What is the Lowest $U_{Breakdown}$?

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Overview

1 Introduction and experimental objectives

2 Experimental protocol

3 Results and analysis

4 Conclusion

1. Experimental objectives

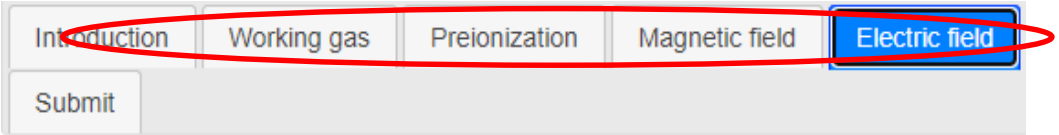
First Objective :

To determine approximately the Lowest $U_{Breakdown}$ value for different pressure values.

Second Objective :

To compare the final result with the theoretical ones for accuracy verification.

2. Experimental protocol



- The GOLEM Tokamak has 4 parameters to vary: Pressure, Toroidal Magnetic Field, Delay & Electric Field
- In our case, we are interested in varying the value of the electric field $U_{CD.}$
- U_{Bt}= 1000 V, p = {6 mPa, 14 mPa, 32 mPa}, δ = 0s

Experience Roadmap

Experimental Setup

- Pick the pressure and capacitor voltage values for generating the toroidal magnetic field (U_{Bt}).
- Utilize the electric gun as the ionization method.

Plasma Ignition Process

- Choose an initial value for $U_{Breakdown}$.
- Adjust the $U_{Breakdown}$ value based on the presence or absence of plasma. U_{cd} in [50V , 700V].

Iterative Approach

- Select a different gas pressure value.
- Repeat the previous step until an interval is found where plasma ignition is certain.

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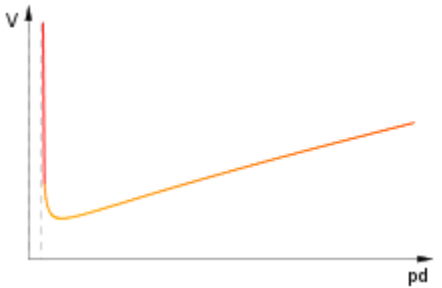
Results and analysis

Results and analysis

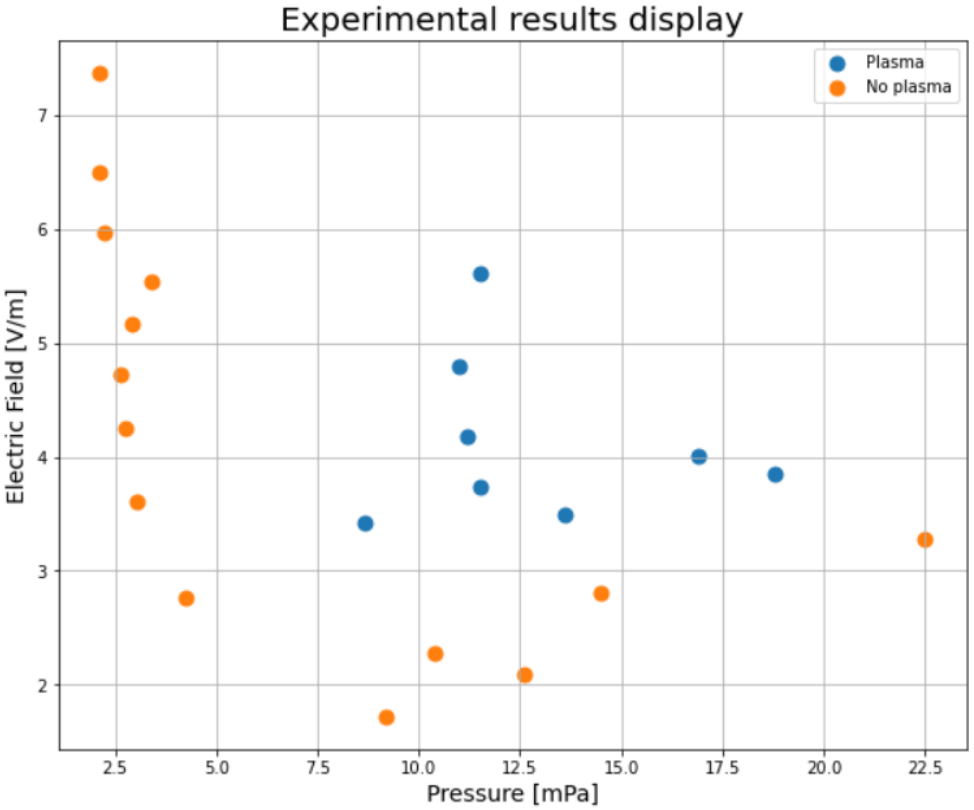
The main formula to describe the Paschen law for breakdown voltage is given by :

$$V_B = \frac{Bpd}{\ln(Apd) - \ln\left[\ln\left(1 + \frac{1}{\gamma_{se}}\right)\right]} \quad (*)$$

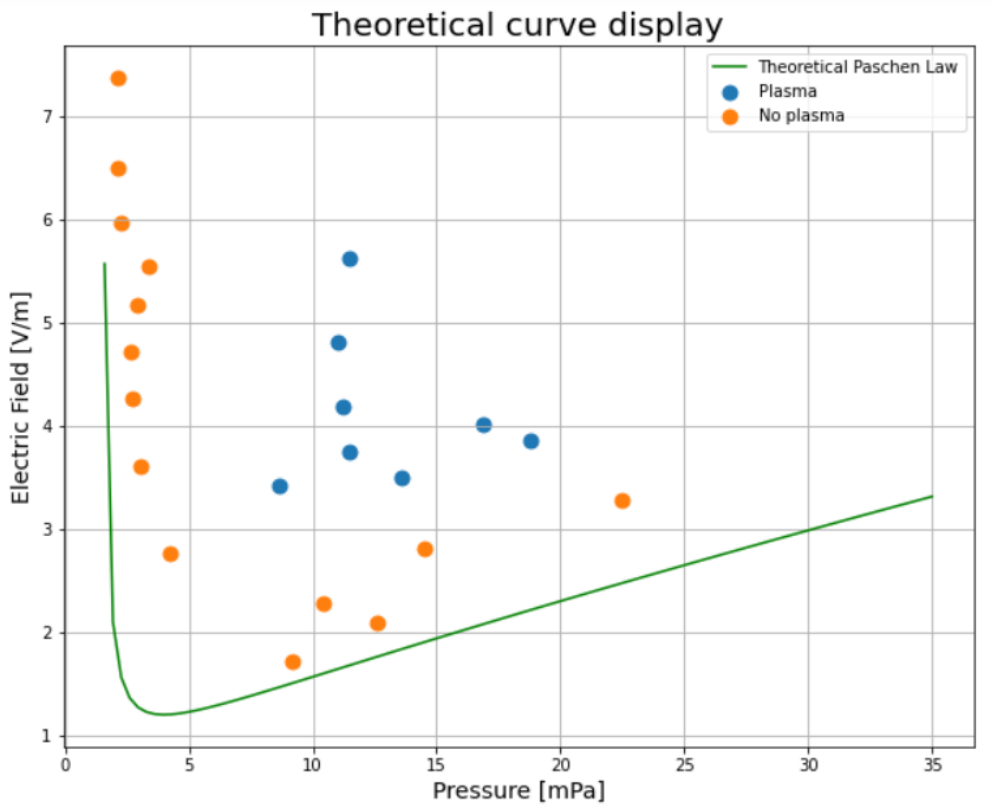
Where:
A, B & C = $\ln(\ln(1+1/\gamma_{se})$ are constants



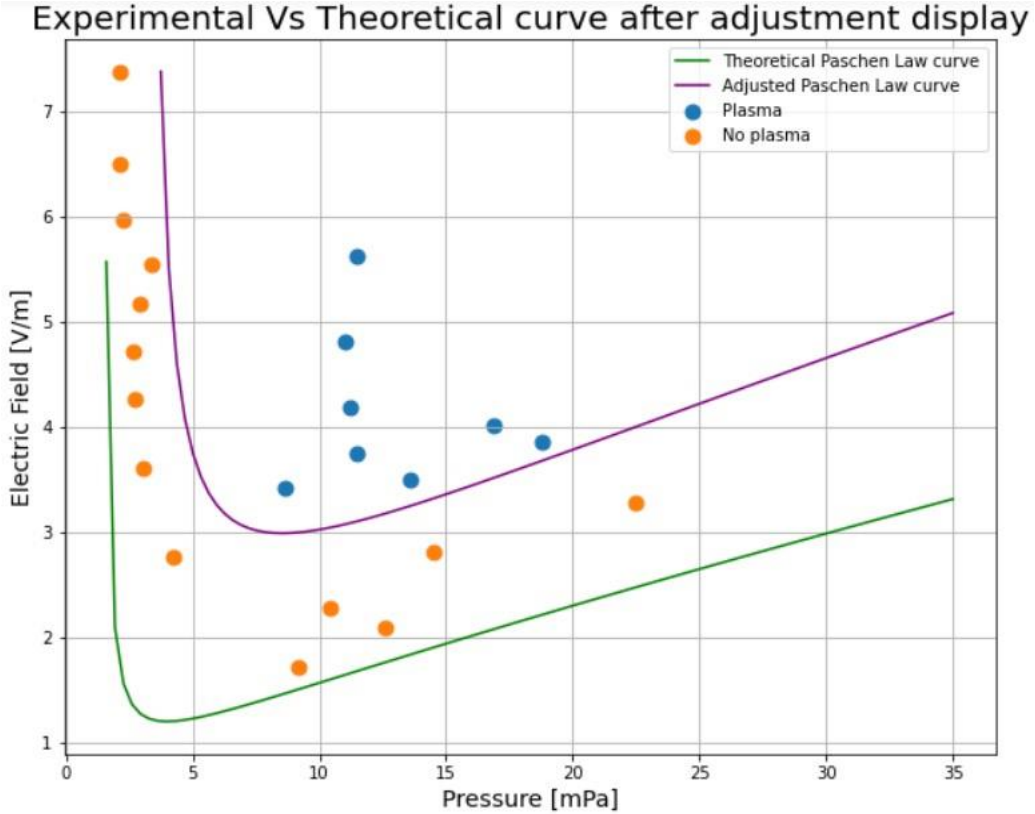
(*) : Operational Domain in Hydrogen Plasmas on the GOLEM Tokamak, Vojtěch Svoboda & colleagues



After each discharge experiences, we plotted the values according to the existence of Plasma.



Then, we tried to classify the values using the theoretical curve and keeping the constants of the reference. (A = 0.9, B = 0.3 & C = 1.2)



Finally, we kept the value of the constant A according to the reference and adjusted the values of the constants B and C to plot a better classifier. (B = 0.35 & C = 1.96)

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Conclusion

4. Conclusion

Energy Efficiency :

Initiating a plasma with a low electric field leads to improved energy efficiency in fusion reactors.

Cost Reduction :

Lowering the electric field for plasma initiation can have cost-saving implications.

Thank you for your attention !