Experience with CLAS12 μRWELL stability

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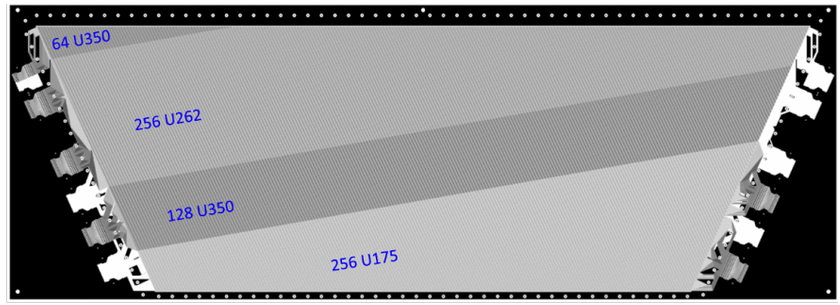
Jefferson Lab

clas

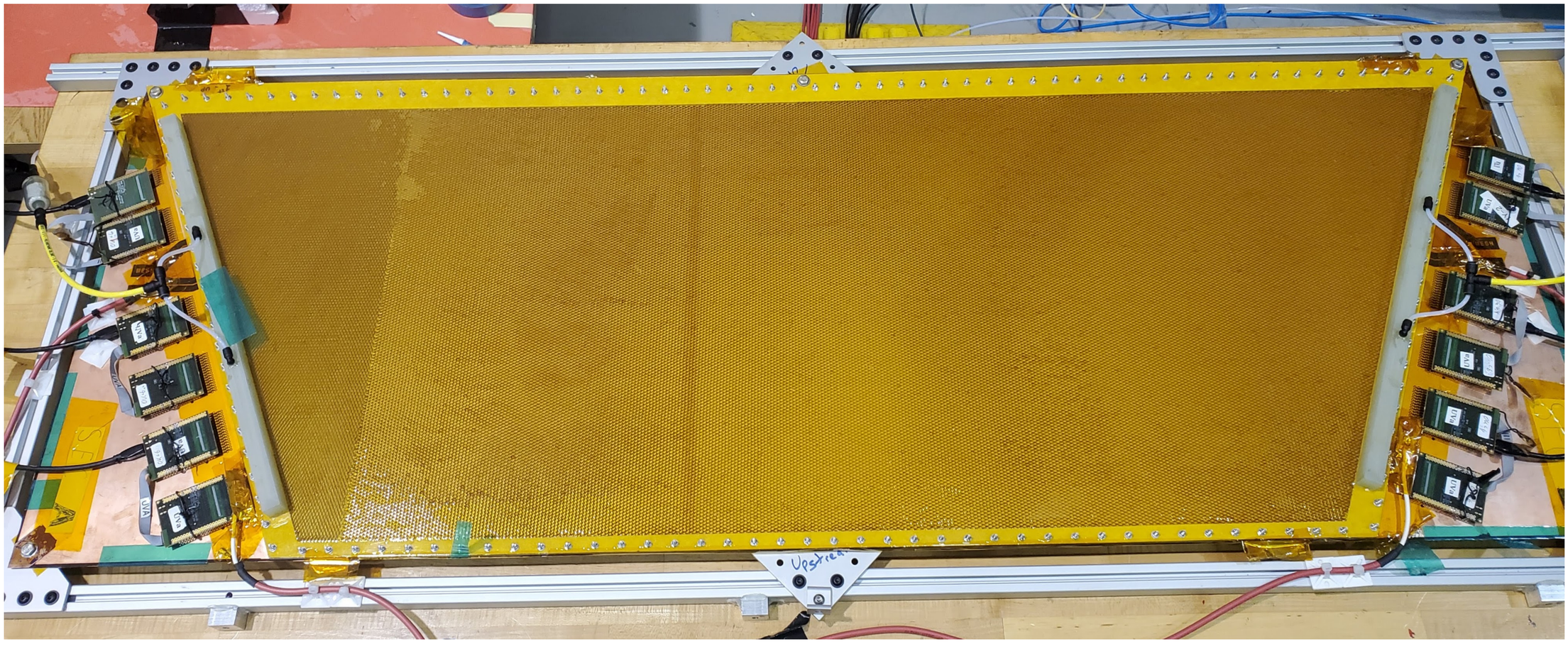
CLAS12 μRWELL Prototype - Overview

- **2D-U/V strip readout with 10 deg stereo angle**
  - **pitch 1mm**
  - **various strip widths (to find optimal combination)**
- **Capacitive sharing**
- **Electronics APV25 and SRS**

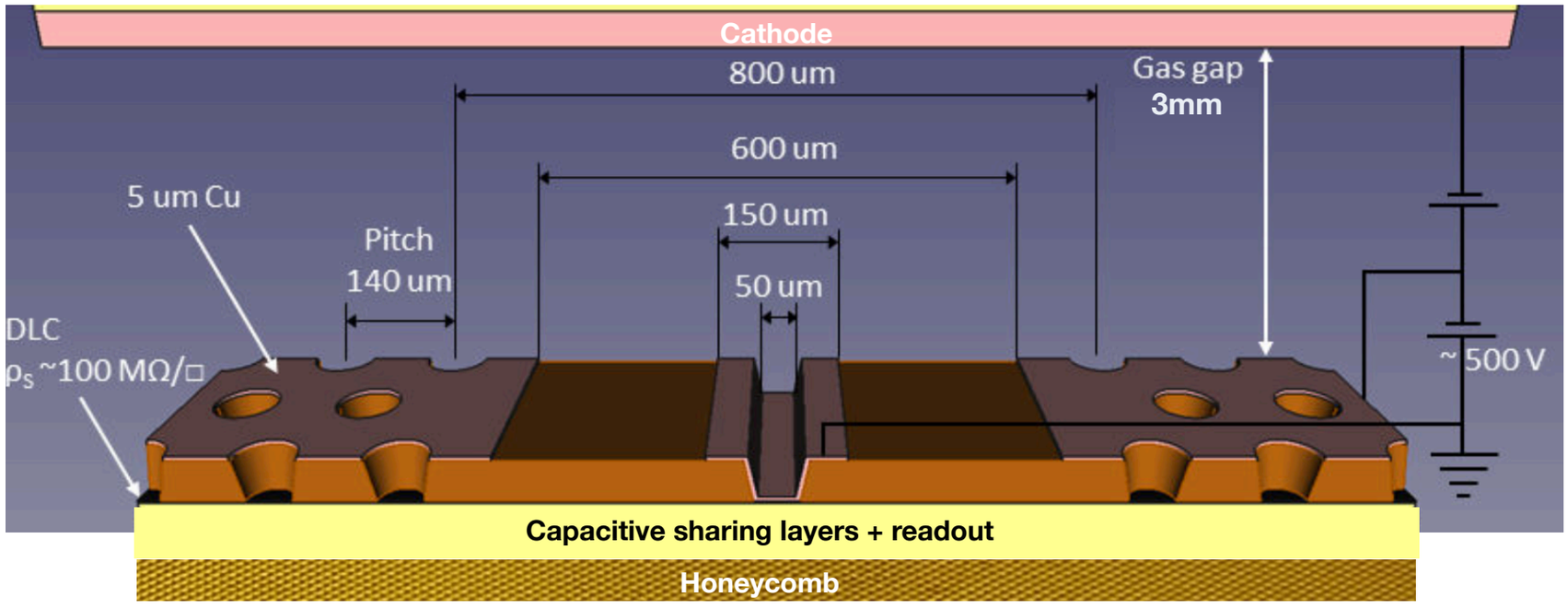


146cm

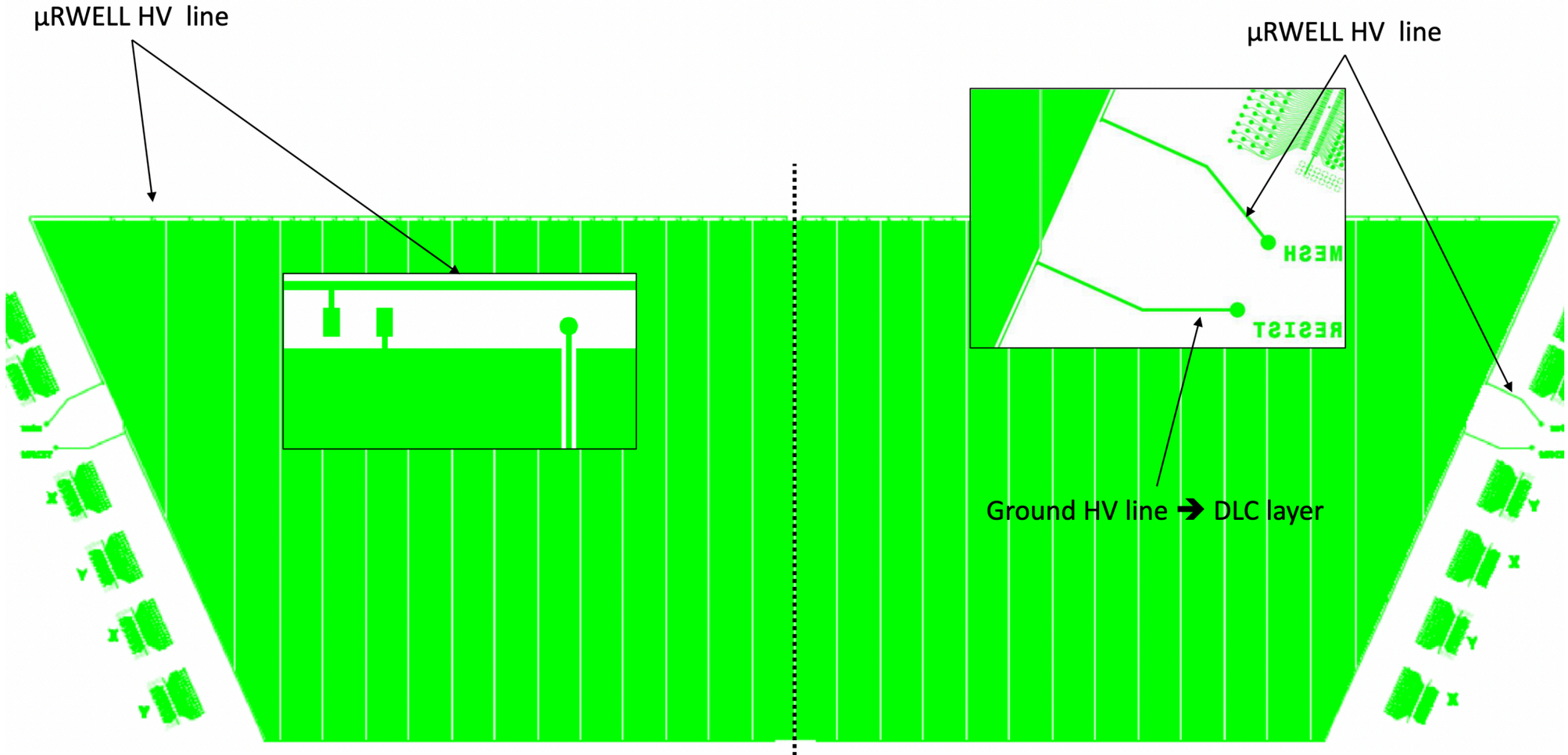
50cm



CLAS12 Prototype - Detector Structures



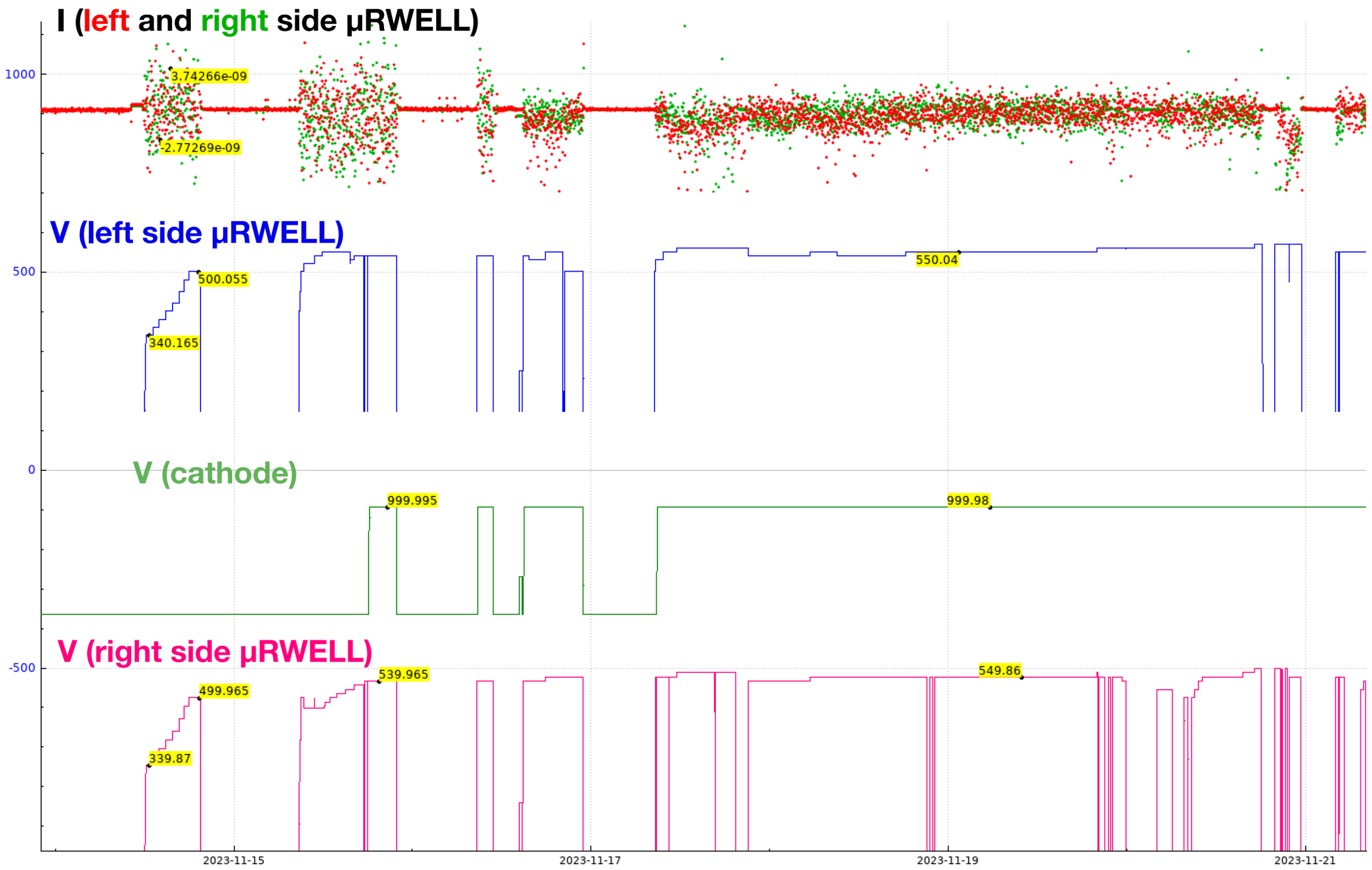
Cross section of prototype



µRWELL foil HV lines

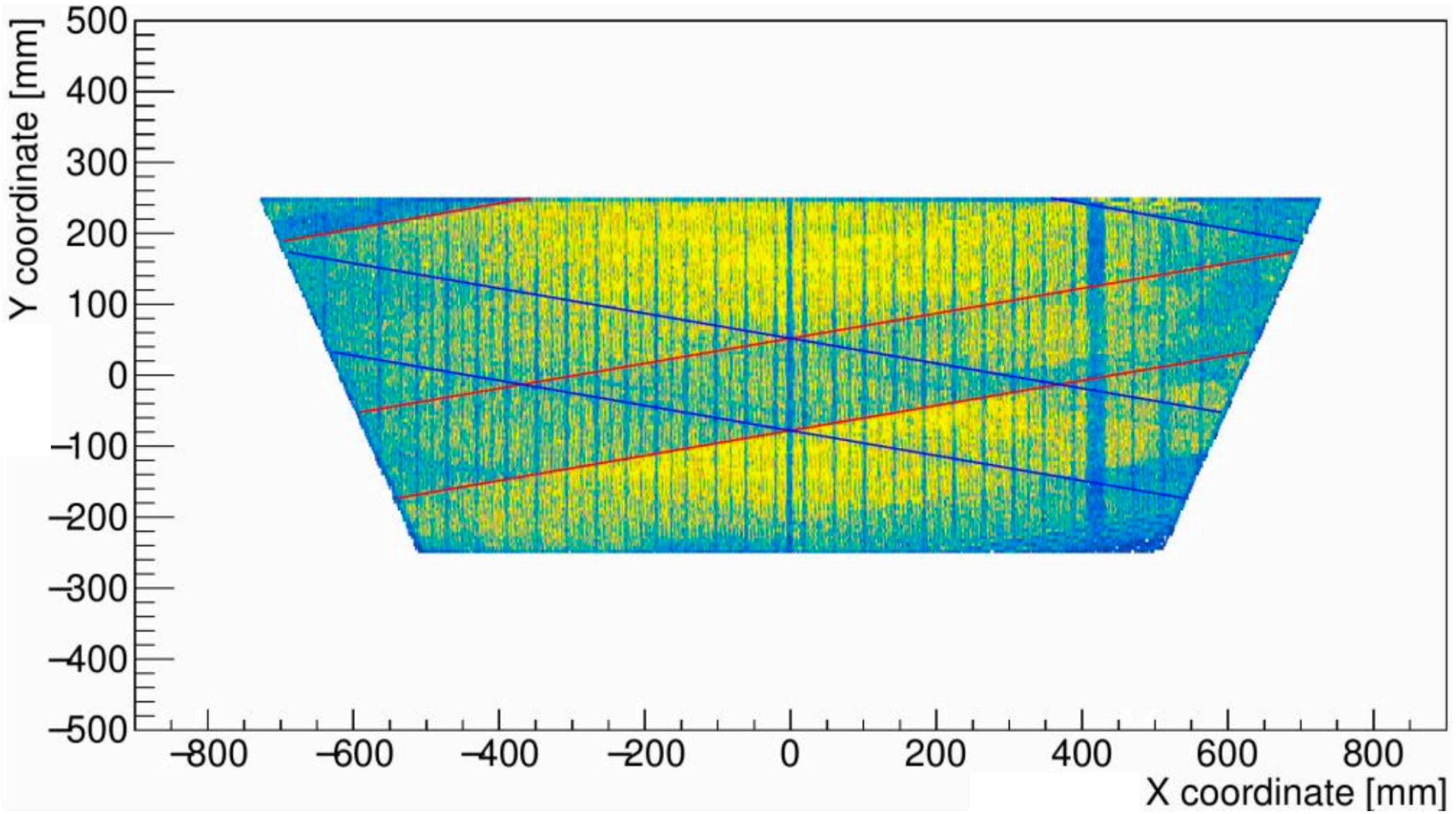
Split in two separate halfs

HV Test with Ar:CO_2 (80:20) and cosmic



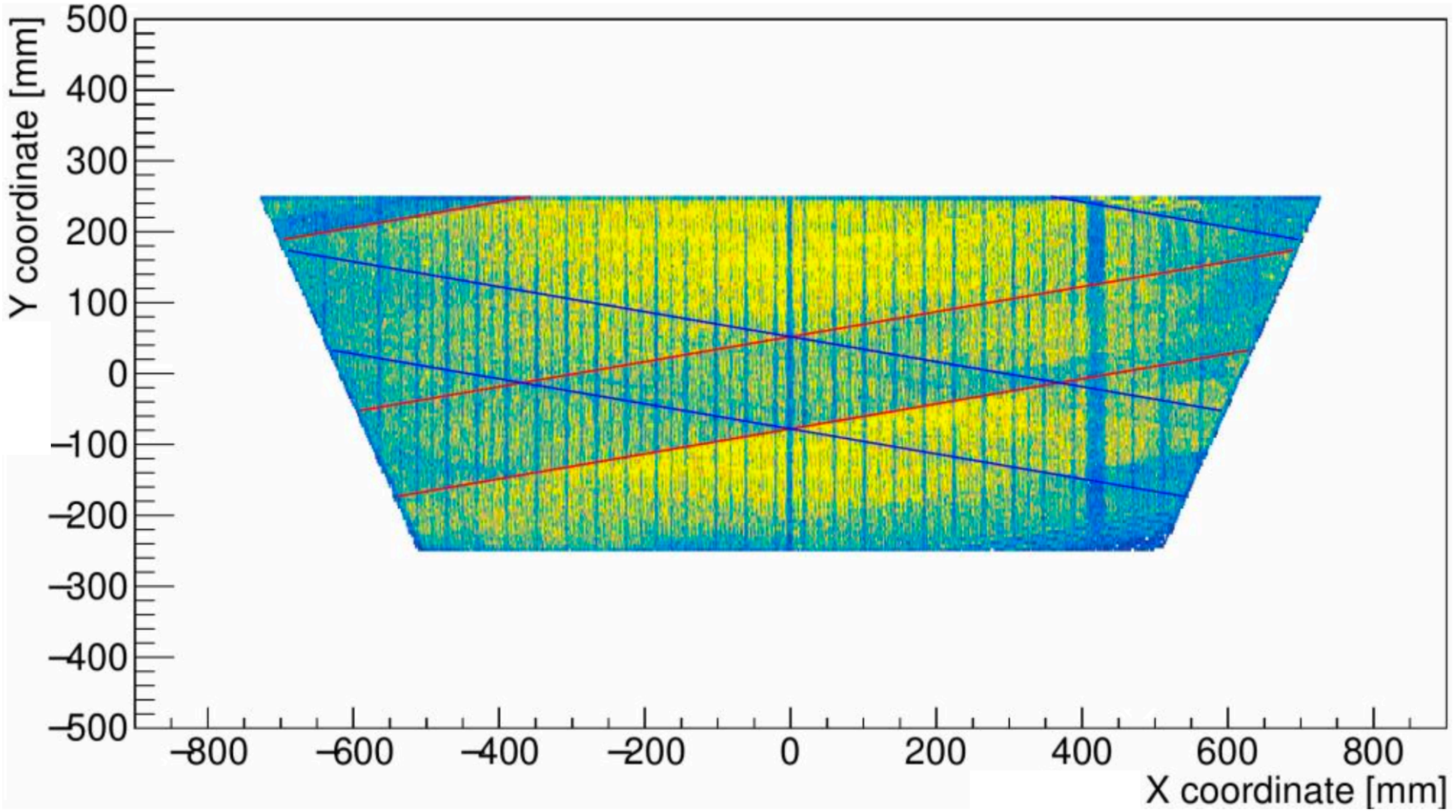
- **stable operation**
- **leakage currents <2-3nA up to 550V on µRWELL and 1kV on cathode**

2D Hit Distribution - Detector works!



- **μRWELL at 570V, cathode at 1020V, Ar:CO_2 (80:20)**
- **Substructure from strips, HV segmentation and APVs visible**

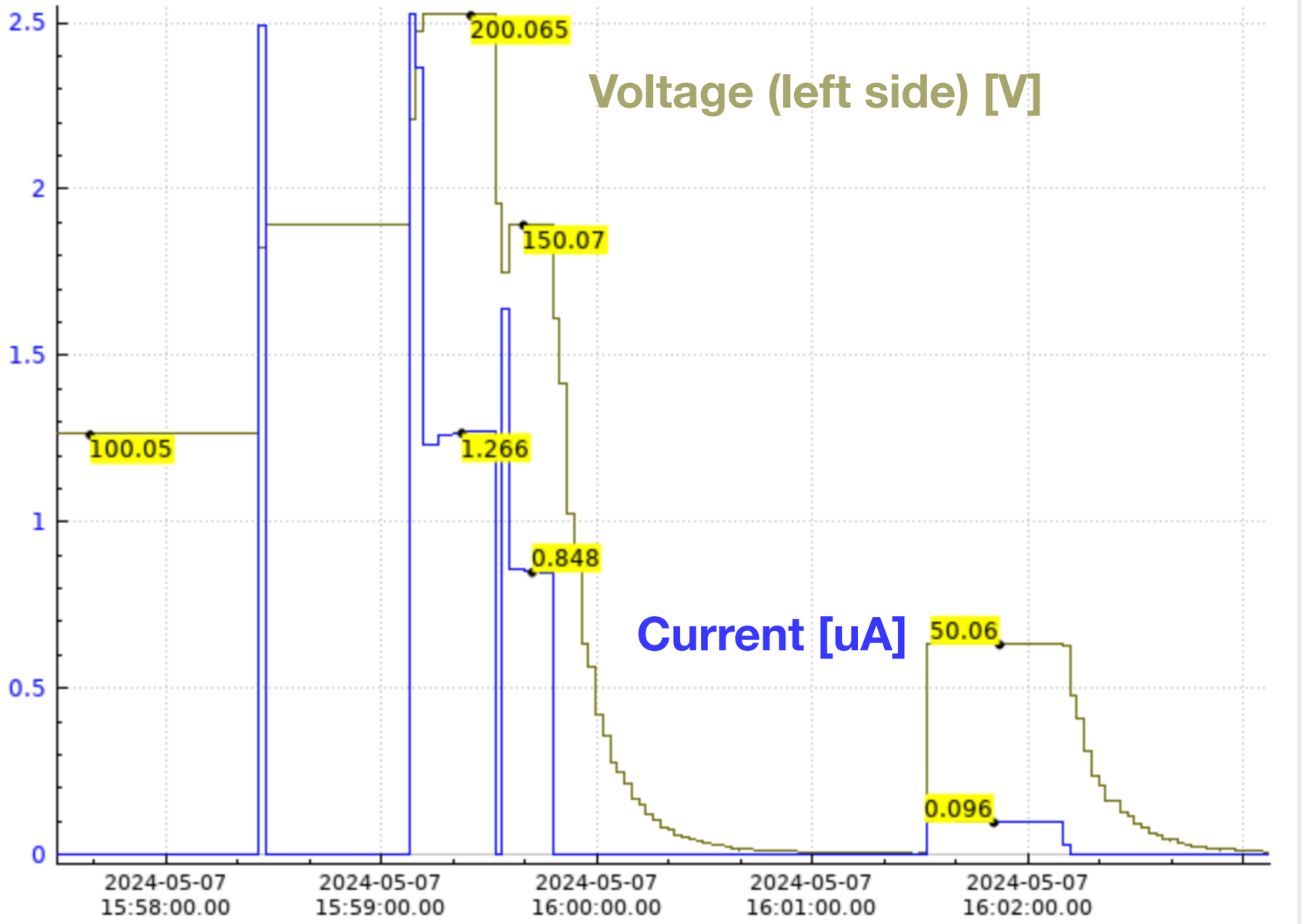
2D Hit Distribution - Detector works!



- **μRWELL at 570V, cathode at 1020V, Ar:CO_2 (80:20)**
- **Substructure from strips, HV segmentation and APVs visible**

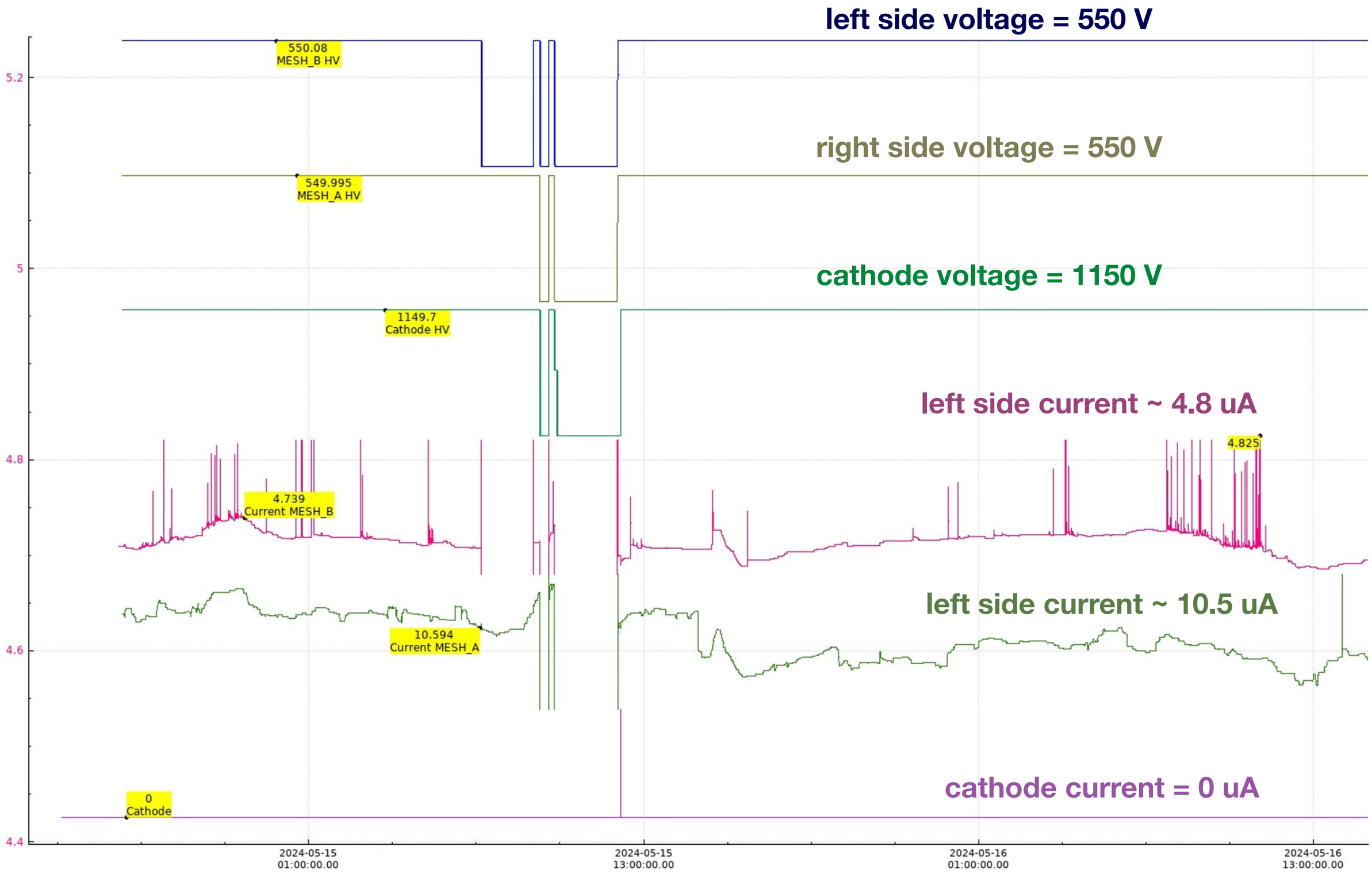
But: Issues with cathode and connections required us to replace cathode —> done in cleanroom at UVA together with Nilanga Liyanage's group

Leakage seen after Cathode Replacement

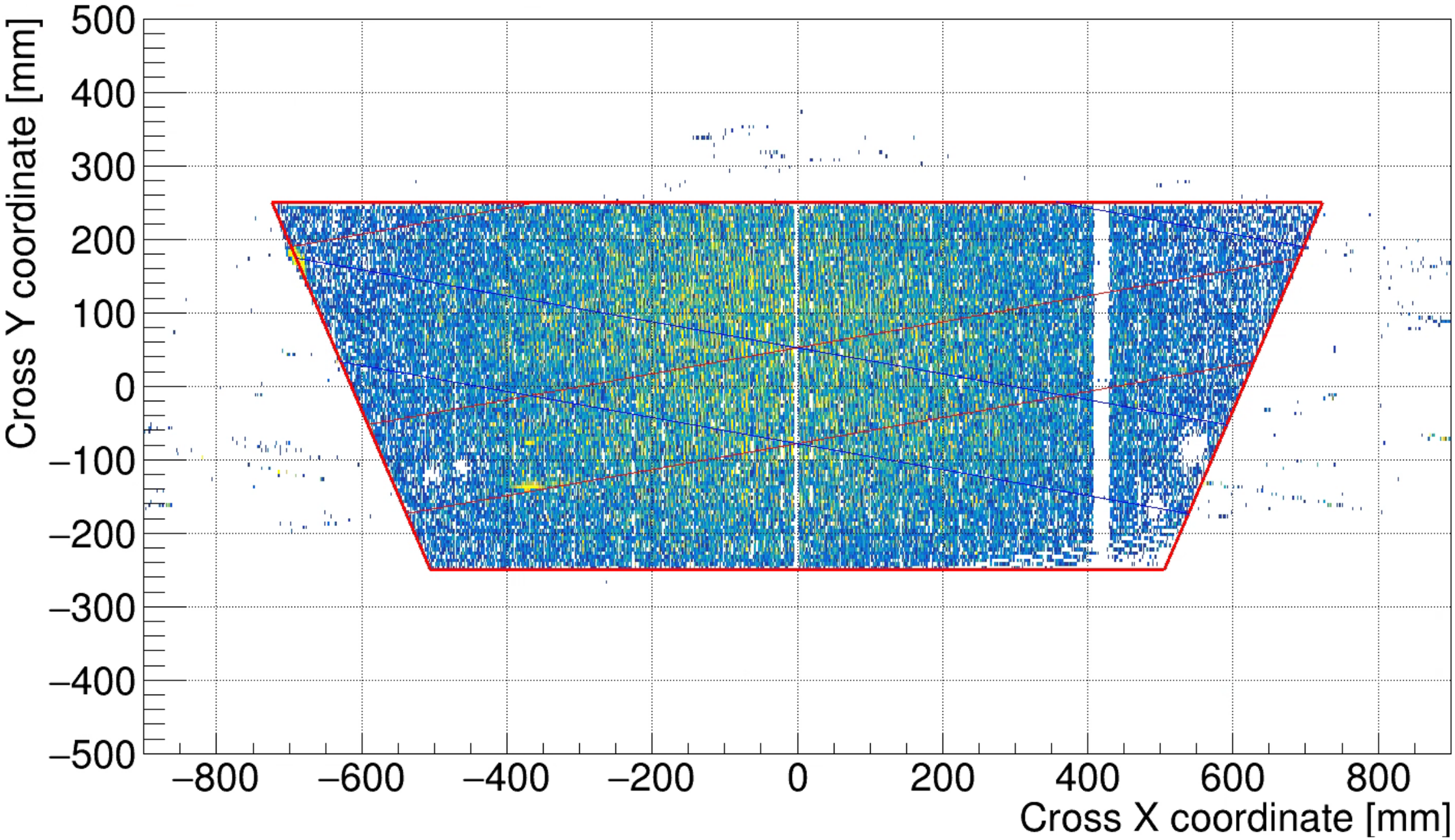


- **CO_2 gas**
- **Leakage current proportional to voltage up to 600V**
- **both sides have leakage**
- **decided to keep running with leakage and take data since current just increases linearly with voltage**

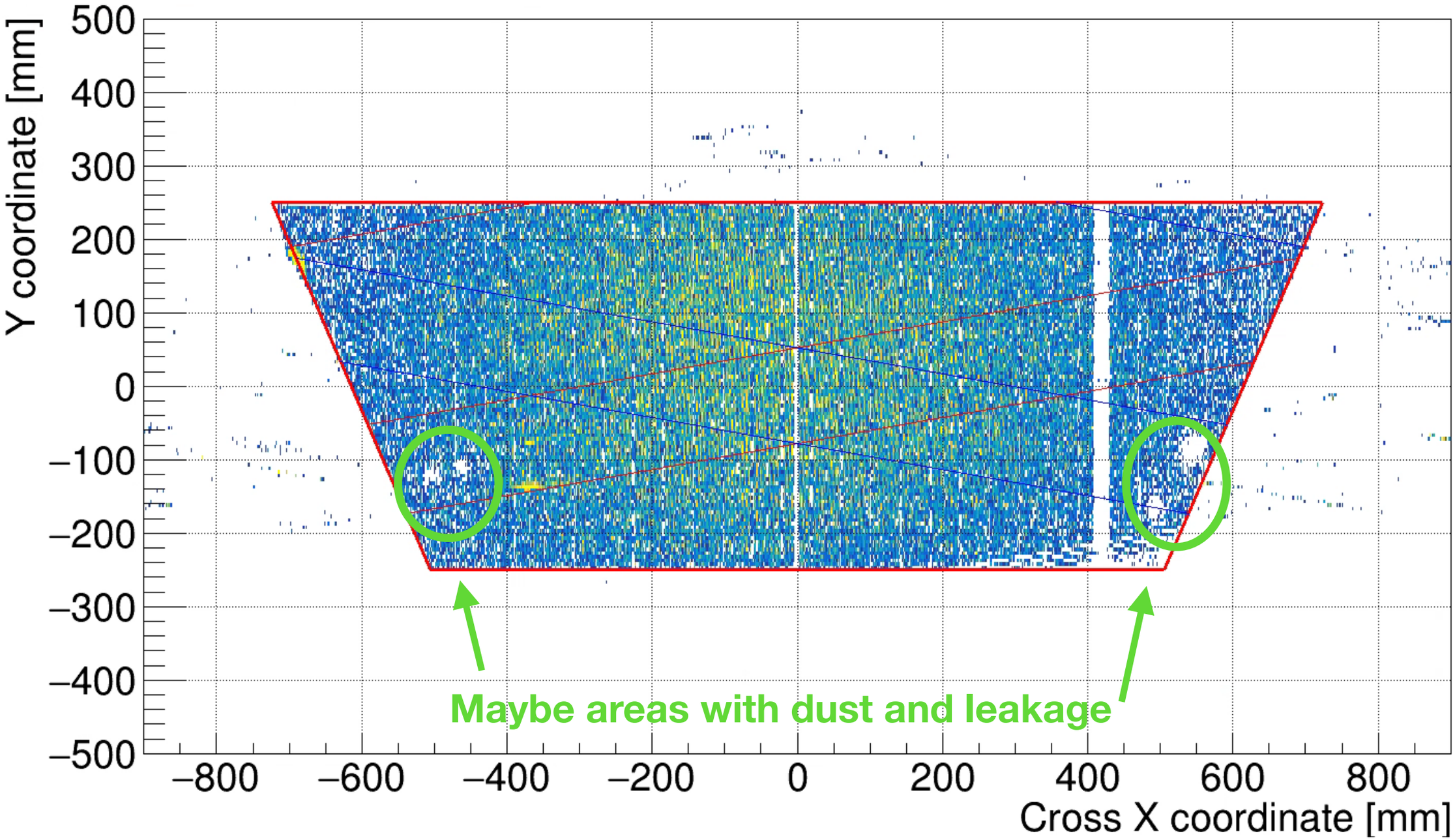
Currents and Voltages with Ar:CO_2 (80:20)



Still good data under these conditions



Still good data under these conditions



Conclusions / Personal Take

- **Large risk of bringing dust or other particles on the μRWELL or the drift region when it is open. We were very careful and had the expertise of GEM experts at UVA when we replaced cathode. Detector was opened for a very short time.**

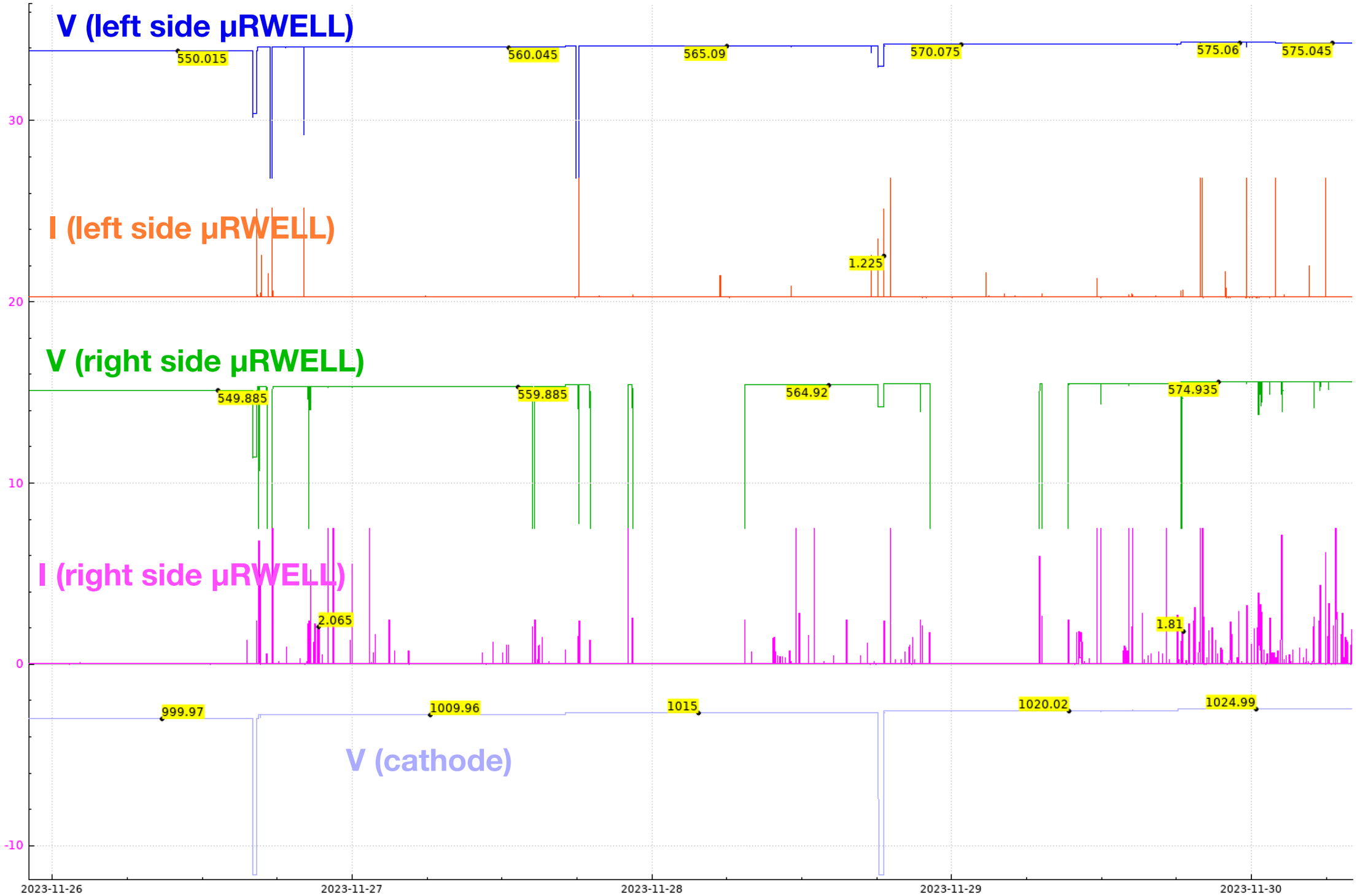
- **Nevertheless, our μRWELL prototype runs so far quite stable even with high leakage from dust or other particles and we could get data.**

- **For the serial production of μRWELL for CLAS12, we prefer to glue the detector and build extra spares.**

- **Note: We can not remove individual HV sectors from the support without opening the detector fully because the connection is under the frame —> better to put these outside the frame so access is possible in case leakage occurs**

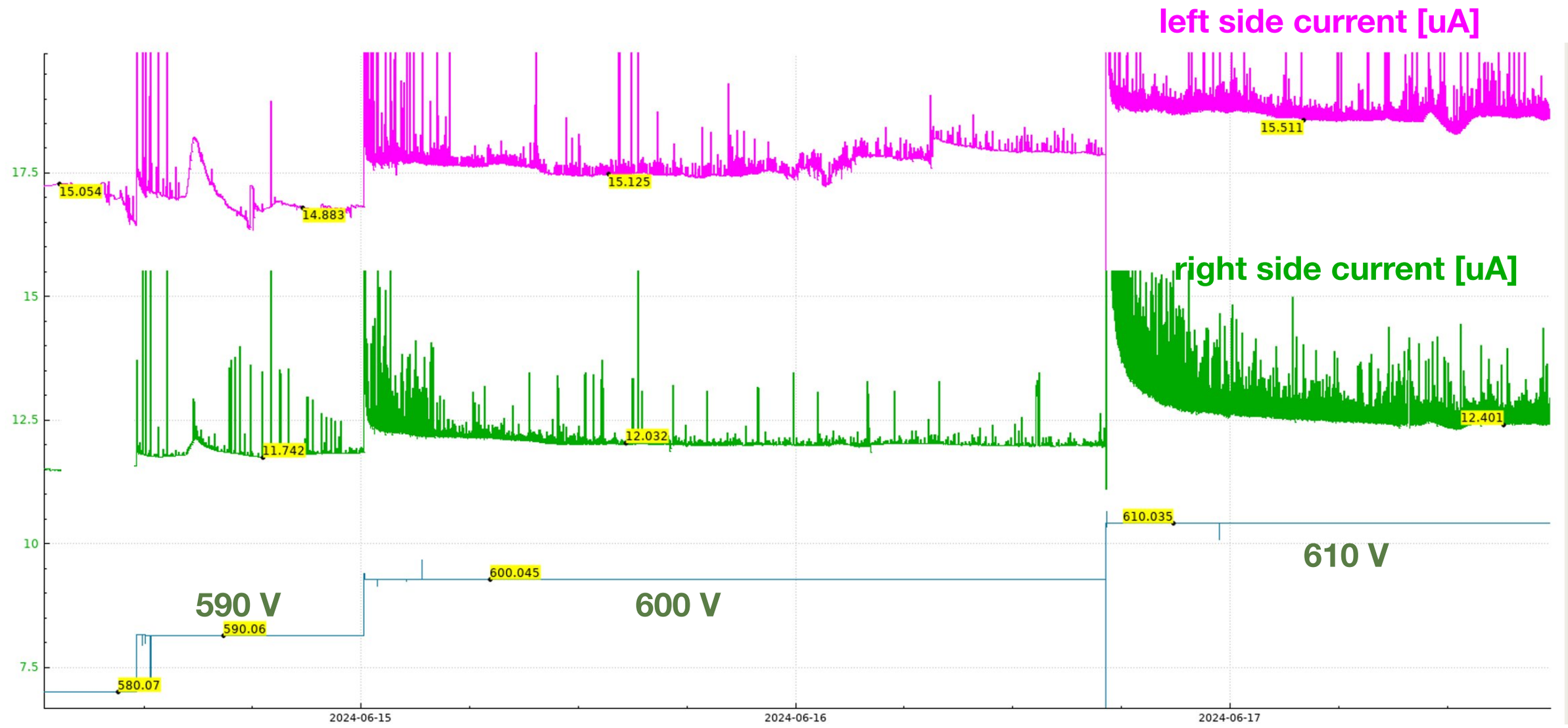
Backup

HV Test with Ar:CO_2 (80:20) before Cathode change



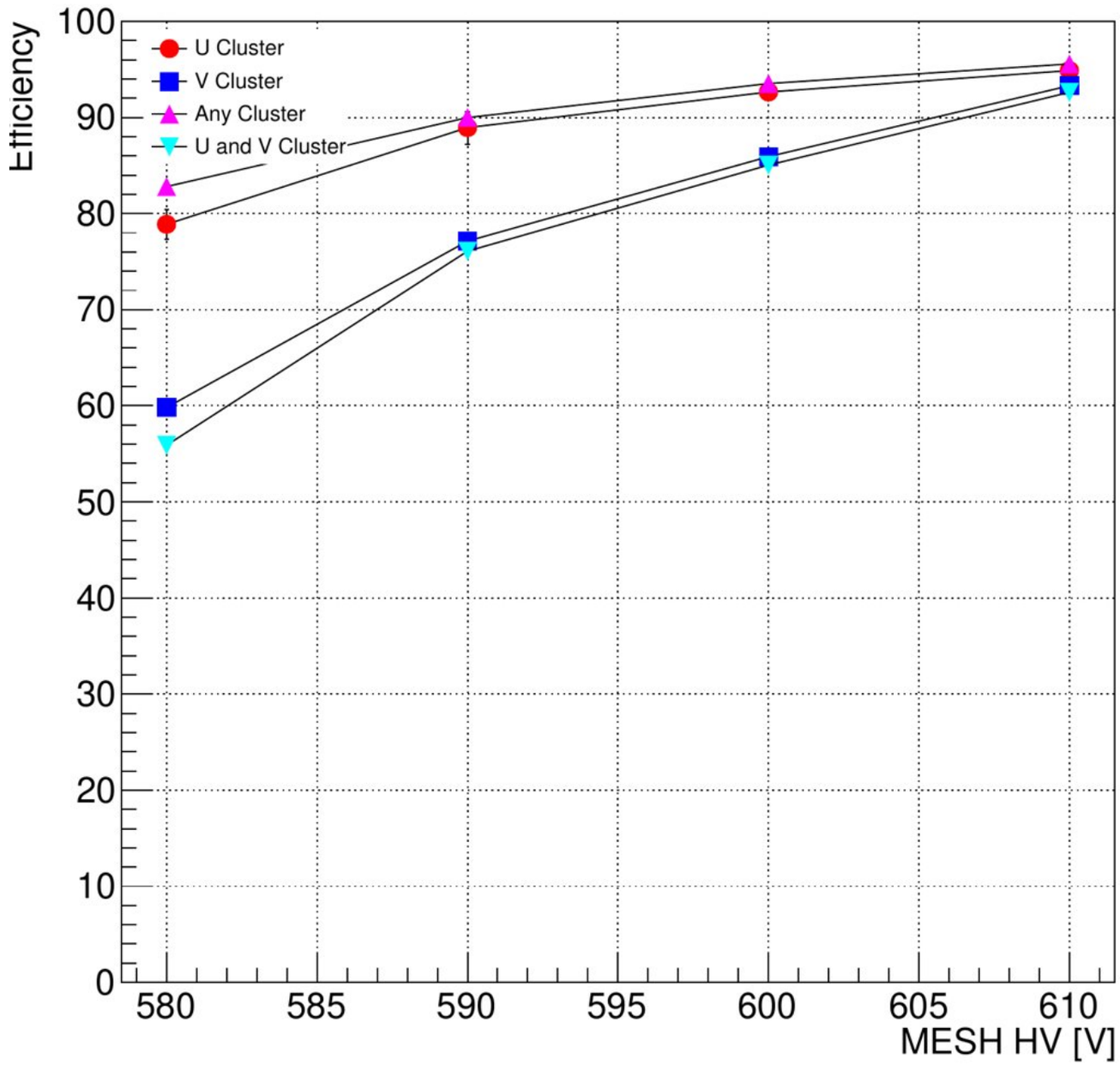
- **stable operation when slowly going up to 575V on µRWELL**
- **more activity for right side then left side**

HV Currents and Voltages with Ar:CO_2 (80:20)



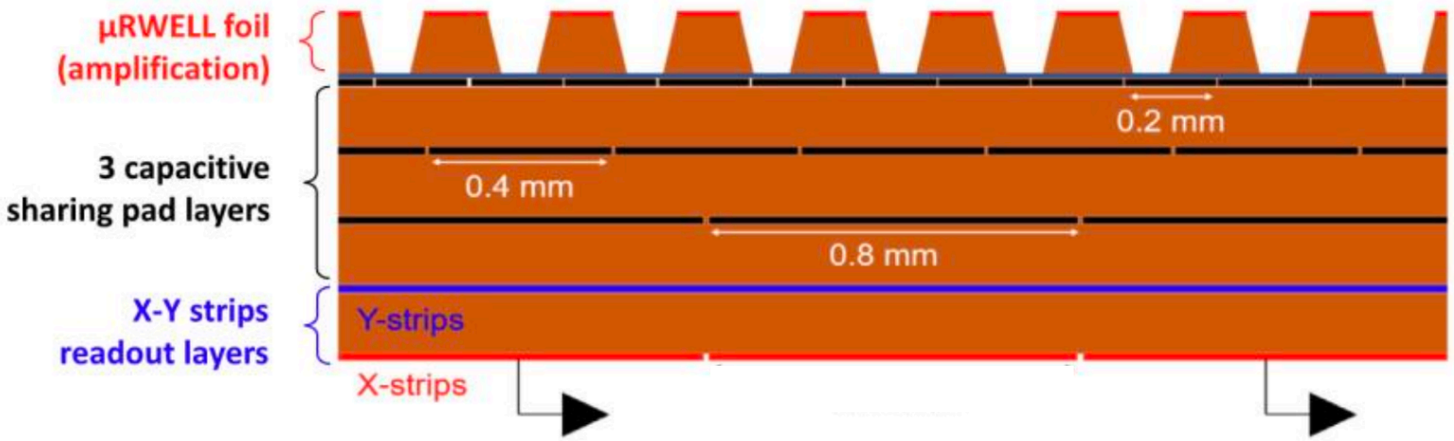
- **More spikes at higher HV as expected**
- **Current baseline still linear to voltage**
- **Above 600V unstable currents but we could still take data**

Efficiency after Cathode Replacement with $Ar:CO_2$ (80:20)



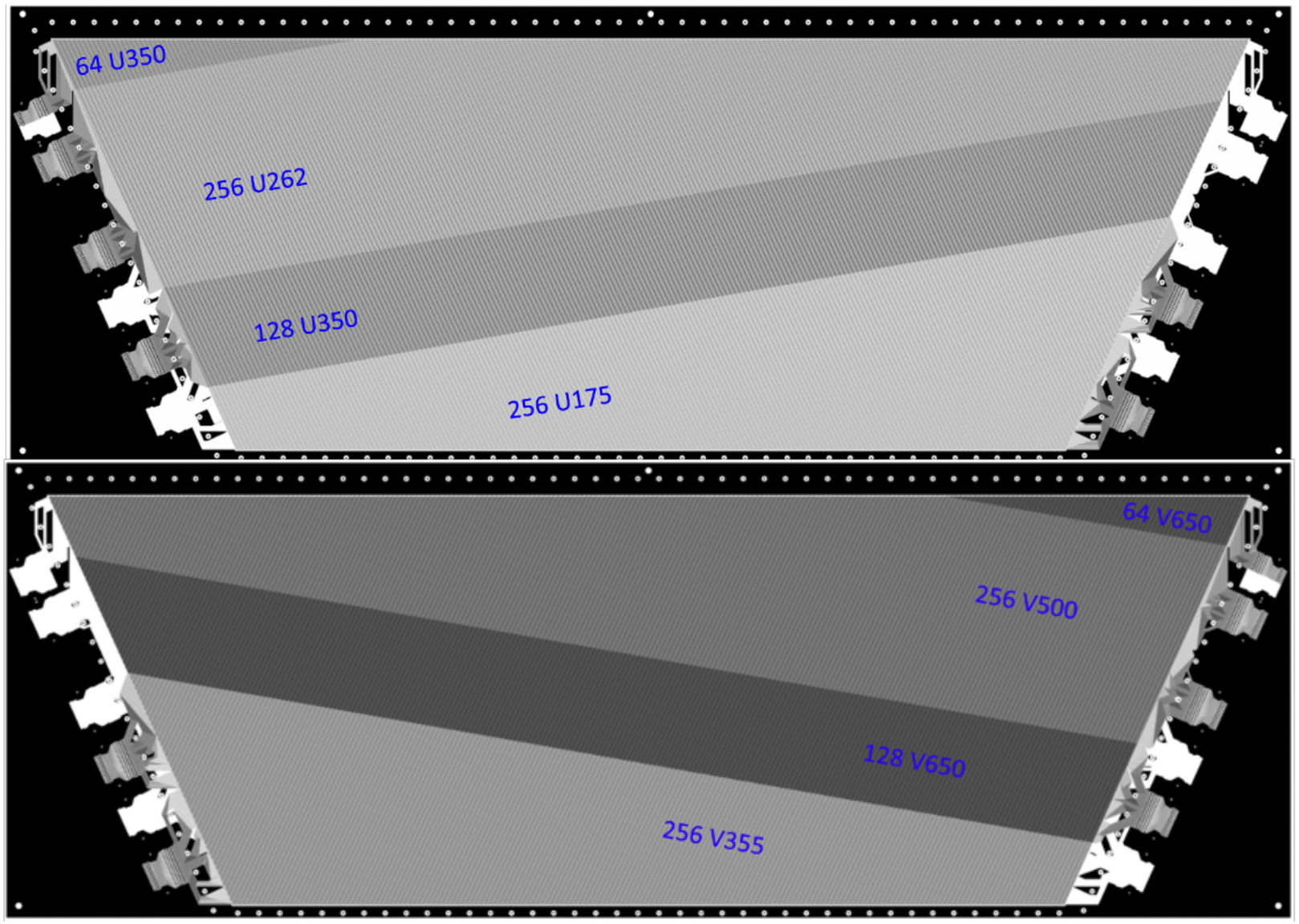
Reaching plateau and similar efficiency for U and V but HV is very high and current unstable

CLAS12 Prototype - Readout Structures



Capacitive sharing

K. Gnanvo, NIM A1047, 167782 (2023)



Readout Structures

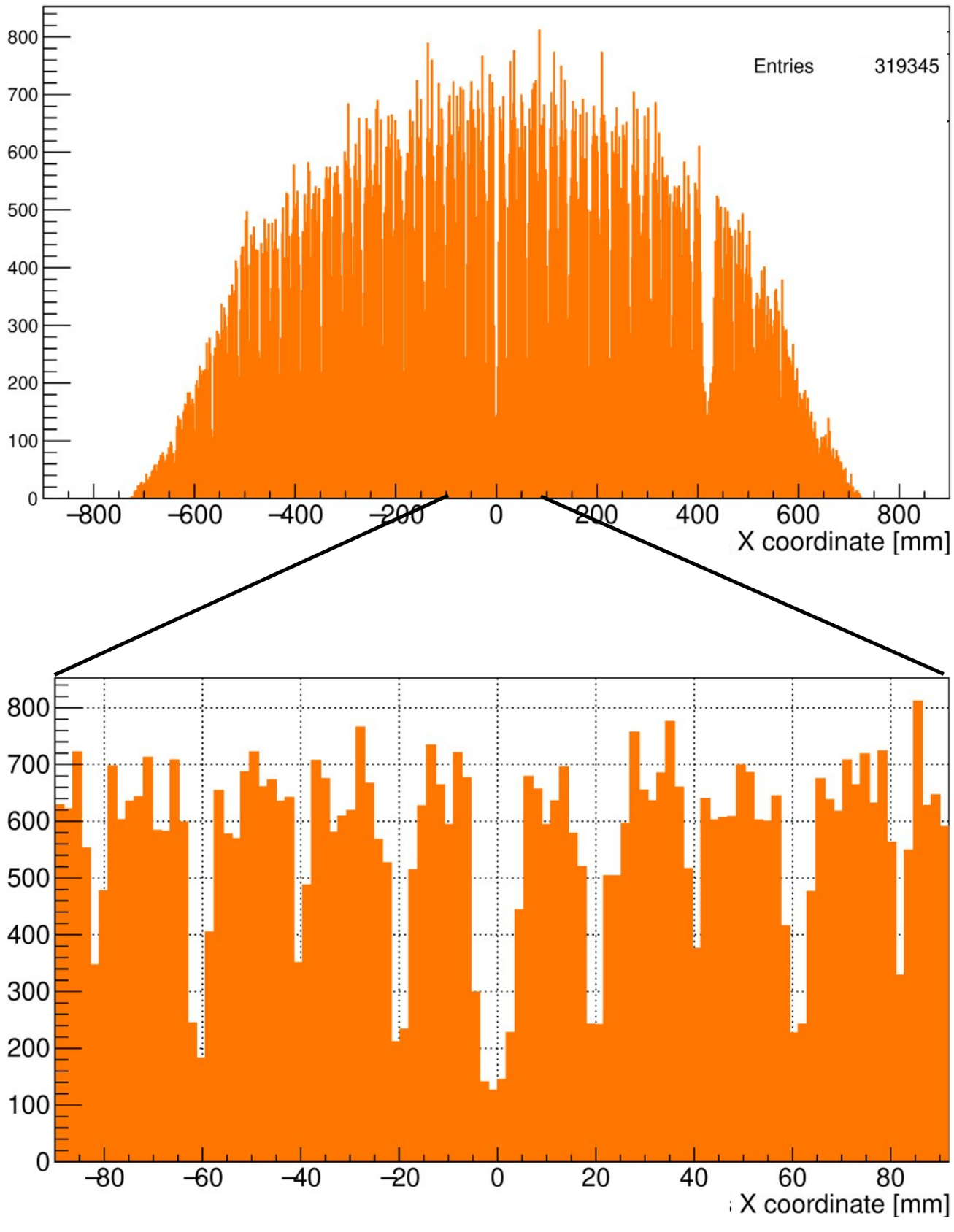
U-strips widths:

- **350μm**
- **262μm**
- **175μm**

V-strips widths:

- **335μm**
- **500μm**
- **650μm**

1D X-Distribution - HV sections visible!



- **Dip structure from gaps in foil between HV sections**
- **Width of gaps follow drawings**