



RADECS



➡ Bremen 2016 ➡

SeSSionS, PaPerS & abStractS
raDecS 2016
September 19-23, 2016



ABOuT ThE ConfERE nCE

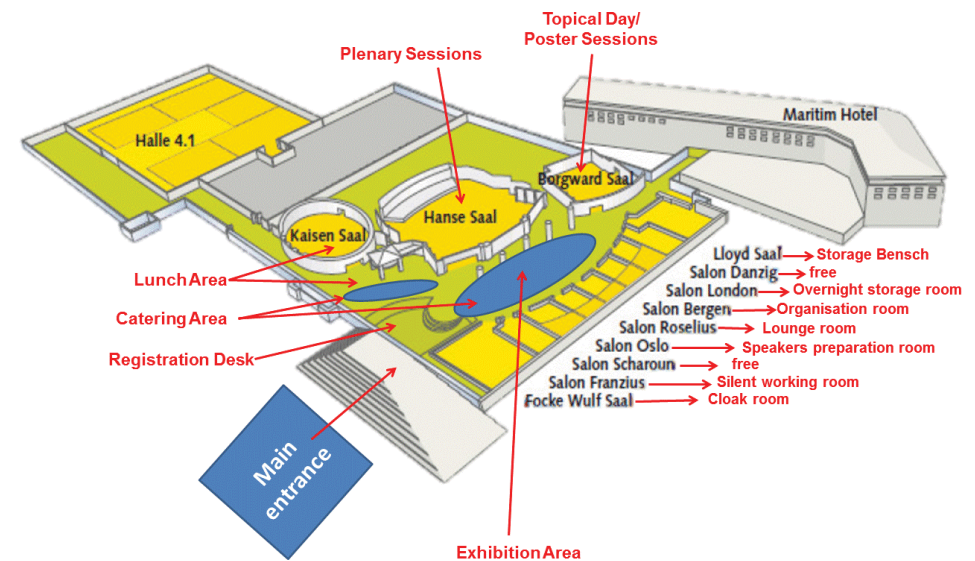
The 2016 RADECS Conference takes place from September 19-23, 2016 at the Congress Centre Bremen, Germany.

The conference features a technical program bringing you the latest developments on radiation effects in the form of oral and poster presentations and a data workshop. The oral presentations is partitioned by topic into ten sessions over the week, with the posters and the data workshop having a dedicated session of their own.

The conference starts with a topical day focusing on „Jupiter’s harsh radiation environment and associated radiation effects and other astrophysics missions with high dose“ on Monday, September 19. In addition to the technical presentations, several invited talks take place during the conference. An industrial exhibit completes the event, providing the opportunity for exhibitors to demonstrate their products and services. Finally an exciting and varied social program for both delegates and accompanying persons has been organized.

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, integrated circuits, boards and equipments, are presented at this meeting of engineers, scientists, and managers. The RADECS is an international conference with participants from all over the world.

ConfERE nCE CE nTER BRE mEn ovER viEW



RADECS 2016 PRoGRAM

Time	Monday	Tuesday	Wednesday	Thursday	Friday
08:00	Registration 8:00 - 18:00	Registration 8:00 - 18:00	Registration 8:30 - 17:00	Registration 8:30 - 16:00	Registration 8:30 - 10:30
09:00	Past/Present/Future Mission to Jupiter 9:00 - 10:30	Opening Ceremony Basic Mechanisms of Radtion Effects 9:20 - 10:30	Radtion Environments 9:00 - 10:10	Single Event Effects (SEE) in Devices and ICs 9:00 - 10:25	Invited Talk: Spaceweather 9:00 - 10:00
	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Single Event Transients 10:00 - 10:04
	Jovian Radtation Environment 11:00 - 12:30	Radtion Effects in Devices and ICs 11:00 - 12:25	Hardening by Design 10:40 - 12:05	Single Event Effects (SEE) in Devices and ICs 10:55 - 11:25	Coffee Break
	Lunch Break 12:30 - 13:30	Lunch Break 12:25 - 14:00	Lunch Break 12:05 - 13:30	Invited Talk: Astronaut 11:25 - 12:25	Single Event Transients 11:10 - 12:40
13:30	Radtion Effects for Jovian Missions 13:30 - 15:00	Invited Talk: Bremen 14:00 - 14:45	Invited Talk: Cosmic and Human Spaceflight 13:30 - 14:30	Lunch Break 12:25 - 14:00	Closing Remarks 12:40 - 13:00
	Coffee Break	Hardness Assurance 14:45 - 15:25	Facilities and Dosi- metry 14:30 - 15:10	SEEs on Boards and Equipments 14:00 - 14:35	END
	Radtion Issues for Future Science Pay- loads 15:30 - 17:00	Coffee Break	Poster Session with Coffee 15:10 - 17:30	Data Workshop with Coffee 14:35 - 16:30	
	Conclusion	Radtion Effects in Photonics and Optical Fibres 15:55 - 17:35		RADECS Committee Open Meeting 16:30 - 17:30	
18:00	Beck's brewery tour 18:00 - 21:30	Industry sponsored get together 17:30 - 20:30	Mayor's reception in Town Hall 19:00 - 20:00	Weser River Cruise with Beer & Pretzels 18:30 - 20:30	
			Conference Gala Dinner 20:00 - 24:00		

RADECS 2016 SoCiAl PRoGRAm
EvEninG EvEnt ovERviEW

Monday, September 19, 18:00 - 21:30

BECKs wATCH & DRink

The award-winning Beck's beer is still brewed in Bremen, Germany. The brand with its distinctive green bottle has a truly international reputation: It is exported world-wide to beer drinkers in over 120 countries and is responsible for 30 percent of all German beer exports.

Start the evening with an interesting and varied tour of the museum, the raw materials area and the brewhouse, passing by malt silos, fermentation and storage tanks and the laboratory, and complemented with information on the company and two films in a cinema. A visit to the bottle filling line is only possible when the line is in operation. Back in the guest room you can expect a beer test and a mini draught course. Afterwards you will be served with brewery products as well as non-alcoholic beverages and pretzel sticks (Laugenstangen).

Registration is required

meeting point: Foyer Congress Center Bremen (**6 pm**) Bus Transfer to Becks Brewery
Entrance of Becks visitor center (**6:30 pm**), Address: Am Deich 18/19

Tuesday, September 20, 17:30 - 20:30

inDuSTRIAl RECEPTion

Get-together with drinks and snacks sponsored by the exhibitors.

meeting point: Foyer Congress Center Bremen

Wednesday, September 21, 19:00 - 0:00

**wElCome RECEPTion „TownhAll“ &
ConfEREnCE DinnER „RATSkEllER“**

The President of the senate of the free hanseatic city of Bremen – Mayor Carsten Sieling has the pleasure of inviting you to a reception in the historic town hall. Bremen's town hall is regarded as the jewel in the crown of the historical market square. The Upper Hall, where the city council used to convene, is the most magnificent ceremonial venue in Bremen. It is the only European town hall built in the late Middle Ages that has not been destroyed or altered, managing to survive in its original form over the centuries. The town hall and Roland statue are among Bremen's main historical attractions and have enjoyed UNESCO World Heritage status since 2004.

After the reception in the Upper Hall you will descend in the cellar beneath - "The Ratskeller" restaurant - to join a gala dinner. Dating back more than 600 years, the Ratskeller is Germany's oldest wine cellar and still holds a collection of exquisite German wines.

Senate Welcome Reception „Town Hall“ (7 pm)

Gala Dinner „Ratskeller“ (8 pm)

meeting point: Town hall (entrance opposite of the Skt. Petri Dom)

Thursday, September 22, 18:30 - 20:30

wESER RiVER CRuiSE wiTh BEER & PRETZEIS

Casual boat trip on the river Weser.

meeting point: Pier "Martinianleger", Address: Martinistr. 12

Tuesday, September 20, 14:00 - 14:45

BREmEn: SuRPriSinGly DiFFEREnT

Peter Siemering, Managing Director BTZ Bremen Tourism Center

You may well be familiar with the fairytale of the Bremen Town Musicians. But it's another story which truly describes the Bremen spirit. It's a story about inventiveness, creativity and ... yes, laziness. Peter Siemering will take you on a journey through time and history to a newly invented city which today is surprisingly different from most visitors' expectations.

,Well, I never knew that!' is a phrase often uttered by people visiting the Free Hanseatic City of Bremen for the first time. The fairytale city of Bremen is traditionally known for its history and its cosmopolitan outlook. But Bremen is also the tenth-largest city in Germany, a European centre for aerospace, a city of science and home to the Überseestadt district, one of the largest urban development projects in Europe. Bremen, a destination full of surprises.

Wednesday, September 21, 13:30 - 14:30

RADiATion EFFECTS on ThE miSSion To mARS

Marco Durante, TIFPA-INFN, Director, University of Trento

Robotic exploration is the precursor for human colonization of the Solar system. Radiation is generally acknowledged as the main health threat for long-term manned interplanetary missions. The RAD detector on the Mars Science Laboratory recently gave the first accurate measurements of the dose rate on the way to Mars (1.84 mSv/day) and on the planet's surface (0.64 mSv/day). The results support previous calculations based on mathematical models of the cosmic ray transport, and demonstrate that any Mars exploration mission will cause crew's exposures above 1 Sv, exceeding the astronauts' professional dose limits and representing a serious risk of late morbidity. The most important health risk is generally considered cancer, but noncancer risks (especially cardiovascular disease and central nervous system effects) have been demonstrated in laboratory experiments. The question is how to mitigate these risks. Passive shielding is limited on the spacecraft, and active shielding or radioprotective drugs are not readily available, and hardly will be in the near future. Reducing transit time with new propulsion can however substantially reduce the radiation risk, and also decrease physiological dysfunctions caused by microgravity and psychological stress related to isolation. Passive shielding can be much more effectively pursued on the planet Mars, building a planetary base on the surface or exploiting deep natural caves.

Thursday, September 22, 11:25 - 12:25

kEynoTE SPEECH: ExPERiEnCE of A GERmAn ASTRonAuT

Thomas Reiter, European Space Agency (ESA) astronaut,
Former director of ESA's Directorate of Human Spaceflight and Operations

Thomas Reiter has totalled 350 days in orbit, making him the European astronaut with the most experience. Between April 2011 and December, Reiter was the Director of Human Spaceflight and Operations at the European Space Agency, ESA. He is now ESA coordinator for the International Space Station programme and advisor to ESA directors.

Friday, September 23, 09:00 - 10:00

**ThE Sun AnD SPACE wEAThER in 3D –
fRom RESEARCh To oPERATionS**

Volker Bothmer, Institute of Astrophysics, Göttingen University

The Sun is the prime source of energy in our solar system and predominantly controls the conditions of space weather. Over the past decades, a variety of solar and heliospheric space missions, such as SOHO, STEREO, SDO or ACE have provided unprecedented observations of plasmaphysical processes in the inner heliosphere. The analysis of multipoint coronal, solar wind and radiation measurements have led to a new understanding of the quantitative impacts of the various forms of solar activity on the planets of our solar system. Of special importance are the effects on our modern day technological infrastructure and the disastrous societal consequences of solar superstorms, especially in view of the increasing importance of space based applications. In my presentation, I will try to provide answers to a number of key questions regarding the specific impacts of space weather effects and how these are intimately connected to state-of-the-art scientific research, e.g., carried out in projects such as AFFECTS, OPTIMAP or HELCATS. I will also provide an outlook on how reliable space weather forecasts can be established in an operational manner, including the development of dedicated missions and instruments as part of ESA's Space Situational Awareness Program and other international efforts.

Monday, September 19, 9:00 - 10:30

TOPICAL DAY SESSION 1

1. Past/Present/future missions to Jupiter

Ali zadeh (ESA)

General overview of JUICE mission

[15 minutes]

insoo Jun (JPI)

General overview of past/present/future US missions to Jupiter (incl. Voyager, Galileo, Juno, Europa/Europa Lander)

[15 minutes]

[TBC] natalia khamidullina (lavochkin Association)

[TBC] General overview of Laplace-P orbiter and lander

[15 minutes]

2. Jovian Radiation Environment

Elias Roussos (mPS)

Science: Jupiter's radiation belt compared with those of other planets

[20 minutes]

hugh Evans (ESA)

Jovian radiation and plasma environment models for JUICE mission

[20 minutes]

Monday, September 19, 11:00 - 12:30

TOPICAL DAY SESSION 2

2. Jovian Radiation Environment (continued)

insoo Jun (JPI)

Jovian radiation belt model history at JPL

[20 minutes]

3. Radiation Effects for Jovian missions

3.1 *Electrostatic charging (internal/external) & plasma interactions*

David Rodgers (ESA)

Electrostatic charging considerations and plasma environment models for JUICE mission

[20 minutes]

wousik kim (JPI)

High level charging (surface and internal) on Jupiter missions

[20 minutes]

3.2 *RHA for EEE parts & materials (radiation effects on EEE parts & materials)*

Renaud mangeret (Airbus)

JUICE EEE parts and materials RHA approach

[25 minutes]

Monday, September 19, 13:30 - 15:00

TOPICAL DAY SESSION 3

3.2 RHA for EEE parts & materials (radiation effects on EEE parts & materials) (continued)

Ali zadeh (ESA)

JUICE EEE parts and materials RHA approach

[15 minutes]

Steve McClure (JPL)

EEE parts and material programs for Jupiter missions

(Juno, Europa)

[25 minutes]

3.3 Radiation shielding

marco vuoto (ESA)

Shielding strategies for JUICE: material options and the “vault”

[20 minutes]

insoo Jun (JPL)

Shielding strategies for JPL Jupiter missions

[20 minutes]

Monday, September 19, 15:30 - 17:00

TOPICAL DAY SESSION 4

3.3 Radiation shielding (continued)

Pete Truscott (kallisto)

Development of shielding analysis tools

[20 minutes]

4. Radiation issues for future Science Payloads

[TBC] natalia khamidullina (lavochkin Association)

[TBC] Radiation design of Laplace-P orbiter and lander

[20 minutes]

Elias Roussos (mPS)

Radiation design of Particle Environment Package (PEP) instrument for JUICE mission

[20 minutes]

Eamonn Daly (ESA)

Radiation issues for post-JUICE “Large” class ESA science missions

[20 minutes]

Tuesday, September 20, 9:30 - 10:30

BASiC mEChAniSmS of RADiATion EFFECTS

Session Chairs: Hugh Barnaby, Arizona State Univ.
Jean-Luc Leray, CEA

mclain, michael (Sandia national laboratories):

Effects of Process Variation on Radiation-Induced Edge Leakage Currents in n-Channel MOSFETs

The effects of radiation-induced defects and statistical variation in the dose and energy of MOSFET channel implants in a modern bulk CMOS technology are modeled using a process simulator in combination with analytical computations.

Gaillardin, marc (CEA):

Total Ionizing Dose Response of Multiple-Gate Nanowire Field Effect Transistors

This summary investigates the TID response of Triple-gate nanowire FETs. This paper discusses the impact of the NWFET design and bias configuration during irradiation to get thorough insights into their TID behavior.

Jiang, Rong (vanderbilt university):

Total ionizing dose effects in passivated and unpassivated AlGaIn/GaN HEMTs
Significant shifts in threshold voltage have been observed during 10-keV X-ray irradiation of passivated and unpassivated AlGaIn/GaN HEMTs. Oxygen and hydrogen impurities are found to contribute to the responses.

Javanainen, Arto (Department of Physics, university of Jyvaskyla):

Incident Angle Effect on Heavy Ion Induced Reverse Leakage Current in SiC Schottky Diodes

Heavy-ion induced degradation in the reverse leakage current of SiC Schottky power diodes shows distinct dependence on the angle of incidence. Simulations have been used to give insight into the physical mechanisms involved.

Tuesday, September 20, 11:00 - 12:25

RADiATion EFFECTS in DEViCES AnD iCS

Session Chairs: Michael McLain, Sandia Labs
Boris Glass, ESA-ESTEC

Santos, fernando (universidade federal do Rio Grande do Sul):

Radiation Sensitivity Evaluation of Pedestrian Detection Algorithm

We experimentally evaluate the reliability of pedestrian detection on two SoC architectures. Neutron beam experiments show that 70% to 90% of errors only slightly impact detection. Through fault injection we identify critical pedestrian detection procedures.

Bagatin, marta (DEI - university of Padova):

Effects of High-energy Electrons in Advanced NAND Flash Memories

We study the effects of high-energy electrons on advanced NAND Flash memories. We analyze the error rate in floating gate cells, discuss the mechanism, and compare the results. We study the effects of high-energy electrons on advanced NAND Flash memories. We analyze the error rate in floating gate cells, discuss the mechanism, and compare the results with the response to gamma-ray irradiation.

vandavelde, Benjamin (TRAD):

Impact of Multiple Write Cycles on Radiation Sensitivity of Flash NAND Memory Devices

The work presented here investigates the impact of multiple write cycles on NAND Flash memory radiation sensitivity. Cobalt 60 and Heavy ion tests have been performed in order to study the data corruption evolution.

Ratti, Iodovico (università di Pavia and infn Pavia):

Charge preamplifier in a 65 nm CMOS technology for pixel readout in the Grad TID regime

A charge sensitive amplifier has been developed in a 65 nm CMOS technology for pixel readout applications in the harsh HL-LHC environment, where it will have to withstand total ionising doses in the Grad range.

moscatelli, francesco (CnR - imm Bologna and infn of Perugia):

Radiation Damage Effects on p-type Silicon Detectors for High-Luminosity Operations

A new comprehensive TCAD radiation damage modelling scheme, featuring both bulk and surface radiation damage effects, has been proposed and validated through the comparison of the simulation findings with experimental measurements

Tuesday, September 20, 14:45 - 15:25

hARDnESS ASSuRAnCE

Session Chairs: Simone Gerardin, Univ. Padova
Marc Poizat, ESA-ESTEC

Pourrouquet, Pierre (TRAD):

Comparative Study Between Monte-Carlo Tools for Space Applications

Comparisons between Monte Carlo tools widely used in the space and nuclear industry were performed. The study focuses on total ionizing dose results from both Forward and Reverse Monte Carlo methods using 3D radiation models.

Rousselet, mathias (universite de montpellier):

Use and Benefits of COTS Board Level Testing for Radiation Hardness Assurance

New Radiation Hardness Assurance RHA approaches to insert commercial-of-the-shelf COTS electronics into space systems are studied.

Tuesday, September 20, 15:55 - 17:35

RADIATION EFFECTS in Photonics AND optical FIBRES

Session Chairs: Sylvain Girard, Univ. St.-Etienne

Jochen Kuhnenn, Fraunhofer INT

Gow, Jason (The open university):

Charge Transfer Inefficiency Mitigation in a CCD by Trap Pumping

This paper describes an analytical algorithm created to investigate the ability to recover lost charge in X-ray images from an irradiated p-channel CCD by creating trap maps using the trap pumping technique.

wood, Daniel (The open university):

Evolution of proton-induced defects in a cryogenically irradiated p-channel CCD

The defect distribution of a p-channel CCD is analysed after proton irradiation at cryogenic temperature.

zeiler, marcel (CERN):

Radiation hardness evaluation and phase shift enhancement through ionizing radiation in silicon Mach-Zehnder modulators

We exposed silicon photonic Mach-Zehnder modulators to ionizing radiation and assessed their performance changes. We demonstrate that the etch depth of the waveguides and the doping concentration therein strongly affect the devices' radiation hardness.

kuhnenn, Jochen (fraunhofer INT):

Gamma Radiation Tests of Radiation-Hardened Fiber Bragg Grating Based Sensors for Radiation Environments

We performed gamma radiation tests on radiation-hardened FiberBraggGratings at high temperatures to qualify them for application in very harsh environments such as nuclear facilities. The results confirm the hardness previously observed under X-ray irradiation

Reghioua, imène (lab hubert-Curien):

Investigation of point defects in silica-based optical fibers by cathodoluminescence

We demonstrated the ability of cathodoluminescence technique to investigate the origin of different point defects present in silica-based optical fibers that are devoted to be used in harsh environments

kuhnenn, Jochen (fraunhofer INT):

Gamma Irradiation Test of Ge-Doped Single-Mode Optical Fiber at Cryogenic Conditions

For the first time we present spectral radiation-induced attenuation data at cryogenic temperatures of gamma irradiated single-mode fiber. The RIA increases by a factor of more than 1000 compared to room temperature.

Wednesday, September 21, 9:00 - 10:10

**RADiATion EnviRonmEnTS
(SPACE, TERRESTRiAl, AnD ACCEIERAToRS)**

Session Chairs: Peter Beck, Seibersdorf Lab
Giovanni Santin, ESA-ESTEC

Bourdarie, Sebastien (onERA):

Benchmarking ionizing space environment models

In flight displacement damage doses, ionizing doses on board various space vehicles are compared to predictions performed with proton measurements and with protons spectrum predicted by AP8min model and the AP9 mean model.

Benck, Sylvie (Center for Space Radiations, universit  catholique de louvain):

Characterization of solar energetic H and He spectra measured by the Energetic Particle Telescope (EPT) on-board PROBA V during the January 2014 SEP event.

Based on Solar Energetic Particle event study, He flux peculiarities as compared to H are identified, so as to infer to conditions under which both ions have to be accounted for in radiation effect analysis.

Jiggins, Piers (European Space Research and Technology Centre):

Defining The SEP Environment For Specifications Using The SAPPHiRE Model
Solar Accumulated and Peak Proton and Heavy Ion Radiation Environment model covers all SEP environment time-scales across relevant ions in a probabilistic manner. Model outputs include mission cumulative fluence, worst-case event fluence and peak fluxes.

Iatocha, Marcin (Seibersdorf Labor GmbH):

Cosmic Radiation Assessment at ESAs Space Weather Portal with AVIDOS

We present an overview of cosmic radiation assessment done by measurements and Monte Carlo modelling. Further, we discuss effects by sporadic solar energetic particles and introduce a nowcast model for radiation exposure at flight altitudes.

Wednesday, September 21, 10:40 - 12:05

hARDenInG By DESiGn

Session Chairs: Raoul Velazco, TIMA
Henning Wulf, OHB Systems AG

Lins, Filipe (UFGRS):

Register File Criticality on Embedded Microprocessor Reliability

We investigate the criticality of register file and compiler optimization on ARM-based SoCs reliability. The analysis performed using a homemade interruption-based efficient fault-injector is correlated with heavy ions experiment results.

Berg, Melanie (AS&D Inc. in support of NASA Goddard):

The Effects of Race Conditions when Implementing Single-Source Redundant Clock Trees in Triple Modular Redundant Synchronous Architectures

We present the challenges that arise when using redundant clock domains due to their time-skew. Radiation data show that a singular clock domain provides an improved triple modular redundant (TMR) scheme over redundant clocks.

Kaur, Raminder (Indian Institute of Technology, Gandhinagar):

Guarded Dual Rail Logic for Soft Error Tolerant Standard Cell Library

A novel technique to implement standard cell library using dual rail logic and TAG gate is proposed. TCAD and SPICE simulations were carried out to validate the idea and compare design with existing techniques.

Danilov, Igor (SRISA):

DICE-based Muller C-elements for Soft Error Tolerant Asynchronous ICs

We propose three 65 nm CMOS circuit implementations of SEU tolerant C-element, whose tolerance is achieved by using of well-known DICE principle and is proved by SPICE simulations and semi-empirical estimations.

Jansen, Richard (European Space Agency):

Radiation and High-Voltage Tolerant Space CAN Driver in Standard Low-Voltage 3.3 V CMOS Technology

A radiation tolerant high voltage (16V) tolerant CAN driver designed in standard 3.3V CMOS technology using a stacked transistor topology.

Wednesday, September 21, 14:30 - 15:10

fACILITIES AND DoSimETRY

Session Chairs: Markus Brugger, CERN
Heikki Kettunen, RADEF

weulersse, Cécile (Airbus Group innovations):

Applicability and extrapolation model for SEE characterization using 14 MeV neutron

This paper explores the domain of applicability of 14MeV neutron generators for SEE characterization. Irradiations are performed on various devices and a simplified model is proposed to extrapolate 14MeV neutron data to atmospheric environments.

Garcia-inza, mariano (uBA-ConiCET):

Integration of Structures and Circuits for Dosimetry in a Single CMOS Chip
We present the design and fabrication in a standard CMOS process of a chip that gathers several structures and circuits for ionizing radiation dosimetry. First experimental results are presented.

Thursday, September 22, 9:00 - 10:25

SinGLE EvEnt EFFECTS in DEvICES AnD iCS

Session Chairs: Farokh Irom, JPL

Stefan Höffgen, Fraunhofer INT

Tali, maris (university of Jyväskylä):

Mono energetic electron induced single event effects at the VESPER facility
We present experimental evidence and simulations of 200 MeV mono energetic electron induced upsets in an SEU monitor at the VESPER facility, CERN.

Gerardin, Simone (DEI - university of Padova):

Complete Loss of Functionality and Permanent Page Fails in NAND Flash Memories

Permanent effects were studied in NAND Flash memories using the GSI microbeam. Complete loss of functionality was observed at very high LET. New insight on permanent page fails is presented.

Chen, Rongmei (Tsinghua university):

Effects of Temperature and Supply Voltage on SEU- and SET-Induced Soft Errors in Bulk 40-nm Sequential Circuits
SE sensitivity of bulk 40-nm sequential circuits as a function of temperature are investigated for different supply voltages. SET-induced errors in flip-flops are more sensitive to temperature variation than those of SEUs.

Surana, neelam (iiT Gandhinagar):

Short and Deep Drain MOSFET for Space Applications Device and Circuit Level Analysis

We propose a novel short and deep drain SDD MOSFET based circuits that can be used effectively for space applications. The 3 D TCAD simulations of heavy ion irradiation have been carried out on SDD

Jiang, hui (vanderbilt university):

Impact of Particle LET and Frequency on Combinational Logic Single Event Effects for Advanced Technologies

Single-event (SE) effects for 28-nm planar, 20-nm planar, and 16-nm FinFET technology combinational and flip-flop (FF) circuits are investigated using different LET particles. Results indicate that high-LET particles have a much stronger impact on the logic SE cross-section as compared to the FF SE cross-section for all three technology nodes. The cross-over frequency at which logic SE cross-section exceed FF SE cross-section remains mostly unchanged for all three technology nodes.

zhang, hangfang (vanderbilt university):

Single-Event Responses of Dual- and Triple-Well Designs at Advanced Planar and FinFET Technologies

Single event responses of dualwell and triplewell flipflop designs show insignificant differences at nominal supply voltage for the 16nm bulk FinFET node. However, the triple well design has superior performance for low LET particles.

Champeix, Clement (STmicroelectronics):

Laser testing of a double-access BBICS architecture with improved SEE detection capabilities

This paper reports a first practical validation of a double-access Bulk Built-In Current Sensor design at efficiently detecting SEEs. Validation experiments were performed with a picosecond range pulsed-laser source on 40 nm CMOS test

Thursday, September 22, 13:30 - 14:30

SinGLE EvEnt EFFECTS on BoARDS AnD EquipMentS

Session Chairs: Andreas Schüttauf, Airbus D&S
Grigory Protopopov, USRC-ISDE

Secondo, Raffaello (CERN):

Analysis of SEL on Commercial SRAM Memories For Latchup Detection and Protection in LEO Space Applications

SEL characterization of commercial SRAM memories has been carried out to select the best candidate for a latchup experiment in LEO space environment. A circuit for SEL detection and protection has been proposed and teste

Iunardi, Caio (universidade federal do Rio Grande do Sul):

On the Error Criticality of Sorting Algorithms for HPC and Large Servers Applications

We investigate neutron errors in three implementations of sort algorithms (QuickSort, Merge-Sort, RadixSort) on GPUs for HPC and large server applications. Radiation can produce wrong elements, misalign values as well as crashes or system hang.

Friday, September 23, 11:00 - 12:00

SinGLE EvEnt TRAnSiEntS

Session Chairs: Steve Buchner, NRL
Florent Miller, Airbus

Evans, Adrian (iRoC Technologies):

Single Event Multiple Transient SEMT Measurements in 65nm Bulk Technology

This paper presents techniques for measuring Single Event Multiple Transients SEMTs including the results of heavy-ion testing of dedicated test-structures implemented in a 65 nm process technology.

quinn, Rachel (vanderbilt university):

Classical probability models have been found to underestimate the SET/SEU latching frequency dependence. This work confirms the importance of including short SET pulses in SEU probability calculations and compares the results to measured data.

morand, Sebastien (AiRBuS GRouP):

Application of two wavelengths laser testing for SETs prediction
Transient's prediction requires several assumptions on the number of sensitive volumes and their thickness in order to determine the single event rate. Laser tests approach is used to determine the best strategy of calculation.

wachter, mason (Georgia institute of Technology):

The effects of ionizing radiation on the single-event transient SET response of devices in a silicon-germanium SiGe bipolar and complementary metal oxide semiconductor BiCMOS platform is examined for the first time.

warner, Jeffrey (naval Research laboratory):

Laser induced, charge collection transients for p channel In_{0.33}Ga_{0.67}Sb MOSFETs are reported for buried and surface channel structures. The removal of the InAlSb layer above the channel eliminates

khachatryan, Ani (nRI/Sotera Defense Solutions):

Comparison of Single Event Transients in AlGa_N Ga_N Schottky Gate and MIS Gate HEMTs Using Single Photon Absorption and Focused X ray Techniques
Single Photon Absorption technique ultraviolet pulsed laser focused X ray beam is used to investigate single event transients in pristine AlGa_N Ga_N Schottky Gate and MIS Gate HEMTs. The results depend strongly structure of devices

Roche, nicolas (George washington university):

3D mapping by scanning focused laser pulses throughout the charge collection paths and analysis of voltage transients resulting from two-photon absorption in a wide bandgap material is reported for high-breakdown voltage vertical Ga_N diodes

ni, kai (vanderbilt university):

Pulsed-Laser Transient Testing with Tunable Wavelength and High Resolution for High Mobility MOSFETs
A tunable wavelength laser system and high resolution transient capture system are introduced to characterize transients in high mobility MOSFETs. The new setup enables resolution of fast transient signals and understanding of charge collection mechanisms.

PoSTER SESSION

Wednesday, September 21, 15:30 - 17:30

Session Chairs: Mirko Rostewitz, Tesat
Alexander Prokofiew, Univ. Uppsala

PoSTERS on BASiC mEChAniSmS of RADiATion EFFECTS

Griffin, Patrick (Sandia National Laboratories):

Uncertainty in Silicon Displacement Damage Metrics due to the Displacement Threshold Treatment

This paper examines the influence of the displacement threshold energy and the treatment of the threshold on the 1-MeV(Si) response function. This uncertainty contribution is characterized in the form of a covariance matrix.

Pershenkov, vyacheslav (national Research nuclear university mEPHi):

The Enhancement Factor of ELDRS in a Wide Range of Total Doses

The ELDRS enhancement factor versus total absorbed dose and dose rate is considered in a wide range of doses.

Pierron, Juliette (onERA):

Monte Carlo Simulations of Low Energy Electrons in Silicon

The electron transport in silicon at low energy (10 eV - 2 keV) is investigated with a Monte Carlo code using optical data. Electron emission yields, ionizing doses and practical ranges are presented.

Bakerenkov, Alexander (national Research nuclear university mEPHi (moscow Engineering Physics institute)):

Effect of low- temperature irradiation on ELDRS in bipolar transistors

The possible physical mechanism of ELDRS effect in bipolar transistors for room and low-temperature irradiation is described. The ELDRS-free device at room temperature suffers on this effect at low-temperature irradiation.

li, xiaolong (university of Chinese Academy of Sciences):

Use of Temperature-Switching Approach to Evaluate the ELDRS of Bipolar Devices

The low dose rate responses of bipolar devices are evaluated on the basis of different experiments. Based on experiments, a time-saving and conservative approach -temperature switching approach -to simulate the ELDRS of devices is presented.

li, xingji (harbin institute of Technology):

Research on Interaction between Displacement Defects and Oxide Charge in NPN Transistors by Deep Level Transient Spectroscopy

Based on DLTS, the interaction mechanisms between oxide charge and displacement defects in NPN transistors caused by the combined irradiations of 70 keV, 170 keV protons together with 5 MeV protons are revealed clearly.

Rodriguez, Axel (universite de montpellier – iES):

TCAD Simulations of Leakage Currents Induced by SDRAM Single-Event Cell Degradation

We implemented the Gossick cluster damage in a TCAD simulation suite to identify the mechanism of retention time drop in irradiated SDRAM cell. The location of the cluster appears to be a key parameter.

lei, zhifeng (China CEPREi lab.):

Heavy Ions Irradiation Effects on AlGaNGaN High Electron Mobility Transistors

Radiation Effects on AlGaNGaN HEMTs were studied by 800 MeV Bi ions irradiation, output and transconductance decreased, gate leakage current increased dramatically, heavy ion induced latent tracks and traps may be the root cause.

PoSTERS on RADiATion EFFECTS in DEViCES AnD iCS

Petitdidier, Sébastien (IuSAC – EAmEA):

Influence of neutron irradiation on electron traps induced by ageing test in AlInN/GaN HEMTs

This paper shows the impact of low fluence neutron irradiation on AlInN/GaN HEMTs before and after a Negative Gate Bias stress done at VGS - 20 V and VDS 0 V during 216 h.

Donegani, Elena (university of hamburg):

Defect spectroscopy of proton-irradiated thin p-type silicon sensors

TSC measurements performed on boron-doped silicon sensors after irradiation with protons of different energy, to investigate proton-induced bulk defects, their introduction rates, annealing behavior and impact on the electrical sensor properties

Chao, Der-Sheng (nuclear Science and Technology Development Center, national Tsing hua university):

Investigation on Electrical Properties and Irradiation-Induced Defects of Neutron-Transmutation-Doped Germanium in Different Neutron Spectra

Edmonds, larry (Jet Propulsion laboratory):

Fitting a Model to Floating Gate Prompt Charge Loss Test Data for the Samsung 8 Gb SLC NAND Flash Memory

A recent model provides risk estimates for the deprogramming, by an ionizing radiation environment, of initially programmed floating gates. The model requires several input parameters. Parameters are given for a Samsung NAND flash memory.

hillebrand, Theodor (university of Bremen):

Unified Stochastic Reliability Aware Model for SONOS Memories in Harsh Environments

Stochastic state based data retention model for SONOS NVM including degradation and radiation. For fast simulations response surface models are used. This enables simulations of large memory arrays at system level over 10 years.

zhuojun, Chen (Shanghai institute of microsystem and information Technology, Chinese Academy of Sciences):

Total Ionizing Dose Sensitivity of a Radiation-Tolerant Phase-Locked Loop in a 130 nm SOI Technology

This paper characterized sensitivity of TID response on a radiation-tolerant PLL fabricated in 130nm SOI process. Based on study of device parameter degradation, the performance attenuation of PLL circuit has been presented and discussed comprehensively.

wang, yan (institute of microelectronics, Chinese Academy of Sciences):

The Heavy Ion Radiation effects on the Pt/HfO₂/Ti Resistive Switching Memory

The radiation effects of Pt/HfO₂/Ti RRAM is investigated under the radiation of heavy ion ⁸⁶Kr²⁶⁺ of HIRFL. The electrical characteristics are still stable after radiation. And the obvious decrease is shown in the original resistance

zebrev, G. i. (national Research nuclear university mEPhi):

Compact Modeling of I-V Characteristics in Irradiated MOSFETs: Impact of Operation Temperature and Interface Traps

We have presented a new compact MOSFET model, which allows us to describe the I-V characteristics of heavily irradiated long-channel and short-channel transistors in all operation modes at different measurement temperatures and interface trap densities.

Taggart, Jennifer

Effects of 14 MeV Neutron Irradiation on the DC Characteristics of CBRAM Cells

CBRAM cells were irradiated with 14 MeV neutrons to a total fluence of 3.19×10^{13} n/cm². The high resistance and low resistance states of the cells is shown to converge with increasing neutron fluence.

PoSTERS on hARDnESS ASSuRAnCE

Salvy, lionel (TRAD):

Total Ionizing Dose influence on the Single Event Effect sensitivity of active EEE components

The aim of this study is to evaluate potential synergistic effects of TID on SEE sensitivity and assess the consequences in terms of radiation hardness assurance for various space missions and especially the JUICE mission.

Guillermin, Jérémy (TRAD):

Part to part and lot to lot variability study of TID effects in bipolar linear devices

Process-induced variability between parts and lots is a critical issue for space applications and Radiation Hardness Assurance. This study explores the possibility to improve common tools by using a more sophisticated statistical analysis.

Andrianjohany, nomena (TRAD):

Prediction methodology of Single Event Effect and application on SRAM device

ASIC designers need to assess SEE reliability during the design stage. A prediction methodology is being implemented in an engineering software. An application of a first prediction method was performed on SRAM device.

zebrev, G. i. (national Research nuclear university mEPhi):

Compact Modeling of Soft Error Rate in Space Environment

Based on a novel parameterization of the SEU cross section vs LET dependence, a new procedure for ion-induced soft error rate calculation, which is adapted to the multiple cell upsets in highly scaled memories.

Abou-Auf, Ahmed (The American university in Cairo):

Worst-Case Test Vectors of FPGAs Exposed to Total Dose

We introduce a novel methodology for identifying the worst case test vector for flash based FPGA devices exposed to total ionizing dose based on cell level fault models of delay failures.

**PoSTERS on RADiATion EffECTS in PhoToniCS AnD oPTiCAI
fIBRES**

Alessi, Antonino (laboratoire h. Curien):

Effect of irradiation temperature on the radiation induced attenuation of Ge-doped fibers

We put in evidence the differences in the UV-visible response of Ge-doped optical fiber irradiated at different temperature and discuss the origin of these dissimilarities by combining optical and EPR measurements.

Aierken, Abuduwayiti (xinjiang Technical institute of Phys.& Chem., Chinese Academy of Sciences):

Comparison of 1 MeV electron irradiated lattice-matched and upright metamorphic GaInP/GaInAs/Ge triple junction solar cells for space application
The electrical parameters and spectral response of 1 MeV electron beam irradiated MOCVD grown lattice matched and upright metamorphic GaInP/GaInAs/Ge triple junction solar cells have been investigated.

li, yudong (xinjiang Technical institute of Physics and Chemistry, CAS):

Research on Spectral Response Degradation of Charge-Coupled Devices Induced by Radiation Damage

Through different kinds of Irradiation, gamma-ray, proton and neutron, the degradation of spectral response of charge-coupled devices CCDs induced by radiation damage is presented.

PoSTERS on RADiATion EnviRonmEnTS

Boscher, Daniel (onERA):

Modeling the trapped proton flux at GEO

We used measurements from GEO-LANL satellites to develop a proton radiation belt model for surface material degradation investigations. The model covers the energy range from 1keV to around 1MeV.

Arruda, luisa (liP):

SEP Protons in GEO measured with the ESA MultiFuntional Spectrometer
The MFS is a radiation monitor that together with the CTTB (Component Technology Test Bed) make the AEEF-TDP8 (ESA Alphasat Environment and Effects Facility – Technology Demonstration Payload 8). The two units are hosted in the X panel of the Alphasat satellite in orbit since July ,2013.

Sicard-Piet, Angélica (onERA):

Is Carrington event in 1859 really worse than other recent extreme events?
The goal of this study is to compare magnetic activity during Carrington event with other more recent events and then to answer the question : is Carrington event a worse event than others?

Anashin, vasily (Branch of JSC uRSC – iSDE):

Results of onboard electron and proton fluxes measurements in geostationary and polar orbits in 2015-2016

Analysis of flight data from spectrometers in geostationary and polar orbits was presented. Flight data were compared with other in-flight measurements and with trapped and solar particles models including AX8, AX9, CRRESELE, JPL, ESP, IGE

murphy, James (Dublin City university):

XMM-Newton radiation monitor re-calibration and data analysis for anomalous events

Anomalous low flux, low energy electron events are observed by XMM-Newton's radiation monitor at high altitudes. Using a re-calibration of the detector and the long historical database these events are identified and characterised.

Abe, Shin-ichiro (Japan Atomic Energy Agency):

Shielding Effect on Secondary Cosmic-Ray Neutron- and Muon-Induced Soft Errors

We have analyzed secondary cosmic ray neutron and muon induced soft error rate (SER) in building. it is found that shielding by building only reduces neutron induced SER, and hence muon induced SER cannot be ignored.

Steffens, michael (fraunhofer iT):

Characterization of Novel Lightweight Radiation Shielding Materials for Space Applications

In this study, novel materials and multilayers as potential alternatives to the standard Aluminum shielding approach are assessed by Monte Carlo simulations and promising candidates are manufactured and characterized by radiation tests.

E.G. Stassinopoulos

Measurement of Cosmic Ray and Trapped Proton LET Spectra on the STS-95 HOST Mission

This paper reports on in situ measurements of the Linear-Energy-Transfer (LET) spectra of galactic cosmic rays and their progeny and of trapped Van Allen belt protons as recorded by a Pulse-Height-Analyzer (PHA) radiation spectrometer which flew on the STS-95 DISCOVERY mission on the Hubble Orbital Systems Test (HOST) cradle.

PoSTERS on hARDEninG By DESiGn

huang, huixiang (information Engineering College, Jimei university):

A Novel Partially-Depleted SOI Structure to Suppress Bipolar Amplification under Heavy Ion Radiation

A novel partial SOI structure with a laterally extended tunnel diode body contact is proposed to suppress parasitic bipolar amplification under transient radiation. It shows a lower parasitic bipolar amplification gain.

Jiang, lu (institute of microelectronics of Chinese Academy of Sciences):

Improved Single-Event Hardness of Trench Power MOSFET with a Widened Split Gate

An improved power MOSFET structure with a widened split gate trench is to enhance single-event burnout hardness by suppressing the parasitic transistor nearly completely due to the elimination of P-well region beneath the N+

Sorge Roland (ihP)

Junction Isolated MOS/LDMOS Cascode Arrangement for Radiation Tolerant RF-Power Applications

We report on the effectiveness of a novel hardening by design approach for radiation tolerant integrated RF power MOS transistors confirmed by single event burn out (SEB) and total ionizing dose (TID) radiation tests. In order to substantially decrease the TID related leakage currents the lateral shallow trench isolation (STI) was replaced by narrow junction isolation regions.

maruoka, haruki (kyoto institute of Technology):

A Non-Redundant Low-Power Flip Flop with Stacked Transistors in a 65 nm Thin BOX FDSOI Process

HPC requests higher reliability and lower power consumption. We propose a non-redundant low-power flip flop with stacked transistors in a 65 nm FDSOI. There is no error by alpha and neutron irradiation tests.

liu, lin (Beijing microelectronics Technology institute):

The 65nm Double-DICE Storage Element Based on Error-Quenching Layout Design to Reduce Single-Event Multiple Node Upsets

This paper proposes a new Double-DICE Storage Element based on Error-Quenching Layout Design. Experiments demonstrate that the proposed cell achieves 2-3 orders of magnitude reduction in cross section compared to our reference DICE

Smith, farouk (nelson mandela metropolitan university):

An alternative implementation of the Muller C element for Single Event Upset mitigation in Memory Elements

A modification of the Muller C Element is proposed as a single event transient, SET, and single event upset, SEU mitigation circuit. Proton tests suggests its efficiency compared to unmitigated designs.

lopes, Jeremy (SPinTEC CEA, CnES, liRmm):

An SEU Tolerant MRAM Based Non Volatile Asynchronous Circuit Design

This work proposes a novel SEU tolerant circuit design based on asynchronous communication coupled with magnetic memory, MRAM, and SOI process that can detect and correct single or multiple errors without triplication of the circuit.

liu, Biwei (national university of Defense Technology):

SET Hardening Technology in Digital-Controlled-Oscillators

The circuit-level and layout-level SET hardening technology for DCOs are discussed. The simulation results show these hardening technology can reduce the phase shift of the DCO from 336ps to 24ps.

Sterpone, luca (Politecnico di Torino):

A Selective Mapper for the Mitigation of SETs on Rad-Hard RTG4 Flash-based FPGAs

This paper proposes a mapping tool to selectively mitigate radiation-induced Single Event Transient phenomena within the silicon structure of Microsemi RTG4 Radiation hardened Flash-based FPGAs. Experimental results on four benchmark circuits demonstrated effective SET mitigation.

Aranda, luis Alberto (universidad Antonio de nebrija):

A Fault-Tolerant Implementation of the Median Filter

In this paper, a novel technique to protect median filters against single event upsets is presented. Experimental results show that a high error detection rate of 91% is achieved introducing low additional resource overhead.

Gonçalves, márcio (universidade federal do Rio Grande (fuRG)):

Evaluating the Efficiency of Software-based Fault Tolerant Techniques to Detect SEUs in GPUs

This paper presents a software-based fault tolerant technique designed to harden Graphic Processing Units against SEU faults.

Chibani, kais (univ. Grenoble Alpes):

Application-Aware Soft Error Sensitivity Evaluation Without Fault Injections - Application to Leon3

We propose and demonstrate on a Leon3 microprocessor an approach avoiding any fault injections but performing at design time worst-case sensitivity evaluations with respect to soft errors, with good accuracy for a given application execution.

Calomarde, Antonio (Politécnica de Catalunya)

Active Charge Collection Strategy for Radiation Environment at Device Level
We present a method to improve the charge collection. Internal electric field drives the charge generated by the ion track out of the sensitive device terminals. Simulations show that the charge collected can be reduced

Coelho, Alexandre

Evidences of Bayesian Machines Robustness Against SEUs and SETs

This work revisits the stochastic computation paradigm as a way to implement architectures dedicated to Bayesian computation. Fault injection experiments assess the intrinsic robustness of a Bayesian Machine with respect to Soft Errors.

Sika, michel

Mitigating Single Event Upsets in Arithmetic Logic Using Residue Codes

This paper presents a low overhead residuecode based approach to detecting and correcting single event upsets (SEU) in arithmetic logic. Experimental validation of error mitigation is presented for circuits fabricated in 28nm technology.

PoSTERS on fACiliTiES AnD DoSimETRY

Aubert, D. (CEA):

A 6 MeV electron linac facility for multipurpose radiation testing
A new irradiation facility has come into operation at CEA Gramat. This resource, based on a linear electron accelerator, is intended for high cumulated dose deposition by means of either photon or electron beam.

Glein, Robért (friedrich-Alexander-universitaet Erlangen-nuernberg):

Detection of Solar Particle Events inside FPGAs
We propose an SEE sensor inside the FPGA with a solar condition detection. We discuss a model for statistical classification as well as the FPGA implementation. Thereby we can detect solar particle events.

underwood, Craig (Surrey Space Centre):

Development of Miniaturised Radiation Environment Monitors for Commercial Spaceflight: Flight Results from the MuREM/RM Payloads
The design, development and flight results of new miniaturised radiation monitors, capable of measuring the space radiation environment and its effects on electronics, are presented, leading to the deployment of standardised monitors for commercial spacecraft.

mahmud, Adnan (Arizona State university):

Influence of TID on Lateral Diffusion of Structures made of Novel Metal-Chalcogenide Glass Combinations: A Flexible Radiation Sensor Development Perspective
We report the results of our study on the influence of total ionization dose (TID) on lateral diffusion of some selected metals into chalcogenide glasses of different composition and variable atomic ratio.

Brucoli, matteo (CERN):

A complete qualification of Floating Gate Dosimeter for CERN applications
In this work, a comprehensive investigation of the Floating Gate Dosimeter is presented. Several experiments were performed to characterize different aspects of this dosimeter, such as linearity, resolution, temperature sensitivity and output retention.

zöllner, hannes (university of Applied Sciences Jena):

Generating SEL and SEU with a class 1 laser setup
Compact and low cost setup for generating SEL and SEU in COTS CMOS components. The setup consists of a pulse generator, a laser driver, focussing optics and diode lasers working as a class 1 laser

moscatello, marie helene (GANIL):

UPDATING OF GANIL FACILITY AND PRESENTATION OF THE NEW SPIRAL2 EXTENSION

GANIL is presented, and the various beam and irradiation system characteristics are updated. SPIRAL2, the new GANIL extension, is described, and the possibilities of irradiation tests with the light ion and neutron beams are presented.

felden, olaf

Application of GeV Protons for Radiation Effects Testing at COSY
Modern microelectronics show an increasing sensitivity to high energy protons, due to the use of heavier materials like tungsten. The cooler synchrotron COSY in Jülich can provide protons with energies of up to 2.5 GeV. Its potential for investigation of radiation effects is investigated in this paper.

PoSTERS on SinGLE EvEnt EFFECTS in DEViCES AnD iCS

yu, Junting (national university of Defense Technology):

Simulation analysis of heavy-ion-induced charge collection between nanoscale bulk-Si FinFET and conventional planar device
Single-event charge collection and pulse width are compared between bulk-Si FinFET and planar devices. Simulation results show that FinFET devices show significant reduction of charge collection and SET pulse widths compared with their planar counterparts.

Bagatin, marta (DEi - university of Padova):

Heavy-ion Upset Immunity of RRAM Cells Based on Thin HfO₂ Layers
HfO₂-based resistive RAMs have been irradiated with high-LET heavy ions and subject to an extensive characterization, showing that the cells are immune from upsets. Reasons for the observed hardness are discussed.

Al youssef, Ahmad (onERA):

Analysis of Low Temperature on Single Event Latchup Mechanisms by TCAD Simulations for Applications down to 50K
This paper presents an analysis of mechanisms induced by cryogenic temperatures on SEL in CMOS inverters for various technology nodes. TCAD simulations show a good agreement of Latchup characteristics with experimental measurements at cryogenic temperatures.

Bosser, Alexandre (university of Jyväskylä/IIRMM):

Comparison of the Effects of Muon and Low-Energy Proton Irradiation on a 65 nm Low-Power SRAM
A 65 nm SRAM has been subjected to muon and low-energy proton beams in static and dynamic test modes. The experimental results are compared to simulations.

González-Toral, Ricardo (universidad Antonio de nebrja):

A Novel Concurrent Error Detection Technique for the Fast Fourier Transform Implemented in SRAM-based FPGAs

In this paper, we present a novel Concurrent Error Detection technique for the Fast Fourier Transform in Field Programmable Gate Arrays. It requires low computational complexity and area occupation while achieving high error detection rates.

Chen, Rongmei (Tsinghua university):

Analysis of Temporal Masking Effect on Single-Event Upset Rates for Sequential Circuits

Reduction in single-event upset rates for sequential circuits due to temporal masking effect is evaluated. Effects of supply voltage, combinational-logic delay, flip-flop SEU performance and particle LET are analyzed for sequential circuits SEU rates.

zhang, zhangang (Science and Technology on Reliability Physics and Application of Electronic Component laboratory, China Electronic Product Reliability and Environmental Testing Research institute):

Monte-Carlo prediction of single-event characteristics of 65 nm CMOS SRAM under hundreds of MeV/n heavy-ions in space
Energy-deposition in SVs, SEU, and SER of 65 nm CMOS SRAM were revealed by Monte-Carlo methods, with heavy-ions energy ranging from 20 MeV/n up to 2 GeV/n, which are hardly obtained by ground accelerator test.

franco, francisco J. (universidad Complutense de madrid (uCm)):

Some Properties of only-SBUs Scenarios in SRAMs Applied to the Detection of MCUs

Statistical properties of experiments in SRAMs with only SBUs are mathematically evaluated. Strategies using deviations of actual data from theory are proposed to extract MCUs from the bulk of errors regardless the SRAM internal structure

Rodrigues, Gennaro (ufRGS):

Analyzing the Impact of Using POSIX Threads versus OpenMP in ARM Cortex-A9 Dual-Core under Soft Errors

This work analyzes the susceptibility of parallel software to soft errors when using Pthreads and OpenMP APIs. We achieve that by simulating and injecting random faults at registers of the ARM Cortex-A9 dual core processor.

hirokawa, Soichi (osaka university):

Multiple Sensitive Volume Based Soft Error Rate Estimation with Machine Learning

We propose a soft error rate estimation method with multiple sensitive volumes and machine learning. We confirmed the correlation between irradiation results and simulation results for 65-nm SOTB SRAM and the accuracy of upset classification.

Tambara, lucas (ufRGS/CERN):

Evaluating the Use of APSOCs for CERN Applications

This work investigates how the Processing System, PS configuration influences the reliability of FLASH based APSOC. We experimentally study differences in the radiation induced error rate of PS, under various configurations while executing an application.

Chen, yanran (vanderbilt university):

Single Event Characterization of first and second order Linear and Bang bang All digital Phase locked Loops, ADPLLs

The SEU vulnerability of common first and second order ADPLLs is investigated through fault injection experiments. SEUs in the highest order pole of loop filter result in worst case error response, often requiring system restart.

Clemente, Juan Antonio (universidad Complutense de madrid (uCm)):

Evaluation of the Sensitivity of a COTS 90-nm SRAM Memory at Low Bias Voltage

This paper presents an experimental study of the sensitivity to 14-MeV neutrons to low bias voltage of a COTS 90-nm Cypress SRAM. These results have also been compared with cross-section and SER theoretical predictions.

Ramezani, Reza (ferdowsi university of mashhad):

Estimation of Hardware Task Reliability on Partially Reconfigurable FPGAs

This paper presents a statistical model to estimate the reliability of hardware tasks on FPGAs operating in harsh environments. It has been validated by fault injection. Experimental results reveal the high accuracy of the model.

wei, he (national university of Defense Technology):

A preliminary study of SEE soft error propagation based on cellular automaton

Aiming at evaluating the SEE performance of complex electronic system, the SEE soft error propagation model based on cellular automation is proposed. Experiment indicates that the cellular automation model is feasible to study the problem.

Tonfat, Jorge (instituto de informática, PGmiCRO, ufRGS):

Analyzing the Influence of the Angles of Incidence and Rotation on MBU events induced by low LET heavy ions in a 28-nm SRAM-based FPGA

This work highlights the impact of low LET heavy ions particles on the reliability of 28-nm Bulk SRAM cells from Artix-7 FPGA.

Ruiqiang, Song (College of Computer, national university of Defense Technology):

Comparison of Radiation-Induced Charge Sharing Generated by Heavy Ion and Pulsed Laser

Charge sharing induced SEU and SEMT are measured using heavy ion and pulsed laser. Experiment results are compared and the mechanisms to influence pulsed laser induced charge sharing are investigated by 3D-TCAD simulations

Zinchenko, Vladimir (Research Institute of Scientific Instruments):

The study of the sensitivity of CMOS integrated circuits to single event latchup using pulsed bremsstrahlung

The features of latchup triggering in CMOS integrated circuits ICs induced by high intensity pulsed bremsstrahlung PB and heavy charged particles HCP are considered.

PoSTERS on SinGLE EvEnT EffECTS in BoARDS AnD EquiPmEnTS

krakowski, Pawel (CERN):

R2E of critical vacuum controls in the LHC

This paper describes the environment to which the critical vacuum controls is exposed in the LHC and presents the results of their radiation tests.

Ammar marwan

Comprehensive Vulnerability Analysis of Systems Exposed to SEUs via Probabilistic Model Checking

This paper presents a hierarchical framework to model, analyze, and estimate micro-electronic systems vulnerability to soft errors due to Single Event Upsets (SEUs). A Continuous-Time Markov Chain (CTMC) model of SEUs propagation is proposed and probabilistic formal techniques are utilized to exhaustively estimate their impact on the system behavior.

PoSTERS on SinGLE EvEnt TRAnSiEntS

ildefonso, Adrian (Georgia institute of Technology):

Modeling Single-Event Transient Propagation in a SiGe BiCMOS Direct-Conversion Receiver

This work presents a theoretical analysis of single-event transient SET signals in a direct-conversion receiver, proposes a new approach for SET testing of RF systems, and introduces using transient error vectors for radiation hardness evaluation.

Robinson, william (vanderbilt university):

Design-Based Variability in Simulating Single Event Transients

Accurate analysis of single event transients requires benchmarks that incorporate physical design of circuits to capture charge sharing effects. This paper provides case studies to show how design variability impacts single event transient simulations.

Bany, hamad Ghaith (Polytechnique montreal):

SMT-based Reliability-Aware Synthesis for Single Event Transients Tolerant Combinational Circuits

This paper presents a framework to estimate digital design vulnerability to Single Event Transients (SETs) based on Satisfiability Modulo Theories.

New strategies to mitigate SETs is proposed by selectively harden vulnerable nodes in the design and improving temporal.

zerarka, moustafa (iRT Saint Exupery):

TCAD simulation of the Single Event Effects in normally off GaN transistors after heavy ion radiation

Electrical behavior of normally off GaN power transistors under heavy ion stress radiation is presented based on 2D TCAD numerical simulation in order to better understand mechanism of Single Event Effects, SEE, in this devices.

Jianjun, Chen (College of Computer, national university of Defense Technology):

Angular dependence of heavy-ion-induced single event multiple

We find that angular heavy ion incidence can induce single event five transient in 65nm technology. Angular incidence reduces the total single events and SEMT, and its effect on twinwell and triplewell circuit is different.

Sterpone, luca (Politecnico di Torino):

Accurate Analysis of SET effects on Flash based FPGA System on a Chip for Satellite Applications

In this paper, we propose a methodology for executing simulation using analytical models execution of SET propagation on System on a Chip implemented on Flashbased FPGAs. Analysis performed on EUCLID based circuit design demonstrated its effectiveness

ma ,yingqi

Metallic Layers Reflections Effects on the Correlation of Laser Effective Energy and Heavy-ion LET for SEL Testing

This work is dedicated to give a relatively quantitative correlation of laser effective energy and heavy-ion LET for SEL testing. The metallic layers reflections effects on the correlation are investigated by series of experimental measurements.

mitrovic, mladen

Dependence of Inverter Chain Single-Event Cross Sections on Inverter Spacing in 65 nm Bulk CMOS Technology

Single-event cross sections of four inverter chains, with uniform inverter spacing ranging from 120 nm to 4 μ m, were experimentally measured and compared. We have observed that the cross section of tightly-spaced inverters is considerably smaller for both direct-hits and propagated single-event transients, and increases with increasing separation by a factor of 10 or more.

DATA woRkShoP

Thursday, September 20, 15:30 - 17:30

Session Chairs: Thomas Granlund, SAAB
Hagen Schmidt, Airbus D&S

Gebelein, Jano (Goethe university frankfurt):

Preparation of COTS TMS570 MCU for use in Ionizing Radiation Environments

Implementation and beamtest of a background refresh routine for the CPU-coupled SRAM of the COTS TMS570 automotive microcontroller with dual lockstep CPU to prevent error accumulation and enable usage for particle accelerator detector control systems.

van vonno, nick (intersil):

Total Dose and Single-Event Effects Testing of the Intersil ISL70517SEH Instrumentation Amplifier

We report the results of single-event effects and total ionising dose testing of the Intersil ISL70517SEH instrumentation amplifier together with a brief discussion of the parts functionality, electrical specifications and fabrication process.

van vonno, nick (intersil):

Total Dose and Single-Event Effects Testing of the Intersil ISL71830SEH Analog Multiplexer

We report the results of single-event effects and total ionising dose testing of the Intersil ISL71830SEH low voltage analog multiplexer together with a brief discussion of the parts functionality, electrical specifications and fabrication process.

Chaumont, Géraldine (STmicroelectronics):

Compendium of Radiation Results from STMicroelectronics

STMicroelectronics continues to enrich its Hi-Rel portfolio by qualifying new devices dedicated to space applications. In order to answer to the customer demand, ST performed SEE and TID tests on these new devices.

von Thun, matthew

Single Event Effects on a Radiation Hardened CAN Transceiver

SEE testing was performed on a radiation-hardened CAN transceiver. Heavy Ion and proton upset cross-sections are presented and compared across receiver architectures. Sensitivities related to bus common mode voltage are also discussed.

kalashnikov, oleg (SPEIS):

Rational Approach for DSP Functional Operability Monitoring within Radiation Tests

The specifics of DSP radiation behavior are analyzed. Upon these specifics the rational approach for DSP functional operability monitoring within radiation tests is developed. Presented radiation test results demonstrate the effectiveness of the developed approaches.

hofman, Jiri (Cobham RAD Solutions):

In-situ measurement of total ionising dose induced degradation of various commercial voltage references

A set of commercial voltage references was irradiated and measured under different bias conditions using an in-situ technique. The goal is to understand TID induced degradation of data acquisition systems for space applications.

wang, Jih-Jong (microsemi-SoC):

Single Event Effects Hardening on 65nm Flash-based FPGA

The single event effects hardening of the first ever radiation hardened Flash-based field programmable gate array, RTG4, are presented. The hardening includes the SEU and SET of the fabric, PLL, SEFI of Flash and SEL.

Gonzalez-Castaño, Diego (Radiation Physics laboratory – uSC):

RADFET characterization under, gamma and electron beams at Radiation Physics Laboratory Gamma Irradiation Facility

Study of RADFET dosimetry in gamma and electron beams at RPL irradiation facility, employing ionometric measurements and Monte Carlo simulation as reference and three different methods for RADFET readout.

Irom, Farokh (Jet Propulsion Laboratory):

Proton Damage in LED and phototransistor of Micropac 66179 Optocoupler This paper reports proton damage in LED and phototransistor of the Micropac 66179 optocoupler. Analysis of the test data reveals interesting information, such as the dependence of the transistor gain on irradiation and photocurrent.

Tsiligiannis, Georgios (CERN):

Investigation on the Sensitivity of a 65nm Flash-Based FPGA for CERN Applications

The continuous need for upgrading the instrumentation in various CERN experiments, has driven the qualification process of the new Flash-Based SmartFusion2 FPGAs. Several proton radiation tests are performed to meet the needs of CERN developers.

Anashin, Vasily (Branch of JSC uRSC – iSDE):

Recent SEE Test Results of Candidates for Space Application

The paper presents single event effects test results for some of space candidates electronics obtained at Roscosmos Test Facilities during recent test campaign in March 2016

Devine, James (CERN):

Radiation Hardening of LED Lighting for Accelerator Tunnels

Modified COTS LED emergency luminaires, including a diode bridge rectifier power converter have been irradiated (to 100 kGy TID using a Cobalt-60 source), with results of a subsequent photometric analysis presented.

Bobrovsky, Dmitry (National Research Nuclear University MEPhI (Moscow Engineering Physics Institute)):

Analog to Digital Converters Single Event Upset Heavy Ion Test Technique
The paper presents single event upset SEU heavy ion test technique for analog to digital converters ADC.

Bobrovsky, Dmitry (National Research Nuclear University MEPhI (Moscow Engineering Physics Institute)):

110 nm Flash Memory SEE Heavy Ion Test

The paper presents new experimental results for single event effects SEL, SEU, SEFI in modern flash memory obtained at U 400M heavy ion accelerator JINR, Dubna, Russia and UCL heavy ion accelerator UCL University, Belgium.

Kruckmeyer, Kirby (Texas Instruments):

TID and SEL Test Results for Texas Instruments LMX2492 14 GHz PLL

This paper describes the environment to which the critical vacuum controls is exposed in the LHC and presents the results of their radiation tests.

Wind, Michael (Seibersdorf Labor GmbH):

Comprehensive Radiation Characterization of Digital Isolators

We investigate TID radiation response and SEE susceptibility of six different digital isolators by exposing them to Co 60 gammas with 300 krad Si and various proton and heavy ion fields with LET.

villa, Paulo (ufSC):

Analysis of Single-Event Upsets in a Microsemi ProAsic3E FPGA

This paper analyses, by means of heavy-ion accelerator experiment, the SEU tolerance of the Microsemi ProAsic3E A3PE1500 COTS FPGA. This component is under pre-qualification process for use in some satellites of the Brazilian Space Program.

kessarinskiy, leonid n. (national Research nuclear university mEPHi):

OpAmp SET comparative investigation at JINR Russia and UCL Belgium cyclotrons

The paper presents new comparative experimental results for single event transients SET for well studied typical bipolar opamp AD627.

Boruzdina, Anna (national Research nuclear university (nRnu) mEPHi):

Influence of FRAM operational mode on its SEE susceptibility

Paper presents experimental results of FRAM single event effects SEE tests. The dependence of FRAM susceptibility to Single Event Functional Interrupt SEFI and Single Event Hard Error SEHE on operational mode during irradiation was analyzed.

Sampaio, Jorge miguel (liP):

Dose calculations from the RADFETs response onboard the ALPHASAT CTTB experiment

Values of accumulated dose are presented for the RADFETs onboard the ALPHASAT CTTB experiments. These values were calculated from the threshold voltage shift and from temperature data transmitted to Earth.

Silveira, marcilei (Centro universitário da fEi):

Ionizing Radiation Effects on a COTS Low Cost RISC Microcontroller

This work discusses experimental data of Heavy Ion and X-Ray radiation effects on a Commercial Off The Shelf low cost microprocessor.

hernandez, francisco

Radiation Validation of Critical Design Blocks of the GR718B Rad-Tolerant 18x SpaceWire Router

The GR718B is a radiation tolerant 18x-port SpaceWire router being developed for space applications. The radiation validation of its most critical design blocks and its insensitivity to Single Event Latch up are reported herein.

lili, Ding

Bitstream-based simulation for configuration SEUs in Xilinx Virtex-4 FPGAs

Bitstream-based simulation approach was proposed and experimentally validated by heavy ions and protons in Xilinx Virtex-4 FPGAs. The simulation approach is able to predict the probability of an SEU to reduce a functional failure.

Domínguez Álvarez, manuel

Radiation Characterisation for New Tantalum Polymer Capacitors

Polymer tantalum capacitor technology was developed in response to demands from the market to lower the ESR of tantalum capacitors while preserving their small case size and high reliability. The technology is promising in several aspects. The higher quality interface between the dielectric and the polymer cathode increases the breakdown voltage of the device, as well as reducing its DC leakage current, even at extreme radiation exposure conditions.

Please note: The posters must be assembled in room „Borgward“ on Tuesday 20th September 2016 from 14:00 to 18:00.

Speakers must report to the Speaker Preparation Room (Oslo) one day prior to their presentation.



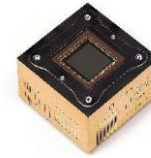
PRESS RELEASE

CNES and 3D PLUS to land again on Mars.

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The CNES (French Space Agency) and 3D PLUS have signed an agreement to develop a camera which will be fully qualified for space applications.

"It is the first color CMOS-based camera that can be called "universal", as it is suitable for various applications, such as planetary science, observation, platform maintenance, etc." said 3D PLUS CEO, Mr. Pierre Maurice.

This development is a logical follow-up to a first R&D study that has been conducted between the two partners in 2015. It will be held over 14 months, and flight models should be available beginning of 2017.

3D PLUS will continue its contribution to space exploration, after its participation in the CIVA camera, that has been used by ROSETTA/PHILAE mission, and in ChemCam Instrument, installed on the CURIOSITY Rover.

The first production batches are selected for two main applications:

- **Mars 2020**, the new NASA Mars rover mission planned to be launched in 2020, which will investigate an astrobiologically relevant ancient environment on Mars. The camera will be installed in the SuperCam scientific instrument developed by Los Alamos Laboratory (Los Alamos National Laboratory, Los Alamos NV, USA) and IRAP (CNRS / Université Paul Sabatier, Toulouse, France) and funded by CNES. It will provide imaging, chemical composition analysis and mineralogy in rocks and regolith from a distance

- **EYE-SAT**, nanosatellite developed by the CNES, which will be used for earth and zodiacal light observation,



About 3D PLUS:

3D PLUS is the world's leading supplier of advanced high density 3D microelectronic products with Die and Wafer Level stacking technology to meet customers' demands for compact, high reliability, high performance electronics.

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Contact

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28199 Bremen, Germany

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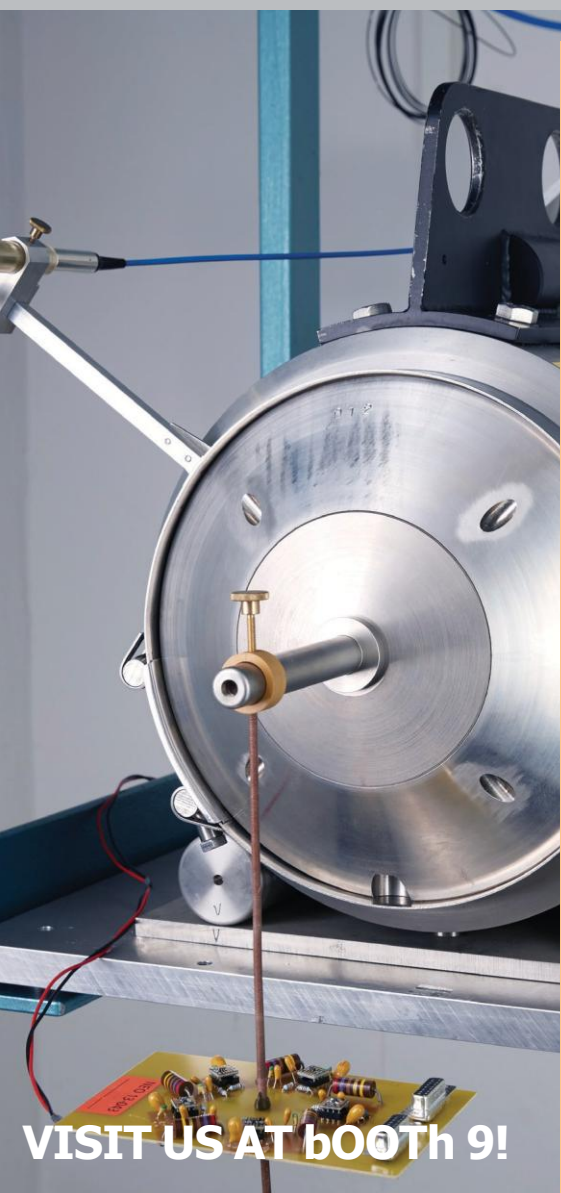
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A multitude of modern equipment to measure electrical and optical parameters is available. Furthermore our institute runs a precision mechanical workshop and an electronic laboratory. This enables us to conduct most of the irradiation tests without help or equipment from the customer.

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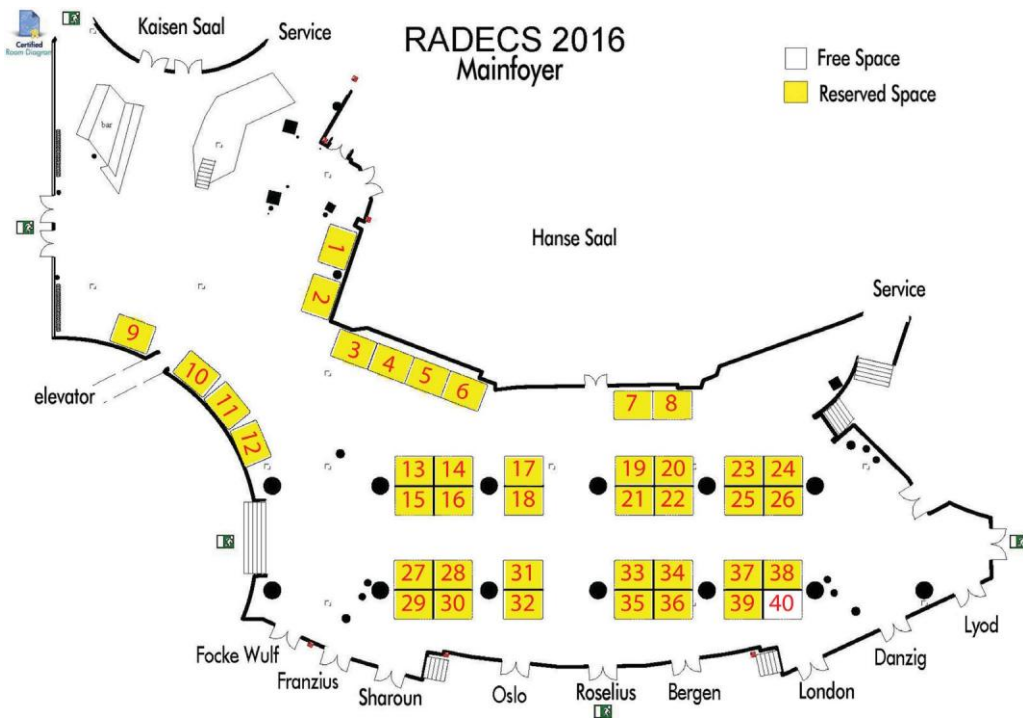


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To timetable information BSAG

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Technical Chair:

Stefan Metzger, Fraunhofer INT

industrial Exhibition Chairs:

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Teresa Farris, Cobham Semiconductor

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