July 16-20, 2018
Hilton Waikoloa Village
Kona, Hawaii

IEEE Nuclear and Space Radiation Effects Conference

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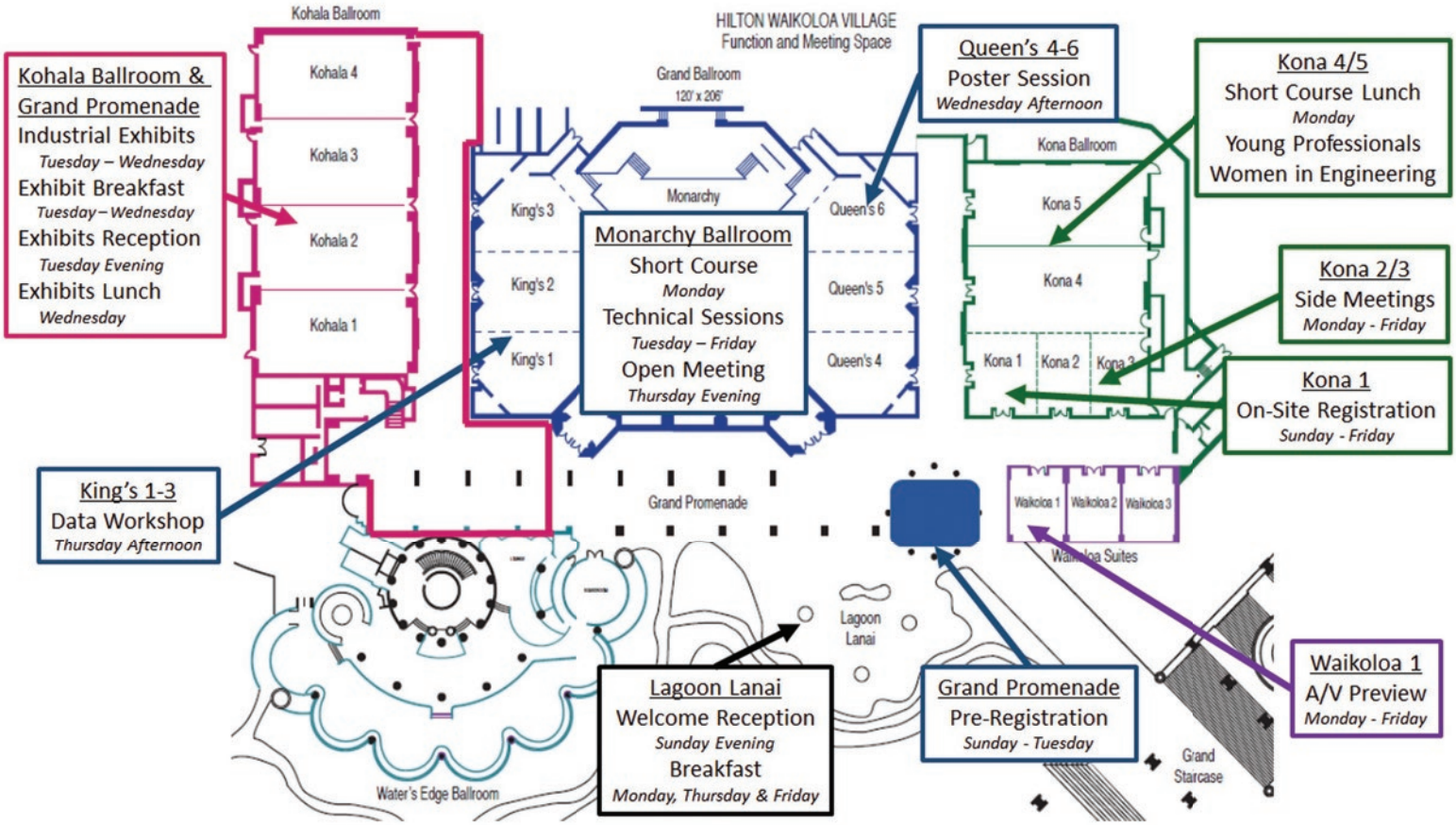
NSREC 2018
Kona Hawaii

Sponsored by:
IEEE/NPSS Radiation Effects Committee



Aerobics

Ocean View Terrace

6:30AM - 7:30AM

Tuesday
Wednesday
Thursday

Schedule

Time	Monday July 16	Tuesday July 17	Wednesday July 18	Thursday July 19	Friday July 20
7:00	[7:00] Breakfast – Lagoon Lanai		[7:00-8:15] IEEE Young Professionals Breakfast – Kona 4 Ballroom (YP talk begins at 7:30 AM) *Ticket Required to Attend* — and — [7:15] Breakfast – Kohala Ballroom		
7:30		[7:15] Breakfast – Kohala Ballroom		[7:15] Breakfast – Lagoon Lanai	[7:15] Breakfast – Lagoon Lanai
8:00	[8:00] **Short Course Introduction** Prof. Simone Gerardin, Monarchy Ballroom				
8:10	[8:10] **Part I – A Brief History of Space Climatology: From the Big Bang to the Present** Dr. Mike Xapsos				
8:15		[8:15] **Opening Remarks/ Awards Presentation** Monarchy Ballroom	[8:15] **Invited Talk – He Lani Ko Luna, A Sky Above** Chad Kalepa Baybayan Monarchy Ballroom	[8:15] **Invited Talk – Hawaiian Volcanoes** Ken Hon & Cheryl Gansecki Monarchy Ballroom	[8:15] **Invited Talk – Searching for the Building Blocks of Life in Planet-Forming Regions around New Stars** Dr. Greg Doppmann Monarchy Ballroom
8:30					
9:00		[8:55] **Session A – Radiation Effects in Devices and Integrated Circuits**			
9:30	[9:40] Break – Grand Promenade		[9:25] **Session E – Space and Terrestrial Environments**	[9:25] **Session G – Single-Event Effects; Devices and Integrated Circuits**	[9:25] **Session I – Basic Mechanisms of Radiation Effects**
10:00	[10:10] **Part II – Radiation Hardness Assurance: How Well Assured Do We Need To Be?** Dr. Renaud Mangeret	**[10:15] Break – Kohala Ballroom**	[10:15] Break – Kohala Ballroom	[10:00] Break – Grand Promenade	[10:15] Break – Grand Promenade
10:30			[10:40] **Session F – Dosimetry**	[10:25] **Session G –** *(continued)*	[10:40] **Session I –** *(continued)*
11:00		[10:55] **Session B – Photonic Devices and Integrated Circuits**		[10:55] **Session H – Single-Event Effects: Transient Characterization**	[11:10] **Session J – Single-Event Effects: Mechanisms and Modeling**
11:30	[11:40] Short Course Luncheon – Kona 4 and 5 Rooms				
12:00		[12:15] Lunch	[12:00] Exhibitor Lunch – Kohala Ballroom	[12:00] Lunch — and — [12:00] Women in Engineering Lunch – Kona 4 Ballroom *Ticket Required to Attend*	
12:30					[12:30] End of Conference
1:00			[1:00] Exhibitor Raffle Drawing		
1:30	[1:20] **Part III – Process Variations and Radiation Effects in Advanced Transistors** Dr. Marc Gaillardin		[1:30-4:30] **Poster Session** Queen's 4-6 Ballrooms	[1:30-4:30] **Radiation Effects Data Workshop** King's 1-3 Ballrooms	
2:00		[1:55] **Session C – Hardness Assurance**			
2:30					
3:00	[2:50] Break – Grand Promenade	[3:00] Break – Kohala Ballroom			
3:30	[3:20] **Part IV – Addressing Device and Environment Variations in Single Event Rate Predictions** Dr. Brian Sierawski	[3:25] **Session D – Radiation Hardening by Design**	[3:30 to 5:30] **Exhibits Area Closed**		
4:00					
4:30	[4:50] Wrap-up	[4:30] End of Tuesday Sessions	[4:30] End of Wednesday Sessions	[4:30] End of Thursday Sessions [4:30 to 6:30] **Radiation Effects Committee Annual Open Meeting** – Monarchy Ballroom	
5:00	[5:00] Exam (for students requesting CEU credit only)				
5:30	[5:30] End of Short Course	[5:30 to 7:00] Industrial Exhibits Reception – Kohala Ballroom			
6:00			[6:00 to 10:00] Conference Social – **Sunset Luau at The Marriott** (Shuttle available on the lower lobby area)		
6:30					
7:00					

Contents

Chairman's Invitation

"I am pleased to invite you to attend NSREC 2018 on the beautiful Big Island of Hawaii. The Conference Committee has put together exciting technical and social programs to make your NSREC experience memorable. I would like to thank the volunteers, authors, exhibitors, supporters and attendees for all your efforts in helping to make NSREC 2018 a success."

Ronald Lacoe
NSREC 2018 General Chair
The Aerospace Corporation

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 2018 Nuclear and Space Radiation Effects Conference (NSREC) committee, it is my pleasure to invite you to attend the 55th NSREC to be held July 16 – 20, 2018. The conference will be in Kona on the Big Island of Hawaii at the Hilton Waikoloa Village.

The conference begins Monday, July 16, with a one-day Short Course titled "Variability in Environments, Devices and Radiation Effects – from Average to Extreme". It is organized by Simone Gerardin of the University of Padova and consists of four sections taught by leading experts in their respective fields. The short course is organized into sections all featuring introductory material and advanced topics, with an emphasis on variability. The first section provides an overview of radiation environments. The second section of the course discusses hardness assurance methodologies. The third section focuses primarily on process variations and cumulative effects in MOSFETs. The final section addresses single event effects in scaled devices.

The Technical Program is from Tuesday, July 17 to Friday, July 20. Hugh Barnaby, Arizona State University, is the Technical Program Chair. He, along with his technical committee, have 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 have selected a set of high quality presentations for the Radiation Effects Data Workshop. Workshop posters will present radiation effects data on electronic and photonic devices and systems, and new simulation or test facilities. Finally, Hugh has invited three engaging speakers to give general interest presentations from Wednesday to Friday.

The Industrial Exhibit, organized by Tony Amort of The Boeing Company, 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. The exhibits will conclude following a luncheon for attendees on Wednesday.

Local Arrangements Chair, Keith Avery, AFRL, has organized an outstanding social program. The Conference Social on Wednesday evening, which will highlight the program, will be a traditional Sunset Hawaiian Luau at the nearby Marriott Hotel. Two companion tours are also scheduled. The first event, on Tuesday, will be a tour of the Volcano National Park. The second event, on Thursday, will be a visit to the Kona Coffee Living History Farm followed by a Kailua-Kona Shopping tour.

The NSREC 2018 Conference Committee, including Publicity Chair Teresa Farris (Cobham Semiconductor Solutions), Finance Chair Sarah Armstrong (NSWC Crane), Awards Chair Stephen Buchner (NRL), Poster Chair Nathan Nowlin (Sandia National Laboratories), Radiation Effects Data Workshop Chair Martha O'Bryan (AS&D, Inc.), and Web Developer Jeff Black (Sandia National Laboratories) welcomes you to one of America's most beautiful locations.

We look forward to seeing you in Hawaii this July!

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

Short Course Program

VARIABILITY IN ENVIRONMENTS, DEVICES, AND RADIATION EFFECTS – FROM AVERAGE TO EXTREME

HILTON WAIKOLOA
MONARCHY BALLROOM – MONDAY, JULY 16

8:00 AM **SHORT COURSE INTRODUCTION**
Prof. Simone Gerardin, *University of Padova Department of Information Engineering*

8:10 AM **PART I - A BRIEF HISTORY OF SPACE CLIMATOLOGY: FROM THE BIG BANG TO THE PRESENT**
Dr. Mike Xapsos, *NASA Goddard Space Flight Center*

9:40 AM **BREAK (Grand Promenade)**

10:10 AM **PART II - RADIATION HARDNESS ASSURANCE: HOW WELL ASSURED DO WE NEED TO BE?**
Dr. Renaud Mangeret, *Airbus Defence and Space*

11:40 AM **SHORT COURSE LUNCHEON**
(Kona 4 and 5 Rooms)

1:20 PM **PART III - PROCESS VARIATIONS AND RADIATION EFFECTS IN ADVANCED TRANSISTORS**
Dr. Marc Gaillardin, *CEA*

2:50 PM **BREAK (Grand Promenade)**

3:20 PM **PART IV - ADDRESSING DEVICE AND ENVIRONMENT VARIATIONS IN SINGLE EVENT RATE PREDICTIONS**
Dr. Brian Sierawski, *Vanderbilt University, Institute for Space and Defense Electronics*

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 the 1980-2018 Short Course Compendium

Short Course

COURSE DESCRIPTION

A one-day short course, *"Variability in Environments, Devices, and Radiation Effects – from Average to Extreme"*, will be presented at the 2018 IEEE Nuclear and Space Radiation Effects Conference (NSREC). The course will discuss space weather and the effects of ionizing radiation in advanced electronic devices, with emphasis on variability and its main sources. Bounding and managing uncertainties is a key to mission success for space systems in harsh environments. The introduction of more scaled technologies, the growing interest towards using Commercial-Off- The-Shelf Components (COTS), and the push to reduce design margins and test time to decrease costs is making variability more challenging than ever. Accurate environmental modeling is therefore needed for a precise assessment of the radiation exposure during a mission. Average metrics may not fully capture the extent of radiation effects in modern devices and need to be replaced. Nanoscale components and sensitive volumes mandate the use of statistical or Monte Carlo techniques for evaluating and predicting failures in space.

This short course will benefit those new to the field by explaining in a clear and concise manner the basic concepts concerning the presence of ionizing radiation in space and its effects on electronic systems, while providing up-to-date material and insight into new phenomena and mechanisms for experienced engineers and scientists.

It is organized into four sections all featuring introductory material and advanced topics, with an emphasis on variability. The first one provides an overview of radiation environments. The second section of the course discusses hardness assurance methodologies. The third one focuses primarily on process variations and cumulative effects in MOSFETs. The final section addresses single event effects in scaled devices.

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

Prof. Simone Gerardin
University of Padova
Department of Information Engineering
Short Course Chairman

Simone Gerardin is an Associate Professor of Electronics at the University of Padova – Italy. He received the Laurea degree (cum laude) in Electronics Engineering in 2003, and a Ph.D. in Electronics and Telecommunications Engineering in 2007, both from the University of Padova. His research has been focused on ionizing radiation effects in advanced CMOS technologies and on their interplay with device aging and electrostatic discharges, in the space, terrestrial, and high-energy physics environments. Lately, his interests have been on innovative non-volatile memories for space and total ionizing dose effects at ultra-high levels. Simone has authored or co-authored more than 200 peer-reviewed journal articles, book chapters, and conference presentations, ten of which were recognized with international awards. He presented four tutorials at international conferences and co-edited a book. He has been an associate editor for the IEEE Transactions on Nuclear Science and member-at-large of the IEEE Radiation Effects Steering Group. He is currently a member of the RADECS Steering Group.

Mike Xapsos joined the Radiation Effects and Analysis group at NASA Goddard Space Flight Center in 2001, where he oversees the group's space radiation environment work and supports space flight and research programs. Prior to that he worked in the Radiation Effects Branch of the Naval Research Laboratory as a research physicist, where his work involved device problems and the space radiation environment. He received the B.S. degree in physics and chemistry from Canisius College in 1978 and the Ph.D. degree in physics from the University of Notre Dame in 1985.

Mike led the development of the ESP/PSYCHIC solar particle event models that are widely used for spacecraft design requirements. He has presented prior Short Courses for the NSREC, Radiation Effects on Components and Systems (RADECS) Conference, and Hardened Electronics and Radiation Technology (HEART) Conference, and was lead author of an NSREC Outstanding Paper Award and a RADECS Outstanding Conference Oral Paper. He has been an editor of the IEEE Transactions on Nuclear Science NSREC issue and held various positions for the NSREC including conference chair in 2015. He has authored or co-authored approximately 100 technical publications.

A BRIEF HISTORY OF SPACE CLIMATOLOGY: FROM THE BIG BANG TO THE PRESENT

Dr. Mike Xapsos
NASA Goddard Space Flight Center

Dr. Mike Xapsos, NASA Goddard Space Flight Center, will discuss space climatology – the radiation environment observed over an extended period of time at a given location, corresponding to a space mission duration and orbit. It will begin with a unique introduction to the early universe and the origin of particles relevant for radiation effects – electrons, protons, neutrons, and heavy ions. A transitional period leading to modern times will be discussed involving the discovery of sunspots, the solar cycle and the sun's pervasive influence on space climatology. This leads to the main discussion about modern space climatology, with emphasis on galactic cosmic rays, solar particle events, and trapped particles. Metrics that describe the effects these radiations have on electronic devices and circuits will be introduced. Radiation properties such as elemental composition, fluxes, energies, and dependence on solar cycle phase and spacecraft orbit will be discussed, with emphasis on variability of these properties. Finally, current radiation models used for space system design along with example applications will be presented.

This will complete the attendee's journey along the space climatology time line ranging from the Big Bang to NSREC 2018!

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

- The early universe from a radiation effects perspective
  - Origin of electrons, protons, neutrons and heavy ions
- Transition to modern times
  - Sunspots and the solar activity cycle
- Modern times – the space radiation environment
  - Definition of space climatology and space weather
  - Galactic cosmic rays
    - Properties
    - Models
    - Current issue: elevated fluxes during prolonged solar minima
  - Solar particle events
    - Properties
    - Models
    - Current issue: use of statistical models vs. worst case observations
  - The Van Allen Belts
    - Properties
    - Models
    - Current issue: the case of the missing electrons
  - Example environments for total dose and single events
- Summary

Renaud Mangeret received his PhD in electronics from the Paul Sabatier University, Toulouse (France) in the Materials and Components for Electronics Department in 1992. He then worked at the IBM Almaden Research Center, California, as a visiting scientist working on non-linear optics (NLO) polymers. From 1993-1995 Renaud worked at Giat Industries, Toulouse as a research and development engineer. Since 1995 Renaud has been the radiation specialist at Matra Marconi Space/EADS Astrium/Airbus Defence and Space, Toulouse, then in 2006 has been Astrium/Airbus Defence and Space's Radiation Expert and is now Transnational Radiation Senior Expert, still at Airbus Defence and Space in Toulouse. He is responsible for all aspects of radiation hardness assurance solutions for use of sensitive devices in space programs (telecommunications, Earth observation, interplanetary scientific and constellations). Renaud is a Member of the IEEE and currently serves as Treasurer for the RADECS Association Steering Committee.

RADIATION HARDNESS ASSURANCE: HOW WELL ASSURED DO WE NEED TO BE?

Dr. Renaud Mangeret
Airbus Defence and Space

Dr. Renaud Mangeret, Airbus Defence and Space, will discuss the intrinsic variability of numerous parameters within the Radiation Hardness Assurance (RHA) process. From the perspective of a space system provider, the need of supplying radiation robust products to multiple customers requires a cost/schedule effective approach of the RHA process. This results in a permanent trade-off between generic versus application specific approaches in several domains. After a short recap of the radiation environment (which is also quite variable), the presentation will address the variability issues in the radiation modelling and calculation process, in the area of radiation testing, in the electronic design domain and, finally, in the EEE parts themselves. This will cover a broad range of technical items which are to be put in perspective with the definition of a radiation design margin.

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

- Introduction
- Radiation environment definition and potential impacts on RHA process
- Some parameters of influence on the RHA process
  - Customer
  - Normative system
  - Program nature
- Key parameters in the RHA process
  - TID/DD hardness assurance
    - Modelling activities
    - Device traceability
    - Test activities
    - Link with Worst Case Analysis
    - Margin policy
  - SEE hardness assurance
    - Device traceability
    - Test activities
    - Link with design tolerance (equipment, system)
    - SEE Rate calculation
- Conclusion

Marc Gaillardin is an engineer at the Commissariat à l'Energie Atomique (CEA), in Arpajon, France. His primary research activities are focused on the radiation effects in innovative technologies including Ultra-thin SOI, FinFET and nanowire devices. He is involved in developing radiation-hardened technologies using modelling and experimental characterization assessment methodologies.
He earned his M.S. in electronic engineering from University of Orsay (Paris-Saclay Univ.) and Polytech' Paris Sud (formerly FIUPSO), Orsay, France, and his PhD. in nanoelectronics from the Institut National Polytechnique de Grenoble, France.

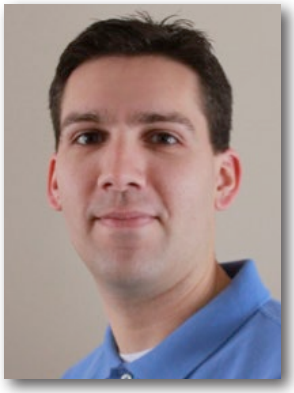
PROCESS VARIATIONS AND RADIATION EFFECTS IN ADVANCED TRANSISTORS

Dr. Marc Gaillardin
CEA

Dr. Marc Gaillardin, CEA, will present radiation effects in advanced transistors with an emphasis on variability. This part of the short course will focus primarily on microelectronics technologies, transistor architectures, and their evolutions. Both Ultra-Thin SOI and FinFET architectures will be discussed, since they represent the best solutions to meet the requirements for nanometer scaled technology nodes. Then, process variability issues will be introduced to discuss their implications on devices and integrated circuits. The second half will review radiation effects in advanced devices. Total Ionizing Dose effects will be thoroughly investigated through the impact of geometry and device structure to discuss potential variability implications. A discussion about displacement damage dose effects in nano-scaled devices will be included as well. The end of the course will be dedicated to providing perspectives about the use of novel technologies in harsh environments.

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

- Introduction
- Microelectronic Technology: from micro to nanometer scaled transistors
  - Transistors architectures
  - MOSFET devices: evolutions and major breakthroughs
  - Variability issues
  - Summary of major keypoints on microelectronic technologies
- Radiation Effects in Ultra-Scaled MOSFETS
  - Basic mechanisms
  - Impact on MOSFET function
  - Nano-scaled MOSFETs TID response: Geometry and device structure dependence
  - Insights into process variability implications on TID response
- Perspectives of Radiation Effects in Ultra-Scaled Devices
- Conclusions



Brian Sierawski is a Research Assistant Professor in Electrical Engineering with Vanderbilt's Institute for Space and Defense Electronics (ISDE). He received his B.S.E in Computer Engineering and M.S.E. in Computer Science and Engineering from the University of Michigan in 2002 and 2004, and his Ph.D. in Electrical Engineering from Vanderbilt University in 2011. He joined ISDE in 2005 where his research interests include the simulation of single event effects and error rate predictions in microelectronics. He developed the CRÈME website, investigated the contribution of low-energy proton and muon single event upsets in memories, and developed Vanderbilt's CubeSat program currently collecting telemetry from two radiation effects payloads. He is an IEEE senior member and served as the Finance Chair for the IEEE Nuclear and Space Radiation Effects Conference (NSREC) in 2016.

ADDRESSING DEVICE AND ENVIRONMENT VARIATIONS IN SINGLE EVENT RATE PREDICTIONS

Dr. Brian Sierawski
Vanderbilt University, Institute for Space and Defense Electronics

Dr. Brian Sierawski, Vanderbilt University, Institute for Space and Defense Electronics, will review how proton and ion-induced single events are modeled, measured, and extrapolated into an on-orbit response. Limited resources for test and analysis favor minimal characterization and efficient models to estimate the rate of events in space. However, some event rates will not be well-predicted by the measured average device response and will require a greater level of attention. The second part of the course will discuss how variations in devices, events, and environments factor into single event error rates and the extent to which they should be accounted for in ground tests and on-orbit predictions. Notably, highly-scaled memories exhibit enhanced sensitivity to proton and electron upsets and radiation hard circuits can exhibit an ion species dependency. Understanding the limitations of data and models will direct test activities to account for the dominant mechanism for errors. Finally, the course will explore how tools have adapted to improve single event rate predictions.

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

- Introduction
  - Basics of single events
  - Ground based tests and rate prediction methods
  - Factoring device and environment variations into rate predictions
- Variations in energy deposition
  - Nuclear reactions
  - LET fluctuations and concerns for small volumes
  - Proton and electron-induced events
- Predicting on-orbit rates
  - Application of Monte Carlo methods
  - Observed error rates in orbit
- Conclusions

Technical Program

TECHNICAL INFORMATION

"On behalf of the Technical Program Committee, I would like to invite you to attend the 2018 NSREC Technical Sessions. The chairpersons for these twelve sessions have assembled an exceptional program covering the latest developments in the nuclear and space radiation effects fields. Our sincere thanks goes out to the many authors and reviewers who work so hard to ensure the continued success of this unique technical exchange."

Hugh Barnaby, Arizona State University
Technical Program Chair

The NSREC technical program consists of contributed oral and 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: Cory Cress, Naval Research Laboratory
- **Dosimetry**
  Chair: Joe Benedetto
- **Hardness Assurance**
  Chair: Kirby Kruckmeyer, Texas Instruments
- **Hardening by Design**
  Chair: Lloyd Massengill, Vanderbilt University
- **Radiation Effects in Devices and Integrated Circuits**
  Chair: Michael McLain, Sandia National Laboratories
- **Photonic Devices and Integrated Circuits**
  Chair: Melanie Raine, CEA
- **Single-Event Effects: Mechanisms and Modeling**
  Chair: Frederic Wrobel, University of Montpellier 2
- **Single-Event Effects: Transient Characterization**
  Chair: Andrew Kelly, BAE Systems
- **Single-Event Effects: Devices and Integrated Circuits**
  Chair: Megan Casey, NASA Goddard Space Flight Center
- **Space and Terrestrial Environments**
  Chair: Justin Likar, Applied Physics Laboratory

POSTER SESSION

Those papers that can be presented more effectively in a visual format with group discussion will be displayed in the Poster Session in the King's Ballroom. The formal Poster Session will be held on Wednesday from 1:30 to 4:30 PM and the authors will be available at that time to discuss their work. The Poster Session is chaired by Nathan Nowlin from Sandia National Laboratories.

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 papers can be viewed Tuesday through Friday, in the Queen's Ballroom. Authors will be available on Thursday to discuss their work from 1:30 to 4:30 PM.. A workshop record will be mailed to all registered conference attendees. The workshop chair is Martha O'Bryan from AS&D, Inc.

INVITED SPEAKERS

There will be three invited talks:

- **He Lani Ko Luna, A Sky Above**
  Chad Kalepa Baybayan, Captain and Navigator for Hokulea Voyages
- **Hawaiian Volcanos**
  Ken Hon, Professor of Geology, University of Hawaii at Hilo
  Cheryl Gansecki, Lecturer of Geology, University of Hawaii at Hilo
- **Searching for the Building Blocks of Life in Planet-Forming Regions around New Stars**
  Dr. Greg Doppmann, Astronomer, W.M.Keck Observatory

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 18, 2018. Detailed instructions for submitting late-news summary are available on the NSREC website at ***www.nsrec.com.***

Technical Program Tuesday

MONARCHY BALLROOM

8:15 AM **OPENING REMARKS**
Ronald Lacoe, The Aerospace Corporation, General Chairman

8:20 AM **AWARDS PRESENTATION**
Allan Johnston, Radiation Effects Steering Group, Executive Chair

8:50 AM **TECHNICAL SESSION OPENING REMARKS**
Hugh Barnaby, Arizona State University, Technical Program Chairman

SESSION A **RADIATION EFFECTS IN DEVICES AND INTEGRATED CIRCUITS**
8:55 AM SESSION INTRODUCTION
Chair: Michael McLain, Sandia National Laboratories

A-1
9:00 AM **TID-Induced Leakage and Drive Characteristics of Planar 22-nm Partially-Depleted Silicon-on-Insulator and 14-nm Bulk and Quasi-Silicon-on-Insulator FinFET Devices**
M. P. King, T. Silva, M. R. Shaneyfelt, S. DiGregorio, W. C. Rice, B. L. Draper, Sandia National Laboratories; G. Massey, P. Oldiges, K. Rodbell, IBM; E. H. Cannon, J. Ballast, M. Cabanas-Holmen, The Boeing Company; D. Loveless, University of Tennessee at Chattanooga

PDSOI 22-nm technology shows order of magnitude reduction of TID-induced leakage over 32-nm. Improvement in the post-irradiation leakage of 14-nm FinFETs is comparable to 32-nm PDSOI.

A-2
9:15 AM **Total-Ionizing-Dose Effects in FinFETs at Low Temperature**
T. D. Haeffner, R. F. Keller, M. W. McCurdy, B. D. Sierawski, D. R. Ball, E. X. Zhang, M. L. Alles, R. A. Reed, R. D. Schrimpf, D. M. Fleetwood, Vanderbilt University

Bulk and SOI FinFETs irradiated with protons at 300 K and 89 K are functional with low leakage to at least 100 krad(SiO_2). Radiation-induced narrow-channel effects are observed in each device type.

A-3
9:30 AM **Characterization and Modeling of GigaRad-TID-induced Drain Leakage Current in a 28 nm Bulk CMOS Technology**
C.-M. Zhang, F. Jazaeri, C. Enz, Ecole Polytechnique Federale De Lausanne; G. Borghello, CERN and University of Udine; F. Faccio, CERN; S. Mattiazzo, University of Padova; A. Baschirotto, INFN & University of Milano-Bicocca

We investigate the TID effects up to 1 Grad on the drain leakage current of 28 nm bulk nMOSFETs. DC characterizations demonstrate a significant leakage increase that is modelled efficiently by succinct physics-based models.

A-4
9:45 AM **Total Ionizing Dose Effects in 3D NAND Flash Memories**
M. Bagatin, S. Gerardin, A. Paccagnella, University of Padova; S. Beltrami, Vimercate (MB); A. Costantino, M. Muschitiello, A. Zadeh, V. Ferlet-Cavrois, ESA - ESTEC

The effects of total dose on 3D NAND Flash memories are investigated. The evolution of threshold voltage distributions and raw bit errors are studied versus dose, and the results are compared with planar Flash technologies.

A-5 10:00 AM

Effect of Radiation on the Classification Accuracy of a Neural Network Trained on Analog TaOx Resistive Memory Arrays

R. B. Jacobs-Gedrim, D. R. Hughart, G. Vizkelethy, E. S. Bielejec, B. L. Vaandrager, S. E. Swanson, K. E. Knisely, M. J. Marinella, Sandia National Laboratories; J. L. Taggart, H. J. Barnaby, Arizona State University

The image classification accuracy of a TaOx ReRAM based neuromorphic computing accelerator is evaluated while intentionally inducing displacement damage to the devices. An effect on classification accuracy only occurred after ~$5x10^{20}$ vacancies were produced.

POSTER PAPERS

PA-1 **Total-Ionizing-Dose Mitigation of Bandgap Reference Circuits Fabricated on Radiation-Hardened SOI Process and Material**

Z. Chen, Hunan University; Y. Dong, Y. Shan, Shanghai Institute of Microsystem and Information Technology; D. Ding, University of Chinese Academy of Sciences; S. Zhou, Xinjiang Technical Institute of Physics and Chemistry

BJT and subthreshold CMOS based bandgap reference circuits are fabricated on radiation-hardened SOI process and material, which provide 35.5 and 4.1 times improvement in TID performance, compared with designs in commercial technology.

PA-2 **Total Ionizing Dose Hardness of an 8Mbit 40nm CMOS Technology Based SONOS NOR Flash**

H. Puchner, V. Prabhakar, I. Kouznetsov, T. Phan, K. Donnelly, Cypress Semiconductor; H. Tausch, JD Instruments

The total ionizing dose (TID) hardness of a 40nm CMOS based SONOS NOR flash non-volatile memory is studied at space radiation levels up to 500krad.

PA-3 **Ionizing Radiation Effects Spectroscopy (IRES) for Analysis of Total-Ionizing Dose Degradation in Voltage-Controlled Oscillators**

B. P. Patel, M. Joplin, R. C. Boggs, D. Reising, T. D. Loveless, University of Tennessee at Chattanooga; M. W. McCurdy, L. W. Massengill, Vanderbilt University

The ionizing radiation effects spectroscopy (IRES) technique for measurement of TID in voltage-controlled oscillators designed in a 130 nm bulk CMOS technology shows minor increases in operating frequency, and increased temporal variation with dose.

PA-4 **Separation of Total Ionizing Dose and Displacement Damage Effects in CBRAM Cells**

J. L. Taggart, H. J. Barnaby, M. N. Kozicki, K. Holbert, Arizona State University; R. B. Jacobs-Gedrim, E. S. Bielejec, W. Hardy, M. J. Marinella, Sandia National Laboratories

Conductive bridging random access memory cells were exposed to heavy ions of different mass and energy to separate total ionizing dose (TID) effects from displacement damage. Radiation effects were found to be dominated by TID.

PA-5 **Total Ionizing Dose (TID) Effects on a Double-Interface CoFeB-MgO Magnetic Tunnel Junction**

B. Wang, Z. Wang, K. Cao, Y. Zhang, W. Zhao, Beihang University; Y. Zhao, Beijing Micoelectronics Technology Institute

Total ionizing dose tolerance of a double-interface perpendicular anisotropy film stacks was experimentally evaluated through a gamma source. The coercivity increased with the irradiation doses, whereas no variation was observed for the saturation magnetization.

PA-6 **Gamma Radiation Effects in Graphene Field Effect Transistors with H-BN Thin Film Substrates**

E. Cazalas, M. R. Hogsed, J. W. McClory, Air Force Institute of Technology; S. Vangala, M. R. Snure, Air Force Research Laboratory

Radiation effects on graphene field effect transistors are investigated using the Ohio State University Nuclear Reactor Laboratory Co-60 irradiator. The study examines h-BN thickness and graphene channel length on a large number of samples.

PA-7 **Influence of Halo Implantations on the Total Ionizing Dose Response of 28 nm P-MOSFETs Irradiated to Ultra-High Doses**

S. Bonaldo, S. Mattiazzo, A. Paccagnella, S. Gerardin, INFN-Padova and University of Padova; C. Enz, Institute of Microengineering - EPFL; A. Baschirotto, INFN-Milano and University of Milano Bicocca; X. Jin, Northwest Institute of Nuclear Technology

Total ionizing dose effects on 28 nm bulk p-MOSFETs show a gate-length dependence. This effect is associated to the halo implantations, which increase the radiation tolerance of short channel transistors.

PA-8 **Total-Ionizing-Dose Irradiation Damage Evaluation Method for High Voltage SOI LDMOS**

X. Zhou, L. Zhang, M. Qiao, Z. Yuan, Z. Li, B. Zhang, University of Electronic Science and Technology of China; L. Shu, Harbin Institute of Technology; Y. Zhao, Harbin Institute of Technology and Beijing Microelectronics Technology Institute

Irradiation conductance modulation model for high voltage SOI LDMOS is proposed to reveal the linear drain current degradation mechanism, which provides a method to achieve the irradiation damage evaluation for the drift region.

10:15 – 10:55 AM
KOHALA BALLROOM
BREAK

SESSION B **PHOTONIC DEVICES AND INTEGRATED CIRCUITS**
10:55 AM SESSION INTRODUCTION
Chair: Melanie Raine, CEA

B-1 **Dose and Single Event Effects on Color CMOS Camera for Space Exploration**
11:00 AM

C. Virmontois, J.-M. Belloir, A. Bardoux, CNES; M. Beaumel, A. Vriet, SODERN; N. Perrot, C. Sellier, J. Bezine, D. Gambart, D. Blain, E. Garcia-Sanchez, W. Mouallem, 3D Plus

This paper focuses on the radiation-induced dose and single event effect on color CMOS camera designed for space missions.

B-2 11:15 AM
Radiation Induced Leakage Current in CMOS Image Sensor Floating Diffusion
A. Le Roch, V. Goiffon, S. Rizzolo, F. Pace, C. Durnez, P. Magnan, CIMI, ISAE-SUPAERO; C. Virmontois, J.-M. Belloir, DSO/SI/CD, CNES; P. Paillet, DAM, CEA

Neutron and proton induced leakage current are investigated in CMOS image sensor floating diffusion for in pixel charge storage applications. High field effects on dark current are analyzed providing new insights on leakage current sources.

B-3 11:30 AM
Radiation Hardness Comparison of CMOS Image Sensor Technologies at High Total Ionizing Dose Levels
S. Rizzolo, V. Goiffon, F. Corbiere, R. Molina, A. Chabane, P. Magnan, Universite de Toulouse; S. Girard, A. Boukenter, T. Allanche, Universite de Lyon; P. Paillet, CEA, DAM, DIF; C. Muller, Universite de Lyon and CEA, DAM, DIF; C. Monsanglant Louvet, M. Osmond, H. Desjonqueres, IRSN; J.-R. Mace, New AREVA; P. Burnichon, J.-P. Baudu, OPTSYS; S. Plumeri, ANDRA

Through the comparison of several CMOS image sensor technologies (including partially pinned photodidiode), the influence of the manufacturing process on the radiation induced degradation is stated up to total ionizing doses of 1 MGy(SiO_2).

B-4 11:45 AM
Radiation-Induced Effects on Fiber Bragg Gratings Inscribed in Highly Birefringent Photonic Crystal Fiber
A. Morana, S. Girard, E. Marin, A. Boukenter, Y. Ouerdane, Universite de Saint-Etienne; T. Baghdasaryan, T. Geernaert, H. Thienpont, F. Berghmans, Vrije Universiteit Brussels

We show that fiber Bragg gratings inside photonic crystal fibers are good pressure and transverse strain sensors, for structural health monitoring of civil structures, as well as for operation in harsh environments, as nuclear industry.

B-5 12:00 PM
Total Ionizing Dose Effects in 70 GHz Bandwidth Photodiodes in a SiGe Integrated Photonics Platform
P. S. Goley, G. N. Tzintzarov, S. Zeinolabedinzadeh, A. Ildefonso, J. D. Cressler, Georgia Institute of Technology; R. Jiang, E. X. Zhang, D. M. Fleetwood, Vanderbilt University; L. Zimmermann, Innovations for High Performance Microelectronics

Silicon waveguide coupled PIN germanium photodiodes from an integrated photonics platform were exposed to ionizing radiation from a 10keV X-ray source. There was no significant degradation observed in device performance up to 5Mrad(SiO_2).

POSTER PAPERS

PB-1
Comparative Study of Cryogenic Versus Room-Temperature Proton Irradiation of N-Channel CCDs and Subsequent Annealing
T. Prod'homme, P. Verhoeve, F. Lemmel, H. Smit, S. Blommaert, C. van der Luijt, I. Visser, T. Beaufort, Y. Levillain, B. Shortt, ESA

Two Teledyne-e2v CCD280 were proton irradiated: one while imaging at cold, the other unbiased at room temperature. We report on differences in post-irradiation hot pixel population, trap species, and CTI, including after annealing.

PB-2 **Long-Term Degradation Study of CMOS SPADs in Space Radiation Environment**

M. Campajola, F. Di Capua, University of Naples and INFN; D. Fiore, Università della Calabria and INFN; L. Gasparini, H. Xu, Fondazione Bruno Kessler

CMOS SPADs have been tested for displacement damage and total ionizing dose. Mitigation effects by possible in-flight cooling and annealing have been addressed. The limit of operability in future space missions has been demonstrated.

PB-3 **Effect of Phototransistor Design on Optocoupler Radiation Tolerance**

S. R. Messenger, M. C. Mishler, P. Dudek, Northrop Grumman Mission Systems; Y. Liu, R. Campanini, R. Spitzer, D. Young, Micropac Industries, Inc.; J. F. Salzman, Salzman Engineering

We examine the effects of 250 MeV proton irradiation on two different sizes of bipolar phototransistors used in Micropac optocoupler packages. The radiation response is shown to be related to device mask layout.

PB-4 **First Proton and Gamma Radiation of the MCT NIR European Astronomy Large Format Array Detector**

P.-E. Crouzet, S. Tetaud, D. Gooding, B. Shortt, T. Beaufort, S. Blommaert, B. Butler, G. Van Duinkerken, J. Ter Haar, F. Lemmel, C. van der Luijt, H. Smit, ESA/ESTEC

We report on the impact of proton and gamma irradiation on an MCT detector. The main result is the proton irradiation prevents the increase of the dark current due to the later total ionizing dose.

PB-5 **Gamma Radiation Induced Effects in Silicon Carbide Films and Photonic Devices**

Q. Du, D. Ma, A. M. Agarwal, J. Hu, Massachusetts Institute of Technology; B. Li, M. Li, University of Minnesota; Y. Huang, Aalto University;

Gamma-ray induced radiation damage is studied in silicon carbide materials and photonic devices, both in-situ and ex-situ. Our results reveal that radiation hard photonic device can be made by engineering waveguide dimension.

PB-6 **Neutron Displacement Damage Effect of Topological Insulator Heterostructure Based Photodetectors**

Y. Chi, H. Sun, L. Fang, National University of Defense Technology

The neutron irradiation was performed on the arrayed topological insulator heterostructure based photodetectors. The variations of the electrical characteristics were analyzed on I-V curve, dark current, open circuit voltage and short circuit current.

PB-7 **Distributed Temperature Sensing Using Type-II Fiber Bragg Gratings in Sapphire Optical Fiber in a Nuclear Reactor**

B. A. Wilson, K. M. McCary, T. E. Blue, The Ohio State University

A cladded sapphire optical fiber with an array of type-II fiber Bragg gratings was tested in the Ohio State Research Reactor. The fiber provided distributed temperature measurements over four days of irradiation without degradation.

12:15 PM – 1:55 PM LUNCH

SESSION C **HARDNESS ASSURANCE**
1:55 PM SESSION INTRODUCTION
Chair: Kirby Kruckmeyer, Texas Instruments

C-1 **The Effect of 1-10 MeV Neutrons on the JESD89 Test Standard**
2:00 PM *H. Quinn, A. Watkins, LANL; L. Dominik, Honeywell*

The JESD89A test standard defines how terrestrial neutron testing is conducted. We present information on whether the minimum energy for neutron-induced single-event effects should be lowered from 10 MeV to 1 MeV.

C-2 **Directional Dependence of Co-60 Irradiation on the Total Dose**
2:15 PM **Response of Flash Memories**
M. J. Gadlage, D. I. Bruce, J. D. Ingalls, D. P. Bossev, M. J. Kay, NSWC CRANE

A strong dependence on the direction of Co-60 irradiation is observed in the total dose induced data corruption of an assortment of flash memories. Hardness assurance implications of this dose enhancement effect are discussed.

C-3 **Process Variation Aware Analysis of SRAM SEU Cross-Sections Using**
2:30 PM **Data Retention Voltage**
D. Kobayashi, K. Hirose, ISAS/JAXA and University of Tokyo; N. Hayashi, University of Tokyo; Y. Kakehashi, O. Kawasaki, JAXA; T. Makino, T. Ohshima, QST; D. Matsuura, Y. Mori, M. Kusano, T. Narita, S. Ishii, K. Masukawa, MHI Ltd.

Parts assurance has to deal with large chip-to-chip and cell-to-cell parameter variations. Proposed is a method of analyzing radiation test results for the purpose. It requires no additional specially designed circuit.

C-4 **Total Dose Testing Methodology for Bipolar Circuits Operating in the**
2:45 PM **Jovian Radiation Environment**
P. C. Adell, S. M. McClure, B. G. Rax, D. O. Thorbourn, A. Kenna, L. Z. Scheick, JPL

A total-dose testing methodology for qualifying bipolar circuits for the Europa Mission is presented. The method leverages from the mission dose-rate profile to bound device performances and reduces qualification test-time.

POSTER PAPERS

PC-1 **Getting SiC Power Devices off the Ground: Overcoming the Radiation Threat**
J.-M. Lauenstein, M. C. Casey, R. L. Ladbury, K. A. LaBel, NASA GSFC

A mounting body of heavy-ion radiation effects knowledge across SiC power devices points to methods for more rugged design and appropriate testing geared toward space applications.

PC-2 **Dose-Rate Dependence of the Total-Ionizing-Dose Response of AlGaN/GaN HEMTs**

R. Jiang, E. X. Zhang, M. W. McCurdy, P. Wang, H. Gong, R. D. Schrimpf, D. M. Fleetwood, Vanderbilt University

Significant threshold voltage shifts are observed during high-rate 10-keV X-ray irradiation of AlGaN/GaN HEMTs. Shifts are much smaller for lower-rate Cs-137 irradiation. No ELDRS is observed; mechanisms are discussed.

PC-3 **Impacts of Proton Radiation on Heavy Ion-Induced Single Event Transients in 65 nm CMOS Technology**

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

$3x10^{13}/cm^2$ 1.2 MeV proton radiation will significantly increase heavy ion SET cross-sections and pulsewidths in 65 nm bulk CMOS technology. Radiation hardness assurance for deep space electronic devices should consider this effect.

PC-4 **Methodology for Identifying Radiation Effects in Robotic Systems with Mechanical and Control Performance Variations**

J. T. Howard, E. J. Barth, R. D. Schrimpf, R. A. Reed, D. S. Vibbert, A. F. Witulski, Vanderbilt University

Complications of identifying radiation effects in electromechanical sensors in the presence of mechanical variation are discussed. A corresponding analysis method is developed to separate radiation degradation effects from expected sensing variation due to mechanical tolerance.

PC-5 **Multi-Scale Modeling of Total Ionizing Dose Effects in Commercial-off-the Shelf Parts**

A. Privat, H. J. Barnaby, B. S. Tolleson, X. Han, ASU; P. C. Adell, B. G. Rax, JPL

A multiscale modeling platform that supports the ``virtual`` qualification of COTS parts is presented. Simulation and experimental results show good correlation and suggest this platform as a complementary tool within the radiation hardness assurance flow.

PC-6 **Temperature-Switching During Irradiation as a Test for ELDRS in Linear Bipolar Devices**

X. Li, University of Chinese Academy of Sciences and Xinjiang Technical Institute of Physics and Chemistry; W. Lu, Q. Guo, C. He, X. Yu, Y. Li, X. Wang, X. Yu, J. Sun, Xinjiang Technical Institute of Physics and Chemistry; D. M. Fleetwood, Vanderbilt University

A temperature-switching irradiation (TSI) sequence based on first-principles understanding of interface-trap buildup and annealing is shown to be a practical and conservative test for ELDRS in linear bipolar devices and ICs.

3:00 - 3:25 PM
KOHALA BALLROOM
BREAK

SESSION D **RADIATION HARDENING BY DESIGN**

3:25 PM
SESSION INTRODUCTION

Chair: Lloyd Massengill, Vanderbilt University

D-1 3:30 PM
SEE Evaluation on ARM M0 Cores Implemented with ST's 28nm FDSOI Technology
S. Shi, University of Saskatchewan and China Institute of Atomic Energy; X. Li, Y. Li, R. Liu, L. Chen, University of Saskatchewan; A. Evan, MINATEC, CEA-LETI DACLE; J. Cunha, L. Summerer, V. Ferlet-Cavrois, ESA; M. Glorieux, IROC Technologies; R. Wong, S.-J. Wen, Cisco Inc.; G. Guo, China Institute of Atomic Energy

Two AMR cores were implemented on the same die with 28 nm FDSOI technology. Heavy-ion experiments showed the cross-section of the core with DICE FFs was about 2 times smaller than with regular FFs.

D-2 3:45 PM
Increasing the Effectiveness of TMR by Manipulating the Placement and Routing for Designs Deployed on SRAM FPGAs
M. Cannon, A. Keller, H. Rowberry, M. Wirthlin, Brigham Young University

The effectiveness of single device TMR is improved to 368x from 76x in neutron irradiation over an unmitigated design through low-level placement and routing manipulations which address single bits that cause multiple domain failure.

D-3 4:00 PM
Design and Test of a RHBD CMOS-Only Voltage Reference
J. Jiang, W. Shu, Y. Qu, K. S. Chong, J. S. Chang, Nanyang Technological University

We report a RHBD CMOS-only reference by a Zero-Temperature-Coefficient technique wherein MOSFETs are biased at strong inversion. 1.5% variation is achieved over 1000 krad TID, and can be improved by technology scaling.

D-4 4:15 PM
Selective Hardening for Neural Networks in FPGAs
F. Libano, P. Rech, Universidade Federal do Rio Grande do Sul; B. Wilson, M. Wirthlin, Brigham Young University

Through fault-injection we identify the most vulnerable portions of neural networks on FPGAs. Using beam experiments, we propose and validate a selective hardening strategy, reducing by 65% the error-rate with a 45% overhead.

POSTER PAPERS

PD-1
ABFT and Smart-Pool: Increasing Efficiently Convolutional Neural Networks Reliability
F. F. dos Santos, P. F. Pimenta, P. Rech, Universidade Federal do Rio Grande do Sul

We improve the reliability of neural-networks for object detection on GPUs. We experimentally analyze faults propagation and modify the neural-network structure to detect 98% and correct 87% of critical SDCs with negligible overhead.

PD-2
Microcontroller Compiler-Assisted Software Fault Tolerance
M. Bohman, B. James, M. Wirthlin, J. Goeders, Brigham Young University; H. Quinn, Los Alamos National Labs

We present a fully automated, compiler-based tool to add SEU fault mitigation to user code. This technique increased the mean work to failure of a MSP430 by seven times in a neutron radiation beam.

PD-3 **Using MRED to Screen Multiple Node Charge Collection Mitigated SOI Layouts**

J. D. Black, D. A. Black, P. E. Dodd, M. R. Shaneyfelt, J. Teifel, J. G. Salas, Sandia National Labs; J. A. Dame, R. Steinbach, M. Davis, Scientic, Inc.; R. A. Reed, R. A. Weller, J. M. Trippe, K. M. Warren, A. M. Tonigan, R. D. Schrimpf, Vanderbilt University; R. S. Marquez, Air Force Research Laboratory

Multiple node charge collection robust SOI latch designs and layouts are simulated and tested. MRED is used to identify potential single-event susceptibilities associated with different layouts prior to fabrication.

PD-4 **Best Practices for Using Electrostatic Discharge (ESD) Protection Techniques for Single-Event Transient Mitigation**

M.-K. Cho, I. Song, Z. E. Fleetwood, J. D. Cressler, Georgia Institute of Technology; A. Khachatrian, Sotera Defense; J. H. Warner, S. P. Buchner, D. McMorrow, Naval Research Laboratory; P. Paki, Defense Threat Reduction Agency

Three different SPST switch configurations (conventional design, floating body, and floating body/N-well) were implemented to provide insight on how to best apply various ESD protection techniques while also achieving robust SET mitigation.

PD-5 **A SEE- Immune Frequency Divider with Mandatory Updating Mechanism for Clock Data Recovery**

H. Yuan, J. Chen, B. Liang, Y. Chi, X. Chen, Y. Guo, National University of Defense Technology

A layout hardened divider with the mandatory updating mechanism that can recover from the error state to normal state is proposed for clock and data recovery. The experiment shows complete SEE immunity during ion strikes.

PD-6 **Single Event Effects Characterization of LC-VCO PLLs in a 28-nm CMOS Technology**

Z. Zhang, University of Saskatchewan and China University of Mining and Technology; C. Gu, L. Chen, University of Saskatchewan; H. Djahanshahi, M. Patel, Microsemi Corporation

Two-photon absorption laser experiments are conducted on a CMOS 28nm tunable LC-tank phased-locked loop circuit. The SEEs sensitivities for each block as well as the effects of varying parameters were analyzed.

4:30 PM END OF TUESDAY SESSIONS

5:30 – 7:00 PM
EXHIBIT RECEPTION

KOHALA BALLROOM

Technical Program Wednesday

KONA 4 BALLROOM
7:00 - 8:15 AM

BREAKFAST WITH YOUNG PROFESSIONALS PRESENTATION
(Ticket Required to Attend)

MONARCHY GRAND BALLROOM
INVITED TALK
8:15 - 9:25 AM

He Lani Ko Luna, A Sky Above
"In losing the sight of land, you discover the stars."
Chad Kalepa Baybayan, Captain and Navigator for Hokulea Voyages

Kālepa Baybayan will present on traditional pacific deep sea voyaging and oceanic wayfinding, the indigenous system of orientation and navigation at sea. The talk will also cover the history of the discovery and settlement of the Hawaiian Islands and the recently completed Mālama -Honua Worlwide Voyage. Also to be discussed is the epic around the world journey of the double-hulled sailing canoe, Hōkūle'a, which traveled 42,000 nautical miles over 3 years, visiting 150 ports in over 20 countries, while training a new generation of navigators, educators, scientists, and community stewards.

Born and raised on Maui, Kālepa Baybayan first sailed on Hōkūle'a in 1975, a traditionally designed reconstruction of a double-hulled deep-sea oceanic voyaging canoe. He has since sailed on all major voyages throughout the Pacific and around the world. Kālepa has served as captain and navigator on Hōkūle'a since 1986. He currently serves as the Navigator in Residence at the 'Imiloa Astronomy Center of Hawai'i developing wayfinding activities, curriculum materials, and conducting outreach events. In 2007, his teacher Mau Piailug, on the island of Satawal, initiated Kālepa into the order of Pwo, a three-thousand-year-old society of deep-sea navigators in Micronesia.

MONARCHY BALLROOM
SESSION E
9:25 AM

SPACE AND TERRESTRIAL ENVIRONMENTS
SESSION INTRODUCTION
Chair: Justin Likar, JHU APL

E-1
9:30 AM

Applications of Satellite Trajectory Optimizations Based on Displacement Damage Dose Deposition in Solar Cells
S. R. Messenger, Northrop Grumman Mission Systems; C. A. Kluever, University of Missouri-Columbia

A model for optimizing spacecraft trajectories based on solar cell degradation has been developed. Comparisons with SCREAM demonstrate this method to accurately determine solar cell degradation for many Earth orbits and low-thrust transfers.

E-2
9:45 AM

Using the Galileo Solid-State Imaging Instrument as a Sensor of Jovian Energetic Electrons
A. Carlton, K. Cahoy, Massachusetts Institute of Technology; M. de Soria-Santacruz Pich, I. Jun, W. Kim, JPL

We develop a technique to quantitatively characterize the Jupiter high-energy electron environment using the Galileo spacecraft Solid-State Imaging (SSI) instrument and particle transport simulations in Geant4, finding agreement with the Energetic Particle Detector.

E-3 10:00 AM

Experimental Evidence of Ground Albedo Neutron Impact on SER for Nanoscale Devices

G. Hubert, L. Artola, DPHY, ONERA

The impact of ground albedo neutron on SER is investigated for nanoscale devices. Experimental evidence is investigated considering 45 nm technologies and neutron spectrometer. The impacts for ground applications are investigated using MUSCA SEP3 simulations.

POSTER PAPERS

PE-1

Correlation of Single-Board Computer Ground-Test Data and on-Orbit Upset Rates from the Gaia Mission

D. L. Hansen, R. Hillman, F. Meraz, J. Montoya, G. Williamson, Data Devices Corp.; E. Ecale, P. Paulet, P. Tatry, Airbus Defense and Space SAS; E. Serpell, ESOC, ESA

On-orbit SEU data for the DDC SCS750 single board computers used in the Gaia mission are analyzed for correlation to space weather. SEU had no effect on mission operation because of SBC error correction.

PE-2

Methods for and the Influence of Uncertainty Propagation in the Solar Energetic Particle Environment Modelling (SEPEM) System

P. Truscott, Kallisto Consultancy, Ltd., D. Heynderickx, DH Consultancy, A. Varotsou, TRAD, F. Lei, RadMon Research, P. Jiggens, ESA / ESTEC, I. Sandberg, Space Applications & Research Consultancy

Recent enhancements to the SEPEM solar proton/ion modelling system include the propagation of uncertainties in the model generation process. The method of this treatment is described and the relative importance of the contributions discussed.

10:15 – 10:40 AM
KOHALA BALLROOM

BREAK

SESSION F 10:40 AM

DOSIMETRY

SESSION INTRODUCTION

Chair: Joe Benedetto

F-1 10:45 AM

SRAM Dosimeter for Characterizing the TRIUMF Proton and Neutron Beams

E. Blackmore, M. Trinczek, TRIUMF; K. Jiang, M. Sachdev, D. Wright, University of Waterloo

An array of thirty 16 Mbit SRAMs has been used to characterize the proton and neutron beams used for radiation testing at TRIUMF. Measurements include SEU cross sections, beam profiles, collimator design and shielding effects.

F-2 11:00 AM

A Flexible Radiation Monitor Based on an SRAM Memory with Dynamic Voltage Control

J. Prinzie, S. Thys, B. Van Bockel, J. Wang, P. Leroux, ESAT-ADVISE

A flexible SRAM based radiation monitor is presented. The sensitivity is adjustable through the SRAM supply voltage. Experimental results are shown with heavy ions and high-energy protons. Furthermore, multi-bit upset rates are analyzed.

F-3 11:15 AM

A Low-Power, Real-Time Displacement Damage Dosimeter (RT3D)

J. H. Warner, C. D. Cress, P. P. Jenkins, J. R. Lorentzen, D. A. Scheiman, M. K. Yakes, R. J. Walters, Naval Research Laboratory; R. Hoheisel, The George Washington University

We describe a real-time displacement damage dosimeter comprised of a GaAs sensor and measurement electronics. The dosimeter measures the diode dark current and determines the displacement damage dose based on a calibration curve.

F-4 11:30 AM

Dosimetry Mapping of Mixed Field Radiation Environment Using Distributed Optical Fiber Sensing and FLUKA Simulation

D. Di Francesca, A. Infantino, Y. Kadi, M. Brugger, CERN; G. Li Vecchi, CERN and University Jean Monnet of Saint Etienne; S. Girard, A. Alessi, University Jean Monnet of Saint Etienne

We study the radiation response of a P-doped single mode optical fiber to Co-60 γ-rays and to a mixed field radiation environment in the aim of coupling distributed optical fiber dosimetry with FLUKA simulation.

F-5 11:45 AM

X-Rays, Gamma-Rays and Proton Beam Monitoring with Multimode Nitrogen-Doped Optical Fiber

S. Girard, A. Morana, I. Reghioua, A. Alessi, E. Marin, A. Boukenter, Y. Ouerdane, Universite de Saint-Etienne; D. Di Francesca, Y. Kadi, M. Brugger, CERN; C. Hoehr, M. Trinczek, TRIUMF; P. Paillet, O. Duhamel, CEA DAM; C. Duzenli, British Columbia Cancer Agency; G. Li Vecchi, Universite de Saint-Etienne and CERN

We investigated the radioluminescence and optically-stimulated luminescence properties of a 50µm core diameter N-doped fiber. This fiber provides precise dose rate and dose measurements and very promising characteristics for protontherapy beam dosimetry.

POSTER PAPERS

PF-1

TID Evaluation System with on-Chip Electron Source and Programmable Sensing Mechanisms on FPGA

K. Maragos, G. Lentaris, D. Soudris, National Technical University of Athens; F. Di Capua, L. Campajola, M. Campajola, University of Naples Federico II; G. Furano, A. Tavoularis, L. Santos, ESTEC, ESA

We combine HW and SW techniques to perform onchip irradiation and characterization of SRAM SoC FPGAs. We present a methodology for modeling TID effects, test setup with Sr90/Y90 source, and preliminary results on Zynq.

PF-2

Radiation Analysis and Shielding Optimization of RADEM, a Radiation Hard Electron Monitor for the JUICE Mission

M. Pinto, P. Goncalves, LIP; W. Hajdas, A. Mrigakshi, PSI; A. Marques, J. C. Pinto, EFACEC SA

Radiation analysis of RADEM, to be flown in the JUICE mission, was computed with Geant4. Shielding was optimized to ensure TID and DD levels compatible with all EEE components sensitivity. SEU rates were also calculated.

PF-3 **Initial Assessment of NurFETs Suitability for Radiation Sensors**

S. Kaya, R. Lok, S. Abubakar, A. Aktag, H. Karacali, E. Yilmaz, Center for Nuclear Radiation Detectors Research and Applications and Abant Izzet Baysal University

Initial device characteristics and Co-60 gamma irradiation response of NurFETs fabricated in NURDAM-Turkey have been investigated. Various gate oxide thicknesses were studied and obtained results were compared with commercial RadFETs.

PF-4 **Analysis of RADFET Response at Different Dose Rates and Re-Interpretation of Flight Data from MERLIN Experiment During Giove A Mission**

A. Jaksic, R. Duane, N. Vasovic, Tyndall National Institute; E. Yilmaz, Center for Nuclear Radiation Detectors Research and Applications; S. Martinez, Universidad Autonoma de Madrid; A. Lalena, University of Granada; S. Stankovic, Institute for Nuclear Sciences Vinca; G. Ristic, Faculty of Electronic Engineering; M. Poizat, ESA-ESTEC

We have performed detailed calibration at different dose rates of Tyndall National Institute RADFETs. We discuss microscopic mechanisms underlying observed response and re-interpret flight data from ESA's MERLIN experiment during Giove A mission.

PF-5 **SOI Thin Microdosimeter Detectors for Low Energy Ions and Radiation Damage Studies**

B. W. James, J. Vohradsky, L. T. Tran, D. Bolst, M. Carr, V. Pan, S. Guatelli, A. Rosenfeld, University of Wollongong; D. Hinde, M. Dasgupta, A. Stuchbery, Australian National University; D. Prokopovich, M. Reinhard, Australian Nuclear Science and Technology Organization; V. Perevertaylo, M. Povoli, A. Kok, SINTEF

The response of 3D silicon microdosimeters developed by CMRP were investigated with low energy ions. The SOI microdosimeters were able to measure LET of different energies of ions, as well as conduct microdosimetric measurements.

PF-6 **Uncertainty Characterization of Silicon Damage Metrics**

P. J. Griffin, Sandia National Laboratories

High fidelity uncertainty characterizations are provided for radiation damage metrics relevant to the modeling of silicon damage. Uncertainty contributors addressed include the nuclear data, damage partition function, threshold treatment, and model defect.

PF-7 **A New Discriminating High Temperature Fission Chamber Filled with Xenon Designed for Sodium-Cooled Fast Reactors**

G. Galli, H. Hamrita, C. Jammes, LIST, CEA; M. J. Kirkpatrick, E. Odic, P. Dessante, P. Molinie, GeePs; B. Cantonnet, J.-C. Nappe, Photonis

Xenon high temperature fission chamber for sodium-cooled reactors, unlike argon filled fission chambers, can operate at temperatures of 500°C without partial-discharges and discriminate neutrons and partial-discharges at temperatures of 650°C.

12:00 – 1:30 PM EXHIBITOR LUNCH
KOHALA BALLROOM

Technical Program Wednesday

POSTER SESSION
1:30 - 4:30 PM
QUEEN'S 4-6 BALLROOMS

INTRODUCTION

Chair: Nathan Nowlin, Sandia National Laboratories

4:30 PM END OF WEDNESDAY SESSIONS

6:00 TO 10:00 PM **CONFERENCE SOCIAL**
"SUNSET LUAU AT THE MARRIOTT"

MONARCHY GRAND BALLROOM
INVITED TALK
8:15 - 9:25 AM

Hawaiian Volcanos
Ken Hon, Professor of Geology, University of Hawaii at Hilo
Cheryl Gansecki, Lecturer of Geology, University of Hawaii at Hilo

The Hawaiian Islands sit in the middle of the Pacific Ocean as far away from continents as is possible on Earth. Ken and Cheryl will tell the story of how the islands are built by massive volcanoes that rise 20-30,000 feet above the surrounding seafloor. Kīlauea Volcano is the most active volcano in the islands and one of most active volcanoes in the world. Cheryl and Ken will explain what drives eruptions of Kīlauea Volcano and how lava flows contribute to the growth of Hawai'i Island. Cheryl will show a video of some of the spectacular eruptive events over the past 25 years, including the recent incursion of lava into the outskirts of the town of Pāhoa.

Ken Hon and Cheryl Gansecki are volcanologists that live on the Big Island of Hawai'i. They have been studying and filming the eruptions of Kīlauea Volcano for over 25 years. Both speakers currently work at the University of Hawai'i at Hilo teaching about volcanoes, and they have previously worked for the U.S. Geological Survey. Their research focuses on the emplacement of lava flows, particularly on how pahoehoe lava flows move. Ken and Cheryl also work with the Hawaiian Volcano Observatory to document the changing chemistry of the eruption and what it tells us about changes in the magma chamber feeding the eruption. One of their long-term projects is the "Eruption Update," an hour-long film that documents the changing eruption over the past 20 years. They are both avid volcano watchers and love to share their knowledge.

MONARCHY BALLROOM
SESSION G
9:25 AM

SINGLE-EVENT EFFECTS; DEVICES AND INTEGRATED CIRCUITS
SESSION INTRODUCTION
Chair: Megan Casey, NASA GSFC

G-1
9:30 AM

Terrestrial Neutron-Induced Single Event Burnout Cross-Sections for High-Voltage SiC Power MOSFETs
D. Ball, B. Sierawski, K. Galloway, A. Witulski, R. Johnson, R. Schrimpf, A. Sternberg, R. Reed, Vanderbilt University; A. Javanainen, University of Jyvaskyla; J.-M. Lauenstein, NASA GSFC

Cross-sections for neutron-induced SEB are estimated using a novel method based upon integration of bias-dependent sensitive volumes, secondary particle production, and heavy ion SEB data. These results explain neutron-induced SEB data.

G-2
9:45 AM

Radiation Response of AlGaN HEMTs
M. J. Martinez, M. P. King, A. G. Baca, A. A. Allerman, A. A. Armstrong, B. A. Klein, E. A. Douglas, R. J. Kaplar, S. E. Swanson, Sandia National Laboratories

We present heavy ion and proton data on AlGaN high-voltage HEMTs showing Single Event Burnout, Total Ionizing Dose, and Displacement Damage responses. These are the first such data, showing burnout thresholds and their mitigation.

10:00 – 10:25 AM
GRAND PROMENADE

BREAK

G-3
10:25 AM

Effects of Process Variations on Single-Event Upset Cross-Section for Conventional D-Flip-Flop Designs

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

Effects of process variations, as seen through power-on state preference of FF cells, on alpha-particle-induced SEU responses for D-FF in a 16-nm bulk FinFET technology are experimentally characterized.

G-4
10:40 AM

Soft Error Scaling in 3D Tri-Gate Transistor Technologies

N. R. Seifert, S. M. Jahinuzzaman, R. Ascazubi, A. Neale, S. K. Sekwao, Intel Corporation

In this work, we discuss radiation-induced soft error rate improvements from 1st generation 22nm to 3rd generation 10nm Tri-Gate transistor technologies. Measured trends are interpreted using calibrated physics-based simulations and laser testing.

POSTER PAPERS

PG-1

Back Gate Impact on SEU Characterization of a Double SOI 4k-Bit SRAM

J. Gao, B. Li, Y. Huang, B. Li, F. Zhao, C. Wang, Z. Cheng, Z. An, Z. Han, J. Luo, J. Liu, Chinese Academy of Sciences; G. Guo, China Institute of Atomic Energy

Double Silicon-on-insulator (DSOI) structure is used in a 4k-bit SRAM to improve SEU tolerance. The back gate bias of NMOSFET and PMOSFET could be applied, changing circuit tolerance against radiation.

PG-2

Gate Structure Dependence of Charge Collection and Single Event Burnout Tolerance for SiC MOSFETs

T. Makino, T. Ohshima, National Institutes for Quantum and Radiological Science and Technology (QST); S. Takano, National Institutes for Quantum and Radiological Science and Technology (QST) and Saitama University; S. Harada, National Institute of Advanced Industrial Science and Technology (AIST); Y. Hijikata, Saitama University

The single-event burnout (SEB) of SiC trench gate MOSFETs are observed for the first time in comparison with those of SiC planar gate MOSFETs. The advantage of trench gate MOSFET for SEB was shown.

PG-3

Analyzing Neutron-Induced Multi-Bit-Upset (MBU) Patterns in 14nm Tri-Gate Flip-Flop Array

S. Kumar, L. Everson, Q. Tang, P. Mazanec, C. H. Kim, University of Minnesota; M. Cho, P. Meinerzhagen, A. Malavasi, D. Lake, C. Tokunaga, M. Khellah, J. Tschanz, S. Borkar, V. De, Intel Corporation

Neutron induced multi-bit-upsets (MBUs) are measured from 14nm flip-flop arrays. Different MBU patterns pertaining to specific sensitive node locations are analyzed from the flip-flop array data.

PG-4 **Ultra High Energy Heavy Ion Test beam on Xilinx Kintex7 SRAM-Based FPGA**

S. Azimi, B. Du, L. Sterpone, Politecnico di Torino; D. M. Codinachs, V. Ferlet-Cavrois, C. B. Polo, ESTEC, ESA; R. G. Alía, M. Kastriotou, P. F. Martínez, European Organization for Nuclear Research

This paper presents results from the first radiation test performed on a Xilinx Kintex7 SRAM-Based FPGA with an ARM-based SoC as benchmark circuit using Ultra High Energy heavy ion beam.

PG-5 **An Empirical Model Based Approach to Explore Design Space for Logic Circuits**

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

A design methodology employing empirical models for identifying the optimum combinational of topology, supply voltage, and frequency for a given SE cross-section specifications is developed for 16-nm bulk FinFET node.

MONARCHY BALLROOM

SESSION H **SINGLE-EVENT EFFECTS: TRANSIENT CHARACTERIZATION**

10:55 AM SESSION INTRODUCTION

Chair: Andrew Kelly, BAE Systems

H-1 **SET Sensitivity of Tri-Gate Silicon Nanowire Field-Effect Transistors**

11:00 AM *M. Raine, M. Gaillardin, M. Martinez, O. Duhamel, J. Riffaud, T. Lagutere, C. Marcandella, P. Paillet, N. Richard, DAM, CEA; M. Vinet, F. Andrieu, S. Barraud, DRT, CEA*

The SET response of SOI tri-gate nanowires is investigated using direct measurements of current transients. Resulting collected charge distributions are compared to Monte-Carlo simulations of deposited energy.

H-2 **Analysis of Combined SET and SEU Data to Extend Transient Pulse Detection below the Logic Capture Threshold**

11:15 AM *R. C. Harrington, J. S. Kauppila, J. A. Maharrey, T. D. Haeffner, E. X. Zhang, D. R. Ball, P. Nsengiyumva, M. L. Alles, B. L. Bhuva, L. W. Massengill, Vanderbilt University*

A novel method is presented to enhance SET measurements, overcoming a common limitation of minimum measurable pulse widths. Using SEU data to extend pulse width acuity, pulses shorter than the logic capture threshold are measured.

H-3 **Optimizing Optical Parameters to Facilitate Correlation of Laser- and Heavy-Ion-Induced Single-Event Transients in SiGe HBTs**

11:30 AM *A. Ildefonso, Z. E. Fleetwood, G. N. Tzintzarov, M. Frounchi, J. Harms, A. Erickson, J. D. Cressler, Georgia Institute of Technology; J. M. Hales, A. Khachatrian,, Naval Research Laboratory and Sotera Defense; S. P. Buchner, D. McMorrow, J. H. Warner, Naval Research Laboratory*

An approach for determining the optimal laser parameters to correlate single-event transients induced via two-photon absorption and heavy ions is presented. This method relies on matching waveform characteristics between laser and ion measurements.

H-4 **Investigation of Single-Event Transients in AlGaN/GaN MIS-Gate**
11:45 PM **HEMTs Using X-Rays**

A. Khachatrian, Sotera Defense Solutions; N. J.-H. Roche, University of Montpellier; C. Affouda, S. Buchner, A. D. Koehler, T. J. Anderson, K. D. Hobart, D. McMorrow, NRL; S. D. LaLumondiere, W. T. Lotshaw, Aerospace Corporation; D. L. Brewe, Argonne National Laboratory

Single-Event Transients are generated with focused, pulsed x-rays in a MIS-gate AlGaN/GaN HEMT. Measured transients reveal current flow between source and drain, in sharp contrast to measurements on Schottky-gate HEMTs.

POSTER PAPERS

PH-1 **Pulsed-Laser Induced Single-Event Transients in InGaAs FinFETs on Bulk Silicon Substrates**

H. Gong, K. Ni, E. X. Zhang, A. L. Sternberg, J. A. Kozub, M. L. Alles, R. A. Reed, D. M. Fleetwood, R. D. Schrimpf, Vanderbilt University; N. Waldron, B. Kunert, D. Linten, IMEC

The pulsed-laser single-event transient response of InGaAs FinFETs on silicon substrates is investigated. The band alignment of this material system reduces charge collection enhancement, as compared with devices on semi-insulating InP substrates.

PH-2 **Laser-Induced Single Event Transients in Black Phosphorus MOSFETs**

C. Liang, Vanderbilt University and Maxim integrated Inc.; R. Ma, Y. Su, S. J. Koester, University of Minnesota; E. X. Zhang, A. L. Sternberg, P. Wang, K. L. Ryder, M. L. Alles, R. A. Reed, D. M. Fleetwood, R. D. Schrimpf, Vanderbilt University

Laser-induced SETs are observed in black phosphorus MOSFETs. The position dependence and the bias-dependence of the measured SETs in BP transistors are investigated to study the charge collection mechanisms.

PH-3 **The Effects of High-Temperature on the Single-Event-Transient Response of a High-Voltage (>30 V) Complementary SiGe-on-SOI Technology**

A. P. Omprakash, Z. E. Fleetwood, A. Ildefonso, G. Tzintzarov, J. D. Cressler, Georgia Institute of Technology; A. S. Cardoso, Georgia Tech Research Institute; J. Babcock, R. Mukhopadhyay, Texas Instruments; A. Khachatrian, Sotera Defense; J. H. Warner, D. McMorrow, S. Buchner, Naval Research Laboratory

The SET response of a high-voltage complementary SiGe-on-SOI technology is investigated across temperature. The impact of ambient and internal device temperature on the transient response is presented

12:00 – 1:30 PM **LUNCH WITH WOMEN IN ENGINEERING (WIE) PRESENTATION**
KONA 4 BALLROOM *(Ticket Required to Attend)*

RADIATION EFFECTS DATA WORKSHOP
1:30 - 4:30 PM
KING'S 1-3 BALLROOMS

INTRODUCTION

Chair: Martha O'Bryan, AS&D, Inc.

W-1 **Single-Event Latchup Measurements on Wireless and Powerline Network Communication Devices for Use in Mars Missions**
F. Irom, S. Vartanian, G. R. Allen, JPL

This paper reports recent single-event latchup results for a variety of microelectronic devices that include Wireless and Powerline Network Communication devices. The data were collected to evaluate these devices for use in NASA missions

W-2 **NASA Goddard Space Flight Center's Compendium of Recent Single Event Effects Results**
M. V. O'Bryan, E. P. Wilcox, C. M. Szabo, M. D. Berg, AS&D, Inc.; K. A. LaBel, M. J. Campola, M. C. Casey, J-M. Lauenstein, J. A. Pellish, NASA GSFC; D. Chen, Analog Devices Inc.; E. J. Wyrwas, Lentech, Inc.

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-3 **NASA Goddard Space Flight Center's Compendium of Recent Total Ionizing Dose and Displacement Damage Dose Results**
A. D. Topper, E. P. Wilcox, N. D. Burton, D. J. Cochran, M. V. O'Bryan, AS&D, Inc.; M. C. Casey, M. J. Campola, K. A. LaBel, NASA GSFC

Total ionizing dose and displacement damage dose testing were 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-4 **2018 Compendium of Radiation-Induced Effects for Candidate Particle Accelerator Electronics**
S. Danzeca, P. Peronnard, G. Foucard, G. Tsiligiannis, R. Ferraro, G. Piscopo, C. G. Mcallister, M. Brugger, A. Masi, S. Gilardoni, CERN

The sensitivity of a variety of components for particle accelerators electronics has been analyzed against Single Event Effects, Total Ionizing Dose and Displacement Damage. The tested parts include analog, linear, digital and mixed devices.

W-5 Compendium of Total Ionizing Dose (TID) Test Results for the Europa Clipper Mission

A. N. Bozovich, B. G. Rax, A. J. Kenna, D. Nguyen, J. Davila, J. L. Thomas, L. Z. Scheick, JPL

This paper reports recent total ionizing dose (TID) test results for a variety of common part types evaluated for use on NASA/JPL's Europa Clipper mission.

W-6 SEE and TID Testing of Components for the Near InfraRed Airglow Camera (NIRAC)

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

We performed SEE and TID testing on select electronic parts used for the upcoming Near InfraRed Airglow Camera (NIRAC) mission to the International Space Station.

W-7 Compendium of Ball Aerospace TID Test Results

B. Griffiths, T. R. Oldham, C. Whitney, Ball Aerospace

We have conducted TID and DDD Tests on a variety of parts intended for application in different Ball Aerospace space systems. Results and discussion are presented.

W-8 Recent Results for Commercial Microprocessor Testing

H. Quinn, A. Watkins, Y. Chen, F. Tom, S. Terra, R. Eric, LANL

Commercial microprocessors could be useful for many space missions that require low-power but not radiationhardened computing support. We present data on recent testing of several commercial microprocessors.

W-9 SEE Characteristics of COTS Devices by 1064nm Pulsed Laser Backside Testing

Y. Ma, R. Chen, J. Han, Chinese Academy of Sciences; S. Shangguan, Z. Xiang, University of Chinese Academy of Sciences

This summary presents SEU and SEL characteristics of commercial-off-the-shelf (COTS) devices by laser backside testing method. The SEU threshold and micro latch-up for the deep sub-micron devices are investigated.

W-10 Heavy-Ion Test Results of Several Commercial Components for Use in a JPL Class D Interplanetary Mission Payload

A. C. Daniel, G. R. Allen, JPL

This paper presents recent heavy ion single-event effects test results for commercial off the shelf devices. Data was taken in CY17 for device evaluation for use in a Class D NASA interplanetary mission payload.

W-11 Results of Recent SEE Testing of GaAs Based RF Communication Components

S. E. Stone, D. A. Clymer, O. Amusan, L. Mason, E. Beach, K. Huntington, Lockheed Martin Space; T. Turflinger, The Aerospace Corporation

This paper examines DSEE in RF GaAs components and while many low power components demonstrated immunity, the work shows the need to establish SOAs while considering all aspects of design space in high power applications.

W-12 **Investigation of a High Power COTS Solution for Space**
L. Z. Scheick, S. Vartanian, JPL

Investigation into a possible high power MOSFET solution for switching applications in space is presented. The trends of SEE voltage as a function of device parameters are analyzed.

W-13 **Compendium of Recent Neutron Testing of Electronic Parts at Los Alamos National Laboratory**
T. Fairbanks, A. Watkins, C. Safi, M. Dale, Los Alamos National Laboratory

Los Alamos National Laboratory has been testing COTS electronic parts for potential use in small spacecraft and high altitude telemetry systems. Results of neutron testing for SEE are presented. TID testing is planned.

W-14 **Calibration Stability and Beam Dynamics at the BASE Facility of the 88-Inch Cyclotron at LBNL**
A. Donoghue, L. Phair, M. B. Johnson, B. Ninemire, S. Small, T. L. Gimpel, LBNL

An investigation is made into the stability of the fluence measurement accuracy over an extended time period. Beam profile fitting is performed to illuminate the underlying causes of changes in the fluence measurement accuracy.

W-15 **A Five-Year Compendium of Proton Test Usage Patterns at the Francis H. Burr Proton Therapy Center**
E. W. Cascio, Francis H. Burr Proton Therapy Center at Massachusetts General Hospital

There has been considerable recent interest in the requirements for a proton radiation test program. We present here a five-year detailed analysis of the actual requirements of the users of our proton test services.

W-16 **Facility for Heavy-Ion Irradiation of Semiconductors at RIKEN RI-Beam Factory**
T. Kambara, A. Yoshida, RIKEN Nishina Center

RIKEN RIBF provides fast Kr and Ar ions for the SEE evaluations of space-use semiconductors. We present the irradiation facility, measurements of the dose and LET, and radiochemical analyses of secondary-beam impurity.

W-17 **The Los Alamos Neutron Science Center High-Energy and Low-Energy Neutron Sources for Semiconductor Testing**
S. F. Nowicki, S. A. Wender, LANL

We describe the Los Alamos Neutron Science Center (LANSCE) high-energy and low-energy neutron sources for testing of electronic devices. Both sources are driven by the 800-MeV proton beam from the LANSCE accelerator.

W-18 **Radiation Hardness Assurance for a COTS-Based Power Converter for Accelerator Applications**
J. Braun, J. Chanois, V. R. Herrero, L. L. Foro, Y. Thurel, CERN

This presents the pragmatic strategy used for the RHA of a LHC Power Converter. An extensive test campaign on COTS have been performed as well as a system level testing of an entire sub-converter.

W-19 Simplified Procedures for COTS TID Testing: a Comparison Between Sr-90 and Co-60

A. Menicucci, Delft University of Technology; F. Malatesta, S. Di Mascio, M. Ottavi, University of Rome Tor Vergata; F. Di Capua, L. Campajola, P. Casolaro, University of Naples Federico II; G. Furano, ESA/ESTEC

We propose 90Sr source as an alternative for SoC TID testing. We compare 60Co and 90Sr experimental results showing that 90Sr allows a simpler test-setup, yet reproducing specific failure modes at comparable total doses.

W-20 Radiation Hardness Qualification of the Amplifier/Discriminator ASICs Production for the Upgrade of the LHCb RICH Detector Front-End Electronics

M. Fiorini, M. Andreotti, W. Baldini, M. Bolognesi, 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, A. Giachero, C. Gotti, M. Maino, G. Pessina, AGH University of Science and Technology and INP; P. Carniti, L. Cassina, P. Dorosz, W. Kucewicz, University of Milano Bicocca and INFN Sezione di Milano Bicocca

Thirty-three-thousand CLARO8 ASICs were produced in 0.35µm CMOS technology and will be installed in the upgraded LHCb detector at CERN. Radiation hardness has been extensively characterized and compared to prototype production.

W-21 Study of Radiation Effects on the Single-Photon Sensitive Opto-Electronics Chain for the RICH Detector Upgrade of the LHCb Experiment at CERN

L. Tomassetti, University of Ferrara and INFN

The LHCb RICH detector upgrade is based on photomultipliers and electronics capable of detecting single-photons at 40 MHz repetition rate. Test of radiation hardness of the complete chain, from optics to electronics, is presented.

W-22 Radiation Test of a BLDC Motor Driver Component

H.-J. Sedlmayr, A. Beyer, K. Kunze, M. Maier, Institute of Robotics and Mechatronics, German Aerospace Center (DLR)

Robotic systems will become in the future of space exploration an important technology, whereby brushless motor drives are used for locomotion and manipulation. This paper presents the radiation test results of a COTS motor driver.

W-23 Guidance on Standardizing GPU Radiation Test Approaches

E. J. Wyrwas, Lentech, Inc.; K. A. LaBel, M. J. Campola, NASA GSFC; M. V. O'Bryan, AS&D, Inc.

A standardized test method has been created to characterize and stress graphics processing units (GPU) during radiation effects testing

W-24 **Total Dose and Single-Event Effects Testing of the Intersil ISL70321SEH Power Supply Sequencer**

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

We report the results of total ionizing dose (TID) and destructive and nondestructive single-event effects (SEE) testing of the Intersil ISL70321 power supply sequencer, together with a brief functional description of the part.

W-25 **Verify the Radiation Performance of TI MCU TMS570LS3171 with Pencil Proton Beam Scanning in the Proton and Radiation Therapy Center of CGMH, Taiwan**

C.-H. Lin, Academia Sinica; S.-C. Yang, K.-C. Han, National Chung Shan Institute of Science and Technology; Y.-C. Tsai, C.-Y. Pan, Chang Gung Memorial Hospital; T.-C. Chao, C.-C. Lee, Chang Gung University

We present results of TI TMS570LS3171 radiation test with 200 MeV scanning proton beam in CGMH, Taiwan. The total delivered fluence is 1.425×10^{11} proton/cm^2. No single-event latch up event is observed.

W-26 **Single Event Upset Results from the Radiation Hardened Electronic Memory Experiment on the International Space Station**

D. R. Alexander, A. Vera, G. Urbaitis, C. Li, University of New Mexico; W. Morris, Silicon X; J. Christian, Radiation Monitoring Devices Inc.; D. Gifford, Vorago Technologies; K. Avery, Air Force Research Laboratory

Results are presented from the Radiation Hardened Electronic Memory Experiment (RHEME) performed on the International Space Station (ISS).

W-27 **Prospect of State-of-the-Art Flash Chips for Dosimetry Application**

L. Davies, P. Kumari, N. P. Bhat, B. Ray, University of Alabama in Huntsville

Fail-bit response of commercial 20 nm Flash chip is measured at low doses. Results show promise for Flash chips for dosimetry applications in the 0.1 to 10 krad(SiO_2) range.

W-28 **Evaluation of Total Ionizing Dose Effects on Commercial FRAMs**

M. Slimani, J.-M. Armani, CEA Saclay LIST/DACLE; R. Gaillard, Consultant

This work evaluates the sensitivity of two commercial FRAMs to total ionizing dose. Functional failure analysis and current measurements under gamma radiation have been performed. Annealing responses at room temperature have also been reported.

W-29 **Total Ionizing Dose Measurements and Associated Non-Destructive Screening Methodology of a Commercial Samsung NAND Flash Memory for a High Dose Mission**

G. R. Allen, F. Irom, D. N. Nguyen, L. Z. Scheick, S. Vartanian, S. S. McClure, K. Stanford, JPL

We present TID measurements of a commercial Samsung NAND flash memory intended for use on a high dose mission. Statistical variation necessitated implementing a screening method to predict likelihood of specific failure modes.

W-30 Radiation Performance of a Flash NOR Device
D. L. Hansen, R. Hillman, F. Meraz, J. Montoya, G. Williamson, Data Devices Corp.

We present the results of single-event effects (SEE) and total ionizing-dose (TID) testing performed on the die used in DDC's 56F64008 flash-NOR devices

W-31 SEL/SEU/SEFI/TID Results of the Radiation Hardened DDR3 SDRAM Memory Solution
P.-X. Wang, P. Kohler, 3D Plus; M. Herrmann, T. Fichna, Institut fur Datentechnik und Kommunikationsnetze

We present the radiation test results of a RHBS DDR3-SDRAM Memory solution. The hard errors (TID/SEL) guaranteed and verified at die level, and soft errors (SEU/SEFI) guaranteed and verified at system level.

W-32 SEE Sensitivity Changes in ISSI DDR2 Memories
S. M. Guertin, A. N. Bozovich, JPL

SEE evaluation of a new revision of ISSI DDR2 devices shows a significant increase in low LET SEFI behavior while SBU sensitivity increases somewhat.

W-33 Total Ionizing Dose Assessment of a Commercial 200V PMOSFET
R. J. Aniceto, MIT and Facebook Connectivity Lab.; R. Milanowski, M&A Associates; N. Hall, J. Shields, B. Vermiere, Space Micro, Inc.; S. Moro, Facebook Connectivity Lab.; K. Cahoy, MIT

Commercial 200V PMOSFETs were TID tested to 100 krad(Si). Data were obtained for OFF state and ON state bias conditions. Moderate threshold voltage shifts observed; ON state drain-source resistance values are stable.

W-34 Total Dose Performance at High and Low Dose Rate of CMOS and Bipolar Voltage References
D. M. Hiemstra, V. Kirischian, MDA; X. X. -T. Li, L. Chen, Univeristy of Saskatchewan

Results of Cobalt-60 irradiation of CMOS and bipolar voltage references at high and low dose rates are presented. Performance in the space radiation environment is discussed.

W-35 Guide to the 2017 IEEE Radiation Effects Data Workshop Record
D. M. Hiemstra, MDA

The 2017 Workshop Record has been reviewed and a table prepared to facilitate the search for radiation response data by part number, type, or effect.

W-36 Part II: Single Event Upset Characterization of the Kintex UltraScale Field Programmable Gate Array Using Proton Irradiation
D. M. Hiemstra, V. Kirischian, MDA

Proton induced SEU cross-sections of additional functional blocks of the Kintex UltraScale FPGA are presented. Extending results previously reported. Upset rates in the space radiation environment are estimated.

W-37 Single-Event Characterization of Xilinx UltraScale+ MPSOC under Standard and Ultra-High Energy Heavy-Ion Irradiation

M. Glorieux, A. Evans, T. Lange, A.-D. In, D. Alexandrescu, IROC Technologies; C. Boatella-Polo, C. Urbina-Ortega, V. Ferlet-Cavrois, ESTEC, ESA; R. Garcia Alia, M. Kastriotou, P. Fernández-Martínez, CERN

Heavy-Ion irradiation of a Xilinx Ultrascale+ MPSOC was performed to measure Single-Event-Latch-up and Single-Event-Upset Cross-Sections. Additionally, irradiation with a ultra high energy xenon beam shows similar upset sensitivity.

W-38 Xilinx UltraScale+ MPSoC Single-Event Upset Neutron Radiation Beam Results

J. D. Anderson, J. Leavitt, M. Wirthlin, Brigham Young University

The paper summarizes the SEU results obtained from neutron testing on the UltraScale+ ZU9EG MPSoC; specifically FPGA CRAM, scrubbing approaches, and processor SEU results for the OCM, caches, and software benchmarks.

W-39 Single-Event Evaluation of Xilinx 16nm UltraScale+TM Single Event Mitigation IP (SEM-IP)

P. Maillard, M. J. Hart, P. Chang, Y. P. Chen, M. Welter, R. Le, R. Ismail, J. Barton, E. Crabill, Xilinx, Inc.

The single-event response of Xilinx 16nm UltraScale+™ SEM IP and Stacked-Silicon-Interconnect (SSI) technology is characterized using a 64 MeV proton source. Single-event upset and multi-bit upset results are presented.

W-40 Test Methodology & Neutron Characterization of Xilinx 16nm Zynq® UltraScale+TM Multi-Processor System-on-Chip (MPSoC)

P. Maillard, J. Arver, C. Smith, O. B. Ballan, M. J. Hart, Y. P. Chen, Xilinx, Inc.

This paper presents a test methodology to characterize the single event response of Xilinx's 16nm Zynq Ultrascale+ ARM core processors using Xilinx System Validation Tool (SVT) design suite. Single-event results are presented.

W-41 Neutron and Proton Characterization of Microsemi 28 nm PolarFire SONOS-Based FPGA

N. Rezzak, J.-J. Wang, S. Varela, G. Bakker, A. N. Gu, Microsemi

The Single-Event response of Microsemi 28 nm PolarFire SONOS-based FPGA is characterized using neutron and 64 MeV proton sources. Single-Event Latchup, Single Event Upset and Single Event Functional Interrupt results are presented.

W-42 Total Dose and Single-Event Effects Testing of the Intersil ISL7059ISEH and ISL70592SEH Current Sources

W. H. Newman, N. W. van Vonno, B. Williams, A. Robinson, L. G. Pearce, O. Mansilla, S. D. Turner, E. J. Thomson, Intersil

We report the results of total ionizing dose (TID) and destructive and nondestructive single-event effects (SEE) testing of the Intersil ISL7059xSEH, 100µA and 1mA precision current sources.

W-43 Radiation Effects Characterization of an Arm®-Based 32-Bit Microcontroller

M. Von Thun, A. Wilson, B. Baranski, R. Anderson, A. Turnbull, Cobham Semiconductor Solutions

A highly flexible radiation-hardened UT32M0R500 Arm® Cortex® M0+ 32-bit microcontroller has been designed, manufactured, and characterized for radiation effects. The radiation effects results will be presented.

W-44 Test Results of Radiation Hardened iCoupler Products from Analog Devices

E. Xiao, D. Guy, B. Barfield, C. Cherry, K. Brown, T. Decker, Analog Devices Inc.

Heavy ion SEE test and TID test results of three radiation-hardened new generation digital isolators from Analog Devices Inc. are presented, including two standard digital isolators and an isolated error amplifier.

W-45 Heavy Ion Test Results of Different Analog to Digital Converters, Transceivers and Drivers

V. S. Anashin, A. E. Koziukov, S. A. Iakovlev, V. V. Lykov, T. S. Napolova, S. V. Kolpachkov, JSC URSC – ISDE; P. A. Chubunov, JSC URSC – ISDE and National Research Nuclear University (NRNU) Moscow Engineering Physics Institute (MEPhI)

The paper presents the single event effects test results for some of drivers, analog to digital converters and transceivers, which are candidate spacecraft electronics, obtained at Roscosmos Test Facilities during test campaigns in 2017.

W-46 Commercial off-the-Shelf MOSFETs SEE Test Results

V. S. Anashin, A. E. Koziukov, S. A. Iakovlev, T. A. Maksimenko, K. B. Bu-Khasan, JSC URSC – ISDE; P. A. Chubunov, JSC URSC – ISDE and National Research Nuclear University (NRNU) Moscow Engineering Physics Institute (MEPhI)

Short test results for 18 different commercial power metal-oxide-semiconductor field effect transistors (MOSFETs) obtained at Russian SEE Test Facilities during test campaign in 2017 are presented.

W-47 Characterization of Widely Used Bipolar Transistors in Wide Temperature Range Before and After Ionizing Radiation Impact

A. S. Bakerenkov, A. S. Rodin, V. A. Felitsyn, V. S. Pershenkov, N. S. Glukhov, V. V. Belyakov, National Research Nuclear University (NRNU) Moscow Engineering Physics Institute (MEPhI) ; A. E. Koziukov, JSC URSC – ISDE Institute of Space Device Engineering

The electrical characteristics of widely used bipolar transistors on temperature before and after ionizing radiation impact were investigated. The operation at low temperatures can be considered as the worst case for bipolar devices.

W-48 TID Response of AD590 Temperature Sensor in Wide Operation Temperature Range

A. S. Bakerenkov, V. A. Felitsyn, A. S. Rodin, V. S. Pershenkov, B. I. Podlepetsky, V. V. Belyakov, E. V. Petkovich, National Research Nuclear University (NRNU) Moscow Engineering Physics Institute (MEPhI); A. E. Koziukov, JSC URSC – ISDE Institute of Space Device Engineering

Total ionizing dose response of AD590 temperature sensor was investigated in wide operation temperature range. Obtained results can be useful for designers of electronic devices for nuclear and space applications.

W-49 TID Effects in One Time Programmable Read Only Memory at Different Dose Rates

A. S. Bakerenkov, S. B. Shmakov, V. A. Felitsyn, A. S. Rodin, A. G. Petrov, D. V. Boychenko, V. S. Pershenkov, V. A. Telets, National Research Nuclear University (NRNU) Moscow Engineering Physics Institute (MEPhI)

TID effects in 4 Mbit AT27 EPROM at different dose rates were investigated. The electrical characterization was performed at different power supply voltages to determine the correlation between a functional failure and corresponding parametric degradation.

W-50 Recent Test Results of Radiation Tolerant Products from Analog Devices

D. Chen, T. Decker, N. Wendell, J. Harris, C. Xiao, Analog Devices Inc.; S. Rezgui, Previously with Linear Technology Corp.; S. Hart, Bastion Technologies Inc.; B. Horton, P. Musil, Anaren Inc.

We present total-ionizing dose and single-event effect test results of the latest radiation tolerant products from Analog Devices. Featured products include analog-to-digital converters, a broadband detector, and a step-down regulator.

W-51 Characterization of the Effects of Proton-Induced Total Ionizing Dose and Displacement Damage on the UC1708 Power Driver

S. Messenger, M. Mishler, J. Hack, P. Dudek, Northrop Grumman Mission Systems

This paper explores combined effects of total ionizing dose and displacement damage caused by 250 MeV protons on the Texas Instruments UC1708 Power Driver. Fluences up to 10^{12} protons/cm^2 were used for this test.

W-52 Low-Dose-Rate Cobalt-60 Testing Results for Kaman KD-5100 Differential Inductive Position Measuring Systems

B. H. McGuyer, S. Moro, Facebook Inc.; R. J. Milanowski, Milanowski & Assoc., Inc.

We report Co-60 gamma radiation testing of a Kaman KD-5100 position-measuring system to a total ionizing dose of 10 krad(Si) at a rate of 5 mrad(Si)/s.

W-53 Measurement of Thermal Neutron Environments in Aircraft with the TinMan Instrument

S. Wender, S. Nowicki, A. Couture, S. Mosby, N. Dallmann, K. McKeown, A. Warniment, D. Seitz, J. Lake, LANL; L. Dominik, Honeywell, Inc.

A neutron detector was developed to measure the thermal neutron environment in airplanes at flight altitudes. Results from the NASA ER-2, the NASA Gulfstream-III and the NASA DC-8 aircraft flights are presented.

W-54 Summary and Analysis of Neutron Displacement Damage Test Results
T. R. Oldham, C. Whitney, G. Ben, Ball Aerospace

A summary of displacement damage sensitivity for bipolar components is presented. For discrete bipolar transistors, sensitivity to DDD correlates with f_t. For more complex circuits, a summary of existing test data is presented.

W-55 Single-Event Characterization of 16 nm FinFET Xilinx UltraScale+ Devices with Heavy Ion and Neutron Irradiation
D. S. Lee, M. P. King, W. L. Evans, W. Rice, SNL; M. Cannon, A. Perez-Celis, J. Anderson, M. Wirthlin, Brigham Young University

This study examines the single-event response of Xilinx 16nm FinFET UltraScale+ device families. Heavy-ion latch-up, upsets in configuration SRAM, BlockRAM, and flip-flops, and neutron single-event latch-up results are provided.

W-56 Radiation Evaluation of the TMP461-SP Radiation Hardened Remote and Local Digital Temperature Sensor
R. Gooty, V. Narayanan, J. Cruz - Colon, R. Baumann, S. R. Viswanath, K. Kruckmeyer, Texas Instruments Inc.

Single Events Effect (SEE) characterization results for TMP461-SP Remote and Local Digital Temperature Sensor is summarized, showing SEL free up to LET_{eff} = 76 MeV-cm^2/mg and have very low cross section for SET.

W-57 Total Ionizing Dose Characterization of a Custom Front-End SoC for Antenna Arrays in 32nm SOI CMOS
A. Zanchi, M. Cabanas-Holmen, A. Amort, R. Brees, The Boeing Company

A full-custom SoC for signal digitization of 16-channel antenna arrays fabricated in 32nm SOI CMOS, including 3-bit 32GSps ADCs/2GSps DSP cores, showed no performance degradation after exposure to 1Mrad(Si) TID.

W-58 TID Testing of Microsemi Integrated Motor Controller LX7720
M. Sureau, R. Stevens, M. Leuenberger, N. Rezzak, D. Johnson, Microsemi

The TID testing results of the Microsemi radiation hardened analog mixed-signal motor controller IC, the LX7720, are presented.

W-59 Radiation Evaluation of the HVD233-SP CAN Bus Transceiver
J. Cruz-Colon, V. Narayanan, W. Vonbergen, R. Roybal, R. Baumann, Texas Instruments

Single Events Effect (SEE) characterization results for HVD233-SP CAN Transceiver is summarized, showing very robust SEE performance up to LET_{eff}=92 MeV-cm^2/mg.

W-60 Radiation Effects Characterization of TI LMT01-SP High Accuracy 2-Pin Temperature Sensor
V. Narayanan, R. Gooty, J. Cruz-Colon, K. Kruckmeyer, Texas Instruments

LMT01-SP is an accurate two pin Temp Sensor released for space applications. This device passed TID testing to 100 krad and was observed to be latchup immune up to 86 MeV-cm^2/mg.

W-61 **Hot-Carrier Effect on TID Irradiated Short-Channel 22nm FD-SOI N-MOSFETs**

J. Cui, Q. Zheng, Y. Wei, X. Yu, W. Lu, C. He, D. Ren, Q. Guo, Chinese Academy of Sciences; B. Ning, Fudan Microelectronics Group

The influence of total TID on hot-carrier effect of short channel FD-SOI n-MOSFETs is investigated. Experimental results show larger parameters degradation for irradiated devices due to irradiation generated defects in box layer.

4:30 PM END OF THURSDAY SESSIONS

4:30 - 6:30 PM
HILTON WAIKOLOA
MONARCHY BALLROOM

RADIATION EFFECTS COMMITTEE ANNUAL OPEN MEETING

Technical Program Friday

MONARCHY GRAND BALLROOM
INVITED TALK
8:15 - 9:25 AM

Searching for the Building Blocks of Life in Planet-Forming Regions around New Stars
Dr. Greg Doppmann, W.M.Keck Observatory

One of the biggest questions that faces humanity is whether life exists elsewhere in the galaxy. Now with over 3000 extra-solar planets confirmed, our chances of finding new worlds that could sustain life is a real possibility. Water and organic compounds are critical sign posts for life as we know it, and if such pre-biotic molecules prove to be ubiquitous in proto-planetary environments, then the potential for life could be great. By utilizing the large collecting area of the Keck II telescope and its world-renown facility spectrograph, NIRSPEC, Greg characterizes the composition and dynamics of nearby planet-forming disks using spectroscopy. In his talk, he will explain the spectroscopic techniques he uses to detect and quantify water vapor and organic compounds, as well as differentiate the gas and dust components in the disks of objects residing outside our solar system. Greg will put his results in the context of other work going on in the field today and the implications for the future development of life from these primordial extra-solar systems.

Dr. Greg Doppmann is a Support Astronomer at the W.M. Keck Observatory, which operates two 10-meter optical/infrared telescopes located at the summit of Maunakea on the Big Island of Hawaii. After receiving his Ph.D. in Astronomy from the University of Texas at Austin in 2002, Greg spent 2 years as a National Research Fellow at NASA's Ames Research Center in the Bay Area. In 2004, he moved down to Chile to join the scientific staff at the Gemini Observatory. Returning to the US in 2007, Greg worked at the National Optical Astronomy Observatory until finally settling in Hawaii in 2011. Throughout his career, Greg's research has been focused the formation of stars and planets, where he specializes in high-resolution infrared spectroscopy of protostars and proto-planetary disks that surround them.

MONARCHY BALLROOM
SESSION I
9:25 AM

BASIC MECHANISMS OF RADIATION EFFECTS
SESSION INTRODUCTION
Chair: Cory Cress, Naval Research Laboratory

I-1
9:30 AM

Dopant-Type and -Concentration Dependence of Total-Ionizing-Dose Response in Piezoresistive Micromachined Cantilevers
C. N. Arutt, M. L. Alles, J. L. Davidson, D. M. Fleetwood, R. D. Schrimpf, Vanderbilt University; P. D. Shuvra, J.-T. Lin, B. W. Alphenaar, K. M. Walsh, S. McNamara, University of Louisville

Total-ionizing-dose-induced resonance frequency shifts in piezoresistive, micromachined cantilevers depend on dopant type and concentration, as well as dose-rate. Mechanisms connecting frequency and resistivity shifts to carrier concentration changes are discussed.

I-2 9:45 AM

A Multi-Field and Frequency Electrically Detected Magnetic Resonance Study of Atomic Scale Defects in Gamma Irradiated Modern MOS Integrated Circuitry

P. M. Lenahan, R. J. Waskiewicz, K. J. Myers, Pennsylvania State University; C. D. Young, University of Texas at Dallas

We utilize electrically detected magnetic resonance to explore radiation damage on an atomic scale in components of present day integrated circuitry. The components include FinFETs and low dielectric constant SiOC:H interlayer dielectrics.

I-3 10:00 AM

Effect of Pulse Length and Flux on the Defects and Gain Degradation in Pnp Si BJTs Irradiated with Helium Ions

B. A. Aguirre, G. Vizkelethy, B. Vaandrager, W. J. Martin, E. Bielejec, Sandia National Laboratories; P. Seidl, A. Persaud, Q. Ji, B. Ludewigt, T. Schenkel, Lawrence Berkeley National Laboratory

We explore defects in the base-emitter junction of pnp Si BJTs under high flux irradiations. We found this produced localized annealing resulting in a higher number of VO defects and more effective recombination centers.

10:15 - 10:40 AM GRAND PROMENADE — BREAK

I-4 10:40 AM

Radiation Induced Defects in InAs/InAsSb Type-II Superlattices Characterized with Time-Resolved Microwave Reflectance and Density Functional Theory

P. A. Schultz, C. N. Kadlec, E. Bielejec, M. D. Goldflam, J. K. Kim, J. E. Moussa, E. A. Shaner, Sandia National Laboratories

Displacement damage in proton-irradiated InAs/InAsSb superlattices is characterized through in situ time-resolved microwave reflectance, annealing and defect energies investigated through temperature-dependence and density functional theory, to provide chemical identification of defects.

I-5 10:55 AM

Effects of Proton Radiation-Induced Defects on Optoelectronic Properties of MoS_2

A. W. Bushmaker, B. Foran, M. Peterson, C. Mann, The Aerospace Corporation; B. Wang, J. Chen, S. Yang, S. B. Cronin, The University of Southern California

We report on photoluminescence spectroscopy and transmission electron microscope imaging of the 2D semiconductor MoS_2 before and after exposure to 100 keV proton radiation. The resulting changes cause by radiation damage are discussed.

POSTER PAPERS

PI-1

Electron and Proton Radiation Effects on Carrier Dynamics in MBE and MOCVD Grown Photovoltaic Test Structures

A. I. Hudson, A. C. Scofield, W. T. Lotshaw, The Aerospace Corporation; S. Hubbard, M. Slocum, Rochester Institute of Technology; B. Liang, M. C. Debnath, B.-C. Juang, D. L. Huffaker, University of California, Los Angeles

p and n-type GaAs heterostructures were exposed to electron and proton radiation. Protons generated trap states. The damage and non-radiative coefficients suggest that n-type specimens are more radiation hard than p-type.

PI-2 **Numerical and Experimental Investigation of TID Radiation Effects on the Breakdown Voltage of 400V SOI NLDMOS**
L. Shu, Y.-F. Zhao, Harbin institute of Technology

The breakdown voltage variations of 400V SOI NLDMOS after exposure to total dose radiation under different experimental bias conditions are discovered. The mechanisms of these variations are analyzed and confirmed by TCAD simulations.

PI-3 **Dissociation Energies of the Divacancy with Various Charged States: First Principle Calculation**
Y. Wei, X. Li, C. Liu, S. Dong, Y. Liu, G. Lv, J. Zhao, Harbin Institute of Technology

The revised screened hybrid functional is used to investigate formation energy and dissociation energies of the divacancy with various charged states. This helps to analyze the effect of electric field on irradiation damage..

PI-4 **Radiation Response of MoS_2-Interlayer-MoS_2 Tunnel Junctions**
P. Wang, A. O'Hara, H. Gong, P. F. Wang, E. X. Zhang, D. M. Fleetwood, R. D. Schrimpf, S. T. Pantelides, Vanderbilt University; C. J. Perini, E. M. Vogel, Georgia Institute of Technology

We have evaluated the nature of the conduction and the radiation response of 2D MoS_2-based tunnel junctions. Devices with HfO_2 interlayer dielectrics show great promise for use in radiation-tolerant, ultimately-scaled tunnel FETs.

MONARCHY BALLROOM

SESSION J **SINGLE-EVENT EFFECTS: MECHANISMS AND MODELING**

11:10 AM SESSION INTRODUCTION
Chair: Frederick Wrobel, Universite Montpellier

J-1 **Mechanisms of Electron-Induced Single Event Latchup**
11:15 AM *M. Tali, University of Jyvaskyla, CERN, and ESA/ESTECR. Garcia Alia, M. Brugger, R. Corsini, W. Farabolini, CERN; V. Ferlet-Cavrois, G. Santin, C. Boatella Polo, ESA/ESTEC; A. Javanainen, A. Virtanen, University of Jyvaskyla*

We discuss possible mechanisms by which electrons can induce Single Event Latchups in electronics and effect of presence of high-Z materials on this phenomenon. First experimental results are shown and future work is discussed.

J-2 **Understanding the Average Electron-Hole Pair Creation Energy in**
11:30 AM **Silicon and Germanium from Full-Band Monte Carlo Simulations**
J. Fang, R. D. Schrimpf, R. A. Reed, R. A. Weller, S. T. Pantelides, Vanderbilt University; S. L. Weeden-Wright, Lipscomb University; M. V. Fischetti, The University of Texas at Dallas

The average electron-hole pair creation energies in silicon and germanium are examined by simulating carrier thermalization with full-band Monte Carlo techniques. Physical processes leading to these energies are identified.

J-3 11:45 AM
A Bias-Dependent Single-Event-Enabled Compact Model for Bulk FinFET Technologies
J. S. Kauppila, D. R. Ball, J. A. Maharrey, R. C. Harrington, T. D. Haeffner, A. L. Sternberg, M. L. Alles, L. W. Massengill, Vanderbilt University

A single-event-enabled compact model for bulk FinFET technologies has been developed, incorporating bias dependence and geometry awareness. The compact model has been validated with heavy ion data over angle of incidence and bias.

J-4 12:00 PM
SEFI Modeling in Readout Integrated Circuit Induced by Heavy Ions at Cryogenic Temperatures
L. Artola, G. Hubert, ONERA; S. Ducret, F. Advent, Sofradir; J. Mekki, CNES

This work presents a modeling approach of SEFI from the radiation particle down to the event in a ROIC. Simulation and experimental results of cross sections for heavy ions are presented and discussed.

J-5 12:15 PM
Ultra-Energetic Heavy Ion Beams in the CERN Accelerator Complex for Radiation Effects Testing
R. Garcia Alia, P. Fernández Martínez, M. Kastriotou, M. Brugger, M. Cecchetto, F. Cerutti, N. Charitonidis, S. Danzeca, L. Gatignon, A. Gerbershagen, S. Gilardoni, J. Bernhard, N. Kerboube, M. Tali, V. Wyrwoll, CERN; V. Ferlet-Cavrois, C. Boatella, H. Evans, G. Furano, ESA; R. Gaillard, Consultant

UltraEnergetic heavy ion beams at CERN are evaluated through simulations and experimental data as a means of qualifying components against SEE, focusing on the impact of the energy on the ionization profile and nuclear reactions

POSTER PAPERS

PJ-1
Impact of the Elemental Makeup of an IC in Generating Single-Event Upsets from Low Energy (<10 MeV) Neutrons: a 3D NAND Flash Case Study
P. M. Conway, M. J. Gadlage, D. I. Bruce, J. D. Ingalls, A. M. Williams, D. P. Bossev, NSWC Crane

The role various elements found in an integrated circuit have in producing single-event upsets from low-energy neutrons is discussed. Neutron data on a modern 3D NAND flash is used as a case study.

PJ-2
Multi-Scale Simulation of Single Particle Displacement Damage in Silicon Device
C. He, D. Tang, Z. Zang, Y. Li, Xian Jiaotong University

A theoretical method combining with molecular dynamics simulation and kinetic Monte Carlo simulation is proposed to investigate the formation and evolution of single particle displacement damage in silicon device.

PJ-3
Heavy Ion Transport in SiC-Based Power Devices
J. A. McPherson, P. J. Kowal, G. K. Pandey, T.-S. P. Chow, W. Ji, Rensselaer Polytechnic Institute; A. A. Woodworth, NASA GRC

Study of heavy ion transport in SiC-based power devices. Energy deposition and charge generation are analyzed. Radiation data with improved fidelity is utilized in a unified physics model between radiation transport and device response.

PJ-4 **Heavy Ion Induced Single Event Burn-Out (SEB) in SiC Schottky Diodes**
G. K. Pandey, J. A. McPherson, P. J. Kowal, W. Ji, T.-S. P. Chow, Rensselaer Polytechnic Institute; A. A. Woodworth, NASA GRC

We perform 3D TCAD modeling for Single Event Burnout due to heavy ion strike on 1200V 4H-SiC SBD and JBS diode. We propose addition of a field reduction layer and evaluate the improved robustness.

12:30 PM END OF CONFERENCE

RESG NEWS

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 January issue of the IEEE Transactions on Nuclear Science in the year following the conference, subject to an additional review.

Janet Barth
Executive Vice-Chair

A data workshop is also held each year at the NSREC. The REC oversees publication of a special Data Workshop issue of papers presented at the conference. The Data Workshop is published in the fall of the year that the conference is held.

NSREC 2018 will be held in Kona, Hawaii, July 16-20, 2018 at the Hilton Waikoloa. Ronald Lacoe of The Aerospace Corporation, is the Conference Chair.

Supporters of the 2018 NSREC include Boeing; Cobham Semiconductor Solutions; Freebird Semiconductor; IR HiRel, An Infineon Technologies Company; Jet Propulsion Laboratory; Renesas Electronics; Southwest Research Institute and The Aerospace Corporation. 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 2019 will be held in San Antonio, July 8-12, 2019 at the Marriott Rivercenter. John Stone, SWRI, is Chair. Hugh Barnaby, Arizona State University, is the 2020 NSREC Chair and has selected Santa Fe, New Mexico as the conference site. Steve McClure, JPL, is the 2021 Chair; site selection for the 2021 conference is in progress.

Papers presented at the 2018 NSREC are eligible for publication in the January 2019 issue of the *IEEE Transactions on Nuclear Science*. Authors must upload their papers prior to the conference for consideration for publication in the January 2019 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.

RESG NEWS

IEEE FELLOWS

A distinguished member of the international radiation effects community was elevated to the grade of IEEE Fellow on January 1, 2018.

Philippe Paillet, CEA, "for contributions to the understanding of radiation effects in electronics".

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 2019), 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 13, 2018). 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 seven 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 2018 NSREC are:

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

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

Heather Quinn, Los Alamos National Laboratory
Email: hquinn@lanl.gov

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Email: philippe.paillet@cea.fr

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, published in January of the year following the conference, is the official archive of research papers presented at NSREC. Papers presented at the conference undergo an additional review before they are accepted for the January issue.

- ***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 *2018 IEEE Radiation Effects Data Workshop Record* and the January 2019 special NSREC issue of the *IEEE Transactions on Nuclear Science* will be mailed to each NSREC technical session attendee. A CD or USB flash drive containing the *NSREC Short Course Notes (2018),* as well as all previous short courses back to 1980, will be given to short course attendees.

RADIATION EFFECTS COMMITTEE ANNUAL OPEN MEETING

THURSDAY, JULY 19
4:30 – 6:30 PM
HILTON WAIKOLOA
MONARCHY BALLROOM

You are invited to attend the IEEE Radiation Effects Committee's Annual Open Meeting on Thursday, July 19 from 4:30-6:30pm, in the Grand Ballroom. All conference attendees and registered guests are encouraged to attend. We will introduce the new Chair, Vice-Chair, and Secretary of the Radiation Effects Steering Group, who were elected by IEEE NPSS members in the spring. Candidates for the election were selected by a committee that was elected during the open meeting of the 2017 conference. The new committee members will serve three-year terms, and will begin their terms by running the 2018 open meeting.

During the meeting we will discuss the 2018 conference and future IEEE Nuclear and Space Radiation Effects Conferences. There will also 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

2017 OUTSTANDING CONFERENCE PAPER AWARD
(Two Papers Received the Award in 2017)

Effects of Heavy- Ion Irradiation in Vertical 3-D NAND Flash Memories
Marta Bagatin, Simone Gerardin, Alessandro Paccagnella, Silvia Beltrami, Emilio Camerlenghi, Massimo Bertuccio, Alessandra Costantino, Ali Zadeh, Véronique Ferlet-Cavrois, Giovanni Santin, and Eamonn Daly

Influence of LDD Spacers and H+ Transport on the Total-Ionizing-Dose-Response of 65-nm MOSFETs Irradiated to Ultrahigh Doses
Federico Faccio, Giulio Borghello, Edoardo Lerario, Dan Fleetwood, Ron Schrimpf, Huiqi Gong, Enxia Zhang, Pan Wang, Stefano Michelis, Simone Gerardin, Alessandro Paccagnella, and Stefano Bonaldo

2017 OUTSTANDING STUDENT PAPER AWARD

Total Ionizing Dose Radiation Induced Dark Current Random Telegraph Signal in Pinned Photodiode CMOS Image Sensors
C. Durnez, V. Goiffon, C. Virmontois, S. Rizzolo, A. Le Roch, P. Magnan, P. Paillet, C. Macandello, and L. Rubaldo

2017 OUTSTANDING DATA WORKSHOP PRESENTATION AWARD

2017 Compendium of Recent Test 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, and S. M. Guertin

2017 RADIATION EFFECTS AWARD

Ronald L. Pease, RLP Associates, received the 2017 IEEE/NPSS Radiation Effects Award. His citation was "for contributions to testing, analysis, and modeling of radiation effects on semiconductor devices and circuits and to the understanding of the underlying physics and engineering".

2018 RADIATION EFFECTS AWARD

The winner of the 2018 Radiation Effects Award will be announced Tuesday morning, July 17. 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.

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 Ethan Cannon, Member-at-Large for the Radiation Effects Steering Group. Ethan can be contacted at: The Boeing Company, PO Box 3707, MC 42-57, Seattle, WA 98124; 253-657-5104 or ***ethan.cannon@boeing.com***

Conference Information

CONFERENCE LOCATION

Photo courtesy of Keith Avery

Hawai'i is the largest island in the Hawaiian Island chain. It earned the moniker of "the Big Island" since it is literally twice as large as all the other Hawaiian Islands combined. With diverse terrain and climates, there is an endless array of unique natural wonders, including the world's largest active volcano, Mauna Loa. Yet another volcano, Kilauea, is one of the world's most active volcanos with its slow eruptions adding girth to the "Big Island" making it even bigger. Fissures, steam, slowly moving lava . . . it's a site to see!

Volcanos are not the only scenic attractions on this island. The 13,796-foot height of Maunakea (an extinct volcano) and its location in the middle of the Pacific, allow for some of the best viewing conditions of space from the numerous high-powered research telescopes on this summit. Rainforests, waterfalls, snow-capped mountain peaks, hilly pasture land, lava fields, golf courses and tropical beaches with multiple colors of sand are also found on this island. The fascination doesn't stop on the land. In the surrounding ocean, you can explore the sea and enjoy a myriad of water activities including snorkeling, scuba diving, sailing, windsurfing, kayaking, deep-sea fishing, boating, dolphin-watching and swimming.

The host hotel for the week is the beautiful Hilton Waikoloa Village, located on the northwest side of the island. In 62-acres of lush vegetation, the property boasts a 4-acre lagoon, sandy beach, three swimming pools, tennis courts, golf courses, full-service spa and watersports galore. Boats on a meandering canal throughout the property take guests from building to building. You can also take the tram or walk the covered walkways connecting the buildings to enjoy the phenomenal artwork displayed along the route. There is something beautiful and unique to see at every turn!

BREAKFASTS, LUNCH AND BREAKS

The 2018 IEEE NSREC will provide breakfasts and refreshments at breaks during the NSREC Short Course and Technical Sessions. For those attendees at the Short Course on Monday, a lunch will be provided. Additionally, a lunch will be sponsored by the Industrial Exhibit companies on Wednesday. These meals and refreshments are for *registered conference attendees only.* Please see the schedule for times and locations.

BUSINESS CENTER

The Hilton has contracted The UPS Store to operate a full-service business center that can handle faxing, photocopying, computer printer access, laminating, graphic design, notary service and shipping/ receiving. They are open Monday through Friday from 8:00am-6:00pm and Saturday/Sunday from 8:00am-4:00pm. Guests can have 24-hour access for internet, computer printing and photocopying. Costs associated with the UPS Store may be paid by credit card or cash (preferred) or put on your room account (only during office hours).

Conference Information

ROOMS FOR SIDE MEETINGS

Limited meeting rooms are available for use by any registered conference attendee at the Hilton 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 the Kona 1 Room in the Convention Center of the hotel.

Notes: ***You must register for the conference before a side meeting room can be reserved!*** All 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 2018 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 2018. 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 (August 6, 2018). 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 1, 2018. Applicants will be notified whether they qualify for these funds within two weeks after the deadline. Due to limited funding, it is likely that not all qualified applicants will be eligible for reimbursement. The application form is available on the website for the 2018 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 15. 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 with payment does not arrive at ETCic by Friday, July 6, then it would be best to hand-carry the payment to the conference for on-site registration. Telephone registrations 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

All conference registration will take place in the Convention Center of the Hilton.

If you have *not yet registered,* go to **"On-Site Registration"** in the Kona 1 Room.
If you have *already registered,* go to **"Pre-Registration"** in the ballroom foyer (Grand Promenade) to pick up your prepared packets.

ON-SITE REGISTRATION HOURS

Sunday, July 15	**5:00 PM – 8:00 PM**
Monday, July 16	**7:30 AM – 5:00 PM**
Tuesday, July 17	**7:30 AM – 5:00 PM**
Wednesday, July 18	**7:30 AM – 3:00 PM**
Thursday, July 19	**7:30 AM – 3:00 PM**
Friday, July 20	**7:30 AM – 10:00 AM**

CONFERENCE CANCELLATION POLICY

A $50 processing fee will be withheld from all conference refunds. Due to advance financial commitments, refunds of registration fees requested after June 15, 2018, 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

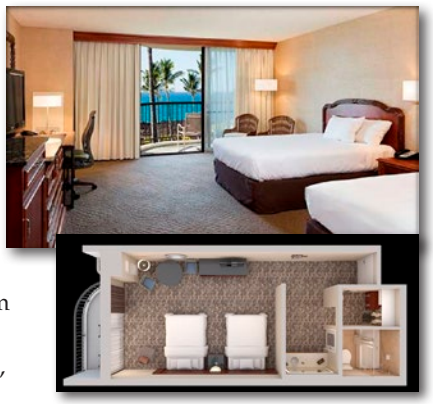
HILTON WAIKOLOA VILLAGE

69-425 WAIKOLOA BEACH DRIVE

WAIKOLOA, HI 96738

TEL: 808-886-1234

The host hotel for the 2018 IEEE NSREC is the Hilton Waikoloa Village, located in the resort community of Waikoloa on the northwest side of the island. This multiple-tower facility sprawls over 62 acres, at part, high above the ocean and at other sections, at sea level. Hilton Waikoloa facilities include multiple restaurants and lounges, a full-service spa, 24-hour health club, concierge, business center, room service, lobby ATM, parking lot, three swimming pools, a lagoon area, containing a waterfall, and populated with sea life including sea turtles and beautiful species of fish, tennis courts, two golf courses, an inter-active dolphin encounter, some specialty shops and numerous seasonal resort activities.



The 1,241 guest rooms and suites are housed in three low-rise buildings, each with its own distinct décor and atmosphere. All rooms are non-smoking and feature large windows with dramatic views, individual climate control, flat-screen TV with video-on-demand & cable, high-speed internet at a fee (see the Resort Services Fee detail), work desk, coffee maker, mini-refrigerator, safe, alarm clock with MP3 connection, hairdryer, iron & ironing board, multiple phones with voice mail, one-king or two-double plush beds, and room service. All rooms have a small lanai (patio or balcony.)

The room rates are available based on the VIEW from the room. "Resort view" would feature golf, garden or mountain views. "Ocean View" or "Partial Ocean View" would offer a partial view of the ocean. "Ocean View" will provide either a partial view or a more direct view of the ocean, depending on the tower.

There are TWO TOWERS in which NSREC guests will be accommodated. The rooms designated "Hilton Waikoloa Village" on the reservation website will be in the Palace Tower (closest to the Convention Center, very nice guest rooms, decent views). In this tower you'll find only "Resort View" and "Ocean View". NOTE: "Ocean View" in the Tower Palace really means "Partial Ocean View."

The rooms designated "Ocean Tower in Waikoloa Village" on the reservation website will be in the "Ocean Tower." These rooms are a bit farther from the Convention center but the rooms could be slightly larger. This tower also features its own swimming pool and great views from most rooms. In this tower, the room type options are Resort View, Partial Ocean View and Ocean View (the most direct view of the ocean). NOTE: "Ocean View" in the Ocean Tower means a "Direct View" of the ocean. Limited construction will be underway on the most "inland" ring of the building (this area is closed off to minimize disturbances) but NSREC guest rooms should be well-buffered from possible disturbances.

Guest room rates for a standard king or double-double are as follows:

NEGOTIATED GROUP RATE:
$219.00 single/double per night for a "Resort View"
$229.00 single/double per night for a "Partial Ocean View"
$249.00 single/double per night for a "Ocean View"

GOVERNMENT PER DIEM:
$189.00 single/double* per night

Registration and Travel

*To be eligible for the government rate, guests must provide current government or military ID. Contractors who request the government per diem must have a letter specifying that they are traveling on a government contract and they must have an employee ID from their company.

Room taxes of 14.416% will be added to all rates listed above. There is no additional charge for children 18 years of age and under when sharing a room with an adult and utilizing existing beds. A charge of $20.00 + tax per night will be added for each third and fourth adult in the room (19 years of age and older.)

Based on availability, the conference room rates will be offered 5 days before and 5 days after the conference.

RESORT SERVICES FEE

The Hilton Waikoloa Village normally has a mandatory Resort Services Fee that is currently at the rate of $35 per night. For guests who book within the NSREC block, however, there are alternative options.

a) Choose the Resort Services Fee @ the discounted rate of $25 per night. This would include the following: WiFi access in guest rooms and designated areas of the resort; hula, lei making & ukulele lesson; unlimited PS3 movies/games; 20% off Lagoon toy rental; Kids scavenger hunt, 4x8 keepsake photo (one per stay); daily fitness/yoga class; bird talk; pool toy inflation; local/toll-free calls
OR
b) Choose "a la carte" services as follows: High-speed internet access @$5 per night, Hula lessons @ $10 each, Lei making lessons @ $10 each, Ukulele lessons @ $10 each, Play Station 3 with unlimited movies/games @ $12 per night

PLEASE NOTE THE FOLLOWING: In a perfect world, the Hilton reservations website would supply the exact information pertinent to the NSREC-Hilton agreement. Unfortunately, the Hilton is limited in customizing their website in all areas, resulting in some contradictory statements. For example, the Resort Services Fee defined above is either optional to NSREC hotel guests OR those services are available on an a la carte basis. In additon, NSREC hotel guest are eligible for 50% off all parking fees. Nonetheless, there are places on the Hilton reservation website that indicate that a full resort fee is required and parking is at the full price. This is incorrect and should be ignored. We are sorry if this causes any confusion.

HOTEL RESERVATIONS

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

http://www.hilton.com/en/hi/groups/personalized/KOATWHH-NSRE-20180712/index.jhtml

This takes you to the page for the negotiated group rate. However, IF you are eligible for the government rate, then click on the red: *Click here for Government Rates.*

When you are on the appropriate page for your rate type (group or government), then you can choose your preference of Tower (page 49-50).

Go to the bottom half of the page and click on *"Book a Room"* next to either the *Hilton Waikoloa Village box* (Palace Tower) or *Ocean Tower in Waikoloa Village* (Ocean Tower). Then simply follow the prompts.

Registration and Travel

Reservations can also be made by calling Hilton Reservations toll-free at 1-800-HILTONS (1-800-445-8667) within the U.S. or Canada. To get the special rates, advise the agent of the following group name: ***NSRE*** for the negotiated group rate or ***NSRG*** for the government rate.

All reservations require a credit card guarantee to hold the room. The cut-off for IEEE NSREC reservations is at 5:00 PM Hawaiian Aleutian Standard Time (HAST) on **June 15, 2018**. Once the room block has been filled OR after the cut-off date (whichever comes first!), room accommodations will be confirmed on a space and rate available basis. Early reservations are strongly suggested!

Please be certain to notify the hotel of any change to your arrival or departure dates. When you check into the hotel, be sure to verify your departure date. **Any cancellation must be made by no later than 7 days prior to your scheduled arrival.** If the cancellation is made by that time, then no penalty will be charged.

AIRPORT AND TRANSPORTATION INFORMATION

The Ellison Onizuka Kona International Airport (code: KOA) is located about 19.5 miles from the Hilton Waikoloa Village. The route is simple and the traffic is normally mild. Taxis to the Hilton are based on time, distance, number of passengers and amount of luggage. They can cost anywhere between $50.00 - $72.00 one way.

Airport Shuttle:
There is no "scheduled" shuttle service from the Kona International Airport directly to the Hilton, nor does the hotel offer an airport shuttle service. Other options are:

1) Speedi Shuttle offers shared and private transfer service from the airport to the Hilton. The rate is dependent on the number of people in the vehicle and the time of your arrival/departure. Advance reservations are highly suggested!

   Speedi Shuttle airport hours: 24 hours a day / 7 day a week
   Tollfree: 1-877-242-5777
   E-mail: hwv@spedishuttle.com
   Website: ***www.spedishuttle.com***

2) 2) Uber is NEW to the Big Island but they DO now offer service. It's worth checking them out so be sure to load the appropriate app into your cell phone.

   Uber website: ***https://www.uber.com/cities/hawaii***

Registration and Travel

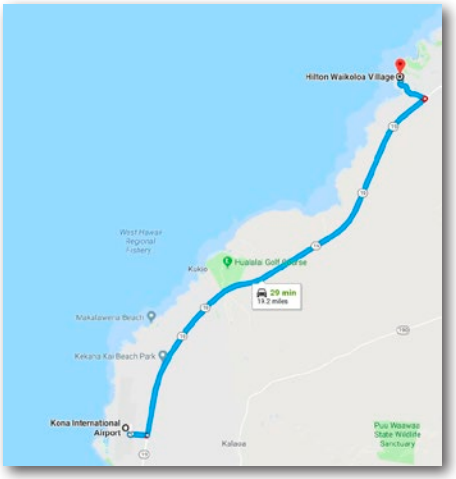
Car Rental:
This is one place where a car rental makes sense!! There is so much to explore on the island that you may want to consider the cost of car rental versus the cost of airport transfers plus any additional transportation you might need during the week. All the major car rental companies are located at the Kona International Airport but additionally, National Car Rental has a station at the Hilton Waikoloa Village. This is particularly helpful if you need a vehicle for only a portion of the week.

Avis Rent-A-Car:	***www.avis.com***
Budget Car Rental:	***www.budget.com***
Dollar Car Rental:	***www.dollar.com***
Enterprise:	***www.enterprise.com***
Hertz Rent a Car:	***www.hertz.com***
National Car Rental:	***www.nationalcar.com***
Thrifty Rent A Car:	***www.thrifty.com***

DRIVING DIRECTIONS

If you choose to rent a car and drive from the Kona Airport to the Hilton, use the following directions.

- Exiting the airport, turn left (north) onto Highway 19 for approximately 20 minutes.
- Turn left (west) onto Waikoloa Beach Drive.
- Along Waikoloa Beach Drive, you will pass five stop signs
- Just after the fifth stop sign, you will see the entrance to the Hilton Waikoloa Village on the left.



PARKING

If you make your Hilton room reservation within the NSREC room block, the hotel contract allows for a 50% discount off the daily valet and self-parking rates in effect at the time of your stay. Currently, the Hilton's daily valet parking is at $37 per night with in/out privileges and the self-parking rate is $27 per day with in/out privileges. You must register your car at the front desk during check-in to get the 50% discount.

GETTING AROUND THE ISLAND

Public transportation on the Big Island is geared towards moving workers to/from their homes or work place, so service is very limited and the times are not geared towards sightseeing. However, there are some other options. As mentioned in the Airport Shuttle section, you can certainly rely on Lyft and Uber for point to point transfers. For sightseeing, however, tours or car rentals are recommended.

SIGHTSEEING TRANSPORTATION

In addition to the private tours that the NSREC offers for attendee companions, Hilton Grand Vacations offers some tours that depart from the hotel. See the following website for more information: ***https://www.hwvtoursandactivities.com***

Registration and Travel

WAIKOLOA RESORT AREA

From the Hilton Waikoloa Village lower lobby, a scheduled shuttle operates (at a fee) to the Kings' Shops, Queens' Market Place, and Waikoloa Beach Marriott. This is normally a continuous shuttle from 10:00am – 10:00pm.

Rates are: Teens & Adults (13+): $2.00 one way
Children 5-12: $1.00 one way
Children under 4 are FREE

Additionally, the Hilton Waikoloa offers two complimentary shuttles to registered guests. First, they offer a beach shuttle to nearby Anaehoomalu Bay, available on-demand at the main drive Valet desk. To return, simply call the hotel for pickup, or ask the Ocean Sports beach desk at Anaehoomalu Bay to call for a pickup.

Second, they offer a golf shuttle to the Kings and Beach golf courses that departs from the lower lobby, on demand. Again, check with the Hilton for more details.

BICYCLES & WALKING

Some restaurants, shopping centers, and attractions are within walking distance of the Hilton. For the most part, sidewalks and walking paths are easily maneuvered. But if you want to cover some territory a bit faster, then simply rent a bike to get around.

On the Hilton grounds, you'll find a Spinway Grab and Go Bicycle Rental station. Simply enter a credit card, choose the duration of your rental and then you're off!!

Or maybe a scooter or motorcycle would be more to your liking? Check out the Big Island Motorcycle Company rentals at the Waikoloa Beach Resort (near the Hilton).
Website: ***http://www.waikoloavacationrentals.com/big-island-info/waikoloabeachresort/waikoloa-bike-scooter-rentals/***

However, if you're into the "better bikes", then venture over to Bike Works Beach and Sports, which is located within the resort village near the Queens Market Place.
Website: ***http://www.bikeworkshawaii.com***

Industrial Exhibits

Tony Amort
Industrial Exhibits Chair

The **2018 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 **2018 NSREC Industrial Exhibits** will be in the Kohala Ballroom of the Hilton Waikoloa Village on Tuesday and Wednesday. Breakfast and conference breaks will be hosted in the Exhibit Area on Tuesday and Wednesday for registered attendees only, with an Exhibitor Lunch to be held Wednesday. 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.

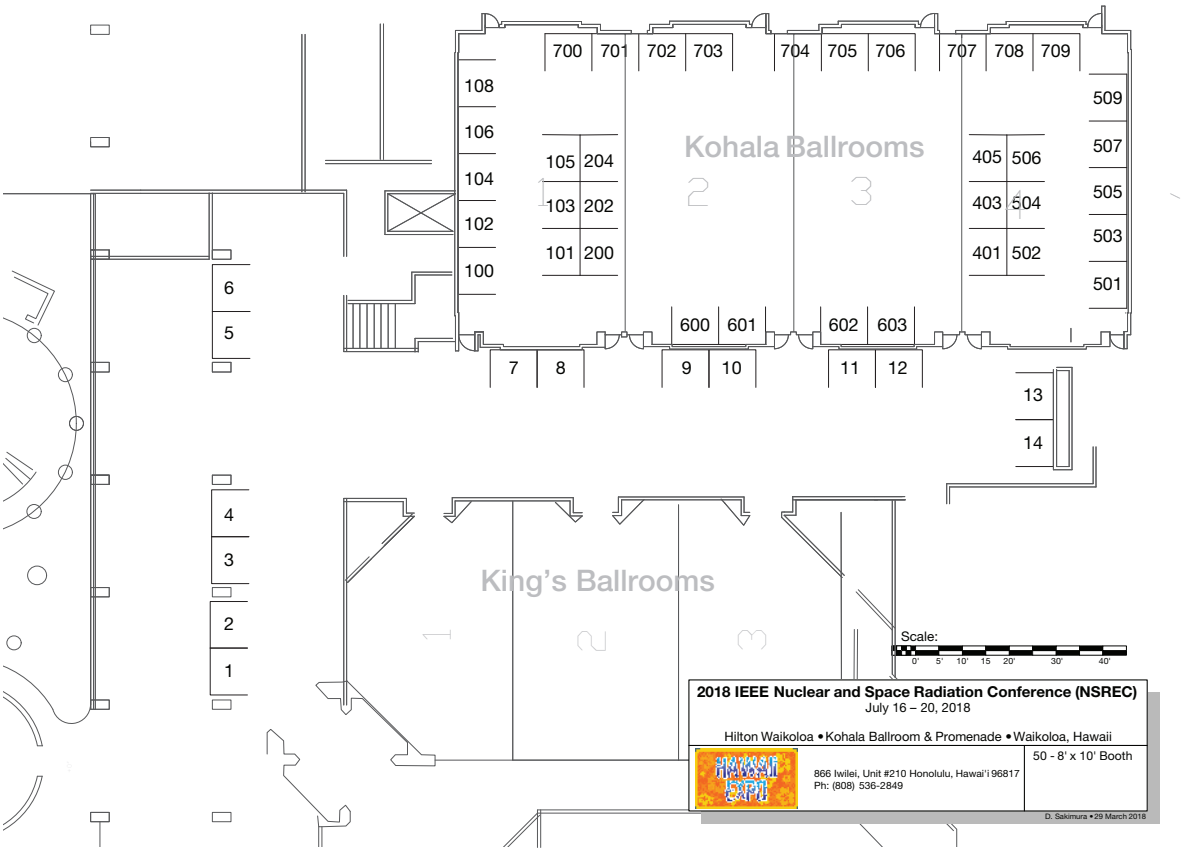
NOTE: Children under 16 must be accompanied by an adult in the Exhibit Area.

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

Tony Amort
The Boeing Company

Phone: 1-206-369-4561
Email: anthony.l.amort@boeing.com

Or visit the 2018 NSREC Industrial Exhibits web site: ***www.nsrec.com/exhibit.htm***



Industrial Exhibits

Please check our web site (***www.nsrec.com***) for a current listing of companies exhibiting at 2018 NSREC.

NSREC
INDUSTRIAL EXHIBITS

HILTON
WAIKOLOA VILLAGE

KOHALA BALLROOM

EXHIBIT HALL HOURS

TUESDAY, JULY 17

7:15 AM – 3:30 PM
10:15 AM MORNING BREAK

5:30 PM – 7:00 PM
RECEPTION

WEDNESDAY, JULY 18

7:15 AM – 1:30 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	403
Alphacore, Inc.	www.alphacoreinc.com	103
Analog Devices	www.analog.com	405
BAE Systems	www.baesystems.com/spaceproducts	104
Cobham Semiconductor Solutions	www.Cobham.com/HiRel	9, 10
Crocker Nuclear Laboratory	http://crocker.ucdavis.edu	700
Cypress Semiconductor / DPACI	www.cypress.com	705
Experimental and Mathematical Physics Consultants (EMPC)	www.empc.com	706
Foss Therapy Services, Inc.	fosstherapyservices@yahoo.com	708
Hopewell Designs, Inc.	www.hopewelldesigns.com	506
IR HiRel/Infineon	http://hirel.irf.com	8
J.L. Shepherd & Associates	http://www.jlshepherd.com/	7
Lawrence Berkeley National Laboratory	www.lbl.gov	707
Microchip	www.microchip.com	102
Micropac Industries, Inc.	www.micropac.com	11
Microsemi	www.microsemi.com	701
NASA NEPP	http://nepp.nasa.gov/	401
National Reconnaissance Office	www.nro.mil	106
Northwestern Medicine Chicago Proton Center	nm.org	501
Provision CARES Proton Therapy Knoxville	www.provisionproton.com	502
Pulscan	www.pulscan.com	105
Renesas Electronics America	www.intersil.com	702, 703
Robust Chip, Inc.	www.robustchip.com	108
Sandia National Laboratories	www.sandia.gov	100
Silvaco Inc.	www.silvaco.com	602
Texas A&M Cyclotron Institute	http://cyclotron.tamu.edu/ref	503
Texas Instruments	www.ti.com	600, 601
The Boeing Company	www.boeing.com	200
Tohoku-MicroTec Co., Ltd.	www.t-microtec.com	13
TowerJazz	www.towerjazz.com	603
Vanderbilt-ISDE	www.isde.vanderbilt.edu	101
Vorago Technologies	www.voragotech.com	704
VPT Rad	www.vpt-inc.com	202
VPT, Inc.	www.vpt-inc.com	204

2018 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 Wednesday, July 18

☐ I plan to attend the Women in Engineering (WIE) Lunch on Thursday, July 19

REGISTRATION FEES (in U.S. dollars)

Late fee REQUIRED if payment received after June 15, 2018

	Early	Late	
IEEE Member *			
Short Course	$300	$360	$_____
Technical Sessions	$570	$680	$_____
Non-IEEE Member			
Short Course	$380	$455	$_____
Technical Sessions	$730	$865	$_____
IEEE Student (or Life Member)			
Short Course	$140	$360	$_____
Technical Sessions	$165	$680	$_____

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 _____

_____

_____

The IEEE NSREC must divulge any use of the contact information derived from your registration. These are:

1) Contact data is included in an Attendee Directory provided to all IEEE NSREC conference attendees following the conclusion of the conference.

2) Contact data is used as the IEEE mailing list for the Conference and Workshop proceedings which aresent to all registered attendees.

3) IEEE NSREC exhibitors who obtain the Attendee Directory could, potentially, use the Attendee Directory to send marketing materials.

4 The IEEE NSREC utilizes the Attendee Directory contact information to provide future conference information and details to each past registrant.

Please check **YES** if you allow usage of your contact information for these purposes and **NO** if you do not want your contact data to be used in any way. ❒ **YES** ❒ **NO**

2018 IEEE NSREC Technical Sessions and Short Course Registration Form

IEEE Policy Statement:

By checking the box below, I AGREE to follow the IEEE policies as outlined in the NSREC website, including the following--

- *No photos or video/sound recordings will be permitted during the Short Course, Technical Sessions, Data Workshop or Poster Sessions.*
- *Conference attendees will not engage in harassment of any kind, including sexual harassment, or bullying behavior, nor discriminate against any person because of characteristics protected by law. In addition, attendees will not retaliate against any person who reports an act of misconduct, or who reports any violation of the IEEE Code of Ethics or Code of Conduct."*

I will follow the IEEE NSREC policies ❒ **YES** ❒ **NO**

CANCELLATIONS

A $50 processing fee will be withheld from all refunds. Due to advance financial commitments, refunds of conference registration fees requested after June 15, 2018, 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 22, 2018.*

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

2018 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 22, 2018.*

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 15, 2018. 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
Conference Social – Sunset Luau, *Wednesday, July 18*				
Adult (21 yrs +)	$65.00	$80.00	____	$_____
Teen (13-20 yrs)	$45.00	$55.00	____	$_____
Child (6-12 yrs)	$25.00	$35.00	____	$_____
Infant (0-5 yrs)	$0.00	$0.00	____	$_____
Kilauea Volcano *Tuesday, July 17*				
Adult (13 yrs +)	$85.00	$95.00	____	$_____
Child (5-12 yrs)	$55.00	$65.00	____	$_____
Infant (0-4 yrs)	$0.00	$0.00	____	$_____
Coffee Farm & Kona Shopping *Thursday, July 19*				
Adult (18 yrs +)	$50.00	$55.00	____	$_____
Child (7-17 yrs)	$20.00	$25.00	____	$_____
Infant (0-6 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 _____

_____

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Social Program

"Welcome to NSREC 2018 on the Big Island of Hawai'i and to the Hilton Waikoloa Village, the host hotel. You may never need or want to leave the hotel property, but if you do there's a diverse growing island to explore. The conference committee has developed a social program with two companion events and the Wednesday social designed to give you a glimpse of the Big Island and the Hawaiian culture. We sincerely hope you relax and enjoy paradise. Aloha!"

Keith Avery
AFRL
Local Arrangements Chair

Welcome to the Island of Hawai'i:
The Island of Hawai'i, also known as the Big Island, is the youngest, largest, and still growing, island in the archipelago containing 66% of the island chain land mass and only 13% of the population. The island is built from 5 separate volcanoes, Kohala (now extinct), Maunakea (dormant), Hualālai (active), Mauna Loa (active) and Kīlauea (active), that erupted sequentially over the past 5 million years and continue to grow the island each year.

Active Lava Flows
- Photograph by Stephen Alvarez
National Geographic Society

The island was discovered about 1500 years ago by Polynesian explorers followed by Tahitian explorers about 500 years later. History indicates that the Tahitians weren't particularly nice to the Polynesians. It wasn't until 1778 that the European influence began with Captain James Cook. The islands were unified under one ruler, King Kamehameha, in 1795. In the early 1800s Christian missionaries arrived, soon followed by Western traders and whalers. Along with them came diseases that reduced the native population form 300,000 to 70,000. Today, the Hawaiian culture is a mixture of the many groups who settled here over the years.

Hawai'i is also known for its vast array of climate zones contained in one relatively small area. While the number of climate zones on the Island of Hawai'i is subject to interpretation (is it 4 out of 5, 10 out of 14, 8 out of 13), travel the island and you will experience several in a short period of time. You can also go from sea level to 13,800 ft. (4,205 m) at the peak of Maunakea in relatively little time.

The conference committee has designed a social program that will provide you a flavor of Hawai'i. The Volcano trip on Tuesday covers the geologic aspects of the Island, including the desert-like area of Waikoloa, the rainforest area surrounding the volcano and the dynamic activity in the Kīluea caldera. The history and lifestyle are highlighted when visiting a coffee plantation and Kailua-Kona on Thursday. And the Sunset Luau (originally called an aha'aina or gathering meal) on Wednesday gives you a look at the cultural influences on the Big Island.

The Hilton Hawaiian Village resides in the Kohala region of the island. This area is known for the stark contrast of black lava, green golf courses, white sand beaches and blue ocean waters. Just steps from the resort is the Puakō Petroglyph Archeological Preserve where you can see lava rock carvings from 1000 to 1800 A.D. Also part of this region is the Waimea upcountry, also known as paniolo or cowboy country, with vast green pastures and livestock. There are five more regions to explore. One highlight of the Hāmākua Coast is Waipi'o Valley, the boyhood home of King Kamehameha I and home to the islands tallest (1300 ft.) waterfall, Hi'ilawe Falls. Next as you make your way around the island is the Hilo region featuring Akaka Falls and Kahuna falls as well as the town of Hilo. Continue on to the Puna region where you'll find Kalapana, a town mostly devoured in 1990 by Kīlauea's lava flow. Now it is more known for viewing the lava flow. It's also home to Volcano Village, a hidden gem in the rainforest on a volcano. As you make your way further south you enter the Kau region. Home to Hawai'i Volcanoes National Park, Punalu'u Black Sand Beach, Papakōlea Green Sand Beach and Ka Lae (south point) the southern-most point on the island. As you make your way around the bottom of the island you head north to the

Social Program

Kona region. Here you will find the famous Kona coffee plantations, Kealakekua Bay where James Cook first landed and of course Kailua-Kona with many shops. There are many historical sites in this area.

Typical summertime weather in the Kailua-Kona area is tropical as you might expect. With around 13 hours of sunlight each day and temperatures in the upper 80's it can feel quite warm. Lows are typically in the low 70's and winds are generally light at an average of 4 miles per hour. If you venture to some of the higher elevations be prepared for cooler temperatures. And if you travel to the opposite side of the island, you will want to bring along a jacket in case of rain. While July is typically one of the drier months on the island, showers are not uncommon in some of the wetter regions. Join us for a week, or more if you're lucky, in paradise. Experience the Hawaiian culture, cuisine, history and beauty of the Big Island.

SUNDAY, JULY 15
6:00 PM TO 9:00 PM

REGISTRATION
WELCOME RECEPTION

Join your colleagues for a reception and light snacks at the Lagoon Lanai area located near the Convention Center rooms. (Location M7 on your resort map.) 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.

TUESDAY, JULY 17
7:00 AM TO 6:00 PM

KĪLAUEA VOLCANO TRIP:
Experience the Heartbeat of a Volcanic Landscape

On Tuesday morning, you will depart from the Lower Lobby level of the Hilton at 7:00 AM for a visit to the Kīlauea Volcano. Located in the in Hawai'i Volcanoes National Park ***(https://www.nps.gov/havo)***, Kīlauea is the youngest southeastern most volcano on the Island of Hawai'i. Kīlauea is the home of Pele, the Hawaiian volcano goddess. Since 1952 there have been 34 eruptions, and since January 1983 eruptive activity has been continuous along the East Rift Zone. In March 2008, a vent also opened in Halema'uma'u Crater at the volcano's summit. The summit crater hosts an active lava pond and a vigorous gas plume. (see notes below) Kīlauea ranks among the worlds most active volcanoes.

- **Visitor Center:** Rangers and volunteers are on duty in the visitor center daily and will provide visitors with the latest information on the current eruption, hiking information, things to do and the daily schedule of ranger-led activities.

Hawai'i Volcanoes National Park Visitor Center (NPS

- **Jaggar Museum/Overlook:** The Thomas A. Jaggar Museum is located along Crater Rim Drive, 3 miles from the Kīlauea Visitor Center. Built on the edge of Kīlauea Caldera, visitors may enjoy spectacular views of the caldera and the main crater Halema'uma'u from this view point. Jaggar Museum's overlook is the best place to view the current eruption that began March 19, 2008. An ash-laden fume cloud is issuing out of a vent within Halema'uma'u crater.

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A view from the Rim Volcano House to the caldera (Avery)

- **Lunch:** Enjoy lunch at the historic Volcano House ***(https://www.hawaiivolcanohouse.com)***, perched on the rim of the Kīlauea caldera with a view toward Halema'uma'u crater.

Inside the Thurston Lava Tube (Avery)

- **Thurston Lava Tube:** This lava tube was discovered in 1913 by Lorrin Thurston, a local newspaper publisher. At that time the roof of the tube was covered with lava stalactites, but those soon disappeared to souvenir collectors. As you walk through the tube consider that several hundred years ago a river of red lava rushed through. Watch your head in the tube - there are some spots with a low ceiling!

The bus ride over to the volcano is approximately 2 hours. The route will utilize the saddle road between Maunakea and Mauna Loa. Near the half-way point there will be a short rest stop at the Rainbow Falls.

The bus will depart at 3:30 PM for the non-stop return to the Hilton.

Important Notes About this Tour

Travel along the saddle road will reach an altitude of 6,765 ft. above sea level. For those who are sensitive to rapid changes in elevation this may be an issue. The summit of Kīlauea is approximately 4,000 ft. and can be rainy and chilly, so a light jacket is recommended. Also, for those with breathing problems, be aware that this is an active volcano area with continuous volcanic gases.

Volcanic Fumes

Fumes (volcanic gases) are hazardous to everyone's health. Visitors with heart or breathing problems and infants, young children, and pregnant women are especially at risk and should avoid being in areas where fumes persist.

Halema'uma'u viewed from Jaggar Museum on September 15, 2017. NPS Photo/J. Wei

The eruptive vents in Halema'uma'u Crater, Sulphur Banks, and Pu'u 'Ō'ō vent generate high levels of gases that may affect visitors - even those visitors who are healthy.

Concentrations of these gases is often dependent on wind direction. Hawai'i's normal tradewind pattern generally blows gases, emitted from the two main vents on Kīlauea, away from most visitor areas. However, even on a tradewind day, fumes from Pu'u 'Ō'ō and Halema'uma'u may cross a roadway or linger in other areas of the park. In this event, follow the instructions from the bus driver or park ranger. If you happen to visit on your own, close the car windows and run the air conditioning on recycled air and leave the area.

Social Program

TUESDAY, JULY 17
5:30 PM TO 7:00 PM
KOHALA AND GRAND PROMENADE

INDUSTRIAL EXHIBITS RECEPTION

Join us for the 2018 Industrial Exhibits Reception hosted by your NSREC exhibitors. NSREC attendees and their registered guests are invited to the Kohala Ballroom and Grand Promenade 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 18
7:00 AM – 8:15 AM

KONA 4

IEEE YOUNG PROFESSIONALS BREAKFAST

A special breakfast will be held in the Kona 4 room of the Hilton Waikoloa Village for IEEE member attendees who are Young Professionals ***(https://yp.ieee.org/, https://www.facebook.com/ieeeyp).*** This is an excellent opportunity for newer industry members to informally discuss radiation effects and to become better acquainted.

Our guest speaker will be **Dr. Ray Ladbury,** who will be presenting an entertaining talk entitled *"A Roundtrip Journey Off The Career Track: Having a Successful Career Despite Your Best Efforts."*

Dr. Ladbury was born and raised in Colorado. He graduated with a B.S. in physics from Colorado State University and with a Ph.D. in experimental particle physics from the University of Colorado. After graduating with his doctorate, Dr. Ladbury served in the Savannah region of Togo, West Africa as a Peace Corps Science Teacher Trainer. After returning to the United States, he taught physics, math and science pedagogy in Kentucky's Appalachian region at Pikeville College and worked as an editor at Physics Today Magazine.

Dr. Ray Ladbury has served as a radiation physicist in the Radiation Effects and Analysis Group (REAG) at NASA's Goddard Space Flight Center since January 2000. He has served as lead radiation engineer for many NASA programs and missions, including the James Webb Space Telescope, SWIFT, Landsat-8, the Origins Spectral Interpretation Resource Identification Security - Regolith Explorer (OSIRIS-REx) and the Geostationary Operational Environmental Satellite (GOES) and Tracking and Data Relay Satellite (TDRS) programs. Within the REAG, Dr. Ladbury's research has centered on the radiation testing and qualification of complex devices for spacecraft applications and the use of statistical models in radiation hardness assurance. He has authored or co-authored over 70 technical papers in peer-reviewed journals and three short courses on various aspects of radiation hardness assurance. In addition, Dr. Ladbury has also authored two dozen popularized articles on cutting-edge physics research. Dr. Ladbury is the lead for the Radiation Community of Practice under the NASA Engineering and Safety Center (NESC) Avionics discipline capability and served on the recent National Academy study of U.S. radiation effects testing infrastructure. Ray started work in radiation hardness assurance at Hughes Space and Communications in El Segundo, CA and then moved to NASA's Goddard Space Flight Center. He lives in Mt. Airy, MD with his wife, Michelle.

In addition, the Young Professionals breakfast will include individuals representing IEEE, the Nuclear & Plasma Sciences Society (NPSS) Radiation Effects Steering Group, and various NSREC committees for discussions on how to become involved in IEEE NPSS activities. For more information, contact Anthony Sanders, ***anthony.b.sanders@nasa.gov.***

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

Social Program

WEDNESDAY, JULY 18
6:00 TO 10:00 PM

CONFERENCE SOCIAL

SUNSET LUAU AT THE MARRIOTT

Photo courtesy of the Marriott Waikoloa

Photo courtesy of the Marriott Waikoloa

It wouldn't be a Hawaiian Social with a luau. In ancient Hawai'i, men and woman ate their meals apart. Commoners and women of all ranks were also forbidden by the ancient Hawaiian religion to eat certain delicacies. This all changed in 1819, when King Kamehameha II abolished the traditional religious practices. A feast where the King ate with women was the symbolic act which ended the Hawaiian religious tabus, and the luau was born.

The Sunset Luau at The Waikoloa Beach Marriott is not just a feast but an experience of the music, art and dance of Polynesia. An ancient chant welcomes all to witness the opening of the imu, the underground pit where a whole pig has been cooking all day. Following dinner journey to Tahiti, New Zealand, Hawai'i and Samoa through the songs and dance of these Pacific cultures. The Samoan fire dance is a spellbinding finale!

It is a spectacular sight against the dazzling backdrop of the picturesque sunsets over 'Anaeho'omalu Bay.

Tickets are not included in the conference registration so be sure to purchase them with your registration. SPACE IS LIMITED so buy your tickets early!!

The Marriott is a short, 15-20 minute walk from the Hilton lobby. For those who prefer not to walk, a shuttle will be available on the lower lobby area to transport attendees between the Hilton and the Marriott.

THURSDAY, JULY 16
8:00AM TO 4:00PM

KONA COFFEE LIVING HISTORY FARM & KAILUA-KONA SHOPPING

The Kona Coffee Living History Farm tells the story of Kona's coffee pioneers during the early 20th century. Living history gives visitors an opportunity to experience history "brought to life" by costumed interpreters who demonstrate traditional crafts, agricultural activities, and the everyday tasks of people from the past. "Talk story" along the way with the farm's living history interpreters and discover the story behind Kona's gourmet crop. Taste the coffee fresh from the farm and take some home to your friends.

Living History Farm

From the farm it is a short bus ride to Kailua-Kona, a lively seaside town in the heart of the sunny Kona Coast. Once a sleepy fishing village and a retreat for Hawaiian royalty, Kailua Village is now a destination for comfortable accommodations, great shopping, dining and learning about Hawai'i's rich culture.

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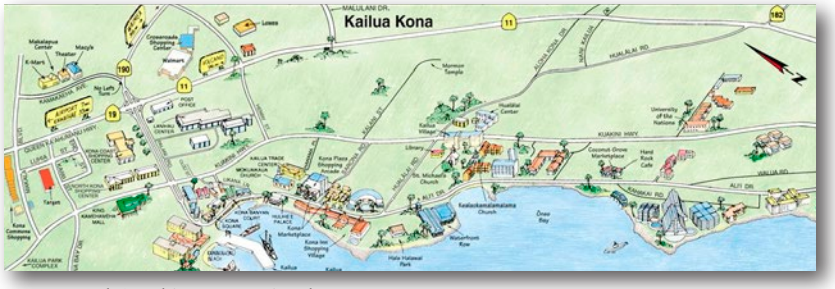


From Travel Graphics International

Stroll down the main road of Ali'i Drive and you'll find a variety of shops and restaurants. Make sure to check out the Farmers Market. But look closer and you'll also discover some very important Hawai'i Island historic spots. Hulihe'e Palace and the Mokuaikaua Church are both located right on Ali'i Drive. King Kamehameha I spent his later years living at Kamakahonu Bay near Kailua Pier until his passing in 1819. The Ahu'ena Heiau is a temple on the register of National Historic Landmarks.

Kona Farmers' Market

You will leave the hotel at 8:00 AM from the Lower Lobby level for the drive to the LHF. You'll have about an hour to visit the farms three areas and sample some coffee. They also have coffee to purchase. At about 10:30 AM, you'll depart the farm and head to the Kailua-Kona area where you can enjoy lunch (on your own), sightseeing and shopping for about three hours. The buses will leave at 3 PM; arriving back at the Hilton around 4:00 PM.

THURSDAY, JULY 19
12:00 TO 1:30 PM

KONA 4

WOMEN IN ENGINEERING LUNCH

IEEE Women in Engineering

A special lunch will be held in the Kona 4 room in the Hilton conference area for Women in Engineering and is sponsored by the IEEE NPSS society. This event is open to all attendees who are interested in discussing women's issues in engineering and other related career fields. This lunch will also include a short talk from a prominent guest speaker. For more information, please contact Kay Chesnut, ***kay.c.chesnut@boeing.com.***

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

Kim Binsted received her BSc in Physics at McGill (1991), and her PhD in Artificial Intelligence from the University of Edinburgh (1996). Her thesis topic was the computational modeling and generation of punning riddles, and her program, JAPE

Social Program

(Joke Analysis and Production Engine), generated puns such as "What do you call a Martian who drinks beer? An ale-ien!". She then went to Japan, where she conducted research at Sony's Computer Science Laboratories on human-computer interfaces, and then started a company, I-Chara KK, which developed social software agents for mobile phones. In 2002, she joined the faculty of the Information and Computer Sciences Department at the University of Hawaii, where she does research on artificial intelligence, human-computer interfaces, and long-duration human space exploration. In 2015, she received a MS in Planetary Geology, for attempting to characterize the deuterium-hydrogen ratio in the primitive Earth mantle.

Kim is a co-investigator at the UH-NASA Astrobiology Institute, which formed in late 2003. She was a NASA Summer Faculty Fellow at Ames Research Center in 2003 and 2004, where she worked on sub-vocal speech recognition technology in the Neuroengineering Lab. She was Chief Scientist on the FMARS 2007 Long Duration Mission, a four-month Mars exploration analogue on Devon Island in the Canadian High Arctic. In 2009, she spent her sabbatical as a visiting scientist at the Canadian Space Agency (CSA), working on the CSA's planetary analogues program. She is now the principal investigator for the NASA-funded HI-SEAS (Hawaii Space Exploration Analog and Simulation) program, which conducts long-duration space exploration simulations at an isolated habitat on Mauna Loa. She is spending the summers of 2016 and 2017 in Russia on a Fulbright Award.

Kim's hobbies include flying, diving, kayaking, cooking and improvisational comedy.

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 on the Ocean View Terrace located at the west end of the Ocean Towers. See location O10 on your resort map.

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 as long as 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 22.

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. Also be aware that not all areas of the companion events are wheelchair and stroller friendly.

Local Activities

GENERAL INFORMATION

There is plenty to do and see at the Hilton Resort, in the Waikoloa Village the surrounding areas and across the island. The Big Island of Hawai'i has a vast array of historical sites, farms, waterfalls, volcanoes, parks, beaches, snorkeling, diving, hiking, golfing, helicopter tours, boat rides, dining and shopping. There's enough to fill a day, a week or a month of activities. Or, you can find a quiet place and just relax and enjoy island time.

AT THE HILTON WAIKOLOA VILLAGE RESORT

Visit ***http://www.hiltonwaikoloavillage.com/resort-experiences*** for more details on the following activities within the Hilton Waikoloa Resort. Also on the Hilton site is an interactive map. Or for a more adventurous time, take a walk around the resort and enjoy the views. You may just find that special place that makes all your cares fade away.

DOLPHIN QUEST

Experience an unforgettable, up-close encounter with a new dolphin friend at Dolphin Quest, where your participation supports vital marine mammal conservation, education and scientific study. Guided by marine mammal specialists, you'll be truly amazed at the dolphin's grace, beauty and abilities. Please refer to the website above for detailed information on times and ages for the various dolphin programs.

Dolphin Quest at the Hilton Waikoloa Village (Courtesy HWV)

LAGOON BEACH

Situated on a rugged stretch of Big Island lava coastline, Hilton Waikoloa Village features a unique, ocean-fed lagoon with its own white sand beach. Rent hydro-bike, kayaks, paddleboats, or water bikes and see colorful reef fish and green sea turtles (or honu in Hawaiian). Explore an undercover world while snorkeling, or simply laze around in a hammock and enjoy exotic cocktails and snacks from The Lagoon Grill.

The saltwater lagoon at the Hilton (Courtesy HWV)

TENNIS

Featuring PlexiCushion hard courts and a 432-seat Stadium Court that hosted USTA Challenger events in the past (drawing then up-and-comers like Andy Roddick, James Blake, and Mardy Fish), the tennis resort at Waikoloa on Hawai'i Island is beloved by players of all skill levels.

POOLS

Kona Pool –the largest pool, featuring a 175-foot waterslide, whirlpools, waterfall, Kona Pool Bar and Orchid Marketplace

Kohala River Pool – perfect for families with four interconnected pools with junior waterslides and a Pool Bar serving refreshments

Ocean Tower Pool – an adults-only pool offering a peaceful, secluded retreat for swimming and relaxation

Local Activities

KOHALA SPA/FITNESS

Stretch out with some yoga, get your heart pumping in their cardiovascular room, or take a wellness class. The modern and fully-equipped Kohala Spa has it all.

ART AND WILDLIFE

Discover the resorts art collection, which consists of works from Asian, Western, and Oceanic cultures – with more than 1800 unique pieces. Celebrate the cultural heritage and hope that through an appreciation of its art, we all can gain a greater understanding and insight into life in Hawai'i.

Around the resort, you will find a variety of exotic wildlife. The resorts family of birds includes Chilean Flamingos, cockatoos, black-necked swans, African crowned cranes, Macaws and, official Hawai'i state bird, the nēnē (Hawaiian goose). Other inhabitants include six red-footed tortoises and several rare green sea turtles, which live in the salt-water lagoon. The waterways are teeming with tropical fish, from yellow tangs and unicorn fish to our resident four-foot barracuda!

Turtles out for a morning swim in the salt water lagoon (Courtesy HWV)

TRAMS & CANAL BOATS

Explore the 62-acre oceanfront resort by Swiss-made air conditioned trams. The trams take you from Lagoon Tower to Ocean Tower with stops at the Main Lobby, Convention Center and Palace Tower along the way.

Each of the trams bears a traditional Hawaiian name in Hilton honor of Hawai'i's rich heritage and culture, which is alive in the island's storytelling and fascinating cultural events. "Kaiona" is "Goddess of the Guiding Birds" in Hawaiian. "Hopoe" translates to "Dancing Stone" in Hawaiian. "Paoa," means "the Magic Fire Stick" in Hawaiian. Scheduled from 6AM – 2AM Daily

Take a romantic starlit ride, or check out the Island's fascinating wildlife with a tour on their complimentary Canal Boatway cruises. Meander through the resort along tranquil waterways on mahogany canal boats - the perfect way to see exotic plants, animals and birds. The picturesque boatway and ocean-fed lagoon is teeming with tropical saltwater fish of all varieties, from yellow tangs and sergeant major or mamo to unicorn fish and spotted damsels. Scheduled from 2PM – 10PM Daily.

SHOPPING

Discover an eclectic array of shops, boutiques, and galleries throughout the Hilton Waikoloa Village. Browse the available wares and purchase the perfect souvenir to take home or find unique gifts to surprise your family and friends.

DINING

There are several places to eat around the Hilton property. Please refer to the dining guide on the Hilton website or the information in your room.

For breakfast you have two options. The first is the Waikoloa Coffee which has coffee, smoothies, pastries, etc. There is one located in the Ocean Tower (5:30AM to 5PM) and one in the Lagoon Tower (5:30AM to 6PM). The other is the Big Island Breakfast at Water's Edge. This is at the same tram stop as the conference area. It is open from 7AM to 10:30AM and children under 5 eat free with a paid adult entrée (see note below).

Local Activities

Only open for lunch is the Orchid Marketplace near the Kona pool area (11AM – 4PM) which offers a variety of snacks, sandwiches and drinks. This is a good place to get snacks to take back to the room if you don't get out to a store in the village area.

Lunch/dinner options: The first is the Boat Landing Cantina located in the Ocean Tower (11:30AM – 9PM) serving Mexican/Hawaiian items. They also have a kids menu and the bar stays open until 10PM. You can get to this via foot, tram or boat. The Lagoon Grill (11AM – 8PM) overlooking the lagoon and dolphin area serves burgers, hot dogs, sandwiches, etc. and has a full bar for cocktails. This is the other location where kids 5 and under can get a meal (grilled cheese or hot dog) with a paid adult (see note below).

The Kamuela Provision Company (KPC) sits at the far south end of the property overlooking the ocean. Only open for dinner (5PM – 9PM) this is dining on the higher end of the scale (entrées start at $36) with locally sourced ingredients. The views are incredible and the sunsets are amazing. They also have a lounge area with a tapas menu. Even if you don't eat here, take a walk to the area for the view.

For some lighter fare you can visit the Kona Tap Room (11AM – Midnight) located off the hotel lobby area. The menu for food is limited to smaller items suited for consumption with your favorite beverage.

Note: Kids Eat Free for breakfast & lunch, ages 5 & under, when you order from the "Kids Eat Free" sections of the Keiki Menus and purchase an adult entrée at the same time. Available at ***Big Island Breakfast at Water's Edge*** *for breakfast or* ***Lagoon Grill*** *for lunch. The kids menus provide select items that are FREE, as well as other value priced items, if preferred.*

ACTIVITIES WITHIN THE WAIKOLOA VILLAGE:

These activities are available via a short to moderate walk or the trolley (for a small fee). If you're in need of some groceries you can stop at Whalers General Store in the King's Shops or Island Gourmet Markets at the Queens' Marketplace. Otherwise the closest full grocery store is in the town of Waikoloa which is a 15-20 minute drive.

THE KINGS' SHOPS
(www.kingsshops.com)

About a 15 minute walk from the Hilton lobby, Kings' Shops is Hawai'i Island's premier shopping and dining destination. Located in the heart of the Kohala Coast, the center offers a great collection of brand name stores such as Michael Kors, Tiffany & Co. and Tori Richard along with island favorites, fine art galleries, casual eateries and fine dining. Open from 9:30AM to 9:30PM daily. There is also a trolley that will take you to this shopping area for a small fee.

QUEENS' MARKETPLACE
(www.queensmarketplace.net)

A little further down the road, probably a 20-30 minute walk or via the trolley, is the Queens' Marketplace. A fun family life style resort destination shopping experience with something for everyone, visitors and residents alike, Queens' MarketPlace presents an exciting collection of boutiques, galleries, shops and services, plus a delightfully diverse Ono Food Court, upscale restaurants and a full schedule of free Hawaiian cultural activities and entertainment.

Meet at the Clock, marvel at the meandering water features and fountains, and learn about Hawai'i's Queens from bronze plaques in the rotunda. Then, explore stores like SoHa Living, Blue Ginger Family, Reyn's, Local Motion, Persimmon and Sunglass Hut, or take a break at Starbucks. Plus a food and wine emporium with everything to suit your tastes, from gourmet to local-style "grinds."

Local Activities

WAIKOLOA PETROGLYPH RESERVE

Ki'i pōhaku (petroglyphs or rock carvings) in the Waikoloa Petroglyph area (https://earthstonestation.com/2013/05/26/waikoloa-petroglyph-preserve/)

Between the Kings' Shops and the Queens' Marketplace you will find the Kings Highway Foot Trail (the adjacent street is called Pohakulana Place, where the Shell station is). Just north of the gas station you will find the entrance to the Waikoloa Petroglyph Reserve. This is a small area where you can see petroglyphs (ki'i pōhaku or rock carvings) and cave shelters. This trail is rugged, not particularly well marked and unfortunately vandals have left their own mark which interferes with seeing the true petroglyphs. Once at the trail head, it's about a 1 hour walk. If you don't have a chance to visit the Puakō Petroglyph Archaeological Preserve ***(http://www.puako.org/culture.html)*** or the Pu'u Loa petroglyph field in Hawai'i Volcanoes National Park ***(https://www.nps.gov/havo/learn/historyculture/puuloa.htm)***, this is a nice glimpse into the history of Hawai'i.

If you're up for a longer hike you can take the Kings Highway Foot Trail further north or even south for several miles. Please make sure to wear close-toed shoes, sunscreen and bring along some water.

GOLF ON THE KING'S AND/ OR BEACH COURSE

No. 7 green on the Beach Course (Courtesy of Hilton Waikoloa Village)

The championship golf courses at the Waikoloa Beach Resort were designed by well-known course architects, and with an oceanfront setting, the beautiful property provides the ideal destination for an unforgettable Big Island golf vacation. Whether you're a beginner or a pro, you'll find the challenge exhilarating – and the scenery breathtaking. You can call the courses directly for tee times or talk with the concierge. A free shuttle is available from the hotel to take you to and from the golf courses.

ANAEHOʻOMALU BEACH

From: https://www.explore-the-big-island.com/anaehoomalu-beach.html

About a mile south of the hotel is Anaehoʻomalu Beach which features a long white-sand beach, several tide pools, fishponds and a large grove of coconut palms. This is a public beach with restrooms and outdoor showers at the south end of the beach. At the north end of the beach there are rentals for snorkeling gear, kayaks, boogie boards. Parking is available a short walk from the beach.

Local Activities

THINGS TO DO ON THE BIG ISLAND

The island is large and diverse and the activities are endless. Listed below are some suggestions. For further information or more details please visit the websites indicated or one or more of the following for general information and ideas for things to do on the island.

https://www.explore-the-big-island.com
https://www.to-hawaii.com
https://www.lovebigisland.com
https://www.gohawaii.com/islands/hawaii-big-island
https://www.hawaii-guide.com/big_island_of_hawaii/big_island_must_see_and_do
https://www.hawaiiactivities.com/en/hawaii/big_island/

HISTORIC AND CULTURAL SITES

There are four National Parks on the Big Island. **Hawai'i Volcanoes National Park** is located on the southeast side of the island and as its name suggests is home to the active volcano, Kīlauea. South of Kailua-Kona, **Pu'uhonua o Honaunau National Historical Park** is just south of Kailua-Kona, still considered a sacred site of refuge. Between Kailua-Kona and the Kona International airport, **Kaloko-Honokōhau National Historic Park** shows how the coastal people lived and survived the harsh lava landscape. North of hotel along the coastline, **Pu'ukohala Heiau National Historic Park** is home to the great temple of Kamehameha the Great where you can walk in the footsteps of a king. You can visit the National Park Service site ***(www.nps.gov)*** for more detailed information on these parks.

There are nearly 20 state parks, waysides and recreation areas around the island. Visit the Hawai'i State Parks site ***https://hawaiistateparks.org/parks/*** for a listing of all the places to visit.

Turtles nesting on the Black Sand Beach, part of Punalu'u Beach Park (Avery)

Along Ali'i Drive in Kailua-Kona you can find **Mokuaikaua Church**, the first Christian church built in Hawai'i, **Hulihe'e Palace**, the vacation residence of Hawaiian royalty, and **Kuamo'o Battlefield and Graveyard** where Kamehameha II and Queen Ka'ahumanu fought over religion.

Just south of Kailua-Kona, **Captain Cook Monument** on Kealakekua Bay (Kealakekua Bay State Historical Park) is the site of Captain James Cook's first encounter with Hawaiians and where he was later killed. The monument, a white obelisk, is on land that is officially the territory of the United Kingdom.

To the far north of the island you will find the small village of Kapa'au, believed to be the boyhood home of Kamehameha the Great. In the center of town you find a statue of the king.

Kamehameha Statue in Kapa'au (http://www.kamehamehadaycelebration.org/)

Near Waimea is the **Parker Ranch Museum *(http://parkerranch.com/)*** home to one of the largest privately owned ranches in the United States and a distinct part of Hawaiian history. Near the entrance to the Ranch Historic Homes is a WWII Memorial to the Marines who trained in the area in preparation for the battles of Iwo Jima and Okinawa. While in the area, check out some of the other things to do in Waimea, like the Keck Observatory Headquarters, and explore its unique cowboy culture.

Local Activities

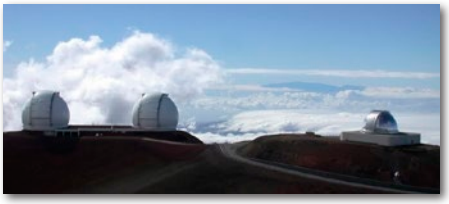
The Waipi‘o (curved water) Valley is the largest of the seven valleys on the windward side of the Kohala Mountains and is also known as the Valley of the Kings. Once home to many early Hawaiian rulers, many buried in caves in the valley walls, after several tsunamis and floods it is now mostly Taro fields. Waipi‘o is a spectacular site with 2000 ft. high walls, waterfalls and river that empties into the ocean via a black sand beach. Visiting the floor of the valley takes time and energy but is well worth the trek. This is still an amazing place even if you only get to the overlook area and rich in Hawaiian history.

Visit the **Lauphoehoe Train Museum *(http://www.thetrainmuseum.com/)*** which preserves the history of the Hawai‘i Consolidated Railway. Started in the late 1800’s, the railway was used to move sugar, lumber and people along that side of the island. The tsunami of 1946 destroyed much of the track, trestles and bridges bringing an end to the railway.

In Hilo you can find the **Lyman Museum and Mission House *(https://lymanmuseum.org/).*** The Lyman Mission House is the oldest standing wood structure on the island. The house is on the State and National Registers of Historic Places.

W. M. KECK OBSERVATORY AND MAUNAKEA VISITOR CENTER

The W.M. Keck Observatory headquarters is located in Waimea. The facility is open from 10AM until 2PM, Monday through Friday. Here you can get information from volunteers about the Keck Observatory and the other Maunakea observatories, see models of the telescopes and learn about the latest discoveries and outreach programs. ***(http://www.keckobservatory.org/)*** Waimea is about 1 ½ hours from the Hilton.



The Maunakea Summit
(Courtesy http://www.ifa.hawaii.edu/)

In addition, you can venture up Maunakea to the Onizuka Center for International Astronomy Visitor Information Station (VIS) (elevation is 9,200 ft.). The VIS is open from 12PM to 10PM every day of the year and is easily accessible via normal 2 wheel drive cars. There are telescopes available during the day and after sunset for stargazing and Maunakea Rangers to answer questions. Please be aware of the elevation and the possibility of altitude sickness. ***http://www.ifa.hawaii.edu/info/vis/***

If you are feeling adventurous, and have a 4 wheel drive vehicle (check your rental agreement carefully), you can continue to the summit after a recommended stop at the VIS to acclimate. If you’re even more adventurous you can hike to the summit. If you choose this option, please plan accordingly.

Please visit the website and read the cautions and suggestions carefully. The VIS is 9,200 ft. and the summit is 14,000 ft. above sea level. From the VIS it is several miles on the road or via the hiking path to the summit.

WATERFALLS

It wouldn’t be Hawai‘i without spectacular waterfalls. You will find them on the east side of the island from the Kohala Mountains down the Hamakua Coast and into the Hilo area. Not all of the Hawai‘i waterfalls are reachable on foot, some are only accessible by helicopter, but there are enough to keep you busy and amazed. You can always just book a waterfall tour and be bused or flown around.

Local Activities

Akaka Falls (Avery)

There are several falls in the Waipiʻo Valley. Depending on the time of year and rainfall amounts, the flow of water will vary from spectacular to not so much. The two most famous are **Hiʻilawe Falls** and **Waiulili Falls.**

Akaka Falls State Park is home to two waterfalls in one short (about ½ mile) hike on a paved path. The first stop is the 100 ft. **Kahuna Falls** followed by the 442 ft. **Akaka Falls.**

Umauma Falls, a three-tiered waterfall, is accessible as part of the Umauma Falls and Garden Tour. This self-guided tour comes with a fee. You can also make it part of a zipline experience, for a bigger fee.

Rainbow Falls is part of the Wailuku River State Park which is easily accessible and usually full of visitors. If you continue up the Wailuku River you will find the Boiling Pots area and then the **Peʻepeʻe Falls** and even further is **Waiʻale Falls.**

MACADAMIA NUTS

Want to visit a Macadamia nut factory? There are two main locations for Macadamia nuts, **Hamakua *(https://hawnnut.com/)*** and **Mauna Loa *(https://www.maunaloa.com/)***. The nearer of the two, Hamakua, is north of Waikoloa in the small town of Kawaihae, it's a nice 20-30 minute drive. The facility sits up on the hill above the town. There are also some shops and dining in the town.

If you are over near Hilo on the east side of the island you can stop by the Mauna Loa factory and visitor center. It is just off Highway 11 on Macadamia Road about 5 miles south of Hilo. This is a great stop if you're on an "around the island" drive.

There are other smaller macadamia nut farms around the island but it's not clear if they have on-site sales or visitor facilities. Of course you can always get Macadamia nut products across the island at virtually any place that sells food or snacks.

For those who have nut allergies, these are tree nuts. Please take appropriate precautions.

KONA COFFEE

If you thought Starbuck's was great coffee, think again. The Kona area is known for its distinctive coffee due to the unique growing area and conditions. While you can get bags of coffee to take home, or enjoy in the hotel, visiting one of the farms is an enlightening experience. There are other areas of the island that grow coffee, Kaʻu, Puna and Hamakua which each have their own unique flavor. You may want to find those as well if you travel around the island or visit some of the local farmers markets.

The flower of a Kona coffee plant (Avery)

There are many local farms and most have tours of some sort, including the ones on the Hilo side of the island. Check the farms website to see if reservations are required or a fee is charged for the tour. The farm tours are interesting and educational. Visit them all if you want to truly sample all the Kona coffees. If you buy coffee to bring home or use while you are here, be aware that only labels that say 100% Kona Coffee are the true Kona coffee. Some may say blend

(typically 10% Kona coffee) or Kona Roast or Kona Style (probably no Kona coffee beans), so please read the labels carefully.

A few of the farms in the Kailua-Kona area are: Kona Living History Farm, Greenwell Farms, Mountain Thunder Kona Coffee, Hula Daddy Kona Coffee, Sunshower Coffee, Buddha's Cup, Kona Joe Coffee, Rooster Farms, etc.

GOLF

If part of your Hawaiian adventure includes a round or two or more of golf, you're in luck. There are several nice courses, two within the Waikoloa Village property, on which you can play. As you might expect, the resort courses can be on the pricier end of the scale, but in general the prices are what you might expect in Hawai'i. If you find one with a low (<$50) green fee, it is likely not well maintained. Within 30 minutes or so of the hotel there is a large selection to choose from. You may want to visit ***golfadvisor.com*** for more reviews.

The Beach and Kings' Courses are located in the Waikoloa resort area.

To the north are: the Mauna Lani Resort North and South Courses (Mauna Lani also has a junior or WikiWiki course); the Mauna Kea Golf Course; the Hāpuna Golf Course; the Waikoloa Village Golf Course in the actual town of Waikoloa.
To the south are: Hualālai Golf Club (two courses, Nicklaus design and Weiskopf design) at the Fairmont resort; Kuki'o Golf and Beach Club; Big Island Country Club (a fun course up on the hillside, beware of goats and nēnē); Nanea Golf Club, and

Nēnē on the course at the Big Island Country Club (Avery)

Makalei Hawai'i Country Club

In the Kailua-Kona area the Kona Country Club is the only non-private course.
If you're headed to the Hilo side of the island there are a few courses that way as well. Hilo Municipal Golf Course and Naniloa Golf Club are in Hilo, the Volcano Golf and Country Club (you can say you played golf on an active volcano) over near the volcano, and Sea Mountain Golf Course down towards the south end of the island.

Local Activities

HELICOPTER TOURS

There are several helicopter tour operators on the Big Island. Prices and packages vary among each of the operators. Blue Hawaiian has a heliport located just outside the Waikoloa Village at the Waikoloa Heliport, so it's the closest. Others operate from the Kona International Airport (Paradise Helicopters), the Hilo International Airport (Paradise Helicopters, Safari Helicopters & Blue Hawaiian Helicopters) or Hapuna Heliport (Sunshine Helicopters). These are the biggest and most popular helicopter operators on the island. You may find others with some savvy searching.

https://www.bluehawaiian.com/bigisland/
https://paradisecopters.com/
https://www.safarihelicopters.com/
http://www.sunshinehelicopters.com/

ZIPLINE TOURS

Don't want to go up in a helicopter but still want to see things from above? How about a zipline tour? Surprising, this is a family friendly activity that takes you over ravines, jungles, meadows, waterfalls and forests. There are 5 zipline companies on the Big Island offering an array of adventures. The closest one to the Hilton is the Kohala Zipline Canopy Tour ***(https://www.kohalazipline.com/hawaii-zipline-tour-kohala-canopy/)*** which is at the north end of the island. All of the others, Umaumau Falls ***(https://umaumaexperience.com/tours/zipline-tour/)***, Skyline Eco Adventures ***(https://www.zipline.com/bigisland)***, Kaphahokine ***(https://kapohokine.com/activities/zipline/)***, and Zipisle ***(https://www.zipisle.com/index.php)*** are located near Hilo.

Note that there may be age, weight, health or clothing restrictions on tours.

SNORKELING & SCUBA DIVING

If you enjoy snorkeling or scuba diving, you've come to the right place. The Big Island has several good locations for both, either on your own or with on an organized trip. If you've never snorkeled, you might try the lagoon area at the hotel or one of the snorkeling tours. For those with some experience there are several beach areas along the coast. For diving, you'll want to find one of the dive shops or tours. Below is a partial list of snorkeling areas. There are lots of tour operators on the island so look closely and find the one that fits the type of adventure you're seeking. Because the west side of the island is more protected from the wind, most of the snorkeling areas are along the west side of the island.

Kealakekua Bay (also known as Captain Cook) is a favorite spot that is best viewed on a tour. There isn't any direct access. You may also get to see some dolphins and hear a little history while on the tour.

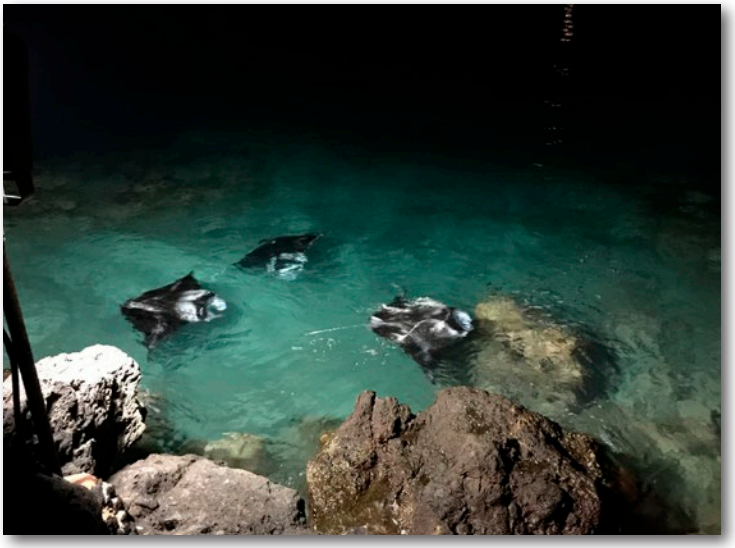
Kahaluʻu Beach Park is located just off Aliʻi Drive in Kailua-Kona. Also a good place for less experienced snorkelers, you will find lots of sea turtles and at low tide, many tide pools. It's a popular spot so getting there early is advised.

Further south is **Honaunau Bay** (also called City of Refuge). Entrance to the snorkeling area is called Paeʻa or two step. There isn't a parking area so you will have to park along the road. There aren't any facilities either, so bring your own food and water.

Near the hotel is **Anaehoʻomalu Beach**. While just OK for snorkeling, it's a great spot for hanging out at the beach and watching the sun set. And it's close to the hotel and the Lava Lava Beach Club for food or the Marriott.

Local Activities

To the north are **Mauna Lani (Makaiwa Bay)**, a small beach at the south end of the Mauna Lani resort. **Pau'oa Bay** at the Fairmont Orchid Hotel is good if there is low surf so you can get outside the rocks. **Waialea Beach (Beach 69)** is a favorite of the locals. The name comes from the utility pole number that marks the parking lot. **Hāpuna Beach** is a nice white sand beach where the snorkeling is good if the water is calm. **Kauna'oa Beach** (also known as the Mauna Kea Beach) is a public beach but is part of the Mauna Kea hotel. You will need to get a pass from security, which are limited, so early is better. A unique thing about Mauna Kea is that they shine a light into the water at night and have a viewing area. Manta Rays are likely but not a given.



Three Manta Rays feed on plankton at night on the shore of the Mauna Kea hotel. (Avery)

Speaking of Manta Rays at night, something unique to try is a night trip to see the Manta Rays. A couple good sites to visit for tours or night viewing are:

https://bigislanddivers.com/charters/kona-manta-ray-night-scuba-dive/
https://www.hawaiiactivities.com/en/hawaii/big_island/ctg/161935:swim_with_manta_rays/

You can also walk around Kailua-Kona and see the many options for snorkeling and scuba tours.

SHOPPING

Besides what you can find in the hotel or Waikoloa Village area, which is pretty good, the biggest area is Kailua-Kona. Here you can stroll down Ali'i Drive and find everything from "touristy" items to local handmade items. Open Wednesday through Sunday, 7AM to 4PM is the Kona Farmers' Market which has a selection of produce, flowers, arts and crafts, coffee, etc.

Along Ali'i Drive you will also find plenty of places to stop for a bite to eat, visit a historical landmark or just relax and look out over the bay.

If you take a drive around the island, there are many small local shops along the way. Take some time to stop and browse around. You never know what hidden treasures you might find. Again, you can find everything from the typical tourist items to the special handmade crafts and art of the locals.

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ANNOUNCEMENT and FIRST CALL FOR PAPERS

2019 IEEE NUCLEAR AND SPACE RADIATION EFFECTS CONFERENCE

Short Course and Radiation Effects Data Workshop

July 8-12, 2019
Marriott Rivercenter Hotel,
San Antonio, Texas

www.nsrec.com

Sponsored By
IEEE/NPSS Radiation Effects Committee

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You are cordially invited to attend the 2019 IEEE Nuclear and Space Radiation Effects Conference to be held July 8-12, 2019 at the Marriott Rivercenter Hotel, in San Antonio, Texas. 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 a radiation effects issue with current relevance offered on July 8, 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
- Systems on Chip, GPUs, FPGAs, Microprocessors
- Isolation Technologies, such as SOI and SOS
- 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 1, 2019

PROCEDURE FOR SUBMITTING SUMMARIES

Authors must conform to the following requirements:

Summaries must be received by February 1, 2019

Detailed submission and formatting instructions will be available after December 1, 2018 at www.nsrec.com

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), an abstract no longer than 35 words, and uploading the summary. 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.

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 2020). 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*.

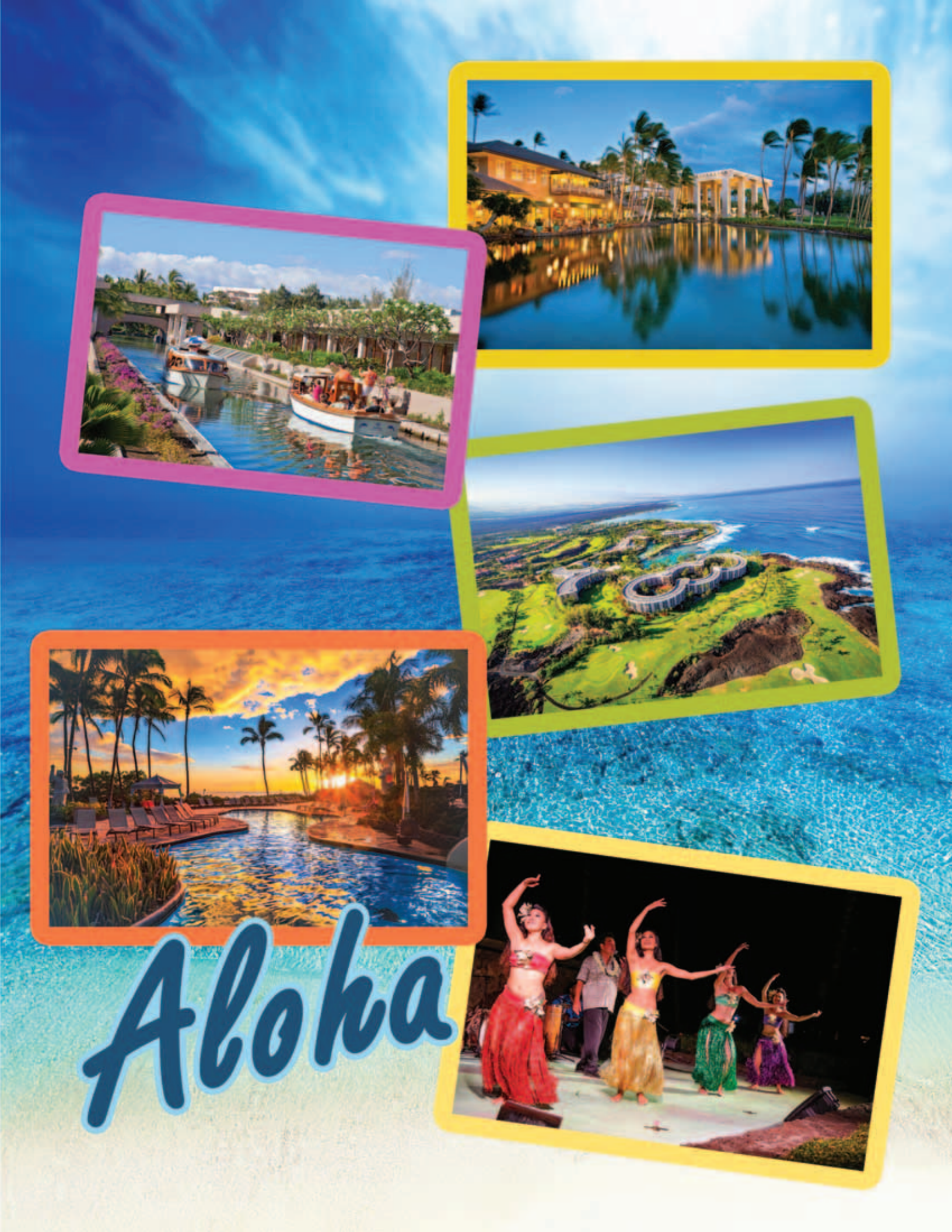
SAN ANTONIO, TEXAS

Deep in the heart of Texas, San Antonio's bold spirit and historic legacies make it an ideal gateway to the region's culture, scenic beauty and restful retreats. San Antonio has been part of colonial Spain, the Republic of Mexico, the Republic of Texas, and since 1845, the United States. Relics and tales from this iconic past linger along the city streets. Originally colonized by Spain, San Antonio has five beautifully preserved Spanish colonial missions including The Alamo, the location of a famed battle for Texas independence. La Villita Historic Arts Village, a small village that housed Spanish soldiers stationed at The Alamo, is full of life and commerce. Commerce also thrives a few blocks away at Market Square. Known as the largest Mexican market north of the Rio Grande, Market Square is filled with local and imported pieces of art, pottery, jewelry and textiles.

Photo courtesy of visitsanantonio.com, Stuart Dee

One distinct locale that houses many of San Antonio's unique offerings is the River Walk. Here you will find miles of meandering paths along the banks of the San Antonio River connecting a Texas-sized sampling of hotels, restaurants, shops, historic landmarks, museums and more. Visitors and locals dine aboard river cruisers and the sounds of mariachis echo from the stone bridges above. This is the river that originally inspired the settlement of San Antonio, and it still flourishes today as the city's center.

From the Marriott Rivercenter, step out onto the River Walk, visit the Alamo, and enjoy one of America's most authentic destinations. It is a city alive: a city of poets and lyricists, painters and sculptors, a city rich and humble. Please join us for NSREC 2019 in San Antonio.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