n3He Target Chamber New Wire Frame

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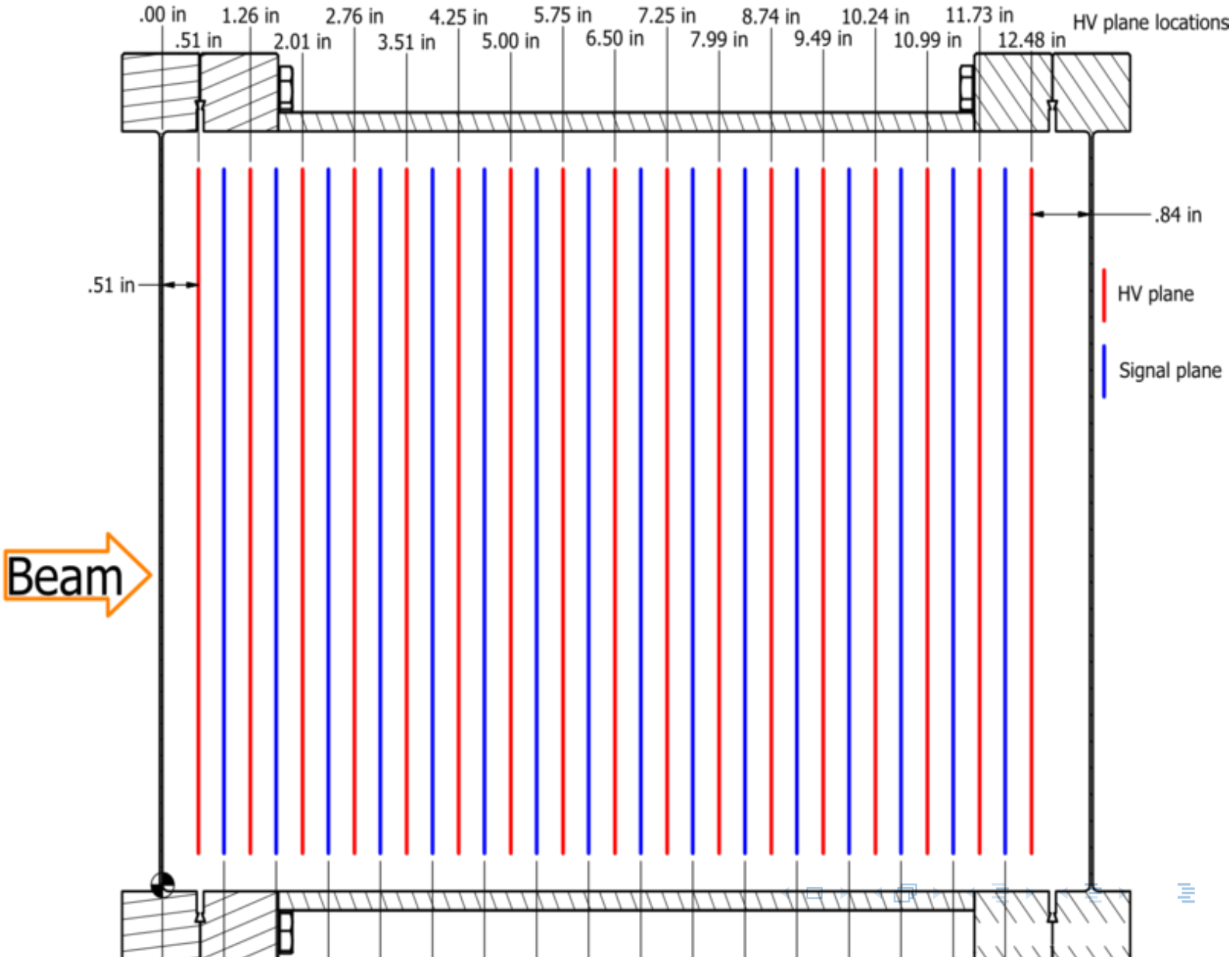
Topics

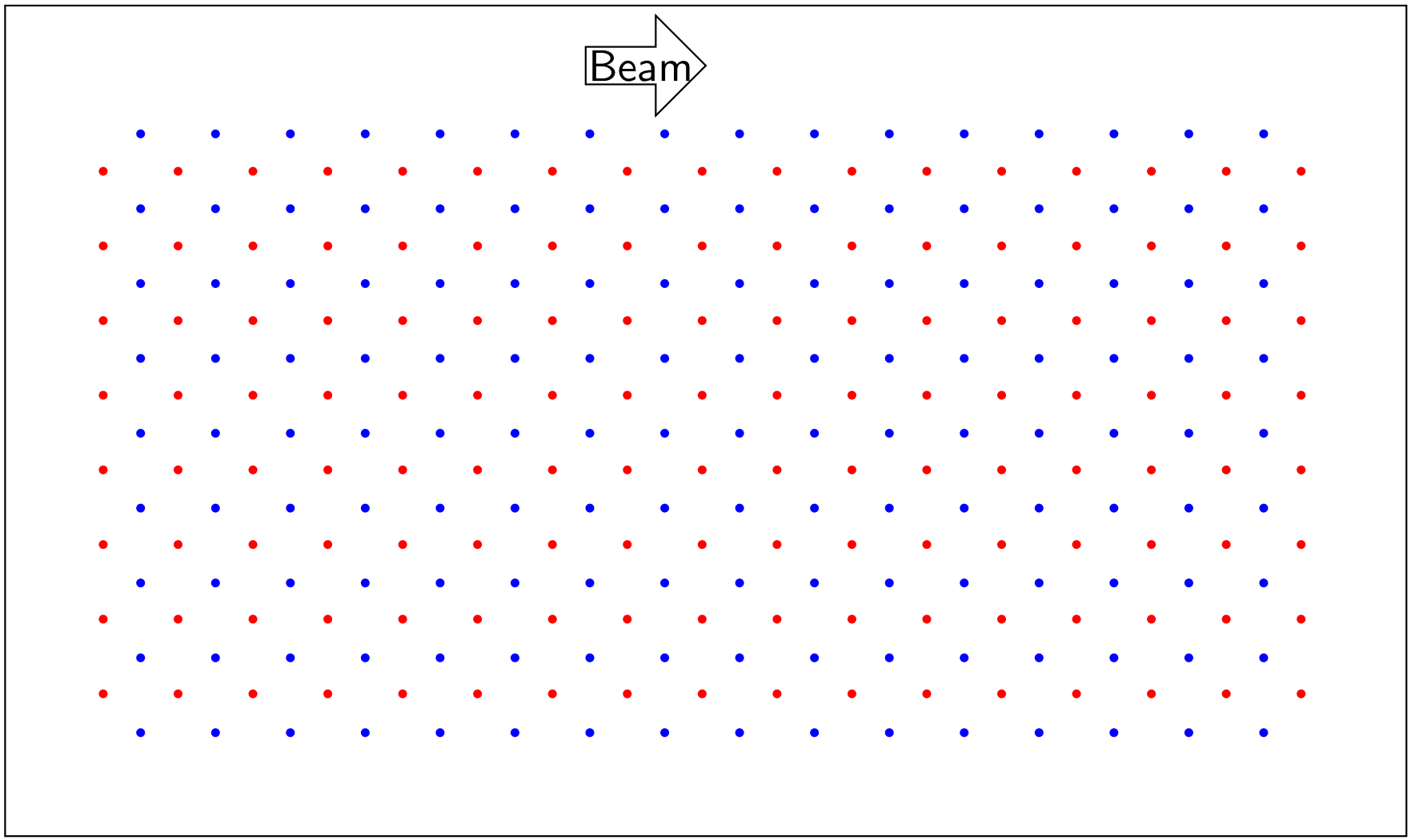
One option to reduce the systematic uncertainty in the n3He experiment is to instrument a front plane on the wire chamber to gather the charge that is deposited in the volume of the chamber that is currently outside of the outer HV plane on the up stream side.

- Chamber Layout
- Charge Collection
- Capacitance of New Plane
- How to Mount New Plane
- Connecting to Preamps
- Construction

Chamber Layout - Side View



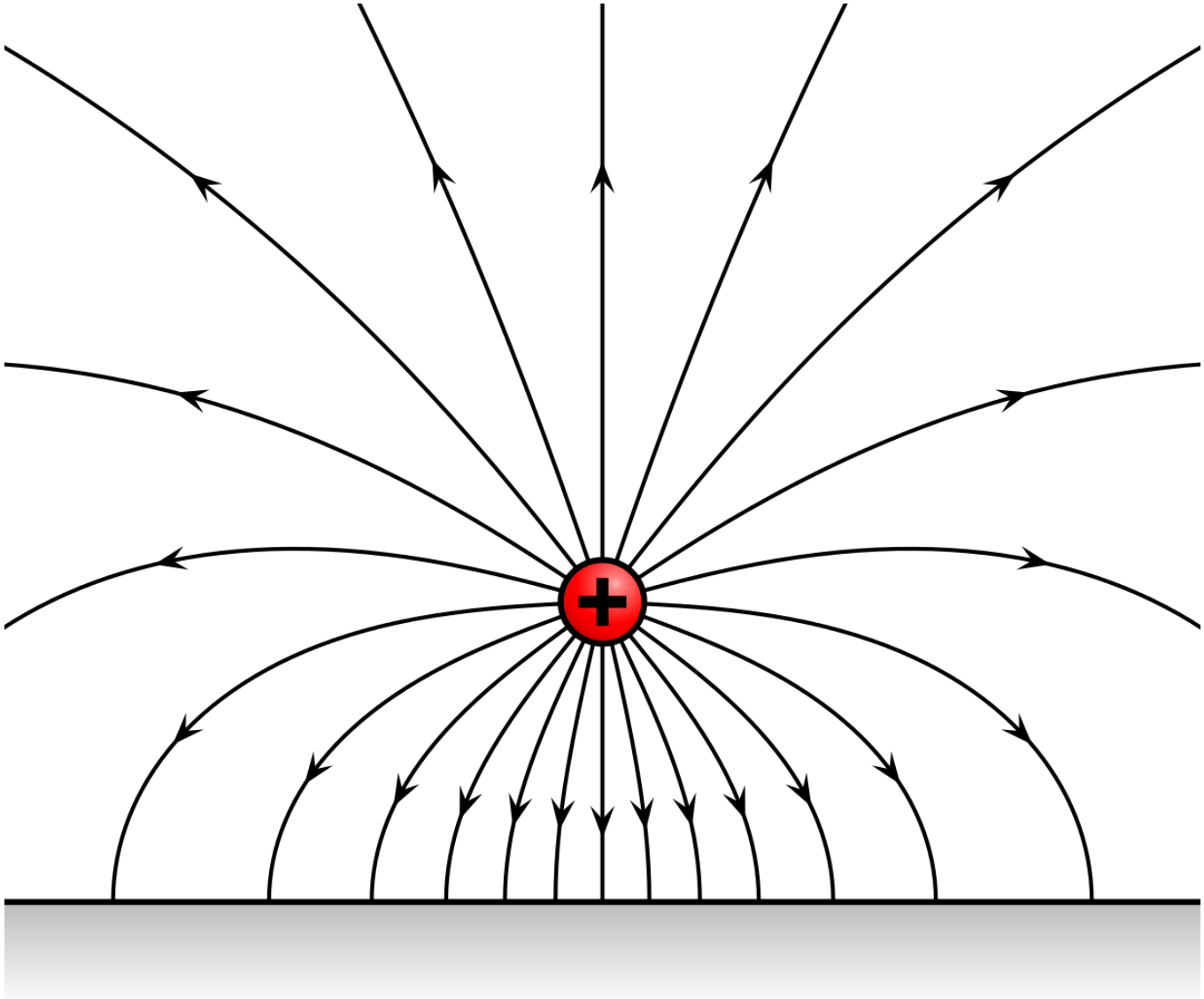
Chamber Layout - Top View



- HV 17 HV Frames with 8 wires each
- Signal 16 signal Frames with 9 wires each

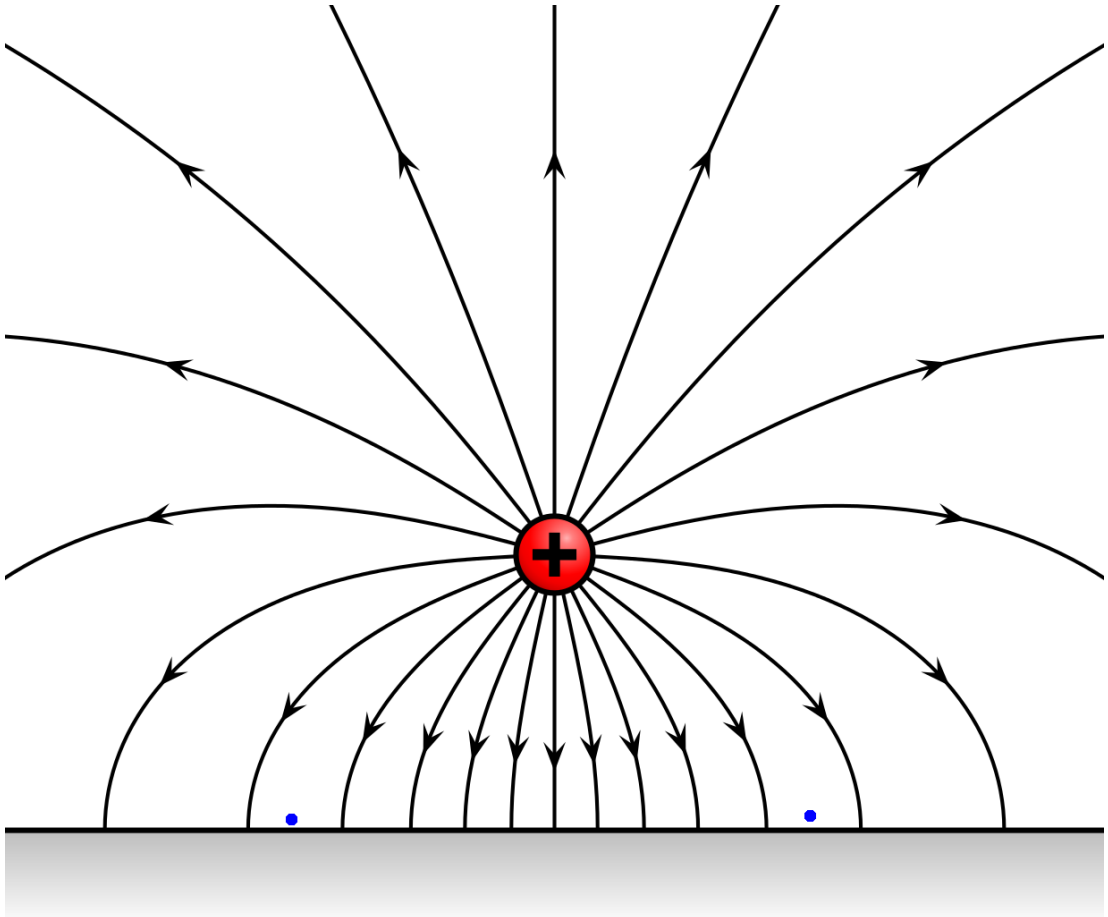
1 atm. He-3

Charge Collection Issue



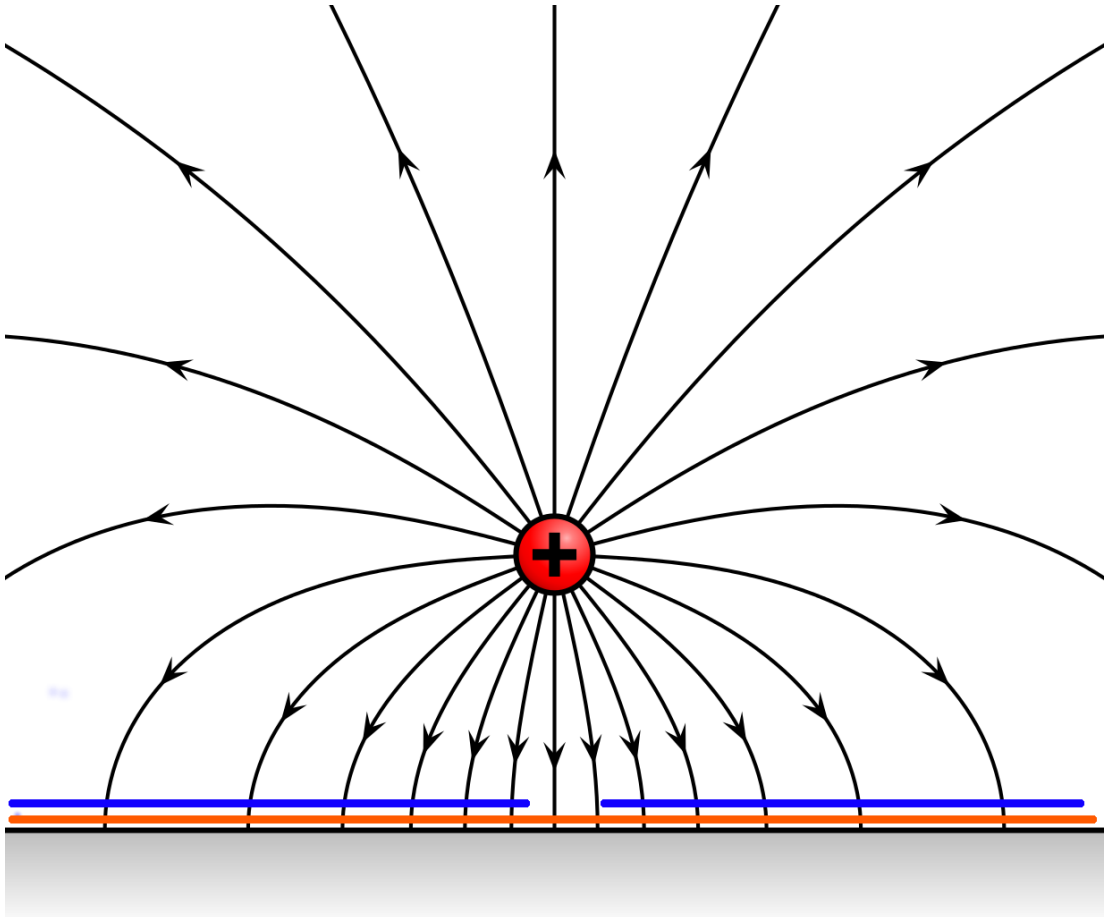
Note:Not Actual Field Line Calculations, illustrative only.

Charge Collection Issue



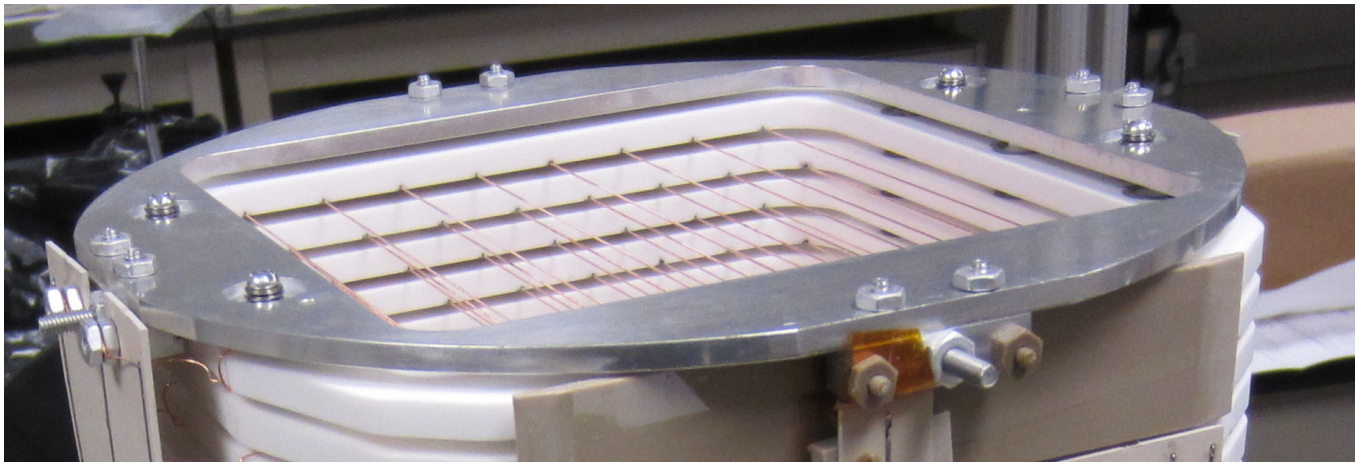
Grounded signal wires in front of a grounded window will only gather a small fraction of the available charge.

Charge Collection Issue



the solution is to replace wires with pads to intercept the majority of the charge.

Lost Charge



As the end plate on the frame stack is between the HV and signal plane and is also grounded it will attract electrons reducing signal to the new wire plane around the edges.

Capacitance Calculations

- Wires - Current Wires

$$C_{measured} = 30 - 40pF \tag{1}$$

$$C_{\text{wire to wire}} = 1.57pF \tag{2}$$

- Wires - New Wires to Window

$$C = \frac{\pi k \epsilon_0 L}{ln(d/l) + \sqrt{d^2/(dl-1)}} = 5.79pF \tag{3}$$

- Pads at 0.1" from Window

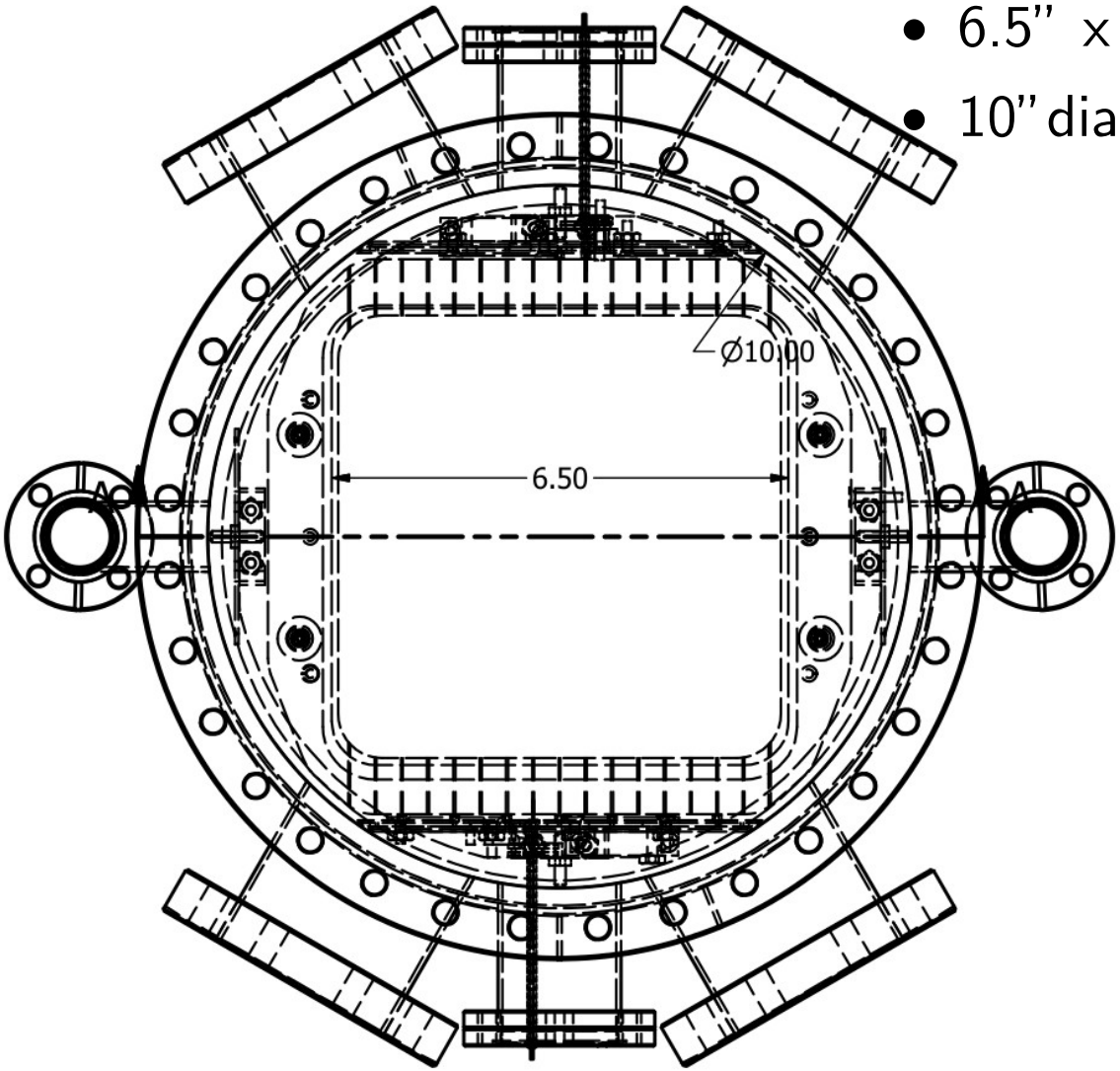
$$C = \frac{k\epsilon A}{d} = \frac{(1)(8.854 \times 10^{-12} F/m)(16.51cm \times 1.9cm)}{0.254cm} \tag{4}$$

$$= 11pF/\text{pad} \tag{5}$$

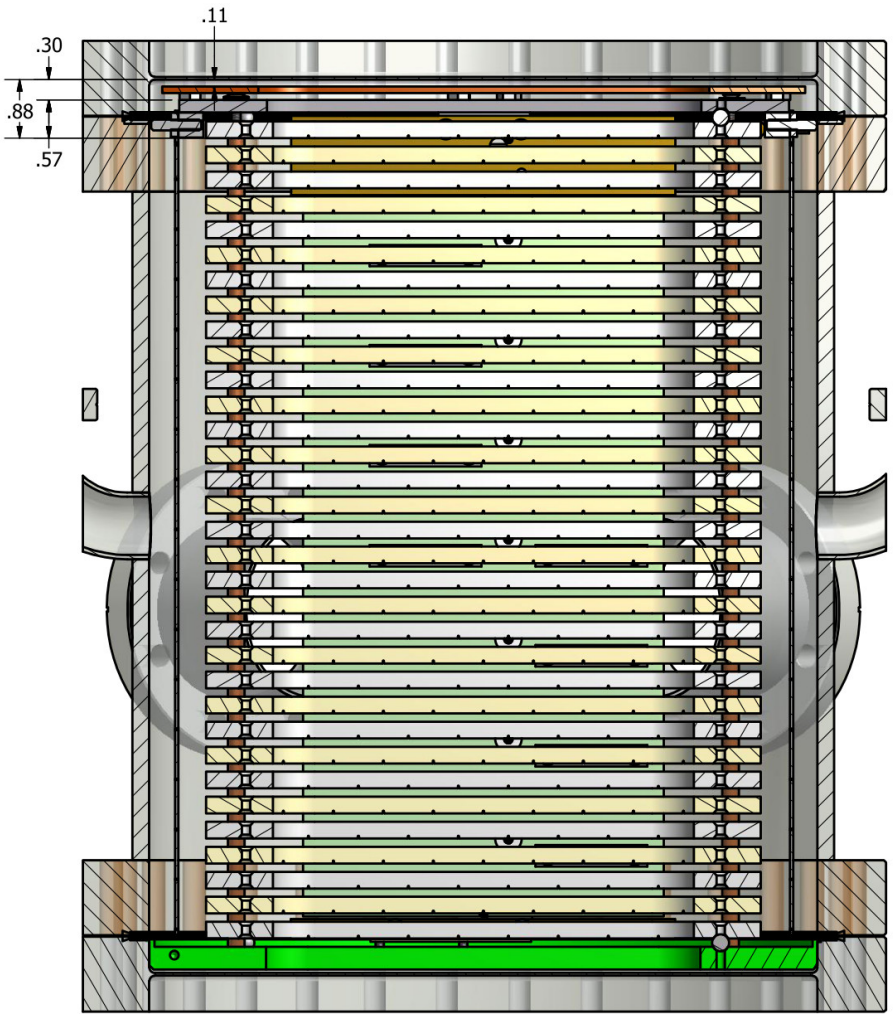
- Pads at 0.005" from Window

$$C = 921pF/\text{pad} \tag{6}$$

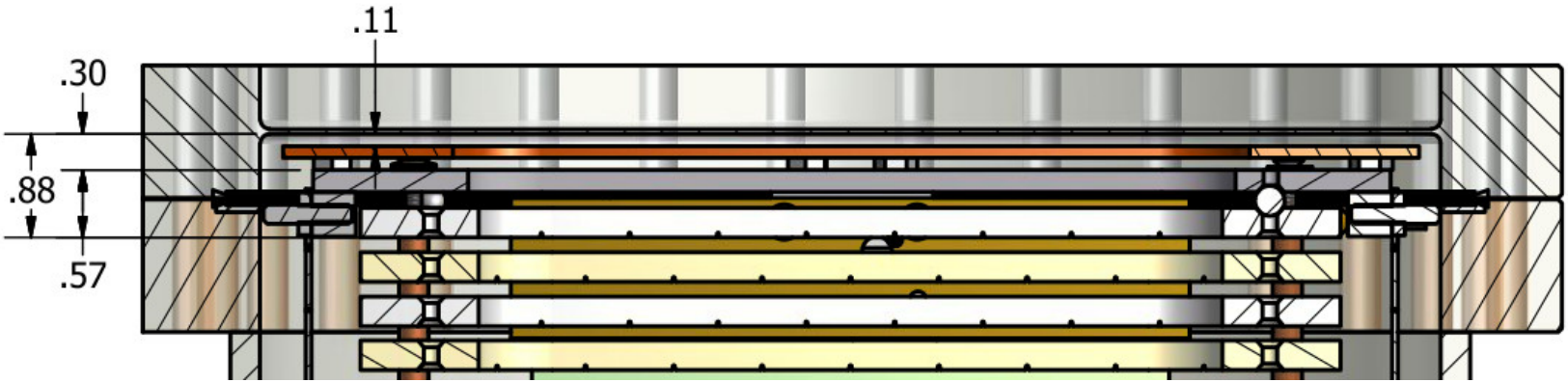
Chamber End View



- 6.5" x 6.5" square to cover
- 10" dia. circle to work in



- current front is green end with 0.51" dead space.
- Not accessible for adding new plane
- current back end has 0.81" dead space, and is accessible.



- Magnetic Spring Washers (can be replaced before chamber sealed, hard to locate non-magnetic replacements)
- 057" to work in
- Orange layer approximate wire plane location
- PEEK frame can be mounted on hooks to inside of compression plate
- can reduce dead space to 0.1-0.15" (other end 0.51")
- Microphonic noise will be high

Neutron Transmission Calculations

$$T(E,l) = exp\left\{-\rho l\left[\sigma_{abs}\frac{v_{ref}}{v} + \sigma_{scatter}\right]\right\} \quad (7)$$

- Aluminum

$$T_{Al}(4meV, 1mm) = 0.988 \quad (8)$$

- Helium-3

$$T_{He}(4meV, 0.1'') = 0.920 \quad (9)$$
$$T_{He}(4meV, 0.5'') = 0.659 \quad (10)$$
$$T_{He}(4meV, 0.7'') = 0.558 \quad (11)$$
$$T_{He}(4meV, 0.8'') = 0.514 \quad (12)$$

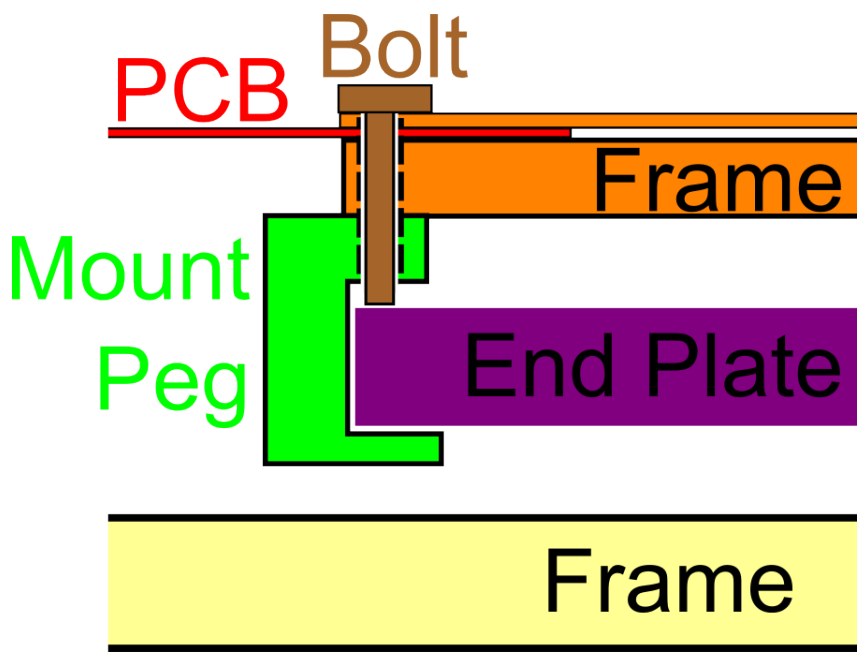
- Copper

$$T_{Cu}(4meV, 2mil) = 0.996 \quad (13)$$

- Kapton

$$T_{Kapton}(4meV, 2mil) = 0.989 \quad (14)$$

Mounting



Using a variation of this peg design 4 pegs could be used to hold a 2 layer PEEK frame to sandwich the flexible kapton circuit into place spaced about the end plate.

Preamp Connection

- Cut and Solder Splice Cable
  - how to insulate over splice
  - how to deal with remaining cable end
  - hard to reverse
- remove pins from plug and attach new cable
  - how to deal with remaining cable end
  - could mix up wire order easily
  - reversible
- Cut Plug in half
  - could just fall apart
  - plug halves can be switched but not rejoined
  - no loose bare ends on cables attached to planes

Conclusion

- Capacitance approximately 80pF per pad with cable
- Reduced charge collection efficiency due to metal end plate between HV and signal pad
- hard to connect to preamps
- Significant wait likely for PCB (6+weeks)

From other discussions this looks like it will not be used and development has been stopped.