

Silicon photonics

Emerging applications

From sensing to AI

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Business developer – Silicon Photonics

Process Flow

300 mm

1

NW GAA / BEYOND CMOS

200 mm

300 mm

2

EMBEDDED MEMORIES

200 mm

300 mm

3

RF (active and passive devices)

200 mm

300 mm

4

Si PHOTONICS

200 mm

300 mm

5

μ LED DISPLAY

300 mm

6

IMAGERS

200 mm

7

MEMS

200 mm

300 mm

8

POWER (Si, GaN, SiC)

200 mm

300 mm

9

3D

200 mm

300 mm

10

SUBSTRATES

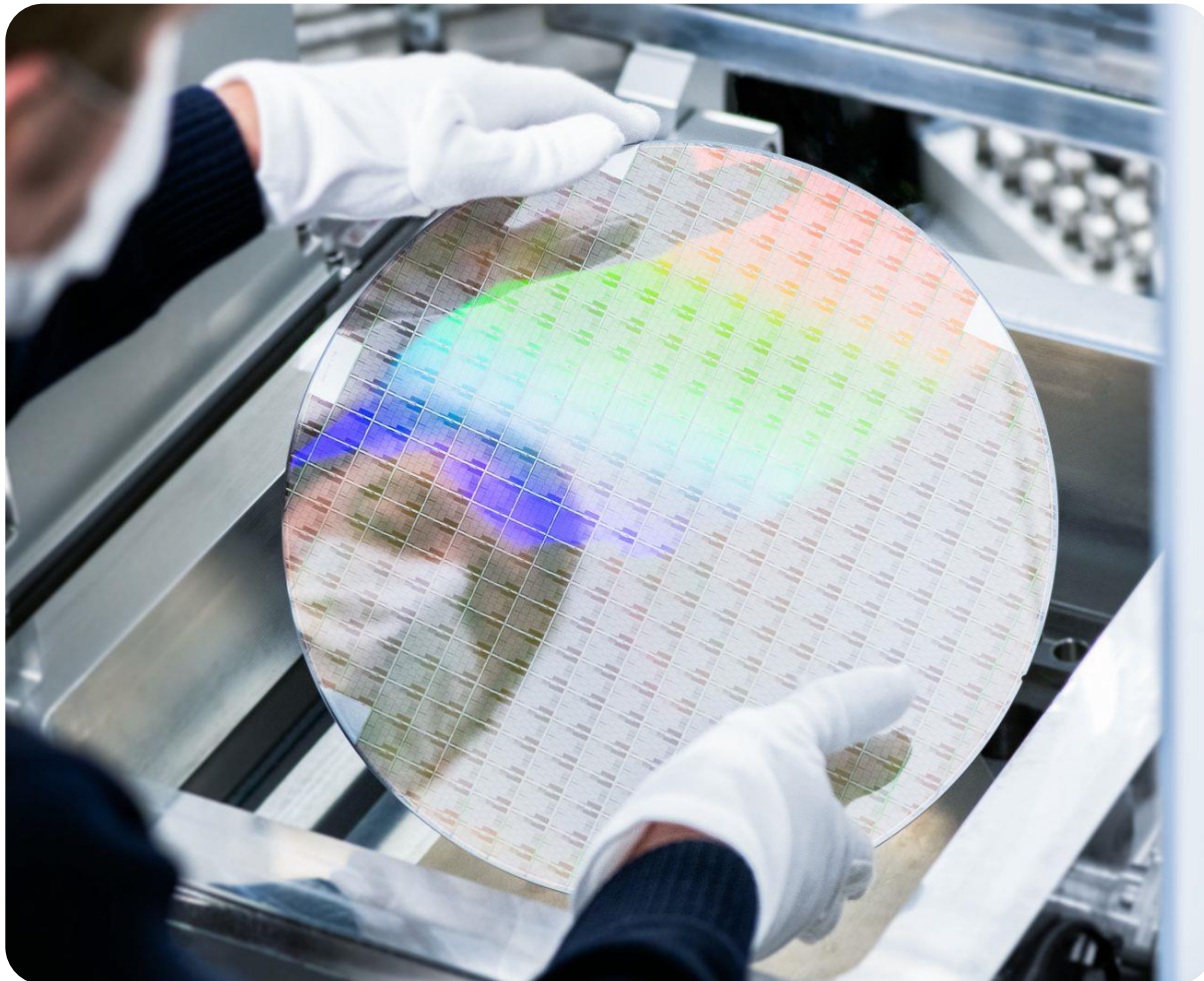
200 mm

11

II-VI and III-V

World-class facilities

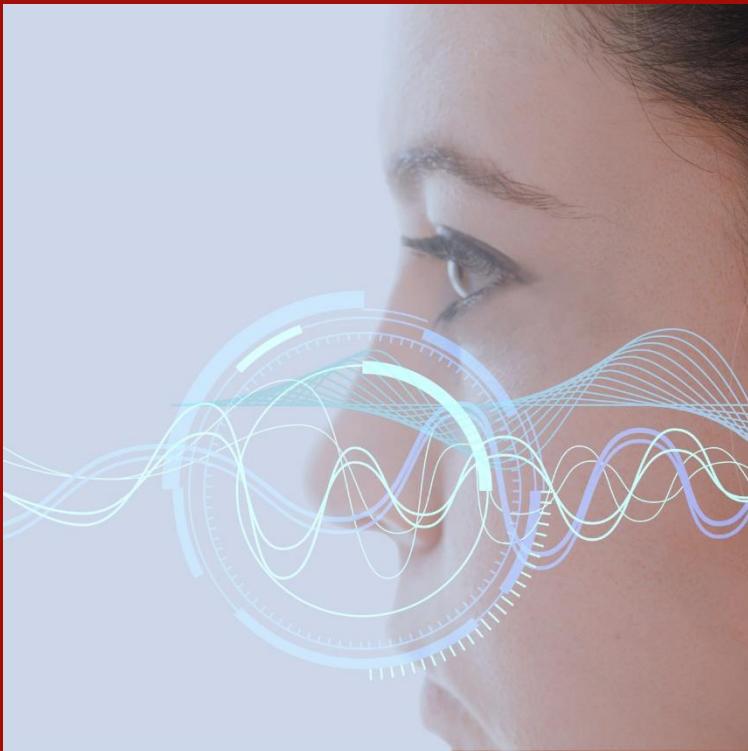
for your future business needs



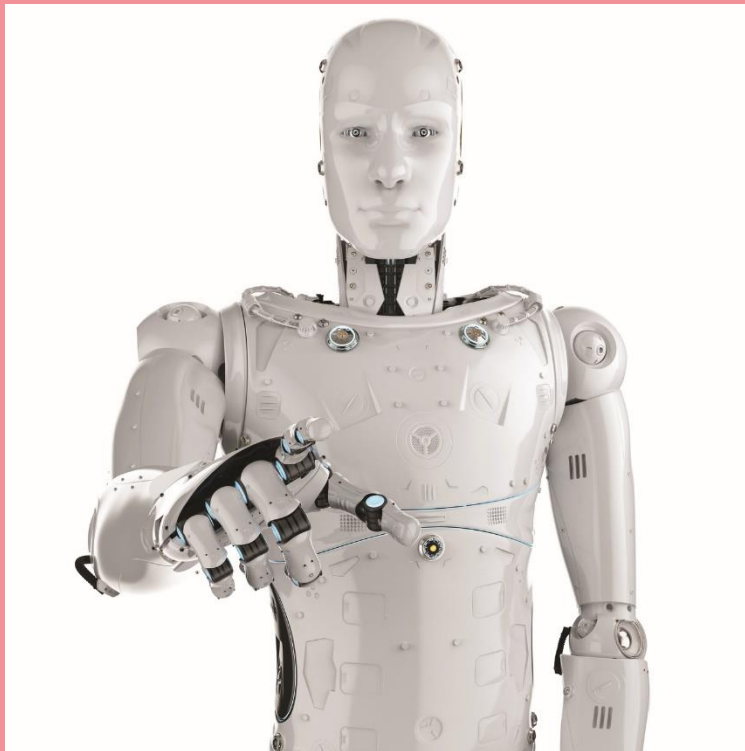
CMOS-compatible photonics

- › A must-have for scalability
- › Enabling increased circuit complexity
- › Giving a path to cost reduction

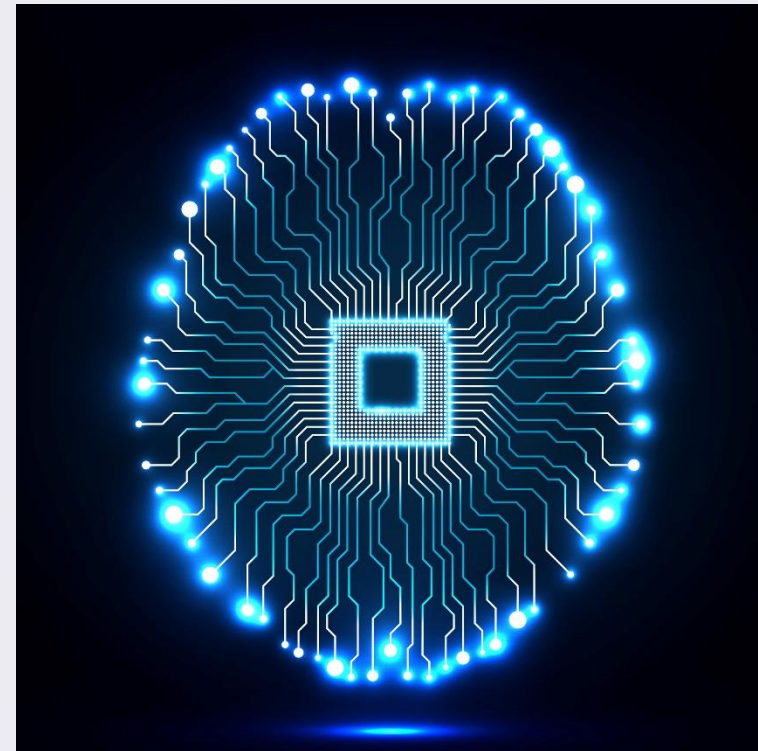
SENSING



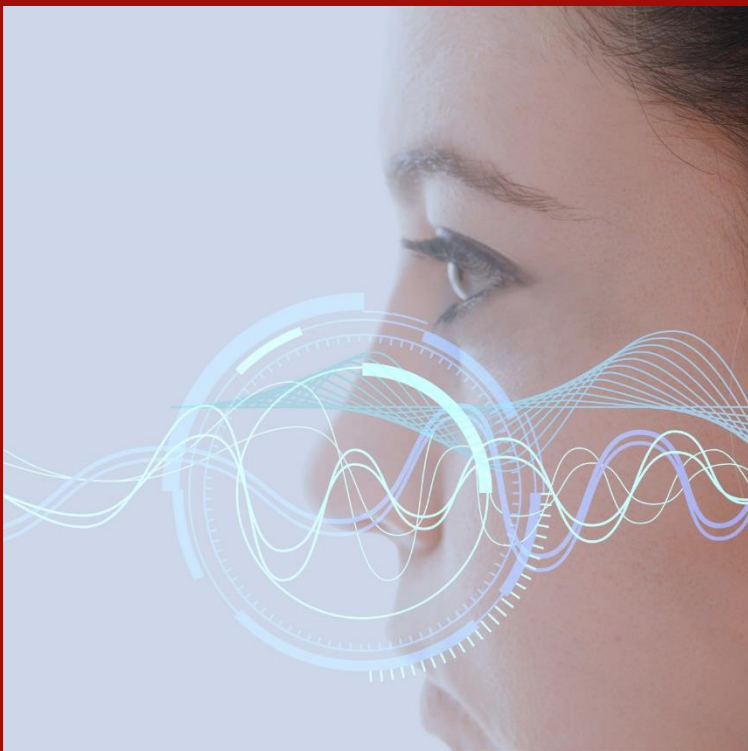
LIDAR



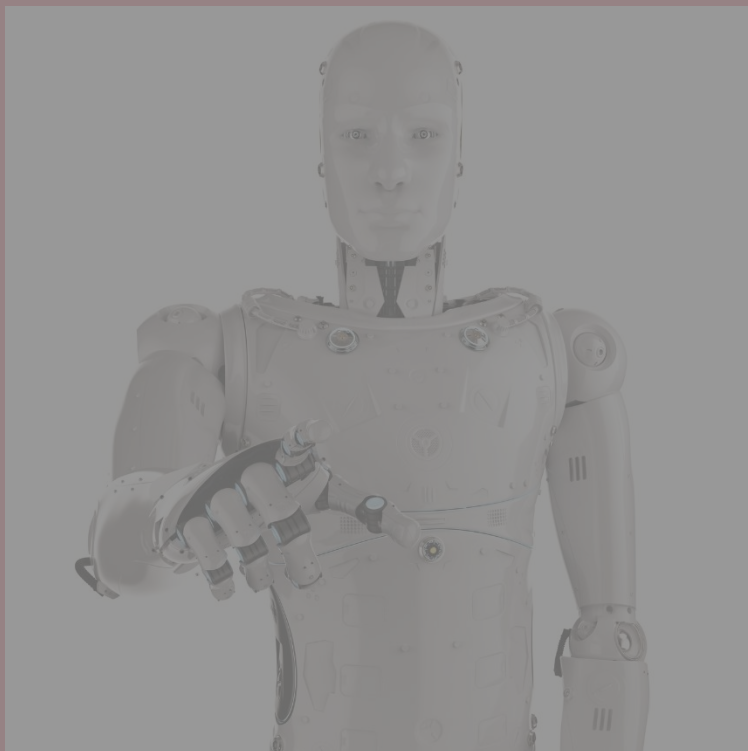
Novel computing



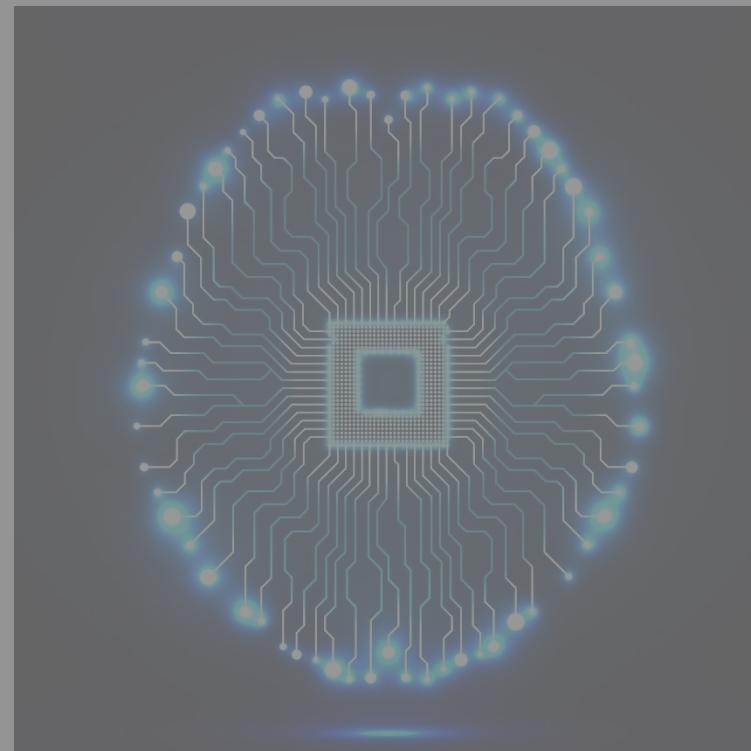
SENSING

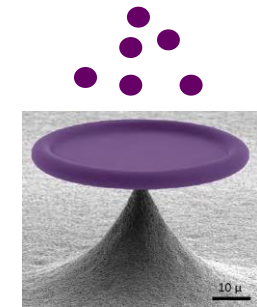
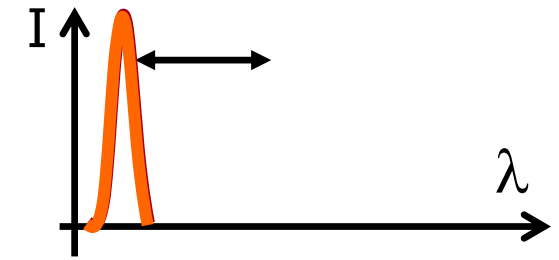
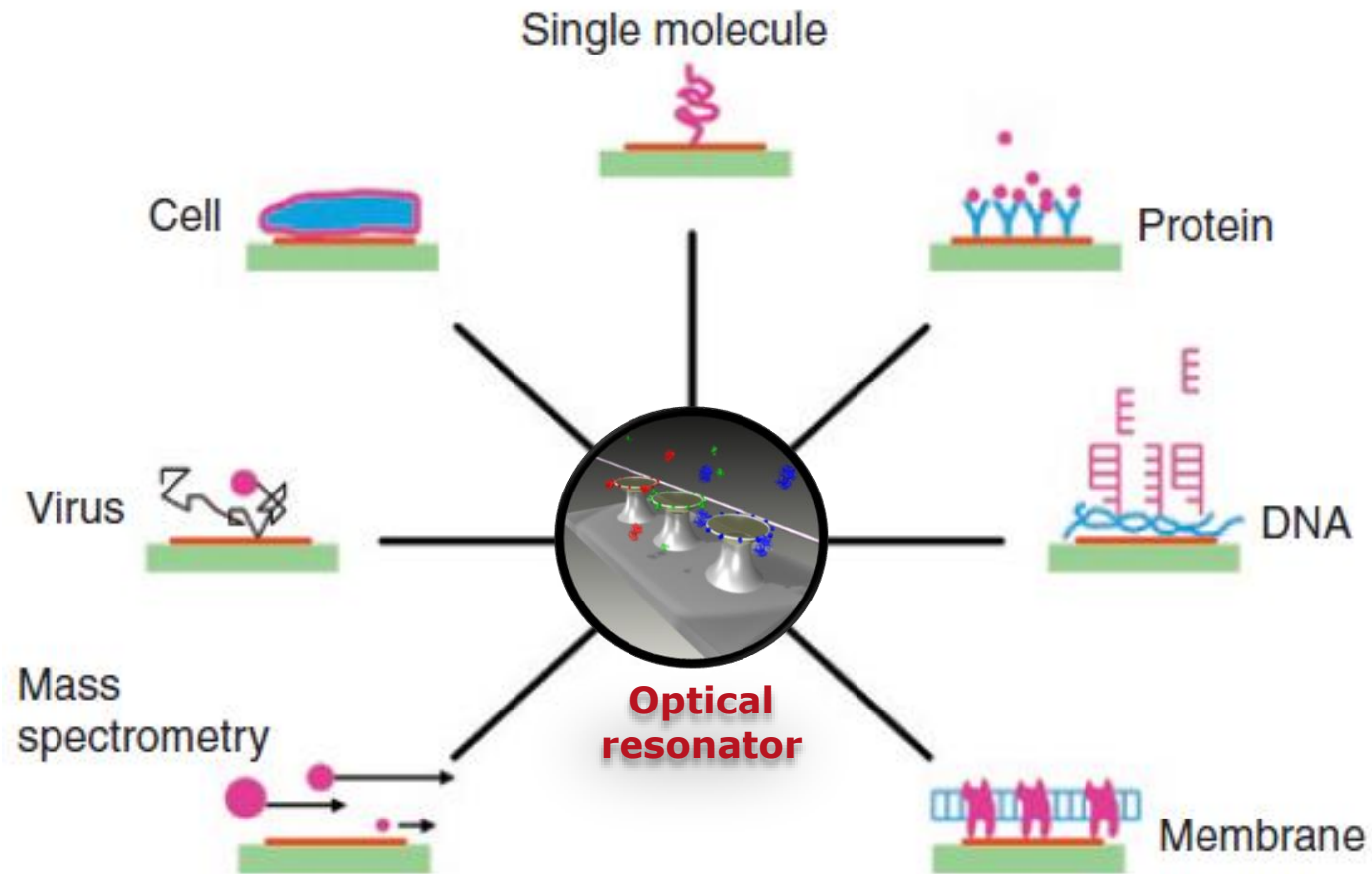


LIDAR



Novel computing





Modified from Frank Vollmer & Stephen Arnold, *Nature methods* 5 (2008), 591-596

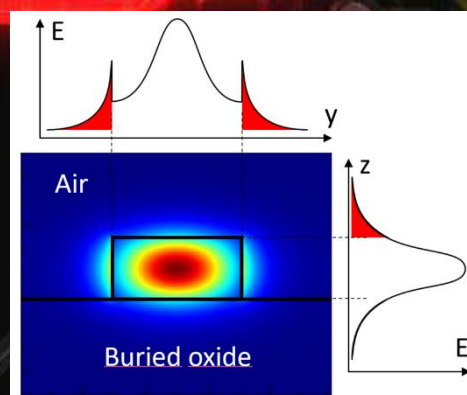
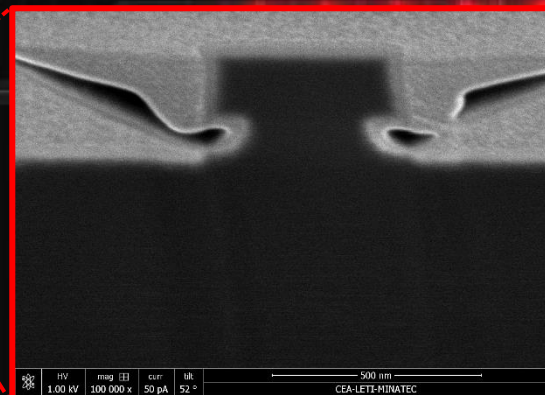
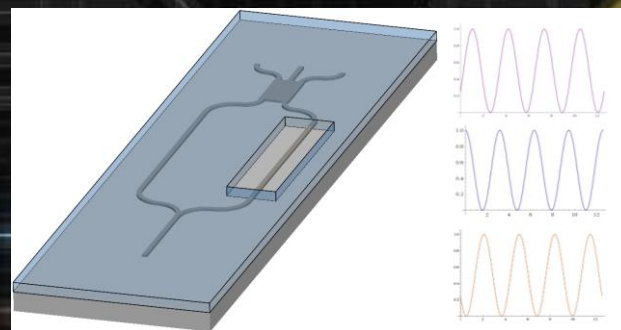
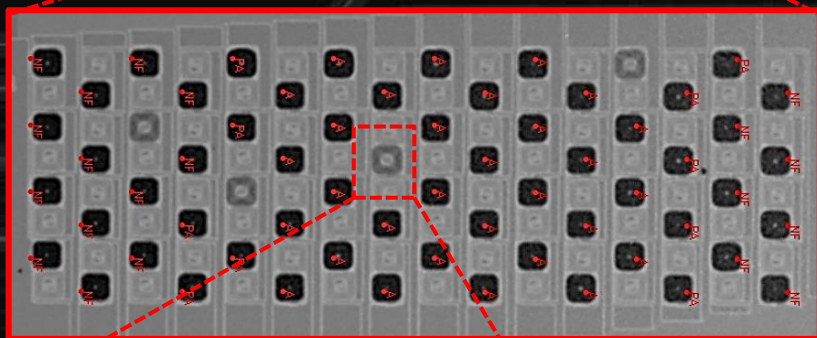
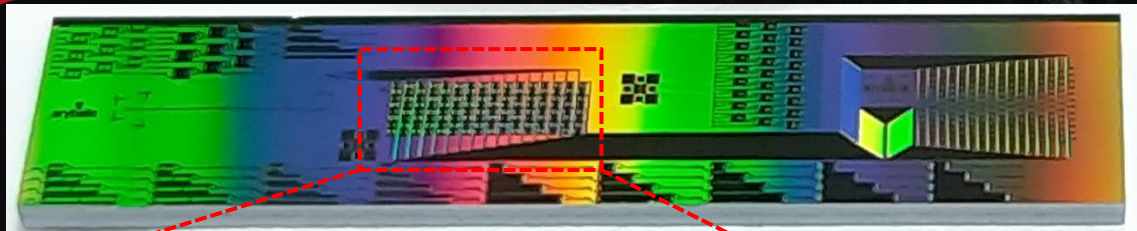
Today's techniques for the identification and quantification of markers (pathogens, odors, chemicals...) requires heavy lab procedures.

Tomorrow we need to:

- > Standardize analyses and classification
- > Make the detection faster, cheaper, closer to the user
- > Make a sensor usable by anyone, anytime, anywhere

CEA-Leti's value proposition

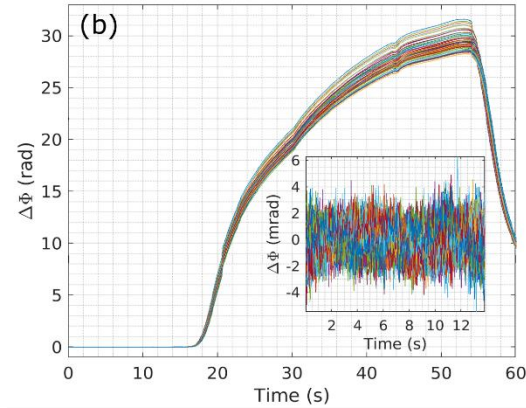
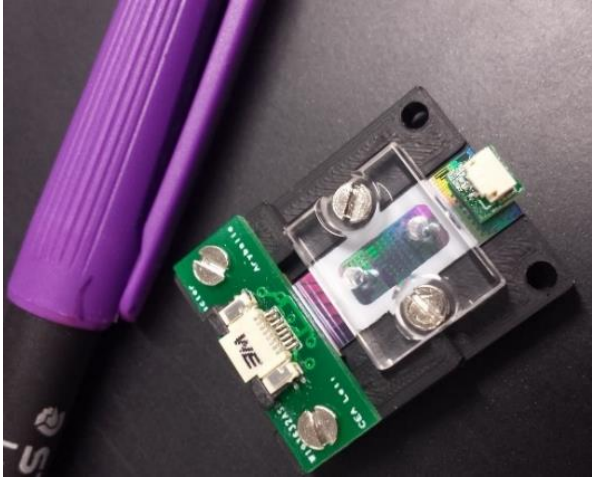
- > Design and implement a compact sensor
- > Combine photonics readout, μ fluidics and surface functionalization
 - > Selectivity and higher performance
 - > Portability
- > Use existing technology blocks



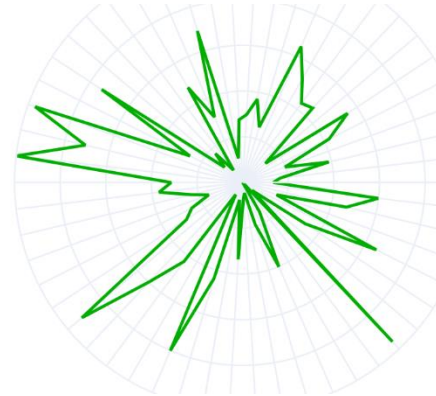
SiN Based MZI Sensor

Each measured MZI is spotted with biomolecules specific to the different markers.

The presence of the marker modulate the output of the PIC.



Recovered signal
from 64 MZI



VOC signature
(Courtesy from Aryballe)

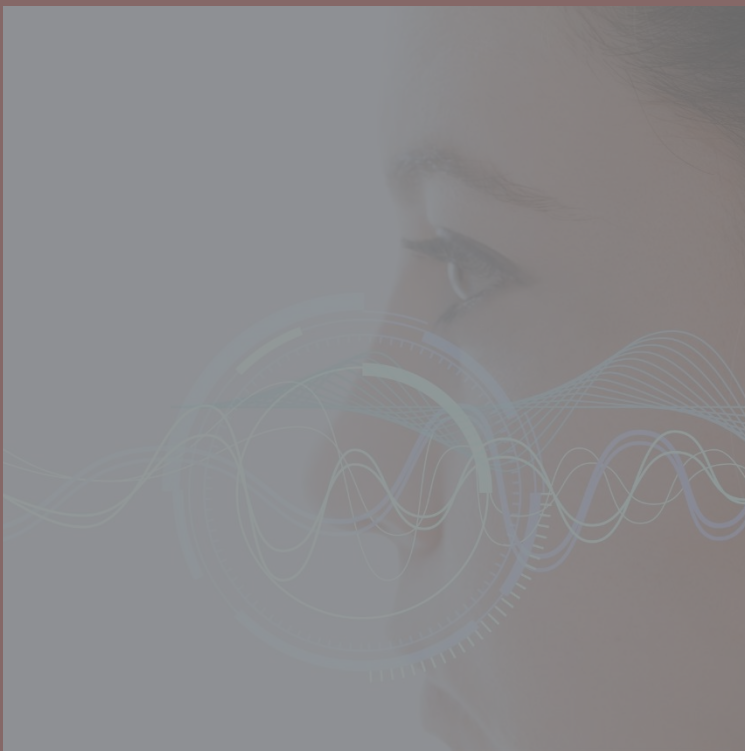


NeOse Advance

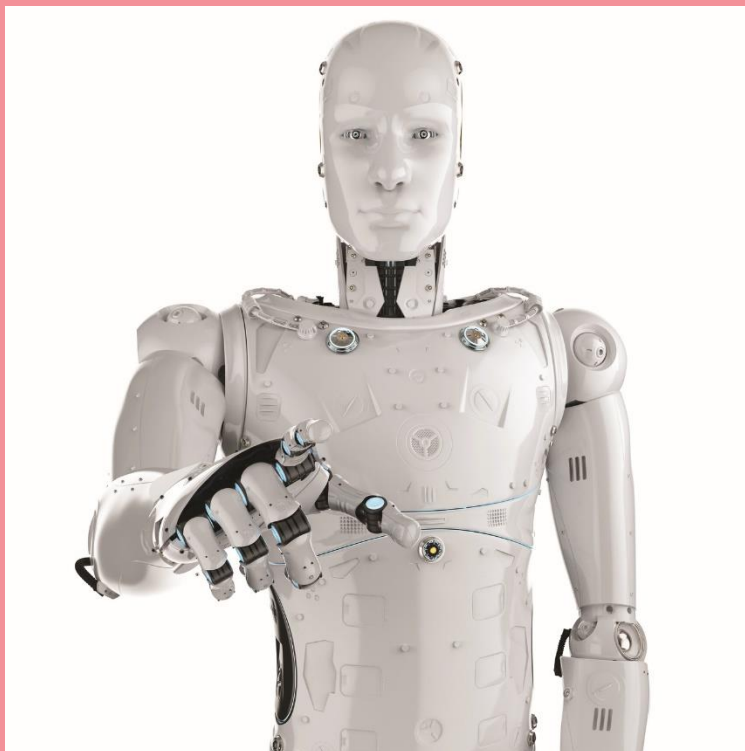
- Limit of detection in the 10^{-7} RIU range
- Fast readout up to 200 Hz
- Low-cost photonic passive dies

- Low-cost laser and CMOS imager
- Multiplexing with up to 64 MZI
- Works for both gas and liquids

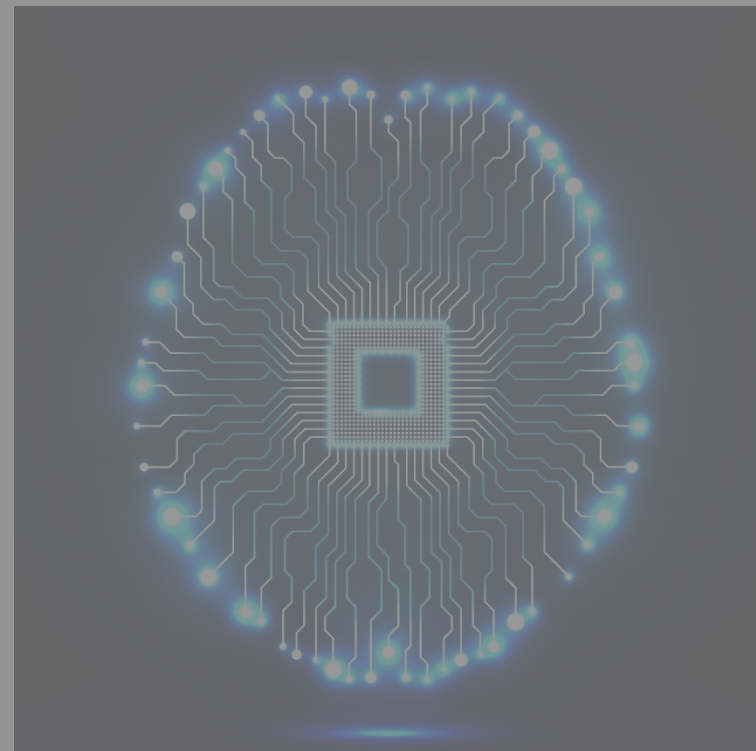
SENSING



LIDAR



Novel computing





Chip-scale Si-photonics FMCW LiDAR

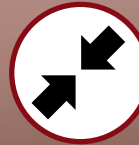
*3D vision for safer & smarter
mobility*



High-volume scaling

Targeted cost 100's \$

Manufacturing in std semiconductor fabs



Highly compact

Target volume < 100 cm³

On-chip LiDAR system with Si Photonics



Highly robust

High immunity to sunlight & other LiDARs



Highly reliable

Targeted duration > 10 years

No moving part & on-chip calibration

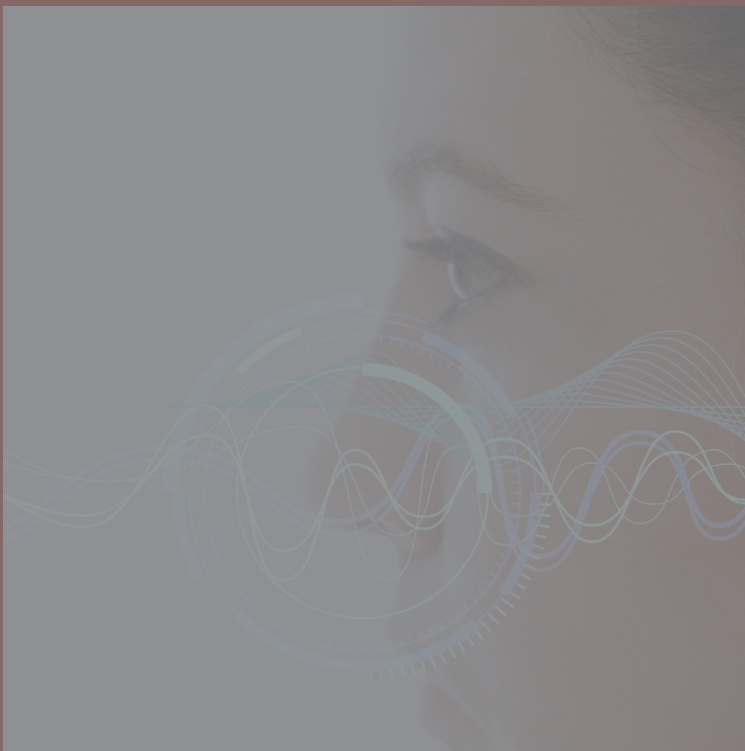


High performance

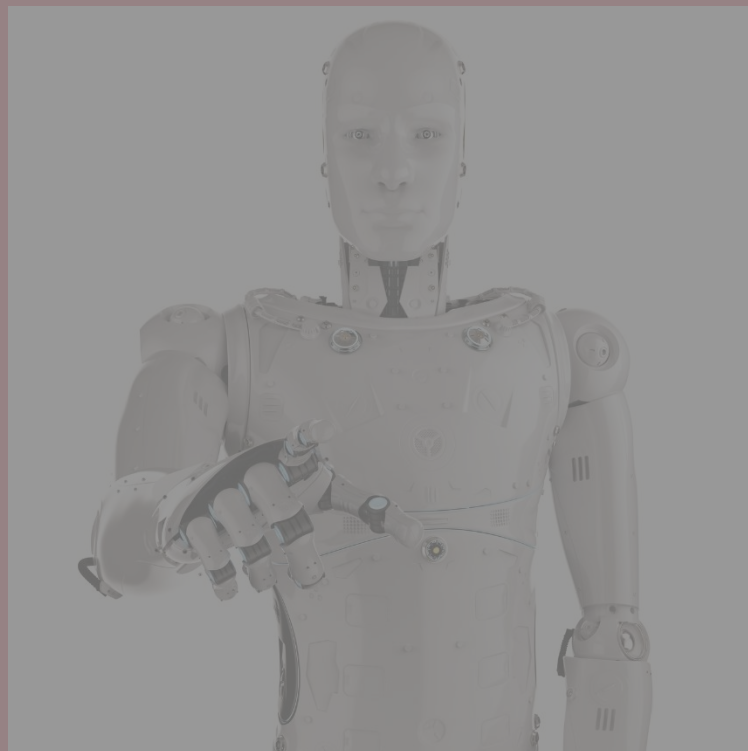
Targeted range 200 m

Coherent detection in mid-infrared

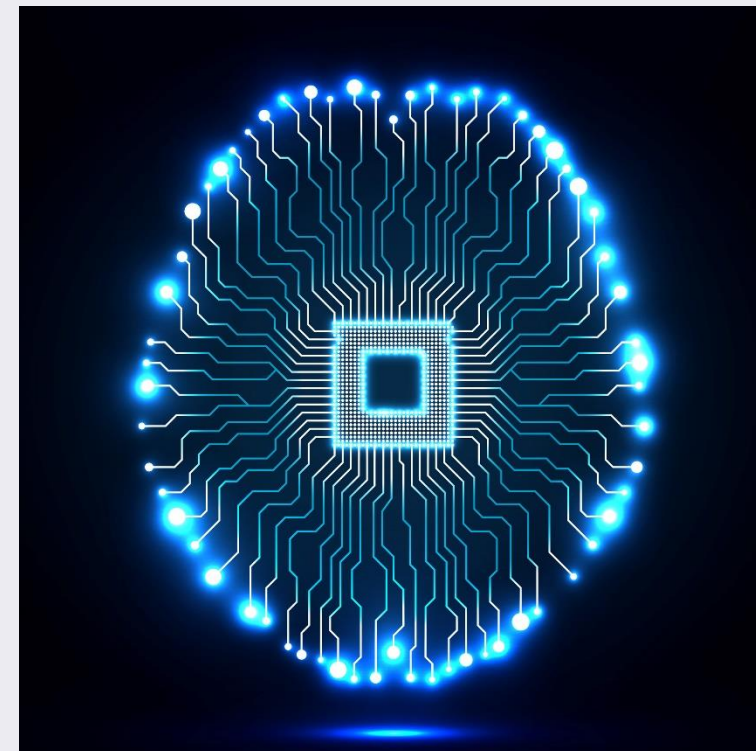
SENSING

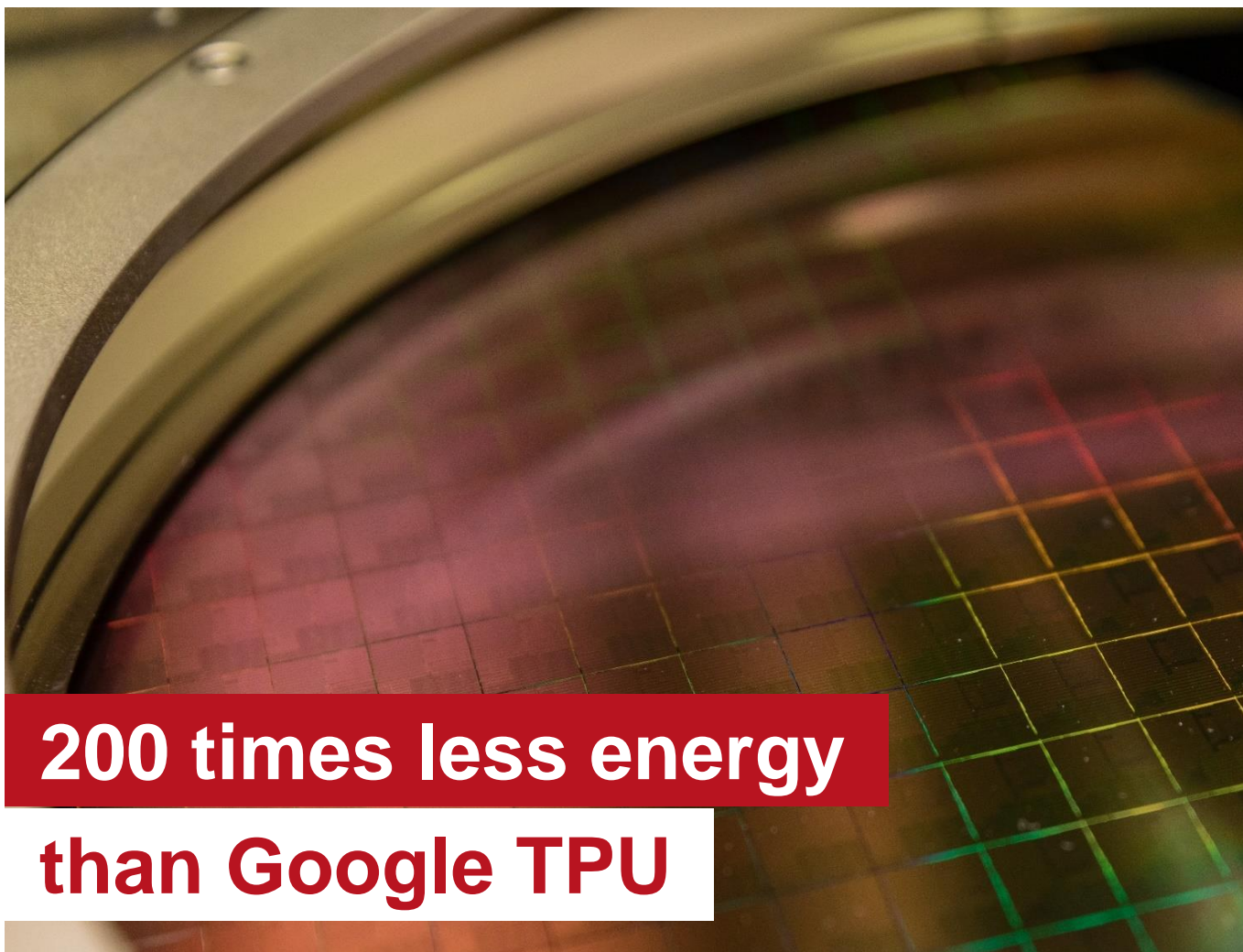


LIDAR



Novel computing





200 times less energy

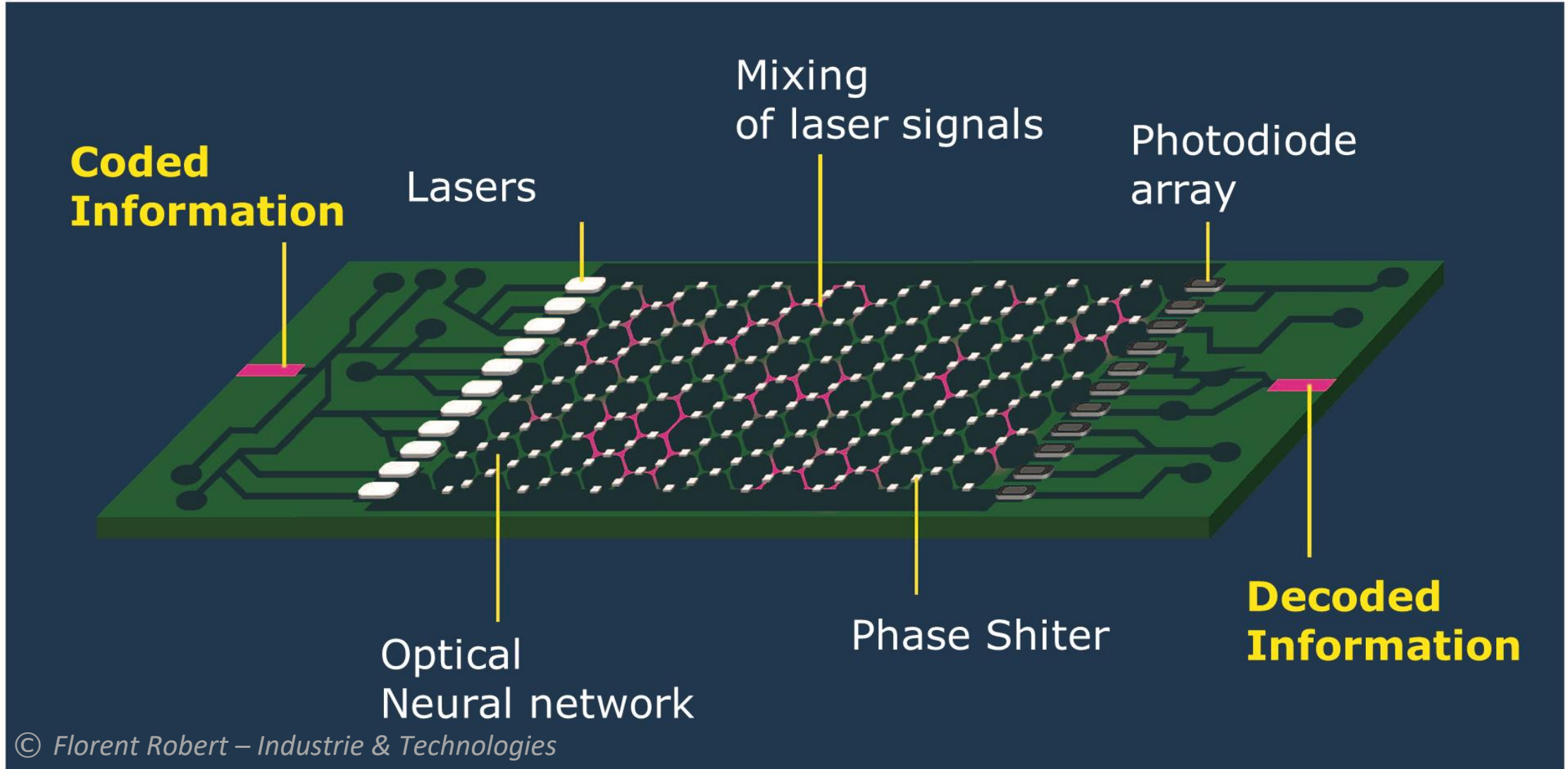
than Google TPU

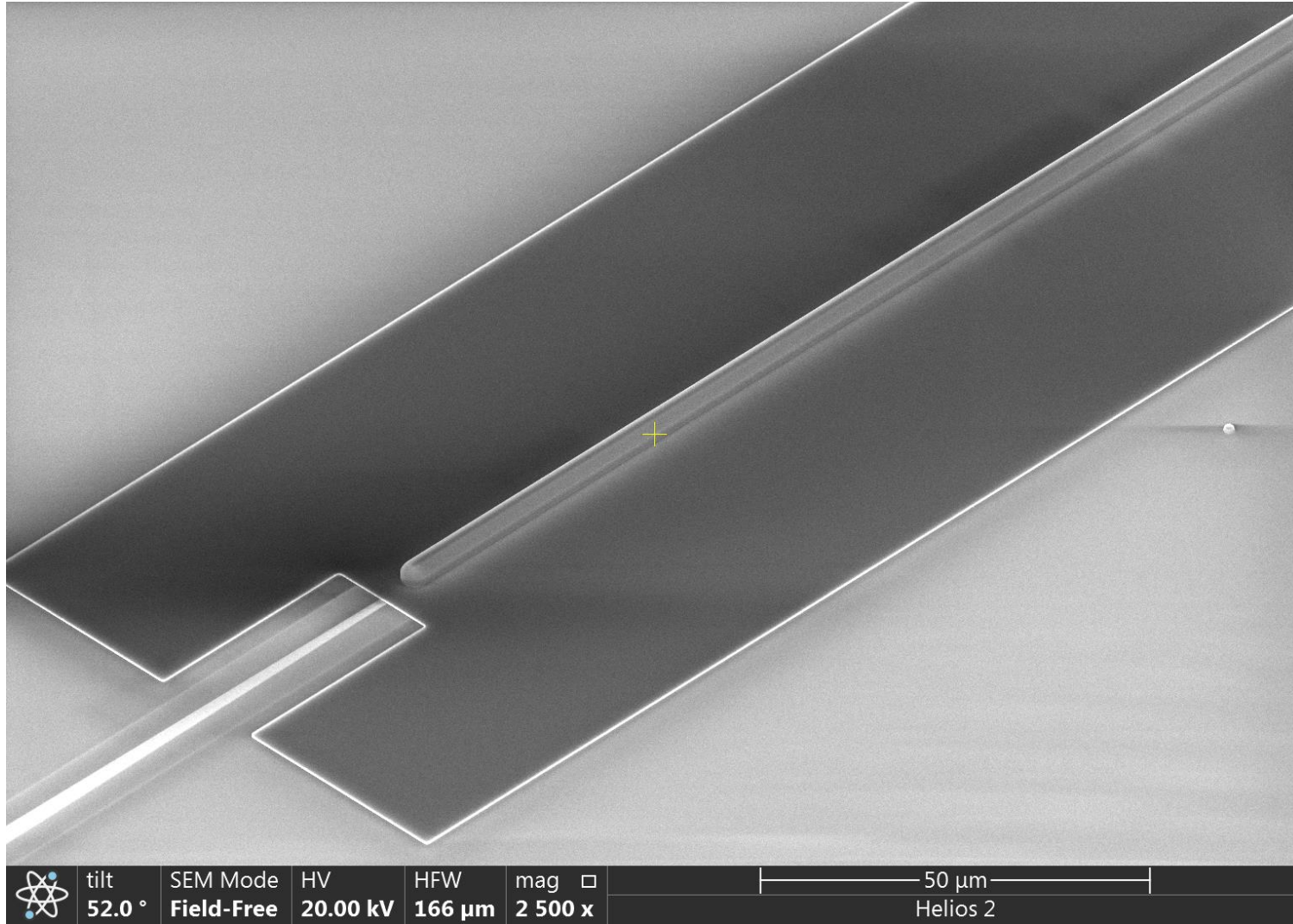
Neuromorphic photonics can offer sub-nanosecond latencies, high-bandwidth & low energies

- > CMOS-compatible platform
- > 12" wafer process

AI HARDWARE THAT REQUIRES LESS ENERGY

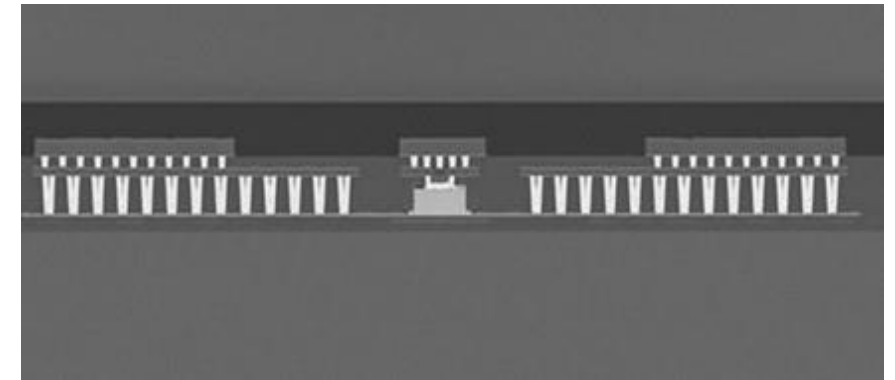
> Silicon photonics





Q-switched lasers

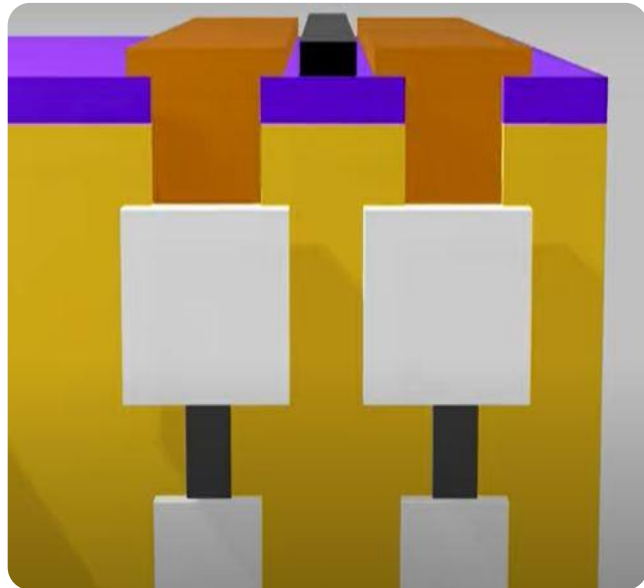
- > High wall plug efficiency
targeting 100fJ/pulse for 10ps pulses
- > Scalable heterogeneous integration
12" integration process



EVERYBODY IS LOOKING FOR THE IDEAL MODULATOR

> CEA-Leti is exploring several paths with new materials

BTO on Si



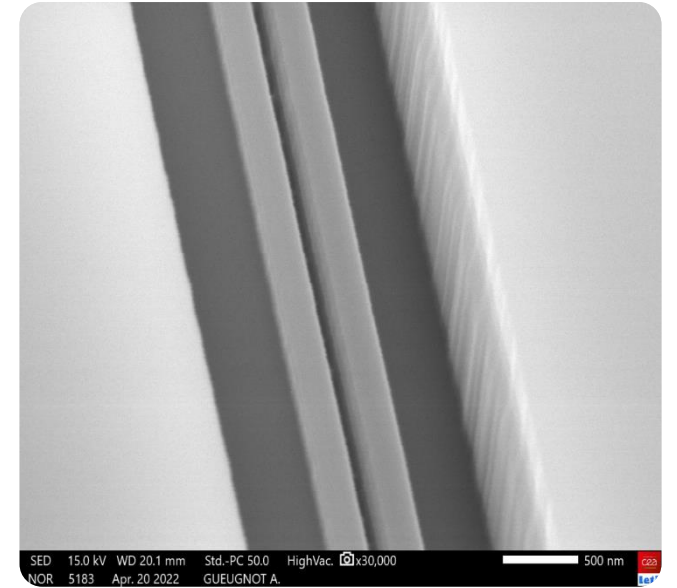
NEoteRIC Lumiphase

LNOI for Si or SiN



ELENAX Lithium Niobate PICs for Europe csem

Silicon Organic Hybrid



Polymer by NLM Photonics

A wide range of novel components for silicon photonics.

Si & SiN photonics

CMOS-compatible platform

**With heterogeneous integration
featuring novel compact and low-power devices**

For emerging applications