Fall 10-2015

Enhanced Electron Yield Measurements of Extremely Low-Conductivity High Yield Dielectrics

Justin Christensen
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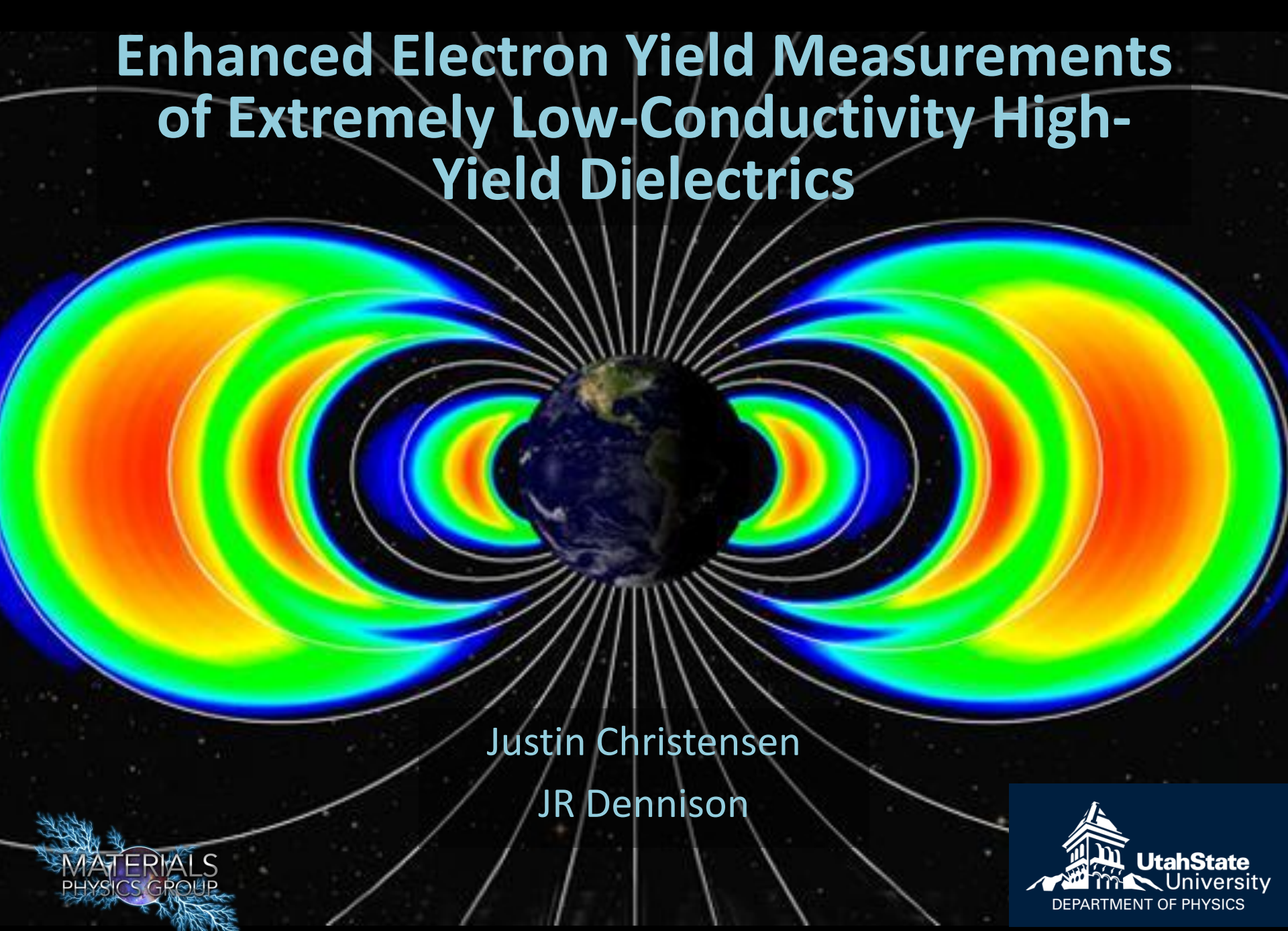

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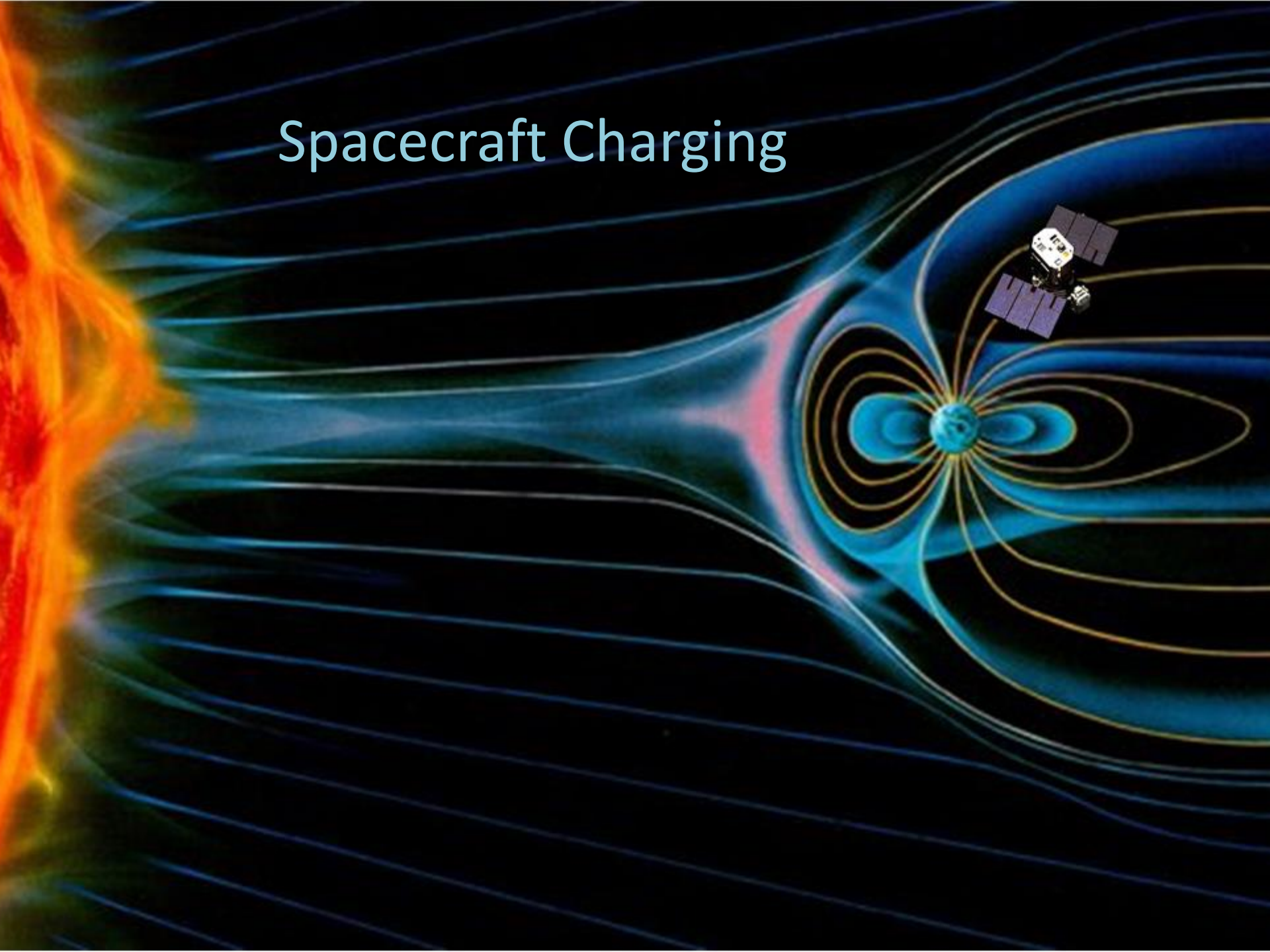
MATERIALS PHYSICS GROUP

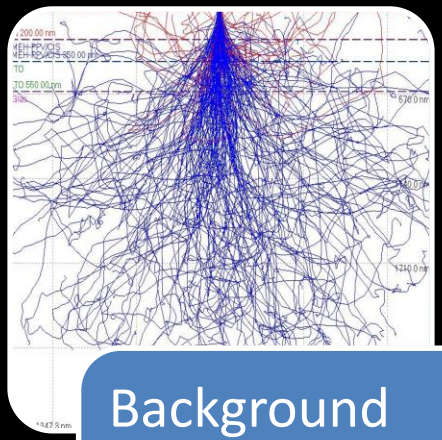
Utah State University
DEPARTMENT OF PHYSICS

Spacecraft Charging



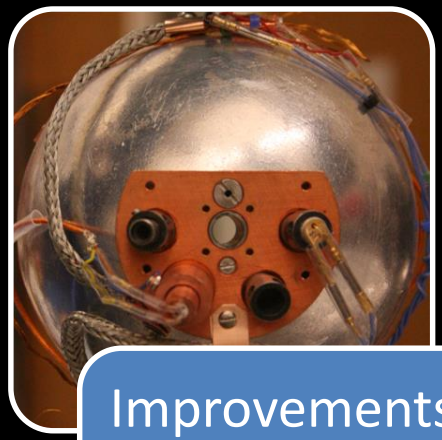
Electron Microscopy

Outline



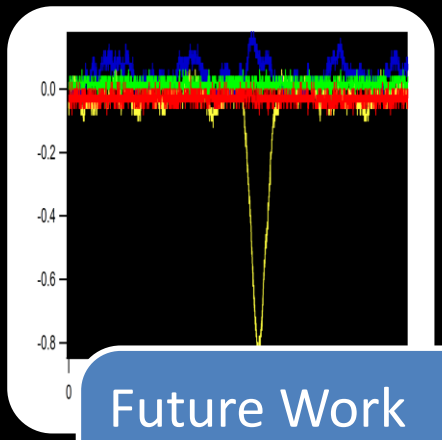
Background

- What is Yield
- Measuring Yield
  - Conductors
  - Insulators



Improvements

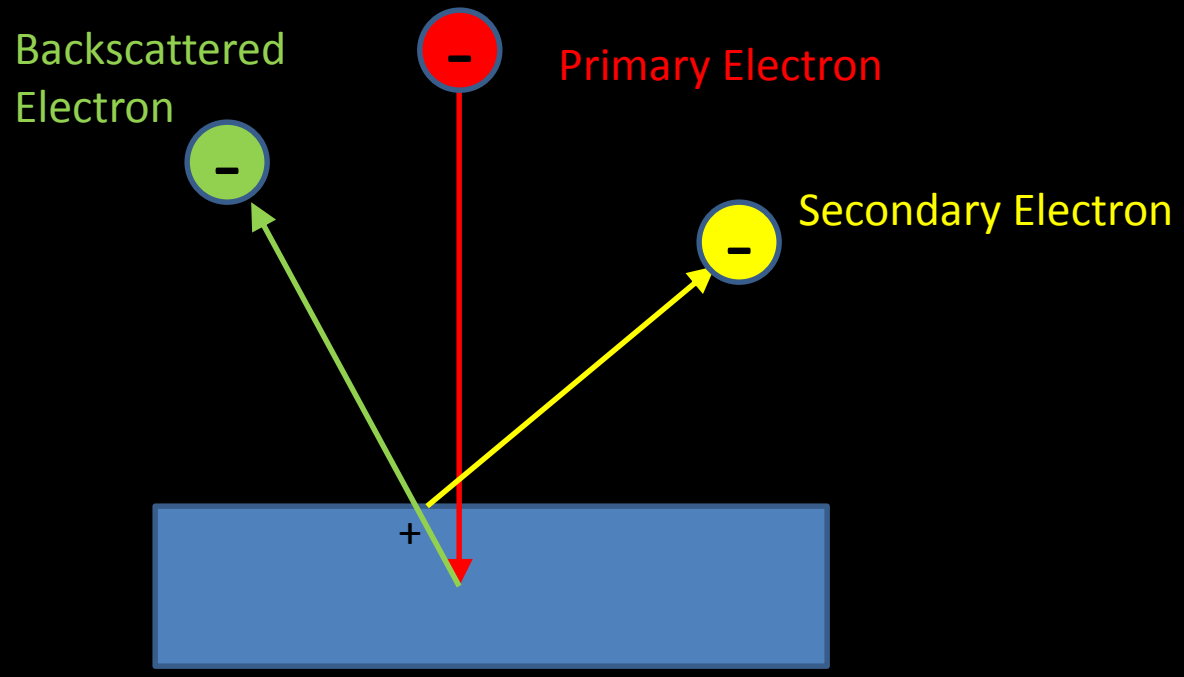
- Measurement
- Neutralization
- Analysis

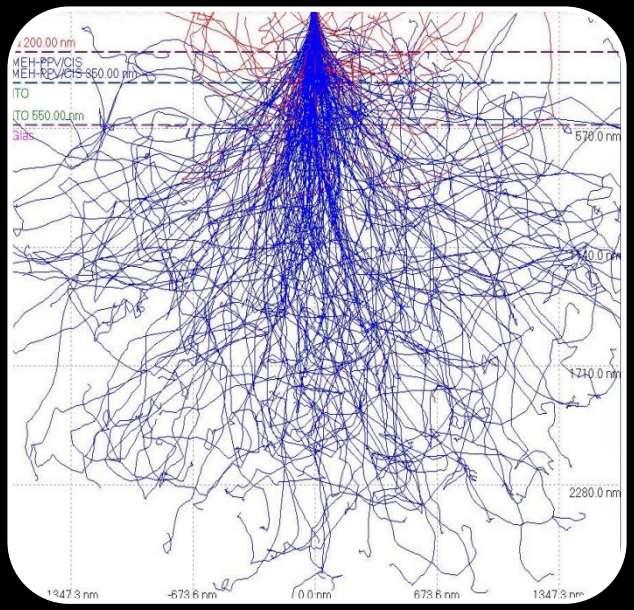


Future Work

- Verify Model
- Various Insulators

What is Yield?

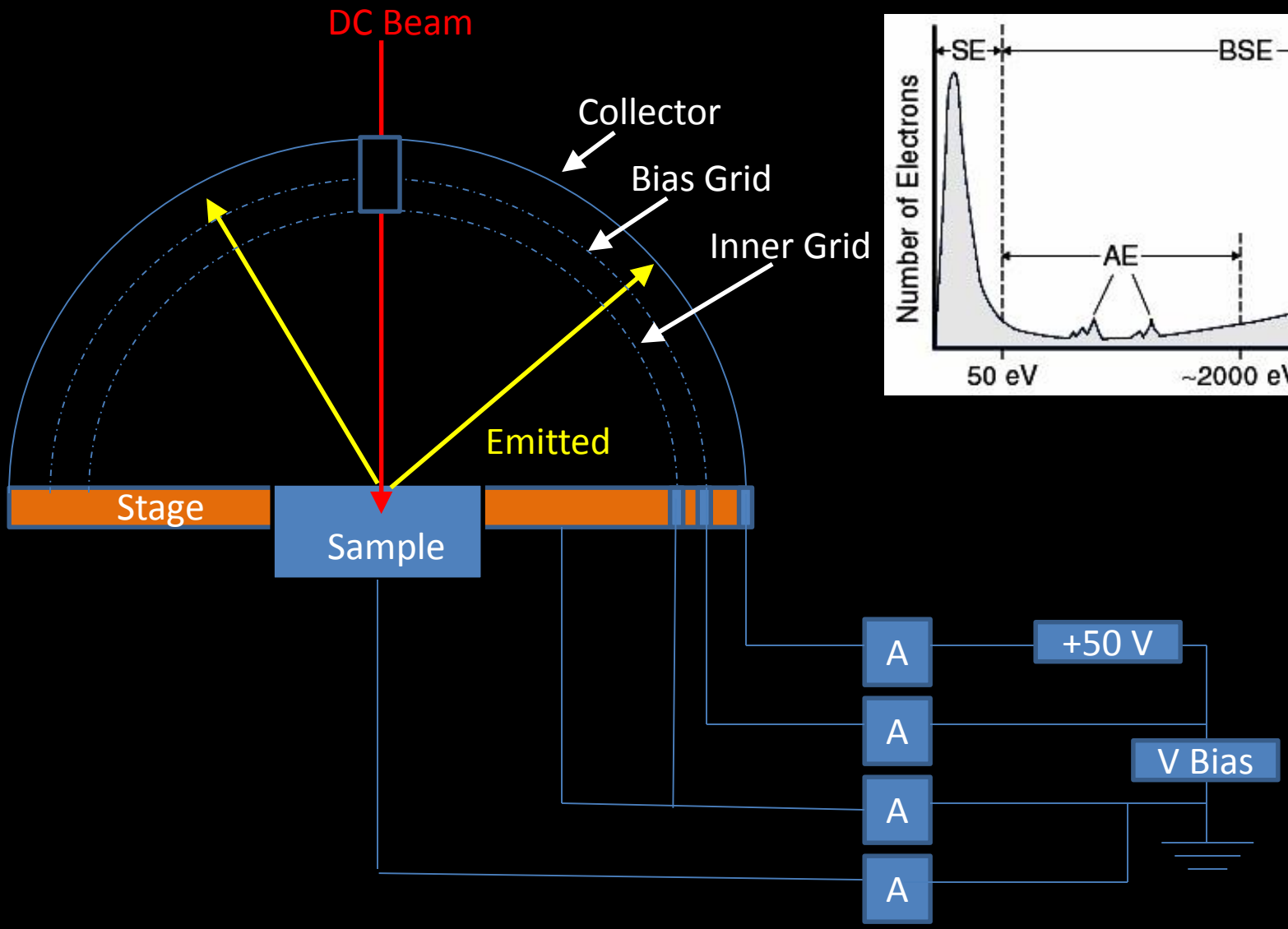




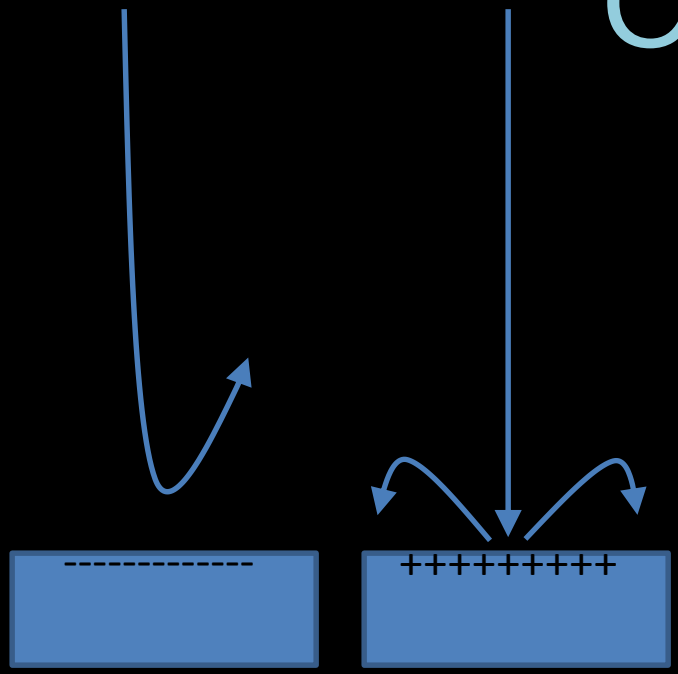
$$\sigma = \frac{charge_{emit}}{charge_{inc}}$$

Charge determined by “Yield” (σ)

Yield of conductors



Charging



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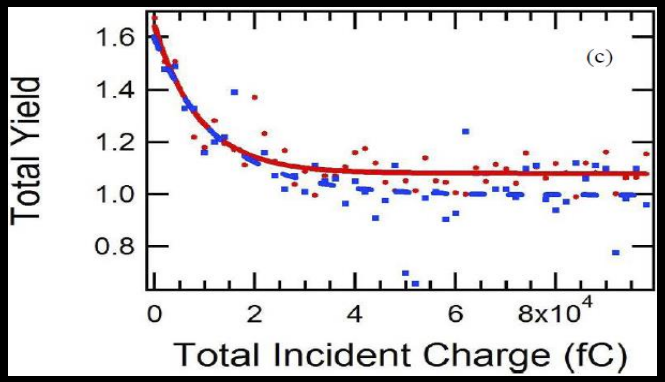
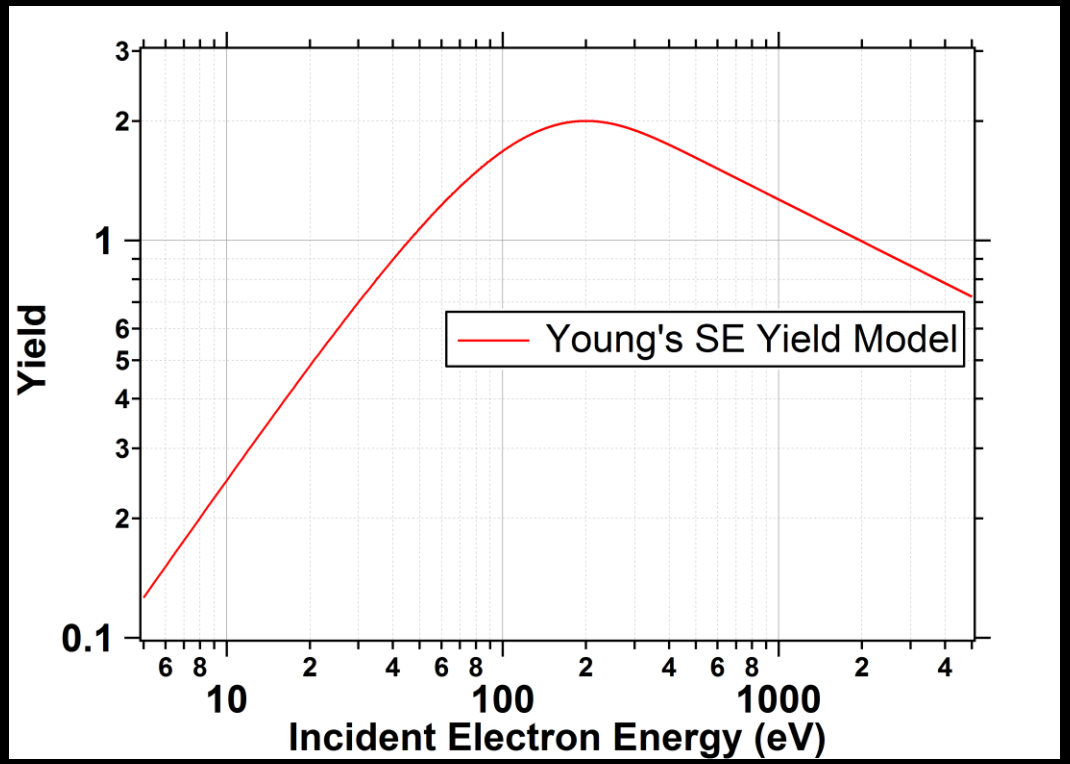
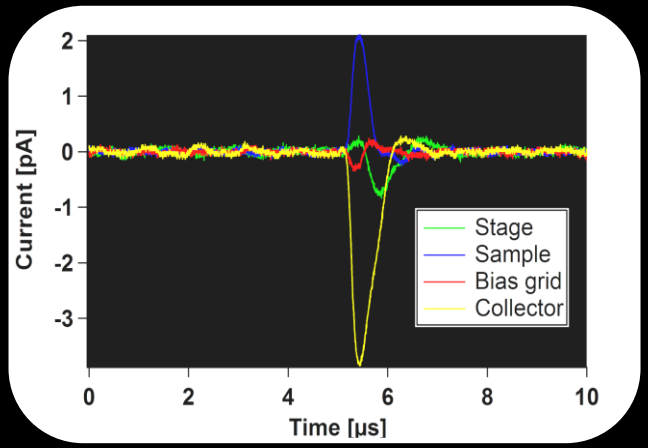

Total Yield
1.6
1.4
1.2
1.0
0.8
(c)
0
2
4
6
8x10^4
Total Incident Charge (fC)

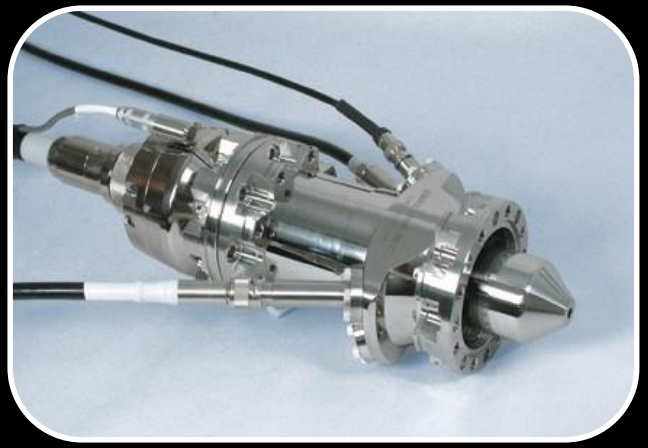

Yield
3
2
1
6
5
4
3
2
0.1
Young's SE Yield Model
6 8
2
4
6 8
2
4
6 8
2
4
10
100
1000
Incident Electron Energy (eV)

How do we fix it?

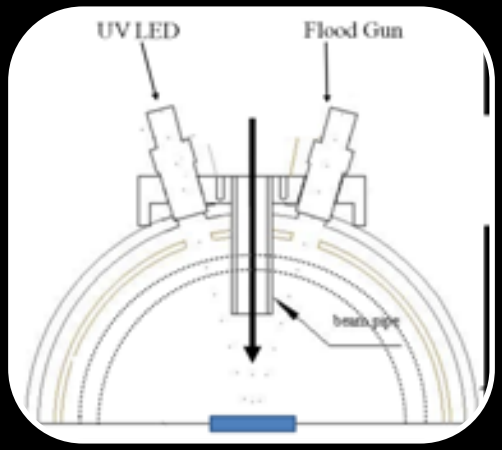
Fast Low-Current Measurement



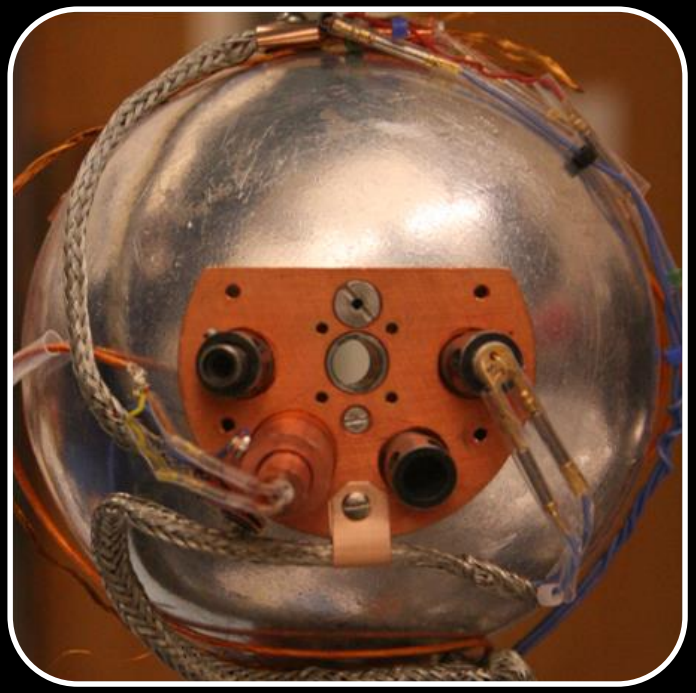
Pulsed Electron Beam

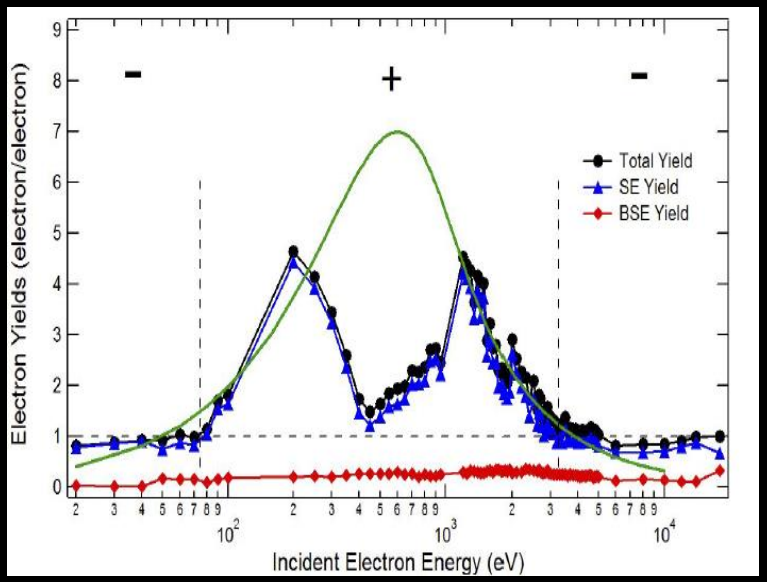


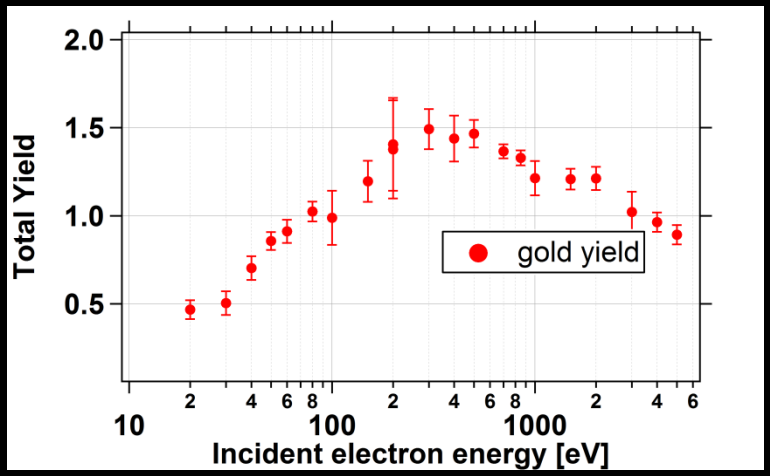
Charge Neutralization



It worked, kind of



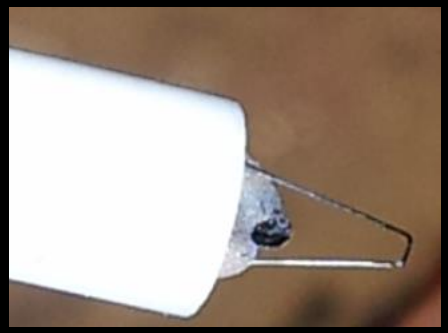


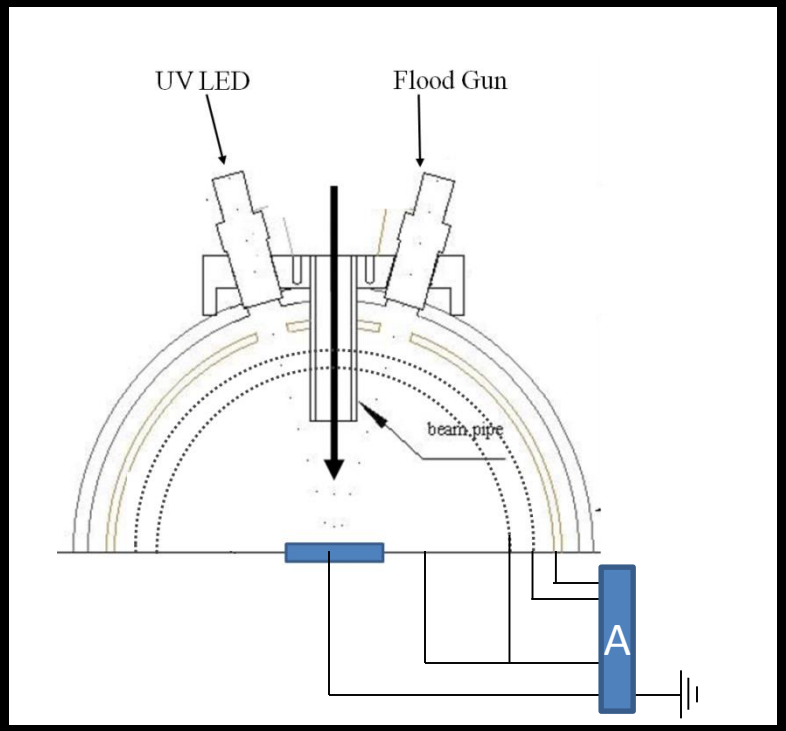


Improvements

Problems

- Tungsten filament
- Grounded inner grid
- Flood gun, UVLED ground loops
- UVLED ~290 nm, low intensity
- Emitted charge calculation





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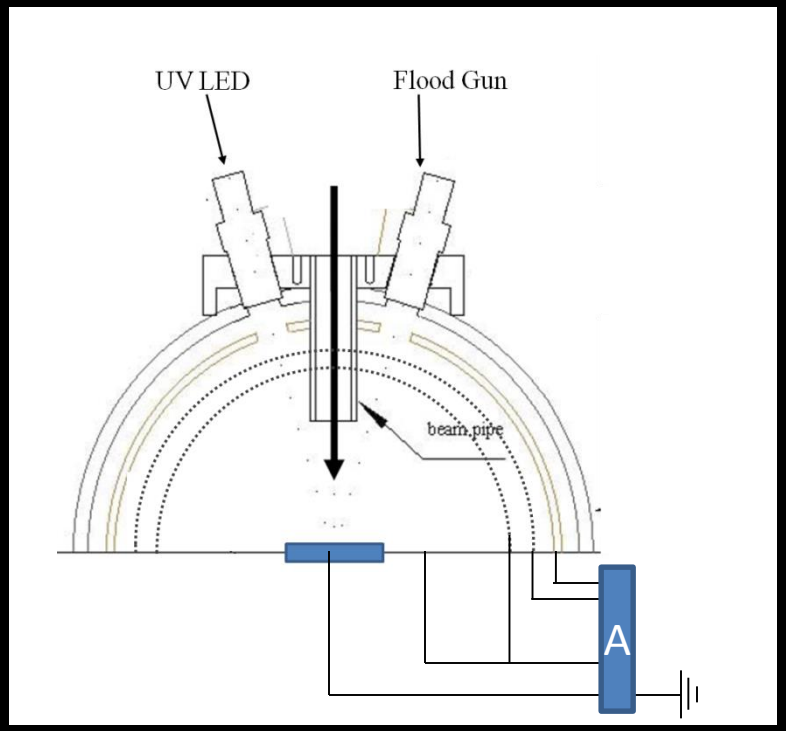

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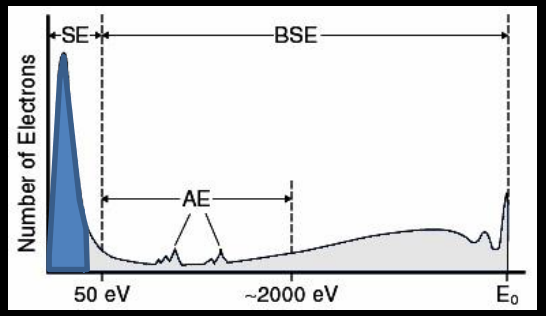

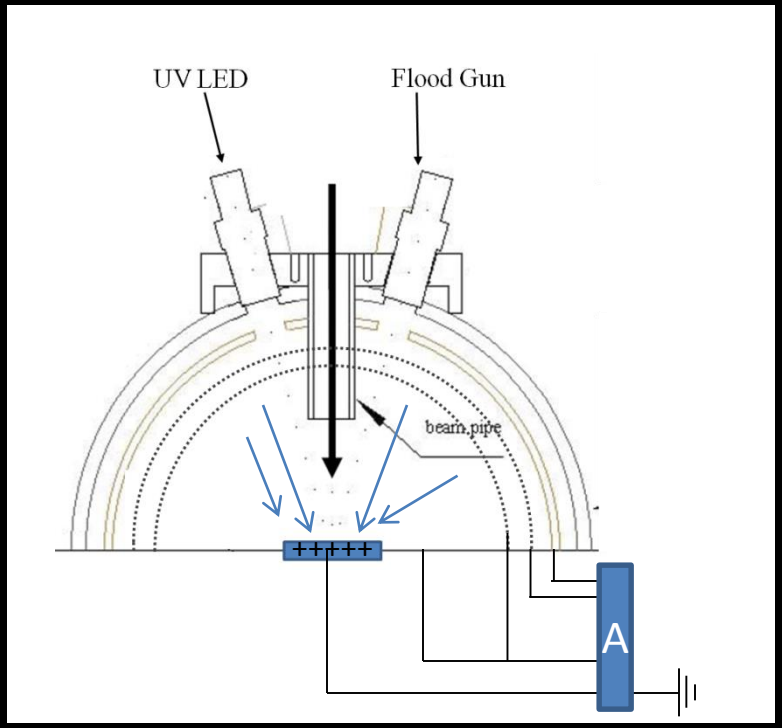

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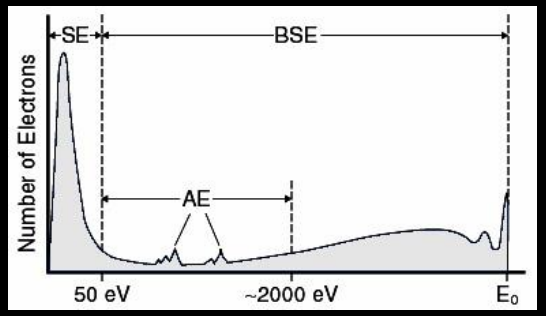
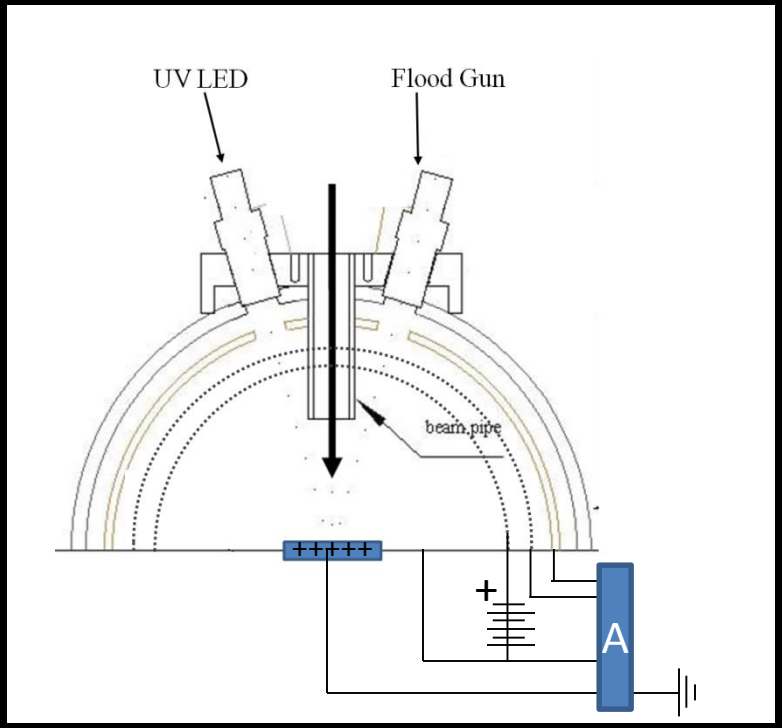
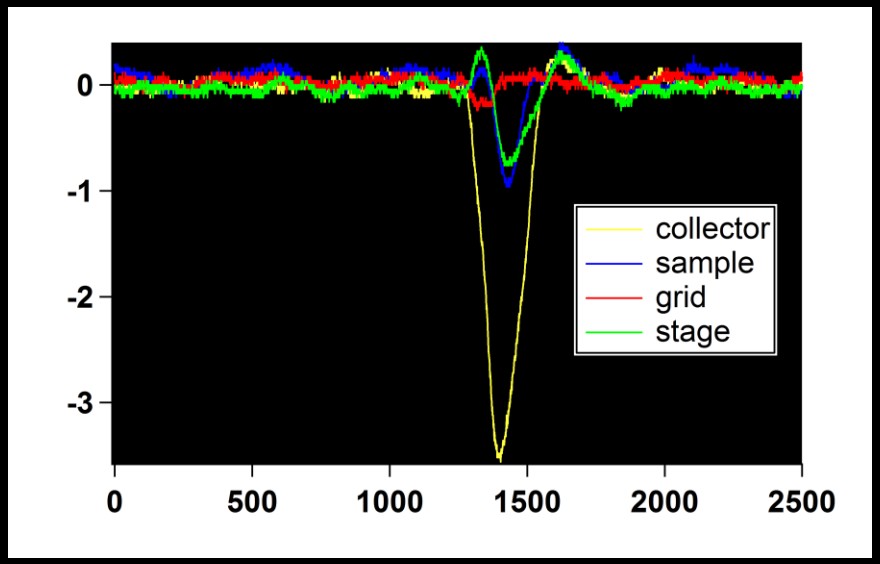


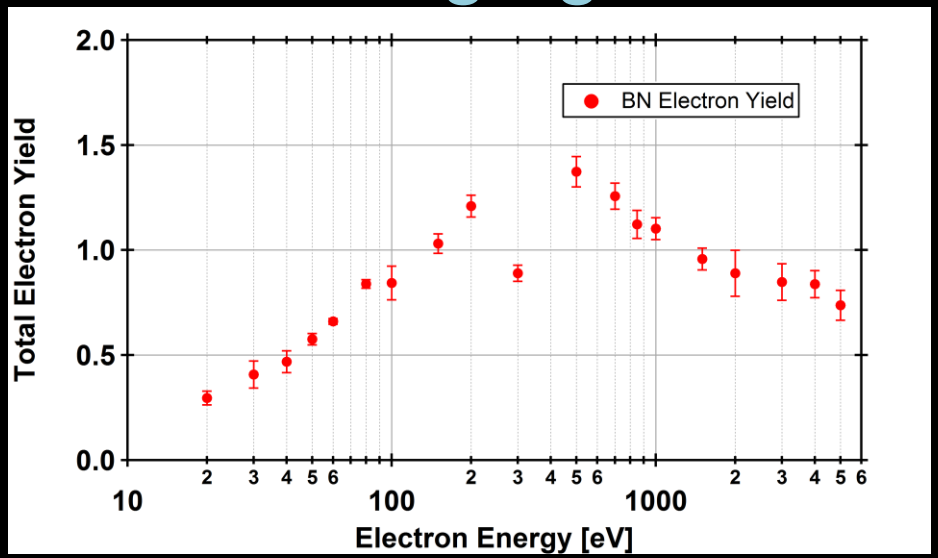


Improvements

Noise reduce

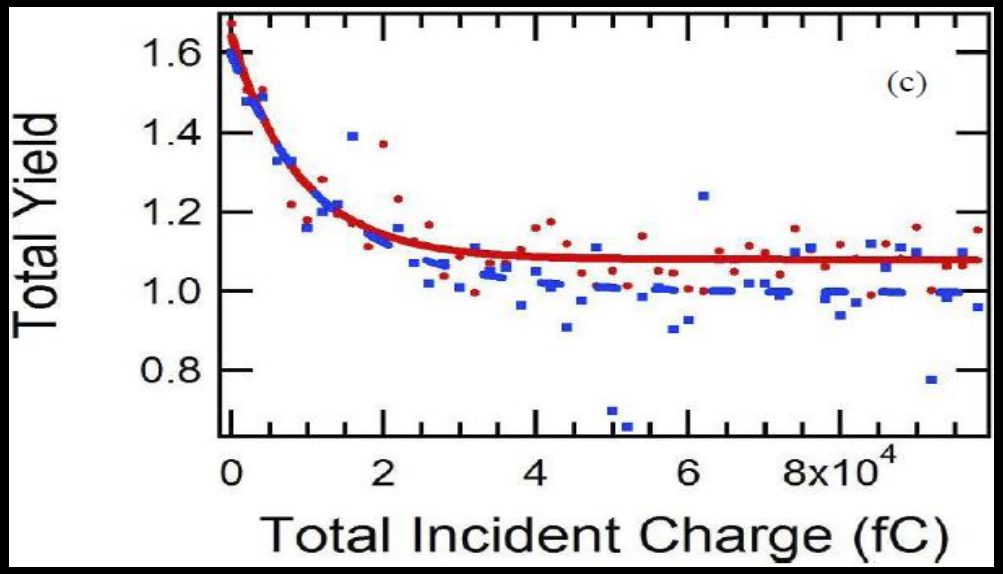


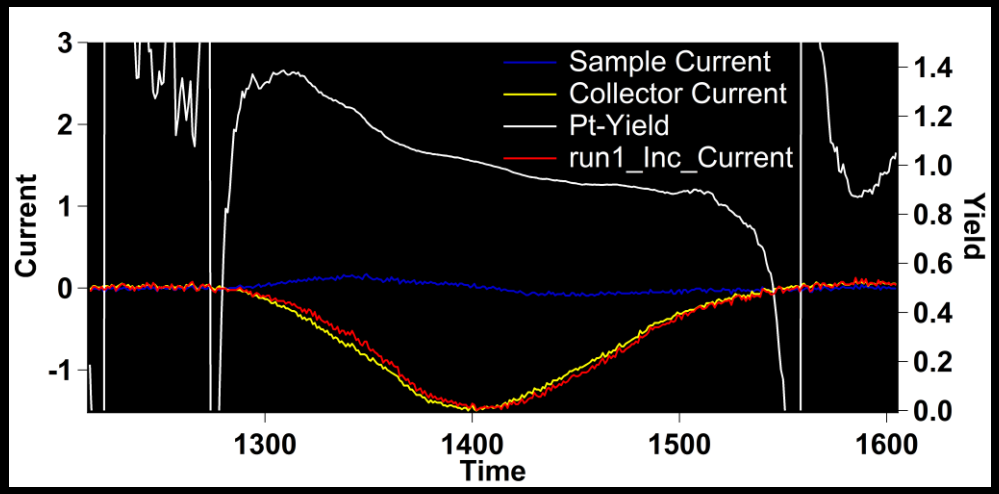
Less charging



Future Work

- Current analysis could show Yield changes in one pulse. (~1% of total pulse charge)
- Gold data should show no charging effects.
- Zero charge plateau.





Conclusion

- Charge Neutralization
- Repeatable measurements
- Better analysis methods
- Lower signal-to-noise ratio

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