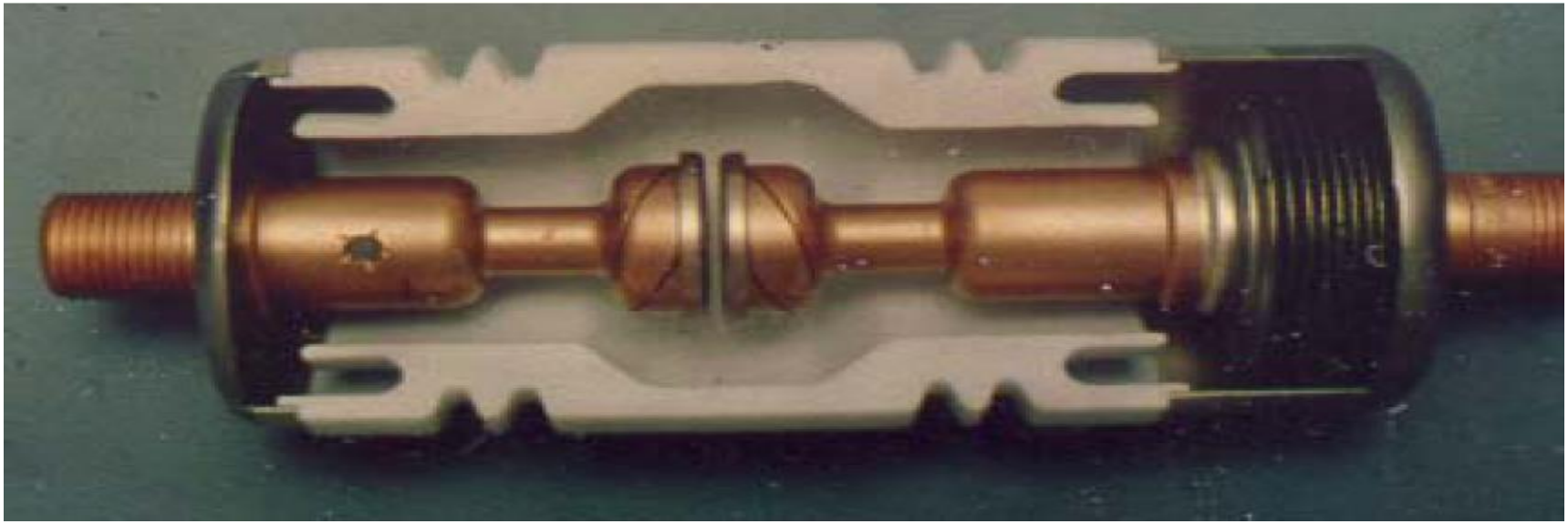
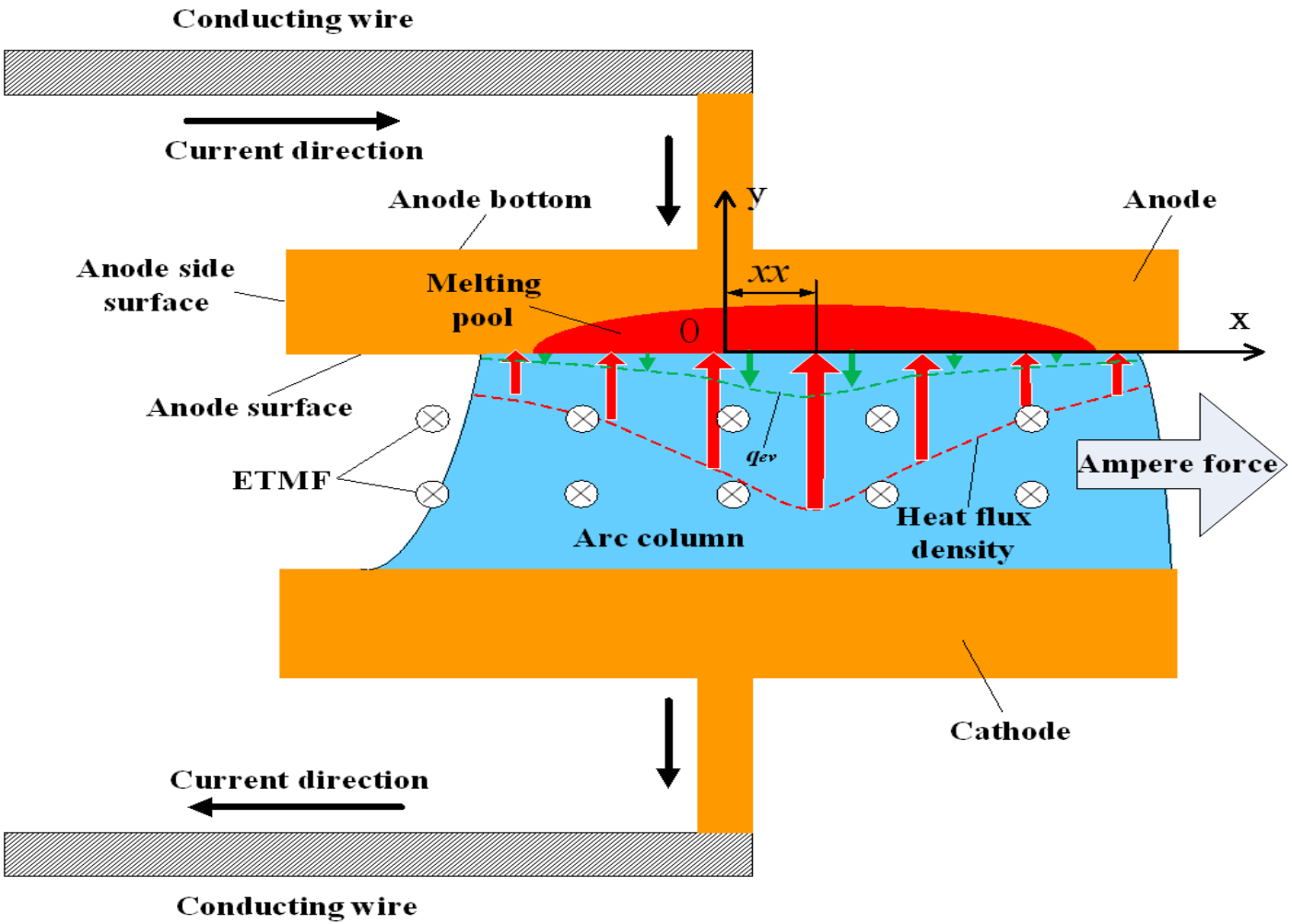
PIC simulation of Vacuum Arc

Mrunal Parekh
VJTI-SIEMENS high voltage laboratory-Mumbai
Electrical Research & Development Association

How it Look like



Schematic of vacuum Discharge



Motivation

- Vacuum arc physics – The crux for vacuum interrupter development

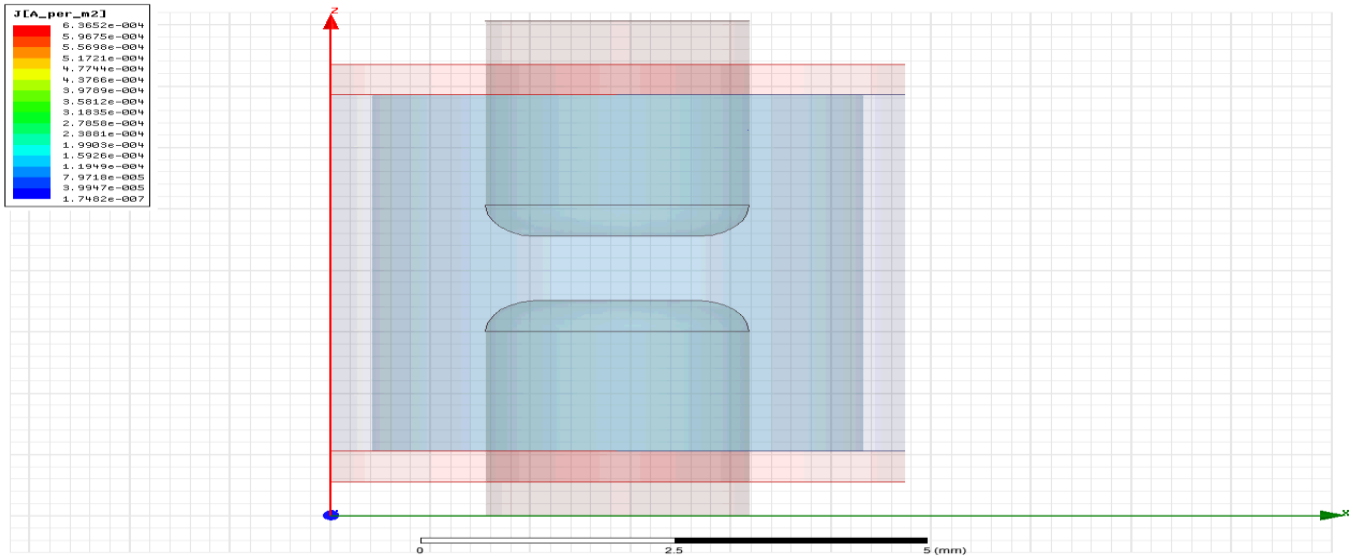
- Mathematical approach for visualization of vacuum discharge process

Electrodynamic Model

- Idea is to identify current density and heat flux in vacuum switch

- Considered Short circuit current of 40kA and 11kV system voltage as input parameter

- Solved Maxwell's equation along with constitutive relations



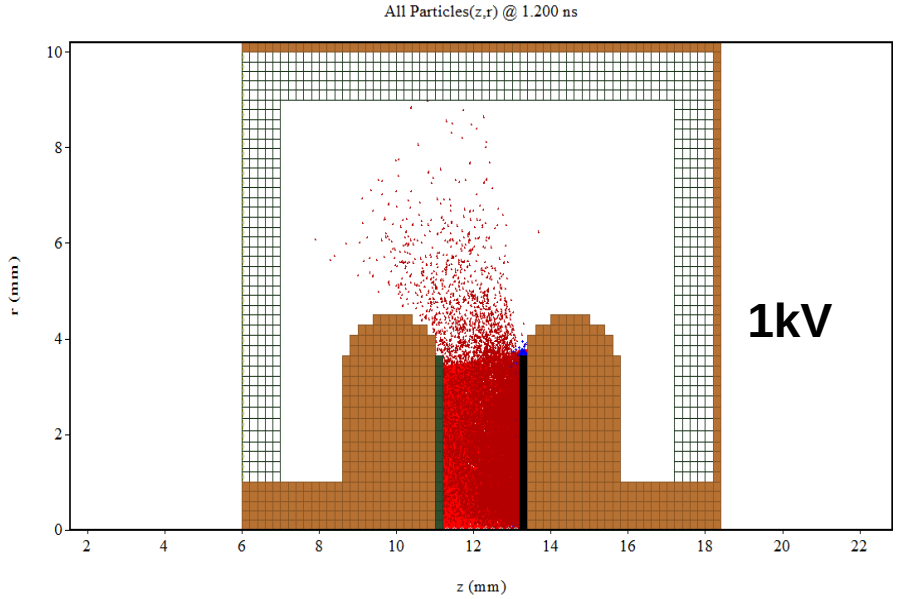
PIC Model

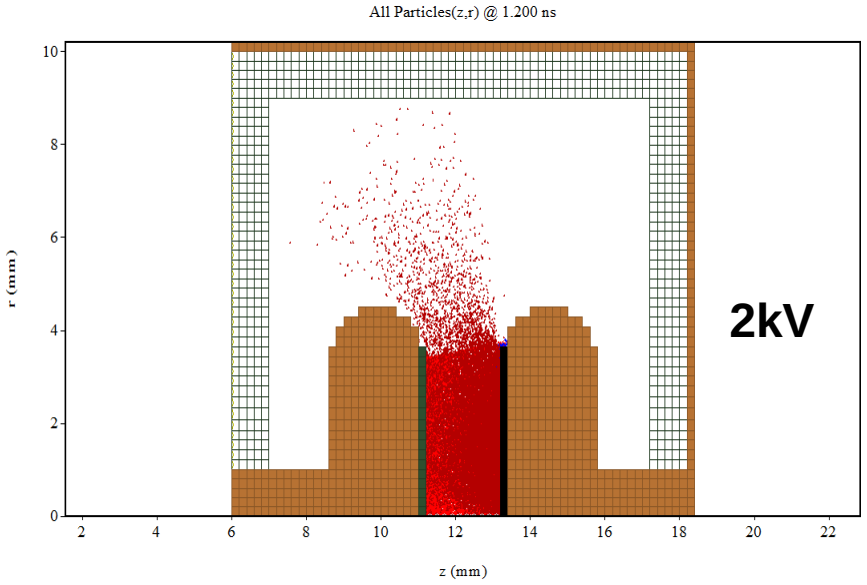
- Tried three scenarios with different voltages: 1kV, 2kV, 4kV, 10kV

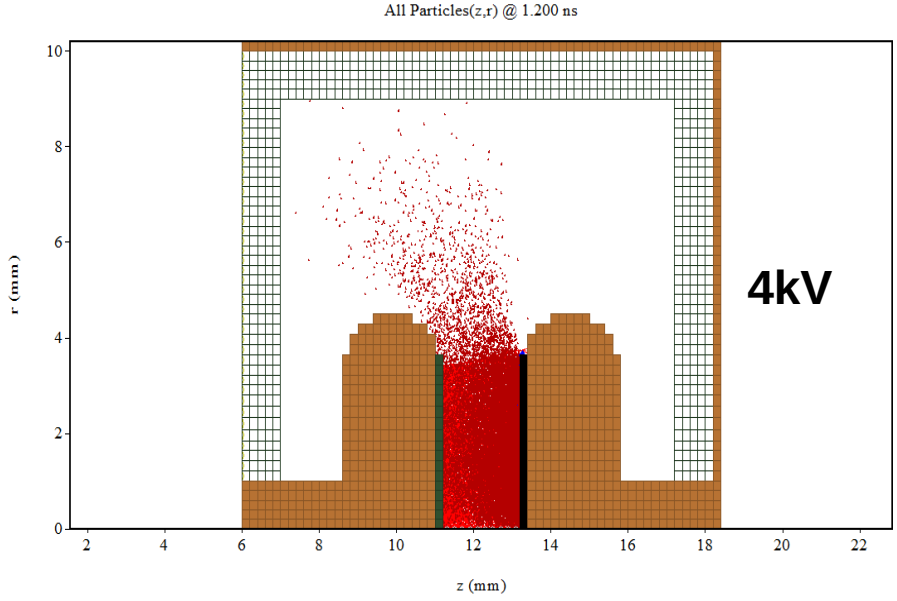
a) 2mm AK gap
b) 10mm AK gap
c) 20mm AK gap

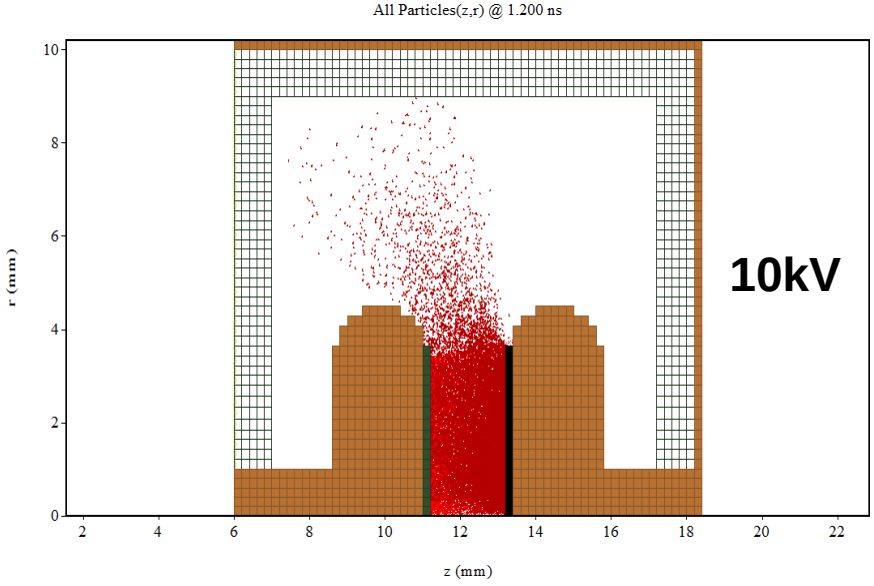
with secondary electron and copper ion (Cu^{+1}) emission from anode

Case (a) 2 mm AK gap

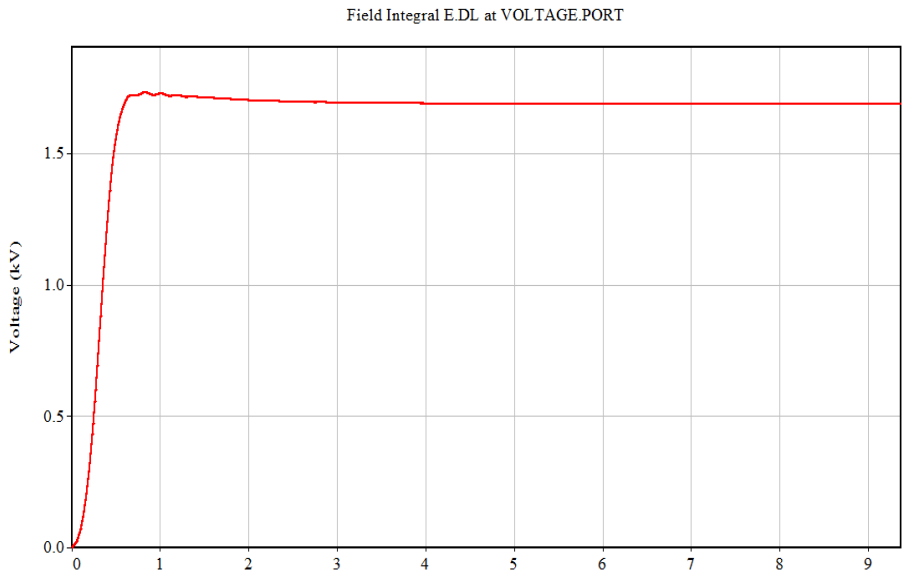


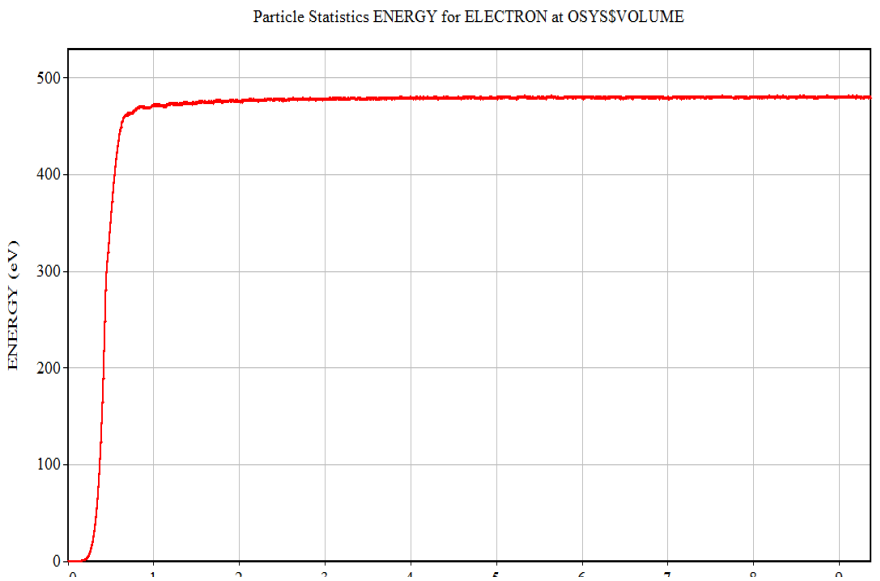


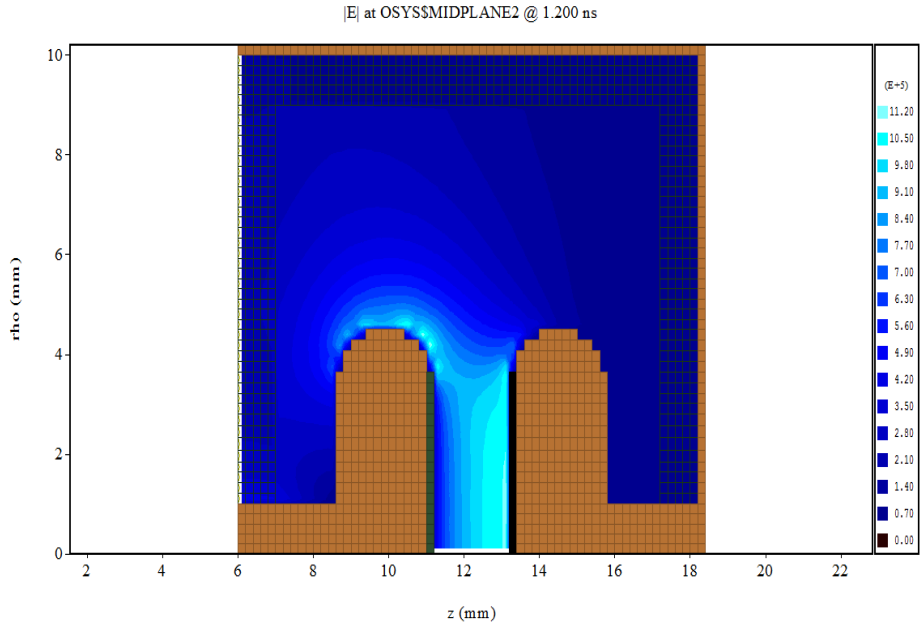


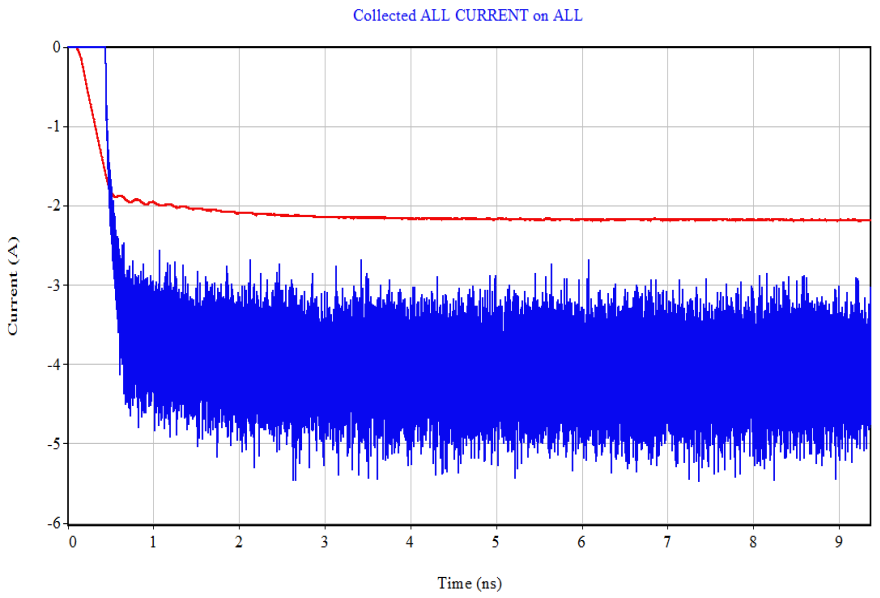


Case (a) 2 mm AK gap with 1kV

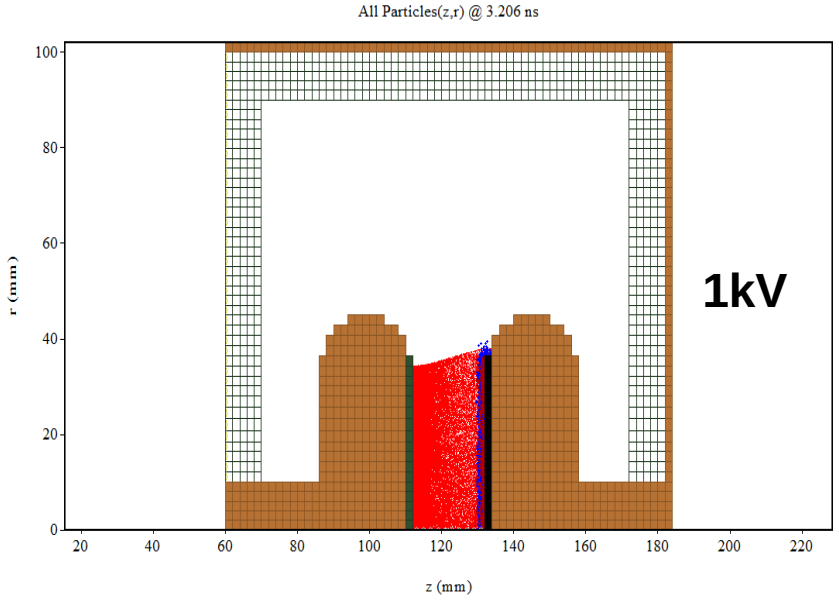


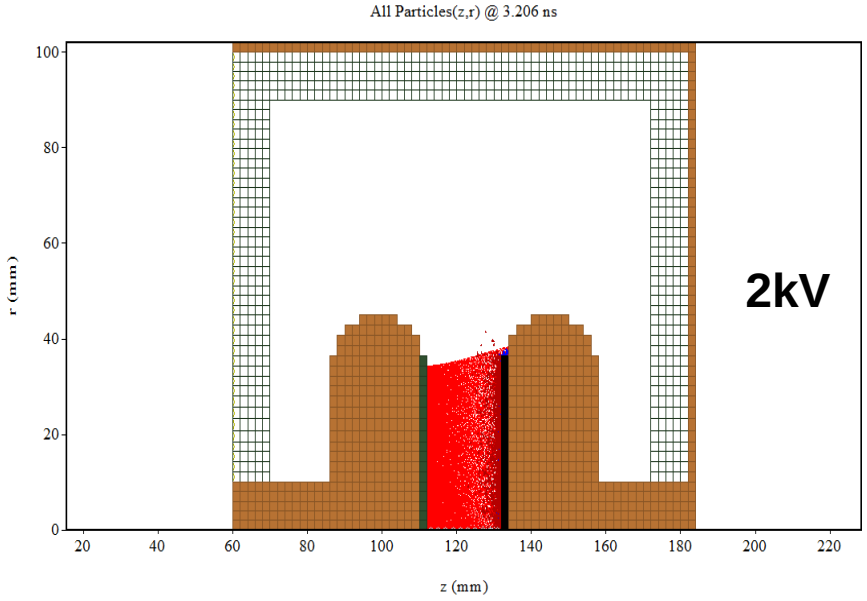


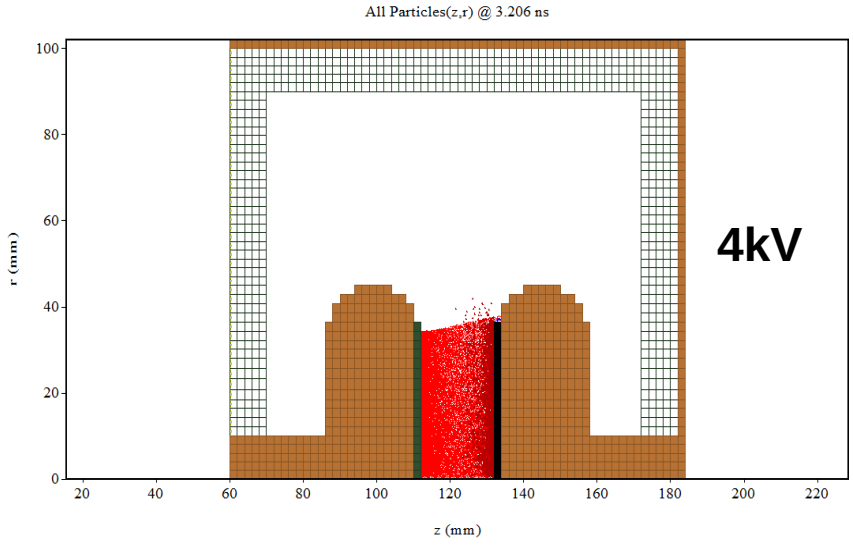


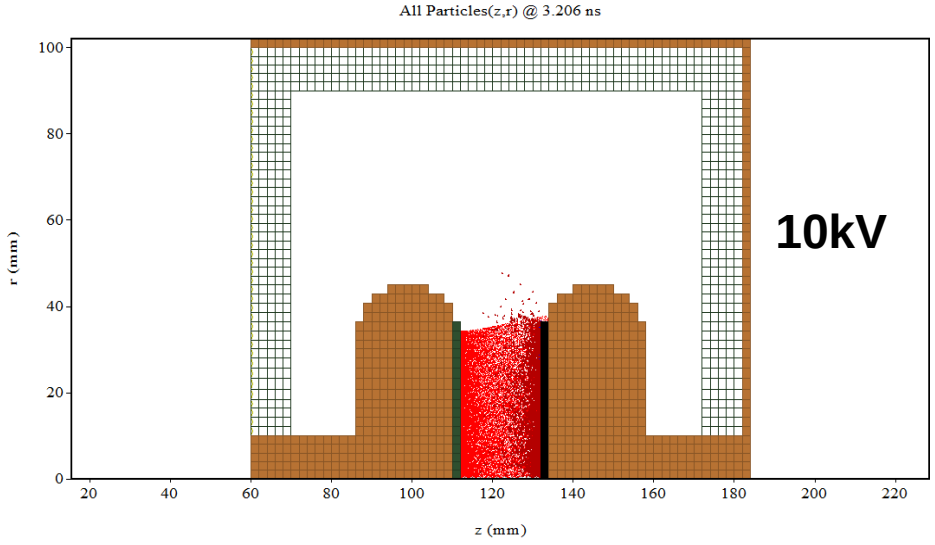


Case (c) 20mm AK gap

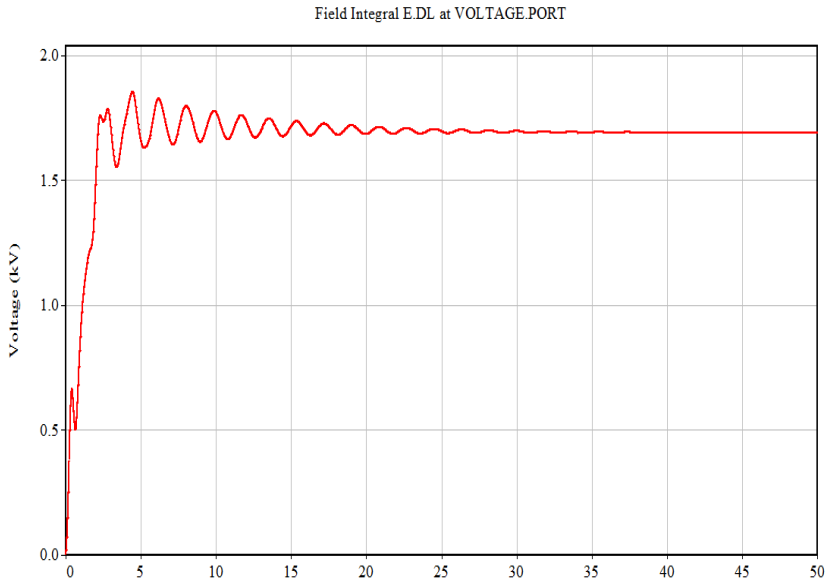


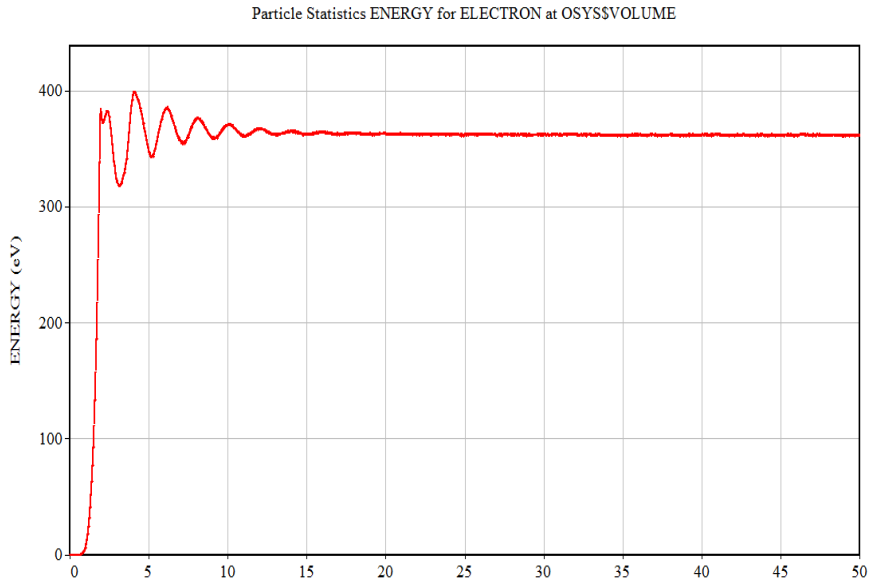


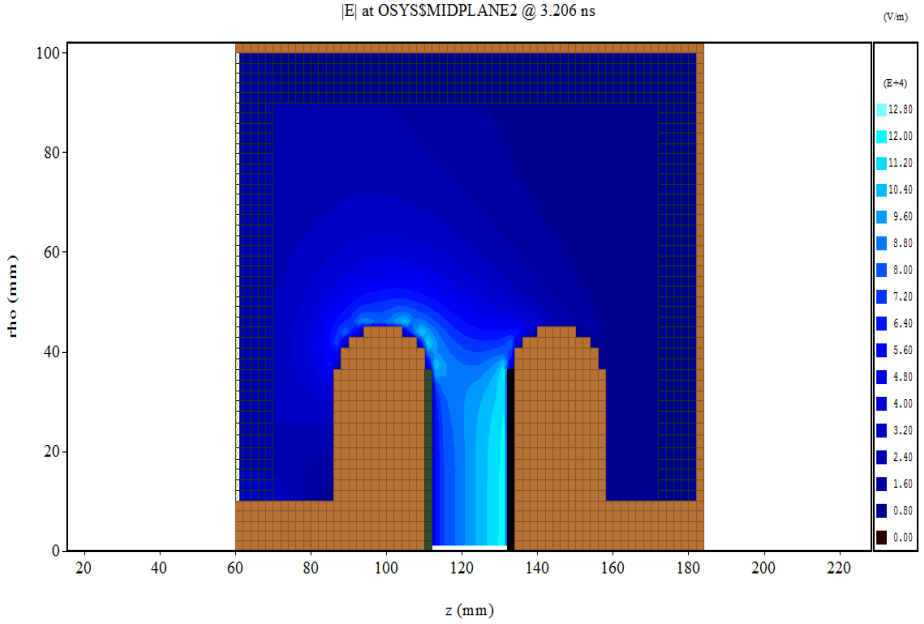


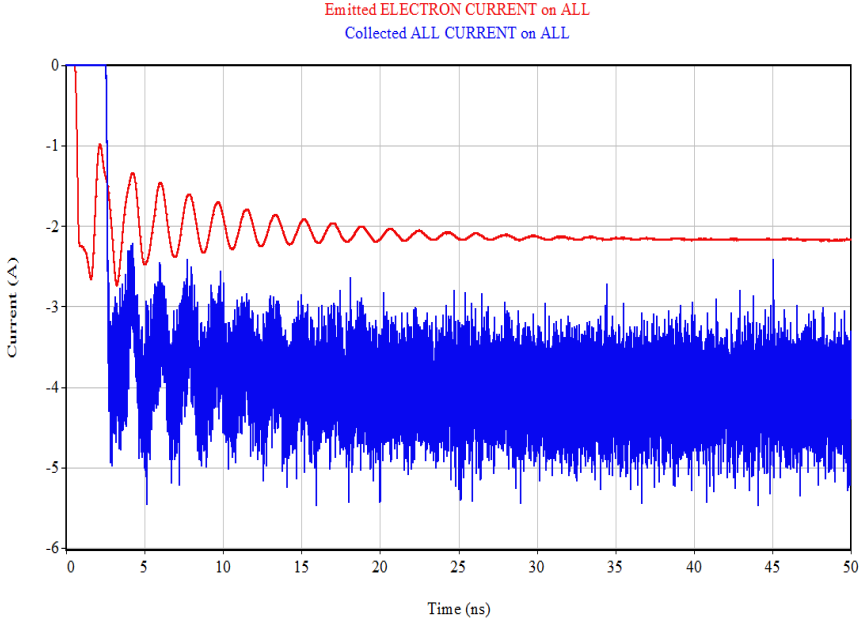


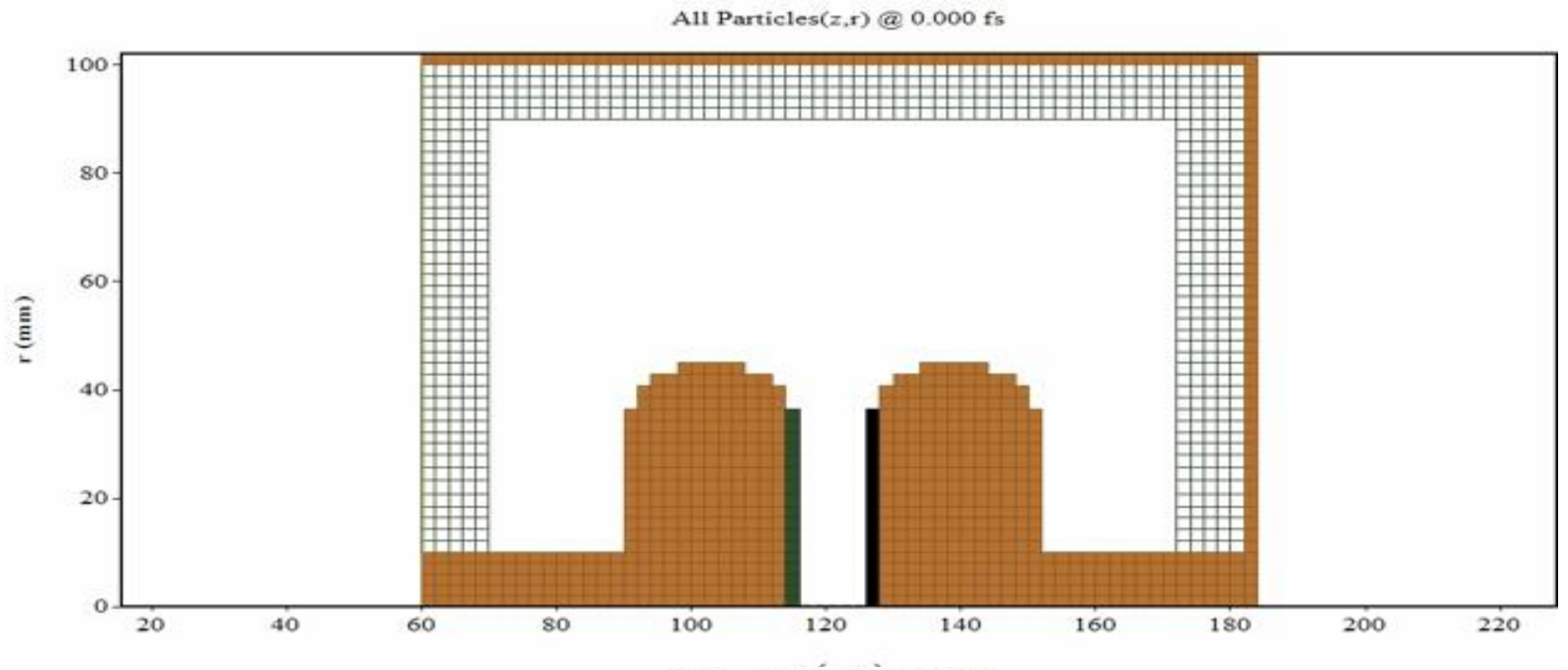
Case (c) 20mm AK gap with 1kV



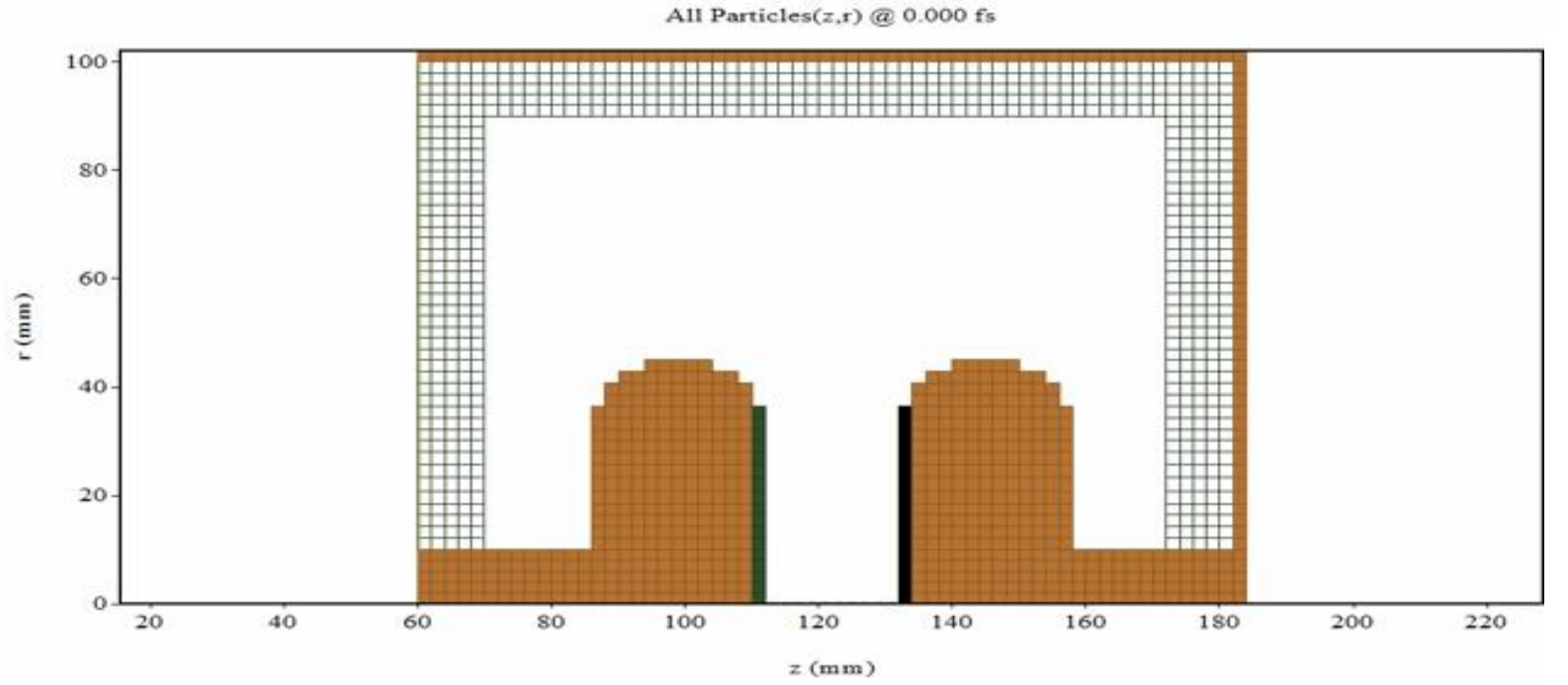








10mm
1 kV



20mm
1 kV

conclusion

- This Hypothetical study can help in setting the basis for studying breakdown phenomena in vacuum circuit breaker

- Approach can give visualization of vacuum breakdown process and partial statistics

Thank you..