

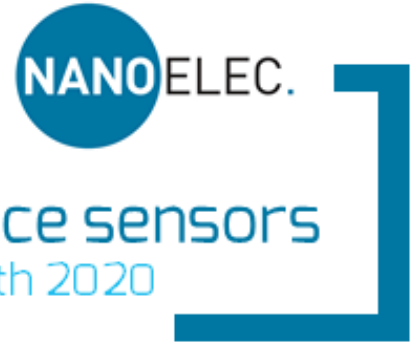


Last update in  
**Photonics technology**  
towards edge performance sensors

**NANO**ELEC.

Join us at IRT Nanoelec webinar  
On Monday, July 6th 2020, 5pm CET

Last update in  
Photonics technology  
towards edge performance sensors  
Live webinar July 6th 2020



# SILICON PHOTONICS APPLIED TO 3D SENSING WITH LiDARs

François SIMOENS

06/07/2020

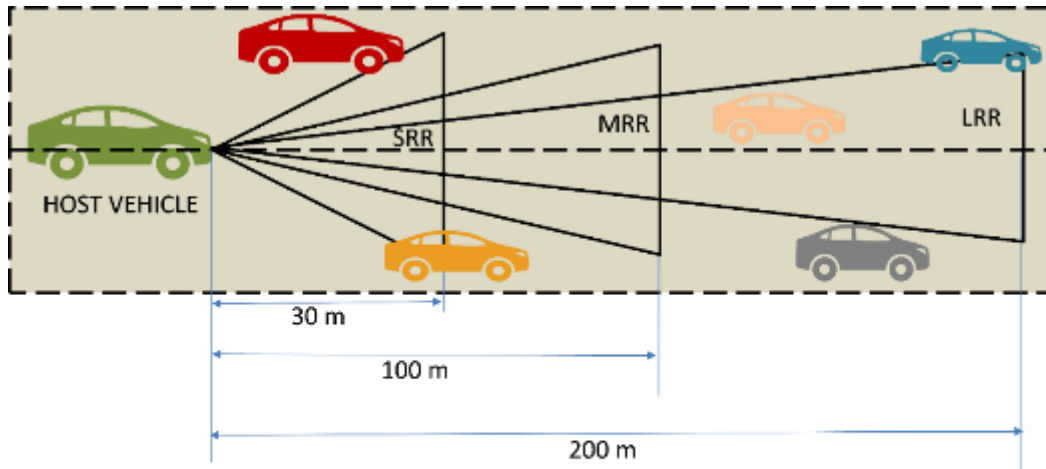


# LIDARS –LIGHT DETECTION AND RANGING- PRINCIPLE

SIMILAR TO RADARS.  
NO UNIQUE LIDAR WILL SATISFY ALL  
THE APPLICATIONS

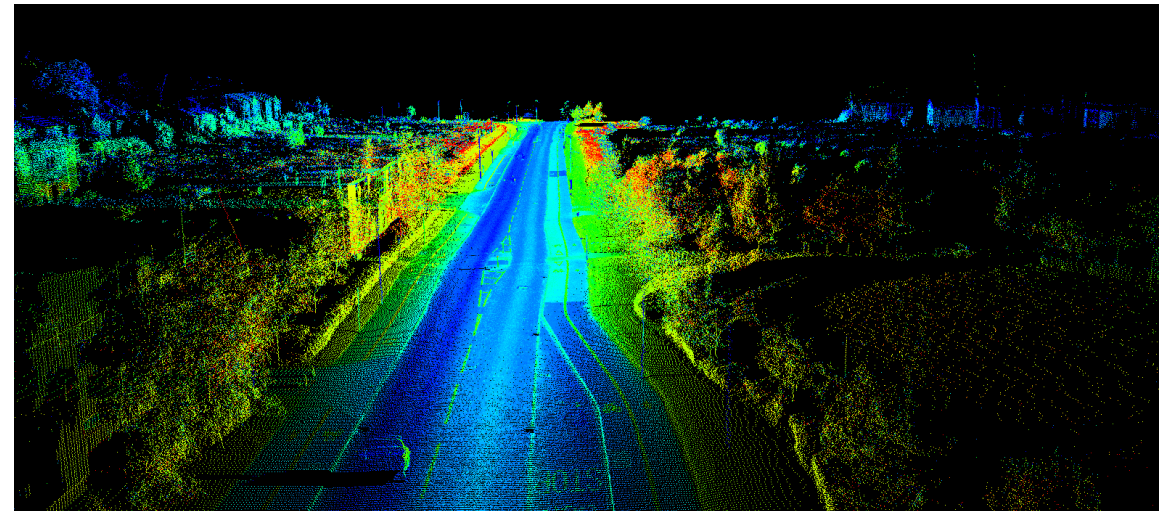
**BUT UNLIKE RADARS**  
LIDARS PROVIDE 3D IMAGES WITH  
HIGH RESOLUTION & PRECISION &  
CAN DETECT VERY SMALL OBJECTS

*Various types of automotive RADAR sensors*



Type	SRR	MRR	LRR
Frequency Band	76 -77 GHz	77- 79 GHz	77 – 81 GHz

(RF wavelengths = mm range / Optics: 0,25-10 $\mu$ m)



# LIDARS ARE 3D PERCEPTION TOOLS ESSENTIAL FOR A WIDE RANGE OF APPLICATIONS



## CONSUMER



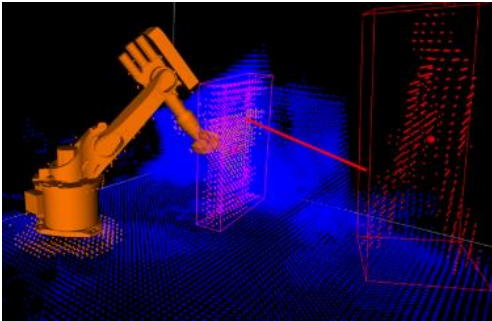
AR

## TRANSPORT



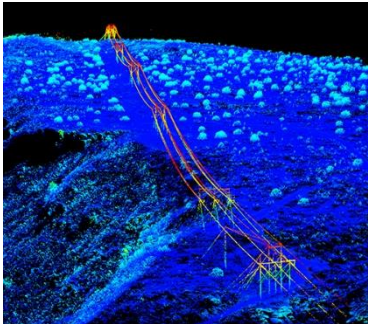
Autonomous driving

## INDUSTRY



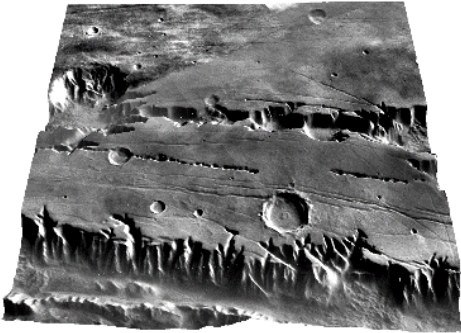
Robotics

## ENGINEERING



Survey

## SPATIAL



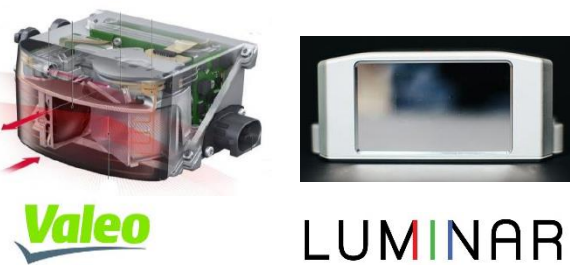
3D topography



# SILICON PHOTONICS ENABLING FUTURE LIDAR

TOWARDS LOW COST AND COMPACT SIZE

## MECHANICAL



## SOLID-STATE

### MEMS MICRO-MIRRORS

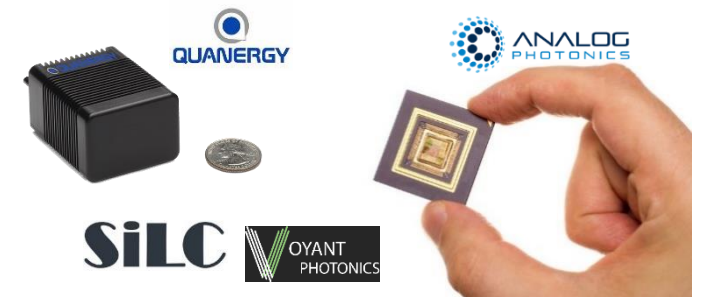


### FLASH LIDARS

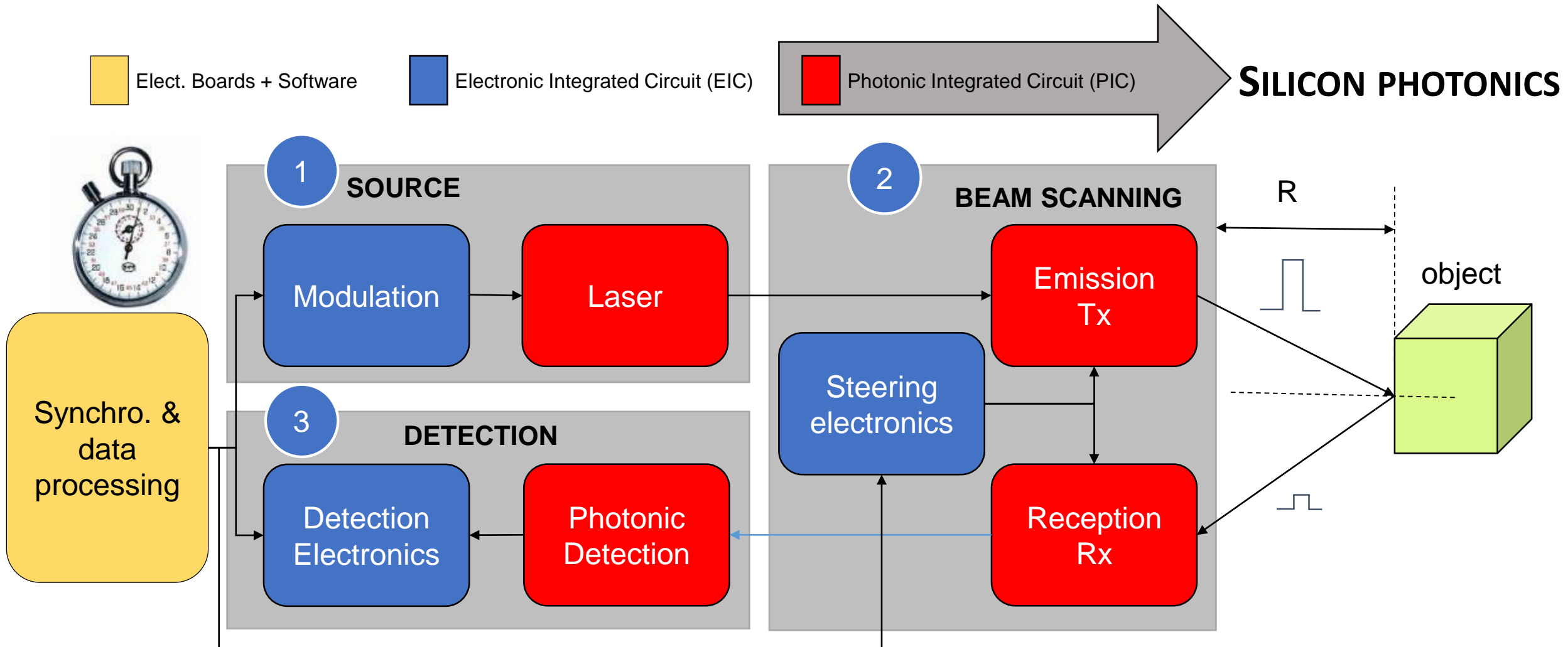


## INTEGRATED OPTICS

### SILICON PHOTONICS



# SILICON PHOTONICS CAN PROVIDE THE OPTICAL FUNCTIONS OF LIDARS

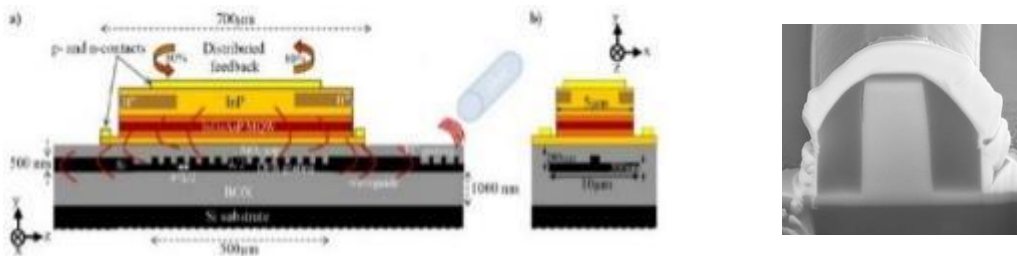


# SILICON PHOTONICS PLATFORM FOR FUTURE LIDAR

1

## LASER SOURCE

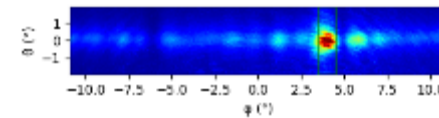
### CMOS-COMPATIBLE HYBRID III-V ON SI LASER



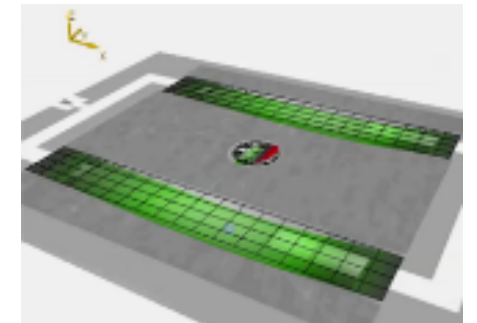
2

## BEAM SCANNING

### OPTICAL PHASED ARRAY



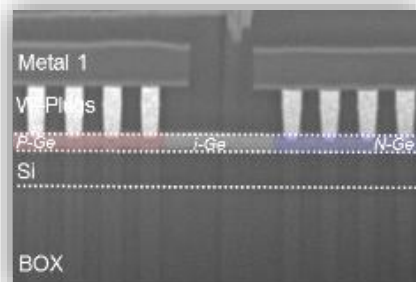
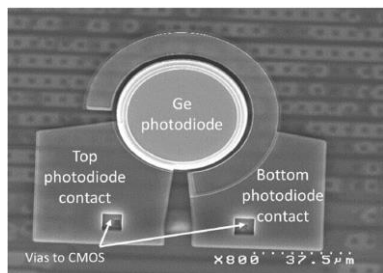
### MEMS $\mu$ MIRROR



3

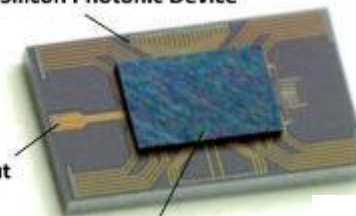
## DETECTOR

### SiGe PHOTODETECTORS



Silicon Photonic Device

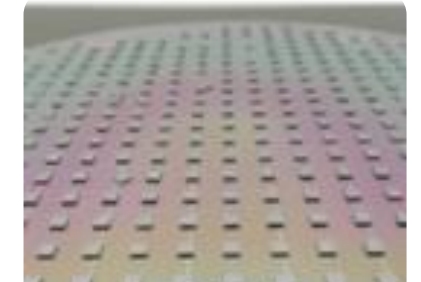
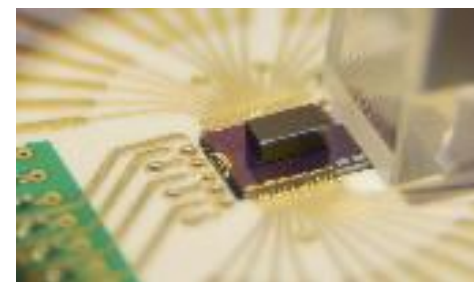
RF Input



Electronic IC

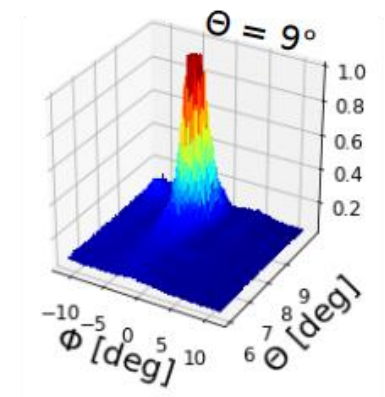
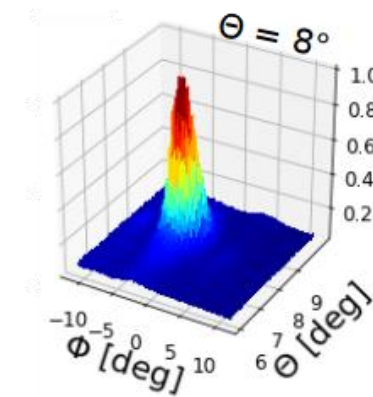
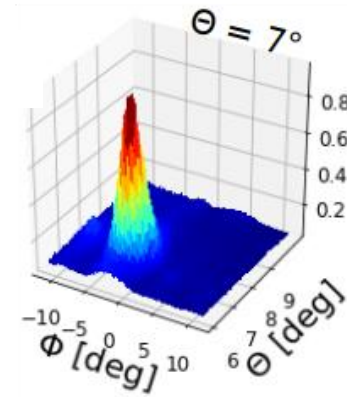
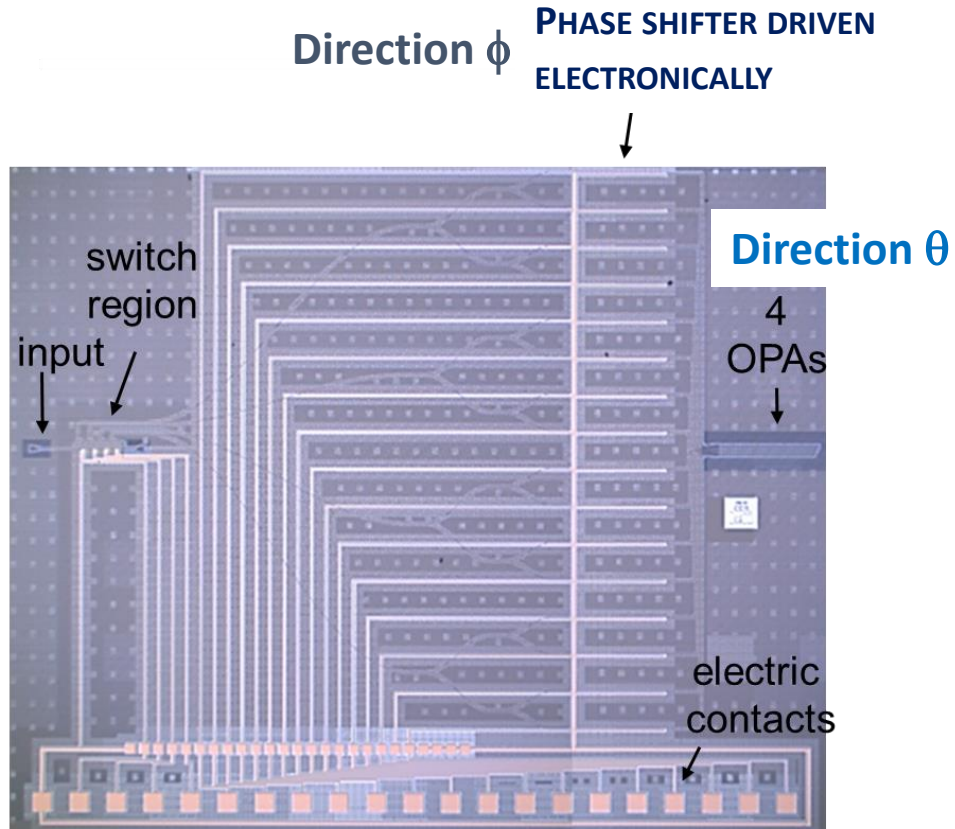
### PHOTONICS / ELECTRONICS CHIP-SCALE ASSEMBLY

### HETEROGENEOUS INTEGRATION & 3D STACKING



# SILICON PHOTONICS PLATFORM FOR FUTURE LIDAR

## EXAMPLE OF BEAM STEERING WITH OPTICAL PHASED ARRAY



N. A. Tyler *et al.* *Optics Express*, Feb. 2019.

Tyler, N. A., *et al.* CPMT Symposium **BEST PAPER AWARD**

- 905nm OPA based on SiN waveguides/devices

### $\theta, \phi$ BEAM STEERING WITH NO MECHANICAL MOVEMENT



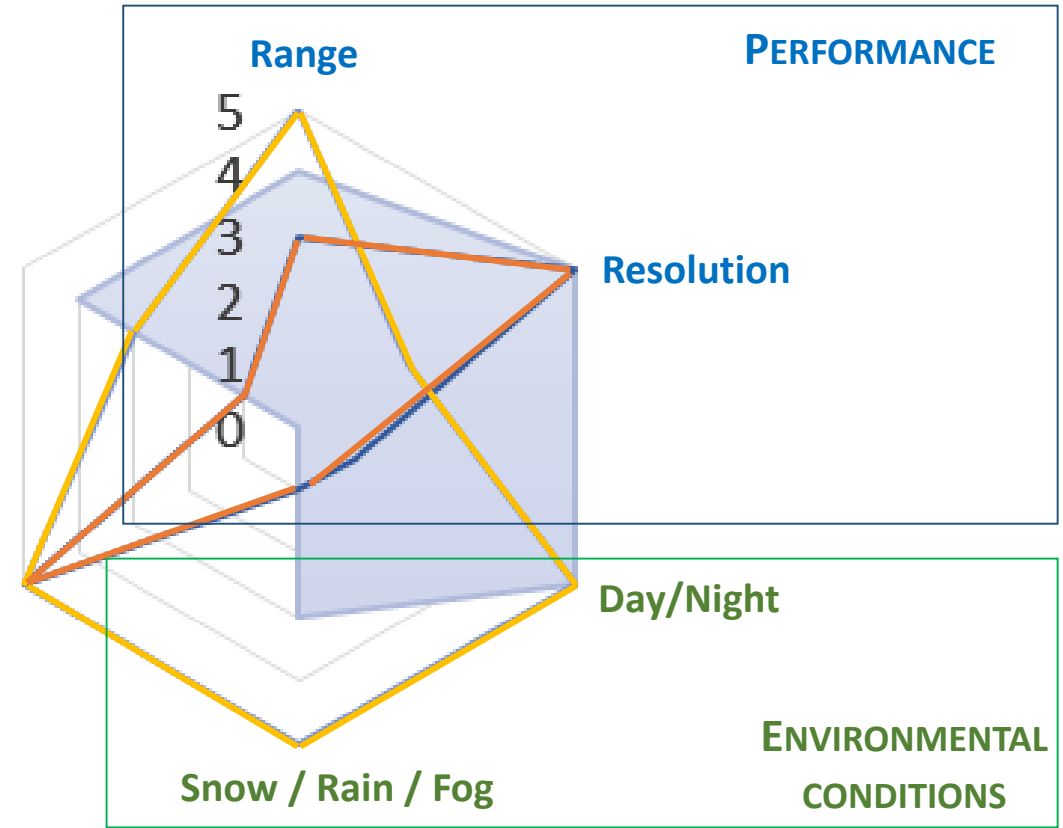
# KEY TAKEAWAYS: SILICON PHOTONICS, ENABLING TECHNOLOGY FOR FUTURE LIDAR

## BENEFITS OF SILICON PHOTONICS

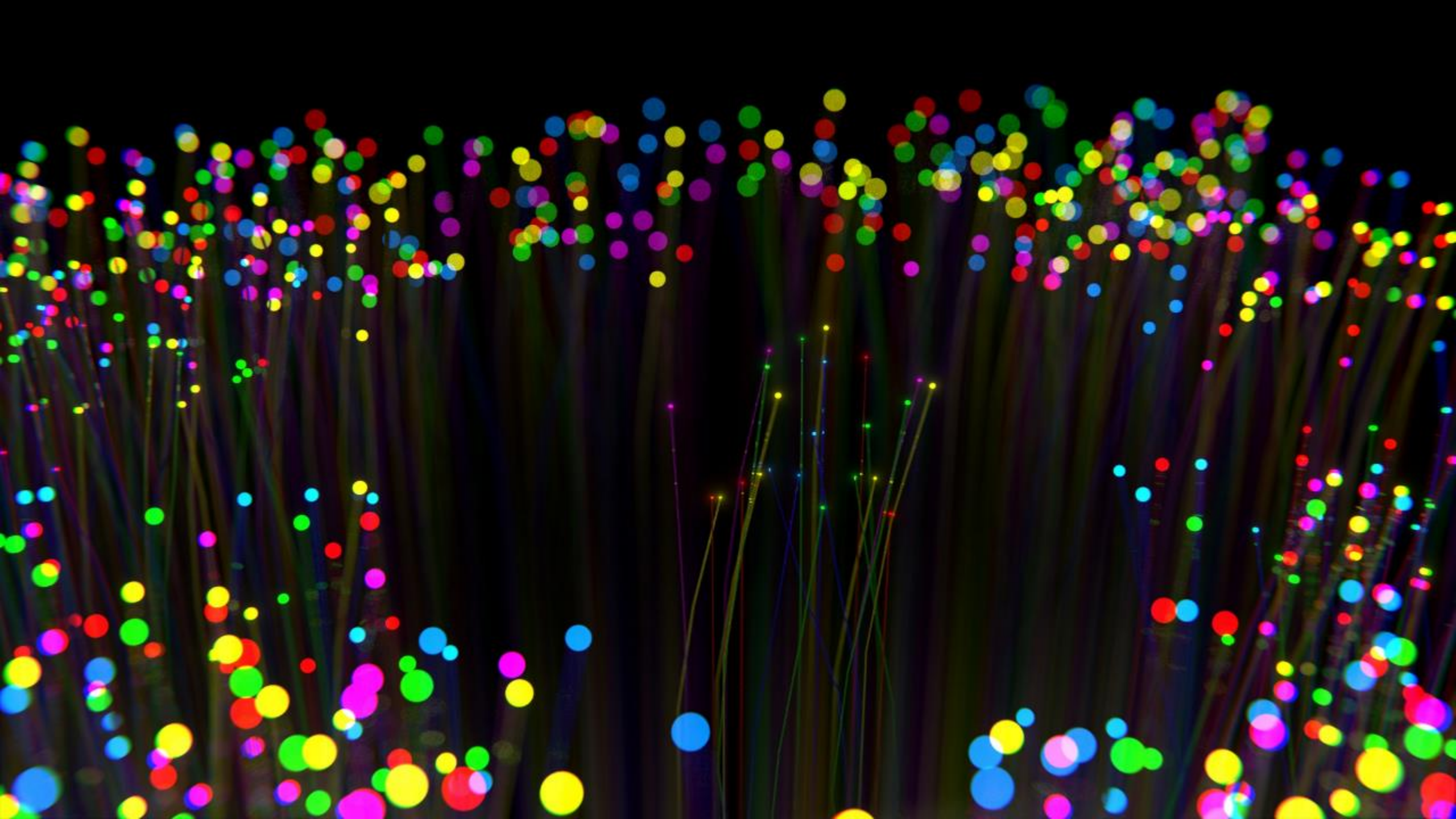
- **LOW COST, HIGH VOLUME CMOS COMPATIBLE FACILITIES**
- **EMBEDDED COMPUTING TO LOWER THE DATA FLOW**
- **REDUCED TEST COSTS BY DRIVING CONTROL & CONTAINMENT THROUGH AUTOMATION**
  
- **HIGH INTEGRATION LEVEL OF PHOTONICS & ELECTRONICS**



- Price**  
Scalability / Availability
- Product or Power
- Computing**
- Manufacturability**
- Maintenance**
  
- Form factor**  
• Size  
• Mass



Lidar
  Radar
  Camera



Thank you for attention



fit | FRENCH INSTITUTES OF TECHNOLOGY

fit | MEMBER



Last update in  
**Photonics technology**  
towards edge performance sensors  
Live webinar July 6th 2020

