

# Photonic Integrated Circuits

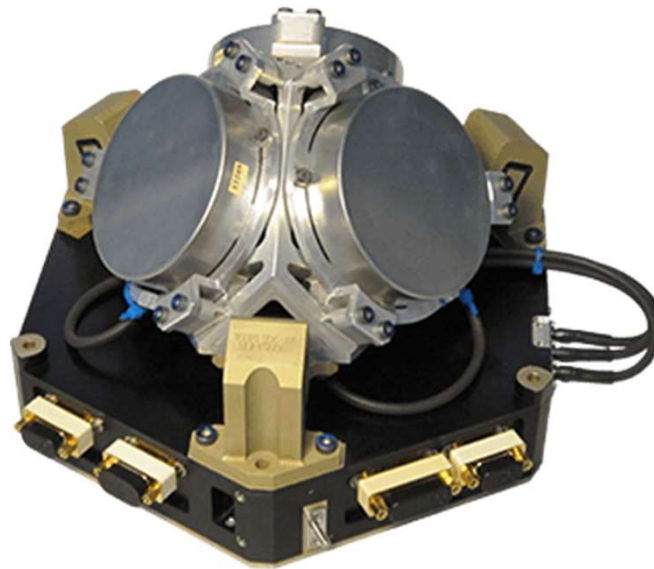
**ACTPHAST**

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20201203

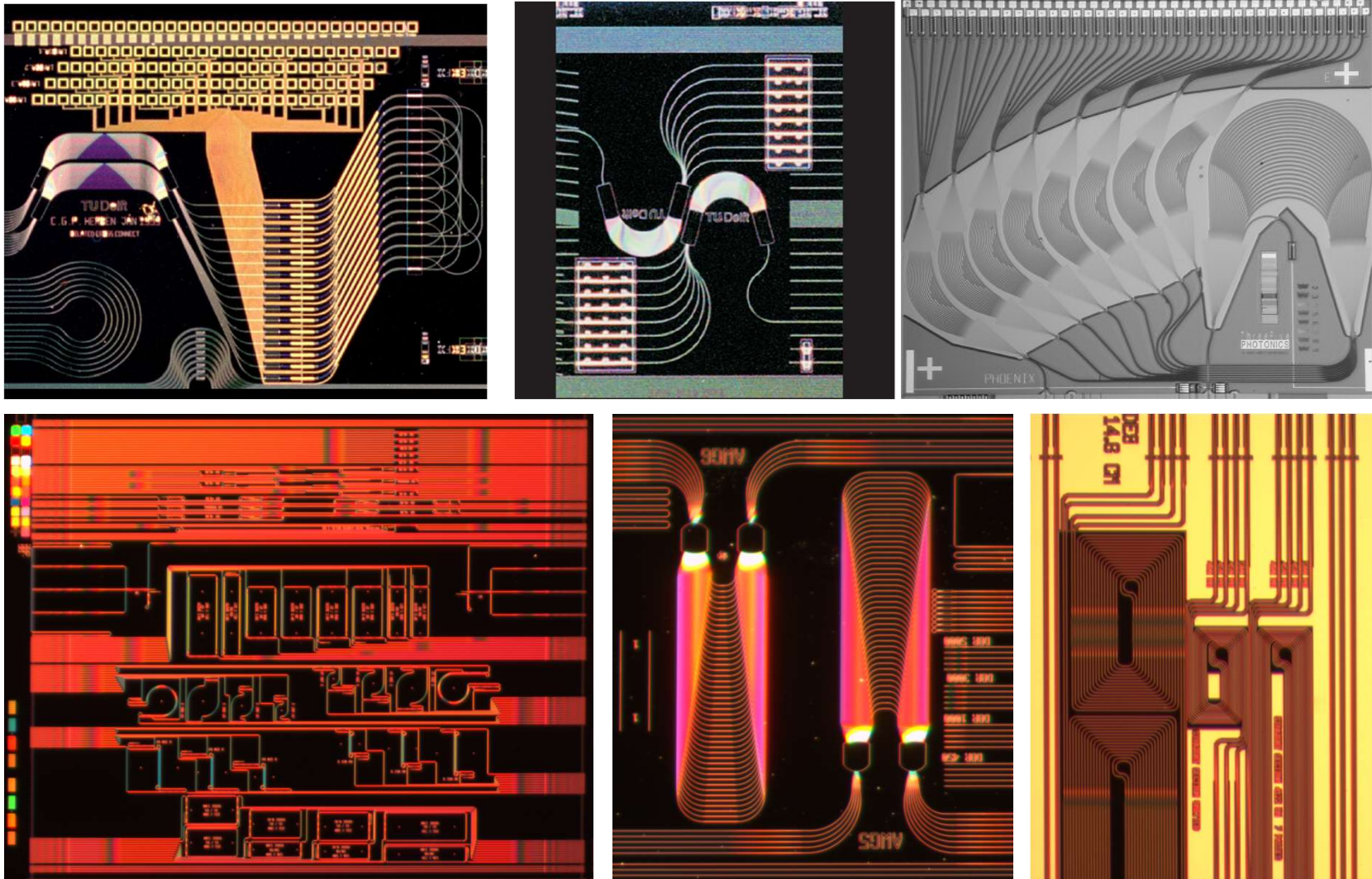
## Classical optics



## Fiber optics



## Optics on a chip “*Assembly by design*”





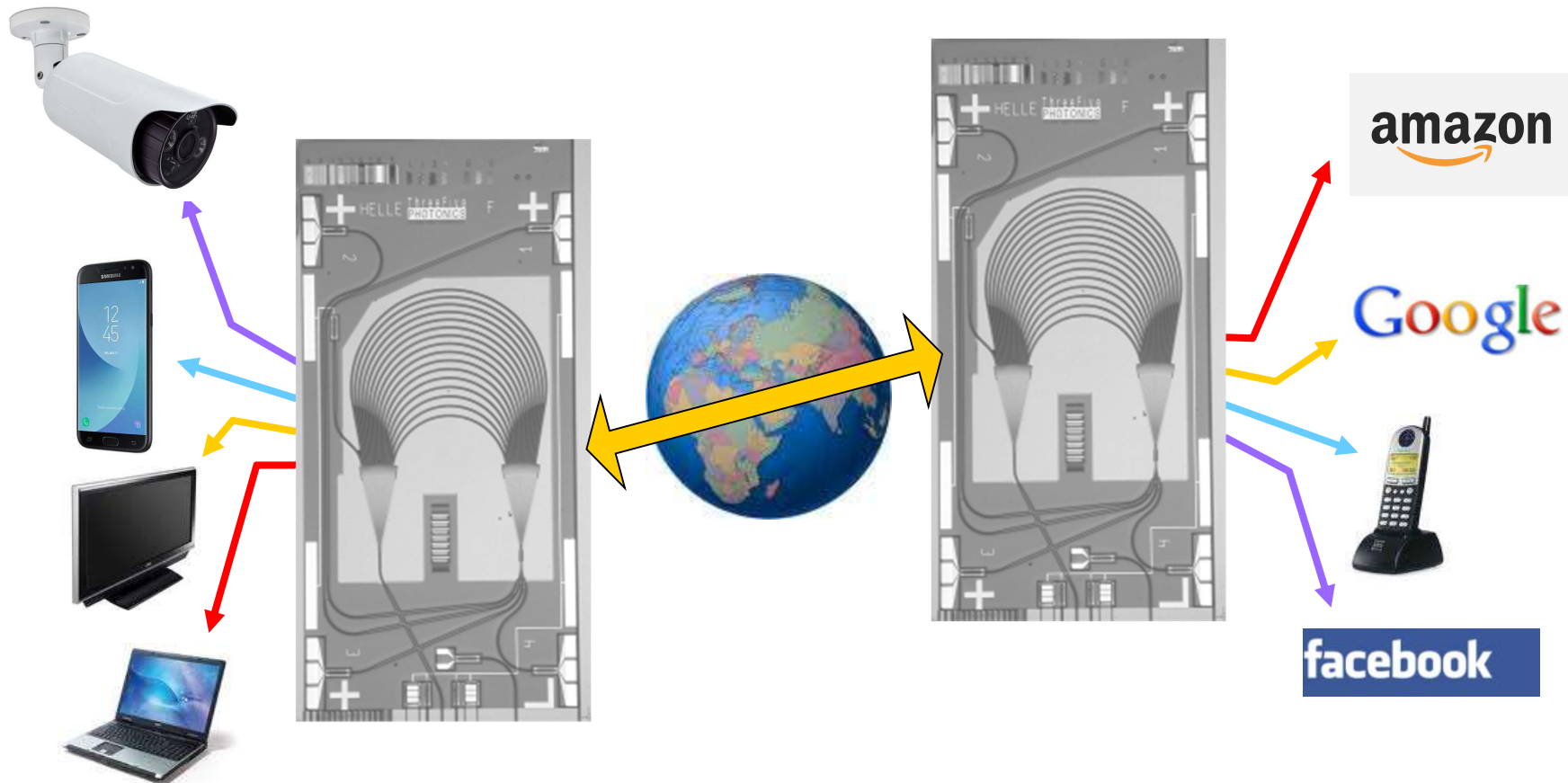
## Optical communication

- › Excessive bandwidth ( $> \text{Tb/s}$ )
- › Loss  $< 0.2 \text{ dB/km}$  @ 1550 nm: 50% transmission over 15 km
- › Optical amplification (Erbium Doped Optical Amplifier)
- › Light weight (6 kg/km)
- › Immune to electro-magnetic interference
- › Harsh environment (high pressure, temperature)



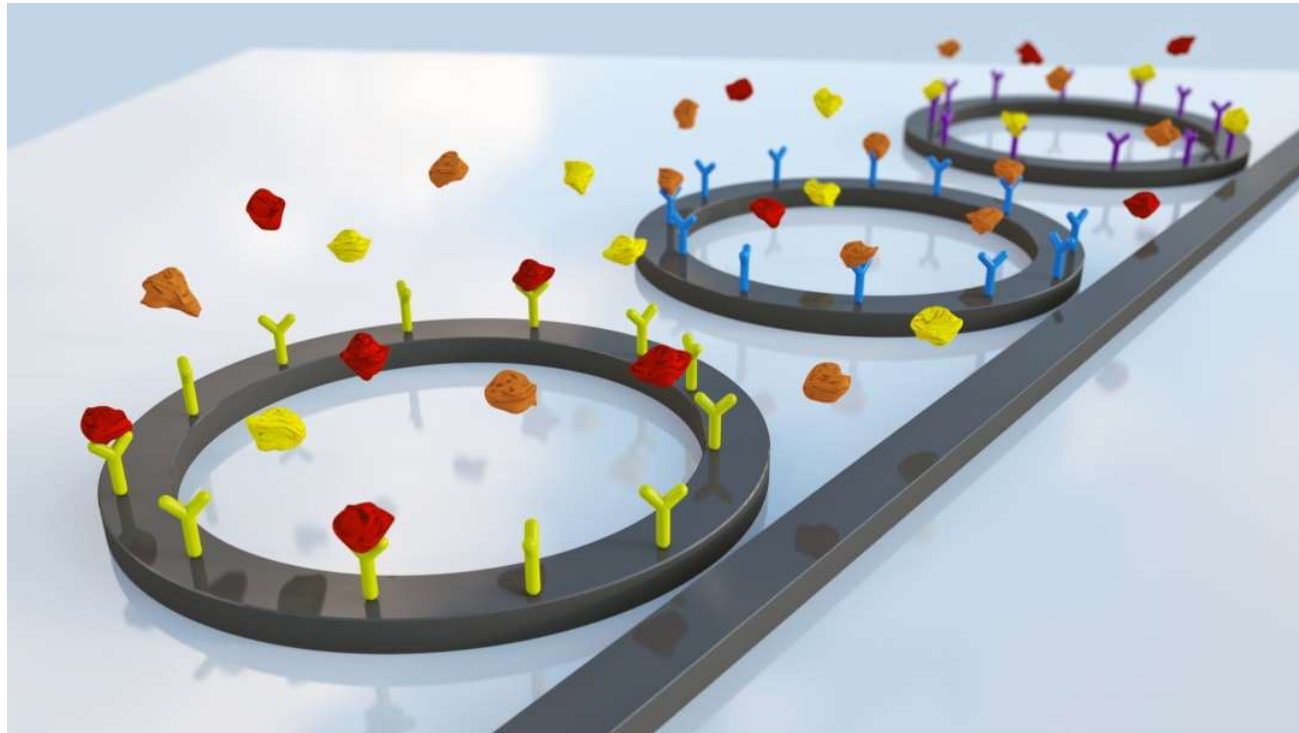
## Wavelength Division Multiplexing

- › Slice up the spectrum is small spectral bands
- › Each spectral band carries its own information

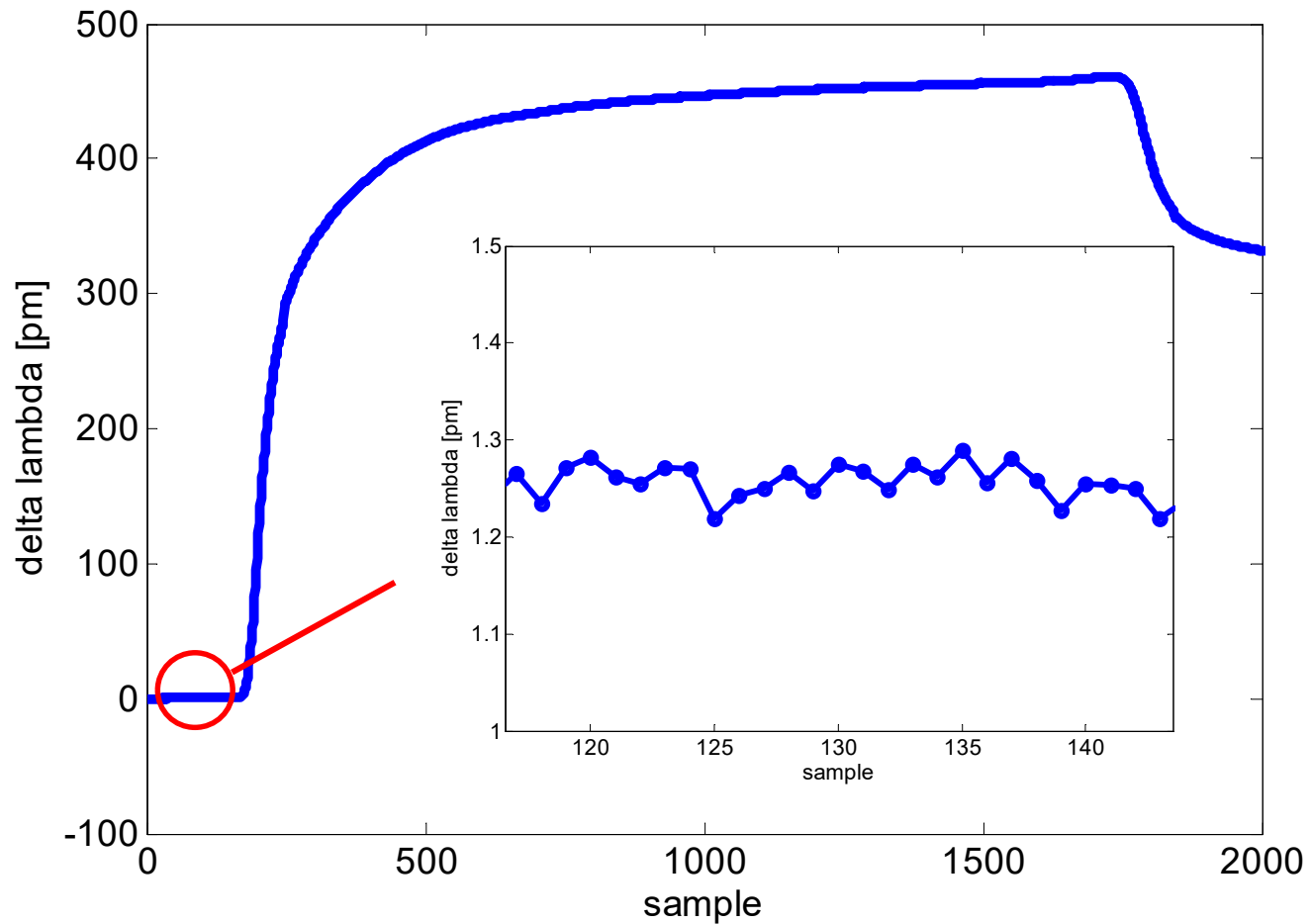


## Bio sensors

- › Detect minimal changes in refractive index at the waveguide surface
- › Caused by selective binding of biomarkers on antibodies



## Bio sensors



› Noise <0.1 pm

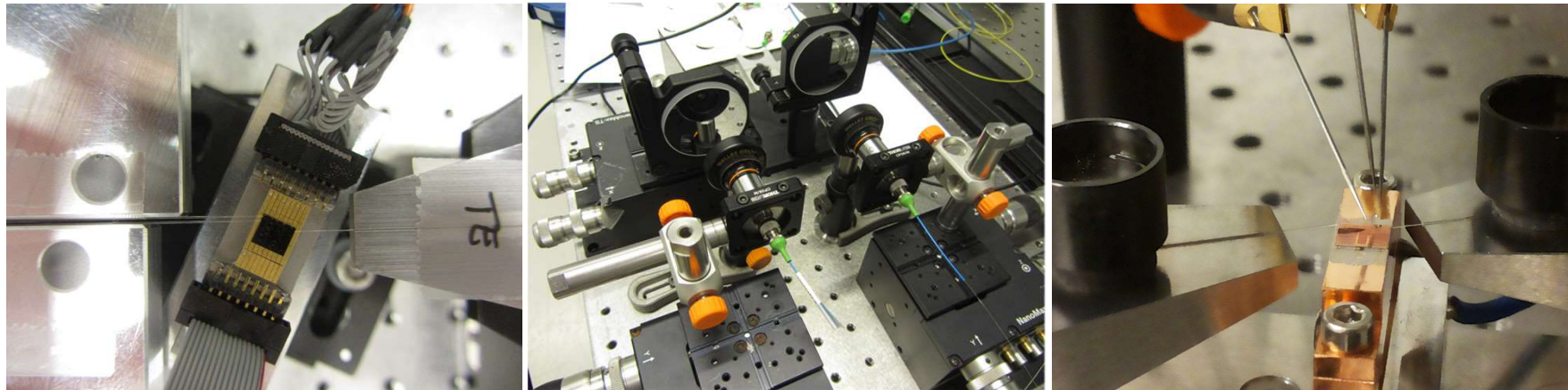
› S = 133 nm/RIU

› LoD =  $7.5e-7$  RIU

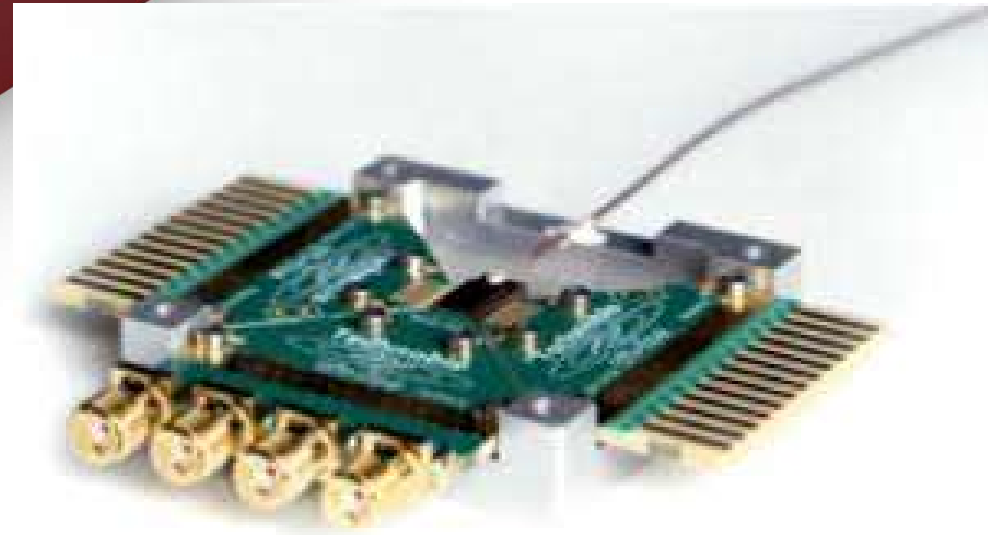


# Metrology

- › Displacement sensing, surface monitoring

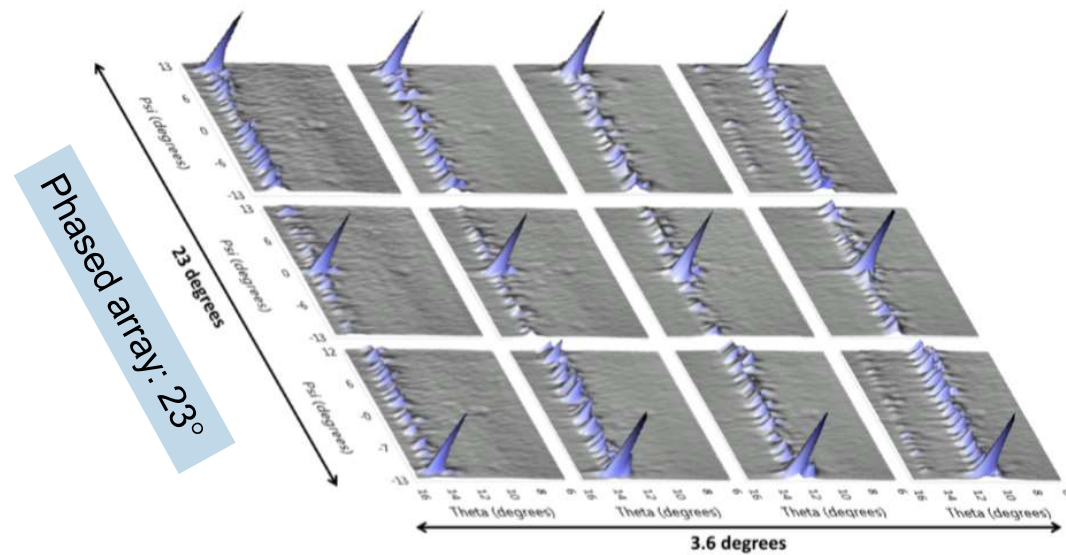
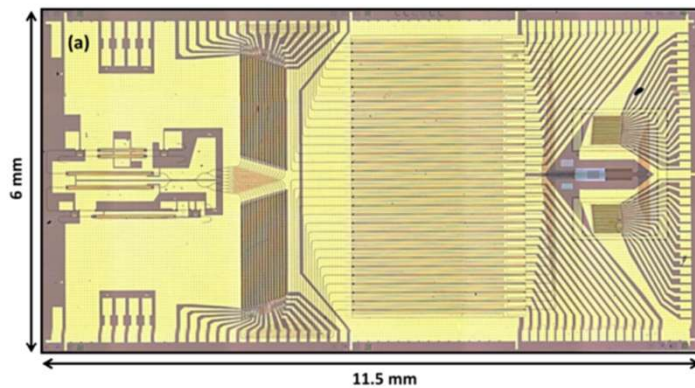


## Fiber Bragg Gratings



## Beam steering / LIDAR

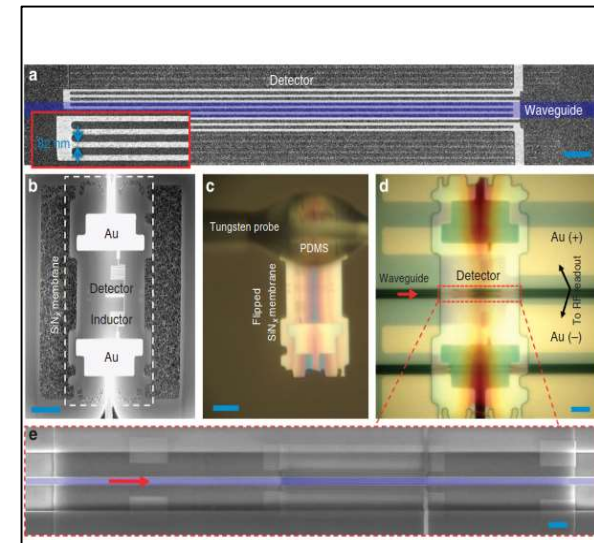
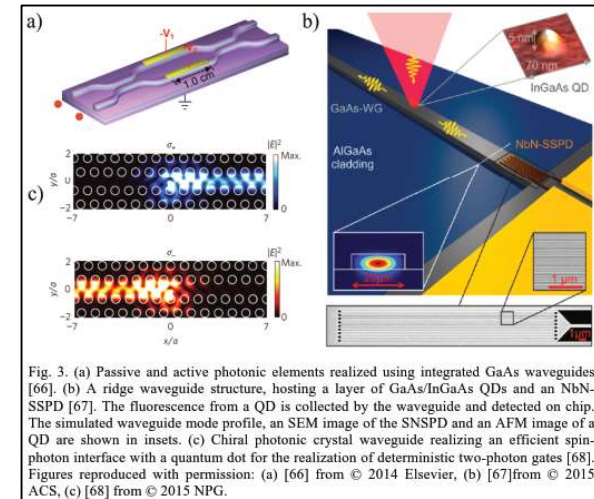
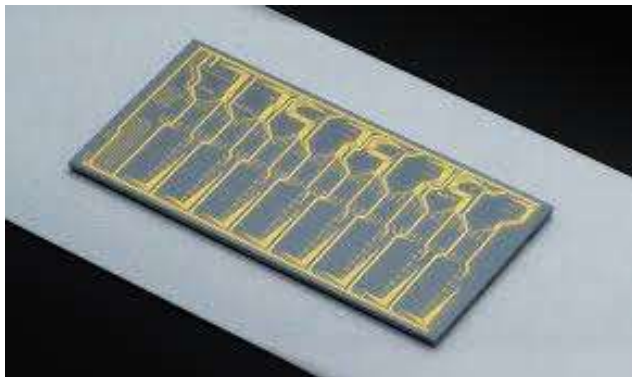
- › Combine 1D phased array antennas (32 Chn) and wavelength control
- › SOI with hybrid integration gain sections
- › 6 x 11.5 mm = 69 mm<sup>2</sup>



$\lambda$  Grating coupler: 3.6°

# Quantum technologies

- › Photons as carriers of quantum information
  - › Generation
  - › Long-distance distribution
  - › Storage
  - › Processing
- › Why integrated photonics
  - › Stability
  - › Miniaturization



## How to explore PIC technology or other optical / photonic technology

- › ‘Onbekend maakt onbemind’
- › Innovation with photonics may advance your company ahead of competition
- › But: exploring the potential of photonics for your application can be a considerable investment.
  - › Expertise, equipment, time, ...
- › Risk: ... it may not work for you...






















## One-stop-shop incubator for photonics

- › Goal: accelerate innovation
- › Heavily subsidized (up to 100%)
- › Provides expertise in photonics
  - › Feasibility studies
  - › Prototyping
  - › Test and measurement
- › Not per se a money supplier
  - › Financial support for consumables included



# 25 partners across EU, > 200 experts

 VUB	 CNIT	 CNR-IFN	 CNRS	 FORTH
 HHI-FEP	 ICCS	 ICFO	 IMEC	 IPHT
 ITME	 JR	 KIT	 LIO	 ORC
 SPH	 TNO	 TU/e	 Tyndall-UCC	 UEF
 UMCS	 UPC	 UPV	 VIT	 WUT
 EUN	 Other Strategic Affiliates			

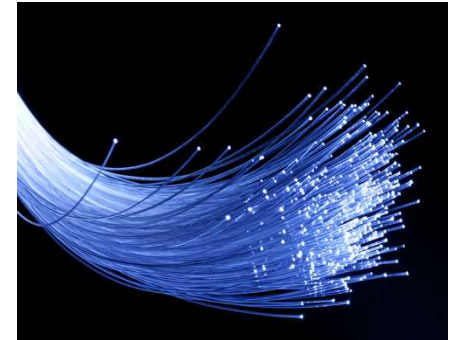
## Technology platforms



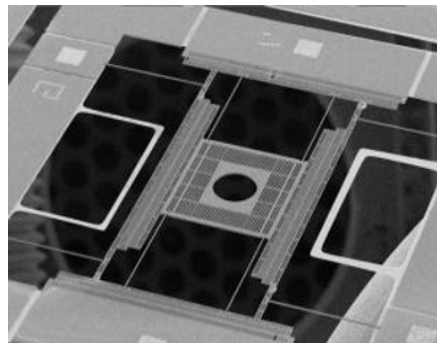
free-space optics



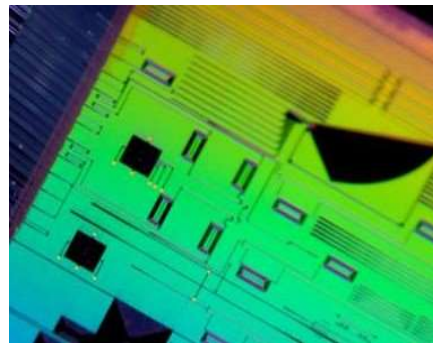
polymer-based optics



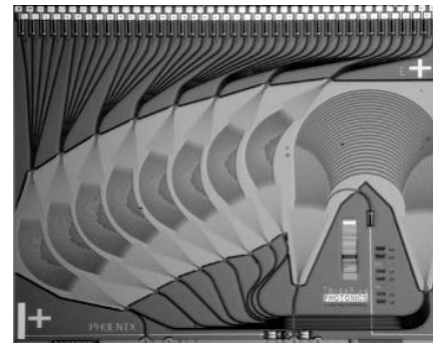
specialty fibers



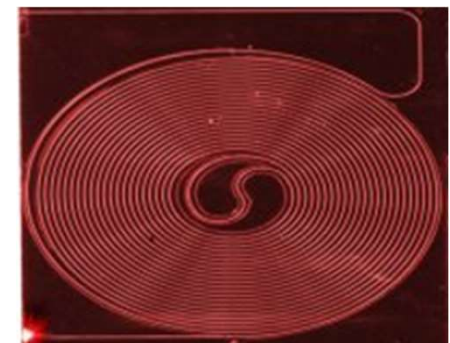
MOEMS



Si -PICs



InP -PICs



SiN-SiO PICs

## Way of working

- › Company can register interest at website
  - › <https://www.actphast.eu/en>
- › Researchers can register here:
  - › <https://researcher.actphast.eu/en>
- › Standardized procedure to:
  - › Understand the challenge and potential in detail
  - › Assess most promising approach
  - › Select a subset of the 25 partners
  - › Write project proposal
    - › Selected partners, company
  - › Proposal review (bi-monthly)
  - › Execute
  - › Evaluate

## What's in it for you

- › Get help in solving an optical problem which you cannot solve yourself, and no solution exists in the market.
- › Access to top experts & facilities
- › Access to broad range of optical technologies
  - › You will not get a fiber or chip if a micro-optics concept works better
- › Business support
- › Confidentiality, IP arrangements
- › Heavily subsidized
  - › 0 ... 30 k: 100%
  - › 30 k ... 100 k: 75%
- › Get your:
  - › Feasibility study
  - › Demonstrator
  - › Custom production in-line inspection tool



# Supported companies

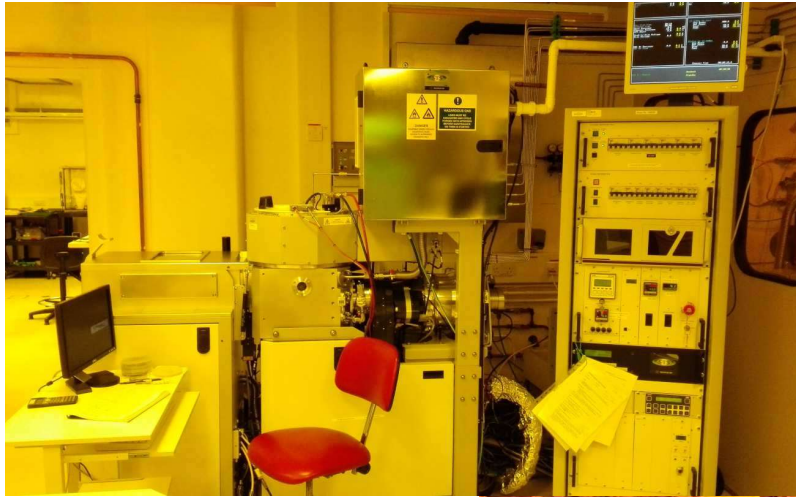


## Take home message

- › Photonics could drive your innovation
- › You can explore this technology at little cost
- › You will get technology and business support.
- › This is not an academic exercise, it's about creating jobs and revenue



# Fabrication



## Fabrication

- › Multi Project Wafer runs
- › B2B dedicated runs

Foundry	Materials
IMEC	Silicon On Insulator / SiNx
LioniX	SiNx
Smart Photonics	InP
VTT	Silicon On Insulator
CEA-LETI	Silicon On Insulator
Ligentec	SiNx
Package	Tyndall
Package	Technobis
Package	PHIX