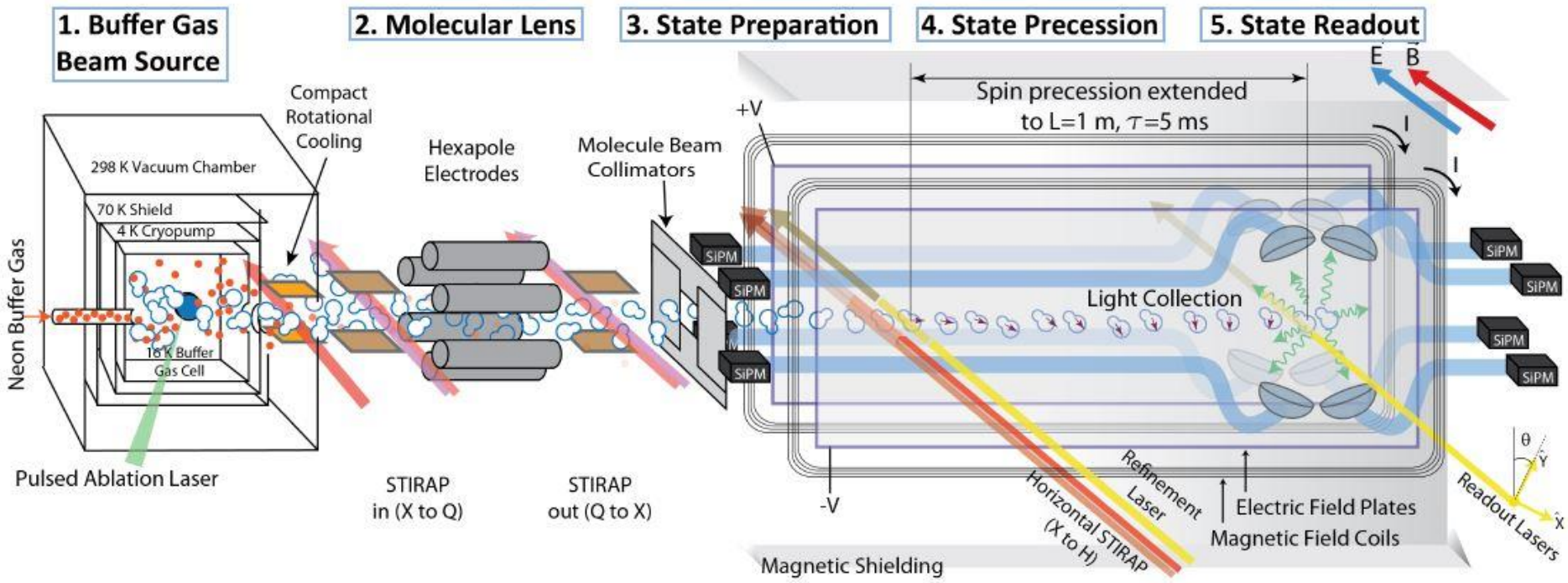
CFP student talk

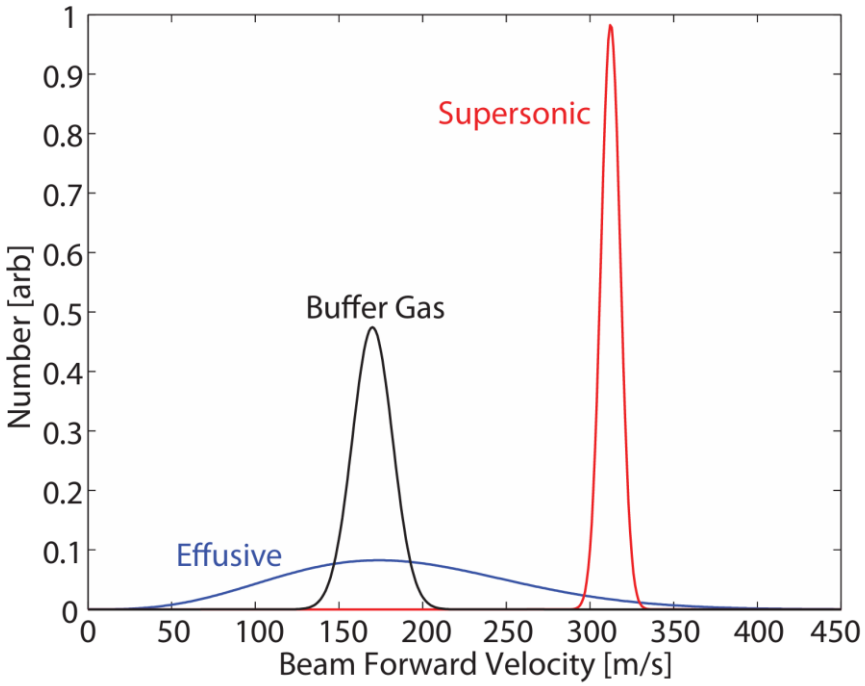
Cryogenic Buffer Gas Beam Source and Electrostatic Lens for ACME project

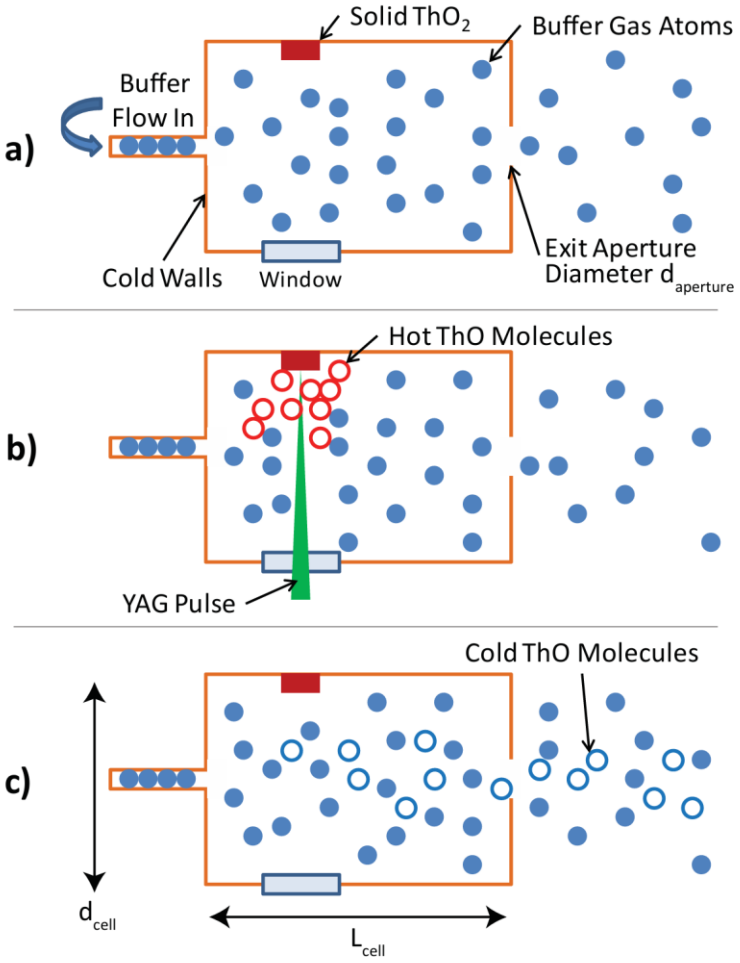
Zhen Han



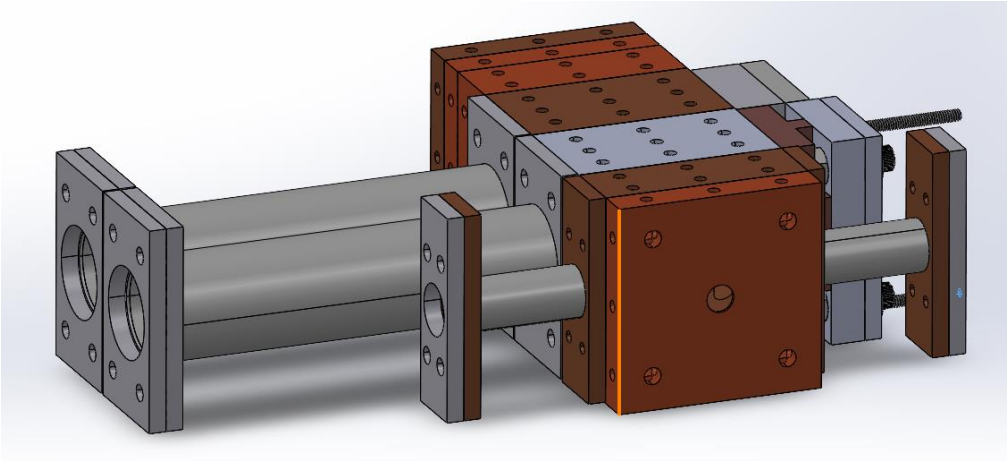
$$\delta d_e = \frac{1}{2T\mathcal{E}_{eff}\sqrt{N}}$$

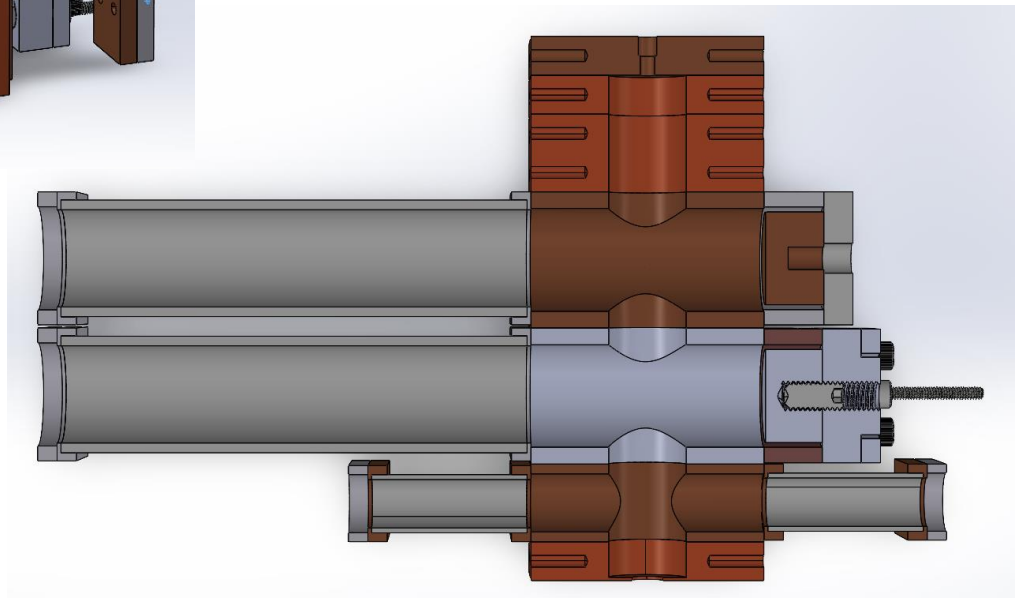
Buffer Gas Beam Source



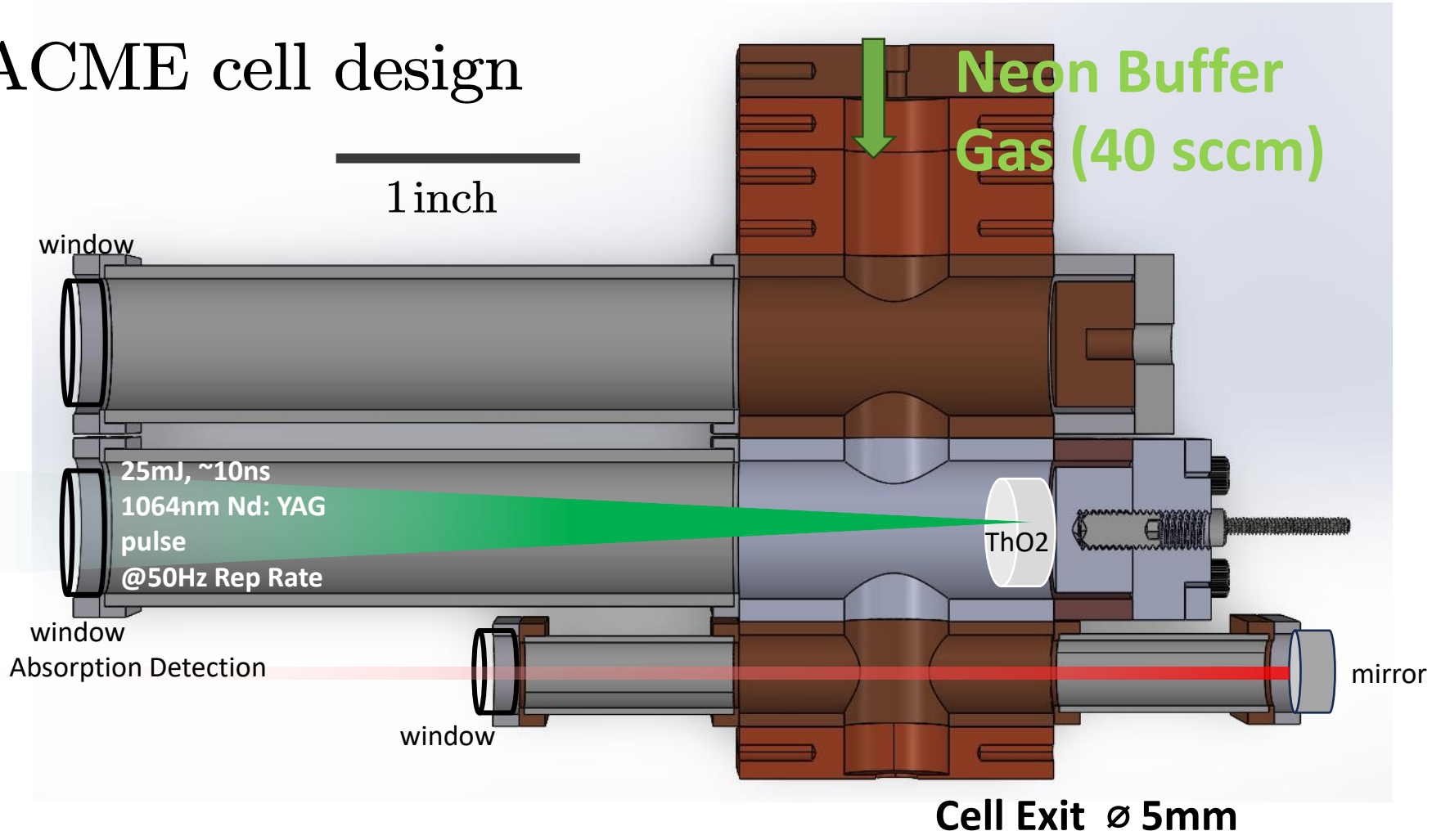


ACME cell design





ACME cell design



ACME

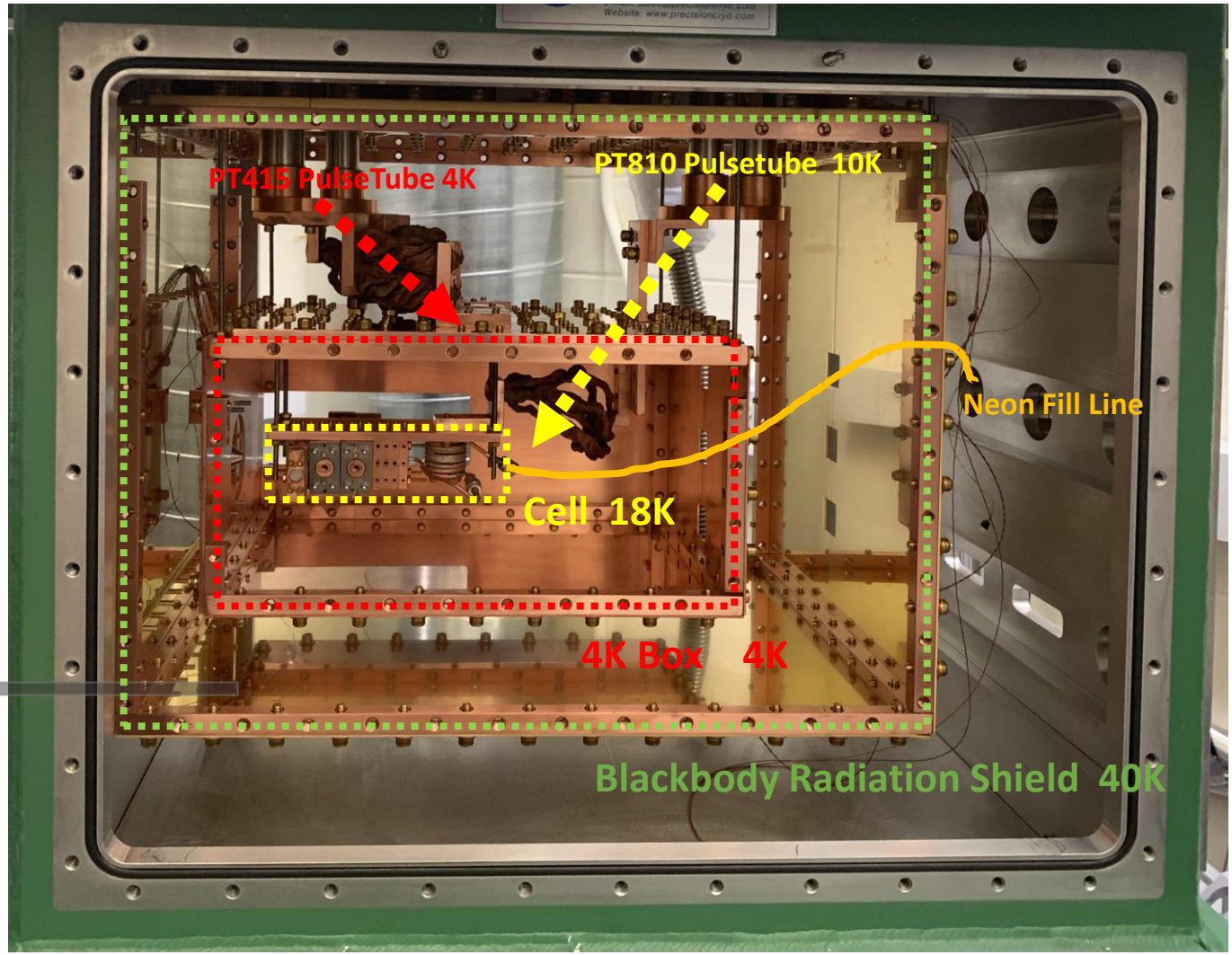
Cryogenic

Buffer

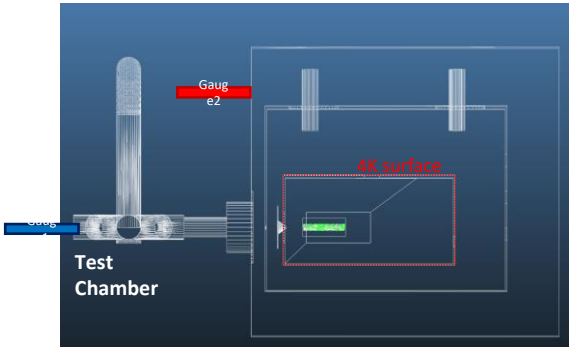
Gas

Beam source

(CBGB)



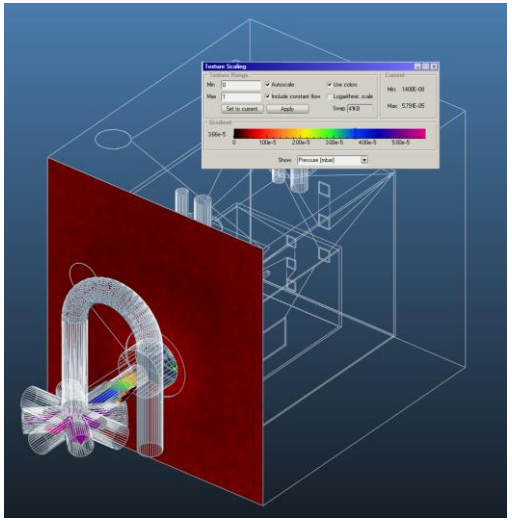
Cryopumping in CBGB



Molflow Simulation

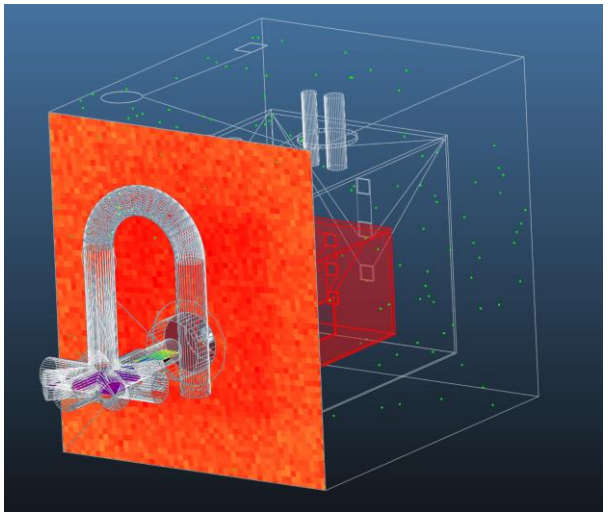
molflow simulation

4K surface, Sticking probability $= 0.6$

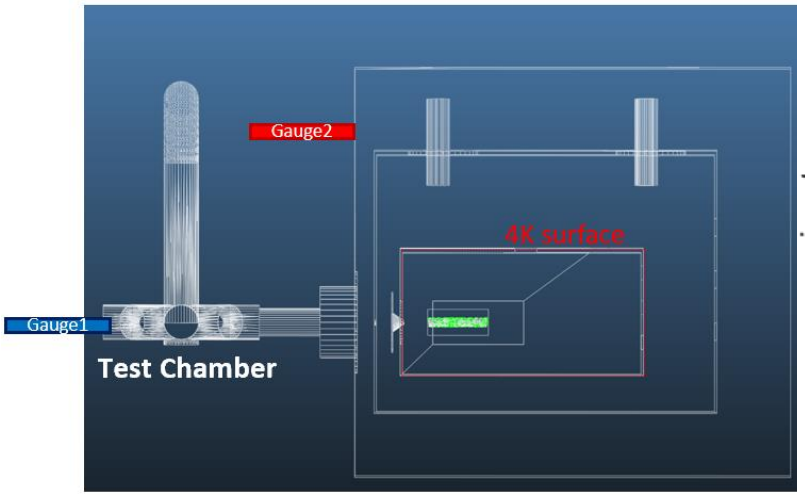


molflow simulation

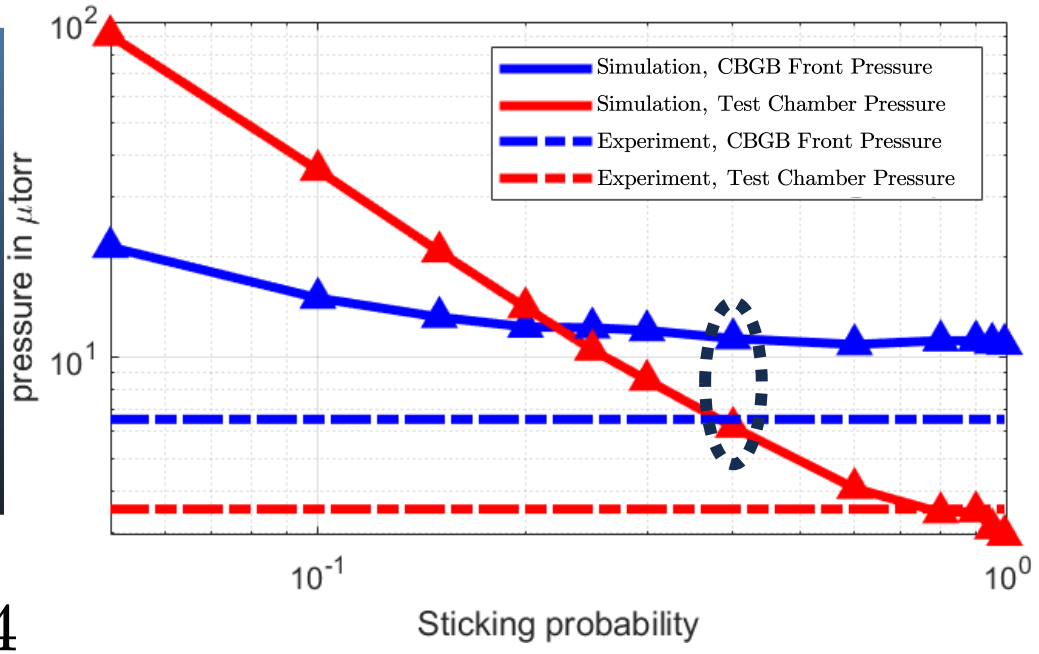
4K surface, Sticking probability $= 0.2$



Cryopumping in CBGB



Pressure vs. Sticking Probability



$$p_{stick} = 0.4$$

($p_{stick} = 0.4 \sim$ 5000 l/s pumping speed for whole 4K system)

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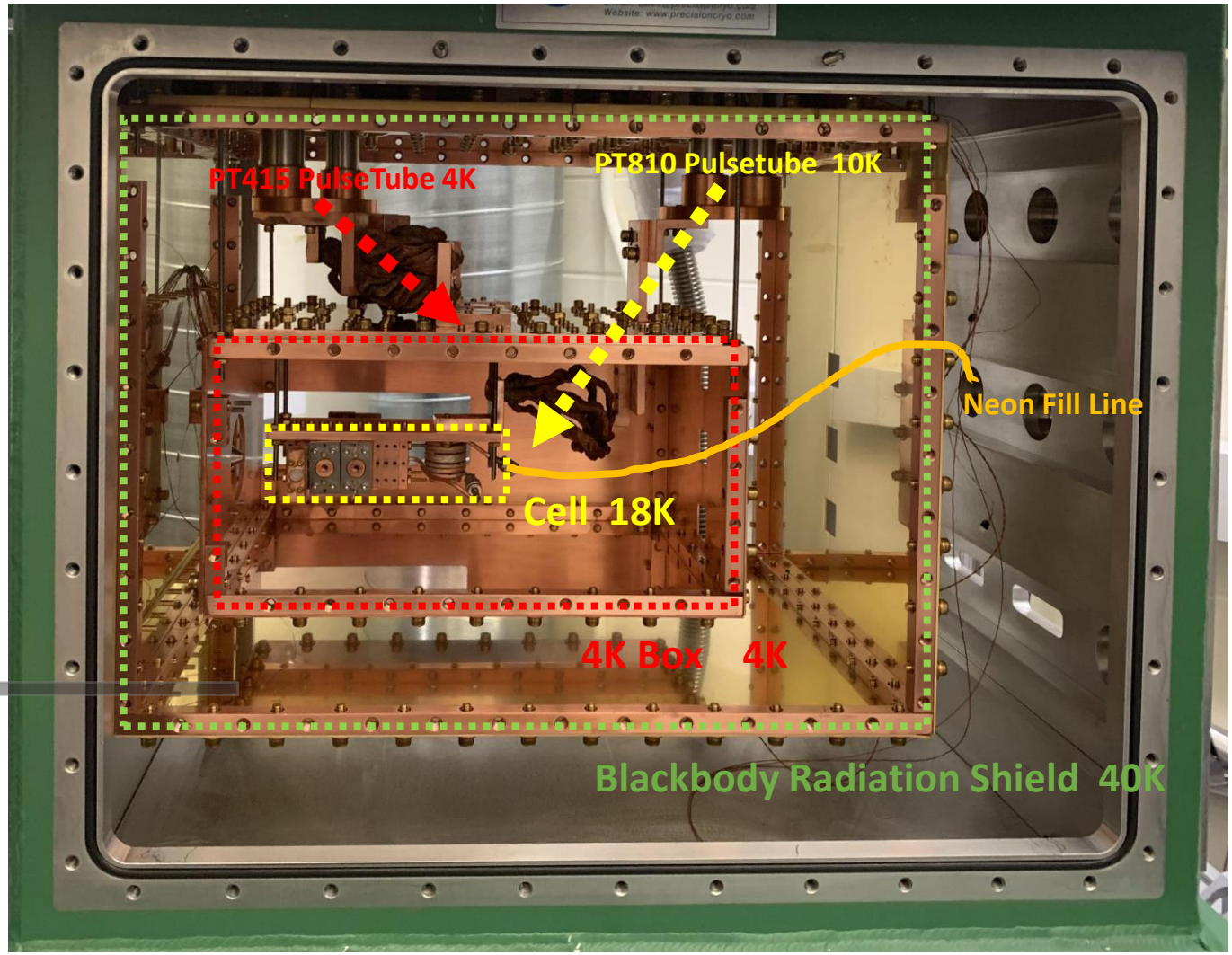
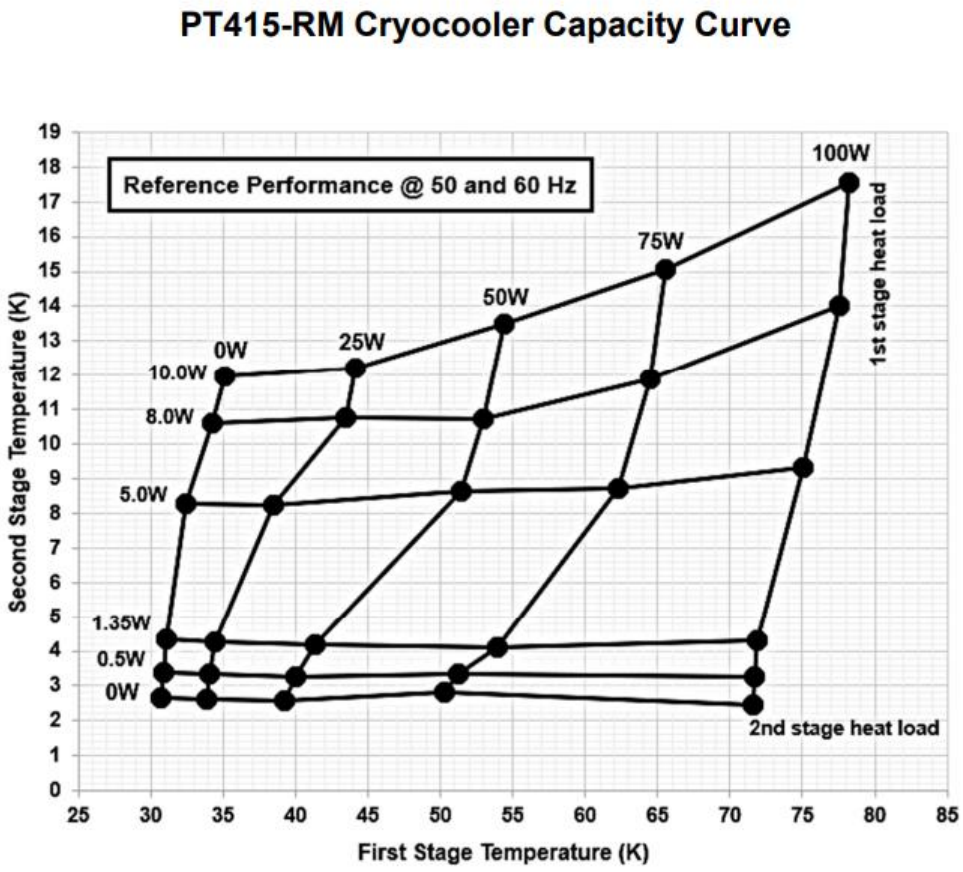


Black Body Radiation

$$P = \sigma A T^4$$

$$\sim 0.05\,\mathrm{W/cm^2} \quad @300\,\mathrm{K}$$



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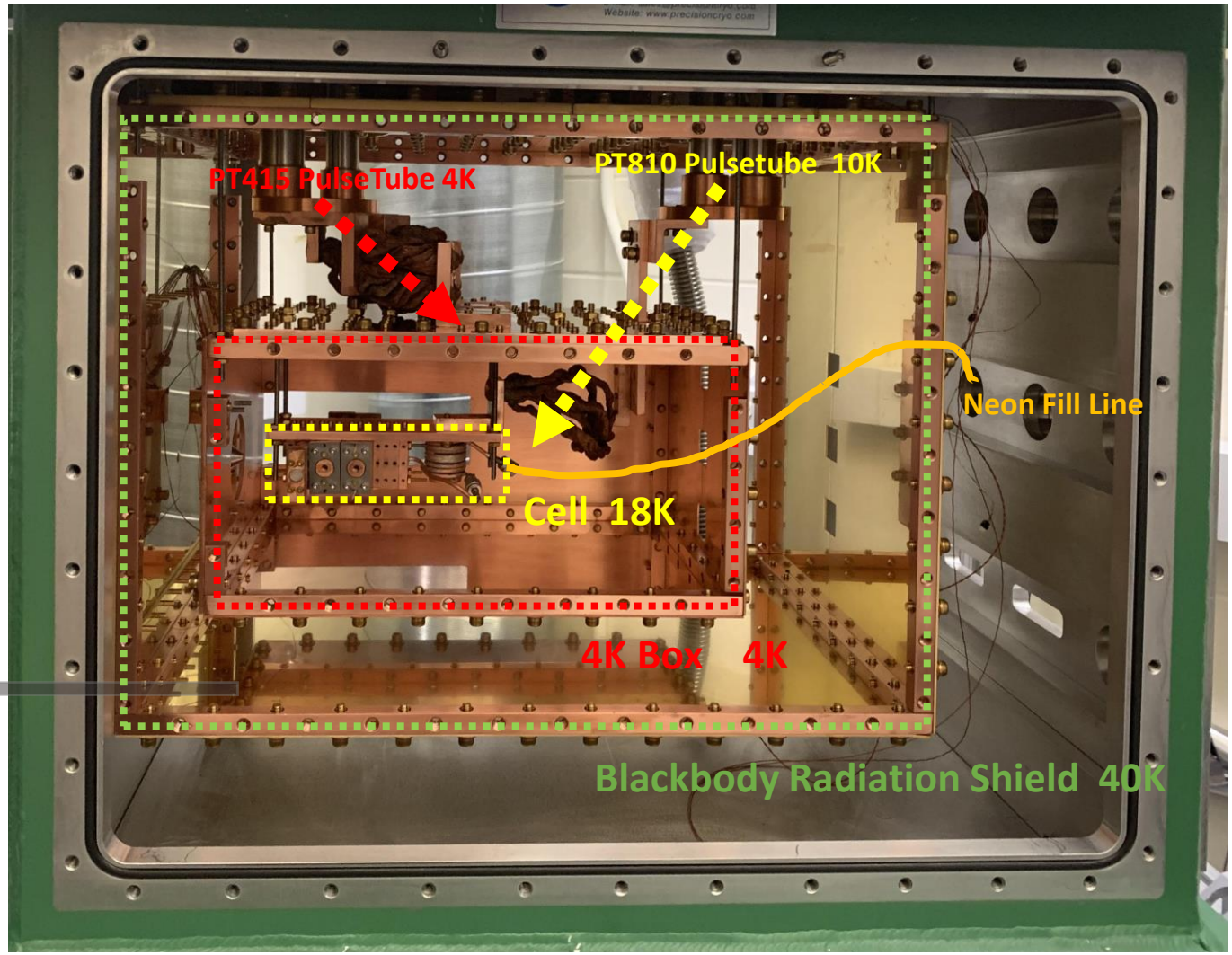
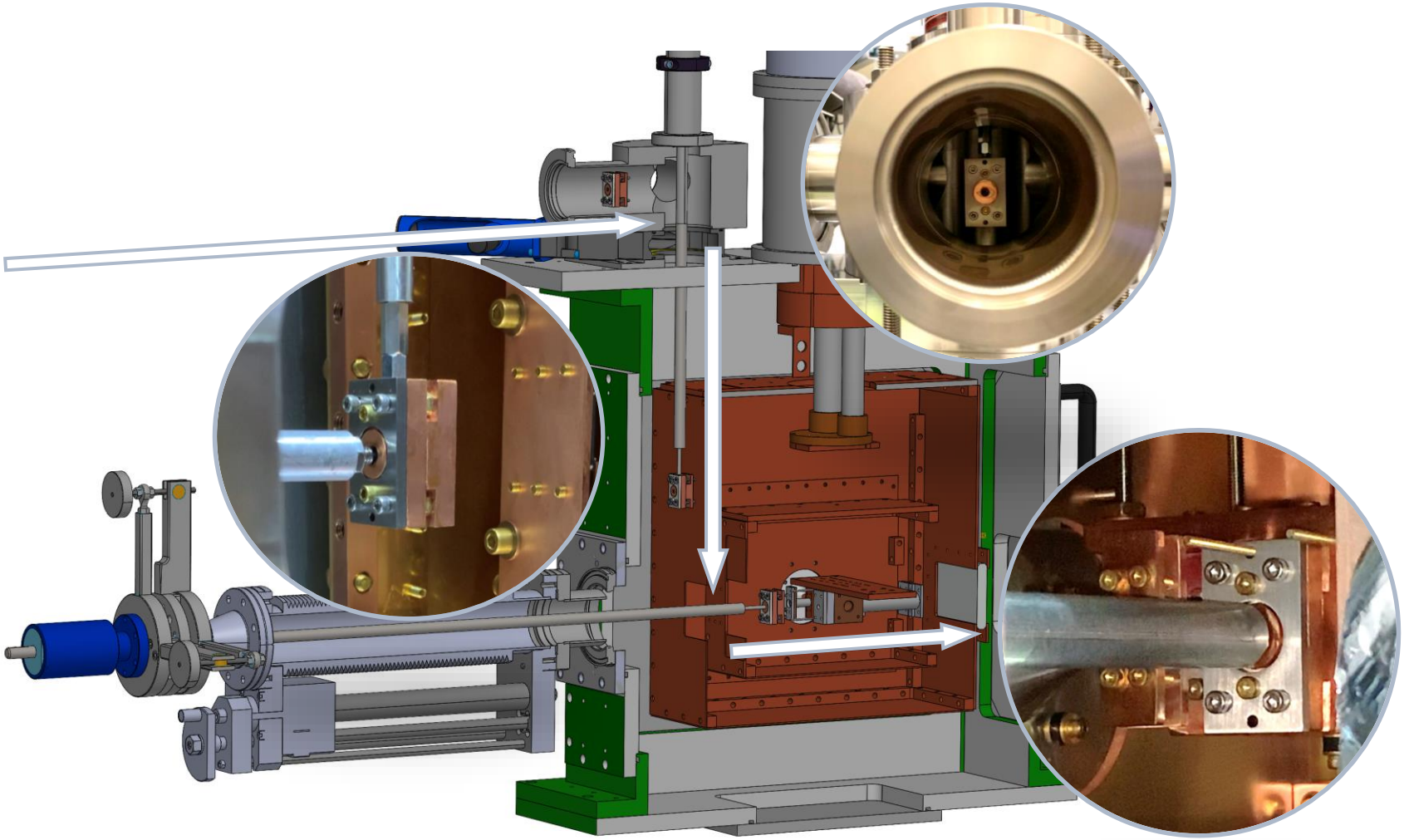
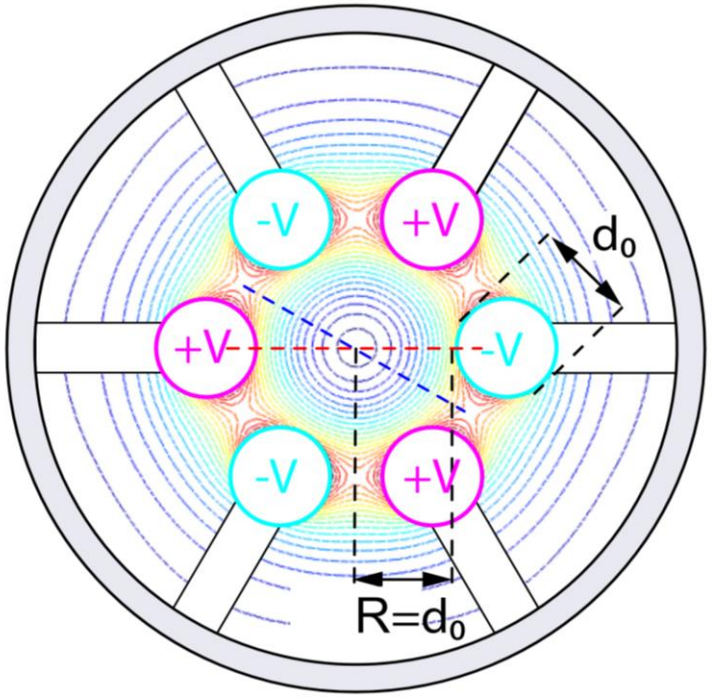


LoadLock Target Removal and Installation



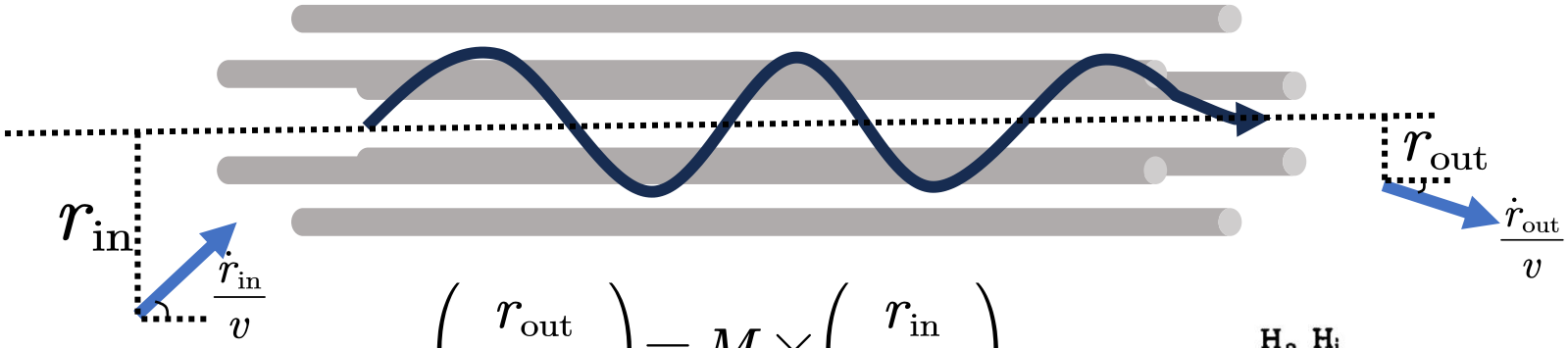
Focusing of beam using hexapole lens



$$W(r) = -\frac{3\mathcal{D}V}{R^3} r^2$$

$$\vec{F}(r) = -m\omega^2 r\, \hat{r}$$

$$\vec{F}(r) = -m\omega^2 r\,\hat{r} \qquad \omega \propto \sqrt{\frac{\mathcal{D}V}{mR^3}}$$



$$\begin{pmatrix} r_{\text{out}} \\ \dot{r}_{\text{out}}/v \end{pmatrix} = M \times \begin{pmatrix} r_{\text{in}} \\ \dot{r}_{\text{in}}/v \end{pmatrix}$$

direct analogy: thick lens imaging

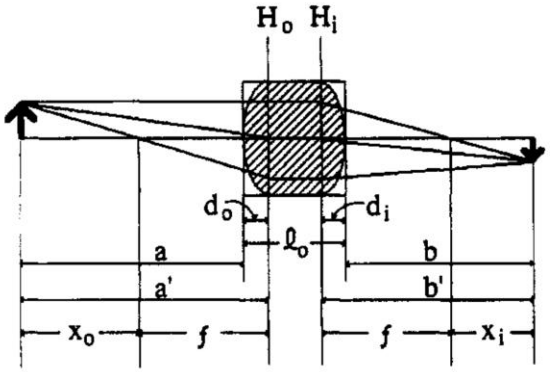
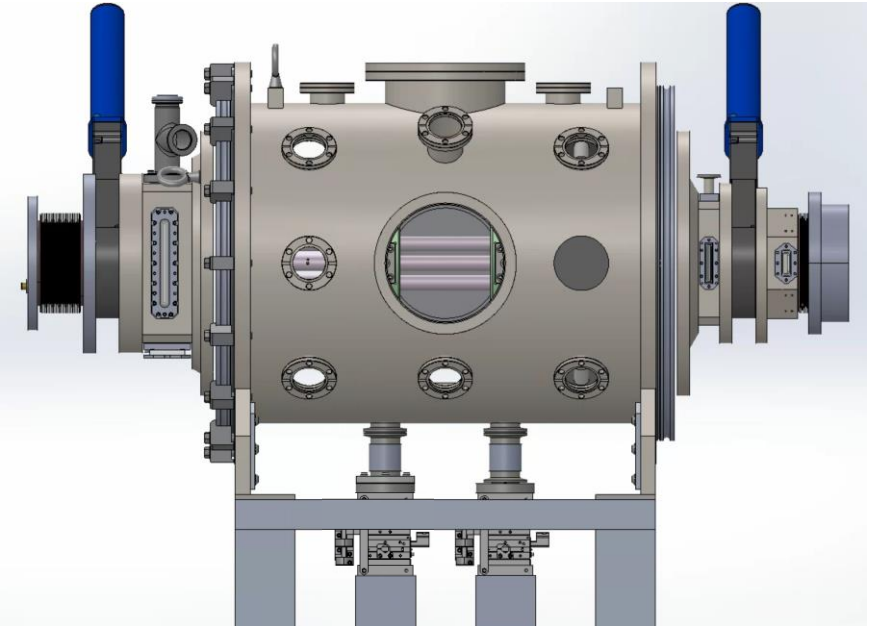
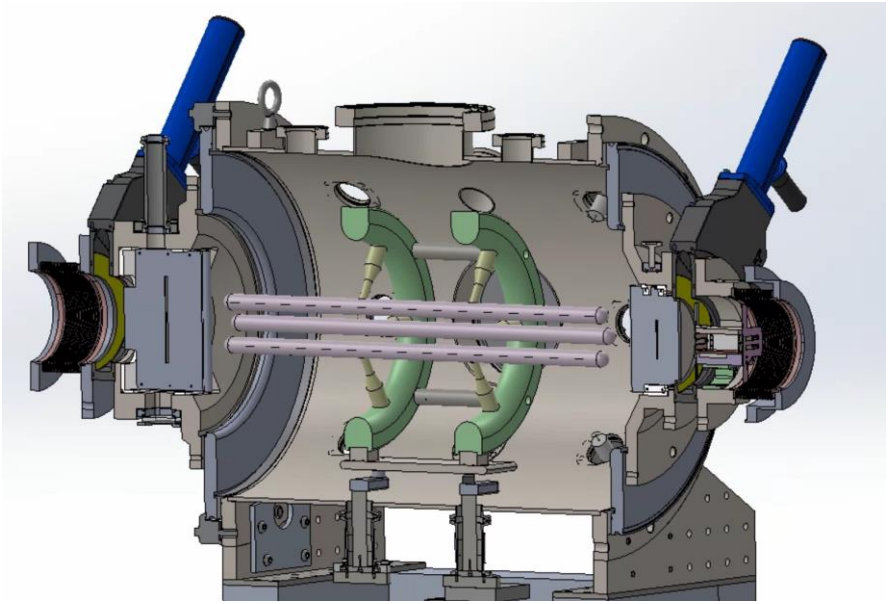


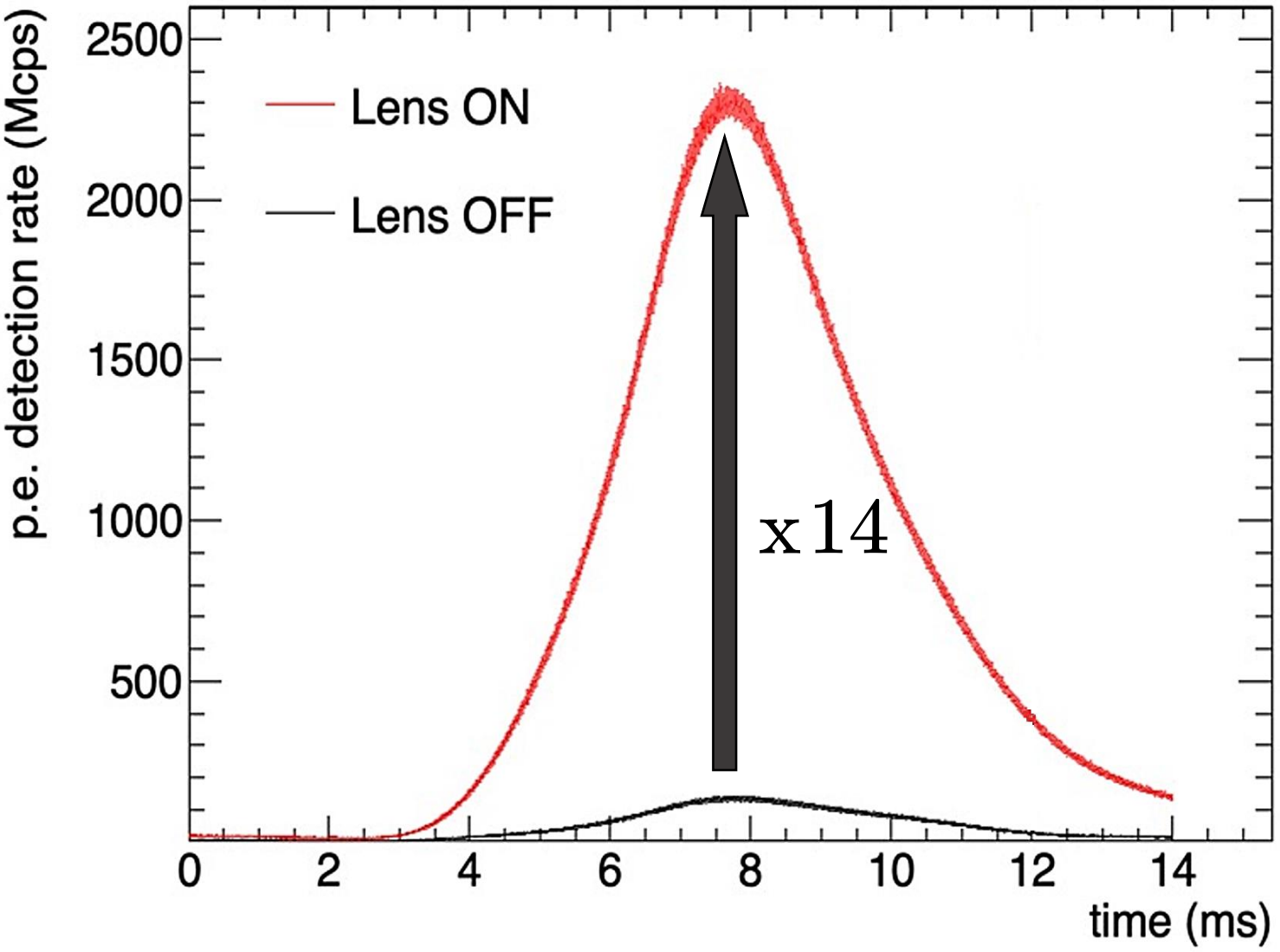
Figure 1. Geometry of a hexapole lens represented as a thick lens. H_0 and H_i denote the entrance and exit principal planes, respectively. (Other symbols are defined in text.)

$$\begin{pmatrix} r_{\text{out}} \\ \dot{r}_{\text{out}}/v \end{pmatrix} = \begin{pmatrix} 1 & b' \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ -f^{-1} & 1 \end{pmatrix} \begin{pmatrix} 1 & a' \\ 0 & 1 \end{pmatrix} \begin{pmatrix} r_{\text{in}} \\ \dot{r}_{\text{in}}/v \end{pmatrix}$$

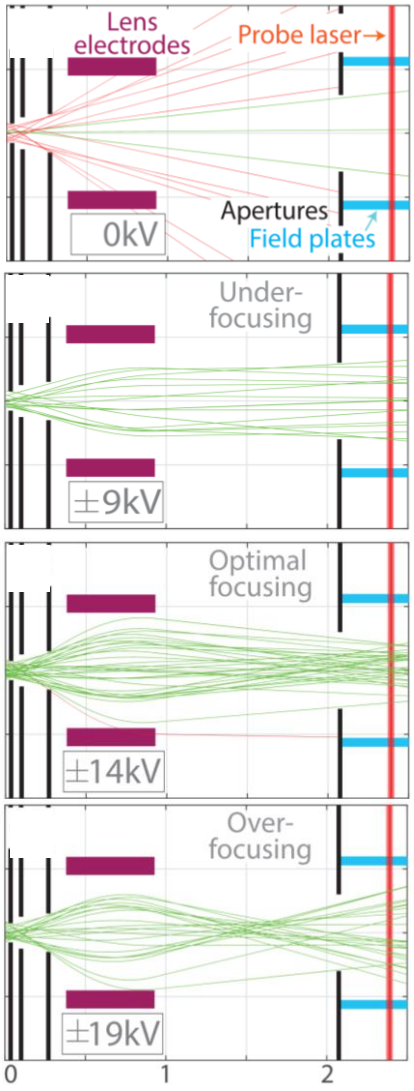


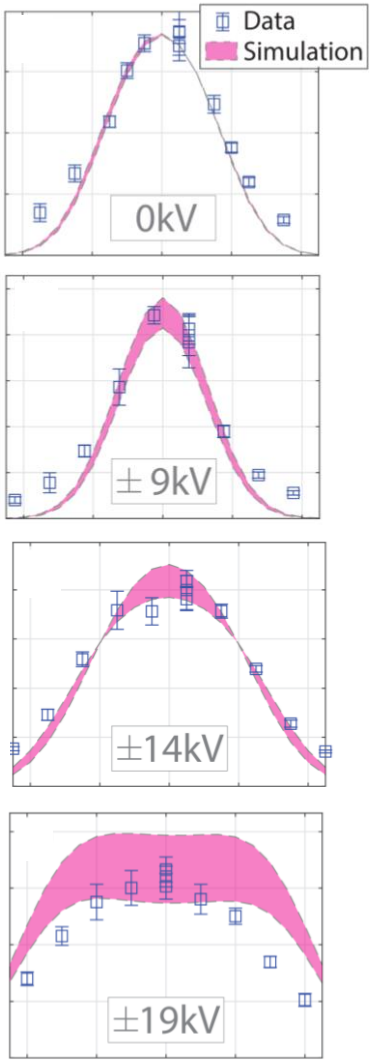


Beam direction


p.e. detection rate (Mcps)
2500
2000
1500
1000
500
Lens ON
Lens OFF
x14
0
2
4
6
8
10
12
14
time (ms)

Trajectory Simulation





Doppler Width Experimental Data