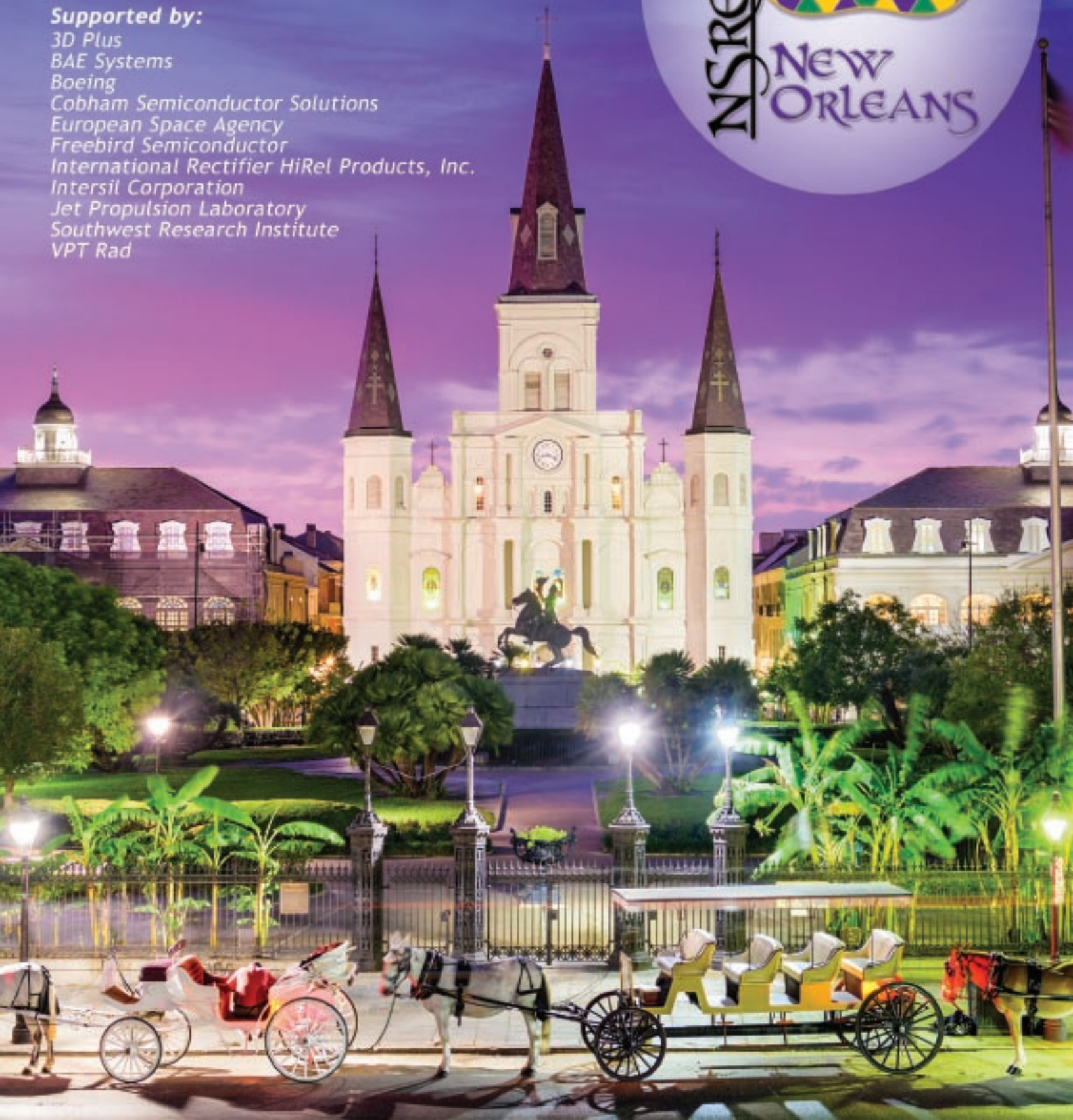


**IEEE Nuclear and Space
Radiation Effects Conference
July 17-21, 2017
New Orleans Marriott**

Sponsored by:
IEEE/NPSS Radiation Effects Committee

Supported by:
3D Plus
BAE Systems
Boeing
Cobham Semiconductor Solutions
European Space Agency
Freebird Semiconductor
International Rectifier HiRel Products, Inc.
Intersil Corporation
Jet Propulsion Laboratory
Southwest Research Institute
VPT Rad



Schedule

Time	Monday July 17	Tuesday July 18	Wednesday July 19	Thursday July 20	Friday July 21
7:00				[7:00-8:30] IEEE Young Professionals Breakfast – 4th Floor Balcony M,N (YP talk begins at 7:30 AM.) <i>Ticket Required to Attend</i> — and — [7:30] Breakfast – Carondelet Ballroom	
7:30	[7:30] Breakfast – Mardi Gras Ballroom	[7:30] Breakfast – Mardi Gras & Bissonet / Carondelet Ballrooms	[7:30] Breakfast – Mardi Gras & Bissonet / Carondelet Ballrooms		[7:30] Breakfast – Carondelet Ballroom
8:00	[8:00] Short Course Introduction Jonathan Pellish Acadia Ballroom				
8:10	[8:10] Part 1 – Total Ionizing and Non-ionizing Dose Radiation Hardness Assurance				
8:15	Christian Poivey				
8:30		[8:30] Conference Opening Acadia Ballroom	[8:25] Session D – Single-Event Effects: Devices and Integrated Circuits	[8:30] Invited Talk – The Mars Reconnaissance Orbiter and the Curiosity Rover: Perspectives on Whether Mars is Habitable Tanya Harrison Acadia Ballroom	[8:30] Invited Talk – The Waters of Katrina: What the Storm Taught New Orleans about its Land, People, and Problems Eve Troeh Acadia Ballroom
9:00		[9:10] Session A – Radiation Effects in Devices and Integrated Circuits			
9:30	[9:40] Break – Mardi Gras Ballroom			[9:40] Session H – Space and Terrestrial Environments	[9:45-12:30] Radiation Effects Data Workshop Mardi Gras A-D Ballrooms
10:00	[10:10] Part 2 – Single-Event Effects Radiation Hardness Assurance	[10:15] Break – Mardi Gras & Bissonet / Carondelet Ballrooms	[10:00] Break – Mardi Gras & Bissonet / Carondelet Ballrooms	[10:15] Break – Mardi Gras Ballroom	
10:30	Raymond Ladbury		[10:40] Session D – (continued)	[10:45] Session H – (continued)	
11:00		[11:00] Session A – (continued)			
11:30	[11:40] Short Course Luncheon – Mardi Gras Ballroom A,B,C & 4th Floor Balcony L, M, N		[11:10] Session E – Single-Event Effects: Mechanisms and Modeling	[11:15] Session I – Dosimetry	
12:00		[12:00] Lunch	[12:00] Lunch – Mardi Gras & Bissonet / Carondelet Ballrooms	[12:05] Lunch — and —	[12:30] End of Conference
12:30				[12:05] Women in Engineering Lunch – 4th Floor Balcony M,N <i>Ticket Required to Attend</i>	
1:00			[1:00] Exhibitor Raffle Drawing		
1:30	[1:20] Part 3 – Introduction to Small Satellites and Correlating Factors for Mission Success	[1:25] Session B – Photonic Devices and Integrated Circuits	[1:30] Invited Talk – New Orleans and the Early Days of Jazz Richard Scott Acadia Ballroom	[1:40] Session J – Hardness Assurance	
2:00	Michael Swartwout				
2:30		[2:30] Break – Mardi Gras & Bissonet / Carondelet Ballrooms	[2:40] Session F – Single-Event Effects: Transient Characterization	[2:45-5:30] Poster Session Mardi Gras E-H Ballrooms	
3:00	[2:50] Break – Foyer				
3:30	[3:20] Part 4 – Design Principles for Radiation Hardness Assurance in Spacecraft Programs - From Macro to Nano	[3:10] Session C – Basic Mechanisms of Radiation Effects	[3:30] Break – Foyer		
4:00	David Roth		[3:55] Session G – Hardening by Design		
4:30		[4:30] End of Sessions			
5:00	[4:50] Wrap-up [5:00] Exam (for students requesting CEU credit only)		[5:00] End of Sessions		
5:30	[5:30] End of Short Course	[5:30 to 7:30] Industrial Exhibits Reception – Mardi Gras & Bissonet / Carondelet Ballrooms	[5:30 to 10:30] Conference Social – A Night in Old New Orleans (Boarding busses begin at 5:30pm and return between 9:00pm–10:00pm)	[5:30] End of Sessions	
6:00				[5:30 to 7:30] Radiation Effects Committee Annual Open Meeting – Acadia Ballroom	
6:30					
7:00					

Contents

Chairwoman's Invitation	1
Short Course Program	2
Short Course	3
Course Description	3
Part 1 – Total Ionizing and Non-Ionizing Dose Radiation Hardness Assurance	4
Part 2 – Single-Event Effects Radiation Hardness Assurance	5
Part 3 – Introduction to Small Satellites and Correlating Factors for Mission Success	6
Part 4 – Design Principles for Radiation Hardness Assurance in Spacecraft Programs – From Macro to Nano	7
Technical Program	8
Technical Information	8
Invited Speakers	8
Late-News Papers	8
Tuesday, July 18	9
Session A - Radiation Effects in Devices and Integrated Circuits	9
Session B - Photonic Devices and Integrated Circuits	12
Session C - Basic Mechanisms of Radiation Effects	15
Wednesday, July 19	18
Session D - Single-Event Effects: Devices and Integrated Circuits	18
Session E - Single-Event Effects: Mechanisms and Modeling	21
Invited Talk - New Orleans and the Early Days of Jazz	22
Session F - Single Event Effects: Transient Characterization	23
Session G - Hardening by Design	24
Thursday, July 20	26
Invited Talk - The Mars Reconnaissance Orbiter and the Curiosity Rover: Perspectives on Whether Mars is Habitable	26
Session H - Space and Terrestrial Environments	26
Session I - Dosimetry	27
Session J - Hardness Assurance	28
Poster Session	30
Friday, July 21	31
Invited Talk - The Waters of Katrina: What the Storm Taught New Orleans about its Land, People, and Problems	31
Radiation Effects Data Workshop	31
RESG NEWS	42
Awards	45
2016 NSREC Awards	45
2017 Radiation Effects Award	45
Conference Information	46
Breakfasts, Lunch and Breaks	46
Business Center	46
Rooms for Side Meetings	47
Child Care Reimbursement	47
Registration and Travel	48
Conference Registration	48
On-Site Registration Hours	48
Conference Cancellation Policy	48
Hotel Reservations and Information	49
Airport and Transportation Information	50
Parking and Driving Directions	51
Getting Around Town	51
Industrial Exhibits	53
2017 IEEE NSREC Technical Sessions and Short Course Registration Form	55
2017 IEEE NSREC Activities Registration Form	56
Social Program	57
Industrial Exhibits Reception	58
A Night in Old New Orleans - Conference Social	59
Local Activities	63
Weather and Clothing	65
2017 Conference Committee	66
Official Reviewers	67
Radiation Effects Steering Group	68
2018 Announcement and First Call for Papers	69

Chairwoman's Invitation



"It is a pleasure to invite you to attend this year's conference in New Orleans. The conference committee has put together terrific technical and social programs and you are sure to enjoy this fantastic multi-cultural city. Many thanks to the volunteers, authors, exhibitors, supporters and attendees for your hard work on making NSREC 2017 possible."

Véronique Ferlet-Cavrois
NSREC 2017 General Chairwoman
European Space Agency

On behalf of the Institute of Electrical and Electronics Engineers (IEEE), its Nuclear and Plasma Sciences Society (NPSS), the Radiation Effects Steering Group (RESG) and the 2017 Nuclear and Space Radiation Effects Conference (NSREC) committee, it is my pleasure to invite you to attend the 54th NSREC to be held July 17 – 21, 2017. The conference will be in New Orleans at the New Orleans Marriott, next to the French Quarter area of the city.

The conference begins Monday, July 17, with a one-day Short Course titled "Radiation Hardness Assurance for Satellite Systems – From Macro to Nano". It is organized by Jonathan Pellish of NASA Goddard Space Flight Center and consists of four sections taught by leading experts in their respective fields. This course will discuss Radiation Hardness Assurance for a wide range of space systems, starting with large- and medium-scale systems, and extending them to small satellites with reduced mass and lower overall cost. This short course will benefit those new to the field by covering traditional hardness assurance methods, and those experienced with the evolving topic of hardness assurance for highly scaled microelectronics and advanced Commercial-Off-the-Shelf (COTS) technologies.

The Technical Program is from Tuesday, July 18 to Friday, July 21. Heather Quinn of Los Alamos National Laboratory is the Technical Program Chair. She, along with her technical committee, has chosen an outstanding set of contributed papers organized into 10 sessions of oral presentations and a poster session encompassing papers from all 10 sessions. In addition the technical committee has selected a set of high quality presentations for the Radiation Effects Data Workshop. This is an additional poster session describing radiation effects data on electronic and photonic devices and systems, and new simulation or test facilities. Finally, Heather has invited three engaging speakers to give general interest presentations from Wednesday to Friday.

The Industrial Exhibit, organized by Anne Minez of 3D Plus, opens Tuesday morning. It will allow one-on-one discussions between conference attendees and exhibitors on the latest developments in areas such as radiation-hardened and radiation-tolerant electronics, engineering services, facilities, modeling, and equipment. Attendees will be able to visit the booths during scheduled breaks. Attendees and guests are invited to a reception in the exhibit halls on Tuesday evening.

Local Arrangements Chair, John Stone of Southwest Research Institute, has organized an outstanding social program. The Conference Social on Wednesday evening, at the Mardi Gras World, will highlight the program. Three companion tours are also scheduled. The first, on Tuesday, will be a narrated tour of New Orleans, which includes a visit to the French Quarter, Cemetery, Lake Ponchartrain, and the Garden District. The second, on Wednesday, will be a cooking demonstration at the New Orleans Cooking School. The third, on Thursday, will be a visit to the National World War II Museum.

The NSREC 2017 conference committee, including Publicity Chair Teresa Farris (Cobham Semiconductor Solutions), Finance Chair Dolores Black (Sandia National Laboratories), Awards Chair Jean-Luc Leray (CEA), Poster Chair Marta Bagatin (DEI – University of Padova), Radiation Effects Data Workshop Chair Jeffrey George (The Aerospace Corporation), and Web Developer Jeff Black (Sandia National Laboratories) welcomes you to one of America's most fantastic cities.

We look forward to seeing you in New Orleans this July!

**Visit us on the web at:
www.nsrec.com**

Short Course Program

RADIATION HARDNESS ASSURANCE FOR SATELLITE SYSTEMS – FROM MACRO TO NANO

**NEW ORLEANS MARRIOTT
ACADIA BALLROOM – MONDAY, JULY 17**

- 8:00 AM **SHORT COURSE INTRODUCTION**
Jonathan Pellish, NASA Goddard Space Flight Center
- 8:10 AM **PART 1 — TOTAL IONIZING AND NON-IONIZING DOSE
RADIATION HARDNESS ASSURANCE**
Christian Poivey, European Space Agency
- 9:40 AM **BREAK (Mardi Gras Ballroom)**
- 10:10 AM **PART 2 — SINGLE-EVENT EFFECTS RADIATION HARDNESS
ASSURANCE**
Raymond Ladbury, NASA Goddard Space Flight Center
- 11:40 AM **SHORT COURSE LUNCHEON**
(4th floor Balcony L, M, N and Mardi Gras Ballroom A, B, C)
- 1:20 PM **PART 3 — INTRODUCTION TO SMALL SATELLITES AND
CORRELATING FACTORS FOR MISSION SUCCESS**
Michael Swartwout, Saint Louis University
- 2:50 PM **BREAK (Foyer)**
- 3:20 PM **PART 4 — DESIGN PRINCIPLES FOR RADIATION HARDNESS
ASSURANCE IN SPACECRAFT PROGRAMS – FROM MACRO
TO NANO**
David Roth, Johns Hopkins University Applied Physics Lab
- 4:50 PM **WRAP-UP**
- 5:00 PM **EXAM (only for students requesting CEU credit)**
- 5:30 PM **END OF SHORT COURSE**

Each short course attendee will receive both a CD and a thumb drive for the 2017 Short Course Notes

Short Course

COURSE DESCRIPTION

A one-day short course, “Radiation Hardness Assurance for Satellite Systems – From Macro to Nano,” will be presented at the 2017 IEEE Nuclear and Space Radiation Effects Conference (NSREC). This course will discuss Radiation Hardness Assurance for a wide range of space systems, starting with large- and medium-scale systems, and extending them to small satellites with reduced mass and lower overall cost. During the past decade, numerous small platforms have been launched into space, often using advanced Commercial-Off-the-Shelf (COTS) technologies. While the radiation effects vulnerabilities of small satellites are the same as those of their larger, traditional relatives, a revised approach is needed for risk management because of differences in technical requirements and programmatic resources for small satellites. This short course will benefit those new to the field by covering traditional hardness assurance methods. Hardness assurance approaches for highly scaled microelectronics will be included, an evolving topic which is of considerable interest to those experienced in the field.

The short course is organized into four sections. The first provides an overview of Total Ionizing Dose and Displacement Damage Dose (DDD), while the second provides an overview of Single-Event Effects (SEE). Each section will be introduced with sufficient background for those new to the community. The third section of the course discusses how traditional approaches can be modified to address state-of-the-art small platforms. A key factor is the difference in success criteria for small satellites compared to traditional platforms. The fourth section will address applied, practical approaches for hardness assurance in a wide variety of space systems, including real examples for small satellites.

This short course is intended for system designers, radiation effects engineers, component specialists, and other technical and management personnel who are involved in developing reliable systems designed to operate in radiation environments. It provides a unique opportunity for IEEE NSREC attendees to benefit from the expertise of the instructors, along with a critical review of state-of-the-art knowledge in the field. Electronic copies of detailed course notes will be provided at registration.

CONTINUING EDUCATION UNITS (CEUS)

For those interested in Continuing Education Units (CEUs), there will be an openbook exam at the end of the course. The course is valued at 0.6 CEUs and is endorsed by the IEEE and by the International Association for Continuing Education and Training (IACET).

SHORT COURSE CHAIRMAN



*Jonathan Pellish,
NASA Goddard Space Flight
Center,
Short Course Chairman*

Jonathan “Jonny” Pellish is an Associate Chief in the Electrical Engineering Division at the NASA Goddard Space Flight Center (GSFC) in Greenbelt, Maryland. The Electrical Engineering Division provides expert leadership in the design, development, integration, and testing of flight electrical systems and associated technologies for GSFC and NASA missions. He received his B.S. (2004), M.S. (2006) and Ph.D. (2008) in physics and electrical engineering from Vanderbilt University. His technical interests span many space environment components and the resulting radiation effects in aerospace systems, with particular attention to hardness assurance methodologies for state-of-the-art technologies and system architectures. Jonny has authored or co-authored over 60 refereed publications in addition to numerous conference and workshop presentations. He is a member of the American Association for the Advancement of Science, the American Institute of Aeronautics and Astronautics, and the IEEE Nuclear and Plasma Sciences Society.

Short Course Monday



Christian Poivey graduated from l'Institut des Sciences de l'Ingénieur (ISI) Clermont- Ferrand, France in 1985. After graduation he carried out research work on electrical simulation tools in the Commissariat à l'Energie Atomique (CEA) at Bruyeres Le Chatel, France. In 1988, he was awarded the degree of "docteur ingénieur" from the University of Clermont-Ferrand II for this work. He then joined Matra Marconi Space (MMS, now Airbus Defense & Space) in Velizy, France and served as a electronic parts engineer from 1988 to 1992. In 1992, he moved to the position of radiation effects engineer in the MMS radiation group and served there for eight years.

In 2000, Dr. Poivey joined the Radiation Effects and Analysis Group at the NASA Goddard Space Flight Center in Greenbelt, Maryland, USA. There he was the radiation lead on ST-5, the Lunar Reconnaissance Orbiter, and Magnetospheric MultiScale projects. During this time he conducted studies on Single-Event Effects (SEE) in linear devices, field programmable gate arrays, and flight data systems.

Since 2007, he has worked at the European Space Agency (ESA) in Noordwijk, The Netherlands, providing radiation hardness assurance (RHA) support to a variety of projects, including ALPHASAT, SWARM, the James Webb Space Telescope, MTG, MPCV/ORION, and JUICE. Dr. Poivey served as the lead for the European Cooperation for Space Standard (ECSS) RHA standard. Currently, he is leading two flight data experiments currently flying on the ALPHASAT and PROBA-2 missions.

TOTAL IONIZING AND NON-IONIZING DOSE RADIATION HARDNESS ASSURANCE

Christian Poivey
European Space Agency

Dr. Christian Poivey, from the European Space Agency, will introduce Total Ionizing Dose and Total Non-Ionizing Dose (TNID) effects on electronic parts. He will present the basics of TID and TNID Radiation Hardness Assurance (RHA) for Space Systems, including a discussion of Radiation Design Margin (RDM) requirements. Systematic errors and uncertainties on the different inputs used to define TID and TNID RDM will be reviewed: mission radiation environment, radiation levels within the spacecraft, electrical, electronic, and electromechanical (EEE) parts radiation sensitivity, and circuit design. Finally, the challenges of adapting current TID and TNID RHA methodologies to small satellites will be presented, including the use of Commercial-Off-The-Shelf (COTS) parts and performing radiation testing at the board level. Application examples will be also presented.

A top-level outline of the presentation is as follows:

- Introduction
- Overview of space radiation environment, TID, and TNID effects
- Basics of TID and TNID RHA
 - Radiation design margin
 - Bounding EEE part radiation response
 - Bounding the radiation environment
 - Understanding the radiation environment at piece-part level
- Challenges
 - New technologies
 - New platforms
- Conclusions

Short Course Monday



Raymond Ladbury is a radiation engineer at the NASA Goddard Space Flight Center (GSFC) in Greenbelt, Maryland. He specializes in radiation testing, data analysis and statistical modeling of radiation effects in complex electronics. He received his B.S. in Physics in 1982 from Colorado State University in Ft. Collins, Colorado and his Ph.D. in experimental particle physics in 1988 from the University of Colorado at Boulder.

After receiving his Ph.D., Dr. Ladbury worked as a science teacher trainer with the United States Peace Corps in the Savannah region of Togo in West Africa, as a professor of physics in the Appalachian region of Kentucky and an editor at Physics Today Magazine. Dr. Ladbury began his work in radiation effects at Hughes Space and Communications, Inc. in El Segundo, California in 1997 and has worked at GSFC since 2000.

SINGLE-EVENT EFFECTS RADIATION HARDNESS ASSURANCE

Raymond Ladbury

NASA Goddard Space Flight Center

Dr. Ray Ladbury, from the National Aeronautics and Space Administration, Goddard Space Flight Center, will discuss Radiation Hardness Assurance (RHA) for Single-Event Effects (SEE) across the spectrum of satellite platforms, from national assets to small satellites. This part of the course first outlines the conventional SEE RHA approach, which emphasizes mission success. Next, Dr. Ladbury will discuss the challenges posed by new satellite platforms (e.g., cubesats, nanosats, etc.), where cost and schedule receive emphasis equal to if not greater than mission success.

These additional pressures, along with growing demands to reduce size, weight and power, coupled with increased performance, drive many projects toward expanding their use of commercial-off-the-shelf (COTS) technologies. While this may reduce direct parts cost and procurement lead times, it undermines many cost-reduction strategies used for conventional SEE RHA and can make radiation testing and analysis one of the most significant risks—or worse, a risk neglected altogether. That section will end with some approaches for restoring balance in the troika of mission success, cost, and schedule. This is captured in SEE RHA as risk management: identify the threat, evaluate the threat, and mitigate the threat.

A top-level outline of the presentation is as follows:

- Introduction
 - Preliminary Concepts
 - Types of SEE
- Classical SEE RHA
 - Identify the threat
 - Requirements, environment, technology assessment and SEE vulnerability
 - Evaluate the threat
 - Proxy data, SEE test data, and analysis
 - Mitigate the threat
 - SEE-hardening strategies
- New SEE challenges and opportunities
 - Challenges of COTS—profusion, complexity and testability
 - Challenges of new platforms—budget, error/failure tolerance and performance
 - Questioning assumptions—even fundamental ones
- Conclusions

Short Course Monday



Michael Swartwout, is an associate professor and chair of the Department of Aerospace & Mechanical Engineering of Saint Louis University. His primary research area is the design and operation of small spacecraft, with a focus on the mission/risk/design implications of CubeSat-class missions. His lab tests these ideas through the design and flight of student-built CubeSats; they have two spacecraft launched and two more in preparation for flights in 2018. He earned his B.S. and M.S. in Aerospace Engineering from the University of Illinois, and his Ph.D. in Aeronautics and Astronautics from Stanford University. As a student, he was the project manager for Stanford's Sapphire spacecraft, which was launched in 2001.

INTRODUCTION TO SMALL SATELLITES AND CORRELATING FACTORS FOR MISSION SUCCESS

Michael Swartwout
Saint Louis University

Dr. Michael Swartwout, from Saint Louis University, will discuss the capabilities of today's small spacecraft, which are quite different than they were a decade ago. New, unprecedented launch opportunities are available for such missions that reduce cost and increase schedule flexibility. Given such a dynamic field, it is important to provide clarity and context for spacecraft developers. This part of the course will review the field of small spacecraft, which we define as anything under 200 kg. Particular attention will be paid to CubeSat systems. We will introduce a taxonomy for describing such missions, and review the launch and onorbit history of the last twenty years, emphasizing mission capabilities and mission success. We will identify key factors that correlate to mission success.

A top-level outline of the presentation is as follows:

- Goals for this section of the short course include:
 - o Orientation of space activities
 - Where do we fly?
 - Budgets, expenses, and production volumes
 - o Taxonomy of space missions with an emphasis on small/secondary spacecraft
 - Definitions for small satellites
 - What are secondary payloads?
 - Multi-mission launch trends
 - Who builds and flies small satellites?
 - o Unique mission assurance challenges for small spacecraft
 - Mission status and success definitions
 - Launch and on-orbit data by developer classification
 - Quality assurance approaches, lessons learned, and implications for future developments
- Conclusions

Short Course Monday



David Roth is a Principal Staff Radiation Engineer at the Johns Hopkins University Applied Physics Laboratory (JHU/APL). He received the Ph.D. in Physics from Clemson University in 1993 and remained at Clemson for several years as visiting faculty, teaching and conducting research in radiation effects in microelectronic structures. Dr. Roth joined JHU/APL in 1997 and has been a leader in studying radiation effects for both spacecraft and instruments, covering environments through transport modeling and testing of parts and materials. Notable programs have included the MESSENGER spacecraft to study Mercury and the New Horizons spacecraft to study Pluto and the Kuiper Belt. Dr. Roth has also participated in several collaborative research efforts, most notably a 12-year effort developing methods of detecting low, medium, and high energy neutrons produced in galactic cosmic ray interactions with shielding materials.

DESIGN PRINCIPLES FOR RADIATION HARDNESS ASSURANCE IN SPACECRAFT PROGRAMS – FROM MACRO TO NANO

David Roth

Johns Hopkins University Applied Physics Lab

Dr. David Roth, from the Johns Hopkins University Applied Physics Lab, will present radiation hardness assurance (RHA) design principles for mission success in a variety of spacecraft and instrument platforms. This presentation will come from a systems engineering point of view, leveraging information from the previous short course sections on how to manage risks for mission success. Topics covered will include radiation effects risk identification and risk management strategies, robust system design practices, and case studies of radiation mitigation for various spacecraft programs, including small satellites.

A top-level outline of the presentation is as follows:

- Introduction
 - o Coverage of space radiation environment and effects beyond scope of prior short course sections (e.g., surface and internal charging)
 - o Satellite as a system
- Robust system design practices
 - o Top-down risk management
 - Requirements development and flow-down
 - Risks are additive
- Examples of design phase case studies as well as operational anomaly investigations
 - o New Horizons
 - o Solar Probe Plus
 - o Other systems and instruments
- Conclusions

Technical Program

TECHNICAL INFORMATION



"On behalf of the Technical Program Committee, I would like to invite you to attend the 2017 NSREC Technical Sessions. We would like to thank the authors and reviewers for helping us assemble a great program with the latest developments in the nuclear and space radiation effects field."

Heather Quinn
Technical Program Chair

The NSREC technical program will consist of contributed oral, poster papers, a data workshop and invited talks. The oral presentations will be 12 minutes in duration with an additional three minutes for questions. The technical sessions and their chairpersons are:

- **Basic Mechanisms of Radiation Effects**
Chair: Elizabeth Auden, Sandia National Laboratories
- **Radiation Effects in Devices and ICs**
Chair: Tim Oldham, Ball Aerospace
- **Single-Event Effects: Devices and ICs**
Chair: Paolo Rech, Federal University of Rio Grande do Sul
- **Hardness Assurance**
Chair: Jerome Boch, University of Montpellier
- **Space and Terrestrial Environments**
Chair: Peter Truscott, Kallisto Consultancy Ltd.
- **Hardening by Design**
Chair: Michael Wirthlin, Brigham Young University
- **Single-Event Effects: Mechanisms and Modeling**
Chair: Laurent Artola, ONERA
- **Single-Event Effects: Transient Characterization**
Chair: Shi-Jie Wen, Cisco Systems
- **Photonic Devices and Integrated Circuits**
Chair: Joe Srouer, The Aerospace Corporation
- **Dosimetry**
Chair: Ewart Blackmore, TRIUMF

POSTER SESSION

Those papers that can be presented more effectively in a visual format with group discussion will be displayed in the Poster Session on Tuesday through Friday in the Mardi Gras Ballroom. The formal Poster session will be held on Wednesday from 2:15 to 5:30 PM and the authors will be available at that time to discuss their work. The Poster Session is chaired by Marta Bagatin from the DEI – University of Padova.

RADIATION EFFECTS DATA WORKSHOP

Workshop papers provide piece part radiation response data and radiation test facilities technical information. The intent of the workshop is to provide data and facilities information to support design and radiation testing activities. Workshop posters can be viewed Tuesday afternoon through Friday morning in the Mardi Gras Ballroom. Authors will be available on Friday to discuss their work from 9:40AM to 12:00PM. A workshop record will be mailed to all registered conference attendees. The workshop chair is Jeff George from The Aerospace Corporation.

INVITED SPEAKERS

There will be three invited talks:

- **New Orleans and the Early Days of Jazz**
Richard Scott
- **The Mars Reconnaissance Orbiter and the Curiosity Rover: Perspectives on Whether Mars is Habitable**
Dr. Tanya Harrison, Arizona State University
- **The Waters of Katrina: What the Storm Taught New Orleans about its Land, People, and Problems**
Eve Troeh, National Public Radio

LATE-NEWS PAPERS

A limited number of late-news papers will be accepted and included in the Poster Session and the Radiation Effects Data Workshop. The deadline for submission is May 19, 2017. Detailed instructions for submitting late-news summary are available on the NSREC website at www.nsrec.com.

Technical Program Tuesday

ACADIA BALLROOM

8:30 AM

OPENING REMARKS

Véronique Ferlet-Cavrois, European Space Agency, General Chairwoman

8:35 AM

AWARDS PRESENTATION

Allan Johnston, Radiation Effects Steering Group Executive Chair

9:05 AM

TECHNICAL SESSION OPENING REMARKS

Heather Quinn, Los Alamos National Laboratory, Technical Program Chair

SESSION A

9:10 AM

RADIATION EFFECTS IN DEVICES AND INTEGRATED CIRCUITS

SESSION INTRODUCTION

Chair: Timothy R. Oldham, Ball Aerospace

A-1

9:15 AM

Evaluation of the Radiation Susceptibility of a 3D NAND Flash Memory

D. Chen, R. Ladbury, K. LaBel, NASA GSFC; E. Wilcox, C. Seidleck, H. Kim, A. Phan, AS&D, Inc.

We evaluate the Hynix 3D NAND, a first NAND flash architecture with SLC and MLC modes. We observed reduced MBU susceptibility relative to a planar NAND. Furthermore, the SEU cross section varied inversely with fluence.

A-2

9:30 AM

High Energy Electron Irradiation of Samsung 8Gb NAND Flash Memory

F. Irom, G. R. Allen, L. D. Edmonds, Jet Propulsion Laboratory,

This paper reports the results of 60 MeV electron irradiation of Samsung 8Gb single-level cell NAND flash memory. The electron percentage bit errors are compared to results from ^{60}Co total ionizing dose measurements.

A-3

9:45 AM

Radiation Tolerant Digital Multiphase Current-Mode Hysteretic Point-of-Load Regulator

P. C. Adell, G. Allen, JPL; M. Sung, B. Bakkaloglu, Z. Yang, K. Joshi, Arizona State University

A radiation-tolerant digital point-of-load regulator fabricated on a commercial process is presented. Experiments and simulations are used to demonstrate its single-event-immunity and its total-dose tolerance over 100 krad(Si)

A-4
10:00 AM

Proton-Induced Total-Ionizing-Dose and Displacement-Damage Effects on Silicon Based MEMS Resonators

H. Gong, W. Liao, E. X. Zhang, A. L. Sternberg, M. W. McCurdy, J. L. Davidson, M. L. Alles, R. A. Reed, D. M. Fleetwood, R. D. Schrimpf, Vanderbilt University; P. D. Shuvra, J.-T. Lin, S. McNamara, B. W. Alphenaar, K. M. Walsh, University of Louisville

The competing effects between total ionizing dose and nonionizing energy loss are investigated by irradiating silicon based MEMS resonators with protons. TID dominates for higher energy protons, while NIEL dominates for lower energy protons.

Technical Program Tuesday

10:15 – 11:00 AM
MARDI GRAS AND BISSONET
/ CARONDELET BALLROOMS

BREAK

A-5
11:00 AM

Total-Ionization-Dose Effects on Microscanners with Al/SiO₂ Electrothermal Bimorph Actuators

W. Liao, E. X. Zhang, M. L. Alles, A. L. Sternberg, C. N. Arutt, S. Zhao, P. Wang, M. W. McCurdy, D. M. Fleetwood, R. A. Reed, R. D. Schrimpf, Vanderbilt University; D. Wang, H. Xie, University of Florida

Total-ionizing-dose effects on electrothermal microscanners are investigated with 10-keV X-rays. The mechanical displacement changes with dose and does not recover during post-irradiation annealing.

A-6
11:15 AM

Investigations on the Bias Configuration and Geometry Effects on the TID Response of SOI Tri-Gate Nanowire Field Effect Transistors

J. Riffaud, M. Gaillardin, C. Marcandella, M. Martinez, P. Paillet, O. Duhamel, T. Lagutere, M. Raine, N. Richard, CEA, DAM, DIF; F. Andrieu, S. Barraud, M. Vinet, O. Faynot, CEA, LETI-Minatec

The effect of the bias configuration during irradiation is investigated in tri-gate nanowire FETs using x-ray irradiation experiments. Implications for hardening by design are discussed

A-7
11:30 AM

Total Ionizing Dose Effects on GaN Based HEMTs and MOSHEMTs: Effects of Channel Thickness and Epitaxial MgCaO as Gate Dielectric

M. A. Bhuiyan, T.-P. Ma, Yale University; H. Zhou, P. Ye, Purdue University; X. Lou, X. Gong, R. G. Gordon, Harvard University; R. Jiang, H. Gong, E. X. Zhang, R. A. Reed, D. M. Fleetwood, Vanderbilt University

Radiation hardness of AlGaN/GaN HEMTs improves with increasing GaN channel thickness. Epitaxial MgCaO shows its promise as a radiation-tolerant gate dielectric. The ACGM method is used to help understand radiation-induced charge trapping.

A-8
11:45 AM

TID Effects in Reconfigurable MOSFETs Using Two-Dimensional Semiconductor WSe₂

J. U. Lee, P. Dhakras, P. Agnihotri, H. Bakhru, SUNY Poly; H. Hughes, U.S. Naval Research Laboratory

We examine TID effects in devices that can reconfigure into both n- and p-channel MOSFETs. The devices are fabricated using 2D TMD semiconductor WSe₂ and allow better insight into radiation effects than unipolar devices.

Technical Program Tuesday

POSTER PAPERS

PA-1 **Dose-Rate Effects on the Total Ionizing Dose Response of Piezoresistive Micromachined Cantilevers**

C. N. Arutt, W. Liao, H. Gong, M. L. Alles, J. L. Davidson, E. X. Zhang, A. L. Sternberg, D. M. Fleetwood, R. A. Reed, R. D. Schrimpf, Vanderbilt University; P. D. Shurva, J.-T. Lin, B. W. Alphenaar, K. M. Walsh, S. McNamara, University of Louisville

Total-ionizing-dose-induced resonant frequency shifts in piezoresistive, micromachined cantilevers are experimentally shown to be dose rate dependent. Lower dose rates produce greater frequency shifts. Mechanisms for carrier generation and frequency shifts are proposed.

PA-2 **Varied Total Ionization Dose (TID) Study of PZT Based Thin-Film Stacks and Actuator Devices for Piezoelectric MEMS Applications**

M. Rivas, U.S. Army Research Laboratory, and University of Connecticut; S. J. Brewer, Georgia Institute of Technology; H. Zhou, J. L. Jones, North Carolina State University; R. Q. Rudy, R. G. Polcawich, U.S. Army Research Laboratory; C. D. Cress, E. R. Glaser, U.S. Naval Research Laboratory; N. Bassiri-Gharb, Georgia Institute of Technology

This paper investigates total ionizing dose (TID) effects on the ferroelectric, dielectric, and piezoelectric properties of lead zirconate titanate (PZT) thin-film devices with two different top electrodes exposed to a ^{60}Co source.

PA-3 **Investigation of TID and Dynamic Burn-in Induced V_T Shift on RTG4 Flash-Based FPGA**

N. Rezzak, J.-J. Wang, M. Traas, G. Bakker, F. Xue, A. Cai, F. Hawley, E. Hamdy, Microsemi

RTG4 TID tolerance is investigated Post Dynamic BurnIn (PDBI). PFlash V_T shift PDBI is due to programming voltage degradation; DBI has minimum impact on RTG4 CFlash TID tolerance since it is dominated by NFlash.

PA-4 **Proton-Irradiation Effects on AlGaIn/GaN HEMTs with Different Isolation Methods**

D.-S. Kim, K.-R. Kim, Y. S. Cho, Korea Atomic Energy Research Institute; J.-H. Lee, Kyungpook National University

AlGaIn/GaN HEMTs with nitrogen ion implantation isolation show relatively higher radiation hardness than those with mesa etching isolation due to reduced displacement damage.

PA-5 **Carrier Lifetime vs. Stepwise 8.2 and 63 MeV Proton Irradiation in III-V Space Detectors**

G. D. Jenkins, C. P. Morath, E. H. Steenberg, V. M. Cowan, Air Force Research Laboratory

Data and analyses are presented on the degradation of minority carrier lifetime in different InAs/InAsSb superlattice detector structures resulting from 8.2 and 63 MeV stepwise proton irradiation to correlate damage factors with NIEL.

Technical Program Tuesday

PA-6 Atypical Effect of TNID on a LM124 Bipolar Integrated Circuits

T. Borel, Institut d'Electronique et des Systemes (IES) and CERN; F. Roig, Nucleides; A. Michez, L. Dusseau, Institut d'Electronique et des Systemes (IES); B. Azais, Direction Generale de l'Armement (DGA); S. Danzeca, CERN; N. J.-H. Roche, Centre Spatial Universitaire (CSU); F. Bezerra, Centre National d'Etude Spatiales (CNES); P. Calvel, Thales Alenia Space

LM124 COTS amplifiers are irradiated with neutrons (TNID). It is shown that a slight modification in the design at transistor and circuit level is responsible for an apparent increase in the slew rate (circuit effect).

PA-7 Total-Ionizing-Dose Response of Nb₂O₅-Based MIM Diodes for Neuromorphic Computing Applications

R. Jiang, E. X. Zhang, S. Zhao, D. M. Fleetwood, R. D. Schrimpf, R. A. Reed, M. L. Alles, Vanderbilt University; J. C. Shank, B. Tellekamp, W. A. Doolittle, Georgia Institute of Technology

We employ capacitance-frequency measurements to evaluate the total-ionizing-dose response of Nb₂O₅-based MIM diodes that are designed for neuromorphic computing applications. Despite their high oxygen vacancy densities, devices are quite radiation tolerant.

PA-8 Nuclear Radiation Tolerant Wireless Transmitter Irradiation Test Results

J. Carvajal, M. Heibel, N. Arlia, M. James, R. Flammang, Westinghouse Electric Company; A. Bascom, K. Ünlü, The Pennsylvania State University

This paper describes the novel implementation of a vacuum micro-electronic device configured as a wireless transmitter. The device's frequency and amplitude response to radiation is discussed and the results of irradiation testing are presented.

12:00 PM – 1:25 PM LUNCH

SESSION B PHOTONIC DEVICES AND INTEGRATED CIRCUITS

1:25 PM SESSION INTRODUCTION

Chair: Joseph R. Srouf, The Aerospace Corporation

B-1 Total Ionizing Dose Effects on Charge Transfer Efficiency and Image Lag in Pinned Photodiode CMOS Image Sensors

1:30 PM

S. Rizzolo, V. Goiffon, M. Estrubeau, C. Durnez, P. Magnan, ISAE-SUPAERO; P. Paillet, C. Marcandella, CEA, DAM, DIF

Various PPD-CIS designs are investigated with the aim to clarify the TID induced degradation on charge transfer performance up to 1 Mrad. The results suggest RHBD solutions for their employment in future space missions.

Technical Program Tuesday

B-2
1:45 PM **Total Ionizing Dose Radiation Induced Dark Current Random Telegraph Signal in Pinned Photodiode CMOS Image Sensors**

C. Durnez, ISAE-SUPAERO, CNES, and Sofradir; V. Goiffon, S. Rizzolo, P. Magnan, ISAE-SUPAERO; C. Virmontois, CNES; P. Paillet, C. Marcandella, CEA, DAM, DIF; L. Rubaldo, Sofradir

Random Telegraph Signals (RTS) due to total ionizing dose are studied in CMOS image sensors with several design variations. The localization and some properties of such RTS centers are reported.

B-3
2:00 PM **Total Ionizing Dose Effects on a Radiation Hardened CMOS Image Sensor Demonstrator for ITER Remote Handling**

V. Goiffon, S. Rizzolo, F. Corbiere, S. Rolando, A. Chabane, M. Sergent, M. Estribeau, P. Magnan, ISAE-SUPAERO; P. Paillet, M. Gaillardin, CEA, DAM, DIF; S. Girard, Université de Saint Etienne; M. Van Uffelen, L. Mont Casellas, Fusion for Energy; R. Scott, Oxford Technologies Ltd.; W. De Cock, SCK-CEN

TID effects are studied up to 10 MGy (1 Grad) on a RHBD 256x256 pixel CMOS Image Sensor Demonstrator for ITER. This work clarifies the influence of several design parameters on the CIS radiation hardness.

B-4
2:15 PM **Steady-State Gamma-Ray Induced Effects on Brillouin Scattering Based Optical Fiber Sensors**

A. Morana, S. Girard, C. Cangialosi, E. Marin, A. Boukenter, Y. Ouerdane, Université de Saint-Etienne; I. Planes, Université de Saint-Etienne and National Radioactive Waste Management Agency (Andra); S. Delepine-Lesoille, National Radioactive Waste Management Agency (Andra)

The effects induced by gamma-rays on Brillouin based optical fiber sensors have been studied during irradiation at high doses, up to 10 MGy. Only small errors on temperature measurements have been observed.

POSTER PAPERS
PB-I

Displacement Damage Dose and DLTS Analyses on Triple and Single Junction Solar Cells Irradiated with Electrons and Protons

M. Tacconi, M. Gervasi, D. Rozza, INFN / University of Milano Bicocca; C. Baur, ESTEC, ESA; R. Campesato, M. Casale, E. Greco, CESI; E. Gombia, A. Kingma, IMEM-CNR Institute; P. G. Rancoita, INFN

In this paper we report the radiation data for triple junction solar cells and related component cells. Radiation results have been analyzed by means of the Displacement Damage Dose method and with DLTS spectroscopy.

Technical Program Tuesday

PB-2 Single Event Transients in Read-Out Circuitries at Low Temperature Down to 50K

A. Al Youssef, L. Artola, G. Hubert, ONERA; S. Ducret, R. Buiron, F. Perrier, S. Parola, Sofradir; C. Poivey, ESA

This paper presents the impact of cryogenic temperatures on the SET sensitivity of two readout circuit of infrared image sensor designed by Sofradir. Experimental SET data are described and the analysis is completed by simulations.

PB-3 Comparison of Methods to Calculate the Dark Current Non Uniformity in Pixel Arrays

M.-C. Ursule, C. Inguimbert, T. Nuns, J. Morio, ONERA

Several methods of DCNU prediction (Monte Carlo and simplified methods based on the central limit theorem) are presented and compared with experimental data. Their domain of validity is explored on a large range of fluences.

PB-4 Radiation Induced Attenuation in Single-Mode Phosphosilicate Optical Fibers for Dosimetry

D. Di Francesca, Y. Kadi, M. Brugger, CERN; G. Li Vecchi, CERN and Universite de Saint-Etienne; S. Girard, A. Alessi, I. Reghionua, A. Boukenter, Y. Ouerdane, Universite de Saint-Etienne

We report a preliminary investigation of the radiation induced attenuation in P and P-Ce doped single-mode optical fibers to evaluate their potential employment as distributed radiation sensors in CERN accelerators.

PB-5 Vulnerability and Hardening Studies of Optical and Illumination Systems at MGy Dose Levels

T. Allanche, C. Muller, R. Clerc, T. Lepine, M. Hebert, A. Boukenter, Y. Ouerdane, S. Girard, Universite de Saint-Etienne; P. Paillet, O. Duhamel, C. Marcandella, CEA, DAM, DIF; V. Goiffon, S. Rizzolo, P. Magnan, ISAE-SUPAERO; M. Van Uffelen, L. Mont-Casellas, Fusion For Energy; R. Scott, Oxford Technologies; W. De Cock, SCK-CEN

We characterize before and after irradiation, up to 1MGy dose, optical materials and components (LEDs) for integration in camera sub-systems. The results are promising to design radiation-hardened imaging systems for ITER (FURHIS project).

PB-6 Fundamental Limitations on Integrated Silicon Photonic Waveguides Operating in a Heavy Ion Environment

P. S. Goley, Z. E. Fleetwood, J. D. Cressler, Georgia Institute of Technology

The impact of heavy-ion induced radial ionization profiles in integrated silicon photonic waveguides are investigated. 3D finite-difference time-domain simulations are used to ascertain transmission characteristics through a variety of ionization profiles.

2:30 PM – 3:10 PM
MARDI GRAS AND BISSET
/ CARONDELET BALLROOMS

BREAK

Technical Program Tuesday

SESSION C BASIC MECHANISMS OF RADIATION EFFECTS

3:10 PM SESSION INTRODUCTION

Chair: Elizabeth C. Auden, Sandia National Laboratories

C-1 Coverglass Radiation-Induced Multijunction Solar Cell Current-Limiting Effects

3:15 PM

S. R. Messenger, M. A. Kruer, Northrop Grumman Corporation

The implications of ionizing radiation-induced coverglass darkening on the current-limiting characteristics of currently-flown multijunction solar cells are discussed. An interesting relationship between displacement damage and ionizing radiation exists.

C-2 Simulation of Single Particle Displacement Damage in Silicon – Part III: First Principles Characterization of Defect Properties

3:30 PM

A. Jay, A. Le Roch, V. Goiffon, P. Magnan, ISAE; N. Richard, M. Raine, P. Paillet, CEA; L. Martin-Samos, University of Nova Gorica; N. Mousseau, Université de Montréal; A. Hémeryck, LAAS/CNRS

First principles characterizations of defects coming from one second simulations are performed to get a better understanding of Dark-Current and Dark-Current Random Telegraph Signal phenomena.

C-3 Effects of Bias on the Total-Ionizing Dose Response of Graphene Transistors with Al_2O_3 and h-BN Over-Layers

3:45 PM

P. Wang, A. O. Hara, E. X. Zhang, H. Gong, C. Liang, R. Jiang, W. Liao, D. M. Fleetwood, R. D. Schrimpf, S. T. Pantelides, Vanderbilt University; C. Perini, E. M. Vogel, Georgia Institute of Technology; B. R. Tuttle, Vanderbilt University and Penn State Behrend

Over-layer material type and thickness and applied bias during irradiation strongly affect the radiation response of graphene transistors. Low-frequency noise measurements and density functional calculations provide insight into defect microstructure and energy distributions.

C-4 Radiation-Induced Charge Trapping in Black Phosphorus MOSFETs with HfO_2 Gate Dielectrics

4:00 PM

C. Liang, P. Wang, S. Zhao, E. X. Zhang, M. L. Alles, D. M. Fleetwood, and R. D. Schrimpf, Vanderbilt University; R. Ma, Y. Su, S. Koester, University of Minnesota

Radiation-induced trapped charge in the HfO_2 dielectric layers of black phosphorus MOSFETs is characterized via current-voltage and temperature-dependent low-frequency noise measurements. The defect-energy distribution decreases strongly with increasing temperature.

C-5 Influence of LDD Spacers and H^+ Transport on the Total-Ionizing-Dose Response of 65 nm MOSFETs Irradiated to Ultra-High Doses

4:15 PM

F. Faccio, E. Lerario, S. Michelis, CERN; G. Borghello, CERN and Udine University; D. M. Fleetwood, R. D. Schrimpf, H. Gong, E. X. Zhang, P. Wang, Vanderbilt University; S. Gerardin, A. Paccagnella, S. Bonaldo, Padova University

Radiation-induced short-channel effects in 65 nm transistors are caused by ionization in LDD spacers and the consequent hydrogen transport. The resulting interface traps shift the threshold voltage and increase parasitic series resistance.

Technical Program Tuesday

POSTER PAPERS

PC-1 **Total-Ionizing-Dose Response of Multi-Fin Ge MOS Capacitors with High-K Dielectrics**

S. Zhao, R. Jiang, E. X. Zhang, W. Liao, C. Liang, D. M. Fleetwood, R. D. Schrimpf, R. A. Reed, N. Collaert, Vanderbilt University; D. Linten, J. Mitard, IMEC

We evaluate capacitance-voltage and capacitance-frequency characteristics of multi-fin capacitors with high-k dielectrics built using advanced Ge-FinFET technology. Capacitance-frequency measurements at flatband voltage provide upper bounds on border-trap densities.

PC-2 **Understanding the Implications of a LINAC's Microstructure on Transient Photocurrent Models**

M. McLain, F. Hartman, K. McDonald, C. Hembree, Sandia National Laboratories

The implications of a LINAC's microstructure on transient photocurrent models are investigated. Typically, the rate the energy is deposited in a material during the microstructure peaks is much higher than the pulse-averaged rate.

PC-3 **Gamma-Ray Irradiation Effects on TiN/Ti/HfO₂/TiN RRAM Studied via Electrically Detected Magnetic Resonance**

D. J. McCrory, Pennsylvania State University

We observe a strong gamma irradiation induced change in electrically detected magnetic resonance (EDMR) of TiN/Ti/HfO₂/TiN RRAM. The EDMR detects defects directly involved in the underlying transport mechanisms within these devices.

PC-4 **Neutron and Gamma Irradiation Induced Effects in HPSI 4H-SiC Photoconductors**

P. V. Raja, N. V. L. N. Murty, IIT Bhubaneswar

14.1MeV neutron and ⁶⁰Co-gamma irradiation produced traps in high-purity semi-insulating 4H-SiC are reported. Irradiation induced changes in substrate resistivity, dark current and UV response of 4H-SiC photoconductors are analyzed.

PC-5 **In Situ Synaptic Programming of Cu-SiO₂ CBRAM in a TID Environment**

J. L. Taggart, W. Chen, Y. Gonzalez-Velo, H. J. Barnaby, K. Holbert, M. N. Kozicki, Arizona State University

Neuromorphic programming of CuSiO₂ resistive memory during gamma-ray irradiation is shown to be feasible. In situ results suggest that ionizing radiation may contribute to an increase in power needed to program the conductance state.

PC-6 **Total Ionization Dose Effects on Charge Trapping Memory (CTM) with Al₂/HfO₂/Al₂O₃ Trilayer Structure**

J. Bi, Y. Xu, K. Xi, Y. Li, M. Liu, Chinese Academy of Sciences; L. Chen, University of Saskatchewan

Total ionization dose (TID) effects by x-ray on Al₂/HfO₂/Al₂O₃ based CTM cells are experimentally evaluated. Program, Erase and Memory Window characteristics are studied in details with different bias conditions during TID irradiation.

Technical Program Tuesday

PC-7 Defects and Gain Degradation in PNP Si BJTs Irradiated with Different Mass Particles

B. A. Aguirre, E. Bielejec, R. M. Fleming, G. Vizkelethy, B. Vaandrager, J. Campbell, W. J. Martin, Sandia National Laboratories

We explore defects created at the base-emitter junction of pnp Si BJTs by different mass particles. We found that V2* and E5 defects dominate the gain degradation whereas VP only has a small contribution.

PC-8 Comparing Radiation Induced Lifetime Degradation in InAs/InAsSb Type-II Superlattices Using 4.5 and 63 MeV Proton Irradiations

E. Bielejec, E. A. Kadlec, M. Goldfarn, E. A. Shander, J. K. Kim, J. Moussa, P. A. Schultz, Sandia National Laboratories; C. P. Morath, G. D. Jenkins, V. M. Cowan, US Air Force Research Laboratory

Lifetime degradation in InAs/InAsSb superlattices is investigated under proton irradiation using time-resolved microwave reflectance measurements. We demonstrate damage equivalence between 4.5 and 63 MeV proton irradiation scaling ion fluence from SRIM simulations.

PC-9 Stochastic Gain Degradation in III-V Heterojunction Bipolar Transistors Due to Single Particle Displacement Damage

G. Vizkelethy, E. Bielejec, B. A. Aguirre, Sandia National Laboratories

Gain degradation in III-V Heterojunction Bipolar Transistors due to single particles was measured. Cumulative Distribution Functions were calculated to help determine design margins. The displacement process was modeled using the Marlowe BCA code.

4:30 PM END OF TUESDAY SESSIONS

5:30 – 7:30 PM
EXHIBIT RECEPTION

MARDI GRAS AND BISSET
/ CARONDELET BALLROOMS

Technical Program Wednesday

ACADIA BALLROOM

SESSION D

8:25 AM

SINGLE-EVENT EFFECTS: DEVICES AND INTEGRATED CIRCUITS

SESSION INTRODUCTION

Chair: Paolo Rech, Federal University of Rio Grande do Sul

D-1

8:30 AM

Multiple-Cell Upsets Induced by Single High-Energy Electrons

M. J. Gadlage, A. H. Roach, A. R. Duncan, A. M. Williams, D. P. Bossev, M. J. Kay, NSWC CRANE

Multiple-cell upsets in SRAM-based FPGAs are recorded from single particle interactions with high-energy electrons. Indirect ionization events are shown to be the cause of the MCUs and trends with scaling are discussed.

D-2

8:45 AM

Single Event Latch-Up: Increased Sensitivity from Planar to FinFET

J. Karp, M. J. Hart, P. Maillard, Xilinx, Inc.; G. Hellings, D. Linten, IMEC

Increased sensitivity of FinFET technology to SEL found with proton/neutron testing. TCAD simulations demonstrated that 3X shallower trench isolation of FinFET significantly increases both $\beta_{npn}\beta_{pnp}$ -gain of parasitic CMOS SCR and SEL sensitivity.

D-3

9:00 AM

From MOSFETs to FinFETs - the Soft Error Trends

I. Chatterjee, Airbus; N. N. Mahatme, NXP Semiconductors; B. Narasimham, Broadcom Corporation; B. L. Bhuva, Vanderbilt University; S.-J. Wen, R. Wong, Cisco Systems

As technology scaled from planar transistors to FinFETs, concerns about soft errors became paramount. This work paints a comprehensive picture of the soft error scaling trends for memories, sequential and combinational circuit elements across technologies.

D-4

9:15 AM

Angular Effects on Single-Event Mechanisms in Bulk FinFET Technologies

P. Nsengiyumva, L. W. Massengill, J. S. Kauppila, J. A. Maharrey, R. C. Quinn, T. D. Haffner, D. R. Ball, M. L. Alles, B. L. Bhuva, E. X. Zhang, J. D. Rowe, A. L. Sternberg, Vanderbilt University

Experimental heavy-ion angular data and single-event mechanisms in bulk FinFET circuits are presented. Results show that upset characteristics can be attributed to separate charge collection mechanisms in the fin and sub-fin substrate.

D-5

9:30 AM

Single-Event Upset Mitigation in a Complementary SiGe HBT BiCMOS Technology

N. E. Lourenco, Georgia Tech Research Institute; A. Ildefonso, G. N. Tzintzarov, Z. E. Fleetwood, J. D. Cressler, Georgia Institute of Technology; K. Motoki, Japan Aerospace Exploration Agency; P. Paki, Defense Threat Reduction Agency; M. Kaynak, Innovation for High Performance Microelectronics

C-SiGe BiCMOS is investigated as a potential SEE mitigation strategy via broad-beam testing of npn and pnp high-speed digital test structures. TCAD simulations are utilized to ascertain the underlying transient mechanisms.

Technical Program Wednesday

D-6 9:45 AM Utilizing SiGe HBT Power Detectors for Sensing Single-Event Transients in RF Circuits

A. Ildefonso, C. T. Coen, Z. E. Fleetwood, G. N. Tzintzarov, M. T. Wachter, Georgia Institute of Technology; A. Khachatryan, Naval Research Laboratory and Sotera Defense; D. McMorro, J. H. Warner, Naval Research Laboratory; P. Paki, Defense Threat Reduction Agency

The use of RF power detectors for sensing single-event transients in RF circuits is studied by using two-photon absorption carrier injection and mixed-mode TCAD simulations.

10:00 – 10:40 AM
MARDI GRAS AND BISSETT
/ CARONDELET BALLROOMS

BREAK

D-7 10:40 AM Transmission Line Pulse Test Method for Estimating SEB Performance of N-Channel Lateral DMOS Power Transistors

P. L. Hower, M. Hamlyn, R. Bauman, Texas Instruments; K. Warren, Vanderbilt University

A method of waferlevel SEB characterization is described. The method uses scribeline LDMOS transistors and a TLP tester. The mechanism of SEB is explored using TCAD simulation. Experimental heavy ion data are compared to TLP results

D-8 10:55 AM Single Event Burnout of High-Voltage SiC Junction Barrier Schottky Diodes

A. F. Witulski, R. D. Schrimpf, A. L. Sternberg, K. F. Galloway, Vanderbilt University; A. Raman, R. Arslanbekov, CFD Research Corporation; A. Javanainen, University of Jyväskylä; D. Grider, D. Lichtenwalner, B. Hull, Wolfspeed

Ion-induced catastrophic failures in high-voltage SiC Junction Barrier Schottky (JBS) power diodes are examined. Experimental data and TCAD simulations suggest that localized heating is responsible for the failures.

POSTER PAPERS PD-1

Analysis of Single-Event Effects in DDR3 and DDR3L SDRAMs Using Laser Testing and Monte-Carlo Simulations

P. Kohler, V. Pouget, F. Wrobel, F. Saigne, University of Montpellier, CNRS; P.-X. Wang, M.-C. Vassal, 3DPlus

This paper presents a comparative analysis of the SEE sensitivity of DDR3 memories from different manufacturers. Events thresholds are analyzed using two-photon laser testing and Monte-Carlo simulations. Bitline upsets are observed and discussed.

PD-2 A Circuit Technique for Characterizing Single-Event-Transient Pulses

S. Kumar, L. Everson, I. Ahmed, M. Liu, Q. Tang, C. H. Kim, University of Minnesota; H. Quinn, Los Alamos National Laboratory; M. Cho, M. Khellah, J. Tschanz, S. Borkar, V. De, Intel Corporation

A novel back-sampling chain circuit technique is implemented in 65nm bulk CMOS to capture single event transients and soft error rate. Radiation induced strike waveform is reconstructed and analyzed for alpha and neutron particles.

Technical Program Wednesday

PD-3 Failure Analysis of Heavy-Ion-Irradiated Schottky Diodes

M. C. Casey, J.-M. Lauenstein, M. J. Campola, K. A. LaBel, NASA GSFC; E. P. Wilcox, A. D. Topper, AS&D, Inc.

In this work, we use high- and low-magnitude optical microscope images, infrared camera images, and scanning electron microscope images to identify and describe the failure locations in heavy-ion-irradiated Schottky diodes.

PD-4 Comparison of FPGA Design Sensitivity to SEUs on Two Different SRAM-Based FPGA Architectures

A. M. Keller, T. A. Whiting, K. B. Sawyer, M. J. Wirthlin, Brigham Young University

Two FPGA designs are tested for SEU sensitivity on an Altera Stratix V and a Xilinx Kintex 7 FPGA (28nm). Fault injection and neutron radiation testing reveal several similarities. SEU mitigation reduces sensitivity 4-728x.

PD-5 Evaluation of Feed-Forward Artificial Neural Networks Reliability in FPGAs

F. Libano, P. Rech, L. Tambara, J. Tonfat, F. Kastensmidt, Universidade Federal do Rio Grande do Sul; N. Medina, N. Added, V. Aguiar, F. Aguirre, Universidade de Sao Paulo; M. Silveira, Centro Universitario da FEI

We evaluate through fault-injection and heavy-ions experiments the reliability of a neural network for pattern recognition implemented in FPGAs. We show that only a small portion of output errors affect the classification.

PD-6 Scaling Effects on Single-Event Transients in InGaAs FinFETs

H. Gong, K. Ni, E. X. Zhang, A. L. Sternberg, J. A. Kozub, K. L. Ryder, R. F. Keller, M. L. Alles, R. A. Reed, D. M. Fleetwood, R. D. Schrimpf, Vanderbilt University; A. Vardy, X. Cai, J. A. del Alamo, Massachusetts Institute of Technology

The single-event transient responses of InGaAs FinFETs with different fin width exposed to pulsed laser and heavy-ion irradiation are investigated. Devices with larger fin width collect more charge in both irradiation environments.

PD-7 Predicting Frequency Dependence of Logic Single-Event Cross-Section at Advanced Technology Nodes

H. Jiang, H. Zhang, J. S. Kauppila, W. T. Holman, B. L. Bhuva, L. W. Massengill, Vanderbilt University

An empirical model to estimate logic SE cross-section is presented. The estimated cross-section matches well with the measured cross-section. The model only needs to be calibrated once for use at a node.

PD-8 Time-Domain Modeling of Linear All-Digital PLLs (ADPLLs) to Single-Event Upset (SEU) Perturbations

Y. P. Chen, L. W. Massengill, J. S. Kauppila, B. L. Bharat, W. T. Holman, Vanderbilt University; T. D. Loveless, University of Tennessee at Chattanooga

A new time-domain model for SEU response of linear ADPLLs is presented and validated against FPGA-based fault injection experiments. The model is applicable to RHBD activities and failure mode predictions.

Technical Program Wednesday

ACADIA BALLROOM

SESSION E

11:10 PM

SINGLE-EVENT EFFECTS: MECHANISMS AND MODELING

SESSION INTRODUCTION

Chair: Laurent Artola, ONERA

E-1
11:15 PM

Effects of Heavy-Ion Irradiation in Vertical 3D NAND Flash Memories

M. Bagatin, S. Gerardin, A. Paccagnella, University of Padova; S. Beltrami, E. Camerlenghi, M. Bertuccio, Micron Technology; A. Costantino, A. Zadeh, V. Ferlet-Cavrois, G. Santin, E. Daly, ESA - ESTEC

The effects of heavy-ion irradiation on 3D NAND Flash memories are experimentally studied. Threshold voltage shifts are analyzed versus ion LET, the mechanisms are discussed, and the results are compared with planar Flash technologies.

E-2
11:30 PM

The Impact of Collection Volume and Parasitic Capacitance on SEUs in SOI vs. Bulk FinFET D Flip-Flops

D. R. Ball, M. L. Alles, J. S. Kauppila, R. C. Quinn, J. A. Maharrey, P. Nsengiyumva, T. D. Haeffner, J. D. Rowe, A. L. Sternberg, E. X. Zhang, B. L. Bhuvva, L. W. Massengill, Vanderbilt University

Dramatic differences between SOI and bulk FinFET SEU thresholds and saturated cross sections in D flip-flops are attributed to SET pulse widths influenced by finite volumes and modulated by parasitic capacitance values

E-3
11:45 PM

Accurate Resolution of Time-Dependent and Circuit-Coupled Charge Transport Equations: 1D Case Applied to 28 nm FD-SOI Devices

V. Malherbe, G. Gasiot, T. Thery, STMicroelectronics; J.-L. Autran, IM2NP

We present a 1D solver for single-event simulation. Owing to its computational speed and circuit-coupling ability, the module is embedded in our SER simulation platform, enabling projections on logic cells in 28nm FDSOI.

POSTER PAPERS

PE-1

Microbeam SEE Analysis of MIM Capacitors for GaN Amplifiers

P. Kupsc, V. Ferlet-Cavrois, M. Muschitiello, A. Barnes, A. Zadeh, M. Poizat, European Space Agency; A. Javanainen, University of Jyväskylä and Vanderbilt University; H. Stieglauer, United Monolithic Semiconductors GmbH; K.-O. Voss, GSI Helmholtz Centre for Heavy Ion Research

Broad-beam and microbeam tests were conducted on Metal - Insulator - Metal (MIM) structures, revealing breakdown either in the MIM or the insulator covering the semiconductor substrate under the air bridge, depending on their respective thickness.

PE-2

Predicting Muon-Induced SEU Sensitivity of a 28 nm SRAM Using Ions to Calibrate the Sensitive Volume Model

J. M. Trippe, R. A. Reed, R. A. Austin, B. D. Sierawski, L. W. Massengill, R. A. Weller, K. M. Warren, R. D. Schrimpf, Vanderbilt University; B. Narasimham, D. Reed, B. Bartz, Broadcom

Muon-induced upset cross-sections are predicted for a 28 nm SRAM using Monte Carlo simulations informed by ion test results. Results are compared to experimental data for validation. A comparative rate prediction is provided.

Technical Program Wednesday

PE-3 Estimation of the Single Event Upset Sensitivity of Advanced SOI SRAMs

M. Raine, M. Gaillardin, T. Lagutere, O. Duhamel, P. Paillet, CEA, DAM, DIF

The SEU sensitivity of UTSOI and SOI FinFET SRAM is investigated using a straightforward simulation methodology

PE-4 Experimental Characterization of the Dominant Multiple Nodes Charge Collection Mechanism

R. Song, S. Chen, Y. Chi, Z. Wu, B. Liang, J. Chen, National University of Defense Technology

We propose an experimental method to investigate the dominant multiple nodes charge collection mechanism. Experimental results confirm diffusion collection dominate charge collection at low LET while parasitic bipolar amplification effect dominate it at high LET.

12:00 PM – 1:30 PM
MARDI GRAS AND BISSONET
/ CARONDELET BALLROOMS

LUNCH

ACADIA BALLROOM
INVITED TALK
1:30 - 2:40 PM

New Orleans and the Early Days of Jazz

Richard Scott



Jazz music is America's art form, and for decades, the story of Jazz was the story of America. The music was the soundtrack for the enthusiasm of the twenties and was the voice of those who struggled through the Great Depression. The music was for dancing and musicians reached legendary status. Jazz was the voice of a social revolution, and is still a frontier of exploration for those who seek it.

The story of Jazz begins in New Orleans, where many different cultures and musical styles came together. **Richard Scott** is experienced in these musical styles, and is very adept at explaining the elements that came together to ignite the spark of jazz. His piano playing is able to transport the listener back in time, demonstrates the musical points he discusses, and is always entertaining. He is also a wonderful vocalist, able to conjure up the sounds of the earliest pioneers of jazz. He believes that this music was always created to be fun, and his love for the art is heard in every note he plays.



Piano sensation **Richard Scott** started playing piano at age four and as a teenager fell in love with Ragtime and New Orleans Jazz. He moved to New Orleans in 2000 and started playing with jazz bands on Bourbon Street. He performed aboard the Steamboat Natchez for nightly dinner cruises for the next thirteen years and toured the world with the famous Dukes of Dixieland. Now you can catch him playing piano most nights at Fritzel's Jazz Pub with some of the greatest musicians in New Orleans. He works also for the New Orleans Jazz National Historic Park, giving weekly programs on New Orleans Jazz History. He has albums of classic New Orleans songs as well as his own original compositions. You can catch him anywhere playing brunches on banjo, playing French musettes on his accordion, or leading a second line parade wearing a sousaphone. He is very passionate about the music, plays different styles with accuracy, has a vast repertoire, and brings to the stage a love and enthusiasm for the music. Learn more at www.richardpianoscott.com

Technical Program Wednesday

ACADIA BALLROOM

SESSION F

2:40 PM

SINGLE-EVENT EFFECTS: TRANSIENT CHARACTERIZATION

SESSION INTRODUCTION

Chair: Shi-Jie Wen, Cisco Systems

F-1
2:45 PM

DAMSEL - Dynamic and Applicative Measurement of Single Events in Logic

M. Glorieux, A. Evans, D. Alexandrescu, IROC Technologies; C. Boatella Polo, V. Ferlet-Cavrois, ESA

This paper describes a circuit for individually measuring both the impact of SEUs and SETs in realistic, synchronous digital circuits. Heavy-ion, pulsed laser and simulation results are presented.

F-2
3:00 PM

Analysis of Single Event Transient Duration and Electrical Delay with Implications for Near-Threshold Mitigation Techniques

J. A. Maharrey, J. S. Kauppila, R. C. Quinn, P. Nsengiyumva, D. R. Ball, T. D. Haeffner, E. X. Zhang, B. L. Bhuvu, W. T. Holman, L. W. Massengill, Vanderbilt University

SETs in 14nm bulk FinFET logic chains have been experimentally measured across bias. The efficacy of filter-based mitigation is assessed by analyzing the voltage dependency of SET duration against the characteristic electrical inverter delay.

F-3
3:15 PM

Correlation of the Spatial Variation of Single-Event Sensivity with Thermo-Reflectance Thermography in $\text{Al}_x\text{Ga}_{1-x}\text{N}/\text{GaN}$ HEMTs

A. Khachatryan, Sotera Defense Solutions; N. J.-H. Roche, Montpellier University; L. B. Ruppalt, J. G. Champlain, A. D. Koehler, S. P. Buchner, T. J. Anderson, K. D. Hobart, J. H. Warner, D. P. McMorrow, NRL; V. Ferlet-Cavrois, M. Muschitiello, European Space Agency; K.-O. Voss, Gesellschaft fuer Schwerionenforschung

Spatial variation of Single Event Transients generated in $\text{Al}_x\text{Ga}_{1-x}\text{N}/\text{GaN}$ HEMTs are studied using focused ion beams and laser light. Regions of enhanced SET sensitivity overlap those with large temperature changes observed using thermo-reflectance.

POSTER PAPERS

PF-1

Delay Monitor Circuit for Sensitive Nodes in SRAM-Based FPGA

M. Darvishi, Y. Audet, Ecole Polytechnique de Montreal; Y. Blaquiere, Ecole de Technologie Supérieure (ETS)

This paper presents a novel monitor circuit architecture and experiments performed for detection of extra combinational delays in a high frequency SRAM-Based FPGA on delay sensitive nodes due to transient ionizing radiation.

PF-2

On-Chip Relative SET/SEU Susceptibility Test Circuit for ICs Working in Real Time

P. Hao, S. Chen, Z. Wu, National University of Defense Technology

A test circuit for measuring relative SET/SEU sensitivity of each node in circuits working in real time is proposed for first time. This is significant for IC design with high reliability and low overhead.

Technical Program Wednesday

PF-3 Evidence of Pulse Quenching in AND Gates in 65 nm Bulk CMOS by Experimental Probing of Full Single-Event Transient Waveforms

M. Mitrovic, M. Hofbauer, K. Schneider-Hornstein, B. Goll, H. Zimmermann, Institute of Electrodynamics; K.-O. Voss, GSI Helmholtzzentrum für Schwerionenforschung GmbH

Full waveforms of single-event transients in AND2 gates under focused heavy-ion micro-beam irradiation were experimentally measured, showing evidence of charge-sharing induced pulse quenching, depending on hit position and logic state.

FOYER
3:30 - 3:55 PM

BREAK

ACADIA BALLROOM
SESSION G
3:55 PM

HARDENING BY DESIGN
SESSION INTRODUCTION

Chair: Michael Wirthlin, Brigham Young University

G-1
4:00 PM

Heavy Ion SEE Response of Multiple Flip-Flop Topologies in a 14nm Bulk FinFET Technology for Near Threshold Computing

M. Cabanas-Holmen, M. Yao, J. Ballast, E. Cannon, J. Tostenrude, T. Amort, The Boeing Company; S. Rabaa, Matrix Visions LLC; K. Lilja, M. Bounasser, Robust Chip Inc.; D. Blaauw, Y. Kim, University of Michigan

We present SEE experimental data for various flip-flops fabricated in a 14nm bulk FinFET CMOS technology. The flip-flops were tested under nominal and near threshold bias conditions at multiple tilt and rotation angles.

G-2
4:15 PM

SET-Mitigated PNP-Based RF Switches in a Complementary SiGe BiCMOS Platform

I. Song, Z. E. Fleetwood, M.-K. Cho, S. Pavlidis, J. D. Cressler, Georgia Institute of Technology; S. P. Buchner, D. McMorro, US Naval Research Laboratory; P. Paki, Defense Threat Reduction Agency; M. Kaynak, IHP Microelectronics

A PNP SiGe HBT RF switch is proposed for SET mitigation. A through-wafer two-photon absorption pulsed-laser experiment was conducted. The proposed RF switch exhibited 55% reduction in transient peaks.

G-3
4:30 PM

SiGe HBT Profiles with Enhanced Inverse-Mode Operation to Mitigate Single-Event Transients

Z. E. Fleetwood, A. Ildefonso, G. N. Tzintzarov, B. Wier, U. Raghunathan, M.-K. Cho, I. Song, M. T. Wachter, J. D. Cressler, Georgia Institute of Technology; A. Khachatrian, Naval Research Laboratory and Sotera Defense; J. Warner, P. McMarr, H. Hughes, D. McMorro, Naval Research Laboratory; P. Paki, Defense Threat Reduction Agency; A. Joseph, V. Jain, GlobalFoundries

The radiation response of inverse mode profile optimization techniques is investigated in fabricated Silicon-Germanium Heterojunction Bipolar Transistors (SiGe HBTs).

Technical Program Wednesday

G-4 **A 2.56 GHz SEU Radiation Hard LC-Tank VCO for High-Speed Communication Links in 65 nm CMOS Technology**

4:45 PM

J. Prinzie, M. Steyaert, P. Leroux, ESAT-ADVISE; P. Moreira, J. Christiansen, CERN

This paper presents a radiation tolerant Phase-Locked Loop CMOS ASIC with an optimized Voltage Controlled Oscillator for Single-Event Upsets. The circuit has been experimentally verified with heavy ions and two-photon laser tests.

POSTER PAPERS

PG-1 **Frequency Dependence of Heavy-Ion Induced Single-Event Responses of Flip-Flops in a 16-nm Bulk FinFET Technology**

H. Zhang, H. Jiang, B. L. Bhuvu, J. S. Kauppila, W. T. Holman, L. W. Massengill, Vanderbilt University

Circuit-level simulations and heavy-ion experiments were carried out to investigate frequency dependence of single-event cross-sections for hardened DICE-based flip-flops with different spacing options in 16-nm bulk FinFET technology.

PG-2 **NMOS Transistor Location Adjustment for N-Hit Single Event Transient Mitigation in 65 nm CMOS Bulk Technology**

Z. Wu, S. Chen, P. Huang, National University of Defence Technology

Heavy ion experiments demonstrate that reducing the distance between NMOS transistor and N-well can mitigate N-hit SET. This principle can be applied for RHBD standard cell design without any area overhead.

PG-3 **An Electrostatic Discharge (ESD) Protection Circuit Technique for the Mitigation of Single-Event Transients in SiGe BiCMOS Technology**

M.-K. Cho, I. Song, S. Pavlidis, Z. E. Fleetwood, J. D. Cressler, Georgia Institute of Technology; S. P. Buchner, D. McMorro, US Naval Research Laboratory; P. Paki, Defense Threat Reduction Agency

The impact of SETs on ESD protection circuits is investigated. For proof-of-concept that SET mitigation can be accomplished through the use of an ESD protection circuit, a RF SPST switch was implemented.

5:00 PM END OF WEDNESDAY SESSIONS

Technical Program Thursday

ACADIA BALLROOM
INVITED TALK
8:30 – 9:40 AM



The Mars Reconnaissance Orbiter and the Curiosity Rover: Perspectives on Whether Mars is Habitable

Dr. Tanya Harrison, Arizona State University

Mars has captured the imagination of space enthusiasts for several decades. Many satellites and rovers have been sent to Mars to study the planet, starting in the 1960s. The Mars Reconnaissance Orbiter and the Curiosity rover have hosted a number of instruments that have allowed us to learn many aspects of Mars, including Mars' ancient climate and Mars' geology. This research allows us to determine whether Mars previously sustained life and whether Mars could sustain human life now. This talk will cover many of the science discoveries from MRO and Curiosity, including whether Mars is habitable.

Dr. Tanya Harrison is a Research Scientist with the NewSpace Initiative at Arizona State University. She specializes in martian surface geology and worked in operations for NASA's Mars Reconnaissance Orbiter and the Curiosity rover. Tanya holds a Ph.D. in Geology with a Specialization in Planetary Science from the University of Western Ontario, a Masters in Earth and Environmental Sciences from Wesleyan University, and a B.Sc. in Astronomy and Physics from the University of Washington.

ACADIA BALLROOM
SESSION H
9:40 AM

SPACE AND TERRESTRIAL ENVIRONMENTS

SESSION INTRODUCTION

Chair: Pete Truscott, Kallisto Consultancy Ltd

H-1
9:45 AM

Extreme Atmospheric Radiation Environments & Single Event Effects

C. S. Dyer, CSDRadConsultancy; A. Hands, K. Ryden, University of Surrey; F. Lei, RADMOD Research

Data from ground-level monitors and cosmogenic nuclides are combined to give a probability distribution for severe events and their effects on ground-level and aerospace systems.

H-2
10:00 AM

The Compact Environmental Anomaly Sensor Risk Reduction (CEASE-RR): a Pathfinder for Operational Energetic Charged Particle Sensors

C. D. Lindstrom, J. O. Ballenthin, D. A. Barton, J. M. Coombs, J. Ignazio, W. R. Johnston, S. Kratochvil, S. Quigley, P. Roddy, R. S. Selesnick, A. Wheelock, Air Force Research Laboratory; J. Aarestad, J. Love, A. Vera, IDEAS Engineering & Technology, LLC; D. McIntire, Applied Technology Associates Corporation; M. Sibley, Sandia National Laboratory; S. Wu, NASA Ames Research Center

CEASE RR is a new compact sensor designed for rapid anomaly attribution due to the space radiation environment. The sensor design, calibration, and planned flight experiment to geosynchronous orbit are reviewed.

MARDI GRAS BALLROOM
10:15 – 10:45 AM

BREAK

Technical Program Thursday

H-3
10:45 AM **The Solar Accumulated and Peak Proton and Heavy Ion Radiation Environment (SAPPHIRE) Model**
P. Jiggins, ESA; D. Heynderickx, DH Consultancy; P. Truscott, Kallisto Consultancy; I. Sandberg, SPARC; A. Varotsou, TRAD Tests and Radiations; F. Lei, RadMod Research; R. Vainio, O. Raukunen, University of Turku

A new probabilistic model aiming to cover all aspects of the SEP environment required for mission specifications is presented; the Solar Accumulated and Peak Proton and Heavy Ion Radiation Environment (SAPPHIRE) model.

H-4
11:00 AM **LHC and HL-LHC: Present and Future Radiation Environment in the High-Luminosity Collision Points and RHA Implications**
R. Garcia Alia, M. Brugger, F. Cerutti, S. Danzeca, A. Ferrari, S. Gilardoni, C. Martinella, O. Stein, A. Tsiganis, Y. Kadi, CERN

Present measurements of the radiation levels in the LHC high-luminosity collision points are used in combination with FLUKA simulations to estimate the radiation levels for the future HL-LHC upgrade.

ACADIA BALLROOM SESSION I 11:15 AM

DOSIMETRY **SESSION INTRODUCTION** *Chair: Ewart Blackmore, TRIUMF*

I-1
11:20 AM **Thin Silicon Microdosimeter Utilizing 3D MEMS Technology: Charge Collection Study and Its Application in Mixed Radiation Fields**
L. T. Tran, L. Chartier, D. Bolst, A. Pogosso, M. Petasecca, S. Guatelli, M. Lerch, A. Rosenfeld, University of Wollongong; M. Povoli, A. Summanwar, A. Kok, SINTEF; D. Prokopovich, M. Reinhard, ANSTO; N. Matsufuji, National Institutes for Quantum and Radiological Science and Technology

This paper presents two significant structures of 3D mushroom microdosimeters, their electrical and charge collection properties and preliminary results of dose equivalent obtained with these devices in a mixed radiation fields.

I-2
11:35 AM **Total-ionizing-dose effects on a graphene oxide X-ray detector**
N.-Q. Deng, Y. Yang, T.-L. Ren, Tsinghua University; W.-J. Liao, E. X. Zhang, D. M. Fleetwood, Vanderbilt University; H. Tian, University of Southern California

We have evaluated the total-ionizing-dose response of graphene-oxide-based X-ray detectors fabricated via laser scribing. The detectors are quite radiation sensitive, but degrade significantly during use due to charge trapping.

Technical Program Thursday

- I-3**
11:50 AM **A Spot-Based Evaluation of TID Performances for COTS Components**
F. Di Capua, L. Campajola, P. Casolaro, M. Campajola, A. Aloisio, Università degli Studi di Napoli; A. Lucaroni, A.R.T.E. Srl; G. Furano, T. Szweczyk, ESA/ESTEC; A. Menicucci, Delft University of Technology; M. Ottavi, S. Di Mascio, University of Rome Tor Vergata

In this work we present a new Total Ionizing Dose test methodology based on the use of a compact $^{90}\text{Sr}/^{90}\text{Y}$ beta source in alternative to ^{60}Co -source. This approach is particularly suitable for complex SoC devices.

POSTER PAPERS

- PI-1** **Dose Rate Dependency of a Floating-Gate Based Voltage Reference for Space Dosimetry Applications**

X. Li, L. Chen, University of Saskatchewan; D. Hiemstra, V. Kirischian, MDA Inc.; N. W. Vonno, Intersil Inc.

Low and high dose rate Co-60 testing is conducted on voltage references with floating gate technology. The voltage references respond differently to low and high dose rates and could be used as satellite dosimeters

- PI-2** **A Novel Passive Wireless Total Dose Dosimeter**

A. Mahmud, Y. Gonzalez-Velo, H. J. Barnaby, J. Aberle, S. Moallemi, J. Kitchen, C. Birtcher, K. Hilgers, T. Eller, K. Holbert, Arizona State University; A. Raman, D. E. Thomas, R. Arslanbekov, K. Bhatt, CFDRC

A novel implementation of a passive remote total dose sensing device operating in the range of 4 to 7 GHz is presented. The wireless sensor is based on a capacitively-loaded folded-patch antenna

12:05 AM – 1:40 PM LUNCH

ACADIA BALLROOM SESSION J

1:40 PM

HARDNESS ASSURANCE SESSION INTRODUCTION

Chair: Jerome Boch, University of Montpellier

J-1
1:45 PM

Hardness Assurance in Advanced Semiconductor Packaging with Krypton-85 Leak Testing

G. Lum, Lockheed Martin Space Systems Company; D. Beutler, MannaTech Engineering, LLC; D. Walters, L3 Applied Technologies; W. P. Ballard, retired from Sandia National Laboratories

Significant gain degradation was observed from Kr-85 leak testing of a bipolar discrete. The implications for hardness assurance are raised in advanced hermetic semiconductor packaging.

Technical Program Thursday

- J-2**
2:00 PM **Application of a Focused, Pulsed X-Ray Beam for Total Ionizing Dose Testing of Bipolar Linear Integrated Circuits**
S. D. LaLumondiere, N. P. Wells, D. M. Cardoza, E. C. Dillingham, J. P. Bonsall, P. Karuza, W. T. Lotshaw, S. C. Moss, The Aerospace Corporation; D. L. Brewe, Sector 20; R. D. Schrimpf, A. L. Sternberg, Vanderbilt University
- We demonstrate the utility of focused, pulsed x-rays for localized TID effect testing of analog integrated circuits. Two dimensional mapping of sensitive regions of transistors in the LM139 is used to demonstrate the technique.
- J-3**
2:15 PM **System Level Radiation Qualification of COTS-Based Control Systems for High Energy Accelerator Applications**
S. Uznanski, R. Garcia Alia, M. Brugger, C. Cangialosi, S. Danzeca, B. Todd, CERN
- Top-down system-level radiation qualification of a complex electronic system prior to component radiation characterization is presented. The approach allows avoiding a system over-design by focusing on failures leading to system unavailability.
- J-4**
2:30 PM **Exploiting Parallelism and Heterogeneity in a FinFET Radiation Effects TCV Optimized for Efficient Heavy-Ion Testing**
J. S. Kauppila, J. A. Maharrey, R. C. Quinn, T. D. Haeffner, P. Nsengiyumva, D. R. Ball, A. L. Sternberg, E. X. Zhang, B. L. Bhuvu, L. W. Massengill, Vanderbilt University
- Novel design techniques for efficient testability were developed and implemented in a FinFET TCV. A 72-hour heavy ion test produced data sets with extensive technology characterization while achieving a 13X efficiency in beam time.

POSTER PAPERS

- PJ-1** **Correlation of a BJT-based neutron displacement damage sensor methodology and NIEL with proton irradiations**
A. M. Tonigan, Sandia National Laboratories and Vanderbilt University; C. N. Arutt, R. D. Schrimpf, Vanderbilt University; E. J. Parma, P. J. Griffin, Sandia National Laboratories
- Three bipolar transistors of varying sensitivity are evaluated as displacement damage sensors with proton, neutron and ionizing dose irradiations. The response is correlated to calculated non-ionizing energy loss (NIEL).
- PJ-2** **Using Two-Photon Absorption to Measure the Single-Event-Latchup Sensitive-Volume**
P. Wang, A. L. Sternberg, J. A. Kozub, E. X. Zhang, D. M. Fleetwood, R. A. Reed, R. D. Schrimpf, Vanderbilt University; N. A. Dodds, Sandia National Laboratories; S. L. Jordan, Jazz Semiconductor Trusted Foundry
- Single-event latchup sensitive volume is measured using a two-photon absorption technique that is based on the intrinsic variability of the laser pulse energy.
- PJ-3** **On-Orbit Flight Observation of Proton Induced SEB in a Power MOSFET**
L. Z. Scheick, R. Davies, R. Menke, R. Schaefer, G. R. Allen, L. D. Edmonds, JPL
- A power system was seen to fail as it passed thru a proton rich environment. A proton induced Single-Event Burnout in power MOSFET was identified as the most probable failure cause.

Technical Program Thursday

POSTER SESSION

2:45 PM – 5:30 PM

MARDI GRAS E-H
BALLROOMS

INTRODUCTION



Chair: Marta Bagatin, DEI - University of Padova

5:30 PM **END OF THURSDAY SESSIONS**

Technical Program Friday

ACADIA BALLROOM

INVITED TALK

8:30 – 9:40 AM

The Waters of Katrina: What the Storm Taught New Orleans about its Land, People, and Problems

Eve Troeh, Marketplace



No one can forget the scenes of August 2005, beamed across the globe in the days after Hurricane Katrina. Thousands left stranded in a devastated, flooded New Orleans, eighty percent of the city submerged when the levees broke. Katrina changed New Orleans forever. It also changed how Americans understood vulnerability to disaster. Yet as you walk around New Orleans today, the scars of Hurricane Katrina can be hard to see. Longtime New Orleans journalist Eve Troeh draws a line from the aftermath of Hurricane Katrina to the present, to tell the story of how the city has changed, and where the marks left by the storm show up the most.

Eve Troeh is Senior Editor for Sustainability at the public radio program Marketplace. She served as the first-ever News Director at New Orleans Public Radio, starting the local newsroom in 2013 and overseeing editorial projects like the podcast “Katrina: The Debris,” the Coastal Desk, and “Tripod: New Orleans @300” about the city’s tricentennial. Troeh was living in New Orleans when Hurricane Katrina hit, and served as a go-to stringer for NPR, as well as Katrina Media Fellow for the Open Society Institute, in the years just after the flood. Troeh grew up in Missouri in a small town along the Mississippi River, and now bounces between New Orleans and Los Angeles.

RADIATION EFFECTS DATA WORKSHOP

9:45 AM – 12:30 PM

MARDI GRAS A-D
BALLROOMS

INTRODUCTION



Chair: Jeffrey George, The Aerospace Corporation

W-1

Single-Event Latchup Measurements on COTS Electronic Devices for Use in ISS Payloads

F. Irom, G. R. Allen, S. Vartanian, Jet Propulsion Laboratory

This paper reports recent single-event latchup results for a variety of microelectronic devices. The data was collected to evaluate these devices for possible use in NASA ISS payloads.

Technical Program Friday

- W-2 2017 Compendium of Recent Test Results of Single Event Effects Conducted by the Jet Propulsion Laboratory's Radiation Effects Group**
G. R. Allen, S. Vartanian, F. Irom, L. Z. Scheick, P. C. Adell, M. D. O'Connor, S. M. Guertin, JPL

We present heavy-ion single event effects results for a variety of microelectronic devices targeted for possible use in JPL spacecraft. The compendium covers devices tested within the timeframe of August 2015 through February 2017.

- W-3 Compendium of Single-Event Transient (SET) and Total Ionizing Dose (TID) Test Results for Commonly Used Voltage Comparators**
A. N. Bozovich, F. Irom, JPL

This data compendium reports single-event transient and total ionizing dose test results for commonly used commercial-off-the-shelf (COTS) and radiation hardened voltage comparators targeted for possible use in space-based missions.

- W-4 Compendium of Current Total Ionizing Dose and Displacement Damage Results from NASA Goddard Space Flight Center**
M. J. Campola, D. Chen, M. C. Casey, K. A. LaBel, J. A. Pellish, R. L. Ladbury, J.-M. Lauenstein, M. A. Xapsos, NASA GSFC; A. D. Topper, D. J. Cochran, E. P. Wilcox, T. Mondy, M. V. O'Bryan, K.-Y. K. Yau, AS&D, Inc.

Total ionizing dose and displacement damage testing was performed to characterize and determine the suitability of candidate electronics for NASA space utilization. Devices tested include optoelectronics, digital, analog, linear bipolar devices, and hybrid devices.

- W-5 Compendium of Current Single Event Effects Results from NASA Goddard Space Flight Center and Selected NASA Electronic Parts and Packaging Program Single Event Effects Tests**
M. V. O'Bryan, C. M. Szabo, M. D. Berg, AS&D, Inc.; K. A. LaBel, D. Chen, M. J. Campola, M. C. Casey, J.-M. Lauenstein, J. A. Pellish, NASA GSFC; E. J. Wyrwas, Lentech, Inc.; S. M. Guertin, JPL

We present the results of single event effects (SEE) testing and analysis investigating the effects of radiation on electronics. This paper is a summary of test results.

- W-6 Compendium of Single Event Effects (SEE) Test Results for COTS and Standard Electronics for Low Earth Orbit and Deep Space Applications**
B. D. Reddell, C. R. Bailey, P. M. O'Neill, NASA Johnson Space Center; R. Gaza, C. Patel, J. Cooper, T. A. Kalb, Lockheed Martin Corporation; K. V. Nguyen, Jacobs Engineering

We present the results of SEE testing with high energy protons and with low and high energy heavy ions. This paper summarizes test results for components considered for Low Earth Orbit and Deep Space applications.

Technical Program Friday

W-7 Compendium of Radiation-Induced Effects for Candidate Particle Accelerator Electronics

S. Danzeca, P. Peronnard, G. Foucard, G. Tsiligiannis, M. Brugger, A. Masi, S. Gilardoni, CERN; R. Secondo, R. Ferraro, T. Borel, Universite de Montpellier 2

Vulnerability of a variety of components for particle accelerators electronics to single event effects, total ionizing dose and displacement damage has been analyzed. The tested parts include analog, linear, digital, and hybrid devices.

W-8 A Fast and Radiation-Hard Single-Photon Counting ASIC for the Upgrade of the LHCb RICH Detector at CERN

M. Fiorini, W. Baldini, R. Calabrese, A. Cotta Ramusino, E. Luppi, R. Malaguti, L. Minzoni, L. Pappalardo, L. Tomassetti, University of Ferrara and INFN Sezione di Ferrara; M. Baszczyk, P. Dorosz, W. Kucewicz, AGH University of Science and Technology and INP; A. Candelori, S. Mattiazzo, L. Silvestrin, Università degli Studi di Padova and INFN Sezione di Padova; P. Carniti, L. Cassina, A. Giachero, C. Gotti, M. Maino, G. Pessina, Università degli Studi di Milano Bicocca and INFN Sezione di Milano Bicocca

A new version of the CLARO8 ASIC has been designed in AMS 0.35um CMOS technology, based on radiation hardened by design cells, and extensively tested. Results on the complete radiation hardness characterization are presented.

W-9 Fast and Low-Cost Soft Error Testing of a COTS Microcontroller with Alpha Particle Source

F. Leite, M. Silveira, R. Baginski, Centro Universitario da FEI; V. Aguiar, N. Medina, N. Added, Universidade de Sao Paulo

This work proposes a fast and low-cost setup to evaluate soft errors on digital programmable systems owing to Single Event Effects caused by ionizing radiation.

W-10 Research of Non-Contacting Laser-Based Approach for DUT Heating During SEE Test with Heavy Ion Exposure

A. E. Koziukov, V. S. Anashin, E. V. Mitin, E. N. Nekrasova, URSC-ISDE

The paper presents a new heating approach for radiation hardness tests of electronic components at elevated temperature. Infrared laser radiation is used to increase temperature of the chip.

W-11 Recent Cocktail Beam Developments at the LBNL 88-Inch Cyclotron for SEE Testing

J. Y. Benitez, M. B. Johnson, W. Lu, B. F. Ninemire, L. W. Phair, D. S. Todd, D. Xie, Lawrence Berkeley National Laboratory

ECR ion sources at LBNLs 88-Inch Cyclotron produce heavy ion cocktails to test the radiation hardness of spacecraft electronics. A 20MeV/u cocktail is underway. The 10MeV/u cocktail is expanded to gold.

Technical Program Friday

W-12 Selectable Fluence Measurement Accuracy at the LBNL 88-Inch Cyclotron BASE Facility

A. Donoghue, L. Phair, M. Johnson, S. Small, T. Gimpel, C. R. Siero, Lawrence Berkeley National Laboratory

An investigation is made of the trade-off between fluence measurement accuracy and time needed for detector calibration. Allowing users to choose fluence measurement accuracy based the type of testing being performed and time available.

W-13 Radiation Hardness Evaluation of the YHFT-DV Digital Signal Processor

Y. Chi, B. Liang, Y. Sun, Y. Guo, National University of Defense Technology

The Total Ionizing Dose and Single Event Effects test results of YHFT-DV, a 32-bit floating-point digital signal processor are reported in this paper. The result shows the DSP is well radiation hardened.

W-14 Single-Event Effects Characterization of a 12-Bit 200MSps A-to-D Converter in 32nm SOI CMOS with MilliBeam and Broad-Beam Heavy-Ions

A. Zanchi, M. Cabanas-Holmen, R. Brees, The Boeing Company; P. Eaton, W. Burke, Microelectronics Research Development Corporation

A 12bit 32nm SOI 200MSps ADC tested at LBNL with MilliBeam showed no upsets with LET<30, while 1-sample SETs up to 600LSB were observed at TAMU with LET ~170 MeV-cm²/mg broad-beam.

W-15 Ionizing Radiation Response of the 4558 Analog Processor / Analog-to-Digital Converter

S. C. Witczak, J. J. Horner, D. C. Harms, T. S. Mason, K. E. Marino, G. E. Macejik, Northrop Grumman

The Northrop Grumman 4558 Analog Processor / Analog-to-Digital Converter was assessed for ionizing radiation tolerance through 12 krad(Si). Neither irradiation nor post-irradiation anneal has a measurable effect on the performance parameters.

W-16 Total Dose Testing of Advanced Mixed Signal ADC/DAC Microcircuits

D. D. Alexander, A. Vera, J. Aarestad, University of New Mexico; J. Castillo, T. Fehl, SPACE-X

Total dose test results are presented for the Maxim 1257/1258 multi-channel ADC/DAC, and the Linear Technology LTC2378-20 low power SAR. The paper discusses radiation testing challenges of complex mixed signal circuits.

W-17 Single Event Upsets Induced by a Few MeV Neutrons in SRAMs and FPGAs

D. Lambert, F. Desnoyers, D. Thouvenot, J. Galinat, Nucletudes; B. Azaïs, T. Colladant, DGA

Single Event Effect (SEE) characterizations under a few MeV neutrons are presented for various commercial SRAMS and FPGAs.

Technical Program Friday

W-18 Neutron Induced Single Event Upset (SEU) Testing of Commercial Memory Devices with Embedded Error Correction Codes (ECC)

J. M. Bird, M. J. Tostanoski, K. Hartojo, R. E. Strayer, Radiation Test Solutions; M. K. Peters, T. F. Deaton, Cobham RAD, Inc.; T. Z. Fullem, Bechtel Marine Propulsion Corporation

Results of neutron induced SEU testing for three devices with error correction codes: Cypress CY7C1061GE30-10BVXI and CY7C1061GE-10BVXI, and a memory system consisting of Micron MT48LC32M8A2TG-75ITD and a Tundra Tsi107 memory controller.

W-19 Single Event Upset Characterization of the Tegra K1 Mobile Processor Using Proton Irradiation

Q. Chen, H. Wang, L. Chen, University of Saskatchewan; D. Hiemstra, V. Kirischinan, MDA Inc.

Proton induced SEU cross-sections of Tegra K1 mobile processor are presented. Overall upset rates of Tegra K1 in the space radiation environment are estimated.

W-20 High Energy Proton Irradiation Results for the DSP Cores of the KeyStone II System-on-Chip (SoC) 66AK2L06

Q. Chen, H. Wang, L. Chen, University of Saskatchewan; D. Hiemstra, V. Kirischinan, MDA Inc.

Proton induced SEU cross-section of DSP cores within the KeyStone™ II system-on-chip 66AK2L06 is presented. Upset rates in the space radiation environment are estimated.

W-21 Single Event Upset Characterization of the Zynq UltraScale+ MPSoC Using Proton Irradiation

D. M. Hiemstra, V. Kirischian, J. Brelski, MDA

Proton induced SEU cross-sections of the SRAM which stores the logic configuration and certain functional blocks of the Zynq UltraScale+ MPSoC are presented. Upset rates in the space radiation environment are estimated.

W-22 Neutron, 64 MeV Proton & Alpha Single-Event Characterization of Xilinx 16nm FinFET Zynq® UltraScale+™ MPSoC

P. Maillard, M. Hart, J. Barton, J. Arver, C. Smith, XILINX, INC.

The single-event response of Xilinx 16nm Zynq® UltraScale+™ MPSoC is characterized using neutron, 64 MeV proton, thermal neutron and alpha foil irradiation sources. SEE results for the programmable logic and the processor are presented.

W-23 64 MeV Proton Single-Event Upset Characterization of Customer Memory Interface Design on Xilinx XCKU040 FPGA

Y. P. Chen, P. Maillard, M. Hart, J. Schmitz, P. Kyu, D. Smith, J. Barton, XILINX, INC.

The SEU characterization of a customer memory interface design on the XCKU040 FPGA was conducted with 64MeV proton source. A corrected FIT estimation methodology is proposed using FPGA utilization factor and architectural vulnerability factor (AVF).

Technical Program Friday

W-24 Experimental Methods and Results for the Evaluation of Triple Modular Redundancy SEU Mitigation Techniques with the Kintex-7 FPGA

K. M. Sielewicz, G. Aglieri Rinella, M. Bonora, P. Giubilato, CERN; J. Schambach, The University of Texas at Austin; M. J. Rossewicz, Utrecht University; T. Vanat, Czech Technical University in Prague

This paper describes experimental methods and results for the evaluation of triple modular redundancy SEU mitigation techniques with the Kintex-7 FPGA. Testing was performed both in the beam and fault injection tests.

W-25 SEE Test Results for the Snapdragon 820

S. M. Guertin, JPL

SEE test results are presented for proton, heavy ion, and neutron testing of the Qualcomm Snapdragon 820 and its support DDR4 device. Processor crashes and DDR4 stuck bits are the primary SEE types.

W-26 Towards a Qualification Data Set: Expanded SEE Data on the P2020 Processor

S. M. Guertin, JPL

Earlier P2020 SEE data are compared and expanded to a recent die revision, significantly increasing samples tested by protons and heavy ions by five each. New static debugger, watchdog, and Ethernet tests were also employed.

W-27 Proton and Heavy Ion Testing of the Microsemi Igloo2 FPGA

S. C. Davis, R. Koga, J. S. George, The Aerospace Corporation

We performed proton and heavy-ion testing of the Microsemi Igloo2 FPGA using several basic designs looking at the logic, embedded SRAM, and mathblocks as well as any SEFI or high current states.

W-28 Heavy-Ion Device Cross-Section Response in Magnetic Tunnel Junctions for a Radiation Hardened 16Mb Magnetoresistive Random Access Memory (MRAM)

R. R. Katti, Honeywell International, Inc.

Heavy-ion cross-sections from MRAM Magnetic Tunnel Junctions are LET/atomic number, and not fluence, dominated; with distributions similar to thermally-accelerated resistance and magneto-resistance shifts that also depend physically on tunnel barriers.

W-29 Single Event Effect Assessment of a 1-Mbit Commercial Magneto-Resistive Random Access Memory

P. C. Adell, S. Moro, Facebook Inc.; L. Gouyet, C. Chatry, TRAD Corp; B. Vermeire, Space Micro Inc.

The single-event susceptibility of a commercial 1-Mbit MRAM was experimentally evaluated. Results show that the memory was not sensitive to SEL, SEU or MBUs whereas it exhibited SEFIs when operated in dynamic mode.

Technical Program Friday

W-30 Total Ionizing Dose Effects in Commercial Floating-Gate-Alternative Non-Volatile Memories

M. J. Gadlage, M. J. Kay, D. I. Bruce, A. H. Roach, A. R. Duncan, A. M. Williams, J. D. Ingalls, NSWCRANE

The total dose response of commercially-available floating-gate-alternative non-volatile memories is characterized. The response of MRAM, FRAM, CBRAM, ReRAM, SONOS, and PCRAM devices are compared to a relatively radiation tolerant NAND flash.

W-31 ELDRS Characterization up to 100 krad(Si) of Texas Instruments Dual Amplifier LM158

B. Myers, K. Kruckmeyer, T. Trinh, Texas Instruments

The ELDRS characterization data is presented for TI's dual op amp LM158, where it is shown that results for the low dose rate performance are better. The LM158 is ELDRS free to 100 krad.

W-32 Radiation Effects Characterization of TI LMH5401-SP Ultra-Wideband Fully Differential Amplifier (FDA)

S. Narayanan, V. Narayanan, C. Yots, J. Cruz-Colon, Texas Instruments

The SEE and TID (up to 50 krad) effects of the LMH5401-SP, industry leading fully differential amplifier, are presented. No latch up events were observed up to an LET of 85 MeV-cm²/mg at 125°C.

W-33 Radiation Effects Characterization of TI OPA4277-SP High Precision Operational Amplifier

V. Narayanan, S. Narayanan, W. Vonbergen, J. Cruz Colon, Texas Instruments

The OPA4277-SP, precision operational amplifier with very low offset is shown to withstand total ionizing dose of 50 krad. No latch-up was observed up to 86MeV at 125°C. Single event transients are also presented.

W-34 Radiation Evaluation of the CDCLVP111-SP Low Voltage 1:10 LVPECL Clock Distributor

J. Cruz-Colon, V. Narayanan, W. Vonbergen, Texas Instruments

Single Events Effect (SEE) characterization results for LVPECL 1:10 Clock Distributor is summarized, showing very robust SEE performance up to LET_{EFF}=65.1 MeV-cm²/mg

W-35 SEU Characterization of Embedded 130nm Compiled SRAMs in a Proton Environment

M. Von Thun, D. Walz, R. Dumitru, A. Wilson, T. Farris, Cobham Semiconductor Solutions

Embedded 130nm SRAMs from a Cobham RadHard Library were characterized for single event upsets and functional interrupts in proton and heavy ion environments.

Technical Program Friday

W-36 Heavy Ion and TID Characterization of 3.3V Voltage Supervisors

A. L. Wilson, D. Walz, Y. Lotfi, K. G. Merkel, M. Von Thun, T. Farris, Cobham Semiconductor Solutions

We present Single Event Transient and TID characteristic data for the UT01VS33D single channel voltage supervisor fabricated in a 0.35 μ m triple-well mixed-signal CMOS process.

W-37 Proton Testing Results for Kaman KD-5100 Differential Inductive Position Measuring Systems

B. H. McGuyer, S. Moro, Facebook Inc.; R. J. Milanowski, M&A Inc.; N. Hall, B. Vermeire, Space Micro Inc.

We report proton testing of a position measuring system, the Kaman KD-5100, with applications including mirror positioning for laser beam control. We measure a device response likely due to TID and/or displacement damage.

W-38 Single Event Effects Assessment of a Commercial 12-Megapixel CMOS Imager

F. Hardy, B. Vermeire, M. Jacox, Space Micro, Inc.; R. Milanowski, M&A, Inc.; S. Moro, Facebook, Inc.

A commercial off-the-shelf 12-Megapixel CMOS sensor was irradiated with 105 MeV protons to a fluence of 3.5E11 protons/cm². No latch-up events occurred. Pixel brightness increases with fluence are reported.

W-39 Single Event Upset and Total Ionising Dose Assessment of Commercial Optical Coherent DSP ASIC

R. J. Aniceto, S. Moro, Facebook; C. Isabelle, R. Milanowski, N. Hall, B. Vermeire, Space Micro Inc.

Proton beam testing of optical coherent application-specific integrated circuit to calculate single event upset cross sections at 64 MeV and 480 MeV. No performance degradation for total ionizing dose exposure to 170 krad(Si).

W-40 Characterization of the Effects of SEE, TID, and DDD on the UC1875-SP Controller

J. S. Hack, Northrop Grumman Mission Systems

This paper explores the effects of proton induced total ionizing dose and displacement damage, as well as heavy ion induced single event performance of the UC1875-SP controller.

W-41 Characterization of the Effects of SEE, ELDRS, and DDD on the UC1708 Driver

J. S. Hack, Northrop Grumman Mission Systems

This paper explores the combined effects of gamma ray-induced total ionizing dose and neutron-induced displacement damage, as well as addressing heavy ion induced single event performance of the UC1708 driver.

Technical Program Friday

W-42 Space and Terrestrial Radiation Response of Silicon Carbide Power MOSFETs

A. Akturk, J. McGarrity, A. Markowski, B. Cusack, CoolCAD Electronics LLC; R. Wilkins, Prairie View A&M University

Effects of heavy ion, terrestrial neutron and ionizing dose radiation on high voltage silicon carbide power MOSFETs are reported along with likely failure modes due to single event effects resulting from heavy ion exposures.

W-43 Proton Cross-Sections from Heavy-Ion Data in GaAs Devices

D. L. Hansen, Data Device Corporation

This paper reports on the calculation of proton SEU cross section from heavy-ion data in GaAs devices using a number of different models. Model accuracy is checked using data from the published literature.

W-44 Displacement Damage Testing of the Intersil ISL70023SEH and ISL70024SEH Gallium Nitride Power Transistors

N. W. van Vonno, O. Mansilla, W. H. Newman, L. G. Pearce, E. J. Thomson, Intersil

We report the results of displacement damage (DD) testing using 1 MeV equivalent neutrons of the Intersil ISL70023SEH and ISL70024 gallium nitride (GaN) power transistors together with a brief discussion of their structure and performance.

W-45 Destructive Single-Event Effects Testing of the Intersil ISL70023SEH and ISL70024SEH Gallium Nitride Power Transistors

N. W. van Vonno, O. Mansilla, W. H. Newman, L. G. Pearce, E. J. Thomson, Intersil

We report the results of destructive single-event effects testing of the Intersil ISL70023SEH and ISL70024SEH gallium nitride (GaN) power transistors together with a brief discussion of the structure and performance of these devices.

W-46 A Radiation Hardened, High-Voltage, High-Precision Analog Family

W. H. Newman, N. W. van Vonno, O. Mansilla, L. G. Pearce, E. J. Thomson, Intersil

Intersil has developed a family of radiation hardened high voltage analog parts in a complementary bipolar process on bonded wafer SOI. PR40 parts include precision op amps, voltage references and a temperature sensor.

W-47 1.8 MeV Proton Testing of Three Different Thermally Stabilized GaN HEMT RF Power Devices in Three Operational Modes

M. W. McCurdy, R. D. Schrimpf, D. M. Fleetwood, Vanderbilt University; K. Bole, B. Poling, Air Force Research Laboratory

We report summary test results of three commercially available GaN HEMT RF power devices irradiated with 1.8 MeV protons in three operational modes. Thermoelectric cooling was used to minimize thermally induced parametric shifts.

Technical Program Friday

W-48 Recent Radiation Test Results for Trench Power MOSFETs

J.-M. Lauenstein, M. C. Casey, R. L. Ladbury, K. A. LaBel, NASA GSFC; E. P. Wilcox, A. M. Phan, H. S. Kim, A. D. Topper, AS&D Inc.

Single-event effect (SEE) test results are presented for commercial/automotive grade and radiation-hardened trench power MOSFETs. Commercial trench MOSFETs showed unexpected single-event degradation when unbiased.

W-49 Testing the Radiation Hardness of Thick-Film Resistors for a Time-of-Flight Mass Spectrometer at Jupiter with 18 MeV Protons

D. Lasi, M. Tulej, P. Wurz, University of Bern; T. S. Carzaniga, K. P. Nestreuk, S. Braccini, Albert Einstein Center for Fundamental Physics; H. R. Elsener, Swiss Federal Laboratories for Materials Science and Technology

18 MeV-proton irradiations with real time monitoring of sample temperature and electrical parameters, combined with chemical composition measurements, are applied to assess the hardness of thick-film resistors for a mass spectrometer at Jupiter.

W-50 Representativeness of ^{60}Co Testing for EEE Components to be Flown in JUICE

M. Pinto, P. Gonçalves, P. Assis, M. Ferreira, Space, LIP; M. Muschitiello, C. Poivey, ESTEC

The representativity of ^{60}Co testing for the Jovian electron environment was tested by comparing TID degradation of selected EEE components irradiated with ^{60}Co gammas and with electron beams with energy above 10 MeV.

W-51 The Impact of Annealing on the Following Radiation Degradation Rate of Bipolar Devices

A. S. Bakerenkov, A. S. Rodin, V. S. Pershenkov, V. A. Felitsyn, Y. D. Bursian, Moscow Engineering Physics Institute

The effect of post irradiation annealing on the following radiation degradation rate of bipolar integrated circuit parameters was estimated. The degradation rate increases significantly during the irradiation in comparison with the irradiation before the annealing.

W-52 Total Dose Radiation Response of N-Channel Enhancement Mode Field Effect Transistors over Wide Operation Temperature Range

A. S. Bakerenkov, V. A. Felitsyn, V. V. Orlov, A. S. Rodin, G. I. Zebrev, National Research Nuclear University MEPhI

Total dose radiation response of the n-channel 2N7002 transistors was examined at different temperatures. Voltage-current characteristics of the devices were measured before and after irradiation in wide temperature range from 80K to 350K.

W-53 TID, ELDRS and DEE Hardening and Testing on Mixed Signal Telemetry LX7730 Controller

M. Sureau, R. Stevens, M. Leuenberger, N. Rezzak, D. Johnson, Microsemi

TID, ELDRS and SEE hardening and testing of the first radiation hardened analog mixed-signal telemetry controller IC, the LX7730, are presented.

Technical Program Friday

W-54 Heavy Ion and Proton Induced Radiation Effects on Differential Bus Transceiver Microcircuits

R. Koga, S. Davis, J. George, The Aerospace Corp

We present observations of proton and heavy ion induced single event effects on selected COTS differential bus transceiver integrated circuits.

W-55 Single Event Transient and Functional Interrupt in Readout Integrated Circuit of Infrared Image Sensors at Low Temperatures

L. Artola, A. Al Youssef, G. Hubert, Onera; S. Ducret, R. Buiron, S. Parola, Sofradir; C. Poivey, ESA

This work presents the measurements of single event transient and functional interrupt on two designs of readout integrated circuit under heavy ion irradiations at cryogenic temperatures. The temperature dependence of the SEFI occurrence is limited

W-56 Heavy Ion Latch-up Test on dsPIC Microcontroller to Be Used in ExoMars 2020 Mission

P. Manzano, M. Álvarez, S. Sampedro, M. J. Rivas, I. Traseira, J. Manzano, J. R. Mingo, INTA - Spain; A. Martín-Ortega, N. Andrés, ISDEFE - Spain

Heavy ion Latch-up test on Microchip Microcontroller has been performed in order to analyze its suitability for ExoMars Mission. SEL rate estimation shows it can be used for non-critical applications

W-57 An Improved SEL Test of the ADV212 Video Codec

E. P. Wilcox, AS&D, Inc.; M. J. Campola, NASA-GSFC; S. Nadendla, M. Kadari, Jackson & Tull; R. A. Gigliuto, Formerly of AS&D, Inc.

Single-event effect (SEE) test data is presented on the Analog Devices ADV212. Focus is given to the test setup used to improve data quality and validate single-event latchup (SEL) protection circuitry.

W-58 Ionizing Radiation Effects in Non-Radiation-Tolerant Digital Video Cameras

E. Simova, P. A. Rochefort, J. DeVreede, Canadian Nuclear Laboratories Limited

Commercial digital video cameras were irradiated with gamma-rays at various dose rates up to the total ionizing dose (TID) for catastrophic failure. Camera performance with respect to both dose rates and TID were analyzed.

12:30 PM END OF CONFERENCE



The purposes of the Radiation Effects Committee (REC) of the IEEE Nuclear and Plasma Sciences Society are to advance the theory and application of radiation effects and its allied sciences, to disseminate information pertaining to those fields, and to maintain high scientific and technical standards among its members.



Allan Johnston
Executive Chairman

The Committee aids in promoting close cooperation and the exchange of technical information among its members. This is done by running conferences for the presentation and discussion of original contributions, assisting in the publication of technical papers on radiation effects in the IEEE Transactions on Nuclear Science, coordinating development of radiation effects measurement definitions and standards within IEEE and other standards organizations, providing a sounding board for radiation effects specialists, providing for the continued professional development and needs of its members, and providing liaisons between IEEE and other technical organizations in the areas of radiation effects.

Each year, the REC provides a forum for the technical exchange of information by holding the Nuclear and Space Radiation Effects Conference (NSREC). The NSREC is an international forum for presentation of research papers on nuclear and space radiation effects. This includes effects on electronic and photonic materials, devices, circuits, sensors, and systems, as well as semiconductor processing technology and design techniques for producing radiation-tolerant (hardened) devices and integrated circuits. Papers presented at the NSREC are submitted for possible publication in the December issue of the IEEE Transactions on Nuclear Science.



Janet Barth
Executive Vice-Chair

NSREC 2017 will be held in New Orleans, Louisiana, July 17-21, 2017 at the New Orleans Marriott. Conference Chair Véronique Ferlet-Cavrois and her committee have assembled a strong technical program and social events that will provide abundant opportunities for discussing radiation effects with old and new friends in the international radiation effects community.

Supporters of the 2017 NSREC include 3-D Plus, BAE Systems, Boeing, Cobham Semiconductor Solutions, European Space Agency, Freebird Semiconductor, International Rectifier HiRel Products, Inc., Intersil Corporation, Jet Propulsion Laboratory, Southwest Research Institute, and VPT RAD, Inc. We thank our supporters for their significant and continuing commitments to the conference, and welcome other organizations to consider becoming supporters of the IEEE NSREC.

NSREC 2018 will be held in Kona, Hawaii, July 16-20, 2018 at the Hilton Waikola. Ronald Lacoe of The Aerospace Corporation, is Chair. John Stone, SWRI, is the 2019 NSREC Chair and has selected San Antonio, Texas as the conference site. Hugh Barnaby, Arizona State University, is the 2020 Chair.

Papers presented at the NSREC are eligible for publication in the January 2018 issue of the *IEEE Transactions on Nuclear Science*. Authors must upload their papers prior to the conference for consideration for publication in the January 2018 TNS Special Issue. Detailed instructions can be found at www.nsrec.com

Keep visiting our web site at www.nsrec.com for author information, paper submission details, exhibitor links, on-line registration, and the latest NSREC information.

IEEE FELLOWS

Two distinguished members of the international radiation effects community were elevated to the grade of IEEE Fellow on January 1, 2017.

Janet Barth, NASA/GSFC Emeritus, “for leadership in spacecraft reliability and electronic systems”

Hugh Barnaby, Arizona State University, “for research of radiation effects in bipolar junction transistors”

EDITORS

Dan Fleetwood
Vice-Chair of Publications

All papers accepted for oral or poster presentation in the technical program will be eligible for publication in a special issue of the *IEEE Transactions on Nuclear Science* (January 2018), based on a separate submission of a complete paper. Each paper will be subject to the standard full peer review given all papers submitted to the *IEEE Transactions on Nuclear Science*. All papers must be submitted on IEEE ScholarOne. Instructions for submitting papers can be found at the Conference web site www.nsrec.com. The deadline for submission of papers is the Friday before the Conference (July 14, 2017). Data Workshop papers are published in a Workshop Record and are not candidates for publication in the *IEEE Transactions on Nuclear Science*. The process for the Workshop Record is managed by the Workshop Chair.

The review process for papers submitted to the *Transactions* is managed by a team of editors. To provide consistent review of papers, this editorial team manages the review process for all radiation effects papers submitted to the *Transactions* throughout the year. The editorial team consists of a senior editor and six associate editors who are technically knowledgeable in one or more specializations and are experienced in the publication process. If you would like to serve as a reviewer for the December issue of the *Transactions* or for radiation effects papers submitted throughout the year, please contact one of the editors. The editors for the 2017 NSREC are:

Dan Fleetwood, Senior Editor, Vanderbilt University
Email: dan.fleetwood@vanderbilt.edu

Dennis Brown, Associate Editor, IEEE NPSS
Email: brownden_1@yahoo.com

Sylvain Girard, Associate Editor, Université de Saint-Etienne
Email: sylvain.girard@univ-st-etienne.fr

Simone Gerardin, Associate Editor, University of Padova
Email: simone.gerardin@dei.unipd.it

Ivan Sanchez Esqueda, Associate Editor, USC ISI
Email: isanchez@isi.edu

William Robinson, Associate Editor, Vanderbilt University
Email: william.h.robinson@vanderbilt.edu

Steven Moss, Associate Editor, The Aerospace Corporation
Email: steven.c.moss@aero.org

RESG NEWS

ARE YOU A MEMBER OF IEEE?

Now is the time to join the Institute of Electrical and Electronics Engineers (IEEE) and the Nuclear Plasma Sciences Society (NPSS). Why? First of all, you'll become a member of the largest professional engineering society in the world. About 60% of NSREC attendees are IEEE members. Full membership in IEEE costs less than \$200. IEEE members receive access to a broad range of benefits, including a terrific insurance program, on-line access to IEEE publications, and reduced rates at all IEEE sponsored conferences, including, of course, the IEEE NSREC and Short Course!

NPSS membership is \$35. NPSS members receive a free subscription to *NPSS News*, and free on-line electronic access via *IEEE Xplore* to the *IEEE Transactions on Nuclear Science (TNS)* and the *NSREC Data Workshop Record*. Now members can search and view digital copies of all *IEEE TNS* papers on-line all the way back to the first IEEE NSREC in 1964. NPSS members get to vote in our NSREC elections, held at the annual open meeting on Thursday of the conference. What are you waiting for? Apply for membership at <http://ieee-npss.org/why-join-npss-and-ieee/> or visit the IEEE registration desk at the conference.

NSREC PUBLICATIONS

NSREC has two publications each year:

- ***IEEE Transactions on Nuclear Science***. This IEEE journal is the official archive of research papers presented at the NSREC Conference.
- ***Radiation Effects Data Workshop Record***. Published each year in October, this IEEE proceedings has become the source for radiation test data on semiconductor components.

A complimentary copy of the *2017 IEEE Radiation Effects Data Workshop Record* and the December special NSREC issue of the *IEEE Transactions on Nuclear Science* will be mailed to each NSREC technical session attendee. A CD and USB flash drive containing the *NSREC Short Course Notes (2017)* will be given to short course attendees.

RADIATION EFFECTS COMMITTEE ANNUAL OPEN MEETING

**THURSDAY, JULY 20
5:30 – 7:30 PM
ACADIA BALLROOM**

You are invited to attend the IEEE Radiation Effects Committee's Annual Open Meeting on Thursday, July 20 from 5:30-7:30pm, in the Acadia Ballroom. All conference attendees and registered guests are encouraged to attend. We will discuss the 2017 conference and future IEEE Nuclear and Space Radiation Effects Conferences. There will be an election for the Junior Member-at-Large on the Radiation Effects Steering Group. Nominations will be taken from the floor. All IEEE NPSS members present are eligible to vote. Refreshments will be provided.

Awards

2016 NSREC OUTSTANDING CONFERENCE PAPER AWARD

Inclusion of Radiation Environment Variability in Total Dose Hardness Assurance Methodology

M.A. Xapsos, C. Stauffer, A. Phan, S.S. McClure, R.L. Ladbury, J.A. Pellish, M.J. Campola, and K.A. LaBel.

2016 OUTSTANDING STUDENT PAPER AWARD

Dark Current Spectroscopy in neutron, proton and ion irradiated CMOS Image Sensors: From Point Defects to Clusters

J.-M. Belloir, V. Goiffon, C. Virmondois, P. Paillet, M. Raine, R. Molina, O. Gilard, P. Magnan

2016 OUTSTANDING DATA WORKSHOP PRESENTATION AWARD

Compendium of Single Event Effects Results from NASA Goddard Space Flight Center

M. V. O'Bryan, K. A. LaBel, C. M. Szabo, D. Chen, M. J. Campola, M. C. Casey, J.-M. Lauenstein, J. A. Pellish, M. D. Berg

2016 RADIATION EFFECTS AWARD

Jean-Luc Leray, CEA, received the 2016 IEEE/NPSS Radiation Effects Award. His citation was "For contributions to the understanding of basic mechanisms of radiation effects in microelectronic devices, and to the development of radiation-hardened SOI technologies in Europe."

2017 RADIATION EFFECTS AWARD

The winner of the 2017 Radiation Effects Award will be announced Tuesday morning, July 18. The purpose of the award is to recognize individuals who have had a sustained history of outstanding and innovative technical and/or leadership contributions to the radiation effects community.

2018 RADIATION EFFECTS AWARD

Nominations are currently being accepted for the 2018 IEEE Nuclear and Plasma Sciences Society (NPSS) Radiation Effects Award. The basis of the award is for individuals who have: (1) a substantial, long-term history of technical contributions that have had major impact on the radiation effects community. Examples include benchmark work that initiated major research and development activities or a major body of work that provided a solution to a widely recognized problem in radiation effects; and/or (2) a demonstrated long-term history of outstanding and innovative leadership contributions in support of the radiation effects community. Examples include initiation or development of innovative approaches for promoting cooperation and exchange of technical information or outstanding leadership in support of the professional development of the members of the radiation effects community.

A cash award and plaque will be presented at the 2018 IEEE NSREC, Kona, Hawaii in July 2018. Nomination forms are available electronically in PDF Format or in Microsoft Word format at <http://ieee-npss.org/technical-committees/radiation-effects/>. Forms should be sent to Tom Turflinger, Member-at-Large for the Radiation Effects Steering Group. Tom can be contacted at: The Aerospace Corporation, 14301 Sullyfield Circle, Unit C CH3-310, Chantilly, VA 20151; 571-307-3715 or thomas.l.turflinger@aero.org

Conference Information

CONFERENCE LOCATION



Photo credit New Orleans Marriott

Today, NEW ORLEANS – the Crescent City – shaped by the Mississippi River and Lake Pontchartrain and “reclaimed” from the swamp, gives one the sense of lazy summer days with the sounds of jazz and the aroma of fine food in the air. With a multi-nation history and blended culture, the city is unique in all the U.S. The culture and creativity of the city come to life in the neighborhoods. From the historic French Quarter to the elegant Garden District to the music-filled Marigny, you’ll find great food, music, architecture and activities to be enjoyed. It is such a varied mix of experiences that you’ll soon learn to appreciate the longtime lure of this truly fascinating city.

Time in New Orleans isn’t kept in hours or days, but in meals. When dining in New Orleans, your culinary adventure will span a wide array of cuisines. From Cajun and Creole to Soul and Contemporary French, award-winning chefs create food for your taste buds and nourishment for your soul. Taste for yourself why Bon Appétit named New Orleans one of America’s Top 5 Restaurant cities. Start the day with a beignet drenched in powdered sugar and a steaming café au lait. Chow down on a fried shrimp po’boy or mountainous muffaletta for lunch. And end your day with gumbo, Shrimp Creole, and flaming Bananas Foster.

New Orleans cuisine isn’t the only thing spicing up the city. Music is where New Orleans’ first settlers found common ground, and no other city loves music more. Jazz, America’s only original art form, was born here, while Rhythm and Blues, Gospel, Cajun and Zydeco all express the rich melting pot of their heritage.

Countless architectural gems await you in New Orleans. In fact, the city is home to more National Historic Landmarks than any other city in the United States. Venture to the Arts District, a vibrant community of galleries, and experience why it has been called the SoHo of the South. Then visit one of the oldest and most diverse districts in New Orleans, Magazine Street, an area filled with art exhibits, restaurants, shops and more. Finally, submerge yourself in the historic French Quarter by strolling down Royal and other famous French Quarter streets.

The 2017 IEEE NSREC welcomes you to New Orleans and to coin its now-famous phrase, “Laissez les bon temps rouler” . . . or “Let the good times roll!”

BREAKFASTS, LUNCH AND BREAKS

The 2017 IEEE NSREC will provide continental breakfast and refreshments at breaks during the NSREC Short Course and Technical Sessions. Lunch is included for Short Course attendees on Monday. A light lunch will be provided on Wednesday in the Exhibit Hall. These meals and refreshments are for *registered conference attendees only*. Please see the schedule for times and locations.

BUSINESS CENTER

The New Orleans Marriott has an in-house FedEx office that features a self-service business center for photocopying, faxing, and computer printing. For additional services, they can handle large print jobs, banner creation and all typical shipping services. The FedEx office is open 7 days a week – Mon-Fri from 7:00am-7:00pm and Sat-Sun from 10:00am-6:00pm. Costs associated with this center must be paid directly to FedEx. For more information, see: http://www.fedex.com/us/office/Hotels-Conventions/marriott-new-orleans.html?lid=neworleans_conventionlocations_neworleans

Conference Information

ROOMS FOR SIDE MEETINGS

Several meeting rooms are available for use by any registered conference attendee at the New Orleans Marriott on a first come, first served basis. *NSREC encourages side meetings to be scheduled at times other than during technical sessions.* Contact ETCic at 720-733-2003 or send an e-mail to etc@etcic.us to make side meeting reservations before the conference. To make a side meeting room reservation during the conference, see the NSREC Registration staff in Balcony J-K on the 4th floor.

Notes: *You must register for the conference before a side meeting room can be reserved!* Any audio/visual equipment and refreshments must be coordinated directly with the hotel and are the responsibility of the attendee hosting the meeting.

CHILD CARE REIMBURSEMENT

The 2017 Conference is offering child-care reimbursement of up to \$400 per family to assist conference attendees who incur additional childcare expenses by attending the conference. This program, funded by the NPSS AdCom, will also be carried out at other NPSS Conferences during 2017. Limited funds are available, and preference will be given to applicants in the early stages of their careers who are IEEE NPSS members. Up to five candidates will be selected.

Eligible applicants:

- Families where both parents are registered attendees at the conference
- Parent (registered attendee) who brings child(ren) to the conference
- Parent (registered attendee) who incurs additional expenses at his or her home location, *above normal child-care expenses*, while attending the conference.

Allowable expenses include:

- Babysitting or child-care expenses at the conference location while the parent(s) attend the conference
- Additional baby sitting or child-care expenses incurred in leaving a child home while parent(s) attend the conference
- Transportation expenses for a child-care provider to care for child(ren) during the conference. Reimbursement is only allowed for an adult or relative that does not share your home residence.

Expenses must be documented by receipts. An expense report, accompanied by receipts, must be received by the conference finance chair within two weeks of the end of the conference (Aug. 4, 2017). If the report is not received by that date, no reimbursement will be made. All reimbursements will be made after the conference.

To apply, an attendee must register for the conference technical sessions, and then complete the application form to request reimbursement for child care. The application must be received no later than June 2, 2017. Applicants will be notified whether they qualify for these funds within two weeks after the deadline. Due to limited funding, it is possible that not all qualified applicants will be eligible for reimbursement. The application form is available on the website for the 2017 NSREC.

Registration and Travel

CONFERENCE REGISTRATION

NSREC encourages Pre-Registration and offers a lower registration rate (“Early Registration”) if the payment is received by no later than Friday, June 16. After that date, the “Late Registration” rates will apply.

There are three acceptable forms of payment for registration and activity fees:

- 1) Check made payable to “IEEE NSREC” in U.S. dollars and drawn on a U.S. bank
- 2) Cash (only on-site), or
- 3) MasterCard, VISA, or American Express credit card

Registrations can be submitted by using the link at the NSREC website:

www.nsrec.com. E-mailed or faxed registrations will be accepted with a credit card payment or you can mail the conference registration form along with your payment to ETCic. If your registration form and payment do not arrive at ETCic by July 10, then it would be best to hand-carry the payment to the conference for on-site registration. Registration via telephone will not be accepted.

ETC Incentives & Conferences (ETCic)
2254 Emerald Drive
Castle Rock, CO 80104
Tel: 720-733-2003
Fax: 720-733-2046
etc@etcic.us

ON-SITE REGISTRATION LOCATION

On **Sunday, July 16**, and in conjunction with the Welcome Reception, Registration will begin in the Marriott New Orleans Hotel in the following locations:

*Not yet registered, go to “On-Site Registration” in the Balcony J Room, 4th floor
Already registered, go to “Pre-Registration” in the Balcony K Room, 4th floor*

ON-SITE REGISTRATION HOURS

Sunday, July 16	5:00 PM – 8:00 PM	Marriott
Monday, July 17	7:30 AM – 5:00 PM	Marriott
Tuesday, July 18	7:30 AM – 5:00 PM	Marriott
Wednesday, July 19	7:30 AM – 3:00 PM	Marriott
Thursday, July 20	7:30 AM – 3:00 PM	Marriott
Friday, July 21	7:30 AM – 10:00 AM	Marriott

CONFERENCE CANCELLATION POLICY

A \$50 processing fee will be withheld from all refunds. Due to advance financial commitments, refunds of registration fees requested after June 16, 2017, cannot be guaranteed. Consideration of requests for refunds will be processed after the conference. To request a refund, you must notify ETCic by fax at 720-733-2046 or e-mail at **etc@etcic.us**.

Registration and Travel

HOST HOTEL INFORMATION

NEW ORLEANS MARRIOTT

555 CANAL STREET

NEW ORLEANS, LA 70130

TEL: 504-581-1000

The host hotel for the 2017 NSREC is the 4-star New Orleans Marriott. Located on Canal Street, this property is in the center of the most thriving main street in New Orleans, and it sits on the western perimeter of the world-famous French Quarter.

The Marriott structure is two towers (one with 41-stories and another with 21-stories) that are connected in the middle with the public and meeting room space. Hotel amenities include one restaurant, one cocktail lounge, a 24-hour health club (complimentary to hotel guests), outdoor pool with large deck, business center, lobby ATM, parking garage, and a coffee bar (Starbucks). The 1,330 guest rooms are comfortably furnished in contemporary design. All rooms are non-smoking and feature large windows (some with dramatic views), individual climate control, flat-screen TV with cable, complimentary basic wireless in the guest rooms, work desk, coffee maker, hairdryer, iron & ironing board, multiple phones with voice mail, alarm clock, refrigerator and room service. Standard rooms have one king bed or two double beds.



Guest room rates for a standard room are as follows:

NEGOTIATED GROUP RATE:

\$149.00 single/double per night plus tax (king or 2 double beds)

GOVERNMENT RATE:

\$128.00 single/double* per night plus tax (king or 2 double beds)

TAXES:

14% hotel room tax + 1.75% Tourism Assessment fee + \$3.00 Occupancy fee per night

Triple or quad occupancy is at an additional \$20.00 + tax per night. There is no additional charge for children 5 years of age and under when sharing a room with an adult and utilizing existing beds.

*To be eligible for the government rate, guests must provide current government or military ID.

Based on availability, the guest room rates will be offered 3 days before and 3 days after the conference.

HOTEL RESERVATIONS

The preferred method to make reservations is by using the weblink:

GROUP BLOCK:

<https://laws.passkey.com/go/2017IEEE>

GOVERNMENT BLOCK:

<https://laws.passkey.com/go/2017IEEEGOV>

Registration and Travel

After accessing the appropriate weblink, please enter your arrival and departure dates and then follow the prompts. Based on availability, you will be given the opportunity to choose a standard room or an upgraded room (with a view or on the Club Level) at an additional cost.

NOTE: The hotel reservation site does not provide the option to choose a room with a king bed or two double beds. If you need a specific bed type, please go to the "Personal Information" section and enter your request in the "Additional Request" block.

Reservations can also be made by calling Marriott Reservations toll-free at 1-800-228-9290 within the U.S. or Canada. Or, you can call the hotel directly at 1-504-581-1000 and ask for "in-house reservations." To get the special rates, advise the agent of the following group name:

2017 IEEE NSREC Conference

All rooms must be guaranteed by providing a credit card or a one-night check deposit to the hotel. The cut-off for IEEE NSREC reservations is at 5:00 PM Central Daylight Time (GMT +6) on Friday, June 16, 2017. Once the room block has been filled OR after the cut-off date (whichever comes first!), room accommodations will be confirmed on a space or rate available basis. Early reservations are strongly suggested!

CANCELLATION: Any cancellations must be made by no later than 6:00pm, Central Daylight Time, two (2) days prior to your scheduled arrival. If the cancellation is made by that time, then no penalty will be charged. If cancellation is made past this timeframe, then one night's room and tax will be charged as a cancellation fee.

NO-SHOW: Any reservations that do not show up on the scheduled day of arrival will be charged one night's room and tax as a no-show fee and the remainder of the reservation will be automatically cancelled. If there are any last-minute changes to travel plans (flight delays, inclement weather, etc.), please notify the hotel as soon as possible.

AIRPORT AND TRANSPORTATION INFORMATION

Louis Armstrong New Orleans International Airport is located 17 miles from the Marriott New Orleans Hotel on Canal Street, about a 30-minute drive.

- 1) **Taxi:** Taxi stands are located on the first level of the Terminal outside of Baggage Claim Belts 1 and 14. Passengers must wait in line at one of these booths for taxi service.

Taxi fares run about \$36.00 one way from the airport to the Marriott hotel or French Quarter for up to 2 passengers. For 3 or more passengers, an additional \$14.00 per passenger is added. Taxis providing transfers to/from the airport are required to accept credit cards as an option for payment.

- 2) **Airport Shuttle:** This company provides shared-ride van service to and from the Louis Armstrong New Orleans International Airport.

The NSREC has negotiated a special group rate of \$40.00 roundtrip with Airport Shuttle, versus their normal \$44.00 roundtrip rate. In order to get this group rate, you must use the link below to make a reservation and print your tickets online. This discount applies ONLY to purchases made online; walkups are not eligible

Registration and Travel

for the discount. Use weblink: <http://airportshuttleneworleans.hudsonltd.net/res?USERIDENTRY=IEEENSREC0717&LOGON=GO>

If you do not purchase your discounted tickets online, then Airport Shuttle's regular rate from the airport to the Marriott New Orleans is \$24.00 per person one-way or \$44.00 per person, round trip. Passengers can have up to 3 bags per person. Passengers can purchase tickets at the airport at Airport Shuttle ticket booths located on the first level in the Baggage Claim area.

NOTE: For departure reservations, please call 504-522-3500 no later than 24 hours prior to your flight. Your advance reservation will ensure your timely departure to the airport.

- 3) **Car Rental:** If you are planning to rent a car from the airport, the Consolidated Rental Car Facility (CONRAC) is located a short walk from the main terminal. Passengers should exit the Baggage Claim area (first level) near Belts 12-14 and continue to the right down a covered walkway to the CONRAC. Nine rental car companies currently operate at the airport. For contact information for these companies, please visit the website: <http://www.flymsy.com/rentalinformation>

If you plan to rent a car in downtown New Orleans, the same car vendors at the airport are located downtown, some near the Marriott Hotel and French Quarter. Hertz is nearest to the hotel.

PARKING AND DRIVING DIRECTIONS

If you have a car and need to park at the Marriott, please know that NSREC attendees who have booked a guest room within the room block at the Marriott, are eligible for a 50% discount off the standard overnight rate of \$43.50. Daily parking is at an hourly rate with very limited space available. Note: Vehicles taller than 5' 9" cannot enter the parking garage.

Airport to the Marriott: Turn left onto US-61 S/Airline Dr. Take the I-10 E ramp to US-90 BUS/Westbank. Keep left at the fork and merge onto I-10 E. Continue onto US-90 BUS W. Take the exit toward Superdome. Turn right onto Dave Dixon Dr. Slight right onto Girod St. Take the 1st left onto Loyola Ave. Continue onto Elk Pl. Turn right onto Canal St. Make a U-turn. Destination will be on the right.

GETTING AROUND TOWN

Aside from walking, you can easily rent a bike, a pedi-cab, or a taxi. You can also take advantage of the public bus or streetcar system in New Orleans – both excellent and easy ways to get around.

Riding New Orleans's iconic streetcar is a not-to-be-missed experience in the Crescent City. Clean, cute and convenient, the streetcar clatters along the essential thoroughfares on 4 lines: St. Charles, Canal Street and Riverfront, along with the latest addition, the Loyola Avenue line. Don't forget to have exact change for fare \$1.25. Or purchase a *Jazzy Pass* and ride the streetcar as much as you wish. Passes are available at Walgreens and select grocery stores. You can purchase a 1-day, 3-day or 31-day unlimited ride pass for \$3, \$9 and \$55.



Website: http://norta.com/fares_passes/Passes/index.html

Registration and Travel

INSIDER TIP While streetcars on the St. Charles Avenue line operate around the clock, they are few and far between late at night and in the early morning hours. After dark, calling a cab is your best bet.

ST. CHARLES AVE. STREETCAR This route runs over 13 miles downtown from Canal St. along St. Charles Ave, past the Greek Revival mansions & raised cottages, Tulane University and Audubon Park. Beyond the shops at the Riverbend, it takes a right hand turn onto Carrollton Ave.

RIVERFRONT STREETCAR This 2-mile route stops at the Convention Center, the Riverwalk, the Aquarium of the Americas, the French Market and the Old Mint on Esplanade.

CANAL/CARROLLTON STREETCAR The newest re-established line, which runs the length of Canal St., is the route to see the famous cemeteries, City Park, New Orleans Museum of Art and Botanical Gardens.

PEDICABS In recent years, "bike taxis" have sprung up all over the Big Easy. They're a fun way to get around town and take an informal tour at the same time. Powered by (mainly) college students, pedicabs are a safe and eco-friendly way for 1 to 2 people to get around town. Pedicabs can be found mostly around hotels and the French Quarter. Contact Nola Pedicab, (<http://www.nolapedicabs.com/>) one of the larger operators in town, for a pre-arranged pickup.

INSIDER TIP Make sure to have cash and don't forget to ask for the fee in advance of your ride.

BY TAXI There are hundreds of taxis available on New Orleans streets and major hotels. Taxi rates are \$3.50 plus \$2 per mile (.25 per one-eighth mile) thereafter. There is also an additional charge \$1 per passenger after the first passenger.

INSIDER TIP If paying by credit, ask the operator when ordering the cab if they can accept credit cards. Few cab drivers will accept them unless notified in advance.

WALKING New Orleans was made for walking. The city's many pedestrian-friendly stretches make walking around a breeze. Visitors especially love to stroll down oak tree-lined St. Charles Avenue, or hit the shops on the 6-mile stretch that is Magazine Street.

INSIDER TIP Particularly in the French Quarter, streets are often shut off to vehicle traffic, ensuring that those on foot can easily navigate.

BY BUS The public bus system in New Orleans is efficient, easy to navigate and clean -- not to mention air-conditioned! Some 36-bus routes can take you anywhere you need to go, so if you purchased a Jazzy Pass, feel free to use it on the bus in addition to the streetcar. Just note that you must have exact change for bus fare. The bus fare is \$1.25 each way and express bus is \$1.50. Children under 2 ride free; children 3 and older must pay full fare. If you will be taking any of the ferries across the river, the fare is \$2.00 each way per person. See website: <http://www.norta.com/Fares-Passes/Overview>

INSIDER TIP Bus stops are not announced by the driver, so make sure you come armed with a New Orleans city map or ask your driver before boarding if she or he can announce when you should get off. To look at bus routes around town, visit <http://norta.com/>

Industrial Exhibits



Anne Minez
Industrial Exhibits Chair

The **2017 NSREC Industrial Exhibits** will feature the leading worldwide suppliers of radiation hardened products, related materials, services, and research and development.

This will be an excellent opportunity for key suppliers, technical engineers and managers to meet and discuss the needs and solutions for electronics used in space vehicles, military electronics, and applications requiring radiation tolerance in harsh environments.

The **2017 NSREC Industrial Exhibits** will be in the Mardi Gras, Bissonnet / Carrondelet Ballrooms of the New Orleans Marriott Hotel (Canal Street) on Tuesday and Wednesday. Conference breaks will be hosted in the Exhibit Area on Tuesday and Wednesday along with a light lunch followed by exhibitor raffles (for registered attendees only). NSREC badges must be worn at all times.

Tuesday evening, the exhibitors will host the **Industrial Exhibits Reception** featuring light hors d'oeuvres in the Exhibit Area. The Reception is open to all NSREC attendees and their guests.

NSREC 2017 has an exciting "Exhibit Game" for attendees. If you participate you will be eligible for a drawing! Your instructions will be in your registration bag.

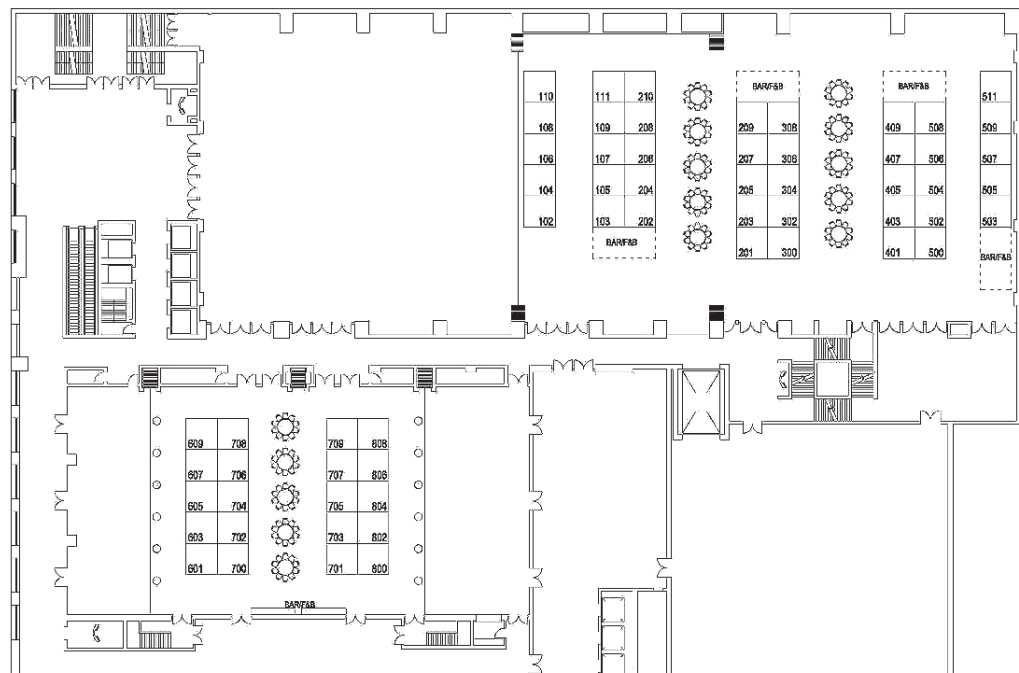
NOTE: Children under 16 must be accompanied by an adult in the Exhibit Area.

For more information, or to get on the waiting list for a booth, contact:

Anne Minez
3DPlus

Phone: +33 1 30 83 26 54
Email: aminez@3d-plus.com

Or visit the 2017 NSREC Industrial Exhibits web site: www.nsrec.com/become-an-exhibitor.html



IEEE Nuclear & Space Radiation Effects Conference

Exhibits: July 18-19, 2017

Marriott • Level 3

555 Canal Street - New Orleans, LA 70130

Industrial Exhibits

Please check our web site (www.nsrec.com) for a current listing of companies exhibiting at 2017 NSREC.

NSREC INDUSTRIAL EXHIBITS

NEW ORLEANS MARRIOTT

MARDI GRAS, BISSONET/ CARONDELET BALLROOMS

EXHIBIT HALL HOURS

TUESDAY, JULY 18

7:30 AM – 5:30 PM

10:15 AM MORNING BREAK

2:30 PM AFTERNOON BREAK

5:30 PM – 7:30 PM

RECEPTION

WEDNESDAY, JULY 19

7:30 AM – 1:00 PM

10:00 AM MORNING BREAK

12:00 PM LUNCH

1:00 PM RAFFLES

(All of the exhibit events, excluding the Tuesday reception, are for registered attendees only)

EXHIBITORS

Organization	Internet Site	Booth
3D Plus USA, Inc.	www.3d-plus.com	709
Allied Scientific	www.alliedscientific.com	506
Analog Devices, Inc.	www.analog.com	302
Anaren, Inc.	www.anaren.com	204
BAE Systems	www.baesystems.com	102
Boeing	www.boeing.com	205
Brookhaven National Lab	www.bnl.com	505
Cobham Semiconductor Solutions	www.cobham.com/HiRel	704/706/ 708
Cypress Semiconductor / DPACI	www.cypress.com and www.dpaci.com	701
Data Device Corporation	www.ddc-web.com	202
EMPC	www.empc.com	105
Foss Therapy	www.fosstherapyservices.net	106
Freebird Semiconductor Corp.	www.freebirdsemi.com	702
Honeywell	www.honeywellmicroelectronics.com	401
Hopewell Designs	www.hopewelldesigns.com	407
Intersil Corporation	www.intersil.com	201/203
IR HiRel	www.infineon.com	503
Isocom	www.isocom.uk.com	507
iXblue	www.iXblue.com	300
JD Instruments	www.jdinstruments.net	111
J.L. Shepherd & Associates	www.jlshepherd.com	500
Lawrence Berkeley National Laboratory	www.cyclotron.lbl.gov	511
Los Alamos National Laboratory	www.lanl.gov	107
Micro RDC	www.micrordc.com	108
Microchip	www.microchip.com	405
Micropac Industries	www.micropac.com	403
Microsemi	www.microsemi.com	306
Micross	www.micross.com	304
Modular Devices, Inc.	www.mdipower.com	705
NASA Electronic Parts and Packaging (NEPP)	http://nepp.nasa.gov	703
National Reconnaissance Office	www.nro.gov	504
Northrop Grumman	www.northropgrumman.com	104
Phoenix Nuclear Labs	www.phoenixnuclearlabs.com	509
Pulscan	www.pulscan.com	508
Robust Chip	www.robustchip.com	502
Sandia National Laboratory	www.sandia.gov	109
Silvaco	www.silvaco.com	206
Synopsys, Inc.	www.synopsys.com	707
Teledyne e2v	www.teledyne.com	700
Texas A&M Cyclotron Institute	www.cyclotron.tamu.edu/ref	409
Texas Instruments	www.texasinstruments.com	207
Ultra Communications	www.ultracomm-inc.com	110
ULTRA TEC	www.ultratecusa.com	209
Vanderbilt University / ISDE	www.isde.vanderbilt.edu	103
Vorago Technologies	www.voragotech.com	308
VPT, Inc	www.vptpower.com	208
VPT Rad	www.vptrad.com	210

2017 IEEE NSREC Technical Sessions and Short Course Registration Form



Name _____
Last Name First Name Middle Initial

Name to appear on badge _____

Company/Agency _____

Address _____

Address _____

City _____

State/Province _____

Zip or Postal Code _____

Country _____

Telephone Number _____

Fax Number _____

E-mail Address _____

IEEE Membership Number _____

* To obtain the IEEE rates, the IEEE membership number must appear on this form.

SPECIAL FUNCTIONS

☐ I am an IEEE Young Professional and will attend the IEEE Young Professionals Breakfast on Thursday, July 20

☐ I plan to attend the Women in Engineering (WIE) Lunch on Thursday, July 20

CANCELLATIONS

A \$50 processing fee will be withheld from all refunds. Due to advance financial commitments, refunds of conference registration fees requested after June 16, 2017, cannot be guaranteed. Consideration of requests for refunds will be processed after the conference. You must notify NSREC Registration by e-mail at etc@etcic.us or fax at 720-733-2046 by no later than June 23, 2017.

REGISTRATION FEES (in U.S. dollars)

Late fee REQUIRED if payment received after June 16, 2017

	Early	Late	
IEEE Member *			
Short Course	\$295	\$355	\$ _____
Technical Sessions	\$565	\$675	\$ _____
Non-IEEE Member			
Short Course	\$375	\$445	\$ _____
Technical Sessions	\$725	\$860	\$ _____
IEEE Student (or Life Member)			
Short Course	\$135	\$355	\$ _____
Technical Sessions	\$160	\$675	\$ _____

TOTAL AMOUNT ENCLOSED: \$ _____

PAYMENT OF FEES

☐ Enclosed is a check in **U.S. DOLLARS ONLY**, drawn on or payable through a U.S. bank.
 Payable to: **IEEE NSREC**

☐ Charge registration fees to my credit card (U.S. dollars):

☐ American Express ☐ Master Card
☐ Visa ☐ Discover

Card No. _____

Expiration Date _____ Security Code _____

Name on card _____

Cardholder
 Signature _____

Billing address _____

Mail or Fax this form and your remittance to:

IEEE NSREC REGISTRATION
P.O. Box 398
Castle Rock, CO 80104

Tel: 720-733-2003 Fax: 720-733-2046

2017 IEEE NSREC Activities Registration Form



Name _____
Last Name First Name Middle Initial

Name to appear on badge _____

Company/Agency _____

Address _____

Address _____

City _____

State/Province _____

Zip or Postal Code _____

Country _____

Telephone Number _____

Fax Number _____

E-mail Address _____

Please register any accompanying guest(s): List ages only for children who are under 21 years.

Name _____ Age _____

City, State, Country _____

Name _____ Age _____

City, State, Country _____

Name _____ Age _____

City, State, Country _____

CANCELLATIONS

To encourage advance registration for conference social activities, the NSREC will refund all activity fees for conference attendees and/or their companions who, for any reason, are unable to attend the conference. If your plans change after this form is submitted and you would like to request a refund, you must notify NSREC Registration by e-mail at etc@etcic.us or by fax at 720-733-2046 by no later than June 23, 2017.

Mail or Fax this form and your remittance to:

IEEE NSREC REGISTRATION
P.O. Box 398
Castle Rock, CO 80104

Tel: 720-733-2003 Fax: 720-733-2046

ACTIVITIES FEES (in U.S. dollars)

Late fee REQUIRED if payment received after June 16, 2017. We strongly encourage early registration; the number of tickets available for each event is limited. Children must be accompanied by an adult during all tours and social events.

	Early	Late	Number Attending	Total Cost
New Orleans City Tour Tuesday, July 18				
Adult (19 yrs +)	\$25.00	\$30.00	_____	\$_____
Child (5-18 yrs)	\$15.00	\$20.00	_____	\$_____
Infant (0-4 yrs)	\$0.00	\$0.00	_____	\$_____

New Orleans Cooking School Wednesday, July 19				
Adult/Child	\$30.00	\$35.00	_____	\$_____
(no children's discount)				

Conference Social – Mardi Gras World, Wednesday, July 19				
Adult (21 yrs +)	\$50.00	\$65.00	_____	\$_____
Teen (15-20 yrs)	\$35.00	\$45.00	_____	\$_____
Child (3-14 yrs)	\$15.00	\$25.00	_____	\$_____
Infant (0-2 yrs)	\$0.00	\$0.00	_____	\$_____

National WWII Museum Thursday, July 20				
Adult (19 yrs +)	\$22.00	\$27.00	_____	\$_____
Child (5-18 yrs)	\$15.00	\$20.00	_____	\$_____
Infant (0-4 yrs)	\$0.00	\$0.00	_____	\$_____

TOTAL AMOUNT ENCLOSED: \$_____

PAYMENT OF FEES

☐ Enclosed is a check in **U.S. DOLLARS ONLY**, drawn on or payable through a U.S. bank.
Payable to: **IEEE NSREC**

☐ Charge registration fees to my credit card (U.S. dollars):

☐ American Express ☐ Master Card
☐ Visa ☐ Discover

Card No. _____

Expiration Date _____ Security Code _____

Name on card _____

Cardholder Signature _____

Billing address _____

Social Program



"Welcome to NSREC 2017 in New Orleans and to the New Orleans Marriott, the host hotel. From your location on the edge of the famed French quarter, almost everything you'll want to see, hear, or taste is within easy access by trolley, bus, or foot. The conference committee has developed a social program with three very different companion events, and the Wednesday social, chosen to give you an introduction to the sights, sounds and flavors of New Orleans. We sincerely hope you enjoy yourself. As the Cajun natives say, 'Laissez les bons temps rouler,' - let the good times roll."

John Stone
Southwest Research Institute
Local Arrangements Chair



*"Crescent City Bridge" Photo by Richard Nowitz
- Courtesy of New Orleans Convention and Visitors Bureau*

New Orleans was established on the Mississippi River in 1718 as a French trading post and was named for Phillippe II, Duke of Orleans, who was the Regent of France at the time. France transferred ownership to Spain during the American Revolution. It was re-transferred to France in 1803 and then sold to the United States as part of the Louisiana Purchase. Successive waves of immigration, by people from both European and African extraction, from French and Spanish possessions in the Caribbean, as well as from the southern United States have combined to produce a truly unique culture that is obvious in the architecture, the music, and the food. Whether you call it the "Crescent City," the "Big Easy," or any other name, there is truly no place like New Orleans.

The conference committee has designed a social program that will allow you to explore New Orleans, its traditions, its food, and its role in the American fight for European freedom during World War II. The conference hotel, the New Orleans Marriott, is located on Canal street between the French Quarter (with its entertainment options) and the Warehouse district (with its excellent restaurants.) This central location provides easy access to most of the city's sights, sounds, and tastes either within a short walk or via the New Orleans Regional Transit Authority's (RTA) trolleys and buses. A transit pass giving unlimited access to trolleys and buses for a day is only \$ 3.00, providing very affordable access to the things you might like to see and do.

Typical summertime weather in New Orleans includes hot days and warm nights, with plentiful humidity, and rain is a regular occurrence, so you should wear a hat, include an umbrella in your bag, and drink plenty of water.

Come and join us as we explore New Orleans, the "Crescent City," with the 2017 NSREC social program.

**SUNDAY, JULY 16
6:00 PM TO 7:30 PM**

**REGISTRATION
WELCOME RECEPTION**

Join your colleagues for a reception with light hors d'oeuvres in the Mardi Gras Ballroom D-E on the Marriott's third floor. This reception is open to all Short Course and Technical Session attendees and their registered guests as a great opportunity to meet new friends and renew old acquaintances. *NSREC attendee or guest badges are required for entrance to the Registration Reception.* The conference registration desk is open from 5:00 to 8:00 PM to obtain your badges.

Social Program

**TUESDAY, JULY 18
9:30 AM TO 12:30 PM**

NEW ORLEANS CITY TOUR



On Tuesday morning, you'll depart from the Marriott front entrance on Canal Street at 9:30 AM for a 3-hour guided bus tour which will orient you to the Crescent City. Included in the tour are an overview of the French Quarter and an exploration of the neighborhood where Jazz was born. You will visit an above-ground cemetery, stop at a city park to purchase beignets & coffee, if you so choose, and take a short side trip to visit Lake Ponchartrain. You will also visit an area affected by Hurricane Katrina while the guide explains how the disaster happened and what has been done to make New Orleans safer today. The tour then traverses the university section of the city and enters the Garden district with a ride along St. Charles Avenue featuring views of some of New Orleans nicest Greek Revival style homes. This is followed by a trip through the museum district for an early afternoon return to the Marriott. By the tour's conclusion, you should have a much better understanding of what you might do or see during the rest of the week in New Orleans. Wear casual clothing and bring your cameras. Strollers will be allowed on the bus.

**TUESDAY, JULY 18
5:30 PM TO 7:30 PM
MARDI GRAS, BISSENET
/ CARONDELET
BALLROOMS**

INDUSTRIAL EXHIBITS RECEPTION

Join us for the 2017 Industrial Exhibits Reception hosted by your NSREC exhibitors. NSREC attendees and their registered guests are invited to the Grand and Mardi Gras ballrooms on the Marriott's third floor to visit the booths, enjoy some refreshments and participate in a raffle. *All attendees and registered guests must show their badges in order to enter the NSREC Industrial Exhibits.*



Social Program

**WEDNESDAY, JULY 19
10:30 AM TO 1:30 PM**

NEW ORLEANS SCHOOL OF COOKING

You'll depart the Marriott at 10:30 on a short, 6 block walk* to the New Orleans School of Cooking for an entertaining and informative Group Demonstration cooking class. Watch, learn & eat as you socialize with your friends! Sit back and enjoy watching the skilled, knowledgeable, and entertaining chefs prepare a classic Cajun / Creole meal while you learn about the vibrant history of New Orleans and its cuisine! Included in the demonstration will be an Authentic New Orleans meal and recipe cards to take with you in case you decide to get adventuresome in your kitchen after the conference. You can even buy the necessary spices and supplies in the well-stocked, attached store. In addition to the chef's demonstration foods, the meal will include bread/butter, water, iced tea, lemonade, coffee, and Abita beer (a local brew) - for those who want something stronger.

Please sign up for this activity as early as you can as an accurate count of attendees is needed at least one month prior to the function!

**Note that we can arrange transportation for those who are unable to walk the short distance to the school.*



Photo courtesy of New Orleans School of Cooking

**WEDNESDAY, JULY 19
5:30 PM TO 10:30 PM**

CONFERENCE SOCIAL

A NIGHT IN OLD NEW ORLEANS

Please meet in the Marriott Lobby near the main entrance. You will board the buses just outside the main entrance on Canal Street. One of the most unique aspects of New Orleans is Mardi Gras, the Big Easy's take on the Carnival season that ends when Lent begins. Begin your conference social with a walk through the "float den" where many of the Mardi Gras parade floats are built and maintained. From up close, you're sure to appreciate the hours of detailed work that goes into creating each of them.

Continue your evening with a social hour and then a buffet dinner between 6:30pm - 8:00pm. The dinner features New Orleans specialties including: Red Beans and Rice, Jambalaya, Muffalettas, Shrimp and Grits, and Bread Pudding. Take in the sights of the indoor plantation set and listen to musical entertainment by local Jazz musicians. After dinner, enjoy the view of the mighty Mississippi River from the outdoor landing

behind the dinner facility. Relax as you watch the great ships carrying the commerce of the U.S. interior to and from the Gulf of Mexico.



Photo courtesy of Mardi Gras World

This is your chance to share some social time with your friends and colleagues before buses shuttle back to the hotel between 9:00pm - 10:00pm. Wear casual clothing, bring your cameras, and strollers will be allowed on the bus.

Social Program

THURSDAY, JULY 20
7:00 AM – 8:30 AM

BALCONY M, N
(MARRIOTT FOURTH
FLOOR)

IEEE YOUNG
PROFESSIONALS
BREAKFAST



A special breakfast will be held in Balconies M and N on the fourth floor of the Marriott for IEEE member attendees who are Young Professionals (www.facebook.com/ieeeyp). This is an excellent opportunity for newer industry members to informally discuss radiation effects and to become better acquainted. Also invited to this breakfast are individuals representing IEEE, the Nuclear & Plasma Sciences Society (NPSS) Radiation Effects Steering Group, and various NSREC committees and they can explain how to become involved in IEEE NPSS activities.

We are honored to have a guest speaker, John D. Cressler, PhD, from Georgia Tech's School of Electrical and Computer Engineering. He will present a fascinating and entertaining talk entitled *"My Take on the Meaning of Life: Vocations and the Path to Happiness."*

YP's, you won't want to miss this so be sure to check the *Young Professional's Breakfast* box when you register! There is no extra fee for this event but space is limited and a ticket is required.

For more information, contact Anthony Sanders, anthony.b.sanders@nasa.gov.

John D. Cressler is one of Georgia Tech's most decorated teachers, is well-known for his research in the field of SiGe devices, circuits and systems, is a dedicated mentor to both undergraduate and graduate students, is a leader in service to his profession and community, is the author of a number of seminal books (both technical and for general audiences), and most recently, is an historical novelist (love stories designed to break open the magic of medieval Muslim Spain for modern readers). Whew, scary huh?! Cressler is the Schlumberger Chair Professor in the School of Electrical and Computer Engineering at Georgia Tech. He received his B.S. from Georgia Tech and his Ph.D. from Columbia University. One of Cressler's passions is speaking on technical topics to non-technical audiences, and on non-technical topics to technical audiences, of which he does both quite a bit. The former began in earnest with the release of his book *Silicon Earth* (now in its 2nd Edition), which introduces microelectronics and nanotechnology and their societal impact to general audiences. He presented on this topic last fall at DragonCon 2016, one of the largest science fiction and fantasy geek-fests on the planet (65,000+ costumed crazies!). He also teaches a course on the topic which is open to undergraduates of all majors and years, and which is required for business majors in the Georgia Tech's Technology and Management Program. Cressler is also deeply interested in the interaction between science and religion, as well as interfaith dynamics, and he recently introduced a new course at Georgia Tech, a first of its kind, titled, "Science, Engineering and Religion: An Interfaith Dialogue," which is also open to undergraduate students of all majors and years. He considers teaching and mentoring of young people to be his life's work. He and his wife Maria have been married for 34 years, are the proud parents of three exceptional young people, and the doting grandparents of five beyond-cute little ones (soon to be six!).

Social Program

**THURSDAY, JULY 20
9:00 AM TO 2:00 PM**

NATIONAL WORLD WAR II MUSEUM

On Thursday, enjoy a visit to New Orleans' number 1 tourist attraction, the National World War II Museum, designated by Congress as the "official WWII museum of the United States" and TripAdvisor© number three rated museum in the country. Originally opened as the D-Day museum to tell the story of New Orleans role in



Photo courtesy of National WWII Museum

providing many of the boats for the D-Day invasion, the museum has grown to tell the broader story of "the war that changed the world" – why it was fought, how it was won, and what it means today.

The museum tells the story of the industrial efforts on the home front, the combat experience of individual soldiers abroad, and the broad sweep of strategic planning both in the European and Pacific theaters of war. The museum features immersive walks through dioramas, multimedia experiences, and an expansive collection of artifacts (from private items to old warbirds) and first person oral histories. The National WWII museum is "must see" and will likely be one of the highlights of your trip. [Descriptive Text is largely copied from the National WWII Museum website] While on site, there are two excellent restaurants and the 4-D Movie "Beyond All Boundaries" -- both are available at your own cost.

Buses will shuttle from the Marriott front entrance (Canal Street) at 9:00, 9:45, and 10:30, and return from the Museum at 12:15, 13:15, and 13:45. You can choose any of these times to transfer back and forth. If you want to stay longer and make your way back on your own, the Museum is a 0.8 mile walk from the hotel or a short ride on the Magazine Street Bus.



Photo courtesy of National WWII Museum

Social Program

**THURSDAY, JULY 20
12:05 PM TO 1:45 PM
BALCONY M, N
(MARRIOTT
FOURTH FLOOR)**

WOMEN IN ENGINEERING LUNCH



A special lunch, sponsored by the IEEE NPSS society, will be held in Balconies M and N on the fourth floor of the Marriott for Women in Engineering. This event is open to any attendees who are interested in women's issues and it is a chance to meet and socialize with one another. This lunch will also include a short talk by Mary Beth Stevens, Los Alamos National Laboratory on "Negotiation and Communication". For more information, please Heather Quinn at hquinn@lanl.gov.

Note: *Tickets are required* so check the box for this lunch when you register for the conference.

Mary Beth Stevens has over 25 years experience in crisis response & conflict resolution, including 16 years as organizational ombuds in a 10,000-person national laboratory. Her educational background in psychology has been made practical by a couple of decades as an ombuds, mediator, critical incident debriefer and facilitator of trauma survivor groups. She regularly provides training on conflict resolution, communications and negotiations skills and is certified by the National Council for Behavioral Health as a Mental Health First Aid instructor.

This presentation distills research from several top resources into communication strategies which are immediately applicable in workplace and personal relationships. The focus is on creating interpersonal safety for problem-solving conversations and modifying the stories we tell about conflict and each other.

AEROBICS AND STRETCHING

Dave Bushmire, our nationally certified fitness instructor, will be inserting a thirty-minute full body stretching session to his aerobics class. The class will begin with thirty minutes of low impact aerobics followed by a stretching session designed to increase your flexibility and range of motion, decrease joint pain, back pain and chance of falling, while reducing stress, depression and fatigue. You will learn a set of stretches that can be done daily to enjoy an active and happy life style.

As in prior conferences, the classes will be held from 6:00 to 7:00 AM on Tuesday, Wednesday and Thursday in the Iberville Room on the fourth floor of the Marriott.

ACTIVITIES POLICIES

Participation: All participants in the NSREC activities must be conference attendees, registered guests of a conference attendee, registered exhibitors or registered guests of an exhibitor. Any children under 18 years of age must be accompanied by an adult at all times; no children will be allowed to attend any function without this adult supervision.

Cancellation: To encourage advance registration for conference social activities, NSREC will refund all activity fees for conference attendees and/or their companions who, for any reason, are unable to attend the conference if that notice is provided as follows. If your plans change after your Activities Registration form is submitted, simply request a refund by notifying ETCic via fax (720-733-2046) or e-mail (etc@etcic.us) by no later than June 23.

Wheelchairs and Strollers: Both wheelchairs and strollers can be stored in the luggage compartment of the buses but please note that you must provide your own personnel to push these devices.

Local Activities

GENERAL INFORMATION

There is plenty to do and see in New Orleans. Most of it is accessible without a car, either because you can ride a trolley or a bus, or because you've selected an event that provides transportation! Historic sites, museums, noteworthy architecture, walkable neighborhoods, beautiful parks, and intriguing tours are all available, along with great dining and entertainment, as well.

New Orleans has many interesting things to do and see. The following is simply a partial listing. Check www.neworleans.com and order an official tourist guide.

FRENCH QUARTER

The Marriott is on the edge of the French Quarter, a National Historic Landmark and the oldest neighborhood in the city. Most of the existing buildings were constructed after fires in 1788 and 1794, during the period of Spanish rule during the late 1700s, or during the first half of the 1800's, after annexation by the United States. The 78-square block area has beautiful Spanish inspired architecture and contains a variety of shops, restaurants, and nightclubs. At its heart is Jackson Square which was the original military square for the city. Along the edge of the square is St. Louis Cathedral and the Spanish Governor's Residence, The Cabildo, home of the Louisiana State Museum. The French Quarter contains the famous Bourbon Street as well as quieter streets, such as St. Peters Street, the location of famous Preservation Hall jazz music venue. On the edge of the French Quarter is Frenchman Street, home of the best live music in town, as well as Café Du Monde which serves New Orleans' beignets and Café Au Lait.



GARDEN DISTRICT

The Garden District is a National Historic Landmark District extending west of 1st street between St Charles Street and Magazine Street. It is accessible via the St. Charles Streetcar Line or the Magazine Street Bus. Primary development of the area began in 1832 and extended through 1900, and it is generally considered to contain one of the best-preserved collections of historic mansions in the southern US. The wide mix of people who settled in the Garden District can be seen in the above ground cemetery at the center of the district. It is the site of the famous Commander's Palace restaurant and of a fascinating set of casual restaurants along Magazine Street. (Interesting tidbit: Eli and Peyton Manning grew up in this neighborhood!)

Local Activities

NEW ORLEANS CITY PARK

Fifty percent larger than New York's Central Park, New Orleans' City Park is the 7th most visited urban public park in the United States. It was founded in 1854, and is the home of the New Orleans Botanical Garden, New Orleans Museum of Art and Sculpture Garden, which features a collection of French and American art, with selected African and Japanese pieces, as well as many activities for Children and Families. It can be reached via the 48 City Park/Museum Streetcar on the Canal Street streetcar line. For more information, visit www.neworleanscitypark.com

AUDUBON PARK AND ZOO

Built on the sight of a former plantation, the 350 acre Audubon Park stretches from St Charles Avenue to the Mississippi River approximately 6 miles west of our Hotel. It was the site of the World Cotton Centennial of 1884. Within the park is Ochsner Island, a birding spot and rookery, which attracts a variety of wading birds including great, cattle, and snowy egrets, ibis, and blue, green and night herons. At the southern end of the Park is the Audubon Zoo, a 58-acre zoo home to some 2000 animals. The Park is accessible from the Magazine Street bus and the St. Charles streetcar line. The Zoo is easily accessed from the Magazine Street Bus.



© Stonewerks Images

AUDUBON AQUARIUM OF THE AMERICAS/ BUTTERFLY GARDEN AND INSECTARIUM

A short walk down Canal Street from the Marriott is the Audubon Aquarium of the Americas, which focuses on aquatic species found in North, Central, and South America. Located in the U.S. Custom House, between the hotel and the aquarium, is the Audubon butterfly garden and insectarium which encourages visitors to use all five senses to explore North America's largest museum devoted to insects. Both attractions are available for a single ticket purchase. Information on the Audubon Zoo, Aquarium, and Insectarium is found at www.audubonnatureinstitute.org

NEW ORLEANS' CEMETERIES

The high-water table in the New Orleans basin has led to the practice of burying the dead in above ground tombs. These "cities of the dead" are popular tourist destinations with a variety of guided tours available. The most famous cemetery is St Louis Cemetery # 1 on Basin Street and within walking distance of the French Quarter, which has the tomb of the "voodoo queen" Marie Laveau, but there are many other interesting sites that can be visited. Whether you take a tour or simply spend an hour or two by yourself reading headstones, these cemeteries will give you a picture of the cultural history of New Orleans.

Local Activities

NATIONAL HISTORIC PARKS

New Orleans is home to two National Historic Parks, the Jean Lafitte National Historical Park and Preserve (www.nps.gov/jela) dedicated to exploring the origins and expressions of New Orleans culture, and the New Orleans Jazz National Historical Park (www.nps.gov/jazz) which explores the origins and development of Jazz, a musical style which owes a lot to that culture. Both parks have visitor's centers in the French Quarter: Jean Lafitte in the 600 block of Decatur Street, and Jazz in the old Louisiana Mint building. The parks do a good job with interpretive displays and performances, so spend an hour or two, or more, learning about the topics presented by these parks.

PLANTATION TOURS

Along the Mississippi, between New Orleans and Baton Rouge, are several antebellum plantations open for visitors, the most popular being Laura, Oak Alley, St Joseph, Houmas House, and Whitney. Some of the plantations have on-site restaurants and interpretive exhibits that give an insight into rural life in southern Louisiana prior to the American Civil War. One can rent a car and visit the plantations individually or book a motor coach excursion that covers one or more plantations and provides on coach narrative regarding the local area and culture. Whichever you choose, a plantation tour is the perfect day trip out.

SWAMP AND AIRBOAT TOURS

For those who want to explore the natural side of New Orleans and southern Louisiana, several companies offer airboat tours of the swamps and Bayous around New Orleans; some even have alligator feedings. Most vendors work with small motor coach companies to provide transportation from downtown New Orleans or provide guided transportation themselves. For more information google "**swamp tours New Orleans.**"

SIGHTSEEING TRANSPORTATION

Hop-on-Hop-off City Sight Seeing of New Orleans is a tour that offers maximum flexibility to see the city at your own pace. Experience 3 centuries of history, architecture and culture of this great city. We have negotiated a discounted group rate shown below.

3 Day Tickets.....Group Rate \$44
1 Day Tickets.....Group Rate \$36
3 Day or 1 Day Children....Group Rate \$10.00 age 3-12

To book your tickets at the promotional group discount, select the link below.

1. Go To the Website: www.CitySightseeingNewOrleans.com
2. Select the desired Ticket Type: **1 Day or 3 Day**
3. Select a Tour Start Date: **July 11 - July 27**
4. Click the **Book Now** Button
5. Enter Promotion Code: **2017IEEENSREC**
6. Click **Apply** to see the group discount subtracted from the grand total
7. Complete the application to purchase tickets, and bring your confirmation number with you and hop on at any stop to collect your tickets.

WEATHER AND CLOTHING

Typical summertime weather in New Orleans includes hot days and warm nights, with plentiful humidity, and rain is a regular occurrence, so you should wear a hat, include an umbrella in your bag, and drink plenty of water.

2017 Conference Committee



General Chairwoman
Véronique Ferlet-Cavrois
European Space Agency
+31 715 656 038
Véronique.Ferlet-Cavrois@esa.int



Technical Program
Heather Quinn
Los Alamos National
Laboratory
505-665-7041
hquinn@lanl.gov



Local Arrangements
John Stone
Southwest Research
Institute
210-522-5073
jstone@swri.org



Short Course
Jonathan Pellish
NASA Goddard Space
Flight Center
301-286-8046
jonathan.pellish@nasa.gov



Publicity
Teresa Farris
Cobham Semiconductor
Solutions
719-594-8035
teresa.farris@cobham.com



Finance Chair
Dolores Black
Sandia National
Laboratories
505-845-9420
dablack@sandia.gov



Awards Chair
Jean-Luc Leray
CEA
+33 96 6114 668
jl.leray@anaxajl.net



Posters Chair
Marta Bagatin
DEI-University of Padova
+39 04 9827 7606
marta.bagatin@dei.unipd.it



Industrial Exhibits Chair
Anne Minez
3D Plus
+33 13 0832 6514
aminez@3d-plus.com



Web Developer
Jeff Black
Sandia National
Laboratories
505-844-5020
jefblac@sandia.gov



Data Workshop Chair
Jeff George
The Aerospace Corporation
310-336-2089
jeffrey.s.george@aero.org

Official Reviewers

Abe, Shin-ichiro - JAEA	Gerardin, Simone - DEI - University of Padova	Mason, Larry - Lockheed Martin Space Systems
Adell, Philippe - NASA JPL	Girard, Sylvain - Université de Saint-Etienne, Laboratoire Hubert Curien	McClure, Steven - NASA JPL
Aguirre, Miguel - Universidad de Sevilla	Goiffon, Vincent - ISAE-SUPAERO, Université de Toulouse	McNally, Brendan - XIA LLC
Allen, Greg - NASA JPL	Golke, Keith - Honeywell	Mizuta, Eiichi - JAXA
Alvarez-Alonso, Maite - INTA	Gonzalez-Velo, Yago - ASU	Monreal, Roberto - SouthWest Research Institute
Assis, Thiago - Robust Chip Inc.	Gorbunov, Maxim - Scientific Research Institute of System Analysis, Russian Academy of Sciences (SRISA)	Narasimham, Balaji - Broadcom Corporation
Baker, Zachary - LANL	Gordon, Michael - IBM	O'Brien, Paul - The Aerospace Corporation
Barnaby, Hugh - ASU	Goussarov, Andrei - SCK-CEN	Pellish, Jonathan - NASA GSFC
Barth, Janet - NASA GSFC Emeritus	Griffiths, Ben - ULA	Pickel, James - PR&T, Inc.
Beaume, Matthieu - SODERN	Guertin, Steven - NASA JPL	Poivey, Christian - ESA ESTEC
Benedetto, Joseph - Cobham RAD Solutions	Hack, James - Northrop Grumman	Pouget, Vincent - IES - CNRS
Bennett, Geoff - Intel	Haddad, Nadim - Vanderbilt University/ISDE	Puchner, Helmut - Cypress Semiconductor
Berg, Melanie - NASA GSFC	Hands, Alex - University of Surrey	Raine, Melanie - CEA
Bezerra, Françoise - CNES	Hansen, David - Data Device Corporation	Reed, Robert - Vanderbilt University
Bhuva, Bharat - Vanderbilt University	Hartman, Spencer - UC Davis Crocker Nuclear Laboratory	Richard, Nicolas - CEA
Bi, Jinshun - Institute of Microelectronics	Heynderickx, Daniel - DH Consultancy BVBA	Rivas, Maria Jesus - INTA
Bird, John - Radiation Test Solutions	Hiemstra, David - MDA	Roche, Nicolas - Centre Spatial Universitaire Montpellier
Black, Jeffrey - Sandia National Laboratory	Horner, Jeremiah - Northrup Grumman	Roche, Philippe - STMicroelectronics
Blalock, Benjamin - The University of Tennessee	Hubert, Guillaume - ONERA	Rodriguez, Juan - NOAA
Bourdarie, Sebastien - ONERA	Irom, Farokh - NASA JPL	Roed, Ketil - University of Oslo
Buchner, Stephen - NRL	Jamieson, David - University of Melbourne	Rollins, Nathaniel - Canadian Department of National Defense
Buck, Benjamin - MIT	Javanainen, Arto - University of Jyväskylä	Salzman, James - Texas Instruments
Campola, Michael - NASA GSFC	Jiggins, Piers - European Space Agency	Schaefer, Justin - SEAKR Engineering
Cannon, Ethan - The Boeing Company	Jih-Jong, Wang - Microsemi	Scheick, Leif - NASA JPL
Cascio, Ethan - Francis H. Burr Proton Therapy Center at Massachusetts General Hospital	Johnson, Mike - LBNL	Schmidt, Hagen - Airbus Defence & Space
Casey, Megan - NASA GSFC	Jun, Insoo - NASA JPL	Schrimpf, Ronald - Vanderbilt University
Castillo, James - SpaceX	Khachatryan, Ani - NRL	Scott, Katherine - The Boeing Company
Chatry, Nathalie - TRAD	King, Michael - Sandia national laboratories	Seifert, Norbert - Intel
Chatterjee, Indranil - Airbus Defence and Space	Kobayashi, Daisuke - Institute of Space and Astronautical Science, JAXA	Shaneyfelt, Marty - Sandia national laboratories
Chen, Li - University of Saskatchewan	Kobayashi, Kazutoshi - Kyoto Institute of Technology	Sterpone, Luca - Politecnico di Torino
Chesnut, Kay - The Boeing Company	Kruckmeyer, Kirby - Texas Instruments	Sturesson, Fredrik - Cobham Gaisler
Clark, Lawrence - ASU	Kwan, Betty - The Aerospace Corporation	Tonfat, Jorge - UFRGS
Clemens, Mike - Air Force	Label, Kenneth - NASA GSFC	Trinczek, Michael - TRIUMF
Clymer, Daniel - Lockheed Martin	Ladbury, Ray - NASA GSFC	van Vonno, Nick - Intersil
Cress, Cory - NRL	Lawrence, Reed - BAE Systems	Velazco, Raoul - TIMA Labs
Daly, Eamonn - European Space Agency	Leray, Jean-Luc - CEA	Vermeire, Bert - Space Micro
Davis, Scott - The Aerospace Corporation	Leroux, Paul - KU Leuven University, Belgium	Virmontois, Cedric - CNES
Duncan, Adam - NAVSEA Crane	Lilja, Klas - Robust Chip Inc.	Vizkelethy, Gyorgy - Sandia national laboratories
Entrena, Luis - University Carlos III of Madrid	Lum, Gary - Lockheed Martin Space Systems Company	Von Thun, Matthew - Cobham Semiconductor Solutions
Espinosa, Daniel - Harris	Mahatme, Nihaar - Freescale Semiconductor	Wampler, William - Sandia national laboratories
Evans, Adrian - IROC Technologies	Makino, Takahiro - QST	Wang, Pierre-Xiao - 3D Plus
Evans, Hugh - European Space Agency	Malherbe, Victor - STMicroelectronics	Warren, Kevin - Vanderbilt University
Fleetwood, Dan - Vanderbilt University	Manzano, Paula - INTA	Wert, Jerry - The Boeing Company
Friebele, Joe - NRL	Marec, Ronan - Thales Alenia Space	Wilkenson, Jeff - Medtronic
Gadlage, Matthew - NAVSEA Crane		Xapsos, Michael - NASA GSFC
Gaillard, Remi - Infoduc		Zadeh, Ali - European Space Agency
Gaillardin, Marc - CEA		
Garcia Alia, Ruben - CERN		

Radiation Effects Steering Group

Executive Chair

Allan Johnston
J-K Associates
308 Marine Drive
Coupeville, WA 98239
818-588-0919
JohnstonAH25@gmail.com
(Term expires: 7/18)

Senior Member-at-Large

Simone Gerardin
Padova University
Via Gradenigo 6B
35131 Padova
Italy
+39 049 827 7786
simone.gerardin@dei.unipd.it
(Term expires: 7/17)

Secretary

Paul Dodd
Sandia National Laboratories
PO Box 5800, MS-1083
Albuquerque, NM 87185
505-844-1447
pedodd@sandia.gov
(Term expires: 7/18)

Special Publications Assignment

Paul V. Dressendorfer
Sandia National Laboratories (retired)
11509 Paseo del Oso, NE,
Albuquerque, NM 87111
505-292-5965
p.dressendorfer@ieee.org

Vice-Chair, 2019 Conference

John Stone
Southwest Research Institute
6220 Culebra Rd
San Antonio, TX 78238
210-522-5073
jstone@swri.org

NPSS AdCom Member

Steve McClure
NASA/JPL
MS 303-200
4800 Oak Grove Dr
Pasadena, CA 91109
818-269-5426
Steven.s.mcclure@jpl.nasa.gov
(Term expires: 12/18)

Executive Vice-Chair

Janet Barth
NASA Retired Emeritus
7394 Minter Lane
Clarksville, MD 21099
301-602-3706
jbarth@ieee.org
(Term expires: 7/18)

Member-at-Large

Tom Turflinger
The Aerospace Corporation
14301 Sullyfield Circle
Unit C CH3-310
Chantilly, VA 20151
571-307-3715
thomas.l.turflinger@aero.org
(Term expires: 7/18)

Vice-Chair, Publications

Dan Fleetwood
Vanderbilt University
EECS Department
VU Station B, #350092
2301 Vanderbilt Place
Nashville, TN 37235
615-322-2498
dan.fleetwood@vanderbilt.edu
(Term expires: 7/18)

Vice-Chair, 2017 Conference

Véronique Ferlet-Cavrois
European Space Agency
Keplerlaan 1
2200 AG Noordwijk
The Netherlands
+31 715 656 038
Véronique.Ferlet-Cavrois@esa.int

Vice-Chair, 2020 Conference

Hugh Barnaby
Arizona State University
7273 S. Hazelton Ln
Tempe, AZ 85283
480-220-0133
hbarnaby@asu.edu

NPSS AdCom Member

Ronald D. Schrimpf
Vanderbilt University
5635 Stevenson Center
Nashville, TN 37235
615-343-0507
ron.schrimpf@vanderbilt.edu
(Term expires: 12/19)

Past Chair

Marty Shaneyfelt
Sandia National Laboratories
P.O. Box 5800, MS-1083
Albuquerque, NM 87185-1083
505-844-6137
shaneymr@sandia.gov
(Term expires: 7/18)

Junior Member-at-Large

Ethan Cannon
The Boeing Company
PO Box 3707
MC 42-57
Seattle, WA 98124
253-657-5104
ethan.cannon@boeing.com
(Term expires: 7/19)

Vice-Chair, Publicity

Teresa Farris
Cobham Semiconductor Solutions
4350 Centennial Blvd.
Colorado Springs, CO 80907
719-594-8035
teresa.farris@cobham.com
(Term expires: 7/18)

Vice-Chair, 2018 Conference

Ronald Lacoe
The Aerospace Corporation
PO Box 92957
M2-244
Los Angeles, CA 90009-2957
310-336-0118
ronald.c.lacoe@aero.org

NPSS AdCom Member

Dave Hiemstra
MDA
9445 Airport Rd
Brampton, ON L6S 4J3
Canada
905-790-2800
Dave.hiemstra@mdacorporation.com
(Term expires: 12/17)

RADECS Liaison

Véronique Ferlet-Cavrois
European Space Agency
Keplerlaan 1
2200 AG Noordwijk
The Netherlands
+31 715 656 038
Véronique.Ferlet-Cavrois@esa.int
(Term expires: 9/17)

ANNOUNCEMENT and FIRST CALL FOR PAPERS



2018 IEEE NUCLEAR AND SPACE RADIATION EFFECTS CONFERENCE Short Course and Radiation Effects Data Workshop

July 16-20, 2018
Hilton Waikola,
Kona, Hawaii

www.nsrec.com

Sponsored By

IEEE/NPSS Radiation Effects Committee

Supported By

3-D Plus

BAE Systems

Boeing

Cobham Semiconductor Solutions

European Space Agency

Freebird Semiconductor

International Rectifier HiRel Products, Inc.

Intersil Corporation

Jet Propulsion Laboratory

Southwest Research Institute

VPT RAD, Inc

Conference Committee

General Chair

Ronald Lacoe, The Aerospace Corporation
ronald.c.lacoe@aero.org

Technical Program Chair

Hugh Barnaby
Arizona State University
hbarnaby@asu.edu

Local Arrangements Chair

Keith Avery, AFRL
Keith.avery.2@us.af.mil

Short Course Chair

Simone Gerardin, University of Padova
simone.gerardin@dei.unipd.it

Publicity Chair

Teresa Farris,
Cobham Semiconductor Solutions
teresa.farris@cobham.com

Finance Chair

Sarah Armstrong, NSWC Crane
sarah.armstrong@navy.mil

Awards Chair

Stephen Buchner, NRL
stephen.buchner@nrl.navy.mil

Industrial Exhibits Chair

Tony Amort, The Boeing Company
anthony.l.amort@boeing.com

Web Developer

Jeffrey Black, Sandia National Laboratories
jefblac@sandia.gov

The 2018 IEEE Nuclear and Space Radiation Effects Conference will be held July 16 - 20 at the Hilton Waikola, Kona, Hawaii. The conference features a technical program consisting of eight to ten technical sessions of contributed papers describing the latest observations in radiation effects, a Short Course on radiation effects offered on July 16, a Radiation Effects Data Workshop, and an Industrial Exhibit. The technical program includes oral and poster sessions.

Papers on nuclear and space radiation effects on electronic and photonic materials, devices, circuits, sensors, and systems, as well as semiconductor processing technology and design techniques for producing radiation-tolerant (hardened) devices and integrated circuits, will be presented at this meeting of engineers, scientists, and managers. International participation is strongly encouraged.

We are soliciting papers describing significant new findings in the following or related areas:

Basic Mechanisms of Radiation Effects in Electronic Materials and Devices

- Single Event Charge Collection Phenomena and Mechanisms
- Radiation Transport, Energy Deposition and Dosimetry
- Ionizing Radiation Effects
- Materials and Device Effects
- Displacement Damage
- Processing-Induced Radiation Effects

Radiation Effects on Electronic and Photonic Devices, Circuits and Systems

- Single Event Effects
- MOS, Bipolar and Advanced Technologies
- Isolation Technologies, such as SOI and SOS
- Optoelectronic and Optical Devices and Systems
- Methods for Hardened Design and Manufacturing
- Modeling of Devices, Circuits and Systems
- Cryogenic or High Temperature Effects
- Novel Device Structures, such as MEMS and Nanotechnologies
- Techniques for Hardening Circuits and Systems

Space, Atmospheric, and Terrestrial Radiation Effects

- Characterization and Modeling of Radiation Environments
- Space Weather Events and Effects
- Spacecraft Charging
- Predicting and Verifying Soft Error Rates (SER)

Hardness Assurance Technology and Testing

- New Testing Techniques, Guidelines and Hardness Assurance Methodology
- Unique Radiation Exposure Facilities or Novel Instrumentation Methods
- Dosimetry

New Developments of Interest to the Radiation Effects Community

PAPER SUMMARY DEADLINE: FEBRUARY 2, 2018

PROCEDURE FOR SUBMITTING SUMMARIES

Authors must conform to the following requirements:

1. Prepare a single Adobe Acrobat file consisting of a cover page and an informative two to four page summary describing results appropriate for 12-minute oral or a poster presentation. The cover page must provide an abstract no longer than 35 words, the title, name and company affiliation of the authors, and company address (city, state, country). Identify the author presenting the paper and provide telephone, fax, and email address. The summary must include sufficient detail about the work to permit a meaningful technical review. In the summary, clearly indicate (a) the purpose of your work, (b) significant new results with supporting technical material, and (c) how your work advances the state of the art. Show key references to other related work. The summary must be no less than two and no more than four pages in length, including figures and tables. All figures and tables must be large enough to be clearly read. Note that this is more than an abstract, but do not exceed four pages.
2. Prepare your summary in single-column or IEEE TNS standard two-column format, using 11 point or greater font size, formatted for either U.S. Standard (8.5 x 11 inch) or A4 (21 x 29.7 cm) page layout, with 1 inch (2.5 cm) margins on all four sides.
3. Obtain all corporate, sponsor, and government approvals and releases necessary for presenting your paper at an open attendance international meeting.
4. Summary submission is electronic only, through **www.nsrec.com**. The submission process consists of entering the paper title, author(s) and affiliation(s), and an abstract no longer than 35 words. Authors are prompted to state their preference for presentation (oral, poster, or data workshop poster) and for session. Details of the submission process may be found at **www.nsrec.com**. The final category of all papers will be determined by the Technical Program Committee, which is responsible for selecting final papers from initial submissions.

**Summaries must be received by
February 2, 2018**

**Detailed submission and
formatting instructions
will be available after
December 1, 2017
at www.nsrec.com**

Papers accepted for oral or poster presentation at the technical program are expected to be submitted for publication in the *IEEE Transactions on Nuclear Science* (January 2019). Selection for this issue will be based on a separate submission of a complete paper. These papers will be subject to the standard full peer review given all papers submitted to the *IEEE Transactions on Nuclear Science*. Further information will be sent to prospective authors upon acceptance of their NSREC summary. It is not necessary to be an IEEE member to present a paper or attend the NSREC. However, we encourage IEEE and NPSS membership of all NSREC participants.

RADIATION EFFECTS DATA WORKSHOP

The Radiation Effects Data Workshop is a forum for papers on radiation effects data on electronic devices and systems. Workshop papers are intended to provide radiation response data to scientists and engineers who use electronic devices in a radiation environment, and for designers of radiation-hardened systems. Papers describing new simulation or radiation facilities are also welcomed. **The procedure for submitting a summary to the Workshop is identical to the procedure for submitting NSREC summaries.** Radiation Effects Data Workshop papers will be published in a Workshop Record and are not candidates for publication in the Conference issue of the *IEEE Transactions on Nuclear Science*.

HAWAII - THE BIG ISLAND & THE HILTON WAIKOLOA VILLAGE

It's easy to feel awed on Big Island of Hawaii. From the molten magma flowing from Hawaii Volcanoes National Park to the snow-capped heights of Maunakea; from the green rainforests of the Hamakua Coast to the jet-black sands of Punaluu Beach; Hawaii Island is an unrivaled expression of the power of nature. Hawaii Island is the youngest and largest island in the Hawaiian chain, but it's remarkable for more than just its size. Picture yourself visiting Kilauea, one of the most active volcanoes in the world, or talk history with a cultural demonstrator at Puuhonua o Honaunau, a historic park that was once a place of refuge. Whether you're walking on a black sand beach, snorkeling with manta rays, horseback riding in Waimea or sailing along the Kona Coast, Hawaii, the Big Island is your island for adventure.

You may never want or need to leave the Waikoloa Village. Feel the Aloha spirit at the 62 acre resort along the Kohala Coast. The resort features an ocean-fed lagoon with a white sand beach for snorkeling or other water activities, Dolphin Quest where you can swim, feed and play with dolphins, three pools featuring waterfalls, a 175 foot waterslide and an adults-only pool. Dine in one of the many restaurants on site, enjoy a day at the Kohala Spa or visit an eclectic array of shops, boutiques, and galleries throughout the Hilton Waikoloa Village. Cruise the resort on the mahogany canal boats along tranquil waterways or take one of the Swiss-made air-conditioned trams, which operate all day for your convenience. Just outside the resort, but part of the Waikoloa area are two championship golf courses and additional shopping/dining options at the King's Shops or the Queens' Marketplace available via the trolley for a small fee or a moderate walk. For a more adventurous walk you can take the Kings Highway Foot Trail and see the petroglyphs. Please join us for NSREC 2018 on the beautiful Big Island of Hawaii.



Photo courtesy of Keith Avery



