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Thales Research & Technology France

ENS Corporate Meeting – November 2021
F. Nguyen Van Dau
Frederic.vandau@thalesgroup.com

Overview

Over **81,000** employees

68 Countries Global presence

1 bn € Self-funded R&D*

* Does not include externally financed R&D

Sales in 2020 **17 bn €**

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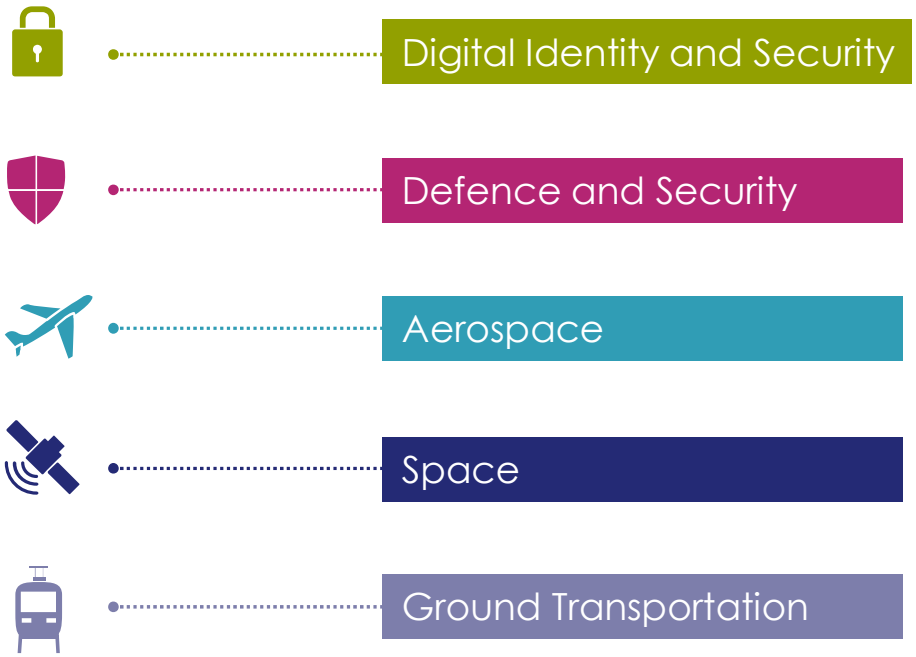
Thales's Mission

Sensing & data gathering

Data transmission & storage

Data processing & decision making



We help customers master decisive moments by providing the right information at the right moment

Thales Research & Technology

A worldwide network

5 TRT
France, UK, Netherlands, Canada, Singapore

400 R&T staff

50 PhD students

20% of Group R&T activity

10 joint labs

Excellence

- External recognition
- Senior experts

Partnerships

- Embedded at the heart of innovation ecosystems
- Joint laboratories

High visibility

- Strongly present within national & European R&D networks

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Thales Research & Technology

A key role for Thales

- Identification of technological breakthroughs which can impact future business of Thales
- Development key technologies
  (advanced materials, devices and concepts)
- Implementation of functional demonstrators
  (jointly with Thales GBUs)

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Key Figures

- TRT permanent research staff : 250
- 35+ PhDs
- 50 invention disclosures, 35 patents / year
- 50+ scientific publications / year
- Clean rooms : 4 000 m²
- > 200 characterization & process main equipments
- 1 Nobel Prize, 3 European Research Council projects (ERC)
- 80 French or European on-going collaborative research projects

TRT Fr Research Activities are certified :

- ISO 9001 V2015 (Quality),
- ISO 14001 V2015 (Environment),
- ISO 45001(Health & Security).

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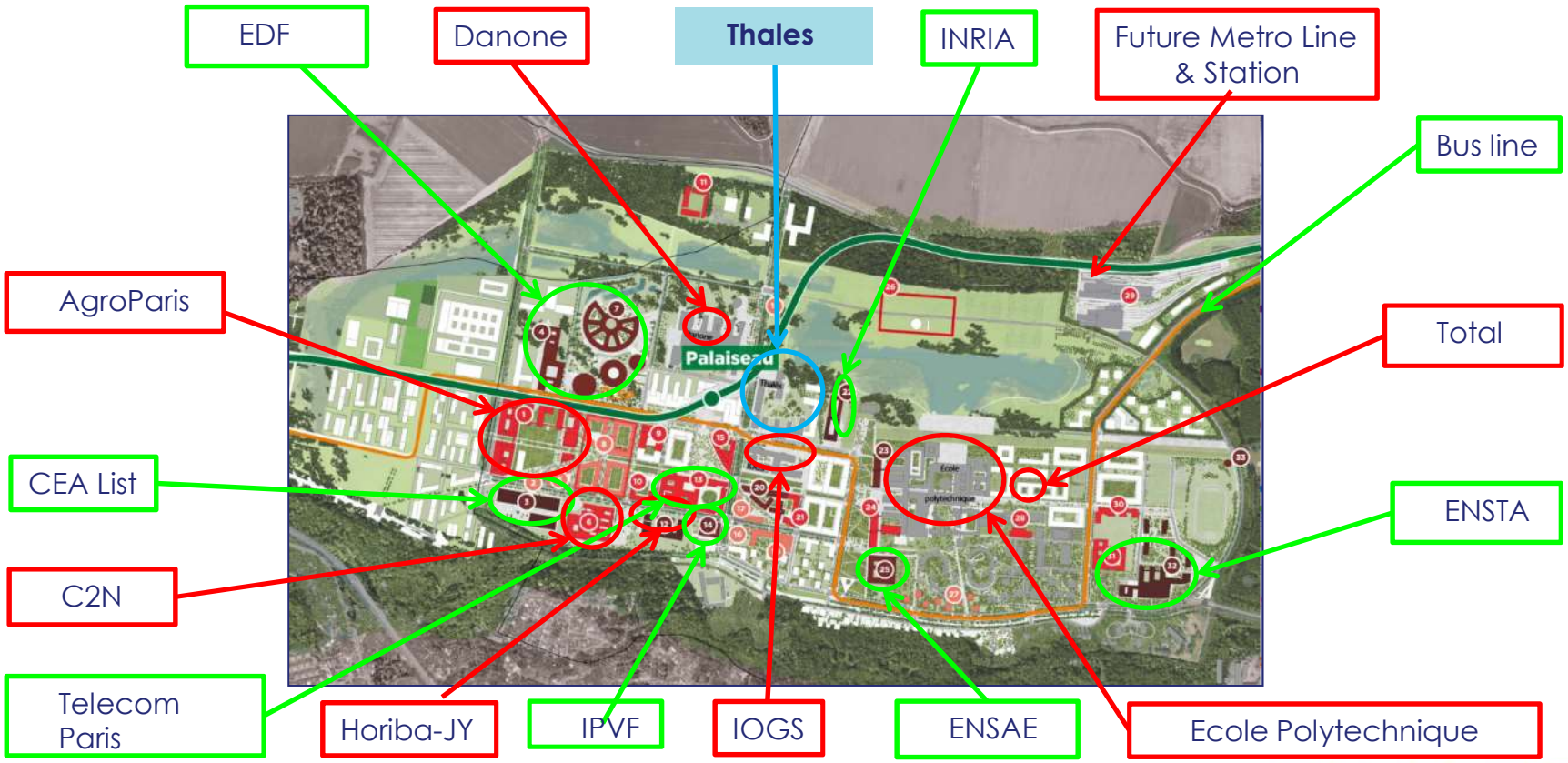
Paris-Saclay on going expansion (East side)



TRT-France at a glance

Joint Labs

- **UMR 137** CNRS
- **LCTL** LUMIN
- **Nanocarb** LPICM
- **Formal Lab** CEA LIST
- **SINCLAIR** EDF, TOTAL
- **Theresis** Thales SIX
- **Vision Lab** CEA LIST

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TRT France Labs : Information Science & Technologies

Key Areas of Excellence

- Determinism & safety for critical system
- Embedded Cyber Security
- Embedded High performance computing
- Low power @ IoT and Edge
- Neural networks and learning algorithms
- Engineering tools for safety and trustable AI
- Formal methods
- Explainable AI
- Semantic information fusion and knowledge mining
- Abductive analysis and reasoning
- Optimization
- Decision aid

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TRT France Labs : Technology & Measurement

Key Areas of Excellence

- Materials Modelling & Engineering
- Materials Chemistry
- Micro & Nano Technologies
- Energy & Thermal Management
- Smart Optics & Photonics
- Antenna & Novel RF Concepts
- Multi-Scale & Multi-Physics Modelling
- Failure Analysis
- Reliability Assessment
- Heterogeneous integration

The « LATPI » Laboratory is accreditated ISO 17025 V2017 by the French Committee for Accreditation COFRAC

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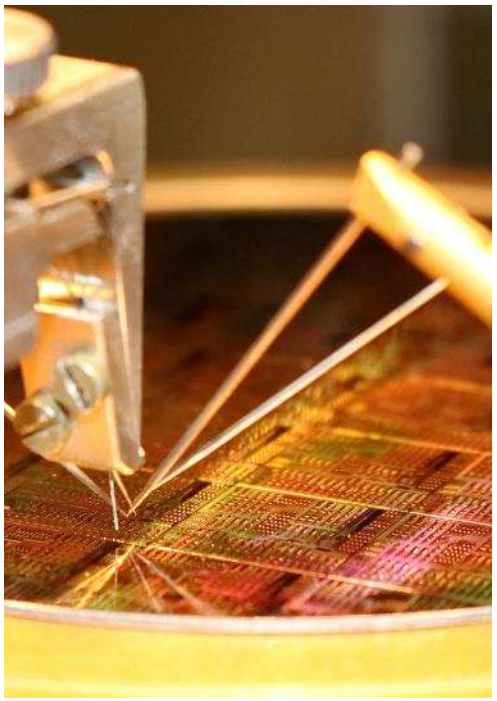
TRT France labs : III-V lab

Key Areas of Excellence

- Opto-electronics & Silicon Photonics
  - Advanced Infrared photo-detection systems
  - Microwave photonics signal processing
  - Laser pumping
  - Next generation optical-fibre communication networks
  - Data communication systems

- Micro-electronics
  - GaN power amplifiers for radars, electronic warfare and wireless communication systems
  - Ultra-fast digital and mixed signal InP circuits



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TRT France Labs : Physics

Key Areas of Excellence

- Nanomagnetism & Spintronics
- Superconductors & hybrid materials
- Functional oxides & nanoelectronics
- Neuromorphic computing
- Novel 2D material based RF & optoelectronic components
- Carbon nanotubes (X-ray and RF sources)
- Quantum sensing for navigation, timing and RF processing
- Microwave signal processing based on optoelectronic, nano-electronic and nano-photonic architectures
- Fiber-based sensing and PIC-based architectures for sensing, navigation and processing
- Laser sources, Lidars & active imaging

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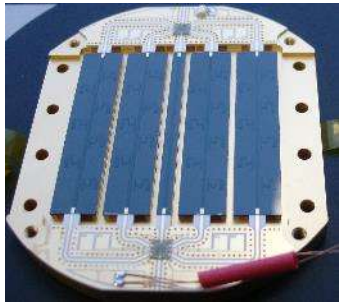
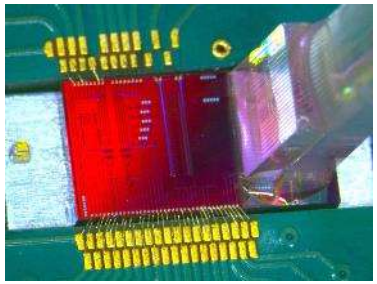
TRT France Labs : Physics

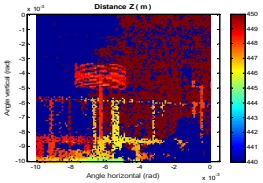
Research topic examples

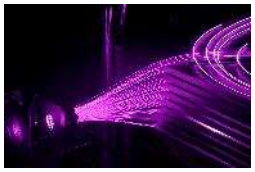


High resolution microwave signal processing using superconducting technologies

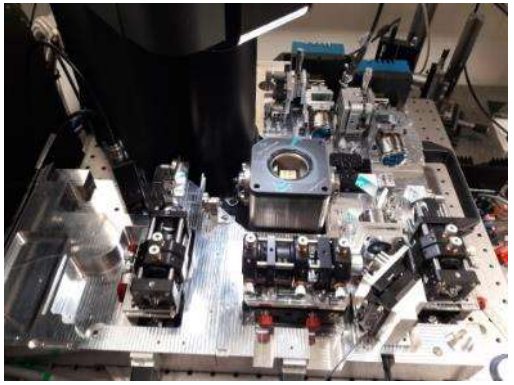
Ultra-compact X-ray sources using nanomaterials (CNTs)







Photonic Integrated Circuits is a multipurpose breakthrough : coherent lidar, RF processing, high power lasers, gyros, hydrophones,…



Quantum-based ultimate RF spectrum analysis with 100 % P.O.I

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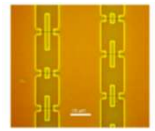
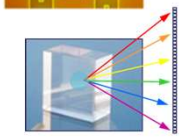
Quantum sensing research activities @ TRT

RF sensing and processing

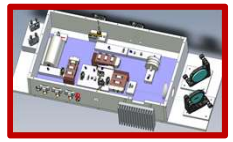
- SQIFs based **electromagnetic sensors**
  - **Targeted applications : Antennas, Airborne HF detection and direction finding, Radio-communications, MAD**
- SHB based **spectrum analysis** and quantum processing
  - **Targeted applications : Electronic warfare, ELINT, COMINT, EM spectral dominance**
- NV centers based **spectrum analysis** and **magnetometry**
  - **Targeted applications : Electronic warfare, MAD**

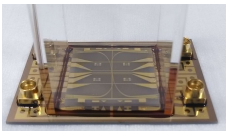




Time/frequency and navigation

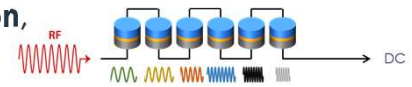
- **Atomic Clocks**
  - **Targeted applications : GNSS, navigation (incl. in GPS denied environment), communication networks synchronization, radar and E.W multistatic systems**
- Cold atoms for **clocks, accelerometers and gyros**
  - **Targeted applications : inertial measurement units, atomic clocks**





Neuromorphic computing

- based on spintronics (magnetic tunnel junctions)
  - **Targeted applications : Direction of arrival with antenna network, Object recognition, Motion recognition**



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2022 Master internships and PhD offers (1/3)

Micro and Nanophysics Lab

- Atomic interferometry on chip for inertial sensors, matthieu.dupontnivet@thalesgroup.com
- Integrated photonics for fiber sensors and for the generation of optical pulse trains, jerome.bourderionnet@thalesgroup.com , possible Cifre PhD
- Neuromorphic properties of opto-mechanical oscillators, alfredo.derossi@thalesgroup.com , possible Cifre PhD
- Development of quantum sensors based on NV centers in diamond, thierry.debuisschert@thalesgroup.com , possible Cifre PhD
- Synthesis of 2D materials by molecular beam epitaxy, pierre.legagneux@thalesgroup.com
- Computer modeling of servo loops for gyroscopes, gilles.feugnet@thalesgroup.com
- Simulation of field emission electron sources (internship @ ILM Lyon), laurent.gangloff@thalesgroup.com , possible PhD @ TRT and ILM Lyon

2022 Master internships and PhD offers (2/3)

Wave and signal processing Lab

- Frequency conversion rangefinder, romain.demur@thalesgroup.com
- Active polarimetric imaging for decamouflage applications, aude.martin@thalesgroup.com
- Programmable radar metasurface: bench development and characterization, christian.larat@thalesgroup.com
- Control and frequency servoing of laser sources for classical and quantum signal processing, perrine.berger@thalesgroup.com
- Distributed stress measurement in a fiber coil by a frequency scanned laser, ines.ghorbel@thalesgroup.com
- Interfacing a miniature CPT clock bench with a dual frequency laser source: servo-controls and characterizations, ghaya.baili@thalesgroup.com
- Realization and characterization of crystalline waveguides for the development of integrated quantum memories compatible at telecom wavelengths, sacha.welinski@thalesgroup.com

2022 Master internships and PhD offers (3/3)

Unité Mixte de Physique CNRS Thales

- Investigation of spin to charge current interconversion at the interface in between TmIG/Bi_2Se_3, jeanmarie.george@cnrs-thales.fr
- Spin dynamics in d-wave superconductors, javier.villegas@cnrs-thales.fr
- Quantum oxide two-dimensional electron gases with imprinted ferromagnetism, manuel.bibes@cnrs-thales.fr
- Nanoscale control of oxygen vacancy distribution in transition metal oxides: a tool to tune their functional properties, lucia.iglesias@cnrs-thales.fr
- Symmetric and antisymmetric magnetic exchange interaction in skyrmion materials, nicolas.reyren@cnrs-thales.fr
- Magnonics and NV-center: towards Bose-Einstein condensates, romain.lebrun@thalesgroup.com