III-V lab

Advanced laser sources and detectors for SWIR LIDAR systems

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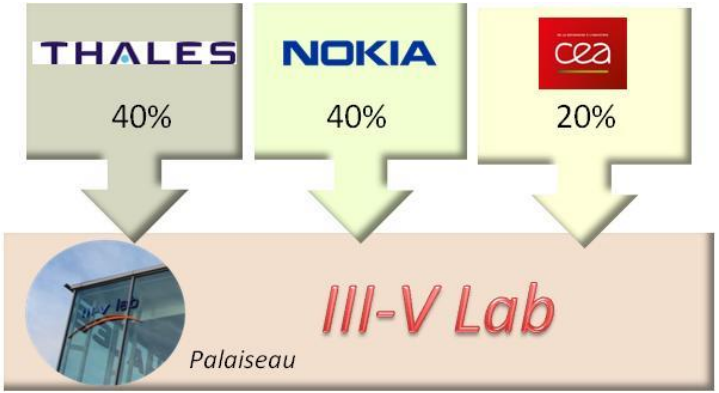
30/10/2019

NOKIA leti CEA tech THALES

Who we are …

- **A private research lab set-up between Thales, Nokia and CEA/Leti**
  - 120 research staff including 20 PhD students
  - Specific legal entity (Group of Economic Interest)
  - 1 site in Paris region: Palaiseau
- **Focus on III-V semiconductors technologies development (GaAs, InP, GaN …) and their integration with Si circuits and micro-systems.**



III	IV	V
B	C	N
Al	Si	P
Ga	Ge	As
In	Sn	Sb
Tl	Pb	Bi

Who we are …

THALES **Defence, Security, space, aerospace and transportation**

NOKIA **Optical and wireless networks and communication technologies**

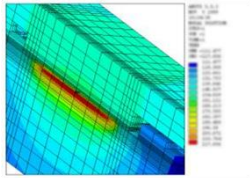
cea **Exploitation for high volume applications**

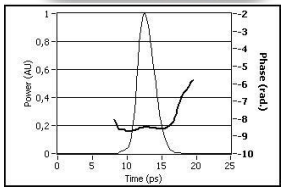
40% 40% 20%

III-V Lab

Palaiseau

Design → Fabrication → Test

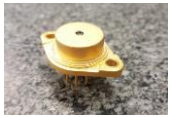




Coherent Receiver

Hybrid RF GaN Circuit

1-Tb/s optical transmitter with 64 QAM modulation



laser diode for atomic clock

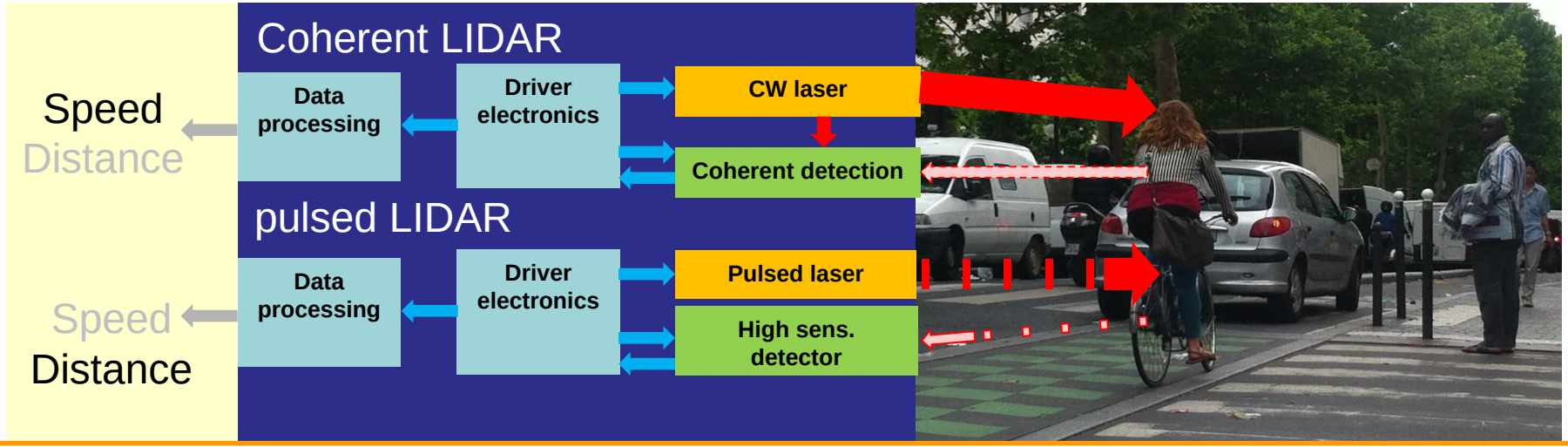
LIDAR activities at III-V Lab

- **Taking benefit of developments for telecom applications:**
  - 1.5µm Single mode lasers, high speed modulators and detectors
- **Using synergies with defence and space applications:**
  - Laser range finder, satellite free-space optical transmissions

→ **Advanced eye-safe emitters and detectors**

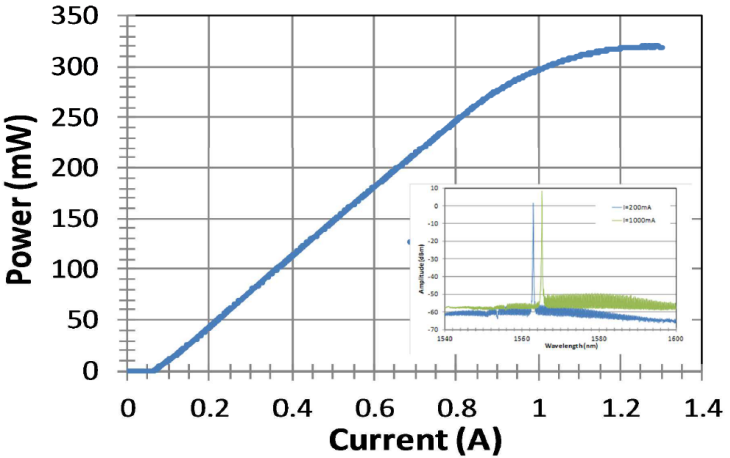
→ **Expertise on advanced sensing systems**

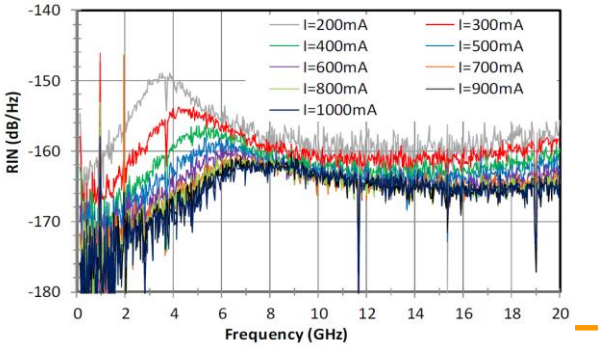
- **Two type of LIDAR systems:**



High power DFB lasers

- **Multiquantum well DFB laser:**
  - Pout > 300 mW (chip)
  - Linewidth <200 kHz (lorentzian fit)
  - Tunability: 1.5 pm/mA
  - RIN<-160dB/Hz from 0.1 to 20 GHz

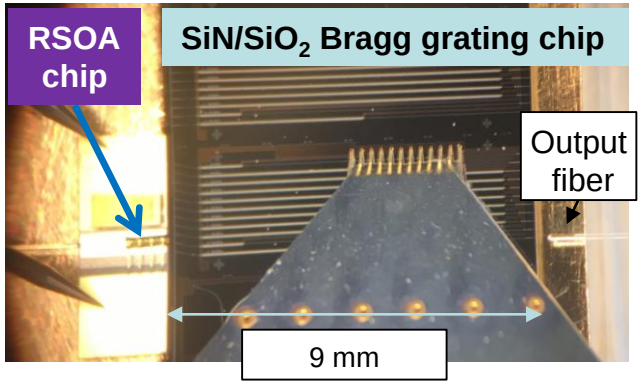


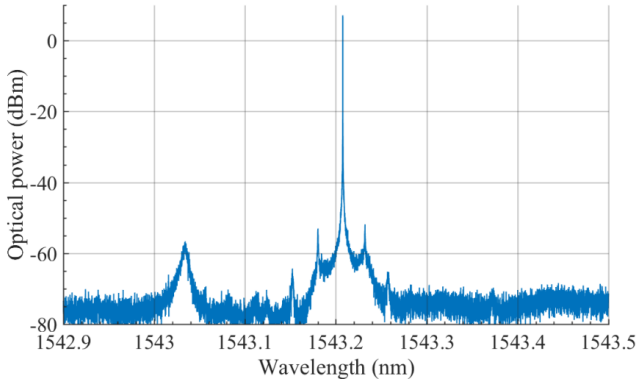


M. Faugeron et al, “High-performance DFB laser module for space applications: the FP7 HiPPO achievements from chip fabrication to system validation,” ICSO Conference 2018.

Narrow linewidth DBR lasers

- **Hybrid SiN/III-V laser cavity:**
  - Bragg grating reflector on low loss SiN platform (<2 dB/m)
  - InP reflective optical amplifier
- **Performances:**
  - Linewidth < 10 kHz
  - Fast continious tuning range > 5 GHz
  - Tuning speed >70 MHz/µs
  - Output power > 10 mW

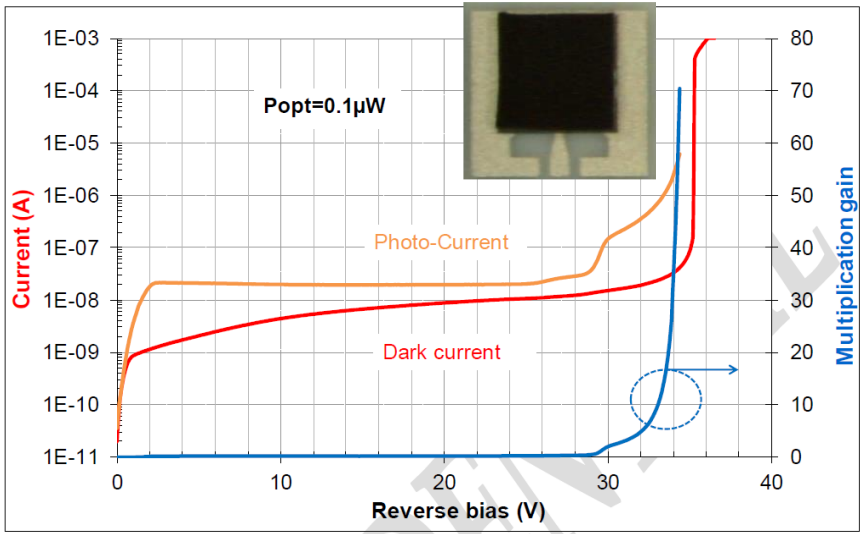




P. Primiani et al., "Silicon Nitride Bragg Grating With Joule Thermal Tuning for External Cavity Lasers," in IEEE Photonics Technology Letters, 2019.

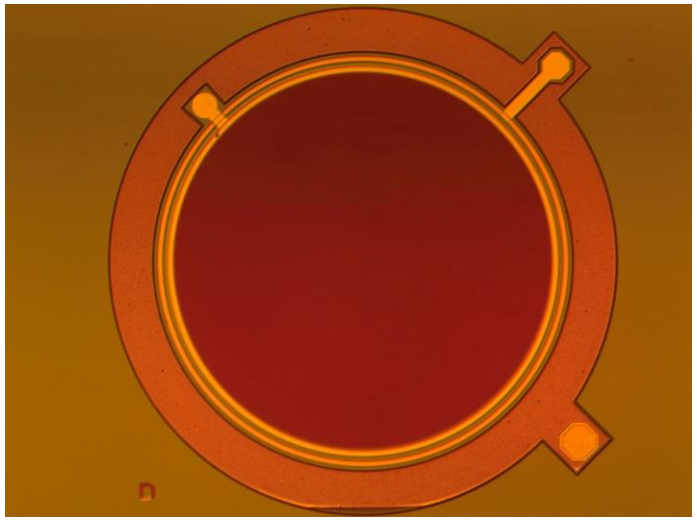
High sensitivity APD detectors

- **200µm diameter Avalanche Photodiodes (APD**
  - Low avalanche voltage (<35V)
  - Dark current <40 nA
  - Multiplication gain > 10
  - Bandwidth > 100 MHz



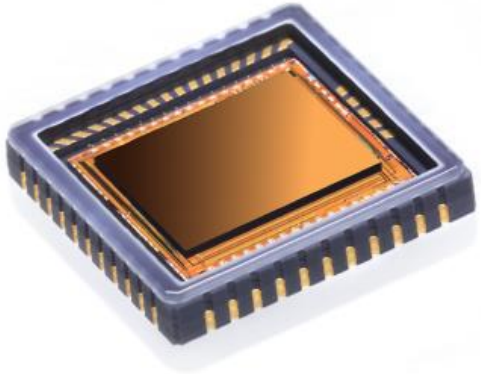
Large area photodétectors

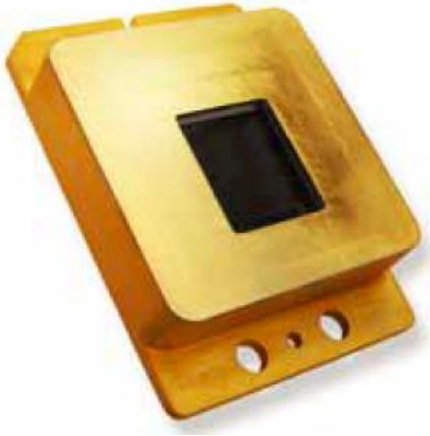
- **Photodiodes from 2 to 3 mm of diameter**
  - Capacitance below 400pF
  - Dark current below 13µA at 98°C and 5 V of reverse bias
  - High bandwidth capability



SWIR InGaAs imagers (Lynred)

- **Snake SW detector**
  - VGA (650 x 512)
  - Quantum efficiency > 70 % from 1 to 1.6 µm
  - 15 µm x 15 µm pixels
  - 30 fA darck current à -0.2 V
  - Scientific applications





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Vision, **I**dentification, with **Z**-sensing **T**echnologies and key **A**pplications

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OBJECTIVE

Develop innovative technologies for **optical sensors** and **laser sources,** for short to long-range **3D-imaging,** and **demonstrate their value** in several key applications

MAIN TARGETS

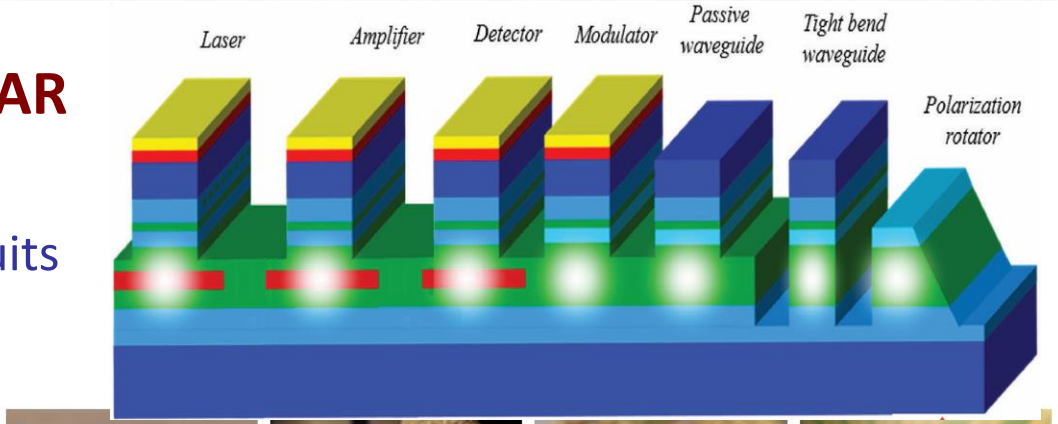
- Develop innovative technologies for 3D-imaging depth map high resolution sensors and associated IR light sources
- Exercise new 3D sensors and light sources in key applications with various ranges: Secured access, driver monitoring, object recognition, few cm to several meters, up to LiDARs systems with hundreds meters range
- Build partnership ecosystems foreseeing future competitive European products for Automotive, Security, Smart Cities and Industry4.0 and anticipate normative requirements

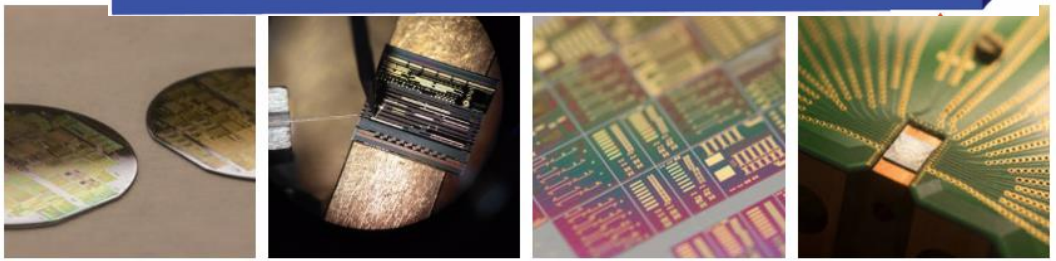
DURATION 3,5 years - May 2019 until Oct 2022 **FUNDING** 21 M€

COORDINATION STMicroelectronics Crolles (France)

VIZTA has been accepted for funding within the Electronic Components and Systems For European Leadership Joint Undertaking in collaboration with the European Union's H2020 Framework Program and National Authorities, under grant agreement n°826600

- **More integration of LIDAR optical elements?**
  - Photonic Integrated Circuits
  - Supported by european platforms





www.inpulse.jeppix.eu

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We can provide:

- R&D capabilities on design, process and test of III-V devices
- High performance lasers emitters and detectors

We are looking for:

- Collaboration in the frame of research projects
- Partners for back-end, packaging
- Partners for further system tests

This presentation was presented at EPIC Meeting on LIDAR Technologies for Automotive 2019

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