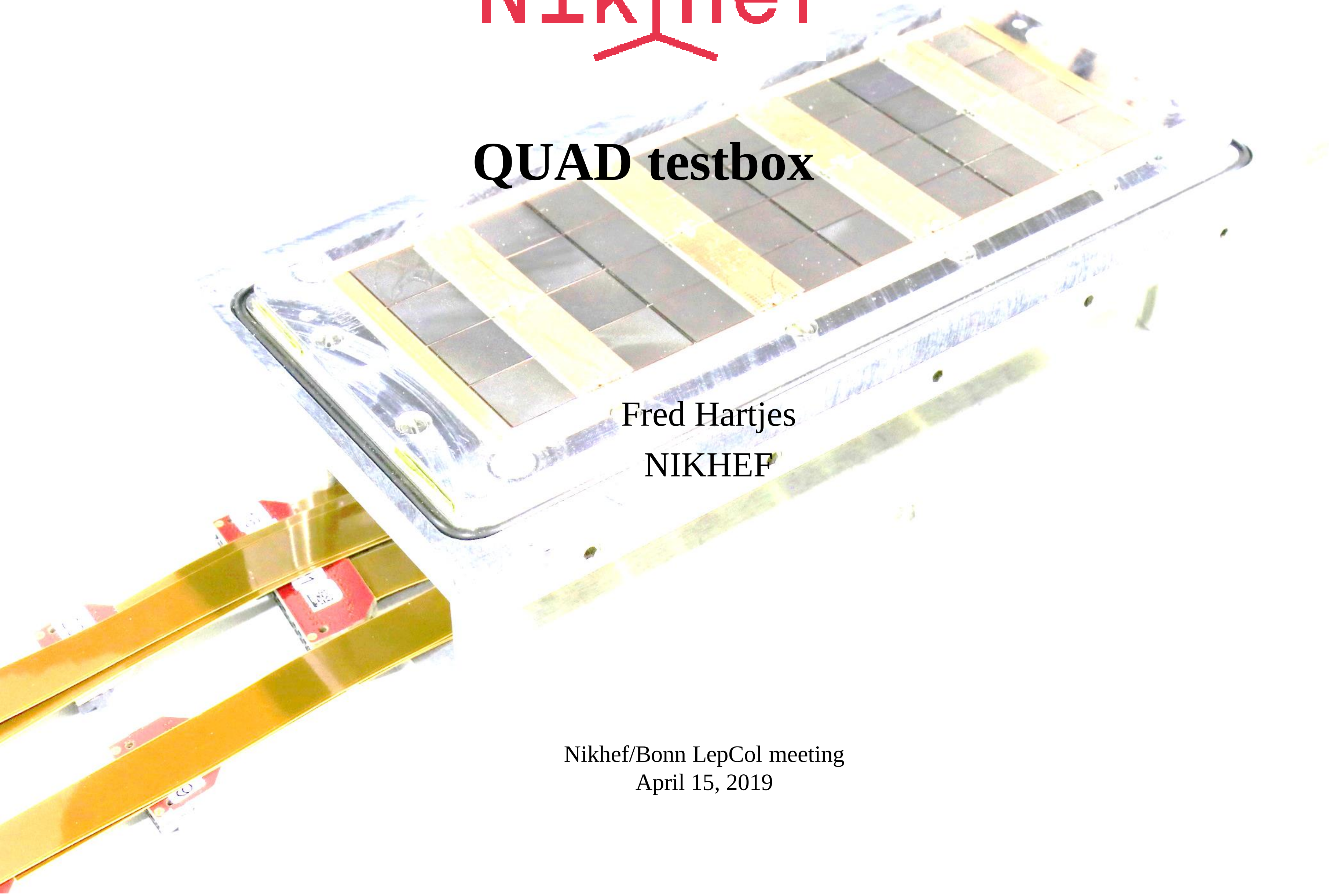
QUAD testbox



Fred Hartjes
NIKHEF

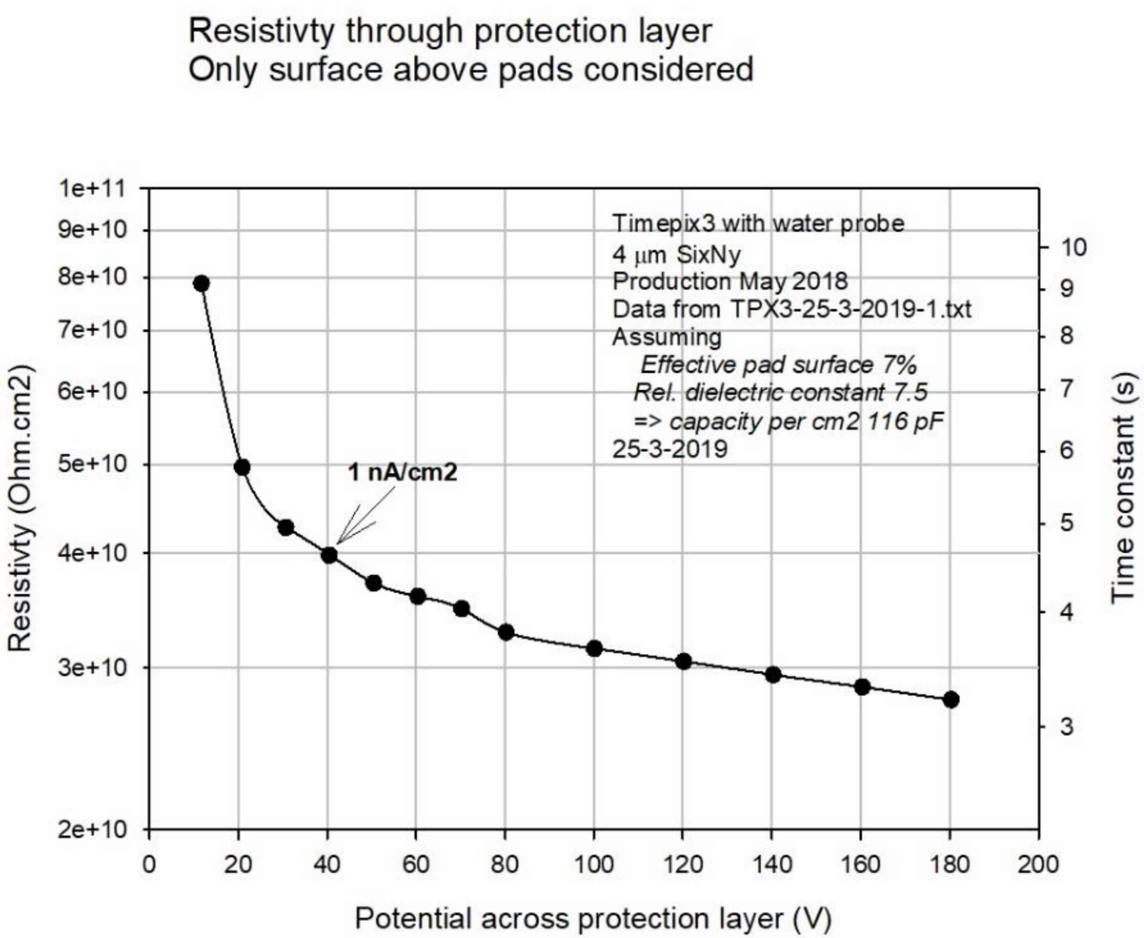
Nikhef/Bonn LepCol meeting
April 15, 2019

Resistivity measurements with metal electrode and soap water

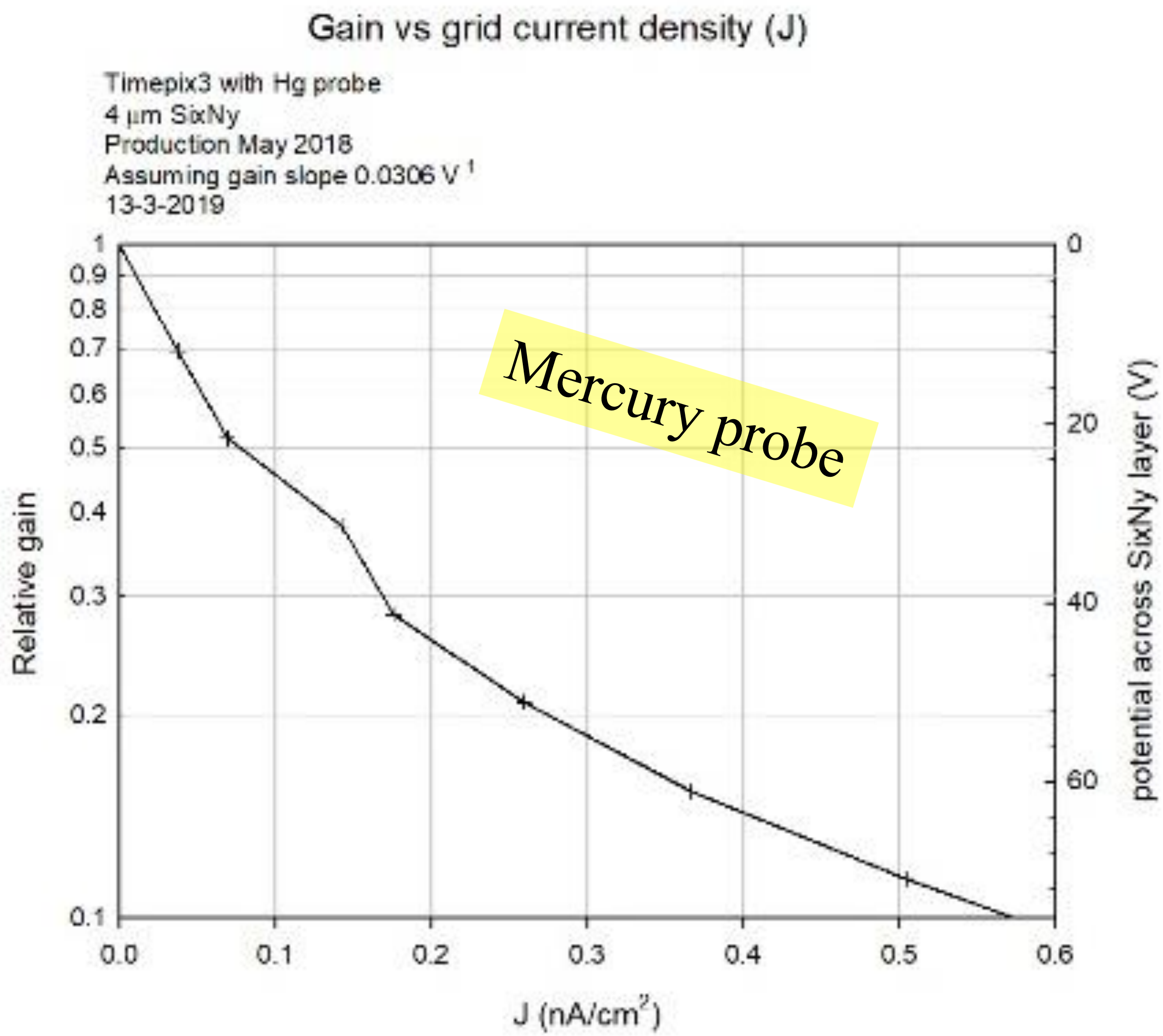
- Earlier measurements with Hg probe gave too high resistivities
- TimePix3 chip with 4 µm thick SixNy layer (run 2018)
- 8 mm diam SS disk
- Measured *through* layer
- => units in $\Omega.cm^2$

- Very high values at low fields
  - < 20V => 5 kV/mm
  - R >> 5.10^{10} $\Omega.cm^2$

- Above 40 V => 10 kV/mm quite constant
  - R ≈ 3.10^{10} $\Omega.cm^2$

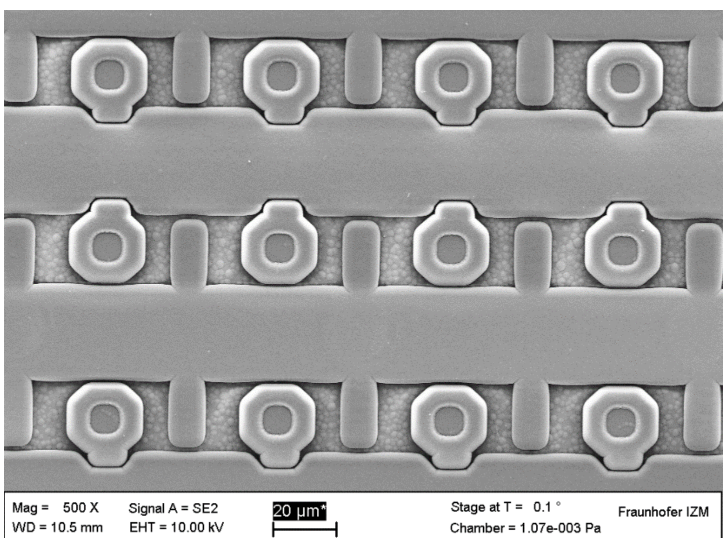


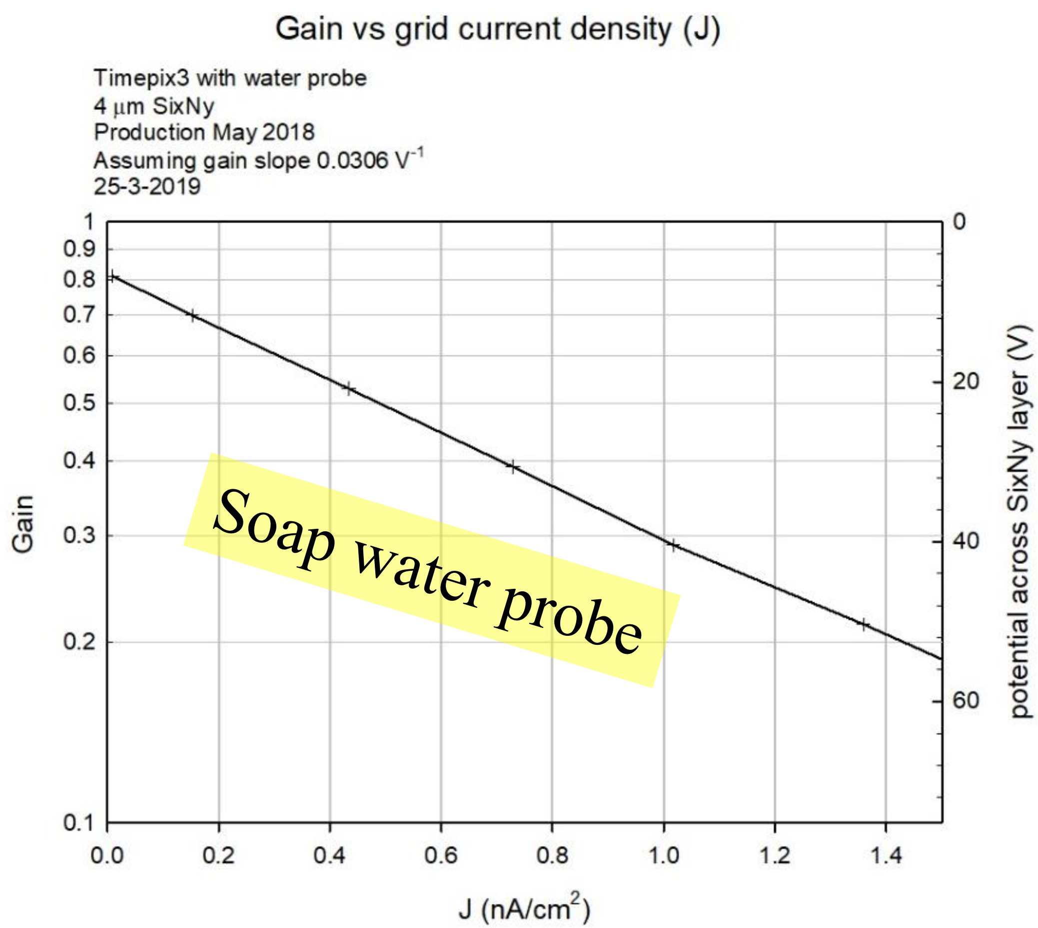
Same curve zoomed in



Calculated gain reduction vs current density

- Gain reduced to 30% at 1 nA/cm2
  - TPX3 chip has ≈ 2 cm2 active surface
- Only 5% of the surface (pads) is conductive
- 2018 testbeam => ≈ 0.5 nA/cm2





Fred Hartjes

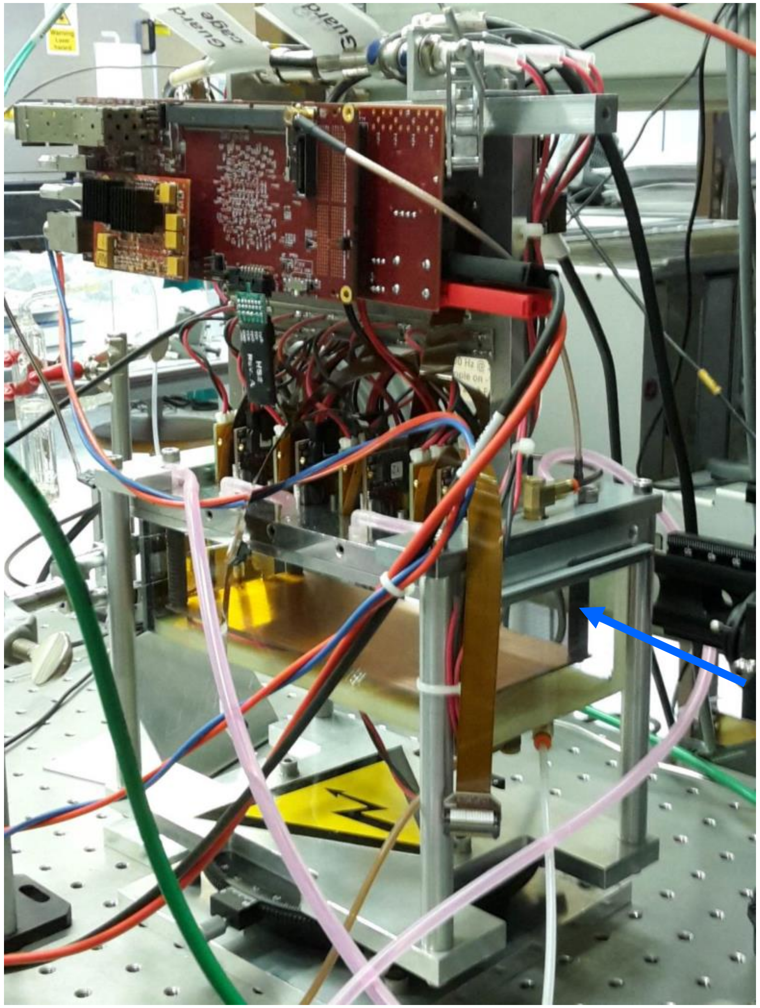
Parallel laser beam

Studies with parallel laser beam

- Range 280 – 360 V in 11 V runs
  - Almost no hits below 280 V
- QUAD 13 examined
- DAQ by single SPIDR board
  - Provisional setup

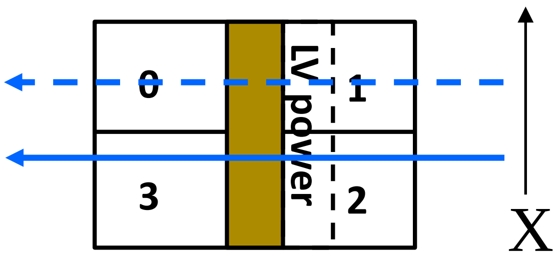
- Laser beam attenuated => ~ 0.3 μJ, 1 ns
- Width ≈ 300 μm
- Per chip few hundred hits per laser shot
- Trigger output from fast diode
- Averaged induced grid current in pA range
  - => potential across SixNy layer < 10 V

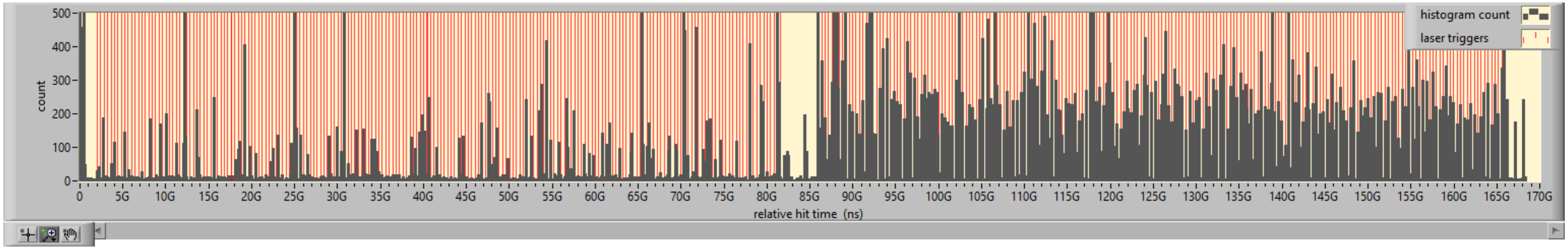
- Measurements by Naomi? on April 3



Data taking protocol

- Laser frequency 2.5 Hz
- Gas: T2K, 300 ppM O2, 2500 ppM H2O
- Drift field: $\boxed{\text{180 V/cm}}$
- Drift distance Z ~ 1 cm
- Measured at
  - X = 10 mm for 200 shots (chip 2 and 3)
  - X = 20 mm for 200 shots (chip 0 and 1)



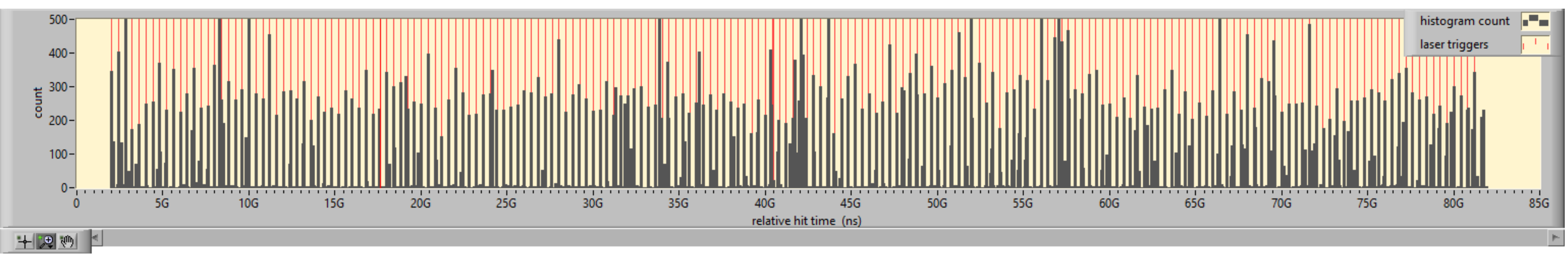


Hit plot for chip 0 at 330 V

Analysis by LabVIEW

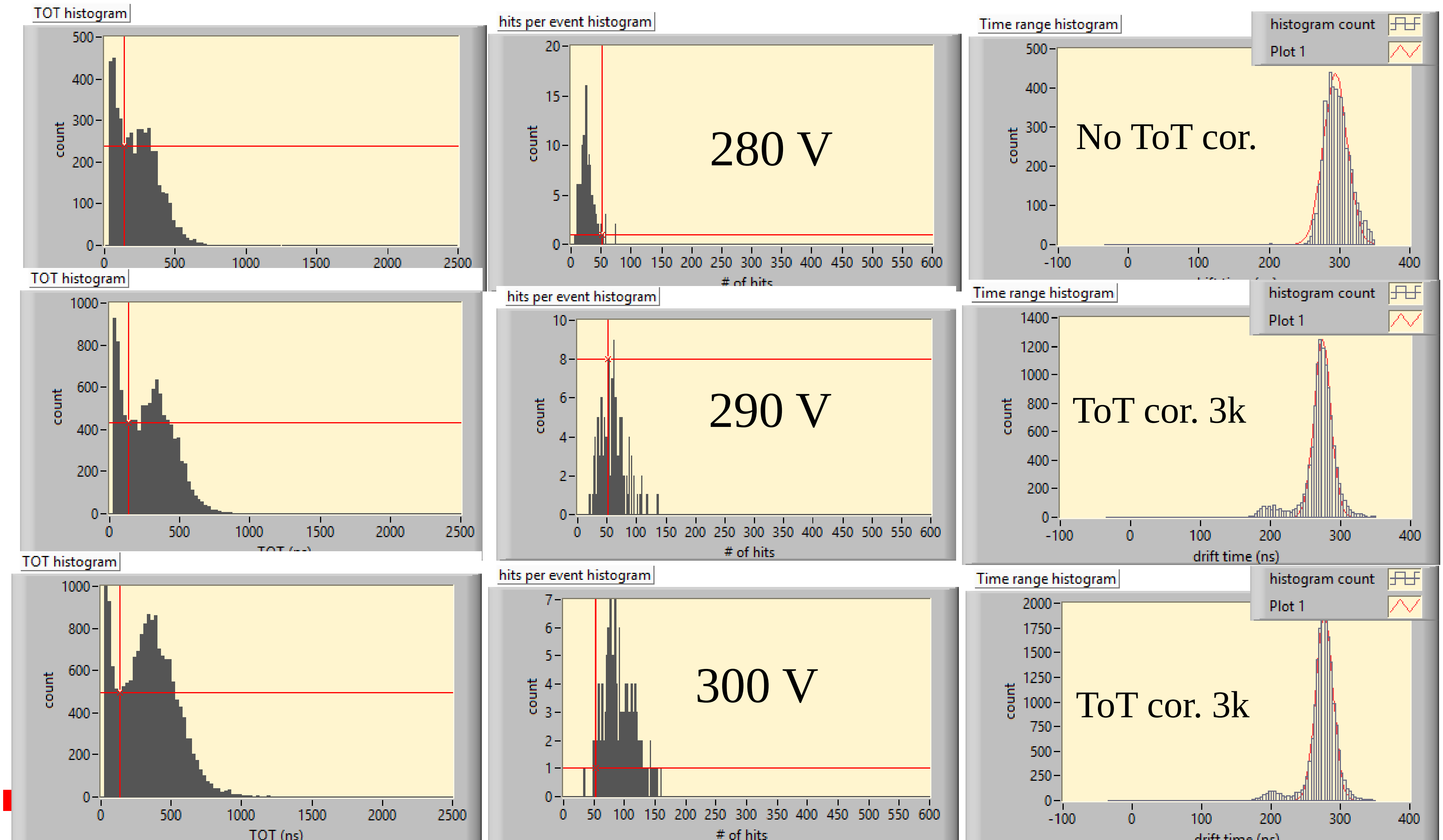
- Time stamp laser trigger close to t0
  - **Subtract 155 ns** from laser trigger time stamp to approach t0
- Apply hit window around laser trigger
  - -40 to 400 ns
- Apply for drift time spectrum a lower limit of 200 ns
- Apply ToT correction on measured drift times by subtracting ToT_{cor}/ToT
  - ToT_{cor} between 3k and 30k, depending on the gas gain (ToT_{cor} and ToT in ns)

Chip 2 at 330 V



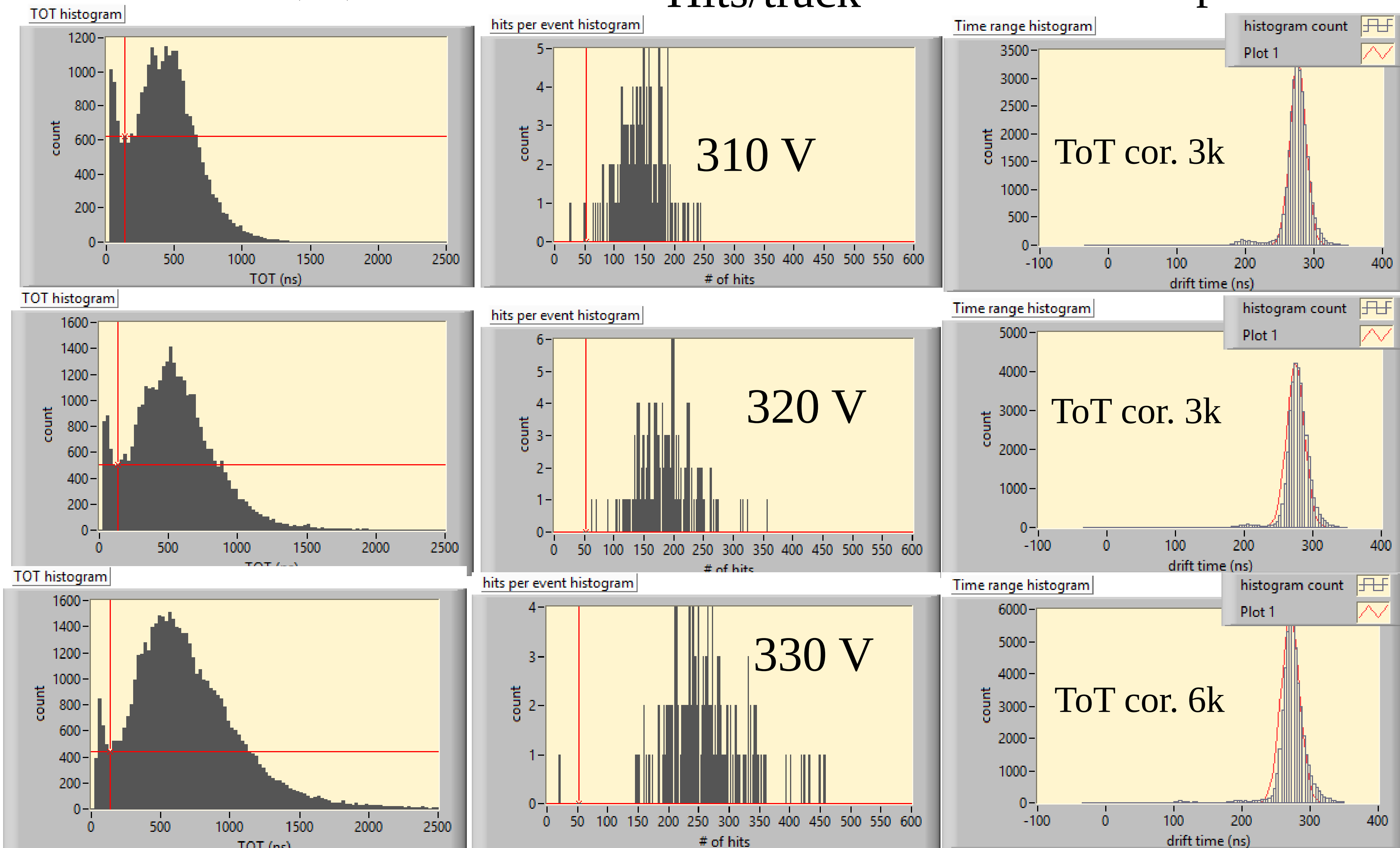
Vgrid = 280 – 300 V

ToT (ns) | Hits/track | Time spectrum



Vgrid = 310 – 330 V

ToT (ns) | Hits/track | Time spectrum

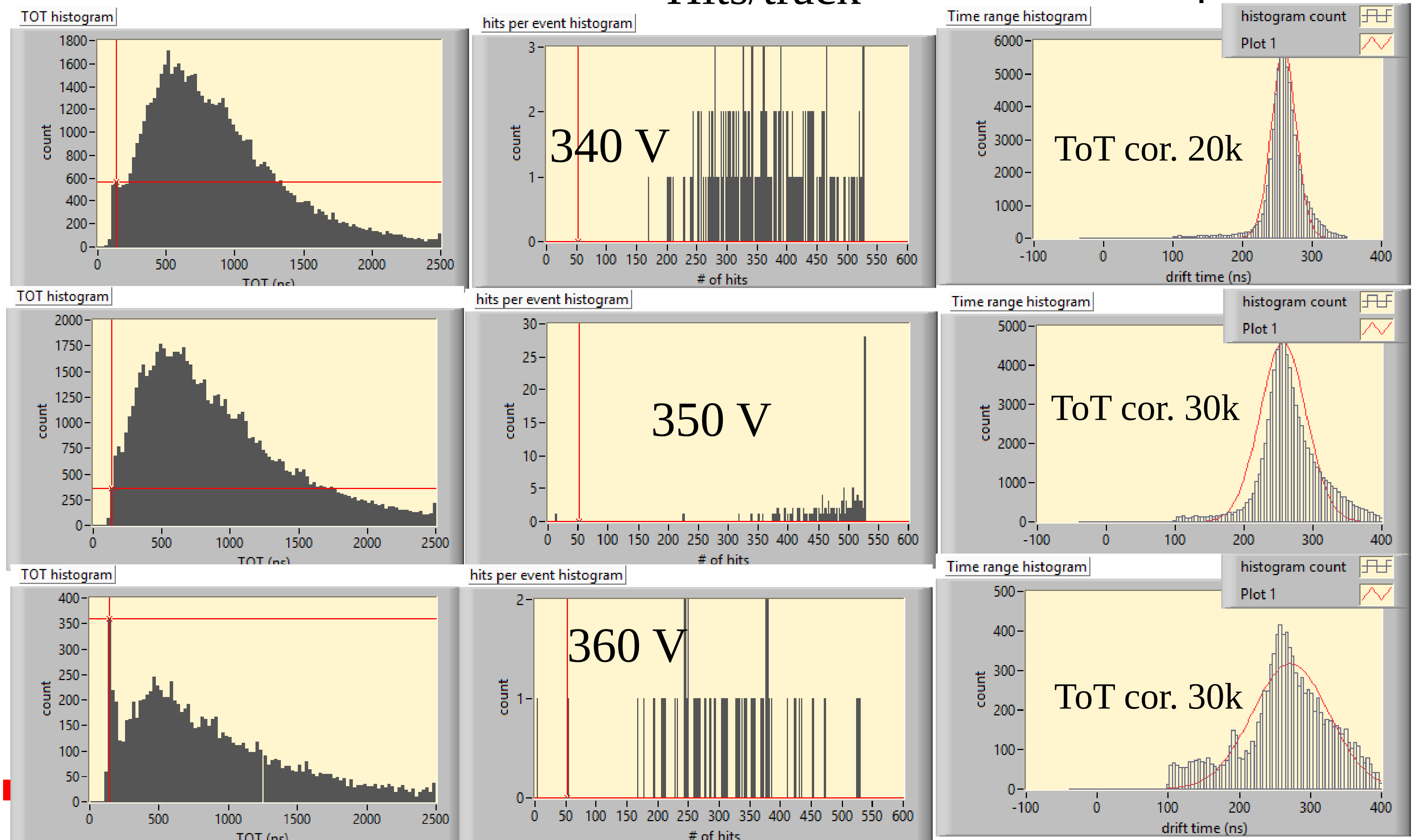


Vgrid = 340 – 360 V

ToT (ns)

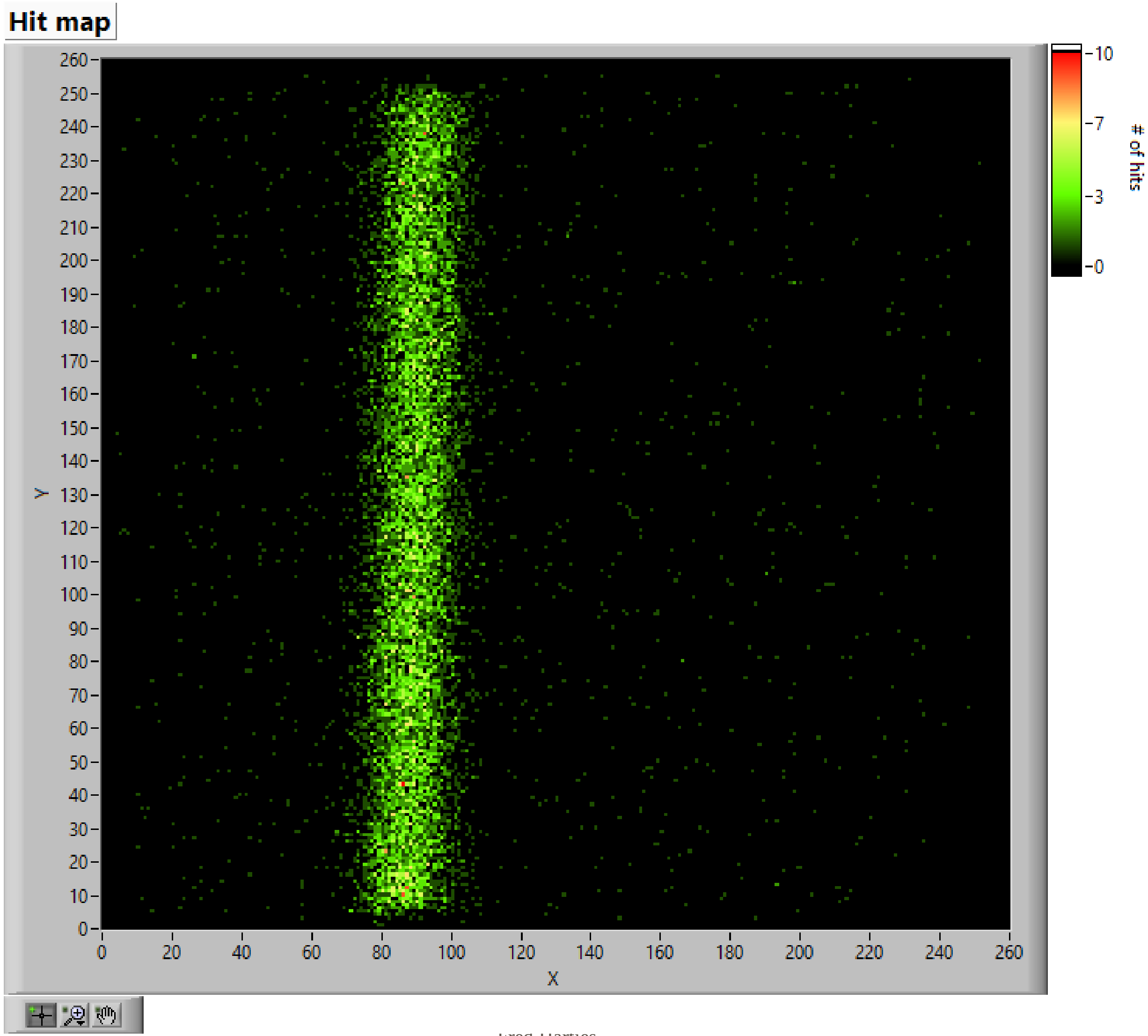
Hits/track

Time spectrum



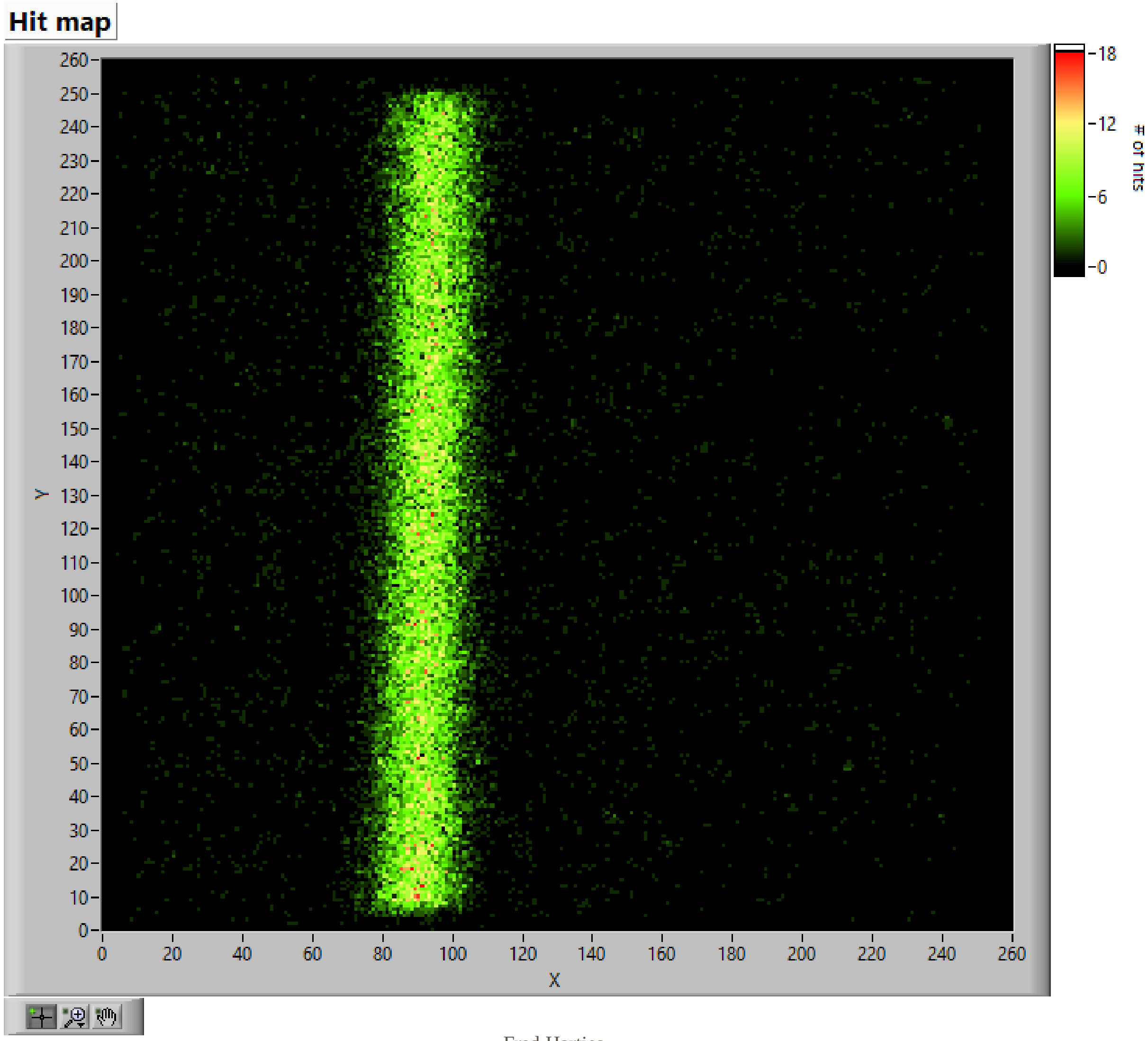
290 V chip 2

- Hits from 200 laser shots

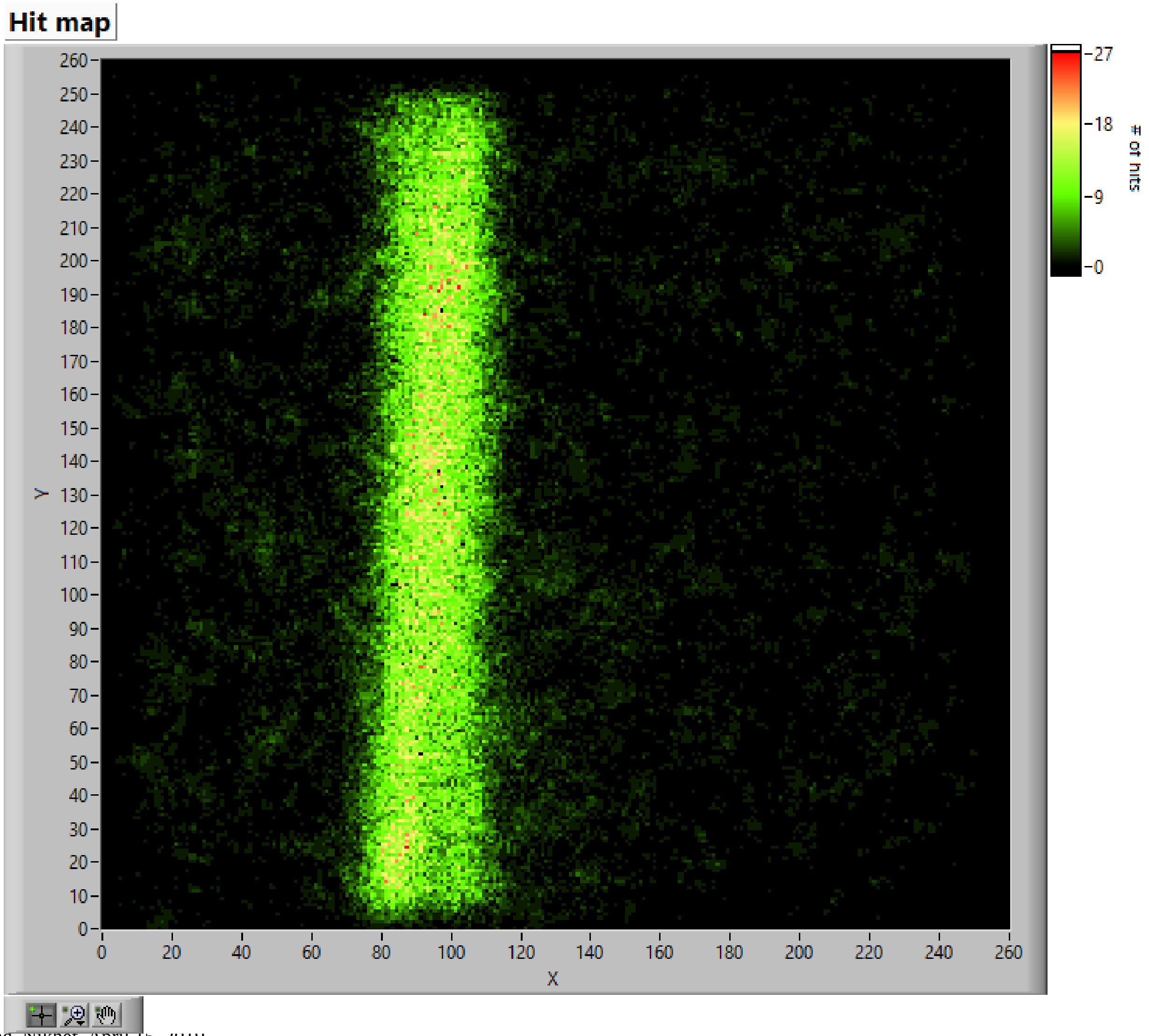


320 V chip 2

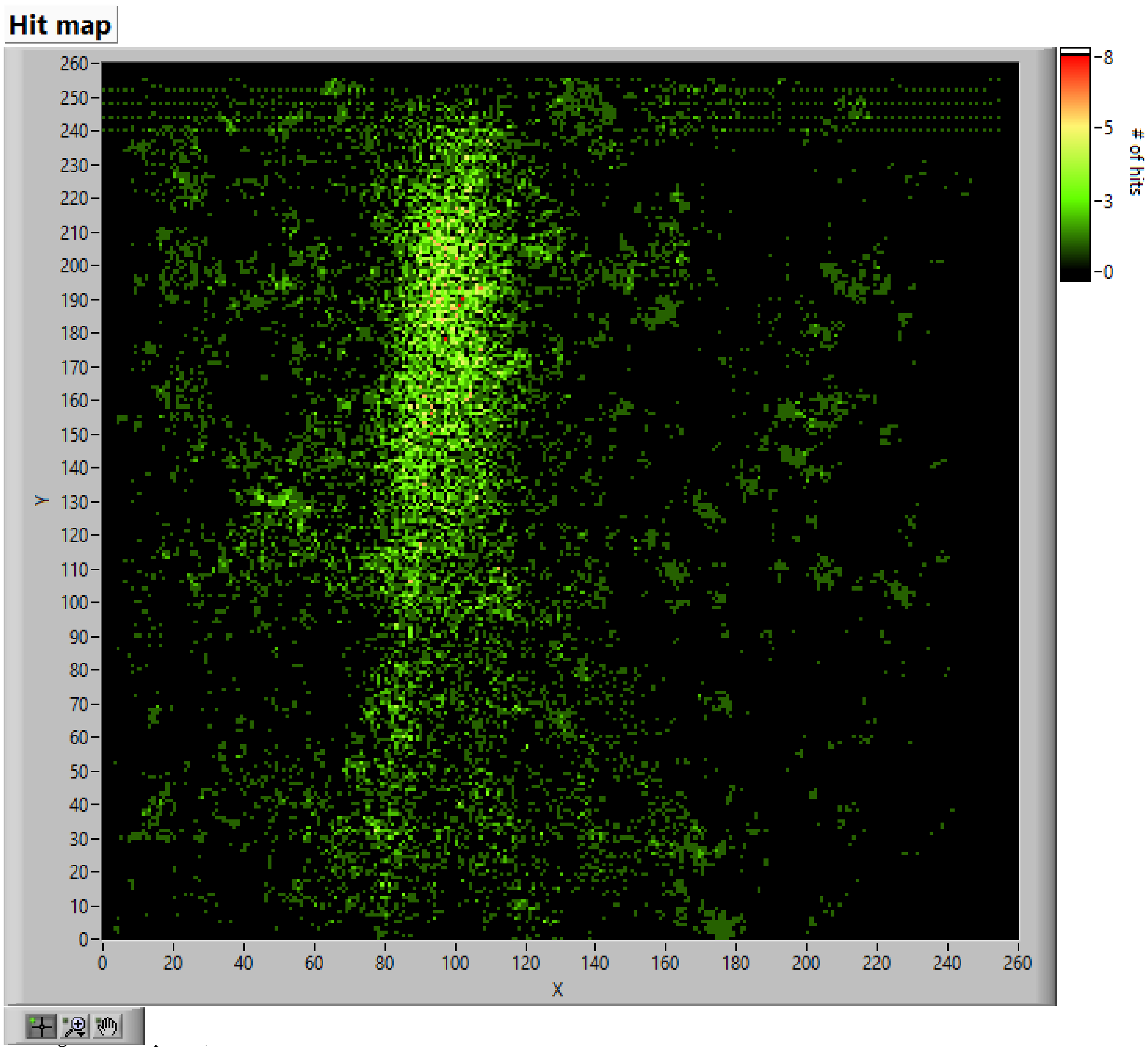
- Hits from 200 laser shots



350 V chip 2

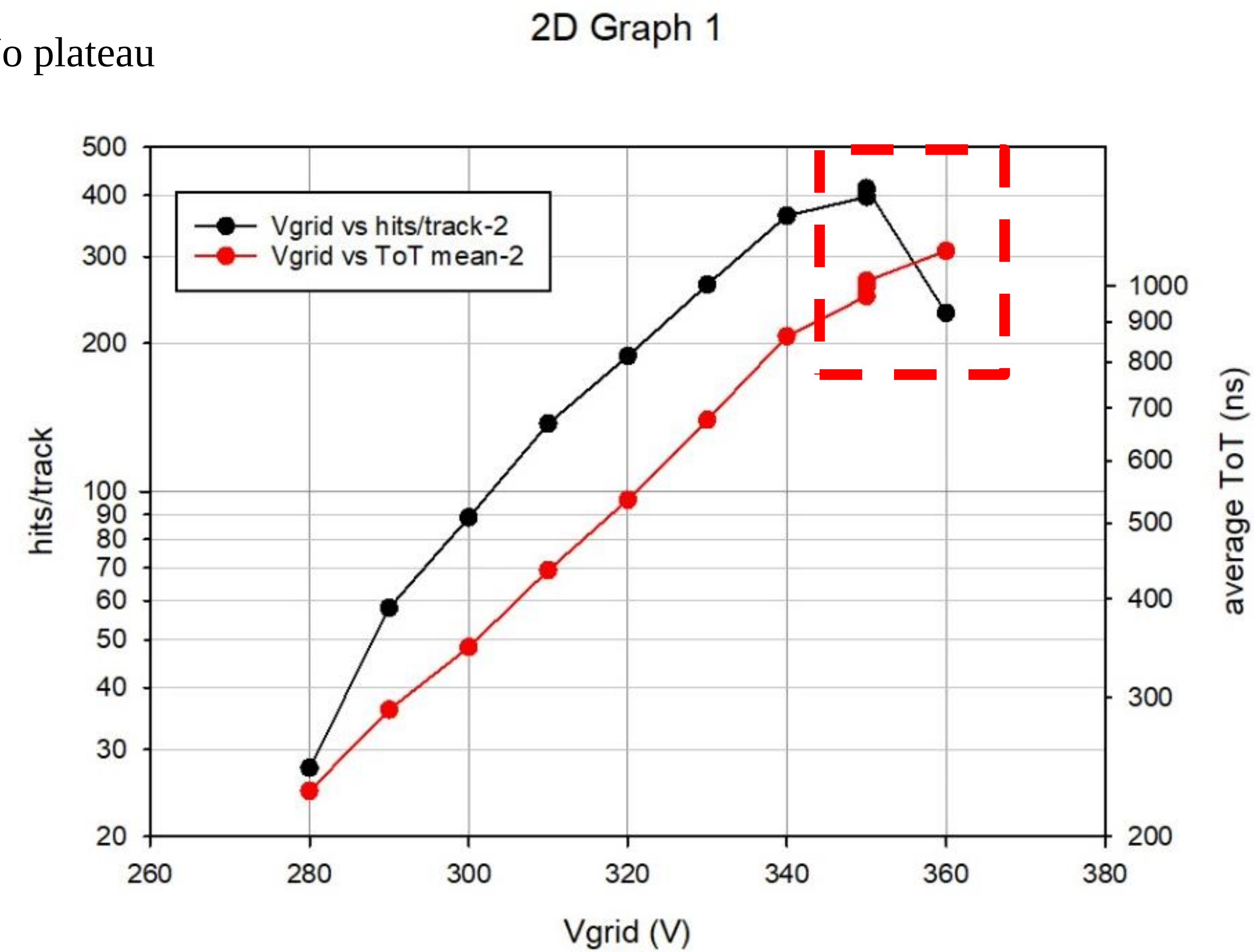


360 V chip 2

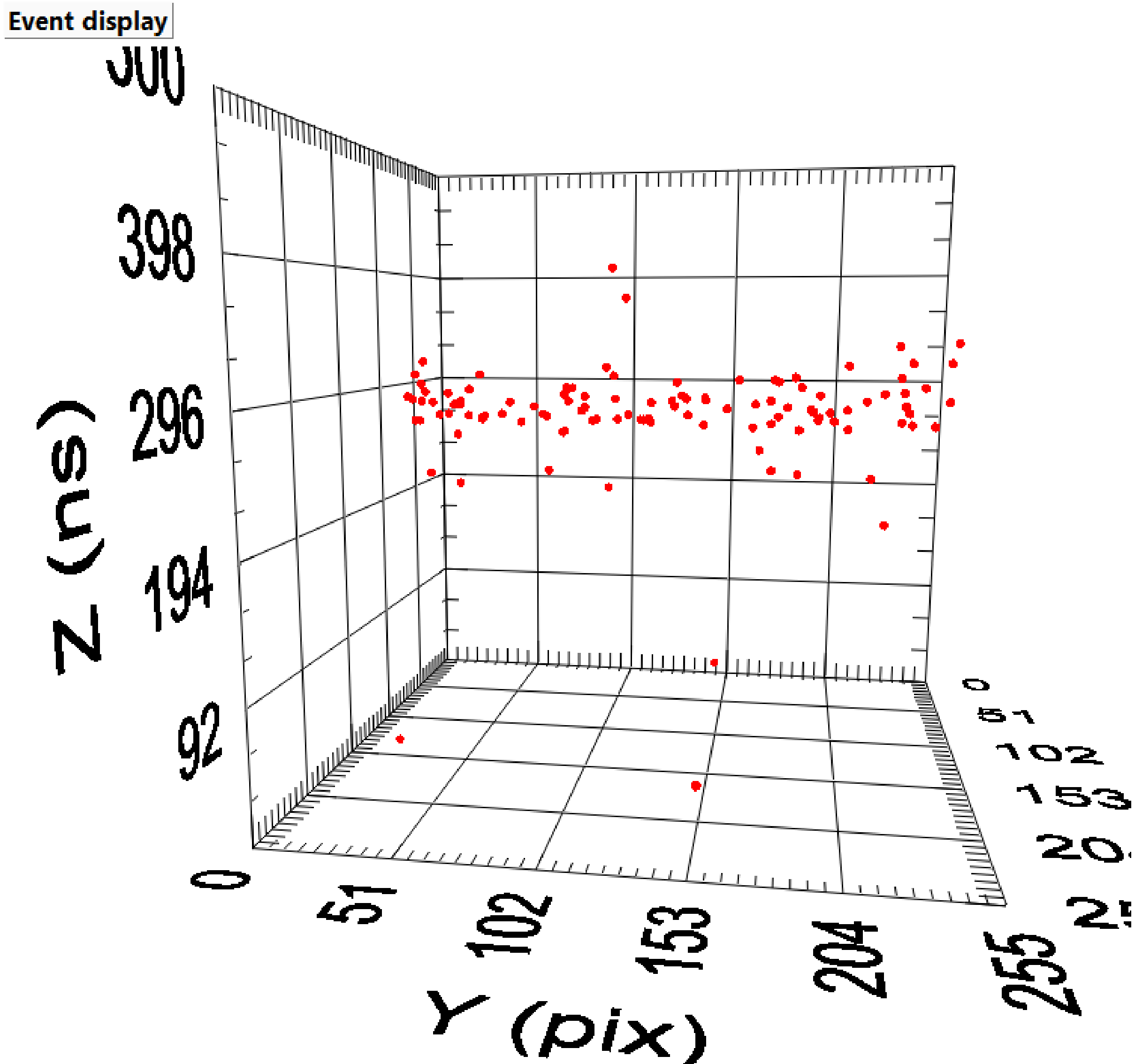

Hit map
Y
X
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
0
20
40
60
80
100
120
140
160
180
200
220
240
260
# of hits
8
5
3
0

Hits/track and ToT vs Vgrid

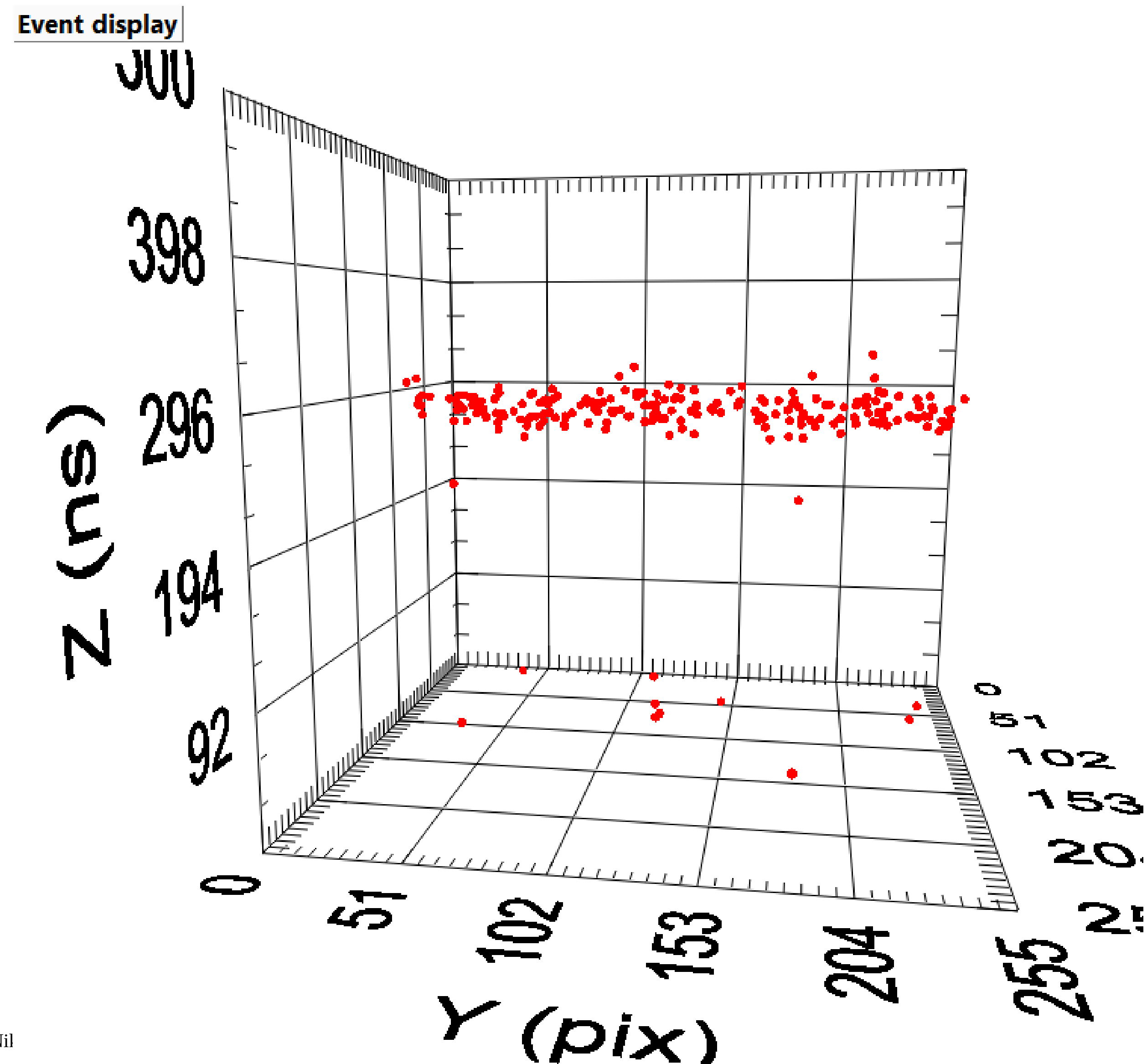
- No plateau



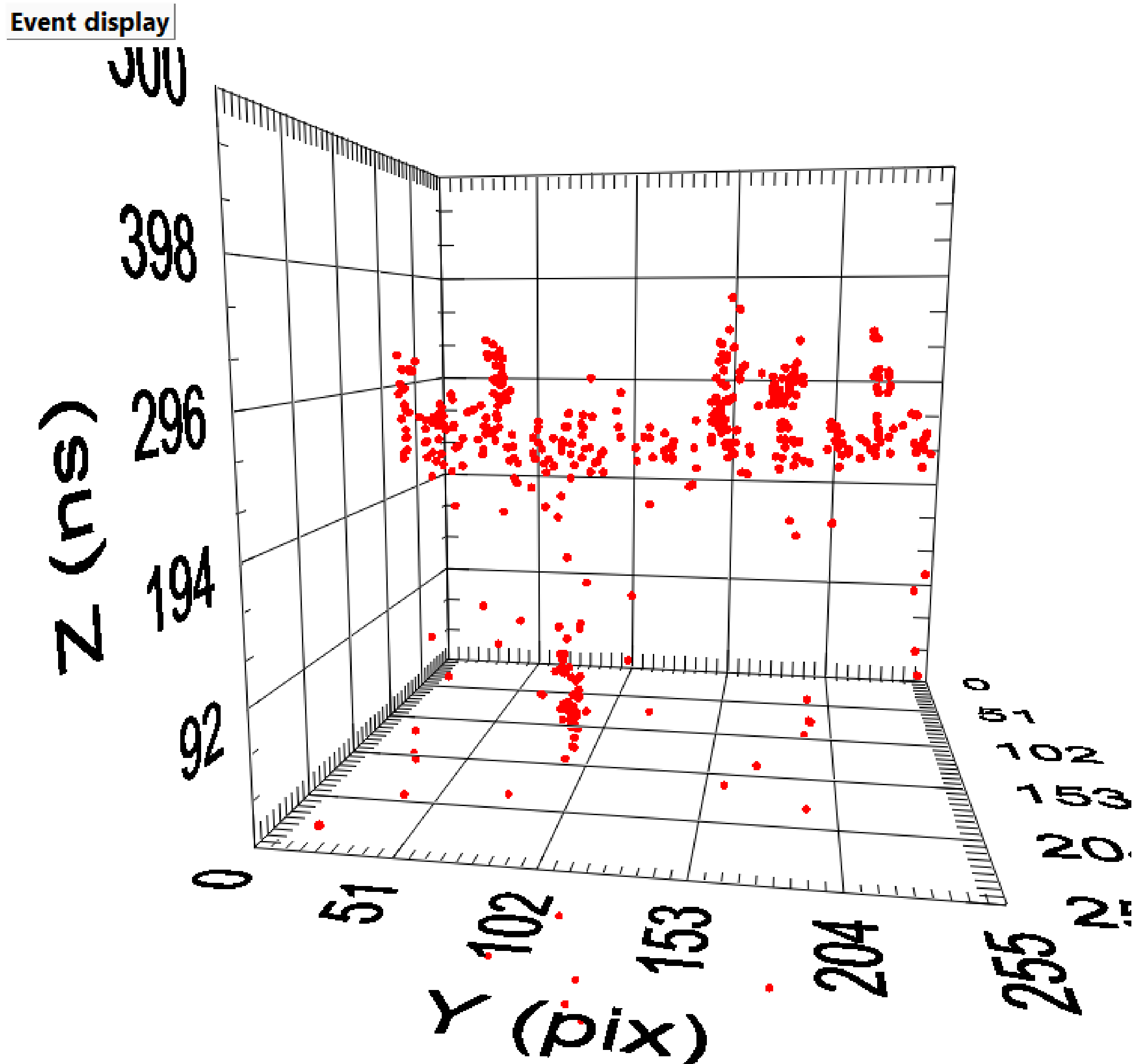
Event 70, 290 V



Event 70, 320 V



Event 70, 350 V



Observed until now

- Until Vgrid = 330 V everything looks normal
  - Nice, clean tracks
- At 350 V many spurious hits
- At 360 V very messy, not decent track visible, only a multitude of spurious hits
- After a short while at 360 V a hard and permanent HV short occurred
- Number of hits/track keeps increasing with Vgrid
  - No plateau visible
- **But above 330 V the additional hits deteriorate the result**
  - Time spectrum gets broader (after-pulsing?)
- => there is an optimal working point
- Optimal grid voltage at 320 – 330 V
  - But probably depending on grid current
- Hits per track is limited at ~ 530
  - DAQ effect => other hits at 409 μs further?
- There are random hits (~ 5%) at Td around zero
  - ToT spectrum agrees with the hits from the laser track
  - Also at the neighbouring chip
  - => probably due to spurious laser light hitting the edge of the holes

We have to redo the measurements with a source