2D Modeling of an Atmospheric Pressure Microwave Plasma System

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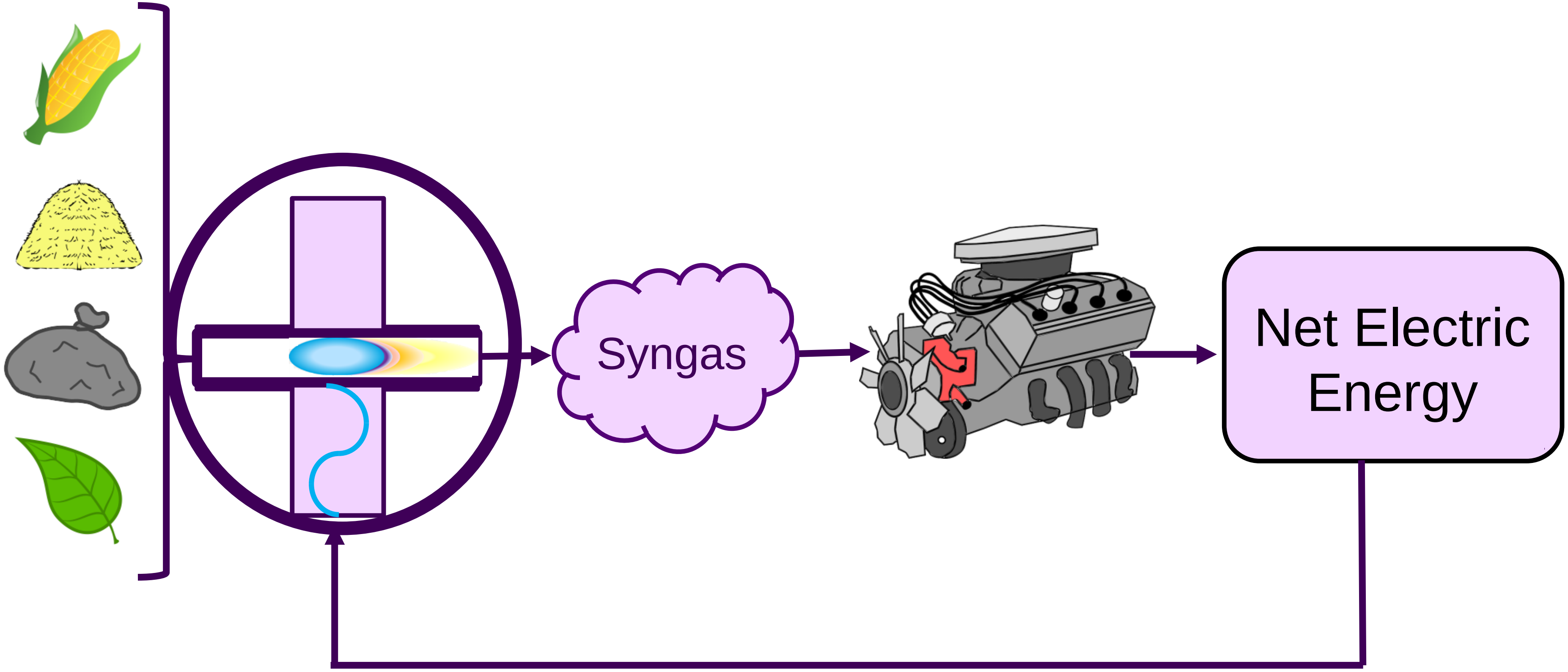
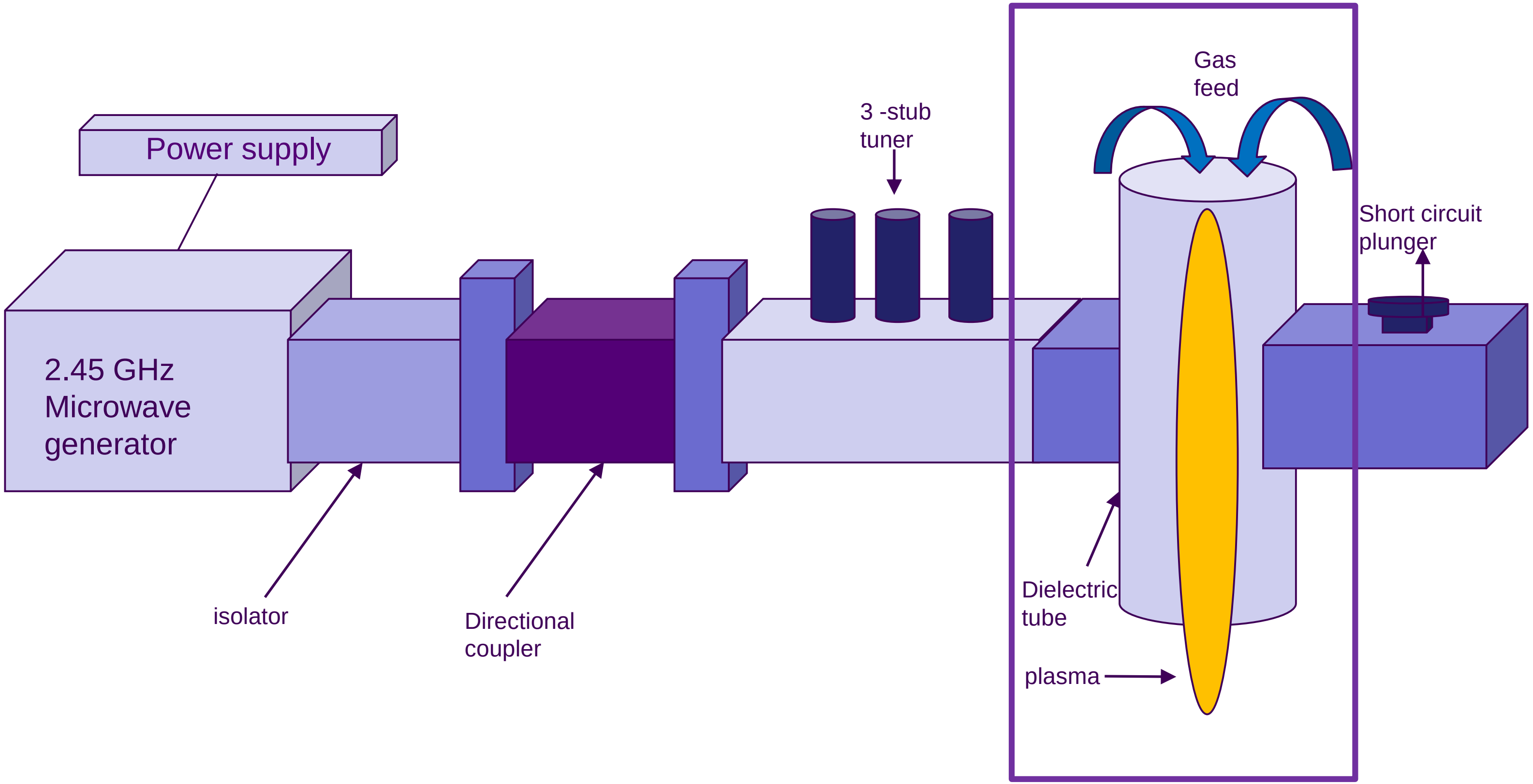
Biomass in Gasification Cycle

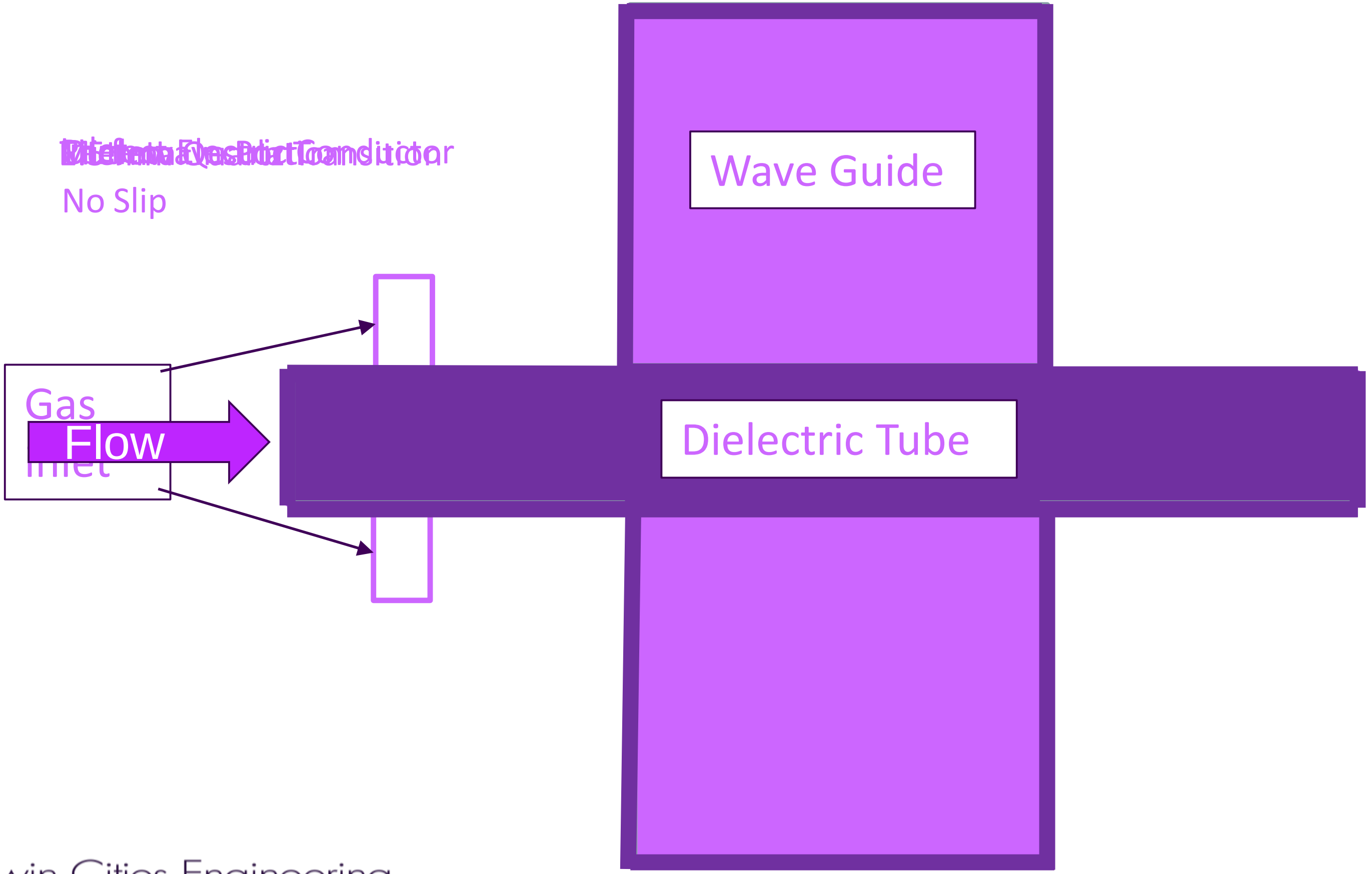


Microwave Plasma Discharge System



Boundary Conditions and Components

No Slip



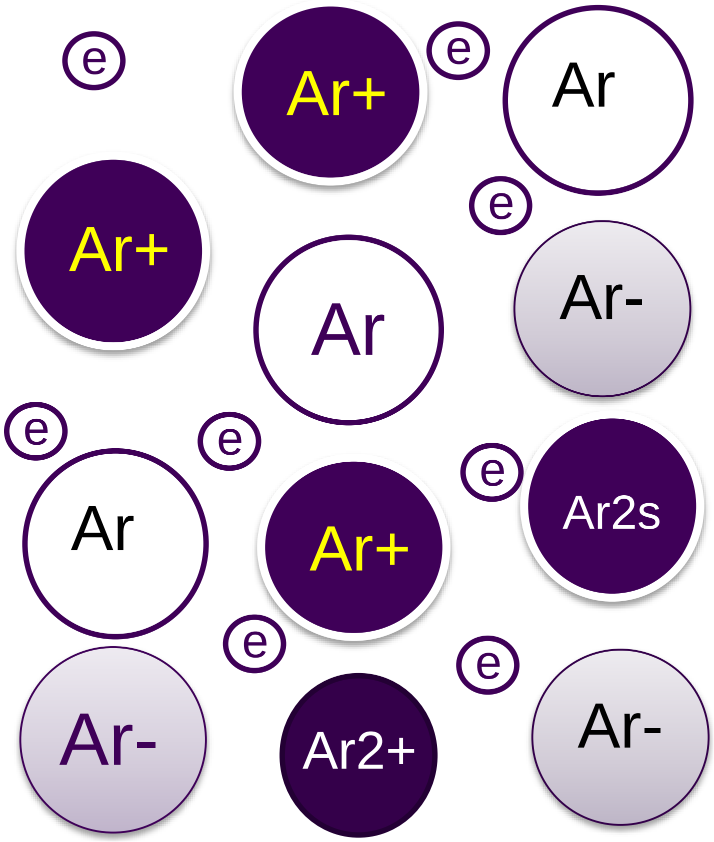
Research Question

Which geometry configuration and microwave inputs allows for the most efficient biomass gasification and syngas production?

Plasma Chemistry kinetics

Elastic	Inelastic	Excitation	Ionization
Metastable Quenching	3 body Reactions	Ion Conversion	Recombination

Chemical species involved



Data Processing and Modeling approach

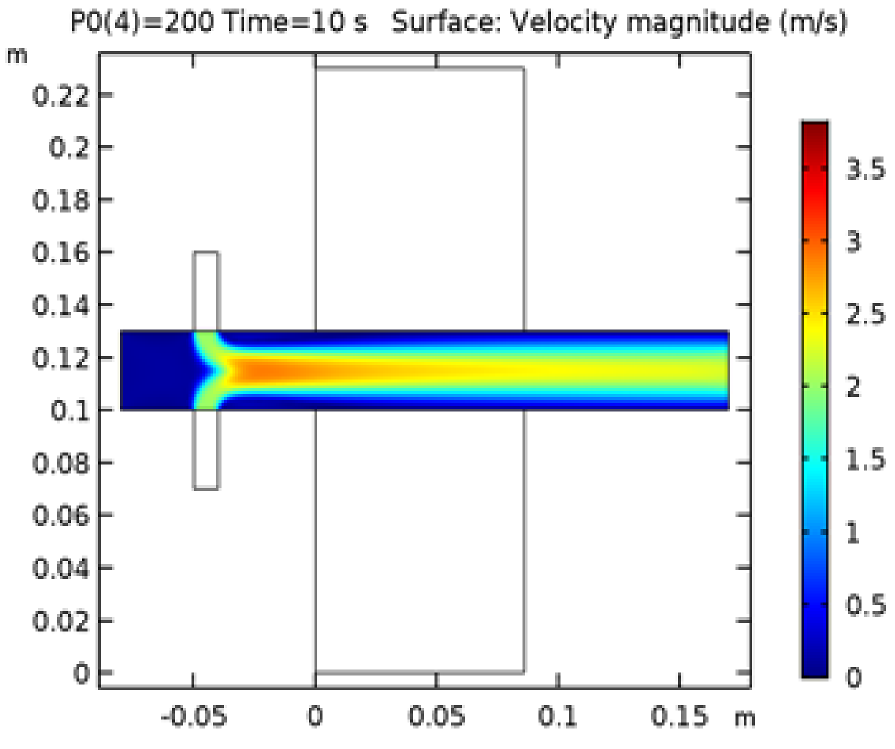
cross-section Data processing

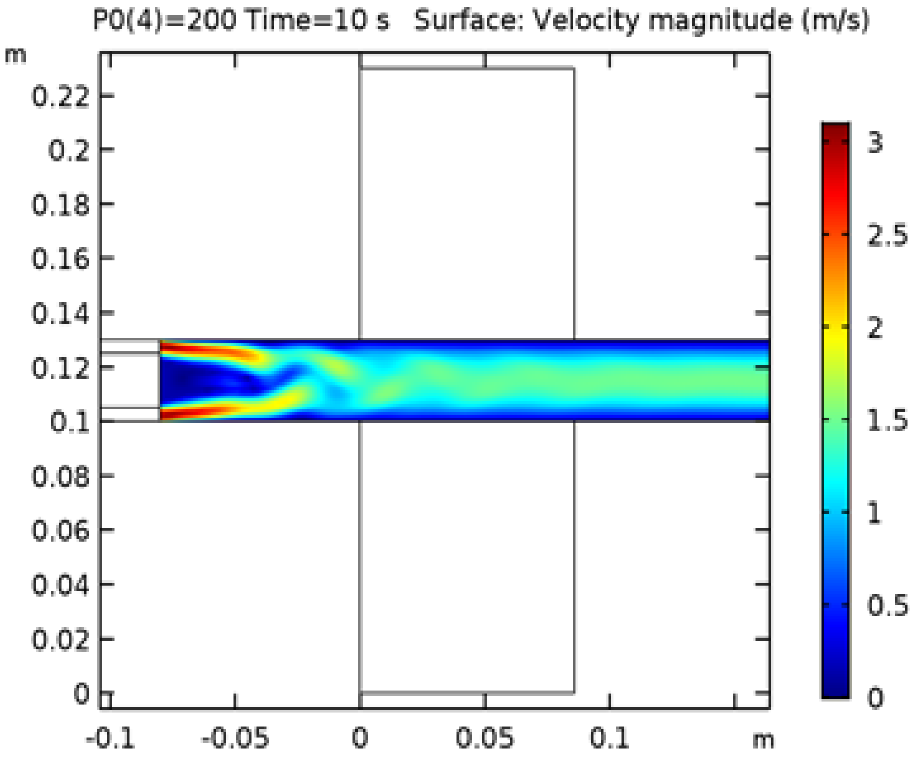
- Boltzmann Analysis
  - EEDF
  - Transport and source coefficient
- Drift diffusion equations
  - Electron Energy
  - Electron density

Multi-physics

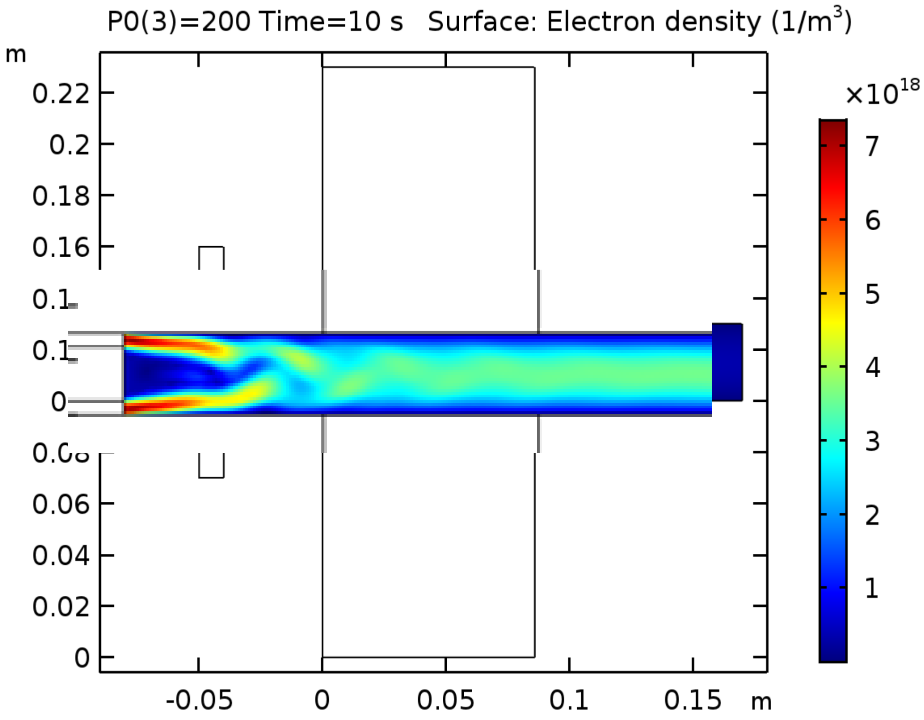
- RF
- Heat Transfer
- Computational Fluid Dynamics

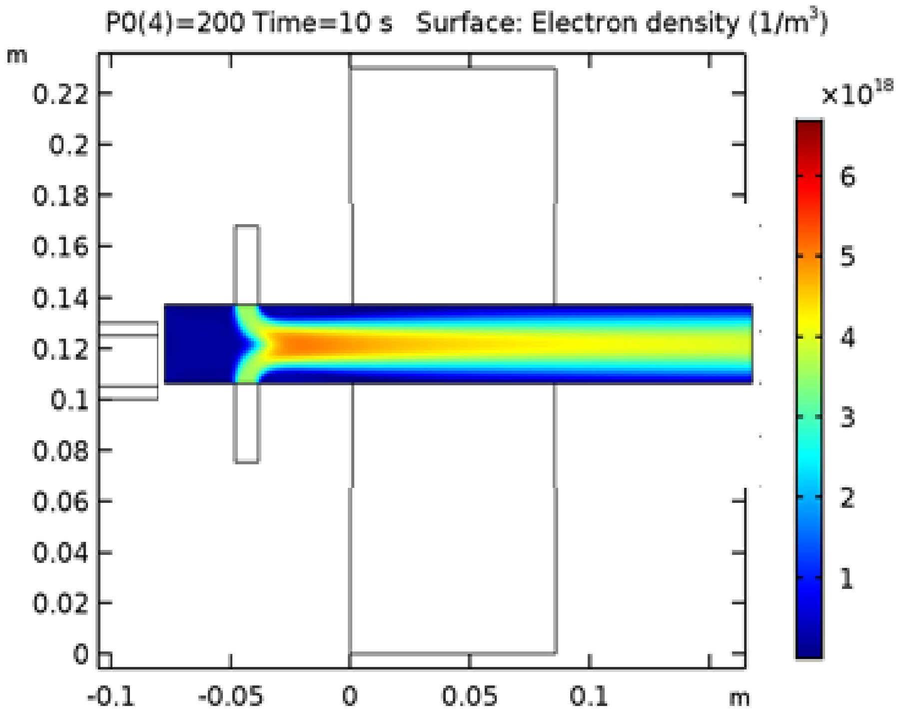
Results: Fluid Flow P_{abs} 200W



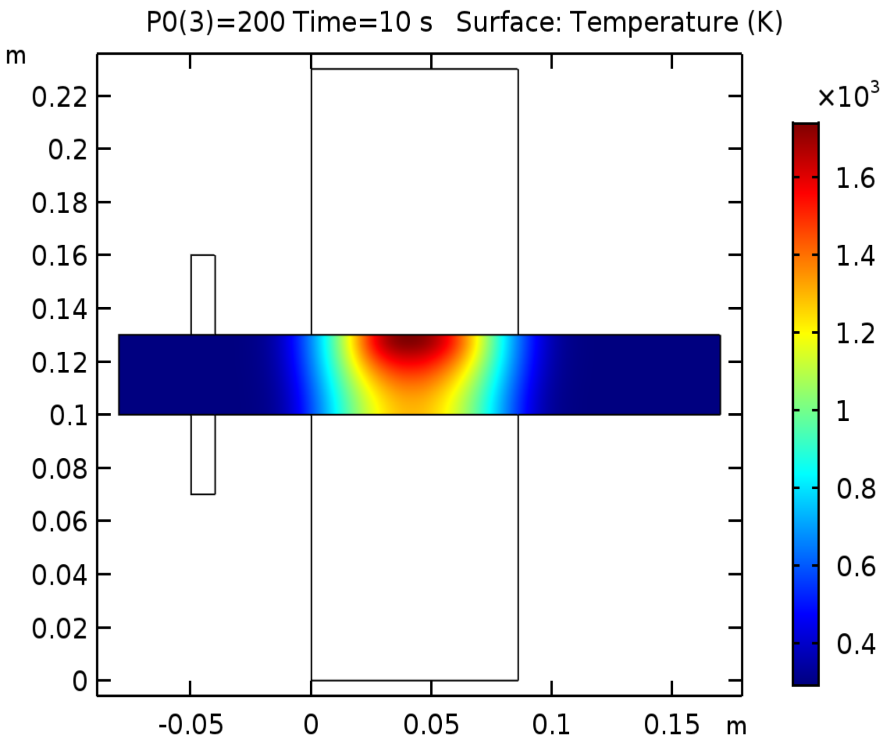


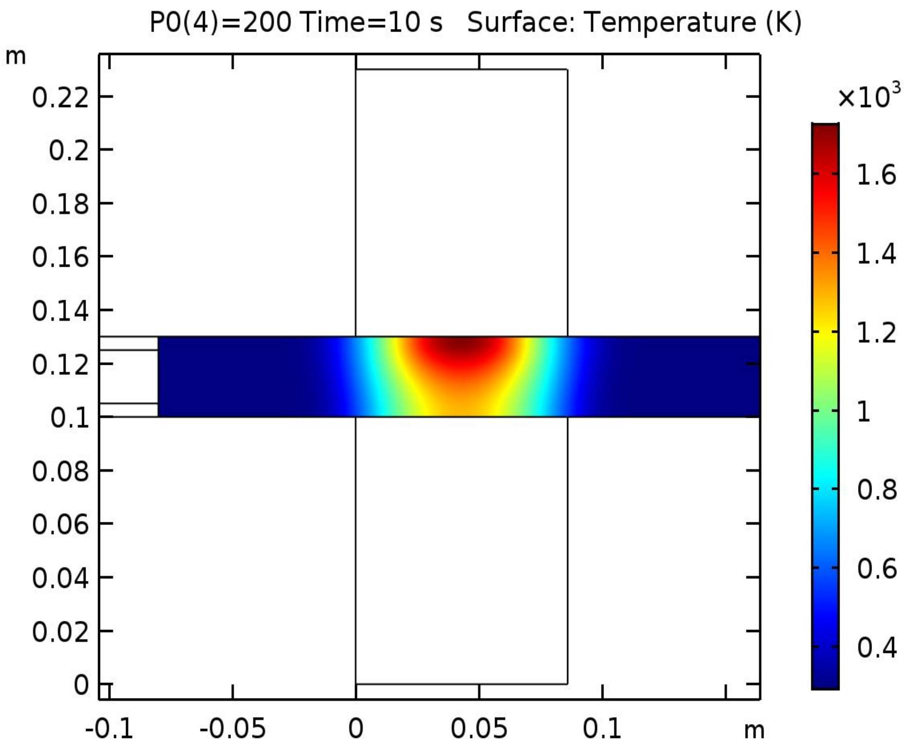
Results: Electron Density P_{abs} 200W

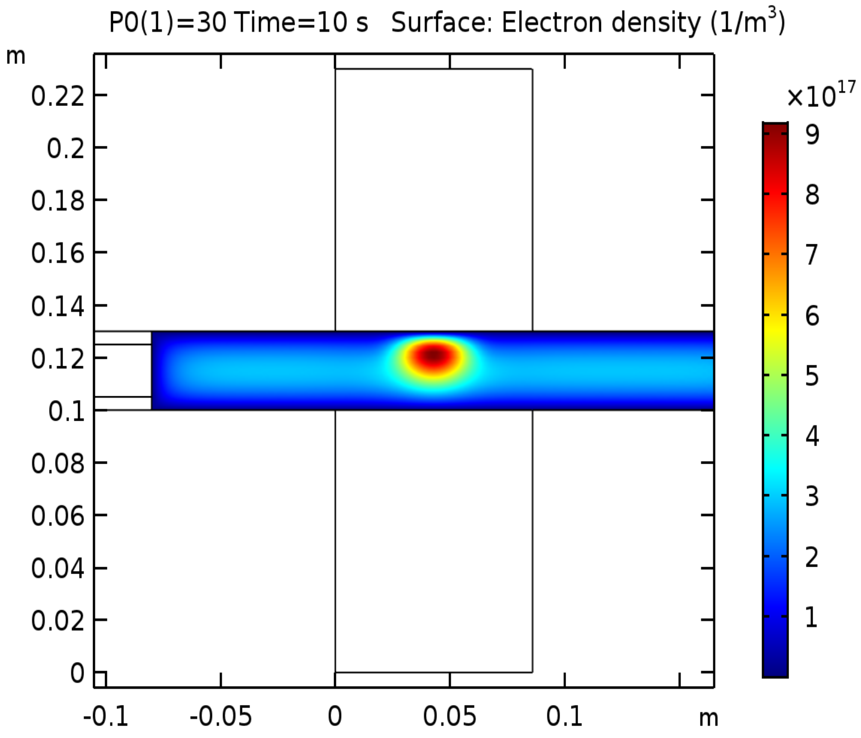


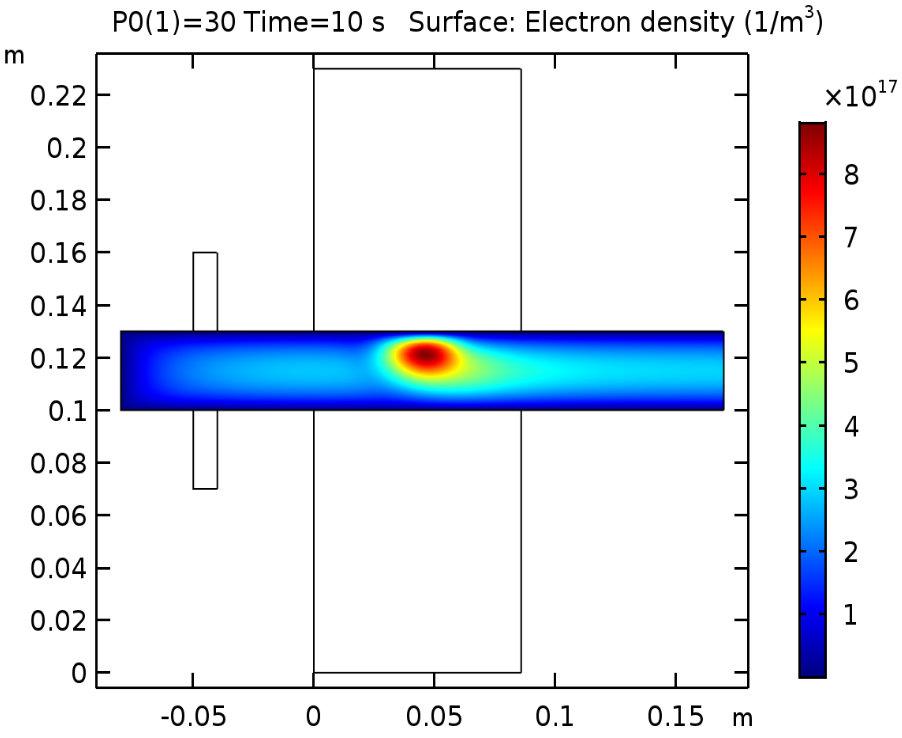


Results: Surface Temperature P_{abs} 200W






P0(1)=30 Time=10 s Surface: Electron density (1/m3)
m
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
-0.1
-0.05
0
0.05
0.1
m
×1017
9
8
7
6
5
4
3
2
1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-0.05
0
0.05
0.1
0.15
m
×1017
8
7
6
5
4
3
2
1

Conclusion & Outlook

We can use flow to manipulate the plasma in hopes to reduce thermal shock on the dielectric tube. With further simulation optimal flow rates can be found for specific power absorbed values.

Lab Experiments need to be done to validate the Simulations results at these specific conditions

This model will serve as a foundation for plasma simulation in air with atmospheric conditions

Acknowledgements

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