KEK 99 Beam Test

Forward Modules

FR_K81

FR_R_006

Zdeněk Doležal

Charles University, Prague

P. Kodyš[1], L. Feld

Freiburg University

with help from many others

[1] on leave of absence from Prague

Basic information

- Place: KEK, Tsukuba
- π2 beamline in 12 GeV PS at KEK, 4 GeV/c π^-
- Modules:
  - M0: KEK-ABCD#1, 12 chips, 285 μm, trim 2fC=200mV
  - M1: FR-ABCD_K81, 12 chips, 285 μm, trim 2fC=200mV
  - M2: KEK-ABCD#2, 12 chips, 325 μm, no trim
  - M3: FR-irrad det-ABCD2T, 2 chips, 285 μm, trim 2fC=200mV
  - M4: KEK-CAFÉ/ABC, 12 chips, 285 μm
  - M5: CG3, ABCD1.2, anchor
- Run Conditions:
  - Edge detection = OFF, Mode = Any Hits
  - 20 x 20 mm triggered region with 3 planes of scintillator
  - Temperature -10 °C

Module description FR-K81

- FW kapton-2 hybrid
- 12 ABCD2T's, 1st batch
- 4 detectors, 285 microns
  - Top W31: CiS338616,
  - Top W32: CiS339108
  - Bottom W31: CiS338610,
  - Bottom W32: CiS339112
- Melbourne support card SC99
- trimmed to 200 mV at 2 fC
- stable
- noise
  - 1400 electrons @ 2 fC in the lab
  - 1470 electrons @ 2 fC in beam test site
- gain 55 mv/fC @ 2 fC
- ~5% bad channels

Module description FR-R_006

- FW kapton-2 hybrid
- 2 ABCD2T's, 1st batch

- 1 W31 CiS3041a03 detector irradiated to $3x10^{14}$ 24 GeV p/cm^2 in 1998 (from Munich)
- mounted on special irradiation ceramic frame with special fan-in
- 1st chip bonded to 6 cm strips, 40 channels of S1 bonded to 2 6-cm-strips in parallel
- Melbourne support card SC99
- trimmed to 200 mV at 2 fC
- stable
- noise 1440 electrons @ 2 fC in the lab (6 cm)

Analysis Method (1)

Common for all runs:

- telescope alignment (3 telescopes used)
- modules alignment - residuals Δ

Module alignment:

$$\Delta = aT_{1x} + b(T_{2x} - T_{1x}) + cT_{1y} + dT_{1x}T_{1y} + eM + f$$

$$|\Delta| \leq 150\ \mu\text{m}$$

Coefficient description:

- a telescope cell size
- b track direction
- c module rotation along z-axis
- d detector fan (forward only)
- e detector pitch
- f module offset
- T telescope channel
- M module channel

Analysis Method (2)

Selection procedure for events:

- track finding (min. 2 telescopes),
- single track events accepted only
- track projection onto module plane
- there is a good hit in anchor
- there are no bad channels in the analyzed region (±150 μm)

GOOD EVENTS analyzed further

- hit in the analyzed region = efficient hit
- more hits in the analyzed region = multihit
- hit out of the analyzed region = noise hit
- noise hit out of the triggered window = noise hit out-window (to avoid misinterpreting the beam hallo)

Analysis Tools

Raw data processing:

- TBOffline (ROOT/C++ package from ST software by Gareth)

Alignment coefficients:

- paw, Excel Solver

Further track and event evaluation:

- user routines under TBOffline run under ROOT environment

Histogram booking and displaying, graphs:

- set of ROOT macros

The tools are not very fancy (we started from scratch in January), but there is an effort towards making them modular and usable by others - some products are already used for recent H8 TB, which uses the same data format

Conclusions

Working regions for modules

Module	Bias (V)	Qth (fC)	Noise Occupancy per channel per event	Efficiency
K81 S 0	100 – 180	1.0 - 1.2	<1.0E-4	99.5%
K81 S 1	80 – 200	1.0 - 1.2	<1.3E-4	99.0%
Irradiated	400 – 500	1.0 - 1.4	<1.2E-4	87.0%

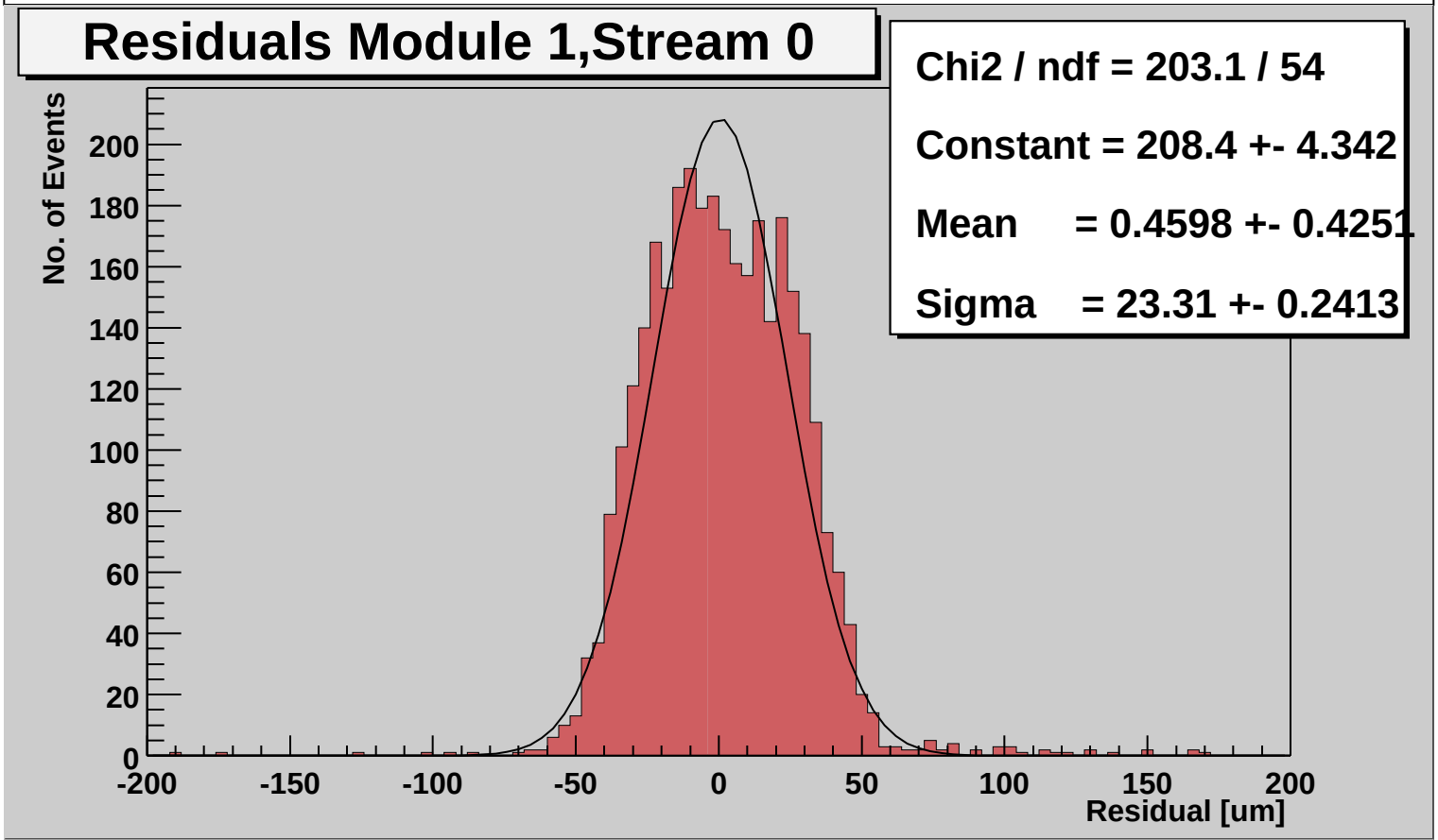
FR_K81:

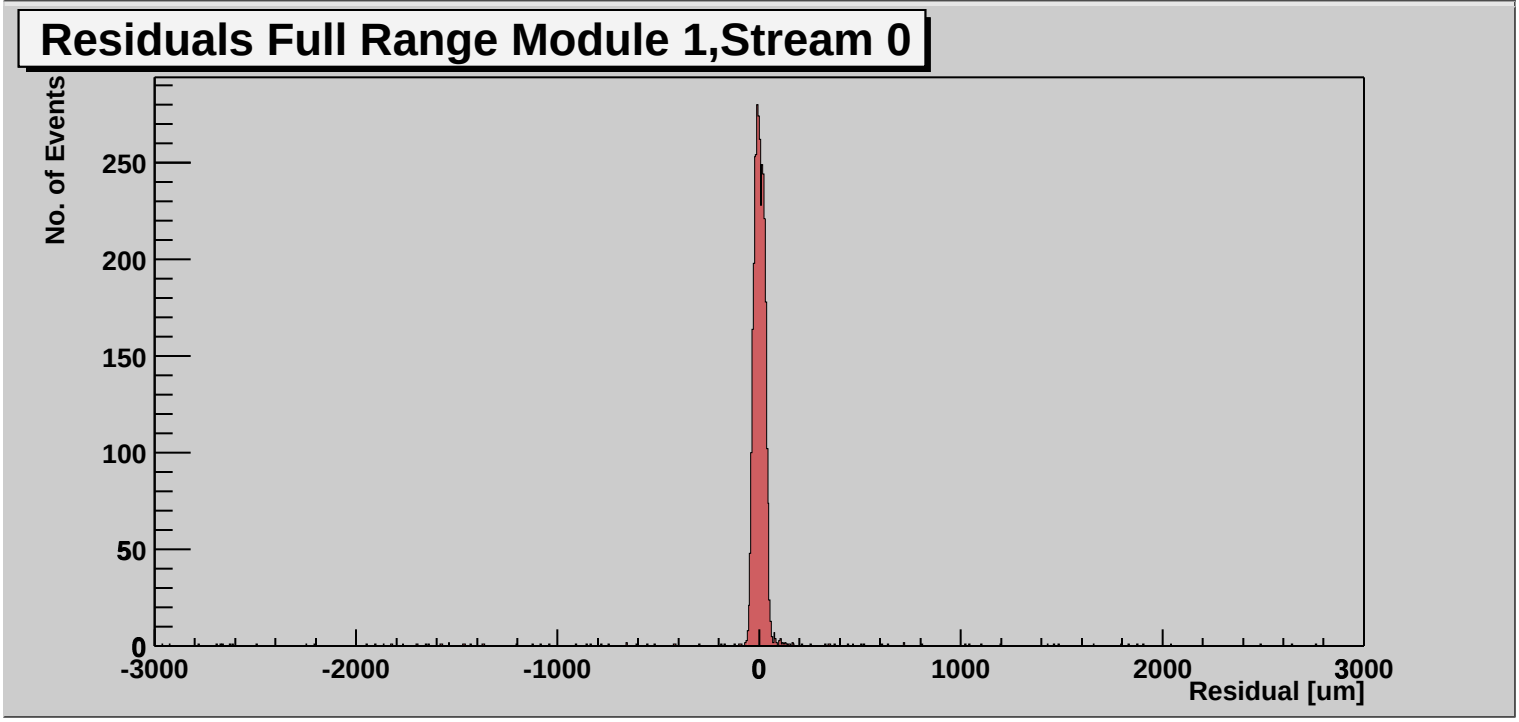
- stable, working region with acceptable efficiency and noise exists, although narrow
- median collected charge 3.2 fC

FR_R_006:

- special module - 1st irradiated detector on ABCD2T chips
- efficiency ~90% reached for threshold <1.4 fC
- noise starts to rise for Qth<1 fC
- median collected charge 2.5 fC (significant loss ~30%)
- further studies on irradiated modules necessary

ATLAS SCT KEK Testbeam Dec, 99 - Residuals, Module 1, Stream 0, Run 804





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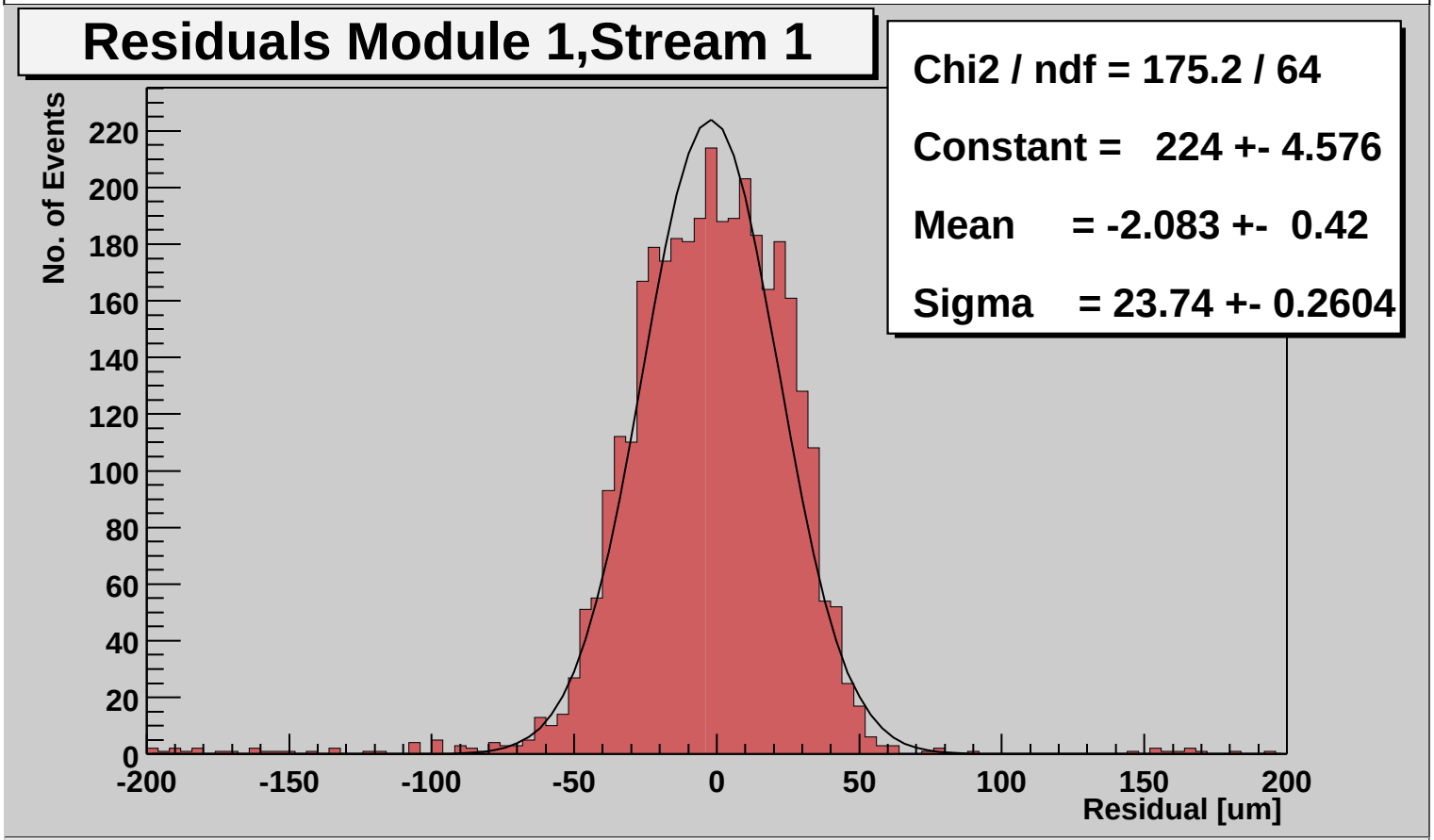

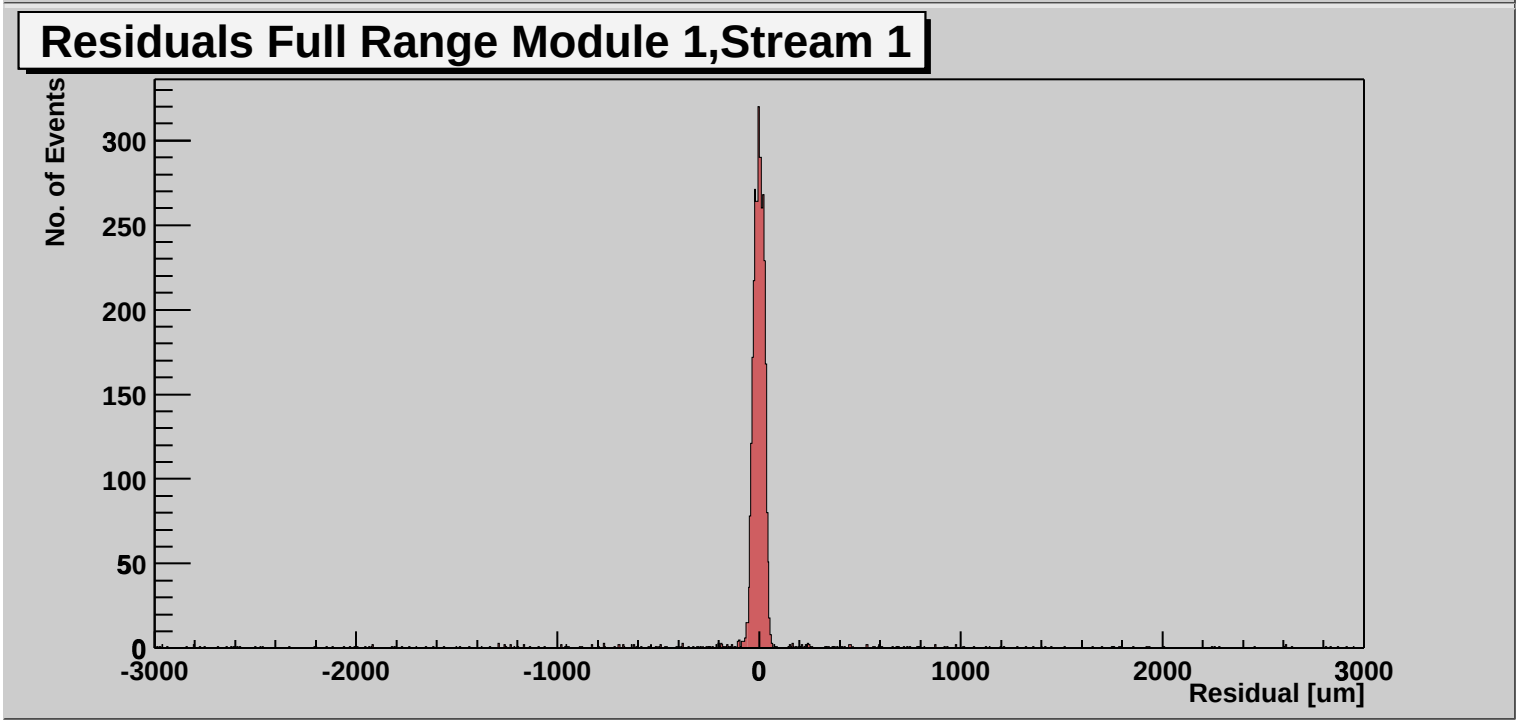

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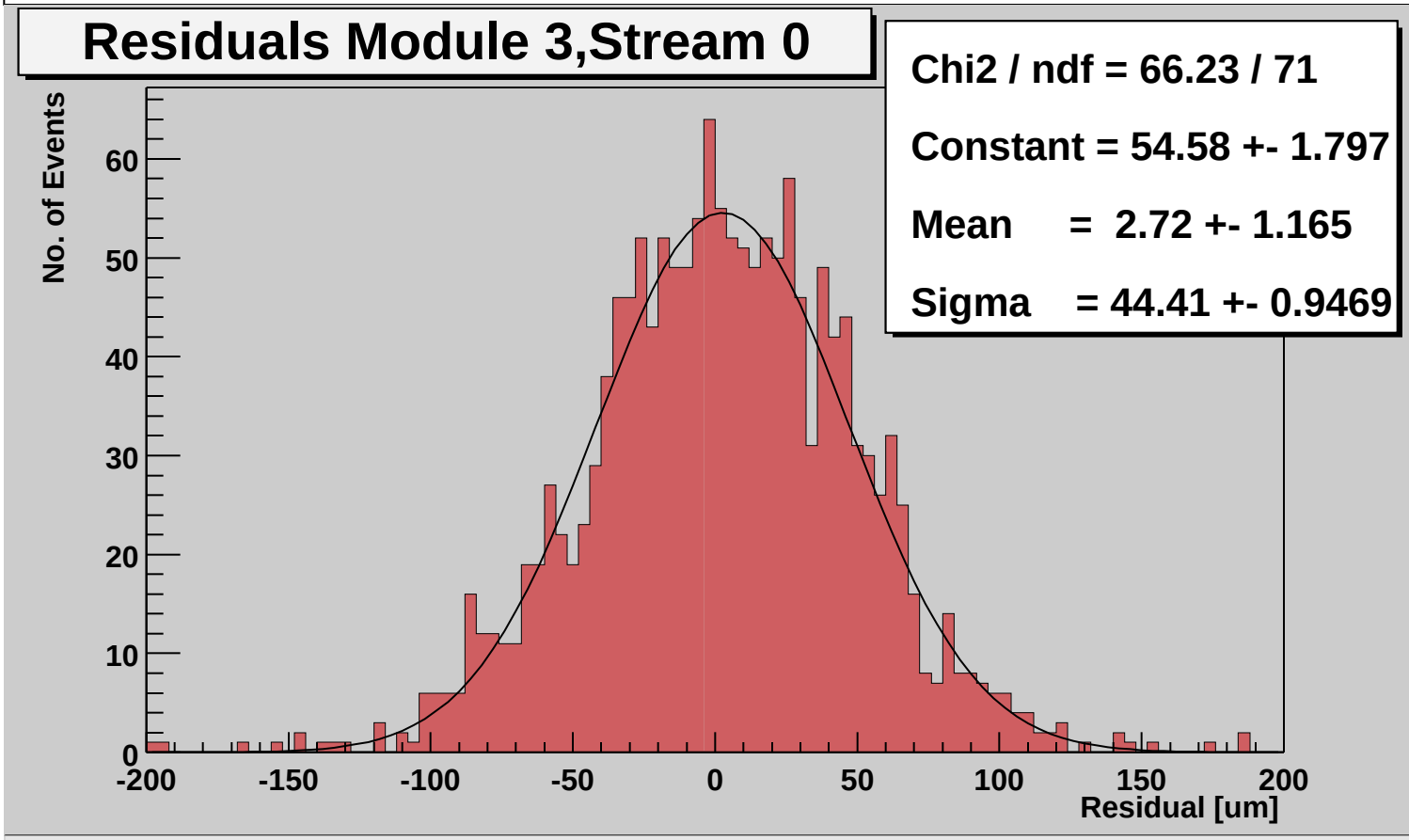

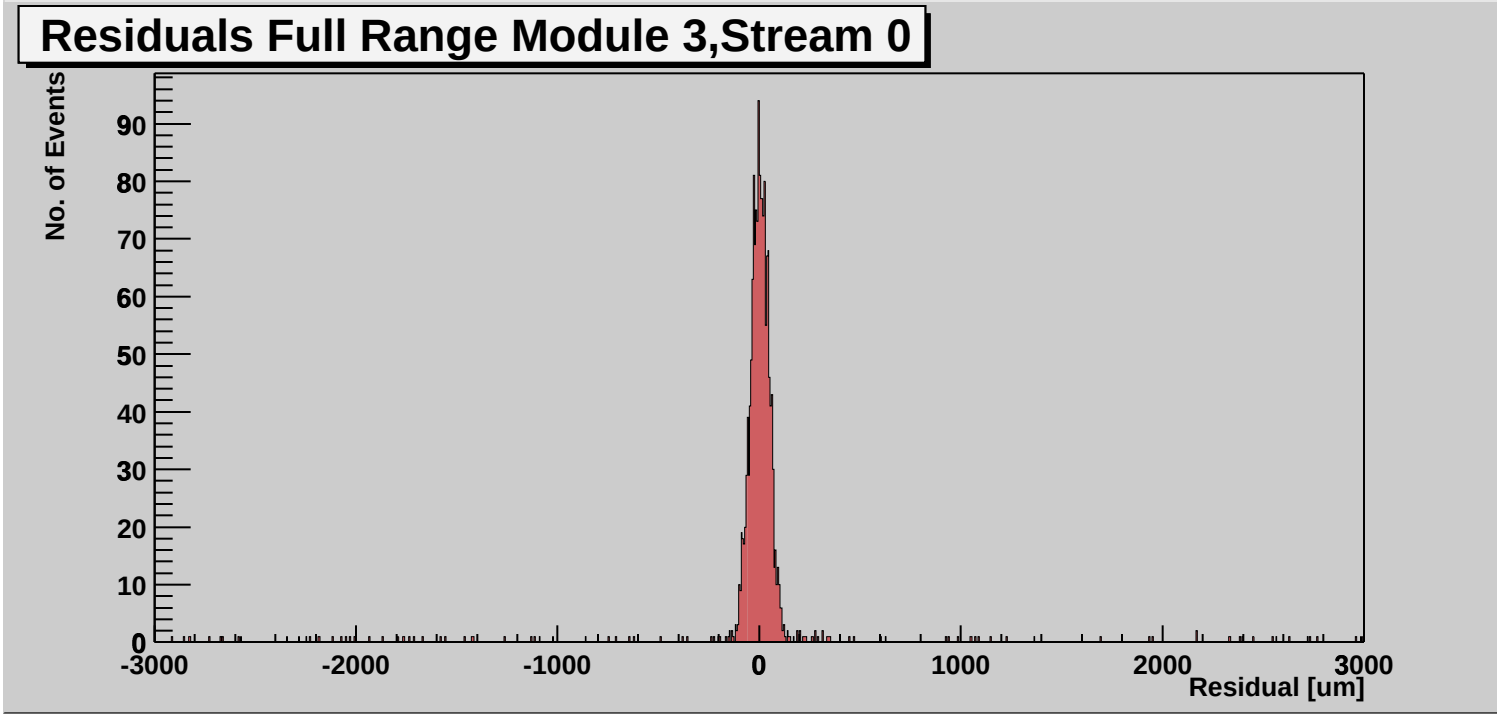

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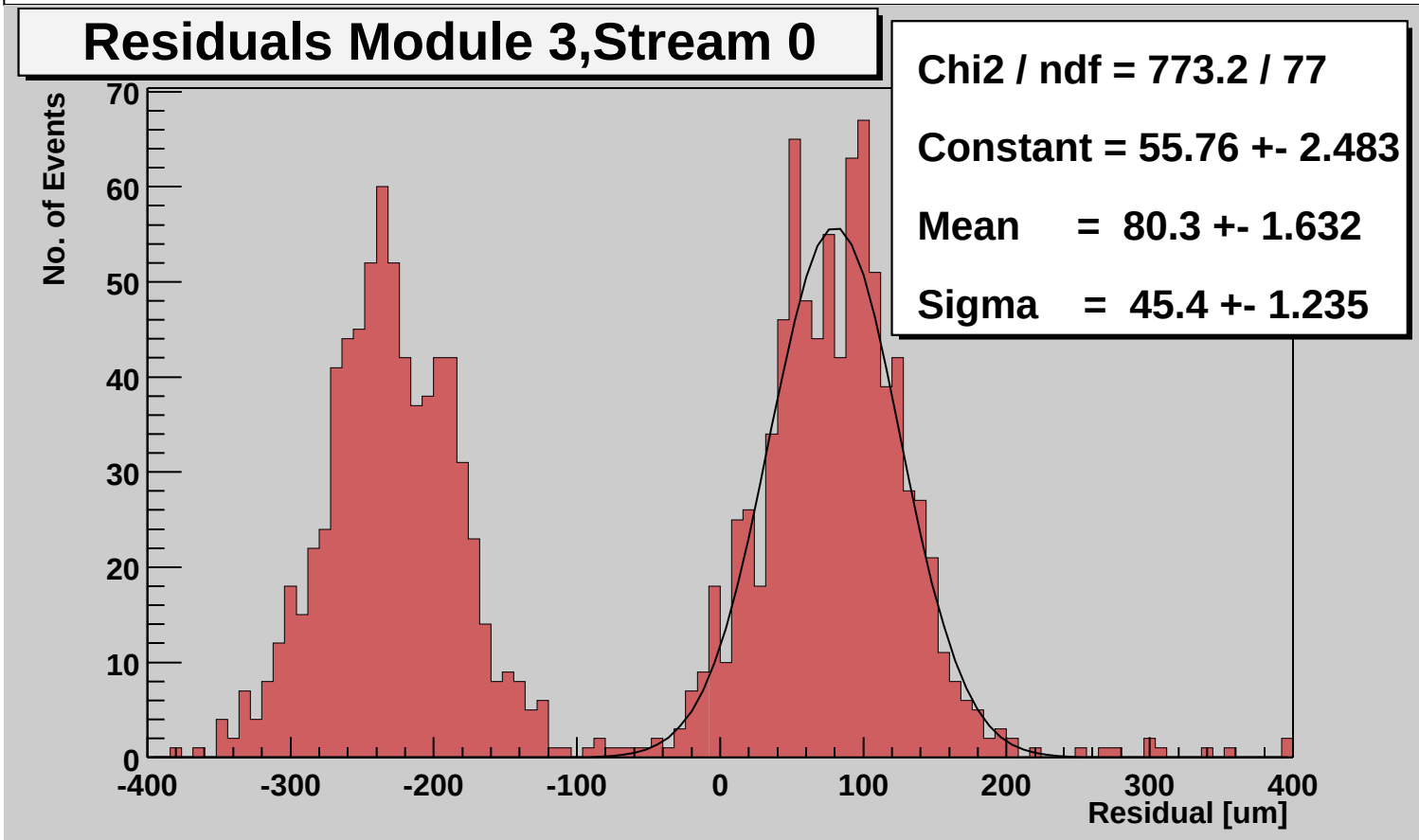
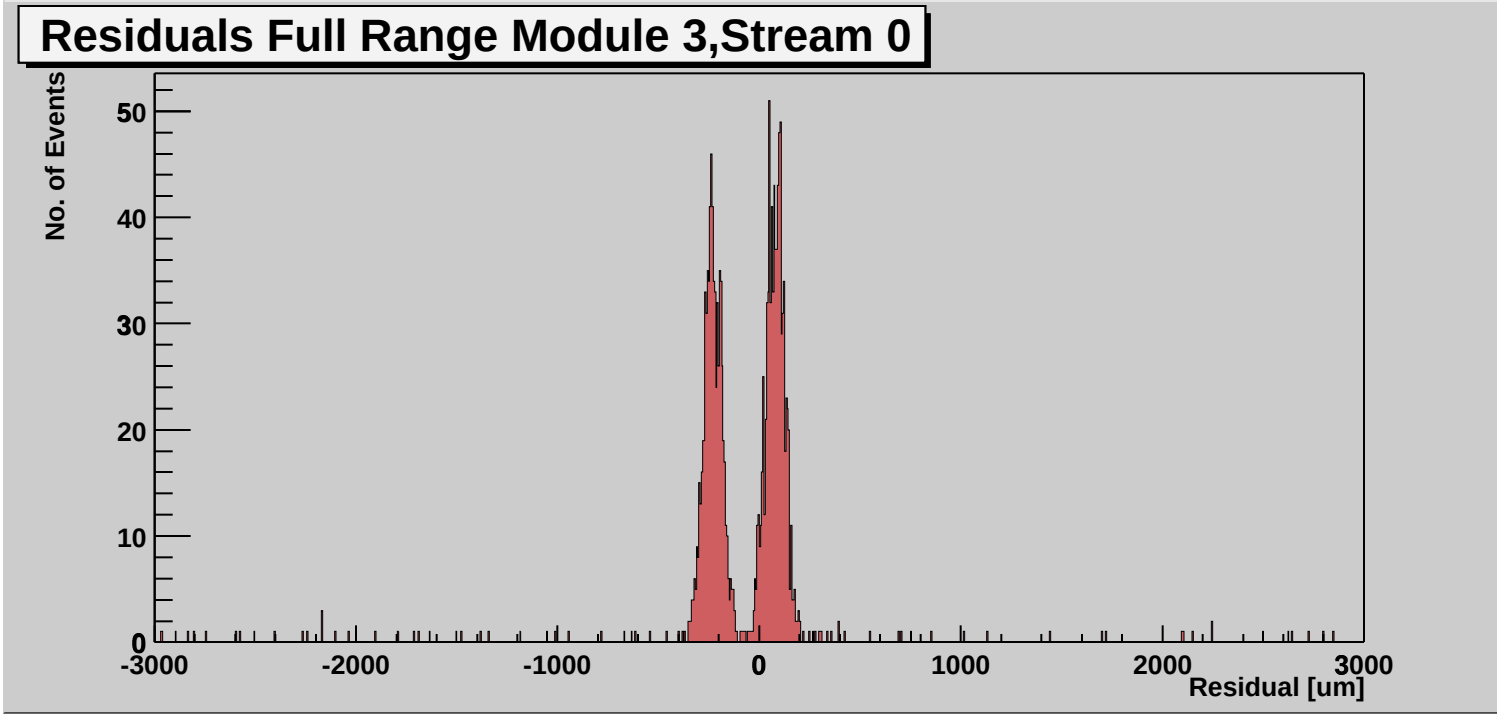
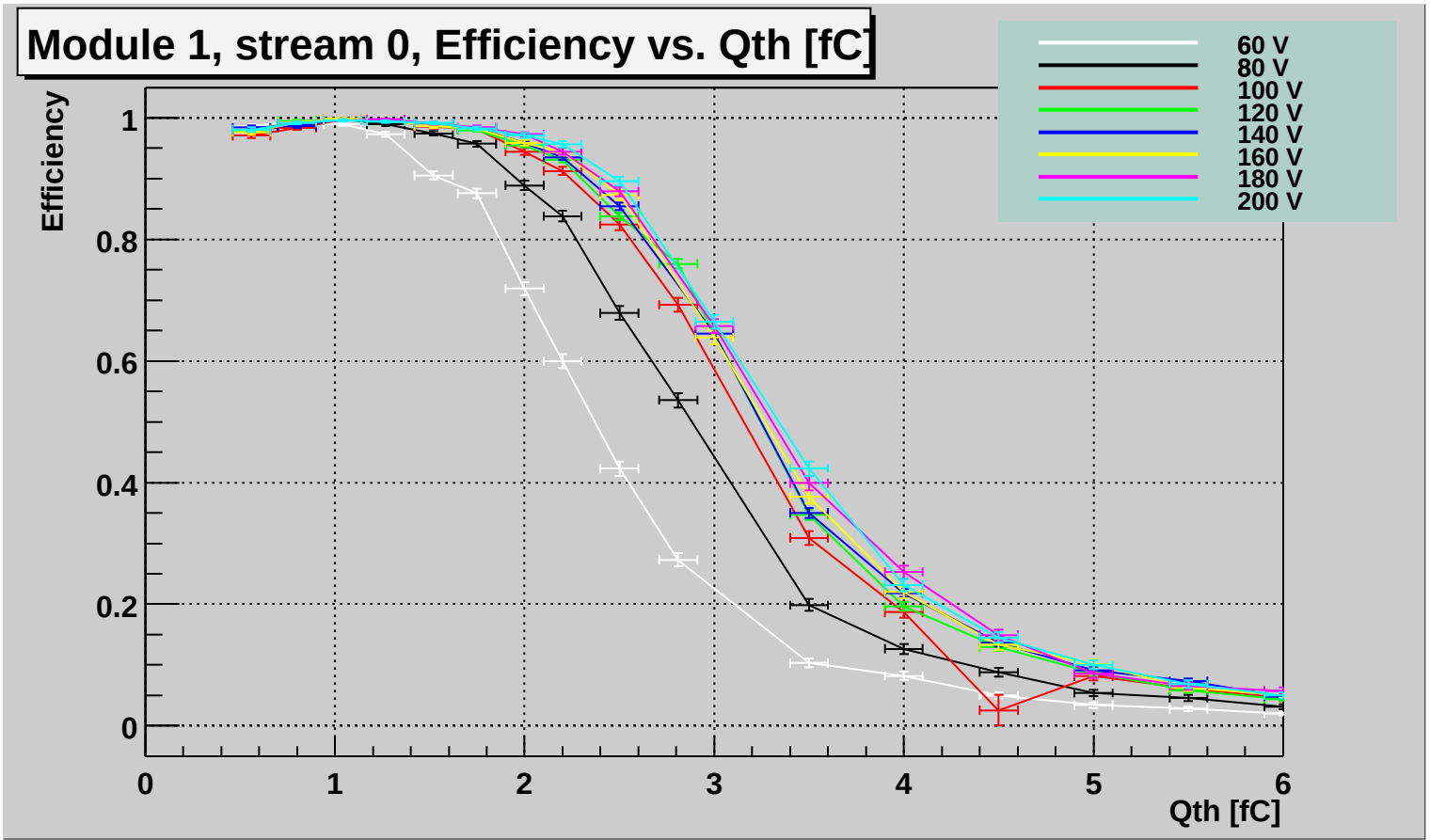
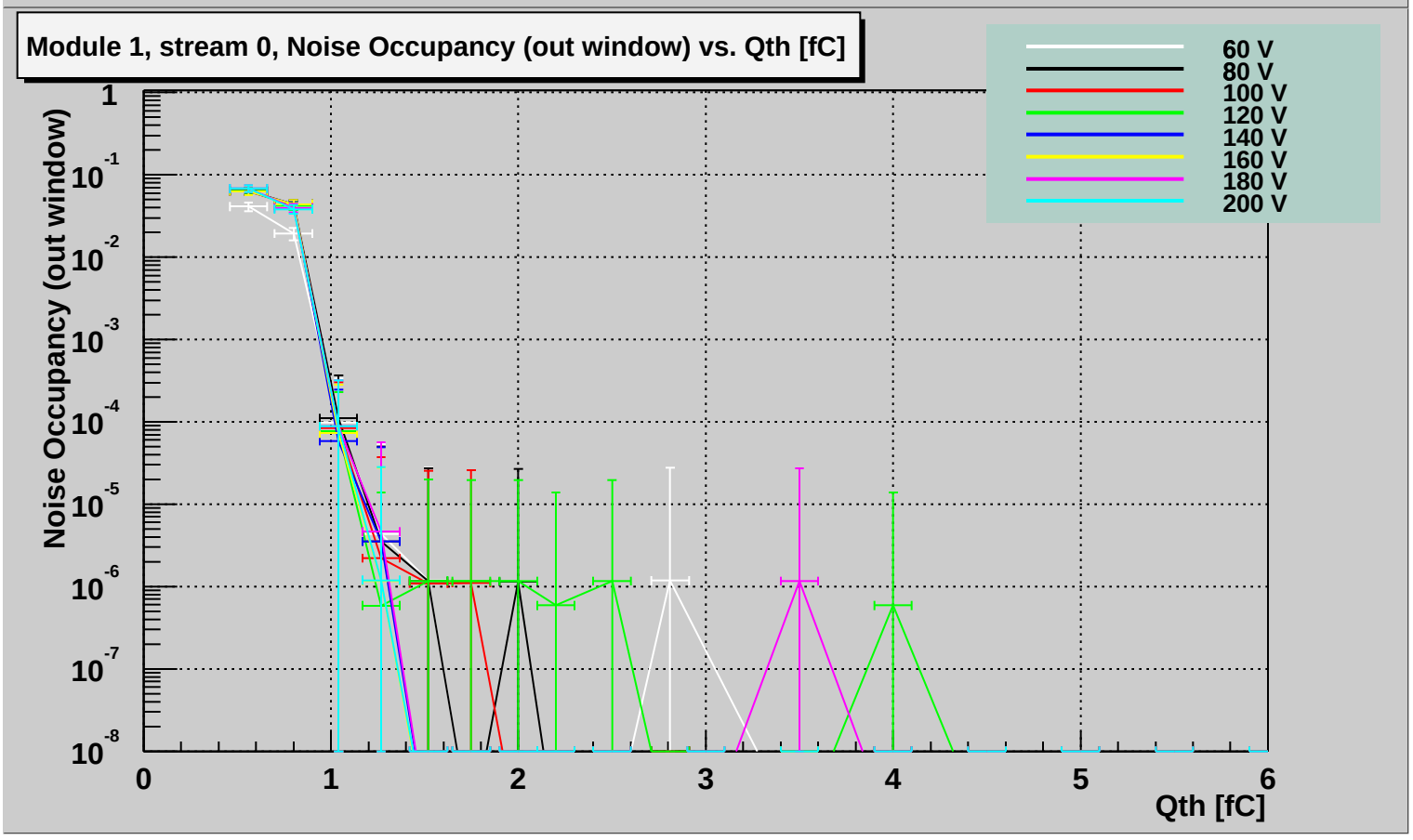
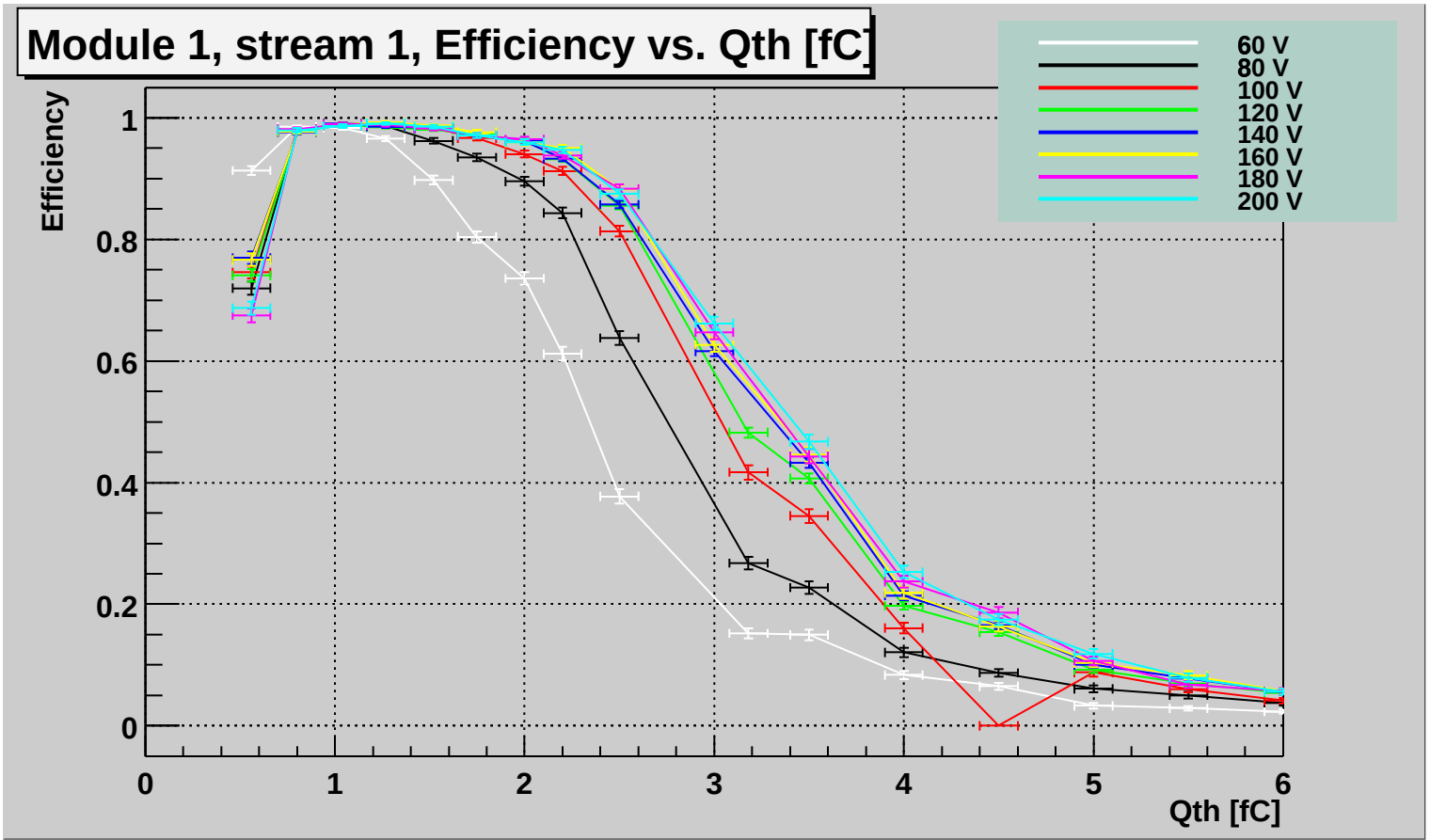





Module 1, stream 0, Efficiency vs. Qth [fC]
Efficiency
Qth [fC]
60 V
80 V
100 V
120 V
140 V
160 V
180 V
200 V


Module 1, stream 0, Noise Occupancy (out window) vs. Qth [fC]
Noise Occupancy (out window)
Qth [fC]
60 V
80 V
100 V
120 V
140 V
160 V
180 V
200 V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120 V
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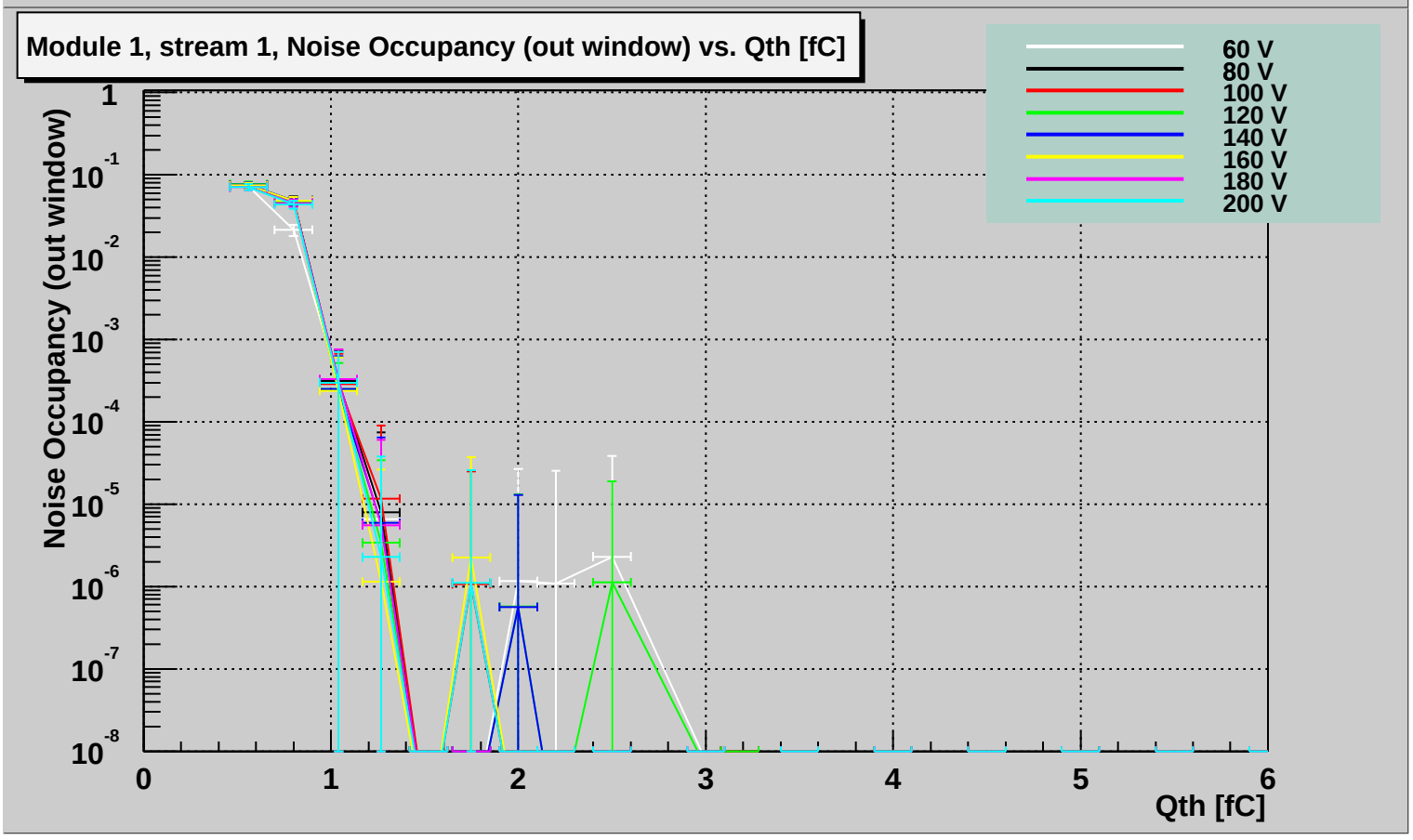
160 V
180 V
200 V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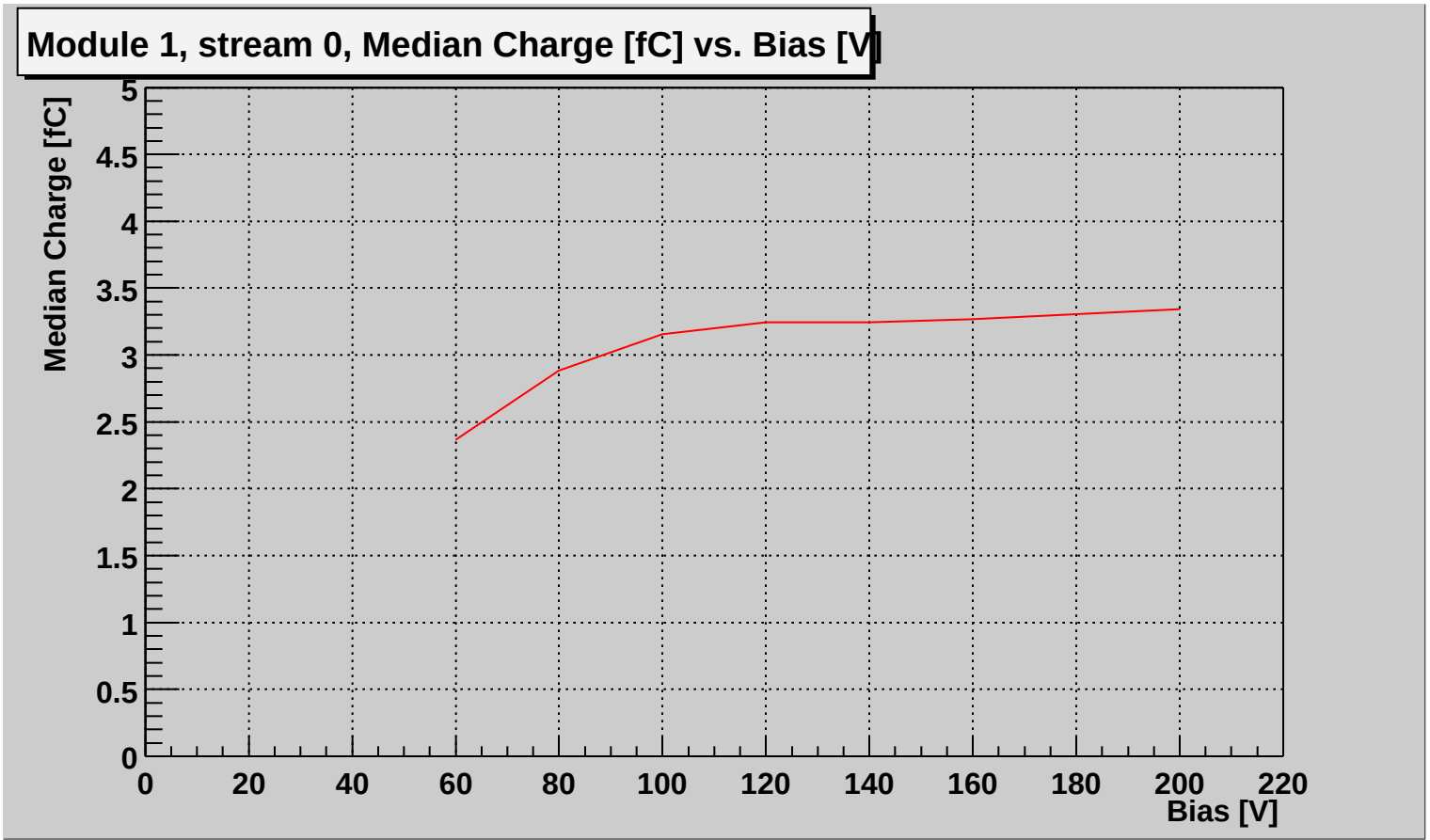
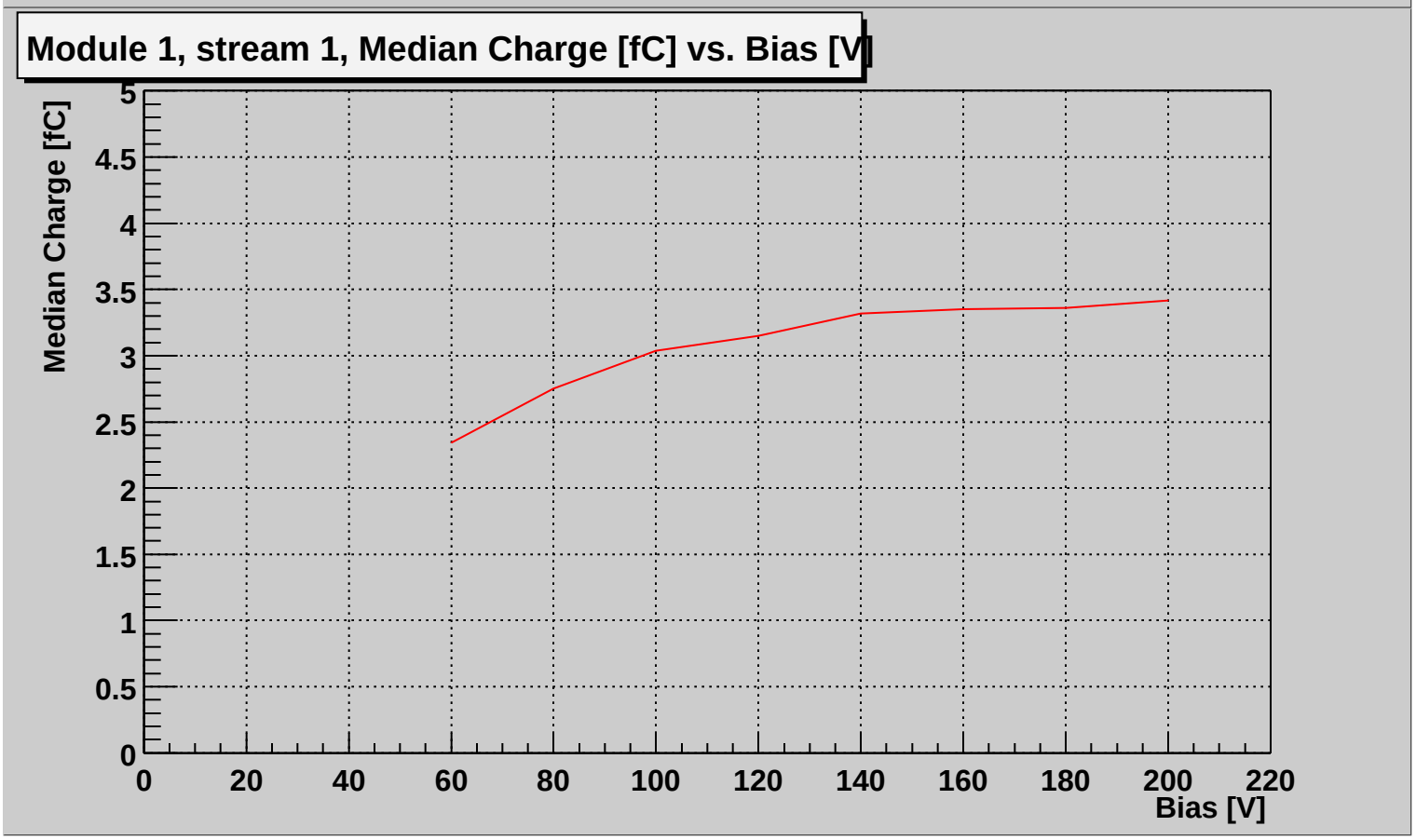
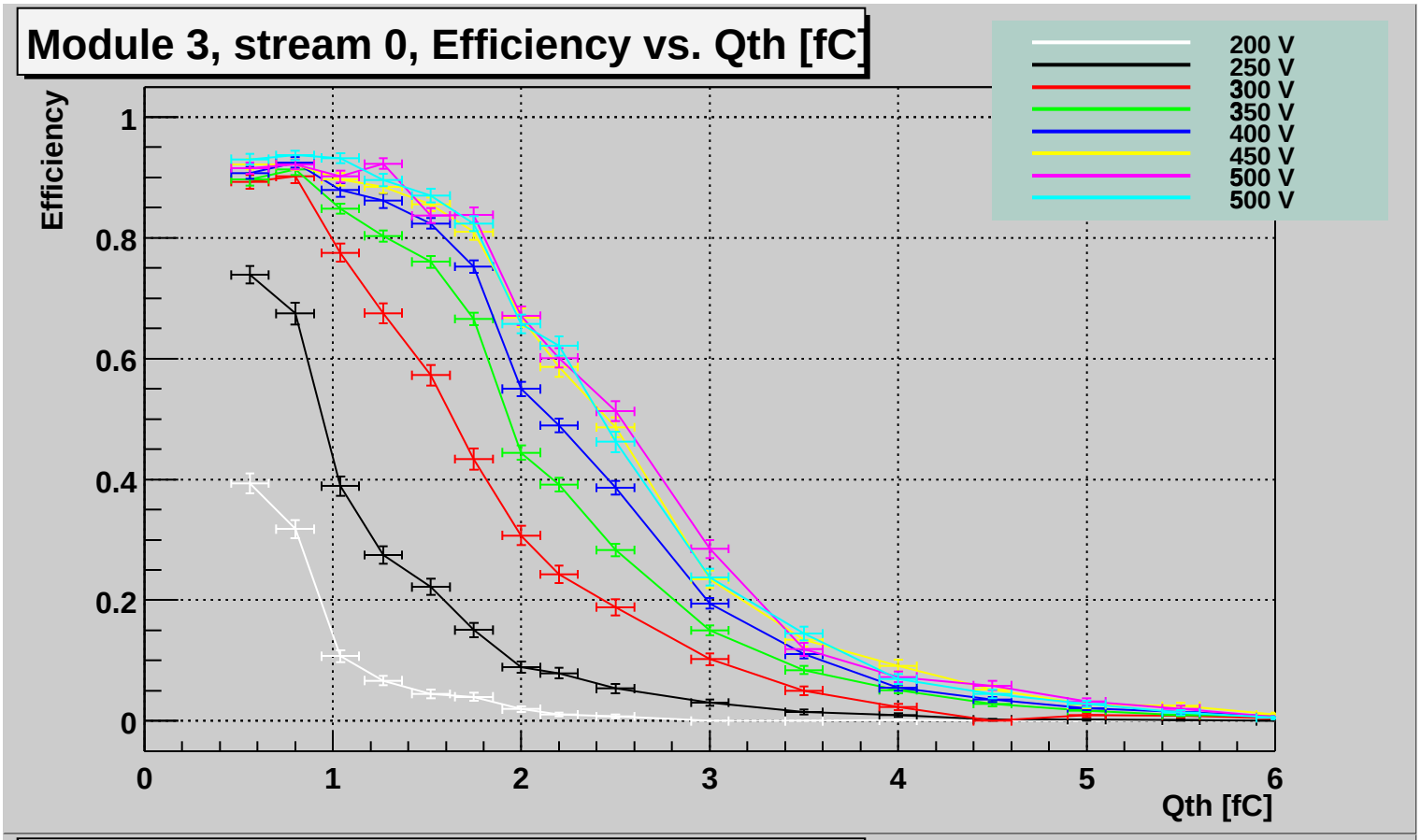
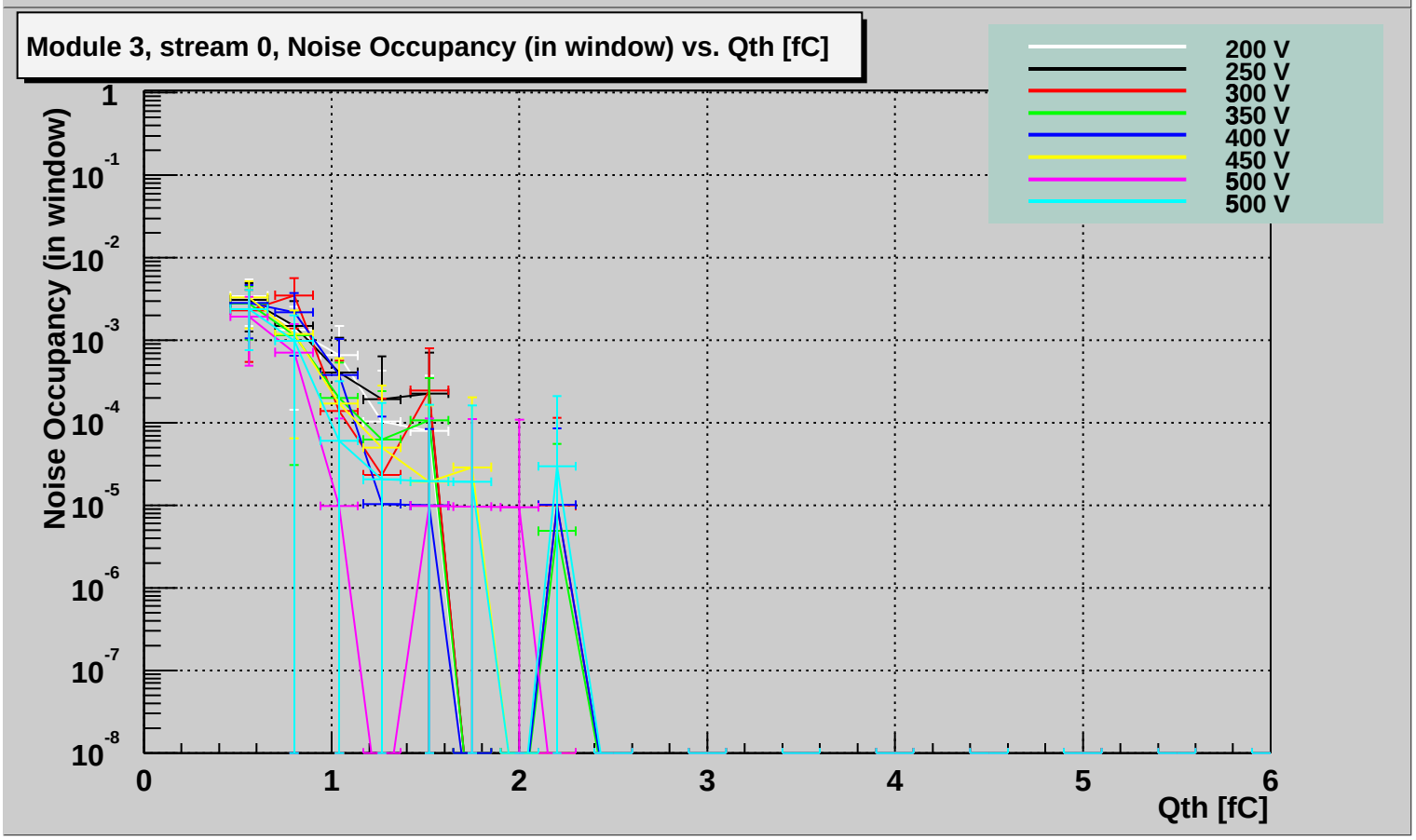
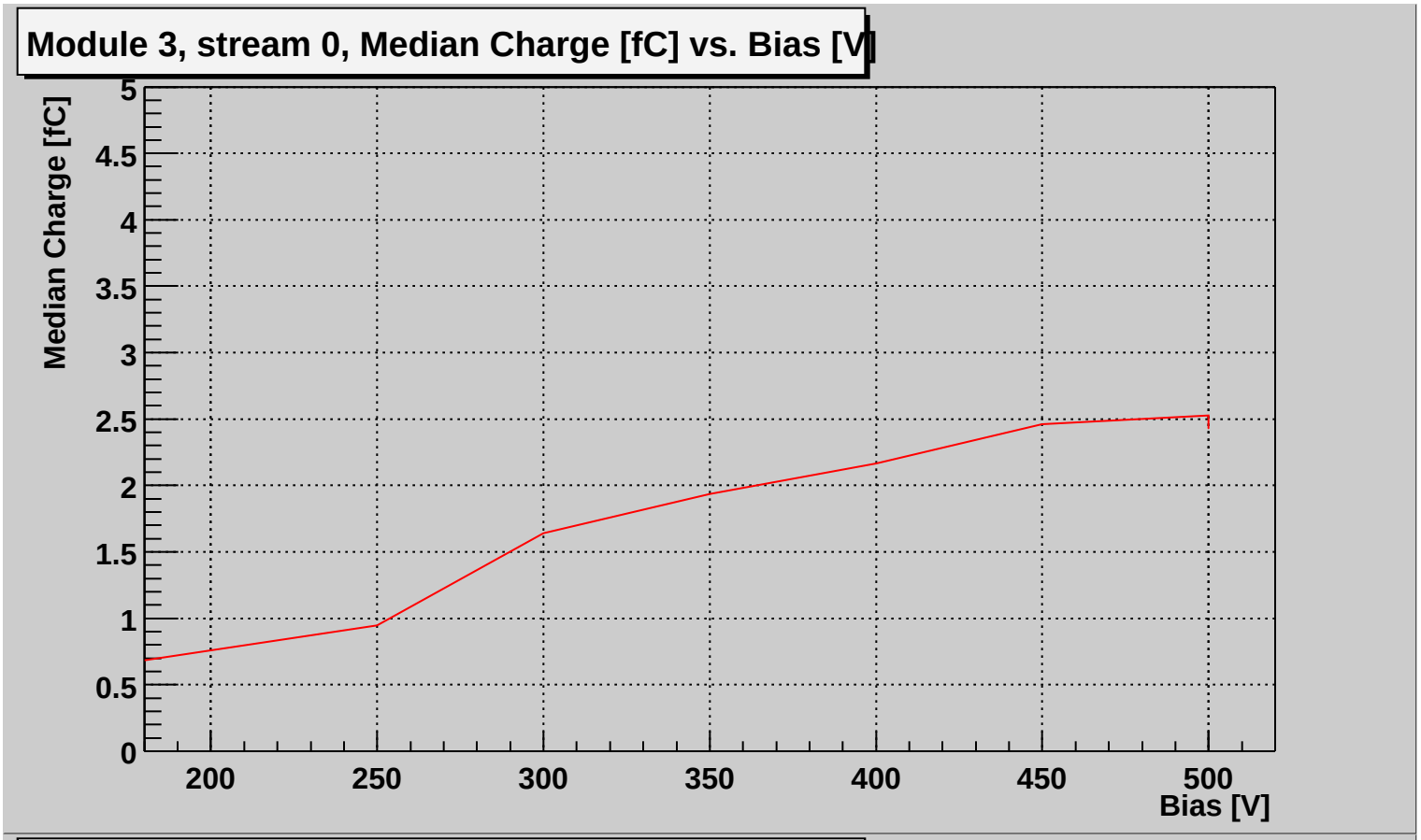
Noise Occupancy (out window)
Qth [fC]
60 V
80 V
100 V
120 V
140 V
160 V
180 V
200 V

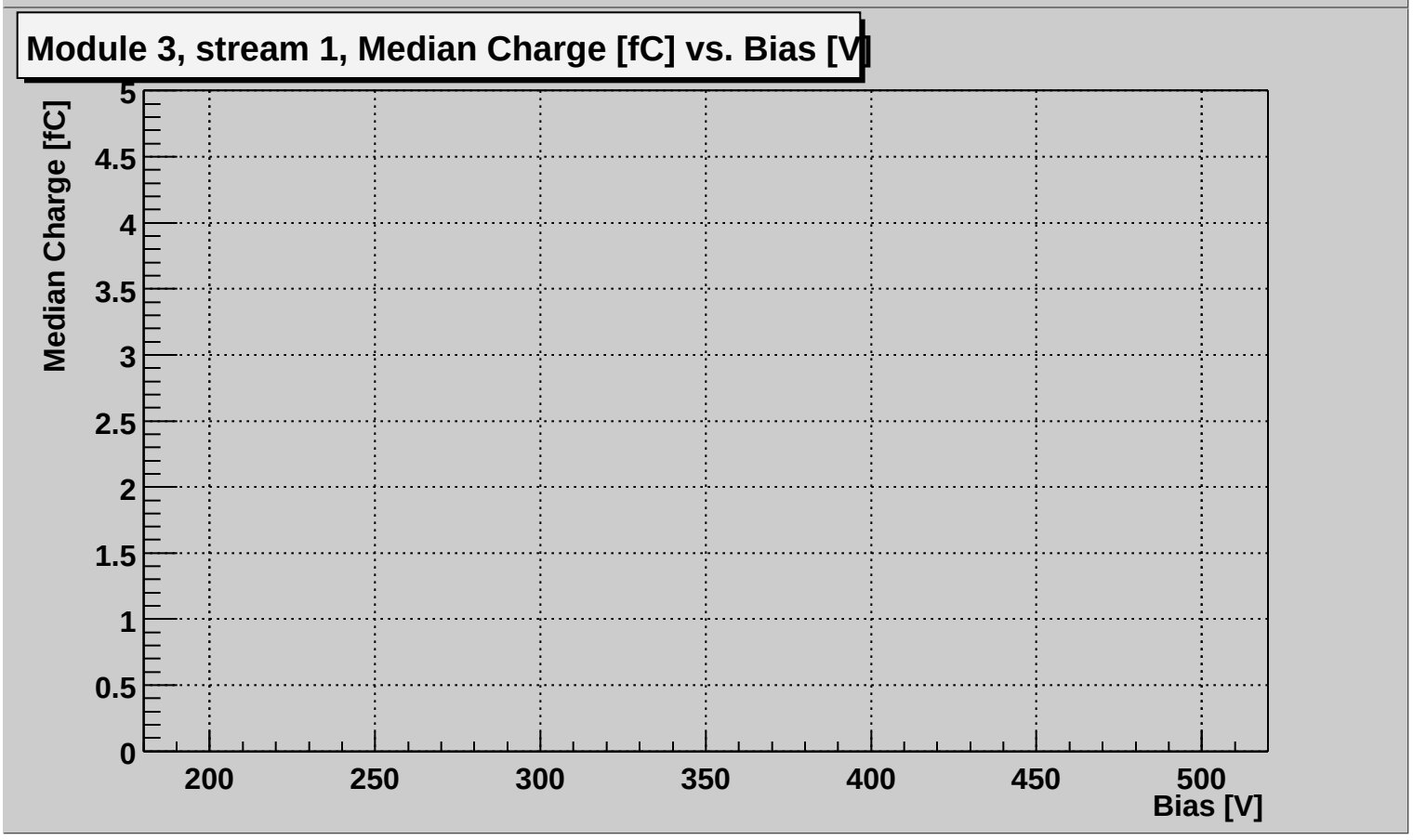

Module 1, stream 0, Median Charge [fC] vs. Bias [V]
Median Charge [fC]
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
0
20
40
60
80
100
120
140
160
180
200
220
Bias [V]


Module 1, stream 1, Median Charge [fC] vs. Bias [V]
Median Charge [fC]
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
0
20
40
60
80
100
120
140
160
180
200
220
Bias [V]


Module 3, stream 0, Efficiency vs. Qth [fC]
Efficiency
Qth [fC]
200 V
250 V
300 V
350 V
400 V
450 V
500 V
500 V


Module 3, stream 0, Noise Occupancy (in window) vs. Qth [fC]
Noise Occupancy (in window)
Qth [fC]
200 V
250 V
300 V
350 V
400 V
450 V
500 V
500 V


Module 3, stream 0, Median Charge [fC] vs. Bias [V]
Median Charge [fC]
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
200
250
300
350
400
450
500
Bias [V]


Module 3, stream 1, Median Charge [fC] vs. Bias [V]
Median Charge [fC]
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
200
250
300
350
400
450
500
Bias [V]