RADECS
2021

VIENNA, 13-17 September

European Conference on Radiation and its Effects on Components and Systems

Hotel Savoyen - Vienna, Austria
Sept 13 - 17, 2021

Conference Booklet

www.radecs2021.org

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Welcome note of the Conference Chair

On behalf of the Association on Radiation and its Effects on Components and Systems, RADECS, it is my great pleasure to invite you to the 2021 RADECS Conference, which will be held September 13-17, 2021, at the Hotel Savoyen in Vienna, Austria.

The conference theme of RADECS 2021 is: “Committed to Safety and Sustainability in Space”. This edition of the RADECS Conference is organized by Seibersdorf Laboratories in collaboration with CERN and partners.

The conference features a technical program dedicated to the latest developments and experimental observations. The technical program is based on critically reviewed presentations describing nuclear and space radiation effects on electronics and photonic materials, devices, circuits, sensors, and systems. Very important for RADECS is the close collaboration link to the industry, which supports the conference. We are very proud that the conference hosts a Short Course, an Industrial Exhibition, a Radiation Effects Data Workshop and Technical Sessions. Very interesting papers on this topic were sent in for evaluation and were reviewed by an excellent team of reviewers!

New features of RADECS 2021 include support for online streaming of lectures to keep in touch with attendees from around the world during these challenging times, as well as online attendance by industry exhibitors. In addition, all attendees will have access to all booked lectures via the Internet for an additional month.

Outstanding invited talks will be given by internationally recognized personalities on 2000 years of architecture in Vienna, on a success story of an Austrian space spin-off, current insights on climate & space, on the new European network RADNEXT on radiation hardness research and test facilities, and a talk on the reliability of nanosatellite missions.
The exhibition chairs have gathered a panel of 27 international exhibitors. Companies working in areas related to the field of radiation effects, microelectronics, design, tests and space application will exhibit their products and services.

To get students involved in the community a support program was established gratefully supported by RADSAGA, the RADECS Association and the RADECS 2021 Conference.
In particular the Jean Marie Palau Award was created for this purpose in the past.

On Sunday, September 12, a city walk through Vienna will be organized to get to know the conference city better. On Monday, September 13, an evening reception will take place in the town hall of Vienna. A Welcome Cocktail for all attendees and their guests will be served on Tuesday, September 14, evening in the area of the Industrial Exhibition. On Wednesday, September 15, there will be the opportunity to participate in a traditional Heurigen Dinner Event. For the Gala Dinner, on Thursday 16 September, its location will be kept secret, but I promise you unforgettable moments as usual during a RADECS Gala Dinner. On Friday you are invited to visit technical facilities related to the topic.

I am looking forward to your participation and wish you an unforgettable RADECS 2021 in Vienna!

Welcome to RADECS 2021 Vienna!

Peter Beck
General Chair RADECS 2021

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Program Overview

All times are given in Central European Summer Time (CEST).

Monday, Sept 13	Tuesday, Sept 14	Wednesday, Sept 15	Thursday, Sept 16	Friday, Sept 17
07:30 - 17:00 Registration	07:30 - 17:00 Registration	8:00-10:30, 15:30-17:00 Registration	8:00-10:30, 15:30-17:00 Registration	08:00 - 12:30 Registration
09:00 Short Course Introduction Part I	08:15 Conference Opening	08:30 Invited Talk	08:30 Invited Talk	09:20 Invited Talk
10:40 BREAK	09:10 SESSION A Basic Mechanisms of Radiation Effects	09:10 SESSION C Single-Event Effects: Mechanisms and Modelling	09:10 SESSION D Single-Event Effects: Devices and ICs	10:00 BREAK
11:15 Short Course Part II	10:10 BREAK	10:00 BREAK	10:00 BREAK	10:30 SESSION E Photonics, Optoelectronics and Sensors
12:30 SHORT COURSE LUNCH	10:40 SESSION H Radiation Environments	10:30 SESSION G Radiation Hardness Assurance	10:30 SESSION J Alternative Testing and RHA Approaches	12:00 End of Sessions
14:00 Short Course Part III	12:20 LUNCH	12:10 LUNCH	12:10 LUNCH	12:00 RADECS Closing Ceremony
14:45 BREAK	13:30 Invited Talk	13:30 Invited Talk		12:30 End of RADECS 2021
15:15 Short Course Part IV	14:00 SESSION B Radiation Effects on Devices & ICs	14:00 SESSION I Facilities and Dosimetry	14:00 RADECS General Assembly	14:00 - 18:00 Technical Tour
17:00 End of Sessions	14:40 Women in Engineering	15:30 BREAK	15:00 BREAK	
17:10 Short Course Exam (30 min)	15:40 BREAK	16:00 Poster Session - Poster: A,B,C,D,E,F,G	15:30 Poster Session and Data Workshop Poster: H,I,J,DW	
	16:10 SESSION F Hardening Techniques	Introduction at the Conference Hall	Introduction at the Conference Hall	
		Poster Presentation online and on-site at the Foyer	Poster Presentation online and on-site at the Foyer	
	17:10 Wrap Up	17:30 Wrap Up	17:00 Wrap Up	
	17:50 End of Sessions	18:00 End of Sessions	17:30 End of Sessions	
19:00 - 21:00 Reception City Hall	19:00 - 21:00 Exhibitor Reception	19:30 - 22:00 Viennese Heuriger	19:30 - 24:00 Gala Dinner	

Industrial Exhibit - Tuesday, 08:00 - Thursday 18:00

Conference Hall Foyer Exhibition Hall

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Conference Venue

RADECS Vienna, 2021

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Conference Venue

Hotel Savoyen, Vienna

Rennweg 16
1030 Vienna
Austria

Hotel Savoyen Vienna is located in the heart of the embassy district, close to the Belvedere Palace and Botanical Gardens – once owned by the hotels namesake, Prince Eugene of Savoy.

The hotel effortlessly combines old and new, occupying a revitalised building that was once home to the imperial Austrian state and court print works.

From the outside, the heritage-protected traditional Viennese facade casts its spell on visitors, while indoors light, modern architecture, the highest levels of comfort and contemporary facilities await.

AUSTRIA TREND HOTELS
HOTEL SAVOYEN VIENNA****S
T: +43 1 206 33 - 0
E: savoyen@austria-trend.at

https://www.austria-trend.at/en/hotels/savoyen

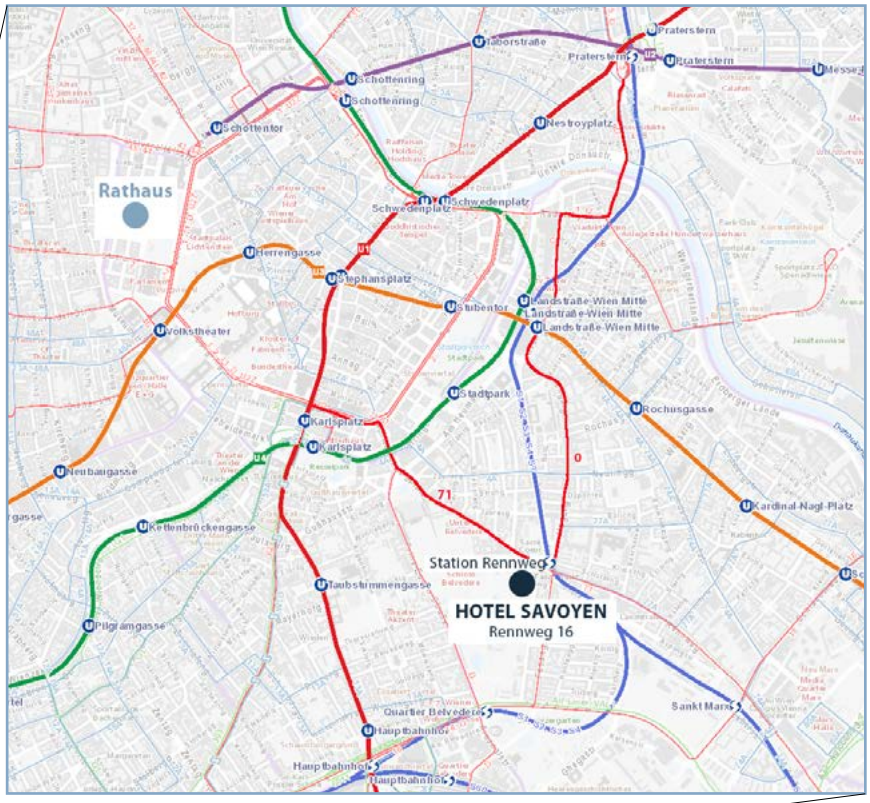
Arrival

Public Transport

https://www.wienerlinien.at/web/wl-en
+ Route to „Rennweg 16“

There is an S-train station „Rennweg“ (100 metres from the hotel);

From U4 Karlsplatz you can use the tram lines „71“ and „0“, exit at Station „Rennweg“.

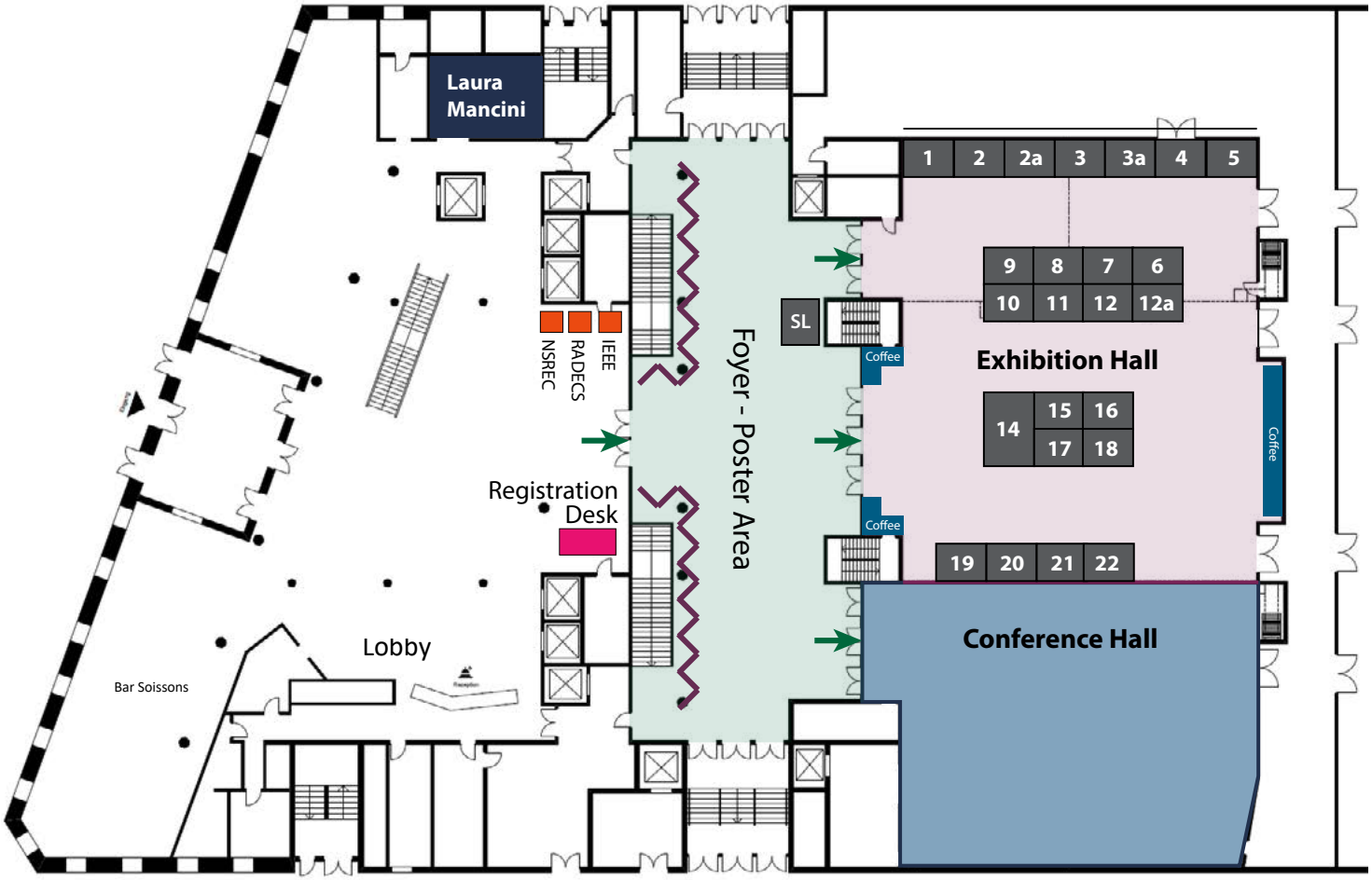


Arrival by Car

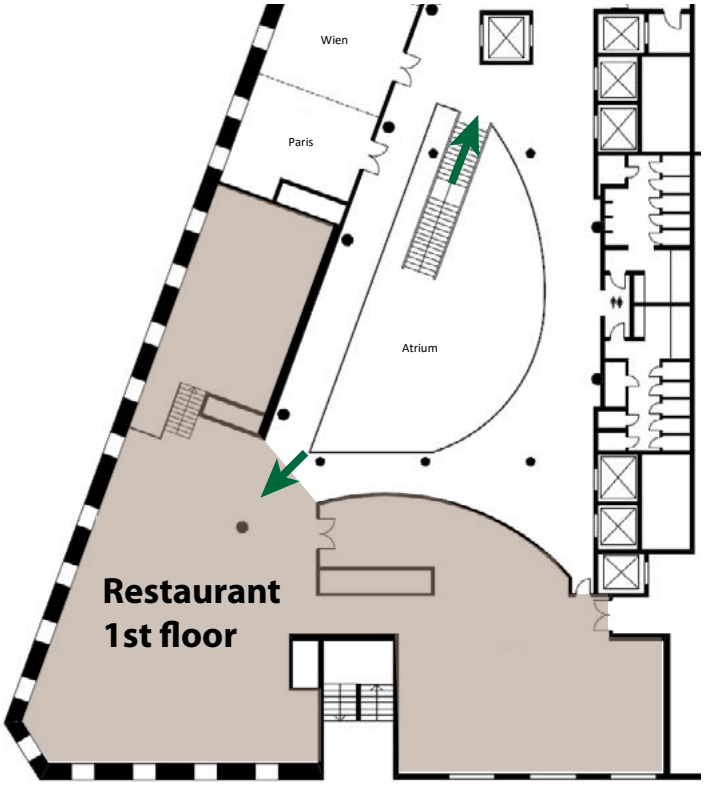
- **West motorway (A1)** towards the city centre to Karlsplatz -till Schwarzenbergplatz - right into Rennweg
- **Motorway (A2)** take city centre exit – continue along Triester Strasse (Strasse =street) until Matzleinsdorferplatz (Platz=square)- right lane Wiedner Hauptstrasse to Paulanergasse - until the traffic lights - turn left into Favoritenstrasse – straight on to Karlsplatz - turn right - into Schwarzenbergplatz, stay in left lane, which leads into Rennweg
- **East motorway (A4)** take city centre exit continue along Schüttelstrasse to Urania - cross Aspernbrücke
(Brücke=bridge) and continue on Stubenring - follow the ring road to Schwarzenbergplatz - turn left into the square

The public hotel parking garage offers direct access to the hotel, with capacity for up to 150 vehicles for a daily fee of € 18.

Conference Floorplan



- Registration
- Preview Room „Laura Mancini“
- Poster Area
- Exhibition Hall
- Conference Hall
- Restaurant, 1st Floor



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RADECS 2021
VIENNA, 13-17 September

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Basic Mechanisms of Radiation Effects

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Radiation Effects on Devices

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Single Event Effects: Modelling Mechanisms & Modelling

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Single Event Effects: Devices & ICs

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Radiation Hardness Assurance

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Session H
Radiation Environments

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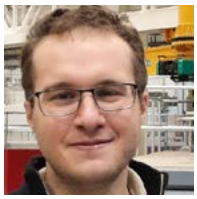
(Interstellar Overdrivers)

Session I
Facilities and Dosimetry



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Alternative Testing and RHA Approaches

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Hybrid Conference

RADECS 2021 is being organized as a hybrid conference, therefore no matter if in person or remote, you have the opportunity to participate. For both online and on-site registered users, we provide the following online features:

- **Short Course:** As live stream and video on demand. Join the Q&A sessions to ask questions to the Short Course Speakers. Participate in an online exam. Follow the instruction by the Short Course Chair.
- **Technical Sessions:** As live stream and video on demand. Join the Q&A sessions to ask questions to the presenters. Follow the instructions and the daily wrap-up panel coordinated by the Technical Chair.
- **Video on demand** is available after the day of the technical presentation for up to one month after the conference. Enjoy the conference whenever and wherever you like!
- **Poster Session:** Both virtually and onsite. Each poster is available as PDF in the live room at any time. Participate virtually and connect with the poster speakers in their personal Video & Text-Chat “Jitsi” rooms during the Poster Session. Follow the instruction by the Poster Session Chair.
- **Data Workshop:** Both virtually and onsite. Participate virtually and connect with the data workshop speakers in their personal Video & Text-Chat “Jitsi” room during the Data Workshop. Follow the instruction by the Data Workshop Chair.
- **Exhibition:** Both virtually and onsite. Join virtually and get in contact with the exhibitors. The online communication with exhibitors is established via Text-Chat “tawk.to”, Video & Text-Chat “Jitsi” or Email. Book meeting appointments with the exhibitors via the conference website using “calendly”.

All these tools are embedded in the RADECS 2021 Live Website. Login data is provided upon registration before the start of the RADECS 2021 Conference.

Live Stream will start on Sept. 13, 2021 for the Short Course and on Sept. 14, 2021 for the Technical Sessions, Poster Session, Data Workshop, and Exhibition.

https://live.seibersdorf-laboratories.at/en

We are looking forward to seeing you!
The RADECS Conference Organizing Team.

RADECS
2021
VIENNA, 13-17 September

Short Course

Monday Sept 13, 2021

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Short Course

Short Course Co-Chairs: Marc Poizat, European Space Agency, ESA
Jerome Boch, Univ. Montpellier

Marc Poizat

Jerome Boch

Short Course Motto: From basics to testing

The main objective of this short course is to review and describe the basics of radiation effects on electronics and to explain how electronic devices can be tested. Applications corresponding to the “traditional space”, but also to the “new space” will be evoked. This short course is intended for beginners as well as experts in the field of radiation effects on electronics devices. This short course is divided in five talks.

In the first talk, Christoph Tscherne begins by defining the natural space radiation environment and will then focus on total ionizing dose (TID) effects. Eventually, the talk presents how electronic devices are TID tested according to ESCC and/or MIL standards.

In the second talk, Dr Indranil Chatterjee discusses single event effects (SEE). After a description of the basic mechanisms inducing SEE, his talk will focus on SEE testing of complex devices.

The use of COTS parts has become the norm in the „new space“ approach, thus allowing the development of low cost satellite systems. Challenges and complexities of SEE testing of complex COTS components will be covered. Merits and limitations of board level SEE testing vs traditional component-level SEE testing are discussed.

The third talk, given by Dr Franco Perez, presents ESA Cubesat Missions and Radiation Testing on Cubesat Electronics. Details on guidelines, radiation requirements, utilized tools, and testing approach (TID and SEE) will be provided. A return of in-orbit experience is also given.

Pulsed laser testing is a remarkable technique that provides an invaluable insight on SEE effects on EEE parts. In the fourth talk, Dr Vincent Pouget presents the fundamentals of the pulsed laser testing technique. The question of laser-particle equivalence is also discussed.

In the last talk, Prof Paul Leroux and Prof Jeffrey Prinzie present radiation hardening by design techniques. A review of layout techniques and circuit techniques for radiation hardening of analog and digital ASICs is given. Typical testing strategies are then discussed.

Short Course Program

RADECS 2021
VIENNA, 13-17 September

Short Course Co-Chairs: Marc Poizat, European Space Agency, ESA
Jerome Boch, Univ. Montpellier

Short Course, Monday, Sept 13, 2021

09:00 **Short Course Introduction**

09:10 **Space Radiation Environment and Total Ionizing Dose**

Christoph Tscherne, Seibersdorf Laboratories
Radiation Hardness Assurance Expert

09:55 **Single-Event Effects –**
Basic Mechanisms and Testing of Complex Devices

Indranil Chatterjee, Airbus Defence and Space
Space Electronics Reliability Expert

10:40 BREAK

11:15 **Overview of ESA Cubesat Missions and Radiation Testing on Cubesat Electronics**

Franco Perez, European Space Agency, ESA

12:00 **Q&A**

Coordinated by the Session Co-Chair

12:30 **Short Course LUNCH**

14:00 **Laser Testing for Single-Event Effects: Basics and use cases**

Vincent Pouget, IES, CNRS, University of Montpellier

14:45 BREAK

15:15 **Design and Testing of TID and SEE Radiation Hardened CMOS ASICs**

Paul Leroux, Katholieke Universiteit Leuven
Professor in radiation hardened micro-electronics

Jeffrey Prinzie, Katholieke Universiteit Leuven
Electronic Circuits and Systems

16:00 **Q&A**

Coordinated by the Session Co-Chair

17:00 **END of Short Course**

Short Course Exam (30 min)

Coordinated by the Session Co-Chair

Monday, Sept 13, 2021

Space Radiation Environment and Total Ionizing Dose

Christoph Tscherne

Seibersdorf Laboratories, Austria

Abstract

Spacecraft are exposed to a complex and harsh radiation environment that poses a great challenge to space mission design and mission success. Electronic devices suffer cumulative long-term radiation effects by charge deposition, called total ionizing dose effects. As a result, the devices may suffer from increased current and power consumption, threshold voltage shifts, increased leakage currents and general decrease or loss of functionality.

The presentation discusses the origin and effects of the space radiation environment, composing of solar particles, galactic cosmic radiation and trapped particles. Total ionizing dose will be discussed in detail, including its origin, its effects and how electronic devices can be tested according to standards before they are applied in the field.

Contents

- Space Radiation Environment
- Total Ionizing Dose Effects
- Total Ionizing Dose Testing

Monday, Sept 13, 2021

Single-Event Effects – Basic Mechanisms and Testing of Complex Devices

Indranil Chatterjee

Airbus Defence and Space

Abstract

With the “New Space” approach, space is envisioned to become accessible and affordable to all with the development of low-cost satellite systems. A large part of this dream revolves around using commercially available high-performance electronic components and systems. However, a key barrier to the widespread usage of COTS parts in space is the harsh natural radiation environment.

In this short course, an overview of the single-event effects impacting advanced semiconductor nodes will be discussed. Key metrics for designing SEE tests, such as sample preparation, biasing conditions, thermal impacts, internal fault tolerance mechanisms, etc. will be covered. Being able to determine the interplay of these variables is an integral part of designing a test to meet the needs of a specific mission.

The short course will also explore designing test fixtures, selection of test facilities, executing tests, and analyzing test data. Efficacies and limitations of board-level SEE testing, as opposed to component-level SEE testing, for evaluating the vulnerability of COTS components for application in space, will also be discussed.

Contents

- Introduction: Traditional space vs. „New Space“
- Single-Event Effects
  - Basic Mechanisms: Charge Deposition and Collection
  - Destructive and non-destructive events
  - Impact of technology scaling
- SEE Testing of Complex Components
  - Sample preparation
  - Typical test campaign
  - Common pitfalls and limitations
  - Mature applications and methods
- System-level SEE Testing as an alternative

Monday, Sept 13, 2021

Overview of ESA Cubesat Missions and Radiation Testing on Cubesat Electronics

Franco Perez

European Space Agency

Abstract

An overview of the main ESA Cubesat Missions and activities will be provided with emphasis on the utilised Radiation Hardness Approach. With the increased complexity of Cubesat design and mission objectives, together with the transition from educational to In-orbit demonstration missions utilising COTS, radiation hardness has become paramount to increase in-orbit availability. Details on the radiation requirements, utilised tools, and testing approach for ESA LEO missions, will be provided, through an overview of the results of High Energy Proton campaigns.

For the new ESA deep space Cubesat Missions (e.g. M-ARGO, HERA Cubesats), an overview of the guidelines, requirements, and ongoing process with the Cubesat industry will be introduced, aiming to reduce the effects of radiation while finding a correct balance in between mission availability, risk and associated programmatic cost.

Contents

- ESA Cubesat missions overview
- ESA Cubesat missions radiation requirements, effects assessment, and testing experience for LEO and deep space missions.
- TID and SEE testing
- In-orbit experience

Monday, Sept 13, 2021

Laser Testing for Single-Event Effects: Basics and use cases

Vincent Pouget

IES, CNRS, University of Montpellier

Abstract

Laser testing for Single-Event Effects consists in using the photoelectric interaction of a short and focused laser pulse with the semiconductor material of a device to mimic the transient and localized track of electron-hole pairs that is produced by primary or secondary ionizing particles from radiation environments. The fundamentals of the laser testing technique will be presented, including an overview of the physical principles, the main advantages and limitations, and the experimental parameters of the main variants of the technique.

The question of laser-particle equivalence will be discussed, with an introduction to the methods for estimating the equivalent LET of a laser pulse. Typical use cases of laser testing will be reviewed and illustrated with various devices and circuit technologies and some guidelines will be provided to obtain valuable results in the context of radiation-hardening-by-design and radiation hardness assurance.

Contents

- Fundamentals of laser testing
  - Single Photon Absorption
  - Two Photon Absorption
- Experimental approaches
  - Parameters definitions, impact and ranges
  - Common base and variations
- Laser-ion correlation
  - Equivalent LET estimation methods
- Use cases and guidelines
  - Different test goals
  - Case studies

Monday, Sept 13, 2021

Design and Testing of TID and SEE Radiation Hardened CMOS ASICs

Prof. Paul Leroux, Prof. Jeffrey Prinzie

KU Leuven

Abstract

After a brief review of total dose and single event radiation effects in deep sub-micron CMOS technologies, we will look at the different levels of radiation hardening by design. Most attention will be paid to circuit architecture and layout techniques for radiation hardening of analog, mixed signal and digital integrated circuits. Layout techniques include the gate enclosed layout of transistors, H-gate transistors, width/length scaling, interdigitation, dummy elements, latch-up protection and layout optimization for compacting triple modular redundancy.

Circuit techniques that will be covered include the use of feedback, feedforward, bias optimization, translinear circuits, dynamic leakage compensation, switching, chopping and offset compensation, capacitive and resistive decoupling, spatial and temporal redundancy, interlocking, error-correcting codes, memory scrambling and scrubbing and data path error detection and correction techniques.

All techniques will be explained and illustrated with concrete design examples of amplifiers, data converters, transceiver circuits, Phase-Locked Loops, Time-to-Digital Converters, SRAM memory and several digital circuits. We will also illustrate typical testing strategies for radiation hardness assurance which are an integral part of the radhard by design process.

Contents

RADECS
2021
VIENNA, 13-17 September

Conference Opening

Tuesday, Sept 14, 2021

Conference Opening

Tuesday, Sept 14, 2021

08:15 - 09:10

Conference Opening Ceremony

Peter Beck, General Chair RADECS 2021 (Seibersdorf Laboratories)
Martina Schwaiger (Seibersdorf Laboratories)
Philippe Pailett, RADECS Association (CEA)
Margit Mischkulnig (Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology)
Andreas Geisler (Austrian Aeronautics and Space Agency)
Max Kowatsch (Austrospace)
Rainer Gotsbacher, Robert Geiger (ecoplus)

Award Ceremony of previous RADECS Conference

Richard Sharp, RADECS Association (Radtest)

Best Data Workshop:
CTTB Memory Test Board Single Event Effects Geostationary In-flight Data Analysis
M. Pinto, P. Gonçalves, J. Sampaio, T. Sousa, C. Poivey

Jean-Marie Palau Award for Best Student Presentation AND Best Conference Paper Award:
Backside Laser Testing of Single-Event Effects in GaN-on-Si Power HEMTs
Catherine Ngom, V. Pouget, M. Zerarka, F. Coccetti, A. Touboul, M. Matmat, O. Crepel, S.Jonathas, G. Bascoul

Gagarine award

Conference Opening Event - Student Project

Christoph Tscherne (Seibersdorf Laboratories), Coordination
Lukas Huber (Seibersdorf Laboratories & TU Wien Space Team)
Stephan Zorn (TGM Wien)
Simon Buchinger (TGM Wien & TU Wien Space Team)
Markus Schwertberger (TGM Wien & TU Wien Space Team)
Thomas Hirschbüchler (TU Wien Space Team)

Opening of the Conference by the
Federal Minister for Climate Action, Environment, Energy, Mobility, Innovation and Technology

RADECS
2021
VIENNA, 13-17 September

Technical Program

Tuesday Sept 14 - Friday Sept 17, 2021

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RADECS
2021
VIENNA, 13-17 September

Technical Program

Tuesday, Sept 14, 2021

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Technical Program

Tuesday, Sept 14, 2021

09:10 - 10:10

Introduction by Rubén García Alía (CERN)

Session A: Basic Mechanisms of Radiation Effects

Co-Chairs: Damien Lambert (CEA) & Michael King (SANDIA National Labs)

ORAL PRESENTATIONS:

A-1 09:25 **Effects of Layer-to-Layer Coupling on the Total-Ionizing Dose Response of 3D-Sequentially Integrated FDSOI MOSFETs**

S. Toguchi[1], E. Zhang[1], M. Rony[1], X. Luo[1], D. Fleetwood[1], R. Schrimpf[1], M. Alles[1], S. Moreau[2], S. Cheramy[2], P. Batude[2], L. Brunet[2], F. Andrieu[2]

1. Vanderbilt University, USA; 2. CEA-LETI, France

3D-sequentially integrated transistors show strong layer-to-layer coupling of total-ionizing-dose responses due to radiation-induced trapped charges in the intermediate dielectric region between upper and lower device layers.

A-2 09:35 **TID Degradation and Low Frequency Noise in 16 nm Bulk FinFETs Irradiated to Ultra-High Doses**

S. Bonaldo[1], T. Ma[1], S. Mattiazzo[2], A. Baschirotto[3], C. Enz[4], D. Fleetwood[5], A. Paccagnella[1], S. Gerardin[1]

1. University of Padova, Italy; 2. University of Bergamo, Italy; 3. University of Milano, Italy; 4. EPFL, Switzerland; 5. Vanderbilt University, USA

DC and low frequency noise measurements on 16 nm Si bulk FinFETs irradiated to 1 Grad(SiO2) show charge buildup in STI. The TID sensitivity depends on channel length, and fin and finger number.

A-3 09:45 **Proton Irradiation Effects on Spin Orbit-Torque and Spin Transfer-Torque Magnetic Tunnel Junctions**

O. Coi[1,2,3], G. Di Pendina[1], O. Garello[1], D. Dangla[2], R. Ecoffet[2], L. Torres[3]

1. CEA, France; 2. CNES, France; 3. University of Montpellier, LIRMM, CNRS, France

This paper aims to investigate proton irradiation effects on a new class of emerging devices: Perpendicular- Magnetic Anysotropy (PMA) Spin Orbit (SOT) Torque Magnetic Tunnel Junctions (MTJ).

Tuesday, Sept 14, 2021

Session A: Basic Mechanisms of Radiation Effects

Co-Chairs: Damien Lambert (CEA) & Michael King (SANDIA National Labs)

POSTERS:

PA-1 Plasma effects in silicon detectors and the Two Photon Absorption Transient Current Technique

F. Palomo Pinto[1], M. Moll[2], M. Fernández García[3], R. Montero Santos[4], I. Vila Álvarez[3]

1. Universidad de Sevilla, Spain; 2. CERN, Switzerland; 3. Instituto de Física de Cantabria, Spain; 4. SGIker Laser Facility, Spain

We analyze plasma effects due to the use of Two Photon Absorption-Transient Current Technique in silicon particle detectors. The Tobe-Seibt model gives a good agreement with the experimental observations.

PA-2 Ion Irradiation Effects on Films and Temperature Sensors for Nuclear Facilities

M. Mitkova[1], A. Simon[1], Y. Sakaguchi[2]

1. Boise State University, USA; 2. CROSS, Japan

Employing GexSe100-x glasses to monitor temperature using the phase change effect is reported. Materials selection, device structure and a prototype of temperature sensor performance are analysed. Heavy ion irradiation by Xe ions has been studied.

PA-3 Simplified Calculations of Radiation Dose-Rate Sensitivity of Bipolar Transistors

H. Hjalmarson[1], S. Witczak[2], R. Samuel[3], H. Barnaby[3], T. Buchheit[1], R. van Ginhoven[4]

1. Sandia National Laboratories, USA; 2. Northrup Grumman Corporation, USA; 3. Arizona State University, USA; 4. Air Force Research Laboratory, USA

A simplified approach to estimating radiation-induced Si-SiO2 interface trap densities, based on steady-state populations of relevant mobile species, is presented. Calculations are consistent with known trends in dose, dose rate, hydrogen content and temperature.

09:55 Q&A of Session A

10:10 Break

Tuesday, Sept 14, 2021

10:40 - 12:20

Session H: Radiation Environments

Co-Chairs: Camille Bélanger-Champagne (TRIUMF) & Eamonn Daly (Interstellar Overdrivers)

ORAL PRESENTATIONS:

H-1 10:45 **Radiation Field Study in ATLAS: Timepix measurements vs Geant4 simulations**

T. Billoud[1], B. Bergmann[1], C. Leroy[2], S. Menke[3], S. Pospíšil[1]

1. Institute of Experimental and Applied Physics, Czech Republic; 2. Université de Montréal, Canada; 3. Max Planck Institute for Physics, Germany

New methods to characterize radiation in the ATLAS experiment have been developed using Timepix detectors. Measurements of total ionizing dose and charged particle fluences at different locations in the experiment are used to benchmark Geant4 simulations.

H-2 10:55 **A Framework for Global Trapped Particle Radiation Modelling**

C. Papadimitriou[1], I. Sandberg[1], S. Aminalragia-Giamini[1], H. Evans[2], P. Jiggens[2]

1. SPARC, Greece; 2. ESA ESTEC, Netherlands

We present a unified framework, to consolidate both data and methodologies, perform comparisons under the same constraints, and produce trapped particle radiation models that can be tailored to any future user's use-case scenarios.

H-3 11:05 **Infer electron space environment along EOR mission profile from LEO measurements: application to EUTELSAT 7C**

D. Lazaro[1], A. Sicard[1], P. Caron[1], D. Falguère[1], R. Ecoffet[2], D. Standarovski[2], N. Balcon[2], J. Mekki[2], V. Thakur[3], P. Timmerman[3], R. Hernandez[3], G. Schneider[3], C. Keys[4], M. Baylocq[4]

1. ONERA, France; 2. CNES, France; 3. EUTELSAT, France; 4. MAXAR, USA

Using correlation between LEO and equatorial electron measurements, a methodology is presented and validated, with the ICARE-NG detector measurements on board EUTELSAT 7C to infer flux encountered by the spacecraft during its EOR phase.

Tuesday, Sept 14, 2021

Session H: Radiation Environment

Co-Chairs: Camille Bélanger-Champagne (TRIUMF) & Eamonn Daly (Interstellar Overdrivers)

H-4 11:15 In-flight Measurements of Radiation Environment Observed by Eutelsat 7C (Electric Orbit Raising Satellite)

P. Caron[1], S. Bourdarie[1], D. Falguère[1], D. Lazaro[1], P. Bourdoux[2], V. Thakur[4], P. Timmerman[4], R. Hernandez[4], G. Schneider[4], C. Keys[5], M. Baylocq[5], N. Balcon[3], D. Standarovski[3], J. Mekki[3], R. Ecoffet[3]

1. ONERA, France; 2. EREMS, France; 3. CNES, France; 4. EUTELSAT, France; 5. MAXAR, USA

Measurements of particle fluxes (protons and electrons) obtained with the ICARE-NG monitor on the Eutelsat 7C orbit (Electric Orbit Raising to geostationary orbit) are presented.

H-5 11:25 Development of a Miniaturized Reference Dosimeter Payload for SmallSat Applications

C. Tscherne[1], M. Wind[1], L. Huber[1], M. Latocha[1], I. Slipukhin[2], S. Uznanski[2], R. Garcia Alia[2], A. Hörmer[3], R. Zeif[3], O. Koudelka[3], H. Fragner[4], A. Dielacher[4], C. Pirat[5], F. Perez-Lissi[5], G. Santin[5], P. Beck[1]

1. Seibersdorf Laboratories, Austria; 2. CERN, Switzerland; 3. Graz University of Technology, Institute of Communication Networks and Satellite Communications, Austria; 4. RUAG Space GmbH, Austria; 5. ESA, Netherlands

We present the TID Reference Dosimeter and SEU Assessment System, a miniaturized dosimetry payload for SmallSats. We provide information on the concept, performance, development, and preparations for its in-orbit demonstration onboard the Austrian CubeSat PRETTY.

H-6 11:35 First results from ESA Next Generation Radiation Monitor units on-board GEO EDRS-C and LEO Sentinel-6

I. Sandberg[1], S. Aminalragia-Giamini[2], C. Papadimitriou[2], R. van Gijlswijk[3], D. Heynderickx[4], W. Hajdas[5], M. Heil[6], H. Evans[7]

1. Space Applications and Research Consultancy, Greece; 2. Space Applications and Research Consultancy (SPARC), Greece; 3. Solenix-DE, Germany; 4. DH Consultancy, Belgium; 5. PSI, Switzerland; 6. ESA ESOC, Germany; 7. ESA ESTEC, Netherlands

First results from ESA Next Generation Monitor on-board EDRS-C are presented. Special attention is given on the measurements of the unit during the GTO of the satellite. Evaluation and comparisons with other monitors are reported.

Tuesday, Sept 14, 2021

Session H: Radiation Environment

Co-Chairs: Camille Bélanger-Champagne (TRIUMF) & Eamonn Daly (Interstellar Overdrivers)

POSTERS:

PH-1 Design of a Space Radiation Monitor for a Sounding Rocket and Results from the First Turkish Sounding Rocket Flight

A. Albarodi[1], M. B. Demirköz[1], U. Kılıç[1], A. B. Can[1], E. Karadöller[1], D. Boztemur[1], M. Aktaş[2], T. C. Atasever[2]

1. Middle East Technical University, Turkey; 2. ROKETSAN, Turkey

A radiation monitor was produced and flown to an altitude of 136 km twice on top the SR0.1 rocket launched with measurement of the Pfotzer-Regener maximum and the effects of the CME on October 28th, 2020.

PH-2 Upper envelop in GREEN model for energetic electrons

A. Sicard[1], V. Maget[1], D. Lazaro[1], N. Balcon[2], R. Ecoffet[2]

1. ONERA, France; 2. CNES, France

The aim of this study is to develop a GREEN “Upper Envelop” model for electrons which takes into account the variation from one solar cycle to another.

PH-3 Investigation of Inner Belt Flux Anisotropies

F. Enengl[1], H. Evans[2], R. Horne[3]

1. University of Oslo, Norway; 2. ESA ESTEC, Netherlands; 3. British Antarctic Survey, United Kingdom

We investigate pitch angle distributions in the inner radiation belt in equatorial regions. We use data from IREM (INTEGRAL mission) and PROTEL (CRRESmission). We find a dependency of flux anisotropies on the proton energy levels.

Tuesday, Sept 14, 2021

Session H: Radiation Environment

Co-Chairs: Camille Bélanger-Champagne (TRIUMF) & Eamonn Daly (Interstellar Overdrivers)

PH-4 Association of relativistic electron enhancements with VLF/ULF wave activity and seed electrons

A. Nasi[1], I. A. Daglis[1], C. Katsavrias[1], W. Li[2]

1. National and Kapodistrian University of Athens, Greece; 2. Boston University, USA

This study addresses the association of solar wind conditions, geomagnetic parameters, wave activity, and seed electrons, and indicates that seed electron presence, plasmasphere erosion and wave activity are conditions leading to substantial relativistic electron enhancements.

PH-5 Flight data analysis of highly miniaturized TID monitor module onboard TRISAT

L. Gonzales[1], G. Kirbiš[1], D. Selčan[2], I. Kramberger[1]

1. University of Maribor, Slovenia; 2. SkyLabs d.o.o., Slovenia

This paper presents design, temperature and irradiation calibration, and in-flight data of PIN diode base TID monitor module, appropriate for use on nanosatellites missions. The module is highly miniaturized and uses COTS components.

PH-6 Space Environment & Effects Satellite (SE&ES) Mission Concept Feasibility Study

P. Jiggens[1], J. Vennekens[1], P. Lux[1], N. Lawton[1], S. Clucas[1], C. Poivey[1], D. Steenari[1], H. Evans[1], M. Millinger[1], V. Braun[1], S. Mutch[1], M. Khan[2], M. Verhoef[1], G. Salinas[1], C. Terhes[1], B. Sousa[2], K. Benamar[1], Y. Le Deuff[1], M. van Pelt[1], M. Magazzu[1], T. Wablat[1], D. Lomanto[1], P. Nieminen[1], S. Rason[1], V. Ferlet-Cavrois[1]

1. ESA ESTEC, Netherlands; 2. ESA ESOC, Germany

Initial conclusions of a feasibility study for a low-cost, short-duration mission to measure the space environment whilst simultaneously measuring effects on components, testing mitigation strategies and giving flight heritage to new detectors and components.

Tuesday, Sept 14, 2021

Session H: Radiation Environment

Co-Chairs: Camille Bélanger-Champagne (TRIUMF) & Eamonn Daly (Interstellar Overdrivers)

PH-7 **Development of a plastic scintillator-based active shield for the ICARE-NG radiation monitor**

M. Pinson[1], P. Caron[1], P. Laurent[2], I. Cojocari[2]

1. ONERA, France; 2. CEA, France

An active shield using a scintillator and silicon photo-multipliers (SiPMs) has been developed to operate with the ICARE-NG instrument to reduce electron contamination through the sides of the detector, thus increasing energy resolution.

PH-8 **Analysis of the photoneutron field near the THz dump of the CLEAR accelerator at CERN with SEU measurements and simulations**

G. Lerner[1], A. Coronetti[1], J. Kempf[2], R. García Alía[1], F. Cerutti[1], A. Gilardi[1,3], W. Farabolini[1,4], R. Corsini[1]

1. CERN, Switzerland; 2. ISAE-Supaero, France; 3. University of Naples Federico II, INFN Naples, Italy; 4. CEA-Saclay, France

We study the photoneutron field near the THz dump of the CLEAR electron accelerator at CERN using FLUKA simulations and SEU measurements with SRAM memories, characterising its properties and evaluating its suitability for radiation tests.

11:45 **Q&A of Session H**

12:20 **Lunch**

Tuesday, Sept 14, 2021

13:30 - 14:00

Invited Talk: Browsing 2000 Years of Architecture in Vienna

by Christa Veigl

Dr. Christa Veigl is an art historian. Working freelance, she guides through and writes about Vienna's architecture, urban development, building material and history of housing. Christa Veigl received her PhD from the Vienna University in 1987, thesis: Literarische Gemäldebeschreibungen – Studien zu einem unbestimmten Genre zwischen 1770 und 1830 (engl. Literary descriptions of paintings - studies on an undefined genre between 1770 and 1830).

Architecture is to a large extent an emotional subject. As in many important European cities, Vienna's architecture is also strongly influenced by history. The imperial and the compact city center of Vienna is extremely present. Enthusiastic about the architecture and architectural history with its structures, materials, models and ornamentation, Christa will introduce to Vienna's architecture and urban development in several steps: Middle Ages and ecclesiastical architecture, Baroque era and palaces, Classicism and revival styles – monumental public buildings, factories and railway architecture, Turn of the 19th century – back and forth, 20th century to present – public housing, post war reconstruction, built aliens, and construction with respect for existing contexts.

Tuesday, Sept 14, 2021

14:00 - 14:40

Session B: Radiation Effects on Devices and ICs

Co-Chairs: Salvatore Danzeca (CERN) & Cedric Virmontois (CNES)

ORAL PRESENTATIONS:

B-1 14:05 **Hours-long Transient Leakage Current in MOS Structures after Ultra-High Total-Ionizing-Doses**

H. Dewitte[1], P. Paillet[2], S. Rizzolo[3], C. Marcandella[2], V. Goiffon[1]

1. ISAE-SUPAERO, France; 2. CEA, France; 3. Airbus Defense and Space S.A.S, France

The abstract investigates the apparition after irradiation and the fast ambient temperature annealing of a leakage current in p-MOS structures. In particular, it discusses the origin of the current, the effect of the bias, and the dose rate.

B-2 14:15 **Enhancement of Sample-to-Sample Variability Induced by Total Ionizing Dose in 16 nm Bulk nFinFETs**

T. Ma[1], S. Bonaldo[1], S. Mattiazzo[2,5], A. Baschilotto[3,5], C. Enz[4], A. Paccagnella[1,5], S. Gerardin[6]

1. University of Padova, Italy; 2. University of Bergamo, Italy; 3. University of Milano Bicocca, Israel; 4. Institute of Microengineering, EPFL, Switzerland; 5. INFN, Italy; 6. DEI - Padova University, Italy

TID-induced sample-to-sample variability is investigated in 16 nm bulk nFinFETs. The sample-to-sample variability increases significantly at ultra-high doses, due to the impact of random dopant fluctuations.

Tuesday, Sept 14, 2021

Session B: Radiation Effects on Devices and ICs

Co-Chairs: Salvatore Danzeca (CERN) & Cedric Virmontois (CNES)

POSTERS:

PB-1 X-Ray Impact on Advanced High Voltage BCD Technology Platform

M. Basso[1], A. Danesi[1], S. Bertaiola[1], A. Veggetti[1], A. Andreini[1], P. Galbiati[1]

1. STMicroelectronics, Italy

Xray effects on BCD platform are studied. Strong dependence of the BVdss vs. radiation dose is found. The impact is correlated with the doping a typical behavior of ReSurF devices and is equivalent to additional charge inside the drain.

PB-2 Characterization of the Effects of Neutron-Induced Displacement Damage on the SiGe:C Heterojunction Bipolar Transistors

D. Sotskov[1], A. Kuznetsov[1], V. Elesin[1], I. Selishchev[1], V. Kotov[1], A. Nikiforov[1]

1. National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Russian Federation

This paper explores effects of neutron-induced displacement damage on static and high frequency parameters of three types SiGe:C npn-heterostructure bipolar transistors from the SGB25V BiCMOS technology.

PB-3L TID Effects in Highly Scaled Gate-All-Around Si Nanowire CMOS Transistors Irradiated to Ultra-High Doses

S. Bonaldo[1], M. Gorchichko[2], E. Zhang[2], T. Ma[1], S. Mattiazzo[3], M. Bagatin[1], A. Paccagnella[1], S. Gerardin[1], R. Schrimpf[2], R. Reed[2], D. Linten[4], J. Mitard[4], D. Fleetwood[2]

1. University of Padova, Italy; 2. Vanderbilt University, USA; 3. University of Bergamo, Italy; 4. Imec, Belgium

Gate-all-around Si nanowire FETs are characterized by DC and low frequency noise measurements at ultra-high doses up to 300 Mrad(SiO2). Worst-case TID degradation is observed for long-channel pGAAFETs.

14:25 Q&A of Session B

Tuesday, Sept 14, 2021

14:40 - 15:40

Women in Engineering

WIE Chair: Alicja Michalowska-Forsyth, Graz Univ. of Technology

During this event, we show how everyone can profit from increased participation of women in STEM (Science Technology Engineering Mathematics). The programme includes talks on the current situation and the future prospects of gender diversity in STEM.

We will discuss how to make a difference to see more women in STEM and to support them at all career stages: on the organizational and individual level—as friend, parent, teacher and mentor. We welcome the three inspiring speakers: Chiara Tran Thi, Rabia Dogan and Simonetta Di Pippo, who will guide us through selected topICs ranging from obstacles to opportunities for women in STEM in scientific and leadership positions. We hope that this Women in Engineering event triggers a discussion that continues beyond this event's physical and virtual rooms.

Programm

14:40 **Introduction - WIE Chair**

14:45 **STEM Career Path: Challenges and Personal Experience**
Chiara Tran Thi, OHB System AG, Germany

15:00 **She Leads**
Rabia Dogan, Infineon Technologies, Austria

15:15 **The UNOOSA Space4Women Initiative**
Simonetta Di Pippo, United Nations Office for Outer Space Affairs, UNOOSA

15:30 **Q & A**

15:40 **Break**

Women in Engineering

STEM Career Path: Challenges and Personal Experience

Chiara Tran Thi

OHB System AG, Germany

Chiara Tran Thi received her BSc and MSc degree in Electronic Engineering from Politecnico di Milano in Italy.

Ms. Tran Thi has contributed to more than 20 space missions and projects, from higher Environment and Satellite level down to the Electronic Components, from Earth Orbit to Interplanetary missions.

Along with the work on higher Class space missions, Ms. Tran Thi is contributing to the qualification of commercial based experiments for Human Space Flight to be used inside or outside the Columbus Laboratory module of the International Space Station (ISS), by performing radiation analyses, providing support for testing and test data analysis.

Ms. Tran Thi gained an international professional background and education in Italy, Germany, France and Spain.

Ms. Tran Thi is working in the space industry covering subjects such as Radiation Effects Engineering, Radiation Hardness Assurance, Radiation Environment analysis.

Furthermore, Ms. Tran Thi is currently completing her studies in the field of Astronomy and Astrophysics, working on a high mass X-ray binary stars system.

Abstract

Ms Chiara Tran Thi will share her personal experience as a woman in STEM, about the access to education and the importance of information exchange.

Ms Chiara Tran Thi will give an overview of the advantages that could derive from bringing more diversity and breaking the so called “glass ceiling” in the industry.

Women in Engineering

She Leads

Rabia Dogan

Infineon Technologies, Austria

Rabia Dogan is head of digital design at automotive radar development at Infineon, in Graz, Austria. She graduated in Electronics Engineering in 2008 in Turkey. Afterwards, she completed her MSc in Electronics Engineering in Linkoping University in Sweden, specializing in System on Chip. In addition, she worked as research engineer in IMEC in Leuven, Belgium and worked with resistive memories. Creating a strong background in Semiconductors and microelectronics, Rabia has continuously been developing several years of professional experience in Turkey, Sweden, Belgium and Austria working in the field of passive keyless entry systems, immobilizers, 3D imagers and RADAR systems contributing to the digital design, concept and verification of new products.

Rabia is one of the founders of Women in Engineering community in Graz. She is actively working towards a more diverse work environment in high tech companies. Women currently remain highly underrepresented in leadership positions in tech companies. Companies are facing the risk of losing women in leadership and future women leaders. There are various reasons for this such as taking less risk, less confidence, work life balance and gender prejudices. Rabia will share some of her personal reflections and key learning points from her leadership journey.

Abstract

In tech industry, companies have been working towards gender diversity for decades. However, women currently remain highly under represented in leadership positions in tech companies. Companies are facing the risk of losing women in leadership and future women leaders. There are various reasons for this such as taking less risk, less confidence, work life balance and gender prejudices.

In this speech I would like to focus on what can we do as individuals. What are the messages we need to tell ourselves and women around us.

I would like to share some of my personal reflections and key learning points from my leadership journey such as focusing on your values, noticing your fears and actively working on them, being vulnerable, importance of teamwork and networking.

Women in Engineering

The UNOOSA Space4Women Initiative

Simonetta Di Pippo

United Nations Office for Outer Space Affairs, UNOOSA

Simonetta Di Pippo is Director of UN Office for Outer Space Affairs (UNOOSA), a position which sees her lead the Office's strategic, policy and programmatic activities and advising the UN Secretary-General on space affairs. Prior to joining UNOOSA, she served as Director of Human Spaceflight at the European Space Agency, and previously also as Director of the Observation of the Universe at the Italian National Space Agency, ASI. She is an Academician of IAA and a member of WEF Global Future Council on Space Technologies since 2016 and its co-chair since 2020. She co-founded Women in Aerospace Europe in 2009 and in 2017 became a UN International Gender Champion.
She holds a Master's Degree in Astrophysics and Space Physics from University "La Sapienza", and Honoris Causa Degree in Environmental Studies, and an Honoris Causa Degree of Doctor in International Affairs. Ms. Di Pippo was knighted by the President of the Italian Republic in 2006 and, in 2008, the International Astronomical Union assigned the name „dipippo" to asteroid 21887 in recognition of her efforts in space exploration. She was also featured in a publication "HERstory: A Celebration of Leading Women in the United Nations, a tribute to women's participation in the development of the UN". Among other awards, she was awarded the Hubert Curien Award in 2018 as the first woman laureate.

Abstract

Disparities exist between men and women within the space sector and science, technology, engineering, and mathematics (STEM) fields. Less than 30 percent of STEM researchers are women and less than 20 percent of the space workforce comprises women. Achieving the United Nations (UN) Sustainable Development Goals (SDGs) requires increased participation from women in STEM and in the space sector. SDG 4: Quality Education and SDG 5: Gender Equality are specifically focused on these topics. To support the achievement of these goals, the United Nations Office for Outer Space Affairs (UNOOSA) has launched a global Space4Women project, which aims to strengthen awareness, capacity, and skills of individuals and institutions to promote gender equality in the space sector. It also helps to communicate and facilitate access to opportunities in STEM education and the space sector itself. This is achieved through four unique activities: (1) a global Space4Women Network, which brings together female role models and mentors to inspire, guide, encourage, and support women and girls in pursuing STEM education and careers in the space sector; (2) a platform to submit capacity building ideas and needs to facilitate tailored advice, expertise, knowledge, and data to improve access to and use of space; (3) a global discussion forum in which women and girls can share experiences, opportunities, and obstacles about working in the space sector, and exchange information on STEM fields; and (4) annual conferences and events that facilitate multilateral and global dialogue on gender equality in the space sector. Altogether, Space4Women activities provide opportunities to enable, develop, and inspire women and girls to become leaders in the future space workforce.

Tuesday, Sept 14, 2021

16:10 - 17:10

Session F: Hardening Techniques

Co-Chairs: Daisuke Kobayashi (ISAS/JAXA) & Maxim Gorbunov (SPELS/NRNU MEPhI)

ORAL PRESENTATIONS:

F-1 16:15 **A Soft-Error Hardened by Design Microprocessor Implemented on Bulk 12-nm FinFET CMOS**

L. Clark[1], A. Duvnjak[1], M. Cannon[2], J. Brunhaver[1], S. Agarwal[2], J. Manuel[2], M. Marinella[2]

1. Arizona State University, USA; 2. Sandia National Laboratories, USA

A radiation hardened microprocessor design implemented on a 12-nm bulk finFET CMOS process is presented. The processor uses a combination of circuit redundancy and micro-architecture for hardening.

F-2 16:25 **Analyzing Scaled Reduced Precision Redundancy for Error Mitigation Under Proton Irradiation**

L. García-Astudillo[1], A. Lindoso[1], L. Entrena[1], H. Martín[1], M. Garcia-Valderas[1]

1. Universidad Carlos III de Madrid, Spain

We propose a Scaled RPR approach for multi-stage circuits and analyze mitigation tradeoffs. FFT designs were tested with low-energy protons and fault injection. This approach achieves error mitigation with good precision, while reducing the overhead.

Tuesday, Sept 14, 2021

Session F: Hardening Techniques

Co-Chairs: Daisuke Kobayashi (ISAS/JAXA) & Maxim Gorbunov (SPELS/NRNU MEPhI)

F-3 16:35 **SEU Mitigation on SRAM-Based FPGAs Through Domains-Based Isolation Design Flow**

A. Portaluri[1], C. De Sio[1], S. Azimi[1], L. Sterpone[1]

1. Politecnico di Torino, Italy

We developed a domain based isolation design flow for the mitigation of SEU effects on SRAM-based FPGAs. Fault injection experimental analysis on TMR circuits mapped on APSoC demonstrates an improvement of 44% versus traditional mitigation techniques.

F-4 16:45 **Dual-Core Hybrid Multi-Threaded Lock-Step for Soft Error Mitigation**

M. Peña Fernández[1], A. Serrano-Cases[2], A. Lindoso[3], S. Cuenca-Asensi[2], L. Entrena[3], A. Martínez-Álvarez[2]

1. Arquimea Ingeniería SLU, Spain; 2. University of Alicante, Spain; 3. University Carlos III of Madrid, Spain

A new hybrid soft error mitigation technique for multi-core processors, validated with low energy proton irradiation, based on multi-threaded lockstep and a custom hardware interfacing the trace port, is presented.

Tuesday, Sept 14, 2021

Session F: Hardening Techniques

Co-Chairs: Daisuke Kobayashi (ISAS/JAXA) & Maxim Gorbunov (SPELS/NRNU MEPhI)

POSTERS:

PF-1 Model-Based Design Code Generator Effects on Codes Reliability

L. Tansini[1], P. Rech[1]

1. UFRGS, Brazil

We evaluate the impact of safety-critical Model-Based Design (MBD) code generation tools in programs reliability. We compare Manual, Simulink, and Scade implementations. In general MBD tools reduce the SDC rate but increase the DUE rate.

PF-2 Fail-Reason Capturing Hardware Module for a RISC-V Based System on a Chip

S. Thomet[1,2], S. De-Paoli[1], F. Ghaffari[2], J.-M. Daveau[1], V. Bertin[1], F. Abouzeid[1], O. Romain[2], P. Roche[1]

1. STMicroelectronics, France ; 2. ETIS Lab - ENSEA, France

This paper presents a fail-reason capturing intellectual property. Integrated in a system-on-a-chip, it provides diagnostic information about the origin of failures thanks to the combination of trace events buffering and error detection with triggering mechanisms.

PF-3 Machine Learning as an Alternative to Thresholding for Space Radiation Fault Detection

A. Dorise[1], C. Alonso[1], A. Subias[1], L. Travé-Massuyès[1], L. Baczkowski[2], F. Vacher[2]

1. LAAS-CNRS, France; 2. CNES, France

This paper describes a new method to detect high current event caused by space radiation. Results of machine learning algorithms used on data sets created for this particular study are discussed.

16:55 Q&A of Session F

RADECS
2021
VIENNA, 13-17 September

Tuesday, Sept 14, 2021

17:10 - 17:50

Wrap-up Panel

Given the hybrid nature of the conference and the broad remote participation from every corner of the planet, the goal of the wrap-up panel is to provide a space where session chairs can discuss and present an overview of the highlights of each technical session of the conference. In today's panel, the contributions presented in the sessions A, B, H and Women in Engineering will be the focus of the discussion.

17:50 End of Technical Sessions

RADECS
2021
VIENNA, 13-17 September

Technical Program

Wednesday, Sept 15, 2021

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Technical Program

Wednesday, Sept 15, 2021

08:30 - 09:10

Invited Talk: Shaping the Future of Humankind – a Personal take on the Commercialization of Space Tech

by Alexander Reissner

Alexander Reissner is an aerospace engineer and founder and CEO of ENPULSION. He holds a MSc degree in Physics and a PhD degree in Aerospace Engineering. Alexander started his career in the space industry with RUAG Space, later joining the Austrian Institute of Technology and becoming the team leader for Electric Propulsion Systems. In 2013, he became the Head of the Department of Aerospace Engineering at FOTEC, the research subsidiary of the University of Applied Sciences Wiener Neustadt. While growing this department from 5 to 17 scientists and engineers, he realized the potential of the Field Emission Electric Propulsion (FEEP) technology for the SmallSat market and founded ENPULSION in 2016.

Space used to be controlled by national space agencies and state-owned companies but with more and more private actors entering the sector the roles are shifting. One core enabler for the resulting rapid development of space infrastructure we see today is the commercialization of ground-breaking research work done by scientists from all over the world. In his role as founder and CEO of ENPULSION, the world's lead manufacturer for electric propulsion systems for nano- and microsatellites, Alexander Reissner has been operating at the cutting-edge of space propulsion technologies for years. In this talk Alexander will, therefore, not only be sharing his learnings from turning extensive research and development work to market-leading products but also his personal take on the opportunities that the democratization of space holds for all of us.

Wednesday, Sept 15, 2021

09:10 - 10:00

Session C: Single Event Effects: Mechanisms & Modelling

Co-Chairs: Adrian Ildefonso (U.S. Naval Research Laboratory) & Arto Javanainen (University of Jyväskylä)

ORAL PRESENTATIONS:

C-1 09:15 **Highly Pulsed Electron Beam induced SEU Effects in a SRAM memory**

V. Wyrwoll[1], K. Roed[1], R. García Alía[2], B. Delfs[3], A. Coronetti[4,5], W. Farabolini[2], A. Gilardi[2], R. Corsini[2]

1. University of Oslo, Norway; 2. European Organization for Nuclear Research (CERN), Switzerland; 3. University Clinic for Medical Radiation Physics, Medical Campus Pius Hospital, Carl von Ossietzky University, Germany; 4. CERN, Switzerland; 5. University of Jyväskylä, Finland

Single-Event Effects (SEEs) induced by high energy pulsed electrons in a ESA SEU monitor are discussed. Measurements with high-energy electrons have been performed at VESPER (CERN) focusing on instantaneous fluxes and dose rates.

C-2 09:25 **SE Performance of D-FF Designs with Different VT Options at Near-Threshold Supply Voltages in a 7-nm Bulk FinFET Technology**

A. Feeley[1], Y. Xiong[1], N. Pieper[1], D. Ball[1], B. Bhuva[1]

1. Vanderbilt University, USA

SE rates for a 7-nm bulk FinFET node are investigated at NTV supply voltage for different VT options. Results show minimal differences at close-to-nominal voltages, and that LVT had lowest SEU cross- section at NTV.

C-3 09:35 **Heavy-Ion Induced Latent Damage in SiC Power MOSFETs**

C. Martinella[1,2,3], P. Natzke[2], R. García Alía[3], Y. Kadi[3], U. Grossner[2], A. Javanainen[1]

1. University of Jyväskylä, Finland; 2. APS - ETH Zurich, Switzerland; 3. CERN, Switzerland

Heavy ions induced latent damage in SiC power MOSFETs, involving the gate oxide and the SiC crystal lattice. The failure site was investigated using plasma SEM-FIB analysis. An overview of the heavy-ion SEEs is given.

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Session C: Single Event Effects: Mechanisms & Modelling

Co-Chairs: Adrian Ildefonso (U.S. Naval Research Laboratory) & Arto Javanainen (University of Jyväskylä)

POSTERS:

PC-1 A Neural Network Approach for Single-Event Latchup Prediction Based on TCAD Simulations in CMOS Technology

D. Truyen[1], E. Leduc[1], L. Montagner[1], M. Briet[1], A. Collange[1]

1. Microchip Technology, France

This work presents a new approach for predictive SEL modeling by neural networks, covering the CMOS technology nodes from 500nm down to 22nm. The SEL model is validated by experimental results.

PC-2 Heavy-Ion-Induced Avalanche Multiplication in Low-Voltage Power VDMOSFET

S. Alberton[1], N. Medina[1], N. Added[1], V. Aguiar[1], M. Guazzelli[2], R. Baginski[2]

1. Universidade de São Paulo, Instituto de Física, Brazil ; 2. Centro Universitário FEI, Brazil

The Lackners' theory for avalanche multiplication provides physical interpretation for the model parameters, although obtaining them through experimental methods is necessary. Comparing computational simulations and experimental measurements, the Lackners' impact ionization coefficients were estimated.

PC-3 Heavy-ion Induced Gate Oxide Rupture in SiC MOSFETs

X. Zhou[1], Y. Jia[1], D. Hu[1], Y. Wu[1], Y. Zhao[1]

1. Beijing University of Technology, China

This paper presents the experimental characterization of SiC MOSFETs exposed to the heavy-ion irradiation. Different leakage paths related to the drain bias used during the tests are observed, suggesting different damage sites in the devices, which can be further verified through the post-irradiation measurements. TCAD simulations are utilized to explore the failure mechanisms.

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Session C: Single Event Effects: Mechanisms & Modelling

Co-Chairs: Adrian Ildefonso (U.S. Naval Research Laboratory) & Arto Javanainen (University of Jyväskylä)

PC-4 **Micro-Latchup Location and Temperature Characterization in a 7-nm Bulk FinFET Technology**

N. Pieper[1], Y. Xiong[1], A. Feeley[1], G. Walker[1], B. Bhuva[1], R. Fung[2], S. Wen[2]

1. Vanderbilt University, USA; 2. Cisco, USA

Location and temperature characteristics of micro-latchups at the 7-nm bulk FinFET technology are investigated. Thermal images show that micro-latchup locations are spatially clustered and are removed serially when supply voltage is reduced.

PC-5L **Isotopic enriched and natural SiC junction barrier Schottky diodes under heavy ion irradiation**

K. Røed[1], D. Eriksen[2], B. Ceccaroli[2], C. Martinella[3], A. Javanainen[3], S. Reshanov[4], S. Massetti[5]

1. University of Oslo, Norway; 2. Isosilicon AS, Norway; 3. University of Jyväskylä, Finland; 4. II-VI Kista AB, Sweden; 5. ESA-ESTEC, Netherlands

The radiation tolerance of isotopic enriched and natural SiC JBS diodes are compared under heavy ion irradiation. The results indicate a marginally lower onset of degradation events for the monoisotopic type under reverse biased conditions.

09:45 **Q&A of Session C**

10:00 **Break**

Wednesday, Sept 15, 2021

10:30 - 12:10

Session G: Radiation Hardness Assurance

Co-Chairs: Rafael Ponce (Airbus DS) & Raymond Ladbury (NASA GSFC)

ORAL PRESENTATIONS:

G-1 10:35 **Analysis of TID testing of a statistically large quantity of parts**

J. Voegtli[1], R. Sharp[1], L. Oswald[2], N. Hong[2], B. Archer[2]

1. Radtest Ltd, United Kingdom; 2. University of Oxford, United Kingdom

1,000 LM239N quad comparators (two manufacturers, ten date codes) have undergone TID testing to improve the definition of the optimum sample size for such a test. This paper presents a statistical analysis of the results.

G-2 10:45 **FPGA Benchmarking structures dedicated to TID parametric degradation evaluation**

G. Bricas[1], G. Tsiligiannis[1], A. Touboul[1], J. Boch[1], T. Maraine[1], F. Saigné[1]

1. University of Montpellier, France

This paper presents a simple, cost-effective and efficient methodology to evaluate and compare parametric degradation of FPGA performance induced by TID. X-ray radiation test results on three FPGA families are presented, compared and discussed.

G-3 10:55 **Time-of-flight SEU Cross-section Measurements for 1-800 MeV neutrons and the Soft-error Rates at 18 MeV Proton Cyclotron-driven Neutron Source**

H. Iwashita[1], Y. Hiroshima[1], Y. Okugawa[1], R. Kiuchi[2], H. Sato[2], T. Kamiyama[2], F. Michihiro[2], Y. Kiyanagi[3]

1. NIPPON TELEGRAPH AND TELEPHONE CORPORATION, Japan; 2. Hokkaido University, Japan; 3. Nagoya University, Japan

We measured the energy-dependent neutron-induced SEU cross-section for 1-800 MeV by the time-of-flight technique. Furthermore, we calculated the soft-error rates at a neutron field from an 18 MeV proton cyclotron-driven neutron source using this cross-section.

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Session G: Radiation Hardness Assurance

Co-Chairs: Rafael Ponce (Airbus DS) & Raymond Ladbury (NASA GSFC)

G-4 11:05 **Impact of experimental conditions for the occurrence of stuck bits in commercial SDRAM**

J. Guillermin[1], B. Vandevelde[1], N. Chatry[1], M. Poizat[2]

1. TRAD, France; 2. ESA, Netherlands

Different commercial SDRAM were irradiated under protons in order to assess their sensitivity to stuck bits and determine the experimental conditions which are favorable to their occurrence.

G-5 11:15 **Processor SER Estimation with ACE Bit Analysis**

T. Hsu[1], D. Yang[1], W. Liao[2], M. Itoh[3], M. Hashimoto[4], J. Liou[1]

1. National Tsing Hua University, Taiwan; 2. Kochi University of Technology, Japan; 3. Tohoku University, Japan; 4. Kyoto University, Japan

We proposed to estimate the SER by considering architecturally correct execution (ACE) bits of memory elements in a processor. In an irradiation experiment, the estimated SER has a good consistency with measured SER.

G-6 11:25 **High-energy hadron testing and in-orbit single-event latchup predictions and boundaries**

A. Coronetti[1], R. Garcia Alía[1], A. Javanainen[2], F. Saigné[3]

1. CERN, Switzerland; 2. University of Jyväskylä, Finland; 3. University of Montpellier, France

Boundaries for the application of a volume equivalent LET approach to predict the SEL in-orbit rate based on the SEL cross-section retrieved from high-energy hadron testing are discussed along with upper bounds for zero events.

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Session G: Radiation Hardness Assurance

Co-Chairs: Rafael Ponce (Airbus DS) & Raymond Ladbury (NASA GSFC)

POSTERS:

PG-1 Lot-to-lot variability TID effects on COTS BJT

F. Krimmel[1], T. Borel[1], A. Costantino[1], M. Muschitiello[1], F. Tonicello[1], A. Pesce[1]

1. ESA - ESTEC, Netherlands

This work presents measurements and lot-to-lot variability analysis of the TID degradation of the gain on three COTS BJT part types (BC817, BC847 BC857).

PG-2 Testing and Validation Methodology for a Radiation Monitoring Systems for Electronics in Particle Accelerators

A. Zimmaro[1,2], R. Ferraro[1], J. Boch[2], F. Saigné[2], R. Garcia Alía[1], A. Masi[1], S. Danzeca[1]

1. CERN, Switzerland; 2. University of Montpellier, France

In this work, a methodology for the design and validation of a novel wireless battery powered radiation tolerant monitoring system in particle accelerators is presented.

PG-3 Proton Cross-Sections from Heavy-Ion Data: A Review of the Models

D. Hansen[1], D. Czajkowski[1], B. Vermeire[1]

1. Space Micro, USA

This paper reports on the calculation of proton SEU cross-sections using heavy-ion data using a numb. Calculations are checked using data on proton and heavy-ion cross-sections from the published literature.

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Session G: Radiation Hardness Assurance

Co-Chairs: Rafael Ponce (Airbus DS) & Raymond Ladbury (NASA GSFC)

PG-4 **PTA based availability analysis of the effects of blind scrubbing of UAV-UAV communication using SRAM based FPGAs**

M. Abdelhamid[1], A. Attallah[1], M. Ammar[1], O. Ait Mohamed[1]

1. Concordia University, Canada

This paper computes the worst-case failure for serial UAV communication components using SRAM FPGAs. Furthermore, our framework implements priced timed automata models to execute the blind scrubbing technique and analyze UAV-UAV communication availability at different scrubbing intervals and durations.

PG-5 **Methodical Approach for SEL Tolerance Confirmation of CMOS ICs at Low Temperatures**

M. Novikova[1], A. Novikov[1], A. Pechenkin[1], V. Lukashin[1], E. Oblova[1], A. Gritsaenko[1], D. Protasov[1], A. Tararaksin[1]

1. Specialized Electronic Systems, Russian Federation

An approach for SEL sensitivity estimation using heavy ions at room temperature and laser facilities at both room and subzero temperatures is proposed. The results of comparison approach approbation are also presented.

11:35 **Q&A of Session G**

12:10 **Lunch**

Wednesday, Sept 15, 2021

13:30 - 14:00

Invited Talk: An Effective Network of Facilities for Radiation Hardness Testing: the RADNEXT Project

by Salvatore Fiore

Salvatore Fiore, nuclear and particle physicist, is a research scientist of the Fusion and Nuclear Safety department of ENEA in Frascati, Italy. He is the coordinator of the Transnational Access activities for the RADNEXT project, aiming at the creation of a network of facilities for radiation hardness testing of electronic components and systems. He received his PhD in particle physics in 2008, he participated in several collider physics experiments (ATLAS, KLOE, BELLE II) and related beam test campaigns, facing the challenges related to the radiation effects testing on particle detectors, from scintillating crystals to photodetectors and front-end electronics. Moving to nuclear physics experiments and fusion applications, he developed radiation resistant detectors for harsh fusion environments, and is now leading the user access program at the 14 MeV Frascati Neutron Generator FNG facility.

To progress in the field of rad-hard electronics, by understanding the basic damage mechanisms, designing and manufacturing radiation resistant devices and system, testing is a key point of the whole R&D process.
The radiation hardness community, in particular its industrial members, not only demand the right particle source for their tests: radiation facilities should provide to these users a service that makes testing effective, reliable and responding to all the technical and organizational needs of a testing campaign.
This is what the RADNEXT project aims at: building a network of irradiation facilities with harmonised and streamlined access procedures, where high scientific and technical standards meet ease of access and full exploitation of such resources by their users.
In my talk I will present the project in its several work packages, focussing on the transnational access opportunities that it offers to the radiation testing community in terms of quantity and quality of its facilities portfolio.

Wednesday, Sept 15, 2021

14:00 - 15:30

Session I: Facilities and Dosimetry

Co-Chairs: Carlo Cazzaniga (STFC) & Alessandra Costantino (ESA)

ORAL PRESENTATIONS:

I-1 14:05 **Secondary Particles Generated by Protons in 3D NAND Flash Memories**

M. Bagatin[1], S. Gerardin[2], A. Paccagnella[1], A. Costantino[3], V. Ferlet-Cavrois[3], G. Santin[3], M. Muschitiello[3], A. Pesce[3], S. Beltrami[4]

1. University of Padova, Italy; 2. DEI - Padova University, Italy; 3. ESA, Netherlands; 4. Micron Technology - Process R& D, Italy

We studied proton-induced secondary byproducts inside 3D NAND Flash memories. The results provide interesting insight into the nuclear reactions occurring in electronics, in addition to showing the usefulness of these memories for monitoring proton beams.

I-2 14:15 **Radiation monitor extension for CMOS imaging instruments in nanosatellites**

J. Florczak[1], T. Neubert[1], E. Zimmermann[1], H. Rongen[1], M. Kaufmann[2], F. Olschewski[3], S. van Waasen[4]

1. Central Institute of Engineering, Electronics and Analytics - Electronic Systems (ZEA-2), Forschungszentrum Jülich, Germany; 2. Institute of Energy and Climate Research (IEK-7), Forschungszentrum Jülich, Germany; 3. Institute for Atmospheric and Environmental Research, University of Wuppertal, Germany; 4. Faculty of Engineering, Communication Systems (NTS), University of Duisburg-Essen, Germany

This paper describes a low-cost extension for an imaging observation instrument as a radiation monitor. Adapted image processing methods enable discrimination between measured data and sensor / radiation-specific hazards and drives mitigation techniques to improve mission lifetime.

I-3 14:25 **Heavy-Ion Charge Yield Measurement by Floating Gate Dosimeters**

M. Brucoli[1], S. Danzeca[1], A. Waage[2], A. Masi[1], R. Garcia Alia[1], B. Servera Mas[3], A. Pineda[3], V. Ferlet-Cavrois[4]

1. CERN, Switzerland; 2. Norwegian University of Science and Technology, Norway; 3. Sealicon Microsystems, Spain; 4. ESA, Netherlands

In this study, charge yield measurement performed by using a floating gate dosimeter for heavy-ions with LET from 0.24 to 44 MeV cm^2 mg^{-1} is presented.

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Session I: Facilities and Dosimetry

Co-Chairs: Carlo Cazzaniga (STFC) & Alessandra Costantino (ESA)

I-4 14:35 X-Ray Radioluminescence in Diversely Doped Multimode Silica-based Optical Fibers

A. Meyer[1], A. Morana[1], H. El Hamzaoui[2], B. Capoen[2], G. Bouwmans[2], M. Bouazaoui[2], S. Girard[1], E. Marin[1], Y. Ouerdane[1], A. Boukenter[1]

1. Université Jean Monnet Saint-Étienne, France ; 2. Université de Lille, France

We investigate the radioluminescence response of optical fibers doped with Ge, P, Al, F and Ce, under 100 keV X-rays with dose rates from 0.1 to 20 Gy(SiO2)/s, and discuss their suitability for dosimetry.

I-5 14:45 Measurements of neutron fields in a wide energy range using multi-foil activation analysis

D. Chiesa[1], C. Cazzaniga[2], M. Nastasi[1], M. Rebai[1], E. Previtali[1], G. Gorini[1], S. Lilley[2], C. Frost[2]

1. University and INFN of Milano - Bicocca, Italy; 2. ISIS Facility, UKRI-STFC, Rutherford Appleton Laboratory, United Kingdom

Neutron activation analysis and unfolding has been used for measurements of atmospheric and moderated neutron fields for SEE testing at a spallation source. Multiple reactions are selected to cover from thermal to 800 MeV.

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Session I: Facilities and Dosimetry

Co-Chairs: Carlo Cazzaniga (STFC) & Alessandra Costantino (ESA)

POSTERS:

PI-1 Benchmark between measured and simulated radiation level data at the Mixed-Field CHARM facility at CERN

D. Prelipcean[1], G. Lerner[1], R. García Alía[1], K. Bilko[1], A. Infantino[1], D. Di Francesca[1], D. Ricci[1], M. Brucoli[1], S. Danzeca[1]

1. CERN, Switzerland

A benchmark for radiation monitors employed at CERN for Radiation to Electronics applications is performed at the CHARM mixed field radiation facility. Their measured values during beam operation are compared to those simulated by FLUKA.

PI-2 Pulsed X-ray Source Dosimetry Based On Radioluminescent Nitrogen Optical Fiber

J. Vidalot[1,2], C. Campanella[1], C. Marcandella[1,2], O. Duhamel[2], A. Morana[1], A. Boukenter[1], Y. Ouerdane[1], S. Girard[1], P. Paillet[2]

1. Laboratoire Hubert Curien - Université Jean Monnet St Etienne, France ; 2. CEA DAM, France

The potential of Nitrogen-doped optical fibers for the monitoring of a pulsed high dose rate X-ray source is investigated.

PI-3 Silicon solid-state detectors for monitoring high-energy accelerator mixed field radiation environments

K. Bilko[1], R. García Alía[1], M. Sacristan Barbero[1], D. Prelipcean[1], C. Cazzaniga[2], A. Coronetti[1], G. Lerner[1], W. Hajdas[3]

1. CERN, Switzerland; 2. STFC-UKRI, United Kingdom; 3. Paul Scherrer Institute, Switzerland

The use of silicon diodes for mixed-field radiation monitoring was studied. Measurements with high-energy hadrons and simulations are presented, focusing on accelerator applications. Compared to other devices, diodes show enhanced sensitivity and energy discrimination capabilities.

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Session I: Facilities and Dosimetry

Co-Chairs: Carlo Cazzaniga (STFC) & Alessandra Costantino (ESA)

PI-4 An Enhanced Sensitivity Operation Mode for Floating Gate Dosimeters

M. Rizzo[1], M. Brucoli[1], S. Danzeca[1], A. Masi[1], A. Pineda[2], B. Servera Mas[2]

1. CERN, Switzerland; 2. Sealicon Microsystem, Spain

A new method for enhancing the sensitivity of the floating gate dosimeter (FGDOS) has been investigated. Results are presented providing the effectiveness of the enhancement and its effect on the sensitivity degradation rate.

PI-5 Design and expected performance of a new 60 MeV proton beam-line dedicated for R&D

P. Hofverberg[1], C. Armando[1], J. Bergerot[1], E. Bourrel[1], J. Dicarlo[1], G. Donadey[1], S. Dumas[1], A. Giusto[1], J. Grini[1], J. Hérault[1], Y. Payan[1], C. Salicis[1], R. Trimaud[1]

1. Centre Antoine Lacassagne, France

Centre Antoine Lacassagne is constructing a new 60 MeV proton beam-line for the MEDICYC cyclotron. This beam-line is dedicated for R&D activities, and will be available to external users from late 2021.

PI-6 Assessment of ICPO Proton Facility for the radiation assessment of electronic devices

S. El Mimouni[1], N. Guibaud[1], F. Miller[1], A. Patriarca[2], L. De Marzi[2], G. Le Morvan[1], M. Vieille-Grosjean[1]

1. Nucletudes, France, 2 Institut Curie - Centre de Protonthérapie, France

Thanks to its upgrades, the Curie institute Proton facility in Orsay offers new perspectives to perform continuous proton irradiations usable for electronics sensitivity assessments. To this end, the facility was characterized with known electronic devices.

Wednesday, Sept 15, 2021

Session I: Facilities and Dosimetry

Co-Chairs: Carlo Cazzaniga (STFC) & Alessandra Costantino (ESA)

PI-7 Sirius electron accelerator

O. Cavani[1], R. Grasset[1], A. Courpron[1], A. Alessi[1]

1. LSI, CEA/DRF/IRAMIS, CNRS, Ecole polytechnique, Institut Polytechnique de Paris, France

The capabilities of the electron accelerator named SIRIUS are reported. In this facility the main irradiation parameters like beam energy, fluence (dose), flux (dose rate), temperature and atmosphere can be adapted to specific irradiation aims.

PI-8 Conceptual design of a novel electron radiation and spacecraft charging test platform for CubeSat dimensioned devices based on laser-driven electron accelerator

I. Zymak[1], R. Antipenkov[1], L. Goncalves[1], G. Grittani[1], C. Lazzarini[1], S. Lorenz[1], M. Nevrkla[1], R. Versaci[1], P. Bakule[1], S. Bulanov[1]

1. ELI Beamlines, Czech Republic

Conceptual design of a radiation test environment has been developed using numerical SIMION and FLUKA models. Concept proof generation of the electron beam accelerated to energies above 1 MeV have been performed.

PI-9 SEREEL2 – a new laser single-event effects test system with benchmark results

R. Sharp[1], A. Crombie[1], C. Chong[1]

1. Radtest Ltd, United Kingdom

This work describes a new pulsed laser test system, SEREEL2, and demonstrates its capabilities by comparison of LM124 test data with similar obtained from other systems. SEREEL2 is a highly reliable, stable and precise instrument.

Wednesday, Sept 15, 2021

Session I: Facilities and Dosimetry

Co-Chairs: Carlo Cazzaniga (STFC) & Alessandra Costantino (ESA)

PI-10L **Characterisation of Radio-Photo-Luminescence (RPL) dosimeters as radiation monitors in the CERN accelerator complex**

D. Pramberger[1], Y. Aguiar[1], H. Vincke[1], J. Trummer[1]

1. CERN, Switzerland

This work provides a characterisation of Radio-Photo-Luminescence dosimeters as a high-level radiation monitor at CERN. Two correction methods to improve the measured dose are presented, one for fading and one for mixed high-energy radiation fields.

14:55 **Q&A of Session I**

15:30 **Break**

Wednesday, Sept 15, 2021

16:00 - 17:30

Poster Session

Chair: Steven Witczak (Northrop Grumman)

16:00 Introduction of the Posters

The following posters will be briefly introduced by the poster session chair.

Posters from Session A
Posters from Session B
Posters from Session C
Posters from Session D
Posters from Session E
Posters from Session F
Posters from Session G

Introduction will be in the Conference Hall.

16:30 Poster Presentations

Poster presentation by the Authors will be done online and on-site in the Foyer.

For details, see associated sessions.

www.radecs2021.org

Wednesday, Sept 15, 2021

17:30 - 18:00

Wrap up

Given the hybrid nature of the conference and the broad remote participation from every corner of the planet, the goal of the wrap-up panel is to provide a space where session chairs can discuss and present an overview of the highlights of each technical session of the conference. In today's panel, the contributions presented in the sessions C, F and G will be the focus of the discussion.

18:00 End of Technical Sessions

Two European projects aiming at advancing the study of radiation effects on electronic components and systems and their development and qualification for space and beyond.

RADSAGA

RADiation and Reliability Challenges for Electronics used in Space, Avionics, on the Ground and at Accelerators (RADSAGA)

- **Innovative Training Network** under the Marie Skłodowska-Curie Actions.
- 15 **PhD students** trained in the field of radiation effects on electronics.
- Consolidation of a **strong collaborative network** among the different partners and institutions.

Development of **innovative research projects** bridging different system applications:

RADiation facility Network for the EXploration of effects for indusTry and research (RADNEXT)

- **H2020 Infrastructure European project** – spinoff of RADSAGA.
- Main purpose is to **enhance irradiation facility infrastructures** for the qualification of electronics under radiation effects.
- Development of scientific research and collaborative networking through several **post-doc and PhD opportunities.**

Transnational Access to irradiation facilities within the RADNEXT network.

More than **6000 beam time hours** will be awarded during 2021-2025.

Call for Proposals!

For more information:
https://radsaga.web.cern.ch and https://radnext.web.cern.ch

These projects have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No **721624** (RADSAGA) and No **101008126** (RADNEXT).

RADECS
2021
VIENNA, 13-17 September

Technical Program

Thursday, Sept 16, 2021

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Technical Program

Thursday, Sept 16, 2021

08:30 - 09:10

Invited Talk: Climate and Space

by Thomas Geist

Thomas Geist started working for the AeronautICs and Space Agency (ALR) within the Austrian Research Promotion Agency (FFG) in 2007.
As an expert for Earth Observation (EO) Thomas is the Copernicus contact point in the agency and responsible for the coordination of EO projects in the national R&D funding programme ASAP (Austrian Space Application Programme). Thomas represents Austria in the ESA Programme Board for Earth Observation and in the period 2017-2020 he chaired the Data and Operations Scientifical and Technical Advisory Group (DOSTAG) at ESA. Furthermore, he is delegate in the Copernicus Committee.
Before joining FFG Thomas worked as a senior researcher at the University of Innsbruck. He holds a Master's degree in Physical Geography from the University of Munich, and a PhD degree from the University of Innsbruck (Faculty of Geo- and Atmospheric Sciences).

Over the past decades, Earth observation satellites have given us an unprecedented view of our world and have become an indispensible tool for monitoring the changing climate. They are particularly useful for monitoring remote areas such as the polar regions, where some of the changes to the climate are most significant.
As the first operational remote sensing missions were already in the late 1970s, we now have the opportunity to look back through forty years of observations for many climate parameters. Not only for climate change investigations satelllite data are of great use, but also for the planning of concrete measures for climate protection.
This talk will give an overview on ongoing and planned space activities with regard to climate change and climate protection, like the European Space Agency's Climate Change Initiative or the Copernicus Programme.

Thursday, Sept 16, 2021

09:10 - 10:00

Session D: Single Event Effects: Devices and ICs

Co-Chairs: Andrey Yanenko (National Research Nuclear University MEPhI) & Juan Cueto (TAS Spain)

ORAL PRESENTATIONS:

D-1 09:15 Impact of the Data Retention Threshold Voltage on the Cell-to-Cell SEU Sensitivity of COTS SRAMs

M. Rezaei[1], A. Arinero Panduro[2], F. Franco[2], J. Fabero[2], H. Mecha[2], M. Letiche[3], H. Puchner[4], J. Clemente[2]

1. Universidad Complutense de Madrid / Departamento de Arquitectura de Computadores y Automática / Facultad de Informática, Spain ; 2. Universidad Complutense de Madrid, Spain ; 3. Institut Laue Langevin, France ; 4. Infineon Technologies, USA

An experimental study on the cell-to-cell sensitivity of 65-nm, 90-nm and 130-nm volatile bulk COTS SRAMs to thermal neutron irradiation is presented. Results show a dependency between VDR and the number of bitflips after irradiation.

D-2 09:25 Assessment of Machine Learning Models in Computing System under Neutron Radiation

M. Trindade[1], J. Brum[1], L. Maldaner[1], R. Garibotti[2], L. Ost[3], R. Possamai Bastos[1]

1. Laboratoire TIMA, France ; 2. School of Technology, Pontifical Catholic University of Rio Grande do Sul, Brazil ; 3. Loughborough University, United Kingdom

This paper compares the effectiveness of three machine learning models running on a low-power processor under neutron radiation. Results suggest that our implementations retain a certain level of effectiveness even without mitigation techniques.

D-3 09:35 Neutron-induced Faults on CNN for Aerial Image Classification on SRAM-based FPGA Using Softcore GPU and HLS

F. Benevenuti[1], M. Gonçalves[1], E. Pereira Jr[2], R. Galhardo Vaz[2], O. Gonçalez[2], J. Azambuja[1], F. Lima Kastensmidt[1]

1. Universidade Federal do Rio Grande do Sul, Brazil; 2. Departamento de Ciência e Tecnologia Aeroespacial, Brazil

This work evaluates neutron-induced SEUs in image classification all-convolutional neural networks implemented on SRAM-based FPGA: one running in softcore GPU and one in HLS design. Reliability, area, execution time and power are discussed.

Thursday, Sept 16, 2021

Session D: Single Event Effects: Devices and ICs

Co-Chairs: Andrey Yanenko (National Research Nuclear University MEPhI) & Juan Cueto (TAS Spain)

POSTERS:

PD-1 Single-Event Transient (SET) sensitivity into the Clock Networks of FPGAs

N. Guibbaud[1], F. Miller[1], T. Colladant[2]

1. Nuclétudes, France; 2. DGA, France

In this paper we propose to measure Single-Event Transient (SET) cross section on the clock tree resources of FPGA towards radiations.

PD-2 Characterization of the Total Charge for SET Voltage Pulses in a Commercial 65 nm CMOS Technology

Z. Li[1,2], L. Berti[1], B. Vignon[1], P. Leroux[2]

1. IMEC, Belgium; 2. Leuven University, Belgium

This paper SET charge measurement circuits and results for a commercial 65 nm CMOS technology. The chip has been tested under the heavy-ion beam with an effective LET from 20.4 to 88.35 MeVcm2/mg.

PD-3 Assessment of Attitude Estimation Processing System under Neutron Radiation Effects

T. Kraemer Sarzi Sartori[1,2], H. Fourati[2], M. Garay Trindade[1], R. Possamai Bastos[1]

1. Université Grenoble Alpes/TIMA, France ; 2. Université Grenoble Alpes/GIPSA-Lab, France

This paper assesses the effectiveness of an Attitude Estimation (AE) processing system in tolerating neutron radiation-induced soft errors. Radiation tests have been conducted on an advanced AE algorithm running on a processing system neutron radiation.

Thursday, Sept 16, 2021

Session D: Single Event Effects: Devices and ICs

Co-Chairs: Andrey Yanenko (National Research Nuclear University MEPhI) & Juan Cueto (TAS Spain)

PD-4 Reliability evaluation of low-power GPU-accelerated System-on-Chip under proton radiation

J. Badia[1], G. Leon[1], J. Belloch[2], A. Lindoso[2], M. Garcia-Valderas[2], L. Entrena[2]

1. Universitat Jaume I de Castellón, Spain; 2. Universidad Carlos III de Madrid, Spain

In this paper we evaluate the influence of the parallelization strategy on the proton radiation reliability of LU decomposition on a GPU-accelerated System-on-Chip. More intensive utilization of GPU resources produce larger cross-sections.

PD-5 Experimental Test Approach for SEFI Categorization in Microprocessors

S. Houssany[1], N. Guibbaud[1], F. Miller[1], T. Cheviron[1], T. Colladant[2]

1. Nuclétudes, France; 2. DGA, France

An experimental test approach to sort the different kinds of SEFI) in microprocessors is presented. It relies on the configuration and use of the interrupt handler combined with an external watchdog.

PD-6 Investigation and Simulation of SEL Cross Sections at Different Temperatures

E. Mrozovskaya[1], P. Chubunov[1], S. Iakovlev[2], G. Zebrev[1]

1. National Research Nuclear University MEPhI, Russian Federation; 2. JSC Institute of Space Device Engineering, Russian Federation

The Single Event Latchup cross sections as functions of LET in different CMOS circuits were experimentally investigated at different temperatures. A simplified simulation method for the SEL cross section temperature dependence is proposed and validated.

Thursday, Sept 16, 2021

Session D: Single Event Effects: Devices and ICs

Co-Chairs: Andrey Yanenko (National Research Nuclear University MEPhI) & Juan Cueto (TAS Spain)

PD-7L **7nm FinFET technology heavy ion SEL evaluation using Xilinx Versal as case study**

A. Dufour[1], J. Carron[1], F. Pierron[2], D. Dangla[1], G. Bascoul[1], F. Bezerra[1], J. Mekki[1], P. Maillard[3]

1. CNES, France ; 2. Bibench, France ; 3. Xilinx, USA

This paper presents the test setup and first SEL results recently obtained under heavy ions on 7nm FinFET Xilinx Versal™, the latest product proposed by Xilinx. We also analyze small current variations observed under beam.

PD-8L **Evaluation of Xilinx Deep Processing Unit (DPU) under Neutron Irradiation**

D. Agiakatsikas[1], N. Foutris[2], A. Sari[1], V. Vlagkoulis[1], I. Souvatzoglou[1], M. Psarakis[1], M. Lujan[2], M. Kastriotou[3], C. Cazzaniga[3]

1. Dept. of Informatics, University of Piraeus, Greece; 2. Dept. of Computer Science, The University of Manchester, United Kingdom; 3. ISIS Facility, STFC, Rutherford Appleton Laboratory, United Kingdom

The paper studies the dependability of the Xilinx Deep-Learning Processing Unit (DPU) under neutron irradiation. It analyzes the impact of SEEs on the accuracy of a DPU running the resnet50 model on an Ultrascale + MPSoC.

09:45 **Q&A of Session D**

10:00 **Break**

Thursday, Sept 16, 2021

10:30 - 11:35

Session J: Alternative Testing and RHA Approaches

Chair: Manuel Rivas (Blue Origin)

ORAL PRESENTATIONS:

J-1 10:35 **System-level Uncertainty Quantification from Component-level Radiation Effects**

G. Karsai[1], N. Mahadevan[1], A. Witulski[1], A. Sternberg[1], J. Kauppila[1], R. Schrimpf[1], P. Adell[2], H. Schrone[2], M. Meyers[2], A. Daniel[2]

1. Vanderbilt University, USA ; 2. NASA JPL, USA

Impacts of transistor-level total ionizing dose are simulated on system-level parameters of a CubeSat computing board. Temperature control loop uncertainty quantification shows TID-induced changes as probability distributions of key system parameters versus mission time.

J-2 10:45 **How the Analysis of Archival Data Could Provide Helpful Information about TID Degradation**

P. Martin Holgado[1], A. Romero-Maestre[1], J. de-Martín-Hernández[2], J. González-Luján[3], I. Illera-Gómez[1], Y. Jiménez-de-Luna[2], F. Morilla[4], M. Sacristan Barbero[5], R. García Alía[5], M. Dominguez[3], Y. Morilla[6]

1. Centro Nacional de Aceleradores, Spain ; 2. Universidad de Sevilla, Spain ; 3. ALTER TECHNOLOGY, Spain ; 4. National Distance Education University, Spain ; 5. CERN, Switzerland; 6. CNA, Spain

This work tries to evaluate if valuable information might be extracted from archival data to carry out the mission risk assessment despite the well-known and dramatic lot-to-lot, or even part-to-part, variation for some technologies.

J-3 10:55 **Radiation Tolerant ATTM-WRTU Wireless Infrastructure for Radiation Harsh Terrestrial Applications**

A. Bernhard[1], D. Selčan[1], T. Rotovnik[1], D. Gačnik[1], I. Kramberger[2], S. Danzeca[3], G. Furano[4]

1. Skylabs d.o.o., Slovenia ; 2. University of Maribor, Slovenia ; 3. CERN, Switzerland ; 4. ESA/ESTEC, Netherlands

This paper provides an overview of the challenges and solutions for wireless communications for terrestrial applications in radiation harsh environments, by utilizing the proven designs used in space applications where radiation tolerance is a must.

Thursday, Sept 16, 2021

Session J: Alternative Testing and RHA Approaches

Chair: Manuel Rivas (Blue Origin)

J-4 11:05 **Proposal of a Lightened Radiation Hardness Assurance Methodology for New Space**

F. Bezerra[1], J. Mekki[1], G. Augustin[2], J. Guillermin[2], N. Chatry[2]

1. CNES, France; 2. TRAD, France

In this paper, we present and discuss a lightened RHA methodology proposed to fulfill the harsh constraints in terms of cost and lead time applicable to New Space projects.

J-5 11:15 **FPGA Qualification and Failure Rate estimation Methodology for LHC Environments Using Benchmarks Test Circuits**

A. Scialdone[1], R. Ferraro[2], R. García Alía[3], L. Sterpone[4], S. Danzeca[1], A. Masi[1]

1. CERN, Switzerland; 2. University of Montpellier, France

In this work, a novel approach for qualifying FPGAs to be used in the LHC radiation environment is proposed. The response of two different FPGAs is presented.

J-6 11:25 **Laser-induced Transients in a GaN-on-Si Power HEMT using Si-SPA Optical Parameters**

C. Ngom[1,2], V. Pouget[3], M. Zerarka[1], F. Coccetti[1], A. Touboul[2], M. Matmat[1], O. Crepel[4]

1. IRT Saint Exupery. France ; 2. IES-University of Montpellier, France; 3. IES-CNRS, France ; 4. Airbus Toulouse, France

This paper investigates the response of a commercial GaN-on-Si HEMT technology to laser testing parameters commonly used for single-photon absorption testing of silicon devices. Transient currents mappings and the influence of bias conditions are presented and discussed.

Thursday, Sept 16, 2021

Session J: Alternative Testing and RHA Approaches

Chair: Manuel Rivas (Blue Origin)

POSTERS:

PJ-1 Estimation of Accelerated ELDRS Test Using Temperature-Switching Irradiation

X. Li[1]

1. Xinjiang Technical Institute of PhysICs and Chemistry, China

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

PJ-2 Searching the Damaged Area on IC Chip Using Ionization Response Mapping

D. Savchenkov[1], G. Davydov[1], A. Yanenko[1]

1. NRNU MEPhI / JSC SPELS, Russian Federation

A method is described for localizing damaged areas on IC chip using ionization response maps. The method can provide some essential information to IC designers to help them improve its resistance to failures.

PJ-3 General Purpose and Neural Network Approach for Benchmarking Microcontrollers Under Radiation

M. Giordano[1,2], S. Danzeca[2], R. Ferraro[2]

1. ETH Zurich, Switzerland; 2. CERN, Switzerland

A testing methodology for microcontrollers under radiation is proposed. General purpose benchmarks are reviewed, a neural network benchmark for IoT-devices is introduced. The testing strategy is validated on ARM M0+/M4 microcontrollers under a 200MeV-proton beam.

Thursday, Sept 16, 2021

Session J: Alternative Testing and RHA Approaches

Chair: Manuel Rivas (Blue Origin)

PJ-4 **Accurate Cross Section Estimation Using High-Level Software Fault Injection on Arm CPUs**

P. Bodmann[1], D. Oliveira[2], P. Rech[3]

1. UFRGS, Brazil; 2. UFPR, Brazil; 3. Politecnico di Torino, Italy

We compare cross-sections predicted with software fault-injection and measured with neutron beam experiments of eight codes on two Arm devices. We improve predictions accuracy using performance and hardware utilization metrICs.

PJ-5L **Generating Proton Energy Spectra for Space Environment Tests with Laser Driven Accelerators**

M. Yigitoglu[1], M. Demirkoz[1], O. Culfa[2]

1. Middle East Technical University, Turkey; 2. Karamanoglu Mehmetbey University, Turkey

In this study, proton energy spectra for four different orbits such as LEO, MEO, GEO and SSO were obtained from the SPENVIS program and proton energy spectrum produced by a laser driven accelerator were compared with them.

11:35 **Q&A of Session J**

12:10 **Lunch**

Thursday, Sept 16, 2021

14:00 - 15:00

RADECS General Assembly

Robert Ecoffet, as the RADECS President is coordinating the RADECS General Assembly. The RADECS General Assembly is the annual meeting of the RADECS assoziation.
The RADECS Association General Assembly will take place on Thursday September 16, 2021 from 14:00 to 15:00 (CEST) in the Conference Hall.

Like other Conference events, remote connection will be available from the RADECS 2021 Conference Live Streaming platform for participants who will not be physically in Vienna. The meeting agenda is:

- Final feedback from RADECS 2020
- RADECS 2022 (Venice, Italy)
- NSREC 2022 (Provo, Salt Lake City UT, United States)
- Short status for RADECS Conferences in 2023 (Toulouse, France), 2024 (Gran Canaria, Spain), 2025 (Saint Petersburg, Russian Federation)
- Status on recent and planned workshops
- Feedback from the audience

All Conference attendees are welcome!

A first feedback from RADECS 2021 will be given at the Conference closure on Friday, September 17, 2021.

15:00 Break

Thursday, Sept 16, 2021

15:30 - 17:00

Poster Session and Data Workshop

Introduction of the Posters

Chair: Steven Witczak (Northrop Grumman)

The following posters will be briefly introduced by the poster session chair.

Posters from Session H
Posters from Session I
Posters from Session J

Introduction will be in the Conference Hall.

Introduction of the Data Workshop Posters

Co-Chairs: Jan Budroweit (DLR) & Greg Allen (NASA JPL)

The following posters will be briefly introduced by the Data Workshop session chair:

DW-1, ..., DW-20L

16:00 Presentation of Posters and the Data Workshop Posters

Poster presentation by the Authors will be done online and on-site in the Foyer.

For details, see associated sessions.

Thursday, Sept 16, 2021

Data Workshop

Co-Chairs: Jan Budroweit (DLR) & Greg Allen (NASA JPL)

DW-1 A Fully Integrated 1 MHz – 2.5 GHz Radiation-Hardened All-digital Frequency Synthesizer

M. Strackx[1], B. van Bockel[2], A. Karmakar[2], S. Ali[1], B. Boons[1], R. van Dyck[1], H. Marien[1], Y. Cao[1], P. Leroux[2], J. Prinzie[2]

1. MAGICs Instruments, Belgium; 2. KU Leuven, Belgium

A fully integrated radiation-hard all-digital frequency synthesizer is presented. Single-event monitoring of the phase-locked-loop is proposed by comparing the time-to-digital-converter output with an adjustable threshold. The validated radiation tolerance reaches 1kGy TID and 62.5MeV·cm^2/mg SEL/SEU.

DW-2 SEE Radiation Analysis and Mitigation on SAM3X8ERT Microcontroller

R. Pilia[1], R. Espinasse[1], C. Poulet[1], F. Bezerra[2], L. Gillot[2], B. Treuillard[3], S. Dumortier[3]

1. EREMS, France; 2. CNES, France; 3. Microchip Technology, France

This paper reports results and analysis of Single Event Effects (SEE) test campaign conducted by CNES and EREMS. The DUT used for the study was the SAM3X8ERT Microcontroller from Microchip.

DW-3 withdrawn

Thursday, Sept 16, 2021

Data Workshop

Co-Chairs: Jan Budroweit (DLR) & Greg Allen (NASA JPL)

DW-4 SEE characterization for a Quad 12-bit 1.6 GSps ADC, Digitizing up to 6.4 GSps (April 2021)

O. Bonnet[1], R. Pilard[1], S. Pelé[1]

1. Teledyne e2v, France

The EV12AQ600, a quad channel 12-bit 1.6GSps ADC, was submitted to a heavy ions test, in order to evaluate its sensibility to Single Event Effect up to a LET of 67 MeV.cm²/mg.

DW-5 Total dose effects on large quantities of LM239N comparators from two manufacturers

R. Sharp[1], J. Voegtli[1], E. Bradley[2]

1. Radtest Ltd, United Kingdom; 2. University of the West of England, United Kingdom

1,000 LM239N quad comparators (two manufacturers, ten date codes) have undergone TID testing to improve the definition of the optimum sample size for such a test. This paper presents the raw results of the work.

DW-6 Single Event Effects Characterization of 55-65nm NOR flash for Space Applications

B. Tanios[1], M. Kaddour[1], B. Forgerit[1], F. Guerre[1], C. Poivey[2]

1. Alter Technology TÜV Nord France, France; 2. European Space Agency (ESA/ESTEC), Netherlands

This work presents a comparative study of Single Event Effects (SEE) radiation sensitivity of two COTS (commercial off-the-shelf) 55-65nm NOR flash memories for space applications.

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Data Workshop

Co-Chairs: Jan Budroweit (DLR) & Greg Allen (NASA JPL)

DW-7 Single Event Effects Characterization of 24-36nm COTS NAND flash for Space Applications

B. Tanios[1], M. Rousselet[1], F. Lochon[1], B. Forgerit[1], F. Guerre[1], C. Poivey[2]

1. Alter Technology TÜV Nord France, France; 2. European Space Agency (ESA/ESTEC), Netherlands

This work presents a comparative study of Single Event Effects (SEE) radiation sensitivity of two COTS (commercial off-the-shelf) 24-36nm NAND flash memories for space applications.

DW-8 Testing of COTS Multiplexer in the Framework of the ESA CORHA Study

M. Wind[1], C. Tscherne[1], M. Bagatin[2], S. Gerardin[2], L. Huber[1], M. Latocha[1], A. Paccagnella[2], M. Poizat[3], P. Beck[1]

1. Seibersdorf Laboratories, Austria; 2. University of Padova, Italy; 3. ESA, Netherlands

We present TID radiation response test data of commercial multiplexers as part of the ESA CORHA study that investigates relevant COTS components and finally aims to formulate a test-data based ad-hoc RHA approach for COTS.

DW-9 SAMRH71F20C RHBD 32-bits Flash Microcontroller Single Event Effects & TID evaluation

G. Bourg Cazan[1], J. Bernard[1], S. Furic[1], E. Leduc[1], A. Solere[2]

1. Microchip Technology Nantes, France; 2. Microchip Technology Rousset, France

This paper reports the results of Single Event Effects (SEE) and Total Ionizing Dose (TID) test campaigns conducted by Microchip on the ARM® Cortex® M7 SAMRH71F20C Microcontroller.

Thursday, Sept 16, 2021

Data Workshop

Co-Chairs: Jan Budroweit (DLR) & Greg Allen (NASA JPL)

DW-10 Updated Radiation Performance of Intersil's Commercial Space Plastic Parts

W. Newman[1], N. van Vonno[1], S. Singer[1], P. Lawrence[1], E. Thomson[1]

1. Renesas Electronics America, USA

The ISL71xxxM/SLHM family of radiation-tolerant and radiation-hardened plastic-package ICs is designed to support the emerging constellations of small satellites that will provide high-speed internet connections to millions of users in communities, governments, and businesses worldwide.

DW-11 Non-Volatile Memory Destructive Failure in Standby Mode

P. Wang[1], P. Kohler[1], A. Bosser[1], L. Thibaut[2], G. Duran Cardenas[2], L. Frederic[2]

1. 3D PLUS, France ; 2. Alter Technology France, France

This paper presents the results of a 256Mb SPI/QSPI non-volatile memory (NVM) SEE characterization. Destructive failures were observed during SEE tests, and the DUT shows sensitivity especially in standby mode instead of Erase/Write/Read modes.

DW-12 TID Characterization of 24-45nm COTS NAND flash for Space Applications

B. Tanios[1], O. Perrotin[1], B. Forgerit[1], F. Tilhac[1], F. Guerre[1], C. Poivey[2]

1. Alter Technology TÜV Nord France, France; 2. ESA, Netherlands

This work presents a comparative study of Total Ionizing Dose (TID) radiation sensitivity of five COTS (commercial off-the-shelf) 24-45nm NAND flash memories for space applications.

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Data Workshop

Co-Chairs: Jan Budroweit (DLR) & Greg Allen (NASA JPL)

DW-13 VSC8541RT Single Port Gigabit Ethernet PHY Single Event Effects and Total Ionizing Dose performances

B. Treuillard[1], S. Furic[1], G. Bourg Cazan[1], E. Leduc[1], P. Fournier[2]

1. Microchip Technology Nantes, France; 2. Microchip Technology Rousset, France

This paper reports the results of Single Event Effects (SEE) and Total Ionizing Dose (TID) test campaigns conducted by Microchip on VSC8541RT Single Port Gigabit Ethernet PHY.

DW-14 The SEE Test Results of the different analog devices

A. Kalashnikova[1], T. Maksimenko[1], A. Koziukov[1], P. Chubunov[1], M. Kuznetsov[1], R. Mangushev[1], A. Drokin[1], K. Bu-khasan[1], N. Bondarenko[1], M. Vyrostkov[1], A. Nilov[1], M. Maltseva[1], N. Il'yin[1], A. Kukharev[1]

1. Branch of Joint - Stock Company "United Rocket and Space Corporation"- "Institute of Space Device Engineering" (Branch of JSC URSC - ISDE), Russian Federation

The article presents the results of single event effect (SEE) testing samples of various representatives of analog microcircuits: operational amplifiers (OpAmp), relays, voltage regulators and transistor.

DW-15 Heavy Ion Test Results for Microcircuits of the SNJ54 Series

A. Koziukov[1], P. Chubunov[1], S. Iakovlev[1], L. Arutunyan[1], M. Shekhovtsov[1], A. Riabtseva[1]

1. Branch of JSC "URSC" - "ISDE", Russian Federation

The article presents the test results of digital microcircuits of the SNJ54 series for resistance to heavy ions obtained on the test means to monitor resistance to heavy ion space.

Thursday, Sept 16, 2021

Data Workshop

Co-Chairs: Jan Budroweit (DLR) & Greg Allen (NASA JPL)

DW-16L Microchip RT PolarFire In Orbit Programming and SEE characterization of the FPGA Fabric

N. Rezzak[1], R. Chipana[1], C. Lao[1], G. Bakker[1], J. Mccollum[1], F. Hawley[1], K. O'neill[1], E. Hamdy[1]

1. Microchip, USA

Microchip RT PolarFire FPGA in orbit programming is investigated using TID, Proton and Heavy ion in-beam programming tests. SEE characterization of the FPGA Fabric and SEL using heavy ion and proton are also presented.

DW-17L Single Event Effects in IDE3466 Readout IC for the RADEM and NORM Radiation Monitors

T. Østmoe[1], S. Benoit[1], P. Øya[1], J. Choe[1], T. Stein[1,2], D. Meier[1], A. Hasanbegovic[1], G. Maehlum[1], A. Kohfeldt[1,2]

1. IDEAS, Norway; 2. University of Oslo, Norway

The IDE3466, a detector readout ASIC used in the space radiation monitors RADEM/JUICE and NORM/ASBM, shows no SEL below 81.5 MeVcm^2/mg, no SEU below 55 MeVcm^2/mg, and no SET below 3.3 MeVcm^2/mg.

DW-18L Compendium of Total Ionizing Dose Effects Results on Commercial Power Regulators

J. Budroweit[1], N. Aksteiner[1]

1. DLR, Germany

This paper presents the latest test results of power regulator ICs under total ionizing dose (TID) irradiation. The devices under test are characterized under high dose rates and low dose rates.

Thursday, Sept 16, 2021

Data Workshop

Co-Chairs: Jan Budroweit (DLR) & Greg Allen (NASA JPL)

DW-19L Total Ionizing Dose Effects on Current Sense Amplifiers

N. Aksteiner[1], J. Budroweit[1]

1. DLR, Germany

This paper presents the latest test results of two current sense amplifiers under gamma-ray irradiation to characterize the behavior for total ionizing dose (TID) effects.

DW-20L Multi chips heavy ions SEE testing of the COTS Myriad-2 vision processing unit

A. Oliveira[1], O. Lexell[1], F. Sturesson[1]

1. Cobham Gaisler, Sweden

This work presents the heavy ions SEE testing of the Intel Movidius Myriad-2. This device is a vision processing unit that will be part of the Cobham Gaisler High-Performance Compute Board platform targeting space applications.

Thursday, Sept 16, 2021

17:00 - 17:30

Wrap up

Given the hybrid nature of the conference and the broad remote participation from every corner of the planet, the goal of the wrap-up panel is to provide a space where session chairs can discuss and present an overview of the highlights of each technical session of the conference. In today's panel, the contributions presented in the sessions D, I and J will be the focus of the discussion.

17:30 End of Technical Sessions

RADECS
2021
VIENNA, 13-17 September

Technical Program

Friday, Sept 17, 2021

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Technical Program

Friday, Sept 17, 2021

09:20 - 10:00

Invited Talk: Reliability of Nanosatellite Missions

by Otto Koudelka

Prof. Otto F. KOUDELKA is a head of the Institute of Communication Networks and Satellite Communications at TU Graz since 2000.
His research and teaching activities are in the fields of small satellites, terrestrial and satellite broadband wireless communication systems and networks, applications of wireless systems (such as mobile broadband, tele-medicine, tele-education, emergency communications and disaster management), ground station technology as well as space systems, mostly under contracts by European Space Agency ESA and the European Union. In the last 17 years he focused on nanosatellite developments.

He is Principal Investigator and project leader of the BRITE-Austria/TUGSAT-1 nanosatellite mission (the first Austrian satellite, launched in 2013 as part of BRITE Constellation measuring the brightness variations of massive luminous stars) and member of the BRITE Executive Science Team. He is author or co-author of more than 170 publications.

Small satellite missions and constellations of small satellites have become indispensable tools for space research, space technology and space applications. Since the first ones were started in the early 2000 years as purely educational projects, they have matured and also the reliability has improved significantly.
For professional missions key questions are which performance and lifetime can be expected from a small, inexpensive spacecraft which utilises automotive-grade COTS components instead of space-qualified electronics.

TU Graz developed and launched the first Austrian satellite TUGSAT-1/BRITE-Austria in February 2013. This spacecraft dedicated to measure brightness variations of massive luminous stars has been originally designed for a two year's mission, but after 8.5 years in orbit it continues to deliver high quality science data.
OPS-SAT is the second spacecraft developed under the leadership of TU Graz. OPS-SAT is the first ESA-owned nanosatellite and constitutes a flexible hardware and software laboratory in Space. It was launched in December 2019 and is successfully operated by the European Space Operations Centre ESOC in Darmstadt with support by TU Graz. A follow-up mission, called PRETTY (Passive Reflectometry and Dosimetry) in collaboration with RUAG Space Austria and Seibersdorf Laboratories is currently under preparation.

10:00 **Break**

Friday, Sept 17, 2021

10:30 - 12:00

Session E: Photonics, Optoelectronics and Sensors

Co-Chairs: Jochen Kuhnhenn (Fraunhofer INT) & Serena Rizzolo (Airbus Defence and Space S.A.S.)

ORAL PRESENTATIONS:

E-1 10:35 Temperature Dependence of Radiation Induced Attenuation of Aluminosilicate Optical Fiber

C. Campanella[1], A. Morana[1], A. Guttilla[2], F. Mady[2], M. Benabdesselam[2], E. Marin[1], A. Boukenter[1], Y. Ouerdane[1], S. Girard[1]

1. UJM, Laboratoire Hubert Curien, France; 2. Université Côte d'Azur, Institut de Physique de Nice (INPHYNI), CNRS UMR 7010, France

We investigated in situ the temperature influence on the Radiation-Induced Attenuation (RIA) of an Al-doped single-mode optical fiber in the Visible and Near-InfraRed spectral regions (400 nm – 2 µm, room temperature to 300°C).

E-2 10:45 Optimization of the Radiation Response of Backup Optical Fiber Amplifiers for Space Missions

M. Aubry[1,2,3,4], A. Morana[1], A. Laurent[2], L. Mescia[3], J. Mekki[4], N. Balcon[4], T. Robin[2], E. Marin[1], Y. Ouerdane[1], A. Boukenter[1], S. Girard[1]

1. UJM, Laboratoire Hubert Curien, France ; 2. iXblue Photonics, France ; 3. Politecnico di Bari, Italy ; 4. CNES, France

We investigated how the photobleaching phenomenon could help in reducing the radiation impact on the performances of backup Erbium Doped Fiber Amplifiers (EDFAs) and Erbium-Ytterbium Doped Fiber Amplifiers (EYDFA).

E-3 10:55 Impact of proton radiation on dark current of InAs/GaSb type-2 superlattice longwave infrared photodetector

R. Alchaar[1], C. Bataillon[1], J. Perez[1], O. Gilard[1], P. Christol[1]

1. Université de Montpellier, France

Electrical characterizations of T2SL IR photodetectors under 60 MeV proton fluence up to 8x1011 cm-2 were performed. Dark current increases with increasing the DDD independently of the cut-off wavelength and the number of T2SL periods.

Friday, Sept 17, 2021

Session E: Photonics, Optoelectronics and Sensors

Co-Chairs: Jochen Kuhnhenn (Fraunhofer INT) & Serena Rizzolo (Airbus Defence and Space S.A.S.)

E-4 11:05 Dark Current Random Telegraph Signal in visible and SWIR Direct Cu-Cu bonding InGaAs Image Sensor

V. Lalucaa[1], L. Calvinhac[1], C. Virmontois[1]

1. CNES, France

Irradiation effects are studied on commercial InGaAs image sensors with hybrid direct Cu-Cu bonding. Performances, dark current and random telegraph signal are measured after 62MeV proton tests with different doses; and compared to existing models.

E-5 11:15 Probing Dark-Current Random-Telegraph-Signal in a Small Pitch Vertically Pinned Photodiodes CMOS Image Sensor after Proton Irradiation

A. Antonsanti[1], C. Virmontois[2], J. Lauenstein[3], A. Le Roch[1], V. Goiffon[1]

1. ISAE-SUPAERO, France ; 2. CNES, France ; 3. NASA GSFC, USA

Dark-Current Random Telegraph signal is studied after proton irradiation in new scale silicon micro-volumes using a commercial CMOS Image Sensor. State-of-the-art empirical trends and new scale effects are discussed.

Friday, Sept 17, 2021

Session E: Photonics, Optoelectronics and Sensors

Co-Chairs: Jochen Kuhnhenn (Fraunhofer INT) & Serena Rizzolo (Airbus Defence and Space S.A.S.)

POSTERS:

PE-1 Ionizing radiation effects in Silicon Photonics Modulators

M. Lalovic[1], C. Scarcella[1], A. Bulling[1], M. Court[1], S. Detraz[1], L. Marcon[1], L. Olantera[1], T. Prousalidi[1], U. Sandven[1], C. Sigaud[1], C. Soos[1], J. Troska[1]

1. CERN, Switzerland

Two popular types of Silicon Photonics modulators have been exposed to ionizing radiation up to 4 MGy. Ring Modulators are shown to be the most tolerant, showing no degradation in performance up to these levels.

PE-2 In-Situ Optical Characterization of Bulk Optical Glasses Under Proton Exposures

T. Allanche[1], A. Morana[1], P. Paillet[2], O. Duhamel[2], D. Lambert[2], C. Hoehr[3], C. Bélanger-champagne[3], M. Trinczek[3], C. Muller[1], Y. Ouerdane[1], A. Boukenter[1], S. Girard[1]

1. UJM, Laboratoire Hubert Curien, France ; 2. CEA, France ; 3. TRIUMF, Canada

We performed at TRIUMF in-situ radiation induced attenuation measurements caused by protons in bulk optical glasses and compared them with gamma-rays effect. We used GEANT4 calculations to compute the right deposited for each glass.

11:25 Q&A of Session E

12:00 RADECS 2021 Closing Ceremony & Certificates

12:30 End of RADECS 2021 Conference

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Technical Tours

Friday Sept 17, 2021

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Technical Tours

Friday Sept 17, 2021

Registration for Technical Tours

Registration is mandatory to take part in a technical tour. Technical Tours are free of charge.

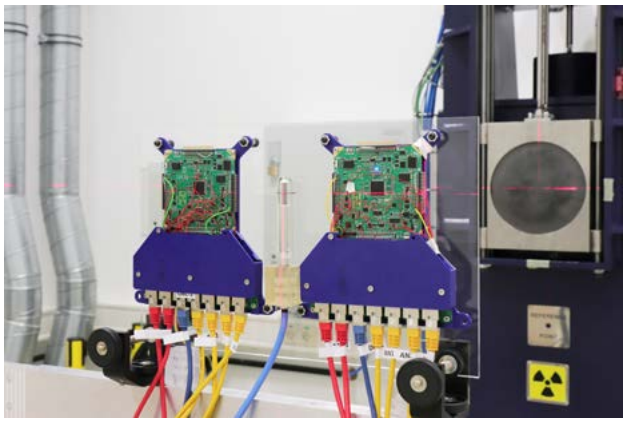
Register online on the RADECS 2021 website **www.radecs2021.org**

Up-to date information will be provided online at the RADECS 2021 website and at the RADECS 2021 onsite registration desk.

Please note: A valid 3G Cerificate is mandatory for all Technical Tours.

1 - Technical Tour to Seibersdorf Laboratories

Friday, Sept 17 14:00 - 17:00



Seibersdorf Laboratories extended its accredited testing capabilities by the TEC-Laboratory (Testing of Electronic Components) for total ionizing dose (TID) exposure tests of electronics, systems and materials with a Cobalt-60 source. The radiation exposure is performed in accordance with accredited procedures compliant with the EN ISO/IEC 17025 standard for test labs.

You are kindly invited to gain first-hand insights in TID testing of electronic components at a state-of-the-art test facility.

Bus - Meetingpoint: Entrance Hotel Savoyen 14:00

2 - Technical Tour to RUAG Space Austria

Friday, Sept 17 14:00 - 18:00

RUAG Space Austria with around 250 employees is the leading space supplier in Austria. It is leading the market for precise positioning of satellites based on navigation receivers. The company also leads the European market for thermal protection of satellites.

During a company tour RUAG Space Austria will present its capabilities in its key areas. We will get an overview of the company and visit the production facility in Vienna.

Bus - Meetingpoint: Entrance Hotel Savoyen 14:00

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Social Program

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Social Program

RADECS Vienna, 13 - 17 Sept, 2021

Register online on the RADECS 2021 website **www.radecs2021.org**

Up-to date information will be provided online at the RADECS 2021 website and at the RADECS 2021 onsite registration desk.

Please note: A valid 3G Cerificate is mandatory for all Social events.

Vienna City Tour

Sunday, Sept 12 14:00 - 17:00

© WienTourismus/Gregor Hofbauer

Time to get moving – join us on a casual guided stroll! Following the foot prints of Prince Eugene of Savoy we are starting at the conference venue, hotel Savoyen, which was named after the Prince, and passing by the Belvedere Palace, his summer residence. The gardens of the Belvedere are a highlight of Baroque landscape architecture, immerse yourself in the beauty of the flower parterres, water basins and trimmed hedges. Continuing the casual walk through the Schwarzenberg square, where the Schwarzenberg Monument and the War Memorial show more of Viennese war history, meanwhile the Palais Schwarzenberg, its garden and the fountain catches the eyes in search of beauty and tranquillity. The Ringstrasse, a boulevard which was created in the course of the city's first expansion in the middle of the 19th century on the area of the former Glacis, circles around the inner city. After listening to the various stories of your tour guide explain its history and the many magnificent buildings located on it, dip on your own into the nowadays pulsating city life.

Price per person EURO 29,- + 20% VAT
Minimum number of participants: 15

Meetingpoint: Entrance Hotel Savoyen 14:00

Register online on the RADECS 2021 website **www.radecs2021.org**

Social Program

Photo: Adobe Stock

Reception at the Vienna City Hall (Rathaus)

Monday, Sept 13 19:00 - 21:00

The Mayor of Vienna will give a welcome reception for all participants of the RADECS 2021 Conference and their accompanying persons. The reception will take place on Monday, September 13, at 19:00 in the Rathauskeller of the Vienna City Hall. The reception is free of charge. To enter City Hall, you will need your invitation card and conference ticket. Pre-registration is mandatory. Please follow the security instructions provided by the conference team. Vienna City Hall is easily accessible by public transportation.

Address:
Rathaus der Stadt Wien
Rathausplatz 1
1010 Wien

Register online on the RADECS 2021 website **www.radecs2021.org**

Social Program

Exhibitor Reception at the Hotel Savoyen

Tuesday, Sept 14 19:00 - 21:00

All participants of the RADECS 2021 conference and their accompanying persons are invited to the Welcome Reception at the Conference Hotel in the Exibition Hall. The reception will take place on Tuesday, 14 September, starting at 19:00. The reception is free of charge. Pre-registration is mandatory. Please follow the security instructions provided by the conference team.

Register online on the RADECS 2021 website **www.radecs2021.org**

Viennese Heurigen Event

Wednesday, Sept 15 19:30 - 22:00

„Ausg'steckt is"

In Vienna, "Heuriger" is the name for the wine harvested in the previous year and also for the inns where it is sold. "Gemma zum Heurig'n" ("Let's go to the Heurigen!") is an invitation to a casual get-together in the afternoon or evening, with Heurigen-music and wine providing a convivial spirit. The typical wine producing locations are situated within the city limit, but in most cases they have the character of charming villages.
The truly homely Heuriger "Fuhrgassl-Huber" on the outskirts of the vineyards, in the traditional Viennese wine-growing village of Neustift am Walde has been awarded as Vienna's top Heuriger with proven quality. Enjoy the traditional rustic ambience inside, while outside awaits a terraced garden with views of the Heuriger's own vineyards and the Vienna Woods. Spend a few hours with great company, wine and hearty food.

Price per person incl. bus ride, food/beverages EURO 65,- + 20% VAT

Register online on the RADECS 2021 website **www.radecs2021.org**

Bus - Meetingpoint: Entrance Hotel Savoyen 19:00

Social Program

Gala Dinner

Thursday, Sept 16 19:30 - 24:00

© WienTourismus/Peter Rigaud

Conference participants and accompanying persons are invited to the Gala Dinner, which will be held on Thursday, September 16, starting at 19:30 at a very famous and historic location in Vienna. Traditionally, we keep the location secret until the Gala Dinner. The dress code is business casual - evening dress.

The gala dinner will take place in one of the most beautiful places in Vienna, the summer residence of the former imperial family of Austria. These buildings, built in the middle of the 18th century, played an important role in the culture of courtly celebrations. It was also the scene of numerous receptions, banquets and theatrical performances during the reign of Joseph II. Famous musical musicians such as Wolfgang Amadeus Mozart also performed in these buildings. The imposing backdrop and imperial atmosphere give you the feeling of dining as the emperor once did.

Additional tickets for the Gala Dinner can be ordered online or at the registration desk. Booking deadline is Tuesday, September 14, 2021, at 17:00.

Price per person incl. bus ride, food/beverages EURO 150,- + 20% VAT

Register online on the RADECS 2021 website **www.radecs2021.org**

Bus - Meetingpoint: Entrance Hotel Savoyen 18:45

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RADECS 2021 Awards

Vienna, 2021

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RADECS 2021 Awards

Vienna, 13 - 17 Sept, 2021

RADECS 2021 Awards

Chair: Marta Bagatin

The conference will deliver three awards:

1) Best Conference Paper Award
2) The Jean-Marie Palau Award for Best Student Presentation
3) Best Data Workshop Award

To be eligible for awards, the final papers must be submitted in time.

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Industrial Exhibition
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Industrial Exhibition

RADECS 2021

Exhibition On-site

Co-Chair(s): Teresa Farris, Anne Minez

Teresa Farris

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teresa.farris@archon-llc.com

Anne Minez

Anne Minez, 3DPlus
C: 00331-30 83 26 54
aminez@3d-plus.com

The 2021 RADECS Exhibit Chairs welcome you to Hotel Savoyen, Vienna.
This year RADECS Exhibition will be both, on-site and online to give all attendees the opportunity to get informed about the latest developments and techniques.

Visit the online exhibition on: **https://live.seibersdorf-laboratories.at/en**

Important dates

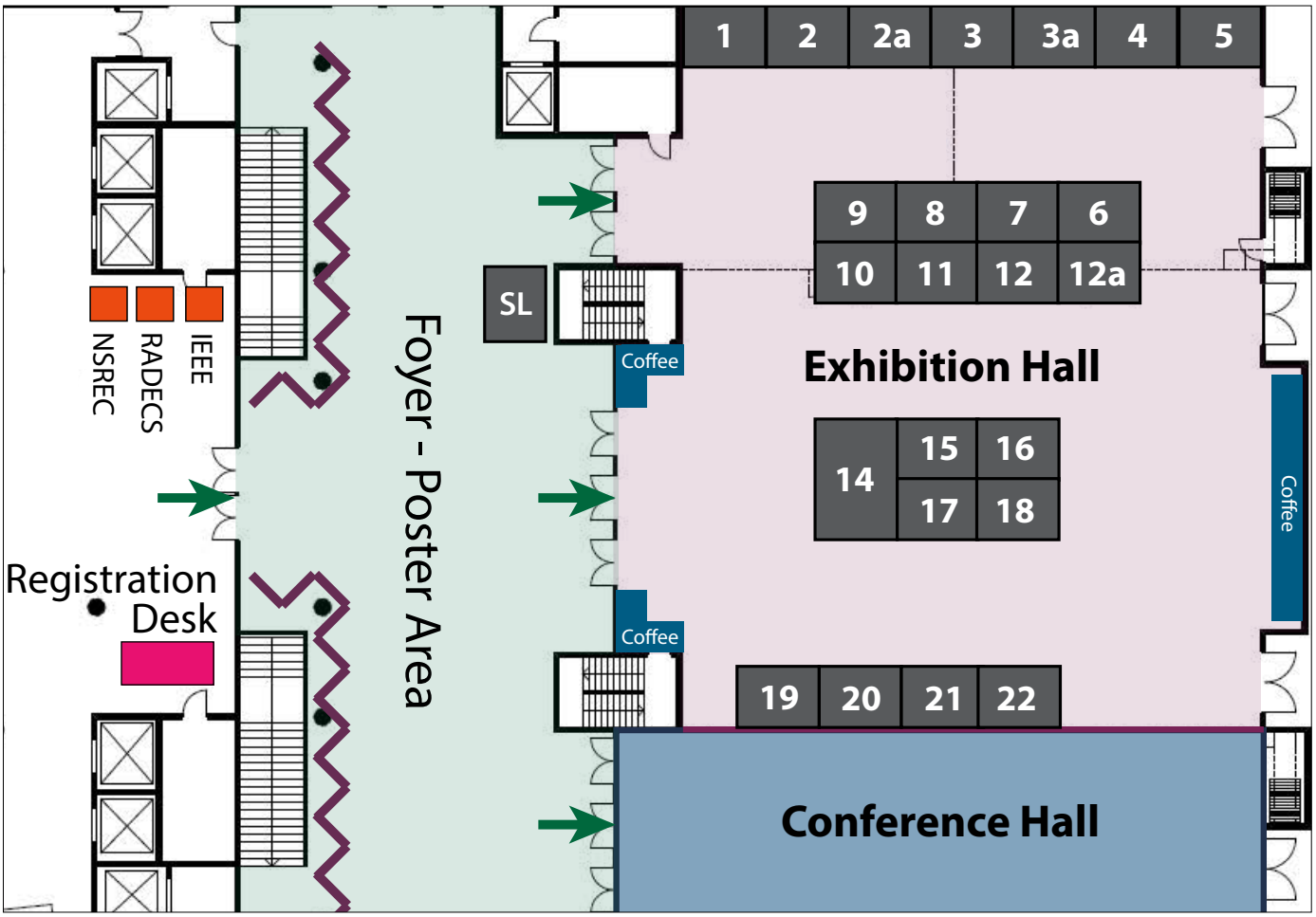
All times are given in Central European Summer Time (CEST).

Setup Hours:	Mo, 13. Sep 2021, 15:00 - 18:00
Exhibition Hours:	Tue, 14. Sep 2021, 8:00 – Thu, 16. Sep 2021, 18:00
Exhibitor Reception:	Tue, 14. Sep 2021, 19:00 - 21:00
Dismantling Hours:	Thu, 16 Sep 2021, 15:30 - 18:00

Watch out for Exhibitor raffles!

If you have any questions, please contact the industrial exhibit chairs.

Exhibition Floorplan



RADECS 2021, Vienna - Onsite exhibition

1	TRAD Tests & RADIATION
2	UNITES Systems a.s.
2a	iXblue Photonics
3	Pulscan
3a	Dimac Red SPA
4	Isocom
5	VPT Inc.
6	IHP
7	Crane Aerospace & Electronics
8	International Rectifier HiRel Products, Inc., an Infineon Technologies company
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18	3D Plus
19	RADSAGA ITN and RADNEXT Projects
20	RUAG Space GmbH
21	Radtest Ltd. & Radiation Test Solutions
22	Micropac Industries & Robust Chip
SL	Seibersdorf Laboratories

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General Information
RADECS 2021

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General Information

RADECS Vienna, 13 - 17 Sept, 2021

Registration Desk and Conference Secretary

Registration is mandatory to access the RADECS 2021 Conference at the Hotel Savoyen, Vienna. In order to be granted access in the conference area each individual will need to wear a name badge.

Register online on the RADECS 2021 website **www.radecs2021.org**

Up-to date information will be provided online at the RADECS 2021 website and at the RADECS 2021 onsite registration desk.

Day pass ticktes are available on-site at the registration desk.
Please contact the on-site registration desk or via email: radecs2021@vb-mice.at

Internet Access

A wireless Internet connection will be available in the conference area, as well as in the exhibition area.

Message Board

A message board will be located in the Foyer. General information also provided at the registration desk. In emergency case, please call Ms. Alexandra Gettler, Tel.: +43 664-88904389)

Preview Room

A preview room is set up near the main conference room in room "Laura Mancini". Software used in the preview room is identical to that used in the conference room. Speakers are requested to make use of this facility. Please test and upload your presentation one day before your presentation at latest, according to the “Oral Presentation Instructions for the RADECS 2021 Conference” note provided to you earlier.

Preview Room Office hours

All times are given in Central European Summer Time (CEST).

Monday, Sept 13	08:00 to 11:00	and from	13:30 to 16:30
Tuesday, Sept 14	08:00 to 11:00	and from	13:30 to 16:30
Wednesday, Sept 15	08:00 to 11:00	and from	13:30 to 16:30
Thursday, Sept 16	08:00 to 11:00	and from	13:30 to 16:30
Friday, Sept 17	08:30 to 10:30		

Refreshments

During breaks coffee, tea, fruits, snacks and other refreshments will be served in the Industrial Exhibit area.

Lunch

Lunch will be provided for conference participants. On Monday, September 13, only Short Course participants will have the opportunity to access the lunch area with their tickets. From Tuesday, September 14, through Thursday, September 16, lunch will be provided for all conferees who have registered for the technical sessions. Please show your conference badge. Access to the lunch area is provided for conference attendees. A limited number of lunch tickets are available for guests. Contact the registration desk if you need a ticket. Please order the ticket no later than 12:00 noon the day before.

Liability

By registering into the Conference and/or by participating in the exhibition joined to the Conference, participants and exhibitors agree that neither the Organizing Committee nor the Administrative Secretariat assume any liability. Participants and exhibitors are advised to organize their own health, travel and personal insurances.

Social Media

Did you know that RADECS 2021 conference is present in the most popular social media platforms such as LinkedIn, Twitter, Facebook and Instagram? If you don't want to miss out the updates and information related to RADECS, please, like and follow our pages (@RADECS2021) on your favourite social media.

Additionally, during this year's conference, a Social Media Contest is organised where our attendees are invited to post a picture describing their first or best moments during any RADECS conference and use the hashtags #myFirstRADECS or #myBestRADECS. The winner will be drawn during the conference and will receive a special prize! Don't forget to tag your colleagues in the picture and invite them to participate. Let's together remember the good moments shared together during the past conferences.

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Contacts

RADECS Vienna, 13 - 17 Sept, 2021

Conference Emergency Contact
Ms. Alexandra Gettler, Tel.: +43 664-88904389, office times: 8:00 - 17:00 (CEST)

A/V Room and Technical Help Desk
Mon - Thu, 8:00 - 11:00 and 13:30 -17:00 (CEST)
Fri, 8:00 - 10:30 (CEST)
Mr. Marcin Latocha in the Lara Mancini Preview Room
Email: marcin.latocha@seibersdorf-laboratories.at, Laura Mancini Room
Tel: +43-50550-2521

Registration Desk
On-site registration desk in the Lobby or via email: radecs2021@vb-mice.at

Industrial Exhibition Chairs
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Technical Program Chairs
Technical Chair
Rubén García Alía (CERN)
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Technical Co-Chair
Christoph Tscherne (Seibersdorf Laboratories)
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Technical Co-Chair
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Short Course Chairs
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Jerome Boch (Univ. Montpellier)
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Women in Engineering - WIE Chair
Alicja Michalowska-Forsyth (TUG)
alicja.michalowska@tugraz.at

Conference Chair
Peter Beck (Seibersdorf Laboratories)
peter.beck@seibersdorf-laboratories.at

Conference Fees

RADECS 2021
VIENNA, 13-17 September

On-site Tickets

Short Course	until July 30, 2021	as of July 31, 2021	On-site Registration
Delegate	EUR 460	EUR 600	EUR 650
Student	EUR 360	EUR 470	EUR 510

Technical Sessions	until July 30, 2021	as of July 31, 2021	On-site Registration
Delegate	EUR 990	EUR 1190	EUR 1290
Student	EUR 650	EUR 780	EUR 850
Accomp. Person	EUR 230	EUR 250	EUR 270

Combi: SC & TS	until July 30, 2021	as of July 31, 2021	On-site Registration
Delegate	EUR 1380	EUR 1660	EUR 1800
Student	EUR 960	EUR 1150	EUR 1250
Accomp. Person	EUR 230	EUR 250	EUR 270

Prices of On-site Tickets include Online Participation, one month Online Access to all Technical Sessions, Coffee Breaks, Lunches, Receptions and Gala Dinner.

Online Tickets

Short Course	until July 30, 2021	as of July 31, 2021	On-site Registration
Delegate	EUR 200	EUR 250	EUR 300
Student	EUR 100	EUR 150	EUR 200

Technical Sessions	until July 30, 2021	as of July 31, 2021	On-site Registration
Delegate	EUR 350	EUR 450	EUR 500
Student	EUR 250	EUR 330	EUR 380

Combi: SC & TS	until July 30, 2021	as of July 31, 2021	On-site Registration
Delegate	EUR 490	EUR 630	EUR 720
Student	EUR 300	EUR 430	EUR 520

Prices of Online Tickets include Online Participation, one month Online Access to all Technical Sessions,

Prices for all kind of participation tickets are given exclusive VAT. Based on the Austrian VAT-law a VAT rate of 20 % is to be charged. When fulfilling the eligibility criteria for input-VAT deduction, this VAT can be claimed back.

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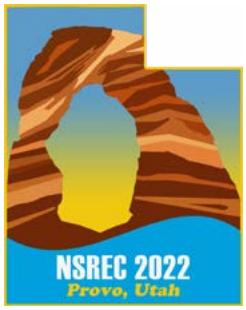
Upcoming conferences



IEEE Nuclear and Space Radiation Effects Conference-NSREC
July 18-22, 2022, Provo, United States

www.nsrec.com

RADHARD
SYMPOSIUM

Radiation Hardness Assurance Symposium
RADHARD 2022, April 26 -27, 2021, Seibersdorf, Austria

www.radhard.eu

RADECS 2022

Radiation and its Effects to Components and Systems
RADECS 2022, October 3-7, 2022, Venice, Italy

www.radecs2022.org

RADECS
2021
VIENNA, 13-17 September

Authors Instructions
RADECS 2021

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Authors Instructions

RADECS Vienna, 13 - 17 Sept, 2021

Author Registration

Authors have to register for the conference.
Early registration and hotel booking are recommended.

Register online on the RADECS 2021 website **www.radecs2021.org**

Final Paper Submission

After acceptance of their paper for oral presentation, poster, or data workshop, authors are invited to provide a final proceedings paper addressing the comments of the reviewers. The comments will be available on the RADOCS website.
The format of the final paper is the standard IEEE Transactions format. Guidelines for preparing the paper are provided here: Preparation of Papers for IEEE TRANSACTIONS and JOURNALS.
Authors shall post their final papers **before September 8, 2021, 23:59 (CEST)** on the RADOCS website. Papers will be published in the conference proceedings, and will be made available electronically to all conference attendees after the conference. They will also be available on IEEE Xplore.

Oral Presentations

Authors accepted for oral shall prepare a presentation using Microsoft PowerPoint in wide screen format. Authors are strongly encourage to use the conference PowerPoint template in order to prepare their presentation.
In case of online participation, presentations have to be provided prerecorded using Microsoft PowerPoint including audio and video of the presenter (for more information, please refer to the tutorial from Microsoft https://support.microsoft.com/en-us/office/record-a-slide-show-with-narration-and-slide-timings-0b9502c6-5f6c-40ae-b1e7-e47d8741161c). If video recording of the presenter is not possible, a photo of the presenter shall be provided within the presentation.
Authors should upload their PowerPoint presentations (and if applicable, recordings thereof) to the RADECS 2021 Oral Presentations Upload website **before September 6, 2021, 23:59 (CEST).**
The conference organizers are also considering the possibility of live online-presentations, but these do not replace the sending of a pre-recorded presentation. In the case of live online-presentations, technical support will be provided as needed in a timely manner prior to the conference. The time allocated for each presentation is 10 minutes (please note: as opposed to 12 minutes in previous conference editions). There will be a Q&A session allocated at the end of each session with 5 minutes for each presentation. Presentations will be available for preview and update during the conference in the A/V preview room no later than the day before they are scheduled to be presented. The A/V preview room opening hours are described earlier. The session chairs will contact the authors before the session to schedule a brief meeting at the presentation stage. This will be an opportunity to review procedures and equipment for the talk.

Posters

Authors accepted for posters in the technical sessions or data workshop shall prepare a poster. The useable area is A0 format in portrait orientation (height: 1189mm, width: 841mm). It is advisable that posters contain a photo of the poster speaker and contact details. Please use the conference PowerPoint poster template.

The poster speakers shall ensure their availability during the poster and DW sessions according to the schedule. Every poster speaker has to provide a PDF of their poster to the following RADECS 2021 upload site **before September 6, 2021, 23:59 (CEST)**. The Poster PDF will be available at the live-web-site of the RADECS 2021 conference during the entire conference. In addition a dedicated virtual room is provided for every poster speaker to present their poster to online participants. Onsite posters must be mounted to the poster board with stickers/double sided tape. Stickers will be provided at the conference in the poster area.

Posters shall be assembled by 12:00 noon on Tuesday of the conference week. All poster shall be left in place until the end of the conference. Posters must be removed by 10:00 AM Friday.
At the beginning of the poster session and data workshop the Session Chair will high-light each poster at the Conference Hall with title, name, and availability of the speaker (on-site / online).

IEEE TNS Submission Process

Each author of an oral or poster paper at RADECS is welcome to submit a manuscript based on this work to the IEEE TNS. Papers not submitted to the TNS or that are not accepted to the TNS will be eligible for inclusion in the RADECS Conference Proceedings. Accepted TNS papers will be indexed in the RADECS Conference Proceedings, to ensure that all contributions to the Conference are acknowledged fully, and so readers are directed to the appropriate TNS publication. Instructions for the RADECS Conference Proceedings are provided separately.

Further information is provided at the RADECS 2021 website: **www.radecs2021.org**.

Note: The IEEE Transactions on Nuclear Science submission site is subject to the IEEE Privacy Policy.

Note: IEEE web sites also use cookies.

RADECS
2021
VIENNA, 13-17 September

On-site Security and Travel Regulations

RADECS 2021

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On-site Security and Travel Regulations

RADECS Vienna, 13 - 17 Sept, 2021

Safety Chair: Gerd-Peter Mitterecker, Seibersdorf Laboratories

Gerd-Peter Mitterecker

Please check the RADECS 2021 website for the latest information: **www.radecs2021.org**

Dear RADCES ON-SITE participant!
We are very glad that you decided to be among us in Vienna next week despite the difficult situation! To ensure a safe conference for us all, we will have to comply with some safety regulations.

Entrance:
Every morning we will check the so-called 3-G status (vaccinated, recovered, tested) of all participants before they enter the conference area. After the check your name badge will be marked with a new daily code every day. Please note: It's mandatory to have your marked badge with you during the whole conference and the social events.

FFP2 masks:
For your own safety we kindly ask you to wear a FFP2 mask, except at the seat in the conference room and the restaurant or during the coffee breaks while eating and drinking. Please don't forget the FFP2 in your daily life planning – FFP2 will be mandatory in all busses (social events), in any kind of public transportation and shops. Of course FFP2 masks will be available for you.

Contact tracing:
In the conference room you will find a form on the seats every morning. Please fill in your name and seat number. Leave the form at your seat, we will collect them during the first coffee break.

Distance:
We are all happy to see each other „live", but let us try to keep a safety distance and to avoid direct contact (e. g. handshakes).

Hygiene rules:
Please wash your hands regularly and use the hand sanitisers the hotel offers you.

Accompanying persons:
We feel honoured to welcome you at our social events.
Of course we have to check your so-called 3-G status (vaccinated, recovered, tested) too.
Please come to the registration desk during the day, after the check you will receive the necessary daily code on your name badge.

Please check the RADECS 2021 website for the latest information: **www.radecs2021.org**

Your travel to/from Vienna

As the travel regulations are changing constantly we urg you to consult the relevant webpages for an update before you start your travel to Austria., e.g.

- the webpages of your government to check your home country's travel warnings
- the webpage of the Austrian Tourist Information:
  https://www.austria.info/en/service-and-facts/coronavirus-information/entry-regulations#who-can-enter-austria
- the webpage of the Austrian Ministry of Social Affairs, where you will find a list of Frequently asked Questions (FAQ):
  https://www.sozialministerium.at/en/Coronavirus/Information-in-English.html

For entry to Austria please note the different rules for

- Safe countries - see list:
  https://www.austria.info/en/service-and-facts/coronavirus-information/entry-regulations#who-can-enter-austria
- Virus variant areas - see list:
  https://www.austria.info/en/service-and-facts/coronavirus-information/entry-regulations#who-can-enter-austria

Other countries (not on a list, e.g. Russia and United Kingdom)

Safe countries:

The following conditions have to be fulfilled:

- 3-G evidence (vaccinated, tested or recovered):
  https://www.seibersdorf-laboratories.at/fileadmin/uploads/intranet/events/radecs2021/saftety-information/3-G-Safety.pdf

When entering Austria, a valid negative test result, a certificate of vaccination or recovery, or a medical certificate confirming this status have to be in your possession. These documents must be issued in German or English (in Latin characters) and have to be shown to the authorities upon request.

If you travel without valid proof of your COVID-19 status, a pre-travel clearance form has to be filled in before entry, and a test for SARS-CoV-2 has to be carried out promptly after arrival, or at the latest within 24 hours. Look here for further information on pre-travel clearance:
https://entry.ptc.gv.at/en.html

Please check the RADECS 2021 website for the latest information: **www.radecs2021.org**

Virus variant areas:

The above mentioned conditions (3-G evidence) have to be fulfilled and in addition ***a 10-day quarantine is necessary***!

Other countries (e.g. Russia and United Kingdom):

The above mentioned conditions (***3-G evidence)*** have to be fulfilled and ***travelers need a certificate of vaccination with an EU-registered vaccine to avoid a 10-day-quarantine***!

Your stay in Vienna

Restaurants, Theatres, Museums etc. are open, for entry you have to show your proof of ***3-G evidence*** (vaccinated, tested or recovered):
https://www.seibersdorf-laboratories.at/fileadmin/uploads/intranet/events/radecs2021/saftety-information/3-G-Safety.pdf

In some places you have to wear a face mask too.

Shops are open, for entry you need a ***face mask*** (but no 3-G evidence)

Face masks are required on **public transport and for taxi rides**.

Detailed information with updates:
https://www.austria.info/en/service-and-facts/coronavirus-information/city-trips
https://www.wien.info/en/travel-info/corona-information/your-safe-stay-in-vienna-388282

Look here for frequently asked questions:
https://coronavirus.wien.gv.at/faq-english/#3GRule

Please check the RADECS 2021 website for the latest information: **www.radecs2021.org**

Testing in Vienna

In Vienna, there are several test centres where you can get tested for free if you meet the requirements of the test centres.

Close to the Hotel Savoyen:

https://www.seibersdorf-laboratories.at/fileadmin/uploads/intranet/events/radecs2021/saftety-information/Testrasse_Aula_der_Wissenschaften_ENGLISCH.PDF

More details:

https://coronavirus.wien.gv.at/faq-english/#Testangebote

https://coronavirus.wien.gv.at/faq-english/faqs-free-rapid-antigen-tests/

Your stay in the hotel and at the conference

During the Check-In to the hotel and also the Check-In for the conference we kindly ask for your negative COVID19 test certificate. You need to keep a valid certificate during your stay.

Please note:
All guests without vaccination or recovery need a new test certificate every day!

Look here for test centers near the hotel:

https://www.seibersdorf-laboratories.at/fileadmin/uploads/intranet/events/radecs2021/saftety-information/Testrasse_Aula_der_Wissenschaften_ENGLISCH.PDF

Look here for further informations about the regulations in the hotel:

https://www.austria-trend.at/en/lp/welcomeback#anchorcontentBlock58