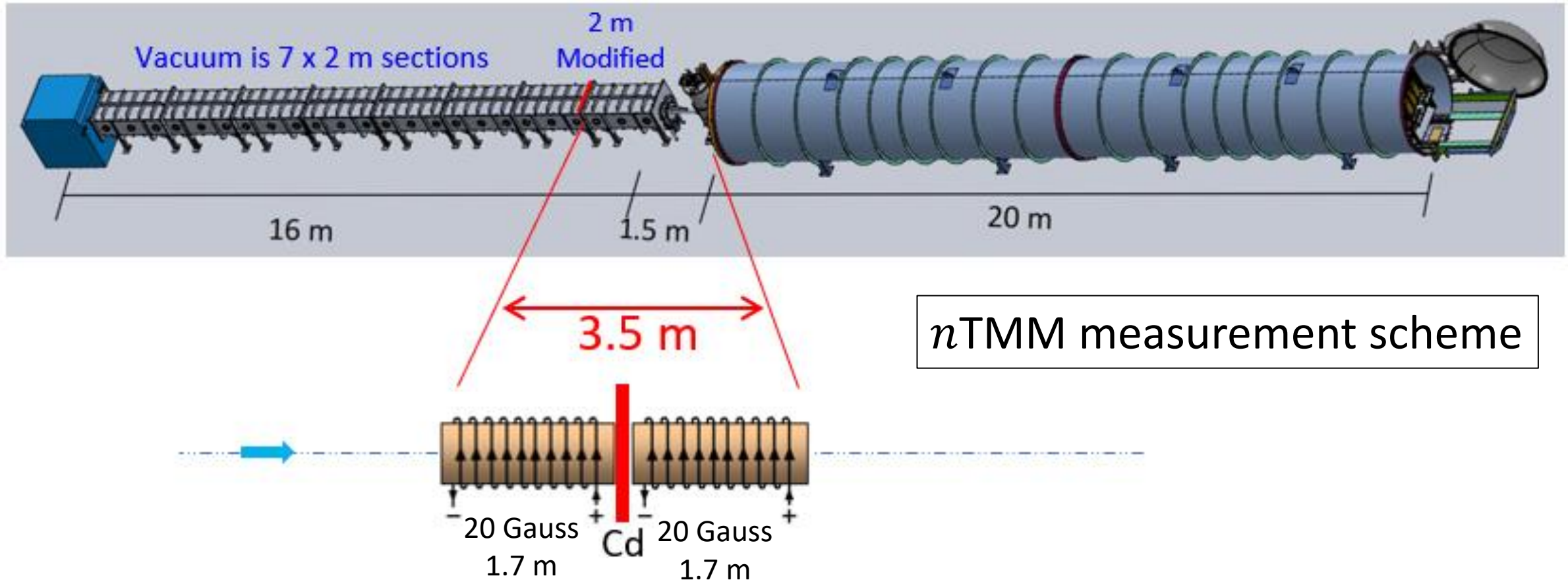




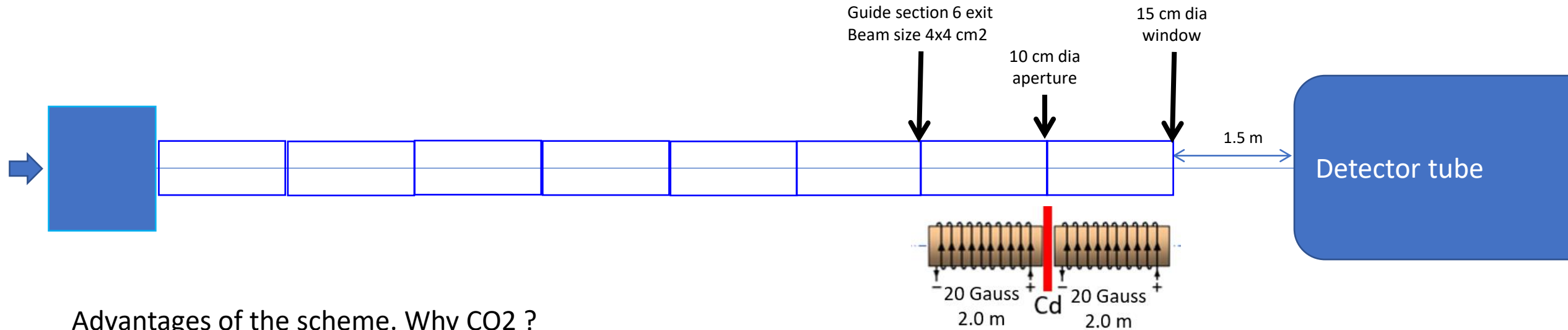
New configuration at GP-SANS for n TMM measurement

Yuri Kamyshev
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Old scheme that required the last guide section conversion to lab table



New idea: use sealed cylinders filled with CO₂ to 1 atm inside the magnets. Install magnets in sections 7 and 8 of the guide. Magnets will be in vacuum.



Advantages of the scheme. Why CO₂ ?

- Slightly higher 1 atm optical potential 0.118 neV vs 0.116 for STP air. → slightly higher field, ~ 20 Gauss
- Scattering length x 1.5 times larger, absorption length x 360 times larger
- Volumes can be filled from the high purity bottle.
- For sealed volume – no need to control environmental parameters p, T, humidity.
- Slightly higher pressure (~ 1.25 atm) can be used → higher mag. field → x 1.5 higher regeneration sensitivity
- Two vessels 2 m + 2 m → + 38% higher regeneration probability
- No need for construction of magnet mechanical supports
- Cd plate is attached to the end of the first magnet

Comparison of optical potentials and x-sections for CO2 at several pressures and for air at 1 atm

Material	atm	Temp	density	A	#density	b	Vopt	Wopt	L_abs,m	2m abs	L_scatt	exp(-2/L)	Equiv B	2 m/Lel
	bar	C	g/cm^3		1/m^3	m	eV	eV	at 1km/s	at 4Å	m		Gauss	ratio
CO2	0.25	20	0.000454	44	6.21E+24	1.8252E-14	2.95E-11	1.74E-18	1.89E+05	0.999989	114.89	0.98274308	4.89	0.01740756
CO2	0.5	20	0.000908	44	1.24E+25	1.8252E-14	5.90E-11	3.49E-18	9.43E+04	0.999979	57.45	0.96578395	9.79	0.03481512
CO2	1	20	0.001815	44	2.48E+25	1.8252E-14	1.18E-10	6.98E-18	4.72E+04	0.999958	28.72	0.93273864	19.58	0.06963024
CO2	2	20	0.00368	44	5.04E+25	1.8252E-14	2.39E-10	1.42E-17	2.33E+04	0.999914	14.17	0.86832582	39.70	0.14118826
CO2	3	20	0.005546	44	7.59E+25	1.8252E-14	3.61E-10	2.13E-17	1.54E+04	0.99987	9.40	0.80836121	59.82	0.21274628
CO2	4	20	0.007411	44	1.01E+26	1.8252E-14	4.82E-10	2.85E-17	1.16E+04	0.999827	7.03	0.75253761	79.94	0.2843043
CO2	5	20	0.009276	44	1.27E+26	1.8252E-14	6.03E-10	3.57E-17	9.23E+03	0.999783	5.62	0.70056907	100.06	0.35586232
Air	1	20					1.16E-10	5.72E-15	1.31E+02		19.23		19.24	

Magnet-Tube cross section

Hard PVC tube OD 8"

Wall thickness 0.25"

Length $\leq 2\text{m}$

With grooved coil outside

May be wrapped with
Mu-metal tape

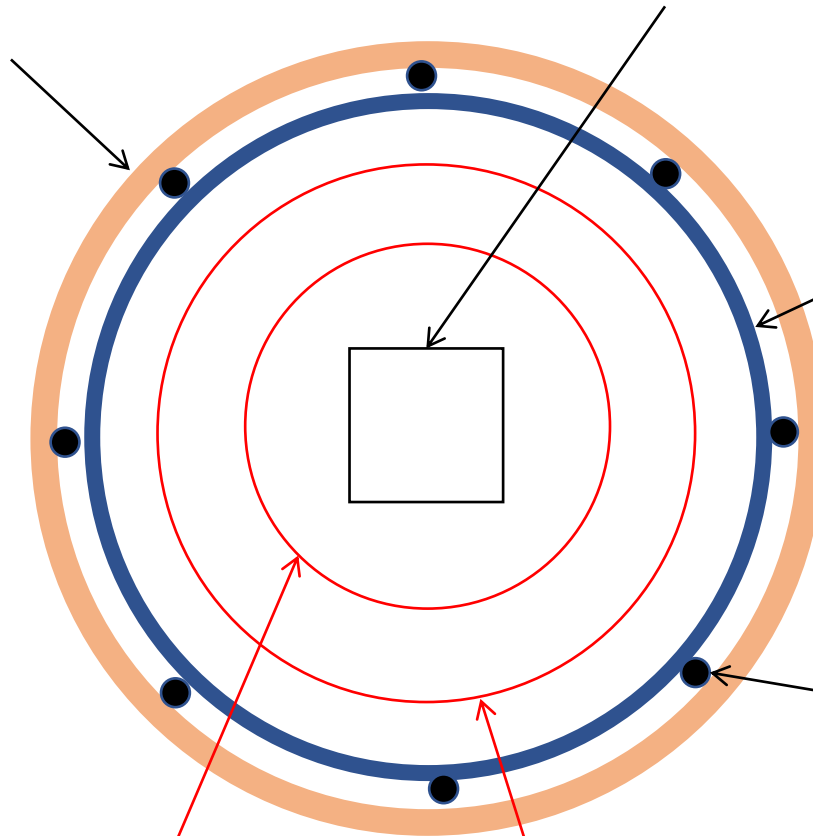
4 x 4 cm² guide exit

Sealed Al tube
with CO₂ gas 1 atm
7" OD tube Al 6061
Wall 0.125"

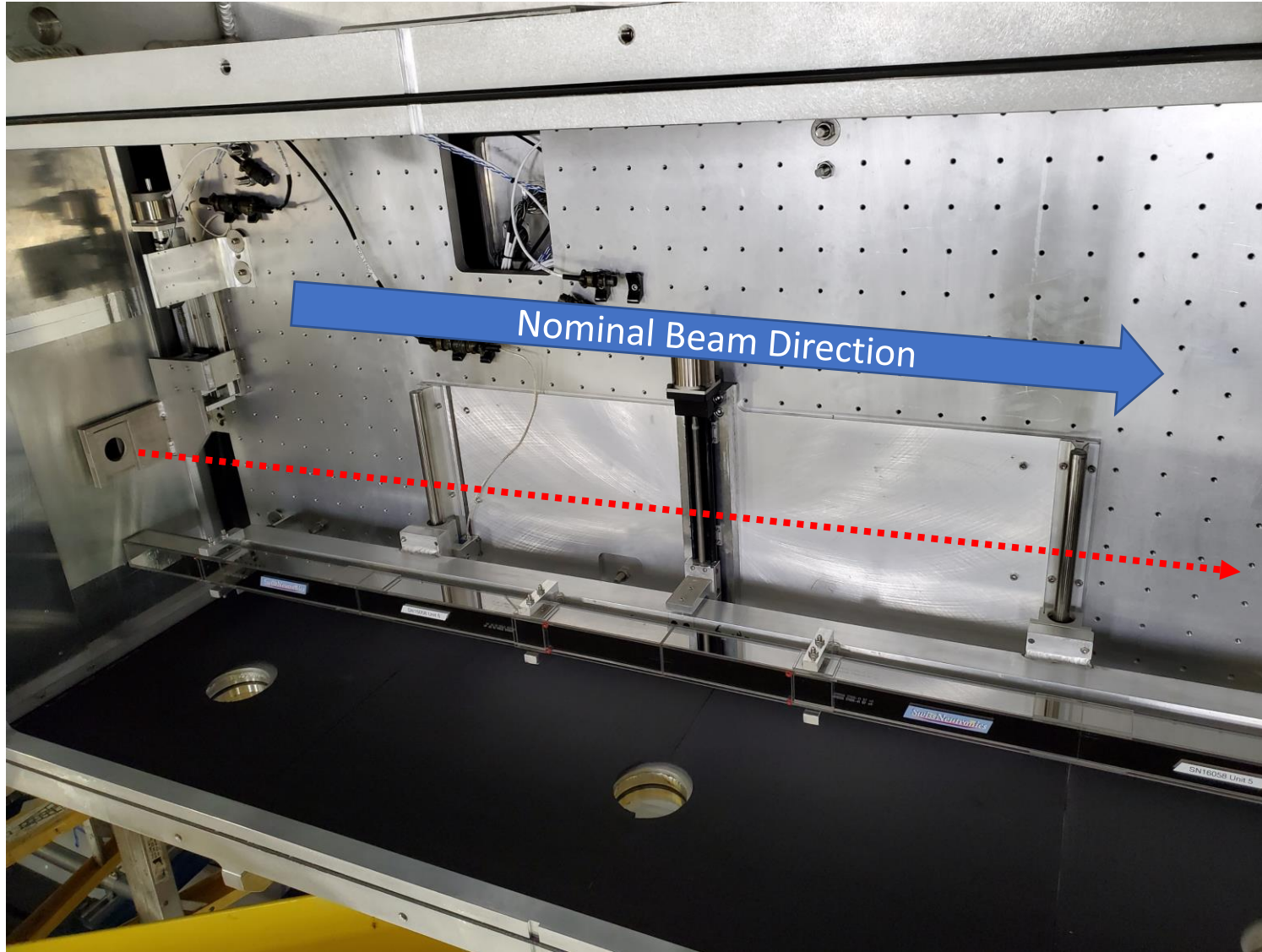
spacers

95% beam end of first tube

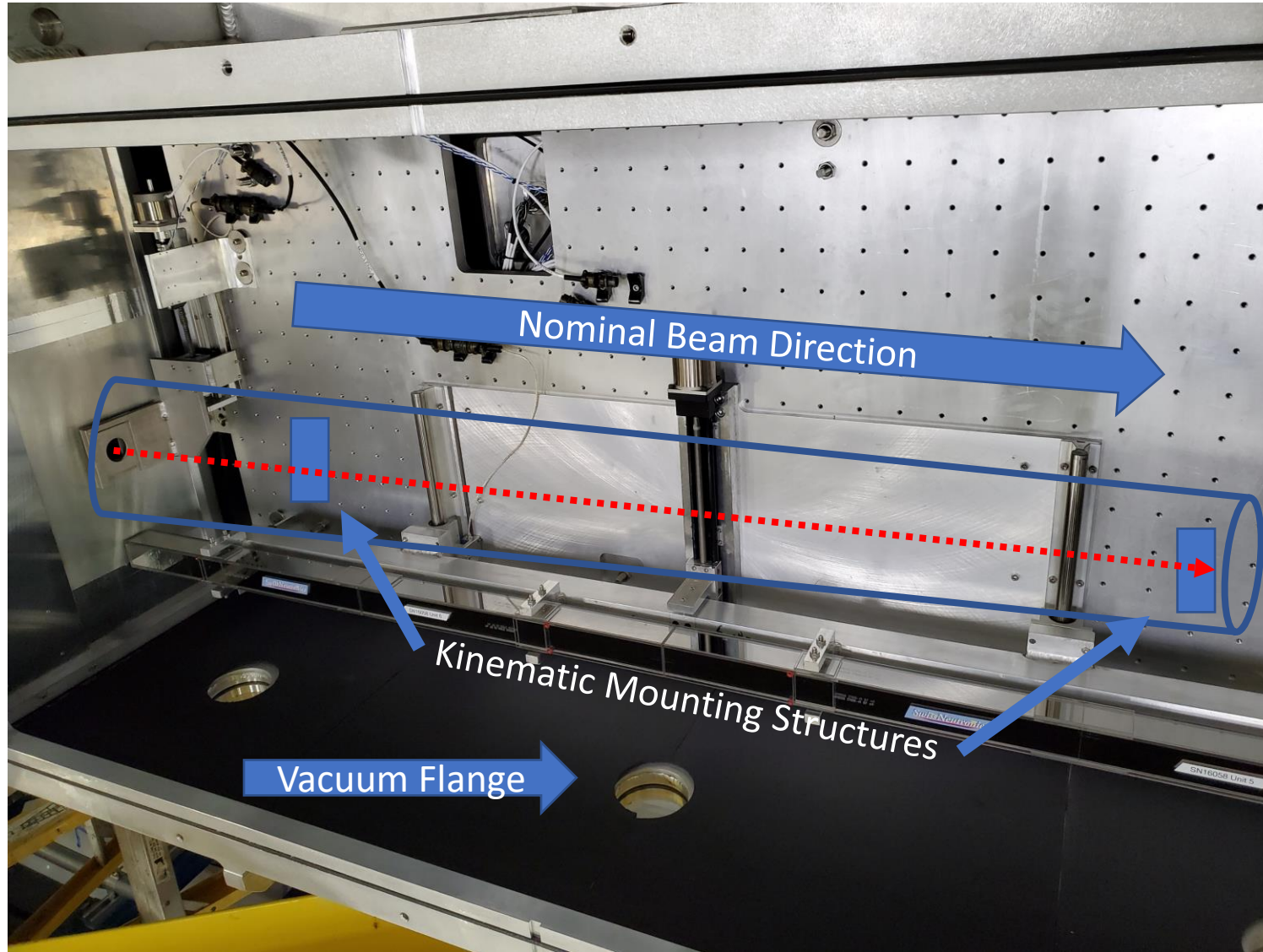
95% beam end of second tube



Typical Collimator Vacuum Vessel Interior (Matt Frost)



Proposed Concept for Field Coil (Matt Frost)



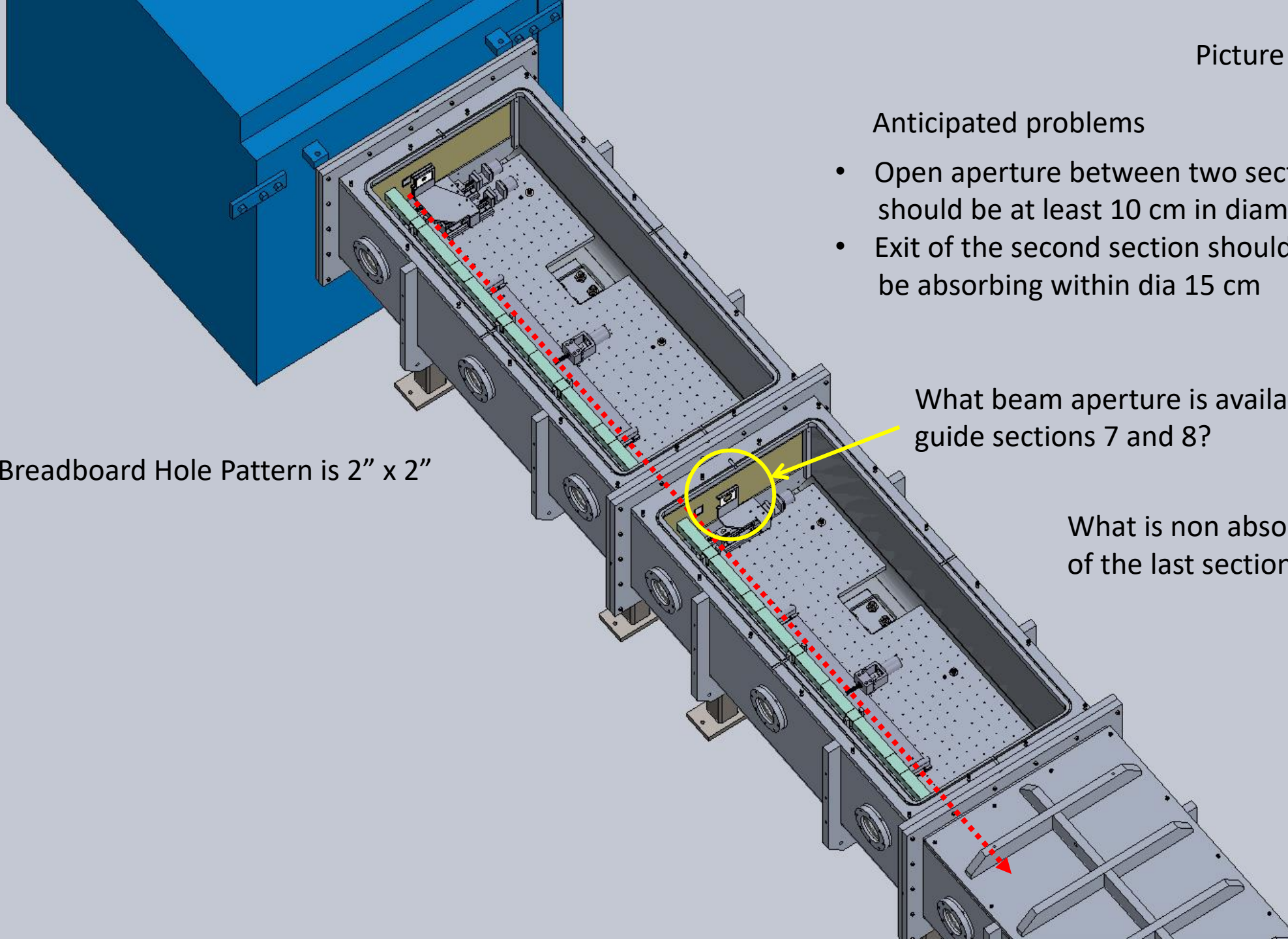
Anticipated problems

- Open aperture between two section should be at least 10 cm in diameter
- Exit of the second section should not be absorbing within dia 15 cm

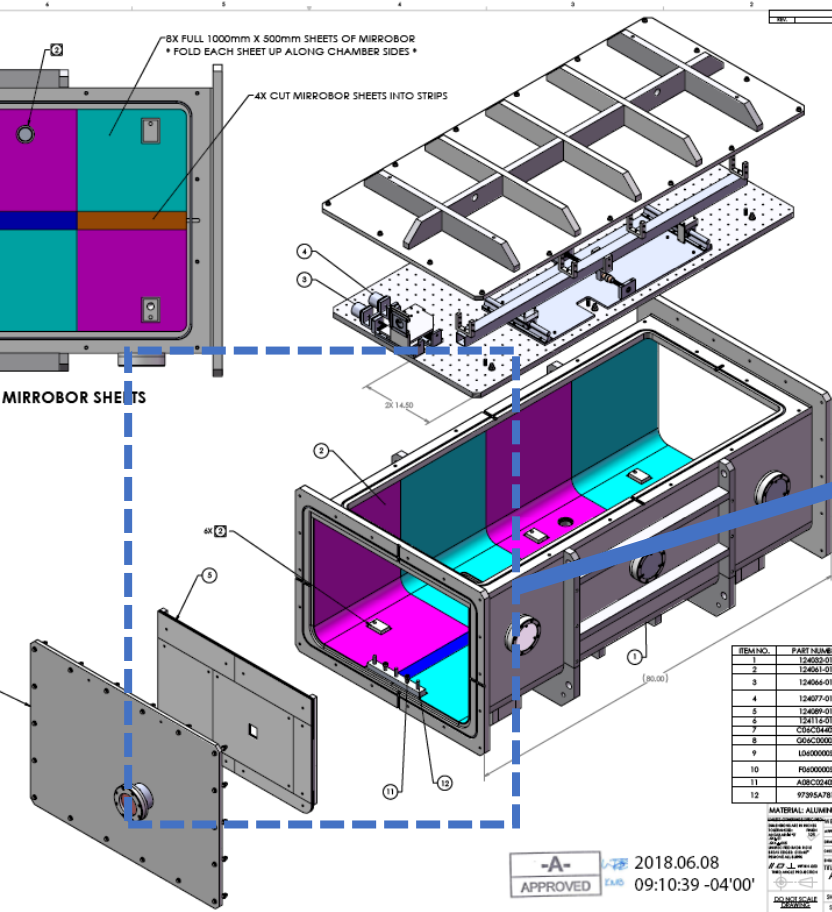
Breadboard Hole Pattern is 2" x 2"

What beam aperture is available between guide sections 7 and 8?

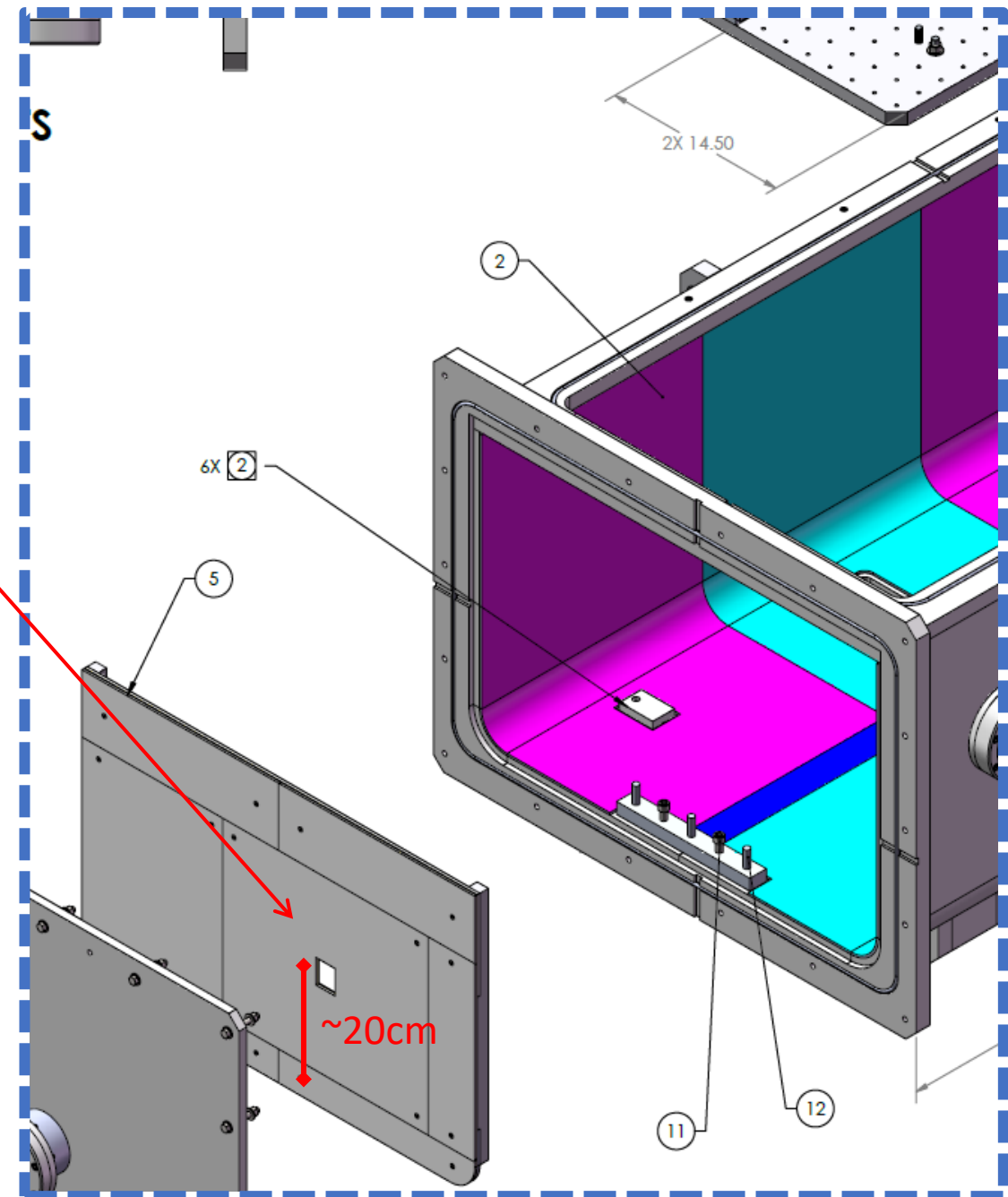
What is non absorbing aperture of the last section 8?



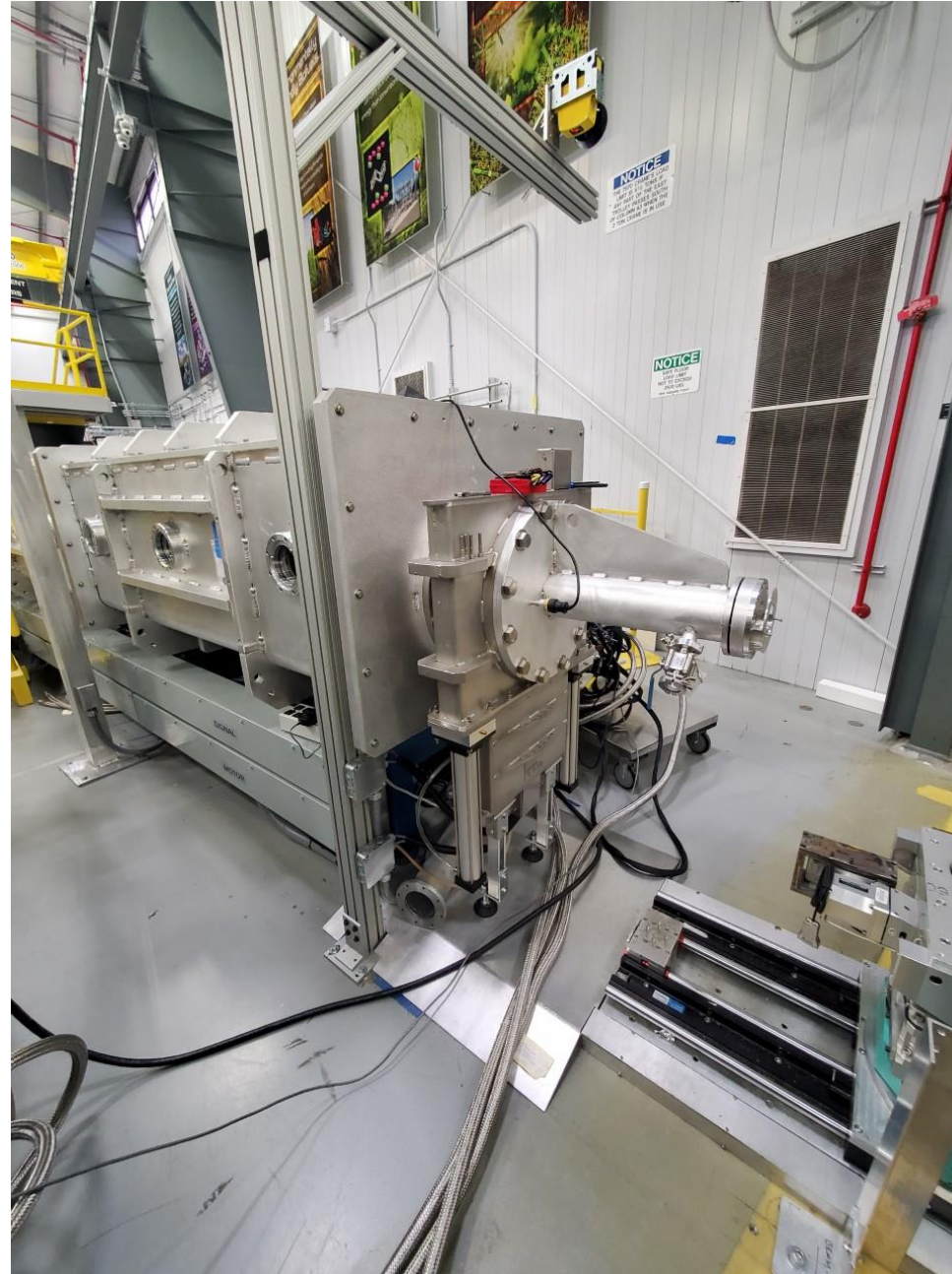
Isometric CAD View



Is this plate
replaceable?



(added) Gate-valve Lisa was talking about at the meeting:



Comment from Leah about pressure safety:



We want maximum pressure rating times system volume to be less than 73 psi-ft³ / 14.2 kPa-m³ for a system of this size.

Let's calculate this limit for the proposed vessel:

Pressure 1.25 atm. Say, max pressure is 2 atm. → 203 kPa

Volume ID =6.75" and length 2 m → V=0.0462 m³

$$P \times V = 9.4 \text{ kPa} \cdot \text{m}^3 < 14.2 \text{ kPa} \cdot \text{m}^3$$

Al vessel design.

Nominal pressure 3 atmospheres = $14.7 \text{ psi} \times 3 = 44.1 \text{ psi}$

Safety factor 3.6 → $158.76 \text{ psi} = 160 \text{ psi}$

6061 aluminum allow has a yield tensile strength 276 Mpa (40000 psi)

Inner radius 4" = 10 cm

Joint Efficiency 80%

https://www.engineersedge.com/calculators/shell_internal_pres_pop.htm

Required wall thickness 0.0201 " = 0.5 mm

For 10000 psi low limit 0.081 " = 2.06 mm

<https://www.onlinemetals.com/en/buy/aluminum/8-od-x-0-125-wall-x-7-75-id-aluminum-round-tube-6061-t6-extruded/pid/7083>

7" OD x 0.125" Wall x 6.75" ID Aluminum Round Tube 6061-T6-Extruded

3' ft length \$198

4'ft length \$234 (custom cut available)

Vessel pressure test: vacuum outside and 1 atm inside = 1 atm outside and 2 atm inside