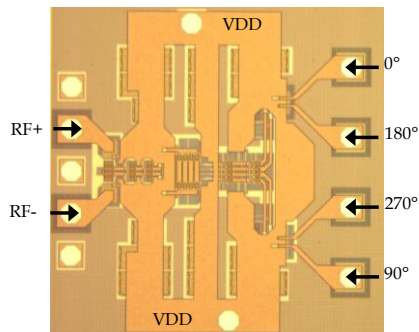


Space strategic axis

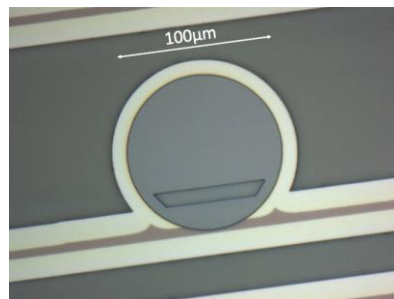
**Innovative devices and system
approaches for space applications**

Motivation/objectives

- > Improving space systems and technologies
- > Work at device level and system level
- > Anticipate the changes such as miniaturization, system reconfigurability, ultimate measurements...
- > Strong relations with CNES and space industry



Integrated RF and optics



Data fusion and acquisition

- > Earth observation (climate change, natural resources...)
- > Competitiveness in space communications
- > Deep space missions and scientific experiments
- > French strategy for space
- > New actors & projects at the international level
- > Regional space research & industry environment



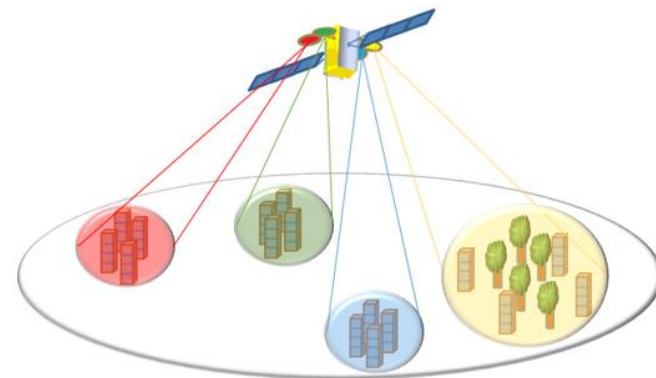
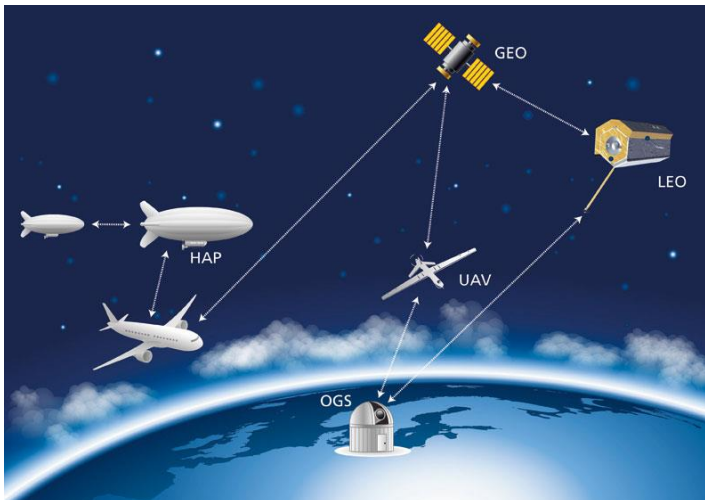
- > Research staff:
 - Permanent researchers: 39
 - Engineers/technicians: 6
 - Ph.D./Post Doc: 17

- > LAAS departments involved: all

- > Platforms
 - RENATECH clean room
 - Characterization

> Space telecommunications

- Increase of RF frequency ($f > 30$ GHz) and circuit integration
- Fiber optics technology in the satellite *and/or* free space optics technologies
- Network reconfiguration: digital RF, frequency allocation, space and ground networks interaction, software defined network, network function virtualization...

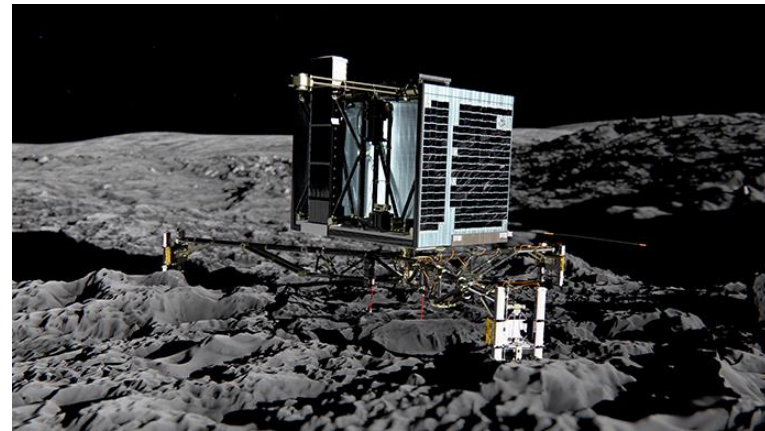


> The spacecraft platform

- Energy generation and management
- Active diagnosis for on-board control procedures
- Attitude and orbit control
- Resource allocation and scheduling



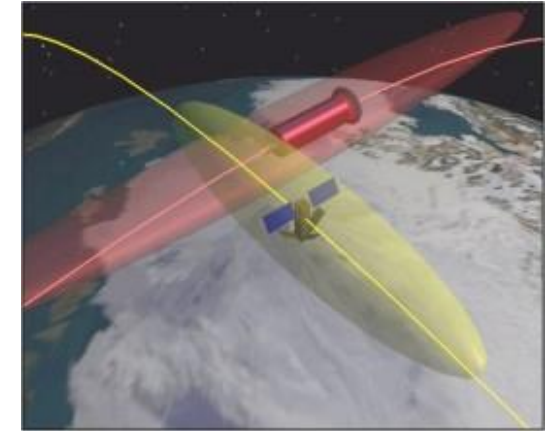
Picard satellite



Philae-Rosetta landing probe

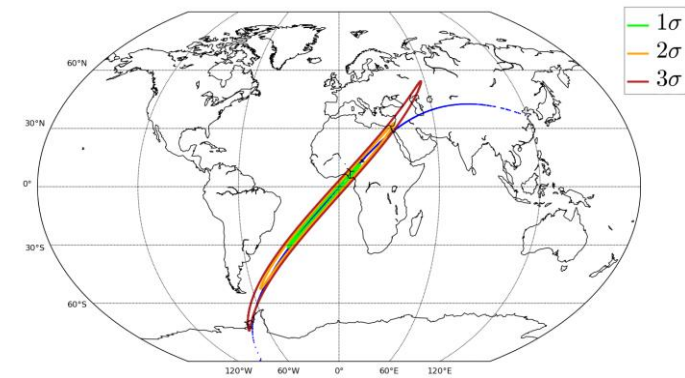
> Guidance and orbit control

- Trajectory computation
- Localization
- Collision avoiding - probabilistic approaches



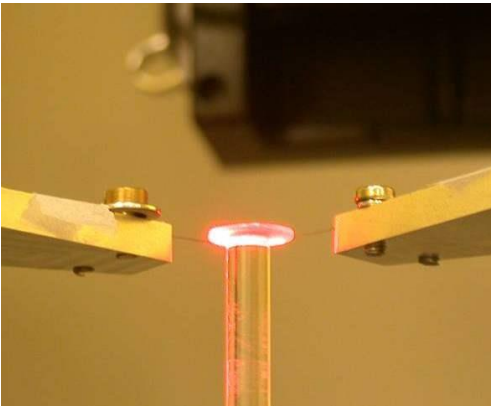
> Autonomous systems

- Multi sensors data fusion (Lidar, hyperspectral or polarimetric vision...)
- Robot or spacecraft environment models

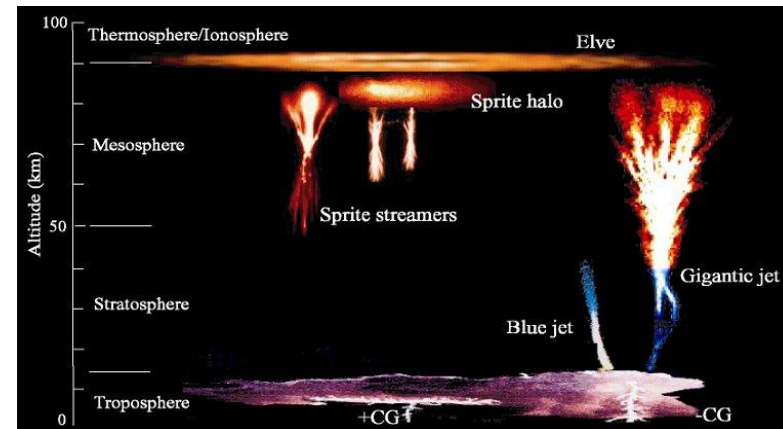


> High precision measurement

- Sources for Time & Frequency applications
- High precision spectroscopy
- Low power signals handling or detection, from RF to THz and optics
- Detection of fast events



High Q optical resonator



Lightning measurement – TARANIS mission

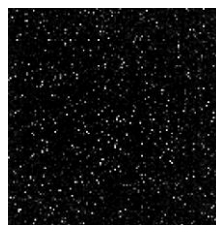
> The reliability challenge

- Qualifying new technologies for space
- Designing fault tolerant systems
- Self test and validation

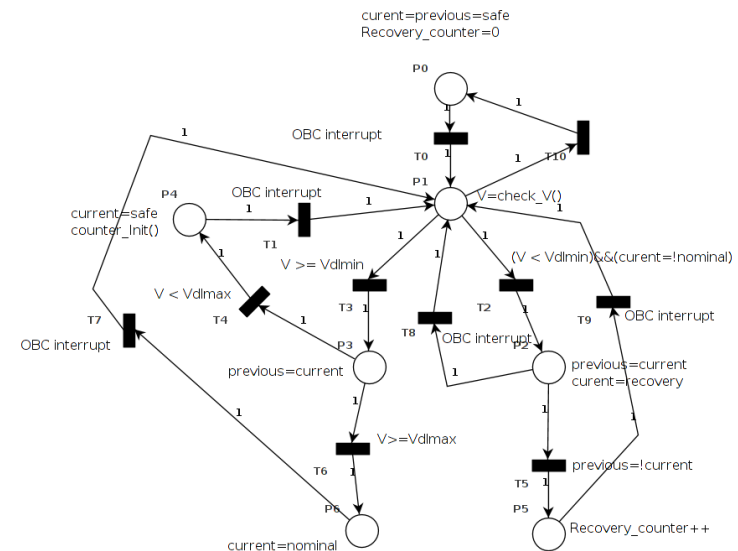
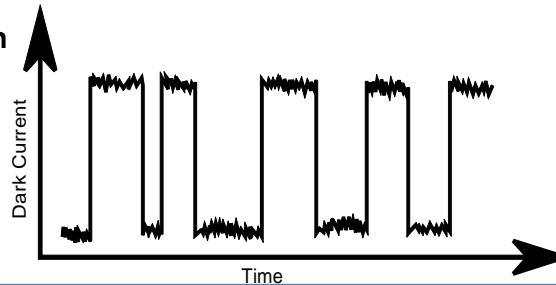
Before irradiation



After irradiation



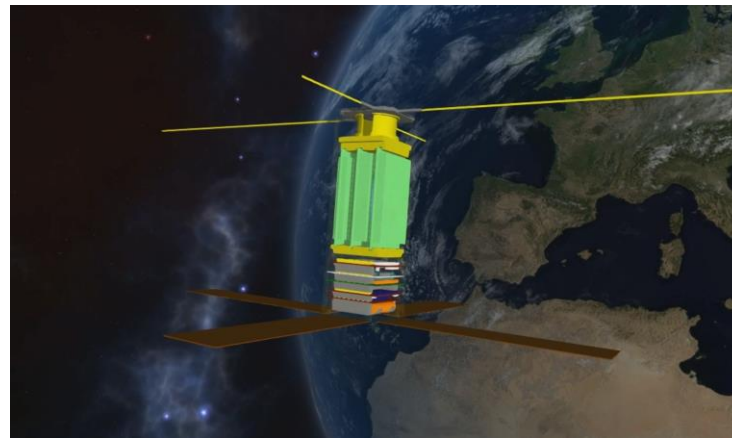
Sensors degradation after irradiation



Cubesat model

> Going smaller!

- Nanosatellites for real missions
- Proof of concept of R&D matured technologies
- Payloads for original experiments
- Federative projects on Toulouse academic environment



NIMPH 3U nanosat

> Topics of the session

- Nanosat NIMPH payload (Arnaud Fernandez)
- Spacecraft rendezvous (Paulo Ricardo Arantes Gilz)
- Task scheduling for Rosetta / Philae probe (Christian Artigues)
- Hyperspectral imager (Simon Lacroix)
- RFµwave energy harvesting in satellites (Alexandru Takacs)

Thank you

bureau-espace@laas.fr

O. Llopis, C. Louembet,

C. Artigues, G. Auriol, P. Berthou, S. Calvez, A. Hemeryck, S. Lacroix, N. Nolhier

espace@laas.fr

A. Monmayrant, A. Fernandez, B. Berthomieu, C. Rossi, D. El Baz, F. Ingrand,
F. Vernadat, F. Blanc, H. Granier, J. Tasselli, L. Bary, A. Coustou, L. Blain, M. Kaaniche,
N. Josefowicz, O. Bernal, O. Gauthier-Lafaye, Y. Pencole, S. Fergani, J.G. Tartarin,
E. Tournier, P. Temple, D. Dragomirescu, C. Rossi, J.G. Tartarin, S. Dal Zilio,
E. Chanthery, E. Hebrard, F. Camps, J. Perchoux, L. Houssin, L. Trave-Massuyes,
O. Gauthier-Lafaye, S. Calvez, P. Pons, Y. Pencole