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INSTITUTO DE PLASMAS
E FUSÃO NUCLEAR

Thesis Proposal

Modelling homogeneous DBD for CO_2 conversion

André Filipe ist1102821

16/01/2026

Supervisors:
Prof. Vasco Guerra
Dr. Pedro Viegas

1D - Discharge Model Formulation

$$\left(\frac{\partial f_i}{\partial t} + \mathbf{v} \cdot \nabla f_i + \mathbf{a}_i \cdot \nabla_{\mathbf{v}} f_i = \left(\frac{\partial f_i}{\partial t} \right)_C \right)$$

1

Continuity Equation

$$\frac{\partial n_i}{\partial t} = -\nabla \cdot \mathbf{\Gamma_i} + S_i$$

Drift-Diffusion Approx.

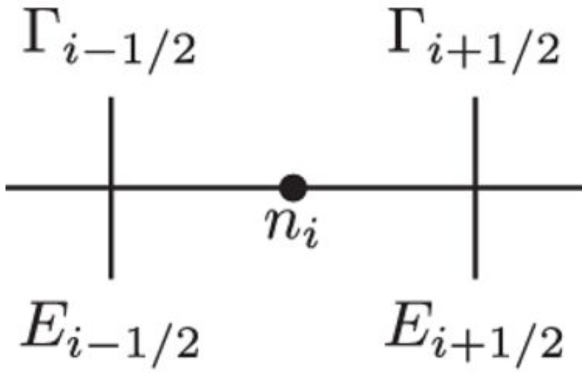
$$\mathbf{\Gamma_i} = \frac{|q_i|}{q_i} n_i \mu_i \mathbf{E} - D_i \nabla n_i$$

2

Poisson's Equation

$$\nabla \cdot (\varepsilon \mathbf{E}) = \sum_i q_i n_i$$

Finite Volume Method (FVM)



Benchmark - Teunissen 2020 [1]

Simulation Conditions:

- 500 cells (10 mm domain);
- Immobile Ions;
- Mobile electron with fixed transport coefficients;
- 10 kV on the left boundary;
- No Source Terms;
- Time-step of 80 ps;

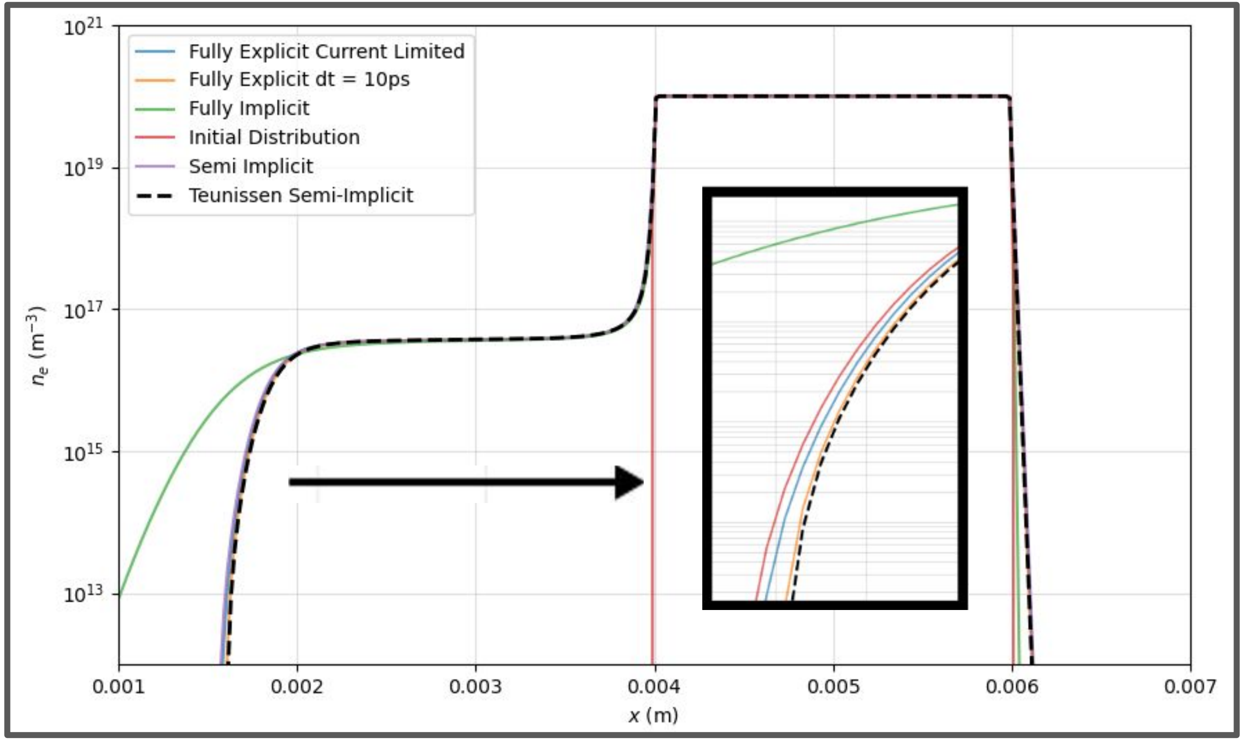


Figure 3 - Comparison of the simulated electron density, at t = 50 ns between the Semi-Implicit model in [2] and the four temporal discretization schemes.

[1] - J. Teunissen. "Improvements for drift-diffusion plasma fluid models with explicit time integration". DOI: 10.1088/1361-6595/ab6757

Thesis Roadmap

Work Started

- Create a fast and easy to use code to simulate a fluid Low-Temperature Plasma (LTP) homogeneous DBD discharge [2];
- Test and implement different schemes for comparison purposes;
- Benchmark the results against literature;

Planned work

- Compare new simulation results to experiments;
- Explore different regimes for the CO_2 plasma conversion.

[2] - C. Bajon et al. *"Homogeneous dielectric barrier discharge in CO2". DOI: 10.1088/1361-6595/acc9d9*

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Thank you for your attention!