Radecs 2012 Summary

Salvatore Danzeca, Julien Mekki , Ruben Garcia Alia

Technical Program

- RADGROUND Short Course
- **Session A** : Space & Terrestrial Environment
- **Session B** : Facilities & Dosimetry
- **Session C** : Basic Mechanisms of Radiation Effects
- **Session D** : Photonics and Optical Devices
- **Session E** : SEE Mechanisms & Modelling
- **Session F** : Radiation Effects in Devices & Ics
- **Session G** : SEE Transient Characterization
- **Session H** : Devices and Integrated Circuits
- **Session I** : Hardening by Design
- **Session J** : Radiation Hardness Assurance

Our Presented Paper

- ‘New Testing Methodology of an Analog to Digital Converter for the LHC mixed radiation field’, S. Danzeca , L. Dusseau , P. Peronnard, G. Spiezia
- ‘Mixed Particle Field Influence on RadFET sensitivities’ ,J. Mekki, M. Brugger, S. Danzeca, K. Roeed, G. Spiezia
- ‘SEU Measurements and Simulations in a Mixed Field Environment , R. García Alía, B. Biskup, M. Brugger, M. Calviani, C. Poivey , K. Røed, F. Saigné, G. Spiezia, F. Wrobel

Session B : Facilities & Dosimetry

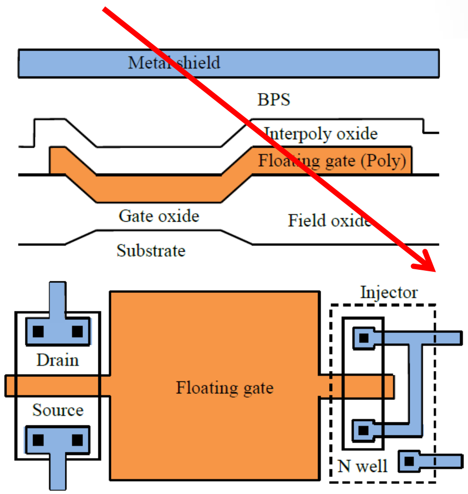
- ‘Improved Floating Gate MOS Radiation Sensor with Current Output’, E. Garcia-Moreno, E. Isern, M. Roca, R. Picos, J. Font, J. Cesari, A. Pineda
- ‘The Two Towers (TTT) Radiation Monitor for Seosat/Ingenio’ ,J.J. Jiménez, C. Hernando, M.T. Álvarez, M. Gonzalez-Guerrero, J.M. Oter, C.P. Fernández, H. Guerrero

Data Workshop :

- Single event upset cross section dose dependence on 90nm SRAM , N. Sukhaseum, D. Le Du, B. Vandevelde, A. Samaras, N. Chatry, F. Bezerra

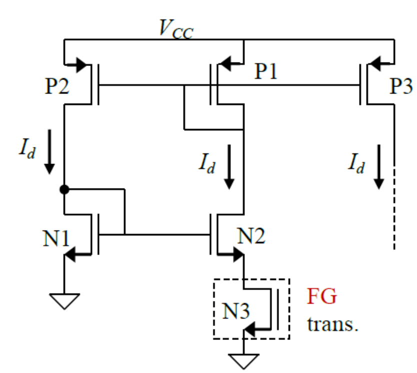
Improved Floating Gate MOS Radiation Sensor with Current Output

- Floating gate MosFET which provides I_{out} **shift vs TID**
- Sensitivity **1,1μA/Gy**, dose range **below 20 Gy** and lowest detectable **dose lower than 0.01Gy**
- Capacitance associated with the FG is **pre-charged prior to irradiation** (Injector → Large V to cause tunneling effect).



- Charges generated by ionizing particles in the **FIELD OXIDE** of the FG are attracted towards the FG and discharge it.
- **The remaining FG charges are a TID indicator**

- *Operating principle:*
  - P1-P2 (current mirror) force $I_{dN1} = I_{dN2}$
  - N3 operates in linear region → variable resistance *controlled by* V_{FG}.
  - **I_d is a function of the FG voltage**



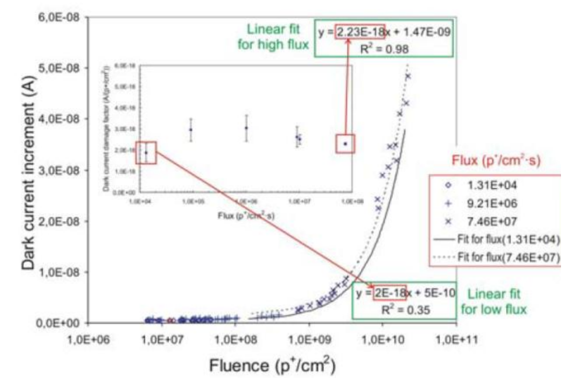
Improved Floating Gate MOS Radiation Sensor with Current Output, E. Garcia-Moreno, E. Isern, M. Roca, R. Picos, J. Font, J. Cesari, A. Pineda

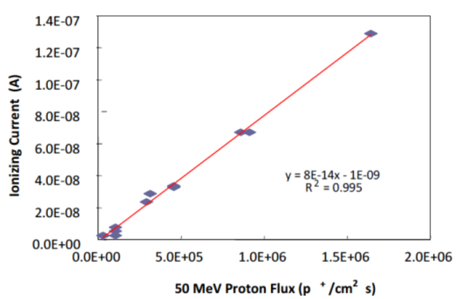
The Two Towers (TTT): The Radiation Monitor for Seosat/Ingenio

- **5 different sensors are used** →

Exp.	Technology	Dosimetry	Measure	Resolution
1	PIPS	Particle Flux	Current	$1 p \cdot cm^{-2} \cdot s^{-1}$
2a	PIN Photodiode	Fluence - DD	Current	$25 \cdot 10^{3}$ $p \cdot cm^{-2}$
2b	PIN Photodiode	Particle Flux	Current	$2.5 p \cdot cm^{-2} \cdot s^{-1}$
3	LED	Fluence - DD	Current	$25 \cdot 10^{3} p \cdot cm^{-2}$
4	RadFET	TID	Voltage	0.2 rad
5	Temperature Sensor	TID	Voltage	1 rad

- **RadFets 400nm :** Total Ionizing dose sensors
- **PIPS:** Photodiode used as particle detector → Intensity of each pulse provides information about the energy of the original particle
- **Silicon PIN diode** → **Proton Fluence** → Increase of dark current
- → **Proton flux** → Temporary increases of the photodiode current due to ionizing radiation
- **LED:** Proton Fluence → Reduce the LED emissivity
- **Temperature sensor:** used as Total Ionizing dose sensors (commercial product)





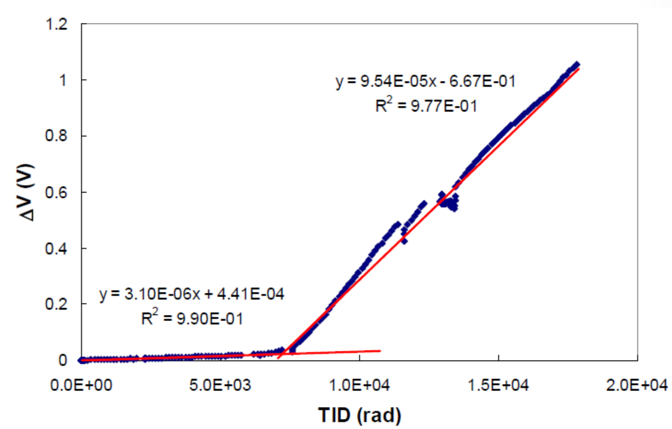


Fig. 12.- Calibration curve of a typical TMP-36 vs. TID.

The Two Towers (TTT) Radiation Monitor for Seosat/Ingenio
J.J. Jiménez, C. Hernando, M.T. Álvarez, M. Gonzalez-Guerrero, J.M. Oter, C.P. Fernández, H. Guerrero

Single Event Upset Cross Section Dose Dependence on 90nm SRAM

- Two 90 nm SRAM**: Cypress CY62148EV30LL (1) and CY62167EV30LL (2)**
- At several dose steps, heavy ion tests were performed
- TID results:
  - (1) At 1.5 kGy, 2/8 devices are no longer functional
  - (2) At 1.9 kGy, all devices remain functional.
- Heavy ion results:
  - No SEL has been observed for both SRAMs
  - ***SRAM (1)***
    - **SEU test results:** SEU is not the predominant effect compared to burst events
    - **Burst Event test results:** Higher x-section than SEU
    - For both cases, there is no correlation between received dose and SEU/Burst sensitivity
  - ***SRAM (2)***
    - Same observation than for SRAM (1)
- Californium test results:
  - Show that burst are due to events occurring in the memory array rather than in address registers

Single event upset cross section dose dependence on 90nm SRAM
N. Sukhaseum, D. Le Du, B. Vandevelde, A. Samaras, N. Chatry, F. Bezerra

Session B : Facilities & Dosimetry

- ‘Improved Floating Gate MOS Radiation Sensor with Current Output’, E. Garcia-Moreno, E. Isern, M. Roca, R. Picos, J. Font, J. Cesari, A. Pineda
- ‘The Two Towers (TTT) Radiation Monitor for Seosat/Ingenio’ ,J.J. Jiménez, C. Hernando, M.T. Álvarez, M. Gonzalez-Guerrero, J.M. Oter, C.P. Fernández, H. Guerrero

Data Workshop :

- Single event upset cross section dose dependence on 90nm SRAM , N. Sukhaseum, D. Le Du, B. Vandevelde, A. Samaras, N. Chatry, F. Bezerra

Session I : Hardening by Design

- A hybrid technique for soft error mitigation in interrupt-driven applications , A. Martínez-Álvarez, F. Restrepo-Calle, S. Cuenca-Asensi, L. M. Reineri, A. Lindoso, L. Entrena

Soft error mitigation in interrupt-driven applications

Key point: Configuration registers in the COTS microcontroller

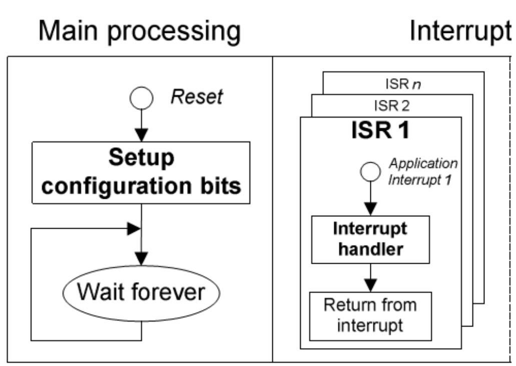
Stress point: Configuration register for the interrupt
Solution: hybrid techniques for the mitigation of the interrupt mask

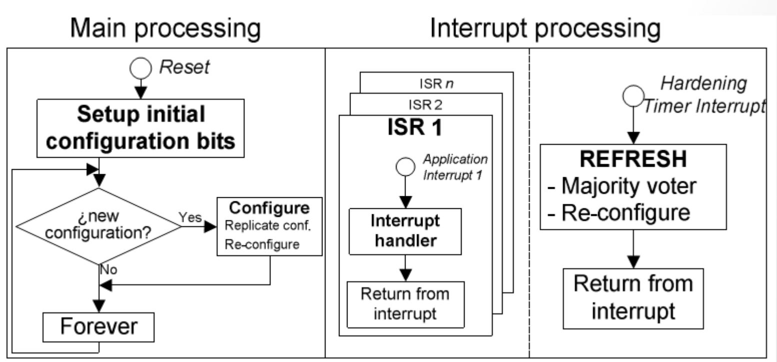
Solution: Hardware timer + software based technique

It is well known how to hardened an ISR (Interrupt Service ROUTINE)

STATIC CONFIGURATION HARDENING:
Configuration registers which remain unchanged
during the whole execution period -> Periodic refreshing of the register by an additional ISR

DYNAMIC CONFIGURATION HARDENING:
Configuration registers which change During the execution period. Main issue the timer routine don't know the new value -> Main algorithm: write data in a second protected storage (replicate).
ISR: Majority voter and reconfiguration





Session B : Facilities & Dosimetry

- 'Improved Floating Gate MOS Radiation Sensor with Current Output', E. Garcia-Moreno, E. Isern, M. Roca, R. Picos, J. Font, J. Cesari, A. Pineda
- 'The Two Towers (TTT) Radiation Monitor for Seosat/Ingenio' ,J.J. Jiménez, C. Hernando, M.T. Álvarez, M. Gonzalez-Guerrero, J.M. Oter, C.P. Fernández, H. Guerrero

Data Workshop :

- Single event upset cross section dose dependence on 90nm SRAM , N. Sukhaseum, D. Le Du, B. Vandevelde, A. Samaras, N. Chatry, F. Bezerra

Session I : Hardening by Design

- A hybrid technique for soft error mitigation in interrupt-driven applications , A. Martínez-Álvarez, F. Restrepo-Calle, S. Cuenca-Asensi, L. M. Reineri, A. Lindoso, L. Entrena

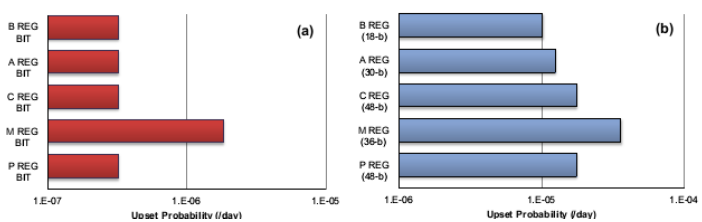
Session F : Radiation Effects in Devices & ICs

- Upset Manifestations in Embedded Digital Signal Processors (DSPs) due to Single Event Effects (SEE) , R. Monreal, G. Swift

Upset Manifestations in DSP due to SEE (Virtex family FPGA)

- Key point: Static and Dynamic cross section of DSP Slices
  - DSP Slices in Virtex 4 (90nm) and Virtex 5 (65nm) Hardened By design (HBD)
- Static cross section: Internal register of the DSP slices.
- Dynamic cross section: while performing the basic operation
- Length of the SEU: a timer is used on the tester to capture the length of each SEE

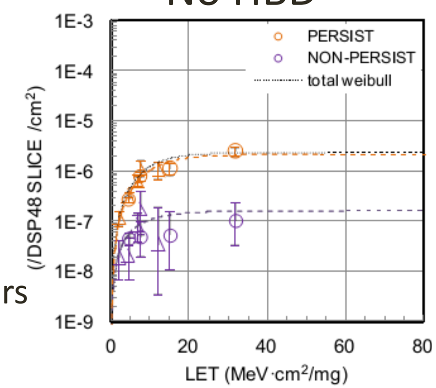
Frequency tested are : 6.25 12.5 25 Mhz



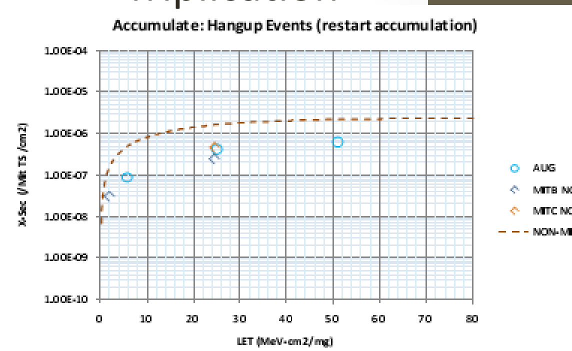
The multiplier output register is the most sensitive registers

Dynamic Test results (Virtex 5)

No HBD



Triplication



Discrimination between the configuration upset and the functional plane upset:

Length of the configuration SEU last > 10us

Length of the plane SEU last 1 or 2 clock cycle

Conclusion : Triplication in HBD fails due to the same clock path

Static error rate< Dynamic error rate

Upset Manifestations in Embedded Digital Signal Processors (DSPs) due to Single Event Effects (SEE)
R. Monreal, G. Swift

Data workshop

Ref Number	Title
DW-2	SEE test results comparison for differential driver-receiver chain using SET and SEU test approaches
DW-3	Ultralow Dose Rate Test Results at 1 mrad(Si)/s to 100 krad(Si) for Texas Instruments' ELDRS Free Bipolar LDO Regulator, LM2941
DW-6	Radiation Testing of FPGA-Based High-Speed Serial Communication
DW-8	Single Event Testing of the Intersil ISL70002SEH Integrated Point of Load Converter
DW-9	Switching DC-DC converters’ TID and SEE hardness investigation
DW-11	Automated Laser Mapping of Single Event Transients in Analogue Integrated Circuits
DW-12	Total Ionizing Dose Effects in Ferroelectric Nonvolatile RAMs FM18L08
DW-16	Compendium of Roscosmos Facility Single Event Effect Data Obtained in the Temperature Range
DW-18	Compendium of Recent Proton and Co60 Radiation Test Data in Radiation Tolerant Optocouplers and COTS
DW-19	Characterization of RADFET Dosimeters for the ESA ALPHASAT CTTB Experiments
DW-25L	New SEE Test Results for 4 Gbit DDR3 SDRAM
DW-23L	New SEE Test Results of 16/32-Gbit SLC NAND-Flash

Link to the Radecs abstract and Short courses

- Abstracts Link:
- \\cern.ch\Departments\AB\Groups\ATB\LP\Equipment Controls\Radmon and Radiation test facility\Conference_WS_scg\RADECS 2012

- Shourt Courses Link:
- \\cern.ch\Departments\AB\Groups\ATB\LP\Equipment Controls\Radmon and Radiation test facility\Conference_WS_scg\RADECS 2012\Short Courses