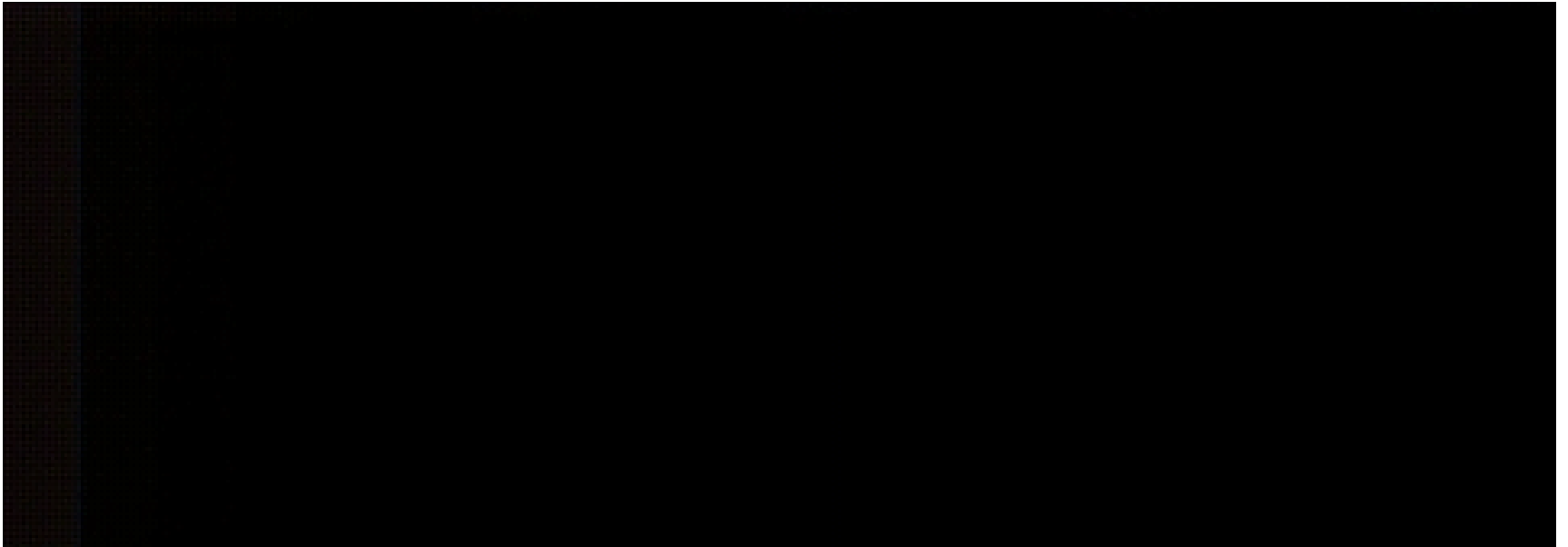
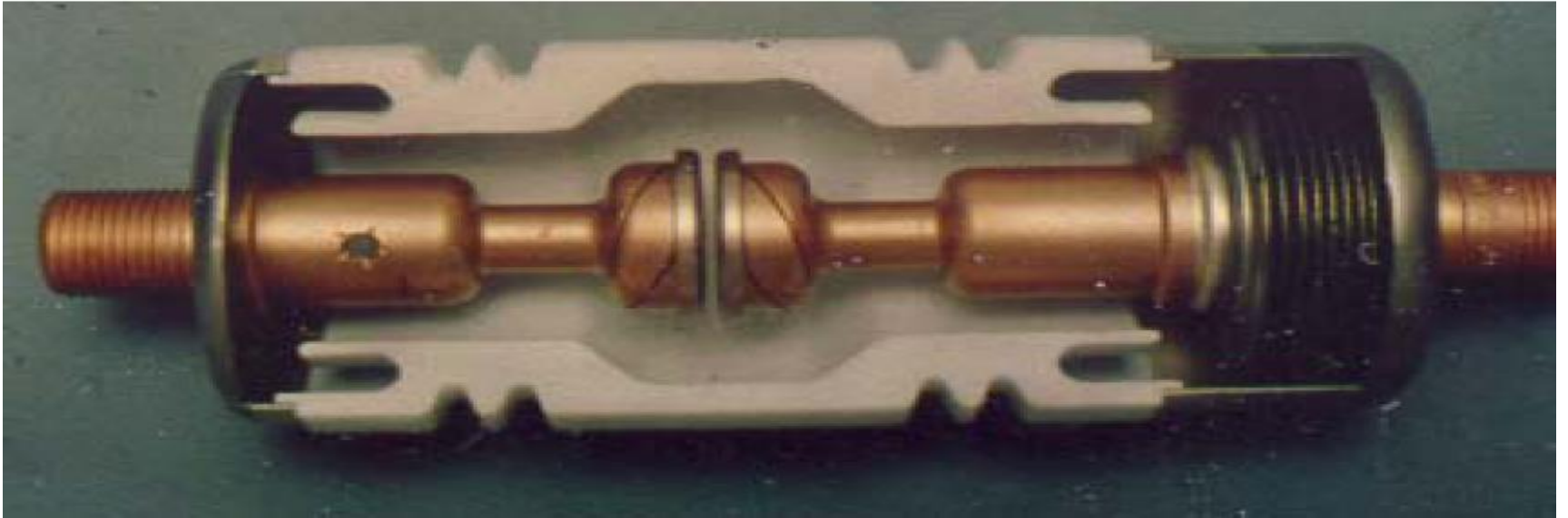


PIC simulation of Vacuum Arc

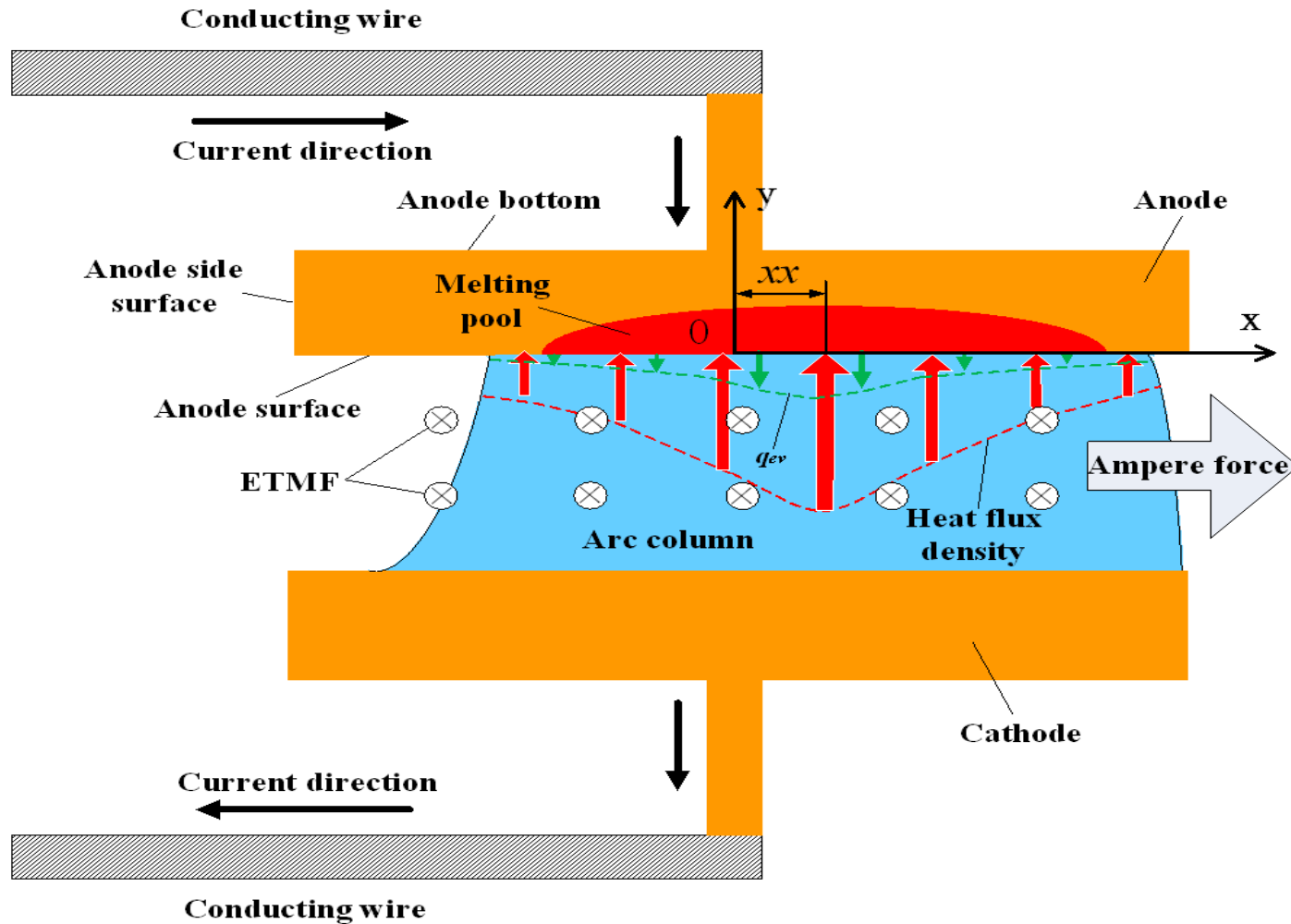
Mrunal Parekh

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

How it Look like



Schematic of vacuum Discharge

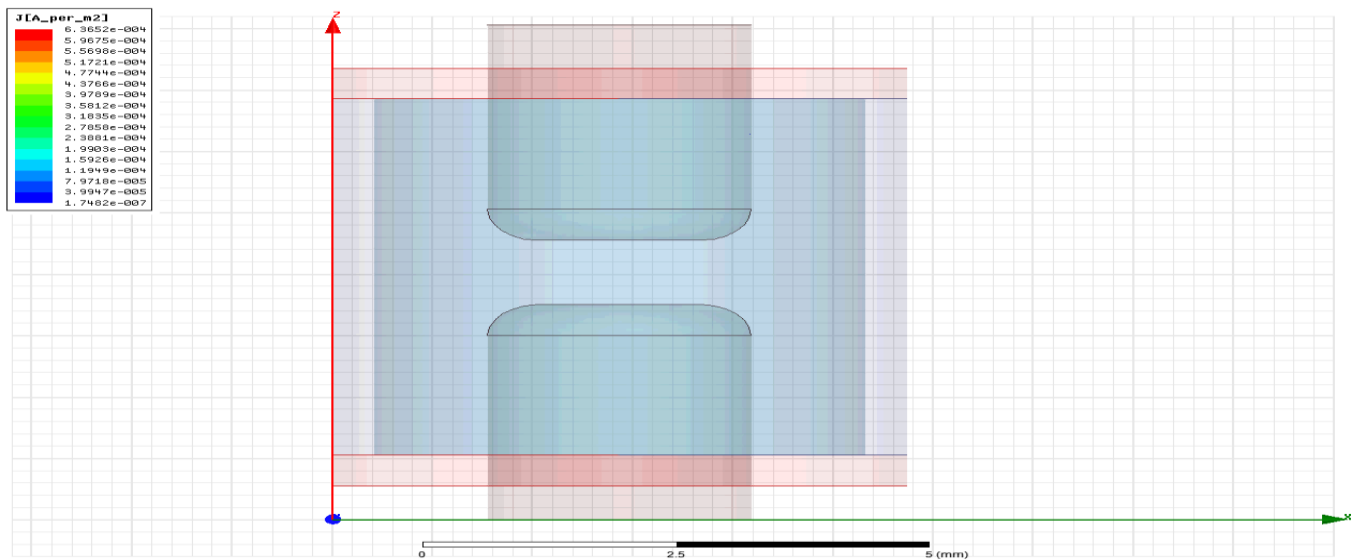


Motivation

- 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

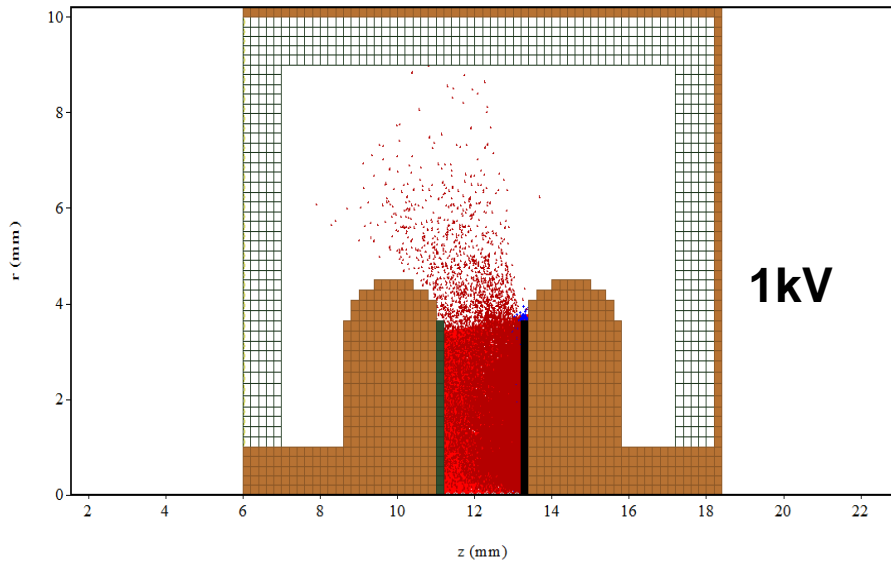
- Tried three scenarios with different voltages: 1kV, 2kV, 4kV, 10kV

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

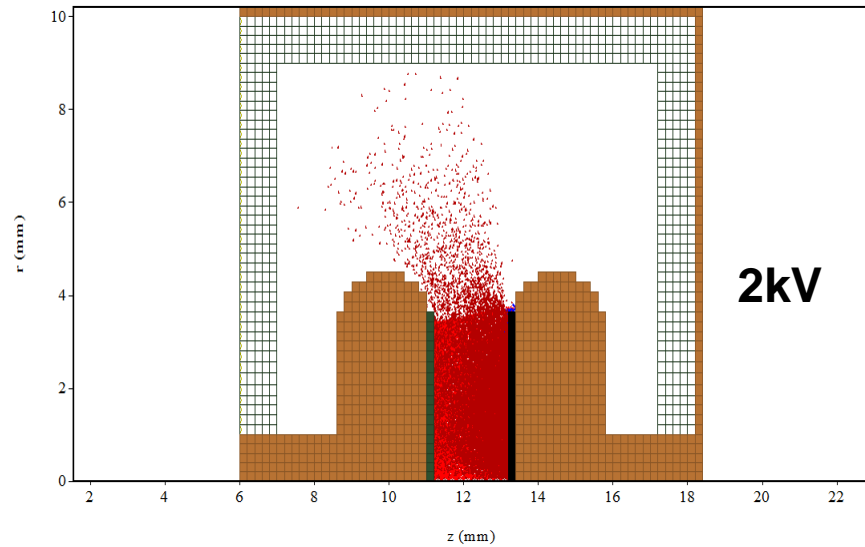
with secondary electron and copper ion (Cu^{+1}) emission from anode

Case (a) 2 mm AK gap

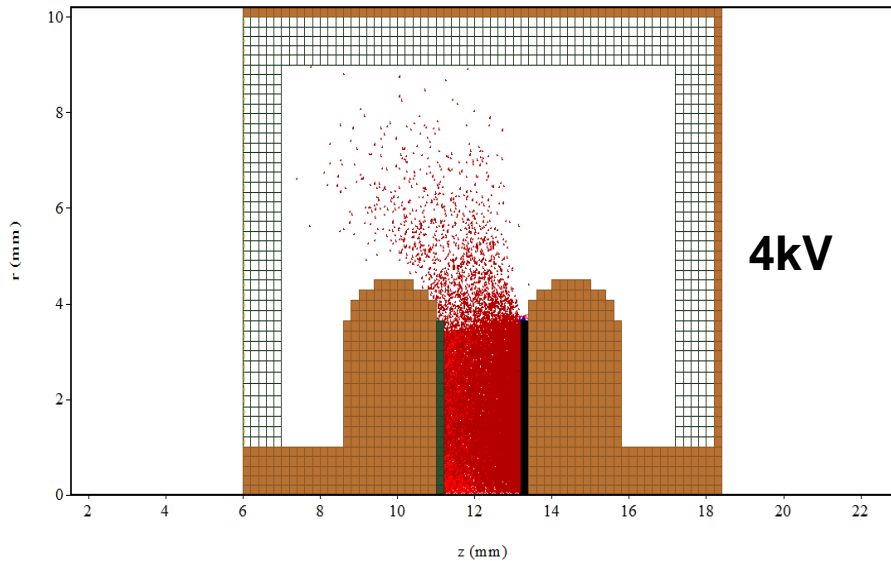
All Particles(z,r) @ 1.200 ns



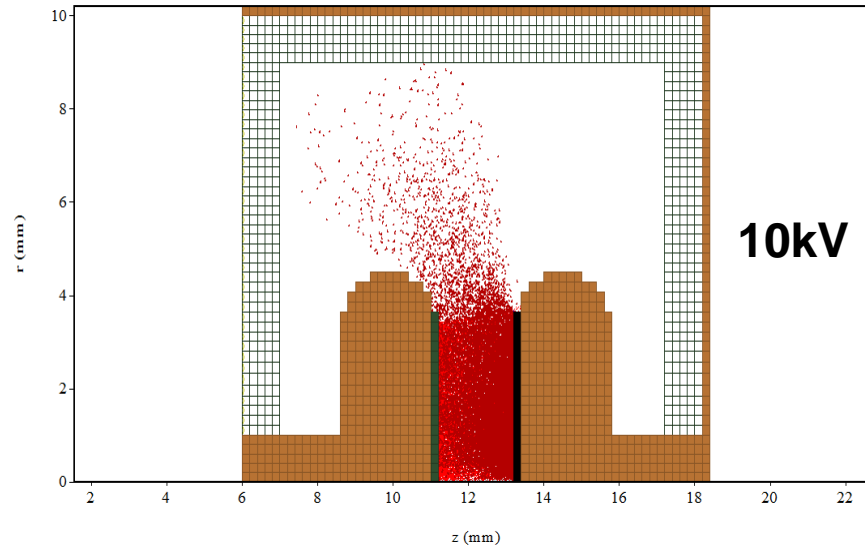
All Particles(z,r) @ 1.200 ns



All Particles(z,r) @ 1.200 ns

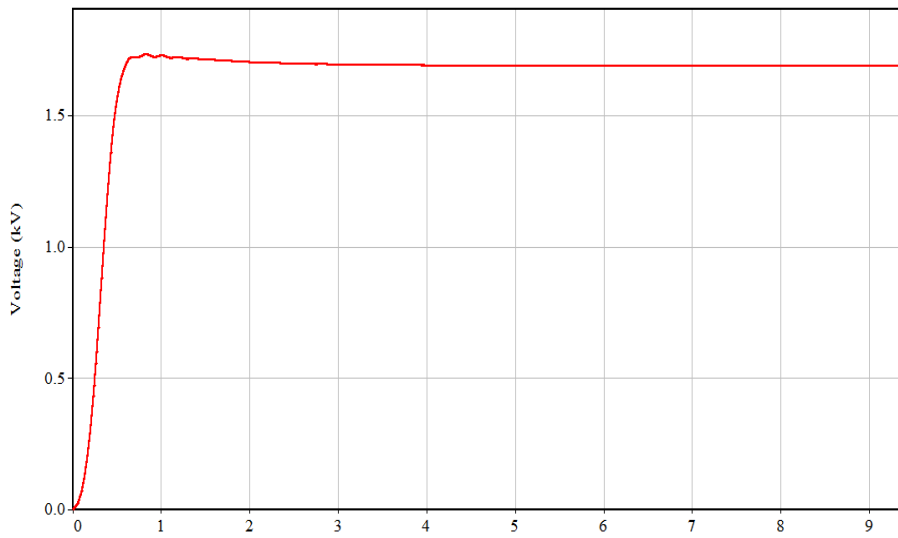


All Particles(z,r) @ 1.200 ns

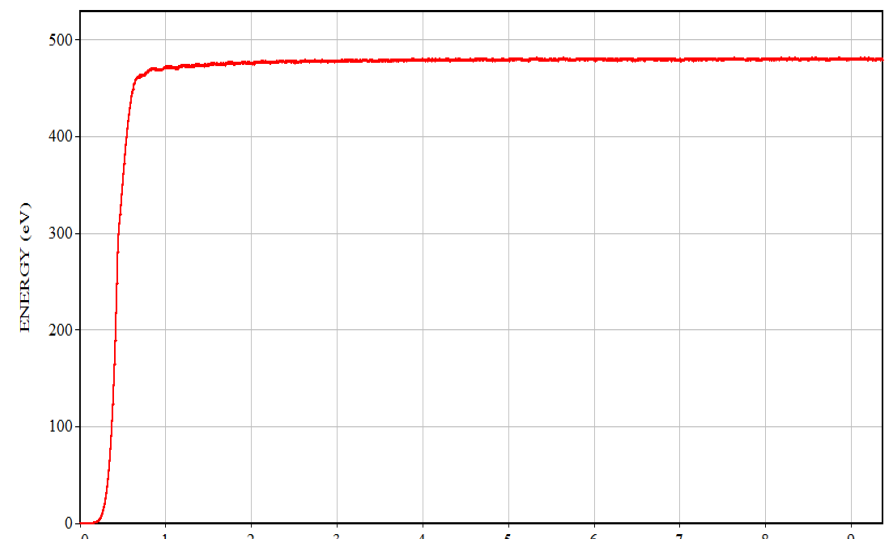


Case (a) 2 mm AK gap with 1kV

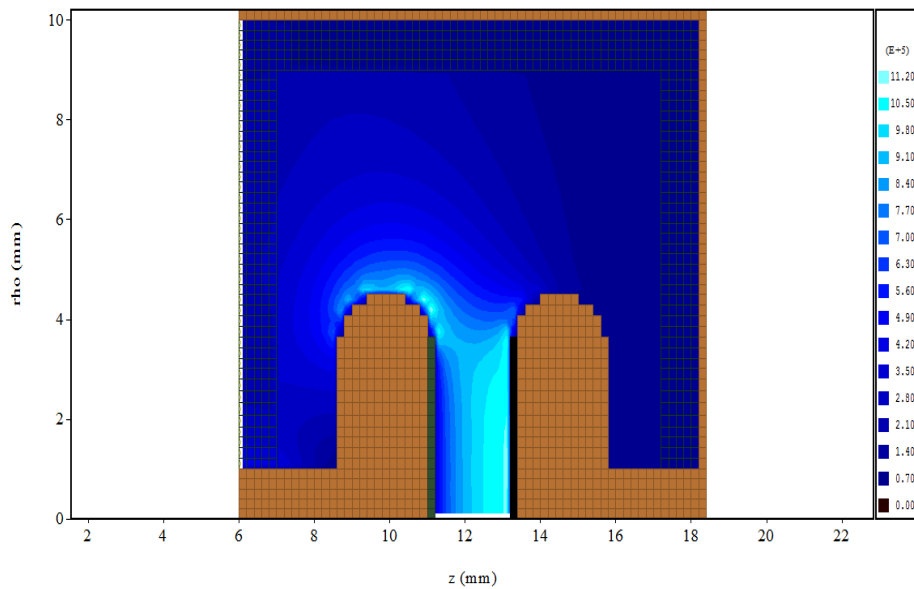
Field Integral E.DL at VOLTAGE.PORT



Particle Statistics ENERGY for ELECTRON at OSYSSVOLUME

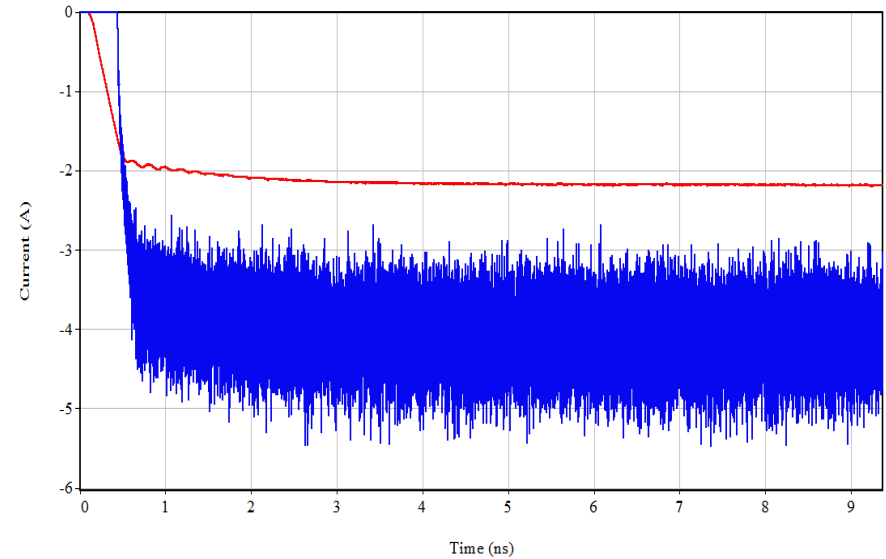


$|E|$ at OSYSSMIDPLANE2 @ 1.200 ns



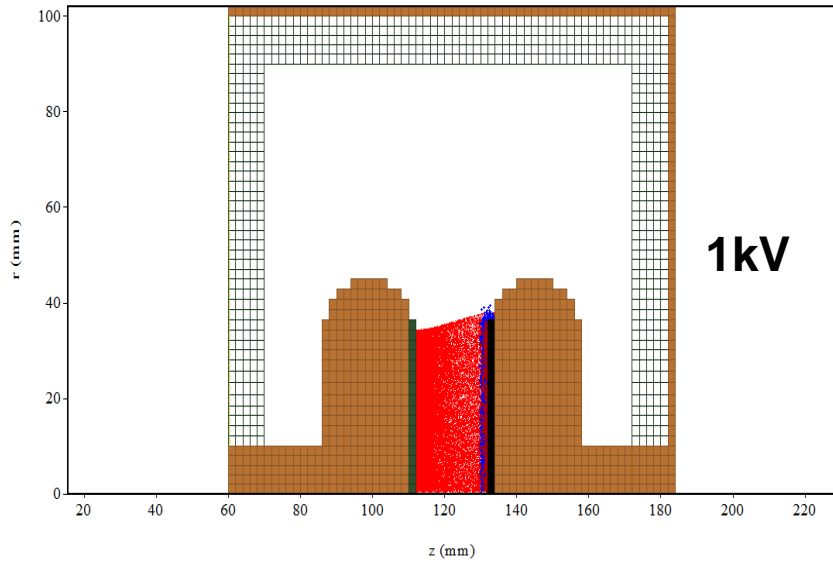
Emitted ELECTRON CURRENT on ALL

Collected ALL CURRENT on ALL

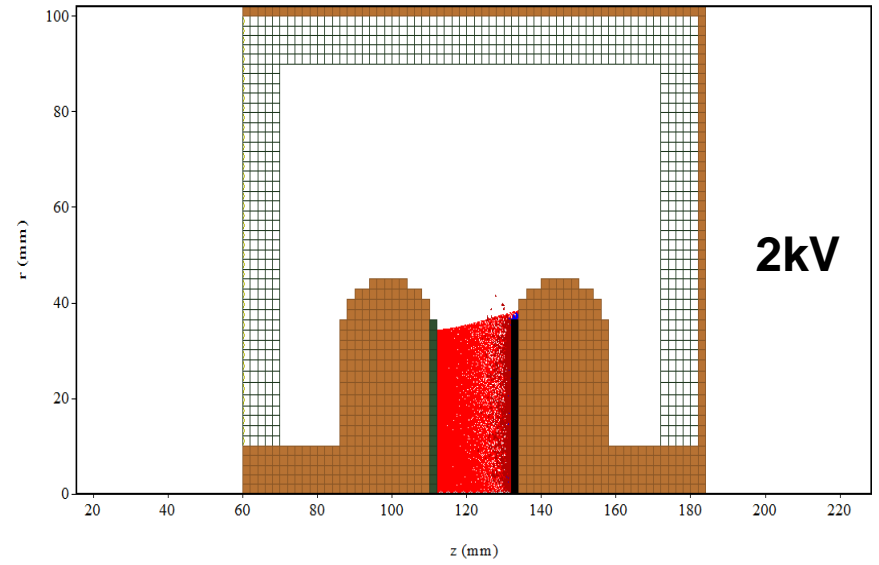


Case (c) 20mm AK gap

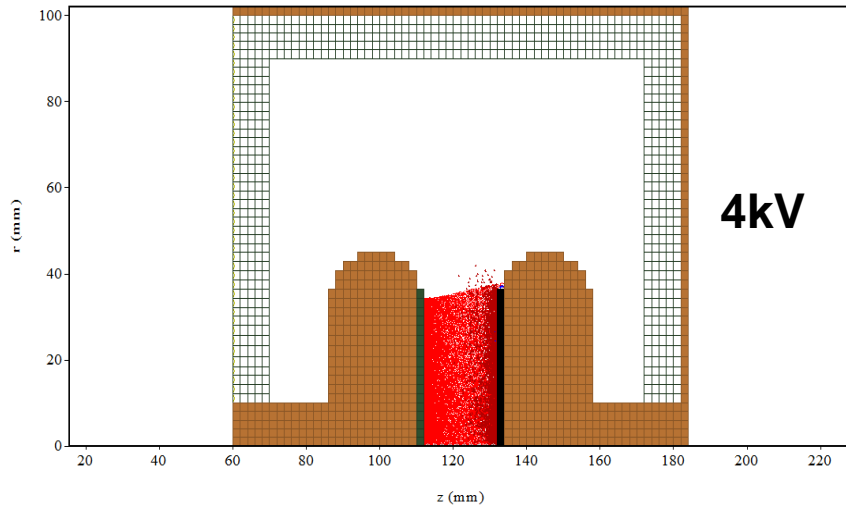
All Particles(z,r) @ 3.206 ns



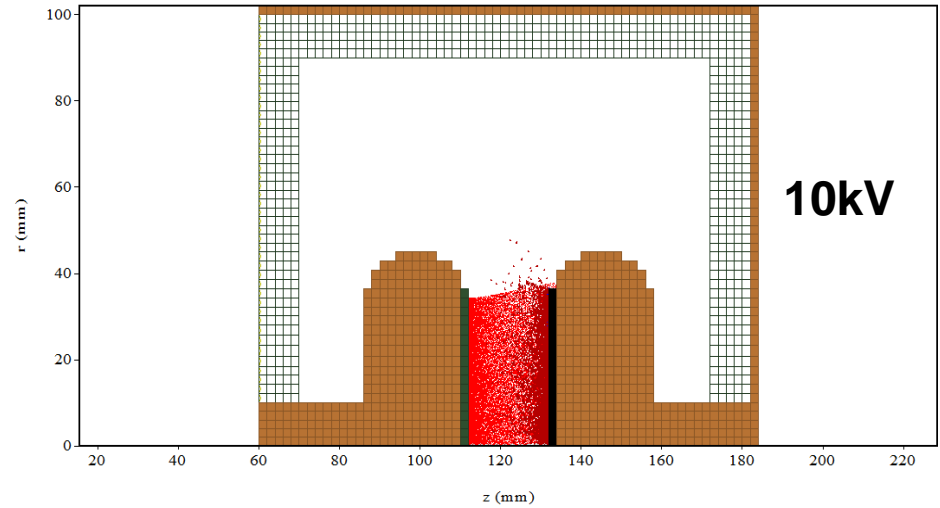
All Particles(z,r) @ 3.206 ns



All Particles(z,r) @ 3.206 ns

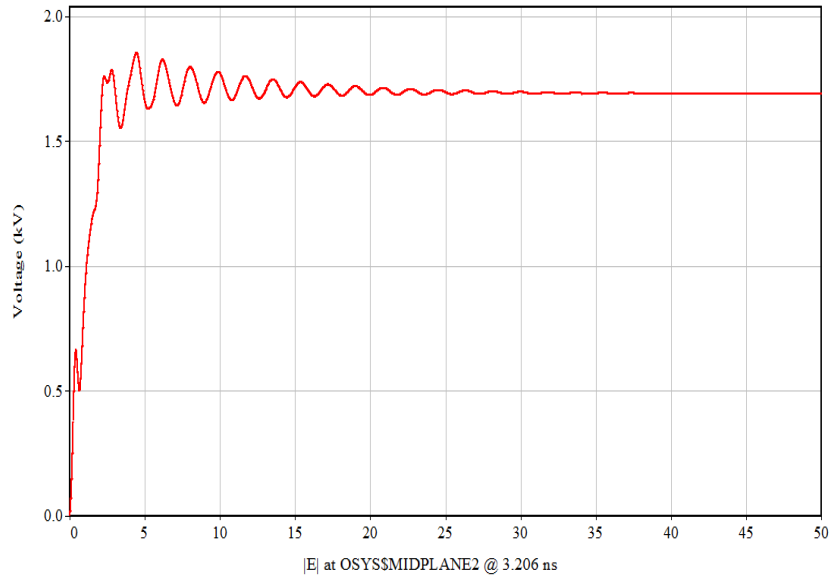


All Particles(z,r) @ 3.206 ns

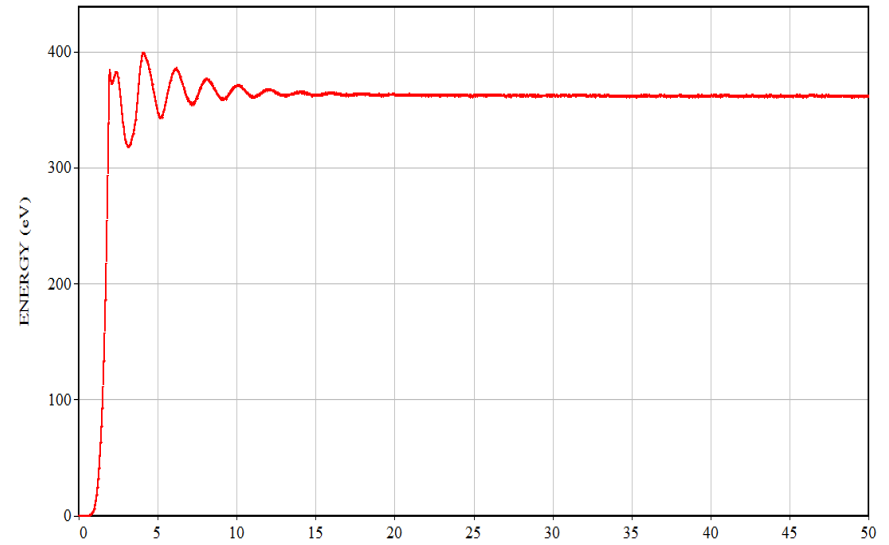


Case (c) 20mm AK gap with 1kV

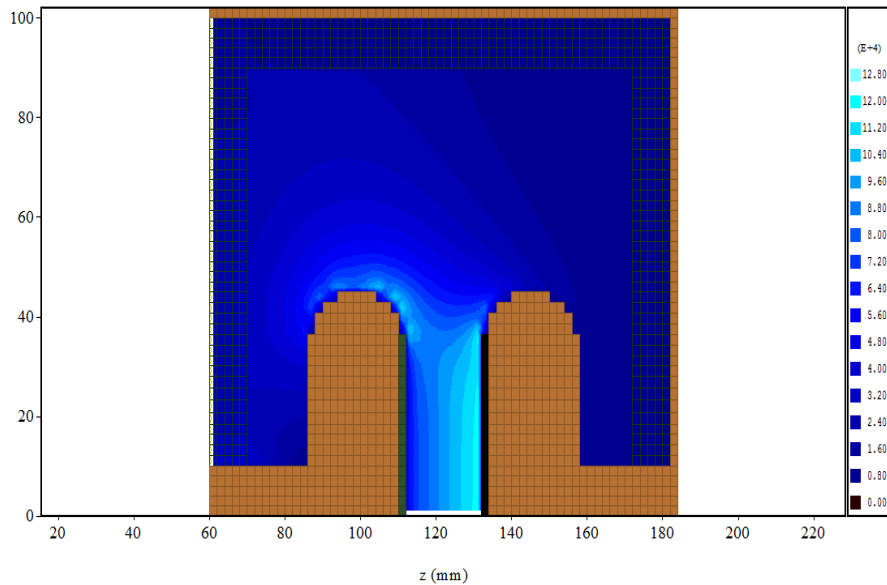
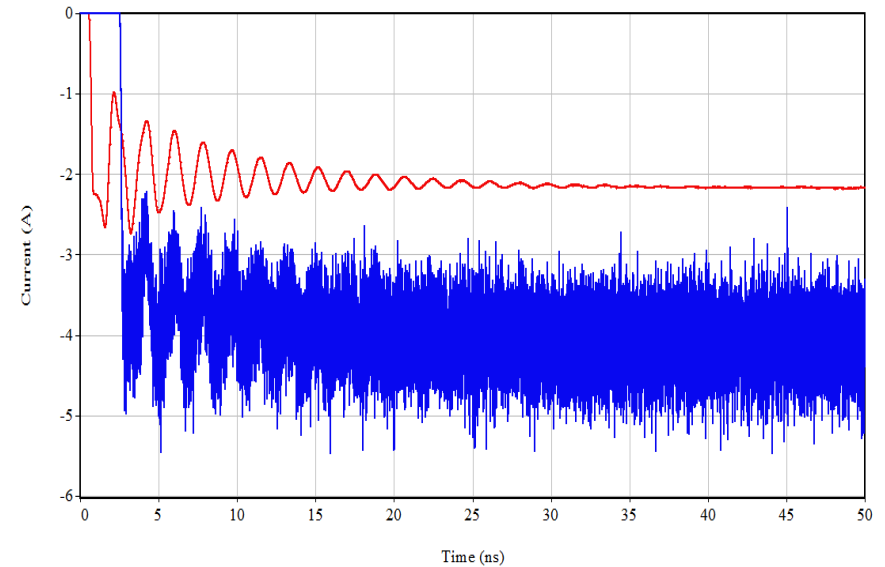
Field Integral E.DL at VOLTAGE.PORT



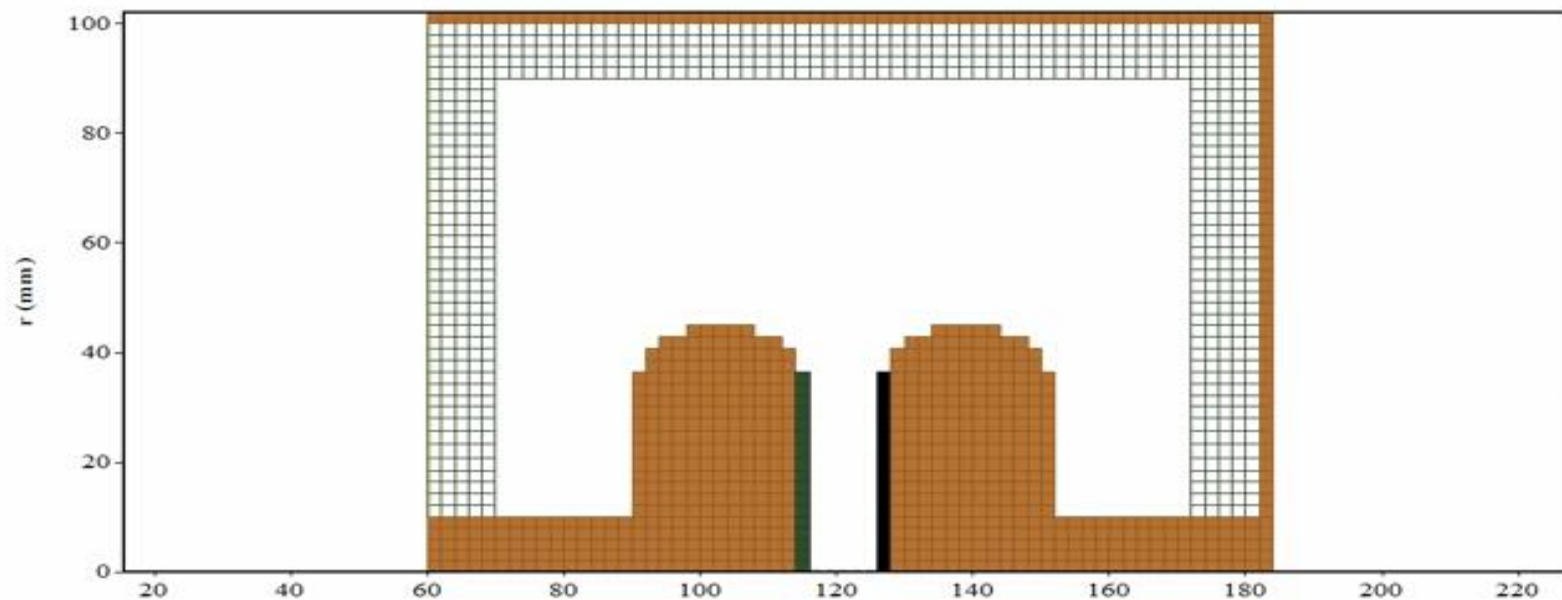
Particle Statistics ENERGY for ELECTRON at OSYSSVOLUME



Emitted ELECTRON CURRENT on ALL
Collected ALL CURRENT on ALL

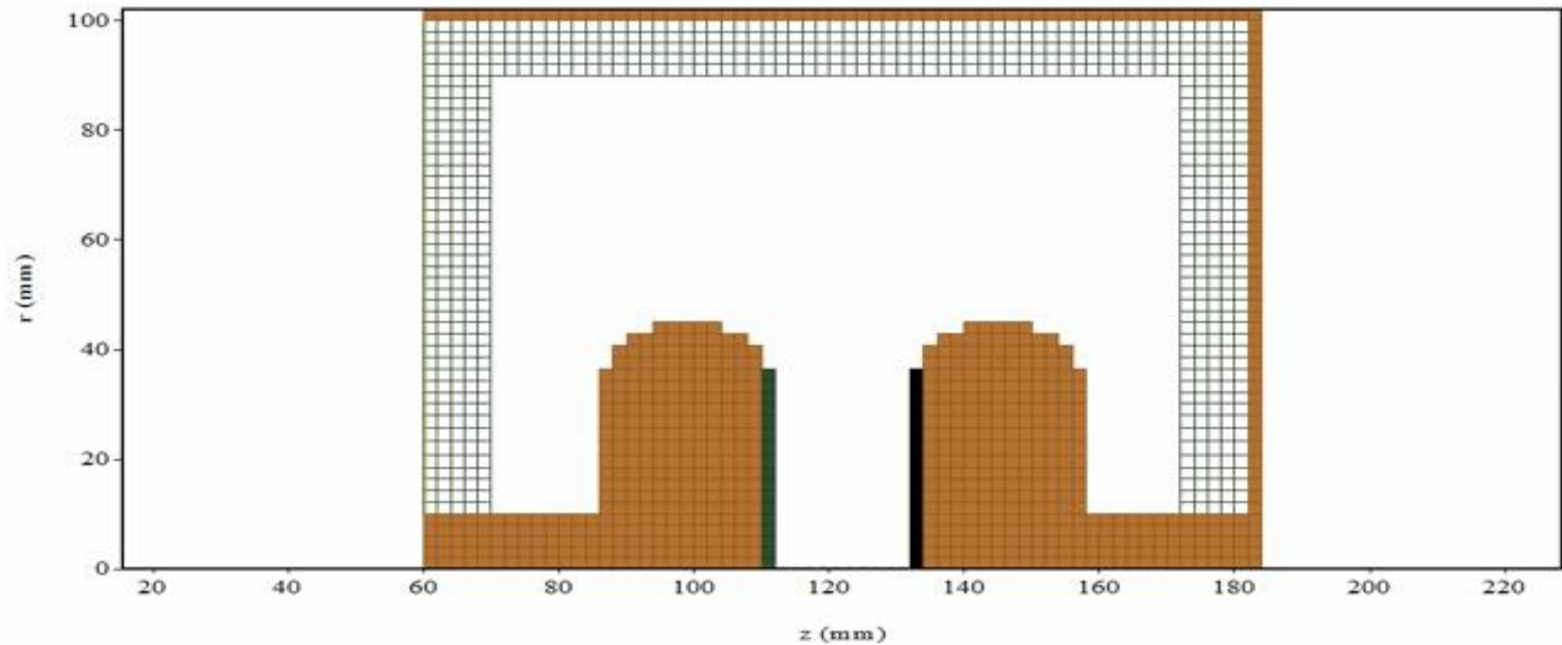


All Particles(z,r) @ 0.000 fs



10mm
1 kV

All Particles(z,r) @ 0.000 fs



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..