



PHOTONICS ASSEMBLY



Photonics packaging and assembly for quantum applications

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COMPANY PROFILE
2024

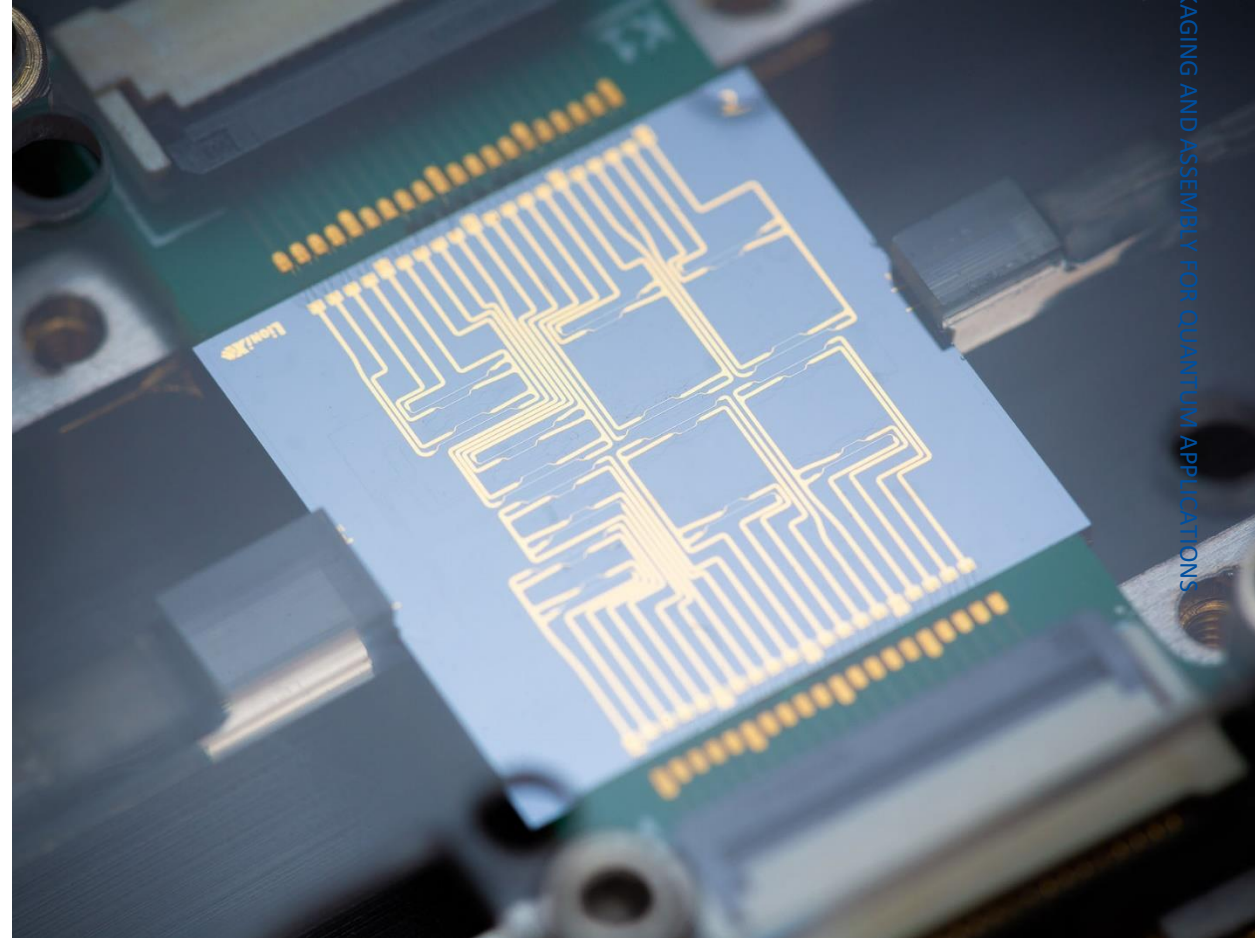
Photonics

Photonics is a technology that focuses on detecting, generating, transporting and processing **light (photons)**.

Transmitting information using **photons** instead of electrons is **faster** and **more energy efficient**. It also enables **new applications**.

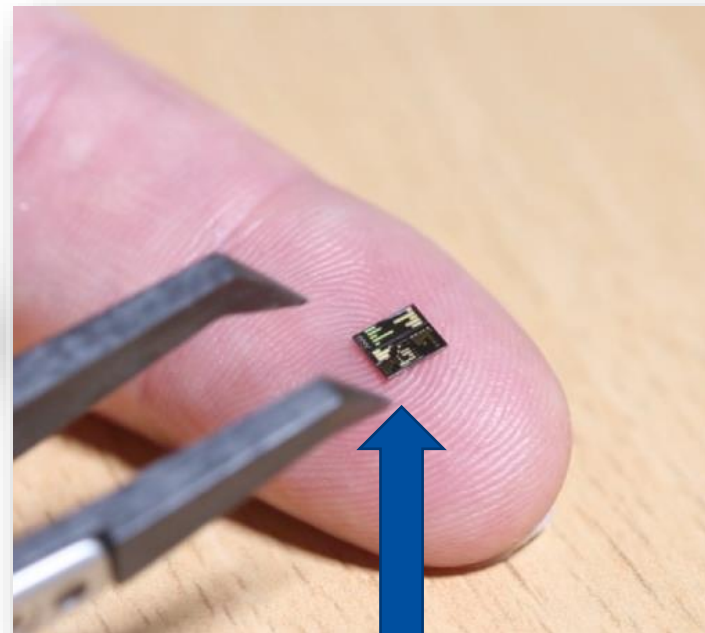
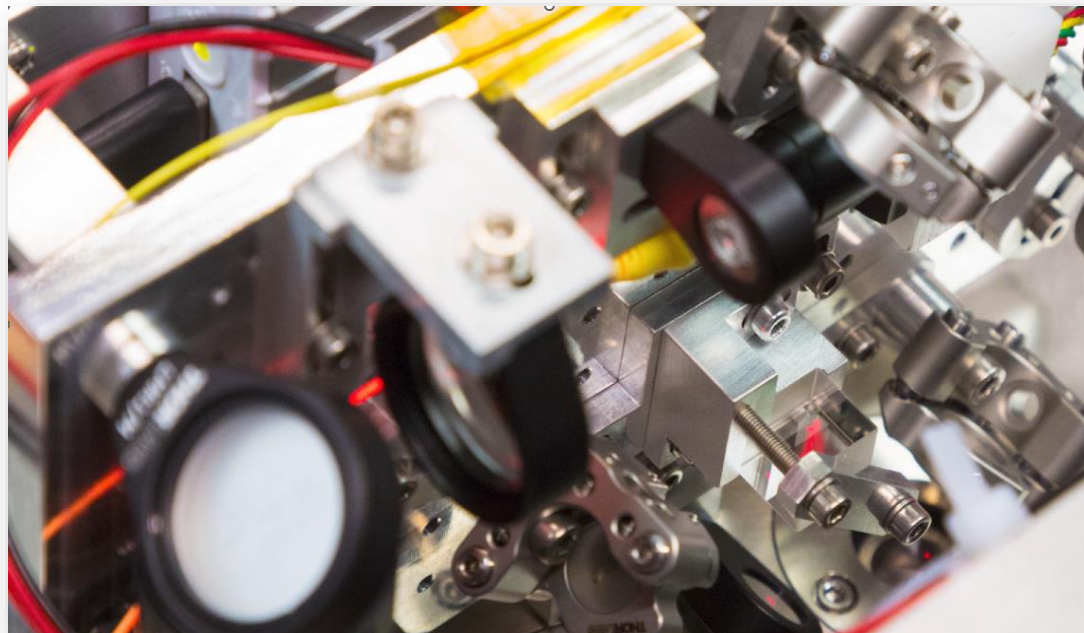
Photonics is used, for example, for displays, lighting, lasers, antennas, sensors and fiber optic networks for communication and data transport.

The technology of combining photonics and electronics is sometimes called **optoelectronics**.



Integrated Photonics

Miniaturization of optical circuits onto chips



Photonic Integrated Circuit (PIC)

Applications for PICs

- Self-driving vehicles (LiDAR and IMU units)
- Photonic quantum computing
- Point-of-care medical devices
- Next generation optical transceivers
- Measurement and sensing (metrology)

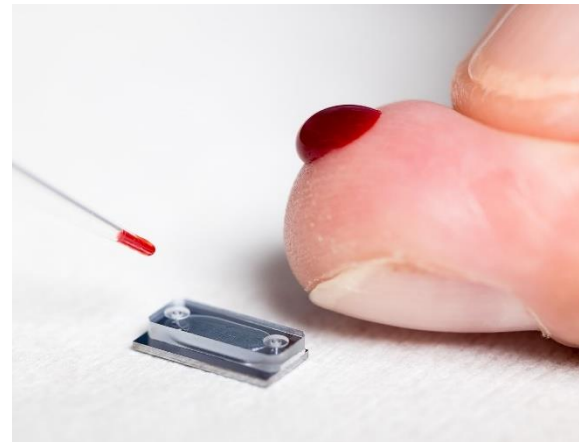


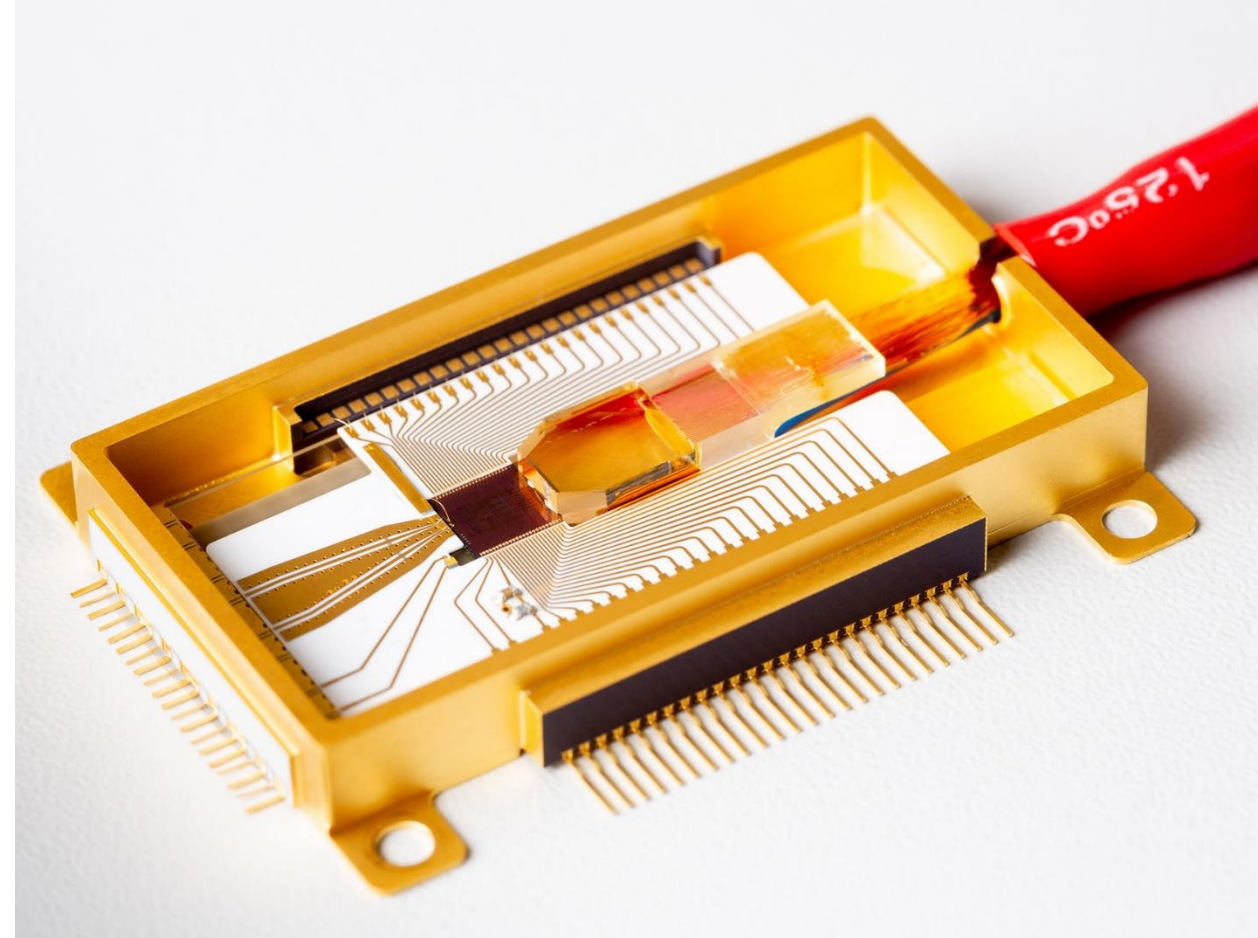
Image courtesy of Surfex Diagnostics



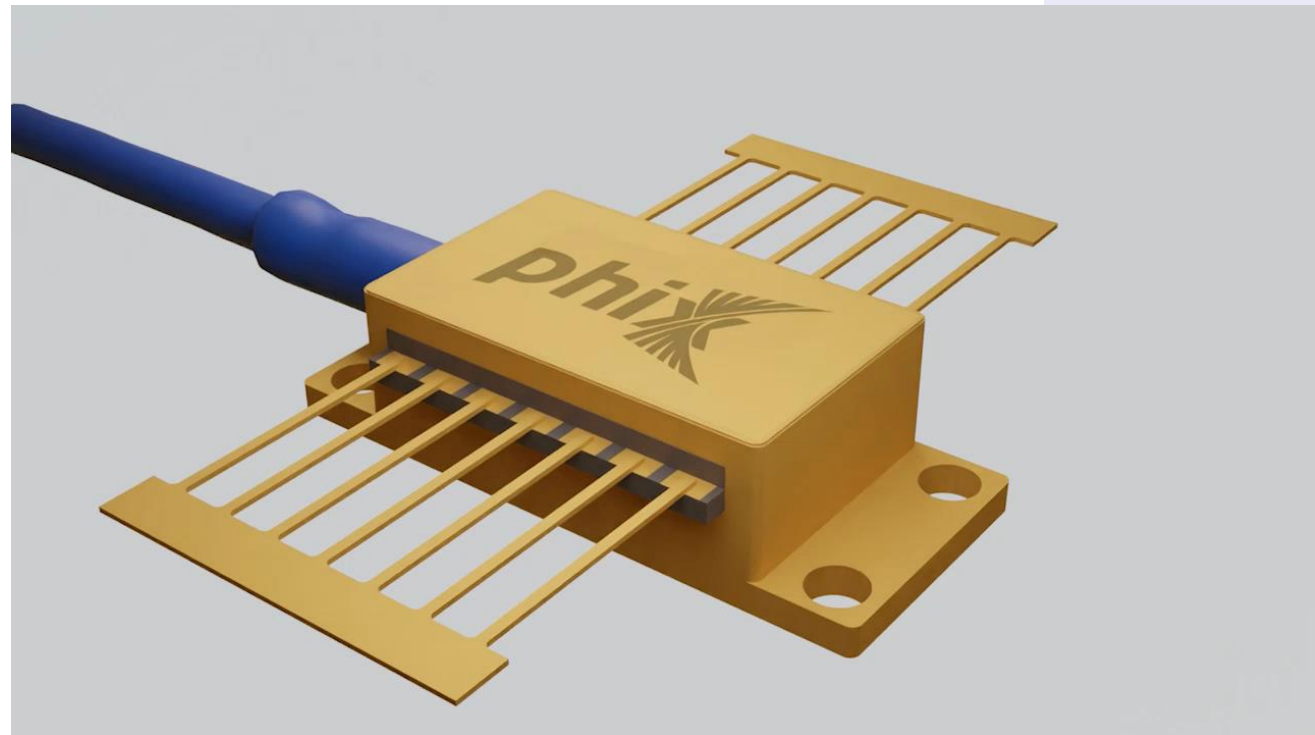
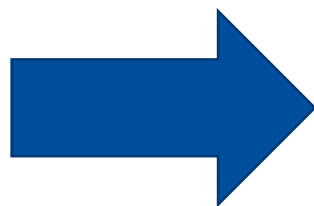
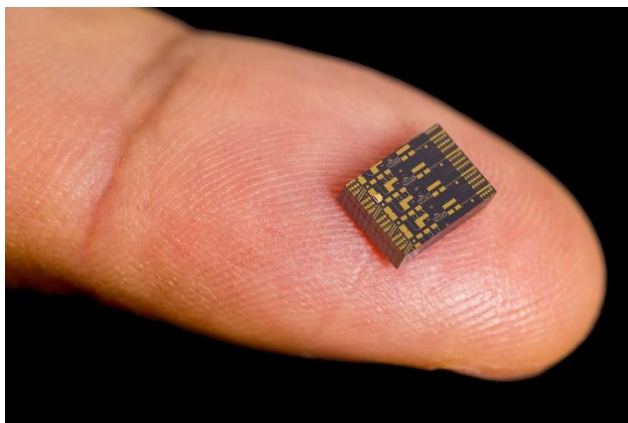
A PIC by itself is not a product!

It needs:

- Optical interconnection (fibers/free-space)
- Electrical interconnection (wire bonds/electronic ICs)
- Thermal management (active/passive)
- Mechanical support (robust package)



Photonics Packaging (What we do)



Who we are

PHIX is a world leading foundry for packaging and assembly of Photonic Integrated Circuits (PICs) and MEMS, supplying components and modules in scalable production volumes.

- Founded in 2017, started operations in 2018
- Independent pure play packaging facility
- Specialized in hybrid PIC assembly and fiber array interfacing



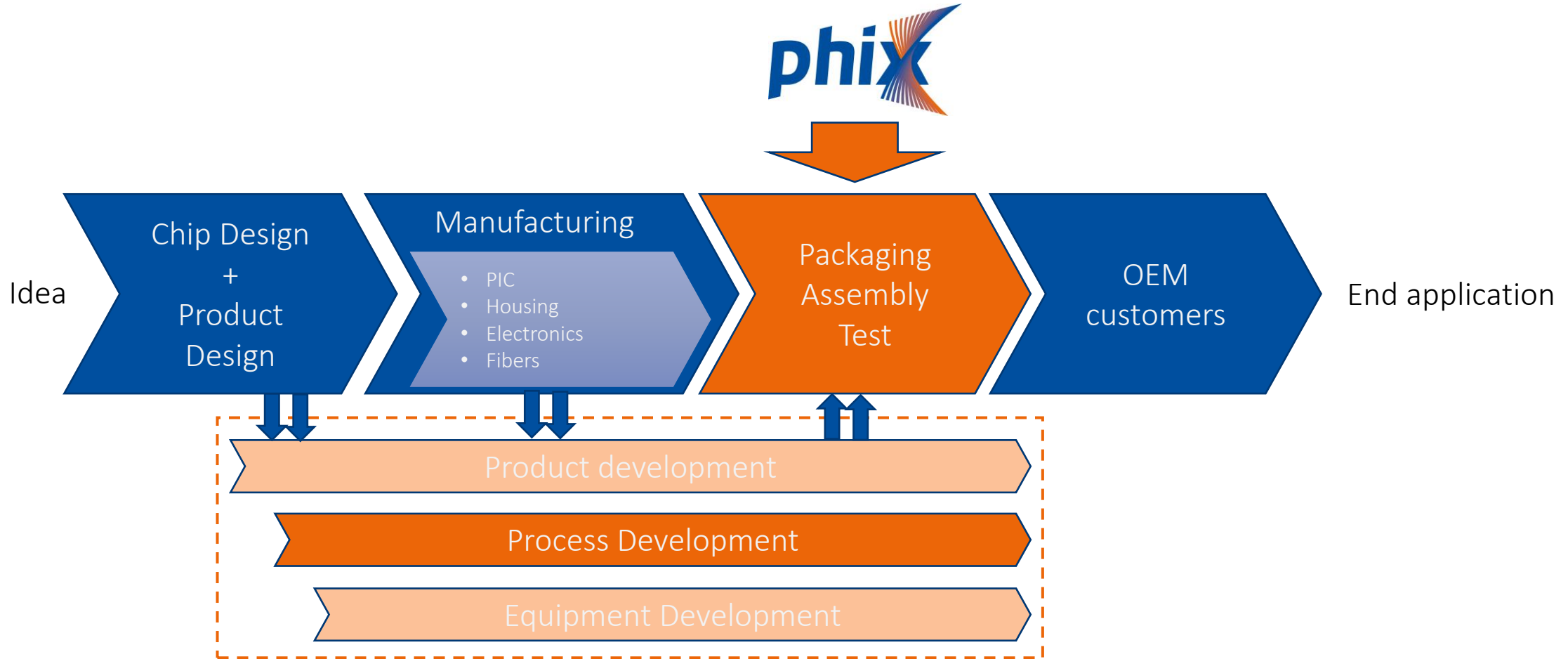
Where we're going

New 1800 m² building in 2024

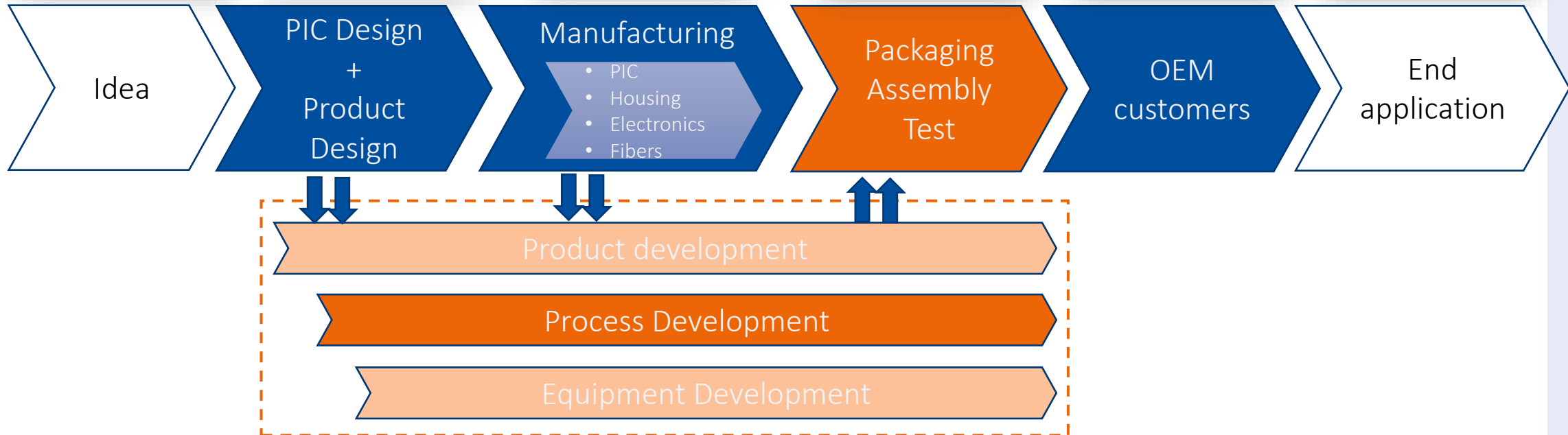
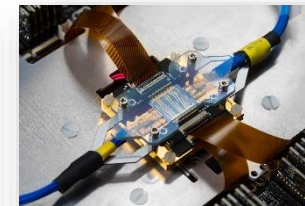
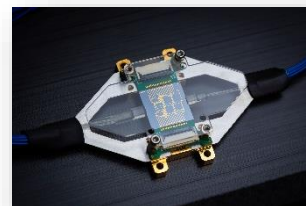
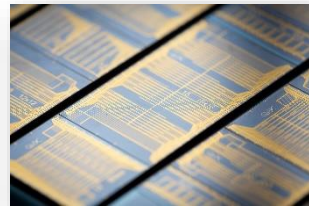
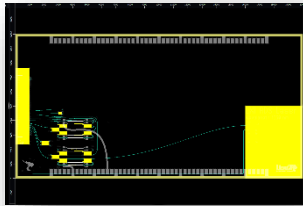
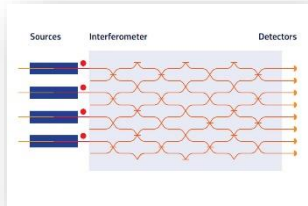
- 600 m² production facilities
- 600 m² auxiliary workspace
- 600 m² room for further growth
- Up to ISO 5 clean room space



Our position in the value chain



Our position in the value chain



Images courtesy of QuiX Quantum

Three types of customers

Characterization / prototype packages

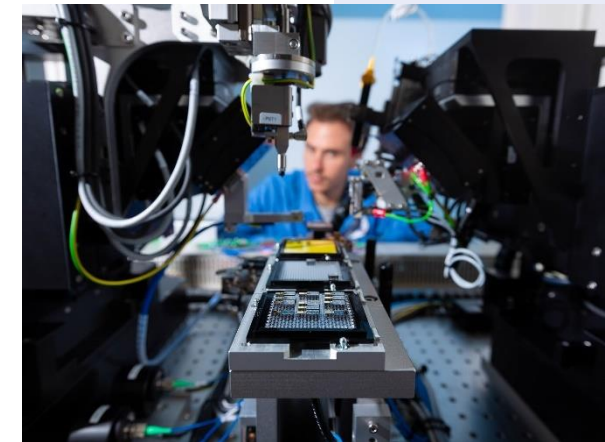
- Chip measurements and system integration tests
- Feasibility studies and system demonstrators
- 1-100 units

Volume packages

- Optimized for manufacturing and reliability
- Testing to firm acceptance criteria
- 100+ units

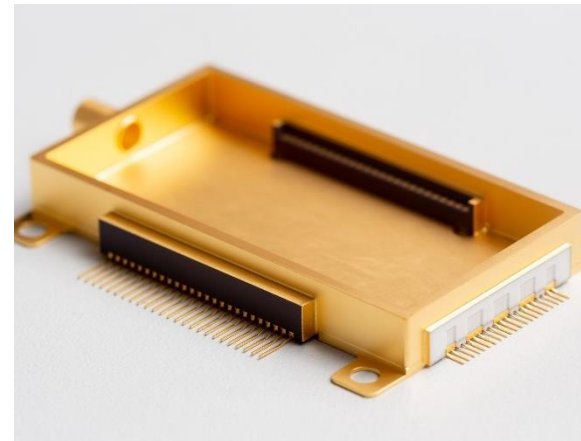
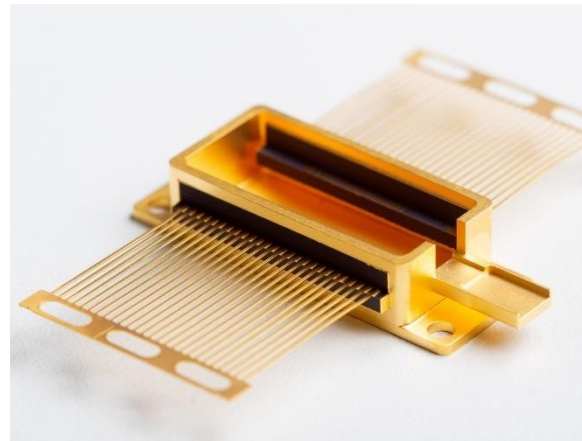
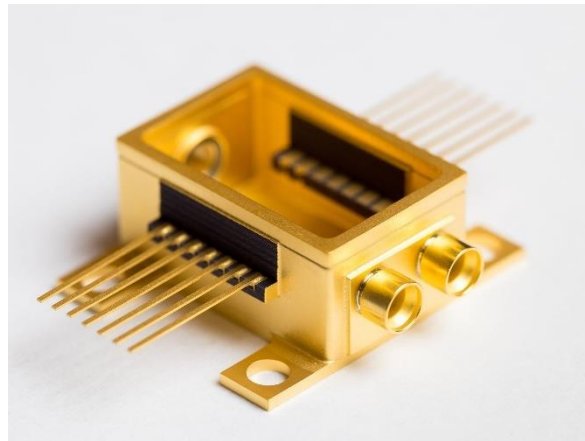
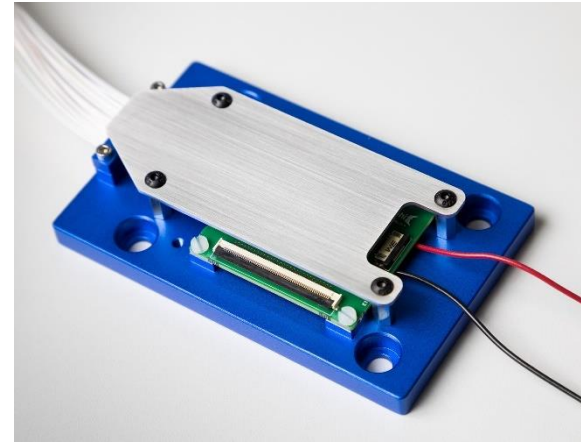
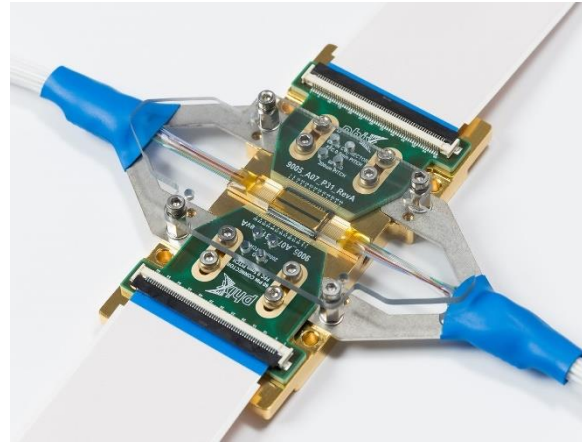
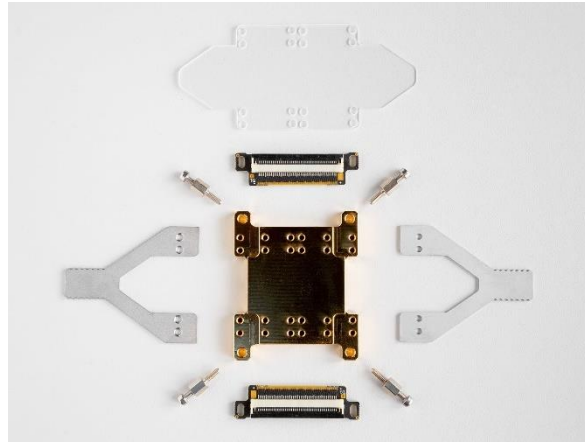
Contract manufacturing

- Providing outsourced or second-sourced component production



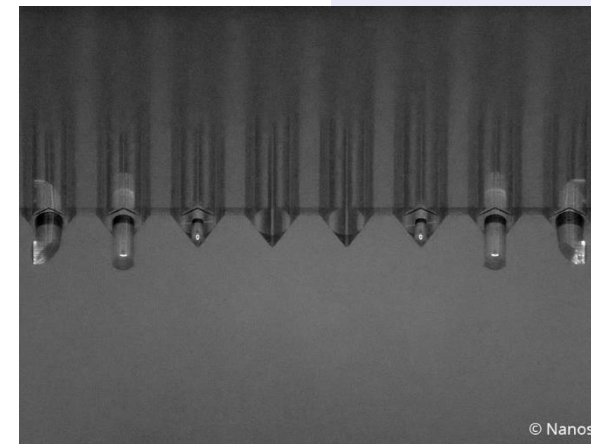
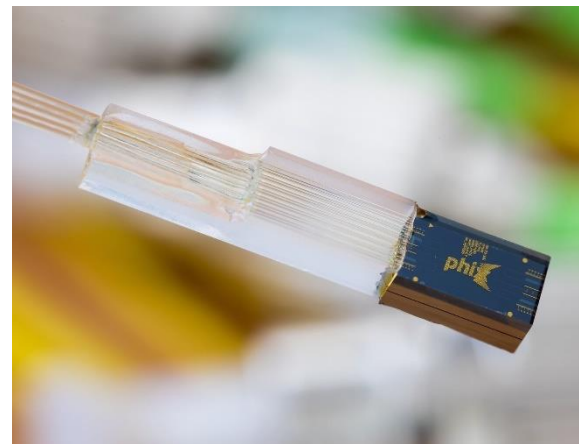
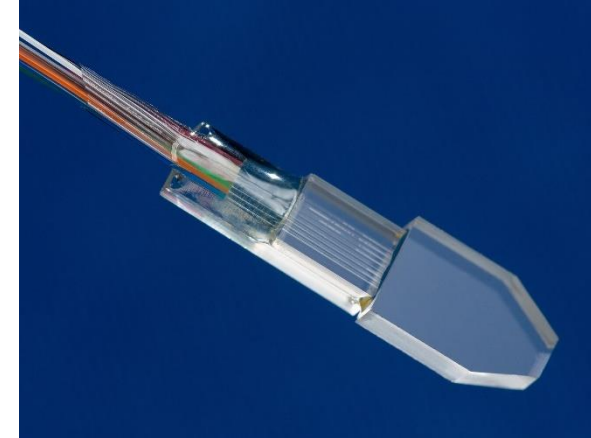
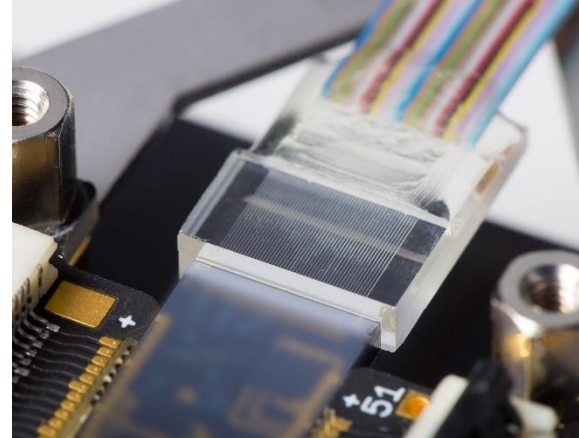
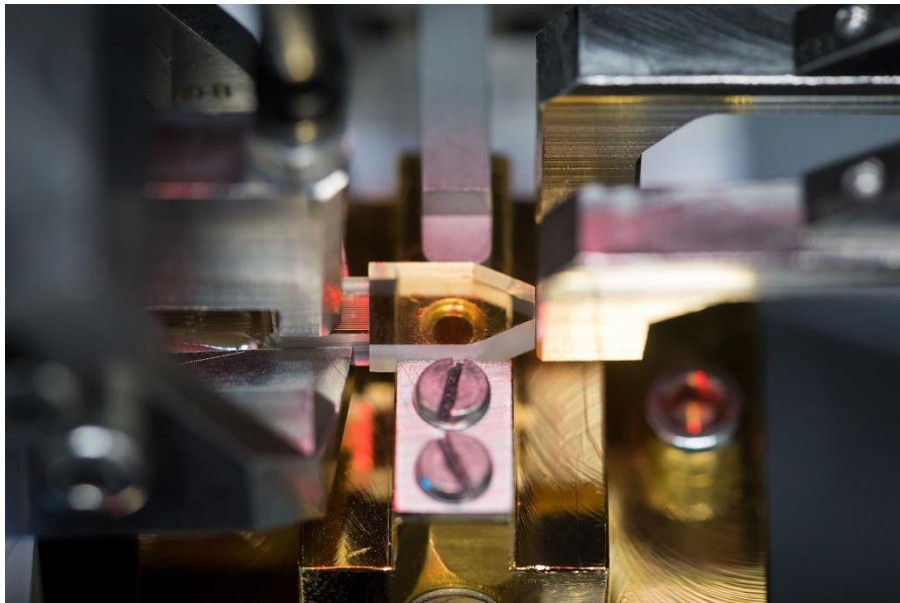
Characterization and prototyping

Providing building blocks and standard housings



Fiber array interfacing

- Polarization maintaining v-groove fiber arrays of up to 128 channels
- Optional ion exchanged glass or silicon nitride spot size converters (SSCs)
- 3D printed microlenses for free space coupling to other components (lensed fiber arrays)
- Automated assembly with active alignment



© Nanos

Engineering support



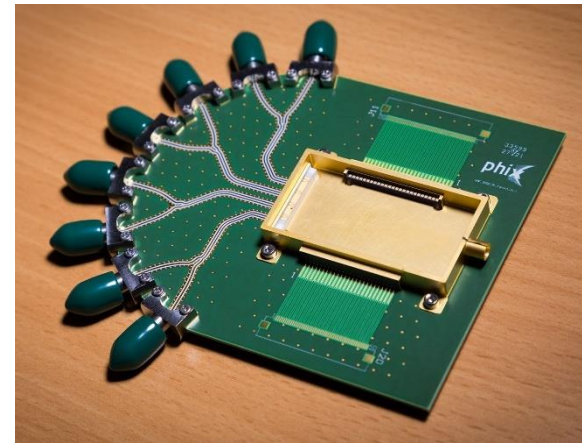
Take off quickly

- Benefit from standard package types and building blocks
- Optional standard electrical (DC/RF) fan-out boards
- PIC Design Guidelines documentation and engineering support



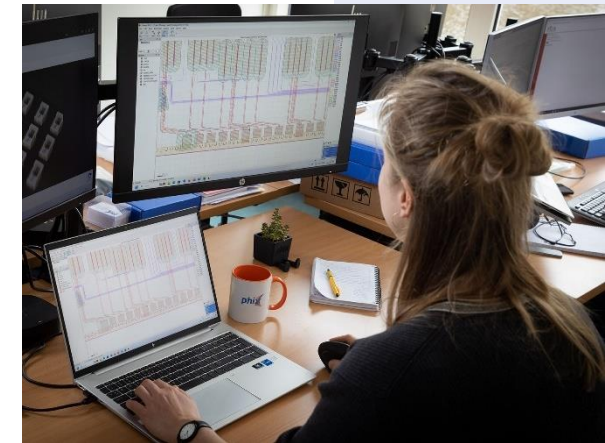
Fly to great heights

- We help you define a roadmap toward volume manufacturing
- We optimize equipment, processes and the bill of materials with the total costs in mind

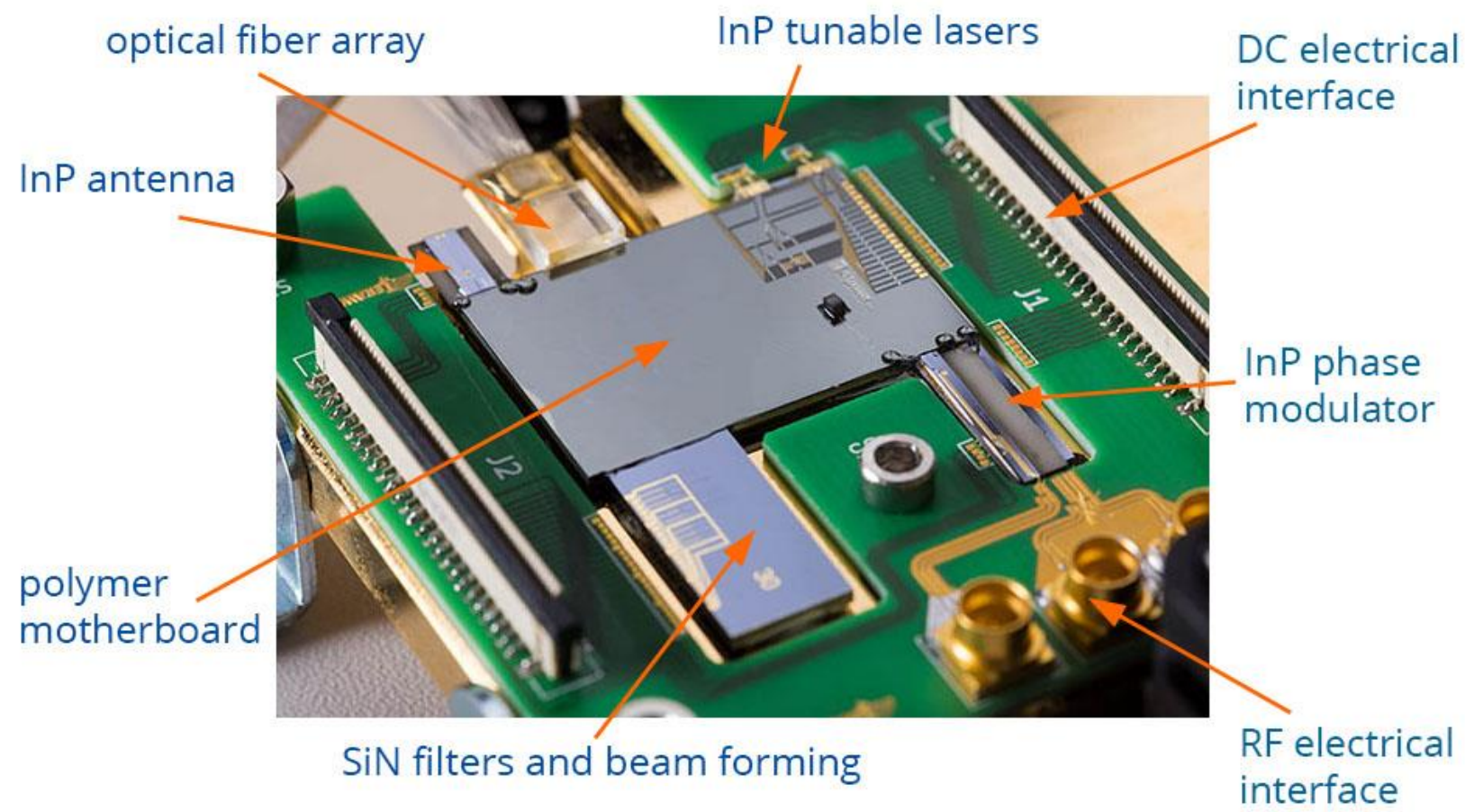


Design Guidelines for Photonic Integrated Circuit Packaging

PHIX is a one-stop-shop for the manufacturing of modules powered by photonic integrated circuits (PICs), from design to volume production. This document describes the core design guidelines for PICs that will enable PHIX to package your chip into a high performance and cost-effective module that is suitable for a scale-up to volume manufacturing. It will also help you select the standard package type that best suits your needs.



Hybrid integration – leveraging the best properties of each PIC technology



PHIX value proposition

Independent packaging foundry

Quality

Low scale-up cost

Speed

Flexibility

Design engineering support

- One-stop shop
- Easy start-up
- Max. performance at min. cost

Technological excellence

- Allround
- Harness the full power of PICs
- Low losses

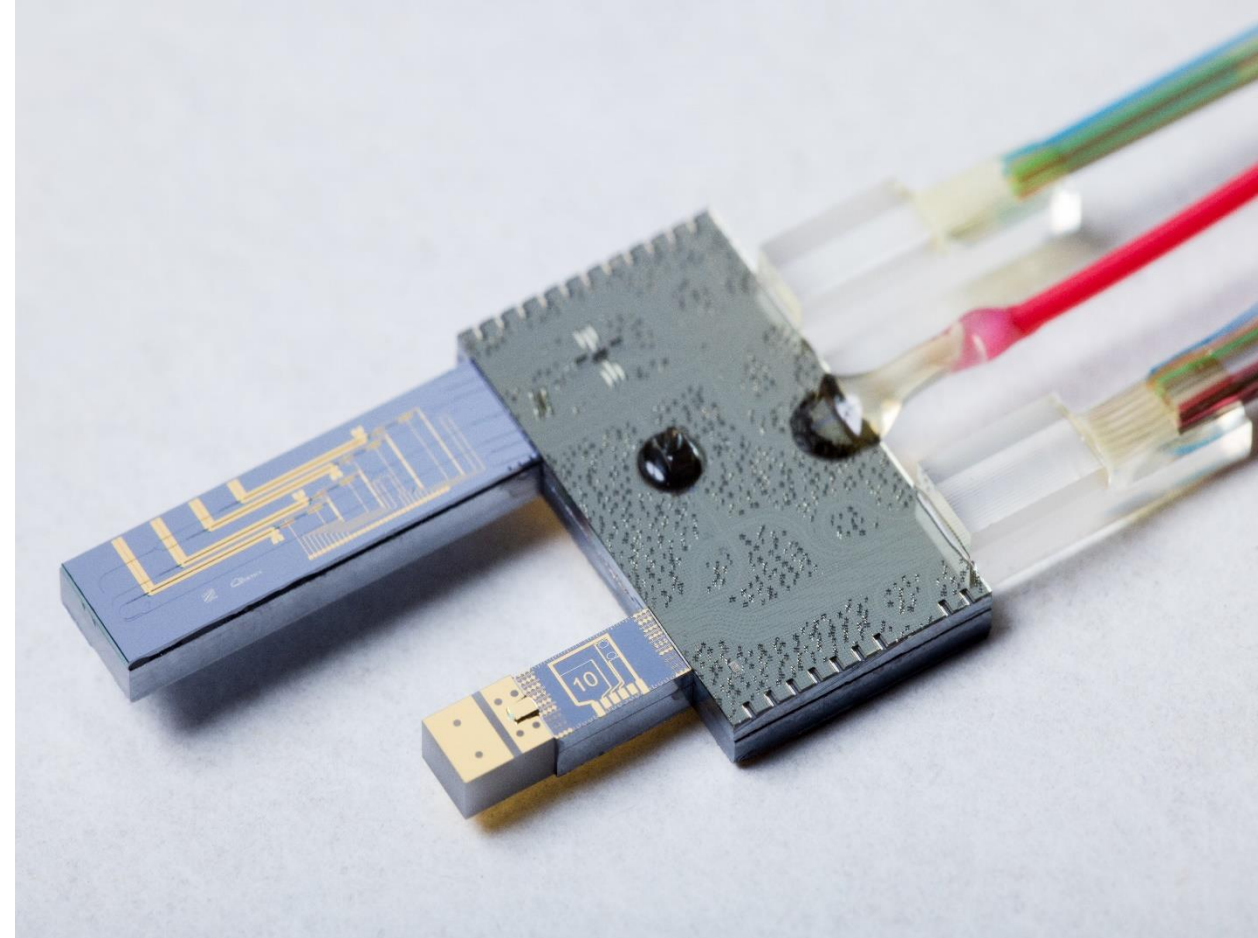
European based

- Connected
- Unique position
- Well-funded
- Trustworthy



Quantum challenges toward the future

- Quantum Doomsday
- No standards
- Limited volume
- Scaling electrical channel count
- Optical loss -> Fidelity
- Cryogenic temperatures



Quantum Doomsday

- How fast is the quantum decryption technology developing
 - Quantum panic ~3 years from now
 - Quantum doomsday within 6 years

This determines

- the business case
- growth requirements
- and fear, no country wants to be late

Working Group

Quantum-safe Security

The goal of this working group is to support the quantum-safe cryptography community in development and deployment of a framework to protect data whether in movement or at rest.

[View Current Projects](#)

Practical Preparations for the Post-Quantum World
Tasks Every Organization Should be Performing Now to Prepare

Download

RESEARCH TOPICS ABOUT TOPIC WORKING GROUP DISCUSSION COMMUNITY PUBLICATIONS

Countdown to Y2Q

05	335	08	56	51
Years	Days	Hours	Minutes	Seconds

No standards

- Not on materials
- Not on wavelengths
- Not on interfacing methods
- Not on measurement methodologies

This is a preview - [click here to buy the full publication](#)



IEC 60793-1-40

Edition 2.0 2019-03
REDLINE VERSION

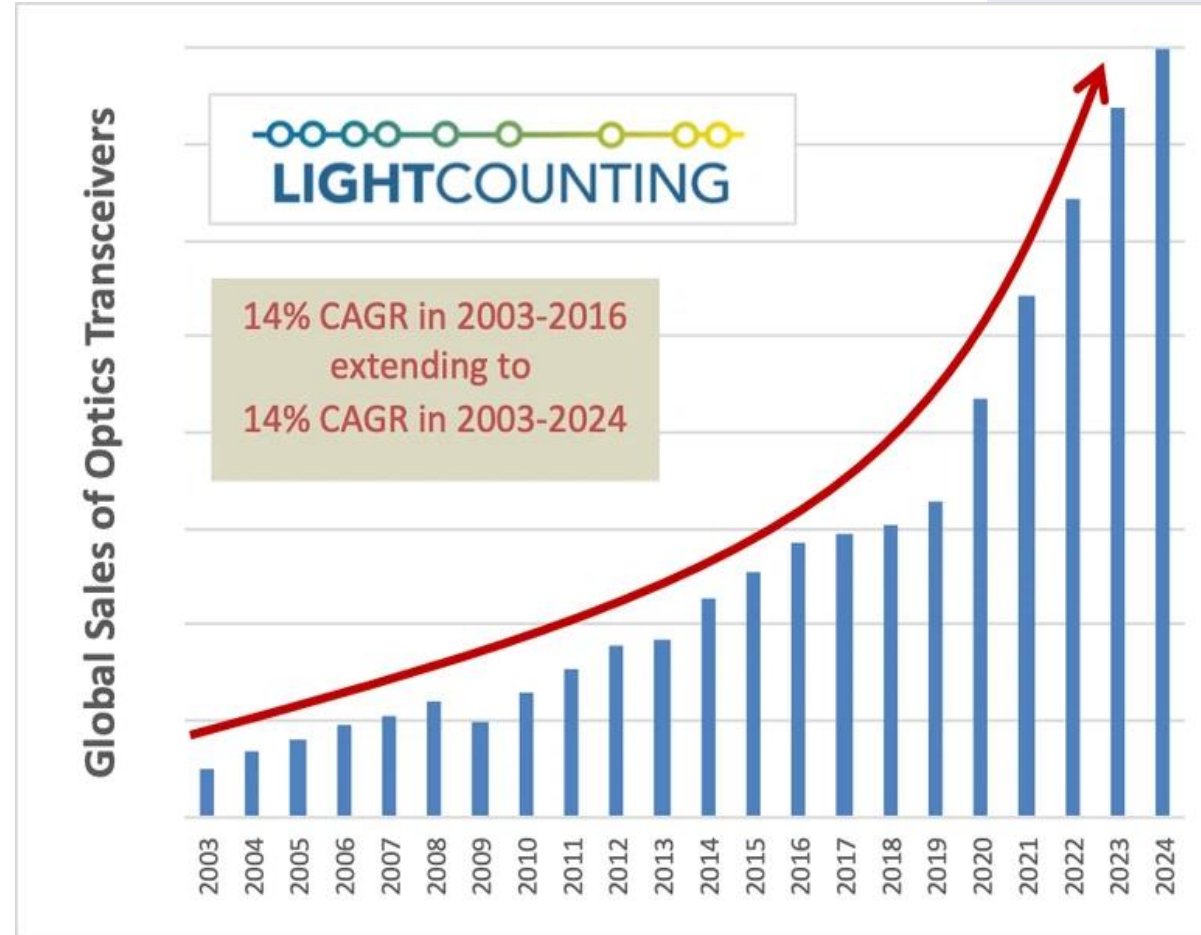
INTERNATIONAL STANDARD



Optical fibres –
Part 1-40: ~~Measurement methods and test procedures~~ – Attenuation
measurement methods

Limited volume

- Transceiver business largest integrated photonics business to date and steadily growing
- Still a small market compared to electronics
- Where is quantum
 - Reduce custom developments -> choose your risk
 - Leverage in place equipment and technology



Scaling electrical channel count

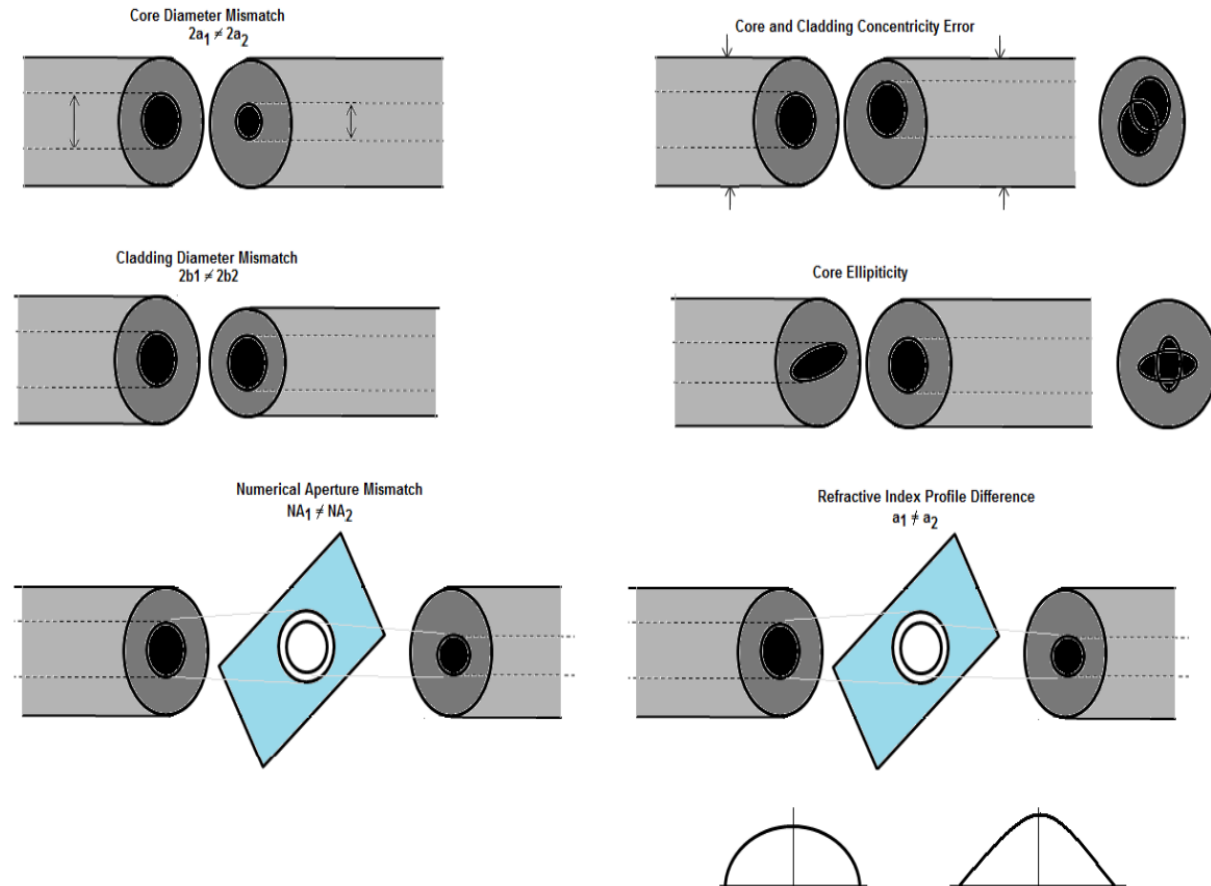
- Absence of serialiser / deserialiser in integrated optics platforms
- Switch electrical IO scales with power of 2 with respect to port count
 - 2x2 switch matrix requires 4 electrical connections + common ground
 - 4 x 4 switch matrix requires 16 electrical connections + common ground
- Same challenge as phased array for automotive beams steering
- Custom electronics being developed
- Flip chip integration
 - Power distribution
 - RF
 - Crosstalk

4" wafer
50x50 switch
~3200 wirebonds



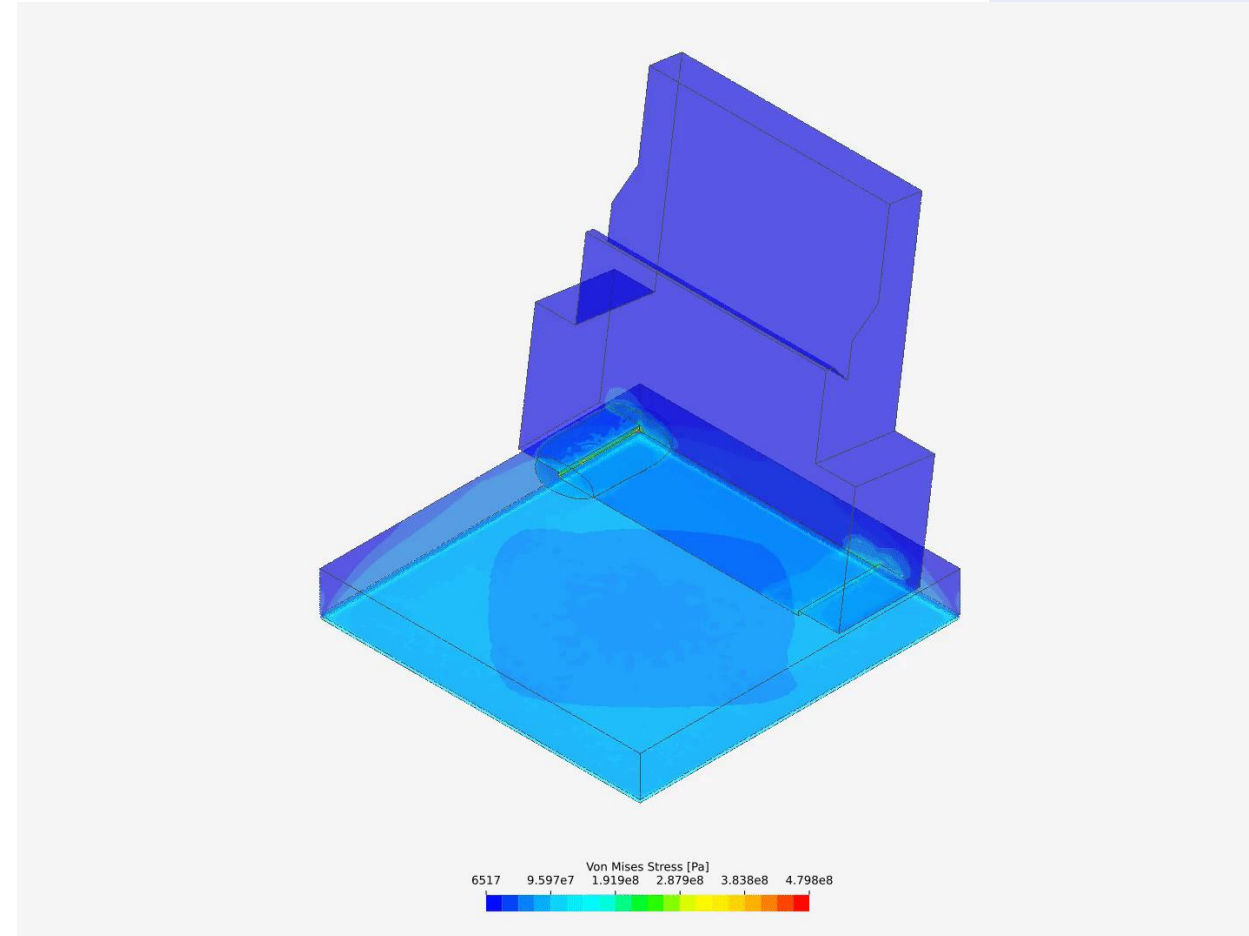
Optical loss -> Fidelity

- Improving mode field overlap
 - Better alignment of the fiber cores
 - Mode field manufacturing tolerance -> chip level
 - Better mode field, fiber is currently fixed to Bessel function
- More fibers
 - Yield
 - Wafer bow
 - Fiber block bow
 - Split in smaller fiber arrays -> more attachments



Cryogenic temperatures

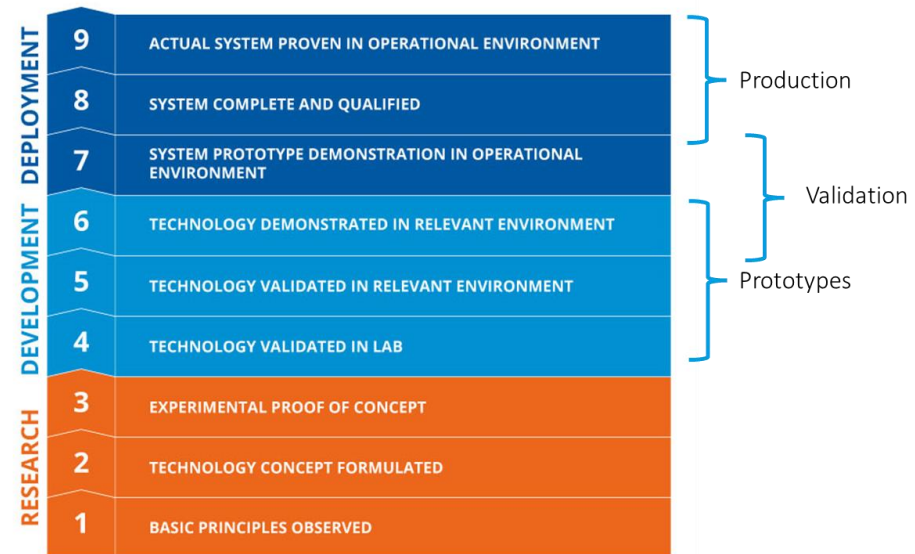
- Large temperature range -> creates mechanical stress
- Mechanical models work well to 70 Kelvin
- Below not always linear especially not for epoxy's



Summary

- New market with huge opportunities in QKG, QKD
- High geographical / political pressure
- High potential but high risk (who will win)
- Drives new technology development, but be careful on TRL, select your battle

How to get from TRL4 to TRL9?



Time/ effort

