

Status of
Pbar Catching & Accumulation

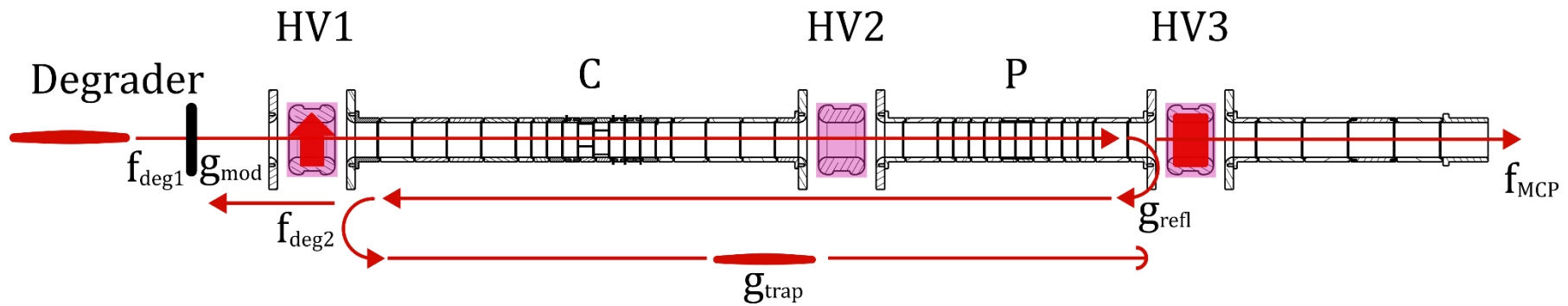
-

December 2024

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Tassilo Rauschendorfer & Ruggero Caravita

Trapping in the 5T

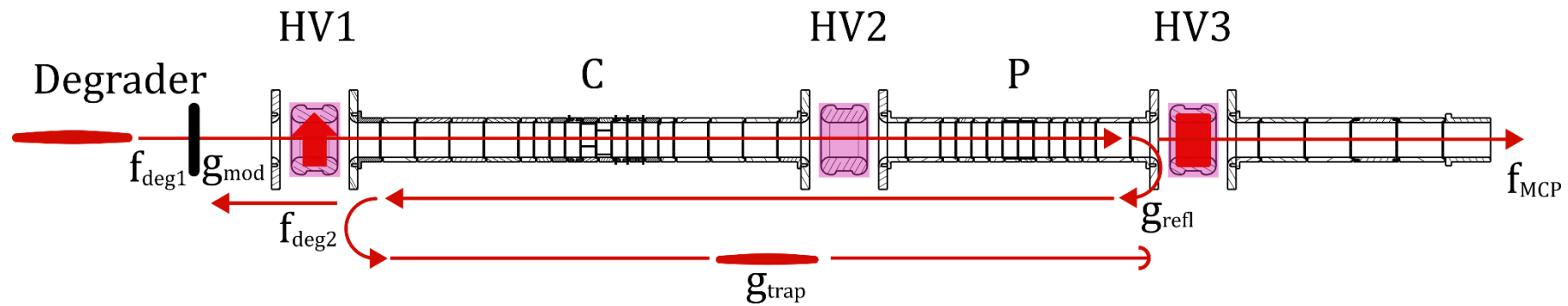


$$1 = f_{deg1} + g_{mod}$$

$$g_{mod} = f_{MCP} + g_{refl}$$

$$g_{refl} = f_{deg2} + g_{trap}$$

Trapping in the 5T



$$1 = f_{inj} + f_{deg1} + g_{mod}$$

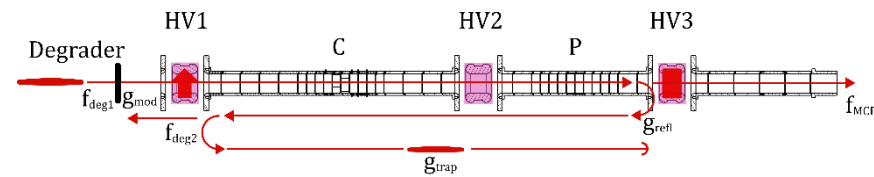
$$g_{mod} = f_{MCP} + g_{refl}$$

$$g_{refl} = f_{deg2} + g_{trap}$$

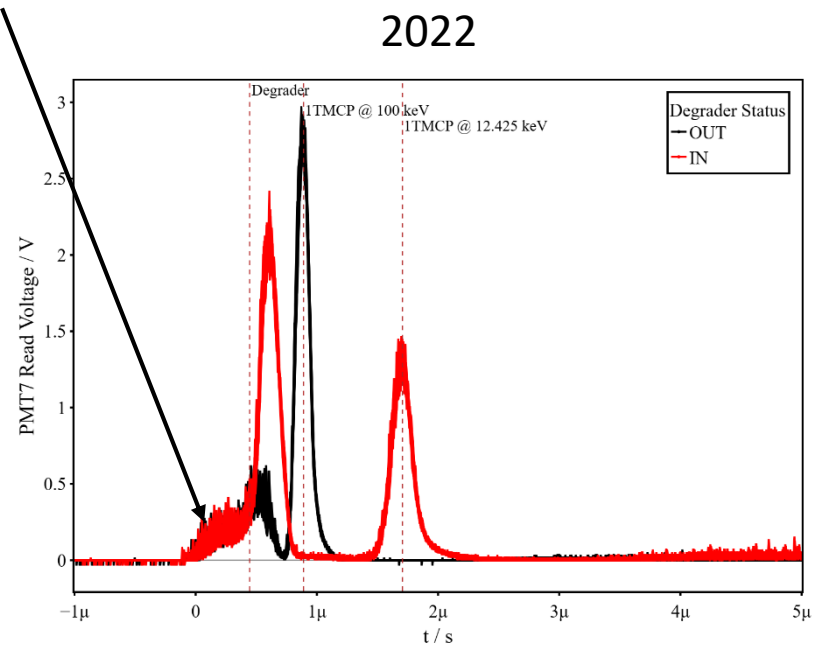
$$g_{trap} = g_{trap-stable} + g_{trap-unstable}$$

f_{inj}

Losses before Thick Degrader

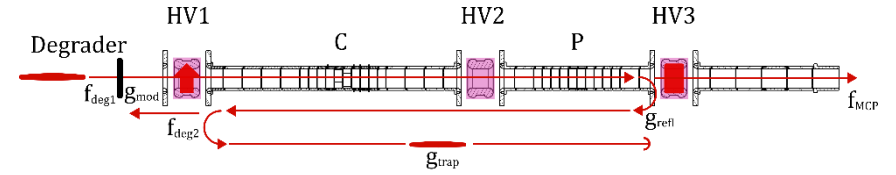


4.46 m from 1TMCP



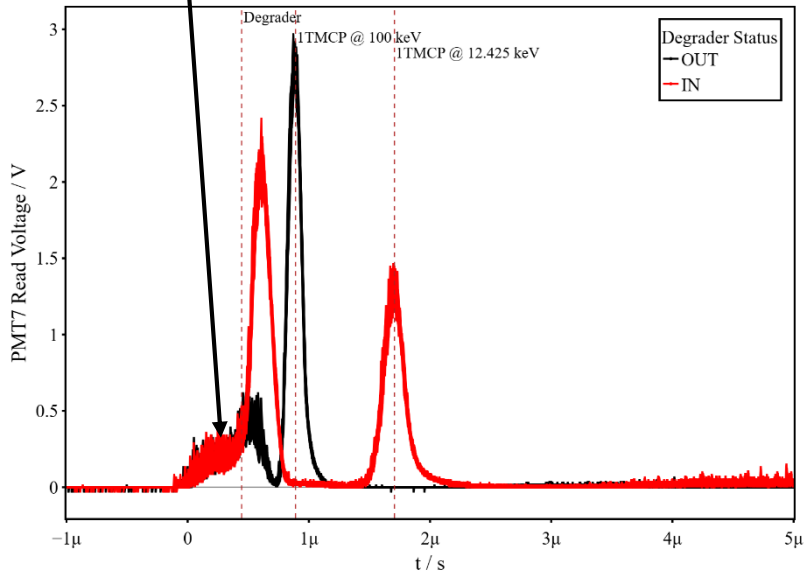
f_{inj}

Losses before Thick Degrader



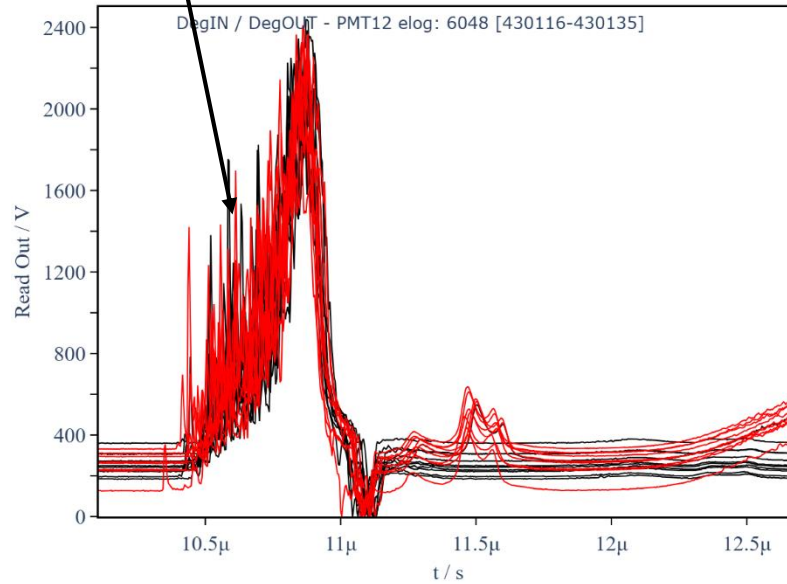
4.46 m from 1TMCP

2022



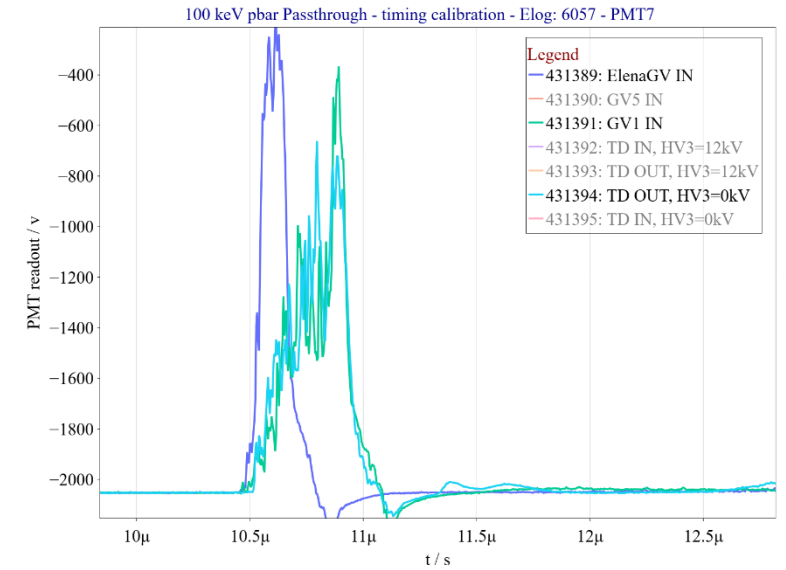
Still there

2024-June



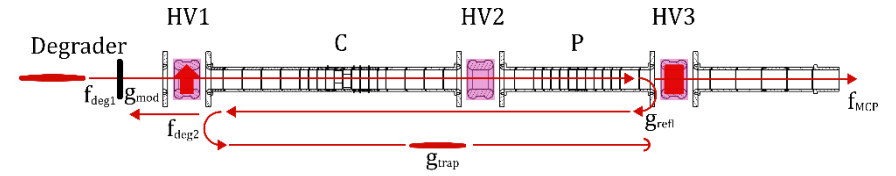
TOF Calibration

2024-November



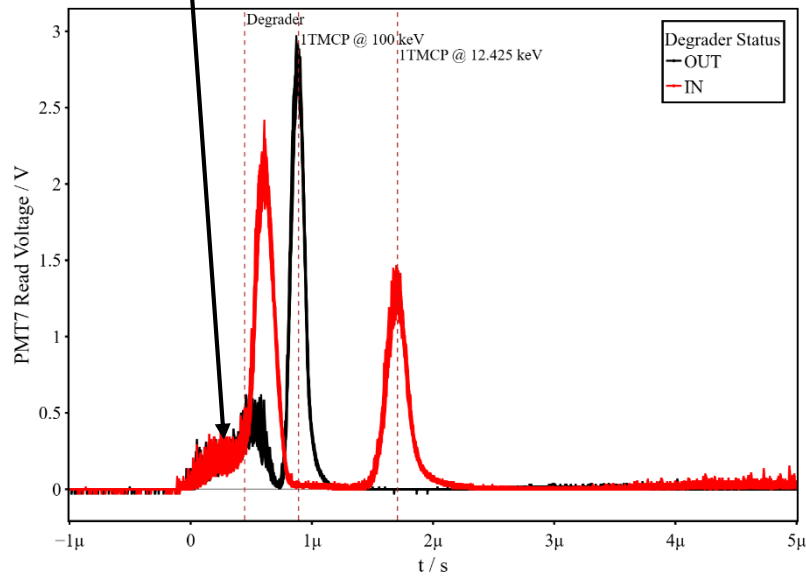
f_{inj}

Losses before Thick Degrader



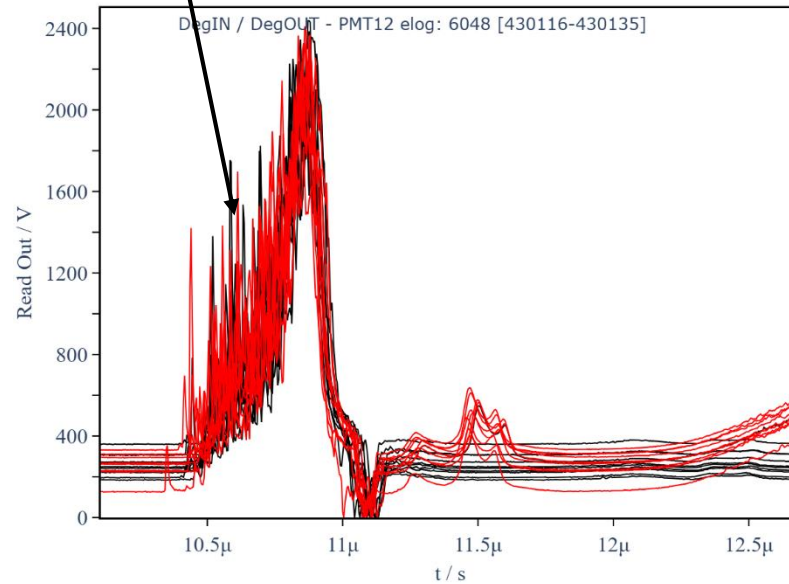
4.46 m from 1TMCP

2022



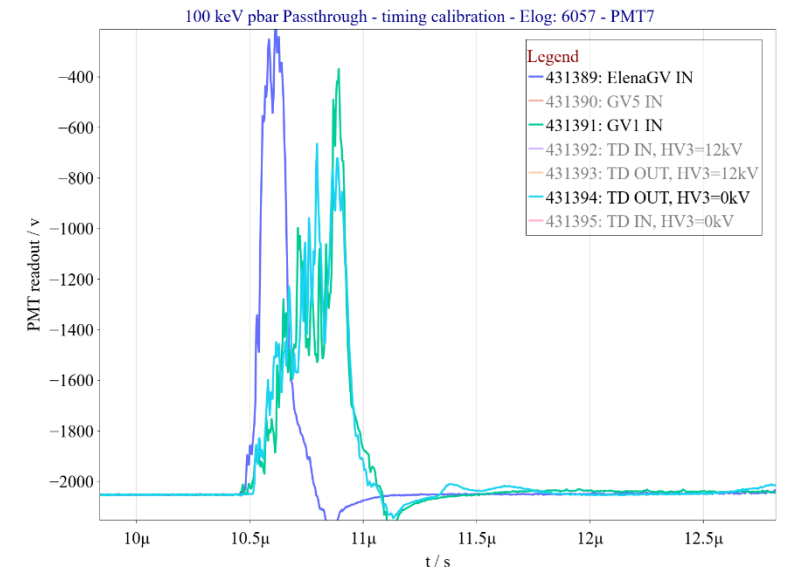
Still there

2024-June



TOF Calibration

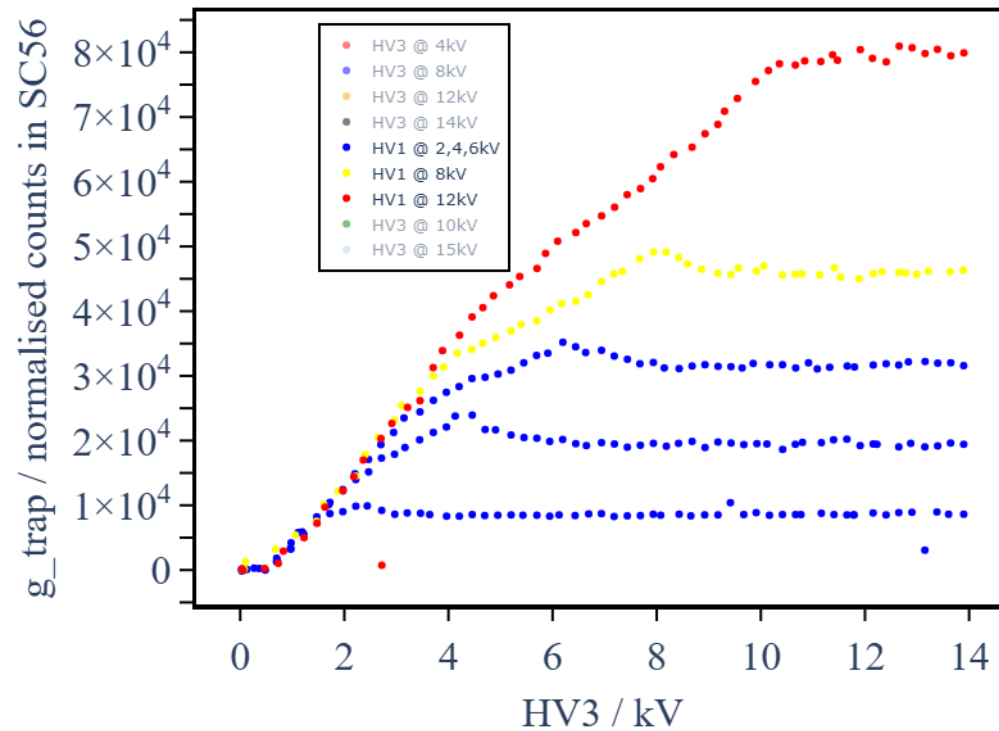
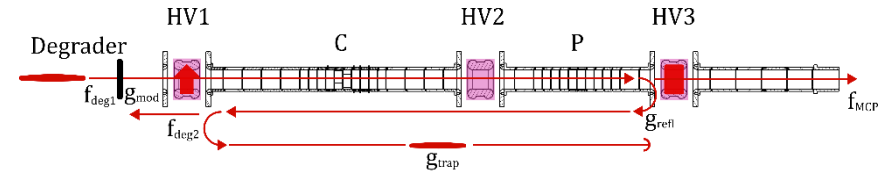
2024-November



→ Losses present at least since 2022

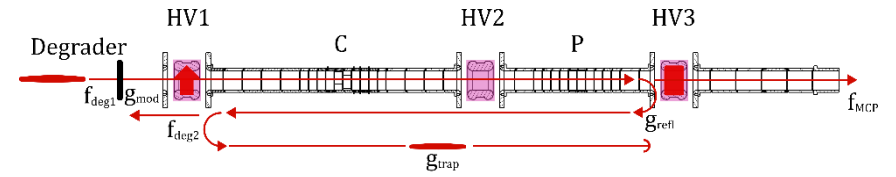
→ More now more losses between GV5 and GV1 → Starship/HH MCP

g_{trap} finally trapped fraction

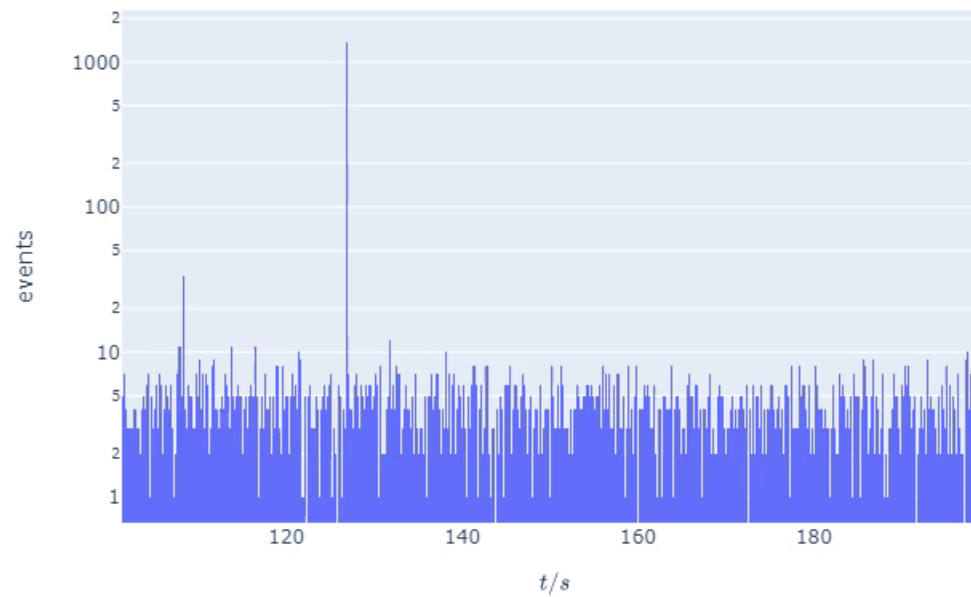


???

g_{trap}
finally trapped fraction

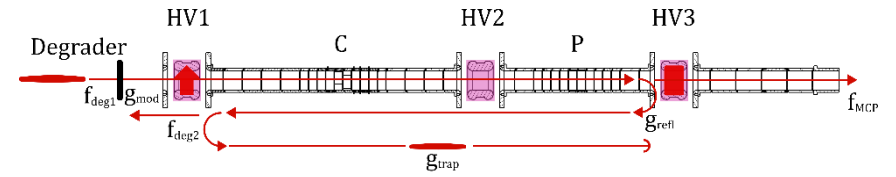


HV3 @ 0.03kV, HV1=11.7 kV, run 420741.



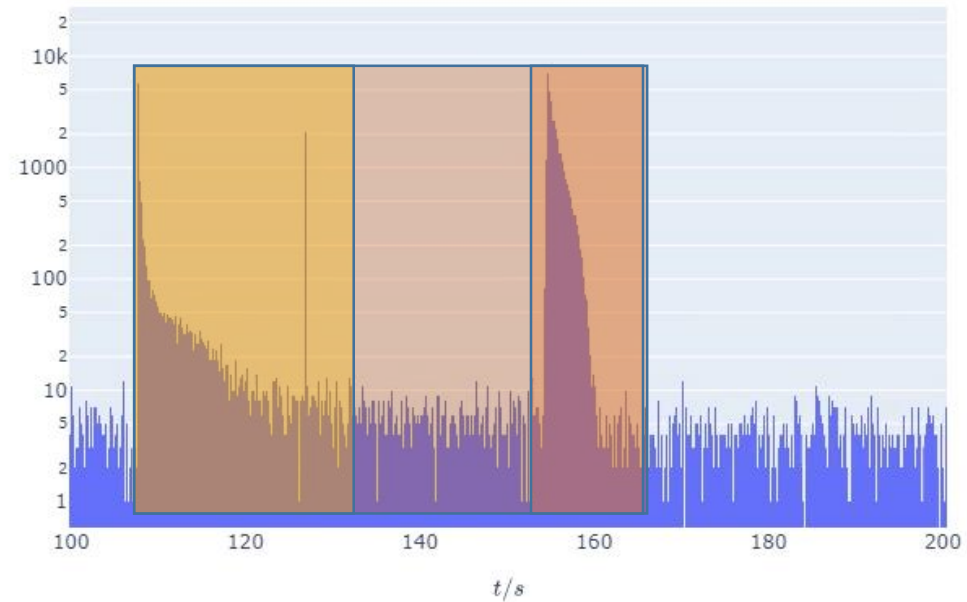
???

\mathcal{I}_{trap} finally trapped fraction

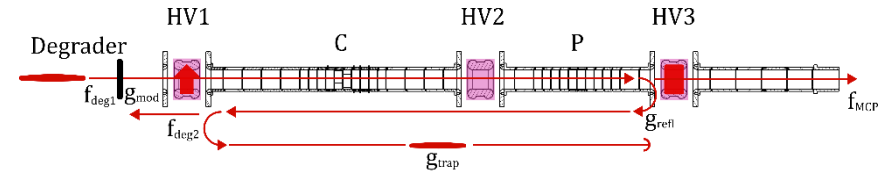


HV3 @ 8.33kV, HV1=11.74 kV, run 420776.

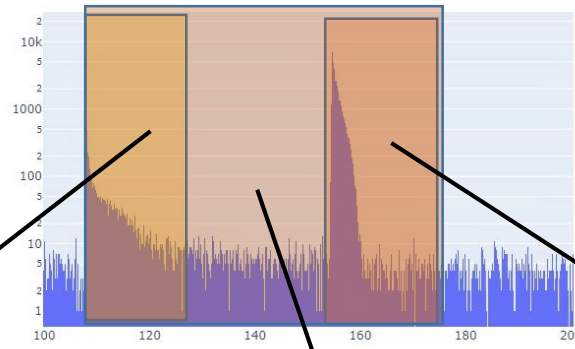
$\mathcal{I}_{trap-unstable}$ $\mathcal{I}_{trap-stable}$



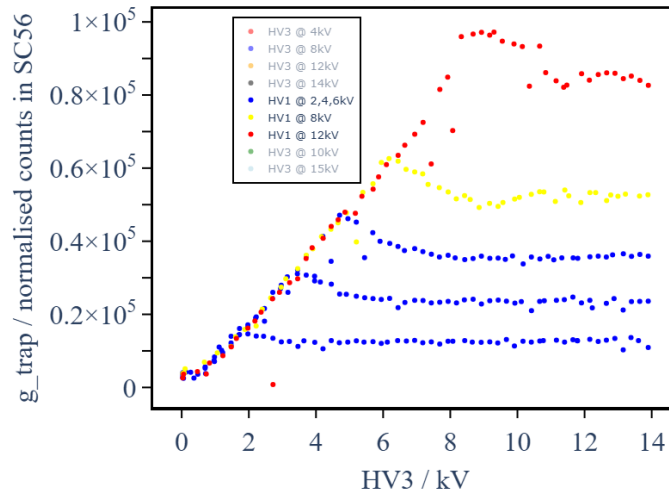
g_{trap} finally trapped fraction



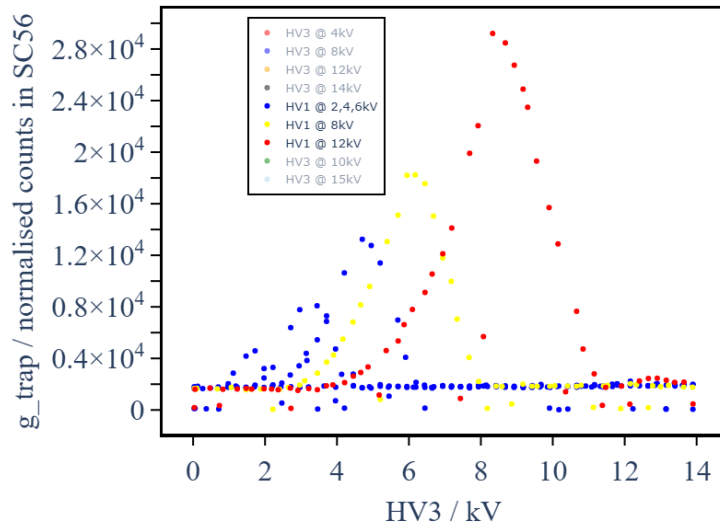
HV3 @ 8.33kV, HV1=11.74 kV, run 420776.



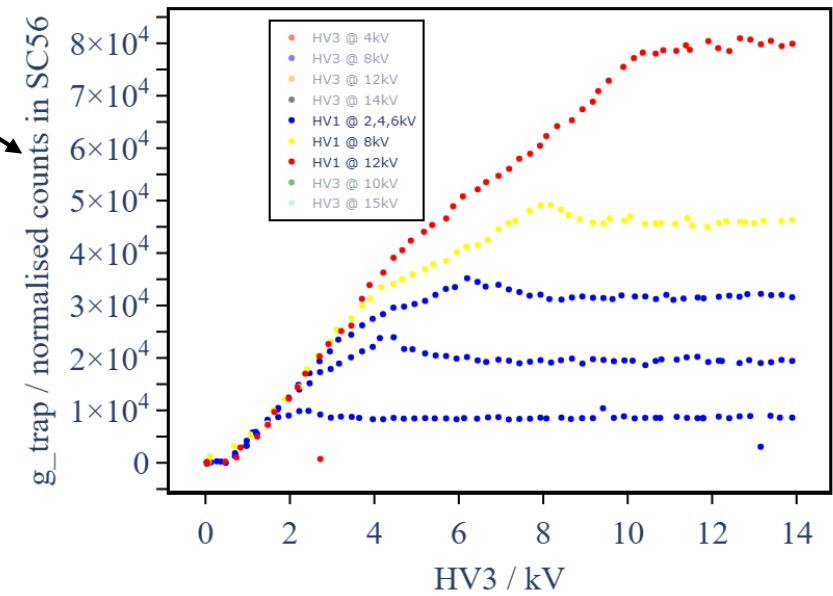
everything



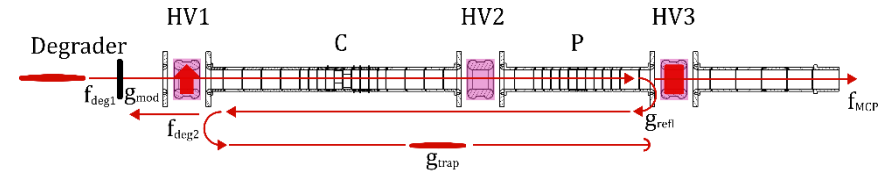
Directly after trapping



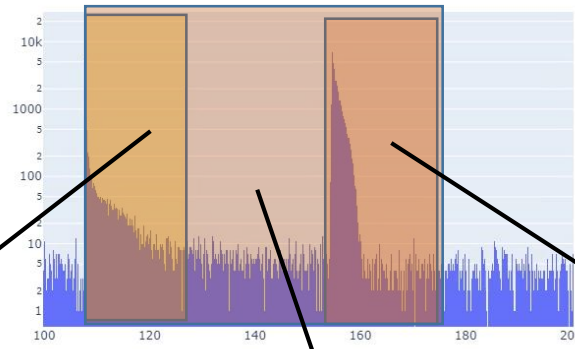
Dump



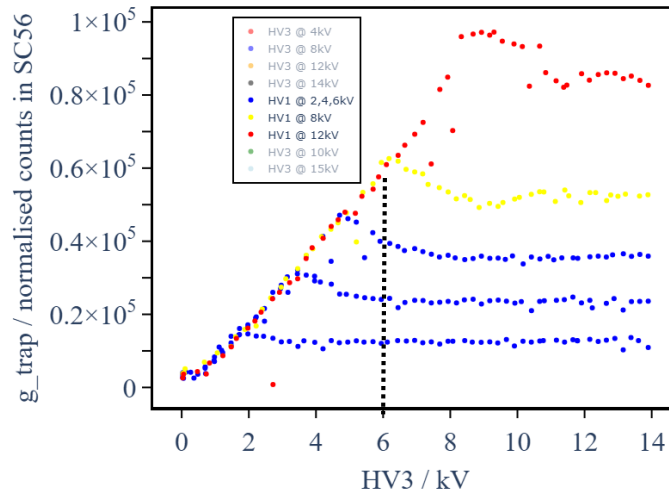
\mathcal{I}_{trap} finally trapped fraction



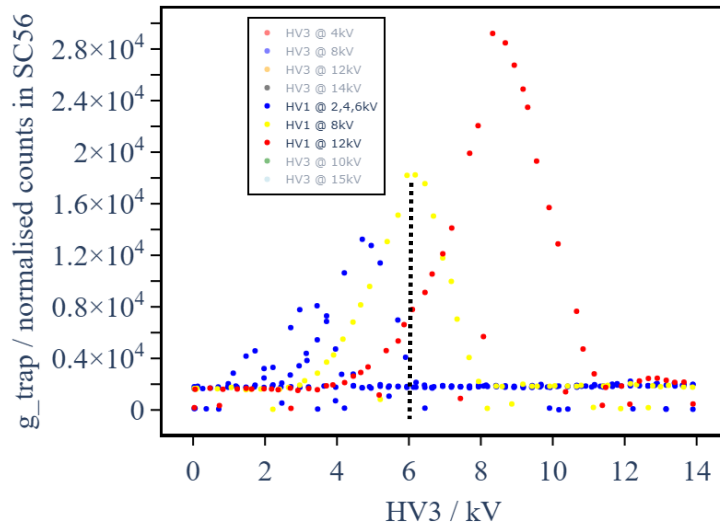
HV3 @ 8.33kV, HV1=11.74 kV, run 420776.



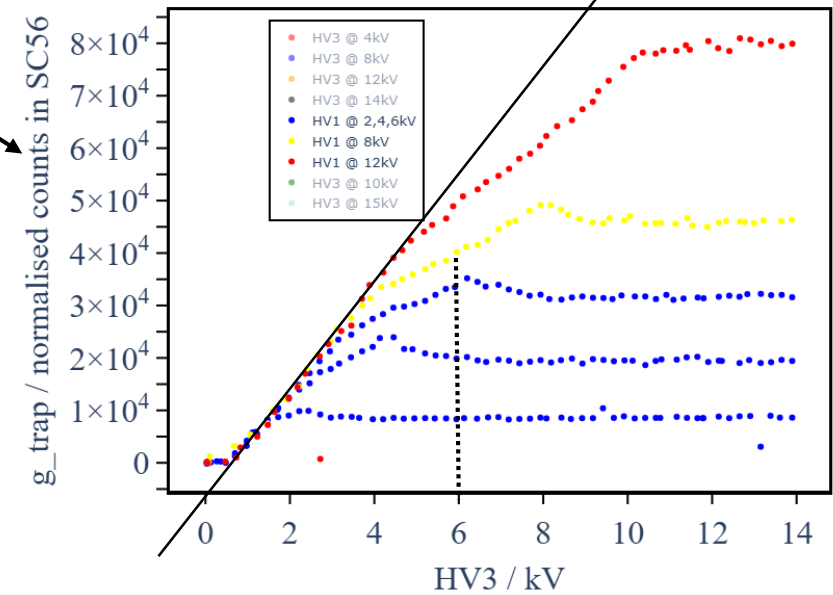
everything



Directly after trapping



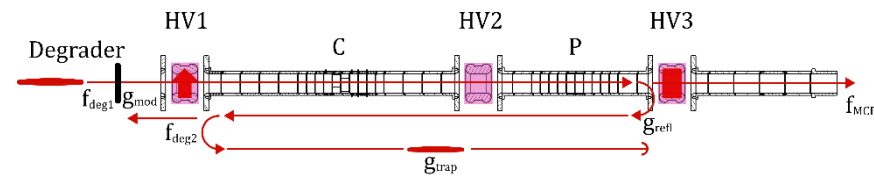
Dump



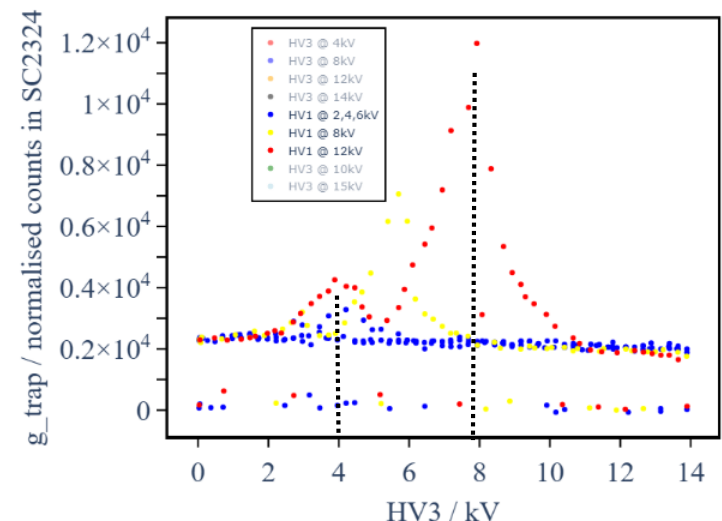
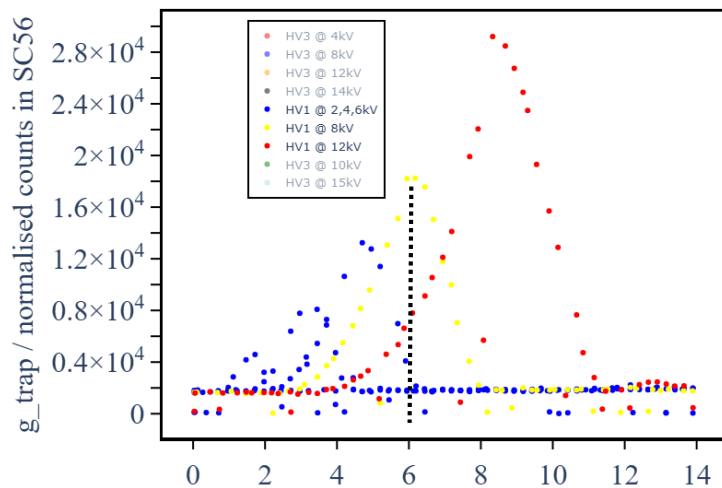
→ We are clearly losing pbars

→ Simply HV1>HV3: more \mathcal{I}_{trap} -stable?

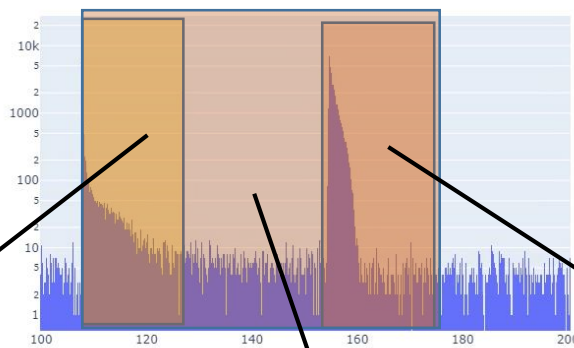
\mathcal{I}_{trap} finally trapped fraction



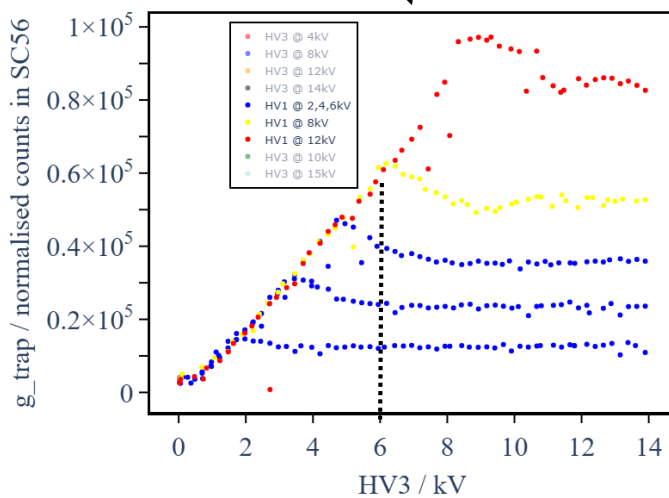
Directly after trapping



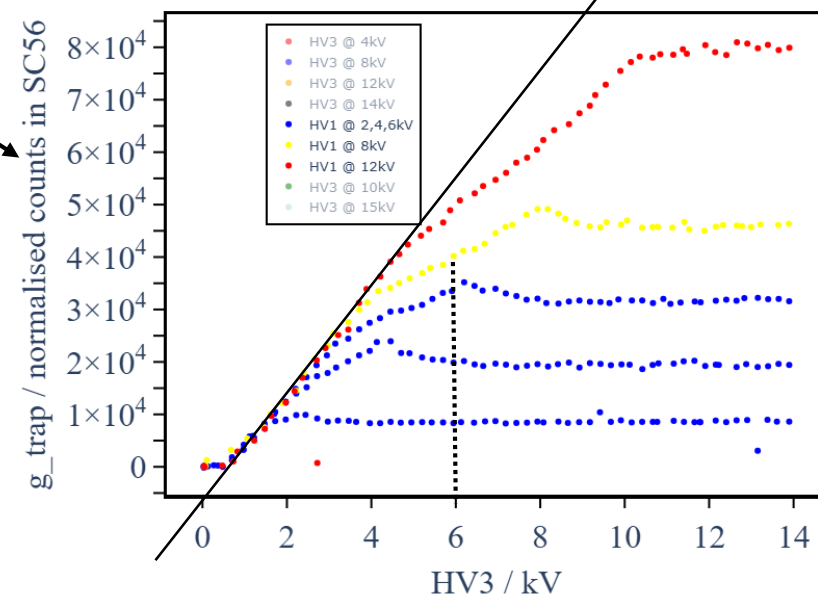
HV3 @ 8.33kV, HV1=11.74 kV, run 420776.



everything

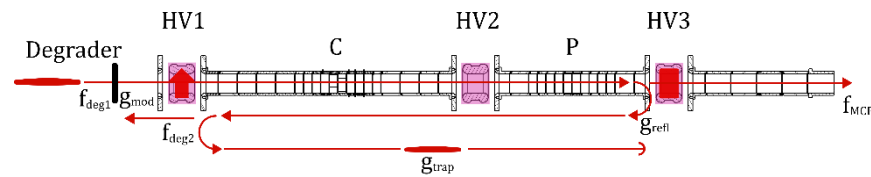


Dump

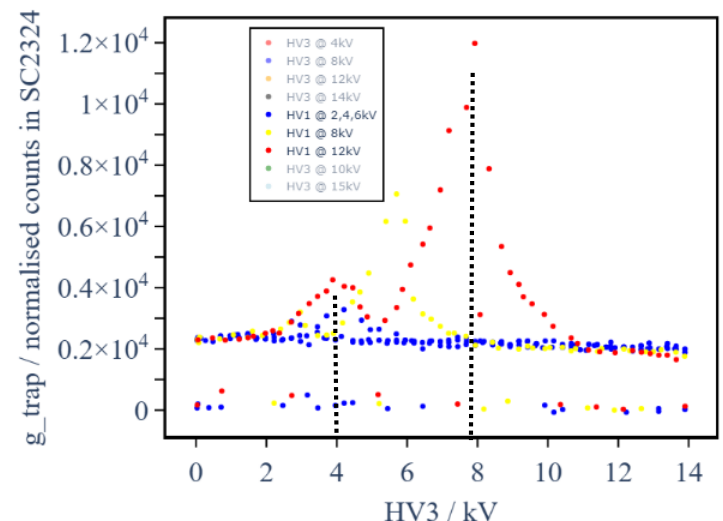
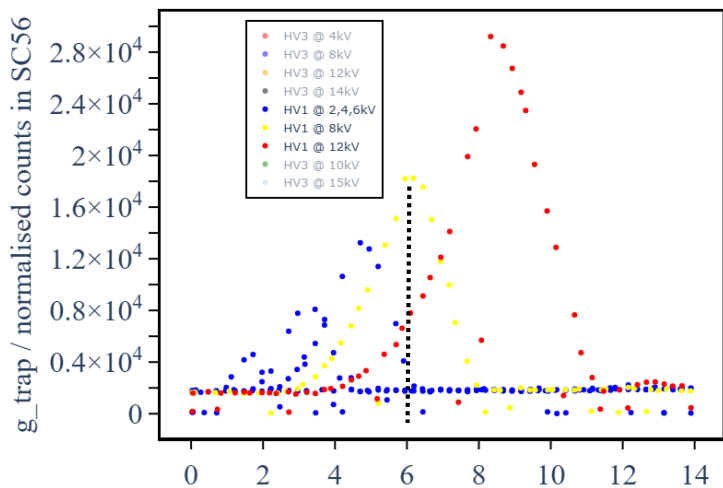


- We are clearly losing pbars
- Simply HV1>HV3: more \mathcal{I}_{trap} -stable?

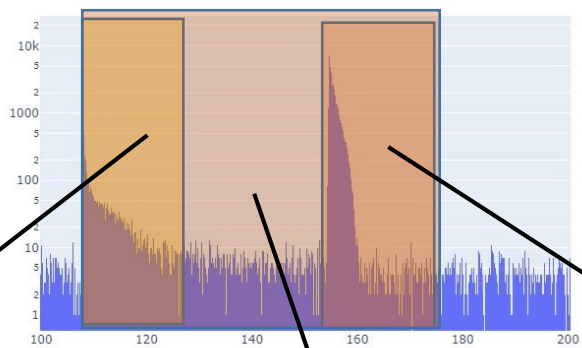
\mathcal{I}_{trap} finally trapped fraction



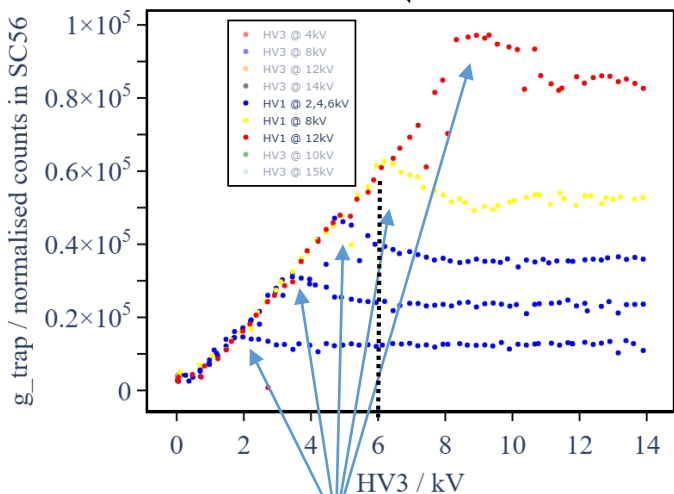
Directly after trapping



HV3 @ 8.33kV, HV1=11.74 kV, run 420776.

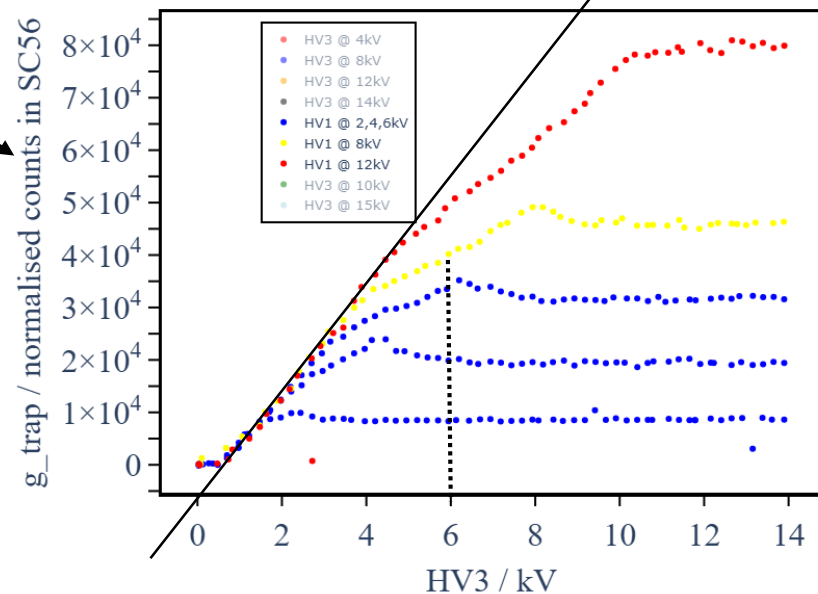


everything



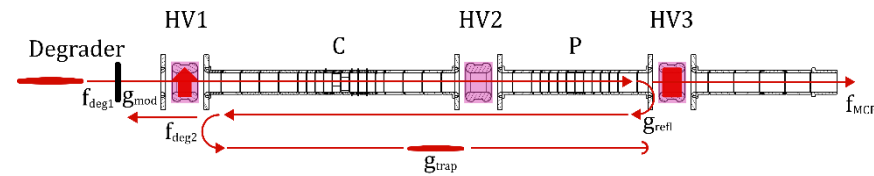
Where is the excess going?

Dump



- We are clearly losing pbars
- Simply HV1>HV3: more \mathcal{I}_{trap} -stable?

\mathcal{I}_{trap} finally trapped fraction



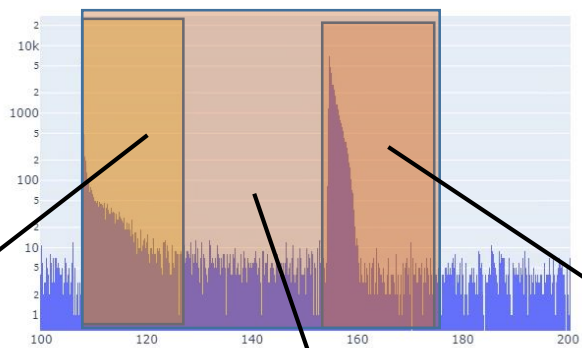
Directly after trapping

→ Losses start occurring HV1>HV3 but decline again after HV1 = 4/3*HV3

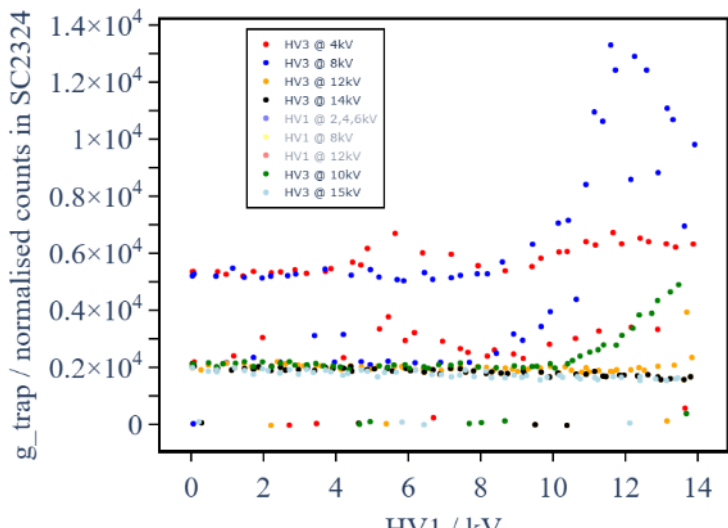
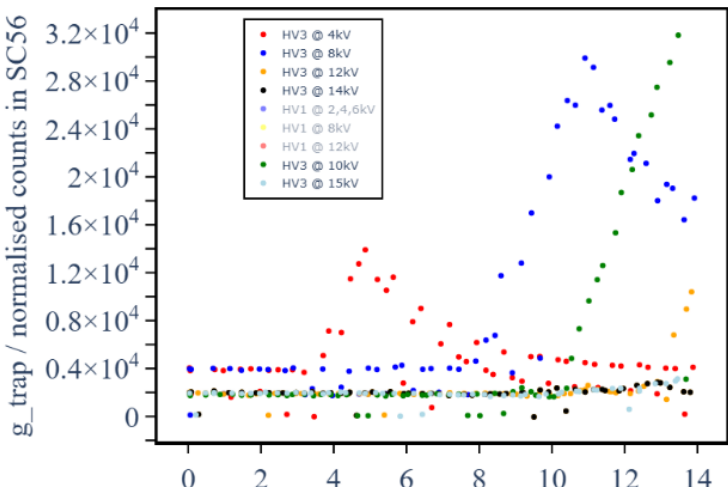
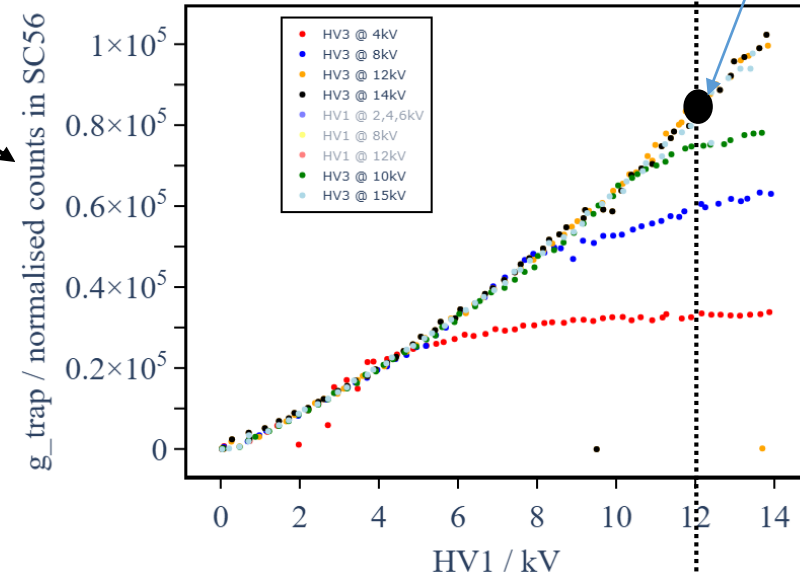
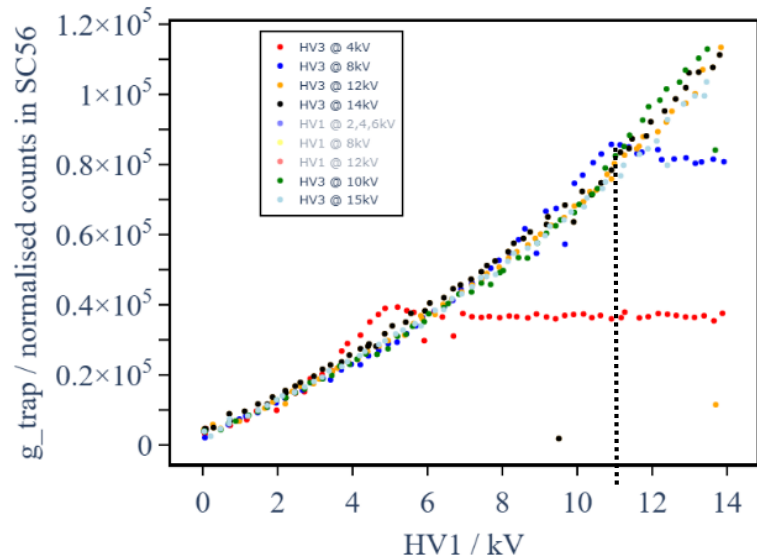
Dump default

→ HV1 asymptotical increase

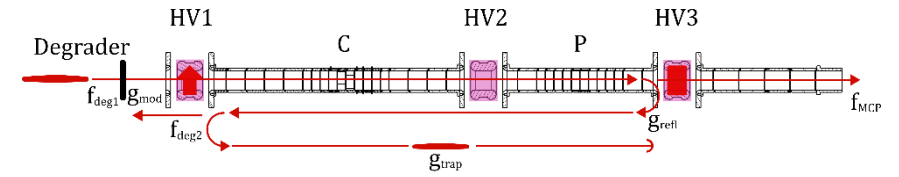
HV3 @ 8.33kV, HV1=11.74 kV, run 420776.



everything

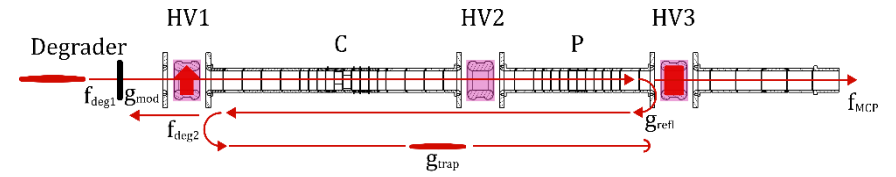


g_{trap} finally trapped fraction



- In balanced trap $g_{trap-unstable}$: 10-15%
- Likely electronic fault
 - High voltage probe testing of HV1
 - Modelling the loss mechanism
- Operate in imbalanced trap

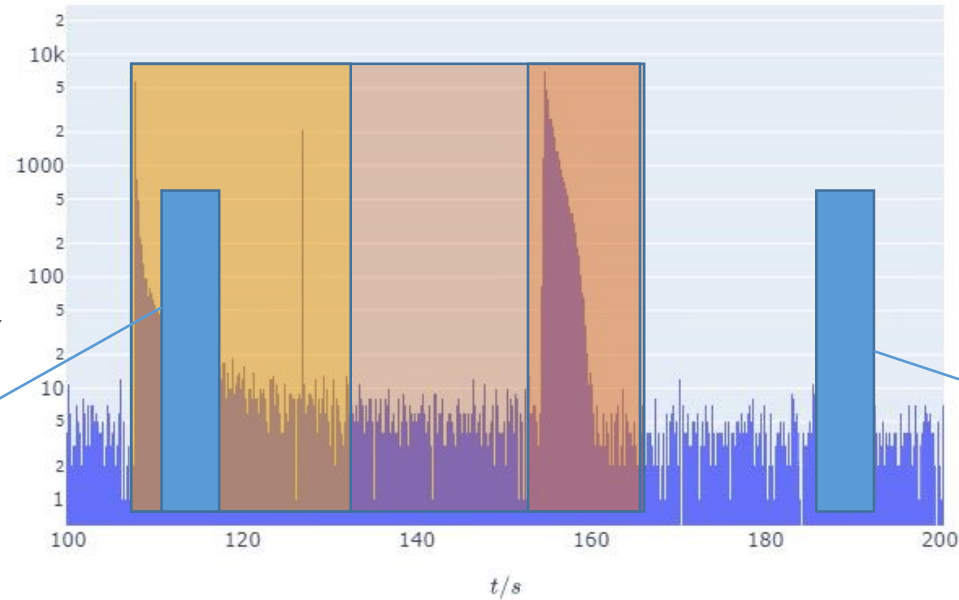
\mathcal{I}_{trap} finally trapped fraction



FFT-Analysis

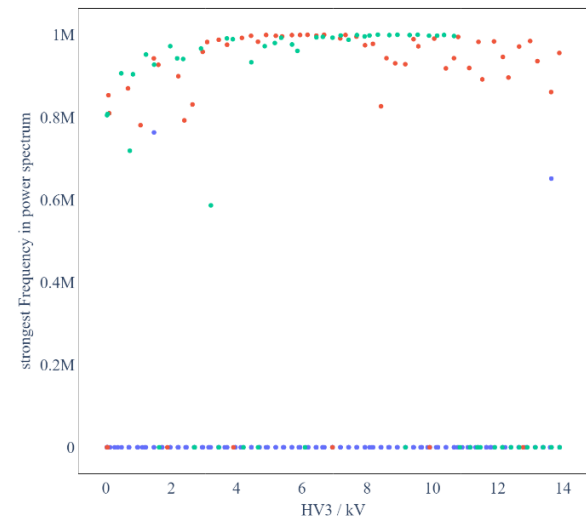
HV3 @ 8.33kV, HV1=11.74 kV, run 420776.

\mathcal{I}_{trap} -unstable \mathcal{I}_{trap} -stable

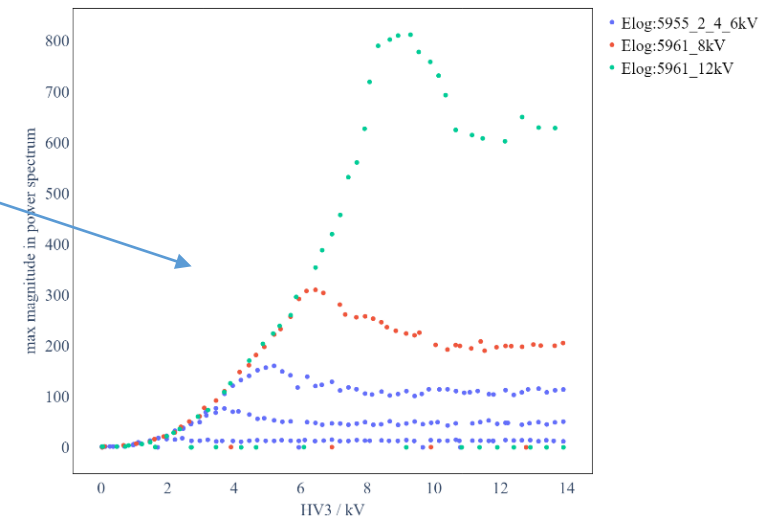


Ca. 0.99 MHz

Max magnitude of frequency in HV3 Scan

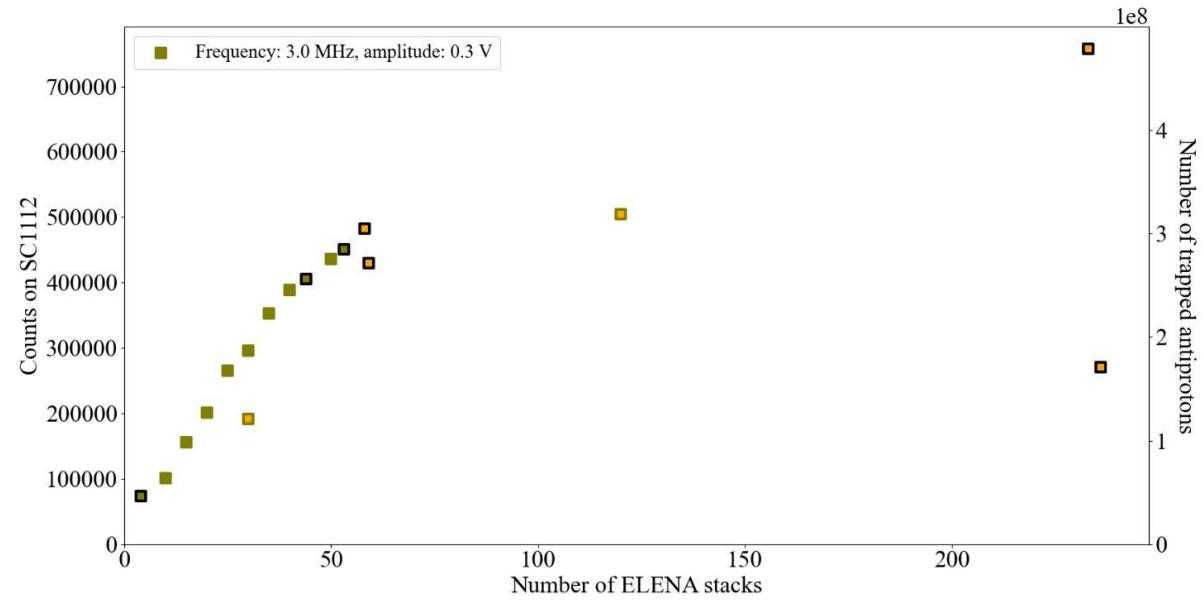


Max magnitude of frequency in HV3 Scan



➡ Do the HVs induce SIS counts???

Accumulation



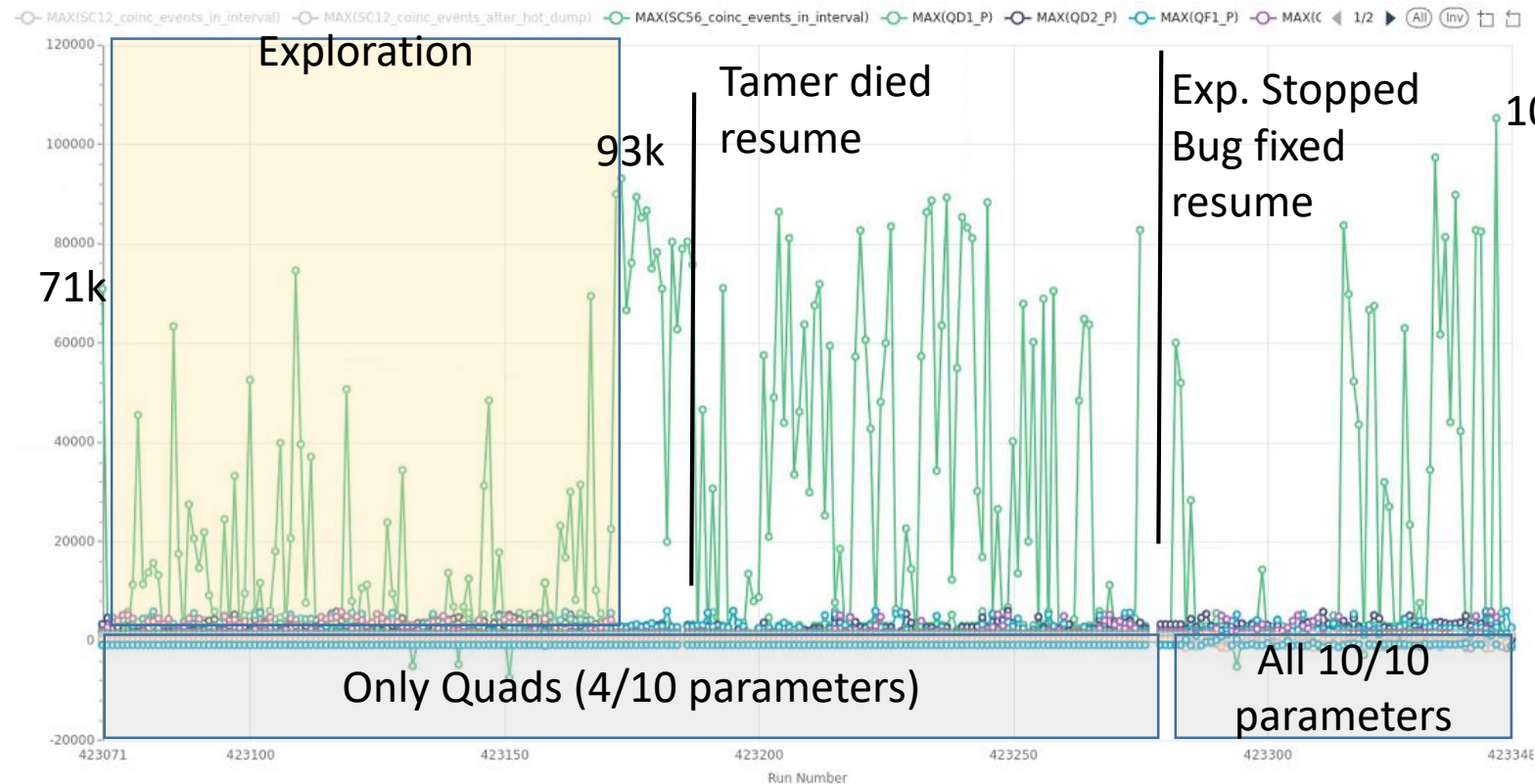
Current Record: 500M pbars → Not yet a billion....

Accumulation

- Developments

- Bayesian Optimizer with training history: counts in CD via SC56

- Pass training history (.csv) before execution
 - Stateless



Accumulation

- Developments
 - Bayesian Optimizer with training history
 - Asynchronous Particle Server
 - Stacking injections from Elena in the 5T using electron cooling and Rotating Wall
 - Monitoring runs
 - Tests:
 - Rotating Wall Frequency and Amplitude
 - Malmberg VS Harmonic Trap
 - Deepen Trap
- Factor 2 to go 😊

