DOCTORAL THESIS

ISAE-SUPAERO Department: Electrical Engineering

CNES Department: Detection Chain/Quality Assurance

III-V lab
Lynred
Thales Alenia Space (TAS): Detection Chain

PhD Advisors: Vincent Goiffon (ISAE-SUPAERO), Jean-Luc Reverchon (III-V Lab), Laurie Pistre (CNES)
Duration: 3 years
Starting date: October-December 2020

Apply on CNES website cnes.fr before end of March

Location: III-V lab (Palaiseau)

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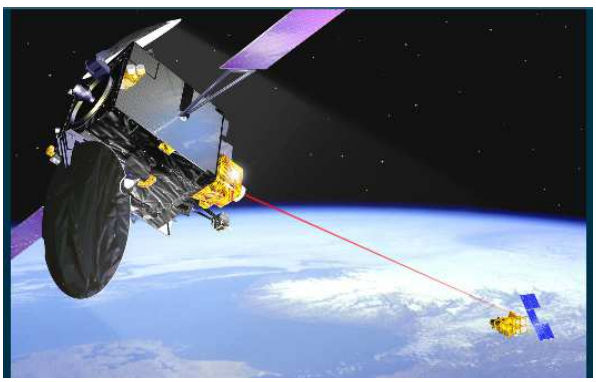
DESCRIPTION

Ref : 2020-234

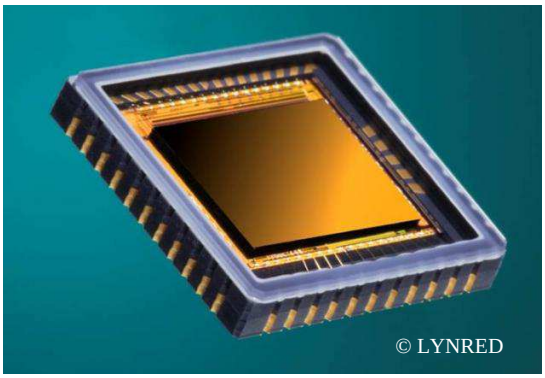
Domain: InGaAs, IR, RTS, radiation, ionizing dose, displacement damage.

Title: **EFFECTS OF SPACE RADIATION ON INGAAS INFRARED DETECTORS**

InGaAs infrared detectors enable InfraRed wavelengths detection in the SWIR range (up to 1.7 µm) without the need for cooling. These detectors cover several fields of applications such as Earth observation, planetology and optical telecommunications. InGaAs detectors are thus a key technology for next generation space missions. However, the sensitivity to this technology to the space radiation environment is not well studied, and it depends on many factor such as its conditions of use and especially the bias voltages. For instance, on SPOT 5, the detection circuit was coupled to a CCD reading register and was under high bias voltages, which had generated a high rate of defective pixels, but today InGaAs circuits are coupled to CMOS readout circuits, with much lower bias voltages, suggesting that the behavior under irradiation will be better.



Optics Telecom.



InGaAs Detector

The purpose of the PhD thesis is to study the degradation mechanisms of InGaAs infrared detection circuits when exposed to the space radiation environment. In particular, the thesis will focus on the two following radiation effects:

- Mechanisms of displacement damage due to proton irradiation
- Cumulative ionizing dose effects

In detail, the PhD candidate will:

- Carry out a literature review of the state of the art concerning:
  - the effects of radiation on InGaAs detection circuits
  - the impact of temperature on these effects
  - the impact of bias voltage
  - Random Telegraph Signal phenomena before and after irradiation
- Model and simulate the key phenomena related to irradiation (e.g. by using Technology Computer-Aided Design (TCAD) physical mesh simulators).
- Search and develop solutions to mitigate the effects of irradiation (e.g. impact of pixel shape and topology)
- Design test vehicles
- Conduct irradiations campaign on these test vehicles
- Perform parametric analyzes as a function of bias voltage and temperature
- The Random Telegraph Signal phenomenon will be particularly studied
- Synthesize the work developed during the thesis and present the results in international conferences.

Applicant Skills

Master of Science (of equivalent) specialized in nano/microelectronics (design, process, ...) / optoelectronics / imaging electronics, sensors, detectors / semiconductor physics / solid-state physics / semiconductor defects/ analog and digital electronics / particle-matter interactions / radiation effects on electronics.