

Progress on Cylindrical μ RWELL Prototypes

Detector R&D Day Meeting

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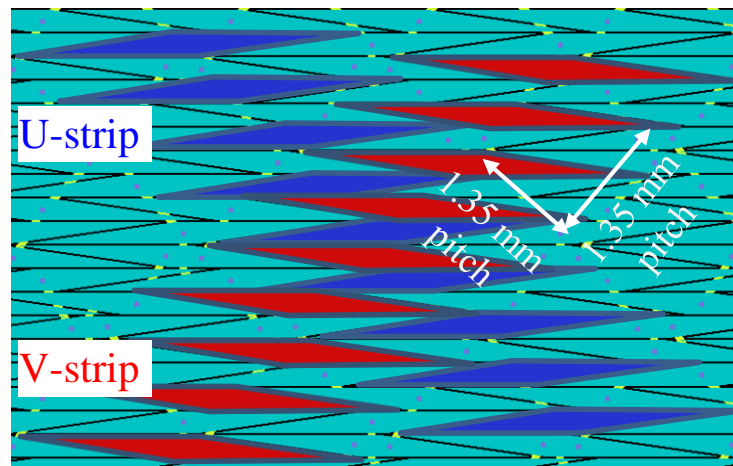
on behalf of eRD108 Consortium

March 25, 2024

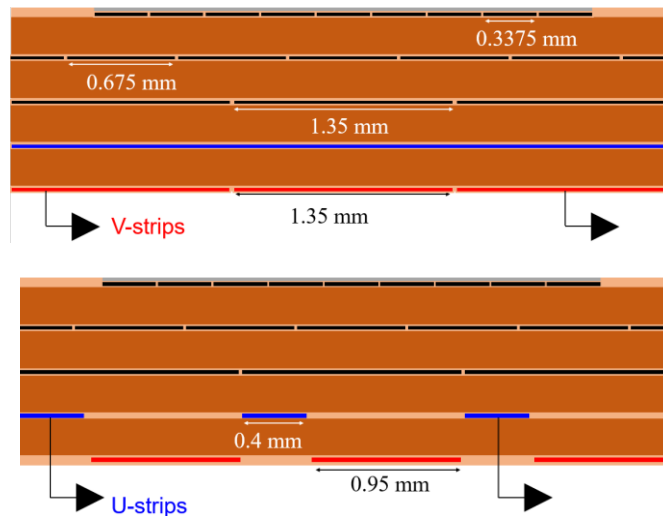
Motivation & Design features

- ❖ Prototype consists of 2 half-cylinder chambers with different readout structures
- ❖ **2D capaSh proto:** μ RWELL/readout foil with U-V capacitive-sharing readout
- ❖ **2D zigzag proto:** μ RWELL/readout foil with U-V "zigzag" readout structure
- ❖ Goal is to study the performance of the two readout options for cylindrical μ RWELL
- ❖ Design of mechanical structure completed with a set of 3 of frames per chamber

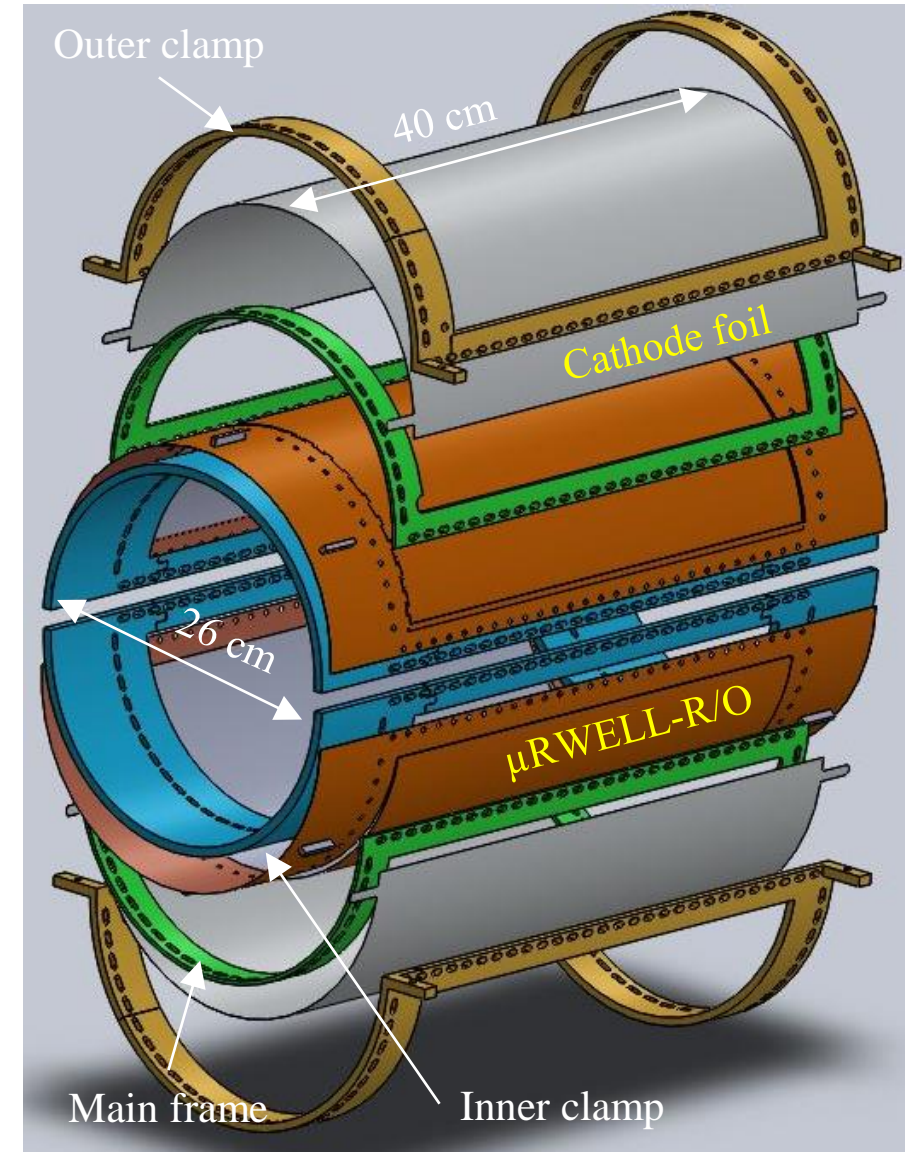
U-V zigzag readout concept (BNL)



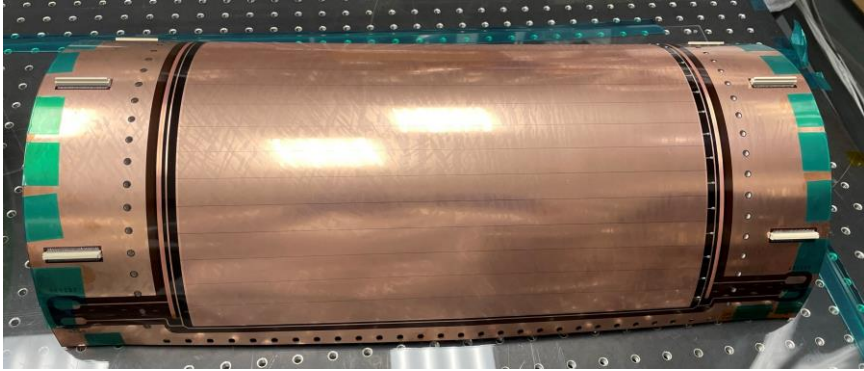
U-V capacitive-sharing readout (JLab)



Exploded 3D view

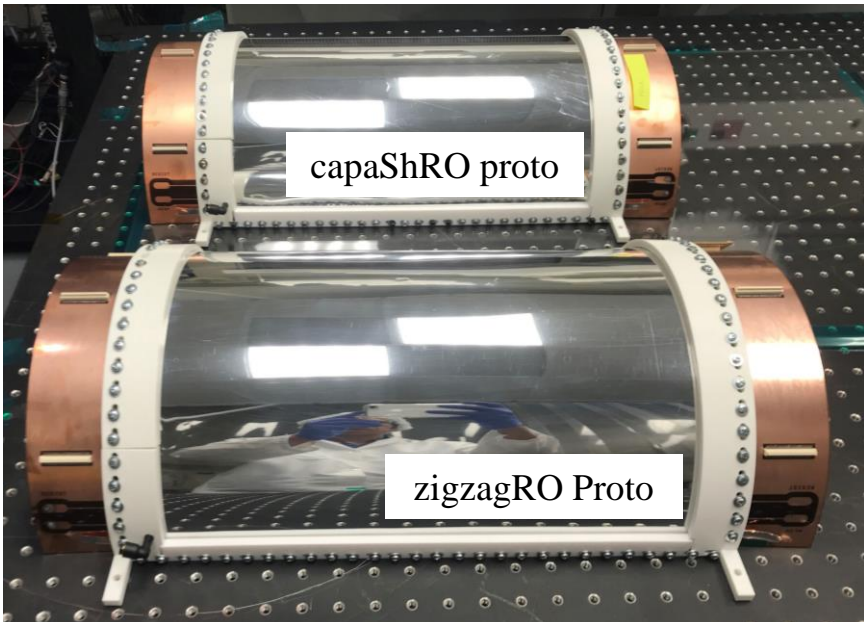


Curved μ RWELL /RO composite PCB



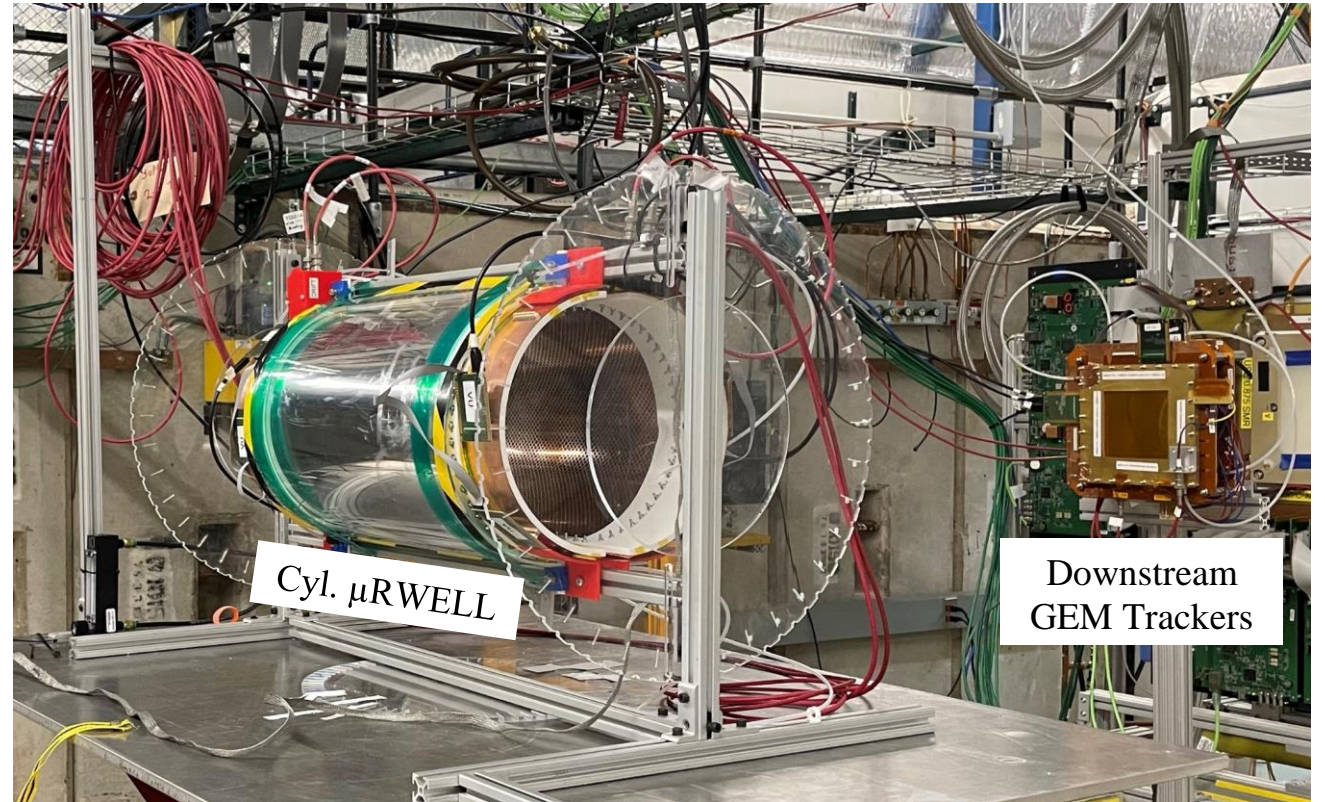
BNL & JLab: Design of μ RWELL+ RO composites

Two half cyl. μ RWELL prototypes



Florida Tech: Mechanical structure and detector assembly

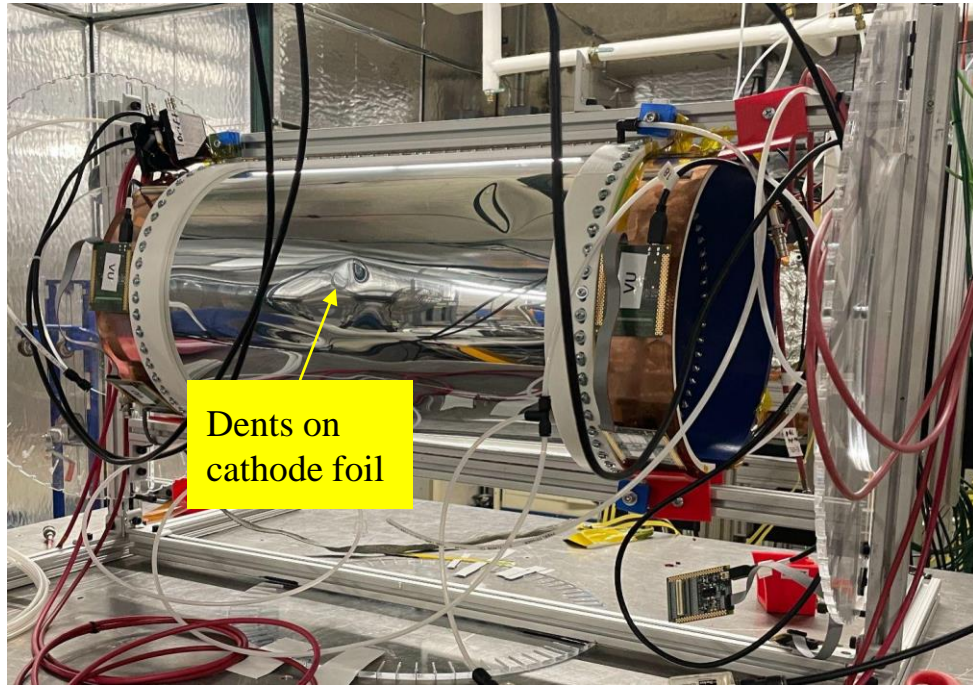
Cyl. μ RWELL prototype at Fermilab test beam setup, June 2023



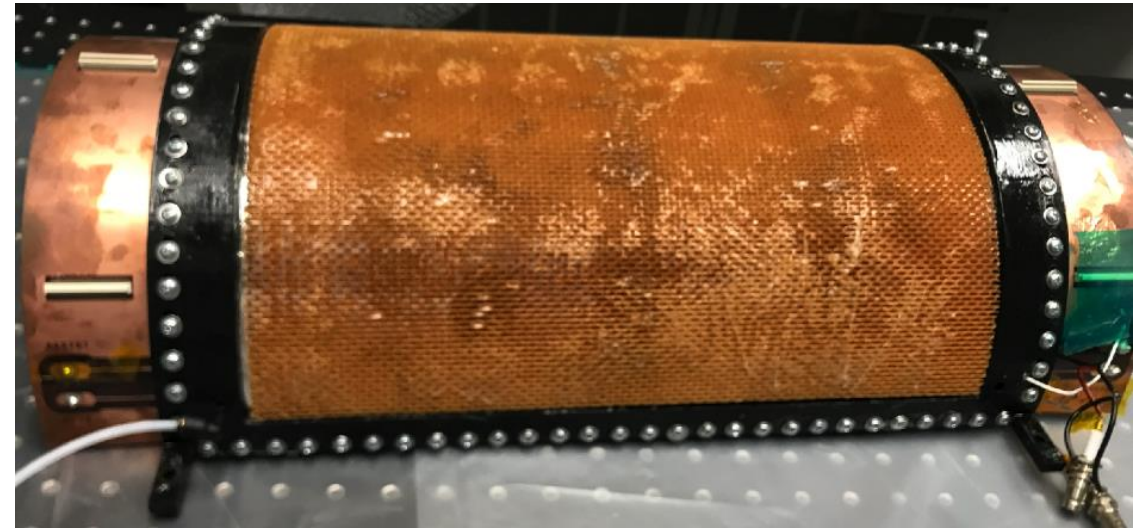
We were unable to operate and take data at the Fermilab 2023 test beam

- ❖ Fermilab shut down that week for safety concerns at the lab
- ❖ Dents appeared on the Al cathode when HV is applied → HV instabilities
- ❖ 2024: Fix the dents issues and test the prototype at in Hall D JLab in Fall 2024

Initial prototype with Al-mylar foil drift cathode



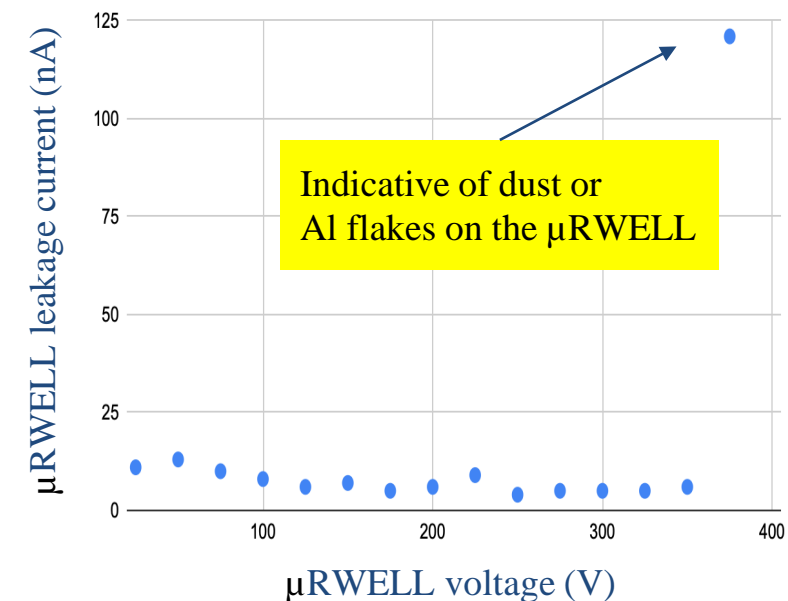
New drift cathode reinforced with honeycomb structure



HV and gas leakage tests

- ❖ Gas pressure drops from 20 mbar to 10 mbar in two min.
- ❖ μ RWELL: small leakage current up to 350V
- ❖ above 350V, sudden current increase observed

μ RWELL @initial reading



- ❖ On the original prototype, the cathode foil shows some dents during operation at Fermilab test beam
- ❖ HV stability issues \rightarrow Detector could not hold HV
- ❖ Decide to reinforce the cathode by gluing the Al-Mylar foil on a honeycomb structure
- ❖ Cathode could sustain up to 1 kV after reinforcement

- ❖ Open half cyl. detector and clean μ RWELL foil (tacky roller)
- ❖ Replace Al-Mylar by Cu-Kapton drift cathode
- ❖ Assemble second detector half cylinder
- ❖ Implement a larger O-ring to improve gas tightness (right)
- ❖ Assemble second detector half cylinder
- ❖ (Re)-assemble both half cyl. prototypes and perform cosmic test at FIT
(possibly at JLab)
- ❖ Conduct an opportunistic beam test at in Hall D JLAB (Fall 2024 run)

Frame with larger O-ring

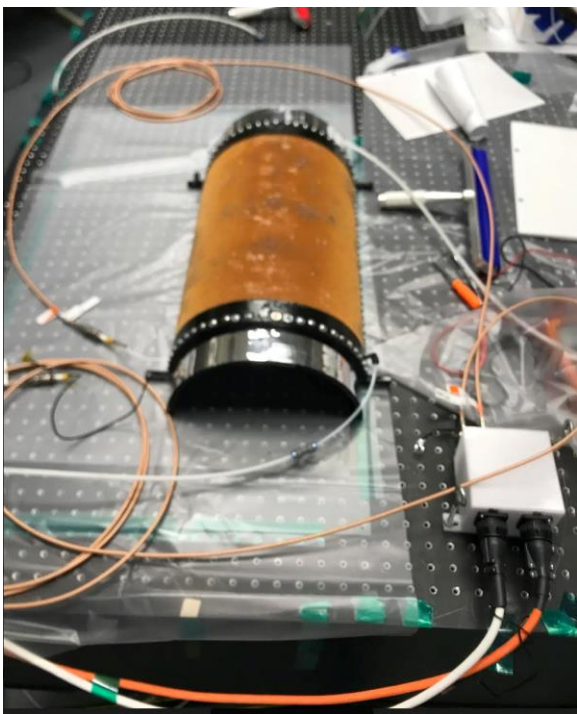


Back up

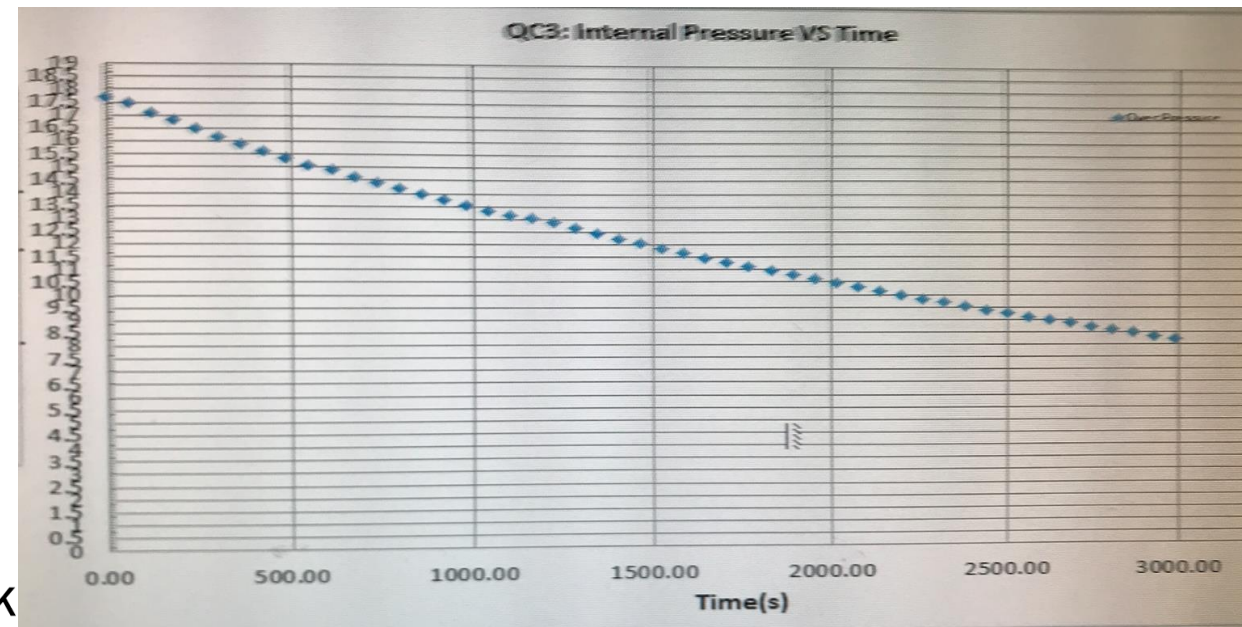
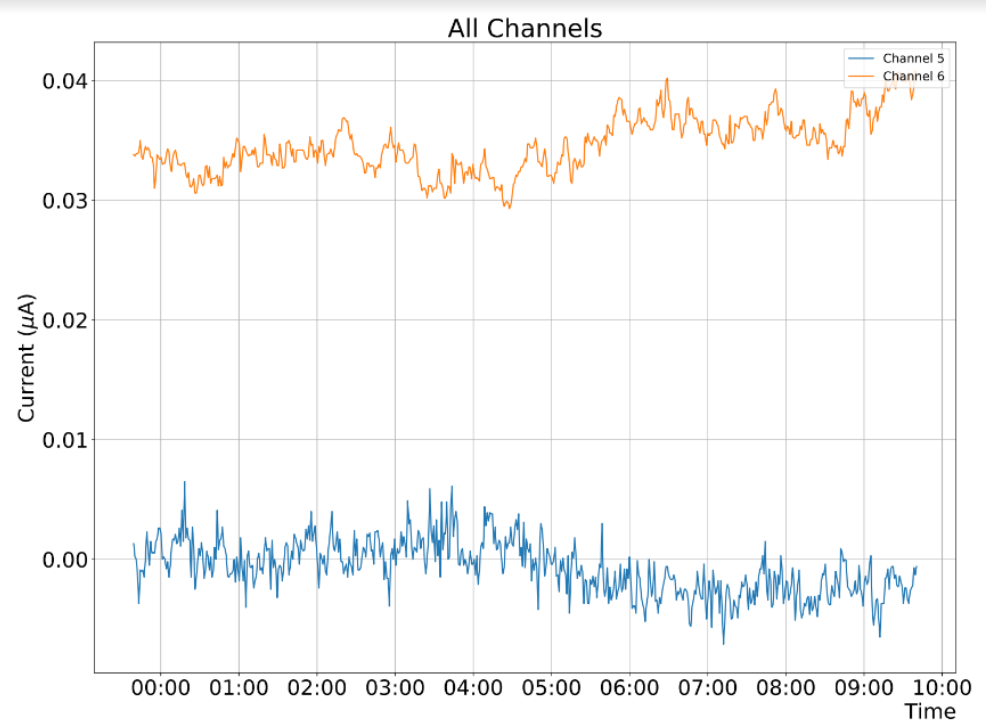
Jefferson Lab Gas Testing & HV continued

Bench Top testing of with high voltage and gas pressure was successfully conducted.

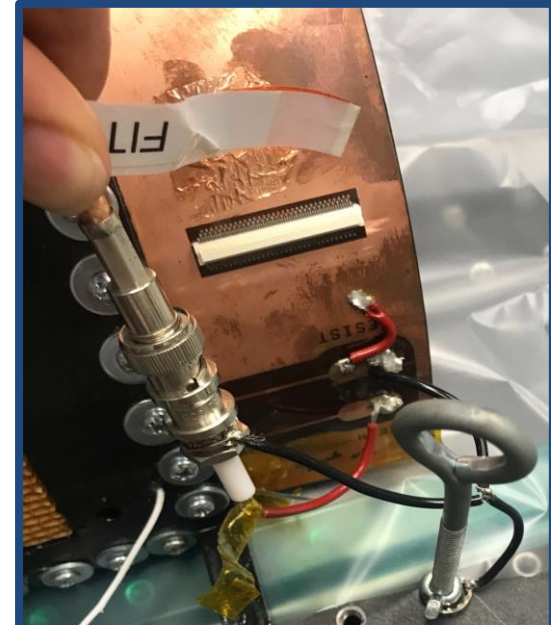
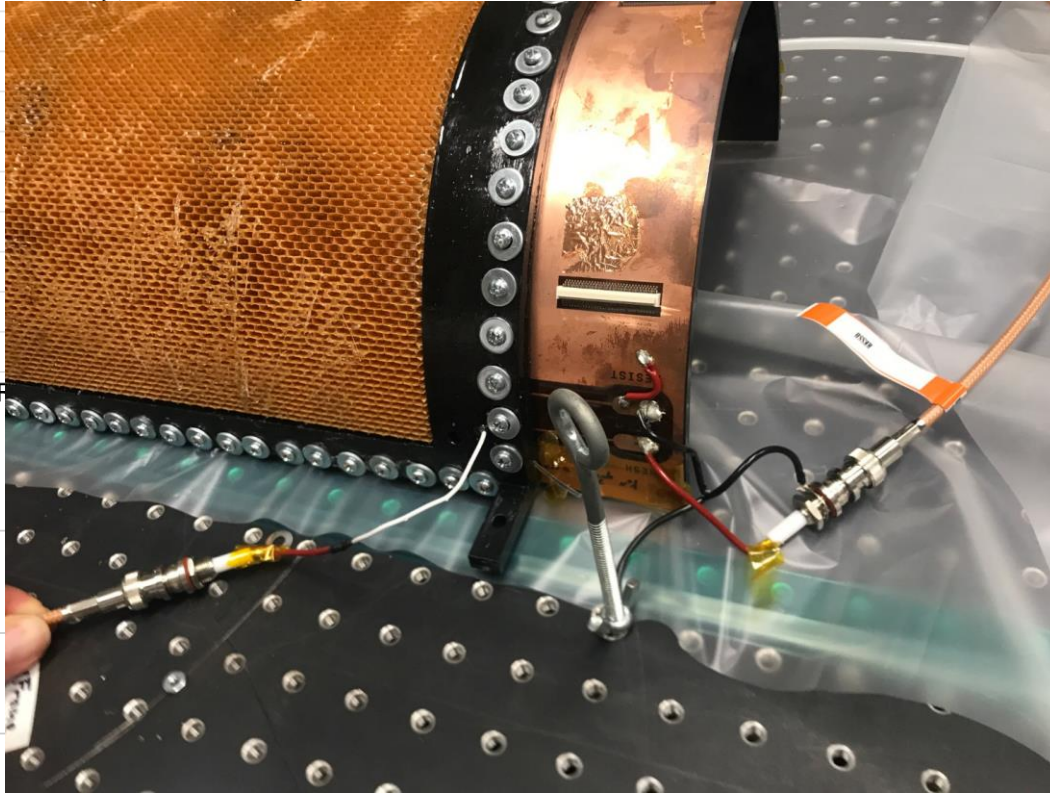
-The first trial included a 300 μm mockup foil instead of the μRWELL foil and the structure successfully held gas pressure with a measured drop from 20 to 10 mbar overpressure in 60 minutes.



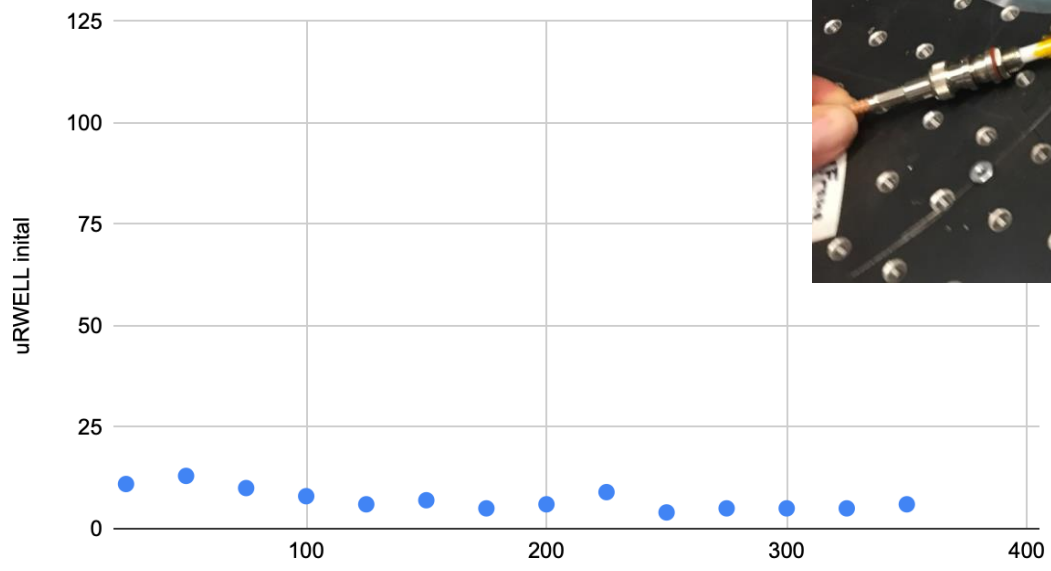
-Second gas pressure trial included the μRWELL foil, the detector held gas pressure in the same range for 2 minutes. The leaking is possibly due to the O-ring being too small we plan to use a larger O-ring and modified groove.



Time	Drift(V) initial	Drift(V) @ 10min	uRWELL initial	uRwell@10min
25	1	0	11	6
50	1	0	13	6
75	1	0	10	6
100	3	0	8	6
125	1	0	6	7
150	0	0	7	5
175	0	0		
200	3	0		
225	4	0		
250	2	0		
275	4	0		
300	2	0		
325	1	0		
350	0	0		
375	1	0		
400				



uRWELL @inital reading



Current

