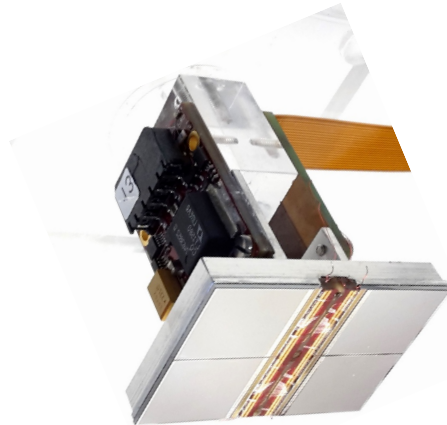
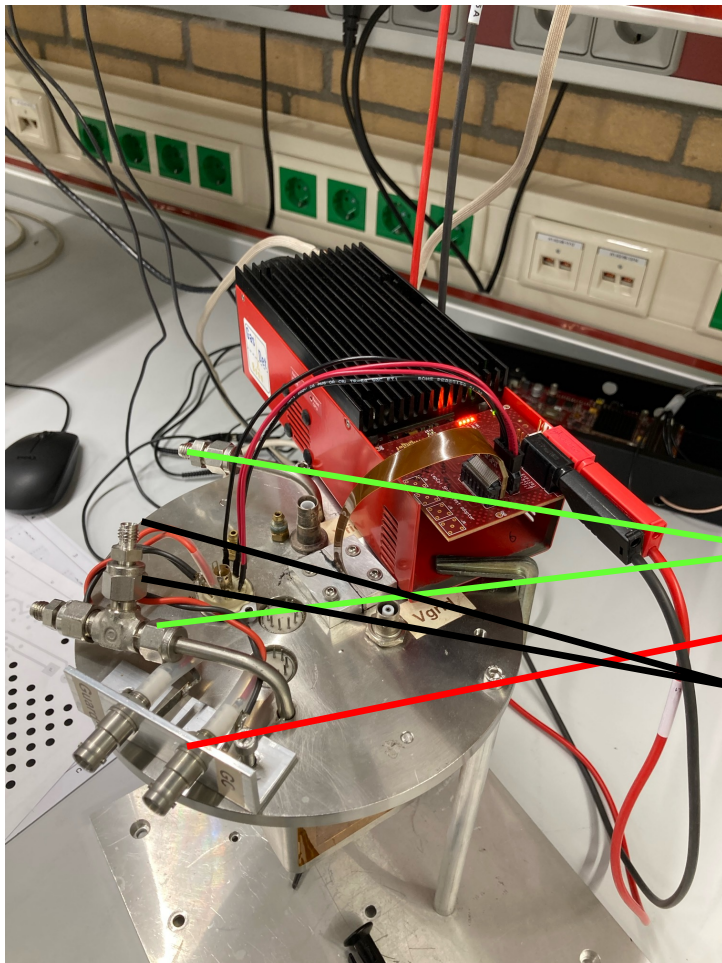


The Quad for EIC



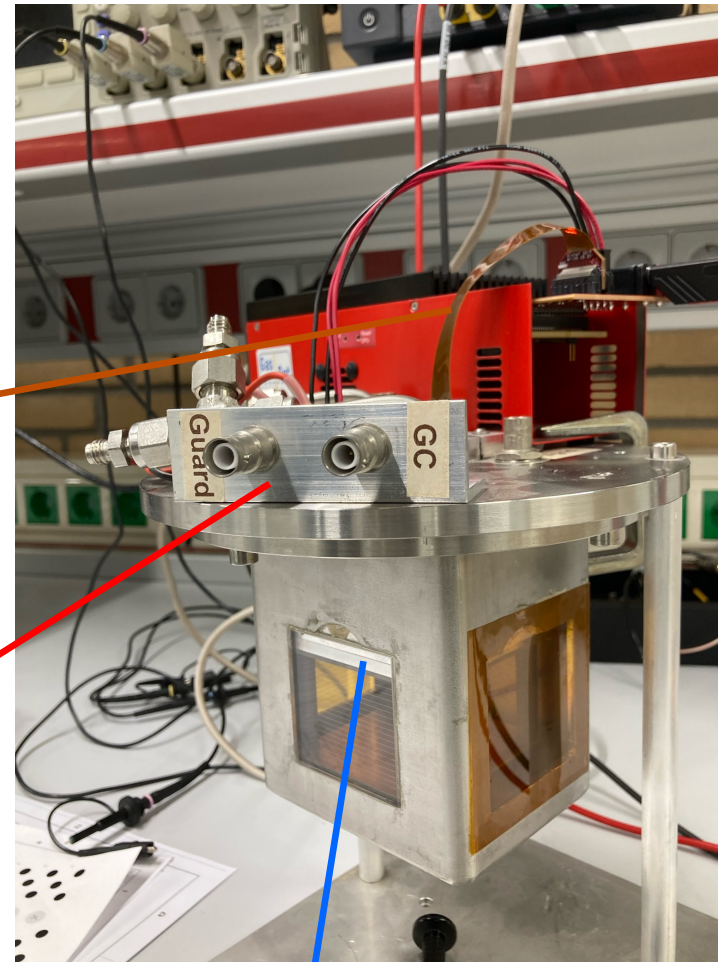
Flex to quad

BR c

Gas in/out

HV Grid/Field/Guard

Cooling in/out



Field cage with wires
and quad

Analysis of Quad data for EIC

The quad was shipped to Yale a year ago.
There tests were done by Nikolai and Prakhar using an Fe source.

Different gasses were tested:

TPC drift field ~ 300 V/cm

He – Isobutane – CF4 80.5 9 10.5 % V grid = 385 V

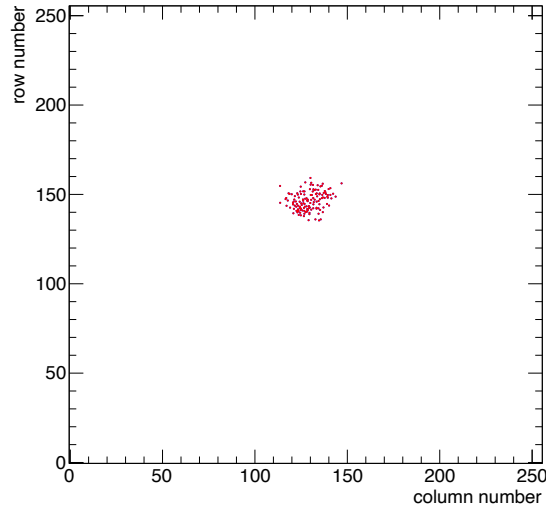
Ne – Isobutane – CF4 80.5 9 10.5 % V grid = 410 V

Data sets

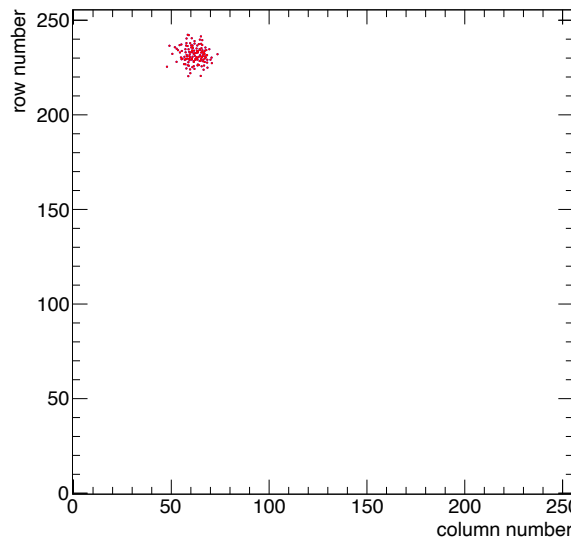
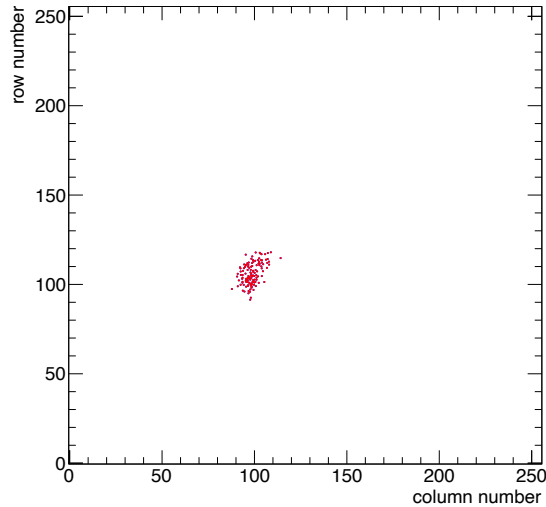
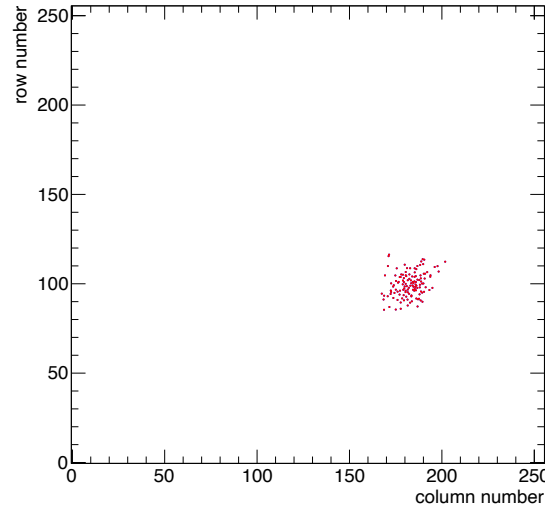
he_cf4_isob_385v_Fe.root ne_cf4_isob_410v_Fe.root

Analysis of Quad data for EIC Helium

Event 810 Chip 0 He-Iso-CF4



Event 280 Chip 1 He-Iso-CF4



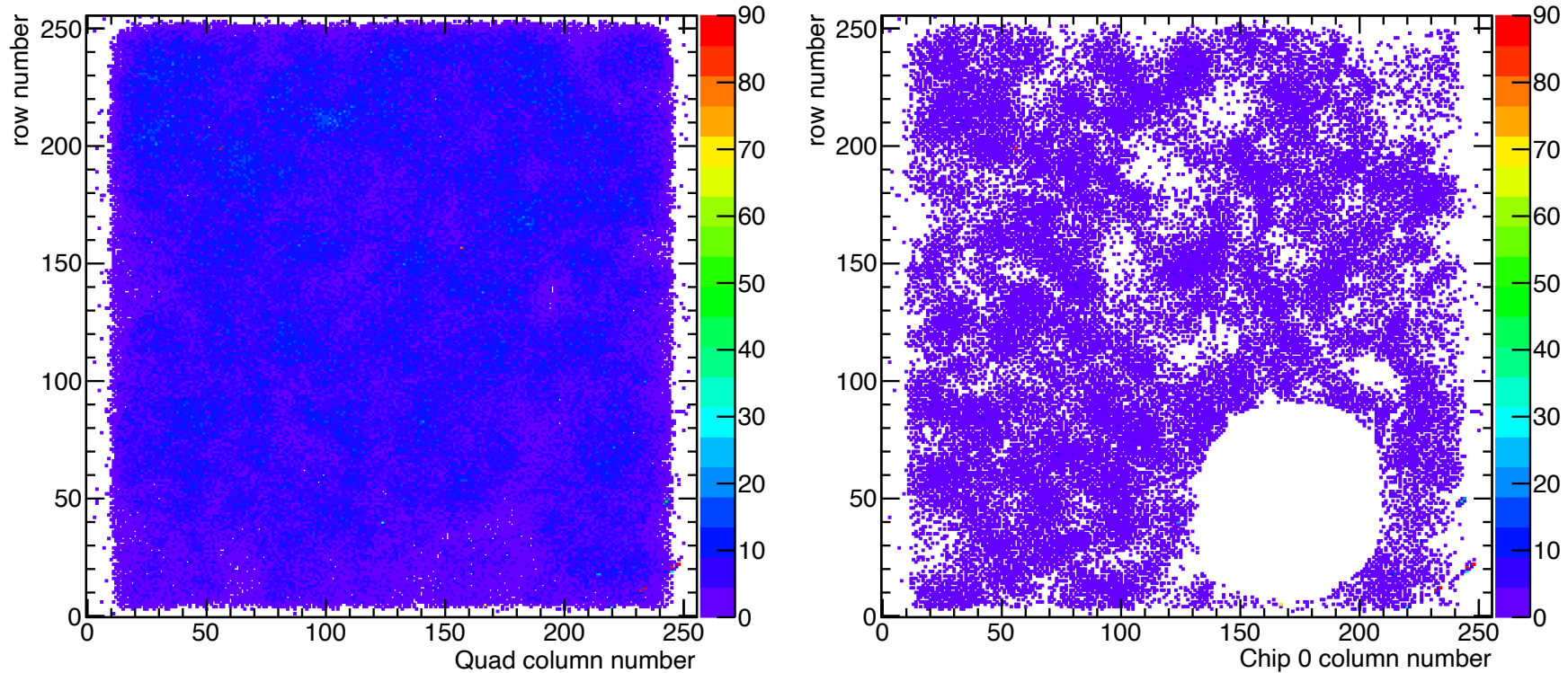
Event displays

Events are selected using the a time window of 1000 ns

Very clean displays

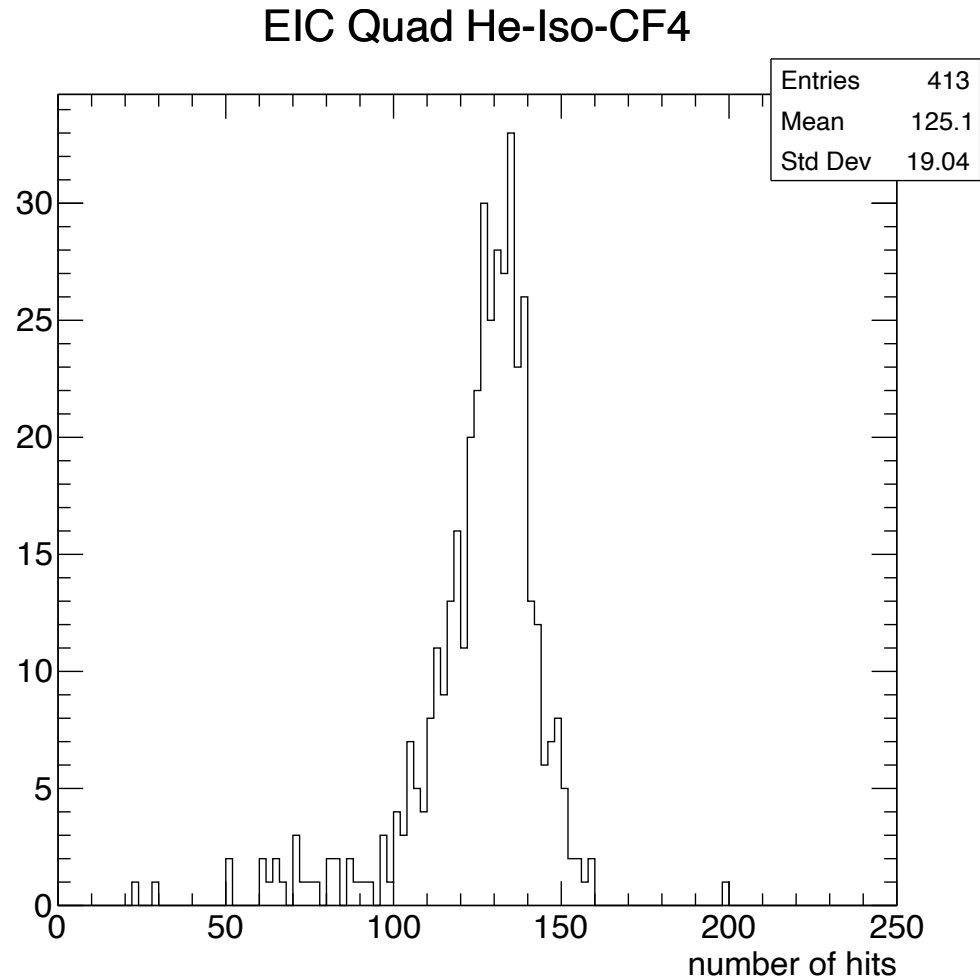
Analysis of Quad data for EIC Helium

EIC Quad He-Iso-CF4



The grid of chip0 was damaged. Nikolai put an insulator

Analysis of Quad data for EIC Helium

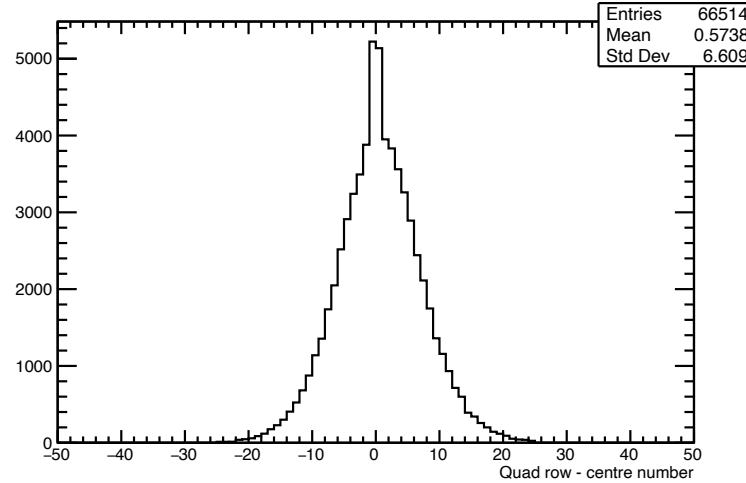
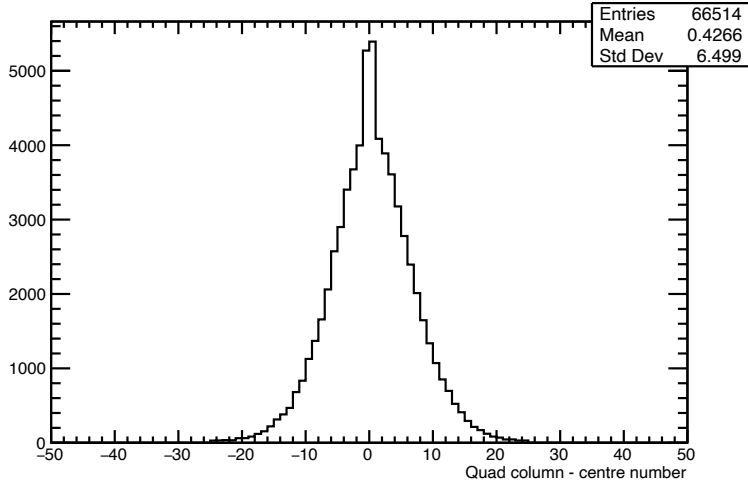


Here the distribution of the number of hits in the blob of with 25x25 pixels.

A mean value of 125 events is found.

Analysis of Quad data for EIC Helium

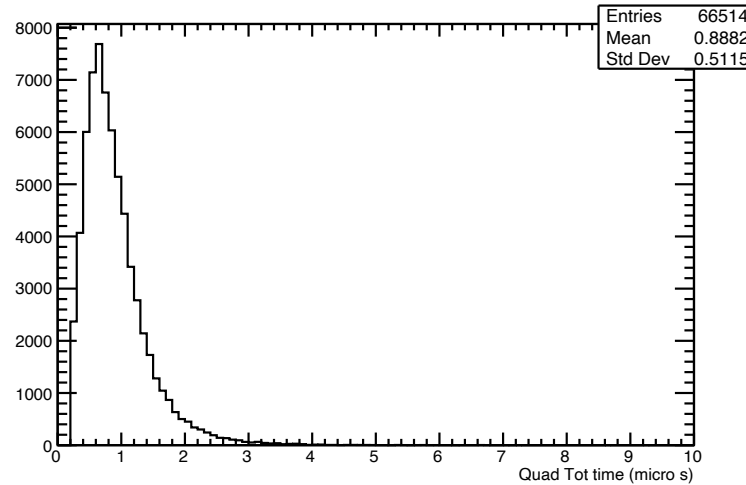
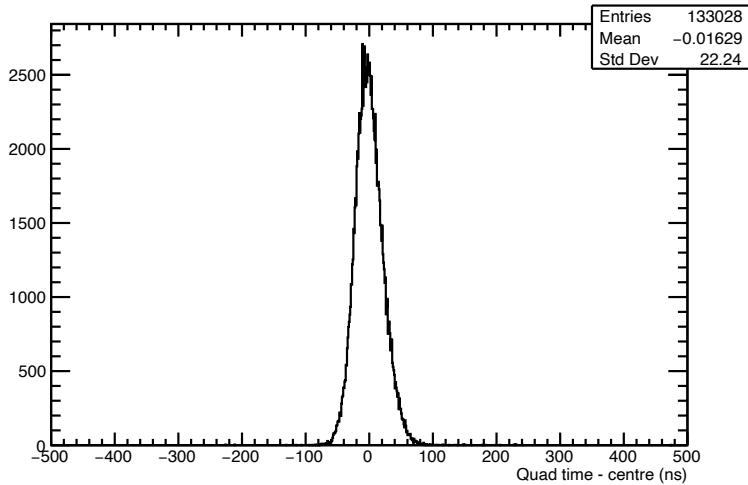
EIC Quad He-Iso-CF4



The rms of the blob is 6.5 pixels

The spread in time 22 ns

The mean ToT is 0.51 μ s

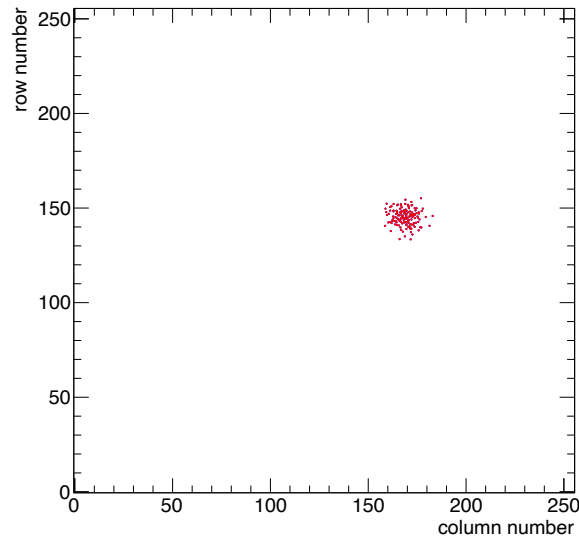


All numbers are diffusion limited

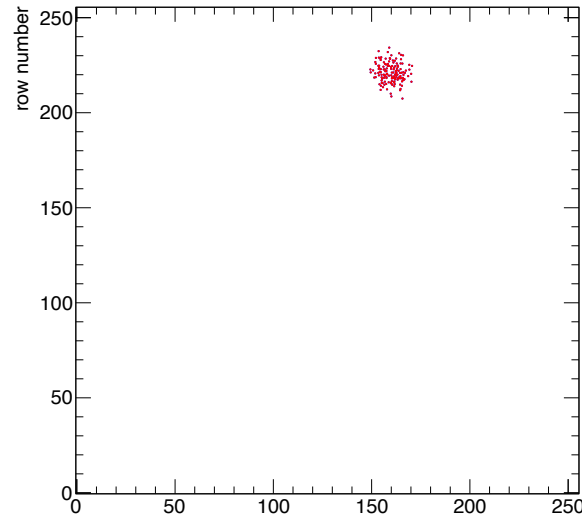
The \langle ToT \rangle corresponds to a gain of \sim 1000 and a single-electron efficiency of 70%

Analysis of Quad data for EIC Neon

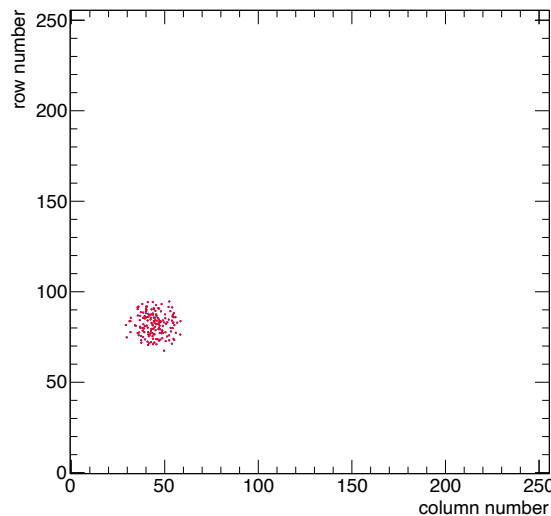
Event 517 Chip 0 Ne-Iso-CF4



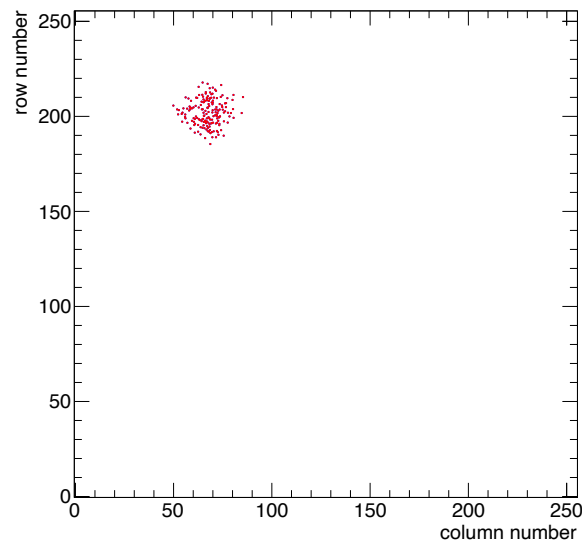
Event 231 Chip 1 Ne-Iso-CF4



Event 199 Chip 2 Ne-Iso-CF4



Event 365 Chip 3 Ne-Iso-CF4



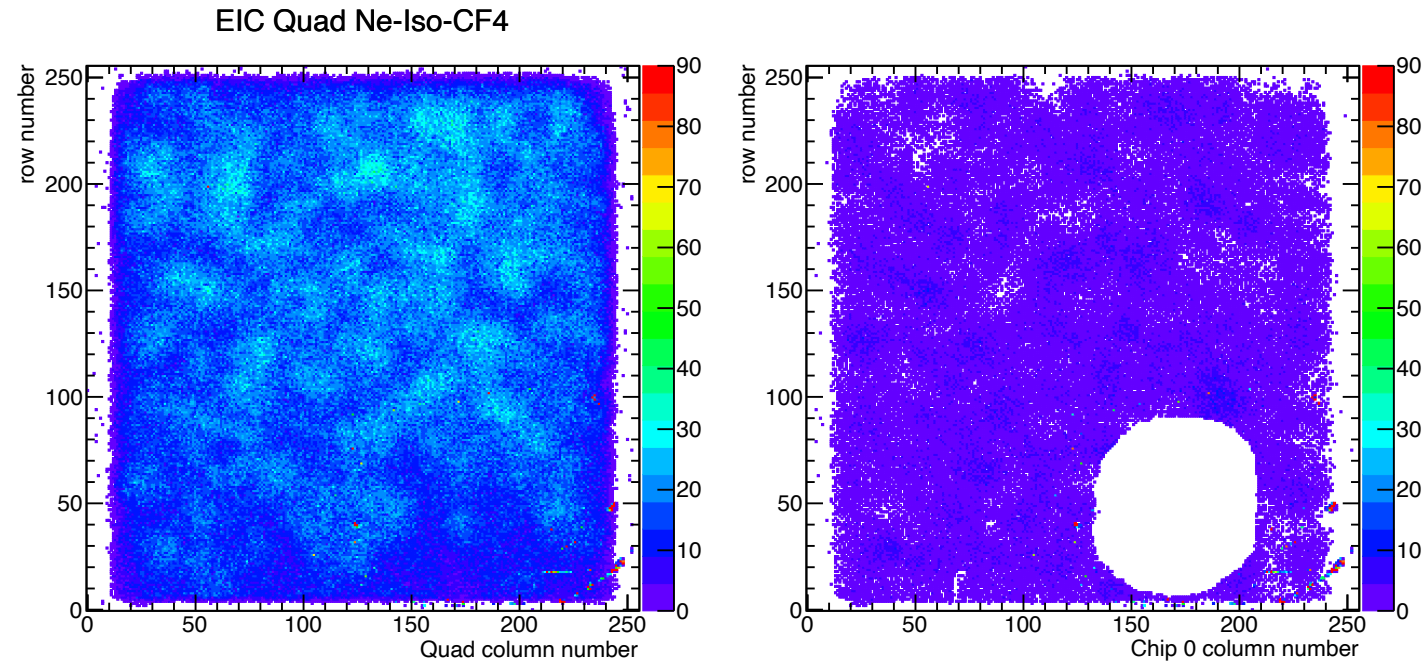
Event displays

Events are selected using the a time window of 1000 ns

Very clean displays

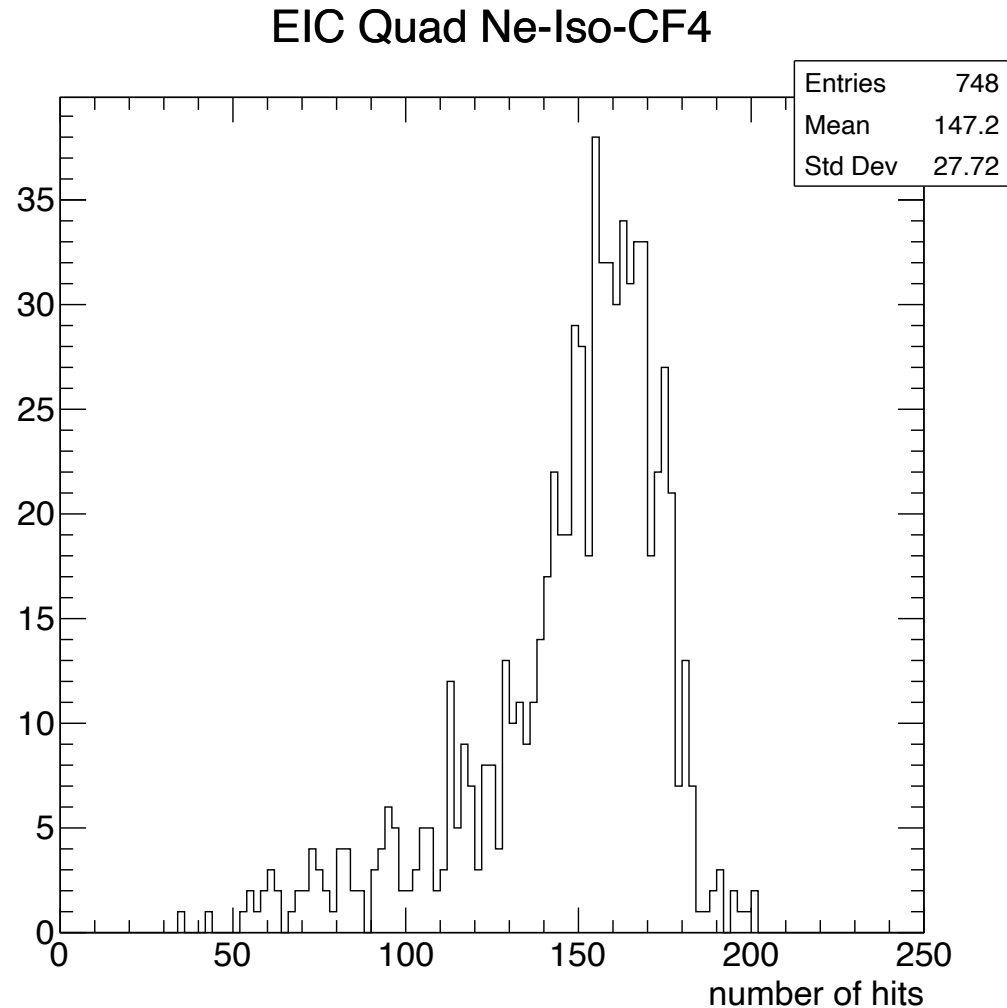
It was found that for hits in large bursts (>150), the time has to be corrected by the spidrtime ($409.6 \mu\text{s}$). Due to the nr of hits at once the time, Spidr is not ready yet and adds an additional time offset (that needs to be corrected)

Analysis of Quad data for EIC Neon



The grid of chip0 was damaged. Nikolai put an insulator

Analysis of Quad data for Neon

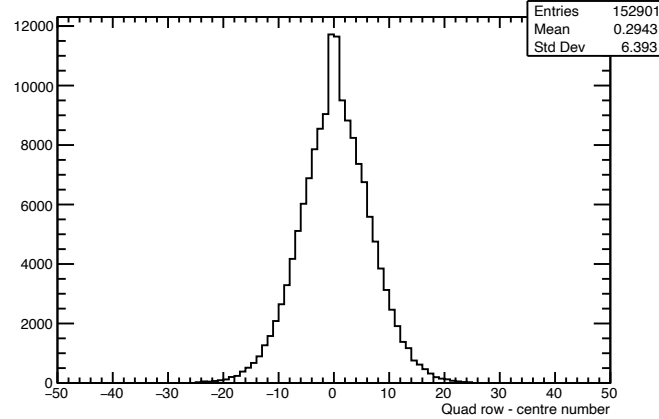
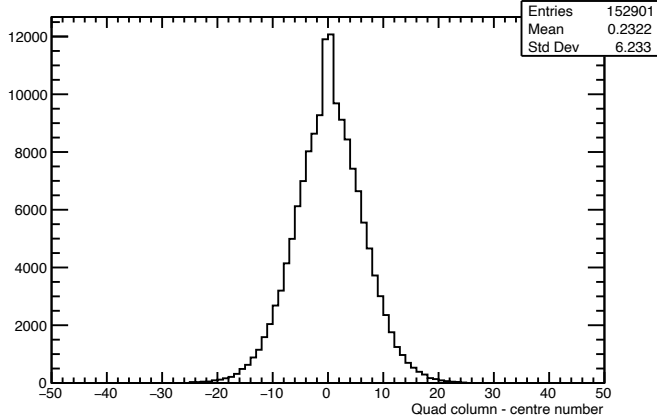


Here the distribution of the number of hits in the blob of with 25x25 pixels.

A mean value of 147 events is found.

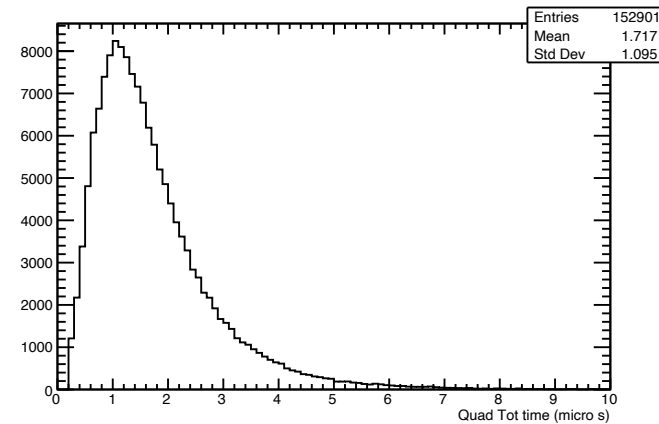
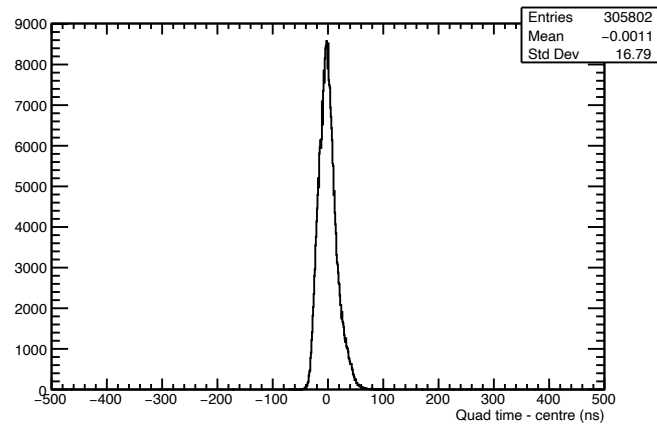
Analysis of Quad data for EIC Neon

EIC Quad Ne-Iso-CF4



The rms of the blob is 6.4 pixels

The spread in time 17 ns, time slewing can be observed



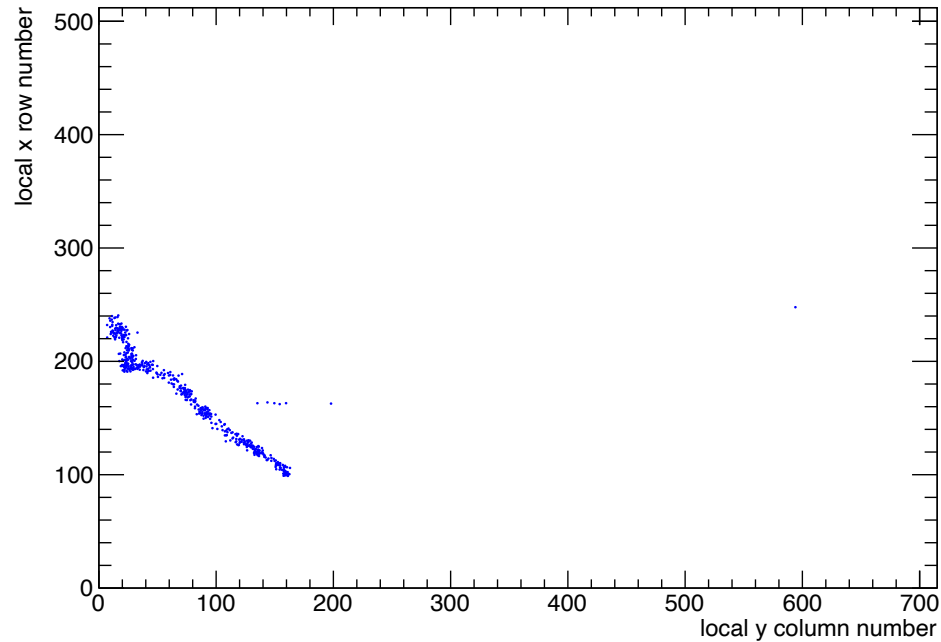
The mean ToT is 1.7 μ s

The \langle ToT \rangle corresponds to a gain of \sim 1500 and a single-electron efficiency of 85%

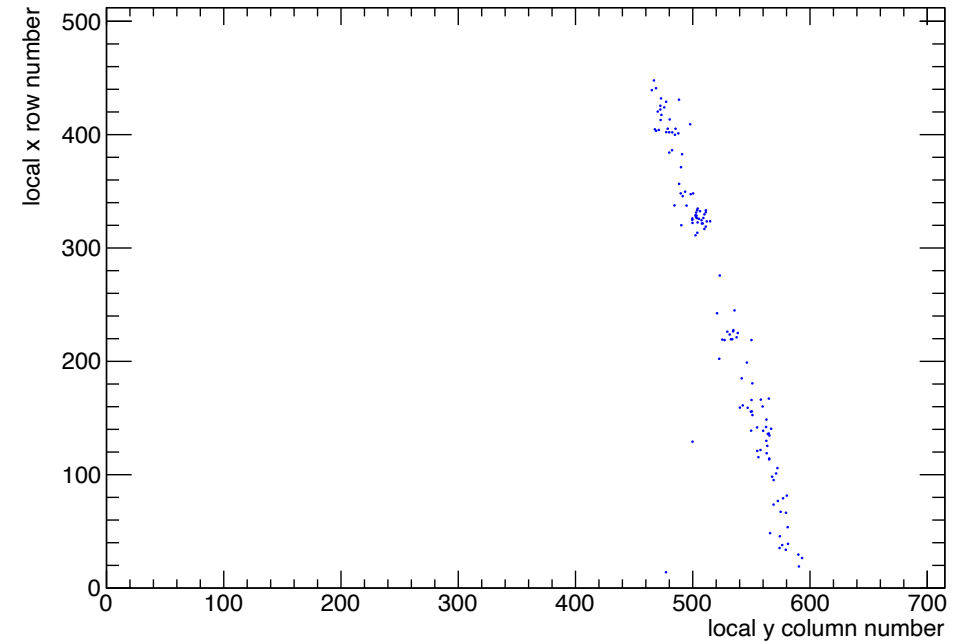
Analysis Quad EIC Neon without Source

Data set ne_cf4_isob_410v_Noise.root

Event 7500 Ne-Iso-CF4-NoSource



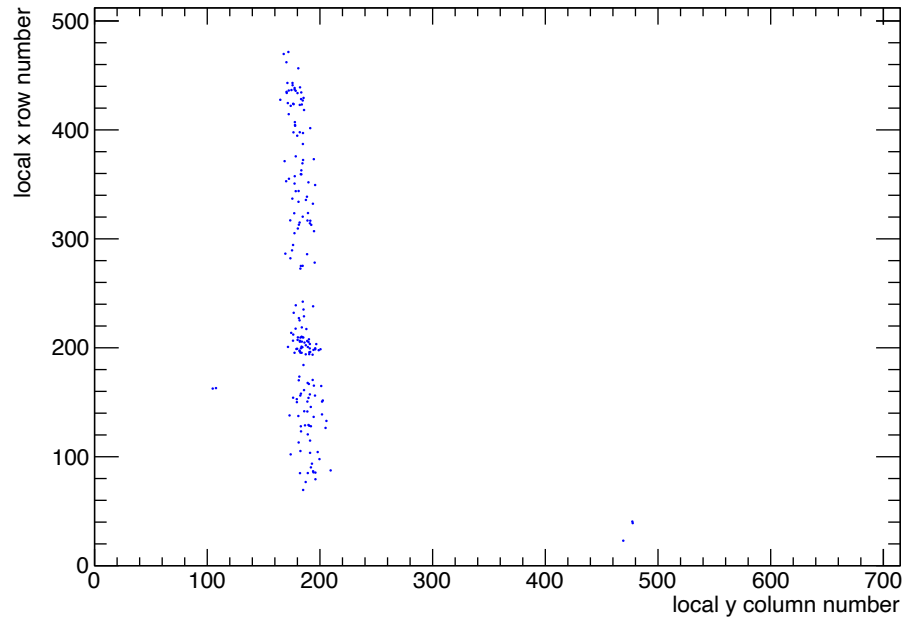
Event 5496 Ne-Iso-CF4-NoSource



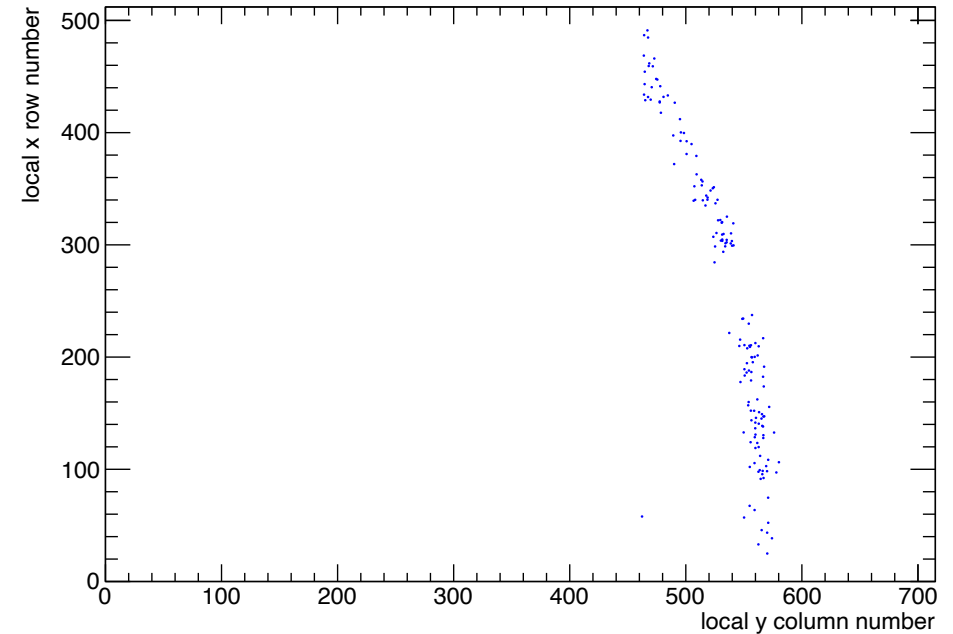
Analysis Quad EIC Neon without Source

Data set ne_cf4_isob_410v_Noise.root

Event 4201 Ne-Iso-CF4-NoSource

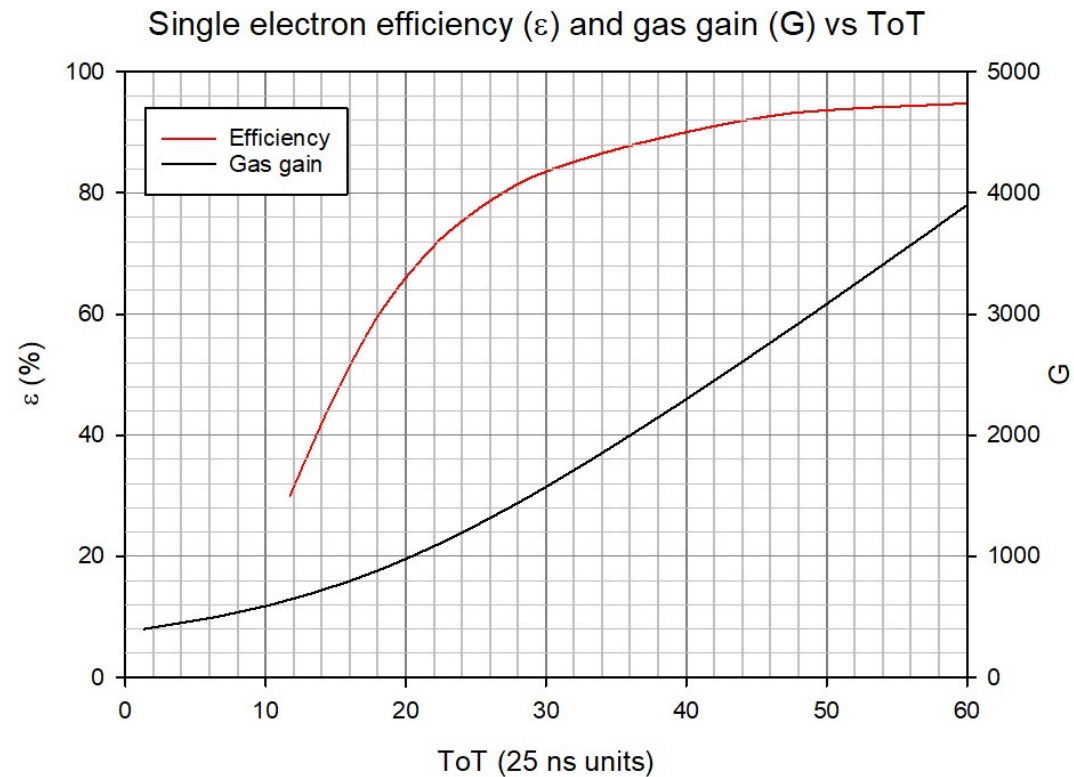


Event 3877 Ne-Iso-CF4-NoSource



Calibration curve ToT gas gain

Values measured with TPX3 chip at $T_h = 550$ e-
Efficiency curve measured in Ar/C4H10 82/18
Gain curve measured with test pulses (Kees Ligtenberg)
8-5-2021



Running a Pixel TPC with He

For example Z run @ CEPC or FCCee

The idea is use in the TPC not the T2K gas. But another gas mixture that gives less hits. And a gas that is less sensitive to the beam background and more performant for dEdx (cluster counting)

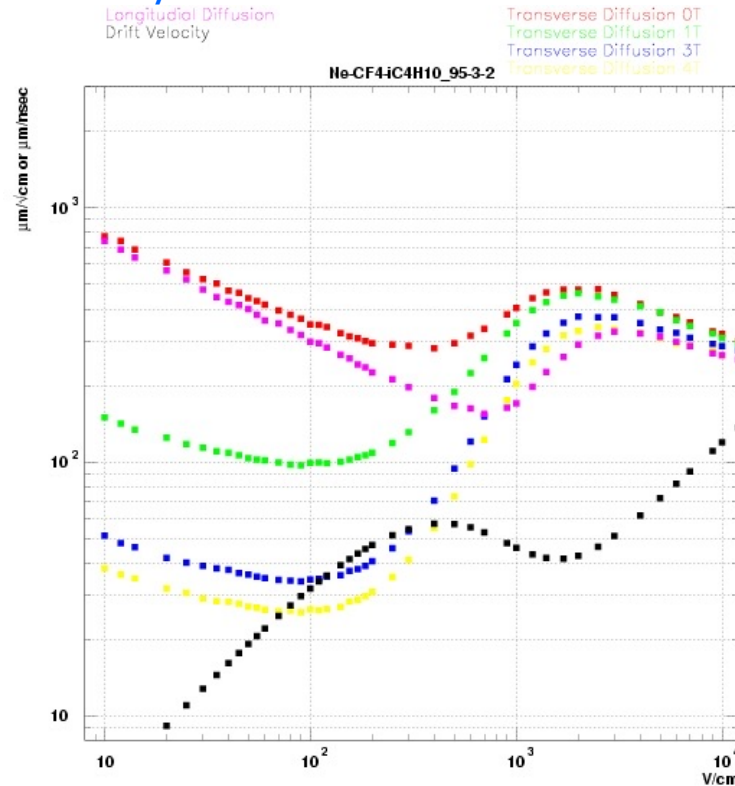
One could think of a He or Ne based gas.

- The advantage would be: the number of electrons /cm is lower by a factor of about 8 (Ne 2.5) w.r.t. the T2K gas. The probability that the photons (from the beam-beam background) interact with Helium is also a factor of 9 (Ne 5) lower.
- I am not absolutely sure but this could bring a factor 80 (12.5) beam background reduction.

Running a Pixel TPC with Ne

For example Z run @ CEPC or FCCee

We could e.g. run with the Neon version of T2K gas: Ne:CF₄:iCH₄H₁₀ 95:3:2 and still reach low transverse diffusion: of about $D_T = 70 \mu\text{m}/\sqrt{\text{cm}}$ at 2 T. Drift field 200 V/cm.



| | PDG clusters/cm | primary | total |
|--------------------------------------|-----------------|---------|-------|
| Ne:CF ₄ :iCH ₄ | 16.04 | 46 | |
| T2K | 26 | 100 | |