PhD position proposal

Title:

Total dose effect on electronic components and systems: comparison between X-ray and Cobalt-60.

Context and description:

RADNEXT[1] (RADiation facility Network for the EXploration of effects for indusTry and research) is an H2020 INFRAIA-02-2020 infrastructure project with the objective of creating a network of facilities and related irradiation methodology for responding to the emerging needs of electronics component and system irradiation; as well as combining different irradiation and simulation techniques for optimizing the radiation hardness assurance for systems, focusing on the related risk assessment. More than 30 partners (facilities, Academia, Agencies & Institutes, Industy) are participating in this project. This project is organized into 10 workpackages. Among these workpackages, workpackage WP07 proposes to investigate cumulative radiation effects on electronics. Cumulative effects in electronics are highly relevant both for actual applications (e.g. space, high-energy accelerators, nuclear dismantling, etc.) as well as related to by-product effects of Single Event Effects (SEE) testing.

The proposed PhD position is a part of this exciting and ambitious RADNEXT project and fits the WP07 workpackage. It will focused on Total Ionizing Dose (TID) effects. The main objective is to understand the physical mechanisms behind the damage and to propose test methodologies adapted to the use of electronic component and system in a radiative environment. This will be done by the use of a new test facility for TID (X-ray with high energy photons) and compared to conventional TID facility (cobalt60).

Cobalt-60 is currently recommended for TID testing. However, the interest in using alternative, more accessible irradiation sources is on the raise. Among these, the use of X-ray facilities seems the most promising. In the proposed work, the use of X-ray facilities with a high energy will be investigated for TID testing at component level and system level. These facilities make it possible to obtain X-rays up to 3 MeV with large field sizes

[1] https://radnext-network.web.cern.ch/main/

IES | Institut d'Électronique et des Systèmes
UMR 5214 - CNRS - UM
Université de Montpellier

Campus St Priest
860 rue St Priest
Bâtiment 5 - CC 05001
34095 Montpellier CEDEX 5

tel +33 (0)4 67 14 37 16
fax +33 (0)4 67 54 71 34
www.ies.univ-montp2.fr

which allow irradiation of entire cards. The main advantages of an X-ray facility compared to a Cobalt60 facility are: (1) no radionuclide source is required, hence also excluding the issue of dismantling and radioactive waste, (2) easy to use, easy in terms of radioprotection, (3) low cost, easily accessible, (4) high dose rates which allow TID level to be reached in short time. The main goal of this work will be the development of a testing methodology using X-ray facilities. To achieve such objective, three areas of work are to be studied:

Task1: The first one is how to perform a TID test with a X-ray facilities: choice of energy, filters; dosimetry and spectrometry, … . Simulation of the X-ray facilities with Geant4 or FLUKA (in link with WP8: Complementary modelling tools) will also be performed in order to provide additional elements to make these choices. Several X-ray facilities will be used (X-ray facilities in Montpellier and Saint-Etienne Universities and ISAE-SUPAERO, the ATRON 3.5MeV electrons accelerator with X-ray target).

Task2: The second task is the comparison of component and system degradation between X-ray and cobalt-60. This comparison will be made on several kind of dosimeters (RADFET, FGDOS, and in link with WP5: Radiation monitors, dosimeters and beam characterization) and on generic electronic components or systems (in link with WP6: Standardization of system level radiation qualification methodology).

Task3: Depending on the progress of the first two tasks, the third task is a specific study on the charge yield. This study will be executed in order to increase our knowledge on the initial recombination which is a key parameter if we are interested in TID effect. Several kind of facilities (Cobalt-60, X-ray, electrons, protons) will be investigated, under a wide temperature range (50K to 400K) and for several bias configuration.

Finally, other points can be studied such as

- When using X-rays from electron LINACs : how the temporal structure of the beam can affect the TID (compared to a "continuous" cobalt 60 irradiation),
- Irradiation with electrons,
- Irradiations with higher energy.

Results derived from this WP will be integrated in recommendations and guidelines related to the complementarity and representativeness of different experimental conditions with respect to those encountered in applications. They will also generate an open source list of cumulative effects radiation results available for the radiation effects community and exploitable by system designers related to their choice of component and possible further radiation test preparation.

Location :

Montpellier University (France), IES laboratory

Duration :

36 months

Field(s) of activity/research:

Radiation effects on electronic

Technical competencies

- General background and specific experience in the technical domains covered by the position (Electronic, Semiconductor Physics, Radiation Effect),
- Hands-on hardware experience in electronic design and conception,
- Experience with laboratory and field testing of relevant technical equipment
- Ability to conduct work autonomously
- General interest in electronic and radiation effect
- Ability to gather and share relevant information

Education:

You should have a Master's degree or equivalent qualification in electrical/electronic engineering or (solid- state) physics as well as an experience in the area of radiation effects on semiconductor components and all aspects of irradiation testing.

To apply :

Application deadline : June 15, 2021
https://www.adum.fr/as/ed/proposition.pl?site=ISS

Contact information:

Pr. BOCH Jérôme
Université Montpellier
☏ +33 (0)4 67 14 96 03
jerome.boch@umontpellier.fr