Experimentally Estimating Total Electron Yield

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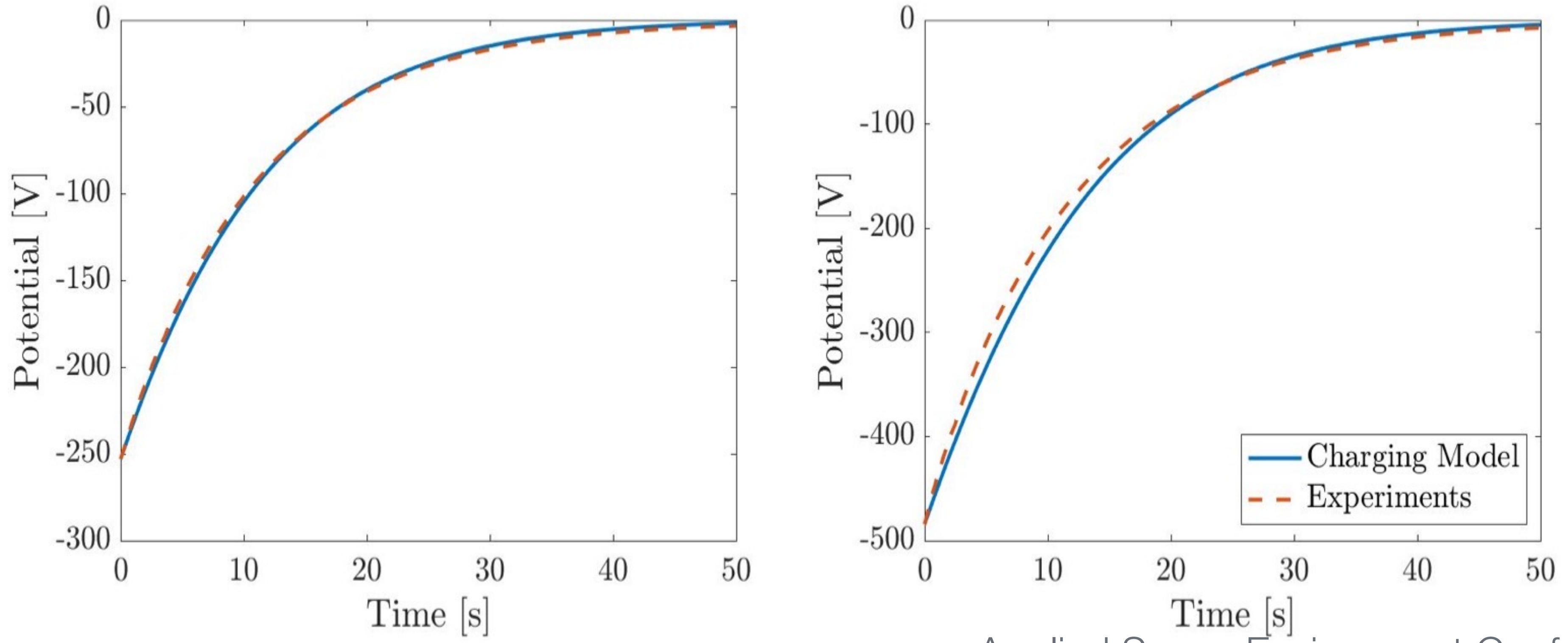
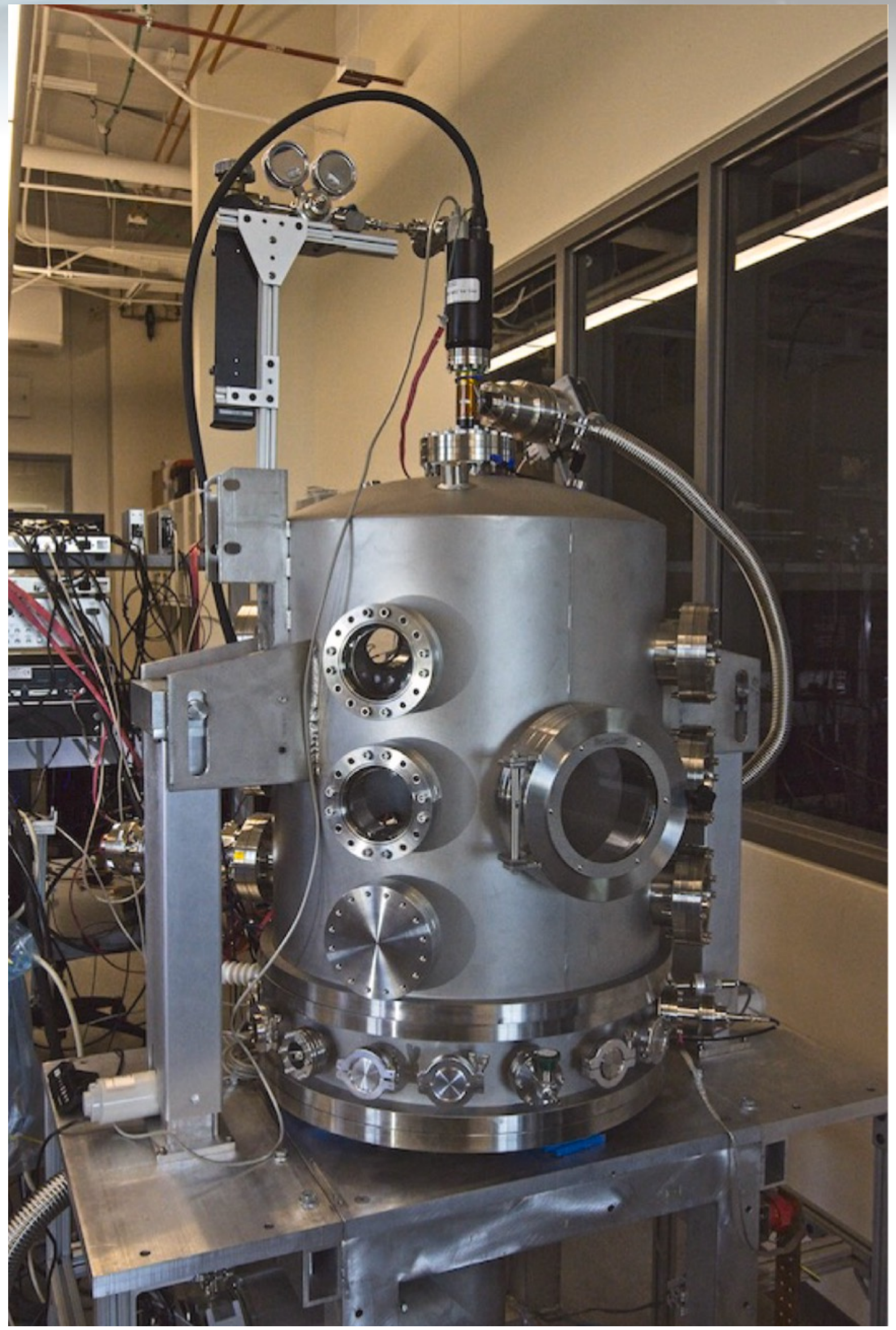
Motivation

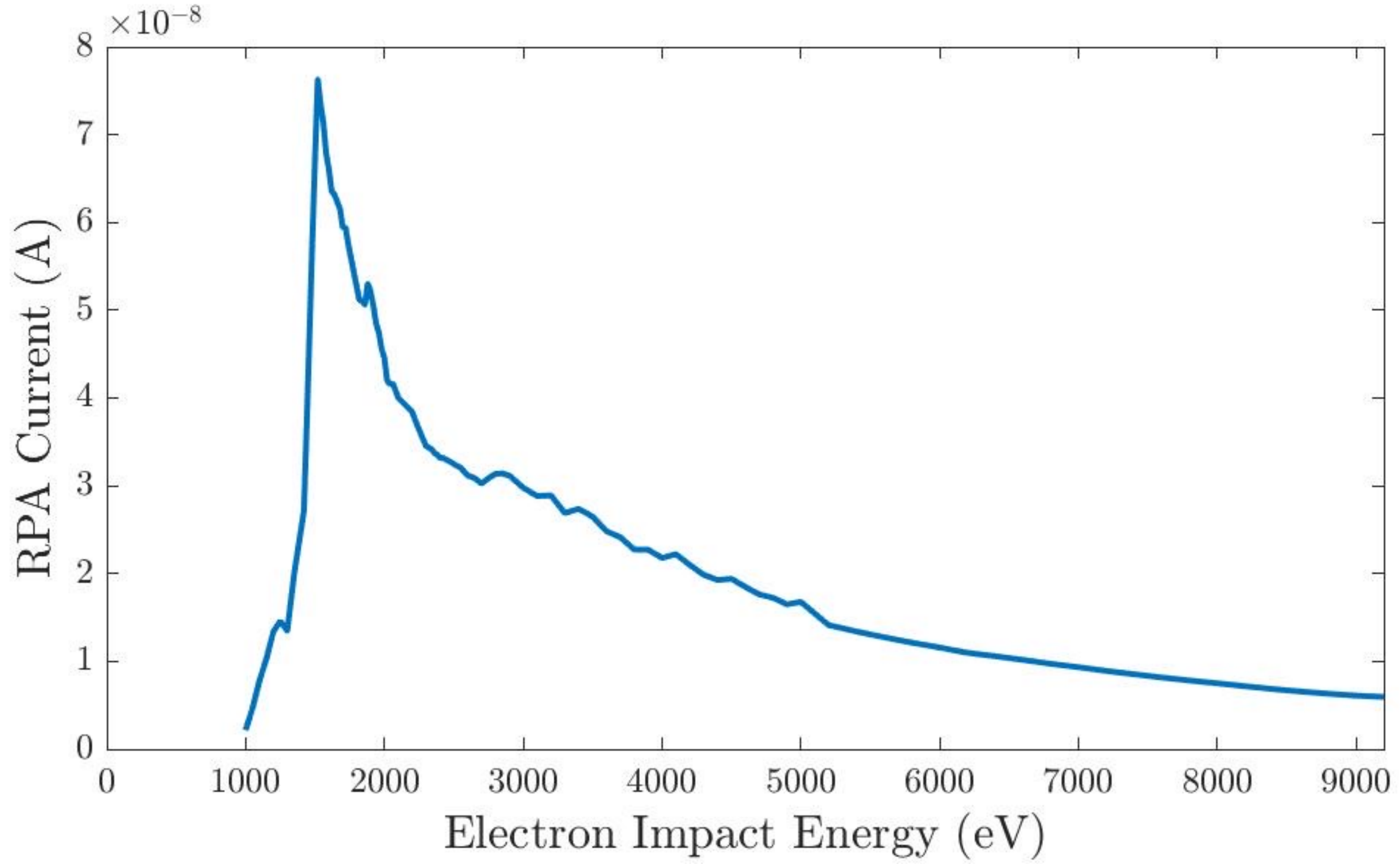
- Simulating realistic spacecraft in ECLIPS vacuum chamber
  - Charge control experiments
  - Previously replicated discharging behavior of large spacecraft
    - Able to represent environmental currents using and RC circuit
  - Need to simulate charging behavior of spacecraft
- Characterize Total Electron Yield (TEY)
  - Use this in our spacecraft charging model
    - Meaningful comparison with vacuum chamber results
  - Secondary and Backscattered electrons are most significant

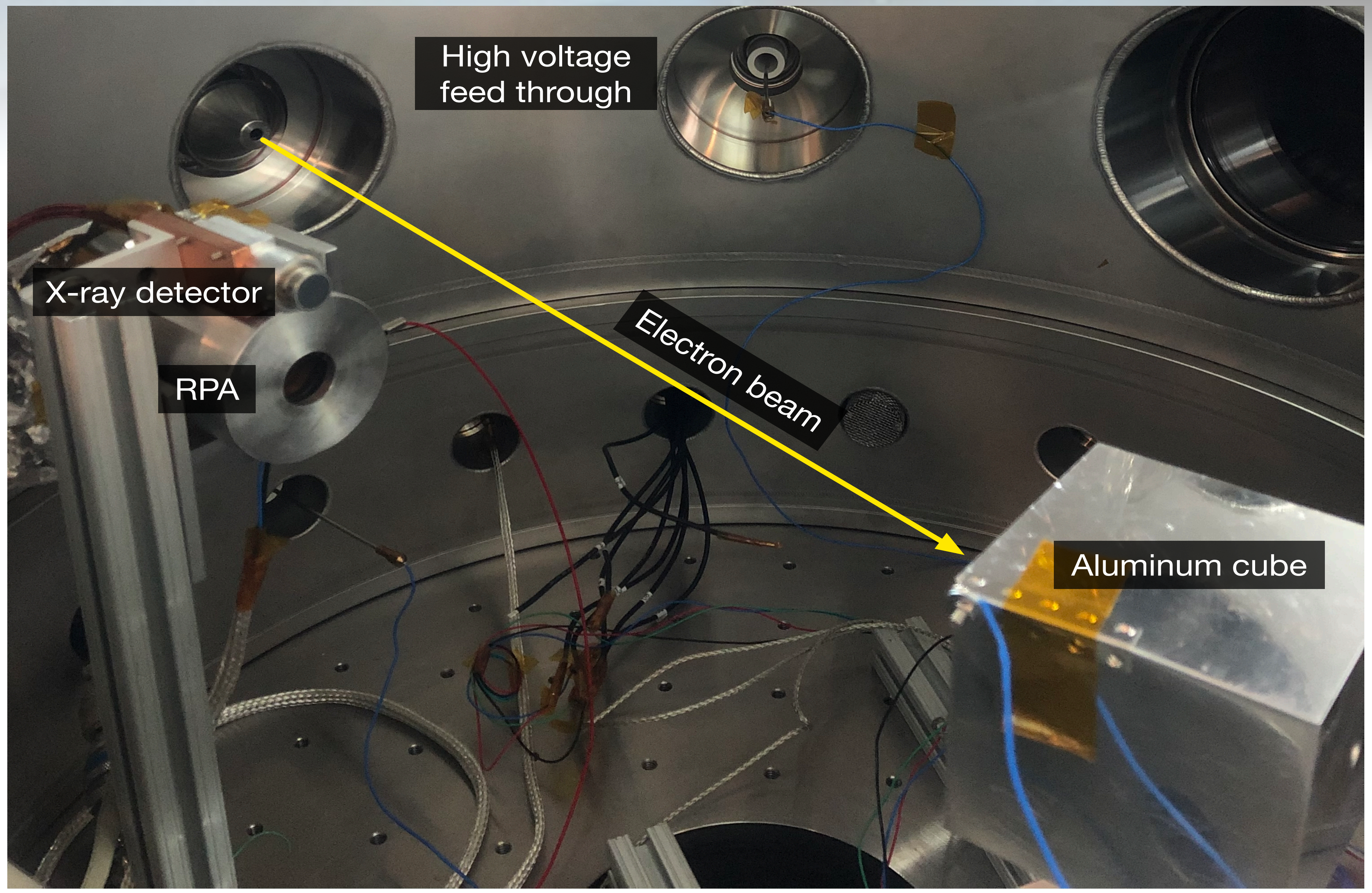




Estimating TEY with an RPA

- Procedure
  - Configure the desired setup
    - Target object at 37° angle to the electron gun
    - Normal to retarding potential analyzer (RPA)
  - Match impact location and area for beam energies
  - Sweep beam energies and measure the resulting current from the RPA.

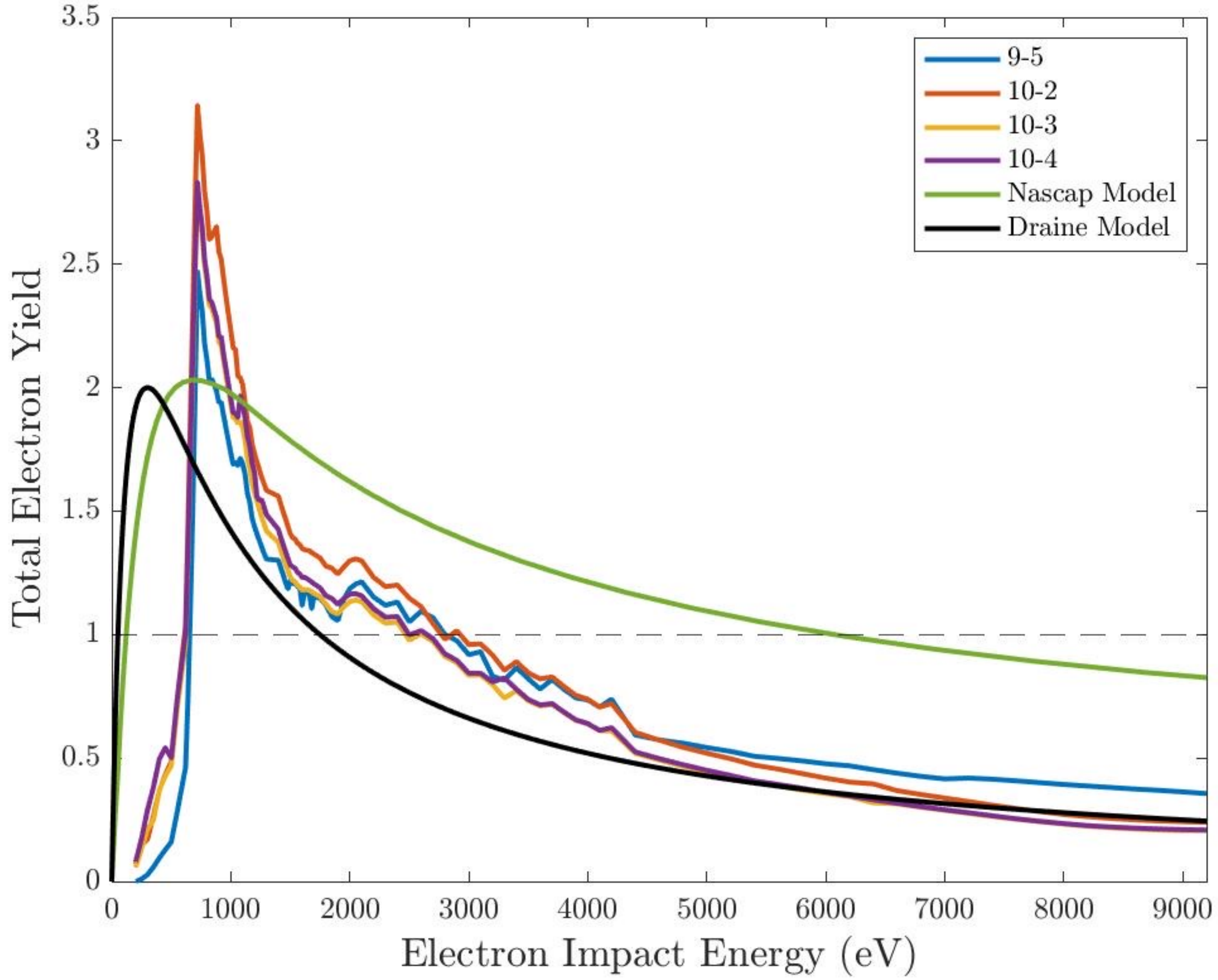




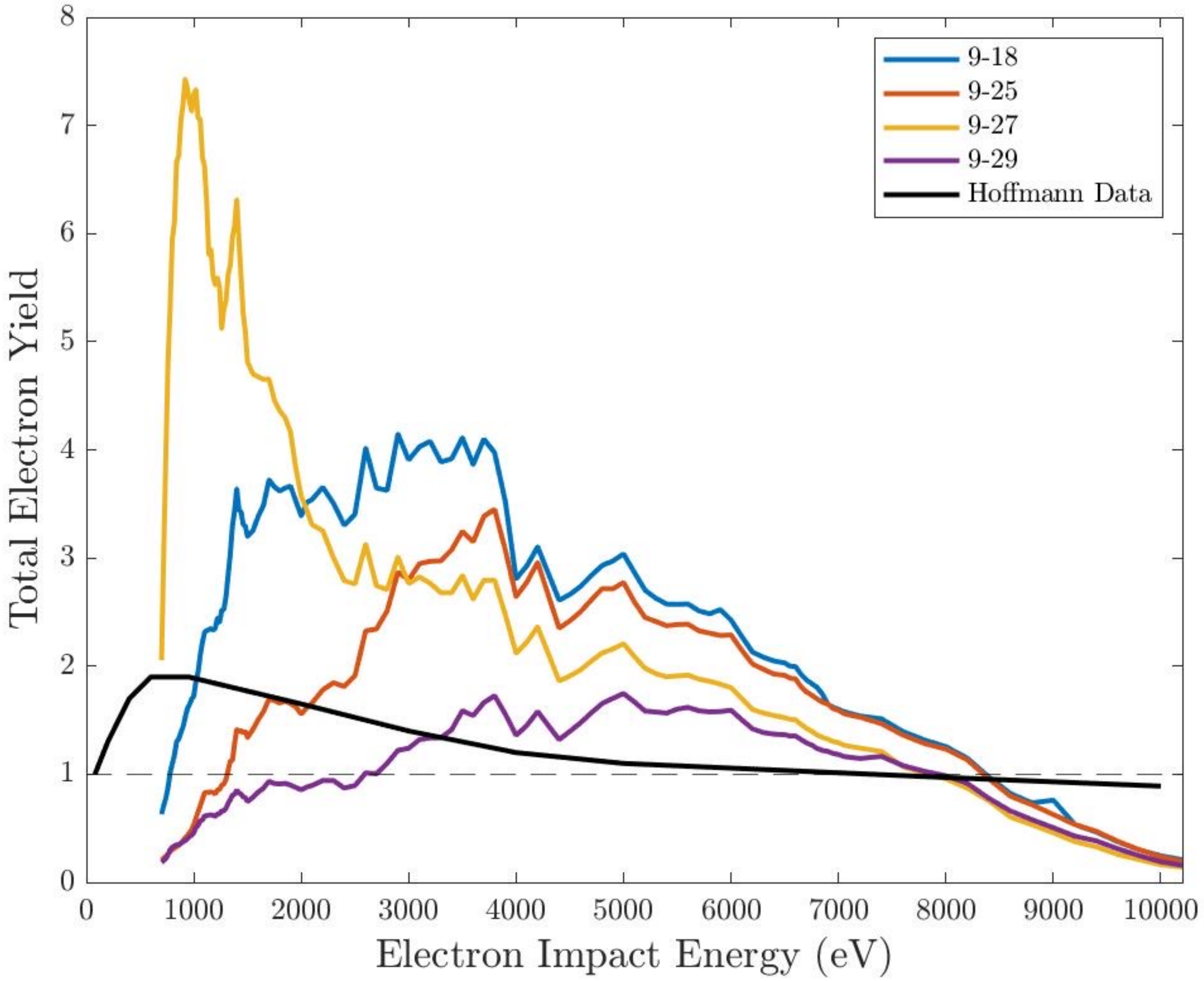
- Scale the relative curve
  - E_2 value is a stable equilibrium where TEY = 1
  - E_2 can be found by conducting floating potential experiments
  - Scale TEY such that the yield is 1 at E_2

Experimental Curves for Al and Au

- Aluminum Oxide
  - Peak occurs at 720 eV
  - E_2 occurs at ~2500 eV

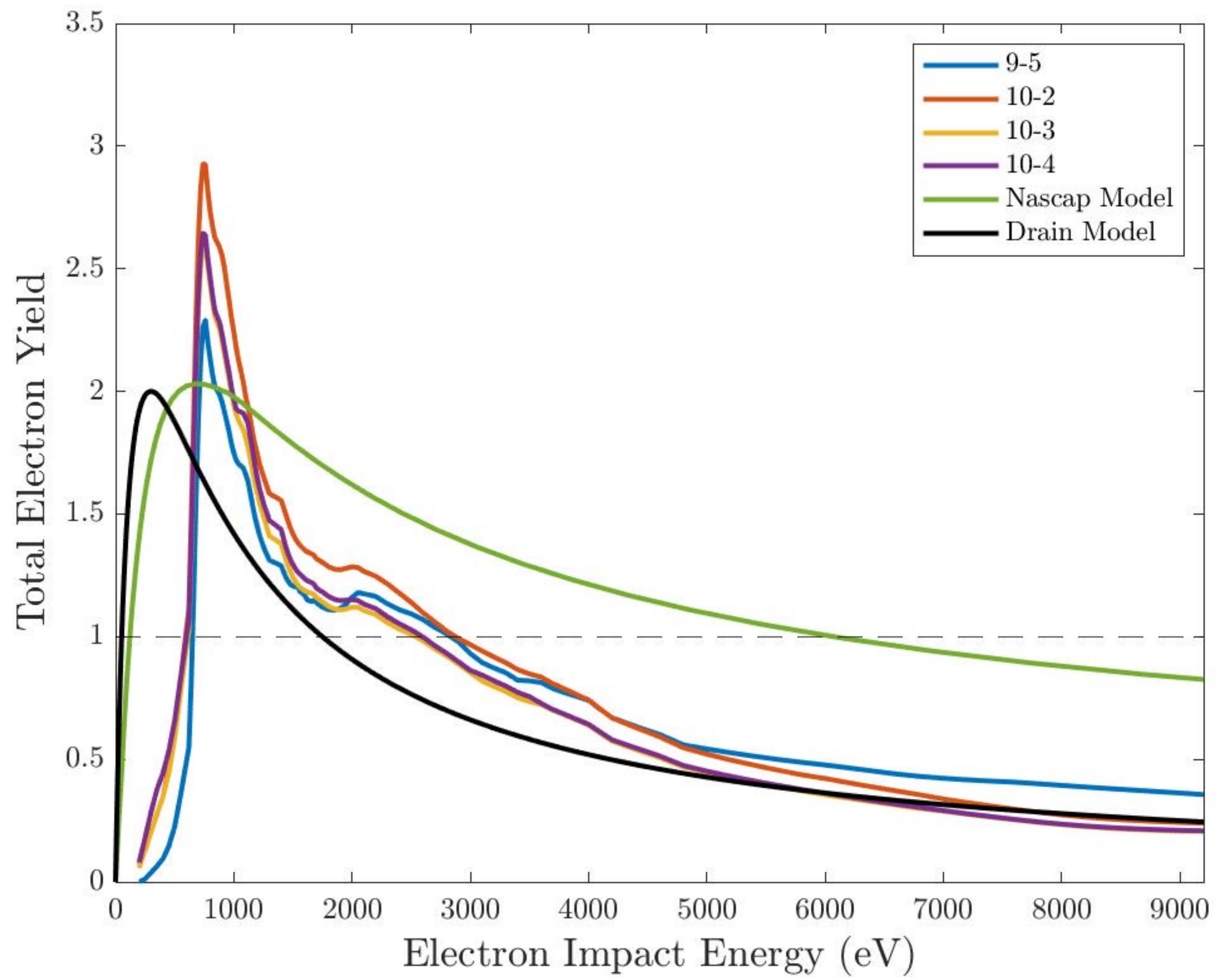


- Gold
  - Significantly different from previous results
  - E_2 occurs at ~8200 eV

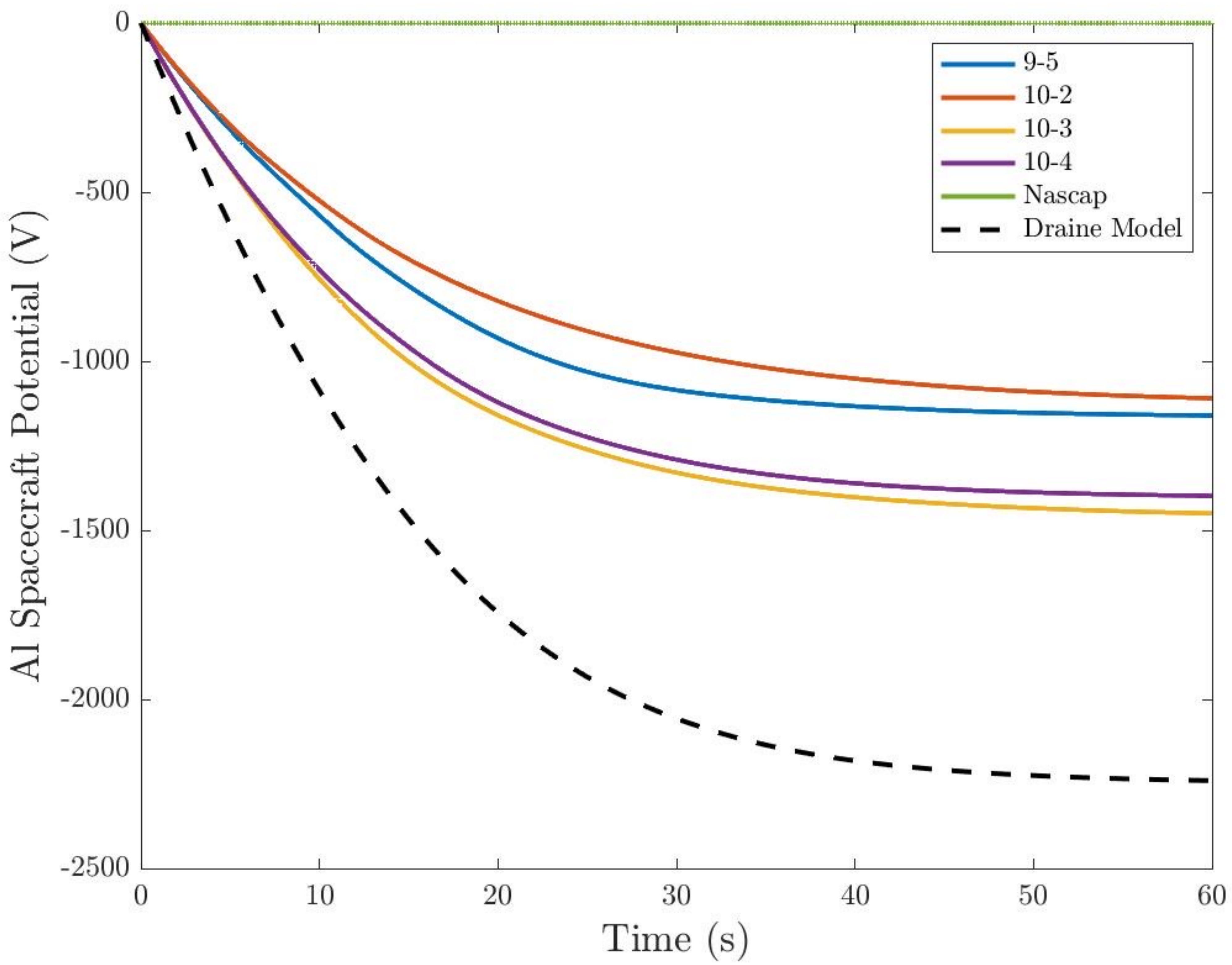


Al Spacecraft Charging Simulations

- Aluminum
  - Multiple TEY = 1 crossings
    - Smoothed data

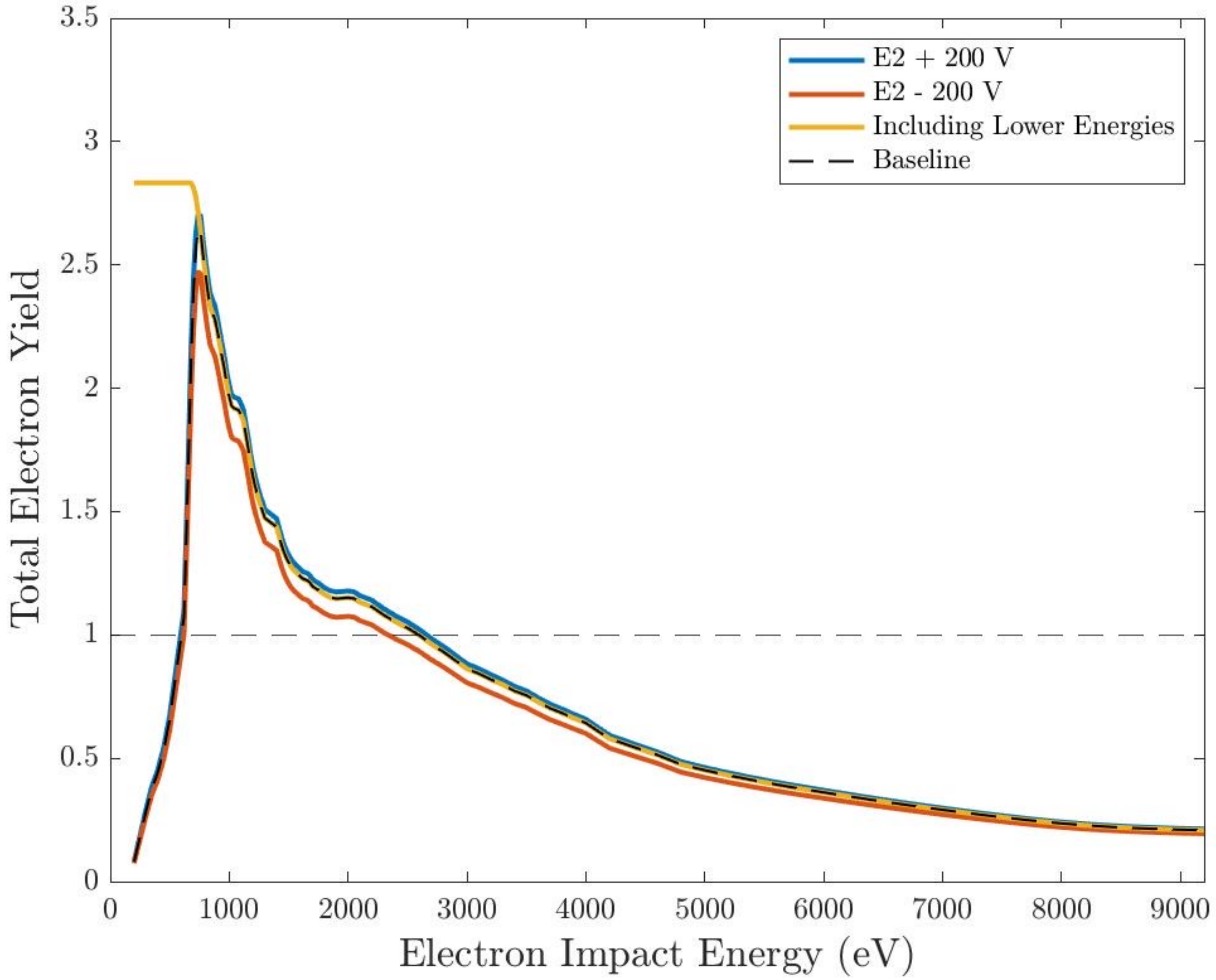


- 4 keV Beam Simulation
  - 1131-779 V difference in final potential
  - Difference in steady state is the same as in E_2

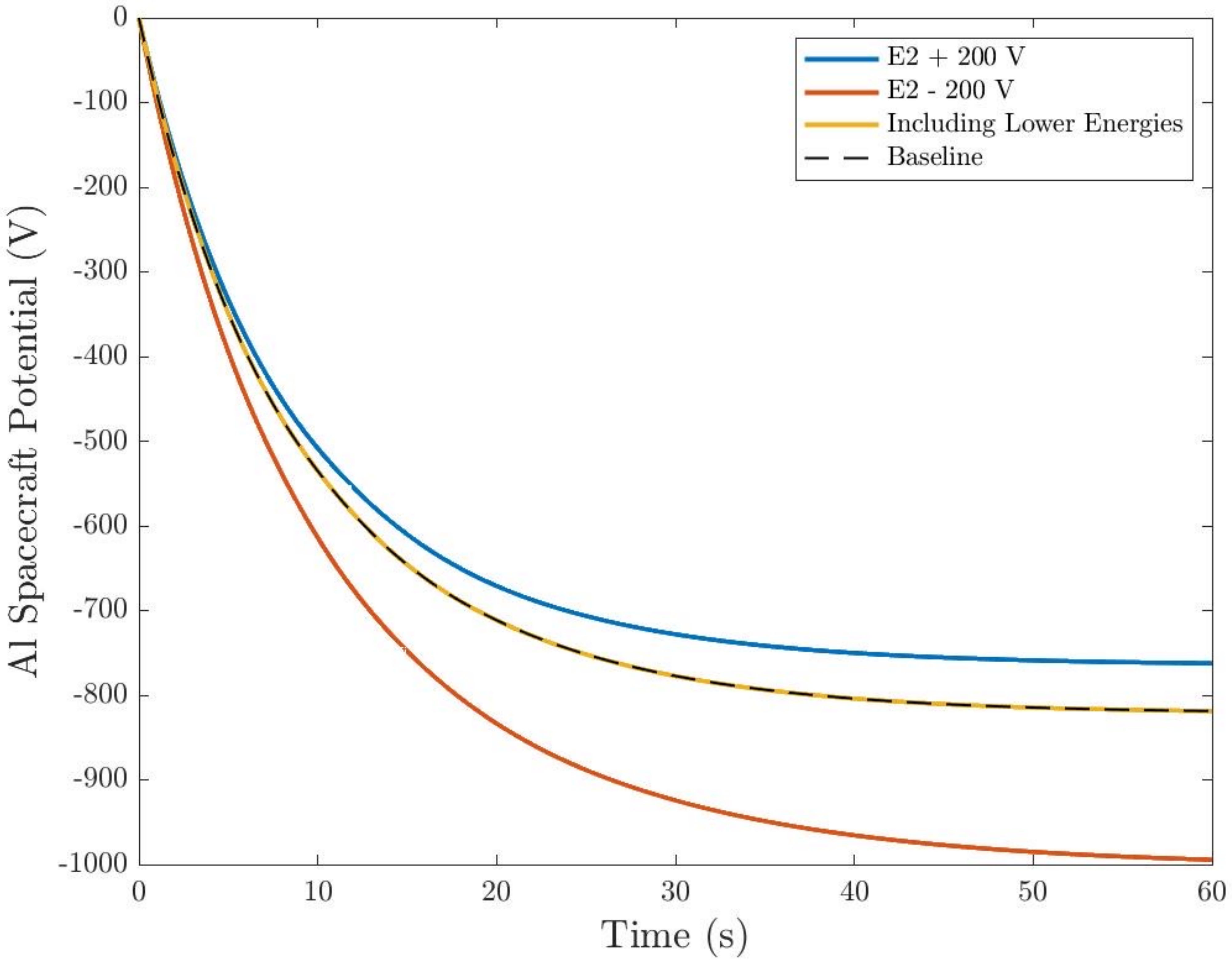


Robustness Testing

- Adjusted TEY Curves
  - Similar curves even with $E_2 \pm 200$ V adjustment
  - Adjusted to include greater TEY at lower impact energies

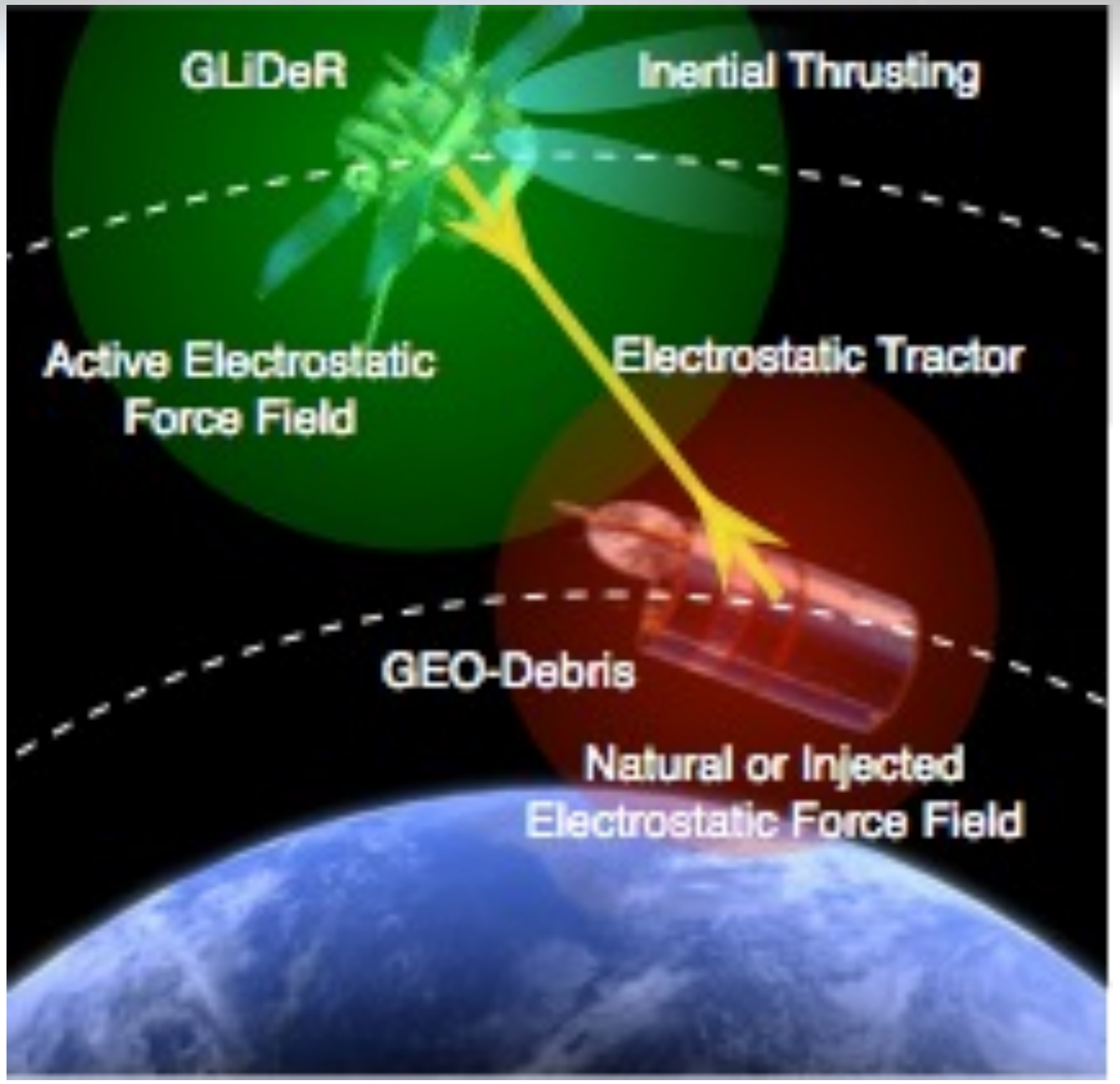


- 4 keV Beam simulations
  - Max 21% deviation from baseline
  - Including lower energies had little effect



Future Work

- Validating the estimation method
  - Confirm impact location at lower energies
  - Measure TEY using previous methods
    - Design and mount enveloping collection surface
  - Compare these curves with experimental charging data
  - Explore different incident angles and materials



Questions?

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