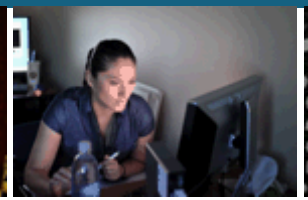
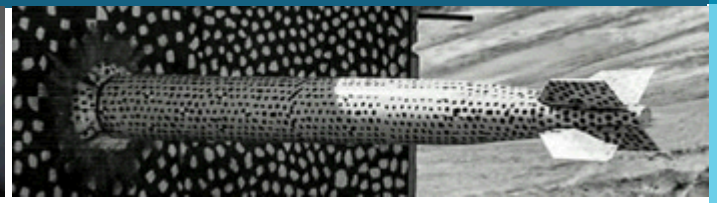
SAND2019-11384PE

# HERMES III Mod/Sim and Characterization





*PRESENTED BY*

Troy Powell

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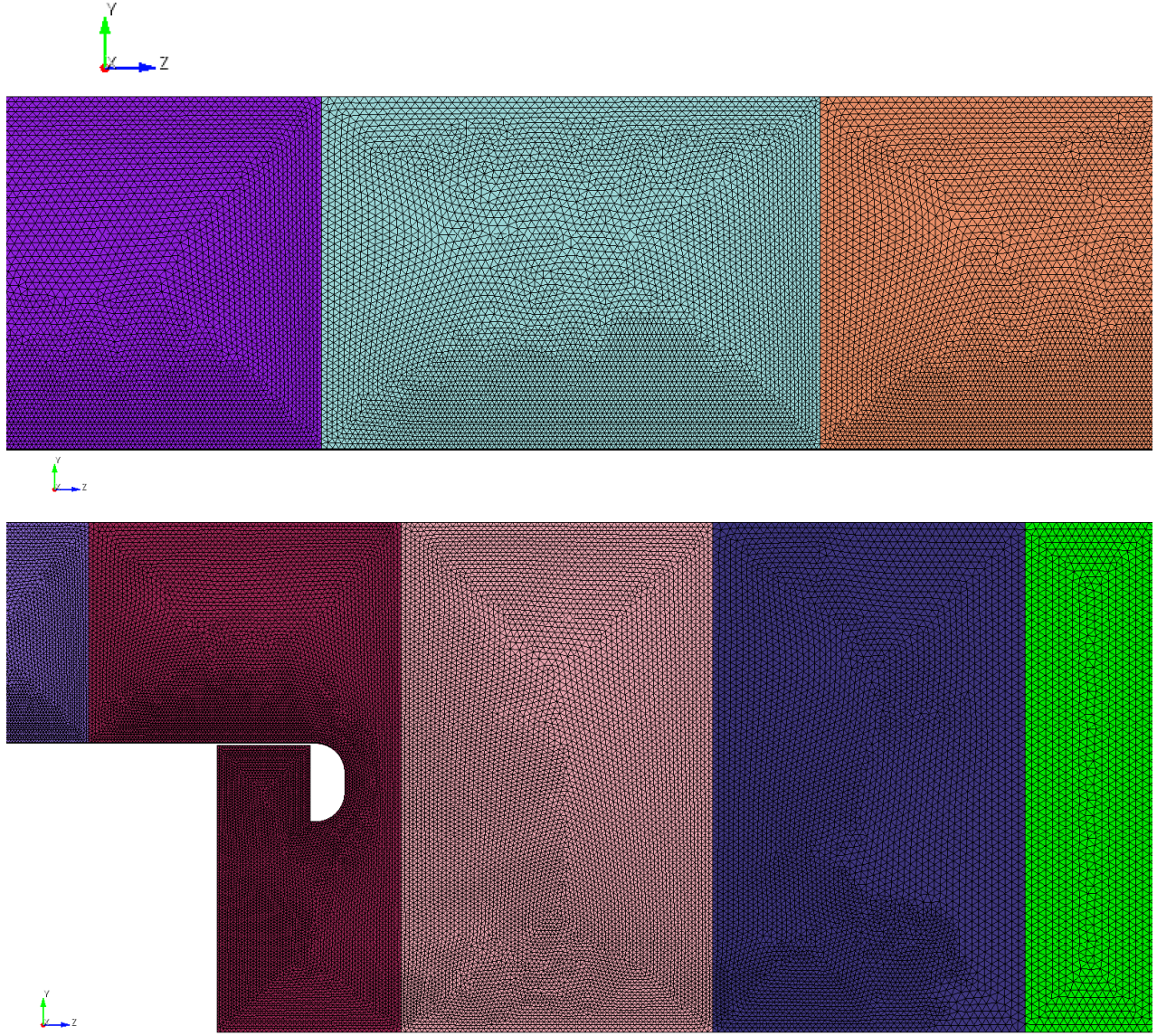
# Model Overview

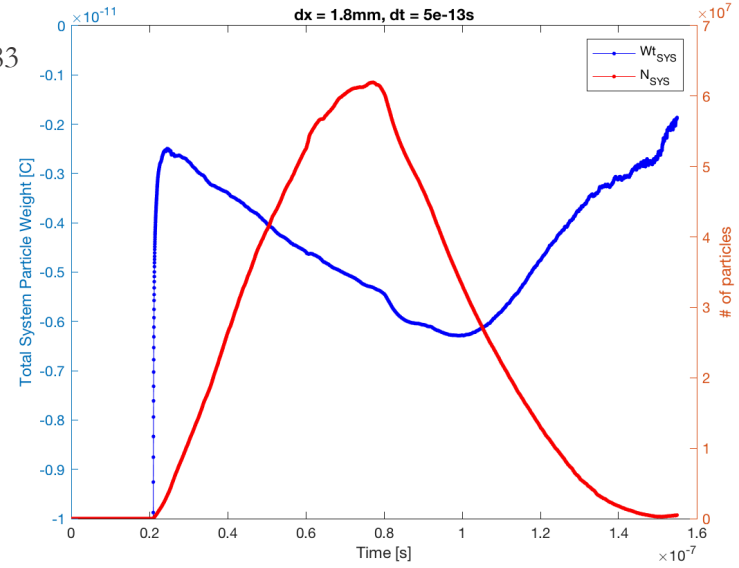


Model:

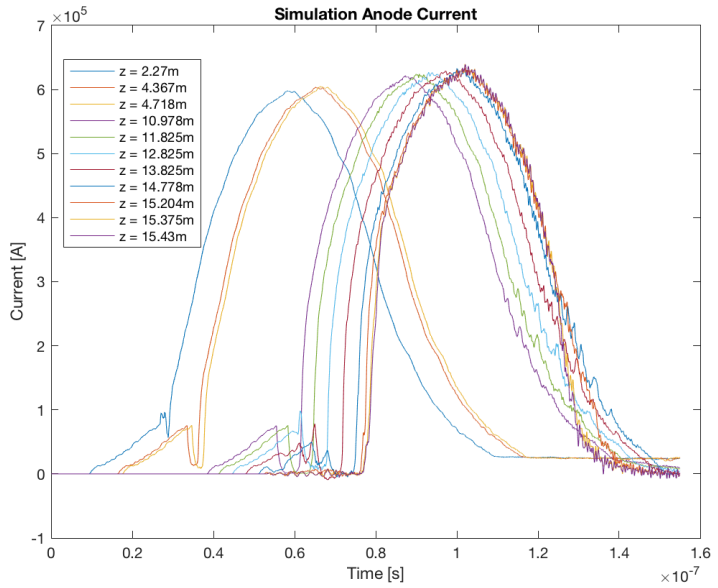
- ~16m coaxial MITL terminated by a diode with a 53-cm AK gap (line-dominated)
- $R_a$ = 32.6cm; $R_c$ = 18.5cm (except for first few m upstream)
- $Z_0 = 60\Omega * \ln(R_a/R_c) = 34\Omega$
- $dx_{min}$ = 1.8mm (~$r_c$)
- $dx_{max}$ = 5.0mm
- dt = 0.5ps ($C_{CFL}$ = c*dt/dx = 0.083 for fields)
- 5° wedge with PMC symmetry
- Multicolored slices used to record killed particle fluxes on the top of the MITL for comparison with TLDs
- 18MV HERMES III voltage waveform launched from coaxial port source at left boundary

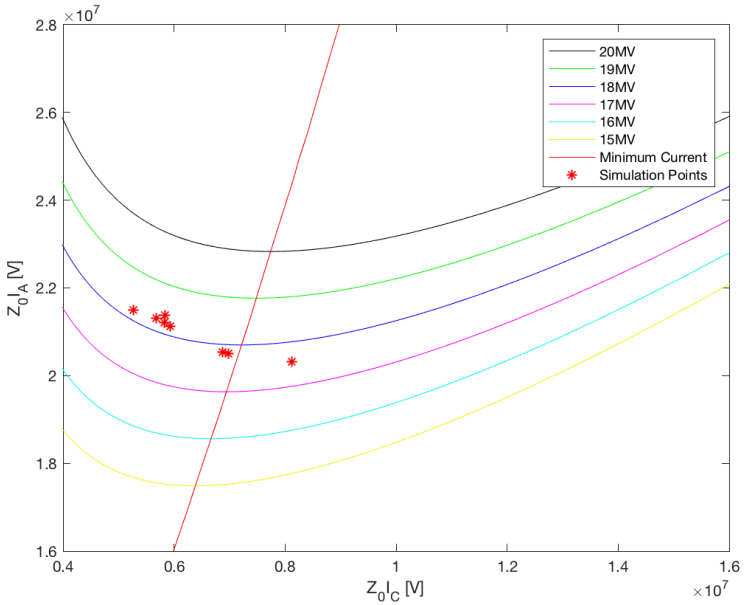
Most Recent Emission Model: SCL

- $E_{emit}$ = 250kV/cm (max $E_k$ = 1700kV/cm)
- Injection height: 1/1000$^{th}$ to 1/100$^{th}$ of a cell (1.8 to 18 μm)
- Thermal energy: 10eV (constant)
- Emission Delay: 0.5ns
- 1 particle/face every 2$^{nd}$ timestep
- Weight floor: 100k e$^-$ (bottoms itself at 37.5M)



# MITL Diagnostics



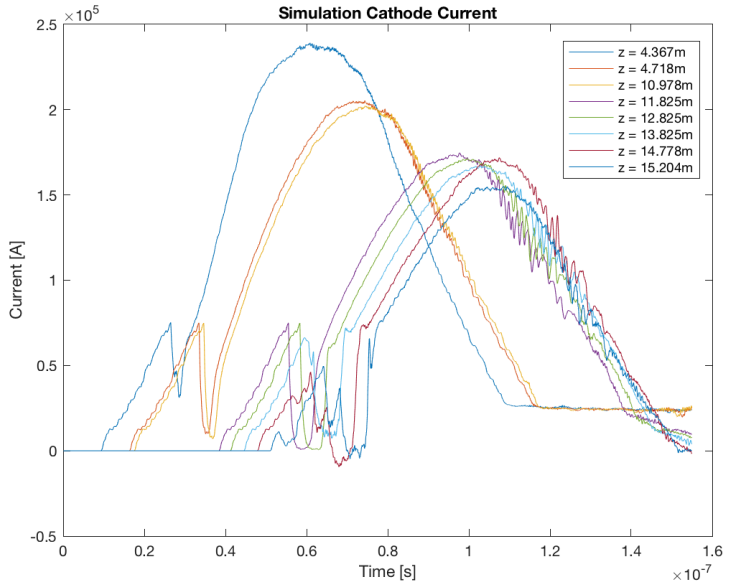



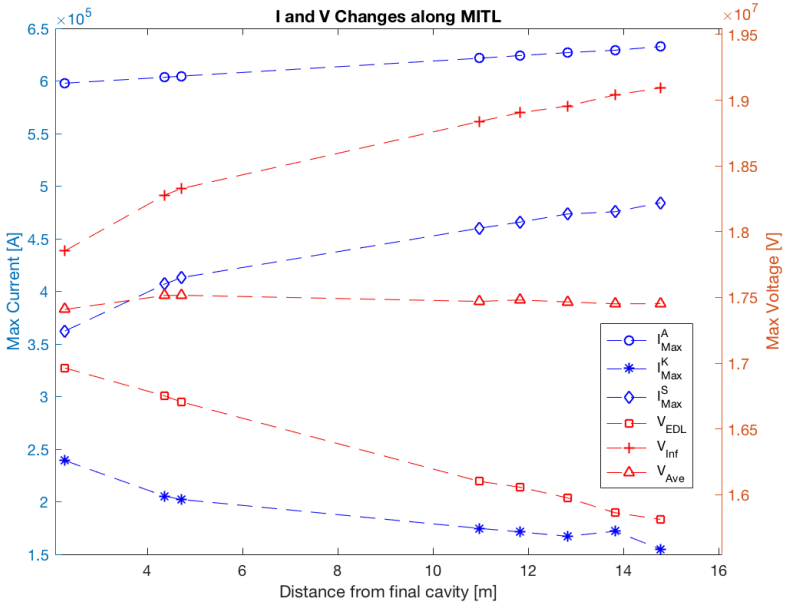

$$V = \int \vec{E} \cdot dl$$

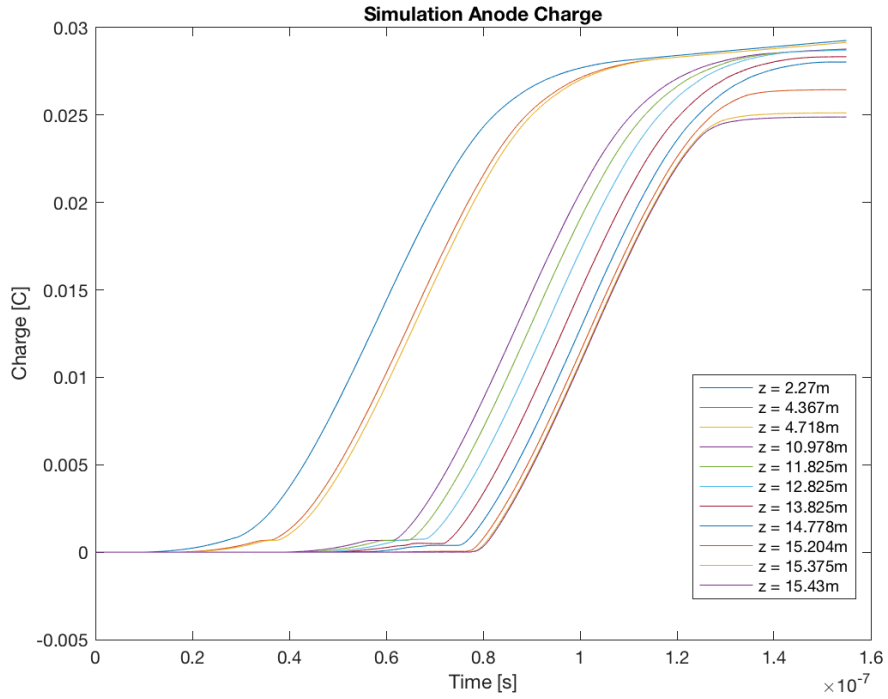
$$V = (Z_0^2 I_a^2 - Z_0^2 I_c^2)^{1/2} - \frac{mc^2}{e} \frac{Z_0 I_a - Z_0 I_c}{Z_0 I_c}$$

Electron pressure factor neglected

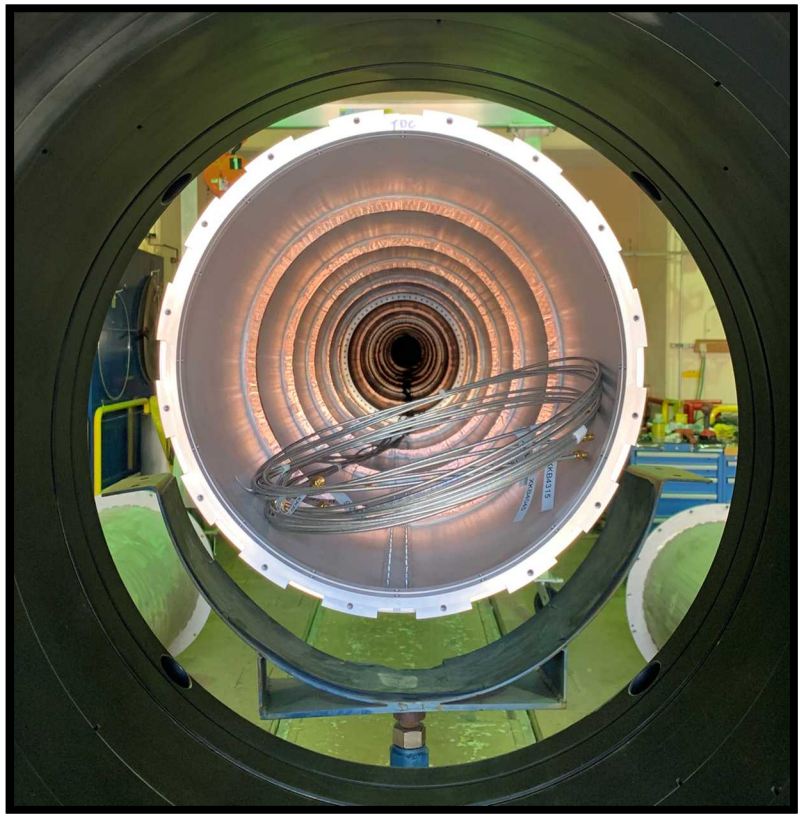
Slight $I_A$ sharpening

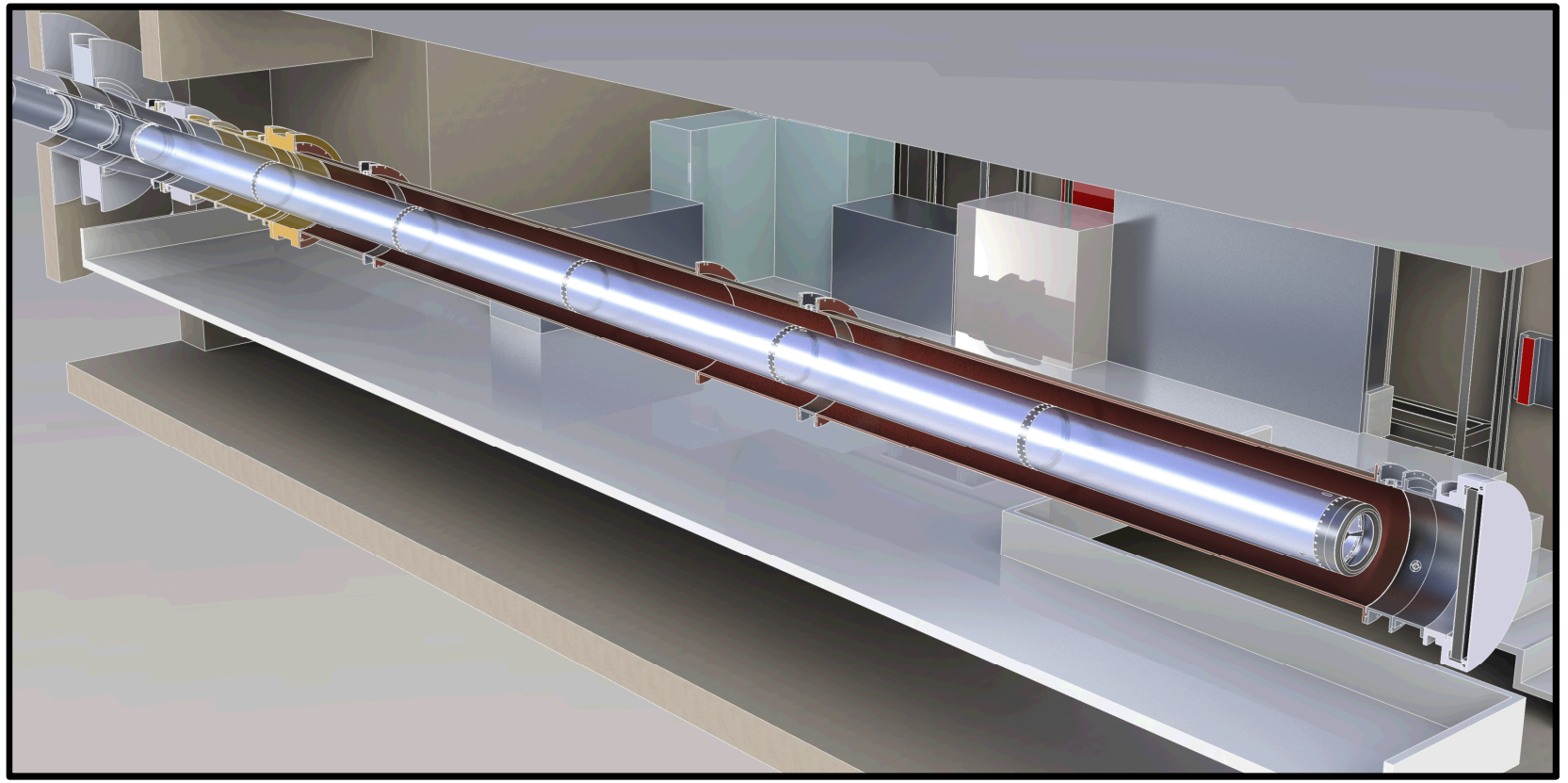


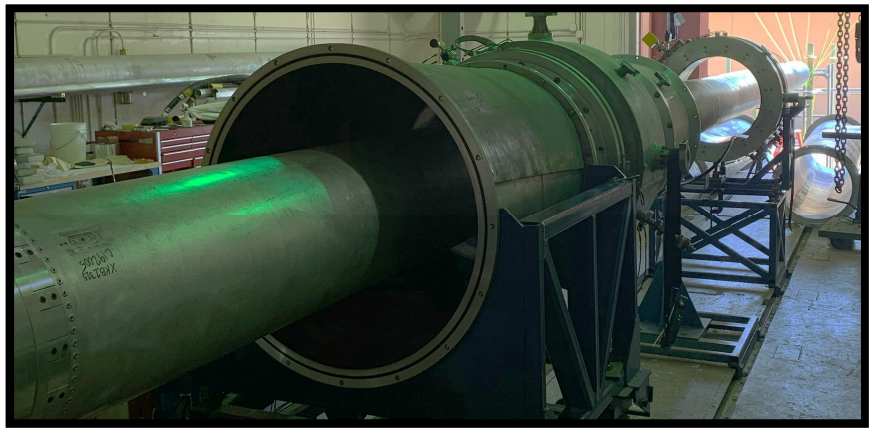



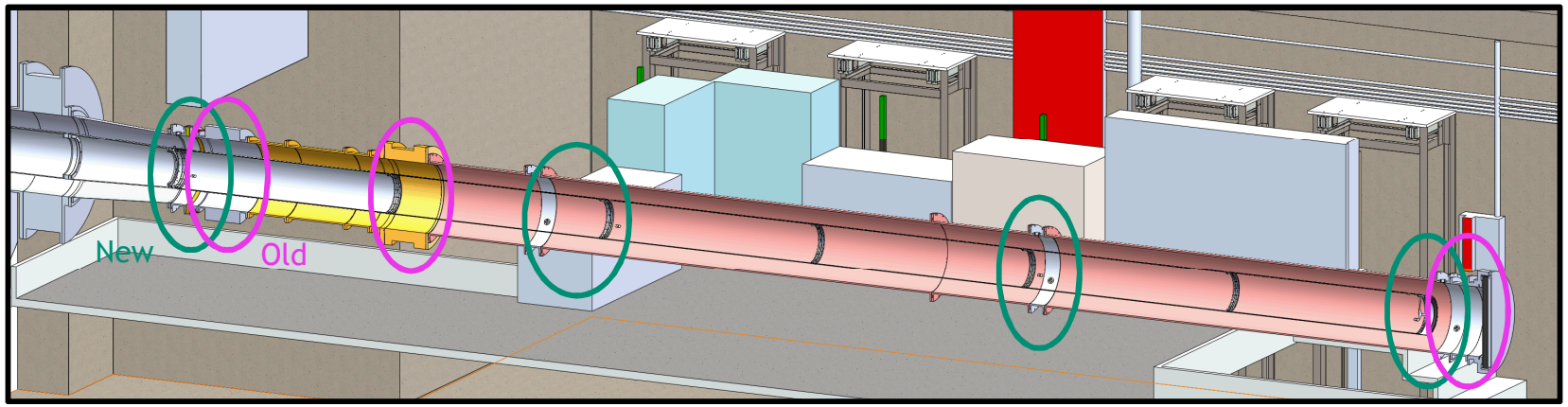



# HERMES III Outdoor Mode (photo credit: Andy Biller)

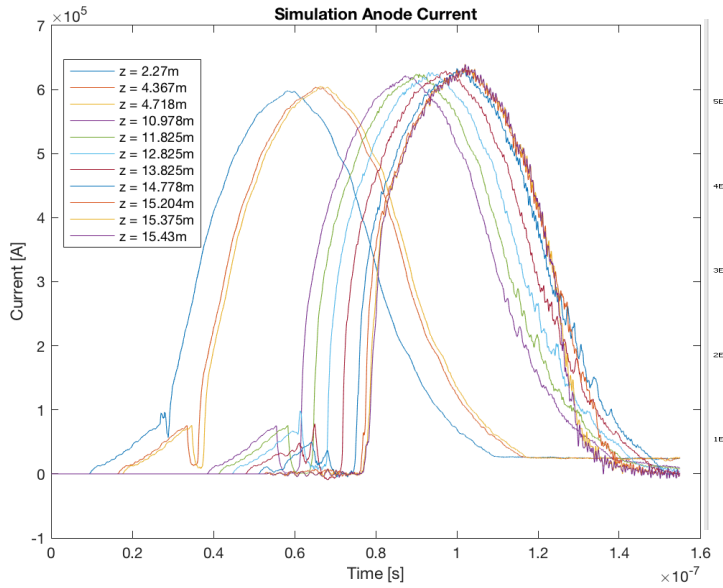


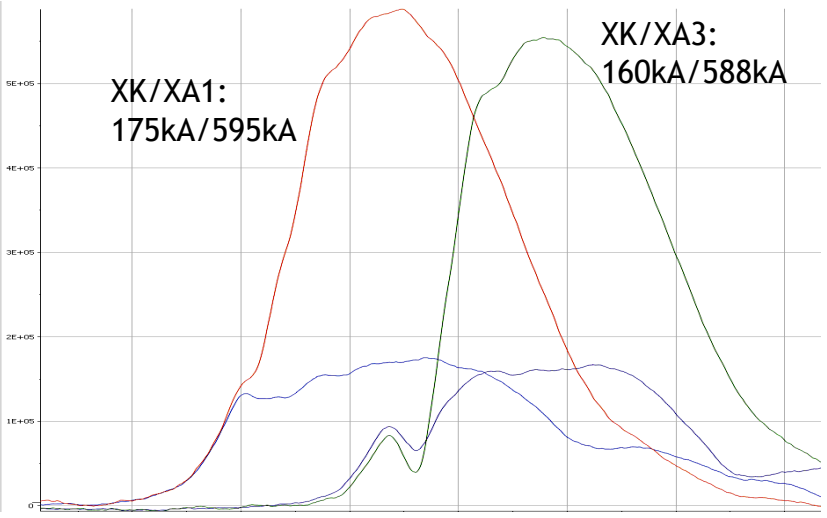


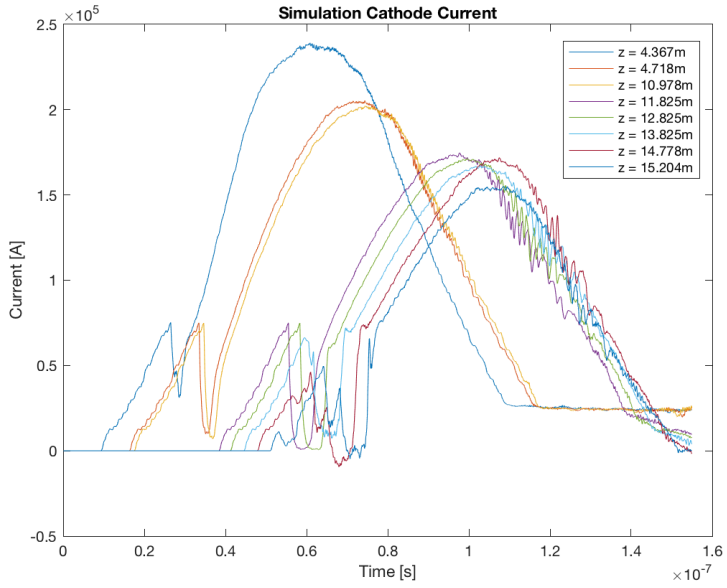


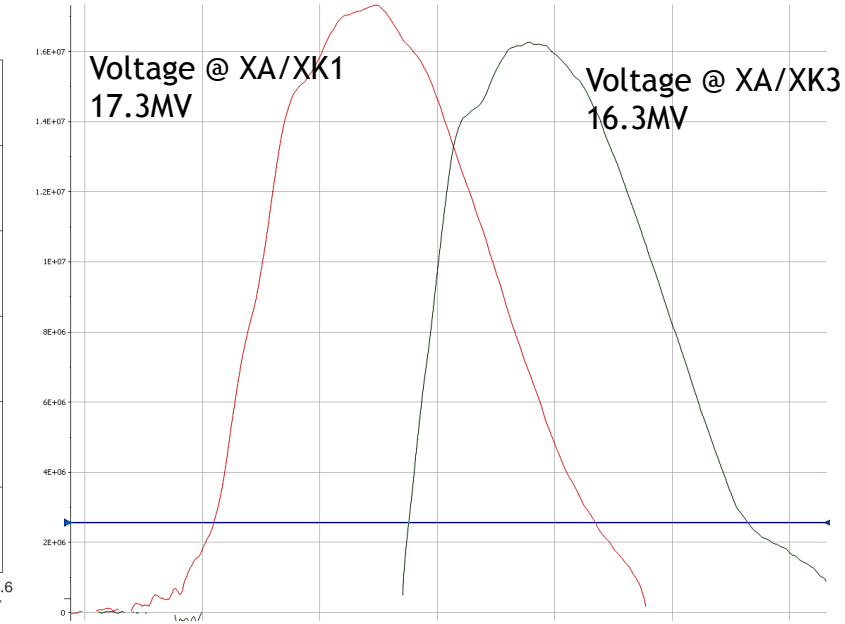


# Experimental Comparison (Shot 1148)




Simulation $V_{inf}$, $I^a_{max}$, and $I^k_{max}$ are 10.%, 8.7%, and 14.% higher than shot.

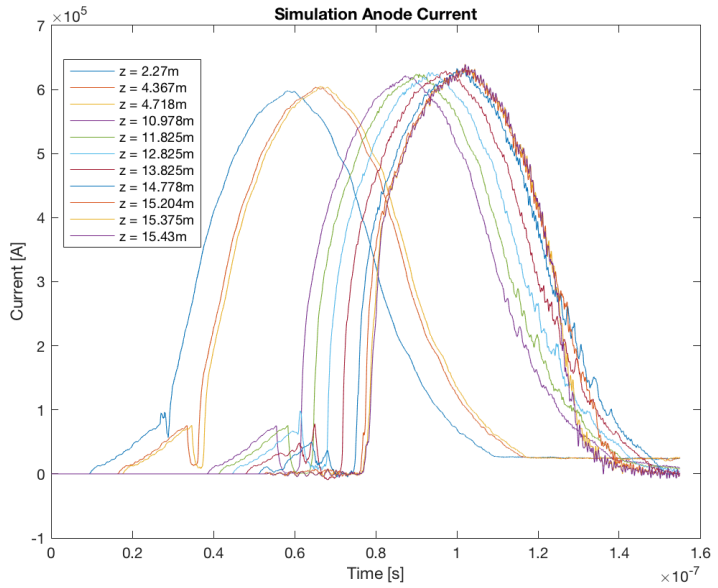
With same $Z_0$, sims approximately scale with shot.

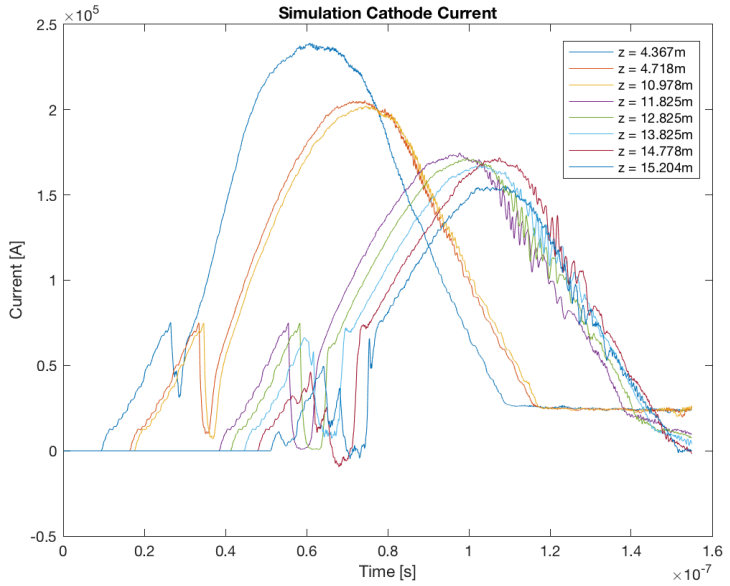
Charge transfer loss for shot: 10.9%

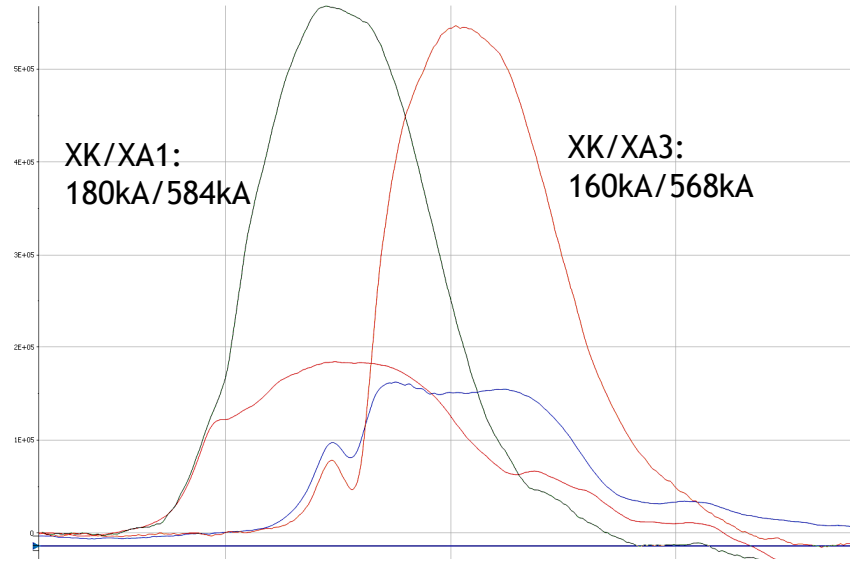
Charge transfer loss for sim: 4.6%

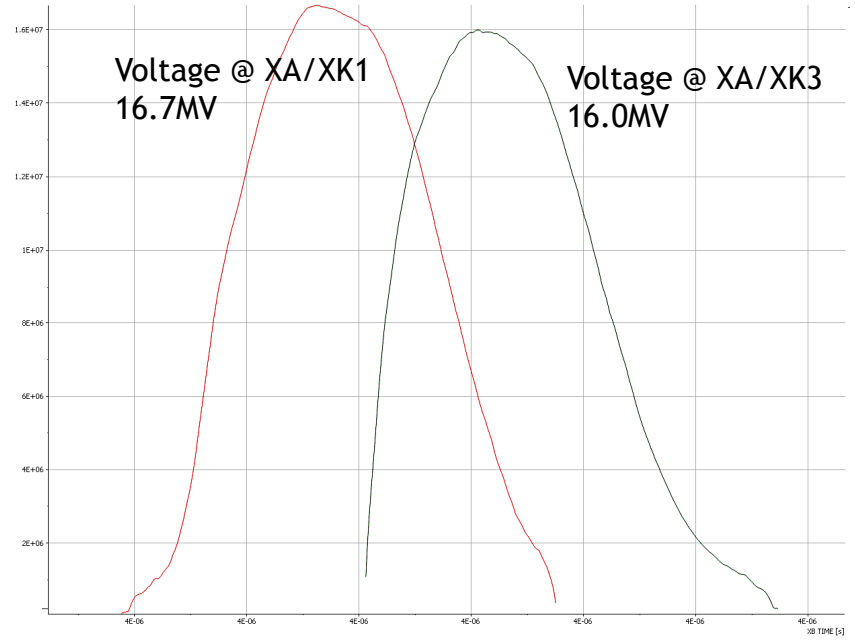
$$V = (Z_0^2 I_a^2 - Z_0^2 I_c^2)^{1/2} - \frac{mc^2}{e}\frac{Z_0 I_a - Z_0 I_c}{Z_0 I_c}$$

# Experimental Comparison (Shot 11150)




Simulation $V_{inf}$, $I^a_{max}$, and $I^k_{max}$ are 13.%, 14.%, and 20.% higher than shot.

With same $Z_0$, sims approximately scale with shot.

$V_{inf}$ more accurate than $V_{EDL}$ since both I and $V_{inf}$ are higher?

Charge transfer loss for shot: 6.9%

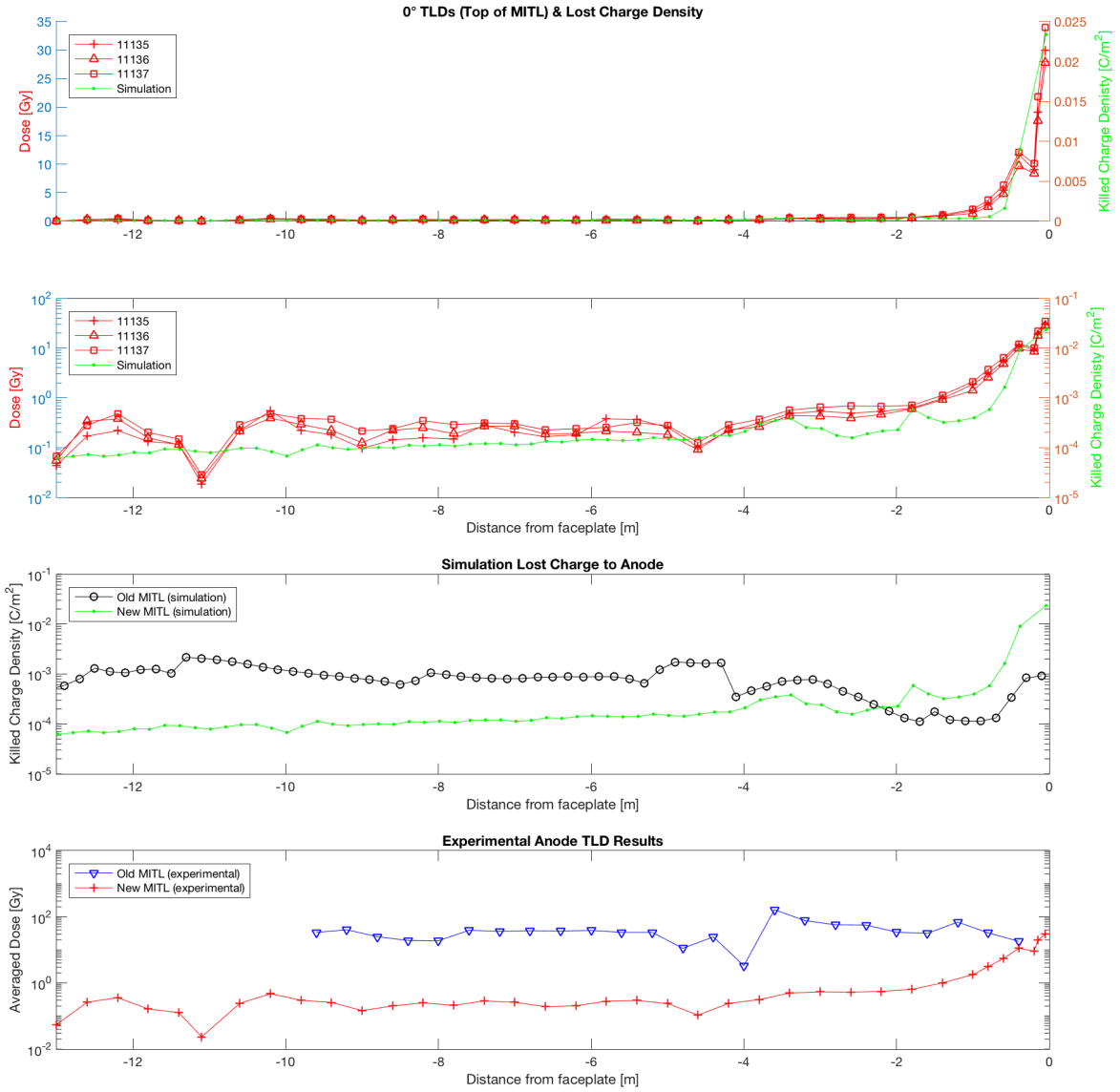
Charge transfer loss for sim: 4.6%

Emission model still needs work to get better $I_K$ predictions. May help with voltage drop.

Increase $e^-$ temperature and injection height, and change emission delay function?

$$V = (Z_0^2 I_a^2 - Z_0^2 I_c^2)^{1/2} - \frac{mc^2}{e}\frac{Z_0 I_a - Z_0 I_c}{Z_0 I_c}$$

# Current "Loss" Characterization




Only for structural comparison

Sharp dips around -11m and -0.2m due to TLD being on a flange.

Orders of magnitude difference between old and new both in experiment and simulation

In summary, the main goal was achieved: the new MITL substantially outperforms the old MITL.