National Cheng Kung University

Institute of Space and Plasma Sciences

2023-2024 Progress Report

Student: CHEN, YI-XIANG

Advisor: Dr. Po-Yu Chang

Abstract

For the 2023-2024 period, my focus is on the plasma gun design and the discharge experiment tests. I have completed the ver.01 and ver.02 gas supply designs, as well as type A and B electrodes. I tested the plasma gun in a vacuum environment, connecting it to capacitors with different capacitances and using an adjustable voltage power supply for the experiment setup. I recorded the voltage diagrams and took photos of the plasma gun's front and side views using a visible light camera.

Based on the experimental results, I will provide recommendations for the project's future direction. Best of luck to the next person who takes on this project.

Table of Content

I. Design of plasma gun
   1. ver.01 gas supply
   2. type A electrode
   3. type B electrode
   4. ver.02 gas supply
II. Simulations in COMSOL
   1. Fluid flow simulation of our design
      a. ver.01A plasma gun
      b. ver.01B plasma gun
   2. Electrostatics simulation of our design
      a. ver.01A plasma gun
      b. ver.01B plasma gun
III. Experiments and Results
   1. ver.01A
   2. ver.01B
   3. ver.02A
   4. ver.02B
   5. Data analysis & reminds
IV. Future perspectives
V. Non-experiment related stuff
VI. Conclusion

I. Design of plasma gun

We want to generate the Spheromak. The concept is shown in Fig. 1, which consists of a circular electrode and a center electrode. The four cylinders on the outer circular electrode are what we want to lead the arcing to the four sides, not just arcing in one path. If it only arcs from one path, the breakdown current intends to follow the path and does not create an azimuthally symmetric Spheromak. It is not acceptable in our experiment. In our system concept, we will put a coil inside the center electrode or outer the circular electrode to generate a radial ($\hat{r}$) magnetic field and inject Argon from the bottom of the device. With the voltage between the center electrode and the circular electrode, a breakdown can happen and generate arcing current. When the current goes through the electrodes, it will generate the toroidal magnetic field (labeled in green) and poloidal current (yellow line). So, the arcing current will have the electromagnetic force $\hat{j} \times \hat{B}$ to push the plasma to move in the toroidal direction. With the plasma moving, it will generate the toroidal current and poloidal magnetic field (blue line), The operating steps are shown in Fig. 2, which shows the confinement of the Spheromak.

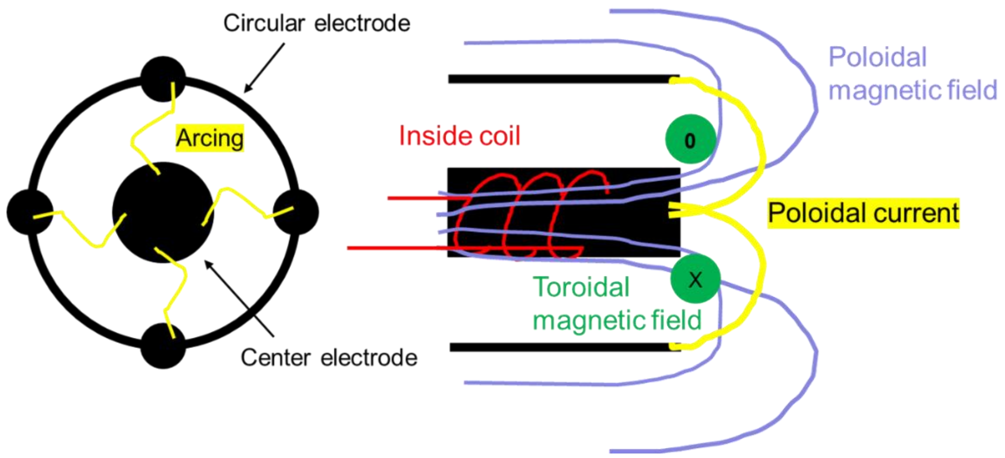


Figure 1

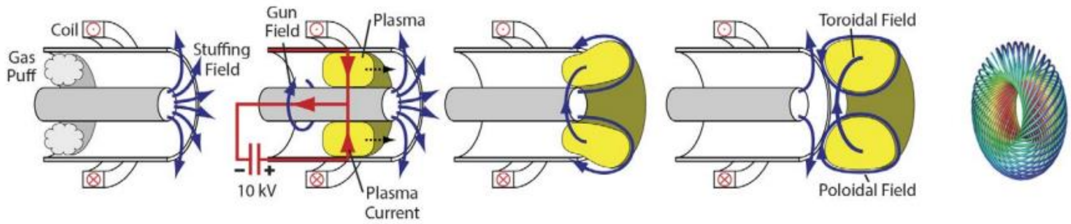


Figure 2

In last year's plasma gun design, as shown in Fig. 3 and Fig. 4, I attempted to combine the plasma gun design with both separate and circular electrodes. However, this idea failed due to technical difficulties. I did not give serious consideration to the gas supply, and the manufacturing capabilities were not sufficient to meet the requirements of my design. Therefore, I need to create a better design for my plasma gun.

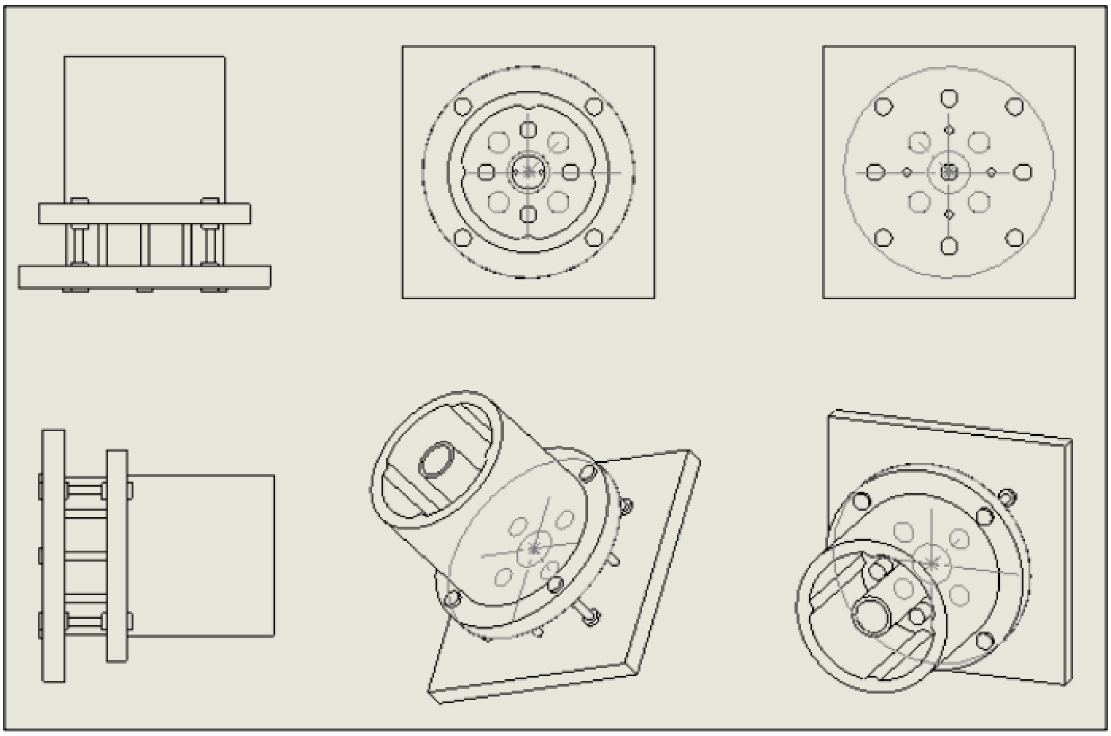


Figure 3

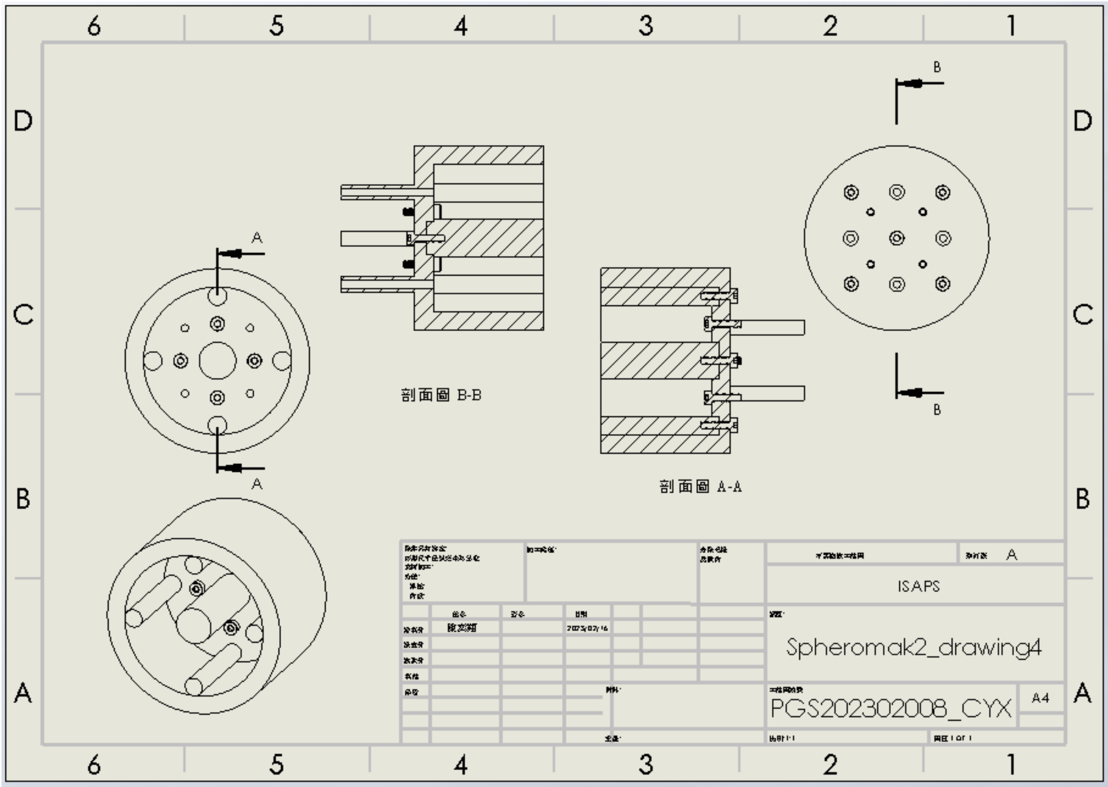


Figure 4

1. ver.01 gas supply

To integrate the plasma gun into our lab system and connect it to the gas supply system, I designed a compatible setup. Our lab system consists of a large chamber with multiple ISO100 flanges. The external gas supply is connected to one of these flanges, as shown in Fig. 5. We need a gas supply tube to connect the plasma gun to the flange, and a gas supply connector to link the gas supply tube with the plasma gun.

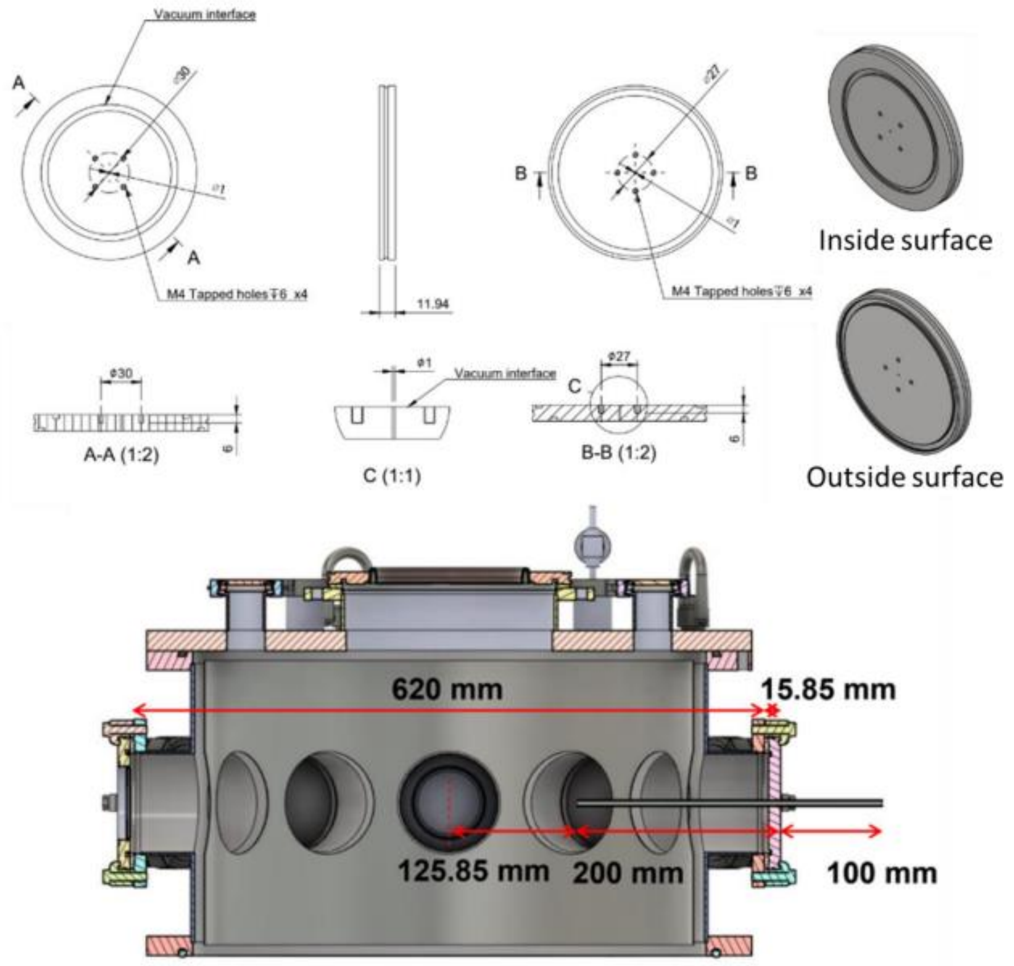


Figure 5

Considering the gas supply and manufacturing capabilities, I designed ver.01 with a total length of 300mm, as shown in Fig. 6. This design includes a gas supply tube (Fig. 7), a gas supply connector (Fig. 8), and the bottom of the plasma gun (Fig. 9). The assembled plasma gun inside the chamber is shown in Fig. 10.

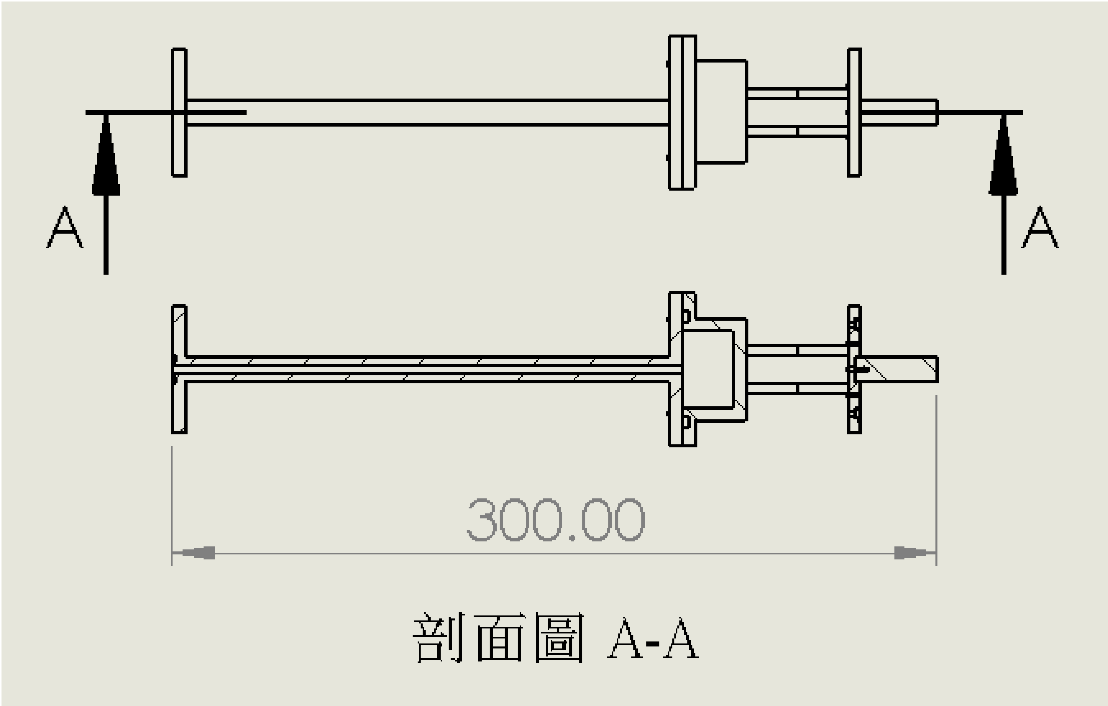


Figure 6

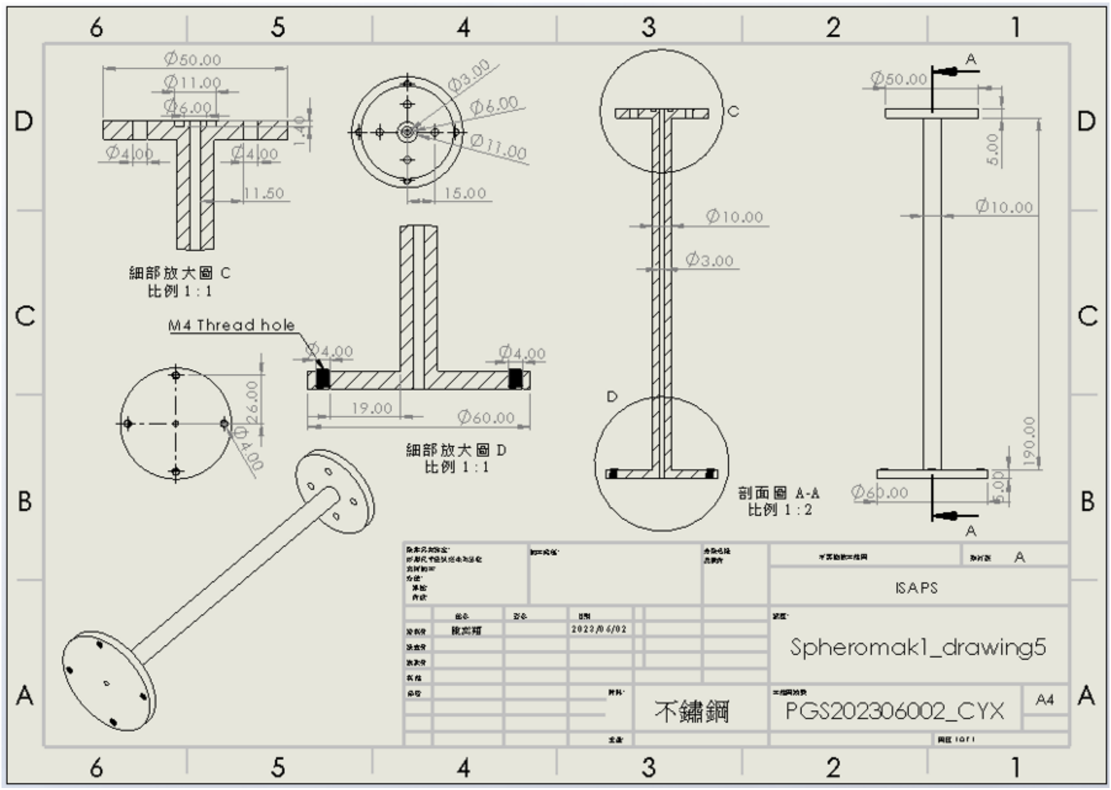


Figure 7

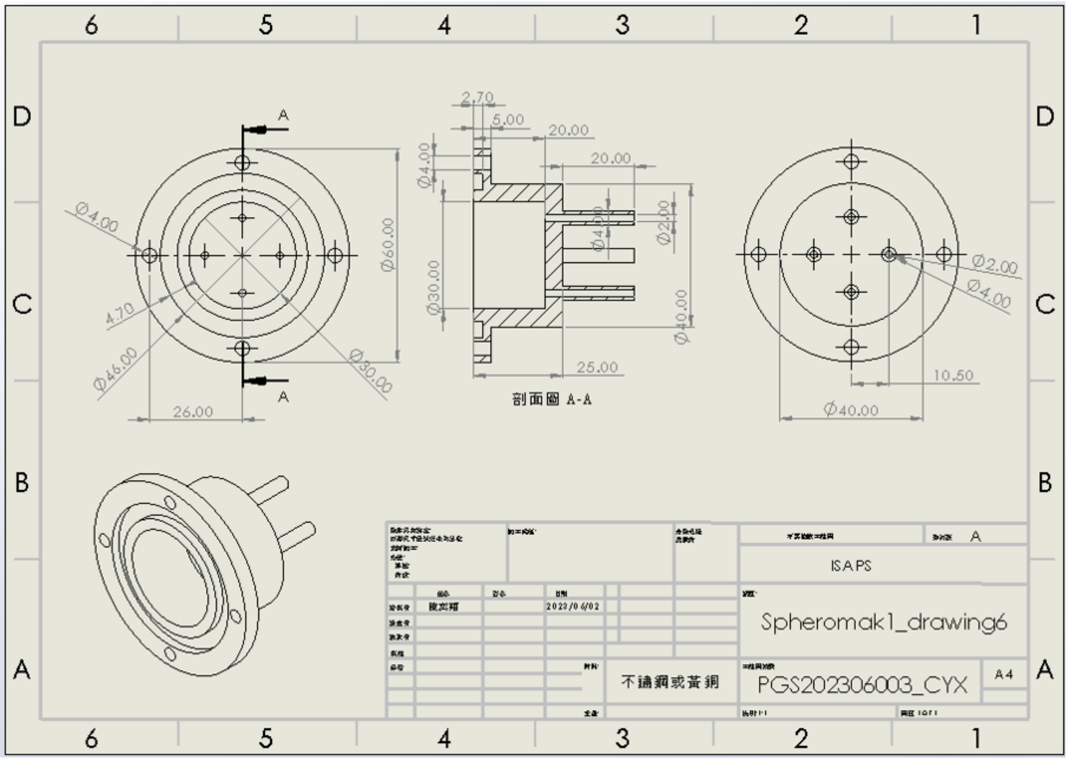


Figure 8

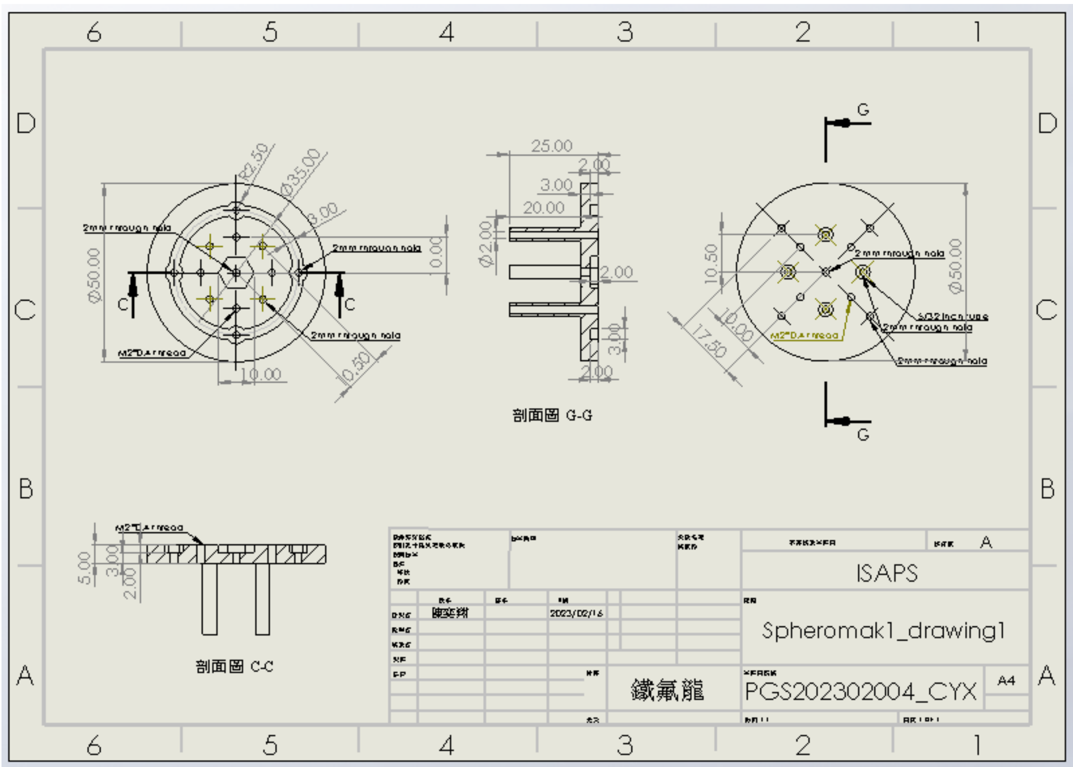


Figure 9

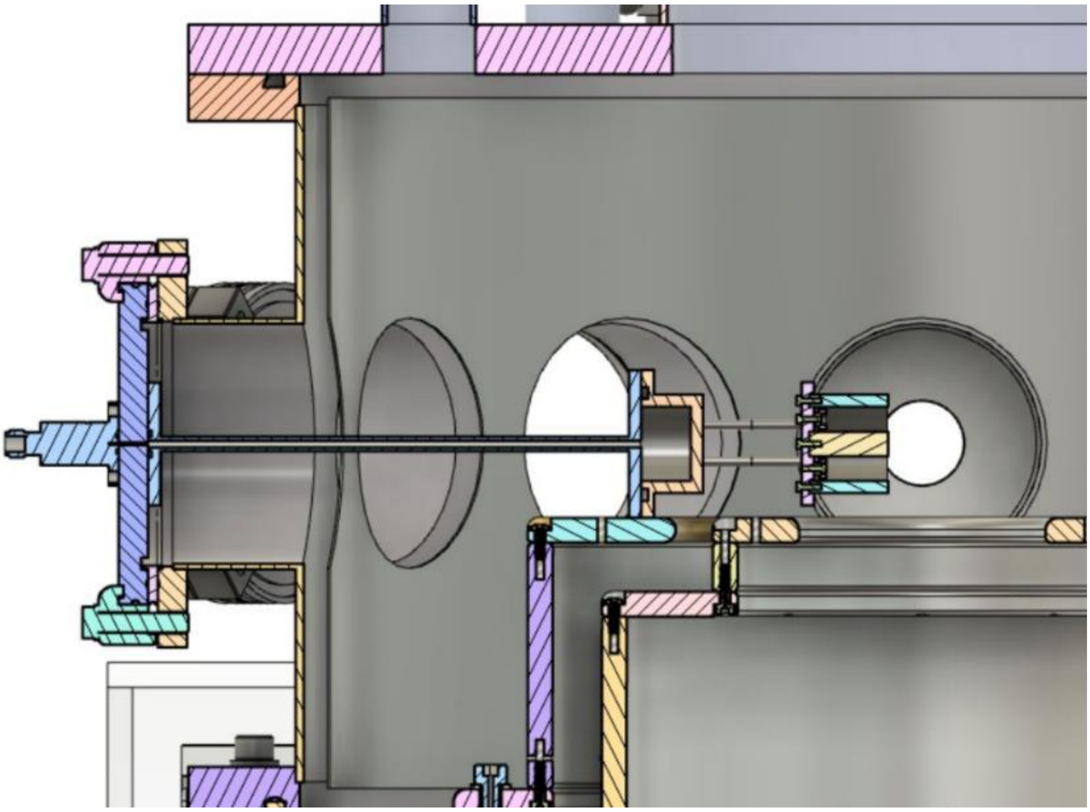


Figure 10

2. Type A electrode

The electrode set will include the center electrode (Fig. 11) and the circular electrode (Fig. 12), along with an additional Gas Stop (Fig. 13) used in the ver.01 gas supply design to address gas diffusion in the plasma gun. The advantage of the Gas Stop is that it can serve as a trigger for arcing and reduce the distance between the center and circular electrodes.

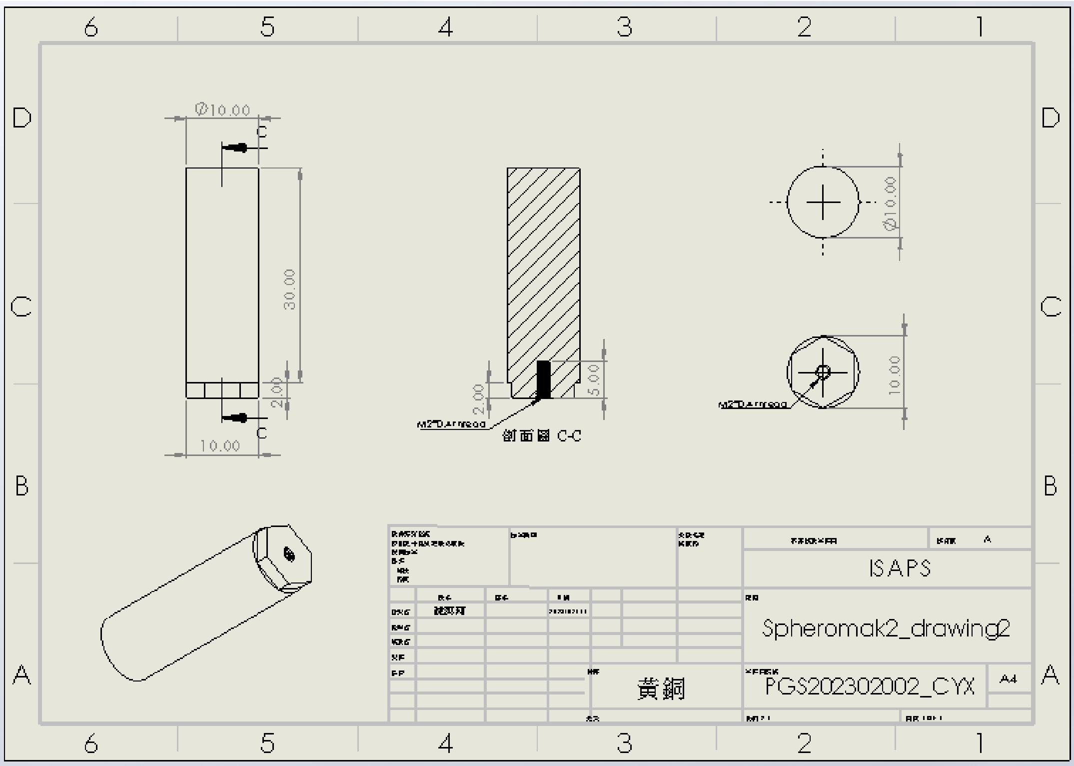


Figure 11

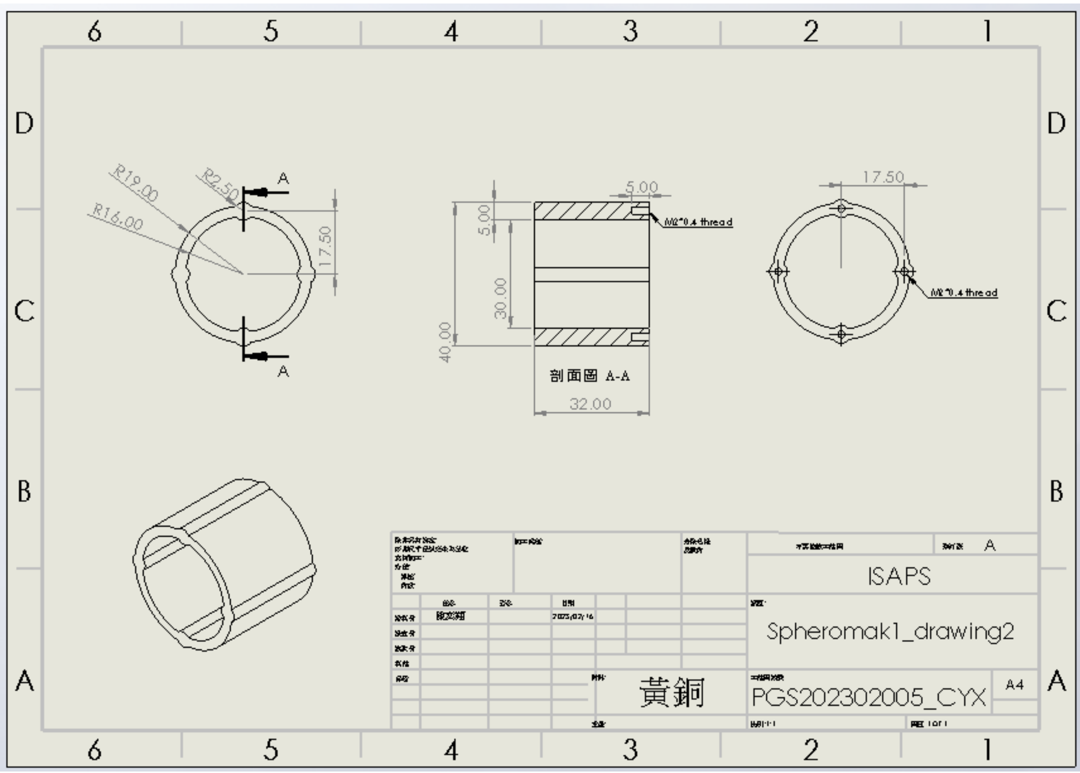


Figure 12

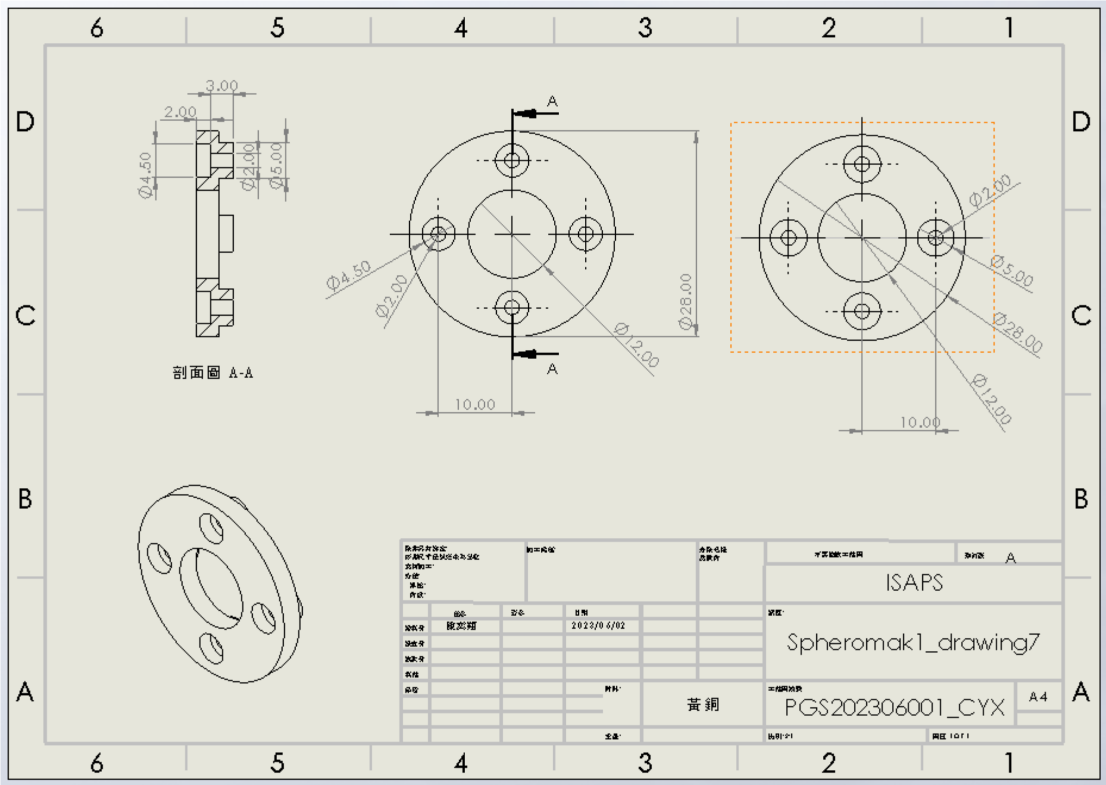


Figure 13

3. Type B electrode

This type of electrode is based on the concept of combining the circular electrode and the Gas Stop, as shown in Fig. 14. This design can also shorten the distance between the center electrode and the circular electrode, making it easier for arc discharge to occur.

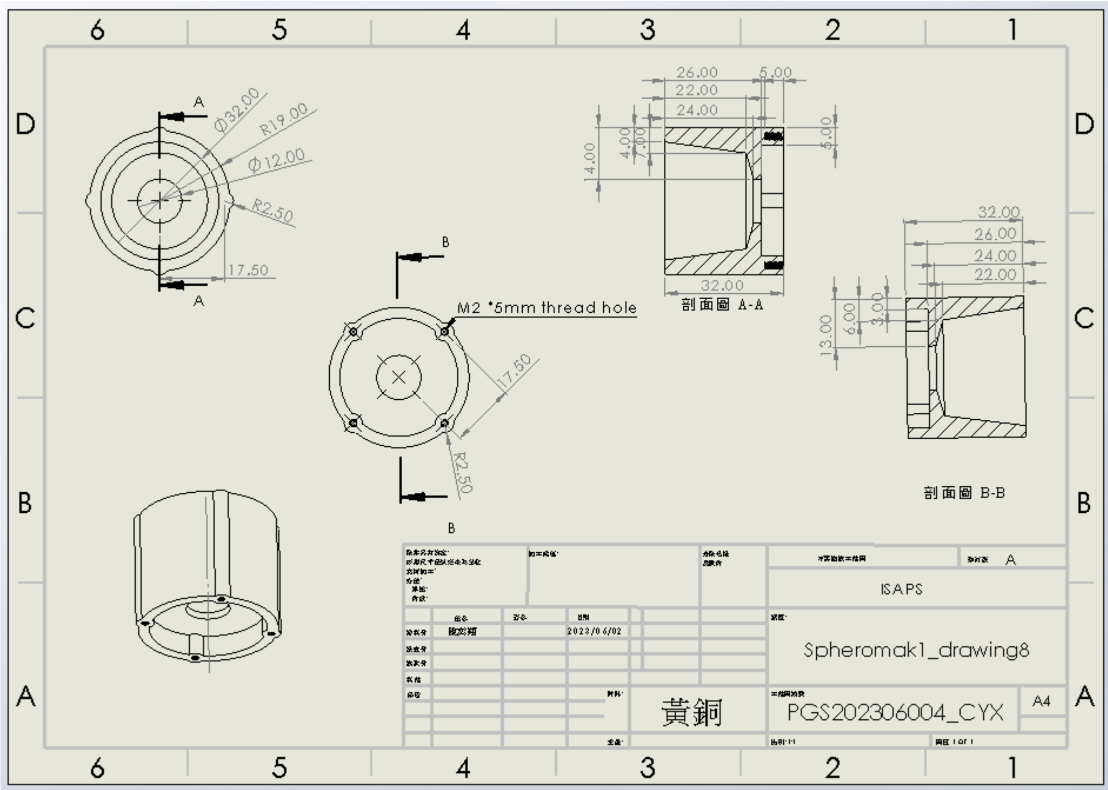


Figure 14

4. ver.02 gas supply

In ver.01, the gas supply operates independently from the electric supply. However, the disadvantage is that the spacing becomes very crowded, and the four-tube connector might be structurally weak.

In ver.02, the gas supply design features a bottom plate compatible with type A and B circular electrodes, as shown in Fig. 17. The gas supply is integrated with the center electrode, as shown in Fig. 16, eliminating the need for additional spacing, which is a significant advantage in the design. The gas supply tube is shown in Fig. 18, and the assembled plasma gun is shown in Fig. 15. The total length remains 300mm.

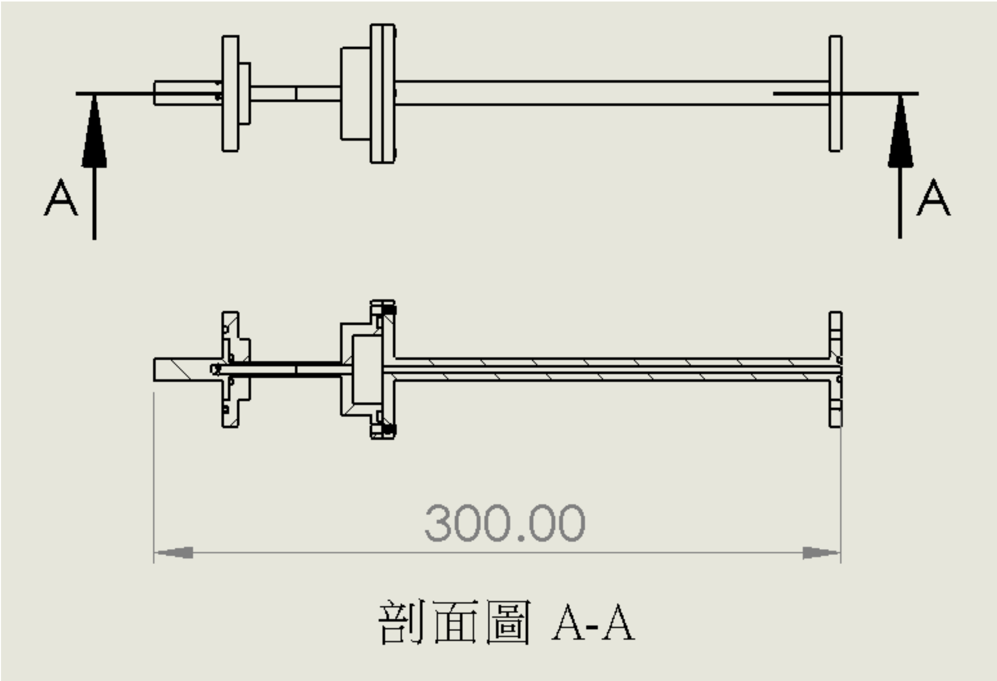


Figure 15

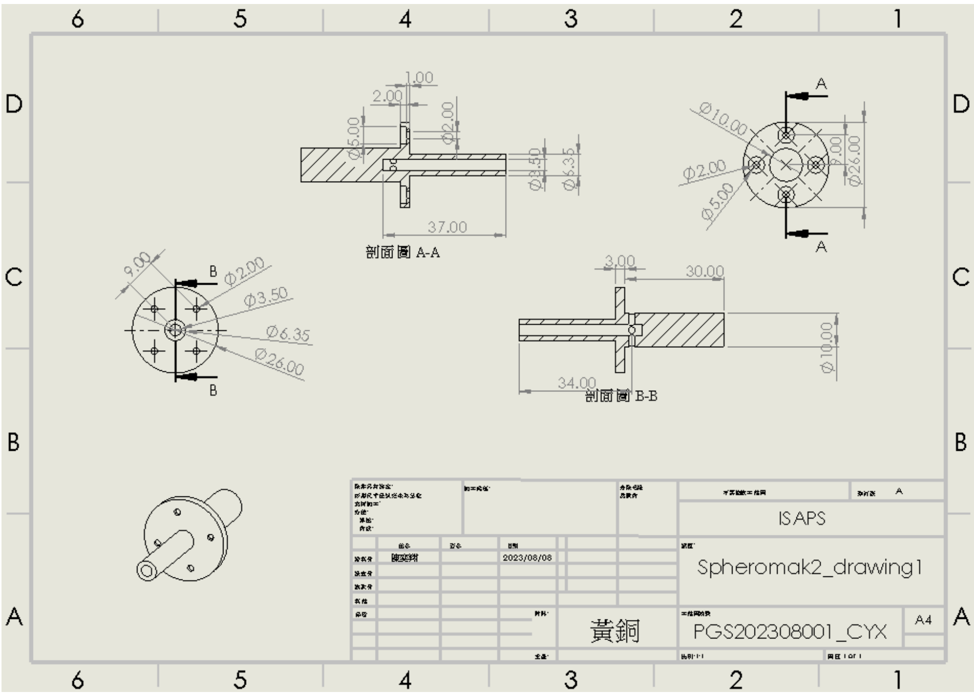


Figure 16

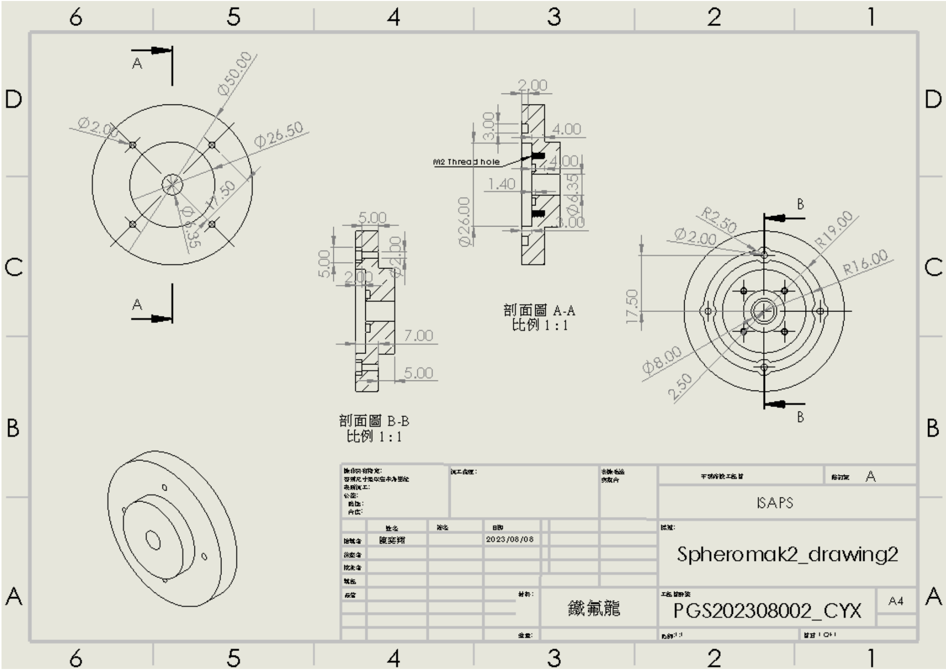


Figure 17

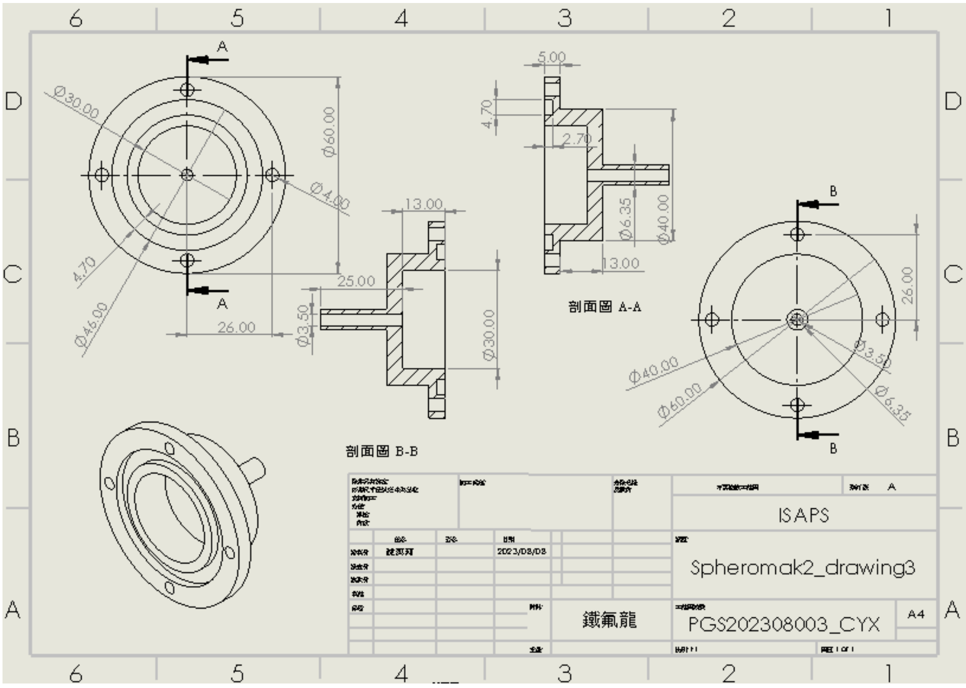


Figure 18

All the drafts of the plasma gun can be found in the NAS

/Drawing/2022_ychen/專題工程圖.

II. Simulation on COMSOL

We should use a simplified model to make it easier for COMSOL to perform the simulation. Eliminating unnecessary drill holes or attached surfaces can prevent COMSOL from crashing due to overly complex models.

When conducting a physics study, it's advisable to start with a demo model. A demo model can help verify if your environment settings are reasonable and reliable for obtaining accurate results.

Steps to do the simulation in COMSOL:

Import or build the model in COMSOL → Set the material for the components → Set the physics values for the simulation → Calculate the study → If an error occurs, check the settings → Display the results.

Example: Electric field simulation between three electrodes in an environment filled with Argon

In Fig. 19, I set up a large space filled with argon, then subtracted three cylindrical spaces representing the electrodes. I set the surface of the thinner cylinder to 0V and the thicker one to 1000V.

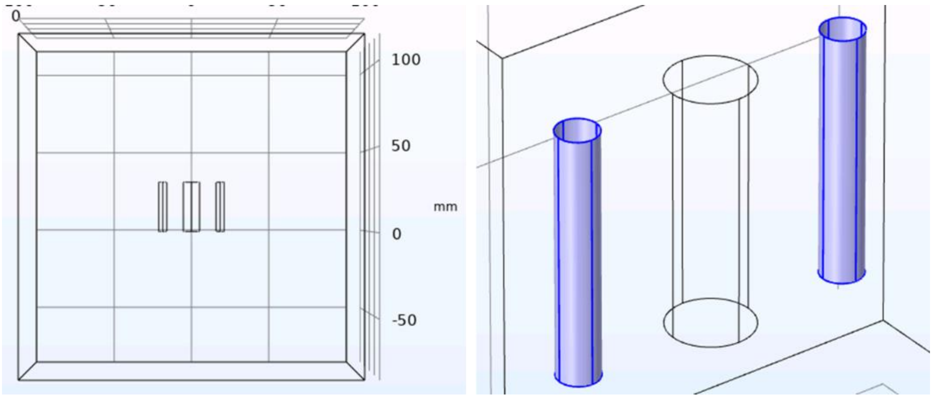


Figure 19

The results of the electric potential and electric field are shown in Fig. 20 and Fig. 21. We can see that the results are consistent with the physics theory, indicating that the environment settings are reliable for our simulation.

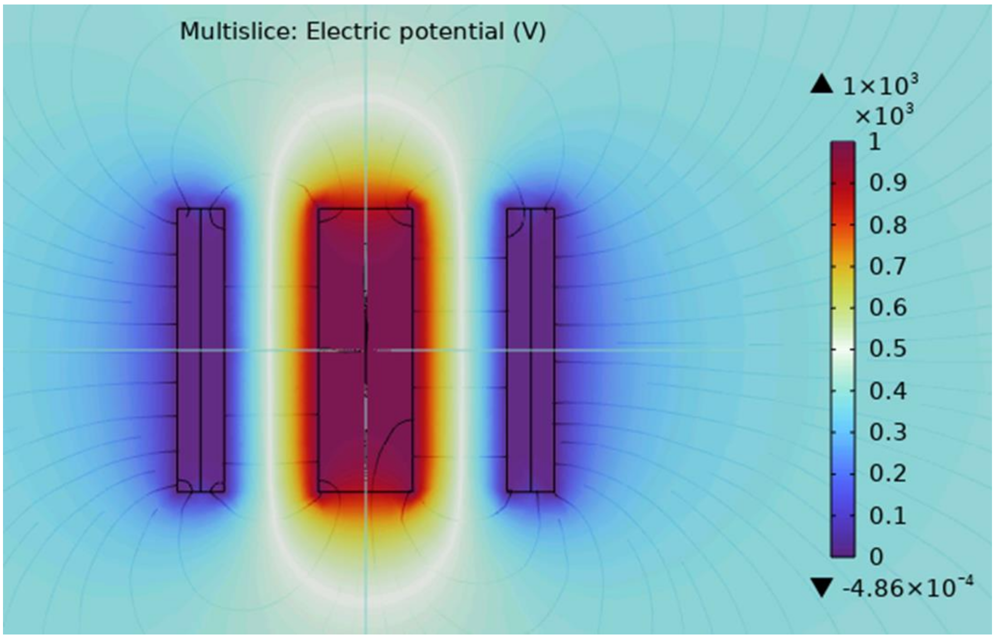


Figure 20

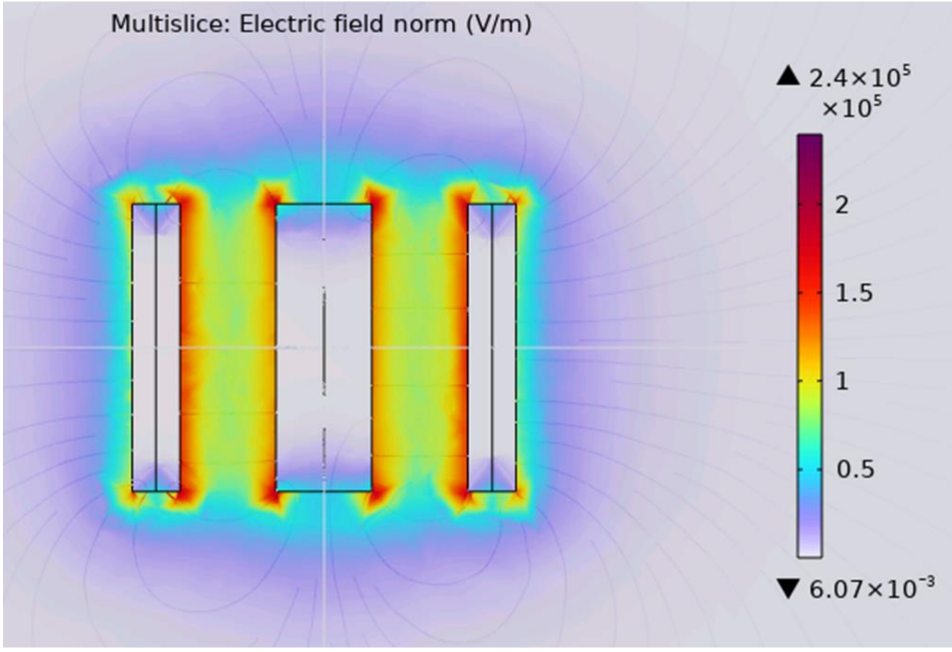


Figure 21

After completing the testing of the demo model, I can start running the simulation using the model I designed under the specified environment.

1. Fluid flow simulation of our design

To generate a Spheromak, we need to understand the fluid flow within the plasma gun. I use COMSOL to perform time-dependent simulations of the argon fluid flow in different plasma gun designs.

a. ver.01A plasma gun

To simplify the calculation, I streamlined the structure of the first design by including only four gas inlets and a cylinder to serve as the plasma gun chamber, as shown in Fig. 22. I set the inlets to 0.1 atm and the outlet to 0 atm to facilitate easier calculations.

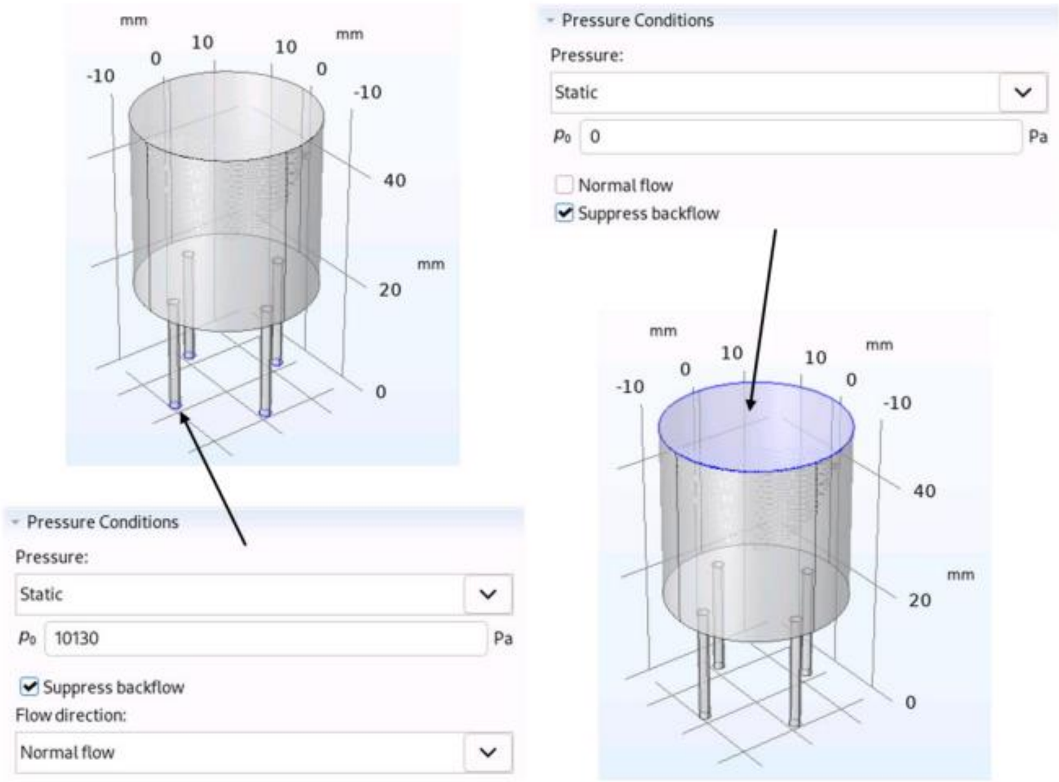


Figure 22

The result is shown in Fig. 23, 24, and 25. It is the time-dependent flow simulation, where we can see that most of the gas flow quickly sprays upwards. We might face the problem of gas leaving the plasma gun before arcing.

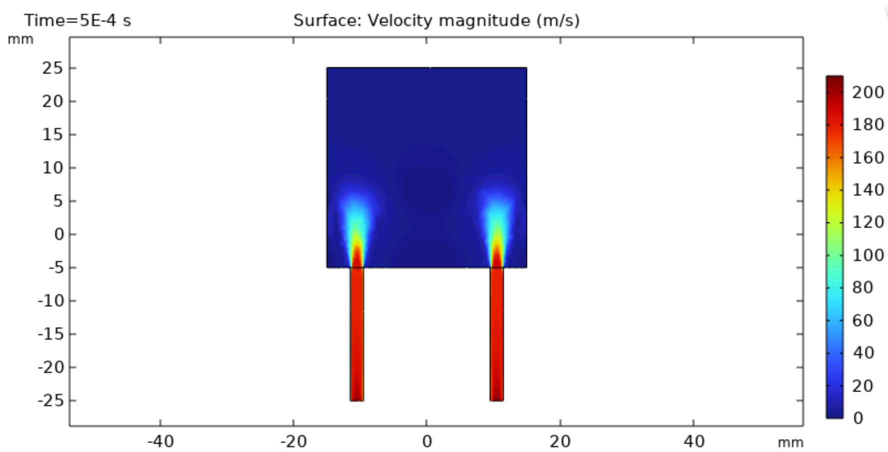


Figure 23

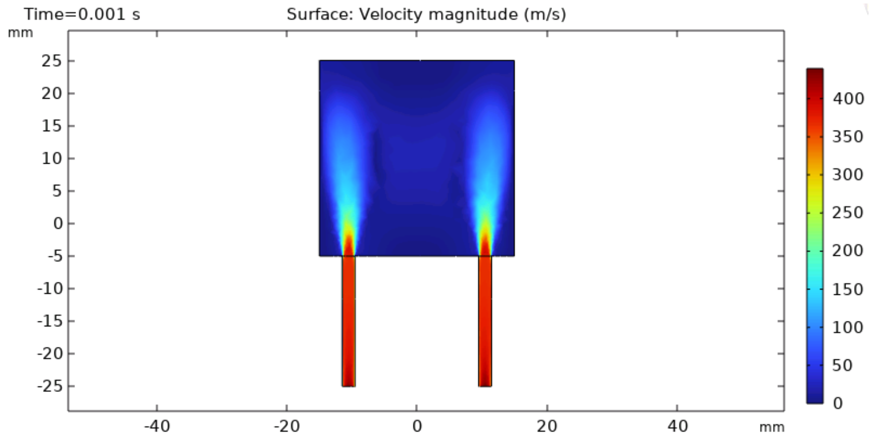


Figure 24

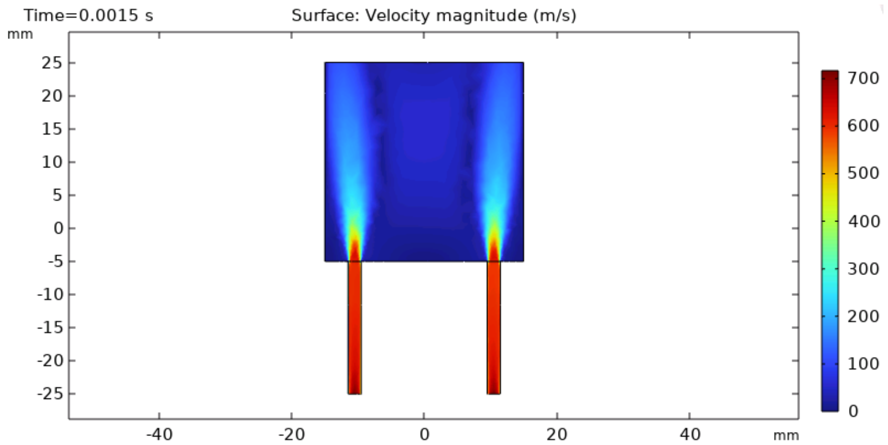


Figure 25

To deal with the gas flow problem, we add the Gas Stop. The setting is shown in Fig. 26. I do it in the 2-D symmetric configuration to make the calculation easier. The initial value in the plasma gun is 1 atm, and the inlet of argon is 10 atm. Instead of defining the top boundary as a flow outlet boundary, I define a big volume downstream of the plasma gun with a background of 1 atm. Therefore, the gas almost leaves the plasma gun into the big volume freely. If the background is set to 0 atm, the process will crush, so we just do the easier case with a background pressure of 1 atm to study the gas flow qualitatively.

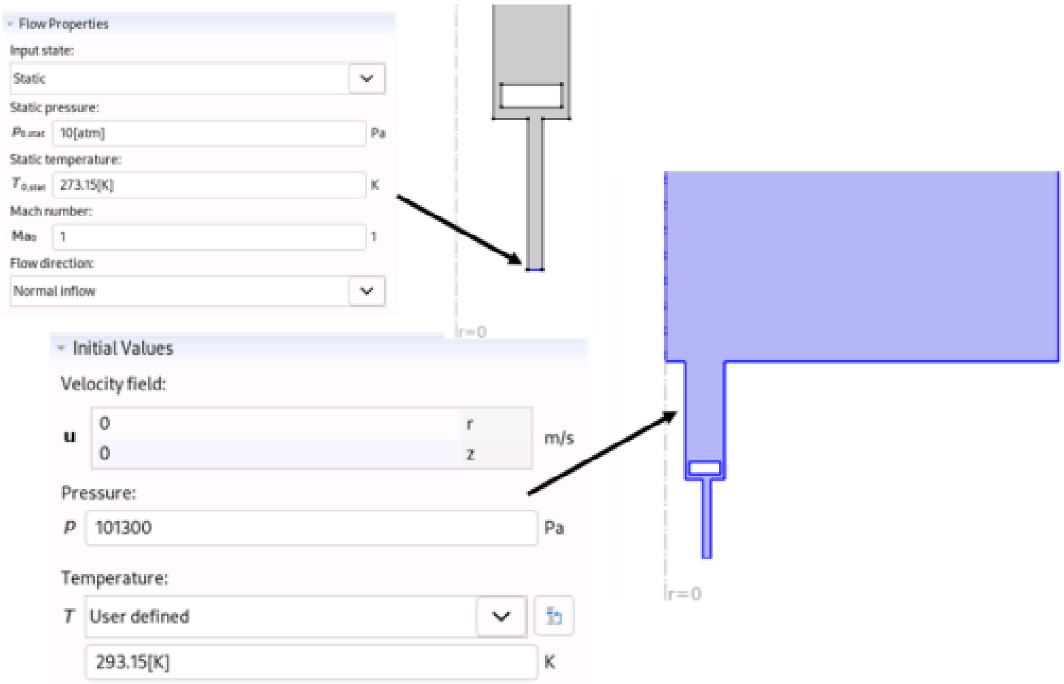


Figure 26

The results are shown in Fig. 27, 28, and 29. We can see that the flow is choked by the stop. We hope that when the gas flows through the wall at 50 μs, an arc between the electrodes can be initiated. At 100 μs, we can see the gas uniformly rising. By 200 μs, the gas reaches the outlet of the plasma gun. This is a good result for our design.

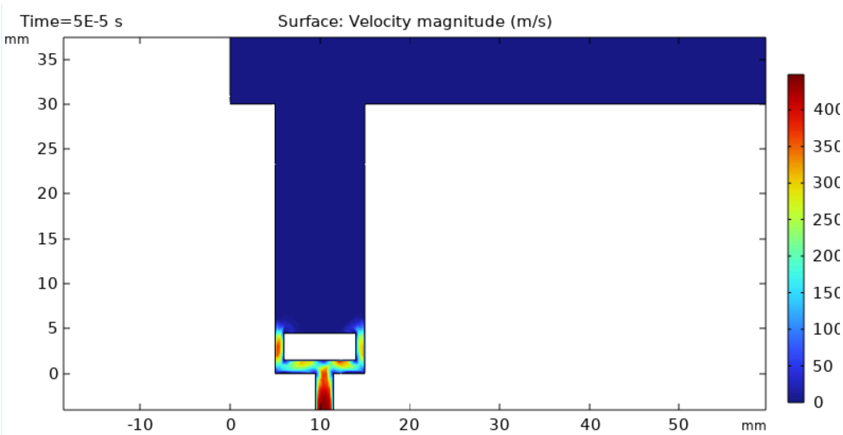


Figure 27

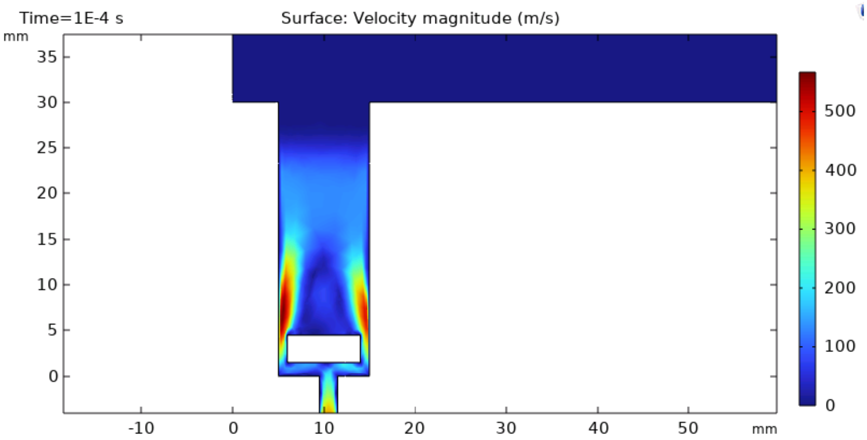


Figure 28

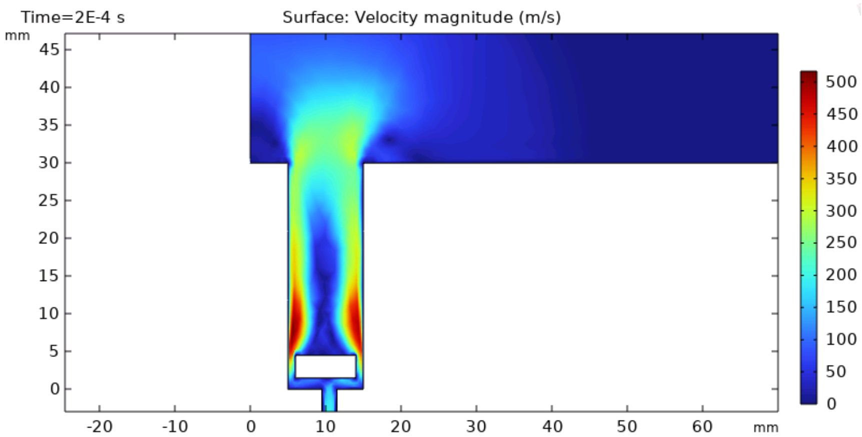


Figure 29

We also examined the density field, as shown in Fig. 30, 31, and 32. In the density field, we can see that the gas rises uniformly at $t = 100\ \mu s$. By $t = 200\ \mu s$, the gas reaches the outlet of the plasma gun.

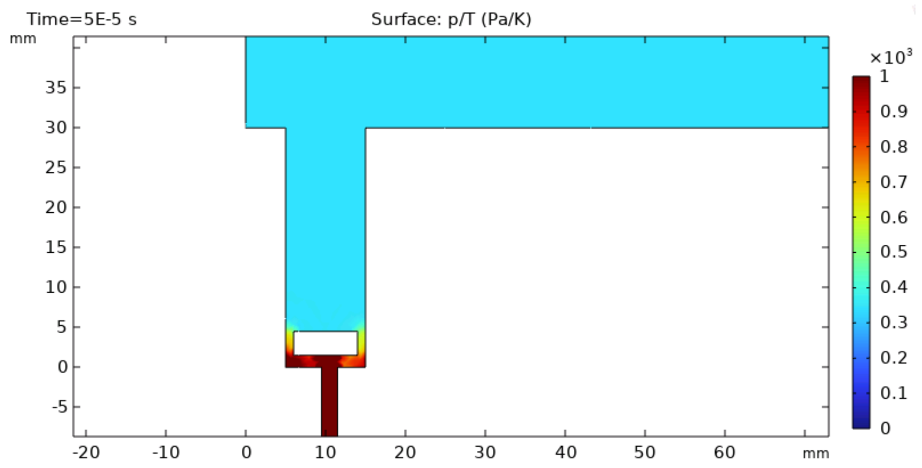


Figure 30

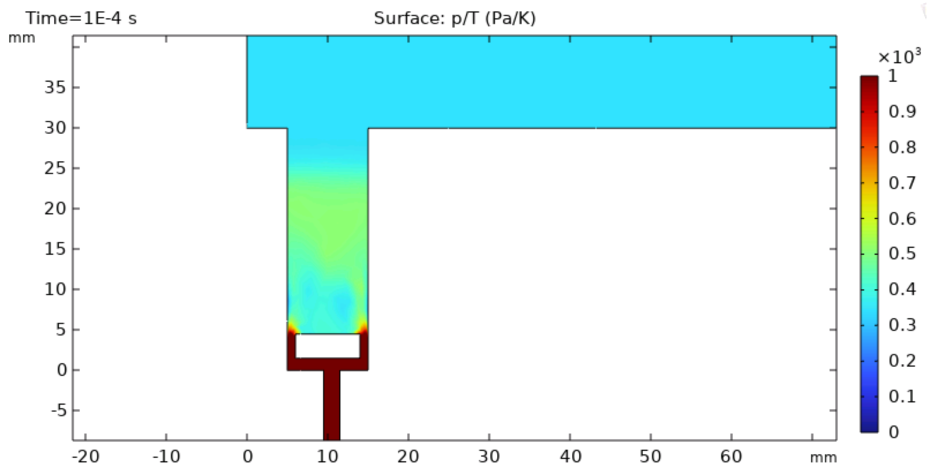


Figure 31

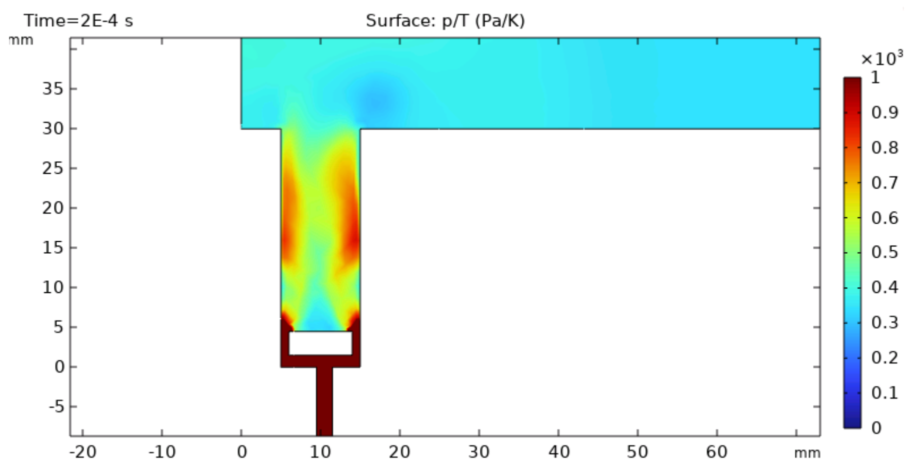


Figure 32

b. ver.01B plasma gun

The setup is shown in Fig. 33. I also used a 2-D symmetric configuration to simplify the calculation. The initial pressure in the plasma gun is set to 1 atm, and the argon inlet is set to 10 atm, with no defined outlet boundary for the same reason as the revision of the first design.

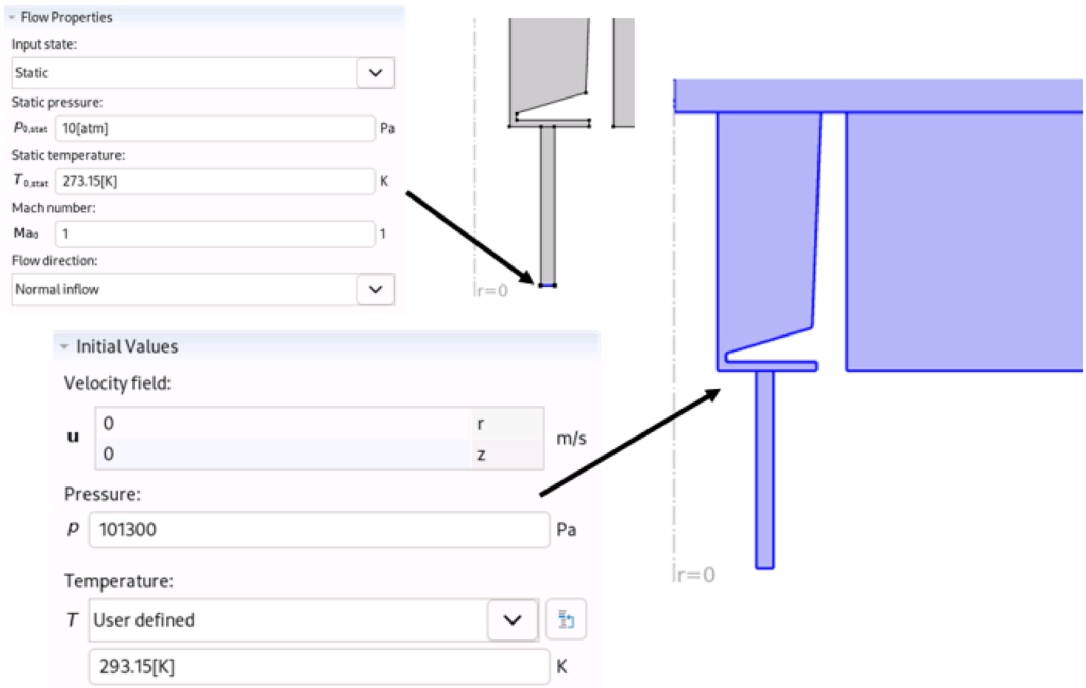


Figure 33

The time-dependent results are shown in Fig. 34, 35, and 36. At t = 42 μs, the gas is stopped and choked by the circular electrode. At t = 86 μs, the flow moves toward the wall instead of going straight up. By t = 164 μs, the velocity direction starts to curve, approaching the outer large volume and forming a vortex-like pattern at the end of the flow.

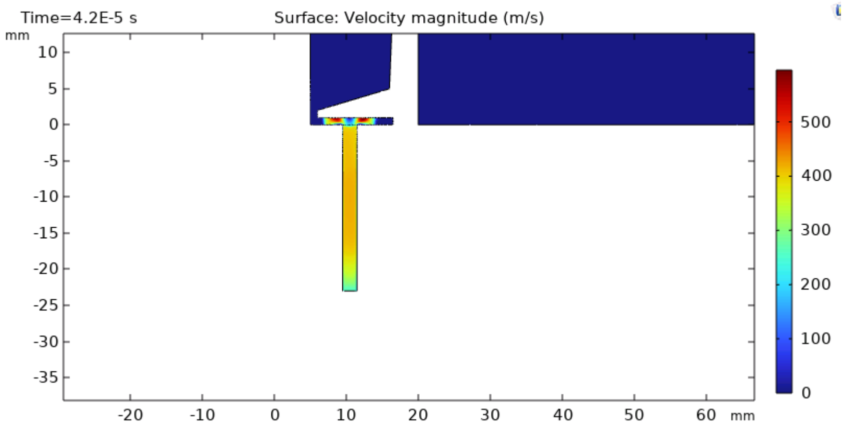


Figure 34

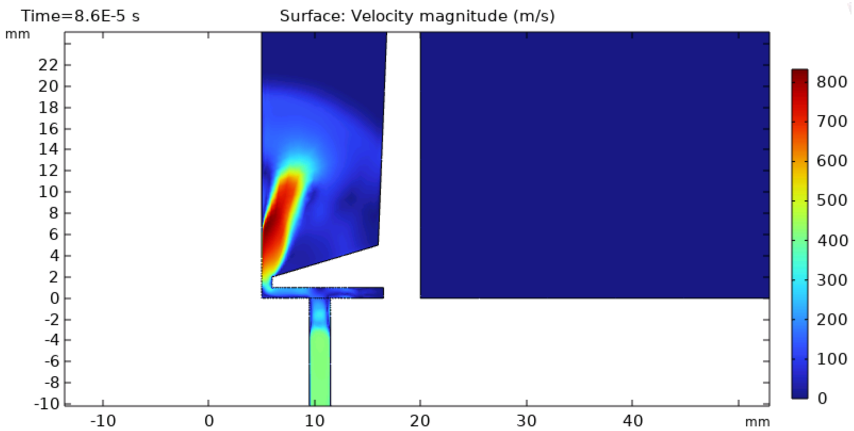


Figure 35

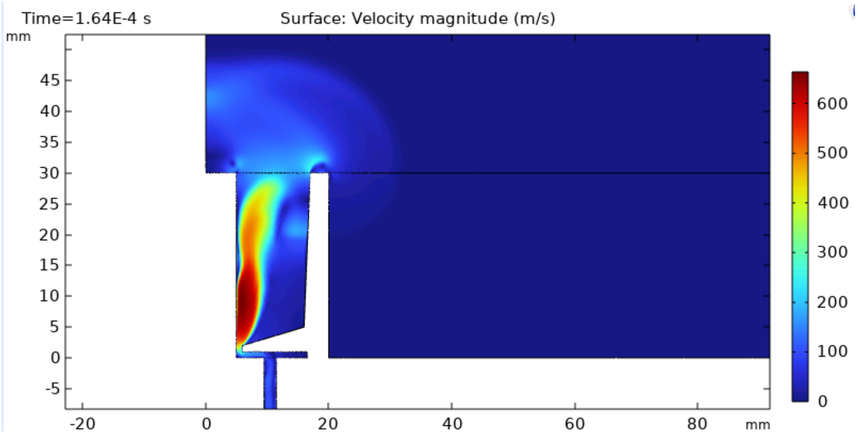


Figure 36

Furthermore, we can examine the density field, as shown in Fig. 37, 38, and 39. We can observe the diffusion of the gas into the plasma gun. Ideally, we hope the arcing process occurs around t = 86 μs, with the density being uniform in the space. After t = 164 μs, the flow starts to curve.

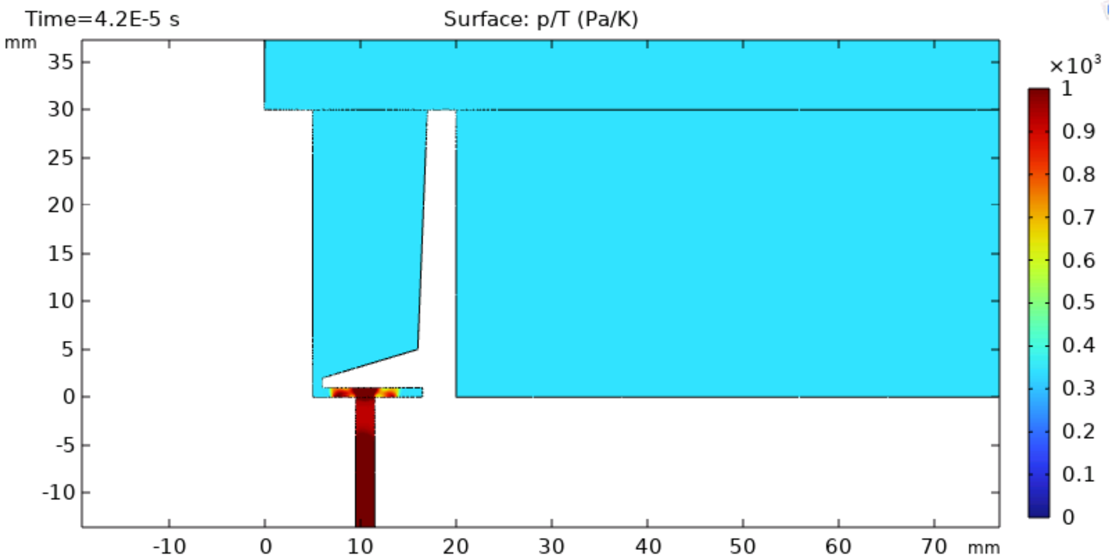


Figure 37

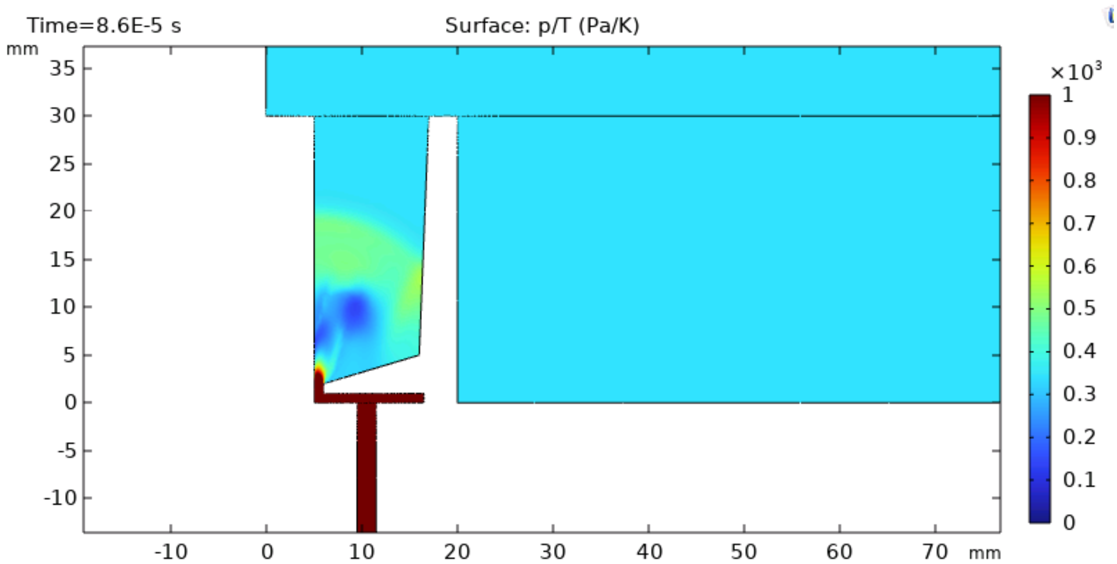


Figure 38

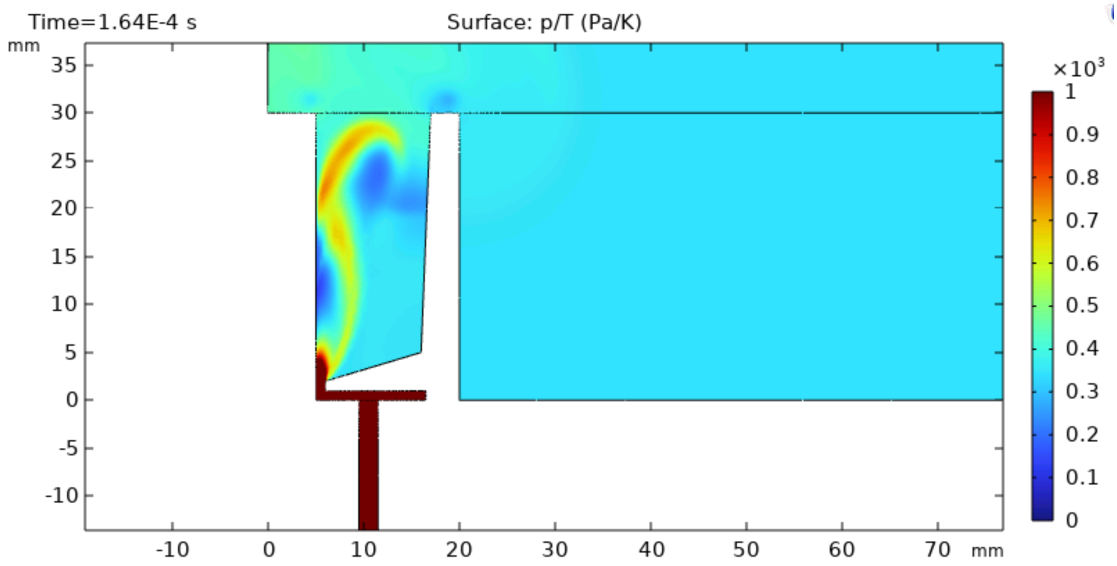


Figure 39

2. Electrostatics simulation of our design

Determining whether arcing will occur in the plasma gun is crucial for generating a Spheromak. Ideally, the arc should occur at the bottom of the plasma gun. I use COMSOL to perform stationary simulations of the electrical potential in different plasma gun designs.

a. ver.01A plasma gun

The setup is shown in Fig. 40. I imported the first design into COMSOL, set the surface of the circular electrode to 0V, and set the surface of the center electrode to 1000V. The environment is filled with argon. Then, I calculated the stationary electrostatics values.

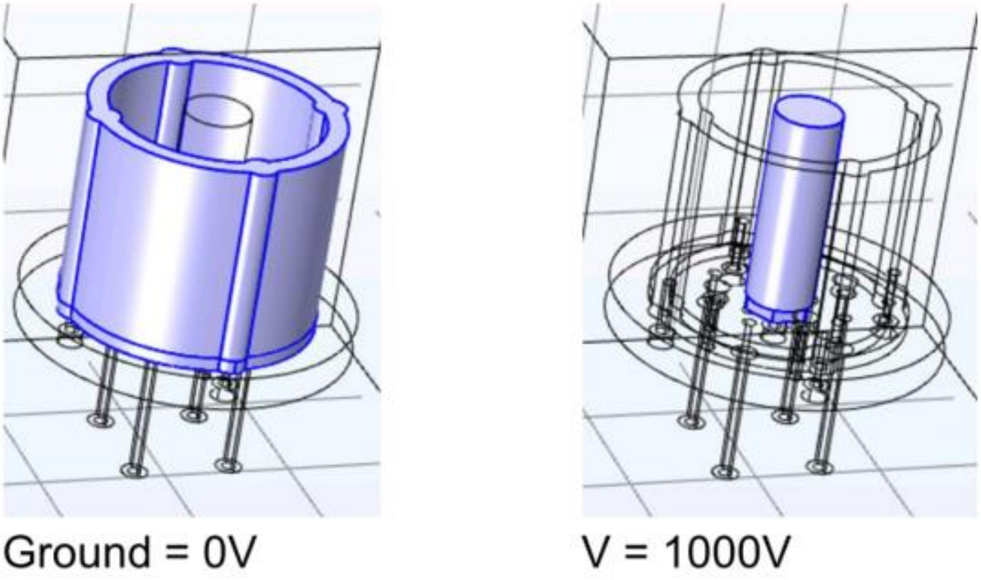


Figure 40

The result of the electric potential is shown in Fig. 41, where we can see the areas with a potential of 0V. The result of the electric field is shown in Fig. 42. The highest value occurs at the corner of the center electrode, indicating that arcing might happen at the location with the highest electric field value.

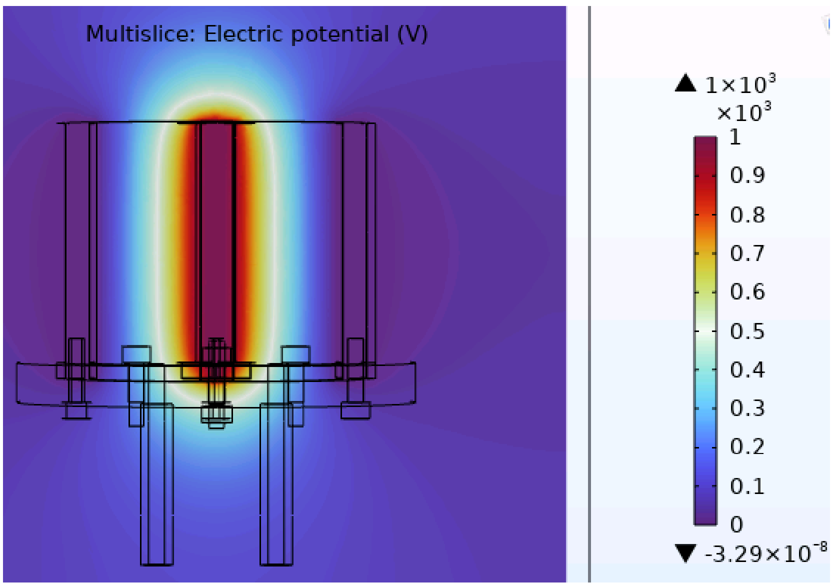


Figure 41

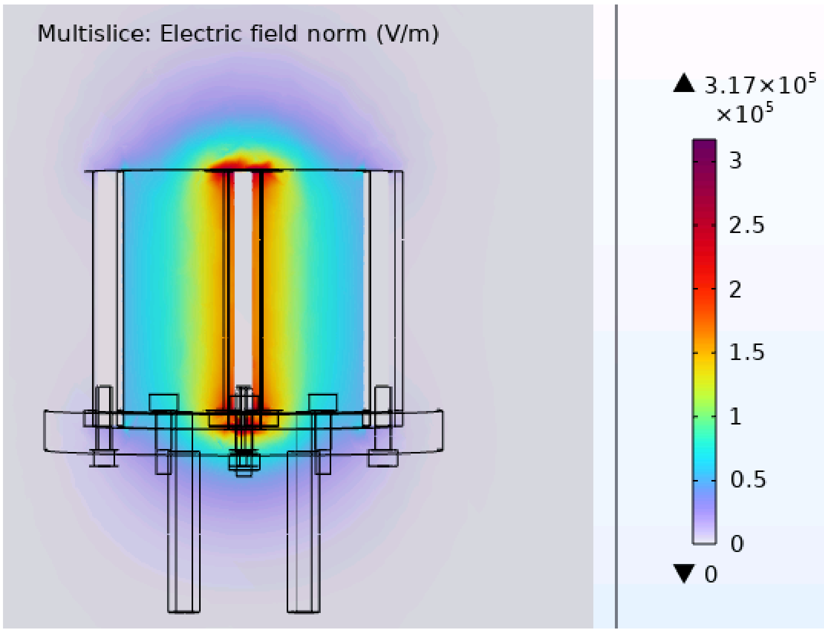


Figure 42

The setup with the Gas Stop is shown in Fig. 43. I revised the first design in COMSOL. I set the surface of the circular electrode to 0V, the surface of the center electrode to 1000V, and the Gas Stop as a trigger to -1000V. The environment is filled with argon.

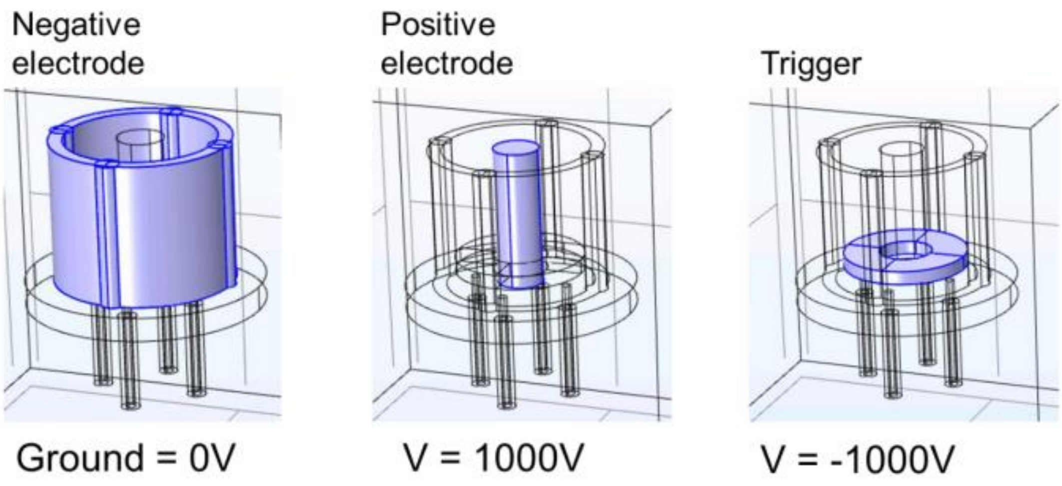


Figure 43

The result of the simulated electric potential is shown in Fig. 44. As expected in this design, the electric field is strongest between the trigger electrode and the center electrode. We aim for the arcing current to occur between the trigger electrode and the plasma gun. The first step involves the center electrode arcing with the gas stop, causing the potential of the gas stop to rapidly rise from -1000V to 1000V. This will then lead to another arcing event between the gas stop and the circular electrode. As shown in Fig. 45, the maximum value of the electric field is at the bottom of the plasma gun, which is the desired outcome.

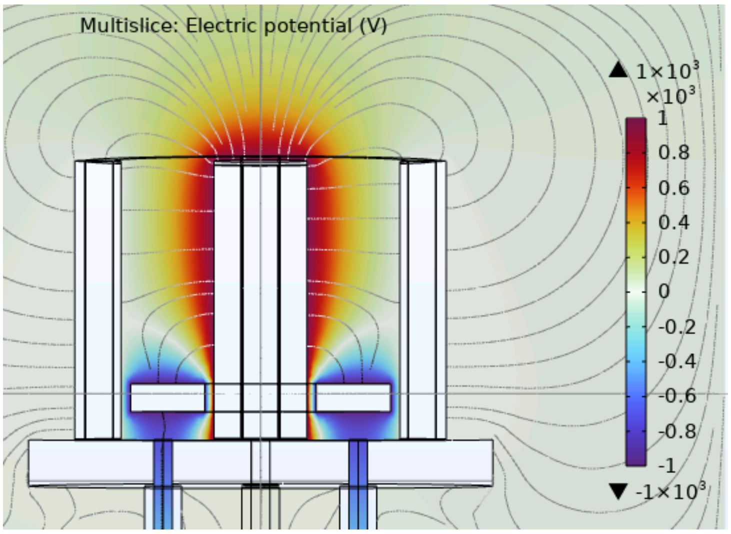


Figure 44

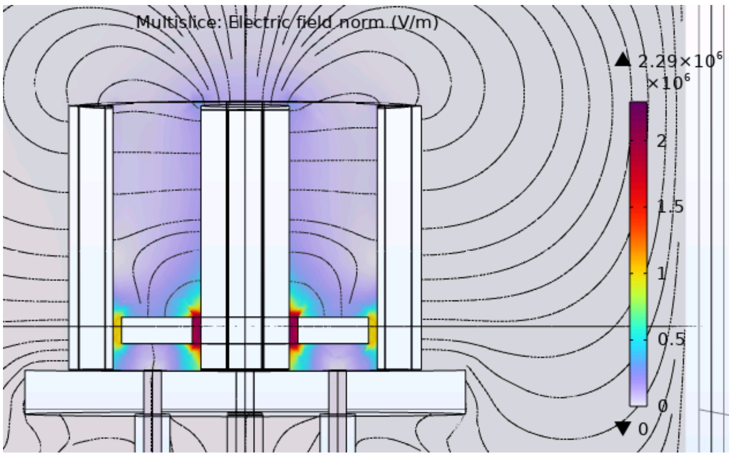


Figure 45

b. ver.01B plasma gun

The setup is shown in Fig. 46. I drew the second design in a 2-D symmetric configuration. I set the surface of the circular electrode to 0V and the surface of the center electrode to 1000V, with the environment filled with argon. Finally, we calculated the stationary electrostatics values.

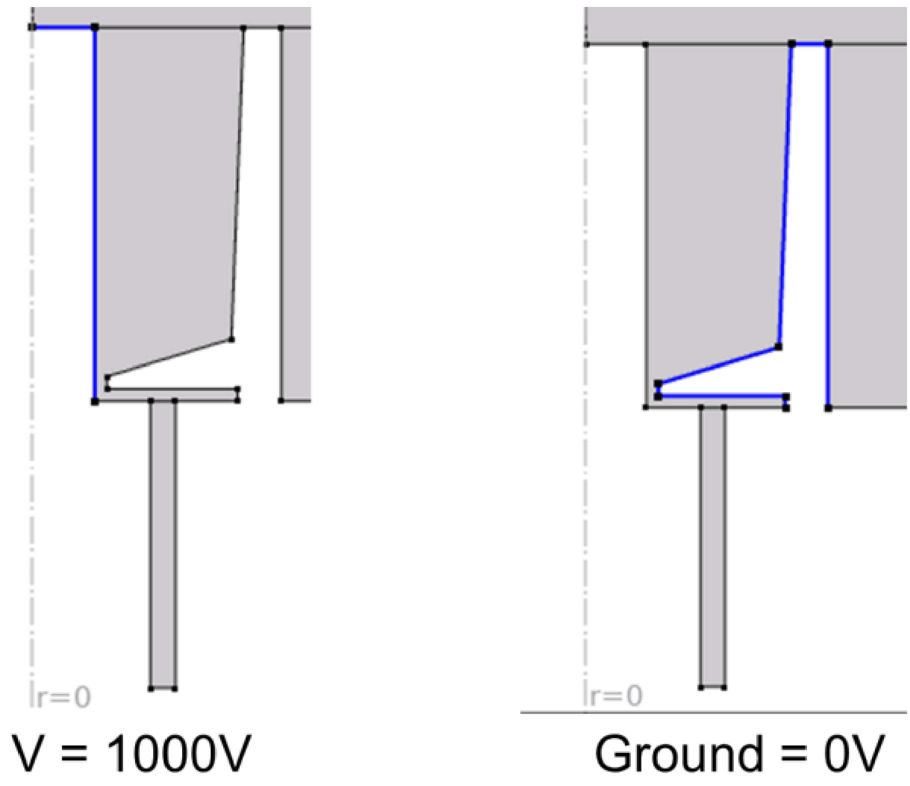


Figure 46

The result of the electric potential is shown in Fig. 47, where we can see the areas with a potential of 0V. The result of the electric field is shown in Fig. 48. The results indicate that the maximum value of the electric field is at the bottom of the plasma gun, which is where we hope to trigger the arcing.

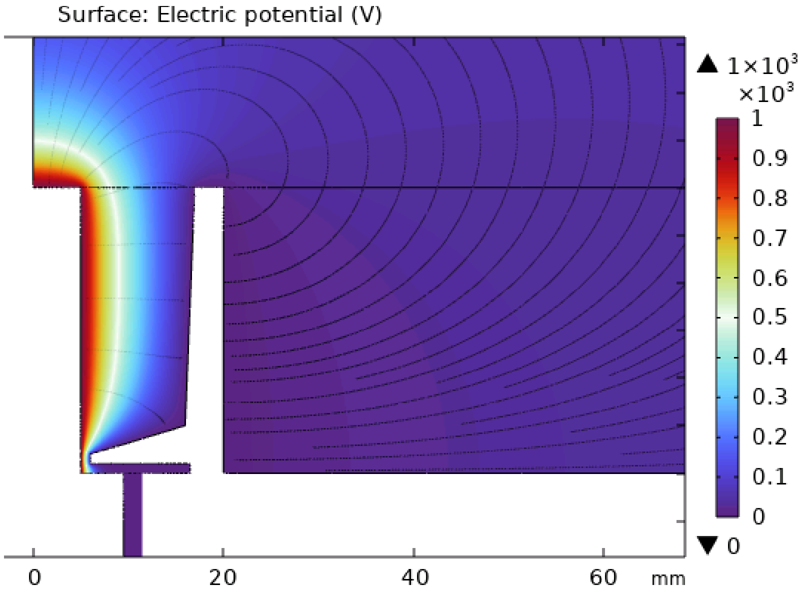


Figure 47

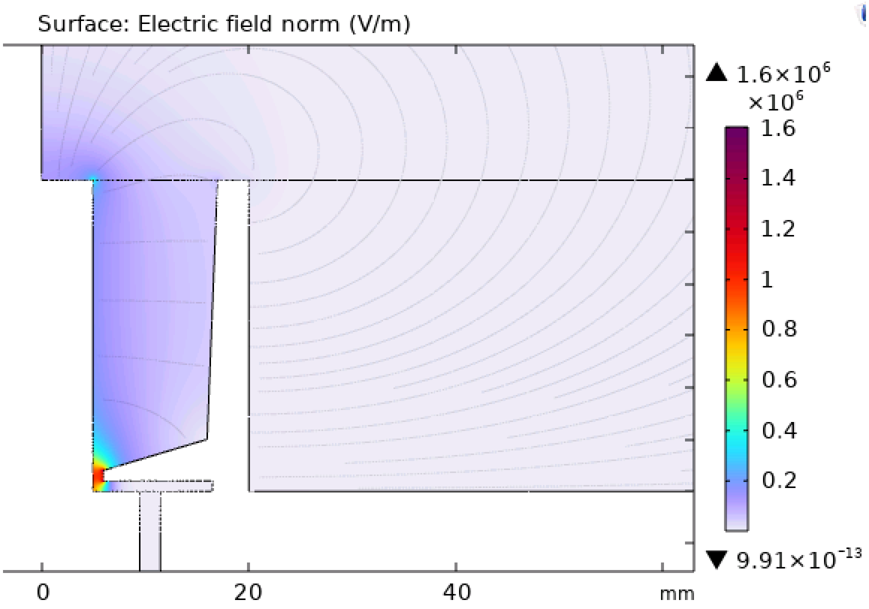


Figure 48

The simulation files and some PPT report files can be found in the NAS

/Shares/2022_ychen

III. Experiments and Results

The circuit diagram of the plasma gun experiment is shown in Fig. 49. The setting of the experiments can be found in the PPT report files. The components you will need:

- ✓ High voltage power supply (1000V or adjustable voltage value)
- ✓ Low voltage power supply
- ✓ Resistance board (2MΩ with 100MΩ)
- ✓ Capacitor (7.5μF, 25μF, 100μF)
- ✓ Gas valve control (12V required)
- ✓ High voltage differential probe
- ✓ Ion gauge for high vacuum

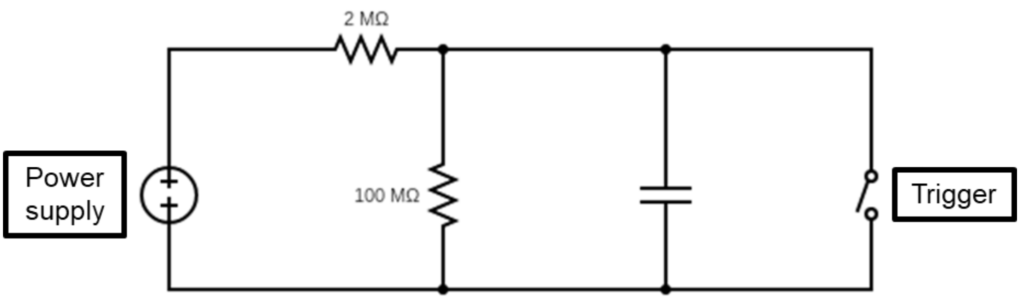
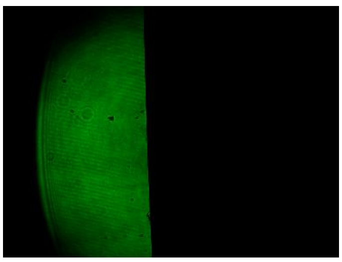
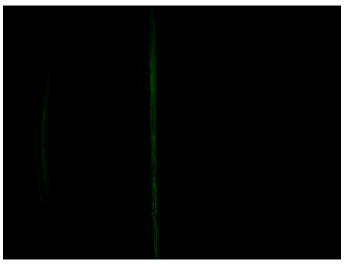
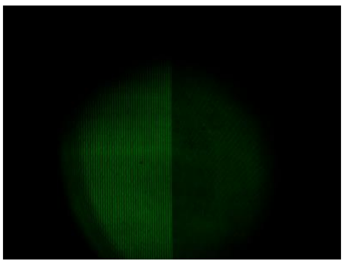


Figure 49

Exp0: Gas Puff Laser Test, 10atm, 25ms open valve

Shadowgraph	Schlieren	Interferometer
		

The results of the laser test show that the gas flow is too slow to cause significant changes in the image, so I cannot use the laser image in my experiment. For the experiment, the following will all be captured by the visible light camera, with the attack angle from the side and front views.

1. ver.01A (Fig. 50)

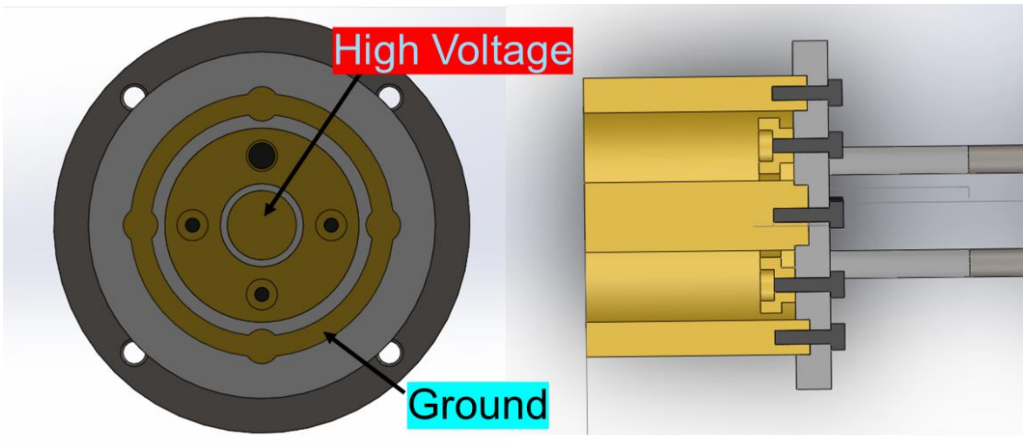
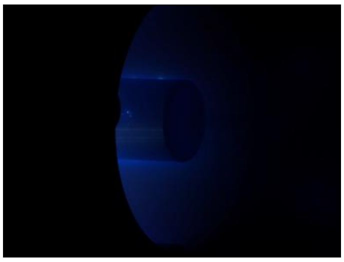
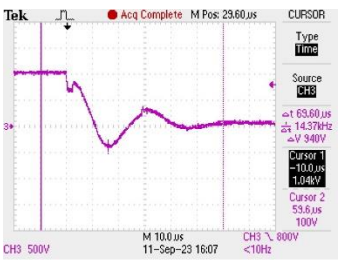
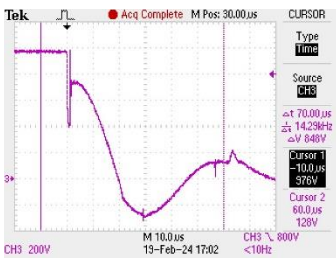
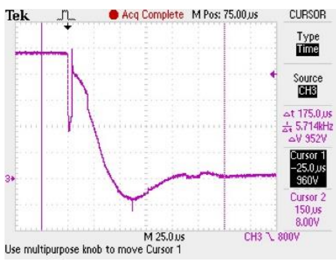
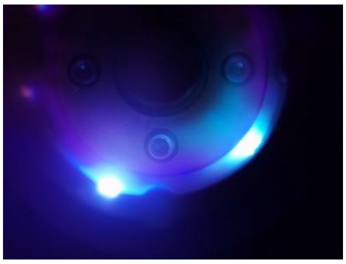
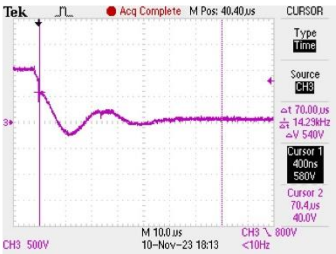
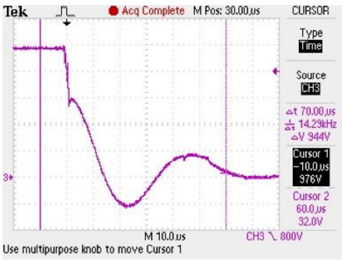
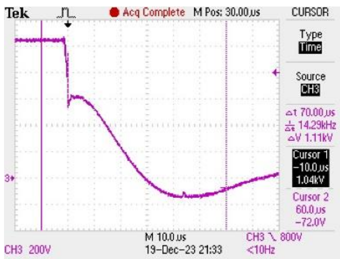
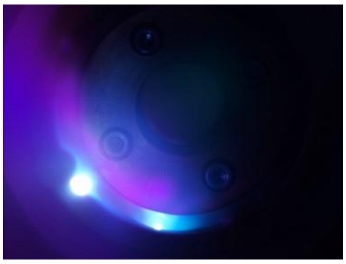
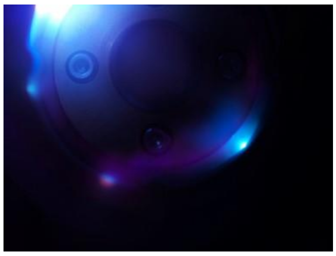
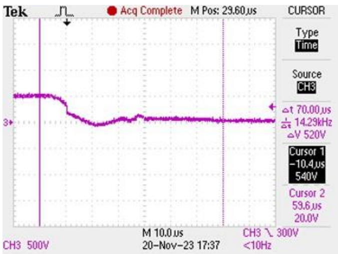
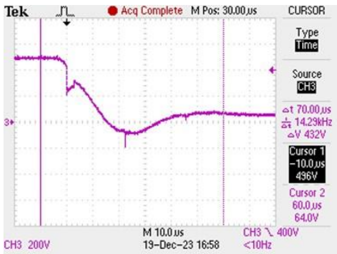
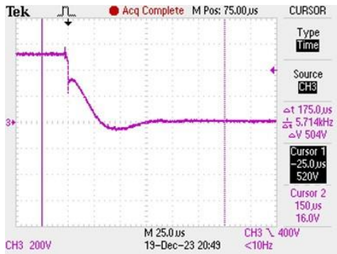
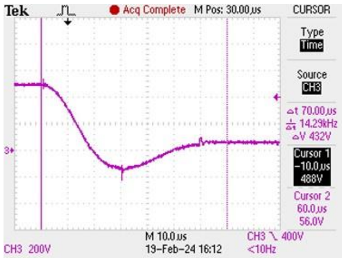
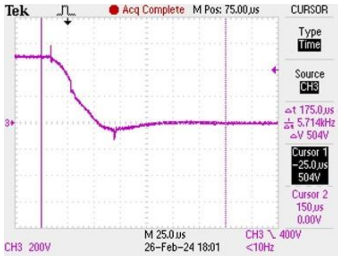


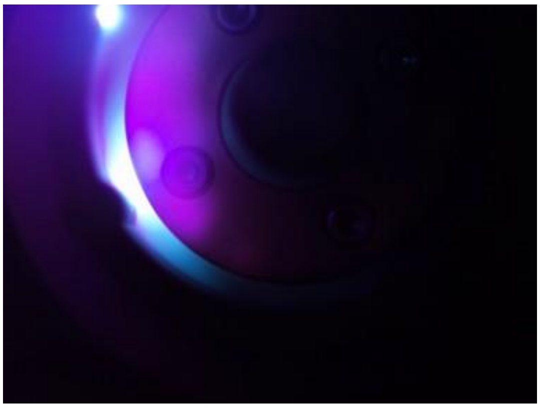
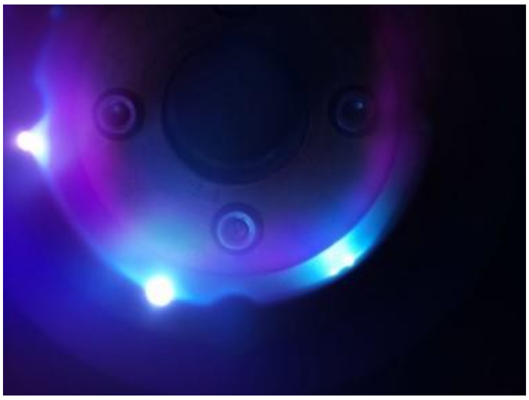
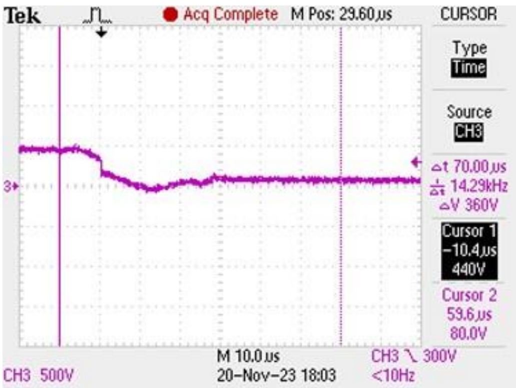
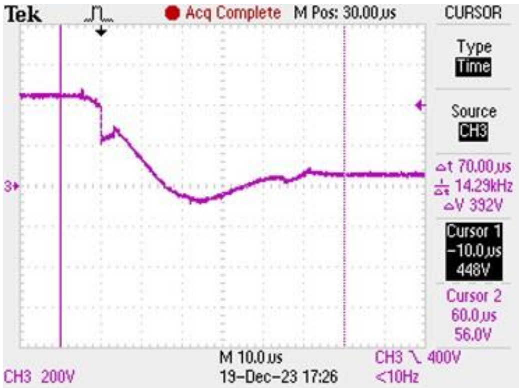
Figure 50

7.5µF	25µF	100µF
1kV, side view		
		
		

<table>
<tr><td colspan="3">1kV, front view</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>
</td><td>
</td><td>
</td></tr>
</table>

<table>
<tr><td>7.5µF</td><td>25µF</td><td>100µF</td></tr>
<tr><td colspan="3">500V, front view</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>
</td><td>
</td><td>
</td></tr>
<tr><td colspan="3">500V, side view</td></tr>
<tr><td>(none)</td><td></td><td></td></tr>
</table>

<table>
<tr><td>(none)</td><td>
</td><td>
</td></tr>
</table>

<table>
<tr><td>7.5μF</td><td>25μF</td></tr>
<tr><td colspan="2">450V, front view</td></tr>
<tr><td></td><td></td></tr>
<tr><td>
</td><td>
</td></tr>
</table>

2. ver.01B (Fig. 51)

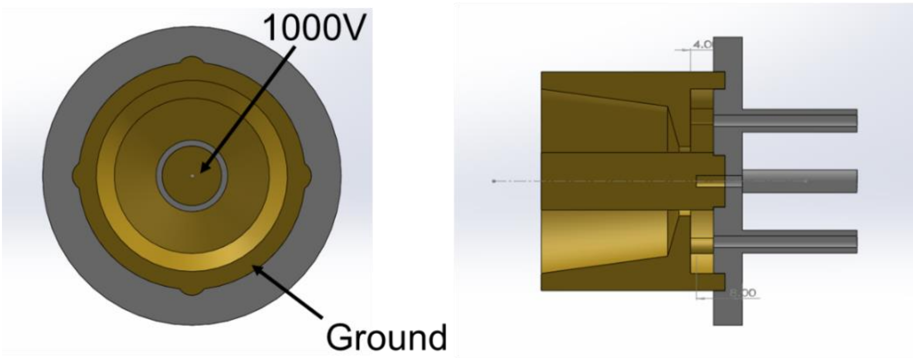
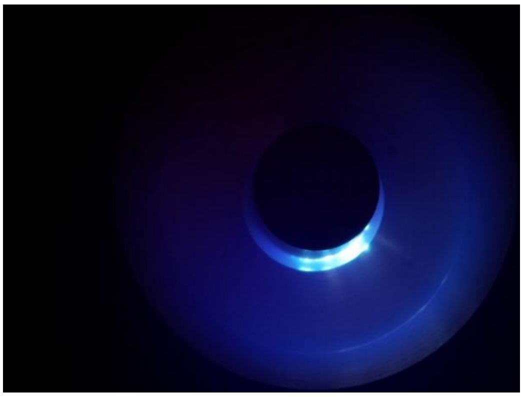
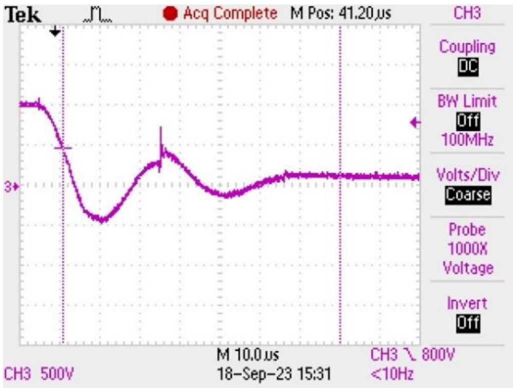
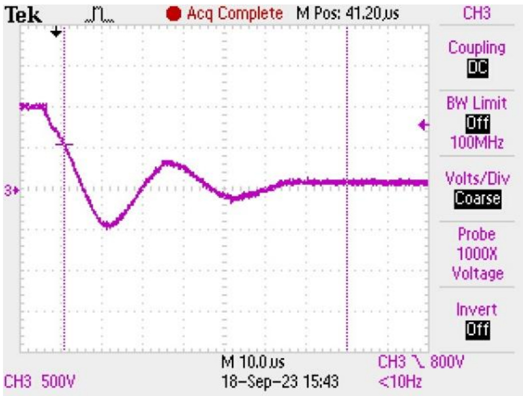
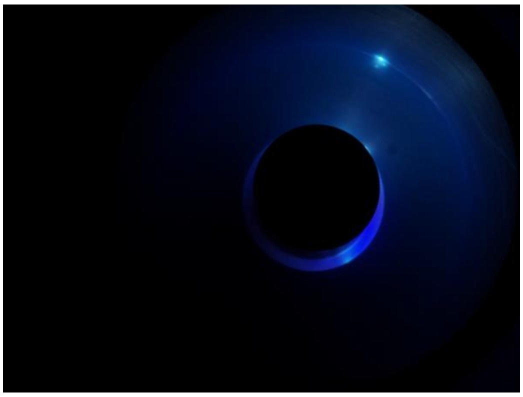
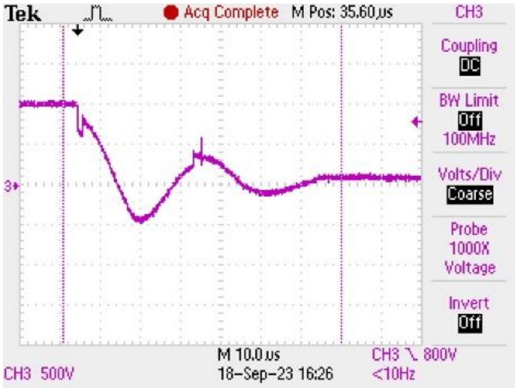


Figure 51

<table>
<tr><th colspan="2">1kV, front view</th></tr>
<tr><td></td><td>
</td></tr>
<tr><td></td><td>
</td></tr>
</table>





3. ver.02A (Fig. 52)

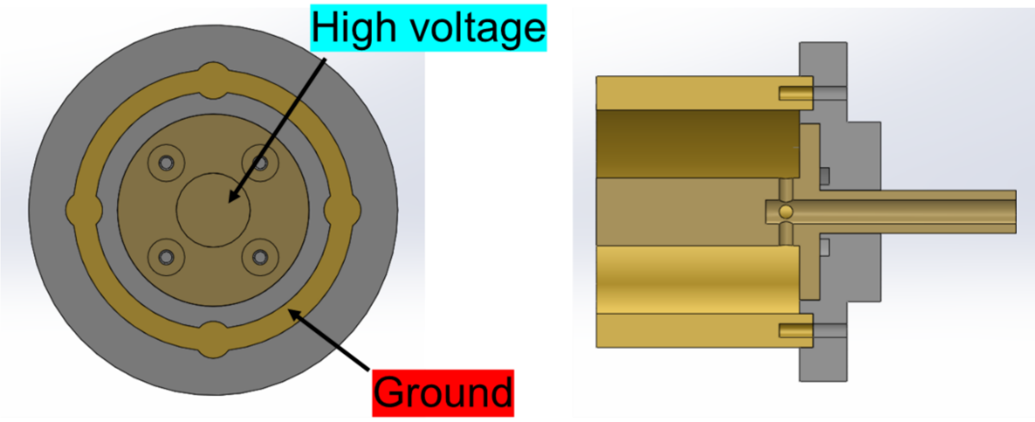
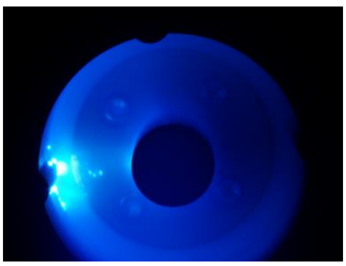
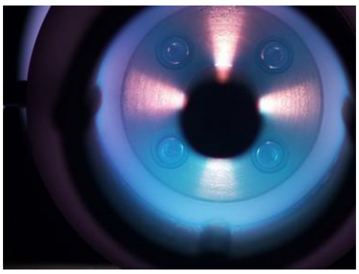
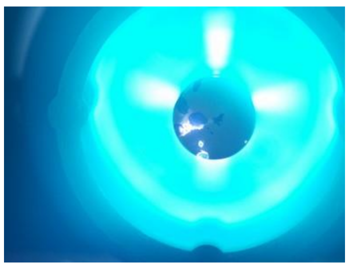
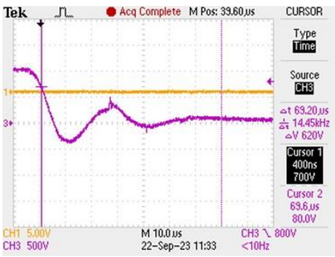
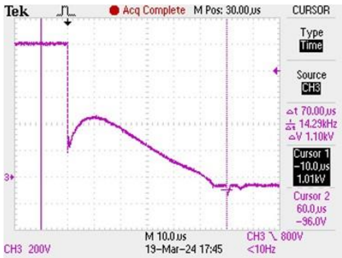
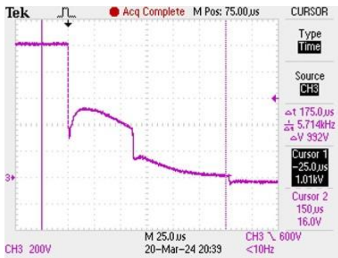
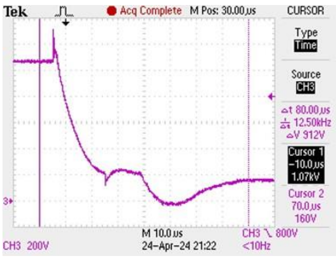
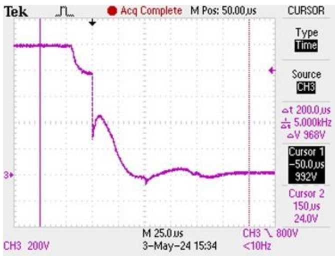
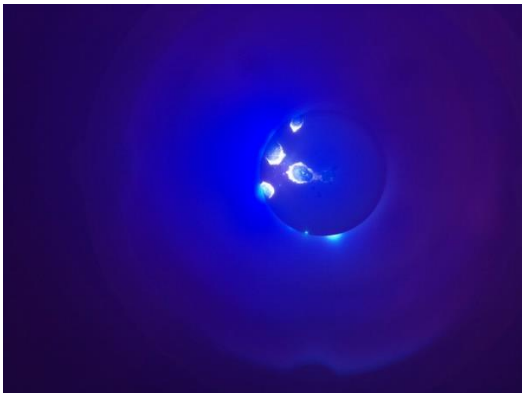
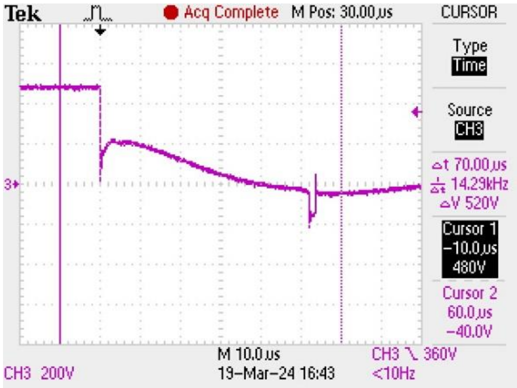


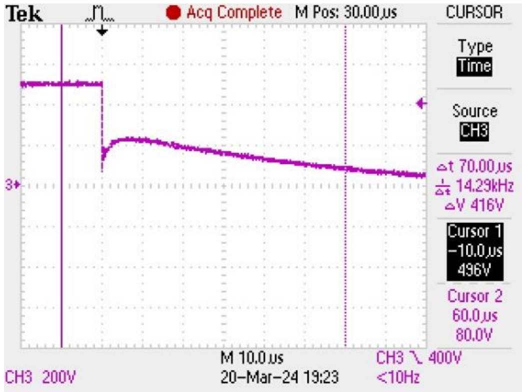
Figure 52

7.5μF	25μF	100μF
1kV, front view		
		

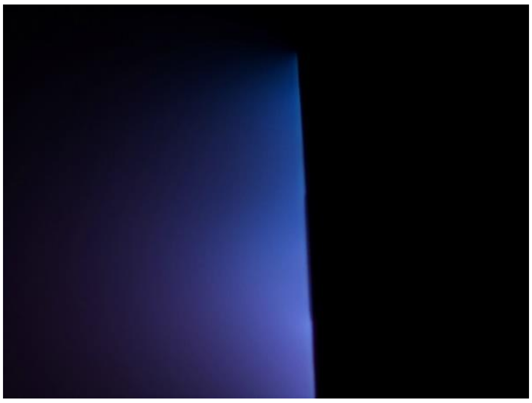
<table>
<tr><td>
</td><td>
</td><td>
</td></tr>
<tr><td colspan="3">1kV, side view</td></tr>
<tr><td>(none)</td><td></td><td></td></tr>
<tr><td>(none)</td><td>
</td><td>
</td></tr>
</table>

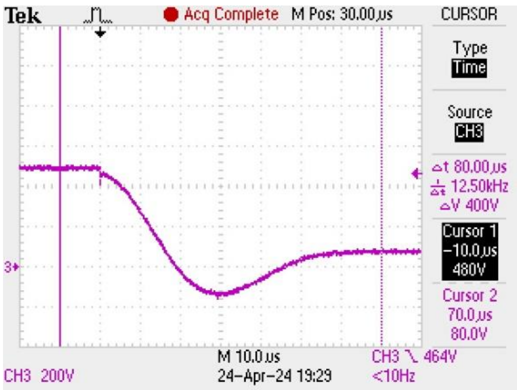
25µF	100µF
500V, front view	
	

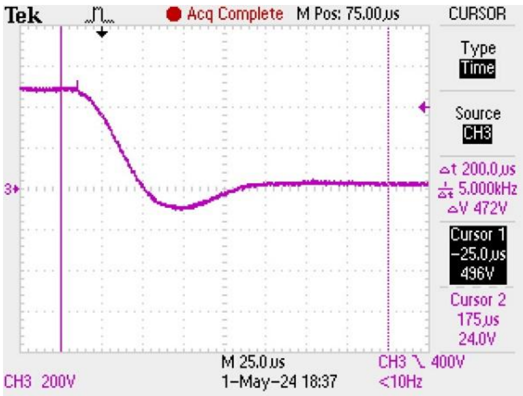




500V, side view







4. ver.02B (Fig. 53)

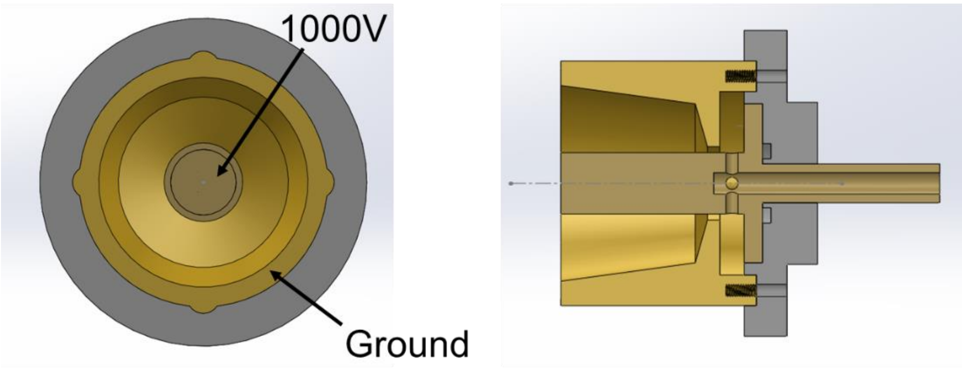
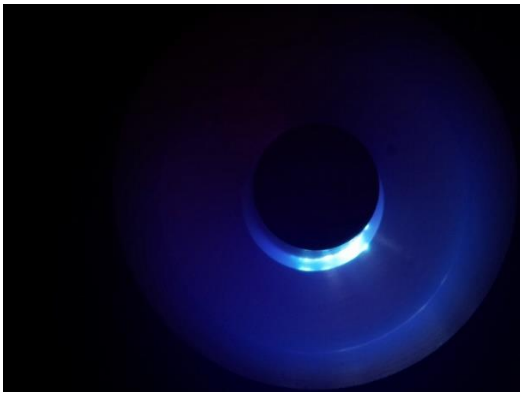
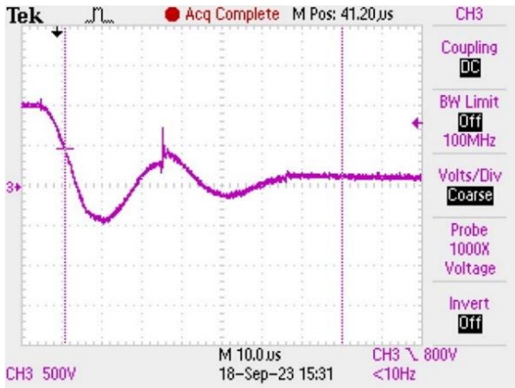
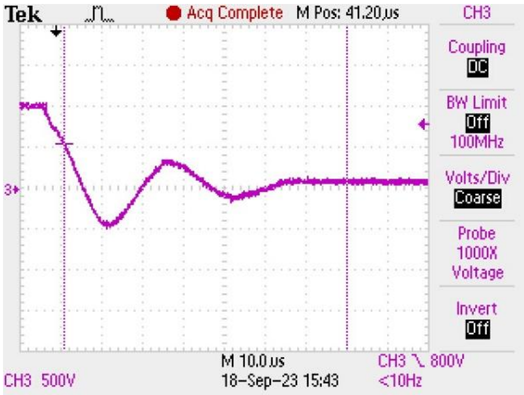
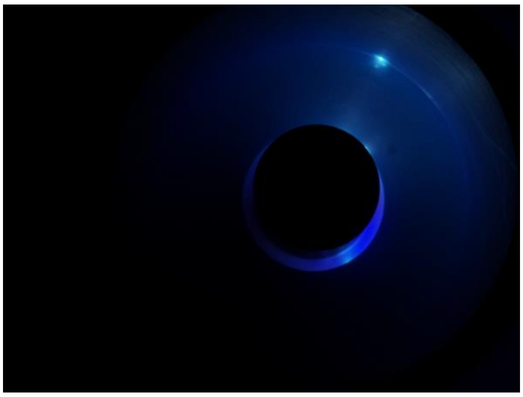
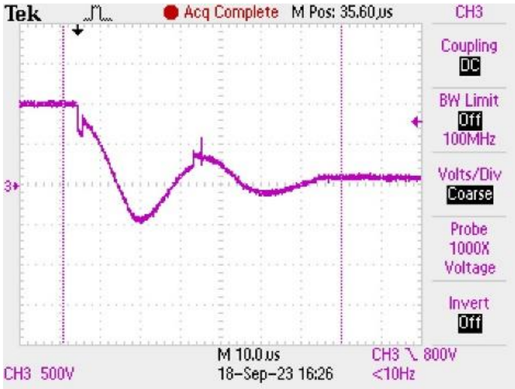


Figure 53

1kV, front view	
	
	





5. Data analysis

I perform data analysis on the collected data, including data smoothing and figure comparison. By differentiating the voltage diagram with respect to time (t) using the smoothed data, we can obtain the current diagram. This helps us determine whether the discharge is an arc discharge (A current scale) or a glow discharge (mA current scale). In the figure comparison, we can observe the differences between each case and try to find the connections between them.

$$Q = CV,\ C = \frac{Q}{V}$$

$$I = \frac{dQ}{dt} = C\frac{dV}{dt}$$

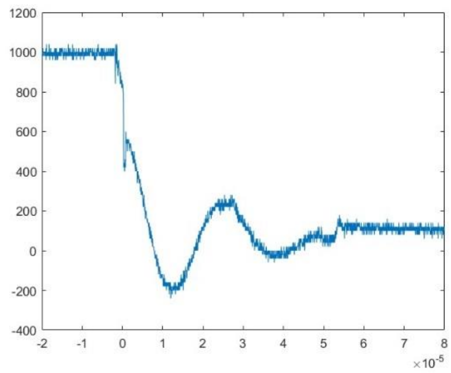
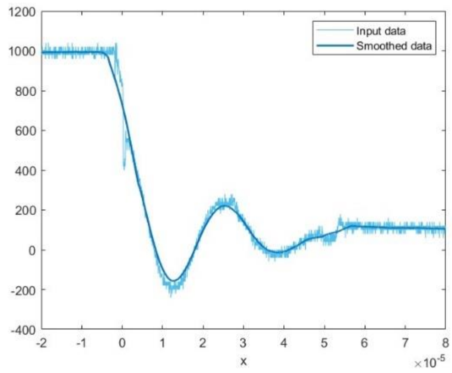
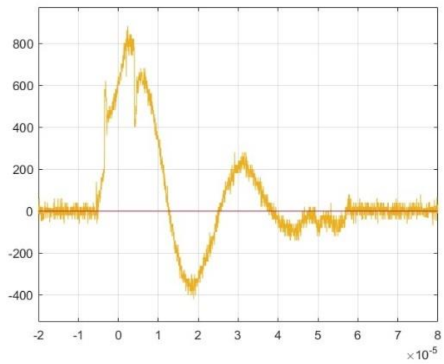
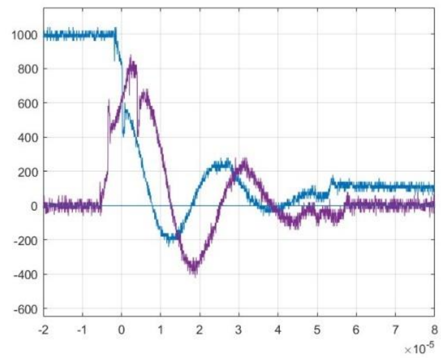
In conclusion, we can obtain the following information:

- The discharge current indicats that it is an arc discharge.
- The arcing position inside the plasma gun is almost random.
- When the voltage value is close to the edge of Paschen’s curve, the arcing position is more likely to go in the desired direction.
- The plasma did emerge from the plasma gun under a high energy supply, but we still need to check its shape using laser imaging.

For data smoothing, I use MATLAB with moving average

```
close all; clear all; clc;
data = readtable("voltage diagram file name");
x=data{1:2500,4};
y=data{1:2500,5};

plot(x,y)
smoothedData = smoothdata(y,"movmean","SmoothingFactor",moving window
value, ...
    "SamplePoints",x);

% Display results
figure
plot(x,y,"SeriesIndex",6,"DisplayName","Input data")
hold on
plot(x,smoothedData,"SeriesIndex",1,"LineWidth",1.5, ...
    "DisplayName","Smoothed data")
hold off
legend
xlabel("x")

Y=smoothedData(:,1);
i = 1:2499;
dt = x(i+1,1)-x(i,1);
dV = Y(i,1)-Y(i+1,1);
figure
plot(x(i+1,1),(dV(i,1)/dt(i,1))*capacitance)
grid on;
figure
plot(x,y)
hold on; grid on;
plot(x(i+1,1),(dV(i,1)/dt(i,1))*capacitance)

figure
plot(x(i+1,1),(dV(i,1)/dt(i,1))*(capacitance)*(Y(i+1,1)))
hold on; grid on;
```

For example, I do the data smoothing with the voltage diagram of ver.01A under 1kV, 7.5μF.

Original data	Smoothed data
	
Current diagram	**Voltage with current diagram**
	

The results show that the peak current of the discharge is about 800A, confirming that it is an arc discharge. According to the relationship

$$f \propto \frac{1}{\sqrt{LC}}$$

when we use a capacitor with a larger capacitance, the duration of oscillation in the voltage diagram increases. I compared the voltage diagrams for capacitances of 7.5μF, 25μF, and 100μF, and the results are consistent with the theory shown in Fig. 54.

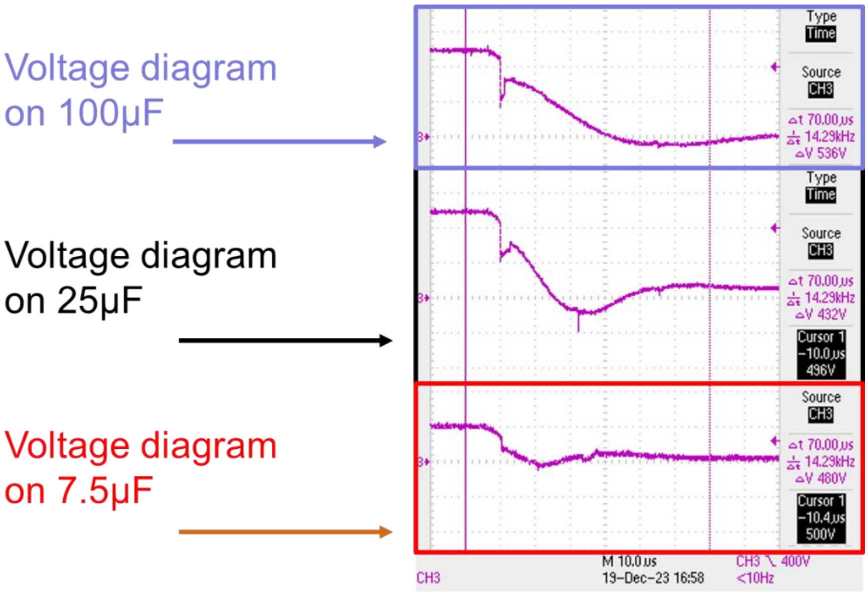


Figure 54

Reminders:

Although I acquired these experimental data, there are still some issues that need to be addressed and hopefully improved in the future.

The first issue is a strange voltage drop with each discharge, as shown in Fig. 55. Initially, I thought it was caused by the discharge current and considered it a sign that could verify the occurrence of a discharge. However, after discussing with the professor, we are more inclined to consider it an error in the circuit and voltage measurement. This might be caused by floating voltage when connecting the circuit to the ground. If the ground of the power supply and the ground of the high differential voltage probe are too far apart, there might be a voltage difference between the two grounds during measurement, resulting in the strange voltage drop.

To solve this problem, the position of the ground connection needs to be reviewed, and another voltage-measuring device should be tried. It is also important to be careful with pre-discharge in the experiment, so the insulation of components other than the electrodes of the plasma gun is crucial, especially the wire connections.

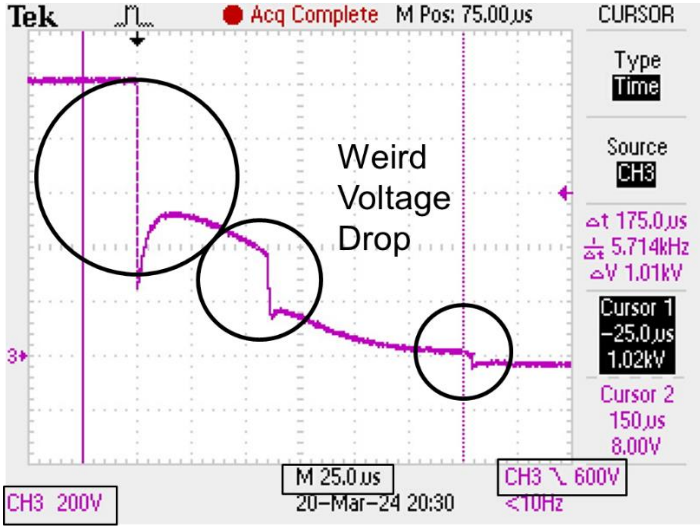
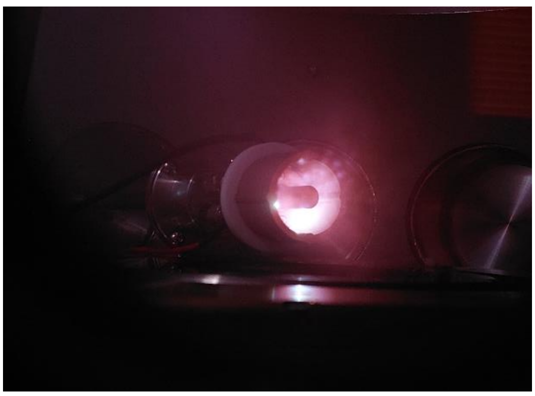
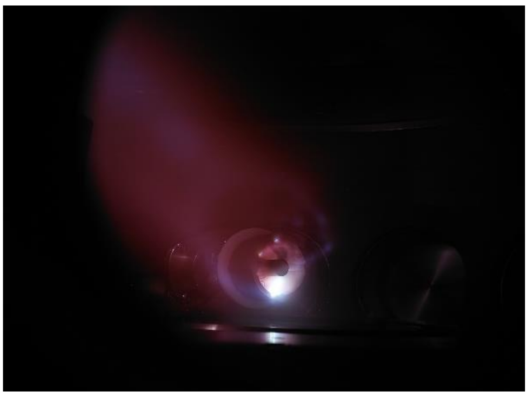


Figure 55

The second issue to be addressed is that the arcing direction in the plasma gun is random. Ideally, the direction should go in four directions simultaneously.

As mentioned in the conclusion above, the arcing position is more likely to follow the desired path when the voltage value is close to the edge of Paschen's curve. However, the problem is that when the voltage value is low, the total energy of the plasma may be too low for it to emerge from the plasma gun. Therefore, it is important to carefully choose the values of the capacitor and voltage, and we hope to find a balance in the future.

The third issue is that in the ver.02 design, the center electrode might be too close to the gas supply tube, causing a pre-fire between the center electrode and the gas supply tube before the gas passes through the center electrode and the outer circular electrode, as shown in Fig. 56. This result is interesting because we don't know if the pre-fire is good or bad. The image captured by the camera shows that the pre-fire helps the plasma to form and fill the entire plasma gun, which might also be a reason for the strange voltage drop.

In this situation, we still want to prevent the pre-fire, so we can change the material of the gas supply tube or improve the insulation between the center electrode and the gas supply tube. However, it's still worth discussing whether the pre-fire is a beneficial phenomenon that can help our plasma gun to function.

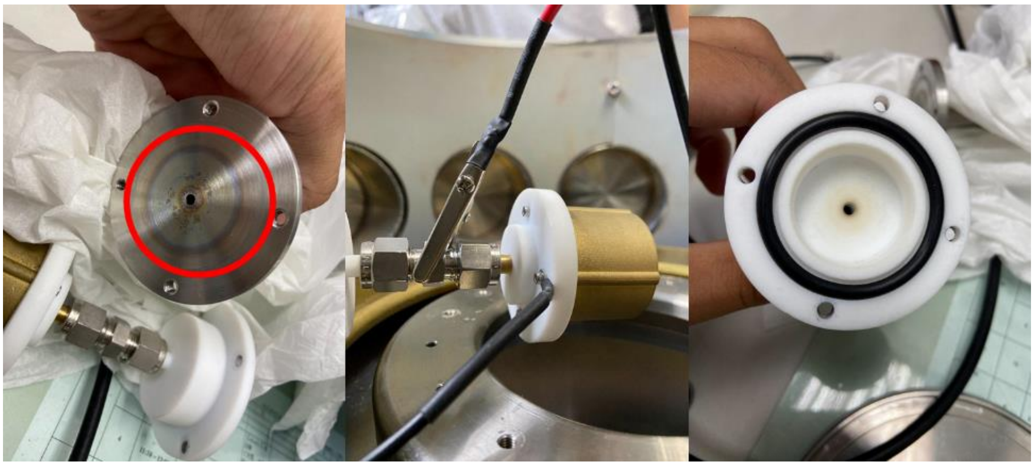


Figure 56

The fourth issue is the scorch marks on the Teflon, as shown in Fig. 57. The scorch marks indicate the presence of carbon on the surface, which poses a significant threat to the experiment. The carbon between the center electrode and the outer circular electrode may create a conductive path, causing the plasma gun to malfunction.

To address this problem, it is important to clean the scorch marks on the Teflon surface. You can use a sonic cleaning machine and isopropyl alcohol for this purpose.

Figure 57

All the records of the experiments can be found in NAS

/Experiments/2022_ychen

IV. Future perspectives

For methods to improve the experimental setup, aside from the issues that need to be addressed, some suggestions might be helpful in the future:

1. Shorten the length of the plasma gun

Due to the issue that the plasma cannot easily emerge from the plasma gun, we want to capture the image of the plasma reconnection at the top of the plasma gun. Therefore, it might be beneficial to consider this in the plasma gun design.

By shortening the length of the plasma gun, as shown in the schematic diagram in Fig. 58, after the gas passes through the center electrode and the outer circular electrode, the arc discharge will create plasma, and the plasma will more easily emerge from the plasma gun. In this situation, we are more likely to observe the reconnection of the plasma at the top of the plasma gun, which can be captured by the laser camera.

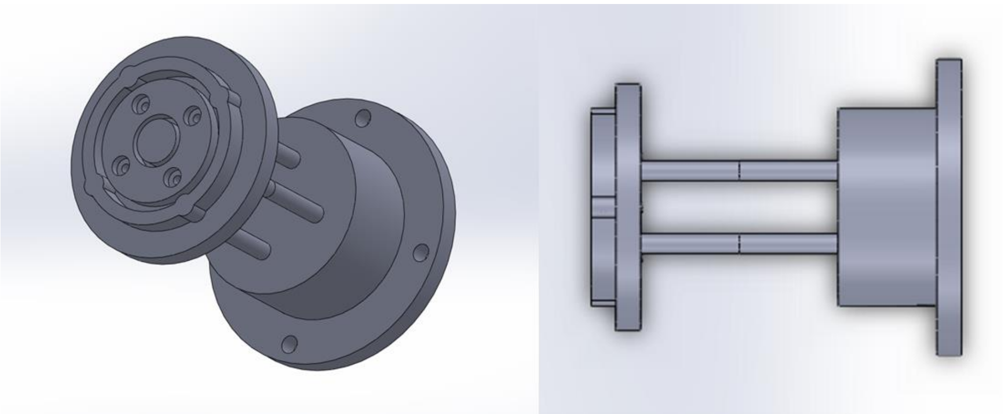


Figure 58

2. Drill a window on the wall of the plasma gun

Once the plasma is triggered, we want to capture images of how the plasma moves inside the plasma gun using a laser camera. By drilling a window on the sides of the plasma gun, we can record the acceleration and velocity of the plasma.

The schematic diagram shown in Fig. 59 is just a hypothetical proposal; it still needs to take into consideration the sealing of the outer circular electrode. A glass cover might be an option.

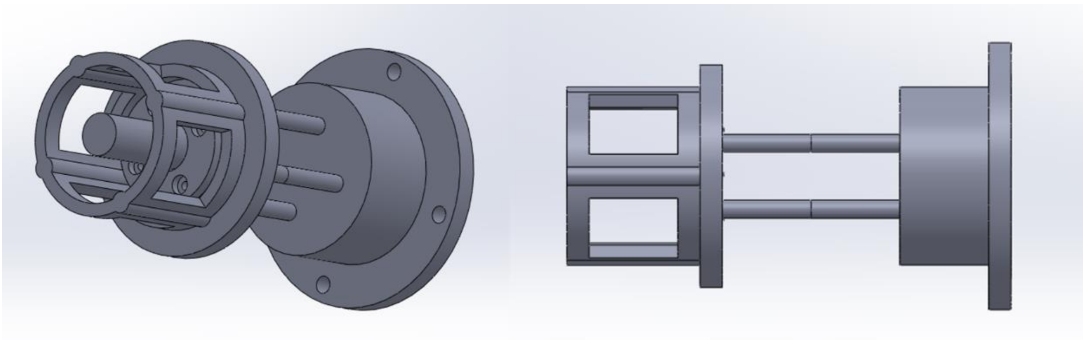


Figure 59

3. Use carbon fiber to cover the center electrode

Carbon fiber is a good conductor that can easily be shaped. The method involves using a carbon fiber web as the center electrode. The carbon fiber should be made prickly on its surface, with each prickle serving as a trigger spot for the center electrode.

Ideally, this method will result in an evenly distributed current discharge within the plasma gun. This may address the issue of random arcing positions in the plasma gun, and there is already some research on carbon fiber discharge.

4. Change the trigger mode from gas trigger to electrical trigger

The self-trigger mechanism in my experiment involves gas passing through the electrodes, which are already charged, allowing the arc discharge to occur naturally. This causes the problem of uneven gas flow in each direction, with one side potentially flowing faster, making arc discharge more likely.

By changing the self-trigger from a gas trigger to an electrical trigger, we can first establish a background atmosphere that fits Paschen’s curve. Then, we will use an electrical trigger system to drive the plasma gun with high voltage. With more evenly distributed air pressure in the chamber, we can expect the arc position to follow multiple paths within the plasma gun.

V. Non-experiment related stuff

Due to some mistakes, I broke the camera holder, so I built a new one as shown in Fig. 60. The file can be found in NAS /Drawing/2022_ychen.

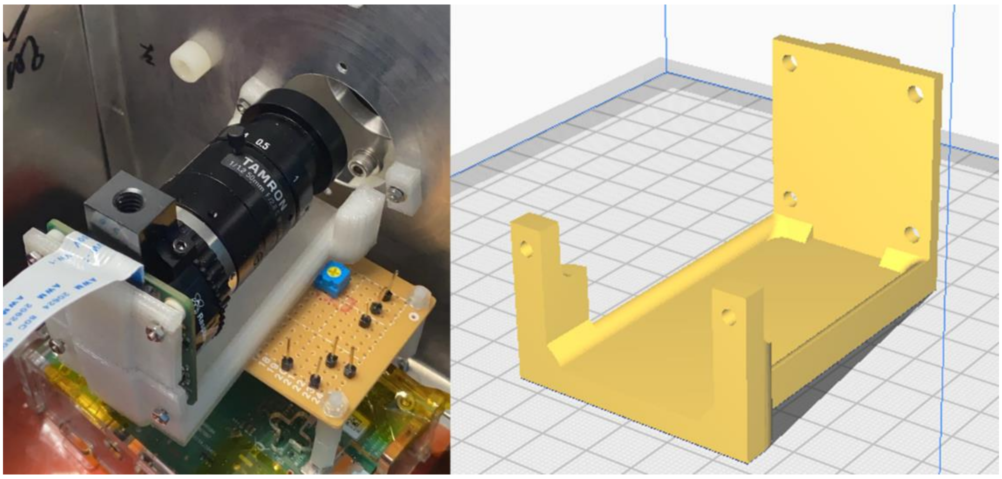
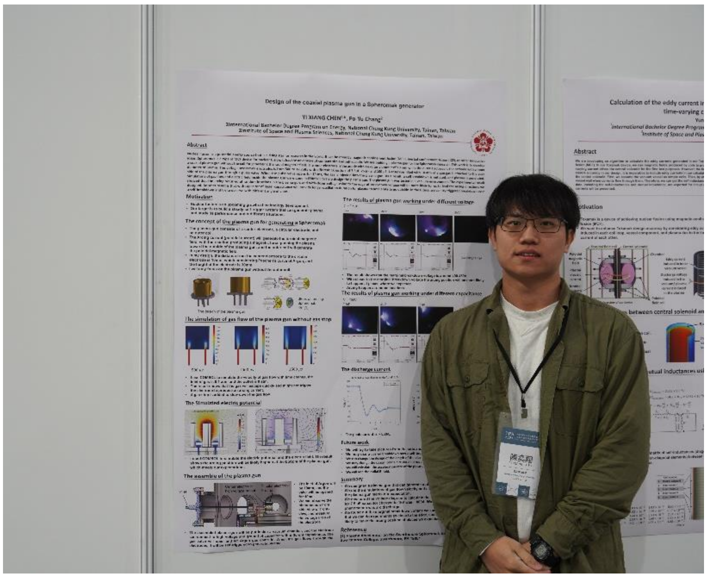


Figure 60

In 2024, I attended the TPS poster report. The report was about my experiment progress and the results I acquired. It was a great experience.



VI. Conclusion

In the past two years, I have worked on the design, simulation, testing, and experiments of the plasma gun. The results show that there are still some problems that need to be resolved, and I hope they can be improved in the future.

I enjoyed my time in the lab with everyone; it was a wonderful journey in my life. Thanks to all the members who had conversations with me, and I wish you all the best.