NASA SBIR Project

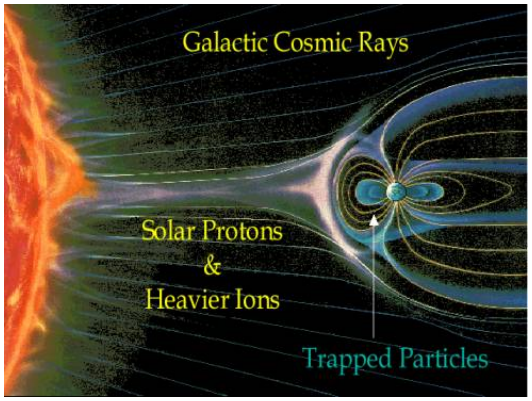
"Improved Models and Tools for Prediction of Radiation Effects on Space Electronics in Wide Temperature Range"

PI: Dr. Marek Turowski/ CFDRC, Huntsville, AL

Proposal Number: X2.04-9709

Identification and Significance of Innovation

- All **exploration systems** that are expected to operate in NASA missions (**Moon, Mars)** for years will need reliable electronics that are able to survive and operate in a **wide temperature range (-230ºC to +130 ºC)** and **high radiation** levels.
- There is **limited knowledge of semiconductor device behavior** in **extreme low temperatures;** also, traditional linear energy transfer (LET) radiation models are not applicable to nanoscale ICs.
- Innovation: Advanced, physics-based TCAD tools for analysis of radiation effects and extreme low-T effects; **fast, higher-level radiation effects models** for **efficient single event error prediction**



Technical Objectives

Predicting the electrical performance and radiation response for electronic components and systems operating in extremely low temperatures by: (a) Development of advanced, physics-based TCAD and mixed-mode simulation capability, and (b) Development and demonstration of fast, engineering models based on TCAD simulation results for efficient radiation response calculation

Work Plan

In **Phase 1:** We demonstrated that CFDRC NanoTCAD solver is capable of radiation-effects simulations to -250ºC, but present physical models are not adequate. We also demonstrated initial coupling between Geant4 and NanoTCAD.

In **Phase 2:** New cryo-T physical models for NanoTCAD will be developed, validated, and demonstrated. The Geant4-NanoTCAD coupling will be automated. Fast, engineering models for single-event response of ICs will be developed and validated.

NASA and Non-NASA Applications

• **NASA Applications:** The developed fast, engineering models and improved TCAD tools will be immediately applicable to the NASA Radiation Hardened Electronics for Space Exploration (RHESE) Program; Efficient circuit and system level prediction of error rates; Help upgrade existing rad. effects prediction tools such as CRÈME 96; Assessment and selection of new electronics tech.

• **Non-NASA Applications:** Potential users include other space electronics suppliers, in particular for DoD space communication and surveillance systems (IR imagers) and commercial satellites.

Firm Contacts

CFDRC: Dr. Marek Turowski, Manager Micro/Nano-Electronics
email: mt@cfdrc.com, phone: 256-726-4889

Vanderbilt-ISDE, Nashville: Mr. Paul Tuinenga (Subcontract)

Georgia Tech, Atlanta: Prof. John Cressler, ECE Dept. (Consultant)