Phase II Comsol Simulations

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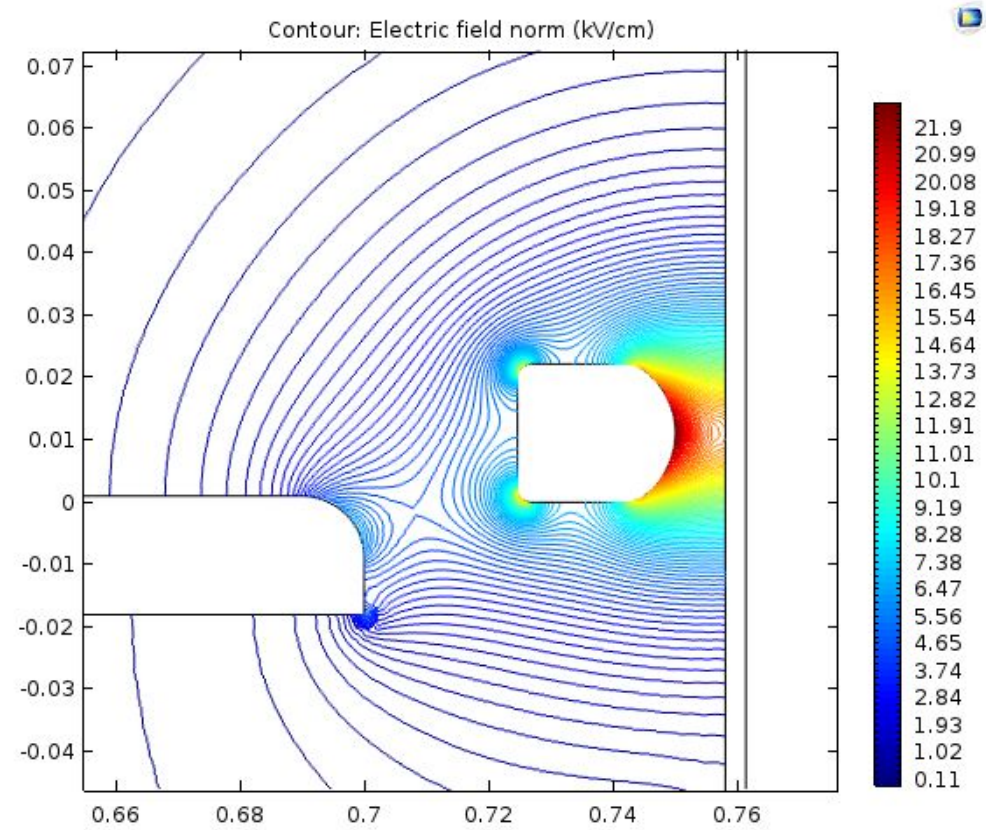
20 June 2017

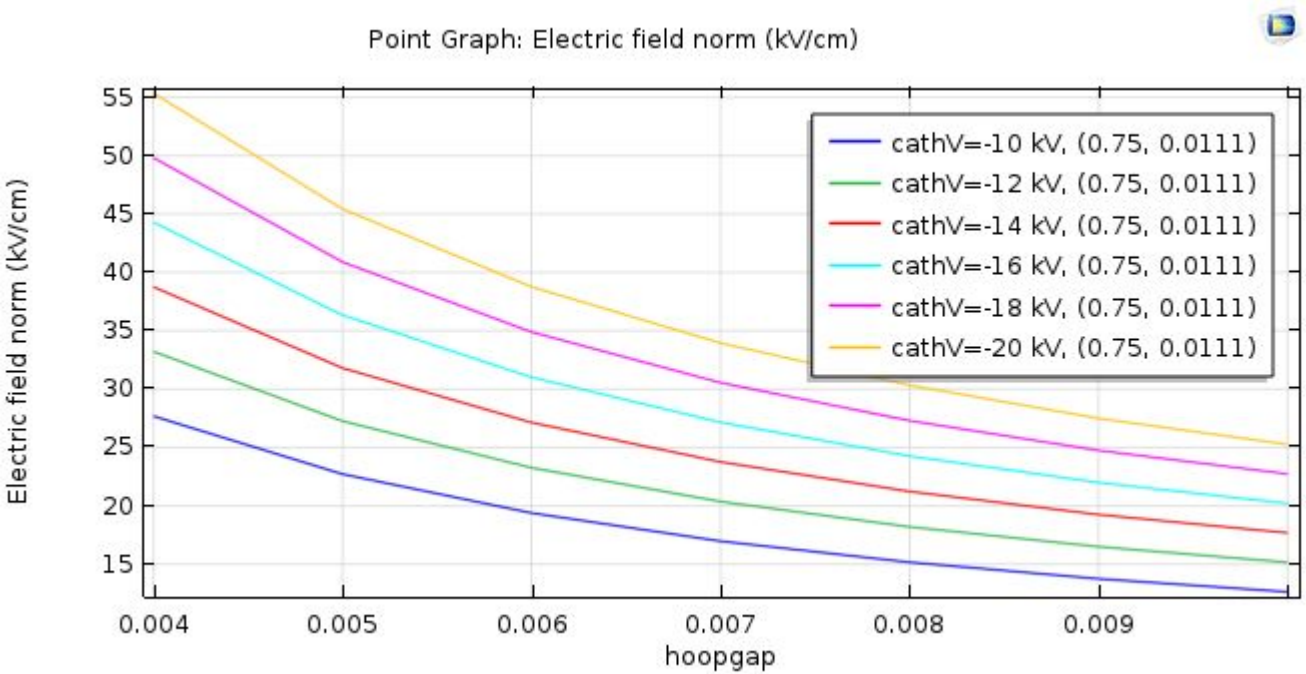
Cathode ring outward: before wires, with field hoop



- Simulate “field hoop” as a plane
- *(left)* Apply -15 kV to the cathode ring with a gap of 0.8 cm between the wall and cathode ring which results in max electric field of 22.7 kV/cm.
  - Will Waldron simulated max E-field of 22 kV/cm on the exterior side of the cathode ring.

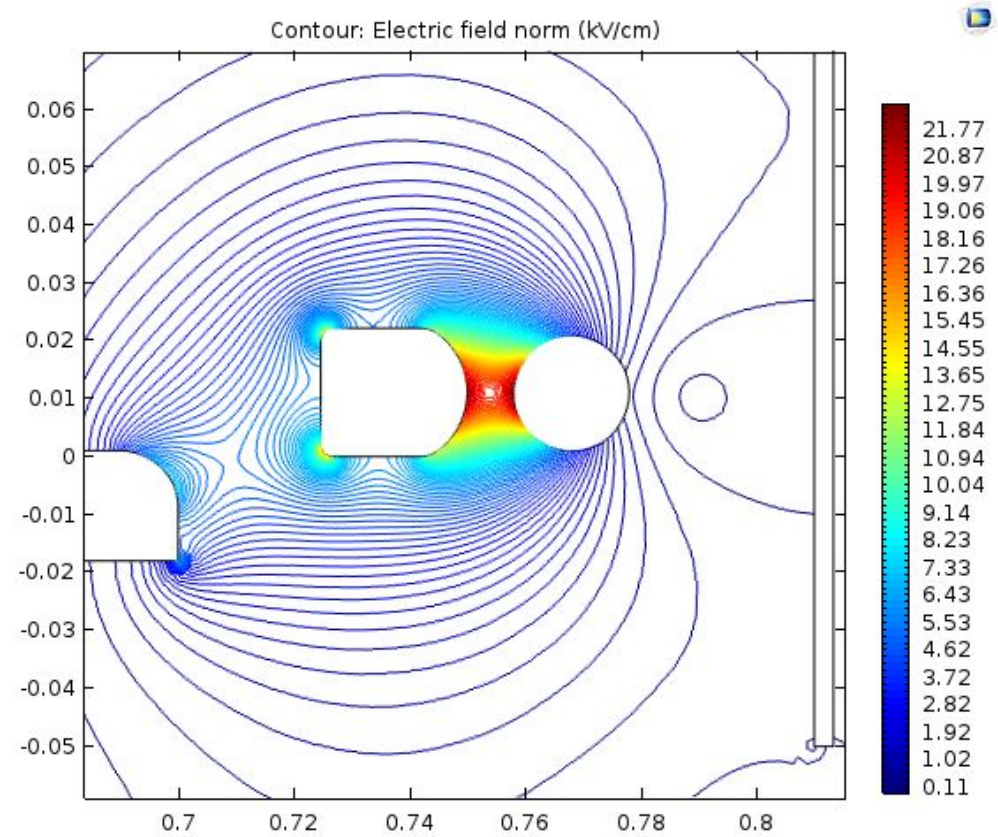
Gap (cm)	Voltage to achieve ~22 kV/cm on ring	Voltage to achieve ~25 kV/cm on ring
0.5	-10 kV (22.7 kV/cm)	-11 kV (24.9 kV/cm)
0.8	-15 kV (22.7 kV/cm)	-16.5 kV (25.0 kV/cm)
1.0	-18 kV (22.7 kV/cm)	-20 kV (25.2 kV/cm)

Cathode ring outward: before wires, with field hoop



- Hoopgap = distance between cathode ring and “field hoop”
- “Hoop” is modeled as a ***vertical plane***

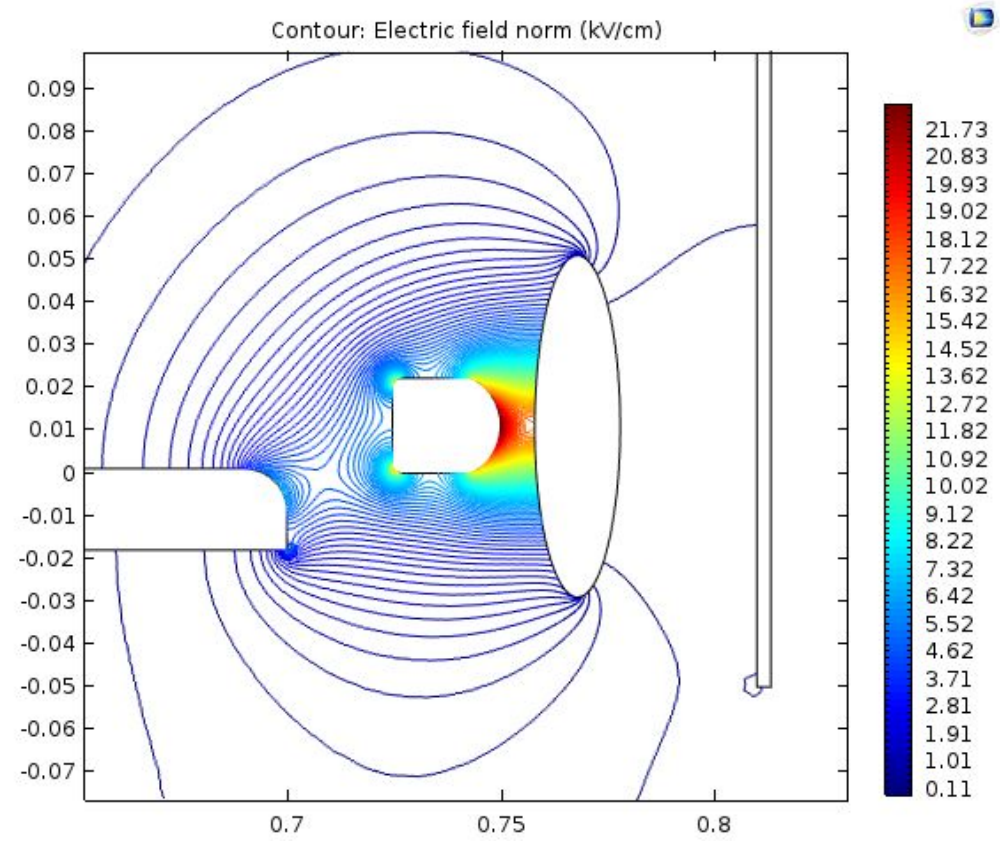
Cathode ring outward: before wires, with field hoop



- Simulate field hoop with a circular cross-section
- *(left)* Apply -16 kV to the cathode ring with a gap of 0.8 cm between the wall and cathode ring which results in max electric field of 22.6 kV/cm.

Gap (cm)	Voltage to achieve ~22 kV/cm on ring	Voltage to achieve ~25 kV/cm on ring
0.5	-10 kV (21.8 kV/cm)	-11 kV (24.0 kV/cm)
0.8	-16 kV (22.6 kV/cm)	-18 kV (25.4 kV/cm)
1.0	-20 kV (23.0 kV/cm)	-22 kV (25.3 kV/cm)

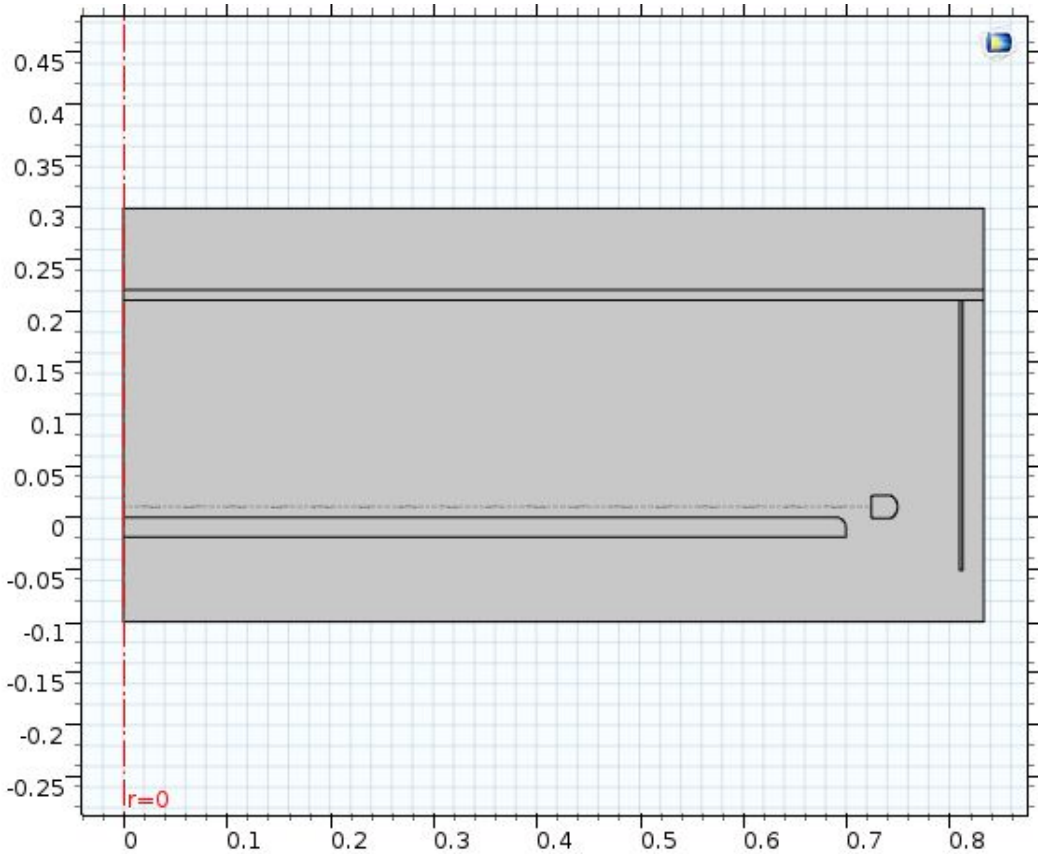
Cathode ring outward: before wires, with field hoop



- Simulate field hoop with an ellipsoidal cross-section (r_x = 1cm, r_y = 4cm)
- *(left)* Apply -15 kV to the cathode ring with a gap of 0.8 cm between the wall and cathode ring which results in max electric field of 22.5 kV/cm.

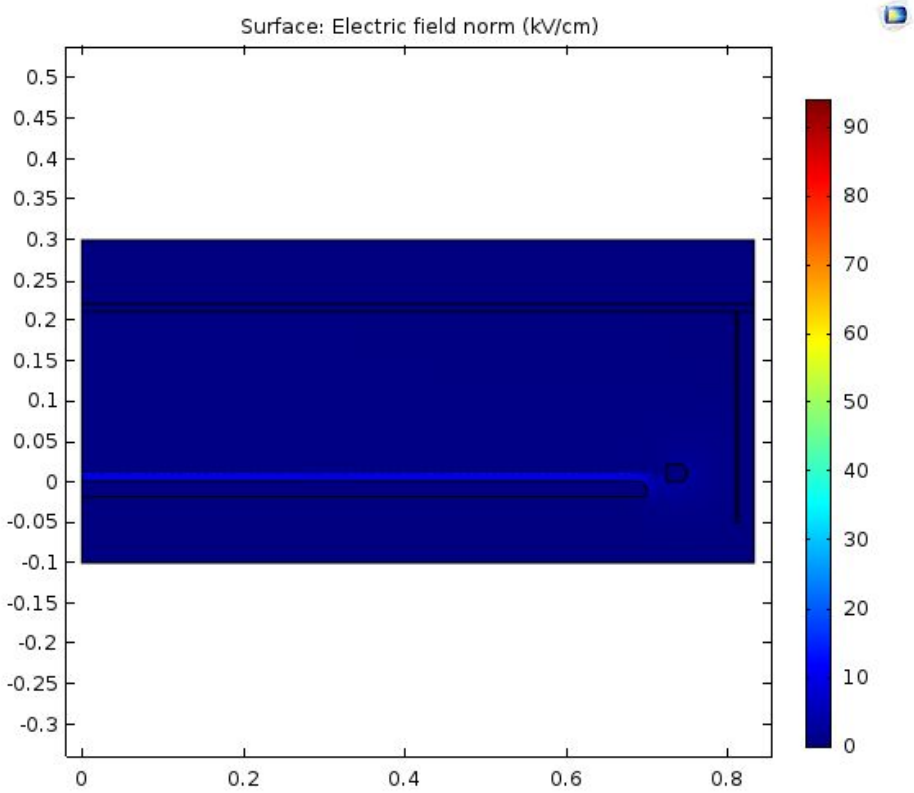
Gap (cm)	Voltage to achieve ~22 kV/cm on ring	Voltage to achieve ~25 kV/cm on ring
0.5	-10 kV (22.5 kV/cm)	-11 kV (24.8 kV/cm)
0.8	-15 kV (22.5 kV/cm)	-17 kV (25.5 kV/cm)
1.0	-18 kV (22.5 kV/cm)	-20 kV (25.0 kV/cm)

Cathode grid: with wires and reflector plate

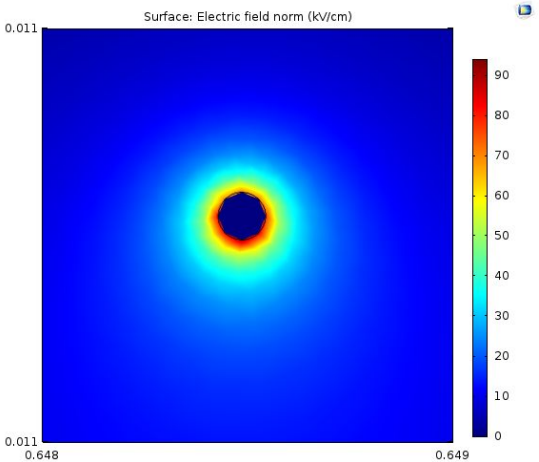


- Cathode grid wires:
  - Diameter = 100 μm
  - Effective pitch = 0.25 cm
  - Need to apply corrections to account for differences between mesh and concentric ring approximation.
- Bottom reflector plate:
  - Thickness = 0.75 in (PSL)
  - Gap to C wires = 1 cm
- Wall reflector plate:
  - Thickness = 0.13 in (PSL)
  - Gap to C ring = 6 cm

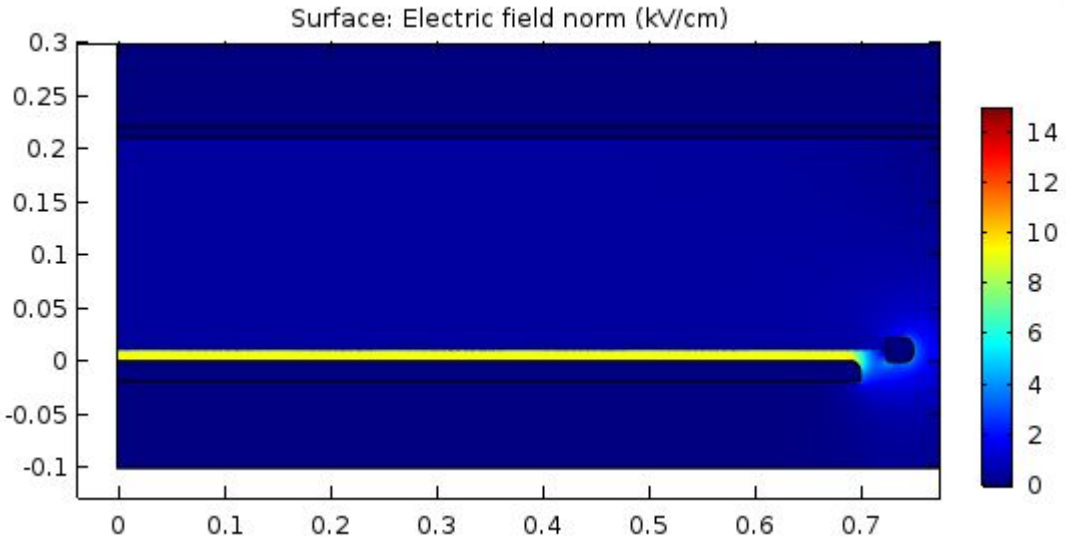
Cathode grid: with wires and reflector plate

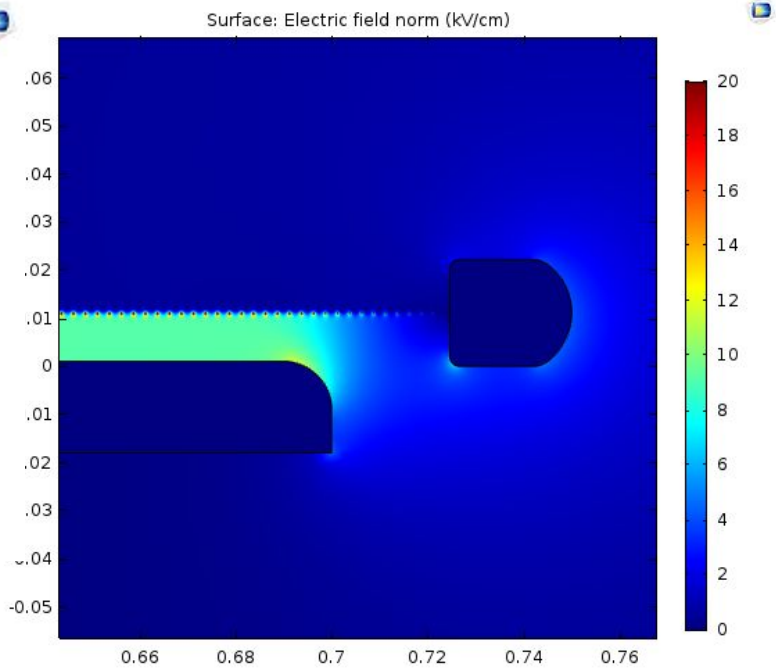


- Applying -10 kV to the cathode yields electric fields << maximum field in the chamber.
- Fields of ~90 kV/cm on wire surface(!)
  - These are not accurate at this scale. Simulations are better for bulk fields.



Cathode grid: with wires and reflector plate



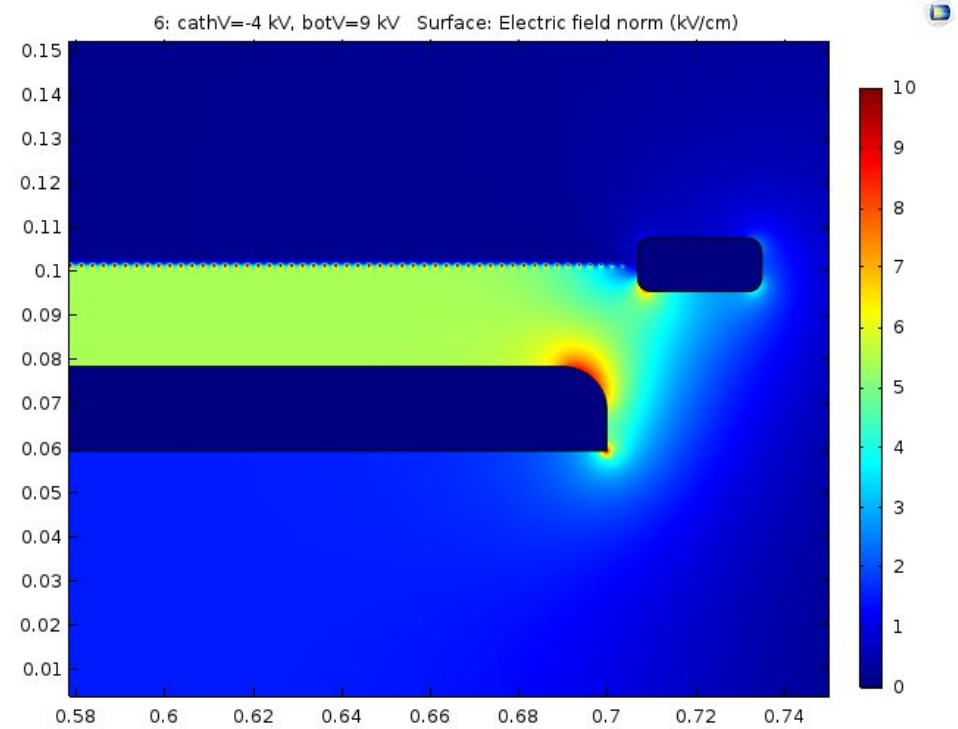


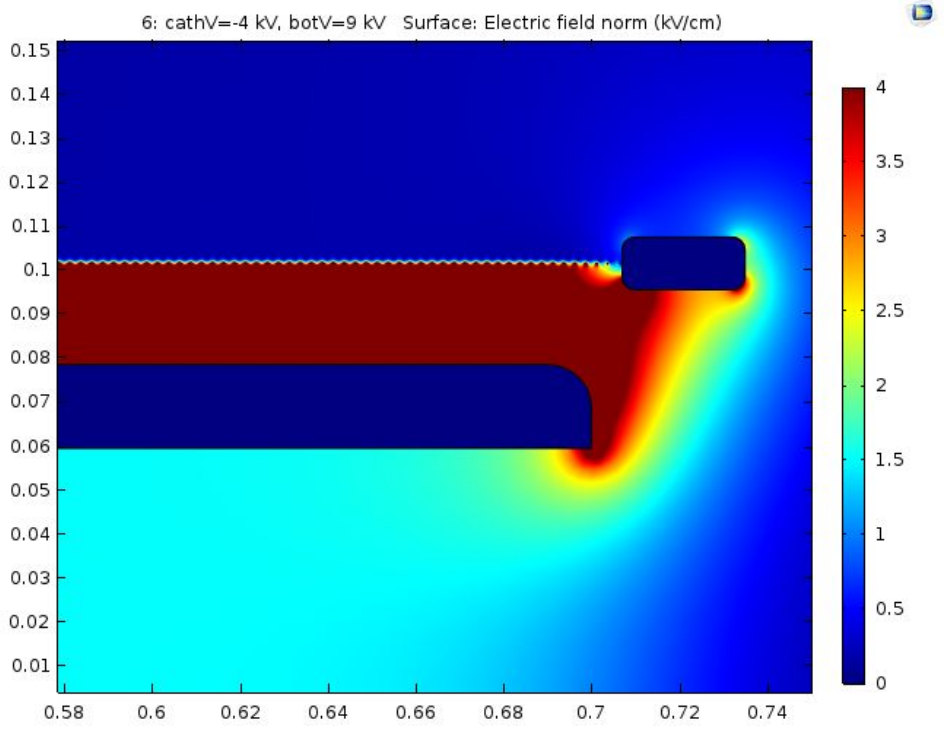
- *(left)* Applying -10 kV to the cathode yields electric fields between wires and bottom plate of ~9 kV/cm.
- *(right)* Fields on ring are small ($\lesssim$ 5 kV/cm) and field on corner of bottom plate is small ($\lesssim$ 12 kV/cm)

Bottom reflector plate geometry

- Bottom grid ring has a smaller radius than cathode ring
  - Reflector plate must fit within both rings
- Bottom ring simulated in COMSOL with its 75 um diameter, 0.5 cm pitch wires
- Now, vary characteristics of the reflector plate:
  - Fillet on corners
  - Radius (fixed at 0.7 m)

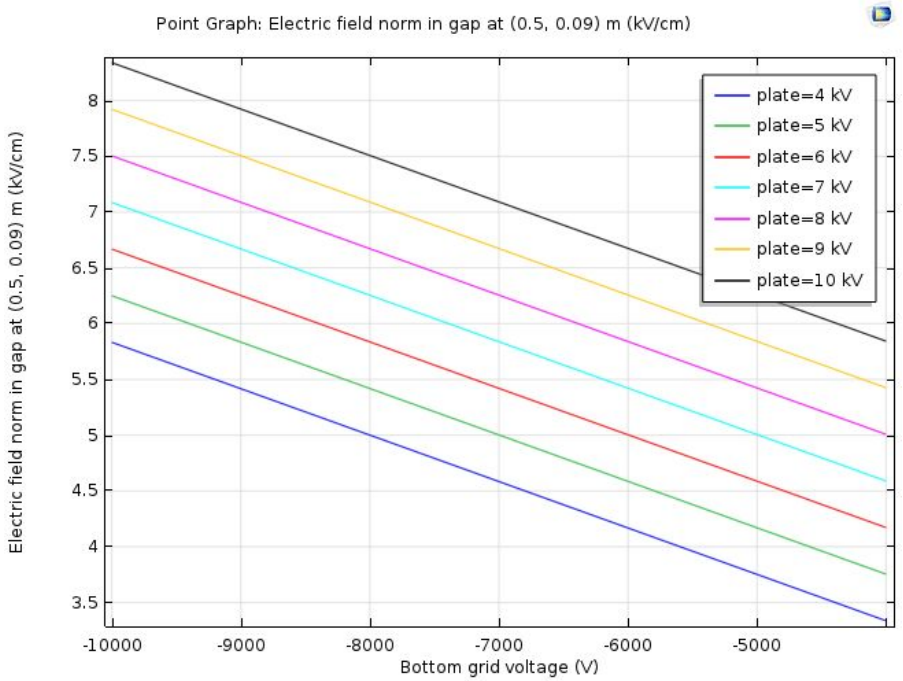
Reflector plate fillet = 1.0 cm, gap = 2.3 cm

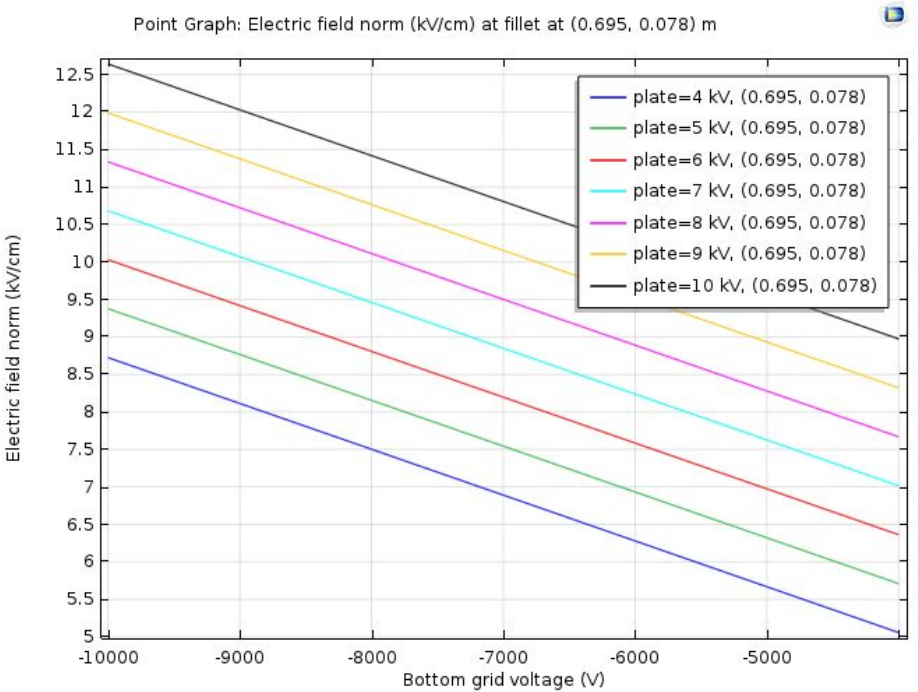




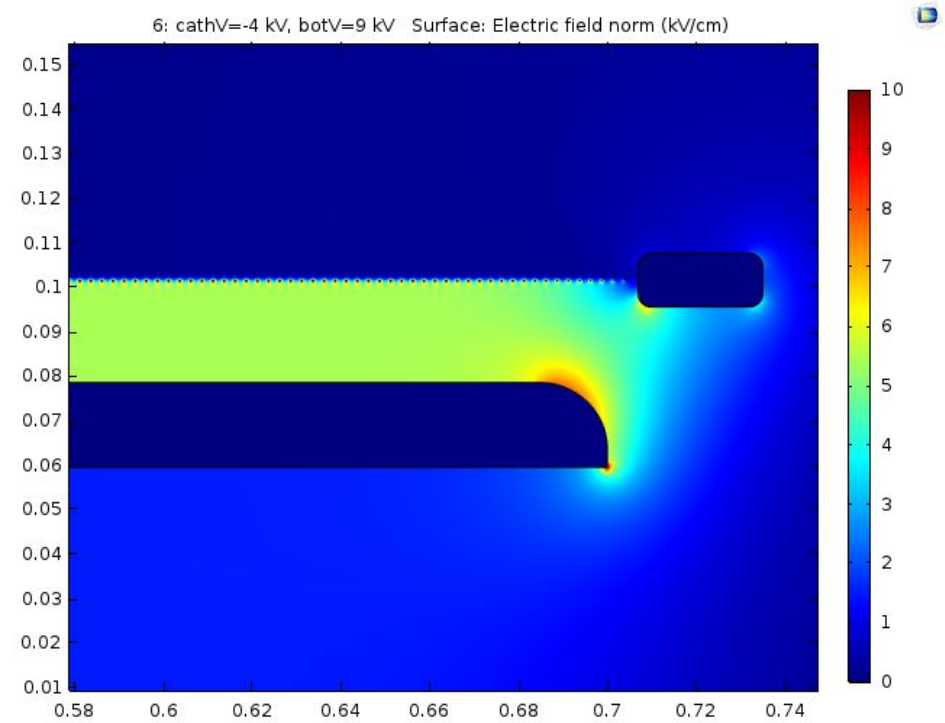
X = radial distance, Y = height in Phase II, colormap = electric field (kV/cm)

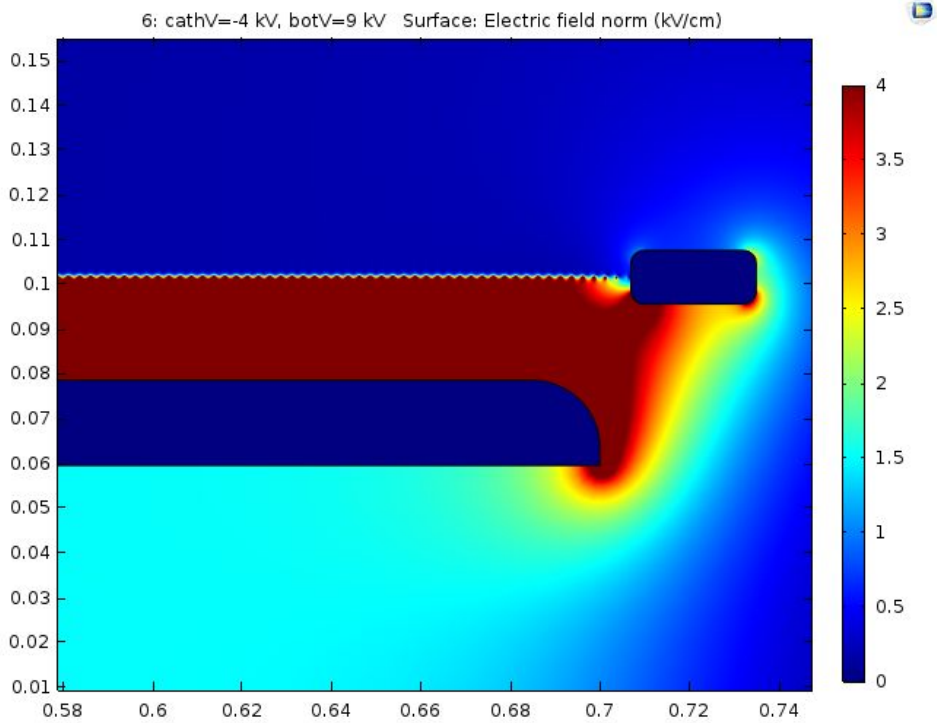
Reflector plate fillet = 1.0 cm, gap = 2.3 cm





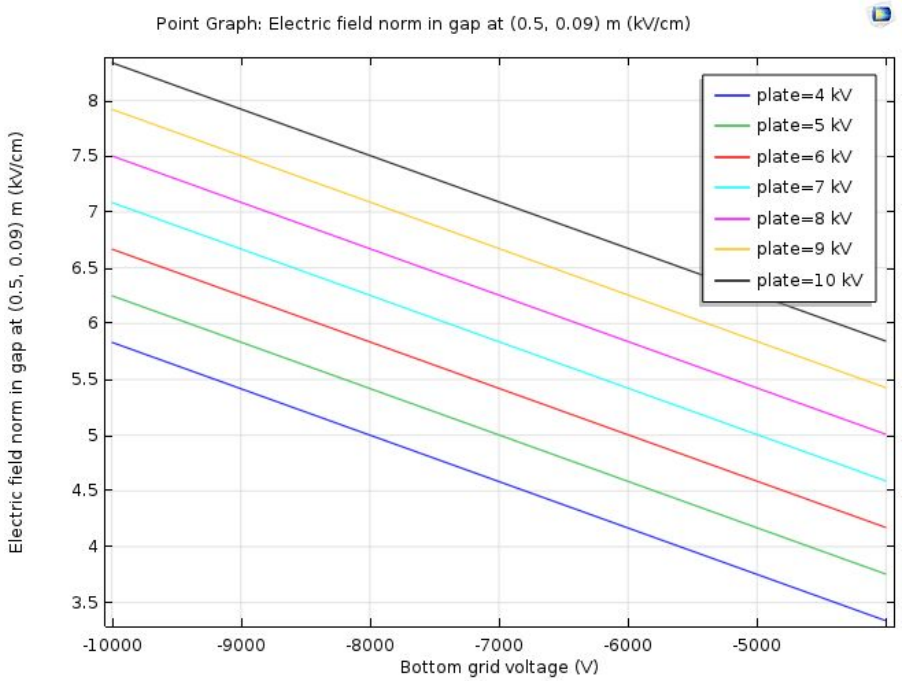
Reflector plate fillet = 1.5 cm, gap = 2.3 cm

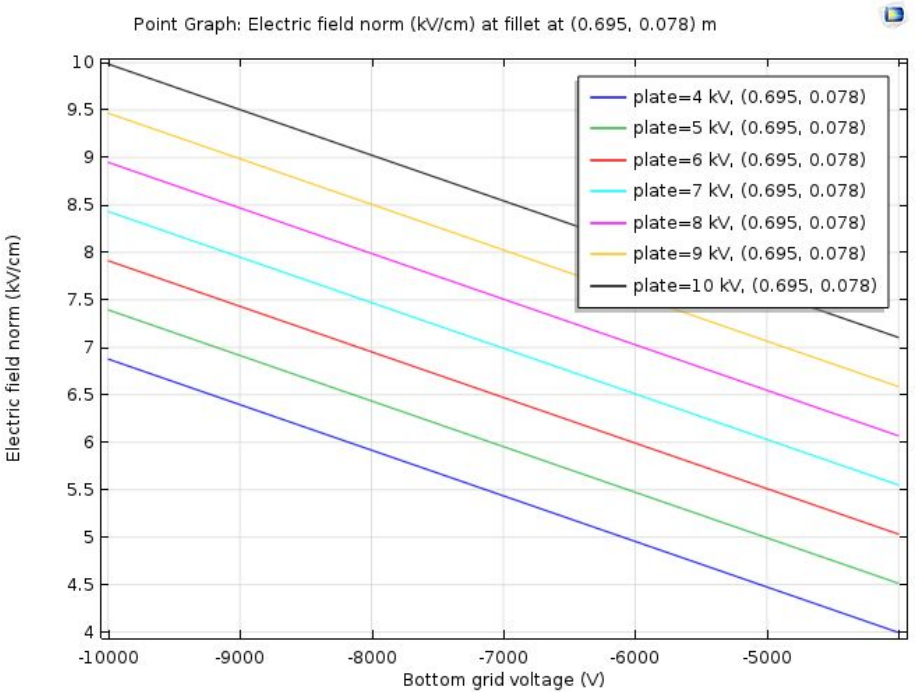




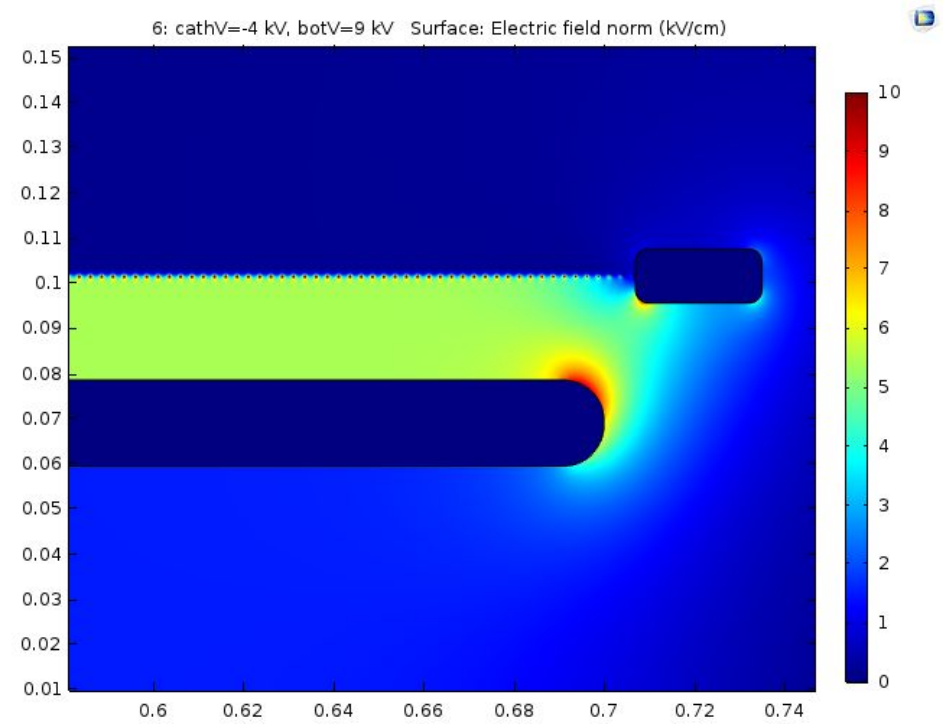
X = radial distance, Y = height in Phase II, colormap = electric field (kV/cm)

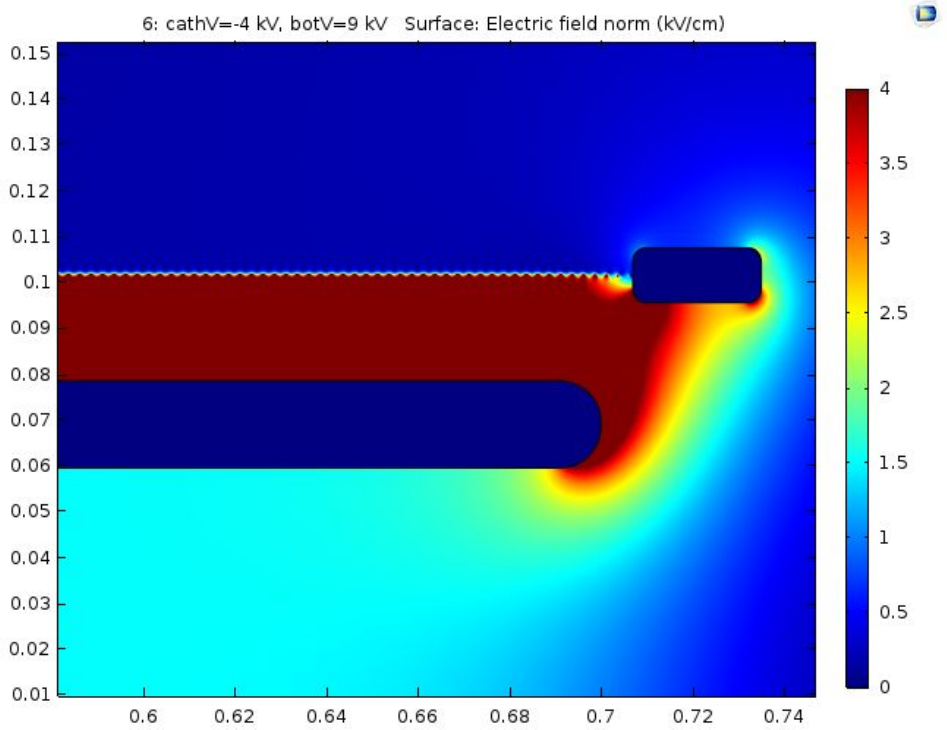
Reflector plate fillet = 1.5 cm, gap = 2.3 cm





Reflector plate fillet = 0.9 cm on both corners, gap = 2.3 cm





X = radial distance, Y = height in Phase II, colormap = electric field (kV/cm)

Reflector plate fillet = 0.9 cm on both corners, gap = 2.3 cm