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Radiation-Induced Conductivity: Capacitor Discharge

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Goal

- **Perform an initial set of calculations to explore the discharge of capacitors by ionizing radiation**

REOS: Transport, SRH Recombination and Defect Reactions

Time-dependent calculations of transport during defect reactions

Continuity Equations

$$\frac{\partial n}{\partial t} = \frac{1}{q}\nabla \bullet J_n + R_n$$

$$\frac{\partial p}{\partial t} = -\frac{1}{q}\nabla \bullet J_p + R_p$$

Shockley-Read-Hall (SRH) recombination

$$T^0 + p \rightarrow T^+$$

$$T^+ + n \rightarrow T^0$$

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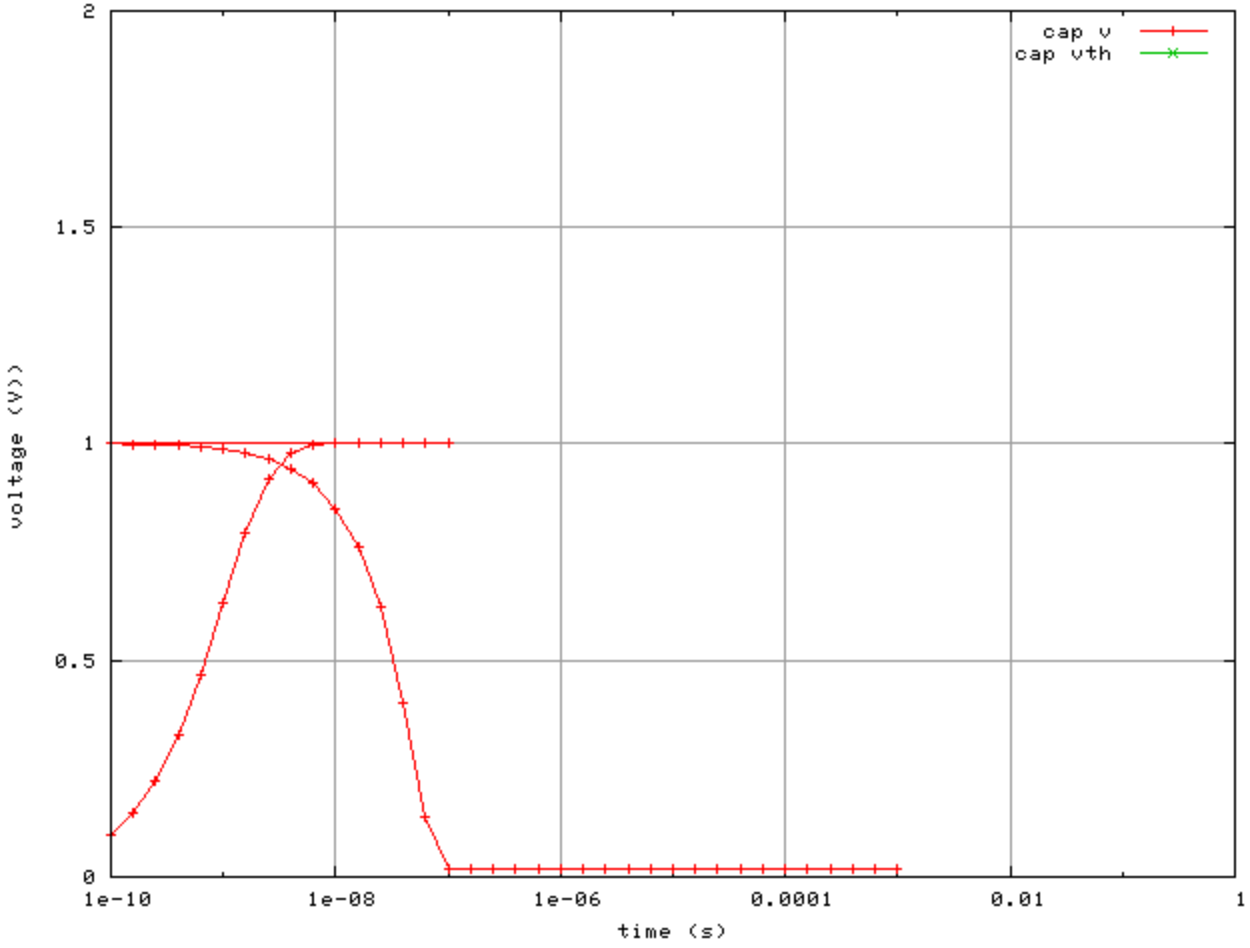
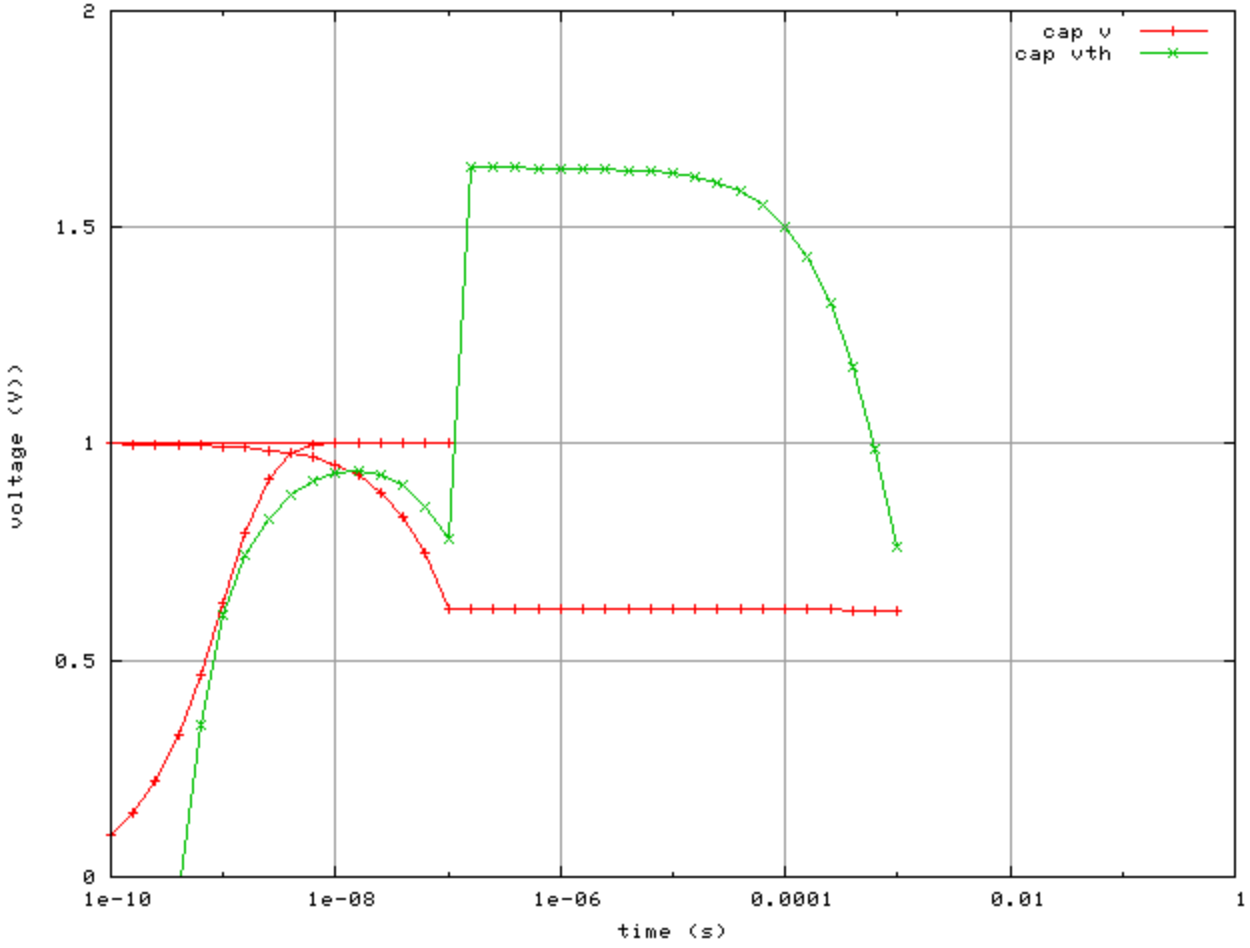
REOS Calculations

- **Structure**
  - 1 micron 1e17 n region
  - 1 micron silicon dioxide region
  - 1 micron 1e17 n region
- **Recombination**
  - Deep hole traps
  - SRH defects
  - Variable density
- **Radiation pulse**
  - Constant, uniform pulse of electron-hole pairs
  - Variable strength
- **Sequence of events**
  - Bias pulse: 1e-7 s duration with 1 V bias
  - Radiation pulse: Constant pulse for 1e-8 s with no bias and high load resistance

Capacitor Charge and Discharge: No Traps



Capacitor Charge and Discharge: With Traps



Discussion

- **No Traps**
  - **First curve**
    - » **Capacitor charging to a bias of 1 V for 1e-7 s**
  - **Second curve**
    - » **Radiation-induced current discharges the capacitor for 1e-8 s**
    - » **Very slow discharge caused by load resistance leakage current**
- **Traps**
  - **First curve**
    - » **Capacitor charging to a bias of 1 V for 1e-7 s**
  - **Second curve**
    - » **Radiation-induced current discharges the capacitor for 1e-8 s**
      - **Current reduced by trapping and recombination at traps**
    - » **Slow discharge by charge released from the traps**
    - » **Very slow discharge caused by load resistance leakage current**
    - » **Threshold voltage increases when radiation ceases and then it slowly falls as traps release holes**

Summary

- **Two effects**
  - **RIC during irradiation**
  - **Trap emission**
- **Next**
  - **Check threshold voltage validity**