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Radiation Effects Module

Total Dose and Single Event Phenomenon, Damage Inducing and Elastic Interactions

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Types of Radiation Effect

- Single Event Effects
  - A single particle creates a one time local ionized charge track

- Total Dose Effects
  - The whole chip is exposed to radiation integrated over time

- Non Damage Inducing Effects
  - The effects of the radiation are temporary

- Direct Particle Damage Effects
  - The radiation particle(s) directly create the physical damage

- Indirect Destructive Damage Effects
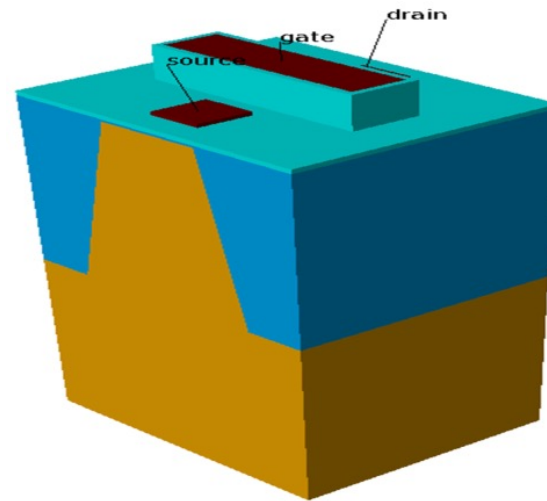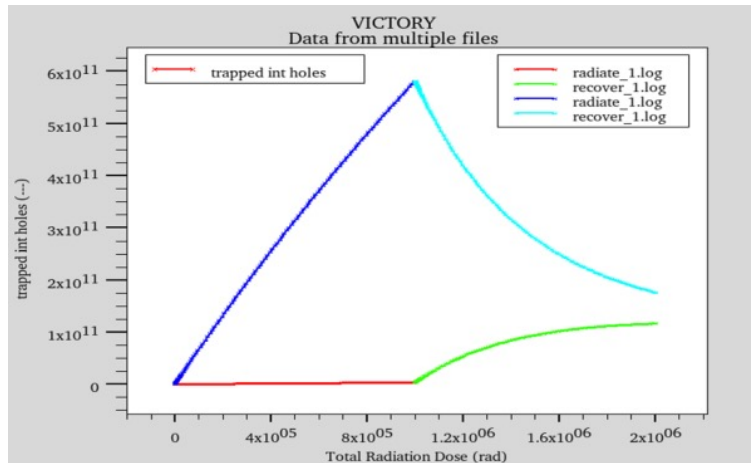 - Destructive secondary damage created by the circuit power supply

Single Event Effects
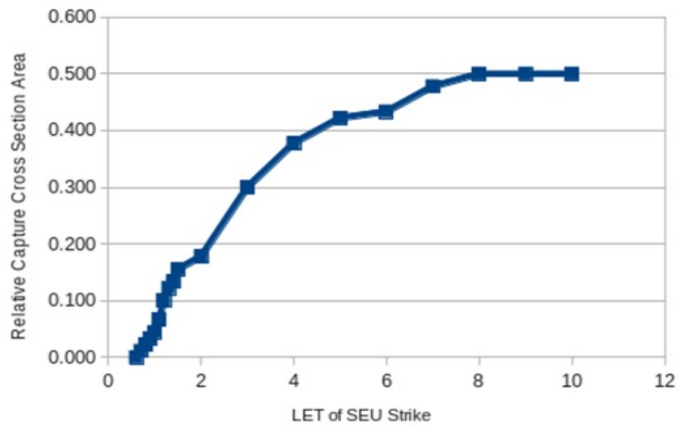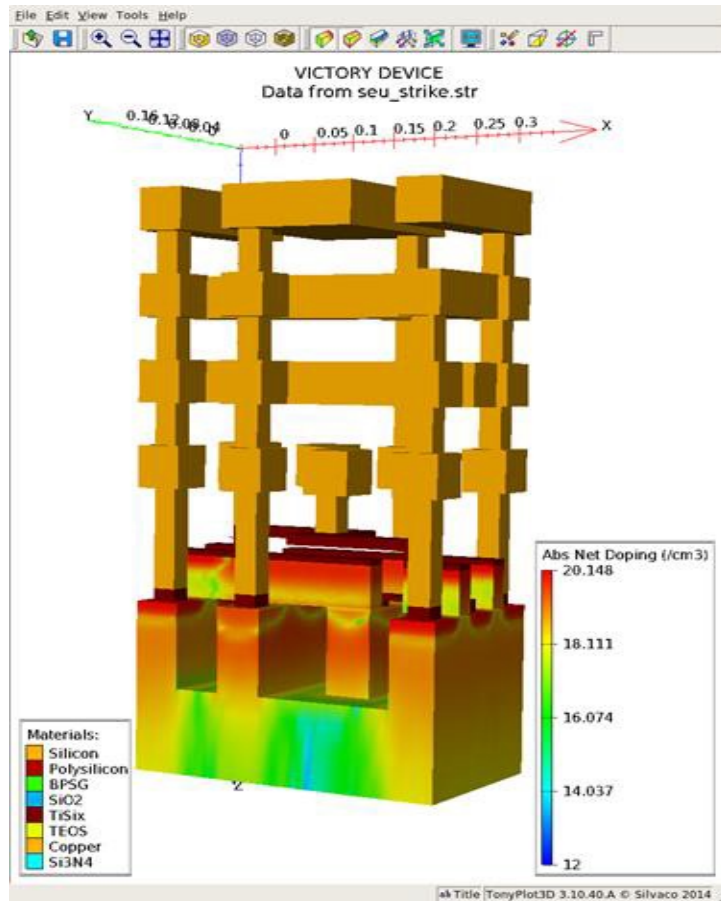
- Creates directional particle track of generated carriers

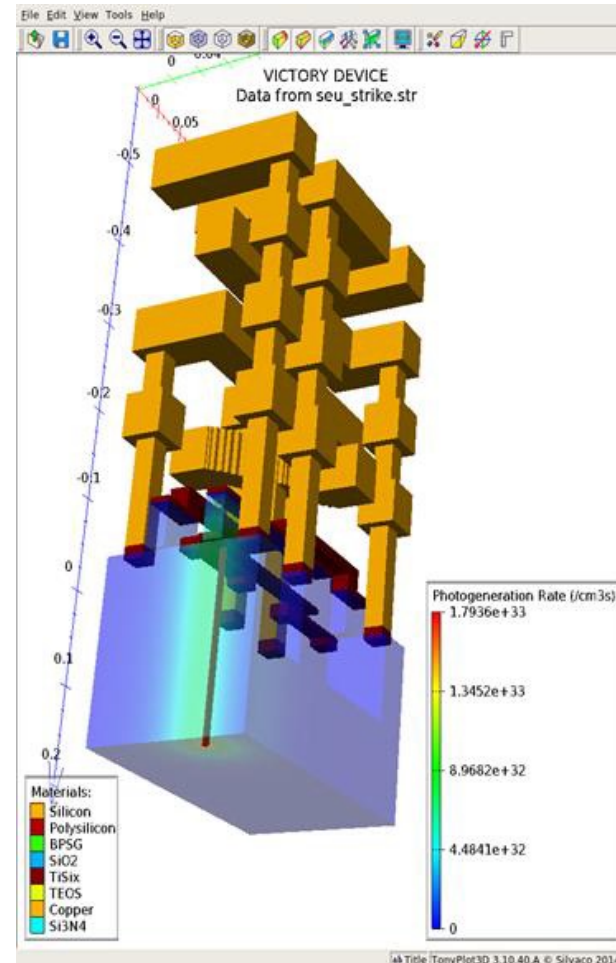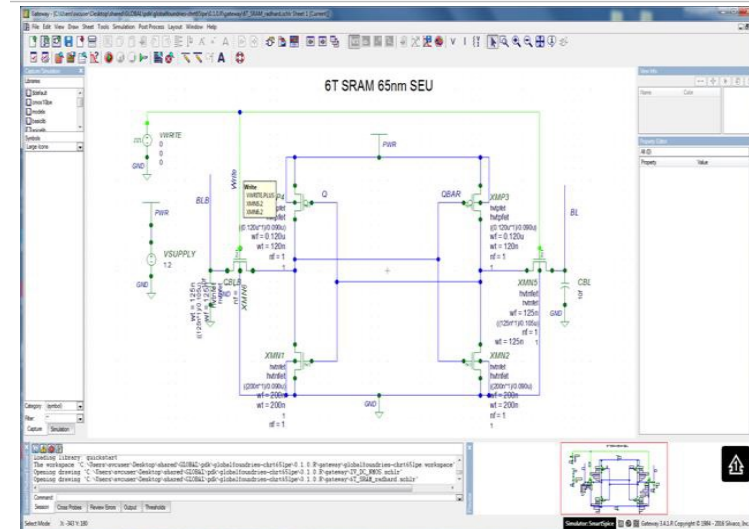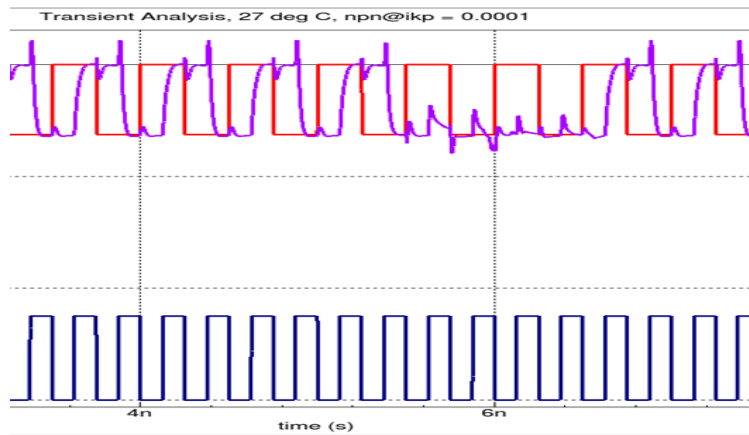- Calculate Weibull function curves, circuit event upsets etc.
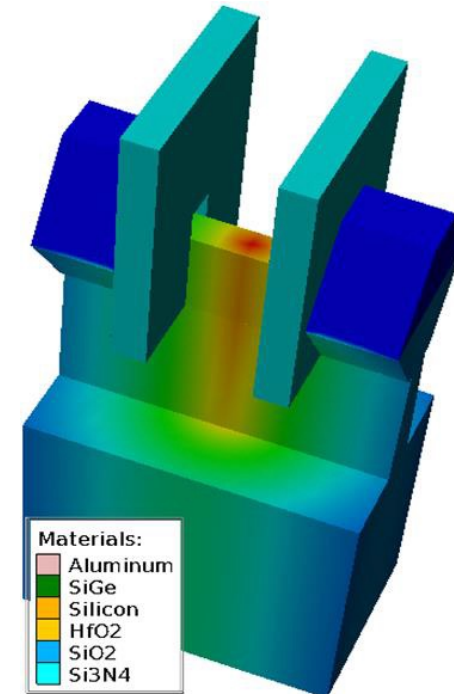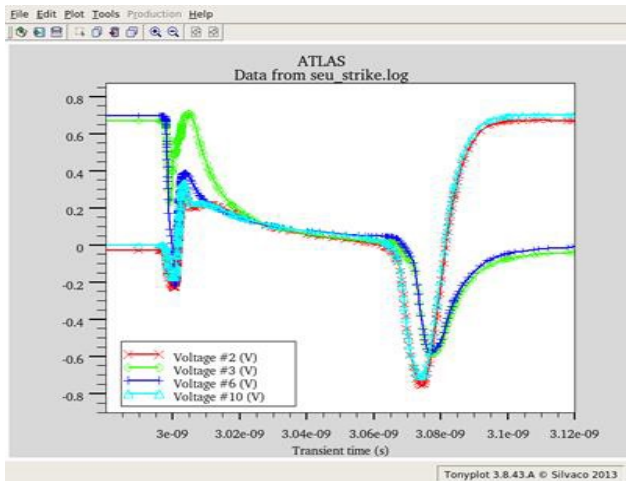
Total Dose Effects

- Unique, physically verified Silvaco model for x-ray/gamma radiation oxide hole trapping

- Vt shift and radiation induced recovery, intra and inter device leakage

- Create post radiation SPICE models using Utmost IV
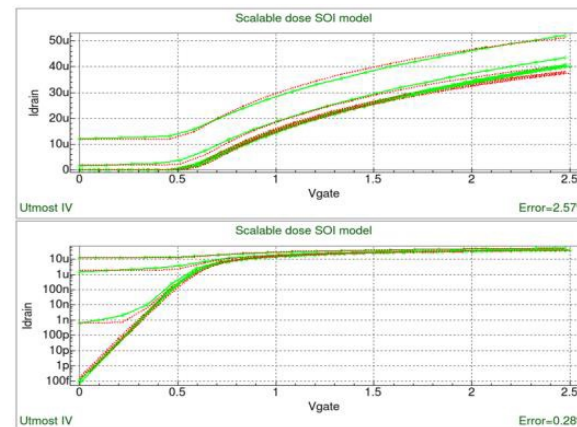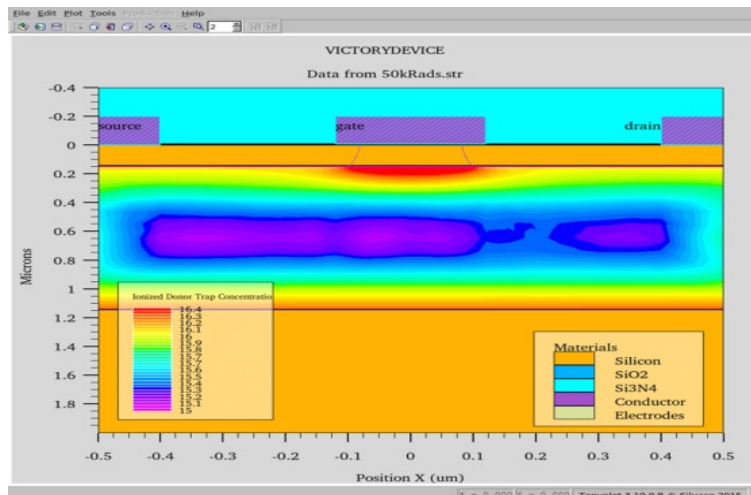
Non-Damage Inducing Effects

- Non damage inducing effects result in a temporary loss of circuit functionality

- These effects can be modelled purely in SmartSpice for worst case corner models, or in TCAD based "Mixed Mode" simulations, or purely TCAD simulations

Direct Particle Damage Effects
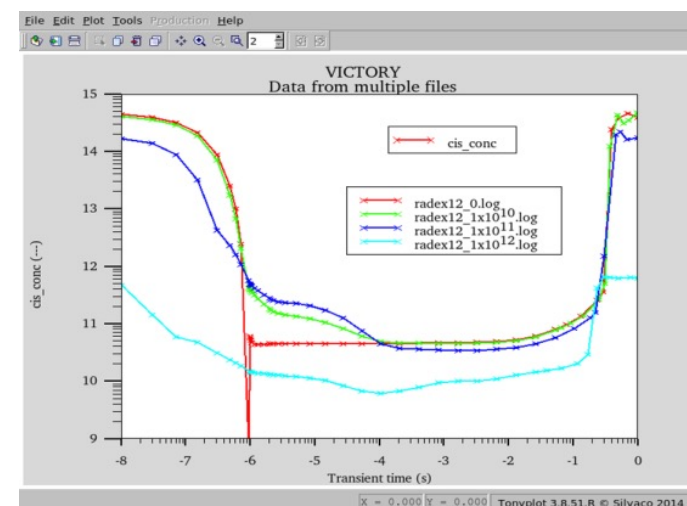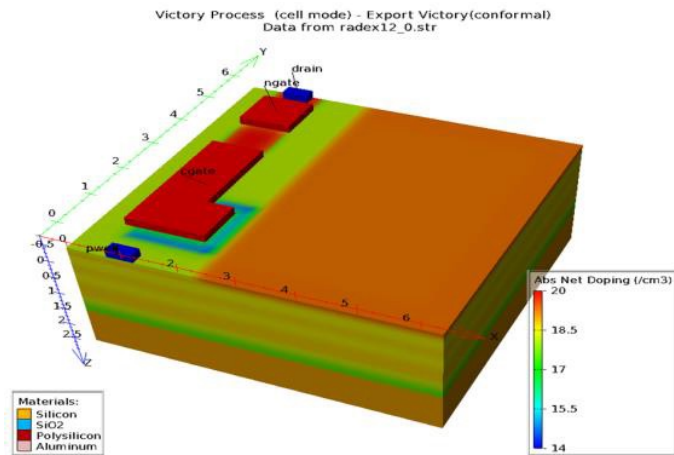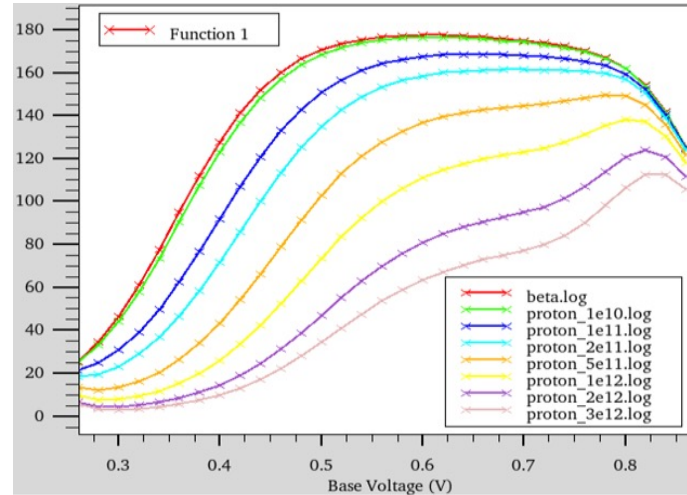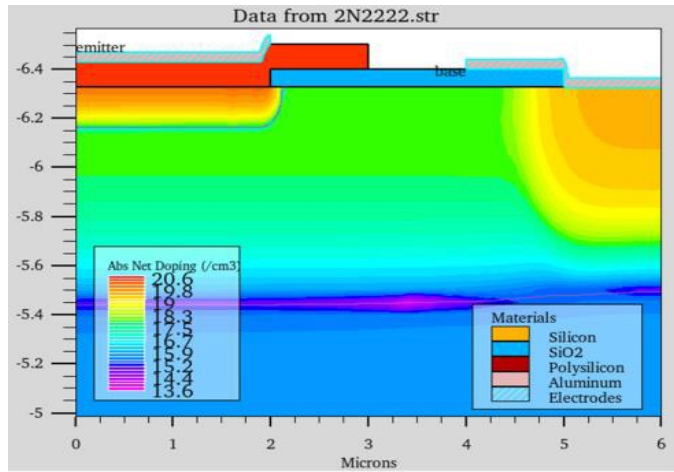
- Direct particle damage occurs as a result of high mass particle such as protons, neutrons etc.

- Crystal damage usually manifests as a reduction of free carrier lifetimes

- Lifetime sensitive devices, such as bipolar transistors or image sensors can be severely effected

Indirect Destructive Damage Effects
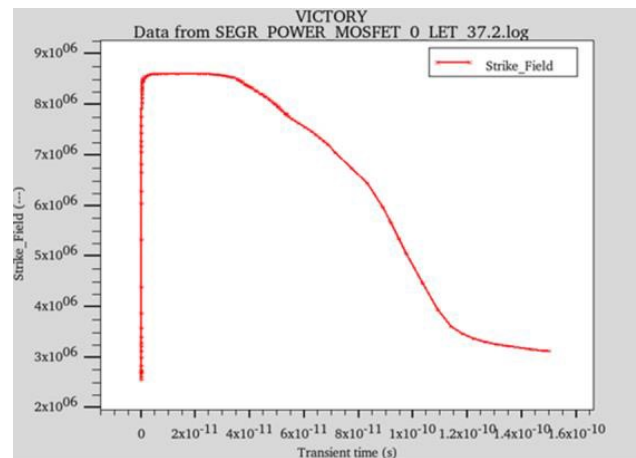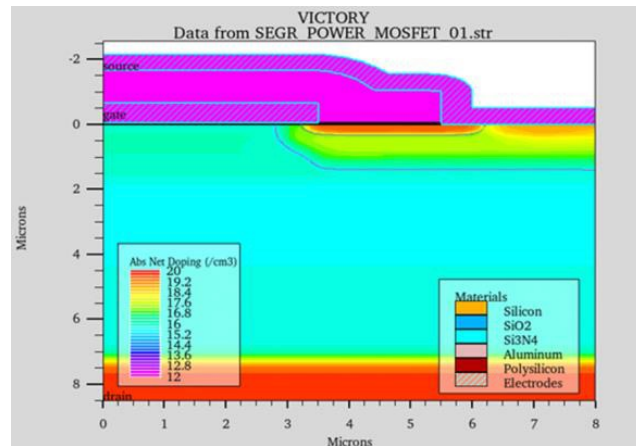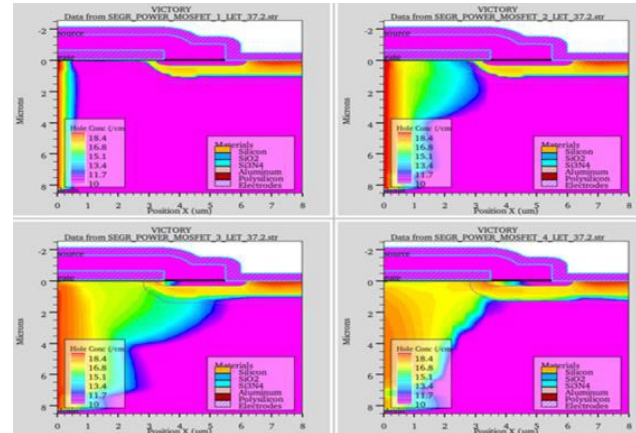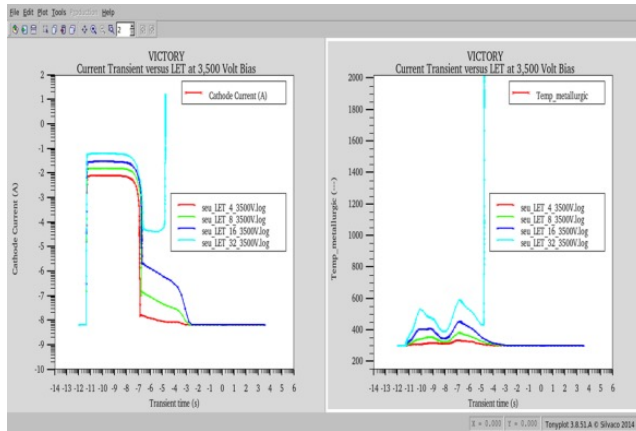
- Destructive damage to a device can be triggered by radiation, but the energy for the destruction, comes from the circuit power supply

- Gate oxides and high power/voltage devices are typically sensitive to such destruction

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Summary

- Silvaco has solutions for most types of radiation effects

- Simulations can be SPICE only, Mixed Mode or purely TCAD

- Radiation effects can be included in SPICE model cards

- Support for ease of use features such as SEU track meshing

- DOE features for circuit sensitive capture cross section, etc.