Overview: RADSAFE & MRED

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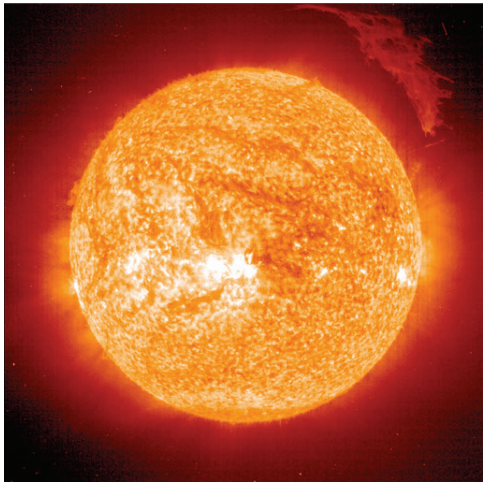
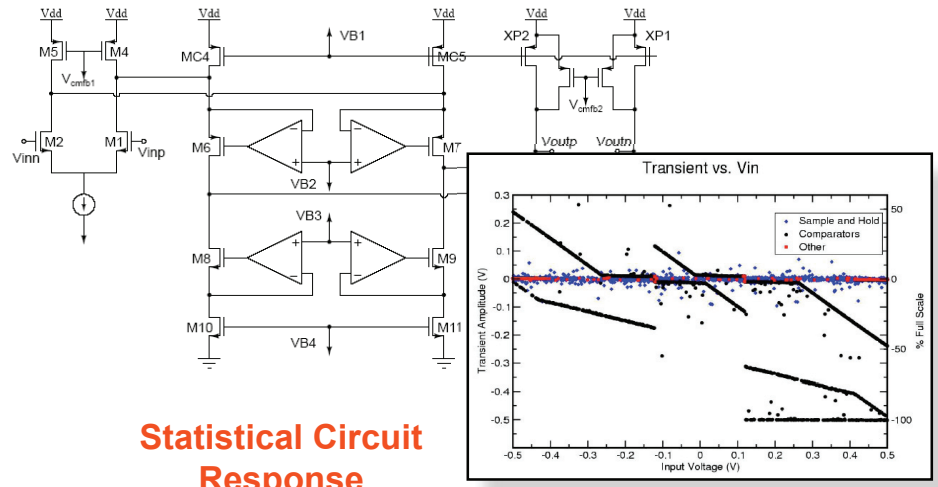
Overview

- RADSAFE: First-principles simulation of radiation effects in semiconductors in terrestrial and space systems.
- MRED: The RADSAFE radiation event generator.
- Highlights of the year's work.
- Challenges for the years ahead.

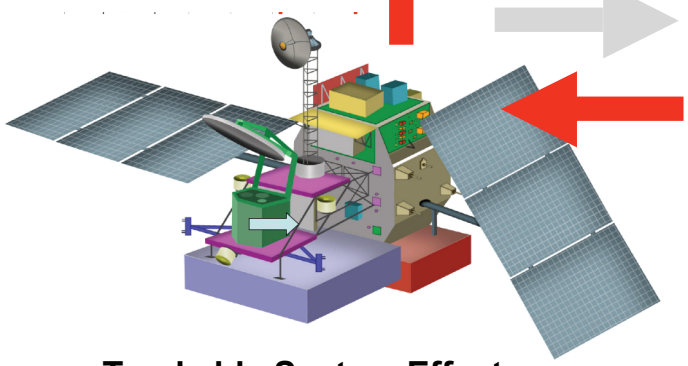
RADSAFE – The Vision



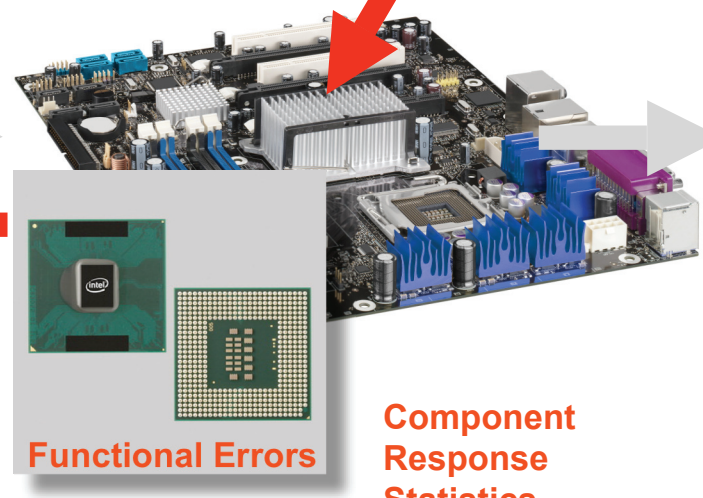
Predictable System Error Rates



Statistical Circuit Response

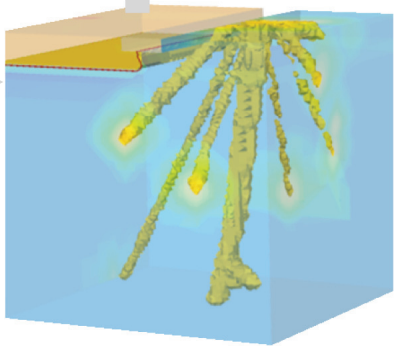


Trackable System Effects



Functional Errors

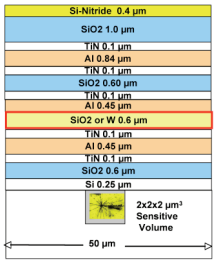
Component Response Statistics



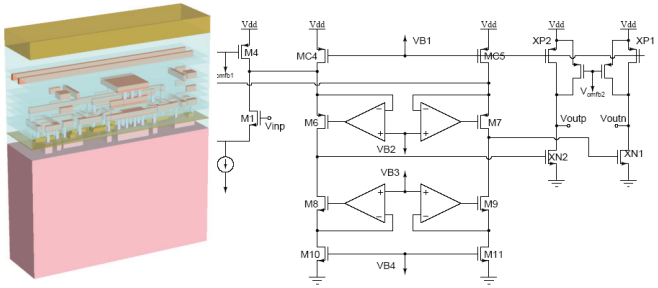
Physics of Radiation Interaction

RADSAFE

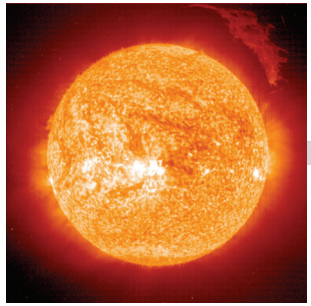
Device/Circuit/System Virtualization

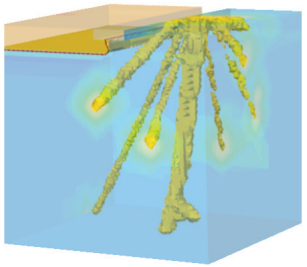


OR

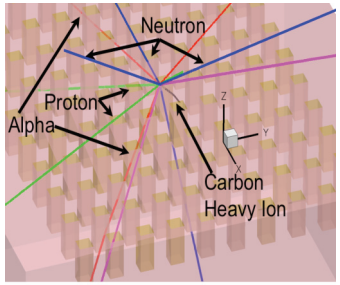


Radiation Event Generation

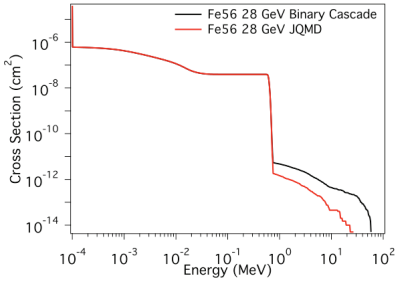




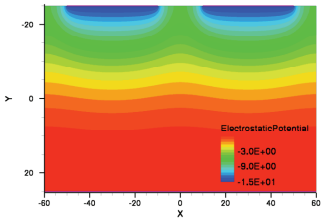
OR



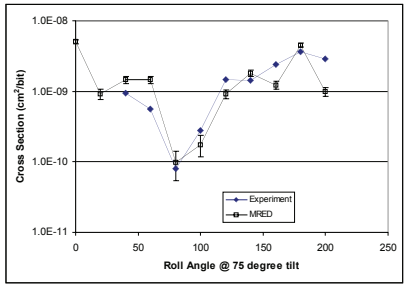
Response Prediction



Calorimetry



TCAD

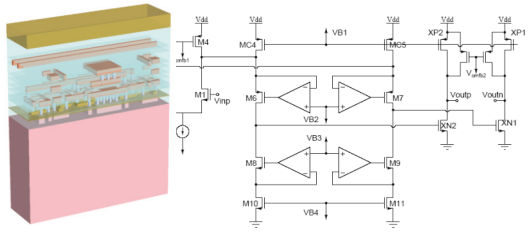
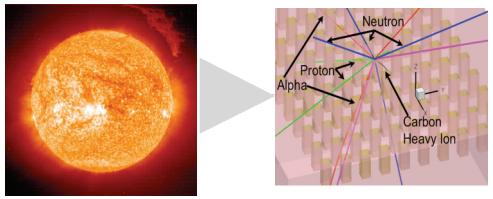


Other…

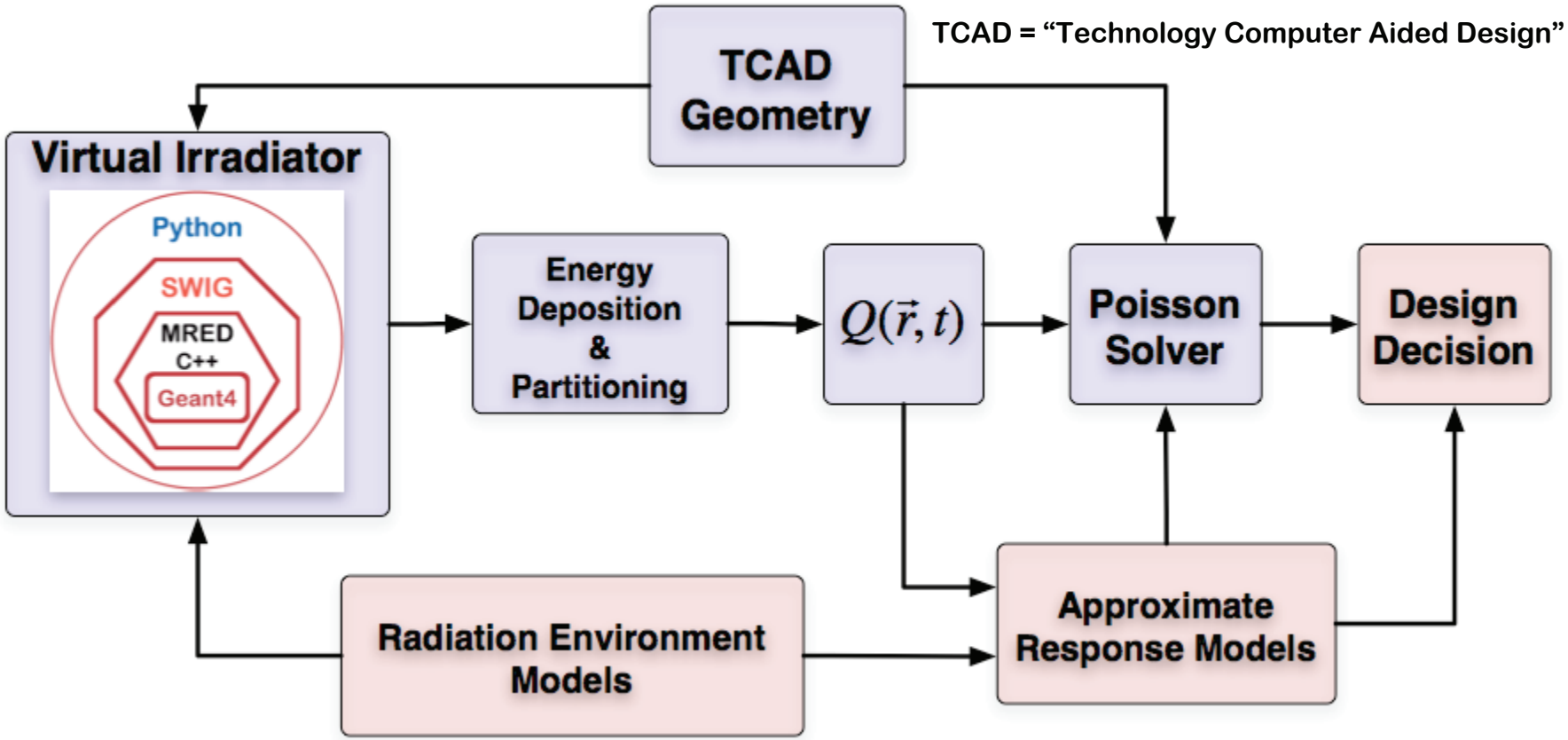
Response Prediction

- Simple calorimetry
- Multi-volume calorimetry
- Coincident calorimetry
- Single-device TCAD
- Mixed-mode TCAD
- Multi-device TCAD
- SPICE (static and dynamic)
- VHDL or other behavioral descriptions

CRÈME96 & RADSAFE

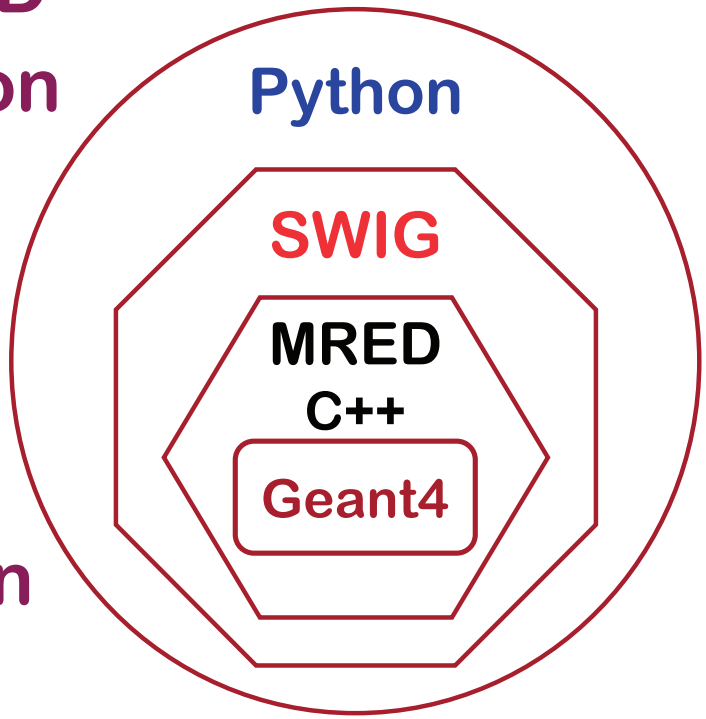
	CRÈME96	VU Analysis
Device/Circuit/System Virtualization		
Radiation Event Generation		
Response Prediction	Integral over path length distribution	Many complementary alternatives

A Response Example

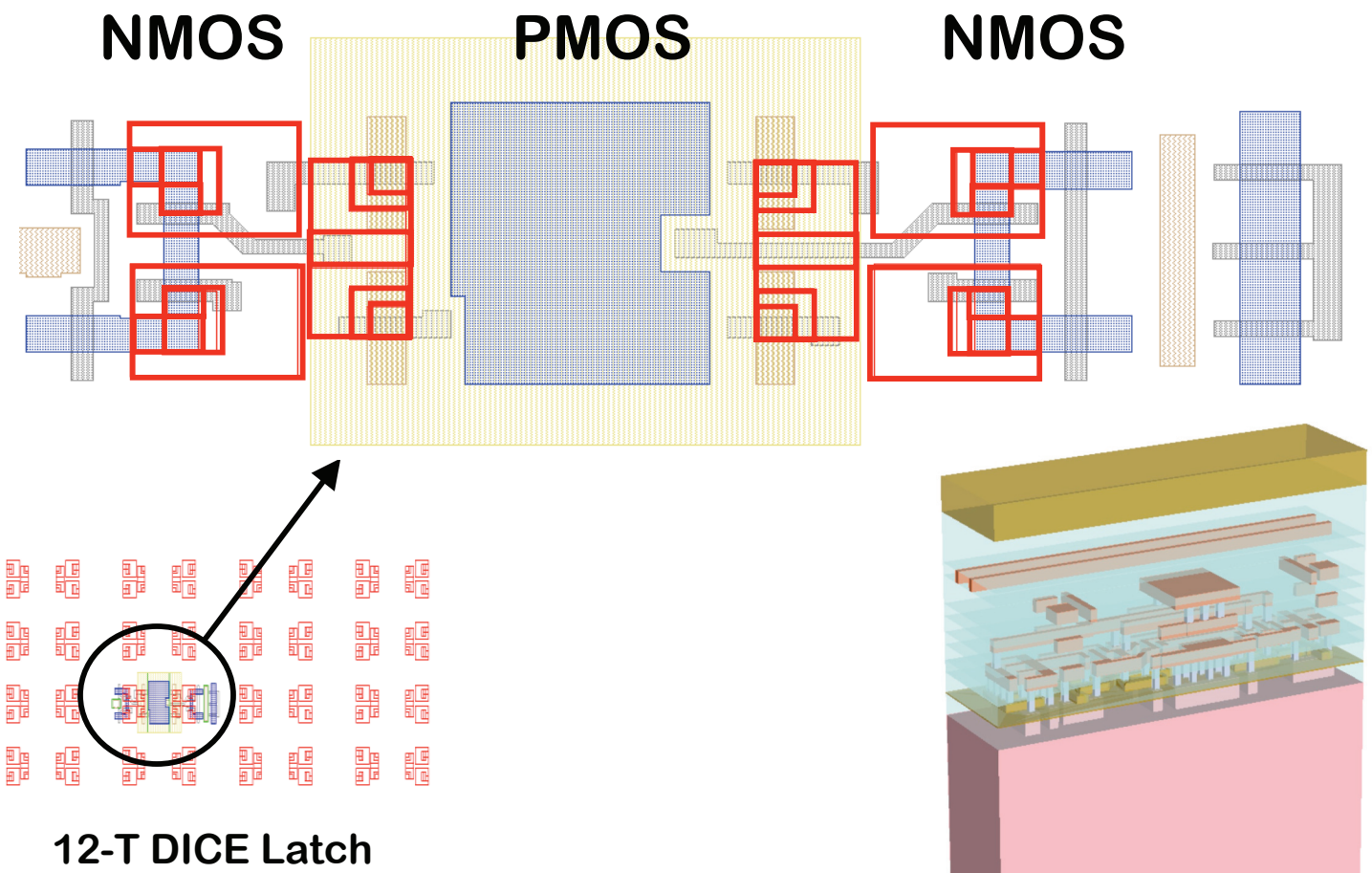


Event Generation

- The event generator is MRED
- MRED is a Geant4 application
- Python version of MRED is now the standard
- Applications using single event mode began this year
- Development focus is ion-ion nuclear reactions



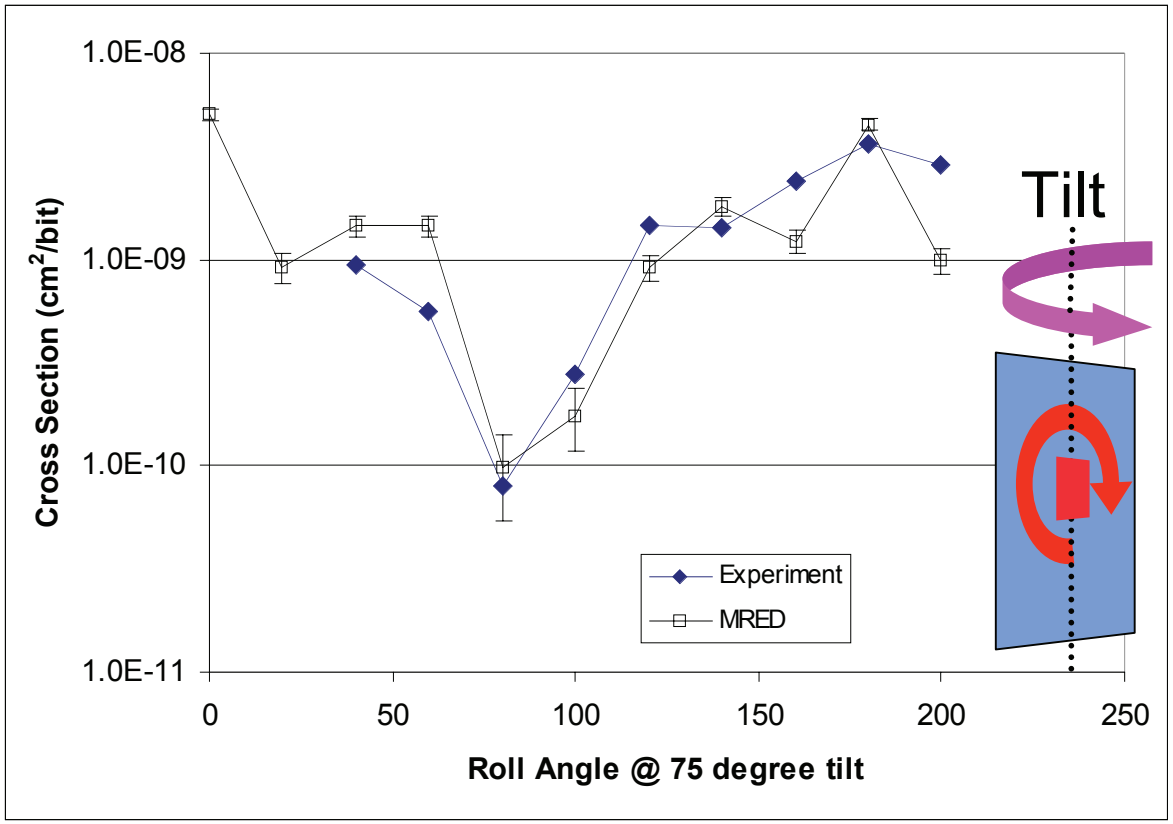
Example RADSAFE Analysis



Kevin Warren, VU ISDE

Comparison with Data

- RADSAFE Model Summary:
  - 4 x 4 bit array (16 bits)
  - Checkerboard pattern
  - 128 transistors
  - 448 micro-volumes
  - 23 coincidence checks (2nd-order) per bit
- Example dataset is of 200,000 events per simulation. One simulation per roll/tilt angle.



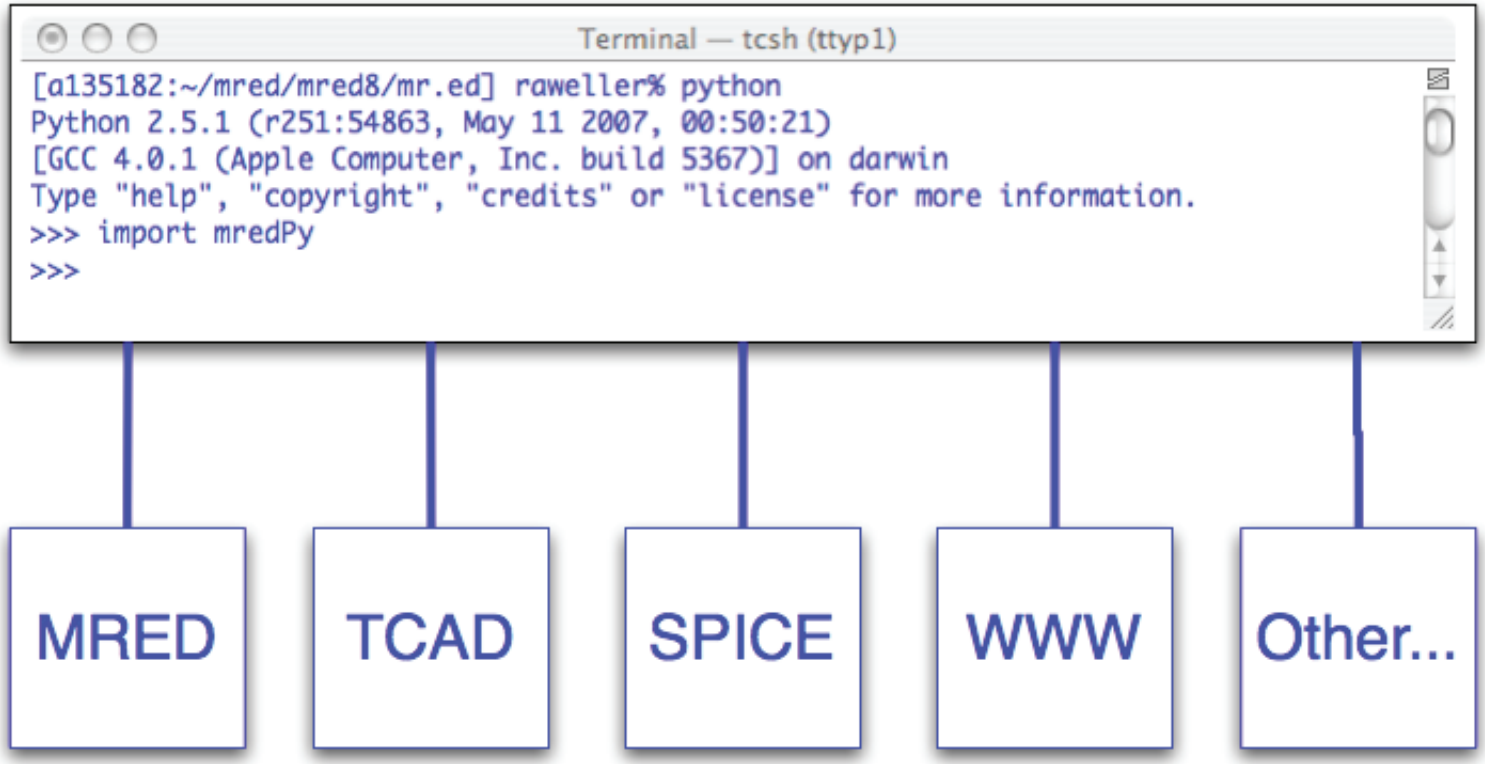
Experiment and RADSAFE Cross Sections @ 75 degree Tilt angle

Highlights 2006-2007

- Full deployment of the Python-MRED
- New project with MSFC to replace CRÈME96
- Acquisition of JQMD for MRED
- Multiple sensitive volume analysis
- Arbitrary CRÈME96 environments
- Complex coincidence analyses
- CRÈME96 coming to ISDE

Significance of Python

This loads the full MRED system.



The choices of tools and ways to combine them are essentially limitless.

Challenges for 2007-2008

- Improve the nuclear reaction physics
- Prototype FLOODS - Python module
- Where are the e-h pairs?
- Refined TCAD/spice/Edep strategy
- Will drift-diffusion continue to be adequate? Is there another way?

Subsequent Talks…

- Robert Reed - Overview of applications
- Christina Howe - Si imagers
- J. Pellish for A. Tipton - neutron-induced multiple bit effects