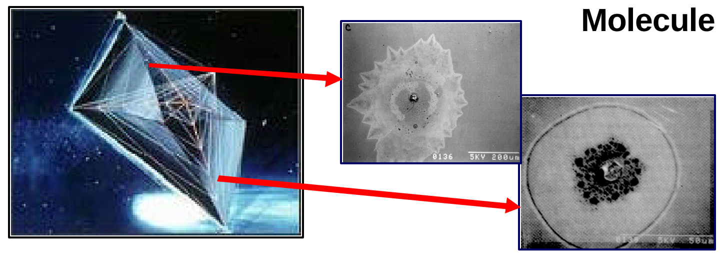
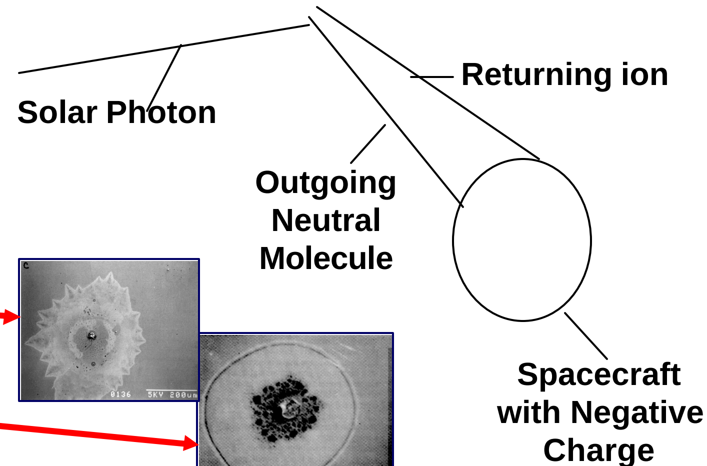
Electrostatic Return of Contaminants (ESR)

- **Model that predicts the level of spacecraft surface degradation from ESR**
- **Solar varying environment**
  - **Solar photons**





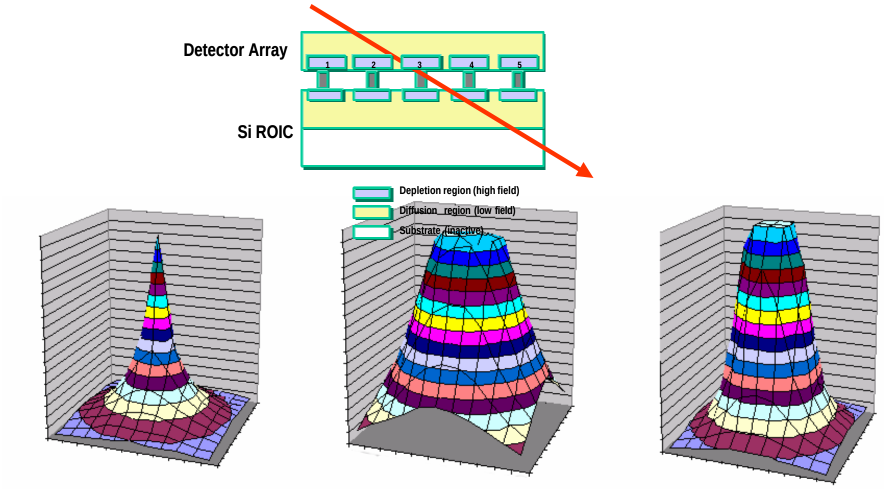
PI: R. Rantanen

- **Predicts the electrostatic return of spacecraft emitted molecules that are ionized and attracted back to the spacecraft by the spacecraft electric potential on its surfaces**
- **Provides levels of surface deposits and surface sputtering caused by the returning ions**
- **Accounts for different emitted molecular species and energy for a range of spacecraft environments (LEO, GEO, interplanetary)**

Modeling Charge Collection in Detector Arrays

- **A Monte Carlo/analytical model for focal plane array (FPA) applications**
- **Solar varying environment**
  - **High energy charged particles**

PI: J. Pickel



Quad 1 Data, 0 Deg

Quad 2 Data, 0 Deg

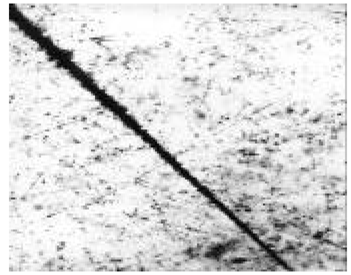
Simulation, 0 Deg

- **Addresses need for high fidelity simulation of particles interactions in complex FPA structures, including multiple layers, sub-regions with layers, variation of linear energy transfer (LET) with range, electron scattering, free-field diffusion, and field-assisted diffusion**
- **Can be applied to any semiconductor detector array**
- **Possible application to SOI and SiGe technologies**
- **Computer code, REACT, to predict charge collection in an array of elements**

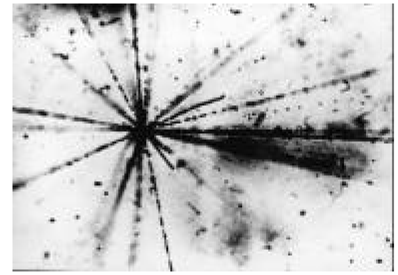
Analysis of CRRES PHA Data for Low-LET Events

- **Charge collection models (COSMIC/CUPID) updated to include elastic interactions for application to modern devices where these interactions have been shown to dominate**
- **Solar varying environment**
  - **Protons and heavy ions**

IMPORTANT SOURCES OF SPACE RADIATION EFFECTS



Track of an iron nucleus that stops in lower right corner



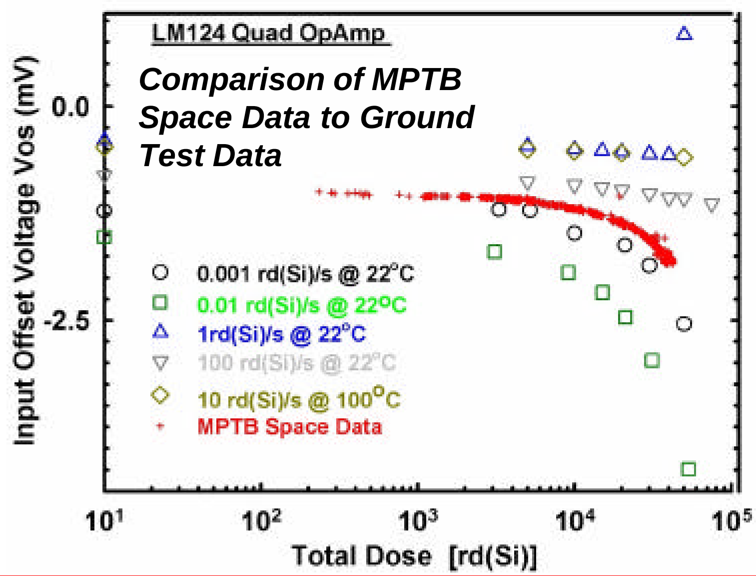
A spallation reaction

PI: P. McNulty

- **Simulations from updated code agree well with the CRRES data**
- **Evidence for significant contributions to the spectrum from both elastic scattering at low energy depositions and pion production at high energy depositions**
- **Small number of large pulses in the data from direct traversals of the detector by heavy cosmic-ray ions**

Mining Enhanced Low-Dose Rate Sensitivity (ELDRS) Data from MPTB

- **Guidelines for accommodating the ELDRS effect on linear bipolar devices**
- **Solar varying environment**
  - **Charged particles**



PI: T. Turflinger

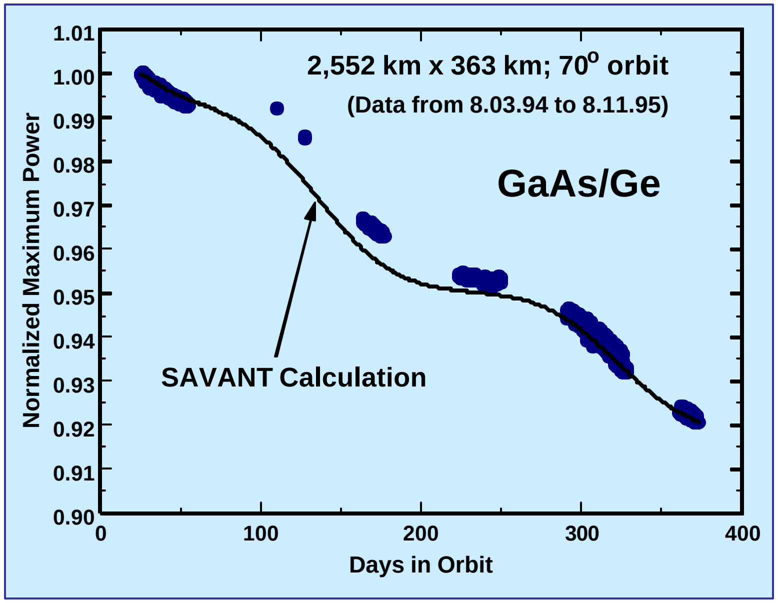
- **Implications for ground testing**
  - **Microelectronics and Photonics Testbed (MPTB) observations agree well with ground test results, increasing confidence in the use of ground testing to predict ELDRS.**
  - **Relatively constant rate of degradation was demonstrated over dose rate of 0.5 mrad(Si)/s to 8 mrad(Si)/s, increasing confidence that 10 mrad(Si)/s ground data are a good predictor of space degradation.**
- **Implications for flight investigations**
  - **GTO is not the ideal platform for studying the ELDRS effect**

Solar Array Analysis and Verification Tool (SAVANT)

- **Update the SAVANT* tool to predict on-orbit solar array output as a function of time for modern solar cell technologies**
- **Solar varying environment**
  - **Charged particles**

SAVANT was developed and is maintained by NASA/Glenn Research Center

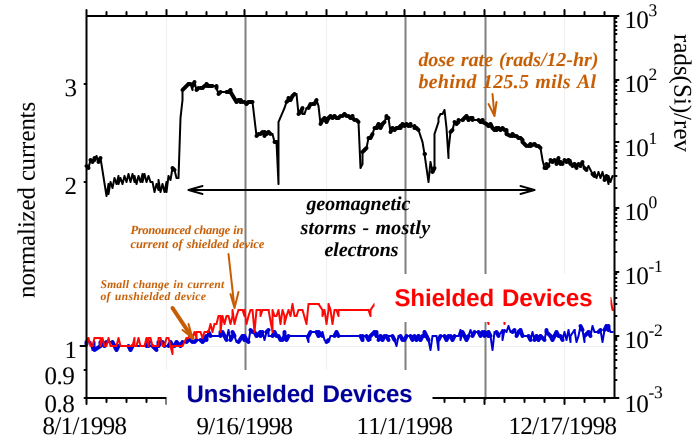
PI: R. Walters



- **Predict solar array degradation using a physics-based displacement damage (Dd) degradation method**
  - **SAVANT is a Windows™ based, user-friendly tool to calculate solar array degradation from radiation**
  - **Update allows for predictions based on minimal amount of ground testing**
  - **Validated with Microelectronics and Photonics Testbed (MPTB) space flight data**
  - **Model can be extended to multijunction and thin film solar cells**

TID Effects of High-Z Material Spot Shields on FPGA using MPTB Data

- **Guidelines for using spot shielding (CuW) for reduction of dose in electron dominated environments**
- **Solar varying environment**
  - **Electrons**



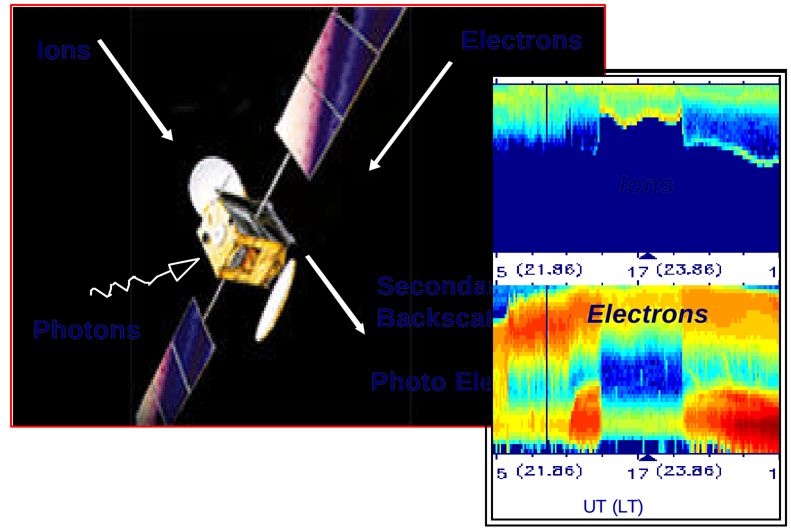
Example of anomalous response to electron storms of a shielded FPGA on MPTB

PI: S.Crain

- **Could not explain the unexpected behavior of the devices that were not shielded**
  - **Models may not be accurately predicting particle interactions in devices**
    - **Particle transport codes used are limited in how they handle photons with E < 1 keV**
    - **Particle transport codes used are limited in how they handle the physics of dose enhancement at the die level**
  - **Measured energy spectra of electrons was much harder during the geomagnetic storms of 1998 than those predicted by the models that average over several solar cycles.**

Characterization of Magnetospheric Spacecraft Charging Environments using LANL Data

- **Guidelines for charging environments fitting functions for NASCAP2**
- **Solar varying environment**
  - **Low energy electrons**

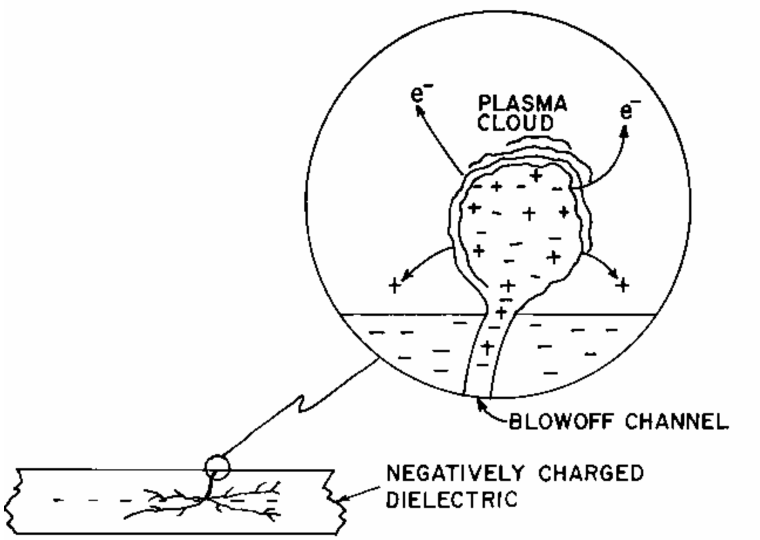


PI: V. Davis

- **Solar Minimum vs. Solar Maximum charging environments**
  - **Fluxes and resulting charging during charging periods are the same at solar minimum as at solar maximum. HOWEVER, during solar maximum, the frequency of high charging environments increases.**
- **Recommendations for environment fitting functions for NASCAP2K**
  - **Kappa fit for electrons and Maxwellian fit for ions give "post-dictions" with accuracy similar to those using the LANL measured spectra**

Mining CRRES IDM Pulse and Environment Data

- **Improvements in ground test fidelity to minimize internal electrostatic discharge**
- **Solar varying environment**
  - **Mid-energy electrons**



Charged electrical insulators break down producing large electric pulses

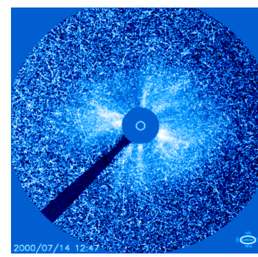
PI: R. Frederickson

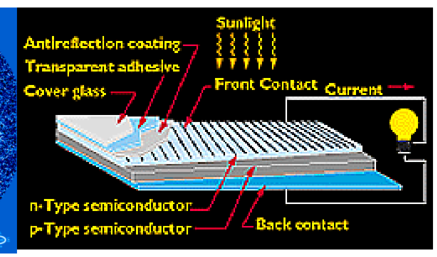
- **Investigate IESD pulsing by insulators flown on the CRRES spacecraft in relation to radiation-belt particle spectra**
- **Ground tests indicate that IESD pulse rate and pulse amplitude are proportional to electric field in the insulator. Estimate the electric fields that occurred in the insulators on CRRES as the particle spectra varied, and correlate this to measured pulse rates and amplitudes.**

Non-Ionizing Energy Loss (NIEL) Tool for Space Applications*

- A tool to calculate non-ionizing energy (NIEL) loss is the dominating damage mechanism in some optical technologies, e.g CCDs, optocouplers, solar cells
- Solar varying environment
  - Charged particles

Non-ionizing energy loss is the dominating damage mechanism in some optical technologies, e.g CCDs, optocouplers, solar cells.





*Co-funded with Code R, Space Environments & Effects Program

PI: M. Xapsos

- Computer program for calculating
  - NIEL in elemental compounds and semiconductors for electrons, protons, and heavy ions
  - NIEL spectra equivalent to linear energy transfer spectra for space environment