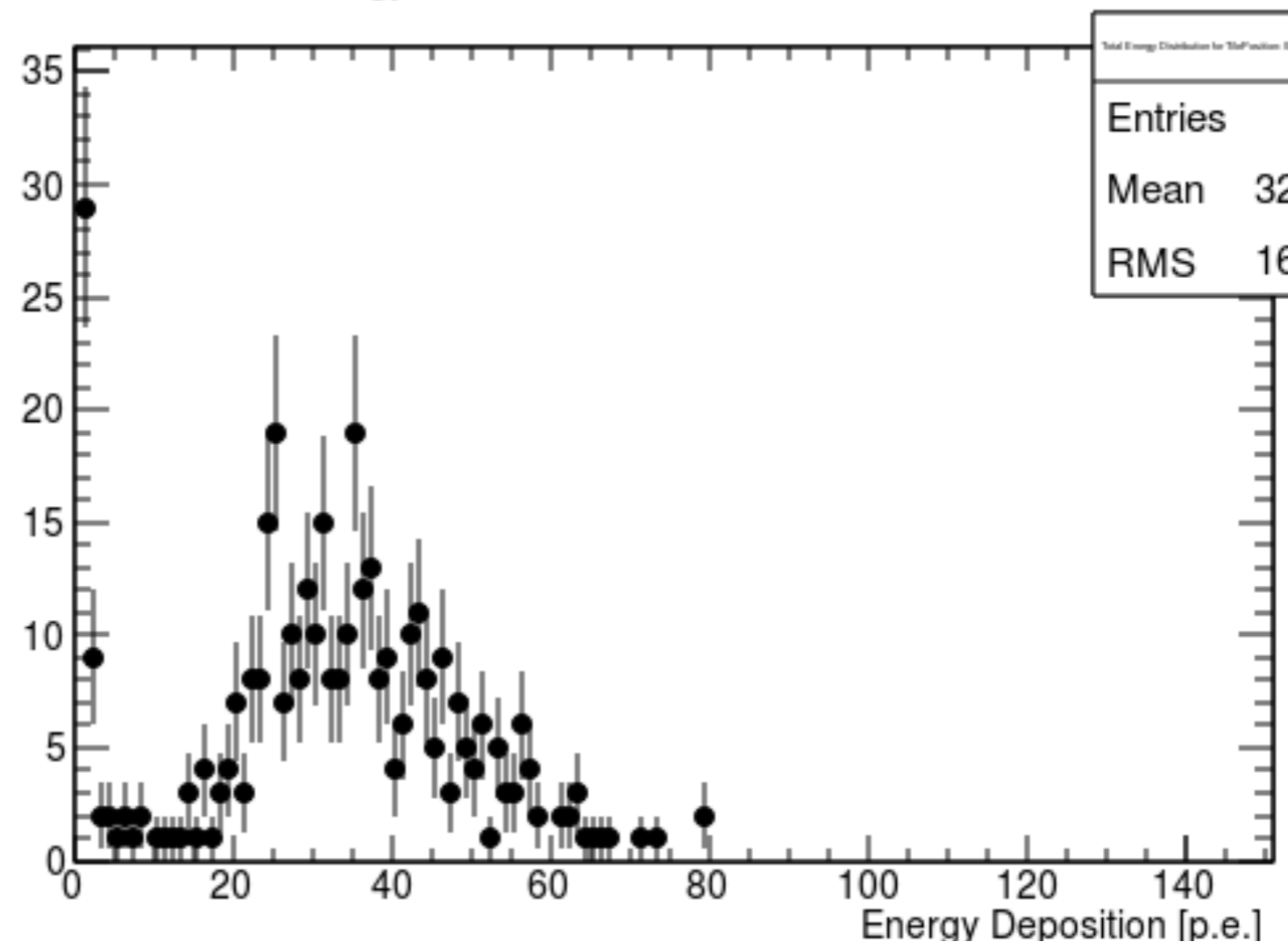
Recommended VBias

Total Energy Distribution for TilePosition: 0 - VBias:67.2619



Total Energy Distribution for TilePosition: 0 - VBias:67.2619	
Entries	355

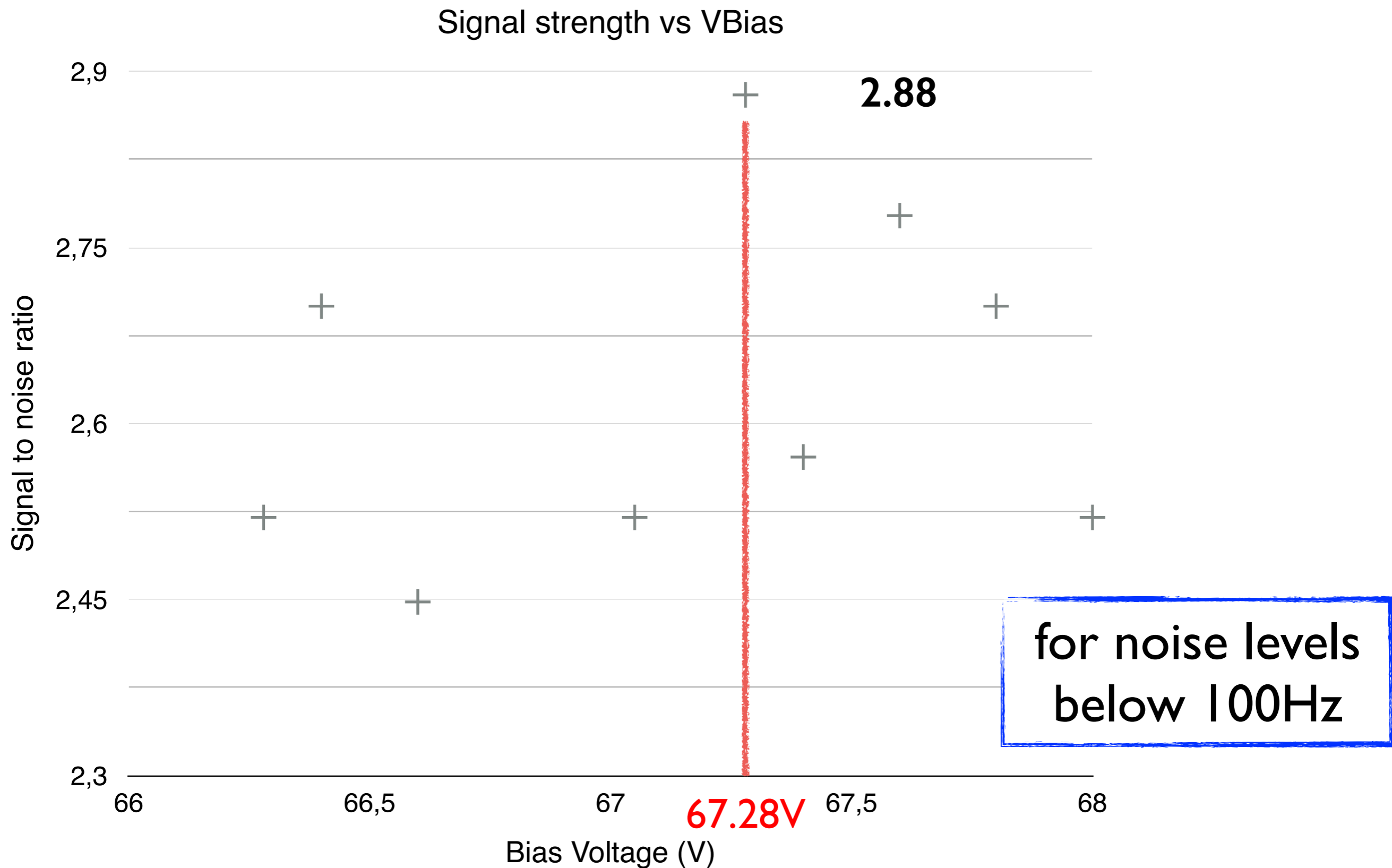
Total Energy Distribution for TilePosition: 0 - VBias:68.2521



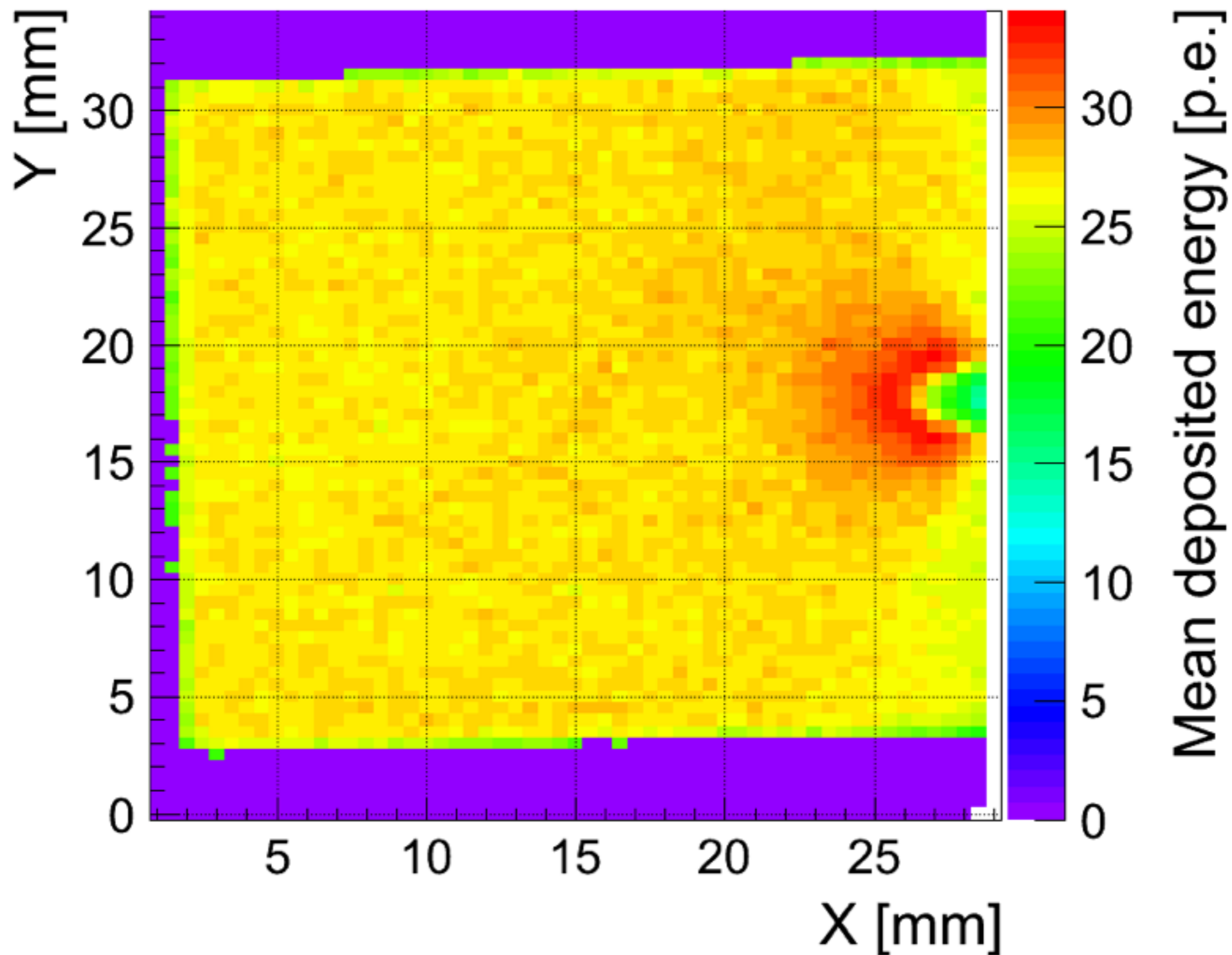
Total Energy Distribution for TilePosition: 0 - VBias:68.2521	
Entries	394
Mean	32.32
RMS	16.02

Mean to MPV ~ x0.9

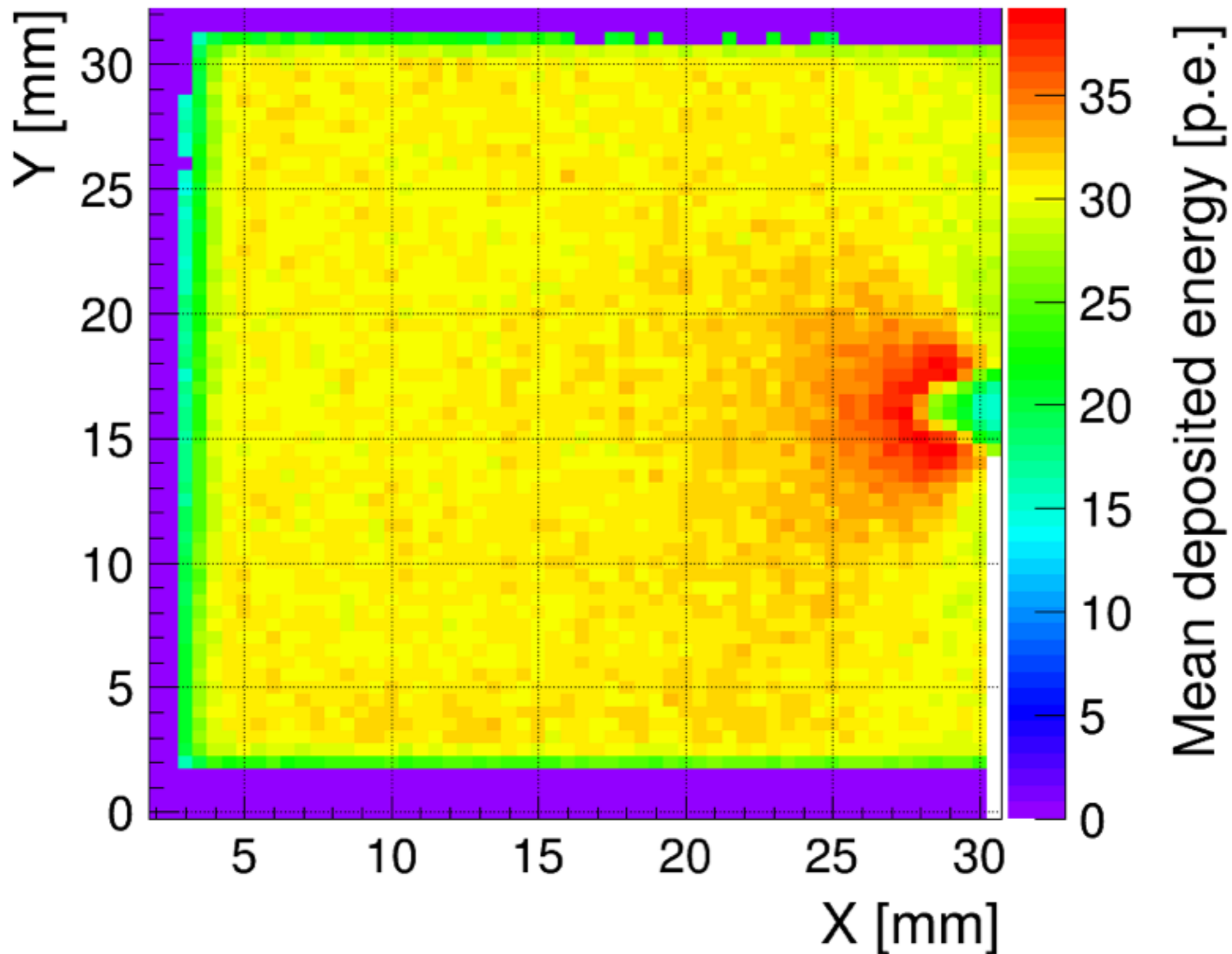
Signal to noise ratio



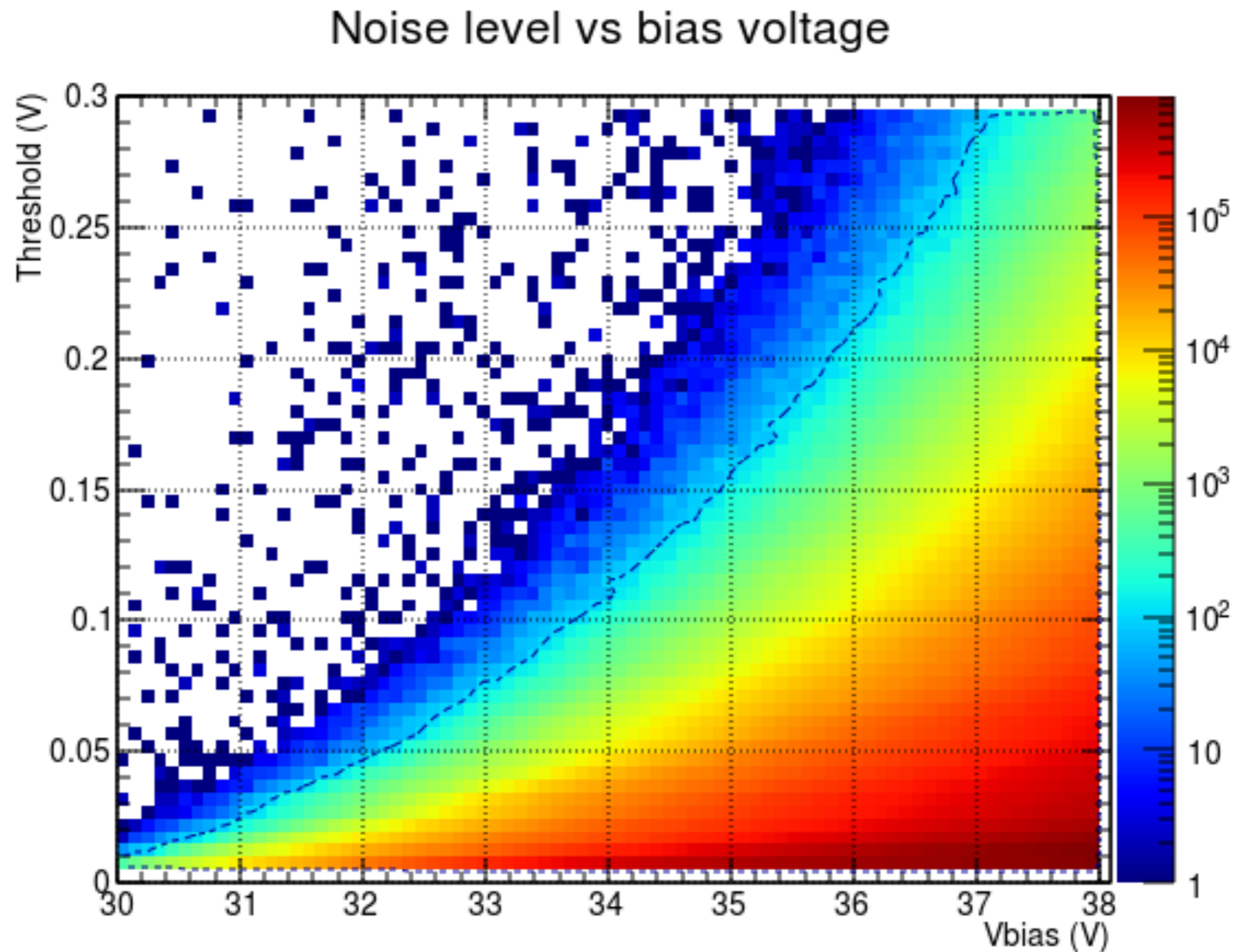
Uniformity scan - I hole



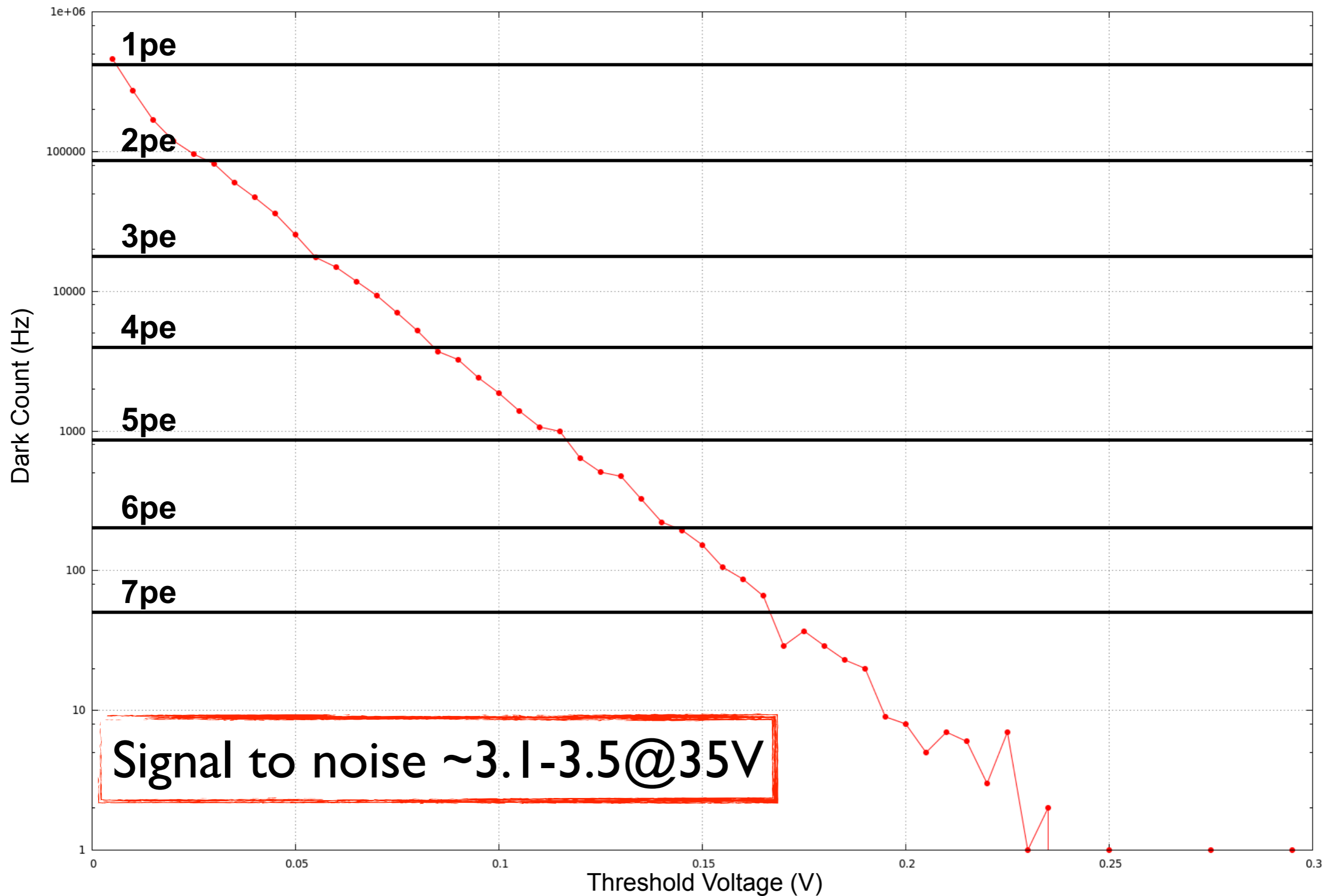
Uniformity scan - 2 holes



Ketek - Noise rate vs VBias



Ketek - Noise rate @ 35 V



Conclusions

- New MPPC25 seem to have higher noise than the previous revision
- BUT higher light yield for signal
- Ketek handle noise very well over a broader overbias voltage range
- Uniformity scans show that the quality (holes, air bubbles) of the reflective foil does not affect the uniformity
- We still need to investigate the gain vs temperature dependence (need to replace our climate chamber)

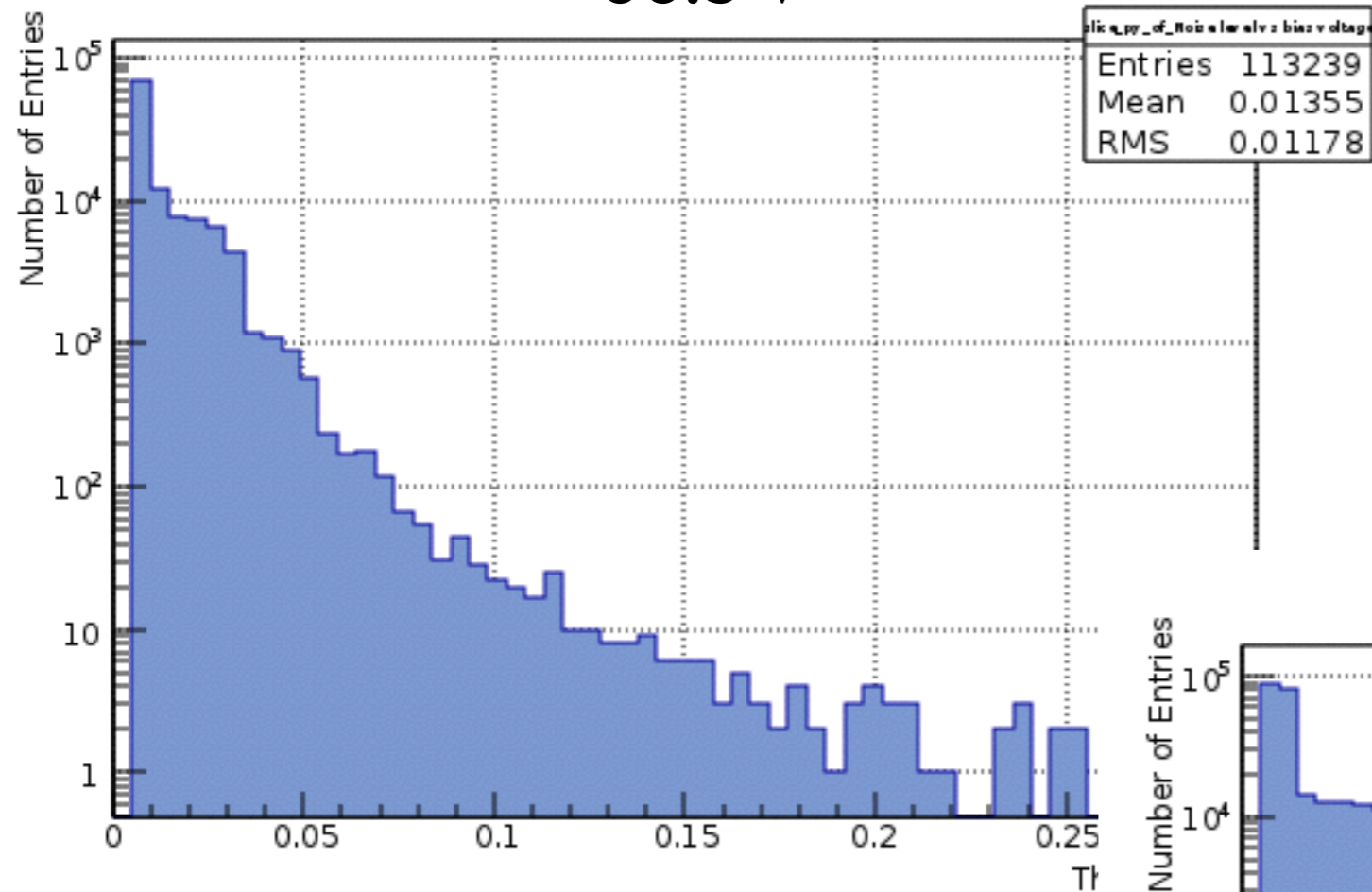
Backup - Signal to noise ratio

Vbias	Mean	mpv (mips)	#p.e. for noise < 100Hz	signal/noise	mip cut
66,28	14	10,08	4	2,52	0,40
66,40	15	10,80	4	2,70	0,37
66,60	17	12,24	5	2,45	0,41
67,05	21	15,12	6	2,52	0,40
67,28	24	17,28	6	2,88	0,35
67,40	25	18,00	7	2,57	0,39
67,60	27	19,44	7	2,78	0,36
67,80	30	21,60	8	2,70	0,37
68,00	31,5	22,68	9	2,52	0,40

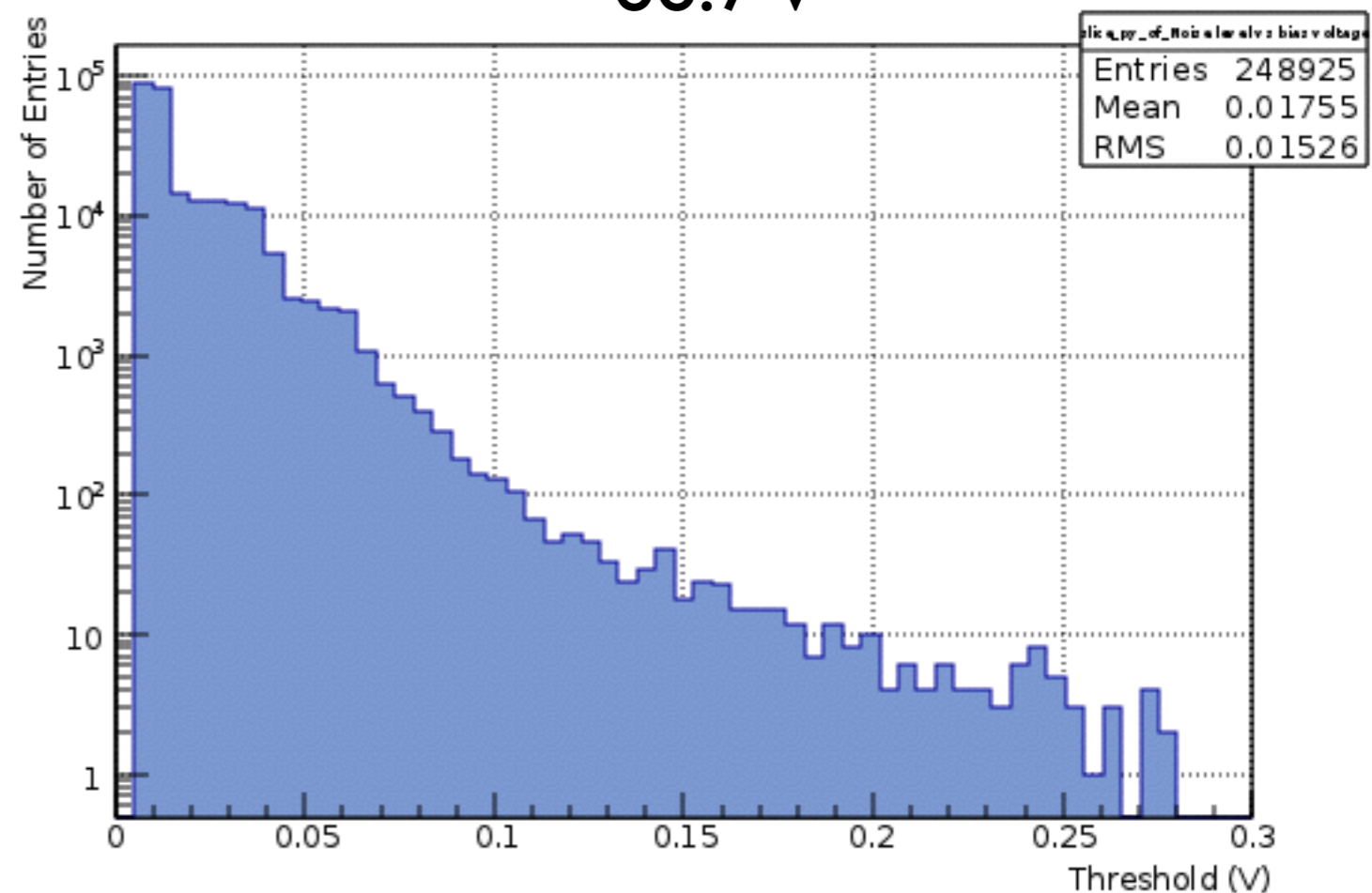
mean	2,63
rms	0,14

Backup - Noise profiles for different VBias

66.3 V

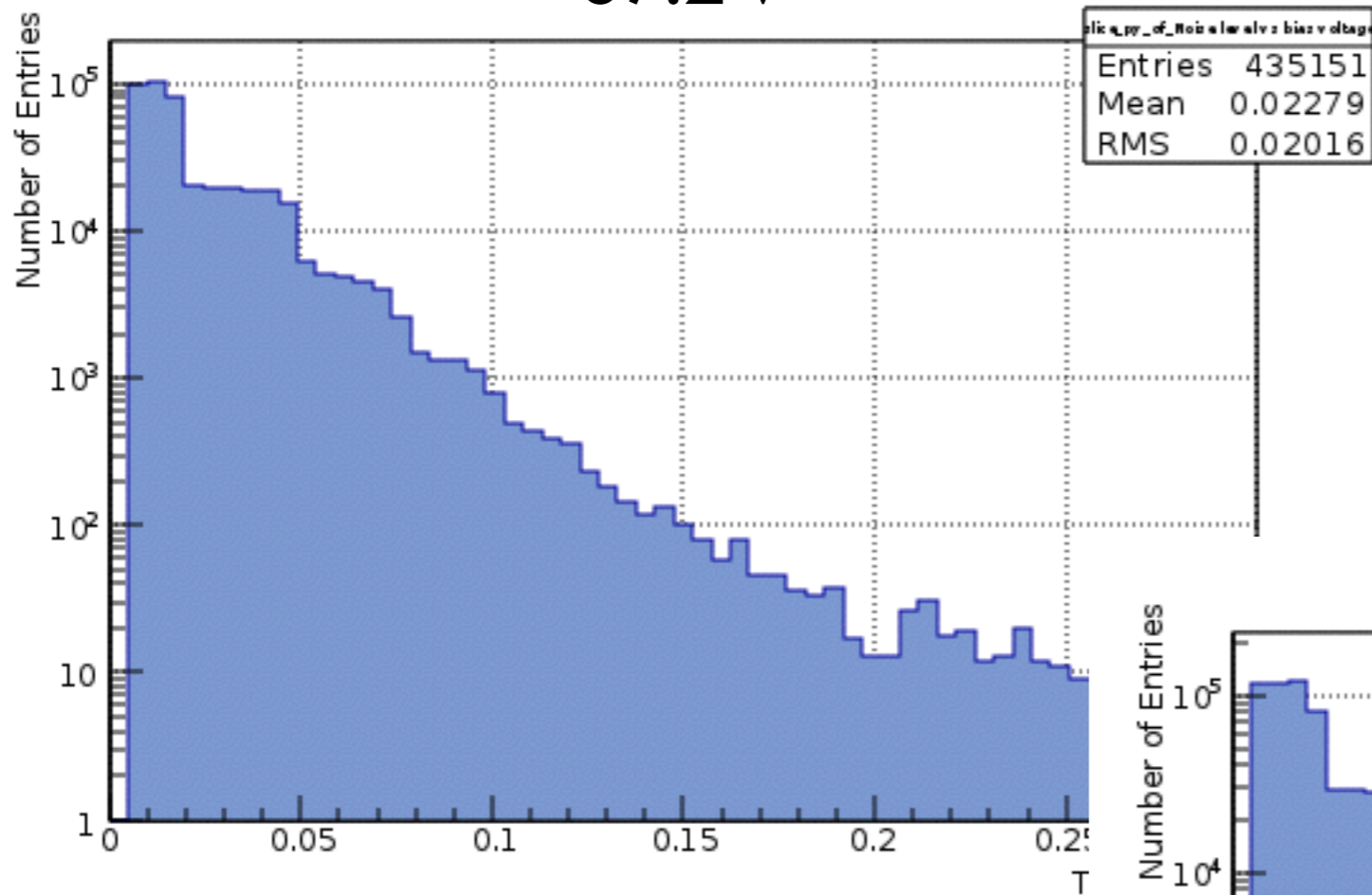


66.7 V

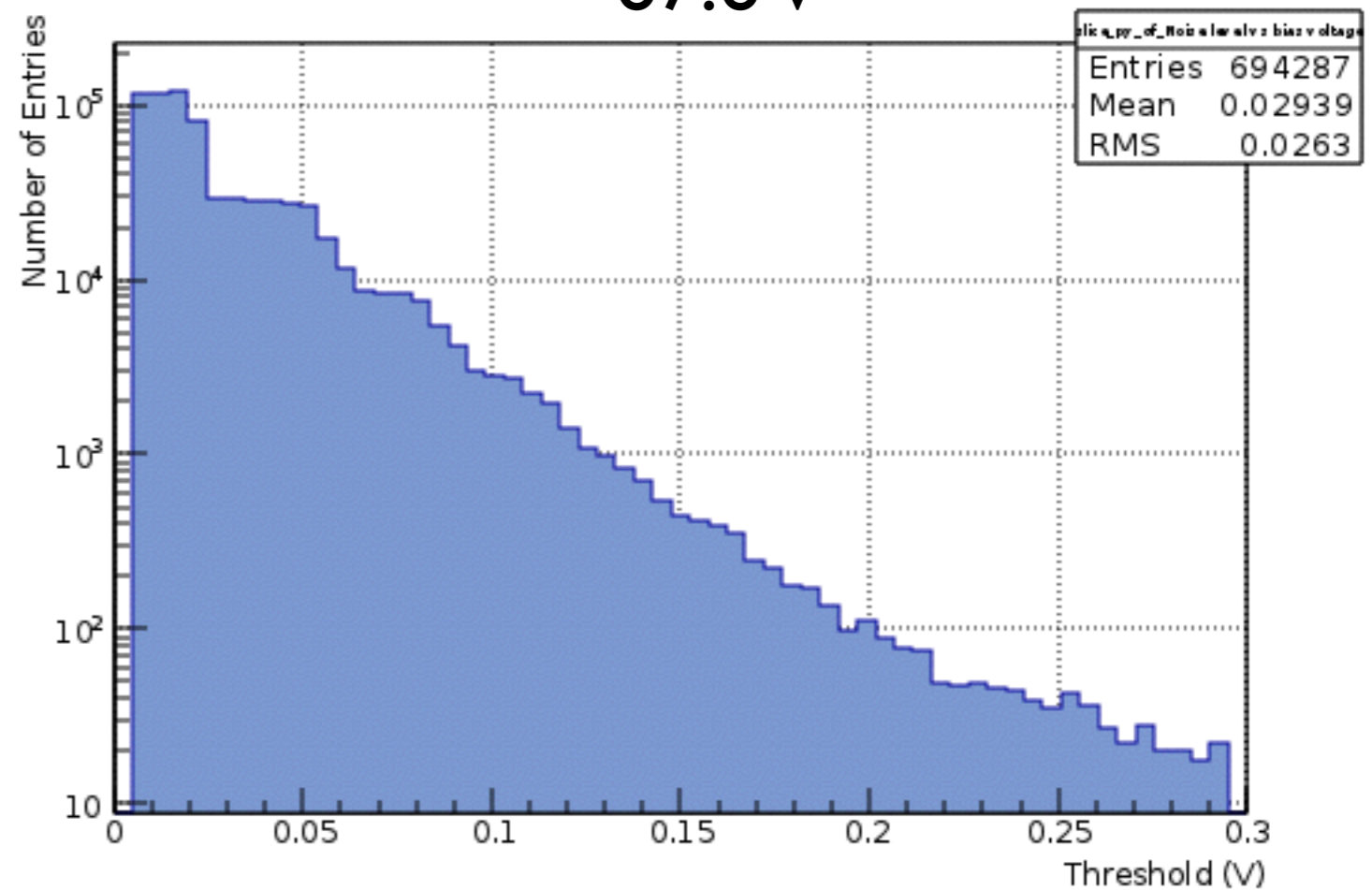


Backup - Noise profiles for different VBias

67.2 V



67.6 V



Backup - Noise profiles for different VBias

