

# NASA SBIR/STTR Technologies

## Improved Understanding of Space Radiation Effects on Exploration Electronics by Advanced Modeling of Nanoscale Devices and Novel Materials

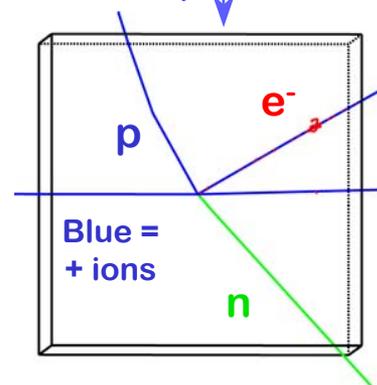
PI: Dr. Marek Turowski / CFD Research Corporation (CFDRC) – Huntsville, AL  
Proposal No.: 04-T1.02-9977 (STTR Topic T1.02)



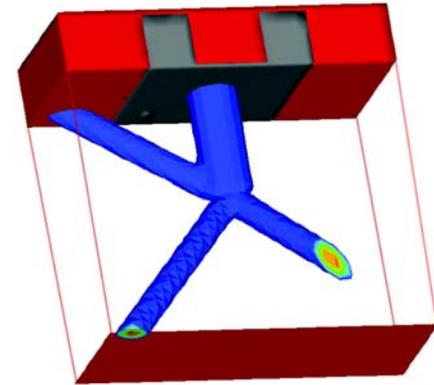
### Identification and Significance of Innovation

- Nanometer-scale electronic device response to space radiation is strongly related to the microstructure of the ionization. The old, linear approach is not accurate.
- Future single-event simulations require the innovation: physics-based simulations of radiation events coupled with advanced device response computations.
- Vanderbilt/Geant4 libraries make it possible to consider a new approach to understanding single-event effects in semiconductor nano-devices and novel materials.

100 MeV p in Si



MOS Transistor



A spallation event: *Geant4* 3D device simulation

### Technical Objectives

- Enhancing the capability to analyze and predict the microscopic response of nanoelectronics to radiation, and the statistics of large numbers of such responses.
- Engineering models for automated analysis & design.

### Work Plan

- Use Vanderbilt/Geant4 abundant set of physics models to calculate the interactions of particles with matter across a very wide energy range and materials.
- Couple Vanderbilt results to CFDRC Device Simulator
- Adaptive/dynamic 3D meshing for multiple ion tracks
- Advanced transport models (kinetic, quantum) for modern nano-scale devices and materials response

### NASA Applications

- Better understanding and predicting of space radiation response of nano-devices and novel materials.
- Radiation Hardening of Exploration Electronics

### Non-NASA Applications

- Radiation Hardening of aerospace and terrestrial advanced electronics for DoD (AF, Navy, MDA) and commercial applications (satellites, aircrafts).

### Firm Contacts

- SBC: Marek Turowski, mt@cfdr.com, 256-726-4889
- RI: Vanderbilt University, Nashville, TN, (Prof. Robert Weller, Dept. of Physics)