PSI

SoM-CAM test with FW4Y signals - second attempt

Beam Development debriefing

November 20th, 2024

Test by: Shu, Pablo, Mariusz, Raphael, Markus, Mattia, Rudolf, Aaron, control room team
PSI

Context

First test on October 24th revealed:

- A presence of unexpected potential on the signal cable (174 V).
- Disagreement between LLCam data (with filter boxes) and SoM-CAM data (obtained without filter boxes); SoM-CAM readings were 2.5-3.5 higer than LLCam plus shifted by about 100 µA.

Goals of this test:

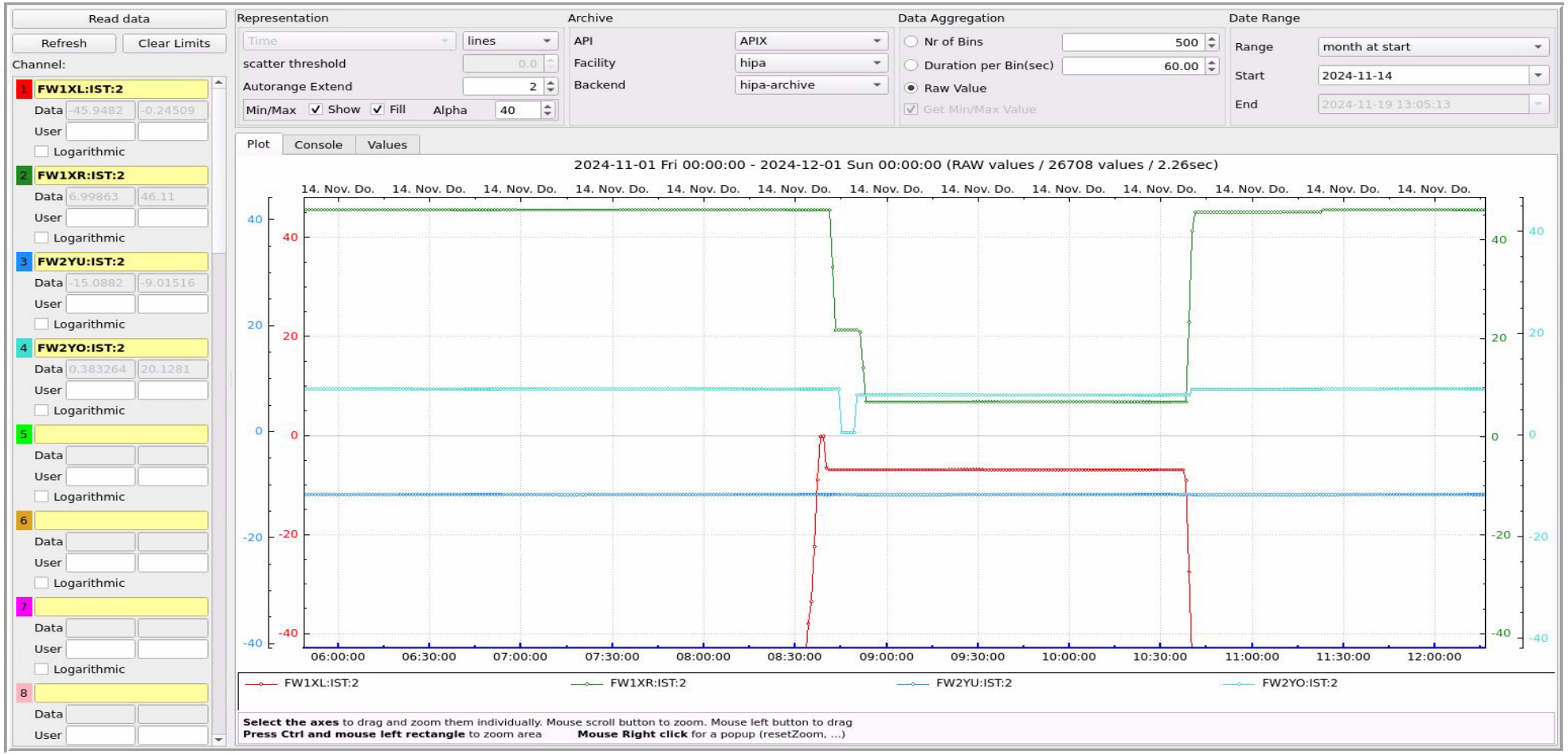
- Use the same filter boxes (27 V Zener diode).
- Bias SoM-CAM readout with potential corresponding to Zener diode.
- Investigate the cable potential.

Signal cable potential measurements

- Beam off, grounding at rack
- Voltage between cable shield and code measured at rack: 0.1 V.
- Voltage between core and ground: 55 V (FW4YU).
- FW4YO: 18 V at position of 8.15 mm, 22 V at 3 mm.
- FW4YO: 20 V at position of 6 mm, raising to 27.7 V when beam is on.
- Current measured at this position (6 mm) is 118-120 µA (FLUKE multimeter), when beam kicker to AVKI it drops to 60 µA.
- This is in contradiction with LLCam/SoM-CAM measurement at this position (~1 µA).
- When CW is shut down we still see 53 µA and 30 V.

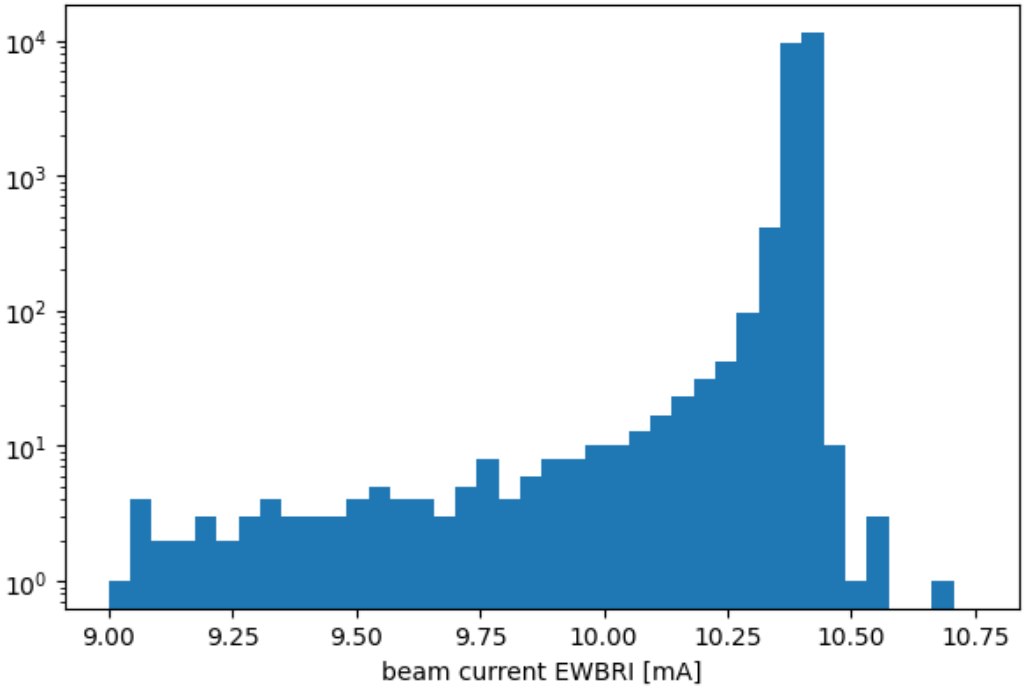
Beam conditions

Beam positions of the upstream slits: fixed during experiments at measurable levels:

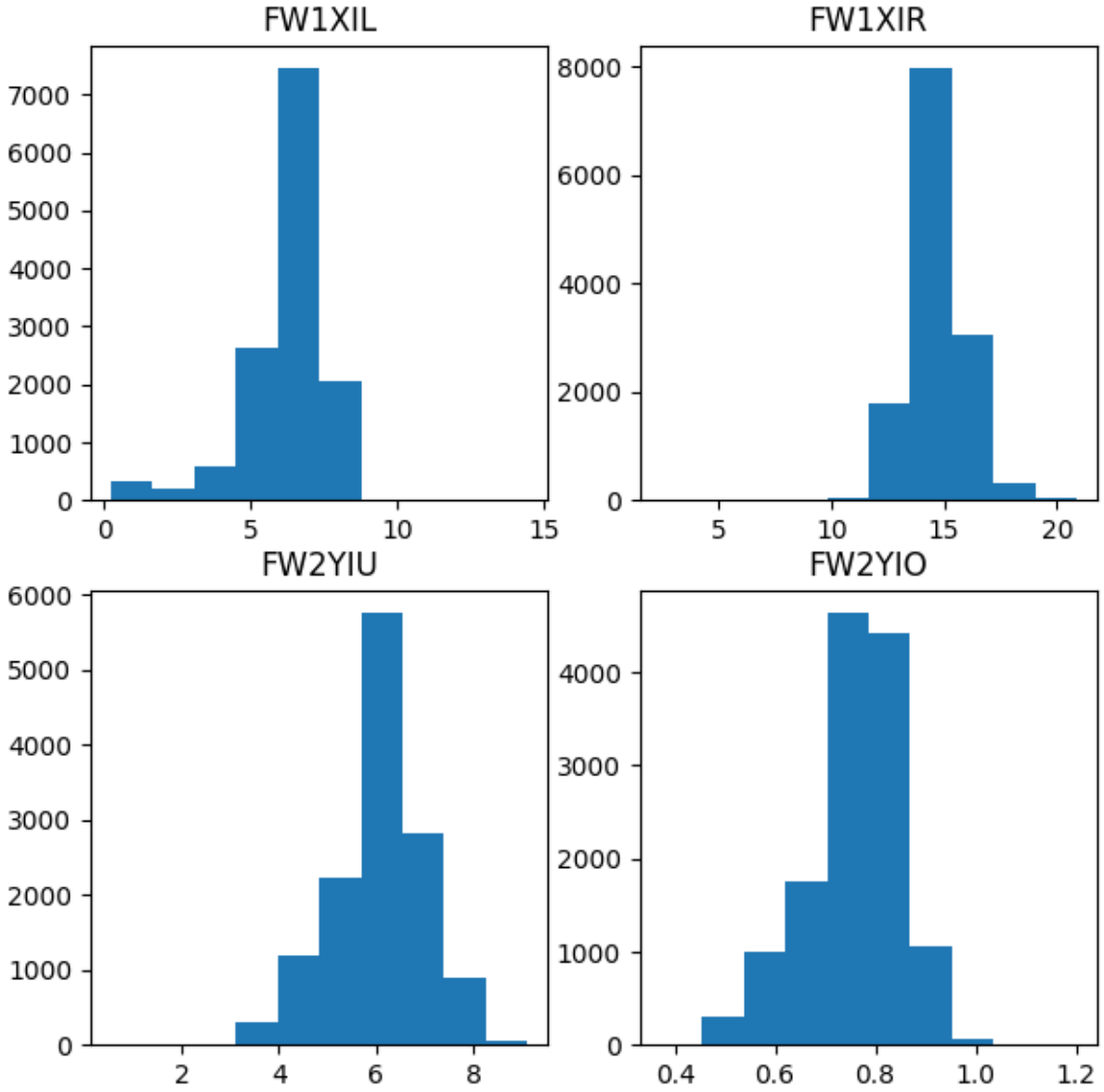


Beam conditions

Beam intensity and signals on upstream slits.

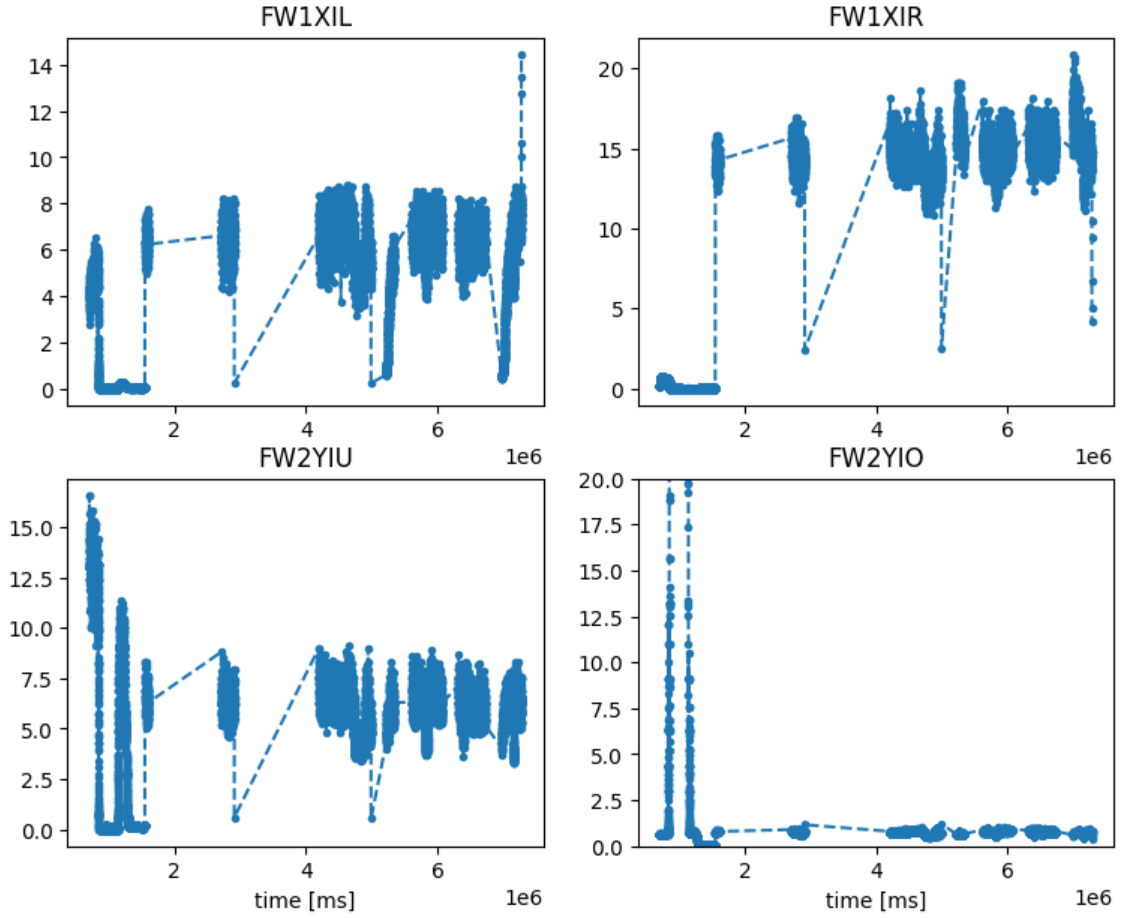


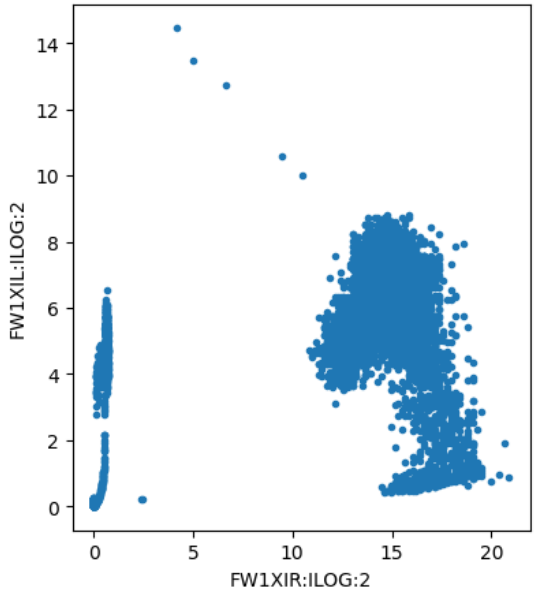
Total beam current quite stable.

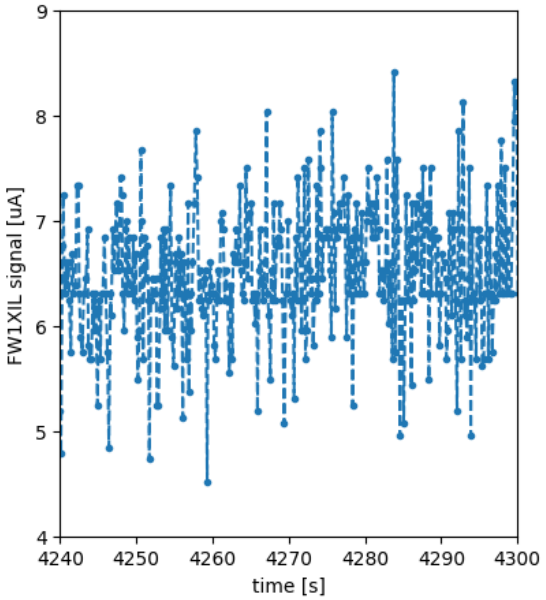


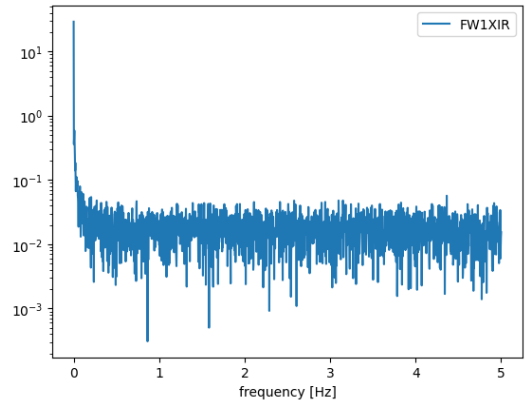
Beam conditions

Beam signals on upstream slits – lot of variation!

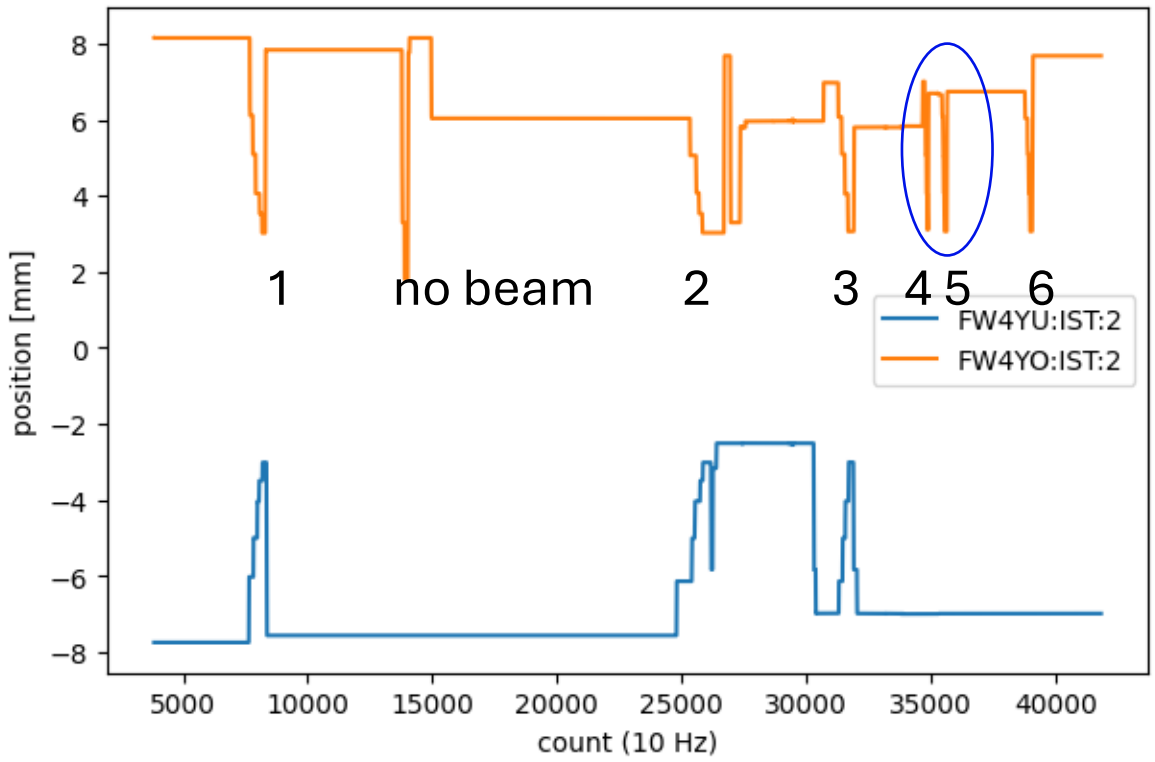








FW4Y slit positions during the experiment

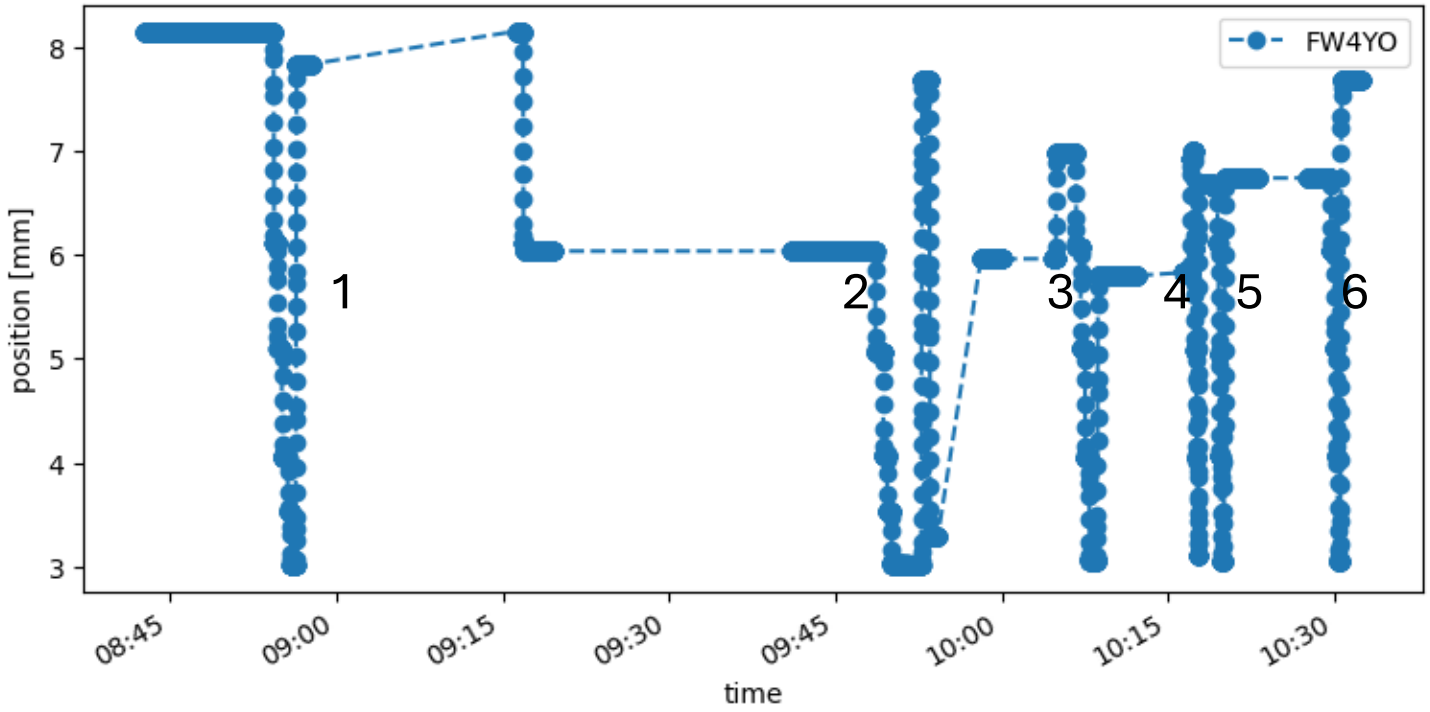


Five scans:

1. LLCam
2. SoM-CAM with filter boxes, grounded at rack
3. SoM-CAM, no filter boxes but +27 V, grounded at rack
4. SoM-CAM, no filter boxes, +27 V, ground at detector side
5. SoM-CAM, no filter boxes, 0V bias, ground at detector side
6. SoM-CAM, with fiter boxes, 0 V bias, ground at detector side

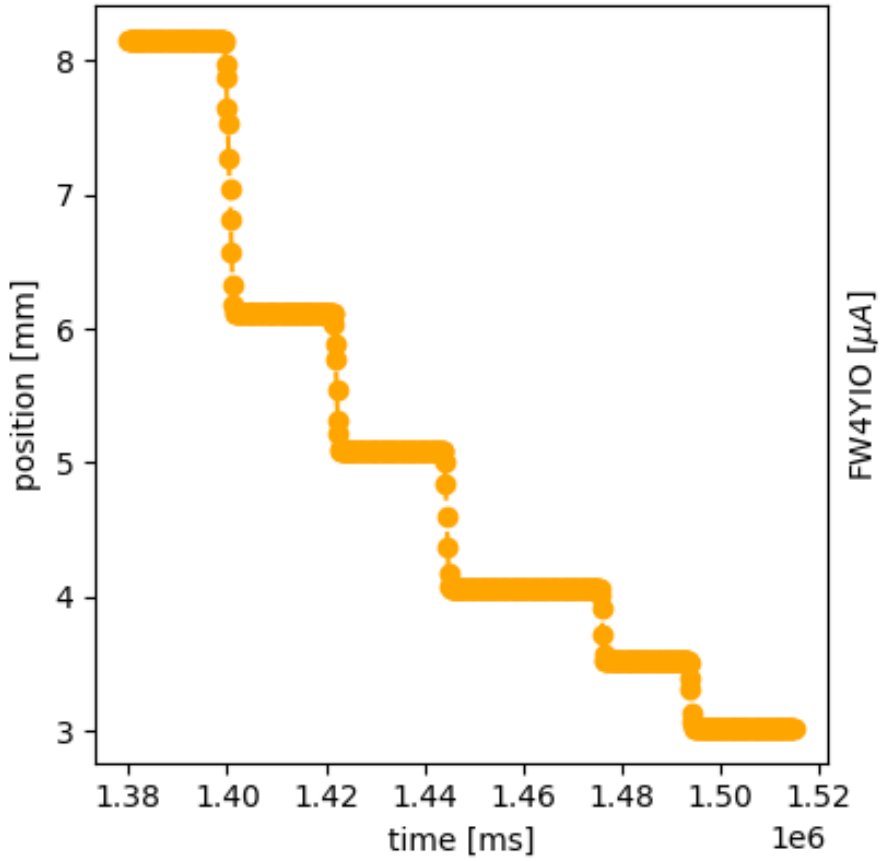
FW4YO slit positions during the experiment

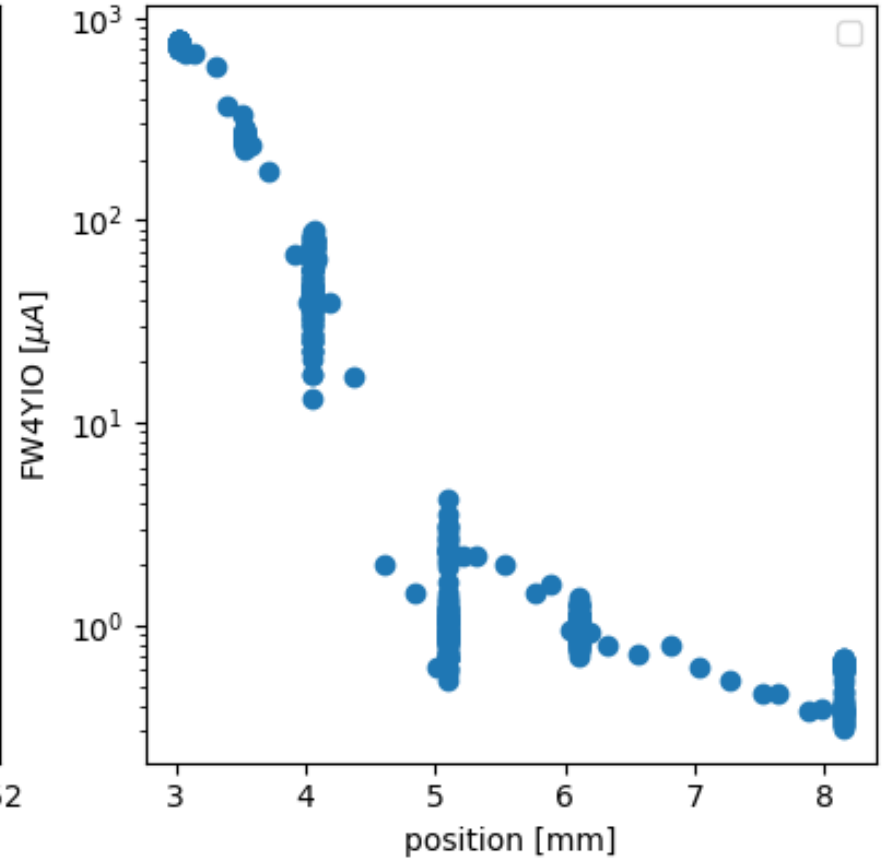
Analyse only upper slit data, bottom slit data look not good for LLCam (too much variation).



Data analysis – FW4YO

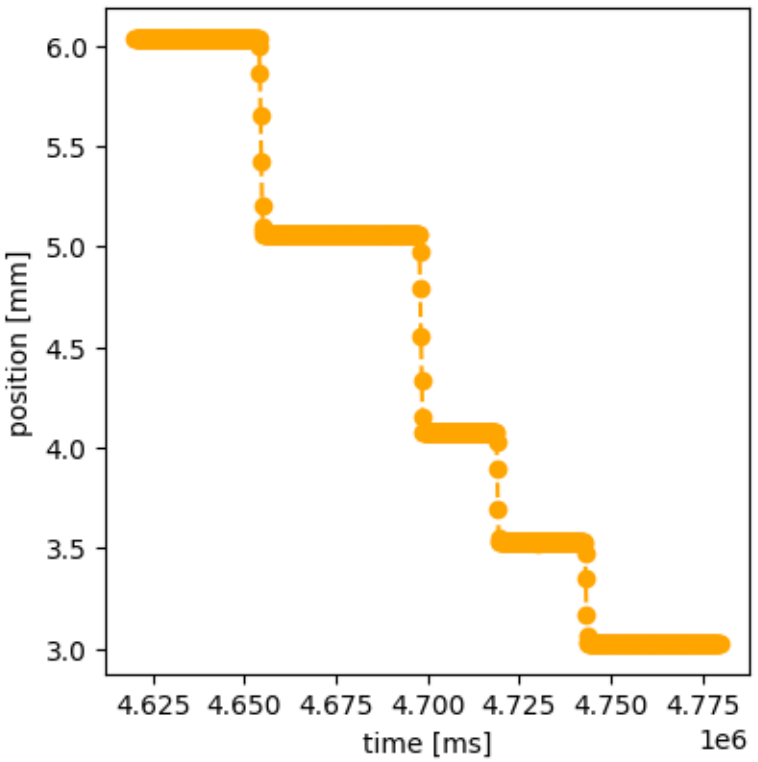
- Scan 1: LLCam data – lots of variations in measurements at fixed points!

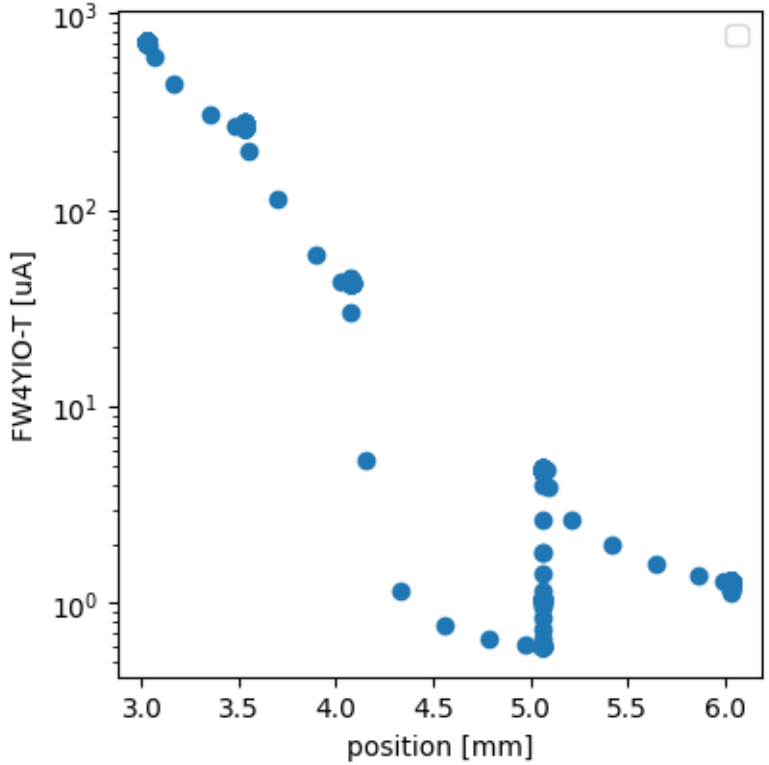


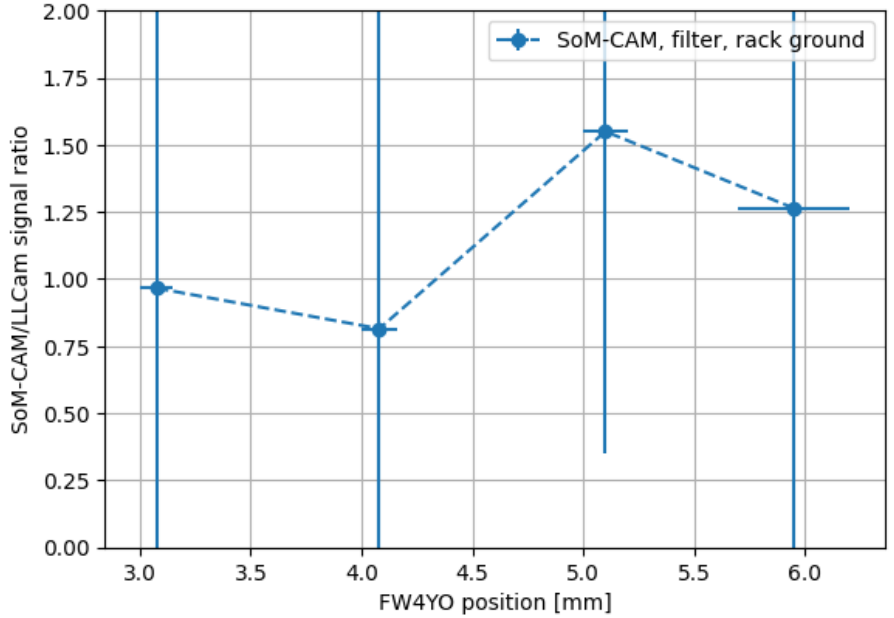


Data analysis – FW4YO

- Scan 2: SoM-CAM with filter box, ground at rack

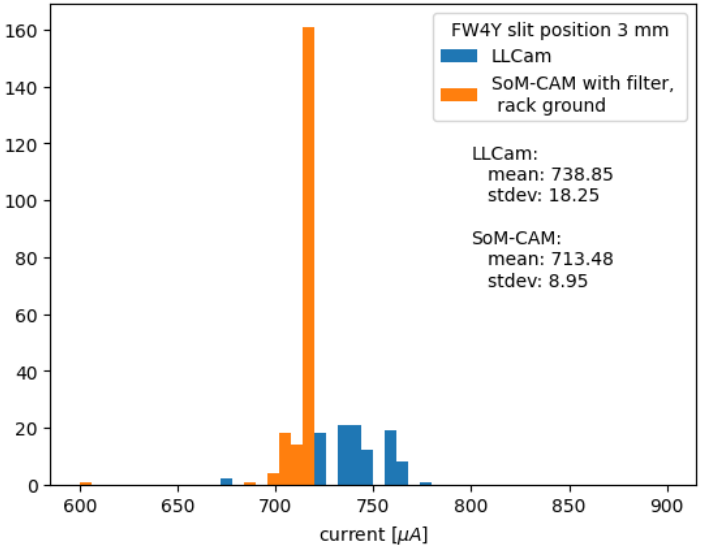


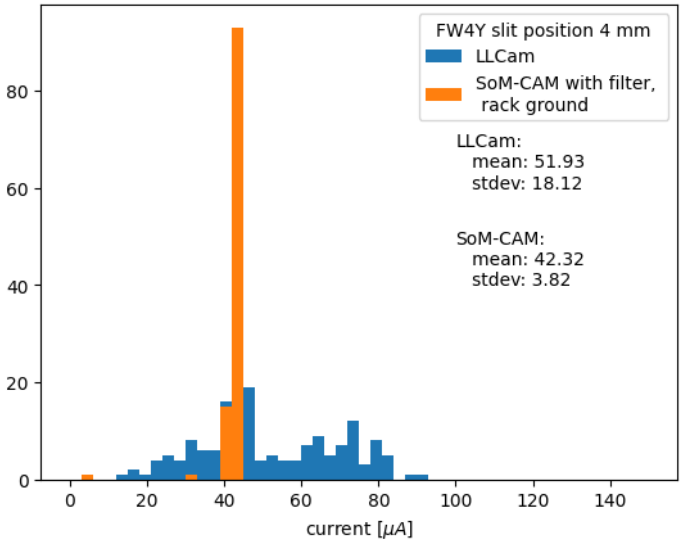


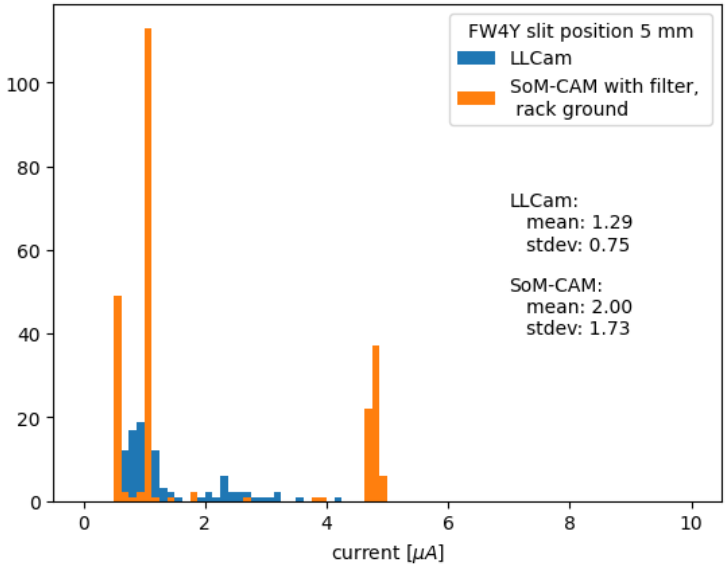


Data analysis – FW4YO

- Scan 1 and 2: better look at each position

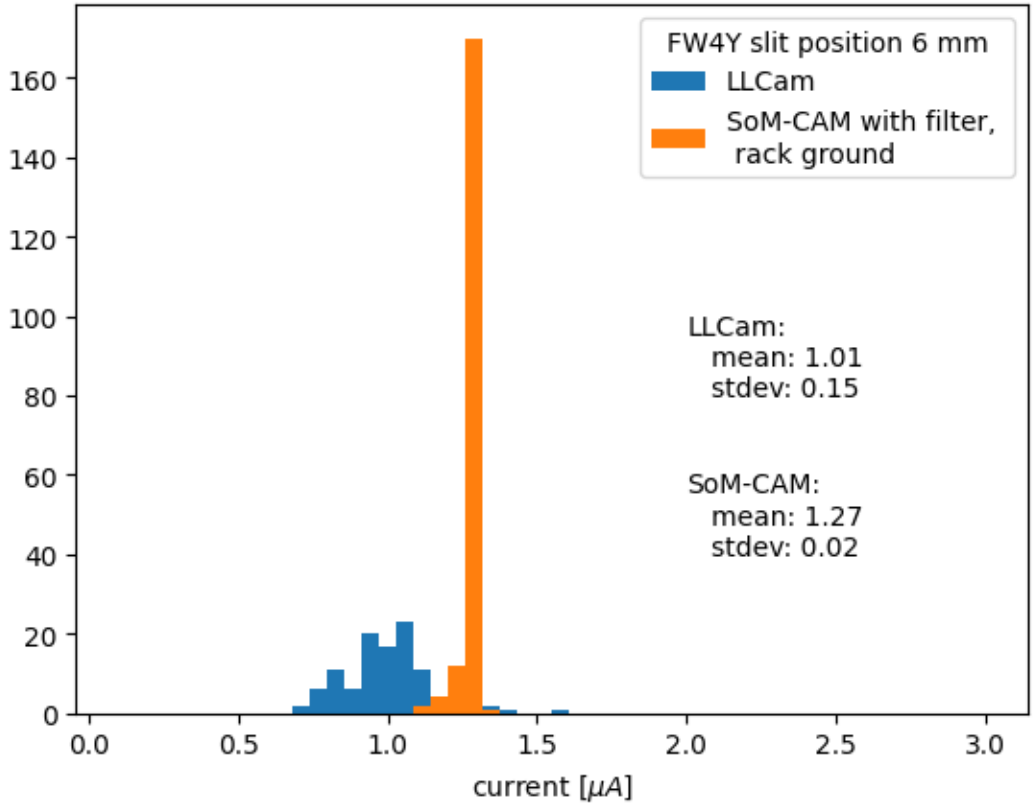






Data analysis – FW4YO

- Scan 1 and 2: better look at each position

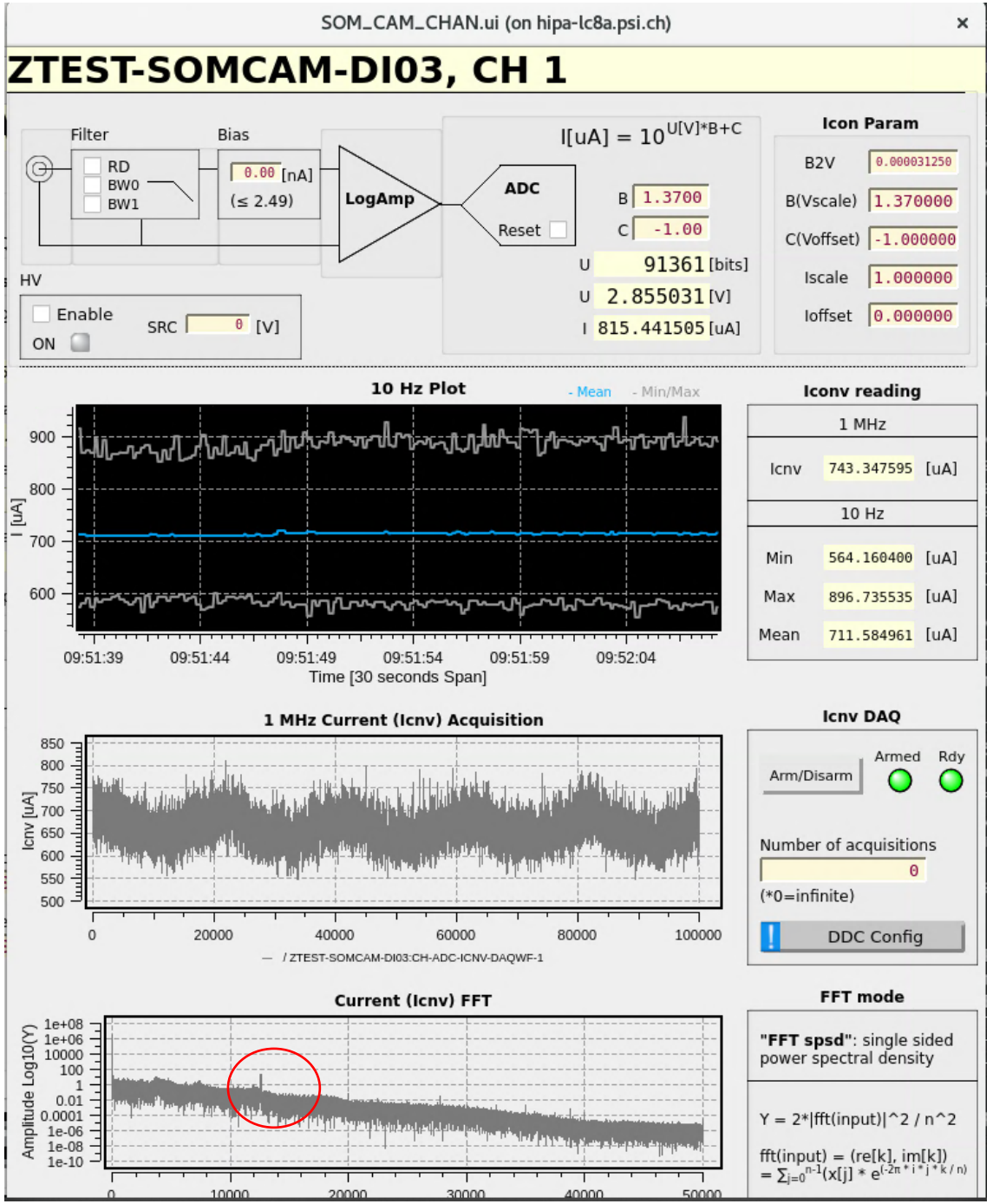


SoM-CAM gives more stable readouts!

It looks more like SoM-CAM feature than beam stability issue.

Data analysis – FW4YO

- Scan 2, position 3 mm(probably):
  1 MHz buffer and its FFT
- Units in 10 Hz
- Peak at ~120 kHz, other features.



SOM_CAM_CHAN.ui (on hipa-lc8a.psi.ch)

ZTEST-SOMCAM-DI03, CH 1

Filter: RD, BW0, BW1 — Bias: 0.00 [nA] (≤ 2.49) — LogAmp — ADC (Reset)

$I[uA] = 10^{U[V]*B+C}$

B 1.3700 — C -1.00

U 91361 [bits]

U 2.855031 [V]

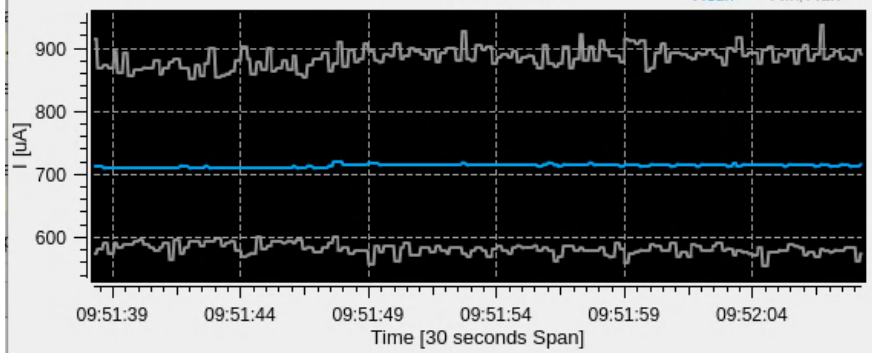
I 815.441505 [uA]

HV: Enable, ON, SRC 0 [V]

Icon Param

B2V	0.000031250
B(Vscale)	1.370000
C(Voffset)	-1.000000
Iscale	1.000000
Ioffset	0.000000

10 Hz Plot - Mean - Min/Max

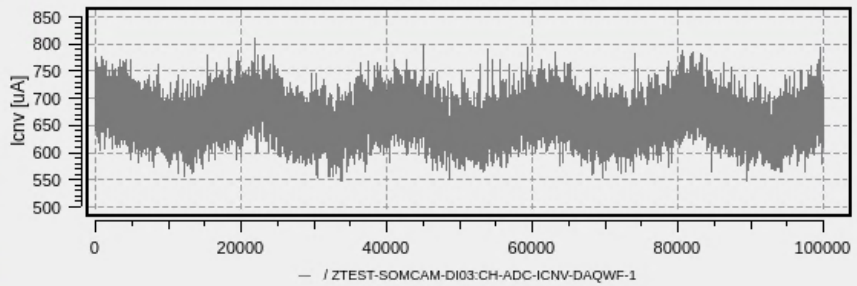


Iconv reading

1 MHz		
Icnv	743.347595	[uA]

10 Hz		
Min	564.160400	[uA]
Max	896.735535	[uA]
Mean	711.584961	[uA]

1 MHz Current (Icnv) Acquisition



Icnv DAQ

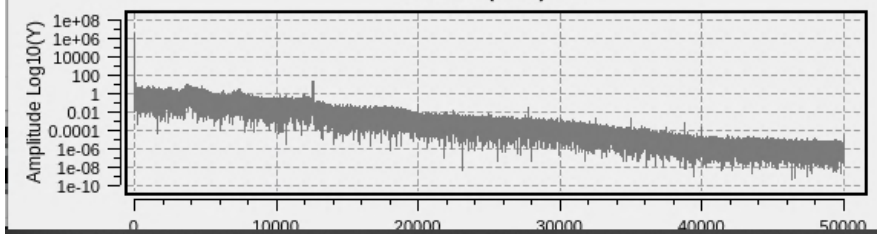
Arm/Disarm — Armed — Rdy

Number of acquisitions: 0

(*0=infinite)

DDC Config

Current (Icnv) FFT



FFT mode

"FFT spsd": single sided power spectral density

Y = 2*|fft(input)|^2 / n^2

fft(input) = (re[k], im[k])
$= \sum_{j=0}^{n-1}(x[j] * e^{(-2\pi * i * j * k / n)}$

SOM_CAM_CHAN.ui (on hipa-lc8a.psi.ch)

ZTEST-SOMCAM-DI03, CH 0

Filter: RD, BW0, BW1 — Bias: 0.00 [nA] (≤ 2.49) — LogAmp — ADC (Reset)

$I[uA] = 10^{U[V]*B+C}$

B 1.3700 — C -1.00

U 46612 [bits]

U 1.456625 [V]

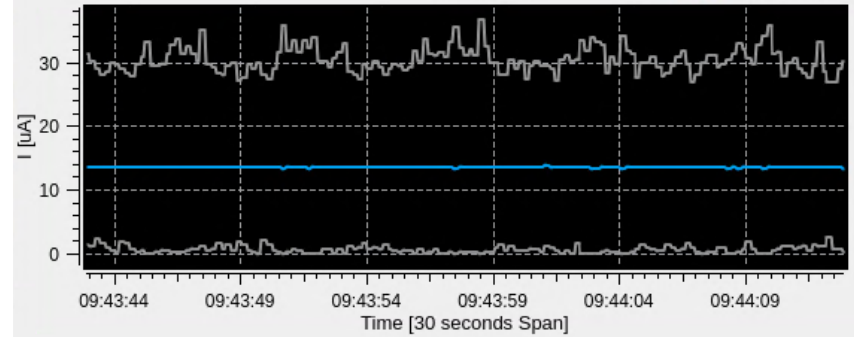
I 9.898656 [uA]

HV: Enable, ON, SRC 0 [V]

Icon Param

B2V	0.000031250
B(Vscale)	1.370000
C(Voffset)	-1.000000
Iscale	1.000000
Ioffset	0.000000

10 Hz Plot - Mean - Min/Max

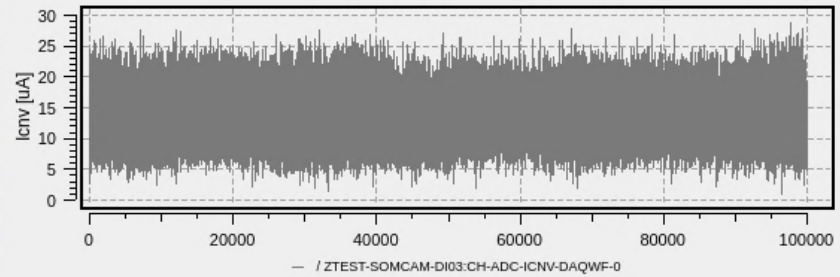


Iconv reading

1 MHz		
Icnv	16.510994	[uA]

10 Hz		
Min	0.074758	[uA]
Max	30.071768	[uA]
Mean	13.397130	[uA]

1 MHz Current (Icnv) Acquisition



Icnv DAQ

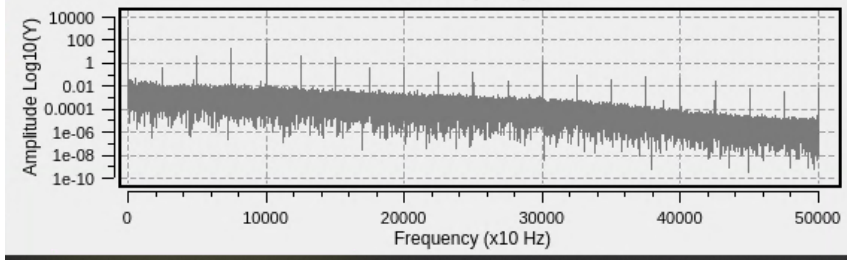
Arm/Disarm — Armed — Rdy

Number of acquisitions: 0

(*0=infinite)

DDC Config

Current (Icnv) FFT



FFT mode

"FFT spsd": single sided power spectral density

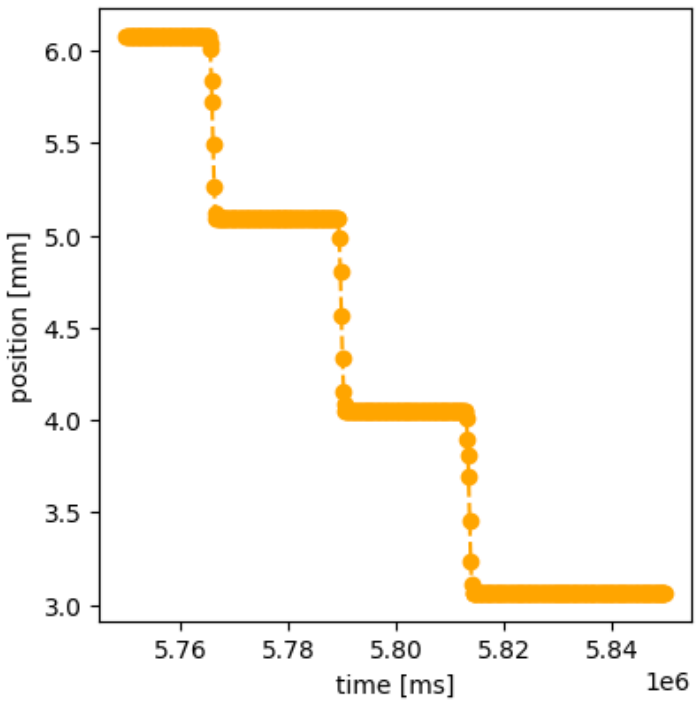
Y = 2*|fft(input)|^2 / n^2

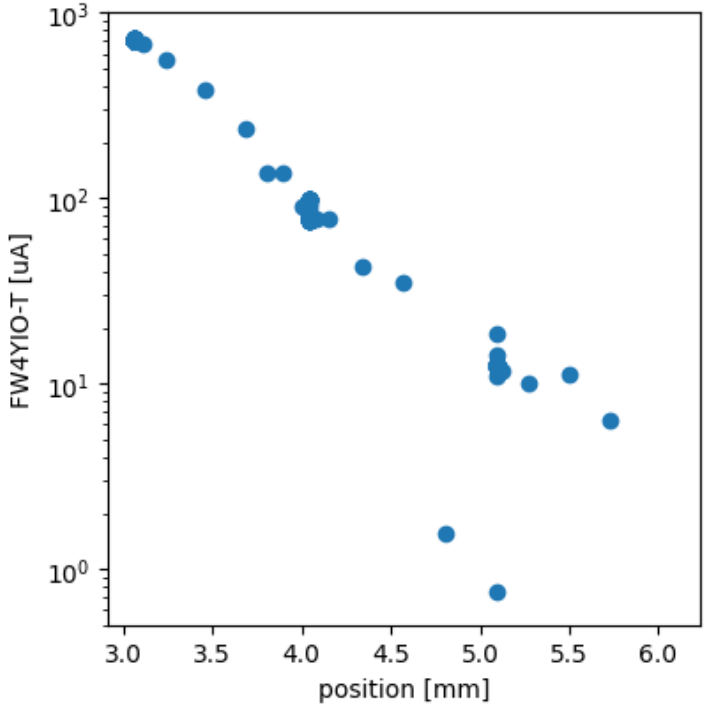
fft(input) = (re[k], im[k])
$= \sum_{j=0}^{n-1}(x[j] * e^{(-2\pi * i * j * k / n)}$

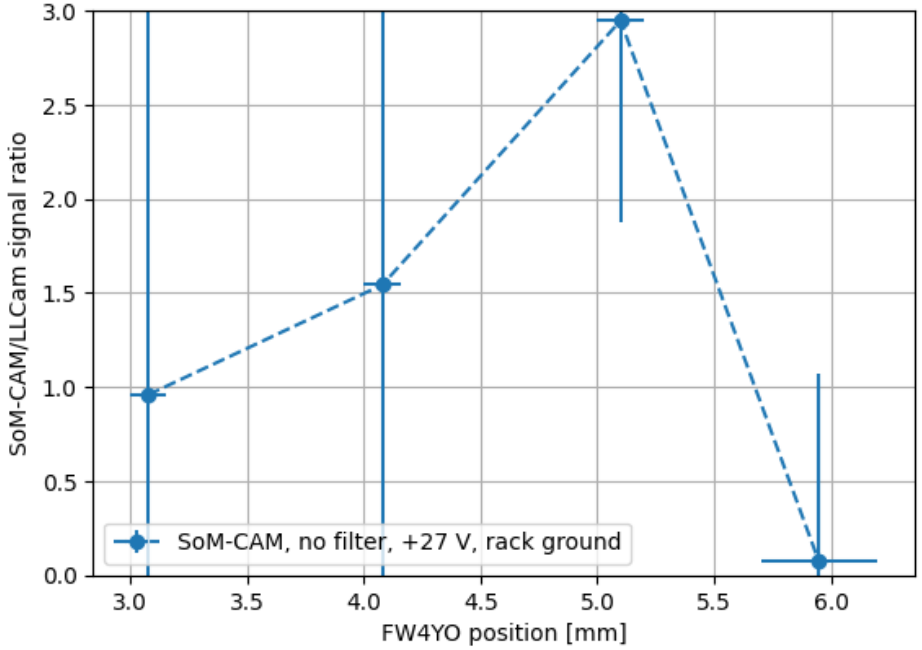
(with i = sqrt(-1), n = 100k)

Data analysis – FW4YO

- Scan 3: SoM-CAM without filter box, bias +27 V, ground at rack

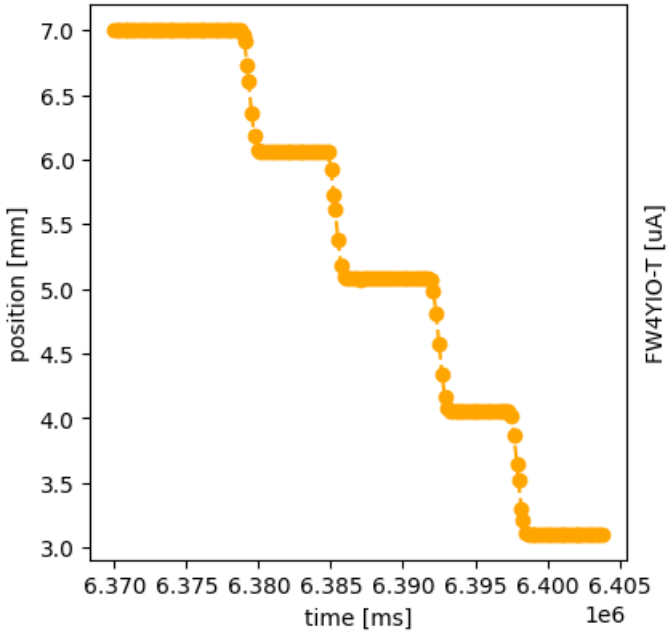


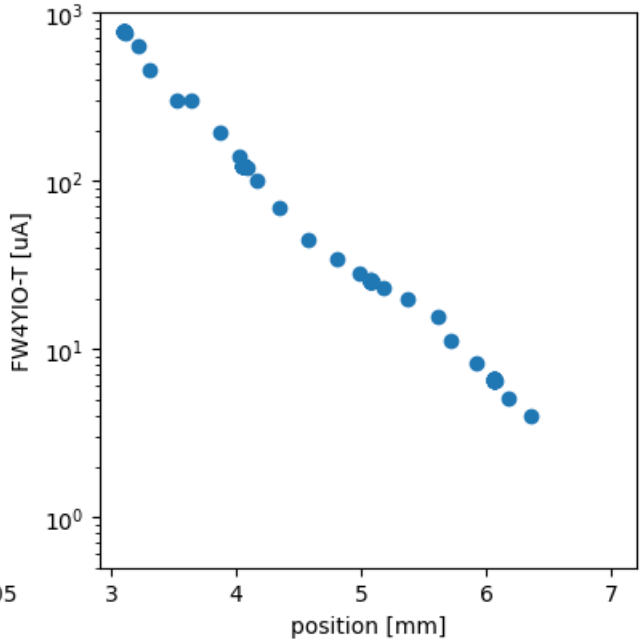


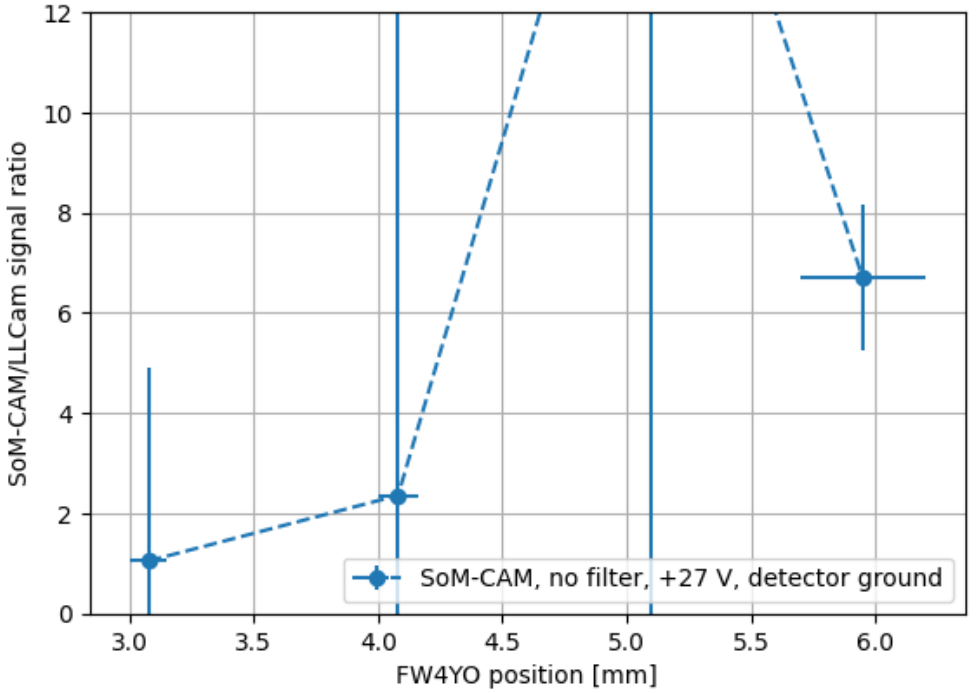


Data analysis – FW4YO

- Scan 4: SoM-CAM without filter box, bias +27 V, ground at detector

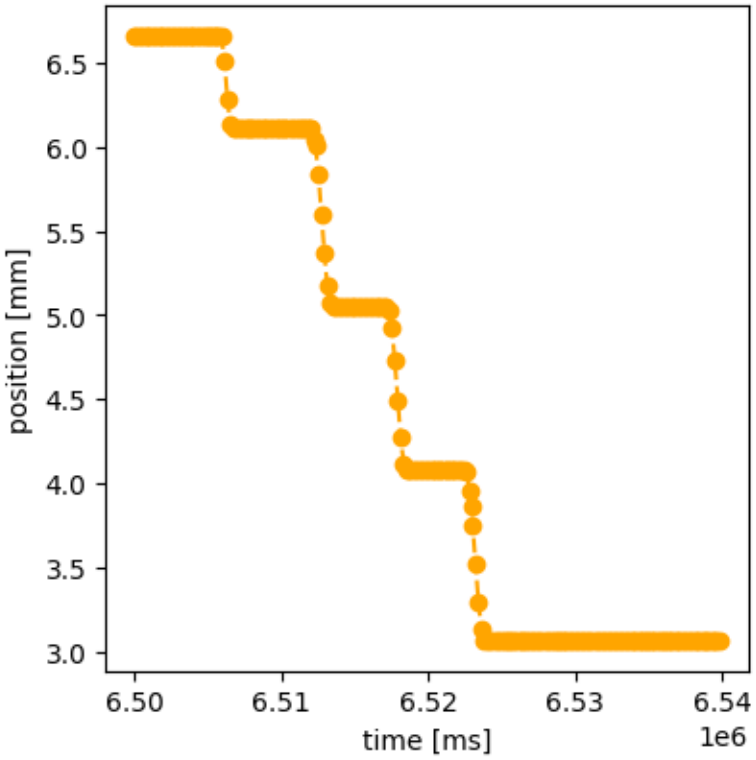


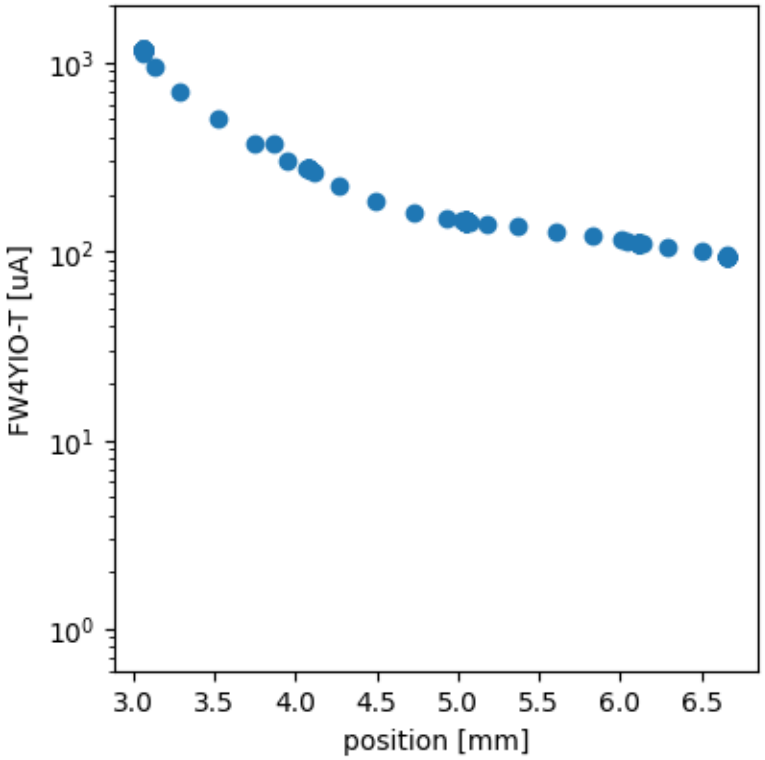


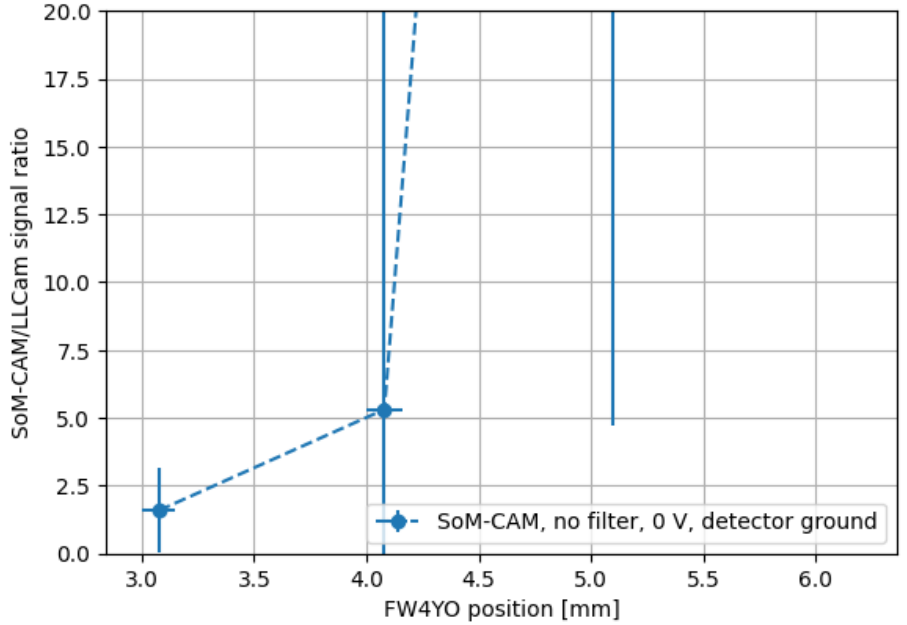


Data analysis – FW4YO

- Scan 5: SoM-CAM without filter box, no bias, ground at detector

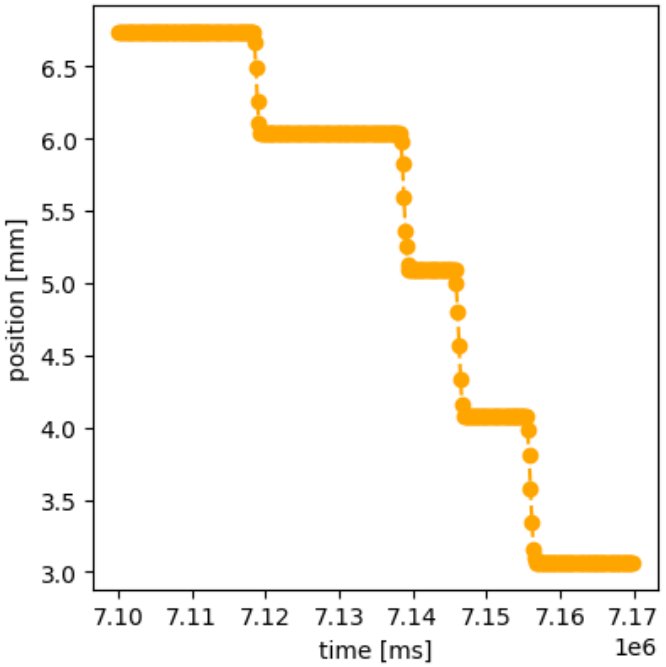


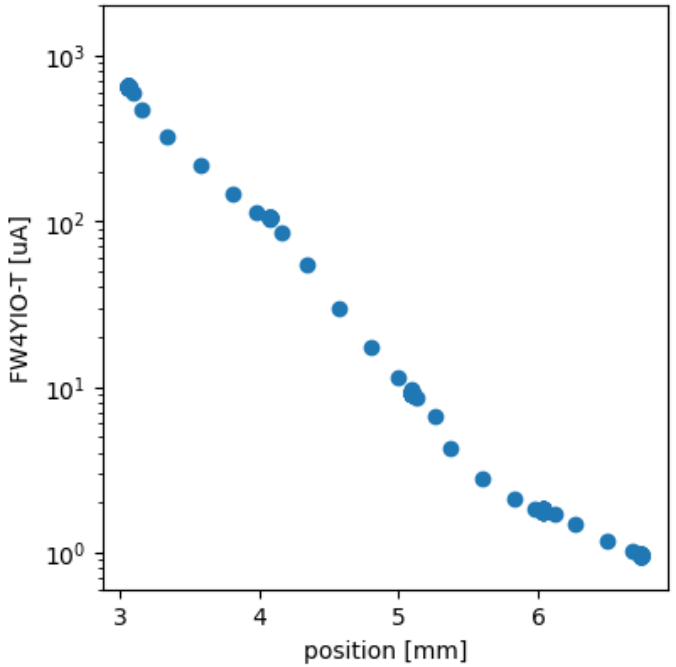


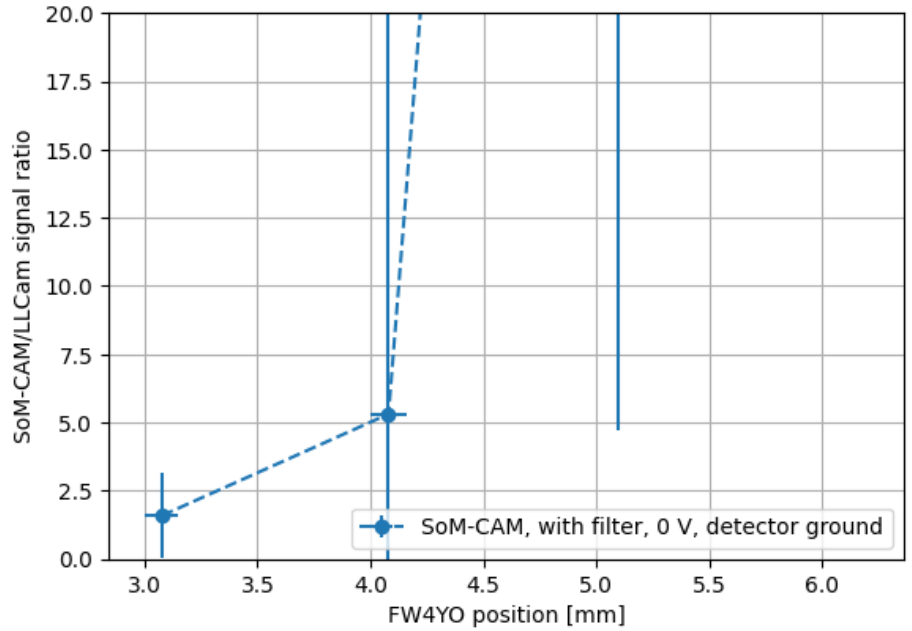


Data analysis – FW4YO

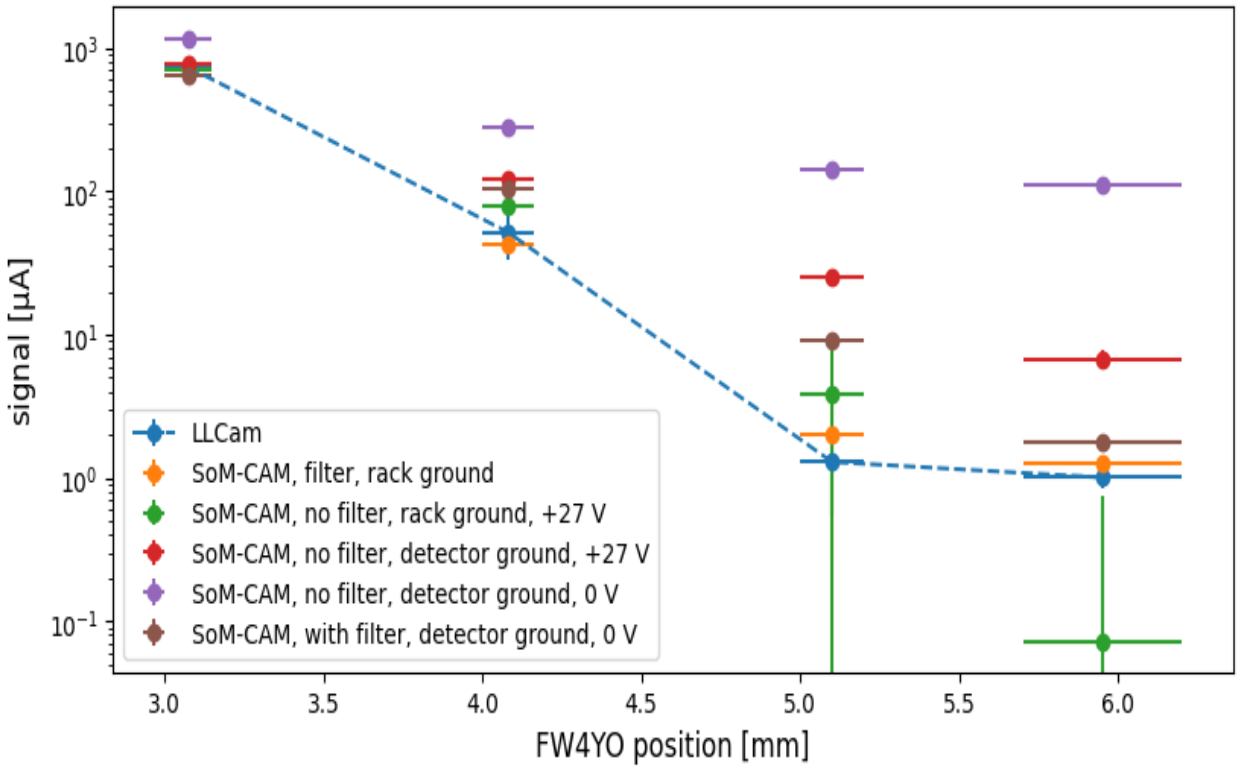
- Scan 6: SoM-CAM with filter box, no bias, ground at detector

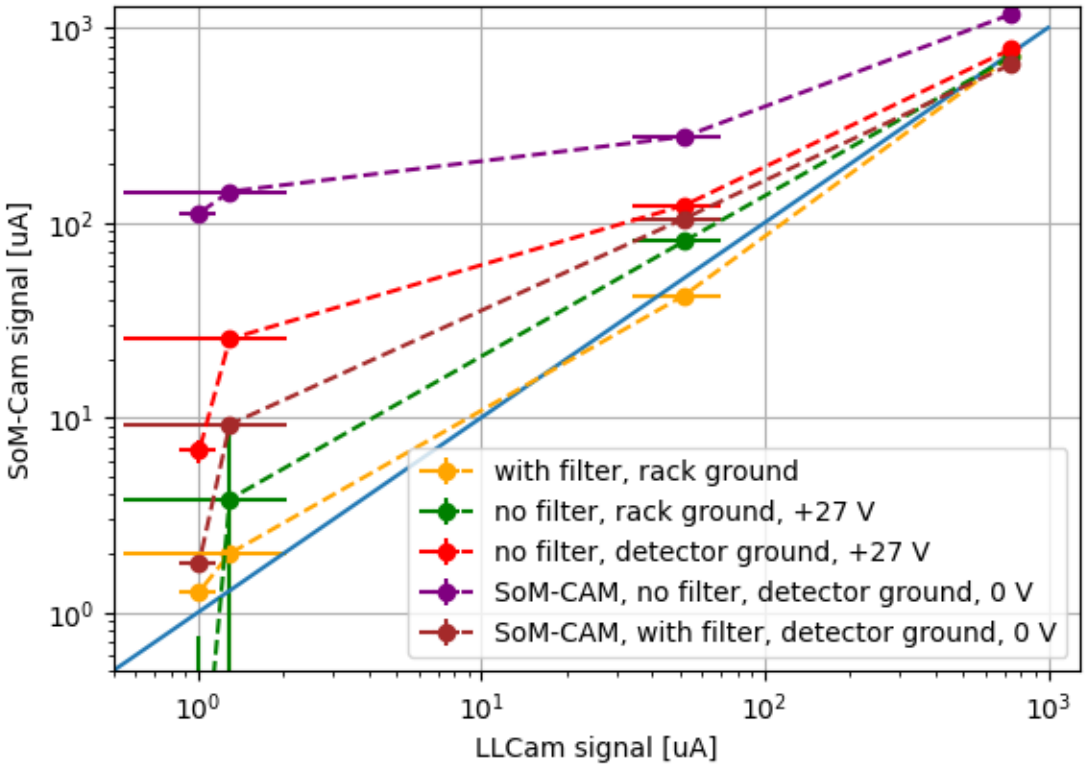






Final plots





Linearity: 0.968

Summary

- SoM-CAM with filter boxes almost agree with LLCam.
- Removal filter boxes and applying +27 V bias looks not bad considering beam instability.
- Grounding at detector side gives significantly worst agreement with LLCam.
- Unfortunately, errors are large, beam intensity is stable, but it seems to wiggle!
- FW4YUnten data not good.