

# Technical Program

## Monday Short Course

### Space Radiation Environments and Their Effects On Devices and Systems: Back to the Basics

- 7:15 **Continental Breakfast**
- 8:00 **Short Course Introduction** (Grand Ballroom)  
Chair: [Steve McClure](#), JPL
- 8:10 **1: Spacecraft Radiation Environment Interactions**  
Instructor: [Hank Garrett](#), JPL
- 9:45 **Break**
- 10:10 **2: Total Ionizing Dose and Displacement Damage Effects  
in CMOS and Bipolar Devices**  
Instructor: [Tim Oldham](#), Dell-Perot Systems
- 11:50 **Short Course Luncheon** (Valencia Ballroom)
- 1:20 **3: Single Event Effects in Digital and Linear ICs**  
Instructor: [Mark Baze](#), Boeing (retired)
- 2:55 **Break**
- 3:20 **4: On-orbit Anomalies: Investigations and Root Cause  
Determination**  
Instructor: [Robert Ecoffet](#), CNES
- 4:45 **Wrap-up**
- 4:55 **Exam** (only for students requesting CEU credit)
- 5:25 **End of Short Course**

## Tuesday

7:45 **Continental Breakfast**

8:30 **Opening Remarks (Grand Ballroom)**

General Chair, Kay Chesnut, *Boeing Space and Intelligence Systems*

8:35 **Awards Presentations**

Rad Effects Steering Group Chair, Dan Fleetwood, *Vanderbilt Univ*

9:00 **Technical Session Opening Remarks**

Technical Program Chair, Robert Reed, *Vanderbilt Univ*

9:05 **Session A – Single Event Effects: Transient**

**Characterization** Chair: Jonathan Pellish, *NASA Goddard*

9:10 A-1

**SET Characterization in Logic Gates Circuits Fabricated in a 3DIC Technology**

P Gouker, B Tyrrell, R D'Onofrio, P Wyatt, *MIT Lincoln Lab*; J Ahlbin, N Atkinson, N Gaspard, B Bhuvu, L Massengill, E Zhang, *Vanderbilt Univ*; M Gadlage, *NAVSEA Crane*

9:25 A-2

**Laser-Induced Current Transients in Bulk FinFETs**

F El Mamouni, E Zhang, N Hooten, R Schrimpf, R Reed, G Kenneth, *Vanderbilt Univ*; D McMorrow, J Warner, *NRL*; E Simoen, C Claeys, *imec*

9:40 A-3

**Investigation of Analog SET on a Bandgap Reference in Triple-Well CMOS Using Pulsed Laser Techniques**

A Zanchi, C Hafer, S Hisano, D Kerwin, *Aeroflex Colorado Springs*; S Buchner, *NRL*

9:55 **Break** (Marquis Ballroom and Foyer)

10:25 **Session B – Single Event Effects: Mechanisms and**

**Modeling** Chair: David Heidel, *IBM*

10:30 B-1

**The Effect of Neutron Energy on Single Event Upsets and Multiple Bit Upsets**

M Clemens, K Warren, N Dodds, R Reed, R Weller, M Mendenhall, *Vanderbilt Univ*; P Dodd, M Shaneyfelt, J Schwank, *SNL*; S Wender, *Los Alamos National Labs*

10:45 B-2

**Combining GEANT4 and TIARA for Neutron Soft Error Rate Prediction of 65nm Flip-Flops**

S Uznanski, G Gasiot, P Roche, *STMicroelectronics*; J-L Autran, *IM2NP*

11:00 B-3

**Monte Carlo Prediction of Heavy Ion Induced MBU Sensitivity for SOI SRAMs Using Radial Ionization Profile**

M Raine, M Gaillardin, P Paillet, *DAM, DIF, CEA*; G Hubert, *ONERA*; A Bournel, *IEF*

11:15 B-4

**Impact of Well Structure on Single-Event Well Potential Modulation in Bulk CMOS**

N Gaspard, A Witulski, N Atkinson, J Ahlbin, W Holman, B Bhuvu, T Loveless, L Massengill, *Vanderbilt Univ*

11:30 B-5

**Angular Dependence of Heavy-Ion Induced Errors in Floating Gate Memories**

S Gerardin, M Bagatin, A Paccagnella, *Univ of Padova*; A Visconti, S Beltrami, M Bonanomi, *Numonyx*

11:45 B-6

**The Implications of Ion Track Structure for Single-Event Effect Analysis**

M King, R Reed, R Weller, M Mendenhall, R Schrimpf, E Auden, S Weeden-Wright, *Vanderbilt Univ*; M Asai, *SLAC National Accelerator Lab*

12:00 **Lunch**

1:45 **Session C – Single Event Effects: Devices and**

**Integrated Circuits** Chair: Heather Quinn, *Los Alamos National Lab*

1:50 C-1

**Single Event Effects in Power MOSFETs Due to Atmospheric and Thermal Neutrons**

A Hands, P Morris, K Ryden, C Dyer, P Truscott, *AeroSPACE*, *QinetiQ*; A Chugg, S Parker, *MBDA*

2:05 C-2

**Single-Event Upsets and Distributions in Radiation-Hardened CMOS Flip-Flop Logic Chains**

P Dodd, M Shaneyfelt, R Flores, J Jorgensen, J Schwank, T Hill, S Swanson, *SNL*

2:20 C-3

**32 and 45nm Radiation Hardened by Design (RHBD) SOI Latches**

K Rodbell, D Heidel, M Gordon, K Stawiasz, *IBM*; J Pellish, K LaBel, *NASA Goddard*; P Marshall, *Consultant*; M Berg, H Kim, M Friendlich, A Phan, C Seidleck, *MEI Technologies*

2:35 C-4

**On the Susceptibility of Latches to Low-Energy Protons**

N Seifert, B Gill, *Intel Corporation*; J Pellish, K LaBel, *NASA Goddard*; P Marshall, *NASA Consultant*

2:50 C-5

**Comparison of Combinational and Sequential Error Rates for a Deep Submicron Process**

N Mahatme, B Bhuvu, S Jagannathan, D Loveless, *Vanderbilt Univ*; S-J Wen, R Wong, *Cisco Systems Inc.*

3:05 C-6

**Predicting the Single-Event Error Rate of a Radiation Hardened by Design Microprocessor**

M Cabanas-Holmen, E Cannon, A Amort, J Ballast, R Brees, S Fischer, A Kleinosowski, B Meaker, T Swann, J Wert, *Boeing*

3:20 **Break** (Marquis Ballroom and Foyer)

3:55 **Session D – Space and Terrestrial Environments**

Chair: James Adams, *NASA Marshall Space Flight Center*

4:00 D-1

**Simulation of the Radiation Environment near Europa Using the Geant4-Based PLANETOCOSMICS-J Model**

P Truscott, *AeroSPACE, QinetiQ*; D Heynderickx, *DH Consultancy BVBA*; A Sicard-Piet, S Bourdarie, *ONERA*

4:15 D-2

**The Interplanetary Electron Model (IEM)**

B Taylor, C Underwood, *Univ of Surrey*; G Vacanti, E Maddox, *Cosine Science & Computing*

4:30 D-3

**Effect of Uranium Chain Disequilibrium on Alpha Disintegration Rate**

M Gedion, F Wrobel, F Saigne, M Portier, A Touboul, *Université Montpellier 2*; R Schrimpf, *Vanderbilt Univ*

4:45 D-4

**Analytical Modeling of Alpha-Particle Emission Rate at Wafer-Level**

S Martinie, J-L Autran, D Munteanu, *IM2NP-CNRS*; F Wrobel, M Gedion, F Saigne, *IES-CNRS*

5:00 **End of Technical Session**

## Wednesday

7:45 Continental Breakfast

8:30 **Invited Talk** (Grand Ballroom)

### **A Short History of Las Vegas, from Artesian Wells to Atomic Weapons**

Mark Hall-Patton, *Museums Administrator, Clark County Museum System*

9:40 **Session E – Radiation Effects In Devices and Integrated Circuits** Chair: Ron Lacoë, *The Aerospace Corp*

9:45 E-1

### **The Mechanism for Subthreshold Leakage Currents in MOSFET's Induced by Nucleons and Ions**

A Chugg, S Parker, *MBDA UK Limited*

10:00 E-2

### **Enhanced Radiation Induced Narrow Channel Effects in a Commercial 0.18 $\mu$ m Bulk Technology**

M Gaillardin, S Girard, M Martinez, P Paillet, *CEA*; V Goiffon, P Magnan, *ISAE*

10:15 E-3

### **Dose Rate Effects in Linear Bipolar Transistors**

A Johnston, R Swimm, D Thorbourn, *Jet Propulsion Lab*

10:30 **Break** (Marquis Ballroom and Foyer)

11:00 E-4

### **Effects of Total Ionizing Dose on the Retention of 41nm NAND Flash Cells**

M Bagatin, S Gerardin, A Paccagnella, *Univ of Padova*; A Visconti, S Beltrami, M Bertuccio, L Czeppel, *Numonyx*

11:15 E-5

### **Layout-Induced Trade-Offs Between RF Performance and Total-Dose Tolerance in 45nm RF-CMOS**

R Arora, K Moen, J Cressler, *Georgia Tech*; E Zhang, D Fleetwood, R Schrimpf, *Vanderbilt Univ*; A Sutton, H Nayfeh, G Freeman, *IBM*

11:30 E-6

### **Impact of Alpha Particles on the Electrical Characteristics of TiO<sub>2</sub> Memristive Devices**

H Barnaby, S Malley, M Land, B Wilkens, *Arizona State Univ*; E Delonno, *The Aerospace Corporation*; W Tong, *TransEL Corp*; J Yang, R Williams, P Kuekes, *Hewlett-Packard Labs*

11:45 E-7

### **Radiation Effects in 3D Integrated SOI SRAM Circuits**

P Gouker, B Tyrrell, R D'Onofrio, *MIT Lincoln Lab*; J Schwank, M Shaneyfelt, *SNL*

12:00 Lunch

1:30 **Session F – Basic Mechanisms of Radiation Effects**

Chair: Ron Pease, *RLP Research*

1:35 F-1

### **Radiation-Induced Defect Evolution and Electrical Degradation of AlGaIn/GaN High-Electron-Mobility Transistors**

Y Puzyrev, T Roy, D Fleetwood, R Schrimpf, *Vanderbilt Univ*; S Pantelides, *Vanderbilt Univ and Oak Ridge National Lab*

1:50 F-2

### **Effects of Bias on the Irradiation and Annealing Responses of SiC MOS Devices**

C Zhang, E Zhang, D Fleetwood, R Schrimpf, X Shen, S Pantelides, *Vanderbilt Univ*; S Dhar, S-H Ryu, *Cree Inc.*

2:05 F-3

### **Mechanisms of Interface Trap Buildup and Annealing During Elevated Temperature Irradiation**

D Hughart, R Schrimpf, D Fleetwood, B Tuttle, S Pantelides, *Vanderbilt Univ*

2:20 F-4

### **A Quantitative Model for ELDRS and H2 Degradation Effects in Irradiated Oxides Based on First Principles Calculations**

N Rowsey, M Law, *Univ of Florida*; R Schrimpf, D Fleetwood, B Tuttle, S Pantelides, *Vanderbilt Univ*

2:35 F-5

### **Modeling Low Dose Rate Effects in Shallow Trench Isolation Oxides**

I Esqueda, H Barnaby, *Arizona State Univ*; P Adell, B Rax, *Jet Propulsion Lab*; H Hjalmarson, *SNL*; R Pease, *RLP Research*

2:50 **Data Workshop** (Valencia Ballroom) Chair: Craig Hafer, *Aeroflex Colorado Springs*

**W-1 Wafer-by-Wafer Low Dose Rate Qualification in a Production Environment**

N van Vonno, L Pearce, A Northen, J Touvell, J Brewster, J Gill, E Thomson, P Chesley, *Intersil Corp*; D Schettler, *Hopewell Designs, Inc.*

**W-2 Total Ionizing Dose Considerations in Space Bound Electronics Subjected to Real Time X-Ray Radioscopic Examinations**

R Lawrence, C Ocheltree, *BAE Systems*

**W-3 The Use of Diodes as Dose and Fluence Probes in the Experimental Beamline at the Francis H. Burr Proton Therapy Center**

E Cascio, *Massachusetts General Hospital*; H Bentefour, *Louvain-la-Neuve*

**W-4 Guide to the 2010 IEEE Radiation Effects Data Workshop Record**

D Hiemstra, *MDA*

**W-5 Recent Total Ionizing Dose and Displacement Damage Compendium of Candidate Electronics for NASA Space Systems**

D Cochran, D Chen, M O'Bryan, *MEI Technologies Inc.*; A Boutte, M Campola, M Carts, M Casey, K LaBel, R Ladbury, J-M Lauenstein, C Marshall, J Pellish, A Sanders, M Xapsos, *NASA Goddard*; T Oldham, *Dell Perot Systems Inc.*

**W-6 Recent Single Event Effects Compendium of Candidate Electronics for NASA Space Systems**

M O'Bryan, D Chen, H Kim, A Phan, M Berg, *MEI Technologies Inc.*; K LaBel, J Pellish, J-M Lauenstein, C Marshall, R Ladbury, A Sanders, M Xapsos, *NASA Goddard*; T Oldham, *Perot Systems*; P Marshall, *Consultant*; D Heidel, K Rodbell, *IBM T. J. Watson Research Center*; J Swonger, D Alexander, *Peregrine Semiconductor*

**W-7 Compendium of Recent Total Ionizing Dose Test Results Conducted by the Jet Propulsion Lab from 2009-2011**

J Bowles-Martinez, D Thorbourn, G Allen, B Rax, L Scheick, R Harris, *Jet Propulsion Lab*; A Kenna, *Northrop Grumman Space Technology*

**W-8 Total Dose Test Results for CubeSat Electronics**

K Avery, J Finchel, R Netzer, *AFRL*; W Kemp, *SAIC*; D Alexander, *Consultant*

**W-9 A Summary of Single Event Upset (SEU) Testing of CD4000 Series Devices**

R Lombardi, A Rubin, A Bogorad, J Likar, C Camacho, *Lockheed Martin Space Systems Company*

**W-10 Heavy Ion Single Event Effects Performance of RadHard Devices Migrated to an Alternate Wafer Fab**

C Hafer, M Lahey, D Harris, B Larsen, F Sievert, T Sims, S Meyer, A Jordan, P Milliken, *Aeroflex Colorado Springs*

**W-11 Low Dose Rate Testing Results of Legacy Intersil Products**

N van Vonno, L Pearce, J Gill, E Thomson, P Chesley, *Intersil Corp*

**W-12 5MGy Gamma-dose Tolerant MASH Delta-Sigma Time-to-Digital Converter with 5.6ps Resolution and 1.7mW Power Consumption**

Y Cao, *ESAT-MICAS and ANS-ICR*; P Leroux, *ESAT-MICAS, ANS-ICR and ICT-RELIC*; W De Cock, *ANS-ICR*; M Steyaert, *ESAT-MICAS*

**W-13 SEE Results for Commercial Non-Opto Galvanic Isolators for Space Application**

S Buchner, M Jacobson, *NRL*

**W-14 Single Event Upset Characterization of a Mixed-Signal Field Programmable Gate Array Using Proton Irradiation**

D Hiemstra, P Gill, *MDA*

**W-15 Radiation Characterization of ACTEL Pro ASIC3 Flash FPGA Family**

C Poivey, D Merodio Codinachs, *ESA ESTEC*; M Grandjean, X Guerre, *HIREX Engineering*

**W-16 Recent Single Event Effects Results in Advanced Reconfigurable Field Programmable Gate Arrays**

G Allen, *Jet Propulsion Lab*; G Madias, E Miller, *Boeing*; G Swift, *Xilinx*

**W-17 Single Event Effect Sensitivity of High-Speed Differential Interface Devices to Heavy Ions and Protons**

R Koga, J George, S Bielat, P Yu, *The Aerospace Corp*

**W-18 Single-Event Characterization of the Multi-Gigabit Transceivers (MGTs) in the Space-Grade Virtex-5QV FPGA**

R Monreal, *SouthWest Research Institute*; G Swift, C Carmichael, *Xilinx*

**W-19 LEON 3FT Proton SEE Test Results for the Solar Probe Plus Program**

C Pham, *JHU/APL*

**W-20 Investigation of Low Cross Section Events in the RHBD/FT UT699 LEON 3FT**

S Guertin, *Jet Propulsion Lab*; C Hafer, S Griffith, *Aeroflex Colorado Springs*

**W-21 Radiation and Reliability Characterization of a Multiplexer Family Using a 0.35 $\mu$ m Triple-Well CMOS Technology**

A Wilson, D Kerwin, T Richardson, Q Ton, K Merkel, G Koziuk, C Hafer, *Aeroflex Colorado Springs*

**W-22 130nm Single Event Upset Performance Evaluation: Commercial Vs. Hardened by Design Architectures**

R Dumitru, C Hafer, T-W Wu, R Rominger, P Milliken, K Bruno, T Farris, *Aeroflex Colorado Springs*

**W-23 SEE and TID Response of Spansion 512Mb NOR Flash Memory**

F Irom, D Nguyen, *Jet Propulsion Lab*

**W-24 SEU and MBU Angular Dependence of Samsung and Micron 8Gb SLC NAND-Flash Memories under Heavy-Ion Irradiation**

K Gruermann, D Walter, M Herrmann, F Gliem, *Technical Univ of Braunschweig*; H Kettunen, *Univ of Jyvaskyla*; V Ferlet-Cavrois, *ESA/ESTEC*

**W-25 Investigation of Current Spike Phenomena During Heavy Ion Irradiation of NAND Flash Memory**

T Oldham, *Perot Systems*; M Friendlich, *MEI Technologies Inc.*; K LaBel, *NASA Goddard*

**W-26 Proton-Induced Single Event Upsets in 90nm Technology High Performance SRAM Memories**

H Puchner, *Cypress Semiconductor*; J Tausch, *JD Instruments*; R Koga, *Aerospace*

**W-27 SEEs Induced by High-Energy Neutrons in SDRAM**

H Quinn, T Fairbanks, *Los Alamos National Lab*

**W-28 Neutron Beam Testing of Tribolades**

S Michalak, A DuBois, C Storlie, W Rust, D DuBois, D Modl, H Quinn, S Blanchard, *Los Alamos National Lab*; A Manuzzato, *Universit' degli Studi di Padova*

**W-29 Radiation Characterization of Commercial GaN Devices**

R Harris, L Scheick, T Miyahira, *Jet Propulsion Lab*

**W-30 TID Response at High and Low Dose Rates of Switching Diodes**

G Chaumont, B Cornanguer, S Savin, *STMicroelectronics*

**W-31 Recent Power MOSFET Test Results**

L Scheick, *Jet Propulsion Lab*; M Gauthier, B Gauthier, B Triggs, *Semicoa Corporation*

**W-32 Effects of Current Injection Annealing on III-V Heterojunction Bipolar Transistors**

E Bielejec, G Vizkelethy, R Fleming, N Kolb, D King, G Patriz, *SNL*

**W-33 Calculating Spacecraft Single Event Environments with FLUKA**

S Koontr, B Reddell, *NASA Johnson Space Center*; P Boeder, *Boeing Company*

**W-34 COTS Based On-Board-Computer on South Africa's Sumbandilasat: A Radiation and In-Orbit Performance Analysis**

A Barnard, *Stellenbosch Univ*; C Nwosa, *South African Astronomical Observatory*

**W-35 FASTRAD 3.2: Radiation Shielding Tool with a New Monte Carlo Module**

P Pourrouquet, J-C Thomas, P-F Peyrard, *TRAD*; R Ecoffet, G Rolland, *CNES*

**W-36 Applicability of the Accelerated Switching Test Method - a Comprehensive Survey Using the LM158 and LM339**

M Wind, P Beck, *Austrian Institute of Technology*; J Boch, L Dusseau, *Université Montpellier 2*; A Zadeh, M Poizat, *ESA/ESTEC*

**W-37L Impact of Reference Voltage on the ELDRS Characteristics of the LM4050 Shunt Voltage Reference**

K Kruckmeyer, T Trinh, L McGee, *National Semiconductor*

5:00 **End of Data Workshop**

## Thursday

7:45 **Continental Breakfast**

8:30 **Invited Talk** (Grand Ballroom)

**A Brief History of the Nevada Test Site**

Dr. William A. Seidler II, *The Boeing Company*

9:40 **Session G – Hardness Assurance** Chair: Alan Tipton,

*JHU Applied Physics Lab*

9:45 G-1

**Comparison of Single and Two-Photon Absorption for Laser**

**Characterization of Single-Event Upsets in SOI SRAMs**

J Schwank, M Shaneyfelt, P Dodd, S Swanson, *SNL*; D McMorrow, J Melinger, *NRL*; V Ferlet-Cavrois, *ESA/ESTEC*; P Gouker, *MIT Lincoln Lab*; J Pellish, K LaBel, *NASA Goddard*; K Rodbell, D Heidel, *IBM T. J. Watson Research Center*; P Marshall, *NASA Consultant*

10:00 G-2

**Characterization of the Two-Photon Absorption Carrier**

**Generation Region in Bulk Silicon Diodes**

N Hooten, R Reed, N Gaspard, M Mendenhall, R Schrimp, A Witulski, A Sternberg, *Vanderbilt Univ*; D McMorrow, J Warner, *NRL*; P Dodd, M Shaneyfelt, J Schwank, *SNL*

10:15 **Break** (Marquis Ballroom 5 – 8)

10:45 G-3

**Variable Depth Bragg Peak Method for Single Event Effects**

**Testing**

S Buchner, N Kanyogoro, *NRL*; C Foster, *Consultant*; P O'Neill, *NASA Johnson*

11:00 G-4

**Enhanced Low Dose Rate Sensitivity at Ultra-Low Dose Rates**

D Chen, J Forney, A Phan, *MEI Technologies*; R Pease, *RPL Research*; M Carls, S Cox, K LaBel, *NASA Goddard*; K Kruckmeyer, *National Semiconductor*; S Burns, R Albarian, *Linear Technology*; J Salzman, B Holcombe, B Little, *Texas Instruments*; G Chaumont, H Duperray, A Ouellet, *STMicroelectronics*; S Buchner, *NRL*

11:15 G-5

**Effects of Ion Species on SEB Failure Voltage of Power**

**DMOSFET**

S Liu, H Cao, D Carrier, M Brisbois, M Zafrani, P Sherman, *International Rectifier*; J-M Lauenstein, K LaBel, *NASA Goddard*; V Ferlet-Cavrois, M Muschitiello, C Poivey, *ESA/ESTEC*; R Marec, *Thales Alenia Space*; F Hernandez, R Mangeret, *EADS Astrium*; L Scheick, *Jet Propulsion Lab*; F Bezerra, R Ecoffet, *CNES*; N Sukhaseum, L Coquelet, *TRAD*

11:30 **Lunch**

1:00 **Session H – Hardening by Design** Chair: Ben Blalock,

*Univ of Tennessee*

1:05 H-1

**An SET-Free, Digital, Programmable Point-of-Load Regulator for Next-Generation Power Systems**

P Adell, D Aveline, *Jet Propulsion Lab*; T Liu, B Bakkaloglu, B Vermeire, *Arizona State Univ*

1:20 H-2

**A Dual Mode Redundant Approach for Processor SEE Hardness**

L Clark, D Patterson, K Holbert, N Hindman, *Arizona State Univ*; S Guertin, *Jet Propulsion Lab*

1:35 H-3

**Design Framework for Soft-Error-Resilient Sequential Cells**

H-H Lee, I Linscott, U Inan, *Stanford Univ*

1:50 H-4

**Single-Event Tolerant Flip-Flop Design in 40nm CMOS**

**Technology**

S Jagannathan, T Loveless, J Ahlbin, B Bhuva, L Massengill, *Vanderbilt Univ*; S Wen, R Wong, *Cisco Systems*; M Sachdev, D Rennie, *Univ of Waterloo*

2:05 H-5

**A Study of Total Dose Mitigation Approaches for Charge Pumps in Phase-Locked Loop Applications**

S Horst, S Phillips, J Cressler, *Georgia Tech*; K Kruckmeyer, R Eddy, A Aude, P O'Farrell, B Zhang, *National Semiconductor*

2:20 **POSTER SESSION** (Valencia Ballroom)

Chair: Philippe Roche, *STMicroelectronics*

**PA-1 Single Event Transient Analysis of a Pulse-Width Modulator IC in a DC-DC Converter**

Y Ren, L Chen, *Univ of Saskatchewan*; S-J Wen, R Wong, *Cisco Systems*; C Lin, N Vonno, *Intersil*; A Witulski, B Bhuvu, *Vanderbilt Univ*

**PA-2 Effect of Transistor Density and Charge Sharing on Single-Event Transients in 90nm Bulk CMOS**

N Atkinson, J Ahlbin, A Witulski, N Gaspard, W Holman, B Bhuvu, E Zhang, L Massengill, *Vanderbilt Univ*; L Chen, *Univ of Saskatchewan*

**PA-3 A Bulk Built-in Voltage Sensor to Detect Physical Location of Single-Event Transients**

Z Zhang, T Wang, Y Ren, L Chen, R Sammynaiken, *Univ of Saskatchewan*; N Gaspard, A Witulski, H Timothy, B Bhuvu, *Vanderbilt Univ*; S-J Wen, *Cisco Systems*

**PA-4 Influence of n-Well Contact Area on the Pulse Width of Single-Event Transients**

J Ahlbin, N Atkinson, N Gaspard, B Bhuvu, T Loveless, E Zhang, L Massengill, *Vanderbilt Univ*; M Gadlage, *NAVSEA Crane*; L Chen, *Univ of Saskatchewan*

**PB-1 Effects of Ion Atomic Number on Single-Event Gate Rupture (SEGR) Susceptibility of Power MOSFETs**

J-M Lauenstein, R Ladbury, *NASA Goddard*; N Goldsman, P Sherman, *Univ of Maryland*; J Titus, *NAVSEA Crane*; H Kim, A Phan, *MEI Technologies*; S Liu, M Zafrani, *International Rectifier*

**PB-2 Probing the SEB Sensitive Depth Using a Two-Photon Absorption Method**

S Liu, B Yang, M Zafrani, P Sherman, *International Rectifier*; J Titus, *NAVSEA Crane*; J-M Lauenstein, *NASA Goddard*; D McMorrow, S Buckner, *NRL*; A Phan, H Kim, *MEI Technologies*

**PB-3 Investigation on the SEL Sensitive Depth of an SRAM Using Linear and Two-Photon Absorption Laser Testing**

E Faraud, V Pouget, K Shao, C Larue, F Darracq, D Lewis, *IMS*; A Samaras, F Bezerra, E Lorfevre, R Ecoffet, *CNES*

**PB-4 In Flight SEU/MBU Sensitivity of Commercial Nanometric SRAMs: Operational Estimations**

L Artola, *ONERA and CNES*; R Velazco, W Mansour, F Pancher, *TIMA Labs*; G Hubert, S Duzellier, T Nuns, *ONERA*; F Bezerra, *CNES*; B Guerard, *Institut Laue-Langevin*

**PB-5 Heavy Ion Characterization and Monte-Carlo Simulations on 32nm CMOS Bulk Technology**

S Uznanski, G Gasiot, P Roche, L Dugoujon, *STMicroelectronics*; J-L Autran, *IM2NP*

**PB-6 Impact of Process Variations and Charge Sharing on the Single Event Upset Response of Flip-Flops**

A Kauppila, B Bhuvu, L Massengill, W Holman, D Ball, *Vanderbilt Univ*

**PB-7 Experimental Evidence of Large LET Dispersion in Thin Active Layer Devices**

M Raine, M Gaillardin, P Paillet, O Duhamel, S Girard, *CEA*; A Bournel, *IEF*

**PB-8 Mechanism for Upsets in FGMOS Device**

P McNulty, K Poole, S Yow, *Clemson Univ*; L Scheick, *Jet Propulsion Lab*

**PB-9L Circuit-Level Layout-Aware Single-Event Sensitive-Area Analysis of 40nm Bulk CMOS Flip-Flops Using Compact Modeling**

J Kauppila, T Haeffner, D Ball, A Kauppila, D Loveless, S Jagannathan, A Sternberg, B Bhuvu, L Massengill, *Vanderbilt University*

**PC-1 Single-Event Damages Observed in AlGaIn/GaN HEMTs**

S Kuboyama, H Shindou, N Ikeda, T Tamura, *JAXA*; T Hirao, *JAEA*

**PC-2 The Single Event Effects on an LC PLL and a Ring PLL Fabricated in 0.25 $\mu$ m Silicon-on-Sapphire Technology**

J Li, P Gui, *Southern Methodist Univ*; Y Ren, L Chen, *Univ of Saskatchewan*; B Bhuvu, *Vanderbilt Univ*

**PC-3 Numerical and Experimental Investigation of Single Event Effects in SOI Lateral Power MOSFETs**

P Shea, Z Shen, *Univ of Central Florida*

**PC-4 Neutron-Induced Failures of Trench Gate Fieldstop IGBT**

L Foro, A Touboul, F Wrobel, F Saigne, *Université Montpellier 2*

**PC-5 Single Event Effects in 90nm Phase Change Memories**

S Gerardin, M Bagatin, A Paccagnella, *Univ of Padova*; A Visconti, M Bonanomi, F Pellizzer, M Vela, *Numonyx*

**PC-6 Single-Event Charge Collection and Upset in 40nm Dual- and Triple-Well Bulk CMOS SRAMs**

I Chatterjee, N Mahatme, B Bhuvu, R Schrimpf, *Vanderbilt Univ*; B Narasimham, J Wang, B Bartz, E Pitta, M Buer, *Broadcom Corporation*

**PC-7 Analyzing the Impact of Single-Event-Induced Charge Sharing in Complex Circuits**

S Pagliarini, F Kastensmidt, *Instituto de Informatica*; L Entrena, A Lindoso, E Heredia, *Univ Carlos III of Madrid*

**PC-8 Internet Routing in Space (IRIS) Enabled by Commercial Processors**

I Troxel, J Schaefer, R Owen, *SEAKR Engineering*; C Olson, E Watko, *Cisco Systems*

**PD-1 Remarks About the On Orbit Non Ionizing Dose Constraint**

C Inguibert, S Bourdarie, P Arnolda, *DESP, ONERA*; C Boatella-Polo, *CNES*

**PD-2 On Orbit Error Rates of RHBD SRAMs: Comparison of Calculation Techniques and Space Environmental Models with Observed Performance**

A Bogorad, J Likar, R Lombardi, R Herschitz, *Lockheed Martin Space Systems*

**PE-1 Total Ionizing Dose Effects of Elementary Devices for Control Circuit of 180nm Flash Technology**

Z Liu, Z Hu, Z Zhang, H Shao, B Ning, M Chen, D Bi, S Zou, *Chinese Academy of Sciences*

**PE-2 The Impact of Device Width on the Variability of Leakage Currents in 90 and 65nm CMOS Technologies**

N Rezzak, P Maillard, R Schrimpf, M Alles, D Fleetwood, *Vanderbilt Univ*; Y Li, *Accelicon Technologies*

**PE-3 Investigation of Low Dose Rate and Bias Conditions on the Total Dose Tolerance of a CMOS Flash-Based FPGA**

S Rezgui, *Microsemi Corporation*

**PE-4 Analyzing the Effects of TID in an Embedded System Running into a Flash-Based FPGA**

J Azambuja, J Tarrillo, F Kastensmidt, *Instituto de Informatica*; E Junior, R Galhardo, O Goncalvez, *IEAv*

**PE-5 Characterization and Modeling of Parasitic Field-Oxide Transistors for Use in Radiation Hardening by Design**

G Schlenvogt, H Barnaby, J Rollins, *Arizona State Univ*; J Wilkinson, S Morrison, *Medtronic*; L Tyler, *Medtronic Microelectronics Center*

**PE-6 Fin Width and Bias Dependence of the Response of Triple-Gate MOSFETs to Total Dose Irradiation**

J-J Song, C-H Park, Y-H Jeong, O Kim, *Pohang Univ of Science and Technology*; B Choi, E Zhang, R Schrimpf, D Fleetwood, *Vanderbilt Univ*

**PE-7 A New Physical Model and Parameter Extraction Approach for Total-Ionizing-Dose-Aware SPICE Models**

M Li, Y Li, *Accelicon Technologies*; R Schrimpf, D Fleetwood, N Rezzak, *Vanderbilt Univ*; J Wang, D Wang, *Chinese Academy of Science*; X Chen, Y Wang, *Tsinghua Univ*

**PE-8 Microdose Effect in Commercial Trench Power MOSFETs and Its Implication to Several Mainstream Devices**

Y Yan, L Ding, Z Wang, *Tsinghua Univ*; R Fan, *Tsinghua Univ and Northwest Institute of Nuclear Technology*; W Chen, H Guo, D Lin, X Guo, Y Wang, K Zhang, F Zhang, Z Yao, *Northwest Institute of Nuclear Technology*

**PE-9 New Evidences of Partial Inactivity Windows in a Switched-Capacitor Analog Array under Gamma-Ray Irradiation**

T Balen, *Unilasalle and CEITEC*; R Vaz, O Goncalvez, *IEAv*; G Cardoso, *UFRGS*; M Lubaszewski, *UFRGS and CEITEC*

**PE-10 Predictive Modeling of TID and SET Effects from Datasheet and Radiation Data for Commercial Components**

A Francis, J Holmes, *Lynguent, Inc.*; N van Vonno, *Intersil*

**PE-11 Study of Synergism Effect Between TID and ATREE on the Response of the LM124 Operational Amplifier**

N Roche, S Perez, J Mekki, Y Gonzalez Velo, L Dusseau, J Boch, F Saigné, *Université Montpellier 2*; J-R Vaillé, *Université Montpellier 2 and Université de Nîmes*; R Marec, P Calvel, *Thales Alenia Space*; F Bezerra, *CNES*; G Auriel, *CEA*; B Azaïs, *DGA*

**PE-12 Radiation Response of Carbon Nanotube PN Junctions**

E Comfort, M Fishman, A Malapanis, H Bakhrui, J Lee, *Univ at Albany*

**PE-13L Effect of Radiation Exposure on the Retention of Commercial NAND Flash Memory**

T Oldham, M Carts, K LaBel, *NASA Goddard*, D Chen, M Friendlich, C Seidleck, *MEI Technologies*

**PE-14L Near-UV Irradiation Effects on Pentacene Based Organic Thin Film Transistors**

A Cester, N Wrachien, D Bari, G Meneghesso, *University of Padova*, J Kovac, J Jakabovic, D Donoval, *Slovak Univ*

**PF-1 Evaluation of ELDRS Mechanisms Using Dose Rate Switching Experiments on Gated Lateral PNP Transistors**

Y Gonzalez Velo, J Boch, F Saigné, N Roche, S Perez, C Deneau, J-R Vaillé, L Dusseau, *Université Montpellier 2*; R Schrimpf, *Vanderbilt Univ*; E Lorfevre, *CNES*

**PF-2L Low-Energy X-Ray- and Ozone-Exposure Induced Defect Formation in Graphene Materials and Devices**

*E. Zhang, A.K.M. Newaz, S. Bhandaru, B. Wang, C.X. Zhang, D.M. Fleetwood, M.L. Alles, R.D. Schrimpf, S.T. Pantelides, S.M. Weiss, R.A. Reed, R.A. Weller, K.I. Bolotin, Vanderbilt University*

**PG-1 Incorporating Probability Models of Complex Test Structures to Perform Technology Independent FPGA Single Event Upset Analysis**

*M Berg, H Kim, M Friendlich, C Perez, C Seidleck, MEI Technologies; K LaBel, NASA Goddard*

**PG-2 Optimization Tool for Estimating the Low-Dose-Rate Response of Bipolar Transistors Using the Switched Dose Rate Technique**

*J Boch, Y Gonzalez Velo, F Saigne, N Roche, S Perez, J-R Vaile, L Dusseau, J Mekki, Université Montpellier 2; R Schrimpf, Vanderbilt Univ; E Lorfèvre, R Ecoffet, Centre National d'Etudes Spatiales*

**PG-3 Dynamic-Stress Neutrons Test of Commercial SRAMs**

*P Rech, J-M Galliere, P Girard, F Wrobel, F Saigne, L Diillo, Université Montpellier 2*

**PG-4 A Bayesian Approach for Total Ionizing Dose Hardness Assurance**

*R Ladbury, NASA Goddard; K Mulker, Boeing Space and Intelligent Systems; B Triggs, Semicoa*

**PH-1 A High Performance Ultralow Power Radiation Hardened Translation Lookaside Buffer**

*S Maurya, N Hindman, D Patterson, K Holbert, L Clark, Arizona State Univ*

**PH-2 Synthesis Using High Speed Radiation Hardened by Design Redundant Logic Structures**

*N Hindman, L Clark, D Patterson, K Holbert, Arizona State Univ*

**PH-3 Dummy Gate-Assisted N-MOSFET Layout for Total Ionizing Dose Mitigation**

*M Lee, H Lee, KAIST*

**PH-4 An Area-Efficient 65nm Radiation-Hard Dual-Modular Flip-Flop to Avoid Multiple Cell Upsets**

*R Yamamoto, C Hamanaka, K Kobayashi, Kyoto Institute of Technology; J Furuta, H Onodera, Kyoto Univ*

**PH-5 A RHBD Bootstrap Current Source Utilizing Sensitive Node Active Charge Cancellation (SNACC)**

*R Blaine, W Holman, L Massengill, J Kauppila, Vanderbilt Univ; S Armstrong, Vanderbilt Univ and NAVSEA Crane; B Olson, NAVSEA Crane*

**PI-1 Radiation Damage Studies of Lasers and Photodiodes for Use in Multi-Gigabit/s Optical Data Links**

*J Troska, S Detraz, S Seif El Nasr-Storey, P Stejskal, C Sigaud, C Soos, F Vasey, CERN*

**PI-2 Single Event Upsets in Receivers for Multi-Gigabit/s SLHC Data Transmission**

*S Seif El Nasr-Storey, S Detraz, P Moreira, P Stejskal, C Sigaud, C Soos, J Troska, F Vasey, CERN; P Gui, Southern Methodist Univ; M Menouni, Université de la Méditerranée*

**PI-3 Ageing Effects on Image Sensors: Neutron Irradiation Studies on Wafer and Packaged Devices**

*G Nampoothiri, Delft Univ of Technology; A Theuwissen, Delft Univ of Technology and Harvest Imaging*

**PI-4L Scintillation-Based Solid-State Spectrometer for Compact Monitoring of Space Radiation/Weather Satellite Conditions**

*C Whitney, X Chen, E Johnson, C Stapels, R Rines, E Chapman, G Alberghini, E Loef, J Glodo, K Shah, J Christian, Instrument Research and Development, Radiation Monitoring Devices*

**PJ-1 Dose Enhancement in Metal-Gate, High-K MOS Devices**

*A Dasgupta, D Fleetwood, R Reed, R Weller, M Mendenhall, B Sierawski, Vanderbilt Univ*

**PJ-2 Statistical and Systematic Errors in Dosimetry Estimated from Multiple Tests**

*R Morris, Universities Space Research Association; C Foster, Foster Consulting Services*

**PJ-3L Displacement Damage Depth-Dose (ShieldDose) Analyses Using SCREAM**

*S Messenger, E Jackson, J Warner, R Walters, NRL*

5:00 **End of Poster Session**

5:30 **Radiation Effects Committee Open Meeting** (Grand Ballroom)

7:00 **Meeting Ends**

## Friday

7:45 **Continental Breakfast**

8:30 **INVITED TALK** (Grand Ballroom)

**The James Webb Space Telescope: Mission Overview and Status**

Matt Greenhouse, *James Webb Space Telescope Project Scientist for the Science Instrument Payload*

9:40 **Session I – Photonic Devices and Integrated Circuits**

Chair: Joe Srour, *The Aerospace Corporation*

9:45 I-1

**In-Orbit Measurement of SET and DD Effects on Optical Wireless Links for Intra-Satellite Data Transmission**

I Arruego, J Martinez, H Guerrero, *Space Sciences, Instituto Nacional de Tecnica Aeroespacial*

10:00 I-2

**Generic Radiation Hardened Photodiode Layouts for Deep Submicron CMOS Image Sensor Processes**

V Goiffon, P Cervantes, C Virmontois, F Corbiere, P Magnan, *Universite de Toulouse, ISAE*

10:15 I-3

**TID Versus DDD Induced Random Telegraph Signal in CMOS Image Sensors**

C Virmontois, V Goiffon, P Magnan, *ISAE, Univ of Toulouse*; S Girard, *CEA*; O Saint-Pe, *EADS ASTRIUM*; S Petit, G Rolland, *CNES*

10:30 **Break** (Marquis Ballroom 5-8)

11:00 **Session J – Dosimetry** Chair: Reno Harboe-Sørensen, *former ESA/ESTEC*

11:05 J-1

**The Use of On-Orbit Solar Array Degradation Data for Displacement Damage Dosimetry**

S Messenger, J Warner, E Jackson, R Walters, *NRL*

11:20 J-2

**The Impact of Spacecraft-Shell Composition on 1 GeV/n <sup>56</sup>Fe Ion-Fragmentation and Dose Reduction**

M Silvestri, *Altran Italia Spa*; E Tracino, C Lobascio, R Destefanis, M Briccarello, *Thales Alenia Space Italia*; M Belluco, *Sofiter System Engineering*; M Durante, *Biophysik, GSI*; G Santin, *RHEA Tech Ltd. for ESA*; R Schrimpf, *Vanderbilt Univ*

11:35 J-3

**Validation of Simulation Codes for Proton-Induced Radiation Effects: The Case for CEM03**

M Sabra, R Weller, M Mendenhall, R Reed, M Clemens, *Vanderbilt Univ*; A Barghouty, *NASA Marshall Space Flight Center*

11:50 J-4

**Low-Energy Proton Testing Using Cyclotron Sources**

J Pellig, K LaBel, *NASA Goddard*; P Marshall, *Consultant*; C Castaneda, *Crocker Nuclear Lab, UC Davis*; R Weller, M Mendenhall, R Reed, *Vanderbilt Univ*; D Heidel, K Rodbell, *T. J. Watson Research Center, IBM Corp.*; M Berg, H Kim, M Friendlich, A Phan, C Perez, C Seidleck, *MEI Technologies*; J Schwank, *SNL*

12:05 **End of Conference**