RADSAGA

WP4 Introduction

17-19 May, 2021

RADSAGA Final Conference and Industrial event

https://indico.cern.ch/event/983095/

Rubén García Alía

RADiation and Reliability Challenges for Electronics used in Space, Aviation, Ground and Accelerators (RADSAGA) is a project funded by the European Commission under the Horizon2020 Framework Program under the Grant Agreement 721624. RADSAGA began in Mars 2017 and will run for 5 years.

WP4 introduction

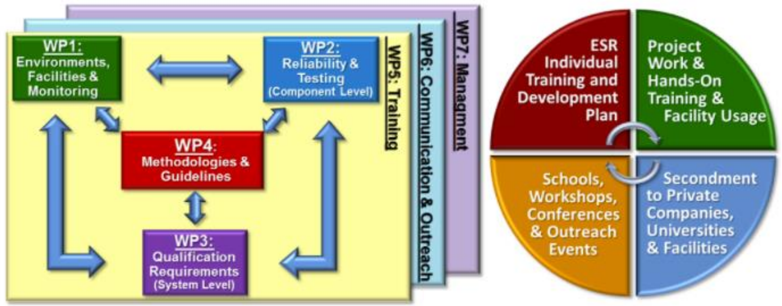

Figure 1: RADSAGA Work-package and training cycle.

Work Package 4

Furthermore, WP4 will make use of the research progress in the first three WPs to develop a handbook of guidelines and tools for rad-hard design and radiation testing of components and systems in complex environments. This document will serve as a decisive input for engineers across the European industry working on the design and characterization of electronic systems in a broad range of application fields. It will combine fundamental radiation aspects (i.e. particle interaction with matter, synergetic and coupled effects, etc.) and practical aspects (i.e. predictive tools, test facility information, etc.) providing an insight to radiation reliability otherwise inaccessible even for the most experienced radiation expert. It is intended to serve as basis for a new European radiation testing standard.

ESR15 – Andrea Coronetti

ESR 15 - Andrea Coronetti

Short biography

Andrea Coronetti holds a Master's Degree in Space Engineering from Politecnico di Milano, Italy and an Advanced Master in Space Systems Engineering from ISAE Supaero, Toulouse, France. He's always been fascinated by space flight and has tackled very different thematics along his studies path. For his thesis at Politecnico di Milano he ventured to the United States, where he's studied Rocket Science at the University of California, Irvine. His main task involved CFD simulations of combustion inside an hybrid rocket chamber. For his thesis at ISAE Supaero he's started studying effects of radiation in space on human beings thanks to a collaboration with MEDES-Institut Médecine Physiologie Spatiale. His main task was to perform an engineering evaluation on an innovative shielding approach involving the reproduction of the Earth's magnetosphere shielding on a human-sized space vessel.

ESR14 – Ivan Slipukhin

ESR14 - Ivan Slipukhin

Short biography

Ivan Slipukhin received his Bachelor's degree in Electronics at the Warsaw University of Technology in 2017 and a master's degree in Electronics in 2019 at the same place. Because of his high interest in electronics for scientific experiments, he started his work as an electronics engineer at the National Centre for Nuclear Research (Otwock, Poland) in 2018. Since then he was a part of an active research group with the main focus on the design of radiation spectrometry systems. While pursuing his masters' degree Ivan has completed the design of a radiation-tolerant data concentrator module for the HyperSat microsatellite project, developed by the Creotech Instruments company, which put a basis in his interest in radiation-tolerant electronics.

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Deliverable and milestones

WP	Deliv. N.	Title	Lead Benef.	Author	Reviewer	Approver	Dissemin. level	Deadline of submission on SharePoint	Deadline of submission (Annex I GA)
WP4	D4.1	Evaluation report of 14 MeV test methodology	CERN	A.CORONETTI (ESR15)	Arto JAVANAINEN, Frederic SAIGNE	Ruben GARCIA ALIA	Public	30.05.2019	30.Jun.19
WP4	D4.2	Handbook of test methodologies and applicable facilities for advanced systems	CERN	A. CORONETTI (ESR15)	Arto JAVANAINEN, Frederic SAIGNE	Ruben GARCIA ALIA	Public	30.09.2020	31.Oct.20

N.	Title	Lead Benef.	Author	Reviewer/ Approver	Submission on Sharepoint	Deadline (Annex I GA)
8	Drafted system level test methodology and respective margins in order to decide on further required studies and respective priorities	CERN	R. Garcia Alia	R. Garcia Alia	1.08.2020	1-Sep-20

14 MeV neutrons (not covered in ESR talks)

- In summary: 14 MeV neutrons are sufficient to reproduce higher energy effects and probabilities (i.e. cross sections) in the case of small(*) sensitive volumes and low LET thresholds (e.g. SEU) but not for larger(*) sensitive volumes and higher LET thresholds (e.g. SEL)
- Conclusion supported by experimental and simulation results

(*) relative to the secondary particle ranges

Manufacturer	Reference	Date code	Technology
Atmel	AT86166H-YM20-E	1330	250nm
Cypress	CY62157EV30LL-45ZSXI	1443*	90nm
ISSI	IS61LV5128AL-10TLI	1246 1303	180nm
Brilliance	BS62LV1600EIP55	12094	180nm

* Date code for mixed-field may be different.

Table 2. SEU Cross sections for the three environments and direct ratio comparison of 14 MeV with respect to spallation and mixed-field [20].

Memory	14 MeV Cross section (cm^2/bit)	Spallation Cross section (cm^2/bit)	Mixed-field Cross section (cm^2/bit)	Ratio Spallation / 14 MeV	Ratio Mixed-field / 14 MeV
Atmel	2.49E-14	2.28E-14	2.67E-14	0.92	1.07
Cypress	6.81E-14	9.85E-14	2.35E-13	1.45	3.45

Table 3. SEL Cross sections for the three environments and direct ratio comparison of 14 MeV with respect to spallation and mixed-field [20].

Memory	14 MeV Cross section (cm^2)	Spallation Cross section (cm^2)	Mixed-field Cross section (cm^2)	Ratio Spallation / 14 MeV	Ratio Mixed-field / 14 MeV
ISSI	< 2.41E-11	5.93E-09	1.69E-08	246	701
Brilliance	< 1.63E-10	1.04E-08	2.18E-08	64	134

RADSAGA Work Package 3-4 System Level Review

- Report available at https://edms.cern.ch/document/2307435/1 (RADSAGA internal)

RADSAGA REVIEW REPORT – CERN EDMS DOCUMENT NUMBER: 2307435

RADSAGA Work Package 3-4 Review

November 12-13th 2019

Report from the Review Committee

NASA esa cnes

CERN AIRBUS intel

Scope of the review:

The review focused on the evaluation of the system level test methodology developed in the European Union-funded RADSAGA project [1], carried out under the Marie Skłodowska-Curie Actions. In particular, the following points were addressed and evaluated:

- Overall progress and deliverables of the innovative training network (ITN) project;
- Industrial needs and applicability of system tests in complex radiation environments; and,
- Readiness and steps required towards a handbook for system qualification in complex radiation environments.

RADSAGA System-Level Testing Guideline for Space Systems

- Available publicly on EDMS
- Related work presented at NSREC 2020 and published in IEEE TNS

Radiation hardness assurance through system-level testing: risk acceptance, facility requirements, test methodology and data exploitation

Andrea Coronetti, Rubén García Alía, Jan Budroweit, Tomasz Rajkowski, Israel Da Costa Lopes, Kimmo Niskanen, Daniel Söderström, Carlo Cazzaniga, Rudy Ferraro, Salvatore Danzeca, Julien Mekki, Florent Manni, David Dangla, Cedric Virmontois, Nourdine Kerboub, Alexander Koelpin, Frederic Saigné, Pierre Wang, Vincent Pouget, Antoine Touboul, Arto Javanainen, Heikki Kettunen, and Rosine Coq Germanicus

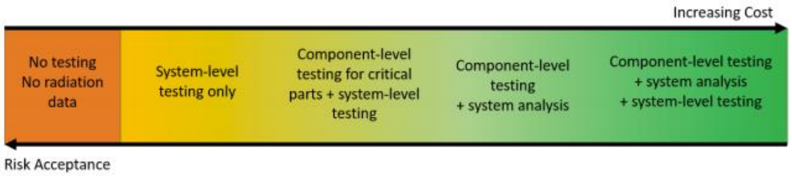

Fig. 1. System-level radiation testing with respect to risk acceptance and cost.

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RADSAGA System-Level Testing Guideline for Space Systems

Contents

Nothing beats a test in CHARM(*)

@Yves Thurel (CERN)

- (*) True for accelerator systems. More generally, it could be "beaten" (i.e. complemented) by incorporating high-energy heavy ion capacity → CHIMERA!

Thanks for your attention!