R2E Annual Meeting 2022

Report of Contributions

Contribution ID: **1** Type: **not specified**

Ground-based research for radiation protection in space travel

Wednesday 2 March 2022 11:30 (1 hour)

Space radiation is generally acknowledged as the main health risk for human exploration of the Solar system. Beyond Low-Earth Orbit (BLEO) missions expose crews to increasingly high fluxes of cosmic rays, including protons and heavy ions. The high uncertainty on the biological effect of the extraterrestrial radiation makes it difficult to design countermeasures. Flight experiments have provided useful data on cosmic ray spectrum composition and dosimetry, but very limited information on late stochastic effects. Most of our knowledge on biological effects of space radiation comes from ground-based experiments at accelerators. We will review the activities in this field under way in the US (sponsored by NASA at the Brookhaven National Laboratory) and in Europe (supported by ESA at the SIS18 synchrotron at GSI) and the impact of this research on the missions to the Moon and Mars. In particular, we will show that the current dose limits for BLEO missions are inadequate and do not allow International missions.

Presenter: DURANTE, Marco

Session Classification: Invited Talk

Contribution ID: **2** Type: **not specified**

IFMIF-DONES facility: a key accelerator neutron source for the design of DEMO

Wednesday 2 March 2022 16:45 (1 hour)

The International Fusion Materials Irradiation Facility Demo Oriented NEutron Source (IFMIF-DONES) will be a novel research infrastructure for testing, validation and qualification of the materials to be used in a fusion reactor like DEMO. IFMIF DONES will mimic the conditions inside DEMO in terms of neutrons by the impact of a high-power deuteron beam onto a lithium target. Together with ITER (International Thermonuclear Experimental Reactor) it is the key facility to design DEMO. In view of the urgent need of data on materials and their durability, the construction of DONES (DEMO-Oriented Neutron Source) was decided. The IFMIF facility will consist of two accelerators delivering deuterons on the same neutron production target, whereas, DONES will consist of a single accelerator. Granada (Spain) was selected as the European city hosting the construction of the facility and the facility itself has been selected as ESFRI (European Strategy Forum on Research Infrastructures). In this talk an overview of the facility and its objectives will be carried out. Also, the complementary applications program will be briefly discussed.

Presenter: PRAENA RODRIGUEZ, Antonio Javier (Universidad de Granada (ES))

Session Classification: Invited Talk

Contribution ID: **3** Type: **not specified**

ESA IOD Cubesat Missions Overview

Tuesday 1 March 2022 11:30 (1 hour)

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. 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.

Presenter: PEREZ LISSI, Franco (ESA)

Session Classification: Invited Talk

Contribution ID: **4** Type: **not specified**

R2E annual meeting opening

Tuesday 1 March 2022 08:30 (20 minutes)

Presenter: GODDARD, Brennan (CERN)

Session Classification: Introduction

Contribution ID: **5** Type: **not specified**

A quick summary of R2E in 2021

Tuesday 1 March 2022 08:50 (30 minutes)

This introductory talk will be a quick tour throughout R2E's exciting 2021, featuring the restart of the CERN injector chain and CHARM facility, the progress on a broad variety of radiation tolerant development, and significant advancement in a rich set of research activities and collaborations.

Presenter: GARCIA ALIA, Ruben (CERN)

Session Classification: Introduction

Contribution ID: **6** Type: **not specified**

RADNEXT research: Status and objectives

Tuesday 1 March 2022 16:30 (30 minutes)

We will present the objectives and recent results from the joint research activities within the EU INFRAIA project RADNEXT. This includes recent results on radiation monitors, dosimeters and beam characterization, on the standardization of system level radiation qualification methodology, on cumulative total ionizing dose and displacement damage effects in electronics and finally on tools and approaches for modelling radiation effects in electronics.

Presenter: LEROUX, Paul (KU Leuven (BE))

Session Classification: Services

Contribution ID: **7** Type: **not specified**

R2M (‘Radiation to Materials’): summary of service activities in 2021

Tuesday 1 March 2022 16:10 (20 minutes)

The R2M coordinates irradiations of non-metallic materials at CERN. Samples of equipment designed for applications in high radiation areas are sent to external facilities for gamma irradiation with 60Co sources. Test results inform design choices and reduce failure risks in operation. In the last year 15 irradiation campaigns have been launched in collaboration with the radiation testing company Radtest Ltd.

Presenter: FERRARI, Matteo (CERN)

Session Classification: Services

Contribution ID: **8** Type: **not specified**

RHA guidelines for electronic equipment for meeting HL-LHC requirements

Tuesday 1 March 2022 14:10 (20 minutes)

The RHA process is meant at ensuring that the qualification process of the CERN electronic equipment is traceable and demonstrates the compliance with respect to the requirements for installation in the accelerator. The status of the related documentation is presented in the context of HL-LHC.

Presenter: CORONETTI, Andrea (University of Jyvaskyla (FI))

Session Classification: Services

Contribution ID: **9** Type: **not specified**

Radiation test service for equipment groups

Tuesday 1 March 2022 14:30 (20 minutes)

An overview of the Radiation Working Group (RadWG) mandate, activities and projects fulfilled by the Radiation Test service within the BE-CEM-EPR section will be presented in this talk. A focus on the service provided through the past year will be presented through key metrics together with a presentation of the qualification procedures , guidelines, research and development activities and radiation facilities.

Presenter: FERRARO, Rudy (CERN)

Session Classification: Services

Contribution ID: **10** Type: **not specified**

Overview of CC-60 facility activity in 2021 and outlook for 2022

Tuesday 1 March 2022 14:50 (20 minutes)

The CERN Cobalt-60 (CC60) facility serves different essential purposes in the context of the R2E project, including components screening, system testing, material testing, and R&D on radiation sensors. To face the increasing number of irradiation requests, a new 110 TBq Co-60 source, 17 times more active than the previous source, has been installed.

Presenter: BRUCOLI, Matteo (Universita e sezione INFN di Napoli (IT))

Session Classification: Services

Contribution ID: **11** Type: **not specified**

Overview of CHARM facility activity in 2021 and outlook for 2022

Tuesday 1 March 2022 15:30 (20 minutes)

Presenters: LENDARO, Jerome (CERN); BRUCOLI, Matteo (Universita e sezione INFN di Napoli (IT)); FERRARO, Rudy (CERN); DANZECA, Salvatore (CERN)

Session Classification: Services

Contribution ID: **12** Type: **not specified**

RadMon System for environmental measurements

Tuesday 1 March 2022 15:50 (20 minutes)

Presenters: AMODIO, Alessio (Universita e sezione INFN di Napoli (IT)); BRUCOLI, Matteo (Universita e sezione INFN di Napoli (IT)); DANZECA, Salvatore (CERN)

Session Classification: Services

Contribution ID: **13** Type: **not specified**

Radiation environment simulations using FLUKA

Tuesday 1 March 2022 10:10 (20 minutes)

In addition to measured data from radiation monitors, FLUKA simulations are a critical tool to asses the radiation levels on electronic equipment at the LHC and in other CERN accelerators, transfer lines, and facilities, especially where no measurement is available and for predictions on future operation.

Presenter: PRELIPCEAN, Daniel (Technische Universitat Munchen (DE))

Session Classification: Services

Contribution ID: **14** Type: **not specified**

Optical Fiber Dosimetry

Tuesday 1 March 2022 13:50 (20 minutes)

The Optical Fibre Dosimetry work package of the R2E project focuses on the development, deployment and operation of optical fibre based solutions for the monitoring of the radiation levels in the accelerators. In particular, the Distributed Optical Fibre Radiation Sensors (DOFRS) are systems deployed in the main machines of the accelerator complex (PSB, PS, SPS, and LHC).

Presenter: DI FRANCESCA, Diego (CERN)

Session Classification: Services

Contribution ID: **15** Type: **not specified**

Radiation monitoring & analysis: Overview of 2021 prompt radiation levels in the injector chain

Tuesday 1 March 2022 09:50 (20 minutes)

Analysis of the radiation levels measured across CERN accelerator complex is a critical activity within R2E project and MCWG, contributing not only to the equipment groups but also beyond, e.g. to Accelerator Operations. In this talk, an overview of this activity is presented, focusing on the 2021 prompt radiation measurements from the Injector Chain.

Presenter: BILKO, Kacper

Session Classification: Services

Contribution ID: **16** Type: **not specified**

The Monitoring and Calculation Working Group: mandate and activities

Tuesday 1 March 2022 09:30 (20 minutes)

The Monitoring and Calculation Working Group (MCWG) is in charge of the characterisation of the radiation environment of the CERN accelerator complex and experimental facilities. This talk will introduce the structure of the working group and its key activities, with emphasis on the work done to address the multiple requests for radiation levels that are coming from different users.

Presenter: LERNER, Giuseppe (CERN)

Session Classification: Services

Contribution ID: **17** Type: **not specified**

R2E assessment and mitigation of failures in the SPS access system

Tuesday 1 March 2022 11:10 (20 minutes)

Radiation to electronics failures were observed during 2021 in several locations in the SPS access system, whose electronics is critical for the machine operation. Mitigation measures were adopted through shielding when the relocation was not feasible. BatMon measurements and FLUKA simulations were conducted to assess the radiation environment to advance a mitigation solution.

Presenter: CECCHETTO, Matteo (CERN)

Session Classification: Services

Contribution ID: **18** Type: **not specified**

High-level dosimetry

Tuesday 1 March 2022 10:50 (20 minutes)

The main goal of the High-Level Dosimetry (HLD) at CERN is to determine the radiation levels at equipment located in the accelerator complex, hence contributing to the evaluation of their radiation lifetime. In this talk, an introduction to the service and a summary of the activities carried out during 2021 will be presented.

Presenter: AGUIAR, Ygor (CERN)

Session Classification: Services

Contribution ID: **19** Type: **not specified**

G4SEE, the open-source SEE simulation toolkit and its applications

Wednesday 2 March 2022 08:30 (15 minutes)

G4SEE toolkit has been validated by comparing simulated and measured inelastic energy deposition distributions of monoenergetic neutrons in the 1.2–17 MeV energy range. While being used extensively within R2E, it is being licensed and released as a free and open-source code, enabling and supporting several external collaborations, for example on simulations of quantum qubits or CMOS image sensor degradation, among others.

Presenter: LUCSANYI, David (CERN)

Session Classification: Research and Development

Contribution ID: **20** Type: **not specified**

Puli Lunar Water Snooper R&D activities at CERN

Wednesday 2 March 2022 16:00 (15 minutes)

The PLWS neutron spectrometer is developed by Puli Space Technologies to in-situ measure subsurface water content on the Moon by detecting thermal and epithermal neutrons using modified COTS CMOS image sensors as detectors. PLWS irradiation tests and Monte Carlo simulations are performed at CERN in collaboration with R2E, paving the way for terrestrial neutron flux monitoring applications in the LHC and other mixed-field environments.

Presenter: LUCSANYI, David (CERN)

Session Classification: Research and Development

Contribution ID: **21** Type: **not specified**

R2E applications of TimePix3

Wednesday 2 March 2022 16:15 (15 minutes)

The PS-BGI data acquisition system, based around the Timepix3 pixel detector, was acquired by the R2E project in late 2020. Originally developed for beam loss monitoring applications, this setup has the potential of being one of the key instruments in providing valuable data for the radiation field assessment in the accelerator environment.

Presenter: SLIPUKHIN, Ivan (CERN)

Session Classification: Research and Development

Contribution ID: **22** Type: **not specified**

Radiation damage studies on lubricants

Wednesday 2 March 2022 14:00 (15 minutes)

Tribological studies are fundamental to mechanical design and especially relevant in the high radiation environment around beam-intercepting devices. Although only few studies exist, the effect of radiation on organic compounds is highly variable and lubricant resistance can be the determining factor in equipment lifetime. Preliminary examination of first lubricant samples irradiated in gamma and mixed fields will be shown.

Presenter: SENAJOVA, Dominika (Imperial College (GB))

Session Classification: Research and Development

Contribution ID: **23** Type: **not specified**

New NEAR irradiation station at n_TOF: design, implementation and first results

Wednesday 2 March 2022 14:15 (15 minutes)

A new irradiation station has been built and commissioned at CERN's n_ToF facility, enabling new types of neutron-dominated irradiations and activation studies. The irradiation setup is radiation tolerant and is handled remotely to reduce dose to operators. Pilot irradiations of commercial lubricants and O-ring materials started in July 2021, and recently concluded successfully, in compliance with RP requirements.

Presenters: SENAJOVA, Dominika (Imperial College (GB)); FERRARI, Matteo (CERN)

Session Classification: Research and Development

Contribution ID: **24** Type: **not specified**

Radiation tolerance of EPDM O-rings used at CERN: recent results

Wednesday 2 March 2022 13:45 (15 minutes)

Synthetic EPDM elastomers are used in vacuum seals throughout CERN, including Beam Intercepting Devices, and seal-lifetime may be severely limited by radiation exposure. Different varieties of EPDM O-rings are available on the market, and recent experiments carried out by R2M at CERN show that there is considerable variation in their radiation tolerance. The results of mechanical and structural investigations will be presented.

Presenter: FERRARI, Matteo (CERN)

Session Classification: Research and Development

Contribution ID: **25** Type: **not specified**

Experimental activities at the CLEAR facility: flash effect and displacement damage

Wednesday 2 March 2022 15:15 (15 minutes)

The CLEAR facility enables a wide range of studies about radiation effects in electronics. Findings on flash effects, that can negatively affect SEU measurements, and on displacement damage from high-energy electrons are reported.

Presenter: CORONETTI, Andrea (University of Jyvaskyla (FI))

Session Classification: Research and Development

Contribution ID: **26** Type: **not specified**

Low-energy protons: numerical simulations, modelling, issues and impact for the accelerator

Wednesday 2 March 2022 09:15 (15 minutes)

Direct ionization from low-energy protons has been a hot topic in the space community for 15 years. Recent experimental measurements suggest that it may be an issue for the accelerator as well. The study of this and other proton effects required further push in the development of reliable simulation tools.

Presenter: CORONETTI, Andrea (University of Jyvaskyla (FI))

Session Classification: Research and Development

Contribution ID: **27** Type: **not specified**

Common building blocks: FPGA testing

Wednesday 2 March 2022 09:30 (15 minutes)

The presentation discusses the challenges one has to face when testing FPGAs, proposing a testing methodology for the LHC environment focusing on the NG-Medium and the PolarFire results. These will be compared with other, currently used, FPGAs, the SmartFusion2 and ProASIC3. A failure rate estimation analysis for the HL-LHC environment is presented showing the advantages and disadvantages of each FPGA.

Presenters: SCIALDONE, Antonio (Politecnico di Torino (IT)); FERRARO, Rudy (CERN)

Session Classification: Research and Development

Contribution ID: **28** Type: **not specified**

IoT BatMon: Wireless radiation monitoring at CERN

Wednesday 2 March 2022 09:45 (15 minutes)

BatMON is a wireless, battery-powered radiation monitoring system for particle accelerators. The system can measure TID and High-Energy Hadron and Thermal Neutron fluences, thanks to the Floating-Gate dosimeter and SRAMs embedded in the sensor mezzanine. Its radiation qualification is complicated both by its low-power and wireless architecture, but also by the unavailability of CHARM. An alternative and specific qualification methodology is needed.

Presenters: ZIMMARO, Alessandro (Universite Montpellier I (FR)); DANZECA, Salvatore (CERN)

Session Classification: Research and Development

Contribution ID: **29** Type: **not specified**

Radiation hardness assurance and testing

Wednesday 2 March 2022 10:15 (15 minutes)

In this talk, details of CERN's RHA will be presented with a focus on new test methods and research developed by the radiation test services to provide representative test conditions specific to CERN accelerator environments and provide reliable estimates of degradation and operating lifetime.

Presenter: FERRARO, Rudy (CERN)

Session Classification: Research and Development

Contribution ID: **30** Type: **not specified**

Flogating gate dosimeter investigation and usage

Wednesday 2 March 2022 10:30 (15 minutes)

The Floating Gate Dosimeter (FGDOS) has finally reached the operational phase and is now embedded in the BatMON. A new method for enhancing the sensitivity has been investigated aiming to reduce the measurement time to assess the radiation levels in locations where the rate is extremely low. In another recent study, the FGDOS has been employed to explore an alternative technique for measuring the charge yield.

Presenter: BRUCOLI, Matteo (Universita e sezione INFN di Napoli (IT))

Session Classification: Research and Development

Contribution ID: **31** Type: **not specified**

Space RadMon, a radiation tolerant monitor device for cubesats

Wednesday 2 March 2022 10:45 (15 minutes)

SpaceRadMon is a radiation monitor device designed for CubeSats. It was developed with the knowledge/experience gained from RadMon. It is a flexible payload platform for Cubesat satellites, that can be embedded in several missions with little effort. Its radiation measurements capabilities are the same of the RadMon but with several sensors tailored for space application. In this presentation, the SpaceRadMon and the SpaceRadMon New Generation (NG) are presented along with the qualification process.

Presenter: GKOUNTOUMIS, Panagiotis (CERN)

Session Classification: Research and Development

Contribution ID: **32** Type: **not specified**

Benchmark between FLUKA and radiation detectors at IR4

Wednesday 2 March 2022 08:45 (15 minutes)

Interaction Region 4 (IR4) hosting the RF cavities and several BI instruments generates a rather low radiation environment compared to the high luminosity experiments. Previously unstudied, this contribution presents the latest benchmark between FLUKA simulated and measured data for several radiation monitors for Run 2, together with future operation scenarios for HL-LHC.

Presenter: PRELIPCEAN, Daniel (Technische Universitat Munchen (DE))

Session Classification: Research and Development

Contribution ID: **33** Type: **not specified**

Radioluminescent optical fibre: recent developments for dosimetry applications

Wednesday 2 March 2022 15:45 (15 minutes)

Radiation Induced Luminescence (RIL) based radiation detection has been investigated for different applications such as accelerators, space, medicine and nuclear plants. We are evaluating the potential use of specially RIL based optical fibre sensors for dosimetry, for both accelerator and space projects in collaboration with CNES and Laboratoire Hubert Curien. We will present here the most recent advances on the topic.

Presenter: KERBOUB, Nourdine (Universite Jean Monnet (FR))

Session Classification: Research and Development

Contribution ID: **34** Type: **not specified**

Photoneutron field analysis near an Al-based target at the CLEAR accelerator

Wednesday 2 March 2022 15:00 (15 minutes)

A radiation test was carried out at the THz test station of the CLEAR accelerator to measure the photoneutron field generated by 200-MeV electrons impacting on an Al-based target. The analysis includes SEU and TID measurements with SRAMs and RPLs, both compared with the results of FLUKA simulations. The possibility of using similar setups for future R2E tests and experiments will be discussed.

Presenter: LERNER, Giuseppe (CERN)

Session Classification: Research and Development

Contribution ID: **35** Type: **not specified**

Neutron measurements in medical LINACs through SRAMs

Wednesday 2 March 2022 14:45 (15 minutes)

The characterization of the neutron field of medical LINACs in Oldenburg and PTB was performed through SRAM devices, whose neutron response was well characterized for CERN applications. The capability of the SRAMs, to measure the neutron fluxes below 10 MeV in this medical application, is evaluated and compared to FLUKA simulations.

Presenter: CECCHETTO, Matteo (CERN)

Session Classification: Research and Development

Contribution ID: **36** Type: **not specified**

nTOF SEE benchmarks

Wednesday 2 March 2022 14:30 (15 minutes)

The new nToF NEAR station collimator was developed with the aim of profitting from the large neutron fluences generated at the nTOF target, which can be particularly useful for electronics testing. As a first activity, the high energy hadron flux was measured by means of SRAM memories and compared to that obtained with FLUKA simulations.

Presenter: SACRISTAN BARBERO, Mario (CERN-CIEMAT)

Session Classification: Research and Development

Contribution ID: **37** Type: **not specified**

IRRAD diode measurements with protons and heavy ions

Wednesday 2 March 2022 11:15 (15 minutes)

A test campaign was organized in the IRRAD facility at the PS with a two-fold objective: to precisely measure the time structure of the proton beam and to monitor the heavy-ion beam propagated down the T8 line in the scope of the CHIMERA project. A silicon diode enabled to perform various measurements with sampling frequencies ranging from 200 Hz up to 1GHz.

Presenter: EMRISKOVA, Natalia (Universite Montpellier I (FR))

Session Classification: Research and Development

Contribution ID: **38** Type: **not specified**

CHIMERA status and outlook

Wednesday 2 March 2022 11:00 (15 minutes)

The CHIMERA project aims at providing high energy (100 MeV - 1 GeV/n) heavy ions (Pb) to the CHARM facility for electronics irradiation testing. These beams will probe an interesting LET range combined with a high penetration depth in state-of-the-art electronics used in, e.g., space applications. The project status and outlook on the coming activities will be presented.

Presenter: WAETS, Andreas (Universite Montpellier II (FR))

Session Classification: Research and Development

Contribution ID: **39** Type: **not specified**

RADSAGA: outcomes and benefits

Wednesday 2 March 2022 16:30 (15 minutes)

RADSAGA is a research and training EU funded project, which involved 30 partners, trained 15 Early-Stage Researchers, and made advancements on the design and qualification of radiation tolerant components and systems. Interdisciplinary training aiming at forming highly qualified professionals, network engagement, communication, and data sharing are key values for the project. The presentation will address those key-elements emphasising on the project's outcomes and benefits.

Presenters: ALLEGRETTI, Sonia (TERA Foundation (IT)); AGUIAR, Ygor (CERN)

Session Classification: Research and Development

Contribution ID: **54** Type: **not specified**

R2E annual meeting closure

Wednesday 2 March 2022 17:45 (20 minutes)

Highlights from the annual meeting

Presenter: GARCIA ALIA, Ruben (CERN)

Session Classification: Meeting closure

Contribution ID: **55** Type: **not specified**

Energy deposition studies for synchrotron radiation (SR) in the FCC-ee arcs in FLUKA

Wednesday 2 March 2022 09:00 (15 minutes)

SR represents a major loss source in high energy lepton colliders, such as the FCC-ee. At a beam energy of 182.5GeV, its spectrum makes it penetrate well beyond the vacuum chamber walls. In order to optimize its containment, dedicated absorbers are envisaged. Furthermore, energy deposition studies were performed to develop a shielding layout in the tunnel with the aim of reducing the impact on the electronics.

Presenter: HUMANN, Barbara (Vienna University of Technology (AT))

Session Classification: Research and Development

Contribution ID: **56** Type: **not specified**

R2E impact beyond particle physics

Tuesday 1 March 2022 09:20 (10 minutes)

This presentation will provide an overview of R2E activities supported by the Knowledge Transfer group to maximize societal impact.

Presenter: CHESTA, Enrico (CERN)

Session Classification: Introduction