



WORKSHOP PROGRAM

“Radiation Effects on Optoelectronic Detectors”

27th NOVEMBER 2018

ISAE Supaéro (Amphi 4)
10 Avenue E. Belin, 31400 Toulouse



Co-organised by CNES, ESA, AIRBUS DEFENCE&SPACE, THALES ALENIA SPACE, SODERN, ISAE-SUPAERO, TELEDYNE E2V

Two years after a very fruitful fourth edition of this event, **CNES, ESA, AIRBUS DEFENCE&SPACE, THALES ALENIA SPACE, SODERN, TELEDYNE E2V** and **ISAE SUPAERO** are pleased to invite you to the 5th edition of the Workshop focused on radiation effects on optoelectronic detectors. This event will be held in Toulouse on November the 27th 2018 within the framework of the **Optics & Optoelectronics (OOE)** and **Environment (ENV) Community of expert (COMET)**.

Optoelectronic detectors (image sensors, radiometric sensors, CIS, CCD...) are key elements in space and scientific instruments, and their performances have direct impact on the overall mission capability. It is well known that, in space application, radiation can strongly degrade major performance characteristics of optoelectronic detectors and even prevent their operation. Current and future space programs are more and more demanding in terms of lifetime and of End-Of-Life performance commitments, requesting deeper on-ground investigations. In addition, the evolution of CMOS and photodetector technologies induces new uncertainties regarding the behaviour of next generation detectors in Space.

Although the workshop is mostly oriented to Visible/IR spectral range, this event is fully open to researchers/user working within other wavelength ranges. Developer working on non-space applications dealing with the same topics (Nuclear Physics, Medical Imaging...) are equally welcome to participate to this Workshop.

This Workshop is coupled with “Ultra-Violet Detectors and instruments” workshop which will be held the 28-29th of November. The two workshops share the **social event** the 27th evening in ISAE SUPAERO

Registration

On line registration: <http://radiation-effects-on-solid-state-optoelectronic-detectors.evenium.net>

9:00 AM **WELCOME INTRODUCTION**
Cédric Virmontois, CNES

SESSION A IONIZING RADIATION EFFECTS ON SILICON PIXEL DETECTORS

9:15 AM Session Introduction
Chair: Alessandra Ciapponi, ESA and Frederic Devriere, Teledyne E2V

A1 Radiation Hardness Comparison of CMOS Image Sensor Technologies at High Total Ionizing Dose Levels
 9:15 AM *S. Rizzolo, V. Goiffon, F. Corbière, R. Molina A. Chabane, P. Magnan, ISAE SUPAERO; S. Girard, A. Boukenter, T. Allanche, Univ. Saint-Etienne; P. Paillet, C. Muller, CEA DAM DIF; C. Monsanglant, Louvet, M. Osmond, H. Desjonqueres, IRSN; J-R Macé, New AREVA; P. Burnichon, J-P Baudu, OPTSYS; S. Plumeri, ANDRA*

A2 CIS113 Ionising Radiation Tolerance
 9:35 AM *P. Turner, W. Hubbard, T. Lemon, Teledyne-E2V*

A3 Total Ionizing Dose Radiation Induced Dark Current Random Telegraph Signal in Pinned Photodiode CMOS Image Sensors
 9:55 AM *C. Durnez, Airbus DS (formerly CNES/ISAE SUPAERO/ SOFRADIR); V. Goiffon, S. Rizzolo, P. Magnan, ISAE SUPAERO; C. Virmontois, CNES; P. Paillet, C. Marcandella, CEA DAM DIF; L. Rubaldo, SOFRADIR*

10:15 AM **BREAK**

SESSION B IONIZING AND NON-IONIZING EFFECTS ON SILICON DETECTORS

10:45 AM Session Introduction
Chair: Olivier Saint-Pé, Airbus DS and Olivier Gilard, CNES

B1 MTG-FCI Qualification Phase Gamma and Proton Test Results
 10:45 AM *R. Simpson, A. Walker, W. Hubbard, Teledyne E2V*

B2 Effect of Ionizing and Non-Ionizing Radiation on CMOS SPADs for Charged Particle Tracking
 11:05 AM *L. Ratti, M. Musacci, C. Vacchi, Univ. Pavia/INFN Pavia; P. Brogi, P.S. Marrocchesi, Univ. Siena/INFN Pisa; G. Collazuol, Univ. Padova/INFN Padova; G.-F. Dalla Betta, A. Ficorella, L. Pancheri Univ. Trento/TIFPA; L. Lodola, STMicroelectronics; F. Morsani, INFN Pisa*

B3 Radiation Testing of the CIS115 CMOS Sensor for the JANUS Camera on ESA's JUICE Mission
 11:25 AM *M. Soman, D.-D. Lofthouse-Smith, C. Crews, E. Allanwood, A. Holland, K. Stefanov, M. Leese, The Open University; P. Turner, J. Pratlong, Teledyne-E2V*

B4 **Dose and Single Event Effects on Color CMOS Camera for Space Exploration**
 11:45 AM
C. Virmontois, J.-M. Belloir, A. Bardoux, CNES; M. Beaumel, A. Vriet, SODERN; N. Perrot, C. Sellier, J. Bezine, D. Gambart, D. Blain, E. Garci-Sanchez, W. Mouallem, 3DPLUS

B5 **Radiation Effects in Pinned Photodiode CMOS Image Sensors: Variation of Photodiode Implant Dose**
 12:05 AM
J.-M. Belloir, C. Virmontois, A. Materne, A. Bardoux, CNES; V. Goiffon, M. Etribeau, P. Magan, ISAE SUPAERO

12:25 AM **LUNCH**

SESSION C PROTON AND NEUTRON IRRADIATIONS ON SILICON DETECTORS

2:30 PM Session Introduction
Chair: Vincent Goiffon, ISAE SUPAERO, Dominique Herve, SODERN

C1 **Radiation Induced Leakage Current in CMOS Image Sensor Floating Diffusion**
 2:30 PM
A. Le Roch, V. Goiffon, S. Rizzolo, F. Pace, C. Durnez, P. Magnan, ISAE SUPAERO; C. Virmontois, J.-M. Belloir, CNES; P. Paillet, CEA DAM DIF

C2 **Random telegraph signal investigation in different CMOS SPAD layout**
 2:50 PM
D. Fiore, F. Di Capua, M. Campajola, Univ. Calabria, INFN Cosenza

C3 **Neutron Irradiation of CCDs and Characterisation using Trap Pumping**
 3:10 PM
N. Bush, The Open University

C4 **Experimental Measurements of Damage Factors in Silicon Devices: Comparisons with NIEL**
 3:30 PM
T. Nuns, C. Inguibert, S. Soonckindt, ONERA; B. Dryer, T. Buggery, The Open University; C. Poivey, ESA

C5 **NIEL Scaling Approach Reliability**
 3:50 PM
C. Inguibert, T. Nuns, ONERA

4:10 PM **BREAK**

SESSION D RADIATION EFFECTS ON COOLED DETECTORS AND FACILITIES

- 5:00 PM Session Introduction
Chair: Stephane Demiguel, TAS, Denis Standarowski, CNES
- D1**
5:00 PM **A Comparison of p-channel and n-channel CCD Technologies Following Cryogenic Proton Irradiation**
A Holland, N Bush, B Dryer, D Hall, The Open University; P. Jerram, Teledyne-E2V
- D2**
5:20 PM **Investigating Differences in End-of-life Performance and Defects Properties of PLATO CCDs: Warm versus Cold Proton Irradiation**
T. Prod'homme, P. Verhoeve, F. Lemmel, H. Smit, S. Blommaert, C. Van der Luijt, I. Visser, T. Beaufort, Y. Levillain, B. Shortt, ESA
- D3**
5:40 PM **Modelling of Luminescence Induced by Proton Irradiation in HgCdTe Infrared Detector Array in Space Environment**
T. Pichon, S. Mouzali, O. Boulade, O. Limousin, CEA Dap; G. Badano, A. Ferron, O. Gravrand, CEA LETI
- D4**
6:00 PM **High-energy electrons impact on Sofradir NGP and Teledyne H1RG IR MCT arrays for JUICE/MAJIS instrument**
P. Guiot, M. Vincendon, Y. Langevin, A. Carapelle, J. Carter, IAS
- D5**
6:20 PM **Live Readout of the Device Under Test for Proton Irradiation Dosimetry During the First Space Component Proton Irradiations with the MC40 Accelerator at Birmingham**
M. Soman, N. Bush, R. Adlard, X. Meng, A. Holland, The Open University; T. Price, Univ. Birmingham
- 6:40 PM **END OF WORKSHOP**
- 7:00 PM **SOCIAL EVENT and COCKTAIL**

Schedule

November 15th: Deadline for registration
November 27th: Workshop

Organization committee

Cédric VIRMONTOIS Olivier GILARD Denis STANDAROVSKI	CNES
Olivier SAINT-PE	Airbus Defence and Space
Stéphane DEMIGUEL	Thalès Alenia Space
Vincent GOIFFON	ISAE-SUPAERO
Dominique HERVE	SODERN
Alessandra CIAPPONI	ESA
Frédéric DEVRIERE	TELEDYNE E2V

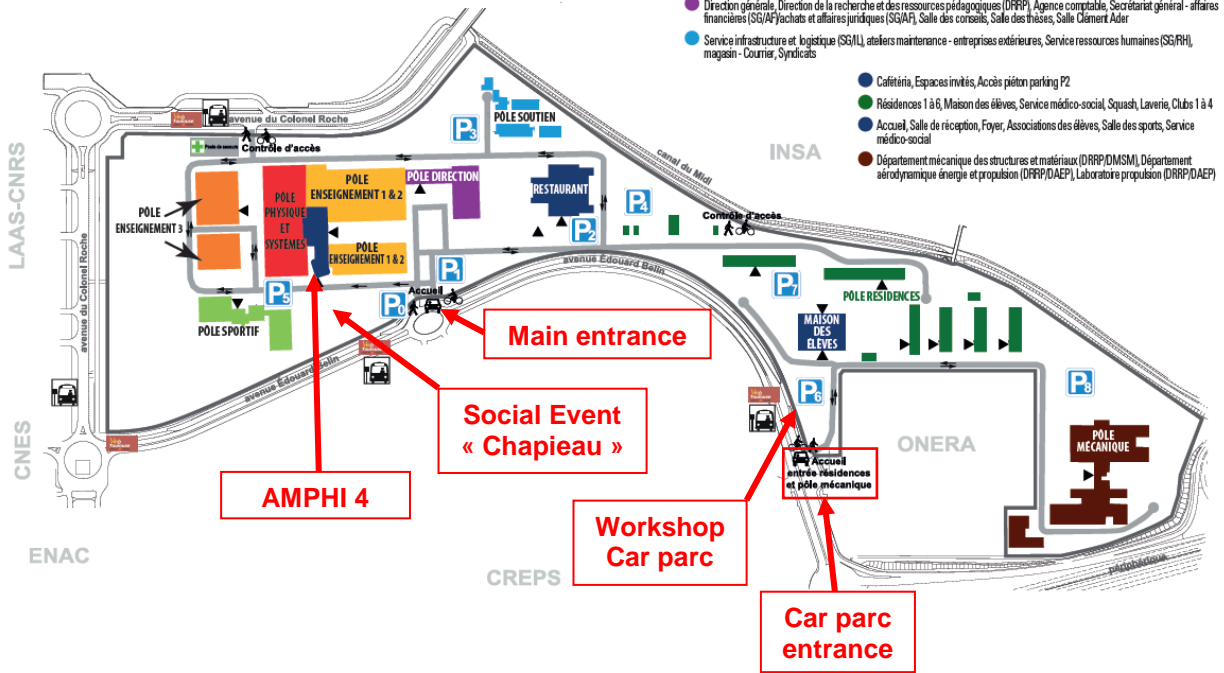
Contact : comet-ooe@cnes.fr

Workshop location : ISAE Toulouse



Plan du campus ISAE-SUPAERO

10 avenue Edouard Belin - Toulouse



- Direction des formations masters et masters spécialisés (DFM), Direction des relations internationales (DRI), Département conception et conduite des véhicules aéronautiques et spatiaux (DRRP/DCA), EUROSAE, Salle d'examen
- Piscine, Gymnase, Stads, Tennis, Terrain de basket, Terrain de Volley
- Département électronique, optique et signal (DRRP/DEOS), Département d'ingénierie des systèmes complexes (DRRP/DISC), Antenne Télécom Bretagne
- Direction des formations ingénieurs (DFI), Département langues, arts cultures et sociétés (DRRP/LACS), Amphithéâtres 1 à 4, Service formations doctorales et masters (DRRP-FDMR), Direction des relations entreprises et du mécénat (DREM), Service systèmes d'information (SGSI), Bibliothèque, Reprographie
- Direction générale, Direction de la recherche et des ressources pédagogiques (DRRP), Agence comptable, Secrétariat général - affaires financières (SG/AF) achats et affaires juridiques (SG/AJ), Salle des conseils, Salle des thèses, Salle Clément Ader
- Service infrastructure et logistique (SG/L), ateliers maintenance - entreprises extérieures, Service ressources humaines (SG/RH), magasin - Courrier, Syndicats
- Cafétéria, Espaces invités, Accès piéton parking P2
- Résidences 1 à 6, Maison des élèves, Service médico-social, Squash, Laverie, Clubs 1 à 4
- Accueil, Salle de réception, Foyer, Associations des élèves, Salle des sports, Service médico-social
- Département mécanique des structures et matériaux (DRRP/DMSM), Département aérodynamique énergie et propulsion (DRRP/DAEP), Laboratoire propulsion (DRRP/DAEP)