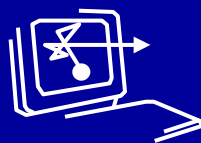
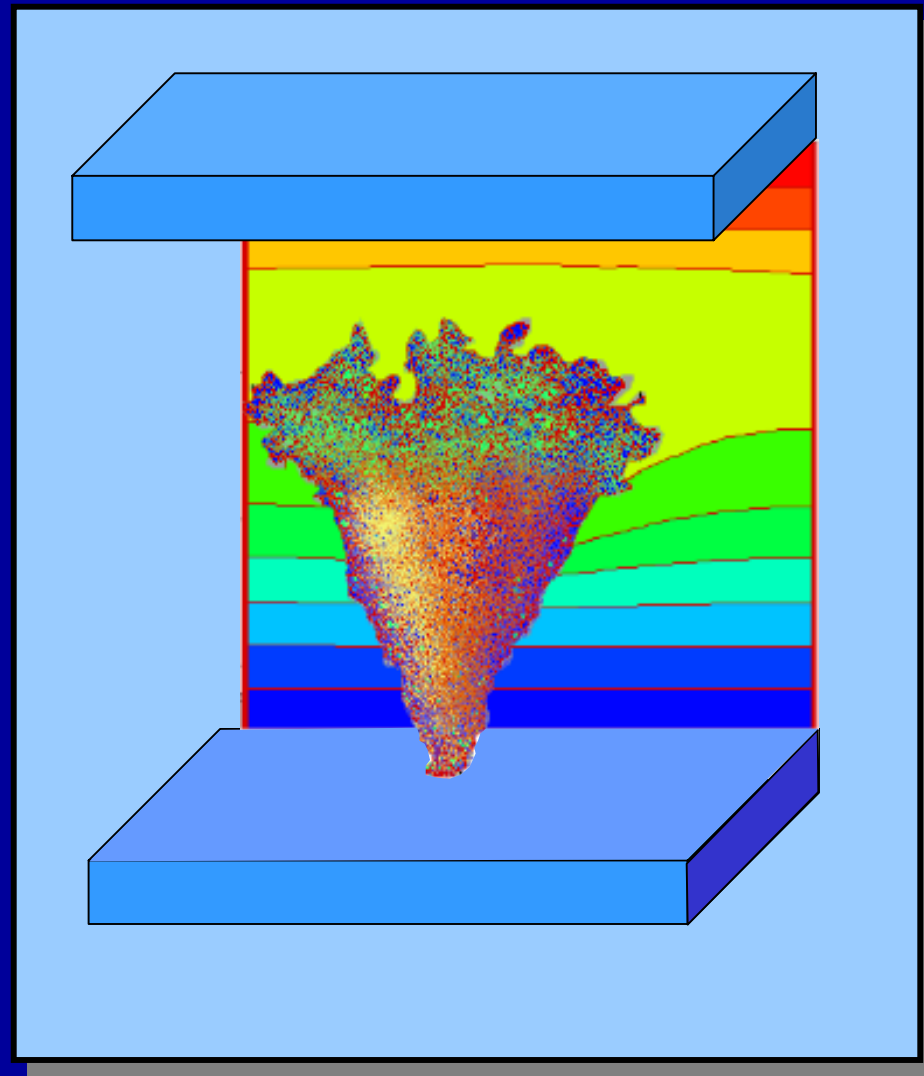


SIMULATION OF DIELECTRIC BARRIER DISCHARGES

by
Gabriel I. Font
and
W. Lowell Morgan

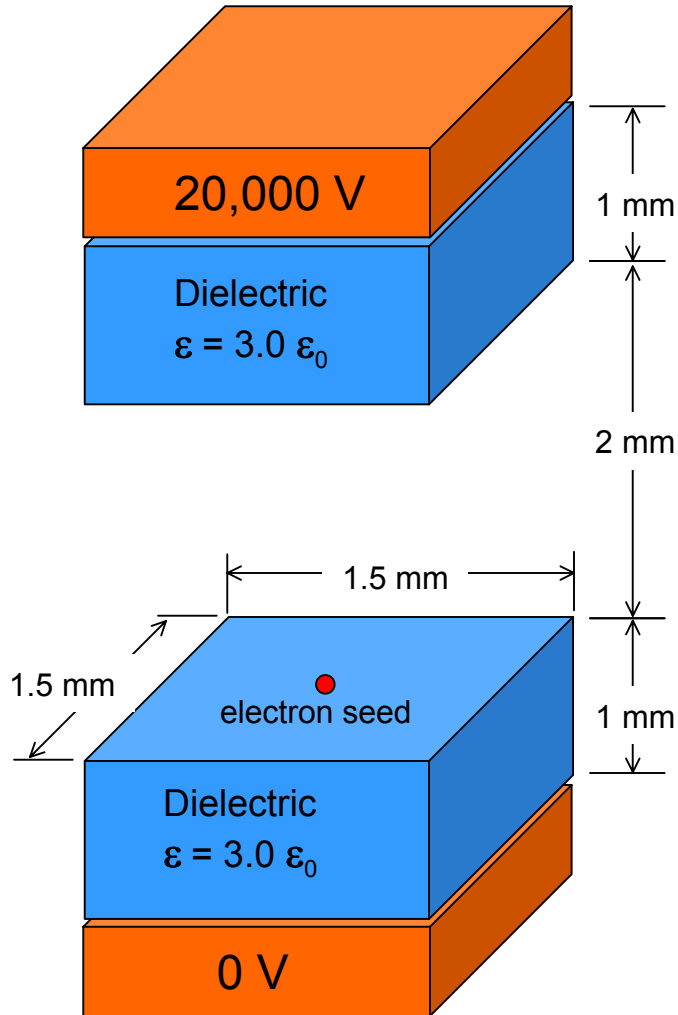


KINEMA

Research & Software, L.L.C.

DIELECTRIC BARRIER DISCHARGE:

Computational Domain



Discharge Conditions:

Pres.	= 1 atm
Gas	= Nitrogen
$n_{e(\text{seed})}$	= $8 \times 10^{12} \text{ cm}^{-3}$
$n_{e(\text{backgrnd})}$	= 0 cm^{-3}
R_{seed}	= $50 \mu\text{m}$

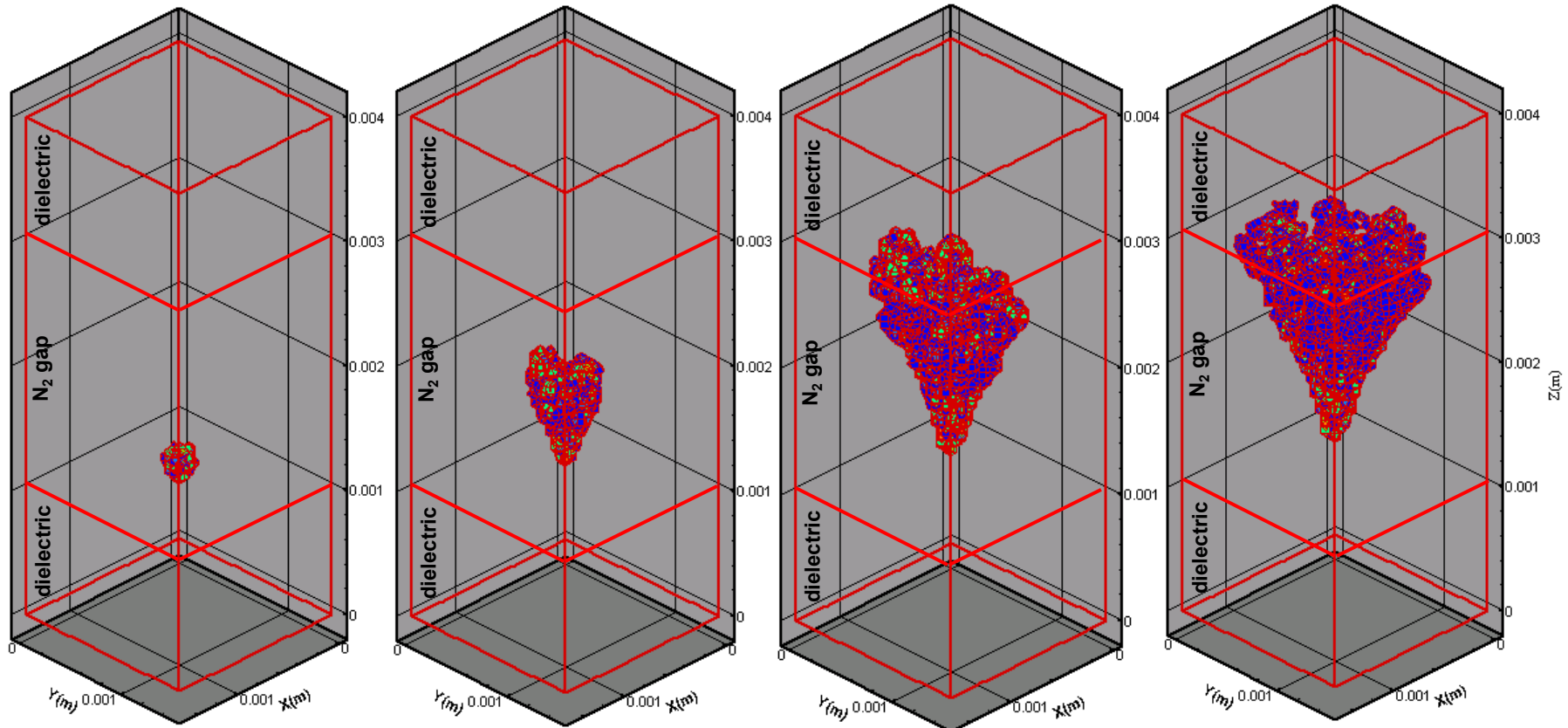
DIELECTRIC BARRIER DISCHARGE: Electron Density Evolution

1 nsec

3 nsec

5 nsec

7 nsec



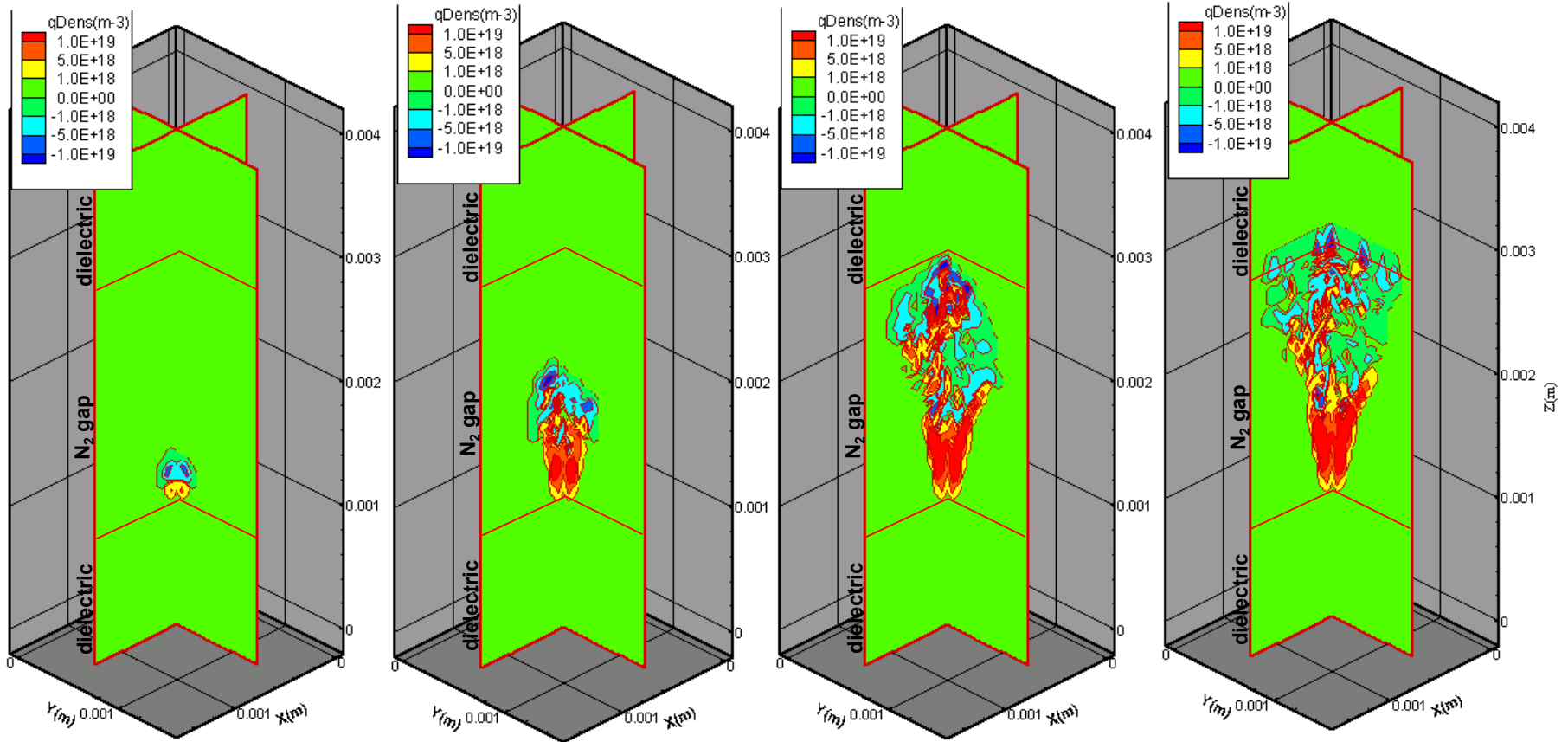
DIELECTRIC BARRIER DISCHARGE: Plasma Density Evolution

1 nsec

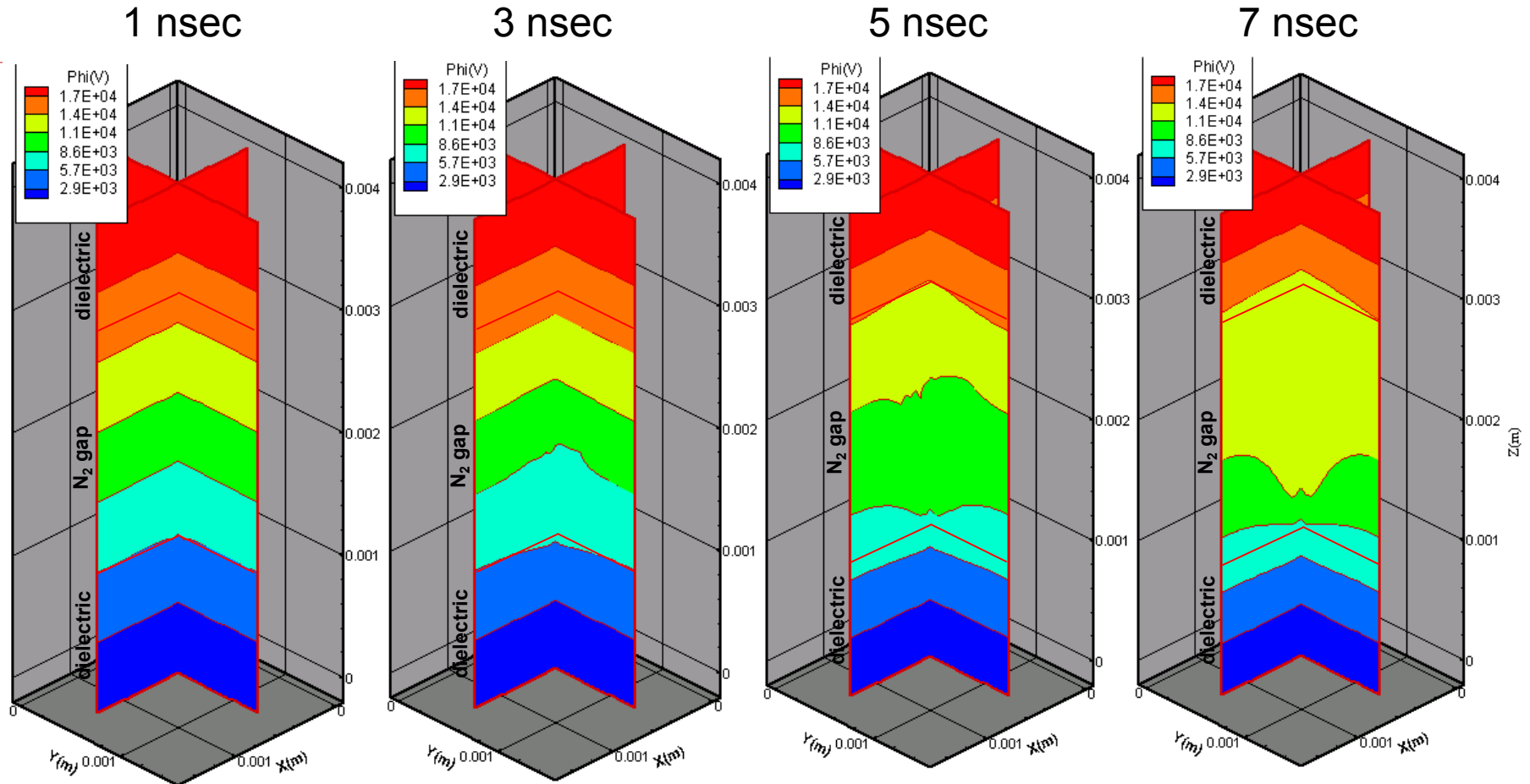
3 nsec

5 nsec

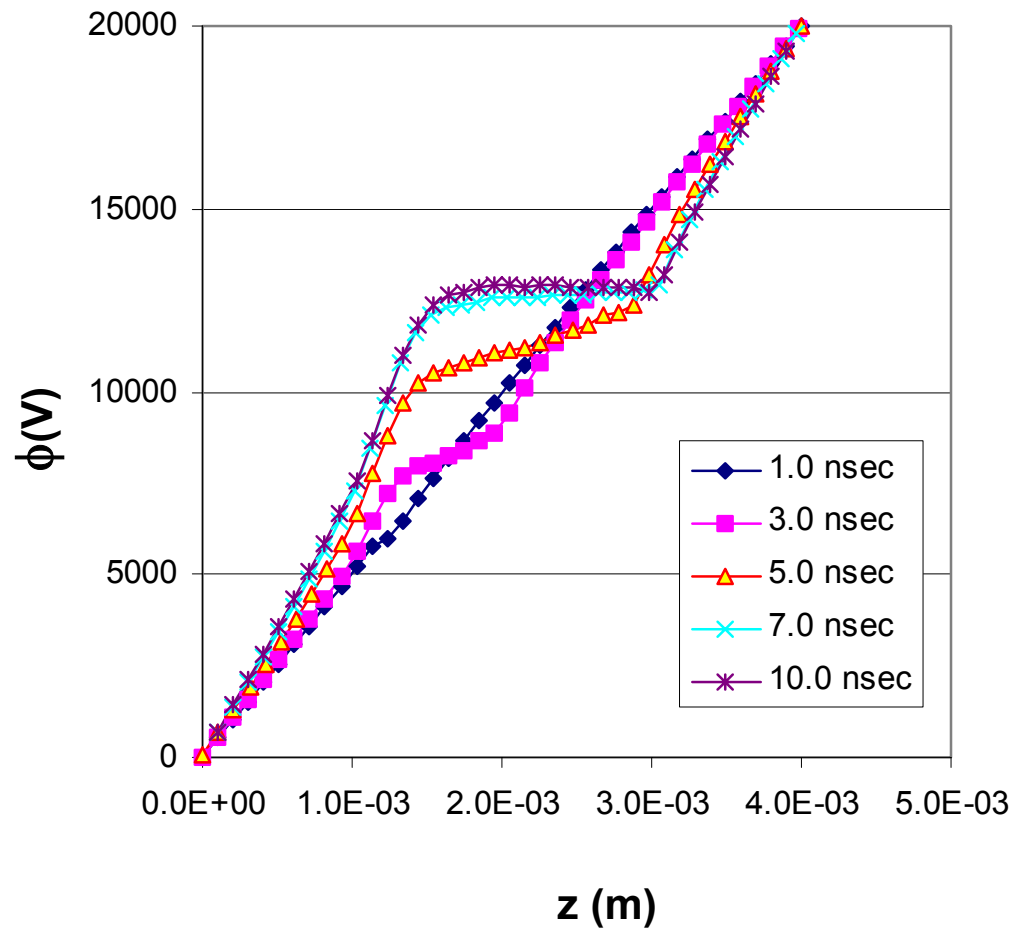
7 nsec



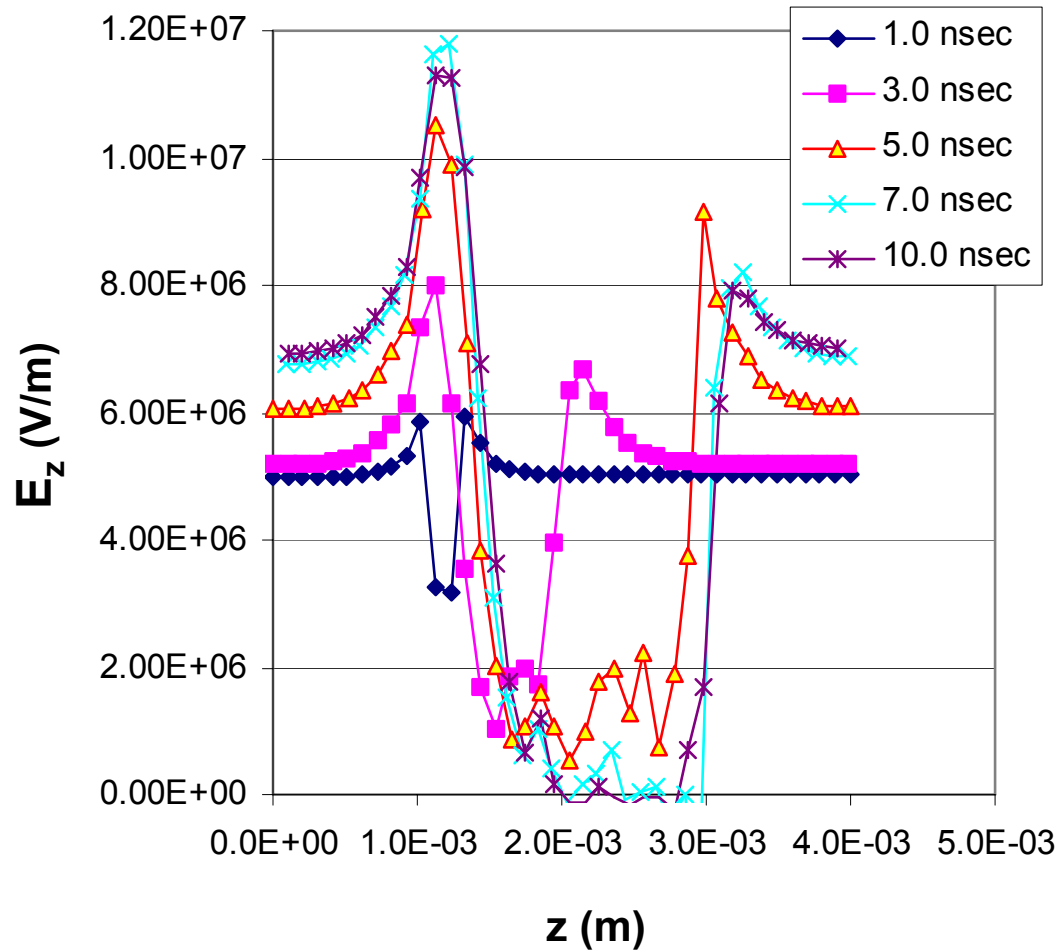
DIELECTRIC BARRIER DISCHARGE: Plasma Electric Potential Evolution



DIELECTRIC BARRIER DISCHARGE: Streamer Core Potential Evolution

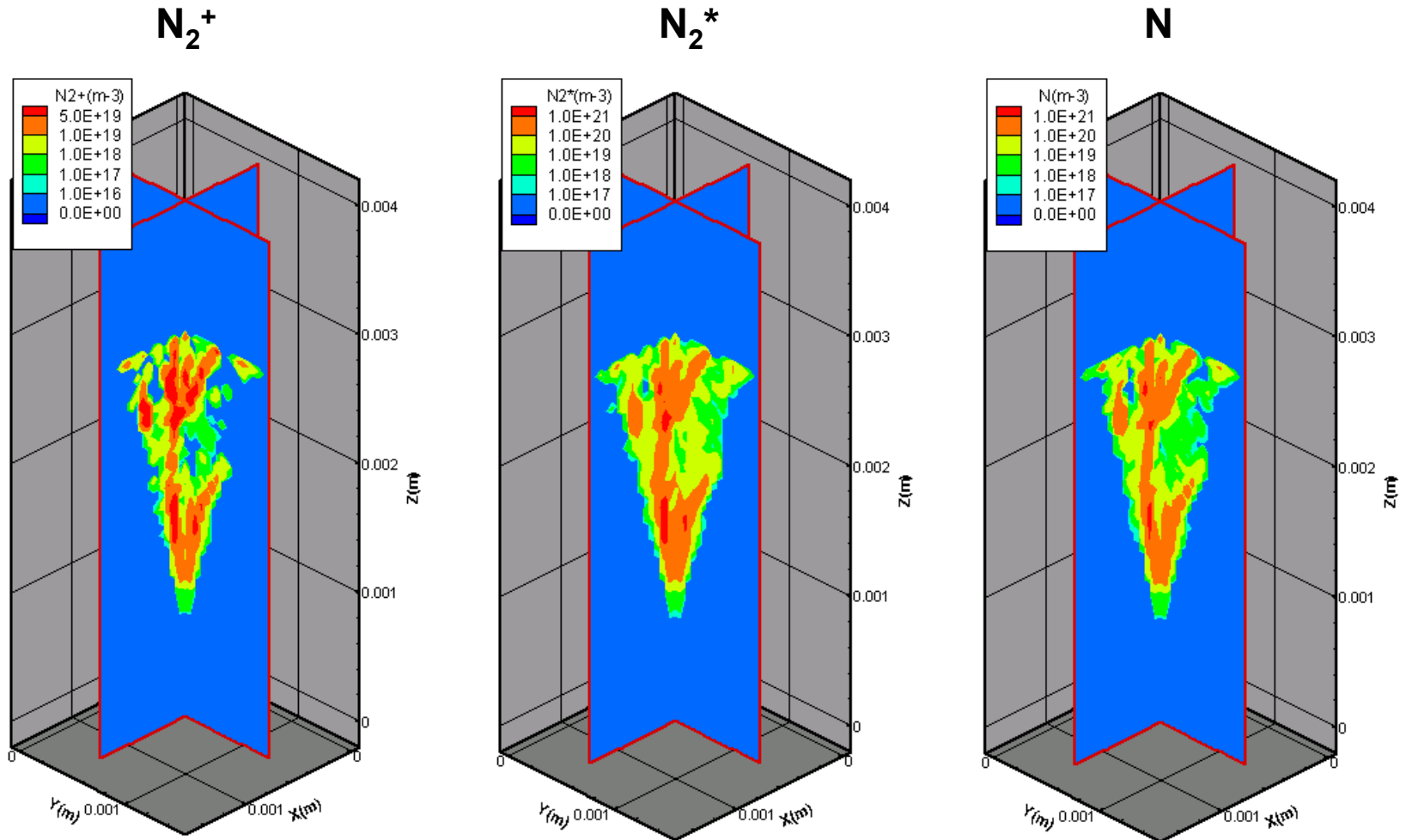


DIELECTRIC BARRIER DISCHARGE: Streamer Core Electric Field Evolution



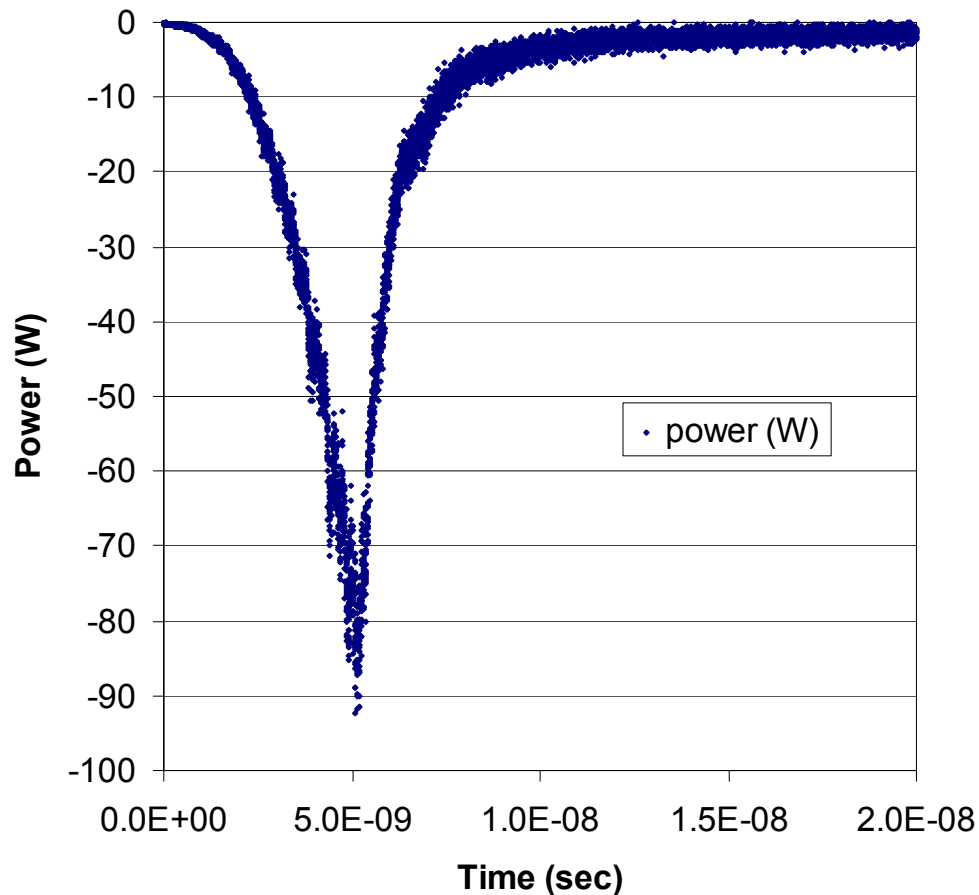
DIELECTRIC BARRIER DISCHARGE:

Plasma Products at 10 nsec – N_2^+ , N_2^* , N



DIELECTRIC BARRIER DISCHARGE:

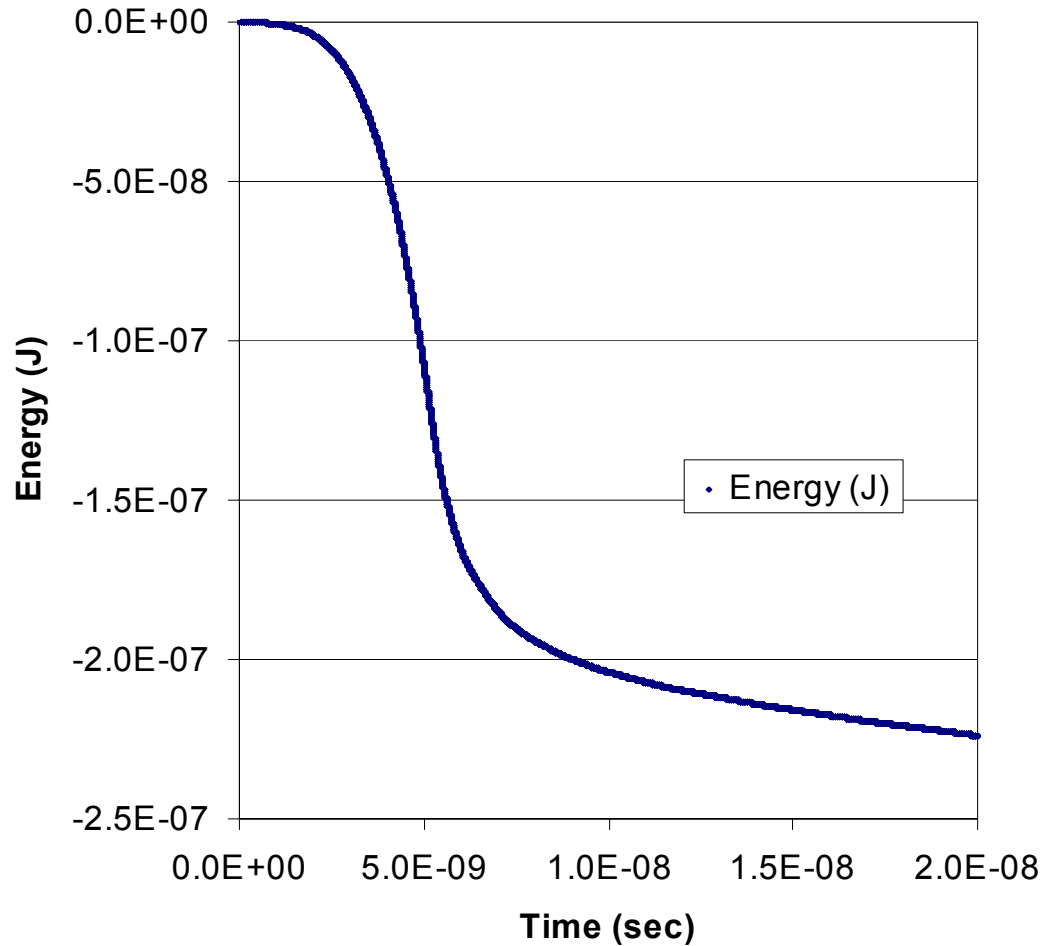
Power Utilization*



*negative because energy is extracted from the field

DIELECTRIC BARRIER DISCHARGE:

Expended Energy*



*negative because energy is extracted from the field

DIELECTRIC BARRIER DISCHARGE:

Summary

3D particle simulations were carried out of a dielectric barrier discharge in Nitrogen gas. The results showed:

- ◆ 3D simulations of arbitrary geometry dielectric barrier discharges are now possible on industrial time scales on a desk-top pc.
- ◆ The electron streamer halts expansion after about 5 nsec, when it reaches the upper dielectric and the impacting electrons diminish and/or reverse the electric field.
- ◆ Under the current conditions, a single streamer shows a peak power of about 90 Watts and a total energy consumption of under 2.5×10^{-7} Joules.