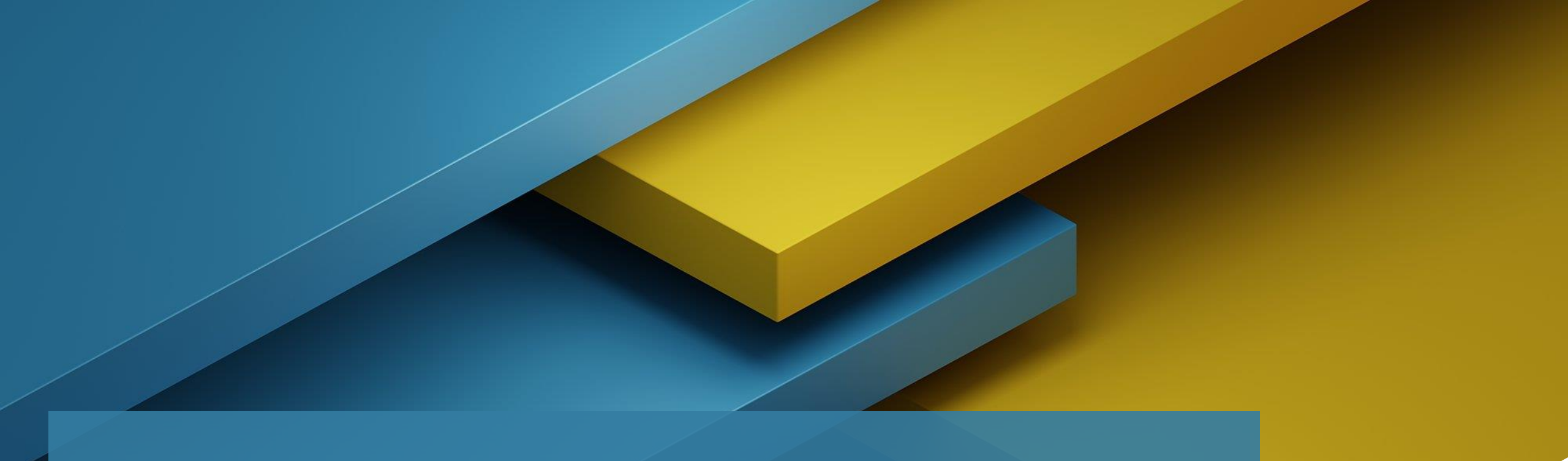

# CCP Fluid Model(II): Model Description & Results

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# CCP Fluid Model(II)

- Fluid electron + nonlinear Poisson-Boltzmann equation (Developed By Shahid).

$n_e$: Electron Density (x,t)

$\Gamma_e$: Electron Flux (x,t)

$\phi$: Electric Potential (x,t)

$e$: Elementary Charge

$\epsilon_0$: Vacuum Permittivity

$n_{io}$: Ion Density (x)

$R$: Reaction Rate (x)

$D$: Electron Diffusion Coefficient

$\mu$: Electron Mobility Coefficient

$m_e$: Electron Mass

Governing Equations

$$\frac{\partial n_e}{\partial t} + \frac{\partial \Gamma_e}{\partial x} = R$$

$$\frac{\partial^2 \phi}{\partial x^2} = -\frac{e}{\epsilon_0}(n_e - n_{io})$$

$$n_{io} = R_0(x_2 - x_1)\sqrt{\frac{m_i}{eT_e}},$$

$$\Gamma_e = -D\frac{\partial n_e}{\partial x} - \mu n_e \frac{\partial \phi}{\partial x}$$

Diffusion Flux

Drift Flux

# CCP Fluid Model(II)

$$R(x) = \begin{cases} R_0, & x \in [x_1, x_2] \cup [L - x_2, L - x_1] \\ 0, & otherwise \end{cases}$$

$$V(t) = V_0 sin(2\pi f t)$$

$$D = \frac{eT_e}{m_e \vartheta_m} \qquad \mu = \frac{e}{m_e \vartheta_m}$$

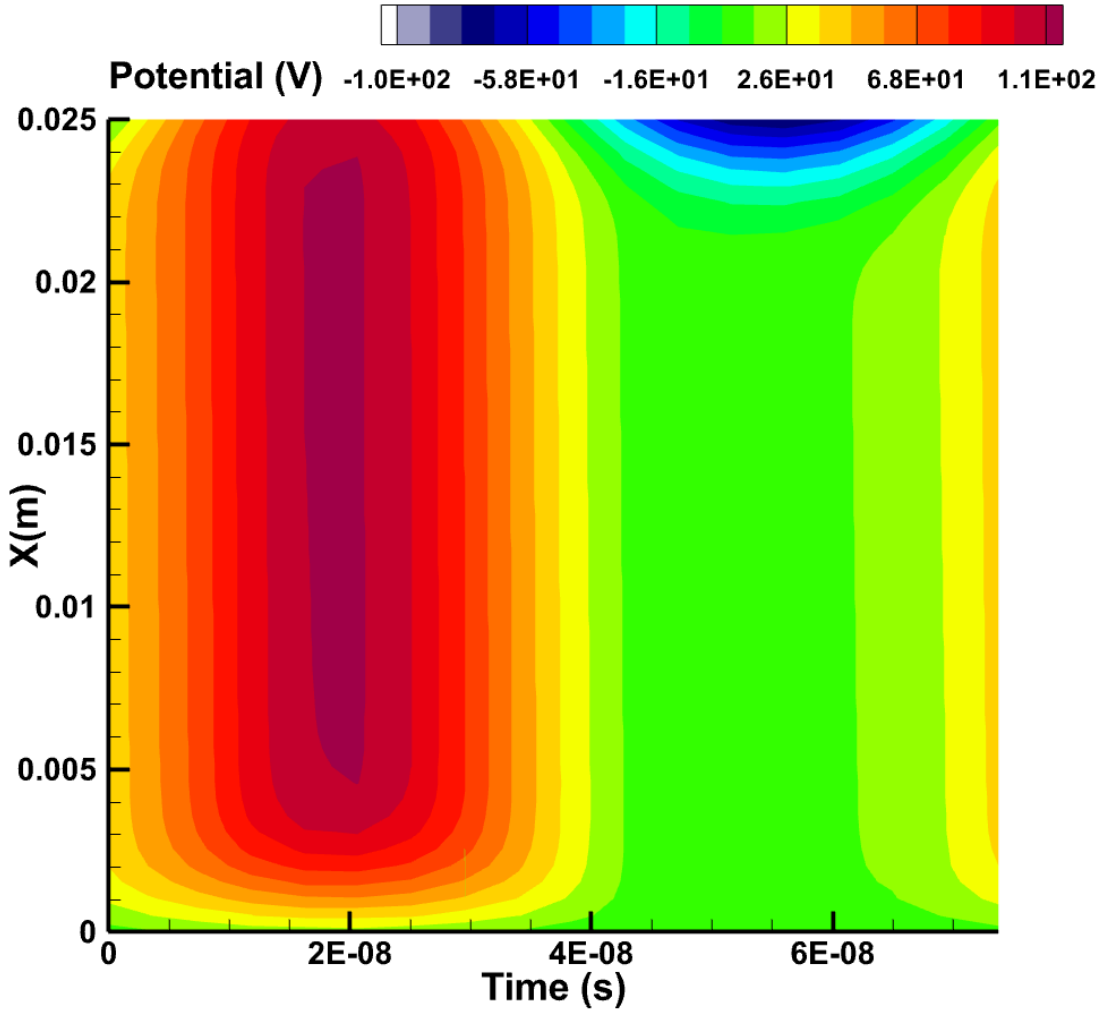
Solution Domain & B.C.

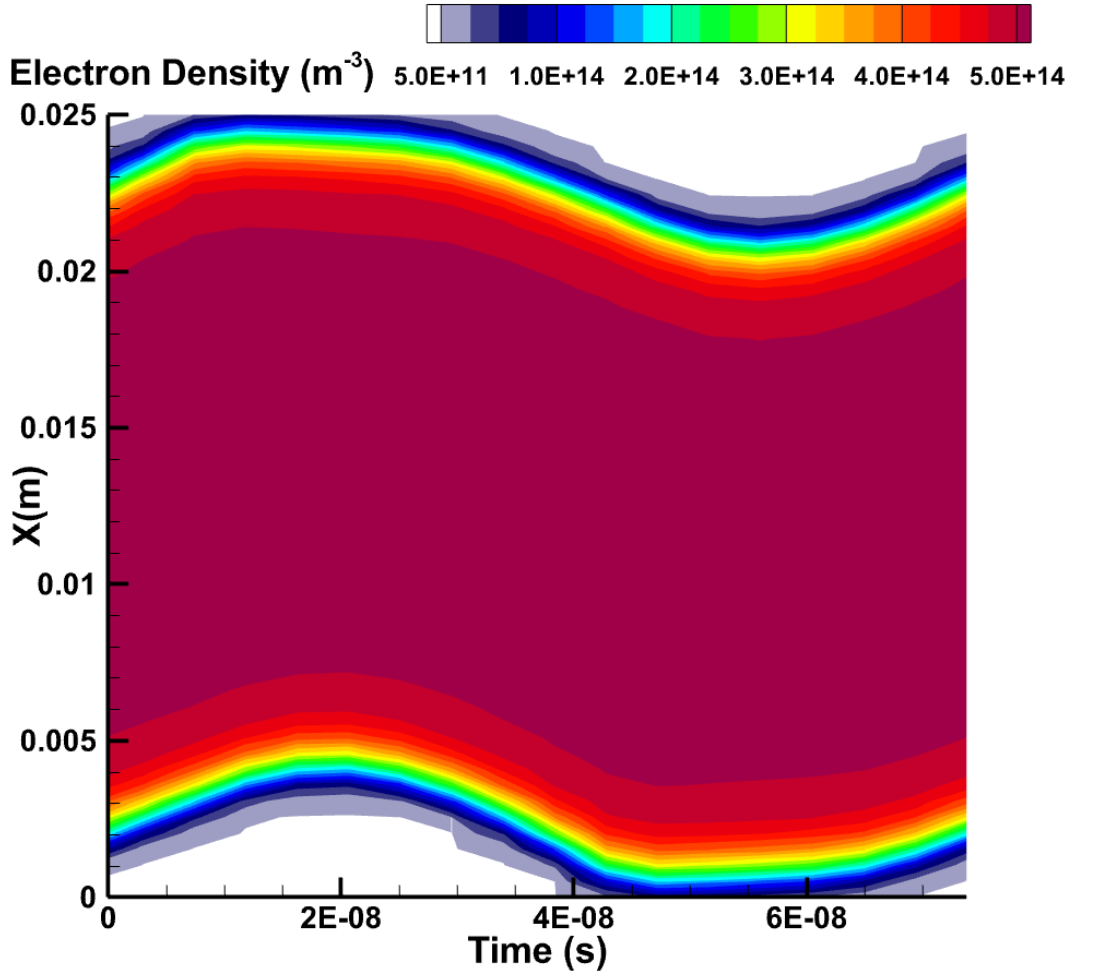
# CCP Fluid Model(II)

| Input Parameters | Baseline Value (Range (min, max)) |
|---|---|
| Domain Length: $L$ | $0.025\ m\ (0.01, 0.035\ )$ |
| Driving Frequency: $f$ | $13.56\ MHz\ (1, 40)$ |
| Driving Voltage Amplitude: $V_0$ | $100\ V\ (100, 300)$ |
| Reaction Rate Coefficient: $R_0$ | $2.7\text{x}10^{21}\ m^{-3}s^{-1}\ (2.7\text{x}10^{18}, 2.7\text{x}10^{21})$ |
| $x_1$ | $0.005\ m\ (0.16L, 0.2L)$ |
| $x_2$ | $0.01\ m\ (1.5x_1, 2x_1)$ |
| Electron Temperature: $T_e$ | $3\ eV\ (2, 4\ )$ |
| Ion mass: $m_i$ | $40\ amu\ (2, 40)[1\ amu = 1.67\text{x}10^{-27}kg]$ |
| Collision Frequency: $\vartheta_m$ | $1E8\ s^{-1}(1E7, 1E9)$ |

| Constants | Value |
|---|---|
| $e$ | $1.6\text{x}10^{-19}\text{C}$ |
| $m_e$ | $9.109\text{x}10^{-31}kg$ |
| $\epsilon_0$ | $8.854\text{x}10^{-12}\text{C}^2\text{kg}^{-1}\text{m}^{-3}\text{s}^2$ |

# Results




L=0.025m, f=13.56MHz, V=100V, $R_0$=2.7E20$m^{-3}s^{-1}$, Te=3.0eV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