

# Swiss high-speed PLCs for data centers

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Nov 24<sup>th</sup>, 2025

Lumiphase



# Lumiphase at a glance

Zurich



Stäfa





# Lumiphase at a glance



**Growing team**

**Founded 2020  
~70 people**

**Unique  
Technology**

**Thin-film-BTO-  
enhanced  
silicon photonics**

**Chip supplier**

**Design,  
manufacture &  
sell optical chips**

**Upcoming  
products**

**First product in  
qual.**



# Swiss high-speed PLCs for data centers

The background image shows a vast, multi-story data center. The ceiling is a complex, high-arched steel structure with numerous lights. The floor is filled with rows of server racks, some of which are illuminated with blue and purple light. A complex network of cables and conduits runs across the floor and up the walls, creating a dense, organized pattern. The overall atmosphere is one of high-tech, industrial precision.



# Swiss high-speed PICs for data centers

**Lumiphase  
product**



**BTO crystal  
inside**

Electrical  
data

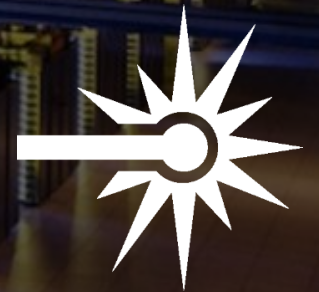


1 mm



Optical transceiver module

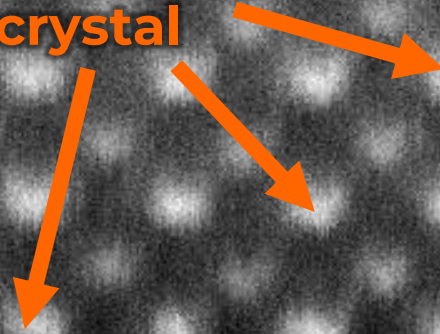
Optical  
data







Atoms of  
crystal

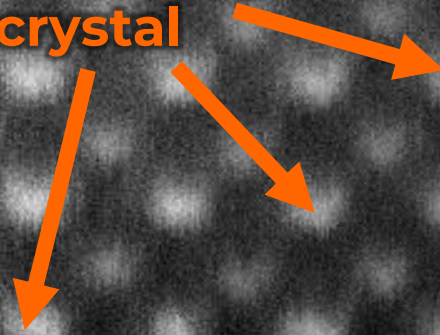


**Barium Titanium Oxide – BTO**  
**Extremely efficient electro-optical**  
**“Pockels” crystal**

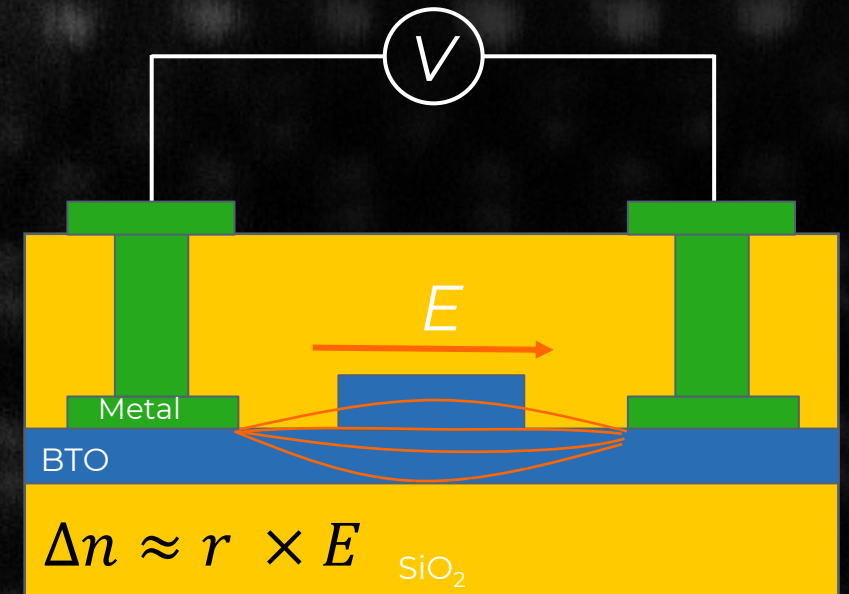




Atoms of  
crystal

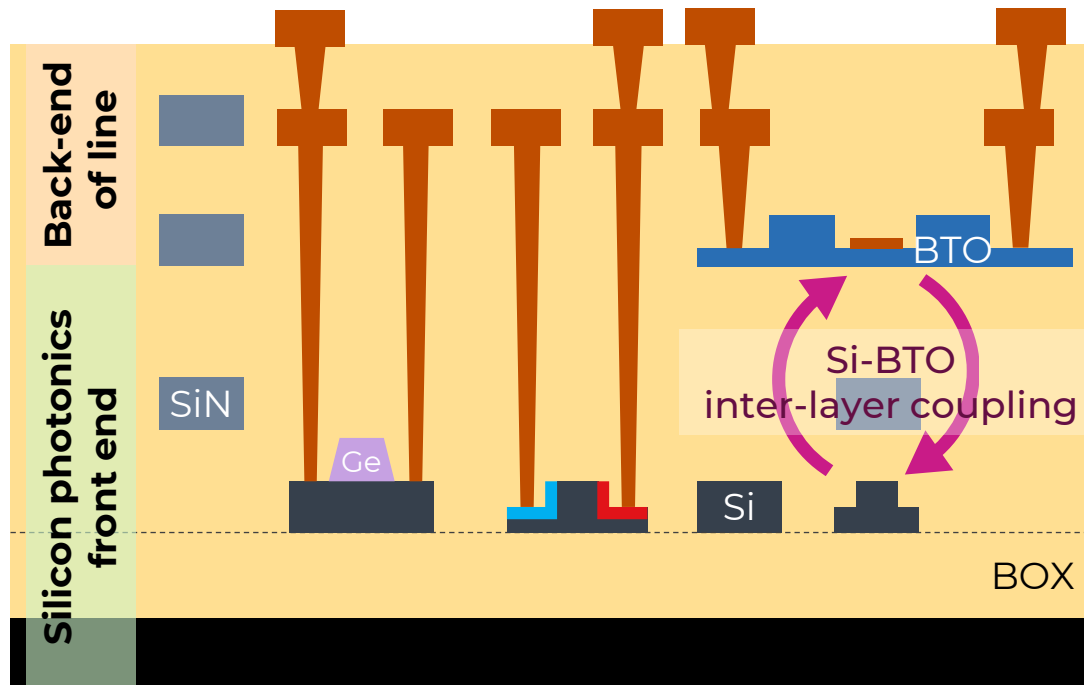


BTO  
phase  
shifter

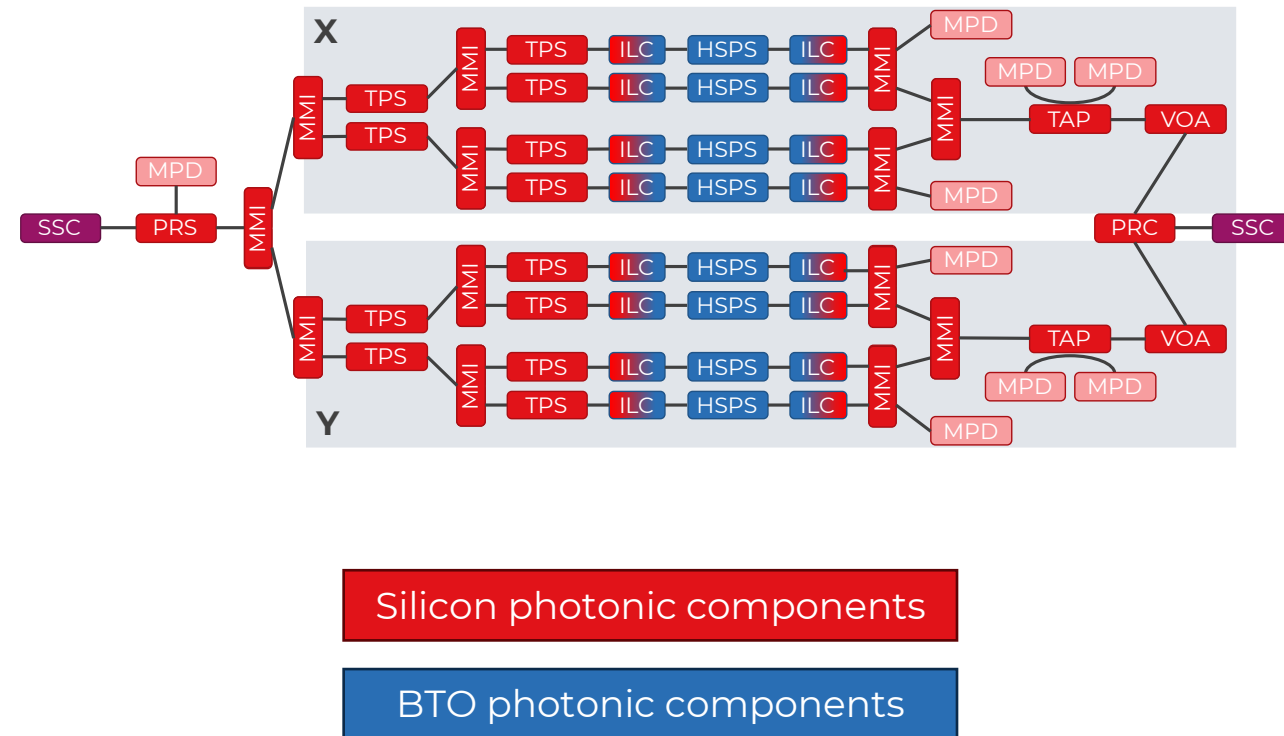


# BTO technology stack

## Schematic: Cross section



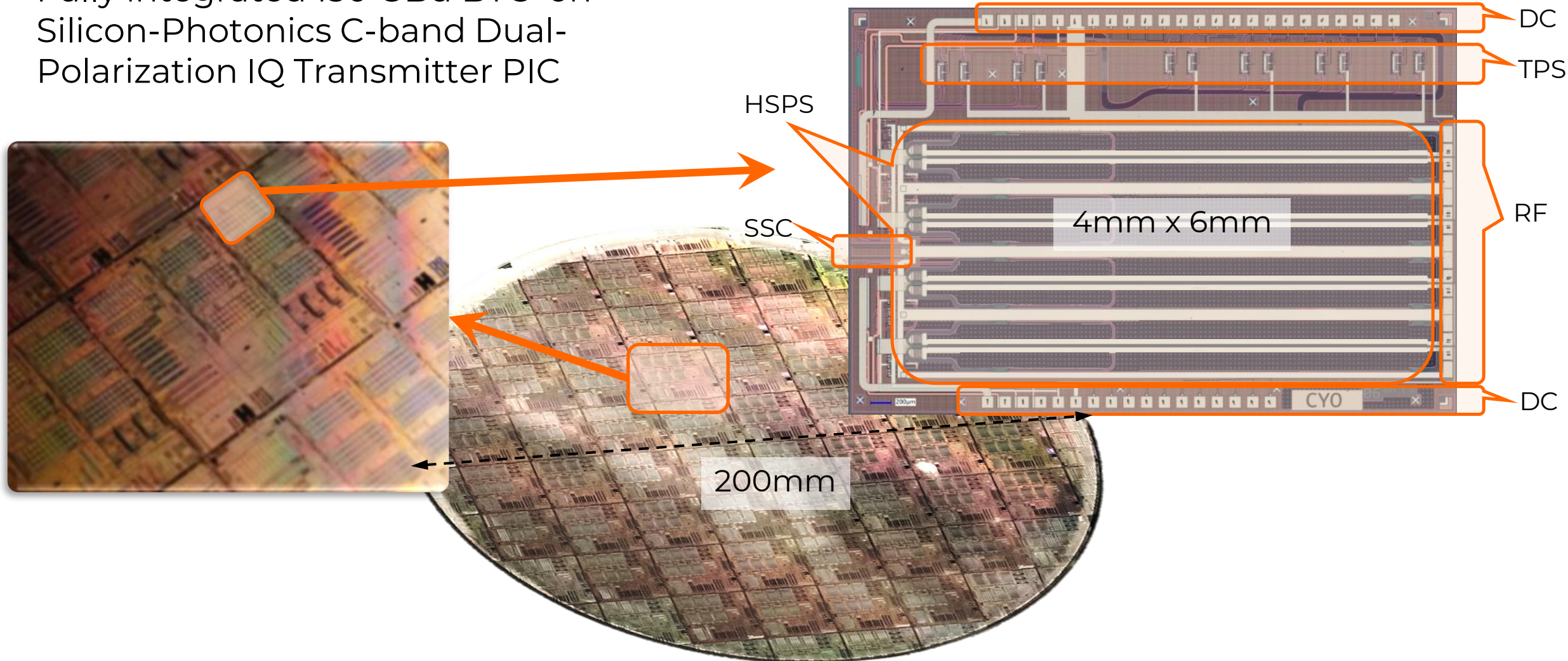
Schematic: Circuit design for coherent transmitter PIC





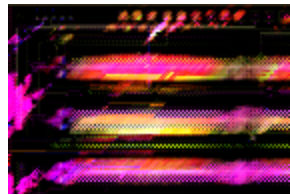
# Example: Coherent transmitter PIC

Fully integrated 130 GBd BTO-on-Silicon-Photonics C-band Dual-Polarization IQ Transmitter PIC

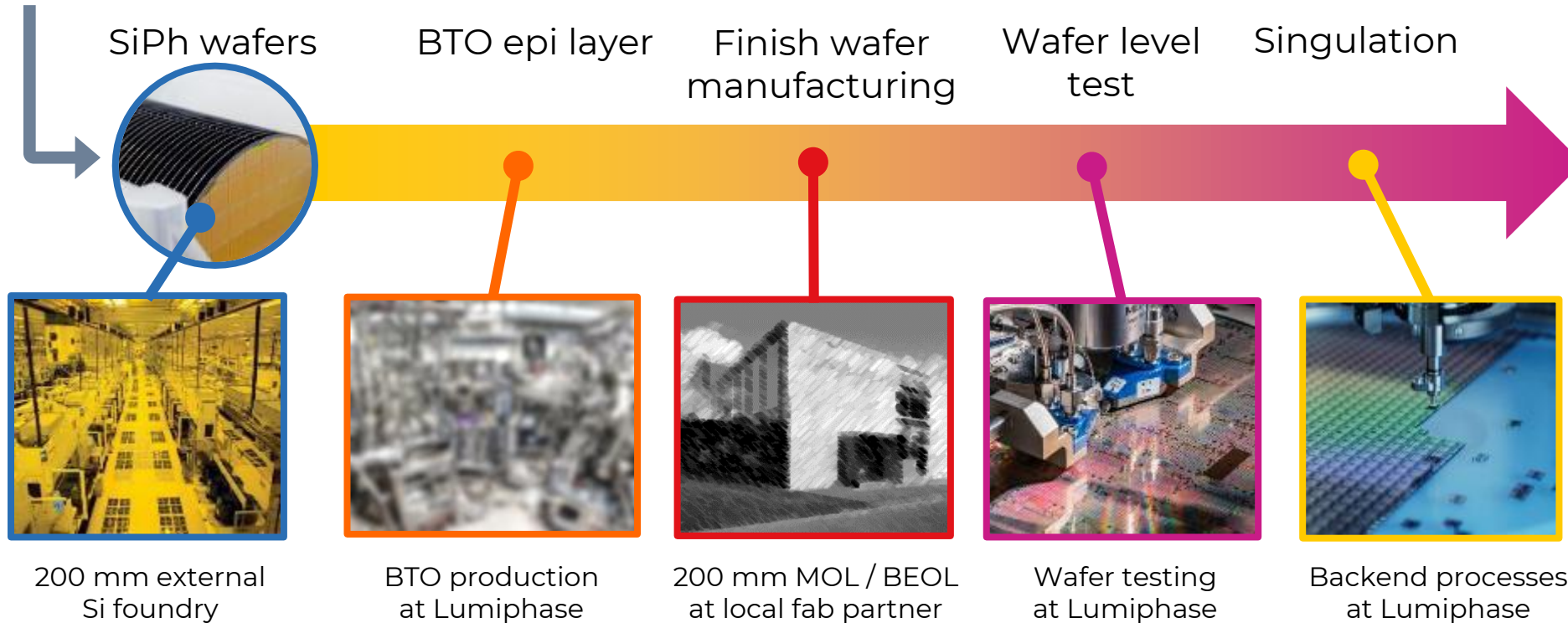




# Lumiphase supply chain



**Standard product or custom chip design**

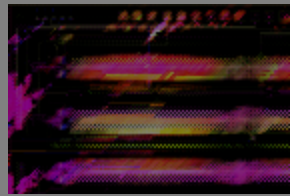


**Product KGDs**





# Lumiphase KGD production



**Standard  
customer**

- Examples for
- Wafer level testing: internal vs external
  - Packaging for reliability tests

SiPh wafers

manufacturing

Wafer level  
test

Singulation

**Product  
KGDs**



200 mm external  
Si foundry



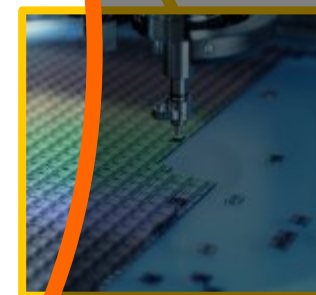
BTO production  
at Lumiphase



200 mm MOL / BEOL  
at local fab partner



Wafer testing  
at Lumiphase



Backend processes  
at Lumiphase



# Lumiphase Testing infrastructure

- Infrastructure
  - R&D and production cleanroom environments
- Equipment
  - Wafer-level and chip-level product testing
  - DC and RF test capabilities, small signal
- External, need for eco system
  - Data transmission / system tests
  - Higher speed measurements





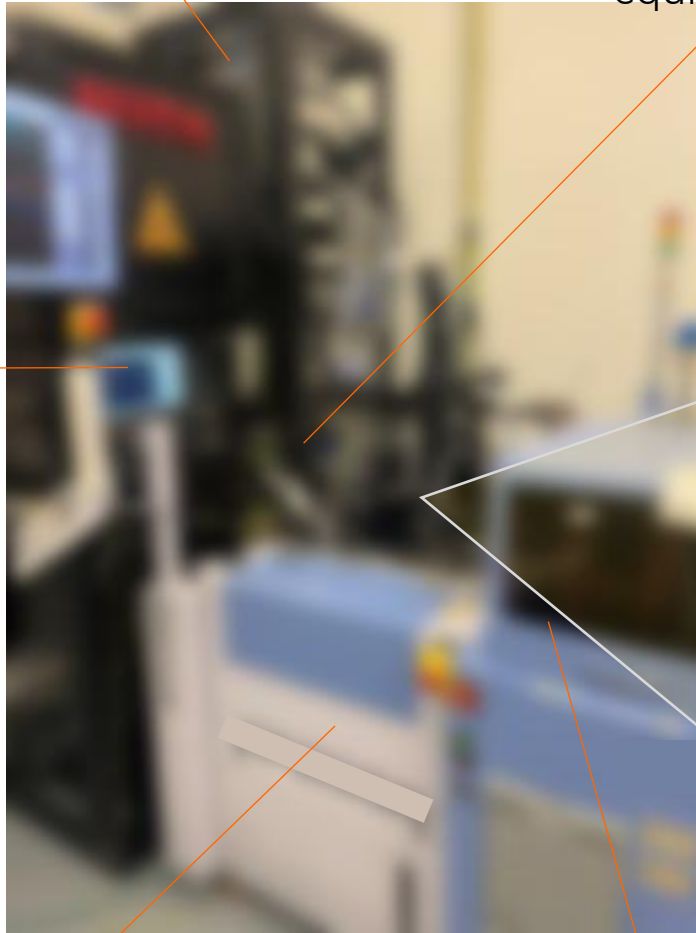
# Example 1: Wafer Level Test System

DC/Function Generators

Optical test equipment

- **For R&D:** Versatile test capabilities (different designs), fast turn-around-times for short learning cycles
- **For production:** Fixed test procedures & layouts, cost reduction in focus

RF/Electrical Test Equipment



Wafer prober

Automatic wafer loader

alignment

Optical inspection

Fiber array

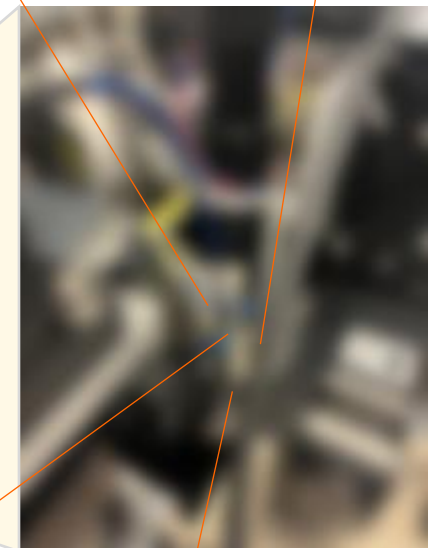
DC probe



probe stages

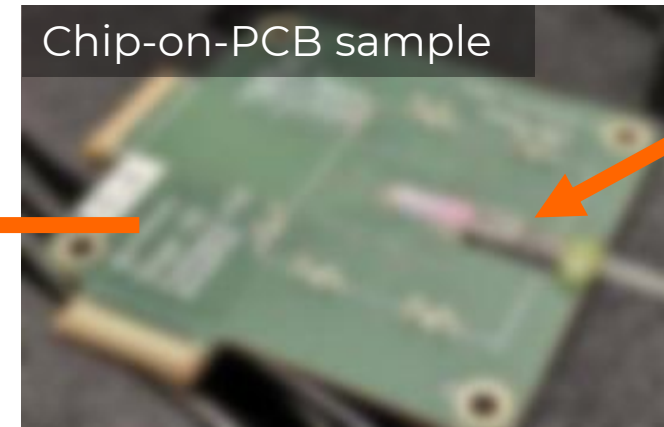
RF probes

Thermal chuck





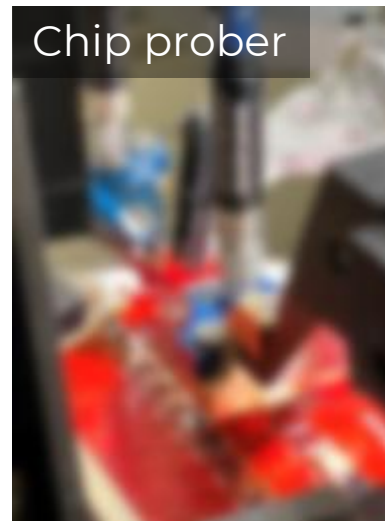
# Example 2: Reliability testing



Connectivity  
Optical: Fiber array  
Electrical: Wire bonds

**Path 1**  
In-situ electro-optical

**Path 2**  
In-situ electrical



- Background
  - BTO is new for integrated photonics
  - Need to prove that BTO devices are long-term reliable
- Approach
  - Infrastructure for GR468 tests and harsher conditions established
  - Chip-on-PCB samples for electrical and electro-optical testing
- External, need for eco system
  - Optical packaging for low volumes



# Summary and conclusion

- Lumiphase offers PICs for high-speed communication, based on BTO-modulator engines
- Supply chain includes fabrication and testing in Switzerland
- Need for Swiss eco system for
  - Very-high speed testing
  - Data transmission and system tests
  - Optical packaging at low-volumes



