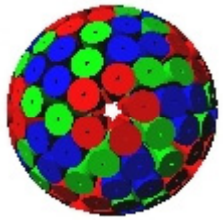
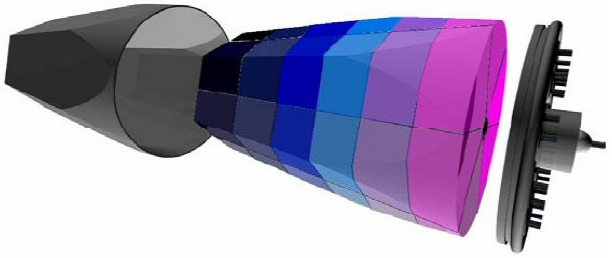


C001 Depletion Scans

Steven Moon, D. Barrientos, A.J. Boston,
H. Boston, S.J. Colosimo, J. Cresswell,
D.S. Judson, P.J. Nolan, C. Unsworth

AGATA Week, Legnaro National Laboratory
20th-22nd January 2010



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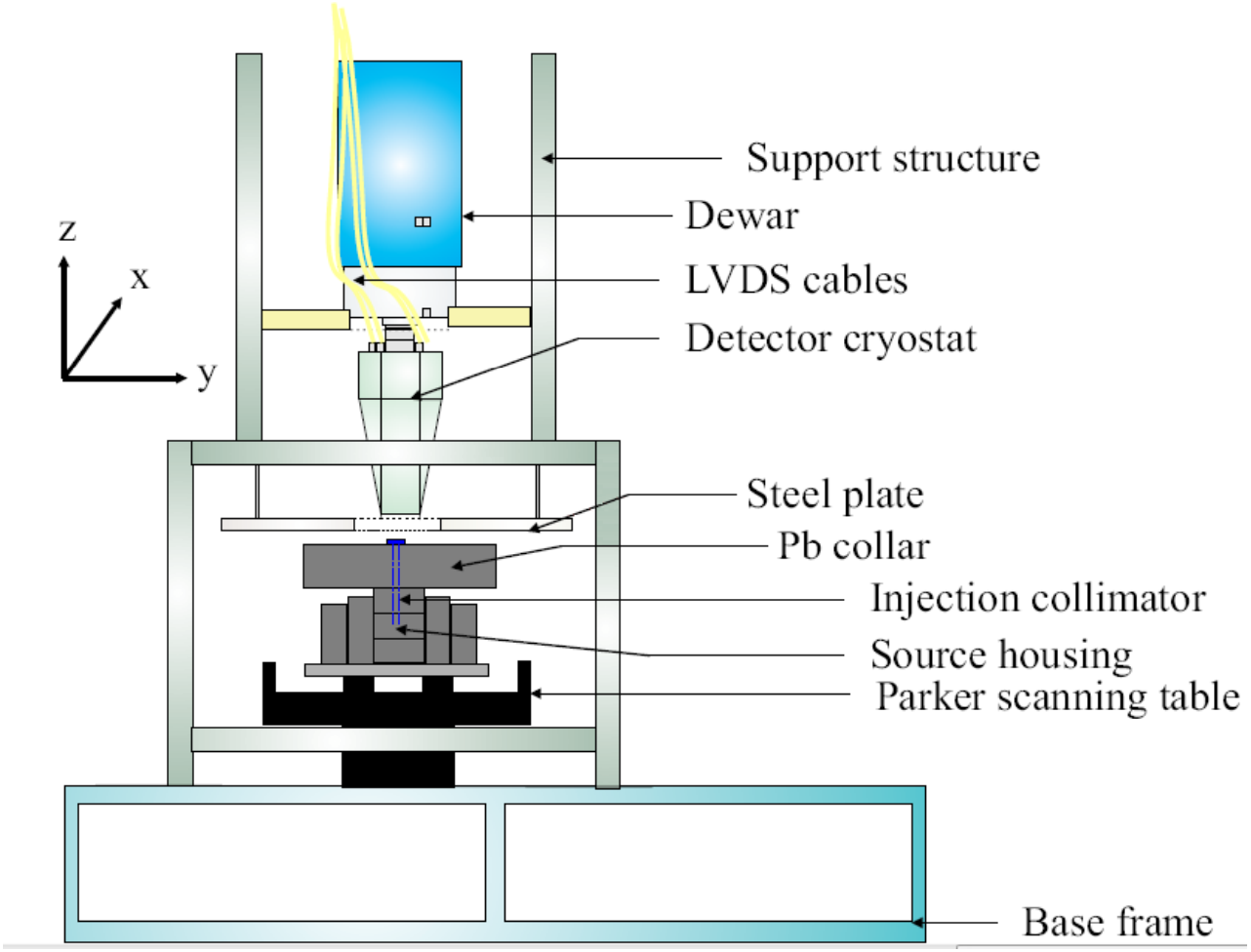
- Overview

  - Experimental Setup
  - Results
  - MGS Simulations
  - Next Steps

• Experimental Setup

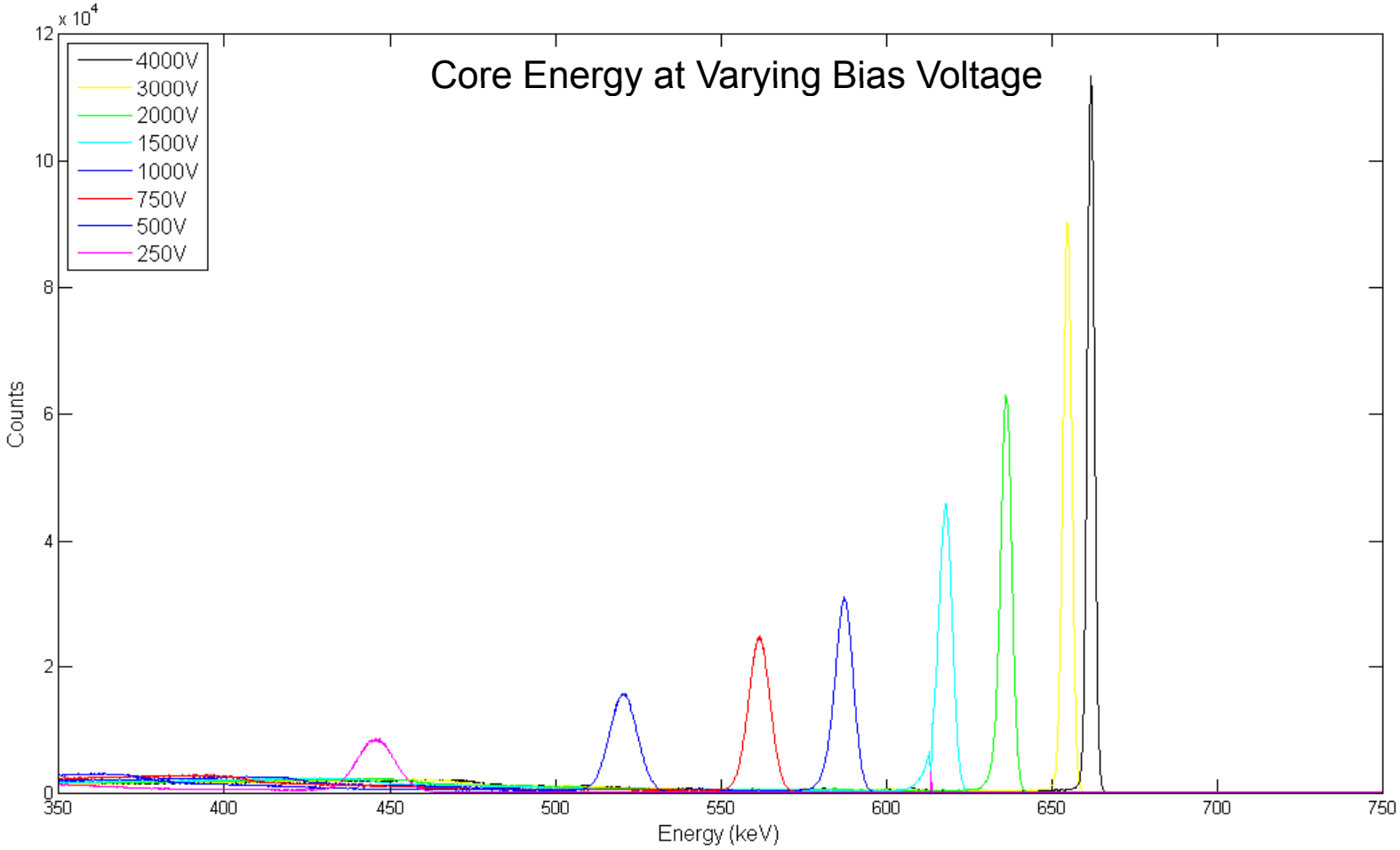


(Image adapted from M. R. Dimmock, PhD Thesis, 2008)

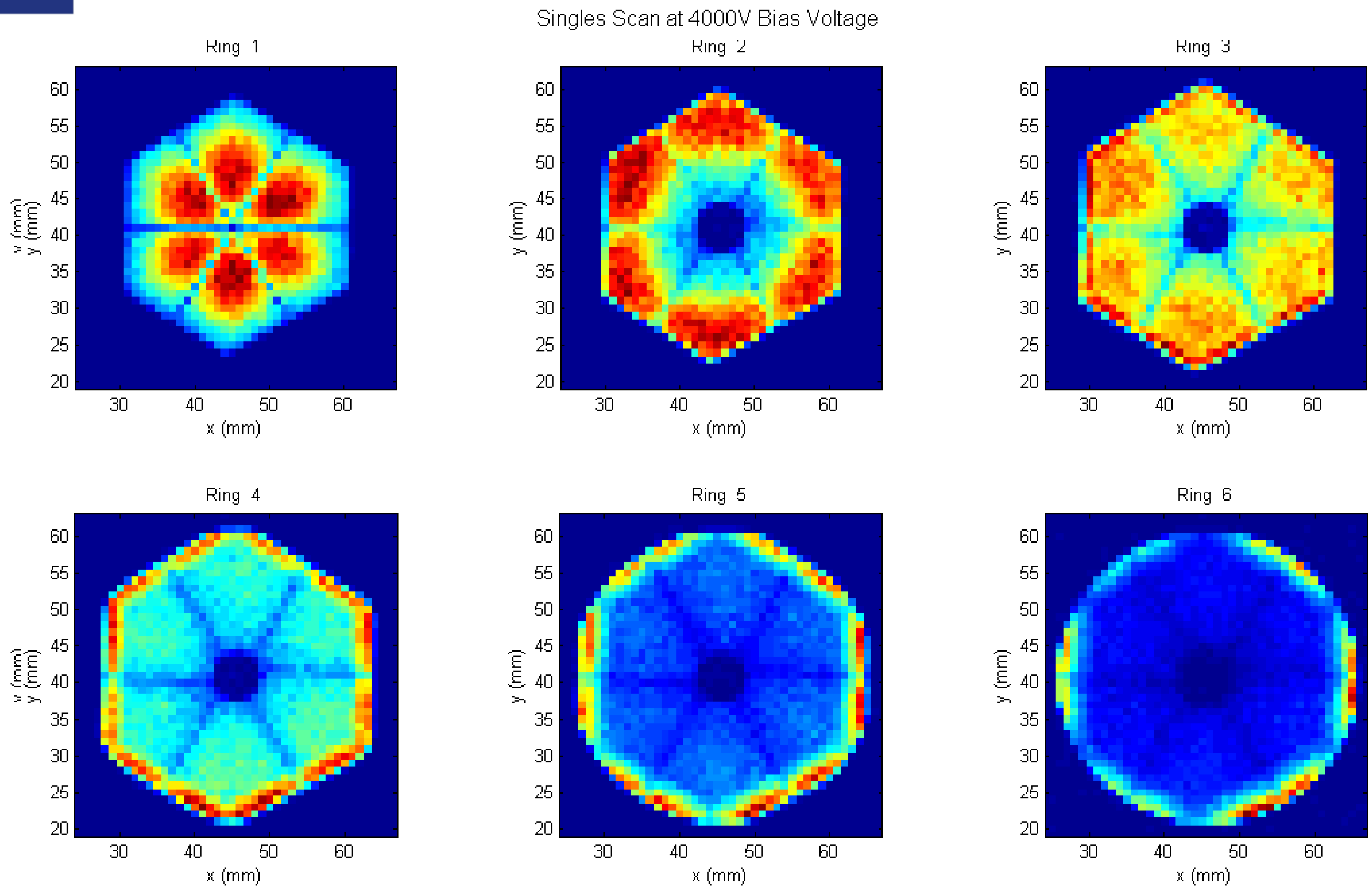
- Acquire in singles mode
- Scan detector on $2mm^2$ grid @ 30s per scan position
- Demand fold-1 (i.e. 1 hit seg.) events of full (662keV ^{137}Cs) energy

• Experimental Setup (cont.)

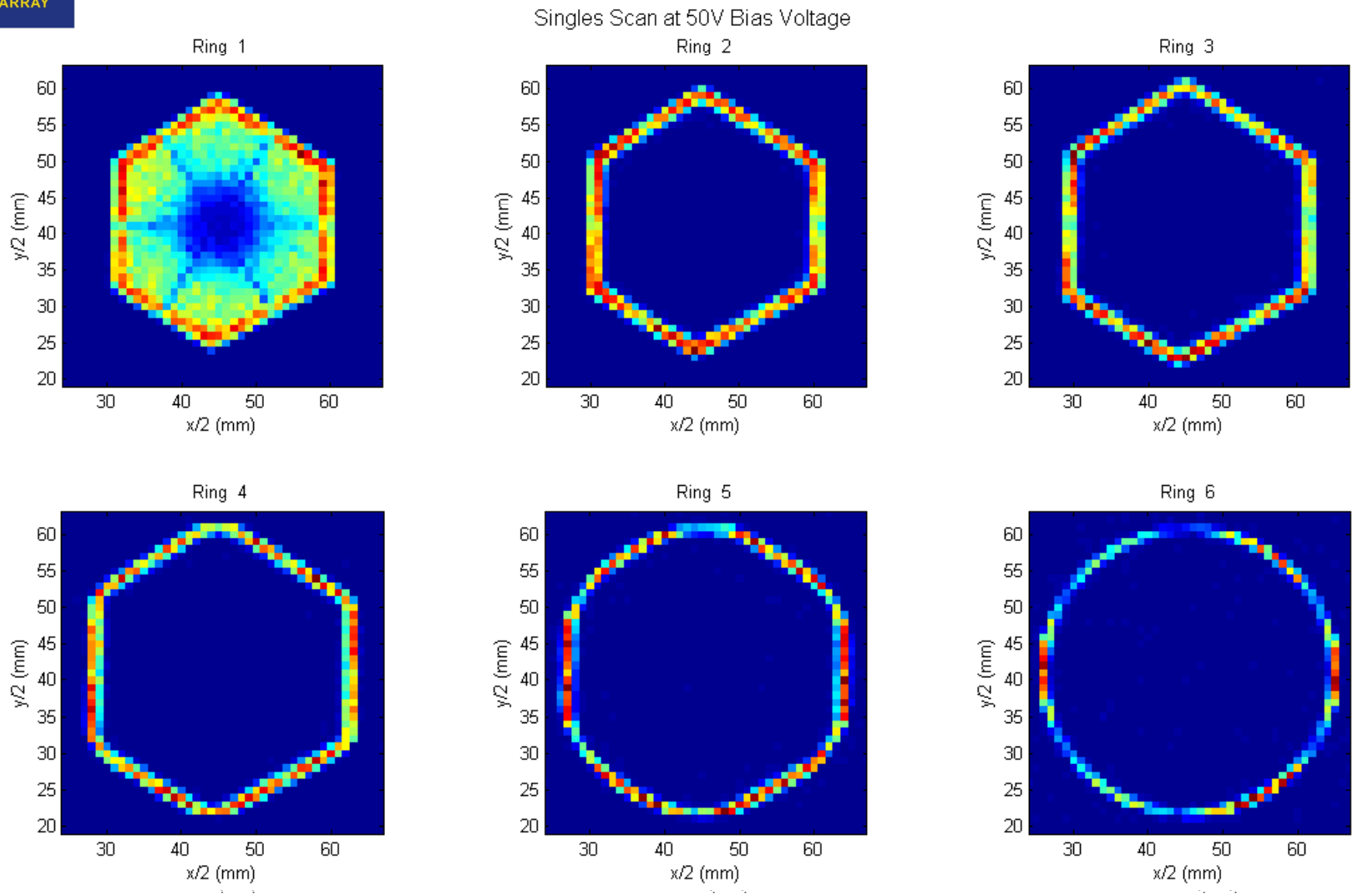
- Repeat for various HV Bias Voltages



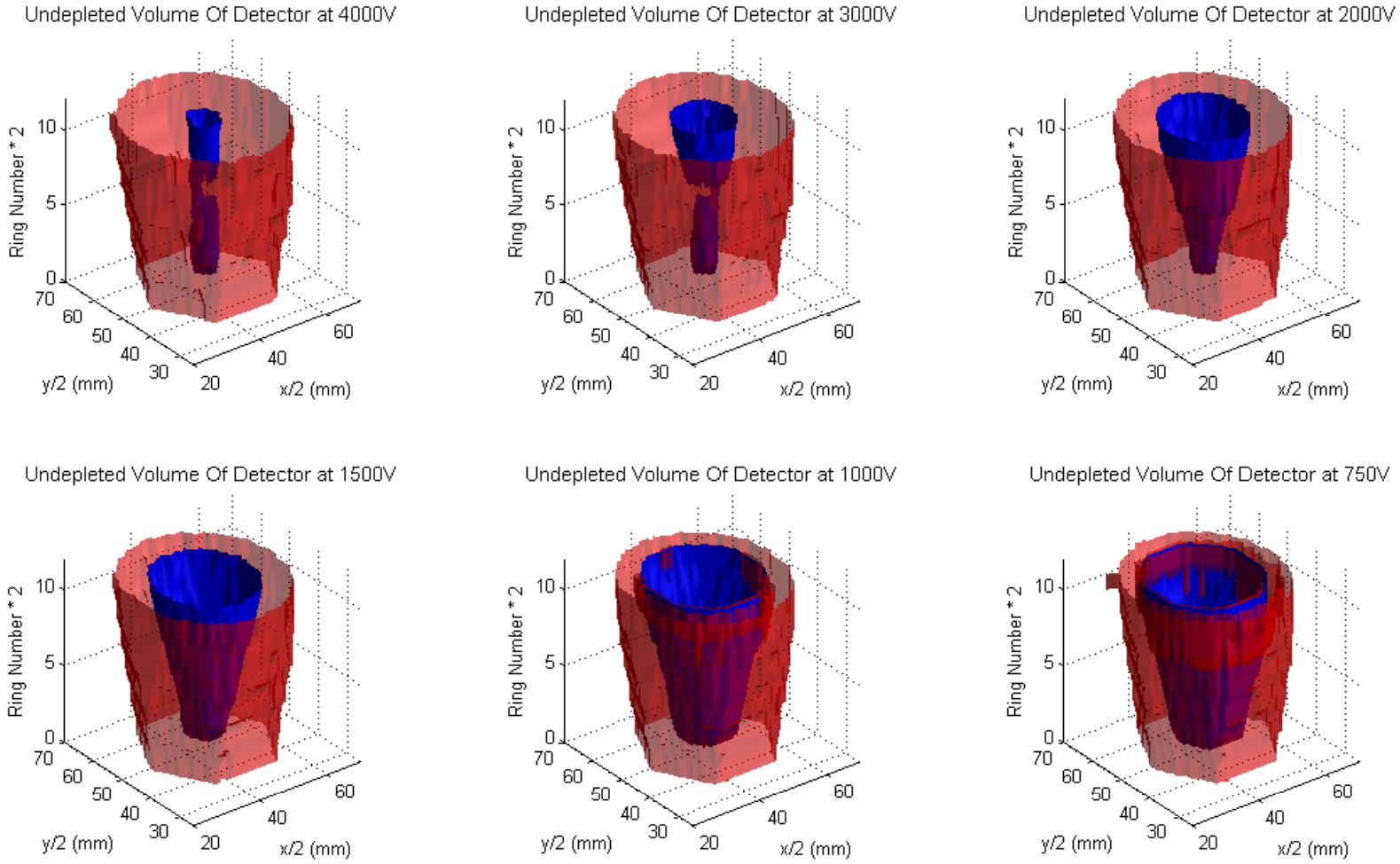
• Results


Singles Scan at 4000V Bias Voltage
Ring 1
Ring 2
Ring 3
Ring 4
Ring 5
Ring 6
x (mm)
y (mm)
20
25
30
35
40
45
50
55
60

- Results


Singles Scan at 50V Bias Voltage
Ring 1
Ring 2
Ring 3
Ring 4
Ring 5
Ring 6
y/2 (mm)
x/2 (mm)
20
25
30
35
40
45
50
55
60

• Results (cont.)



- MGS Simulations

- C001 simulated for all experimental bias voltages using MGS

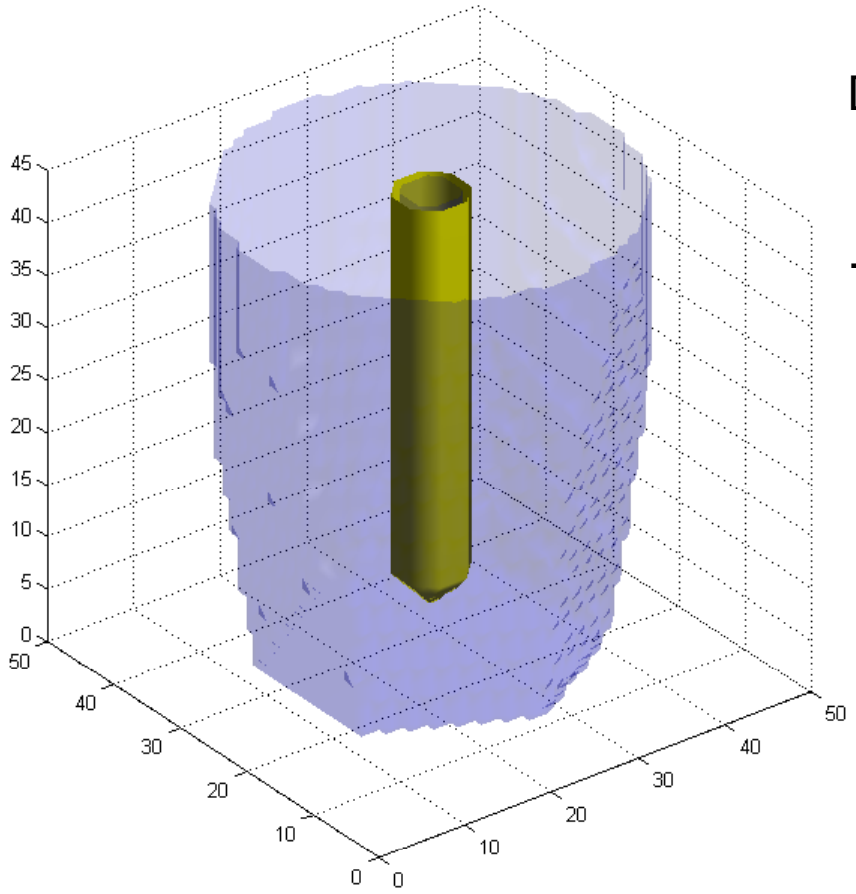
- Impurity concentrations (supplied by Canberra)

  - Front: 0.65×10^{-10} cm^{-3}

  - Back: 1.4×10^{-10} cm^{-3}

- Image results in similar fashion...

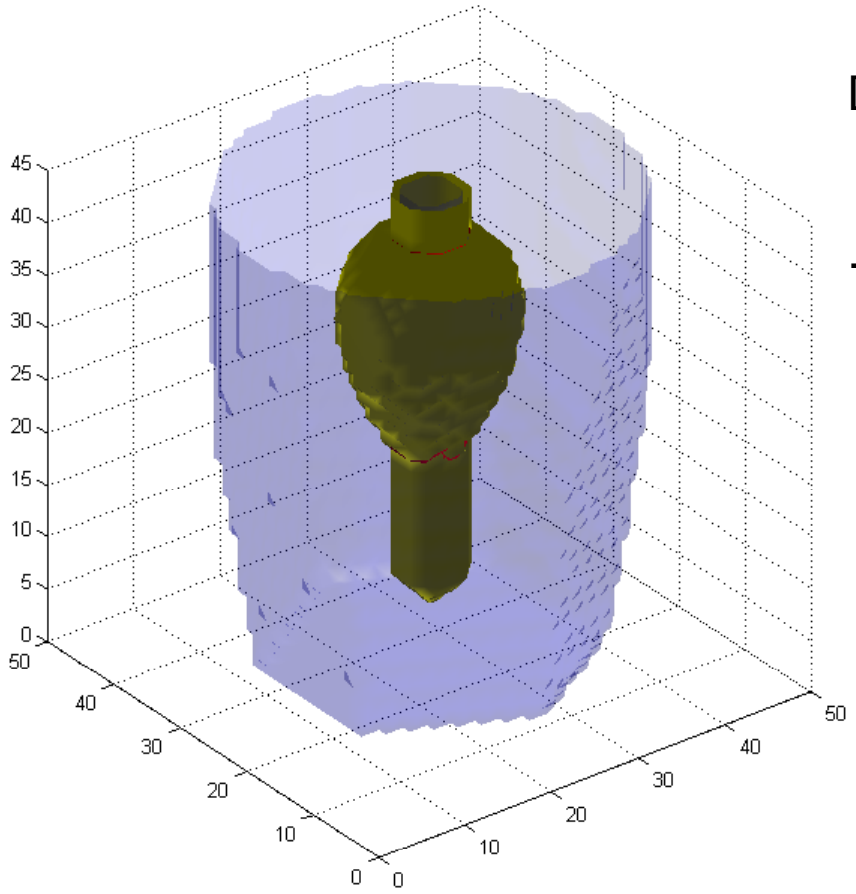
- MGS Simulations (cont.)



Detector at 4000V

→ 100% depleted

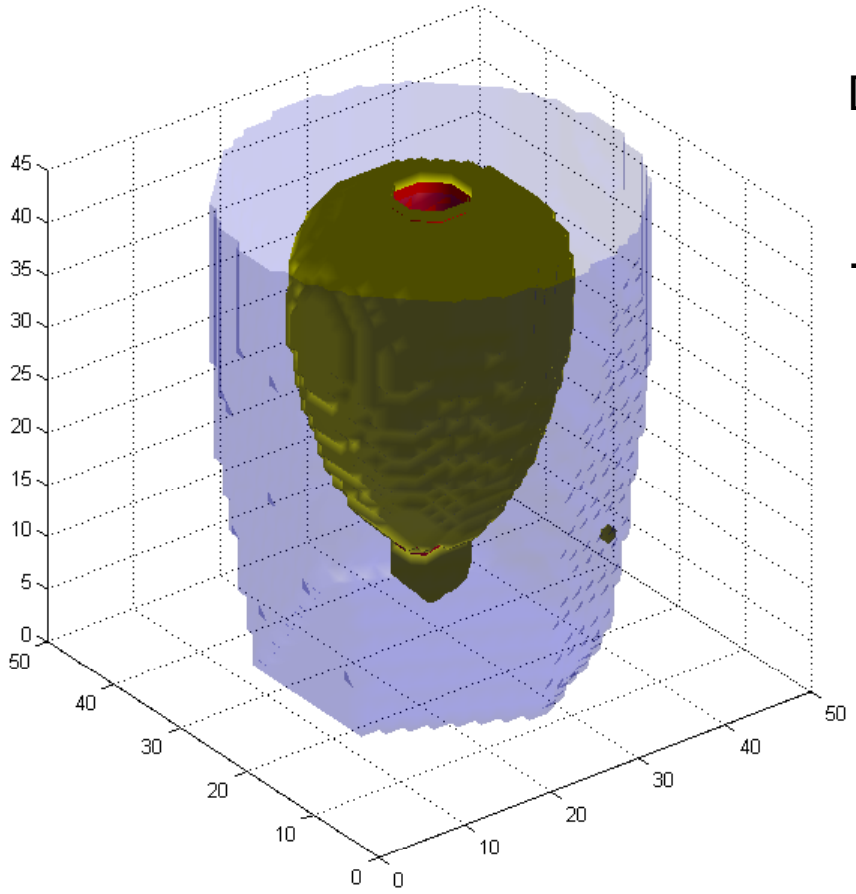
- MGS Simulations (cont.)



Detector at 3000V

→ 94.8% depleted

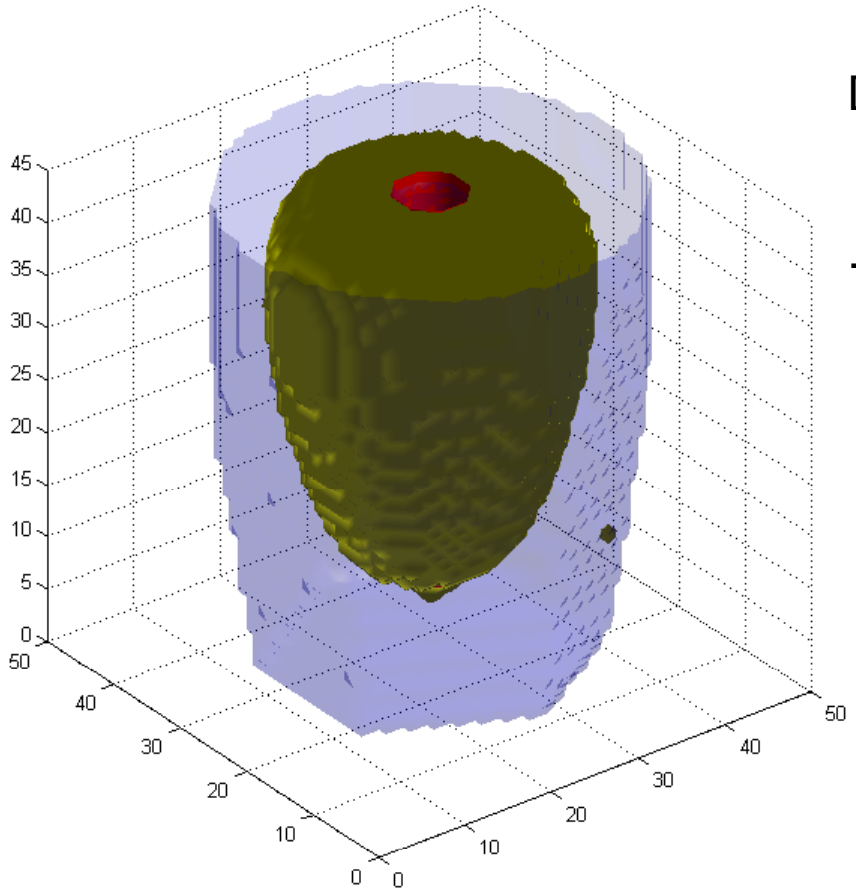
- MGS Simulations (cont.)



Detector at 2000V

→ 76.6% depleted

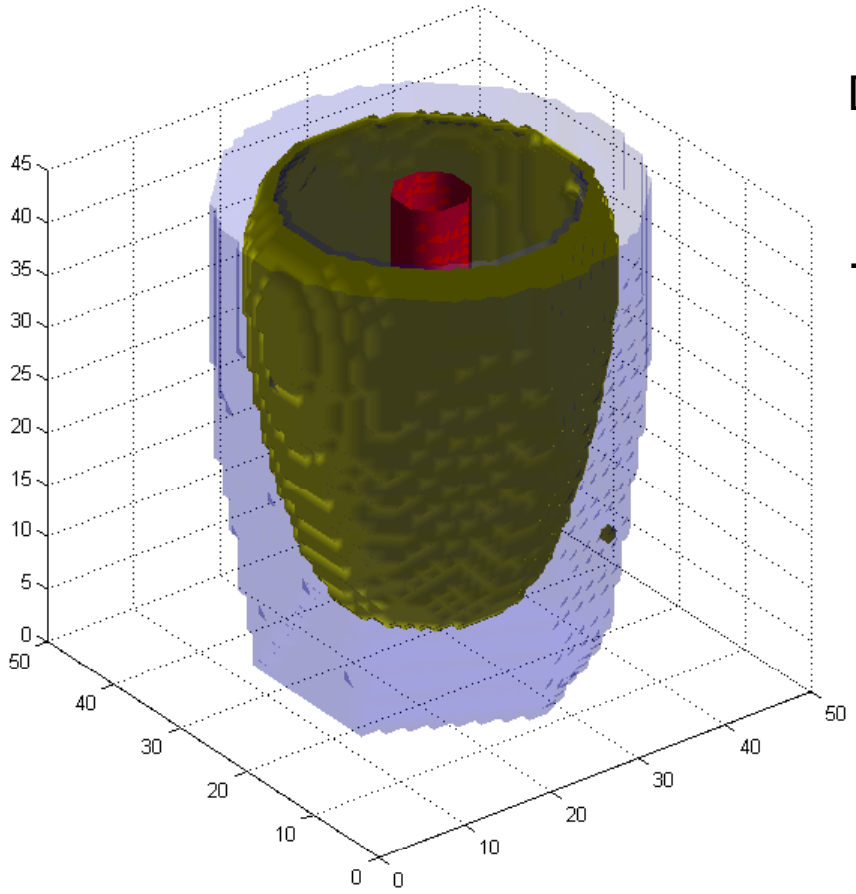
- MGS Simulations (cont.)



Detector at 1500V

→ 62.2% depleted

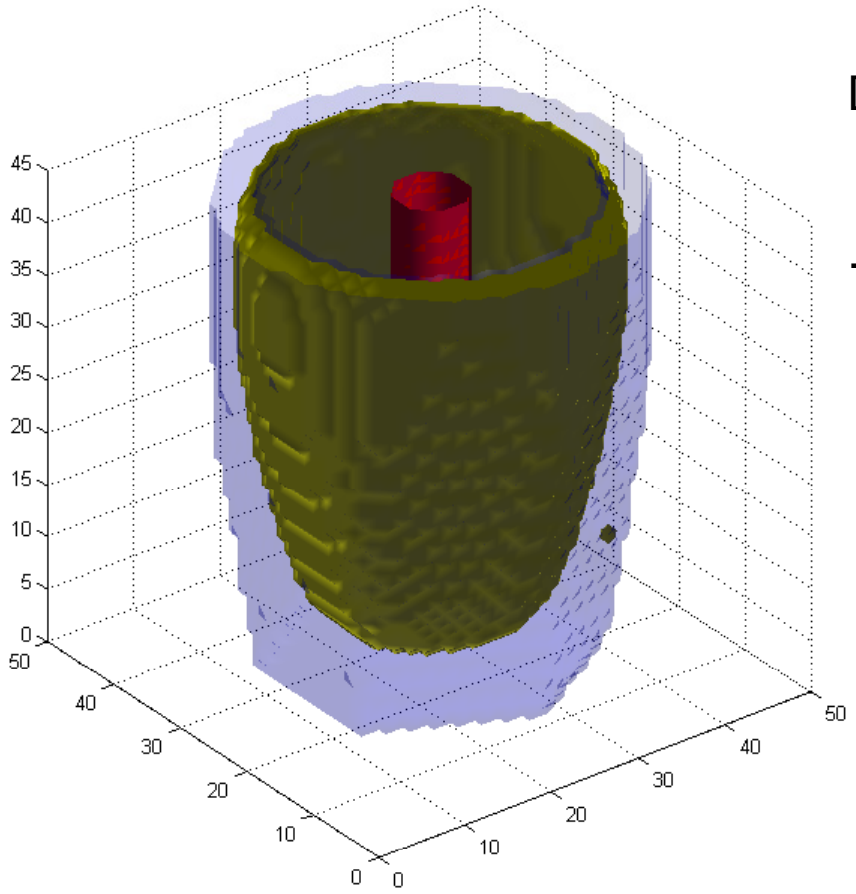
- MGS Simulations (cont.)



Detector at 1000V

→ 44.0% depleted

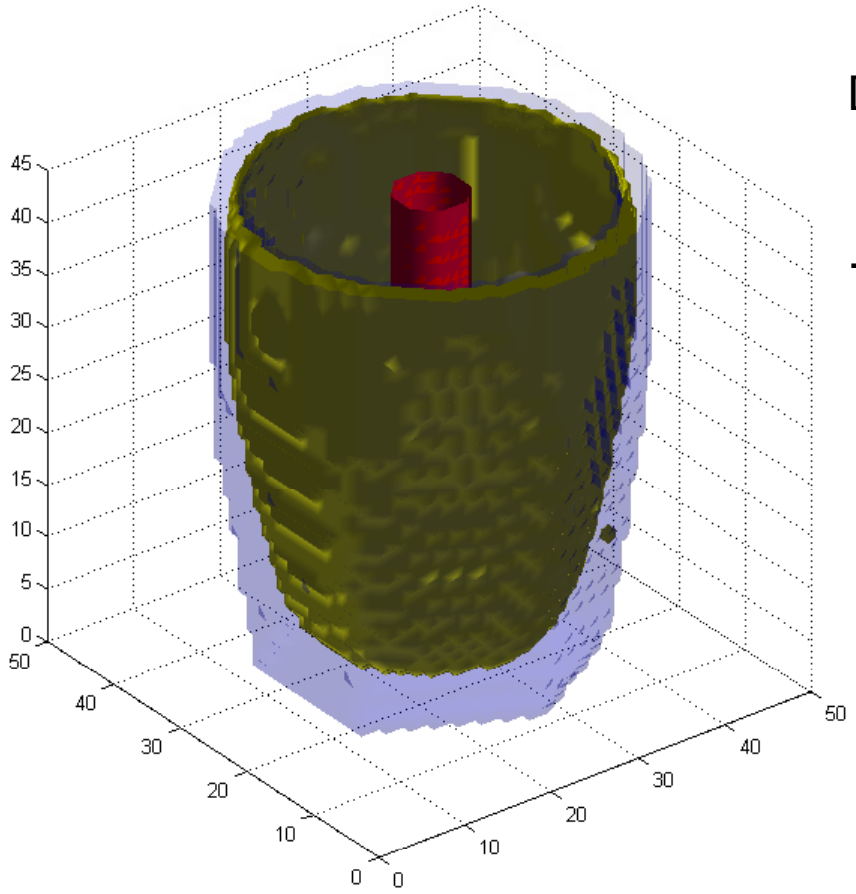
- MGS Simulations (cont.)



Detector at 750V

→ 33.8% depleted

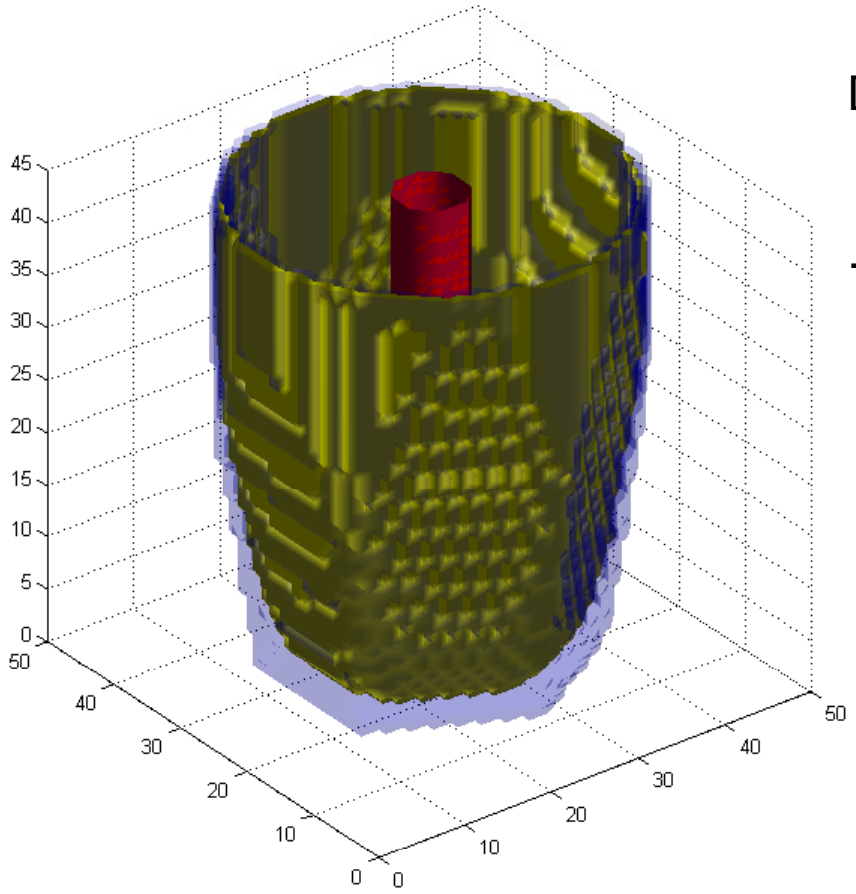
- MGS Simulations (cont.)



Detector at 500V

→ 22.6% depleted

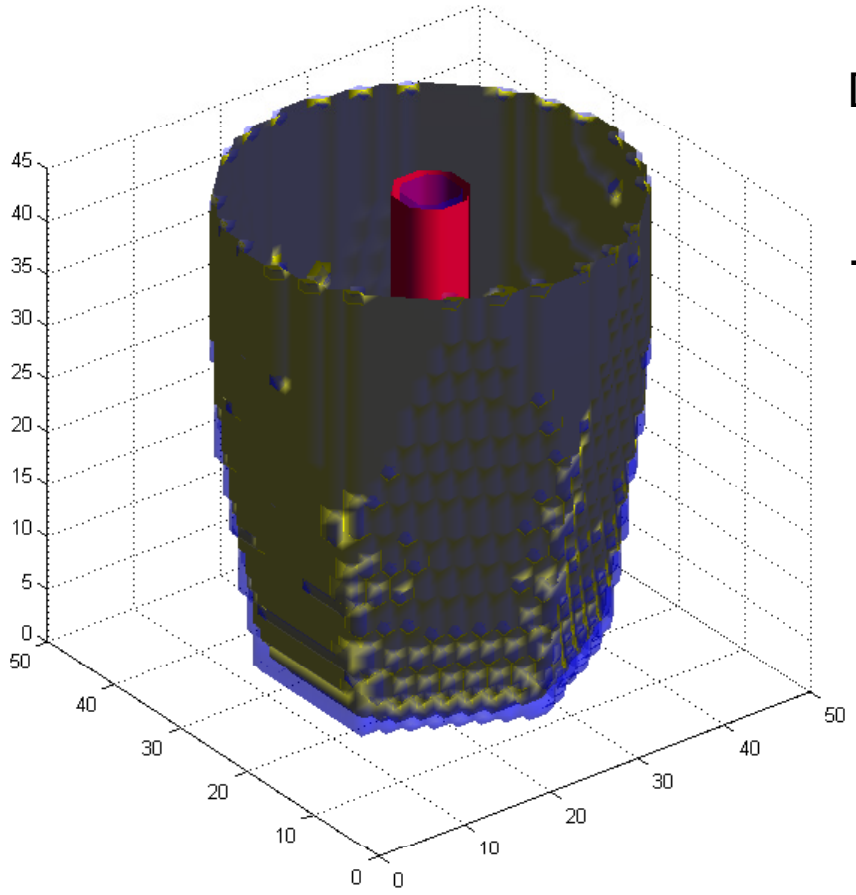
- MGS Simulations (cont.)



Detector at 250V

→ 10.4% depleted

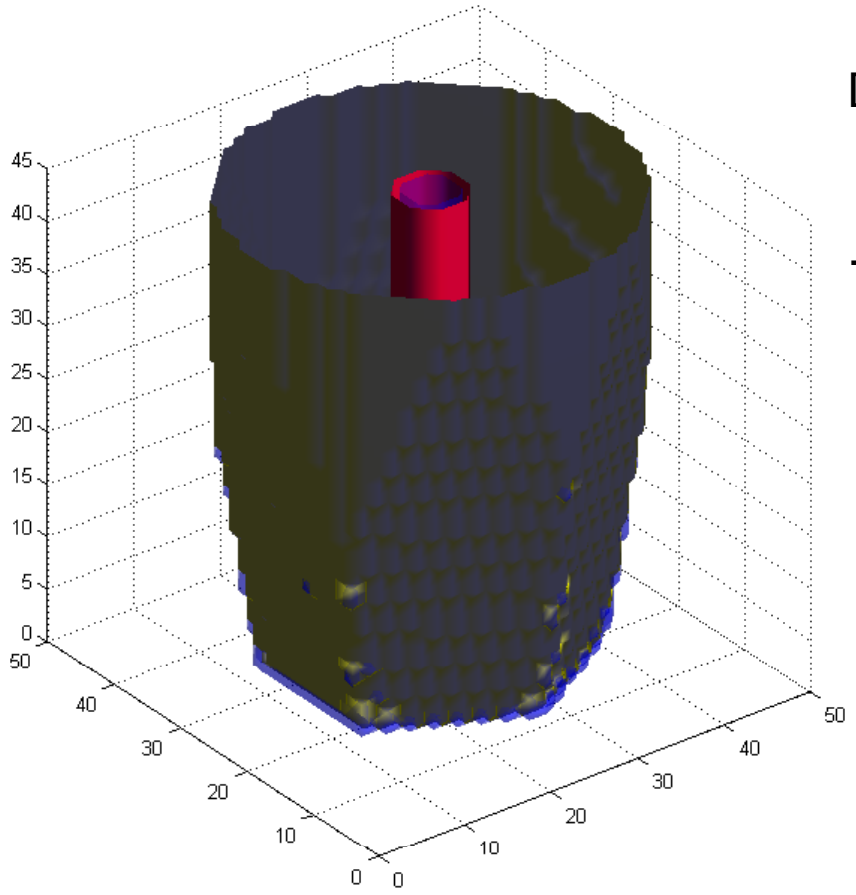
- MGS Simulations (cont.)



Detector at 100V

→ 1.7% depleted

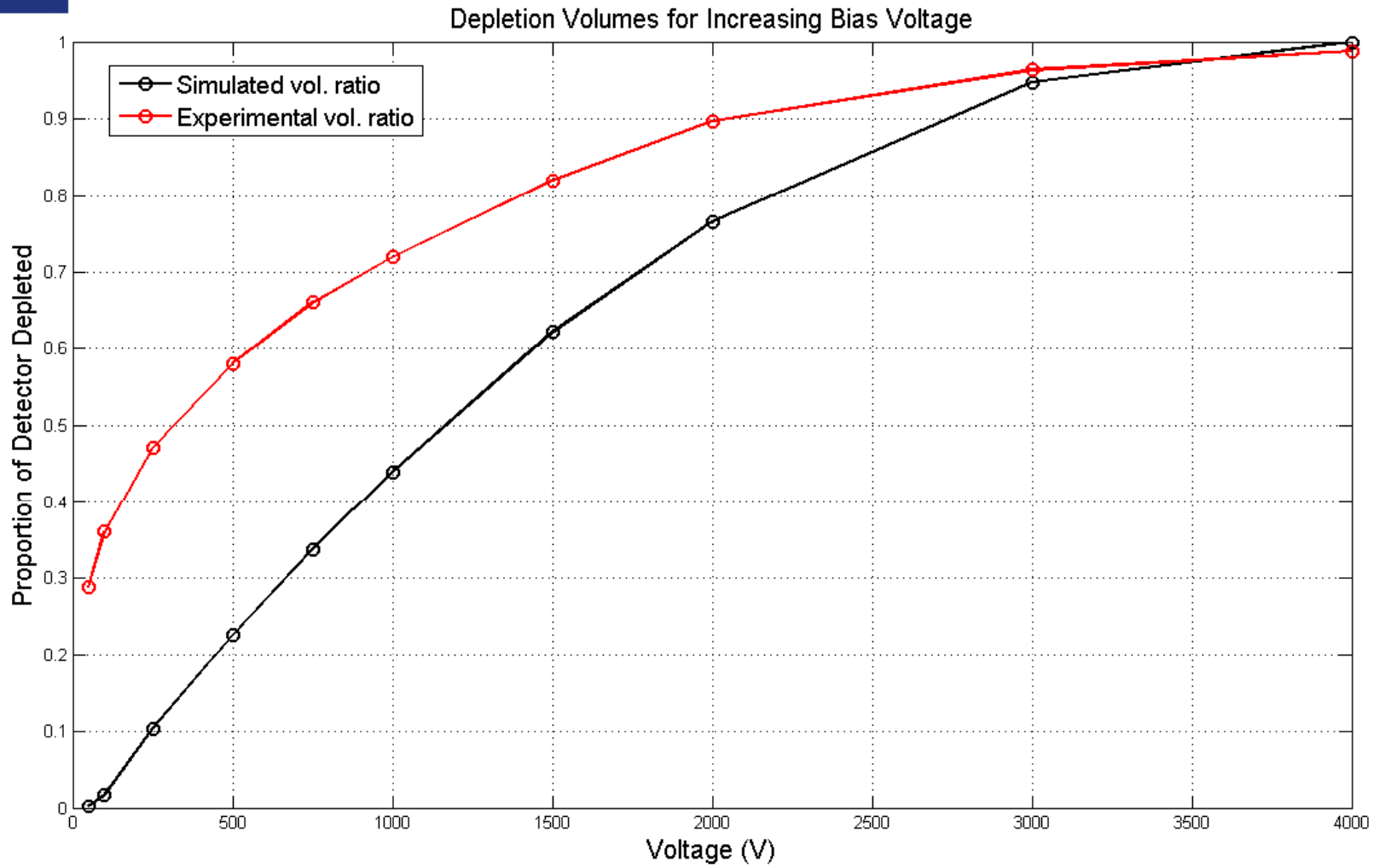
- MGS Simulations (cont.)



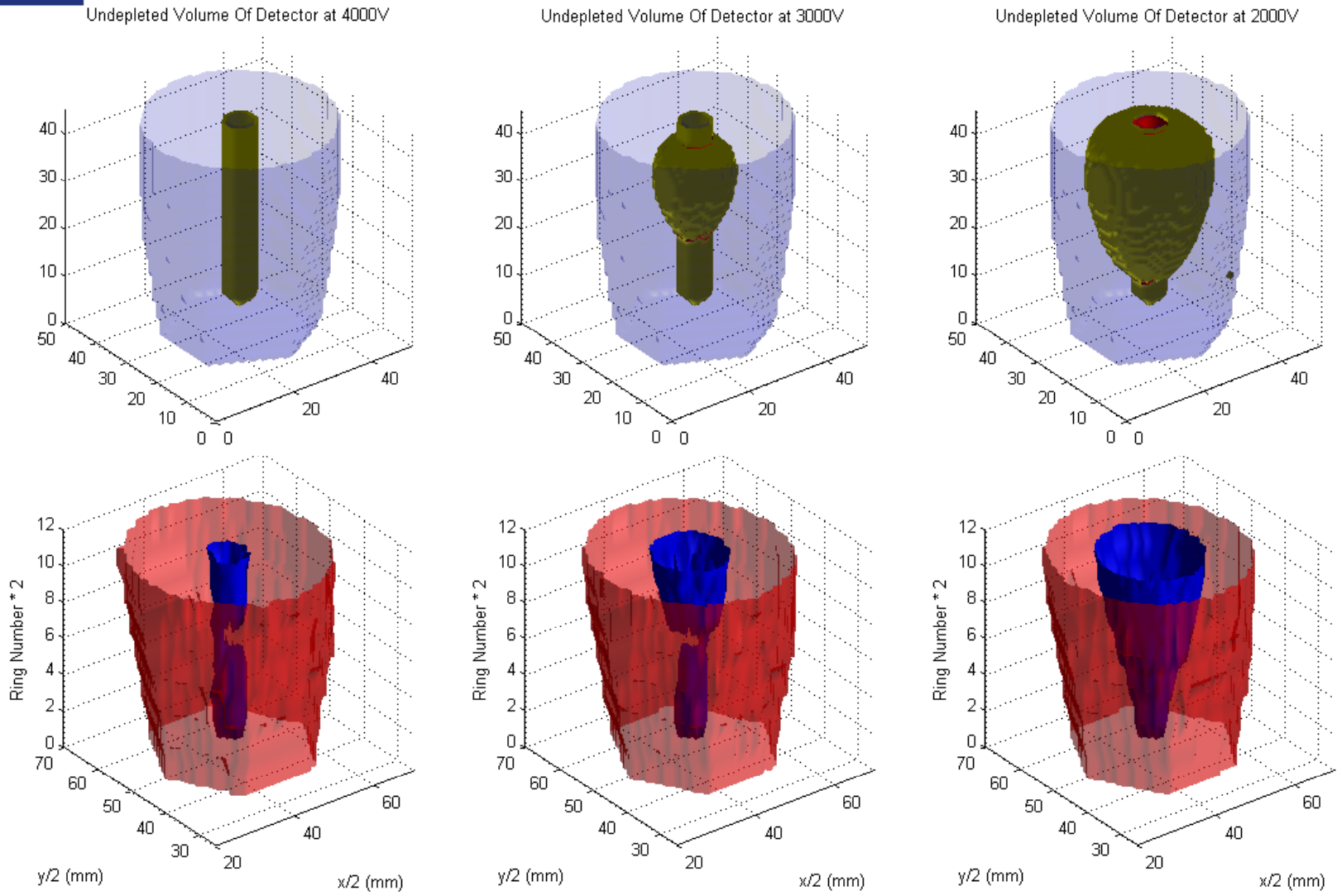
Detector at 50V

→ 0.3% depleted

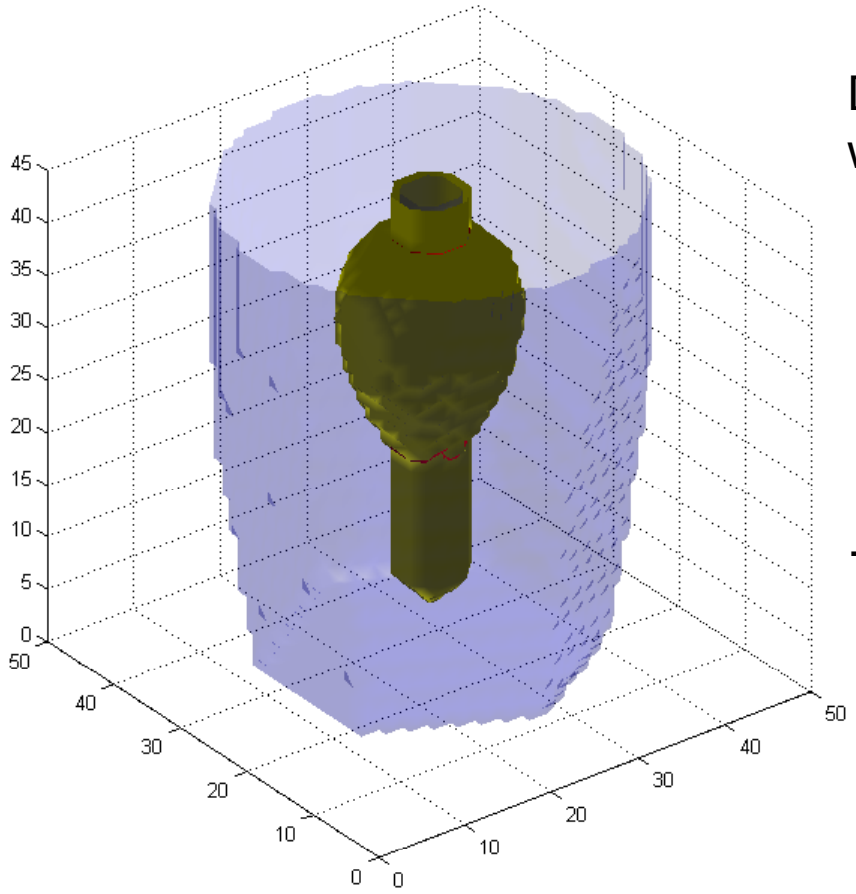
- MGS Simulations (cont.)



- MGS Simulations (cont.)



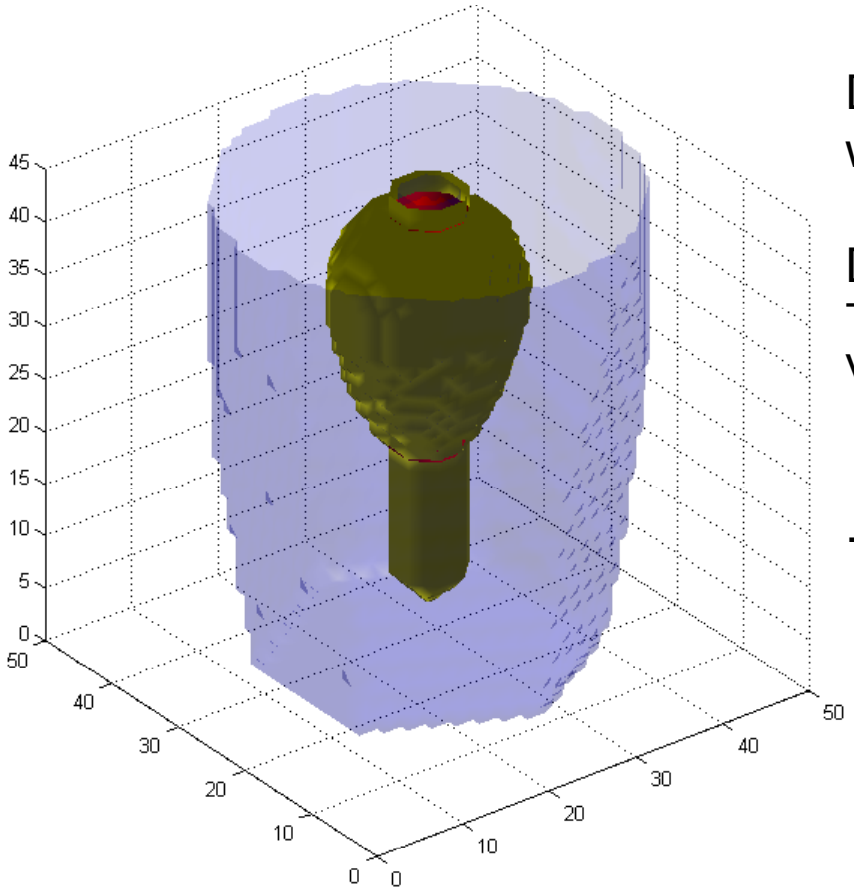
- MGS Simulations – Inclusion of ‘Isolant’



Detector at 3000V
with no ‘Isolant’

→ 94.8% depleted

• MGS Simulations – Inclusion of ‘Isolant’

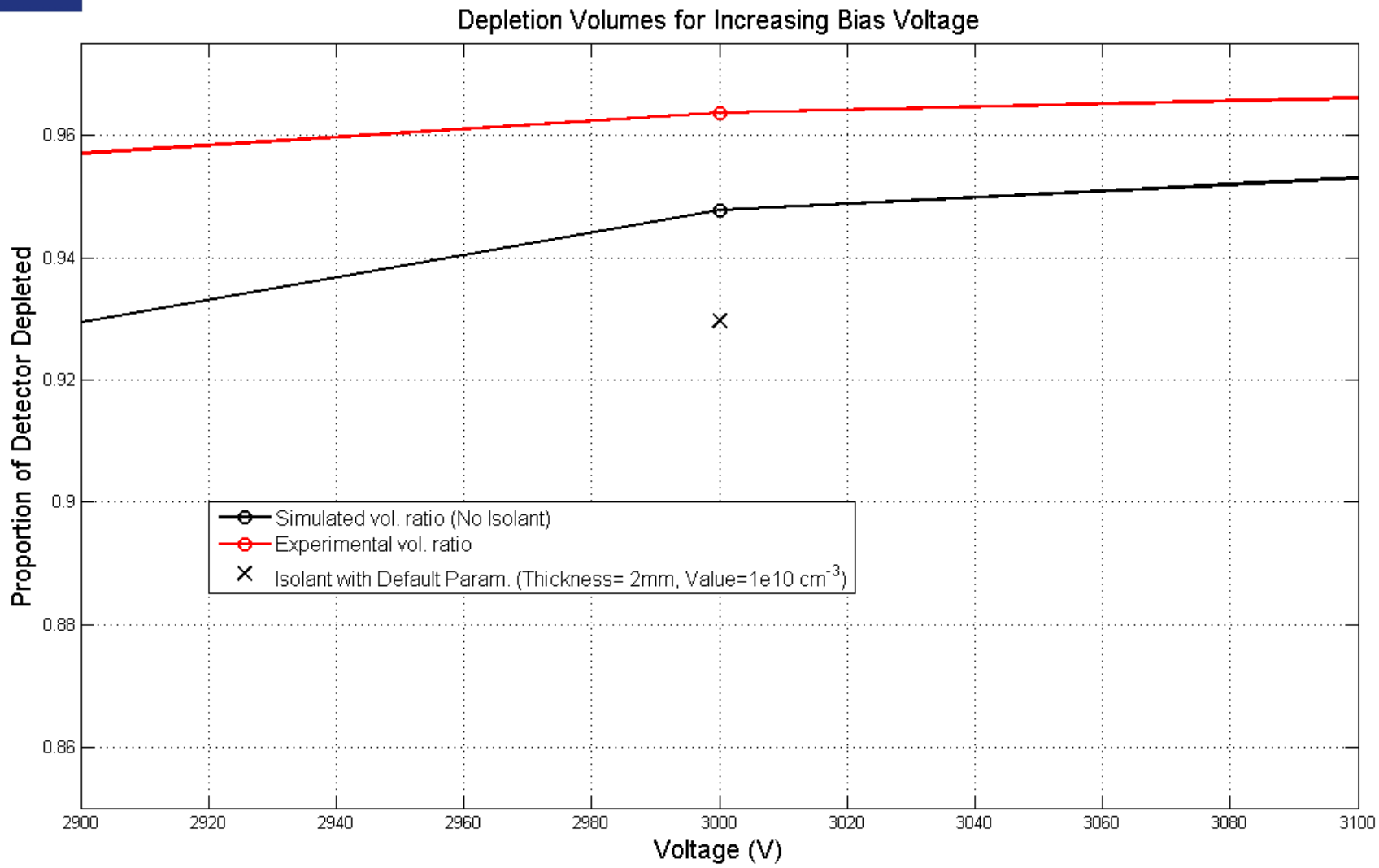


Detector at 3000V
with ‘Isolant’

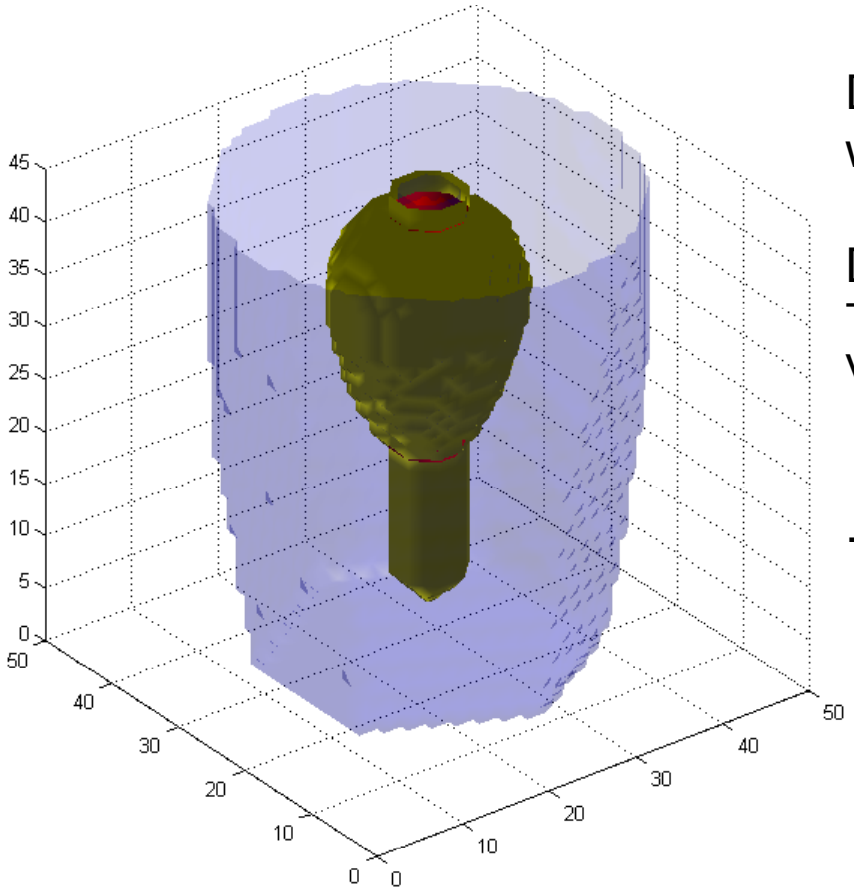
Default parameters:
Thickness = 2mm
Value = 1e10cm^{-3}

→ 93.0% depleted

- MGS Simulations – Inclusion of ‘Isolant’



• MGS Simulations – Inclusion of ‘Isolant’

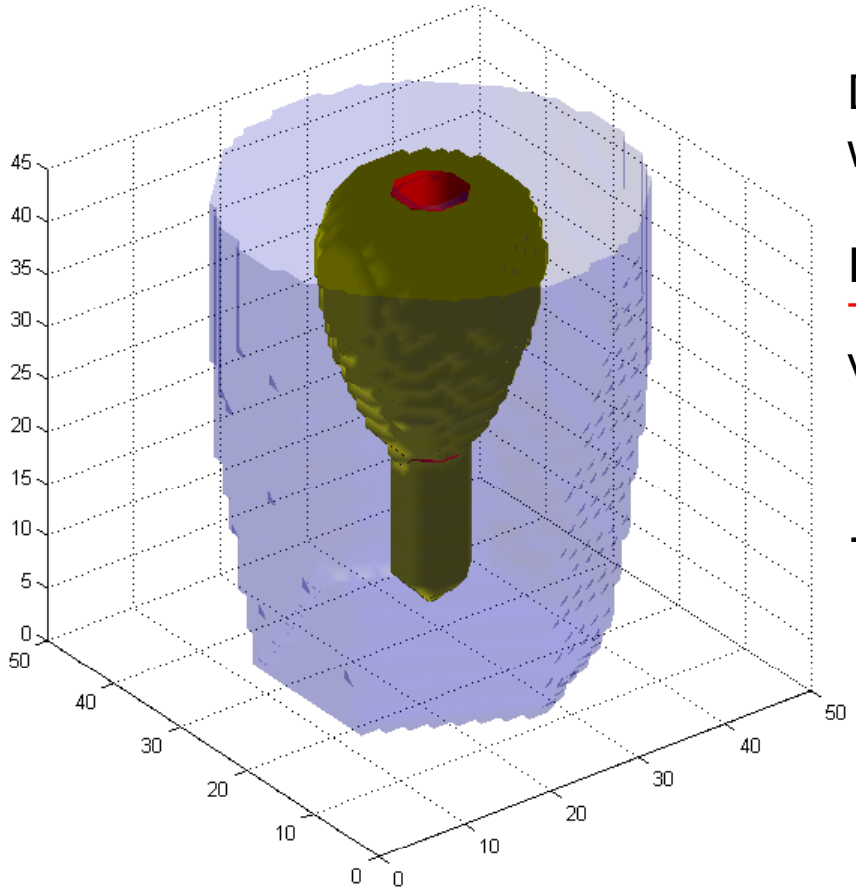


Detector at 3000V
with ‘Isolant’

Default parameters:
Thickness = 2mm
Value = 1e10cm^{-3}

→ 93.0% depleted

• MGS Simulations – Inclusion of ‘Isolant’

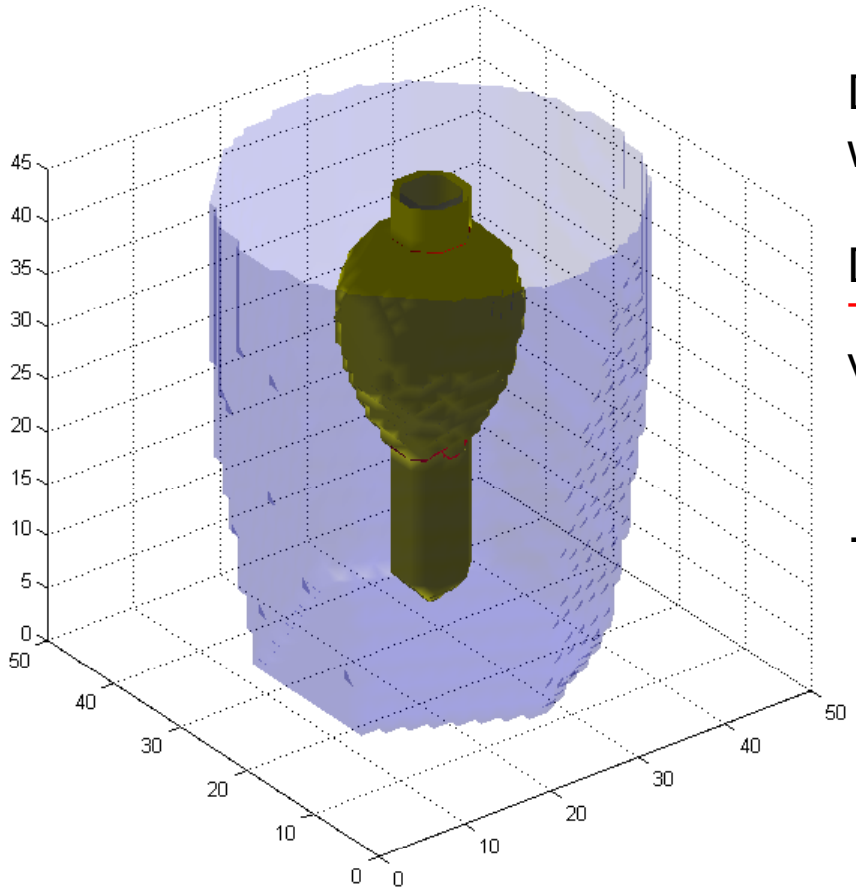


Detector at 3000V
with ‘Isolant’

Increase ‘Thickness’:
Thickness = 4mm
Value = 1e10cm^{-3}

→ 89.6% depleted

• MGS Simulations – Inclusion of ‘Isolant’

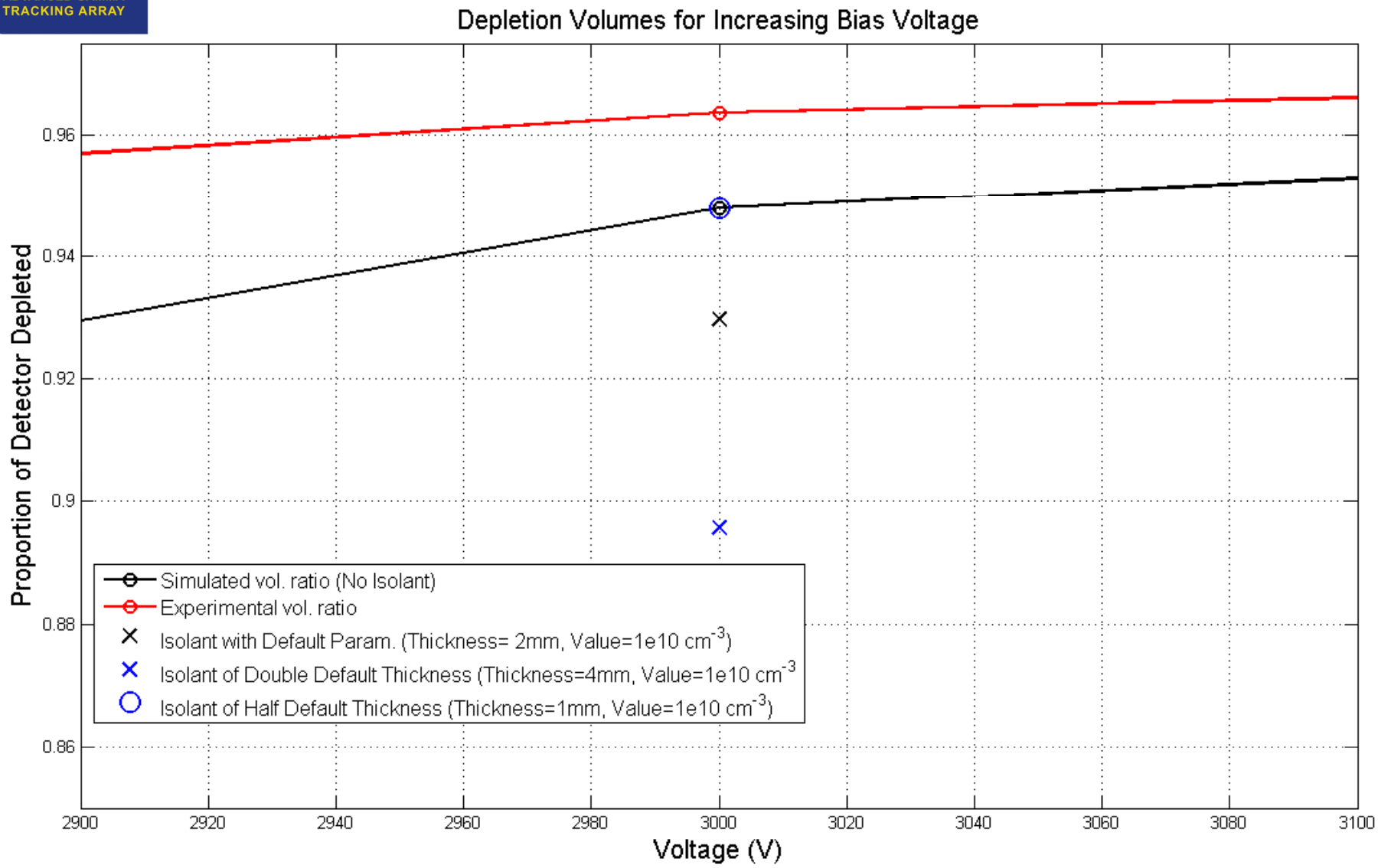


Detector at 3000V
with ‘Isolant’

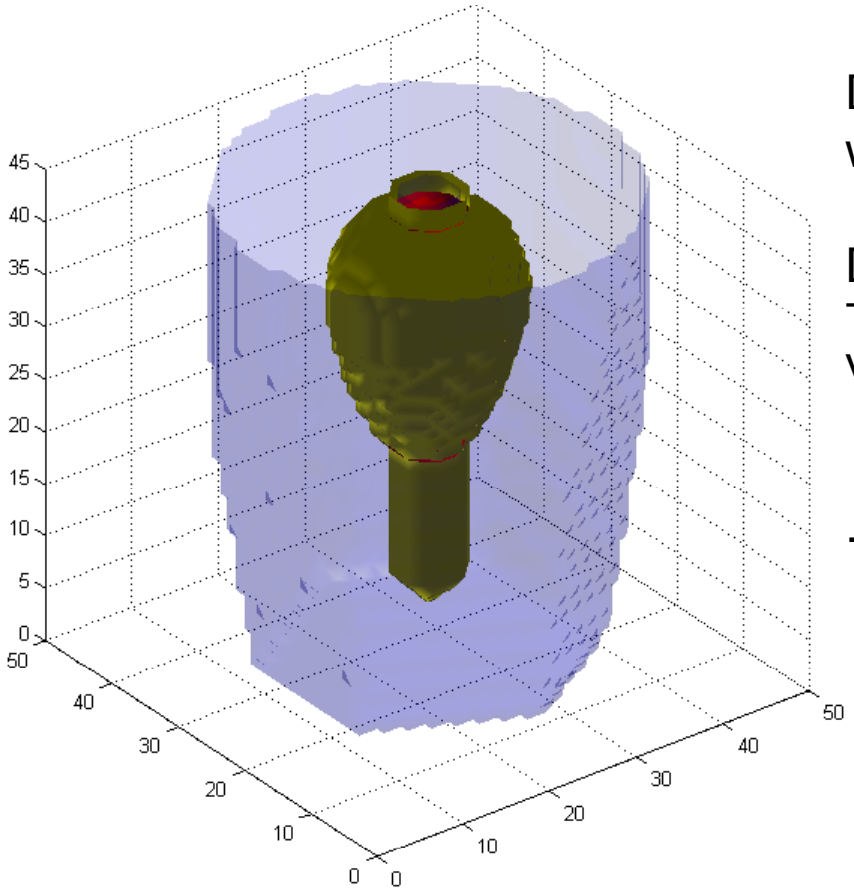
Decrease ‘Thickness’:
Thickness = 1mm
Value = 1e10cm^{-3}

→ 94.8% depleted

- MGS Simulations – Inclusion of ‘Isolant’



• MGS Simulations – Inclusion of ‘Isolant’

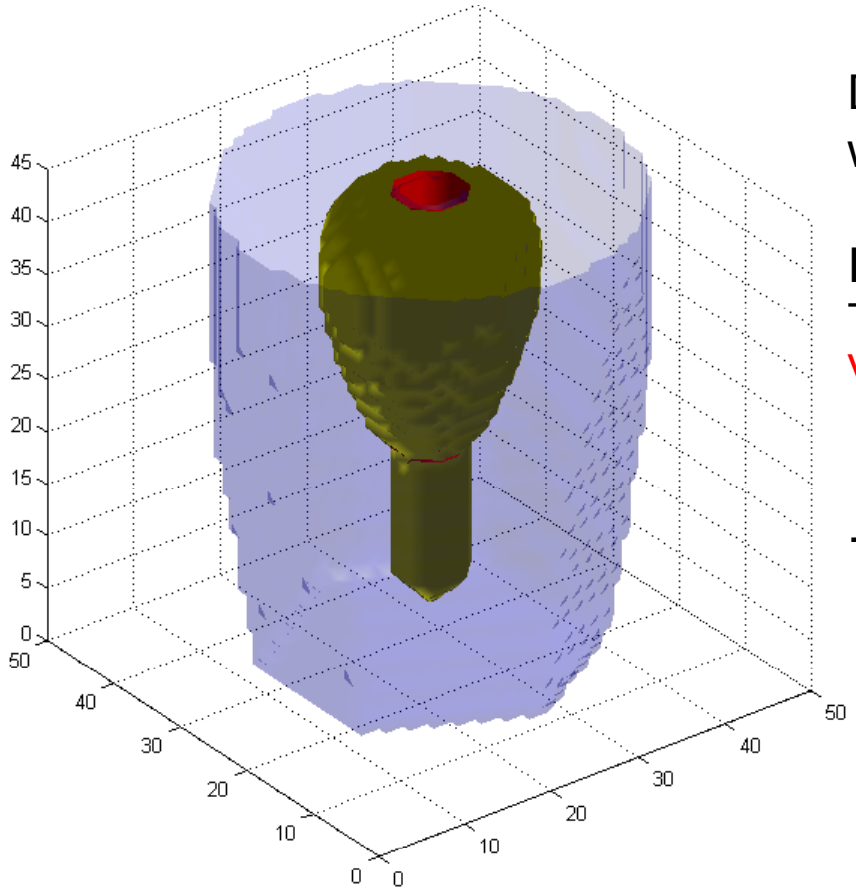


Detector at 3000V
with ‘Isolant’

Default parameters:
Thickness = 2mm
Value = 1e10cm^{-3}

→ 93.0% depleted

• MGS Simulations – Inclusion of ‘Isolant’

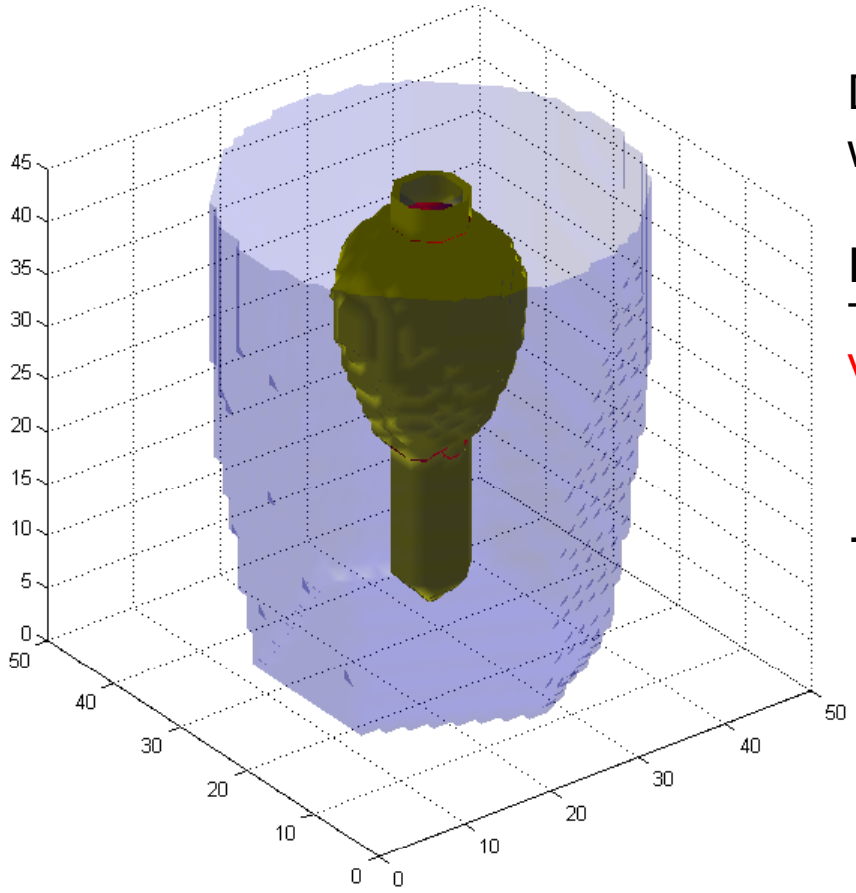


Detector at 3000V
with ‘Isolant’

Increase ‘Value’:
Thickness = 2mm
Value = 2e10cm^{-3}

→ 90.4% depleted

• MGS Simulations – Inclusion of ‘Isolant’

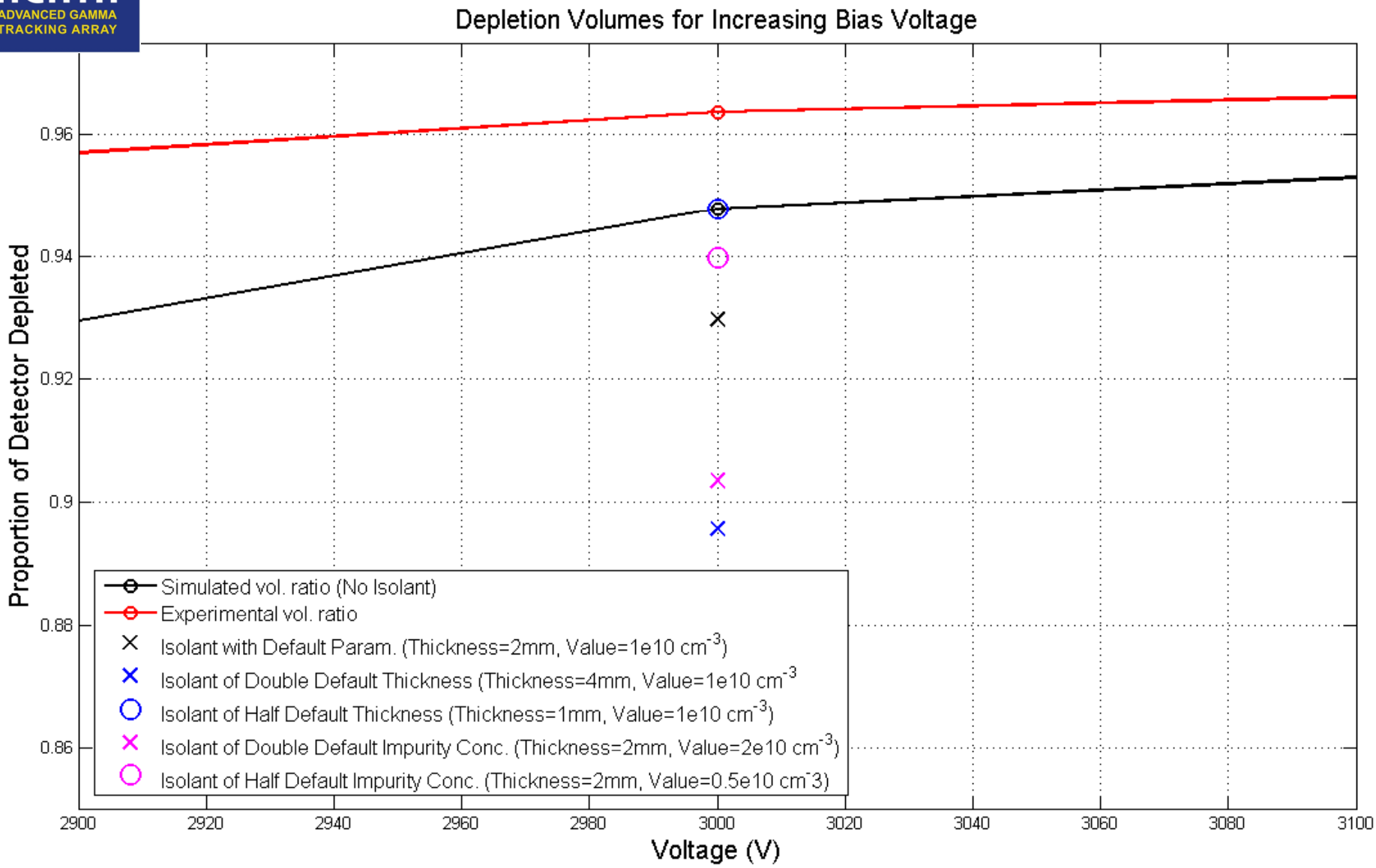


Detector at 3000V
with ‘Isolant’

Increase ‘Value’:
Thickness = 2mm
Value = 0.5e10cm^{-3}

→ 94.0% depleted

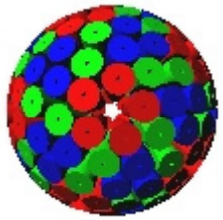
- MGS Simulations – Inclusion of ‘Isolant’



• Next Steps

- Continue comparison of experimentally derived depletion volumes and MGS simulation
- Further investigate MGS ‘Isolant’
- Refine MGS impurity concentration input values and consider non-linear impurity gradients
- Compare experimental & simulated pulse shapes
- Compare with other depletion simulations (e.g. using JASS)
- Compare with C-V measurements conducted in Cologne (*B. Birkenbach & B. Bruyneel, to be published*)

→ does this method of scanning allow a practicable derivation of the crystal impurity concentration??



Questions & Comments...

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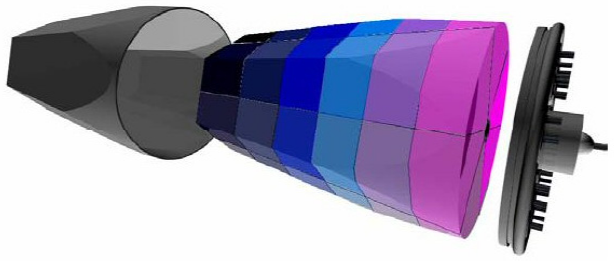
P.J. Nolan, C. Unsworth



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• Exp. Volumes at Low Bias