Quantum Photonics at AMO GmbH

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Head of Photonics

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Advanced Microelectronics Center Aachen (AMICA)

AMO GmbH – Quantum Photonic Research Foundry

- **High-Tech SME (non-profit)**
- **Research Foundry**
- **Close ties to RWTH Aachen University**
- **> 50 staff members**
- **> 25 years experience of nanofabrication**
- **> 17 years experience of silicon photonics**

Gesellschaft für Angewandte Mikro- und Optoelektronik mbH

Managing Directors:

- Prof. Max Lemme
- Dr. Michael Hornung

Fundamental Research → Applied Research → Prototype Development → Small Scale Production → Mass Production

- **Key technologies:**
  - **Silicon technology based**
  - **Nanoelectronics**
  - **Photonics**

- **We offer: customized prototyping and contract research**

Light-based Quantum Computing

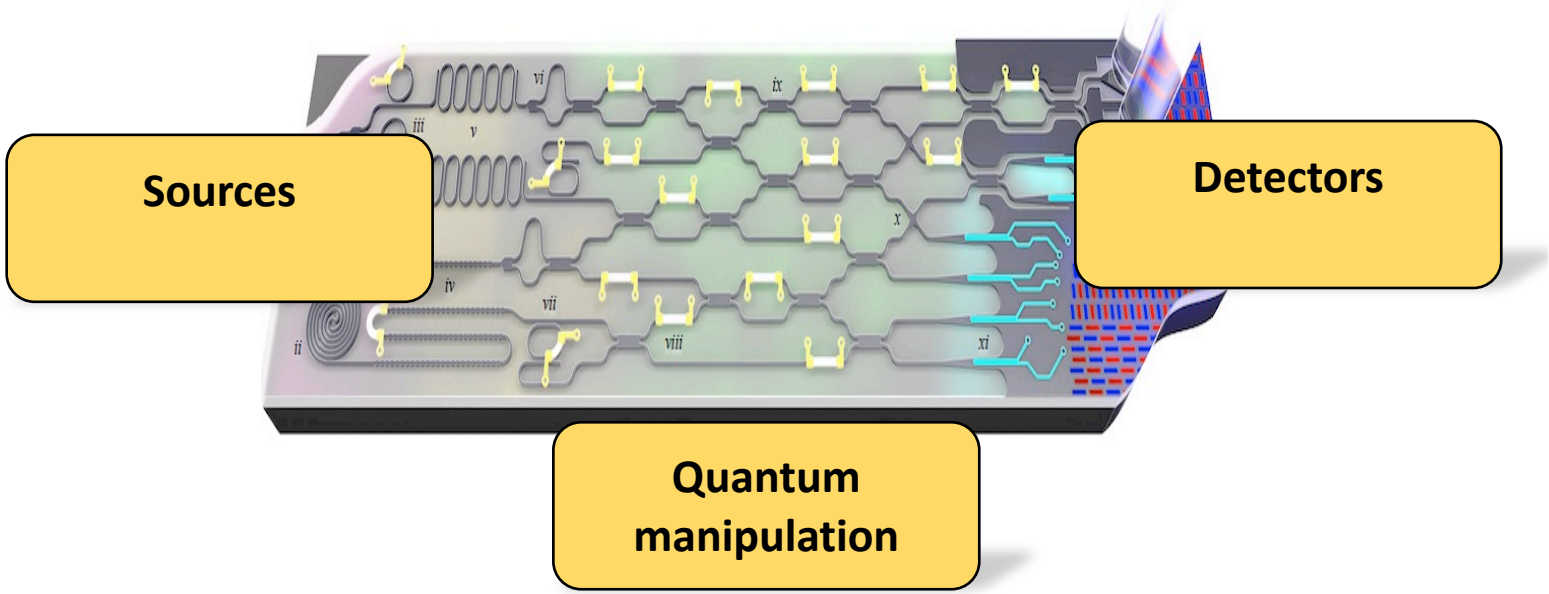
Most approaches for Quantum Computing are matter-based:

- Trapped ions
- Superconducting Q-bits
- Annealers
- Quantums dots

Light-based:

- Integrated photonics

→ High number of „useful“ Qbits needed!



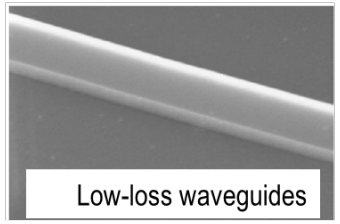
Avantages of light-based approaches:

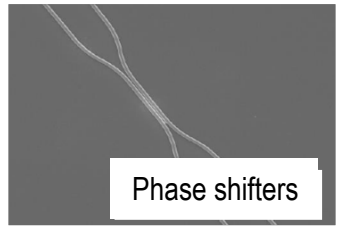
- Photons can easily be manipulated → photonics technologies (EPIC)
- Intrinsic carrier of quantum information
- Manufacturable → advanced silicon photonics technologies
- No decoherence as in matter-based systems
- Aim at room temperature (no cryogenics)

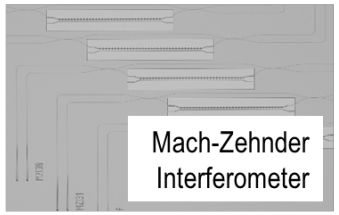
- **→ Integration is key for disruptive technology change!**

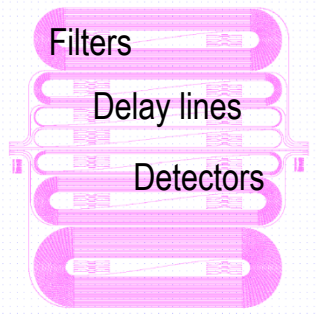
[1] D. Bonneau, J. W. Silverstone, and M. G. Thompson, “Silicon quantum photonics,” *Top. Appl. Phys.*, vol. 122, no. April, pp. 41–82, 2016

Photonic Platforms for Light-based Quantum Computing









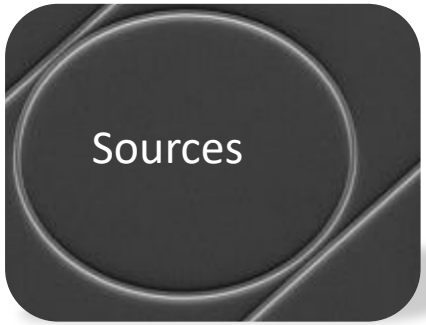
AMO's Silicon Photonics and Si_3N_4 Photonic Platforms

passives

- **Wave-guides**
- **Grating & Broadband couplers**
- **Microring resonators**
- **Mach-Zehnder interfero-meter MZI**
- **Directional couplers**
- **Spot-size converters**

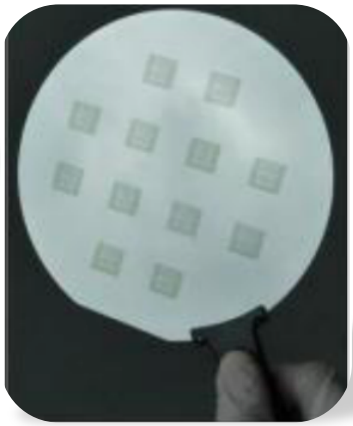
actives

- **Heaters / Thermo-optical switches**
- **EO-Modulators** Based on MZI or microrings
- **Si-Photo-detectors**



Generation of entangled states via microring resonators relying on Spontaneous four wave mixing $\chi^{(3)}$

Wafer scale manufacturing



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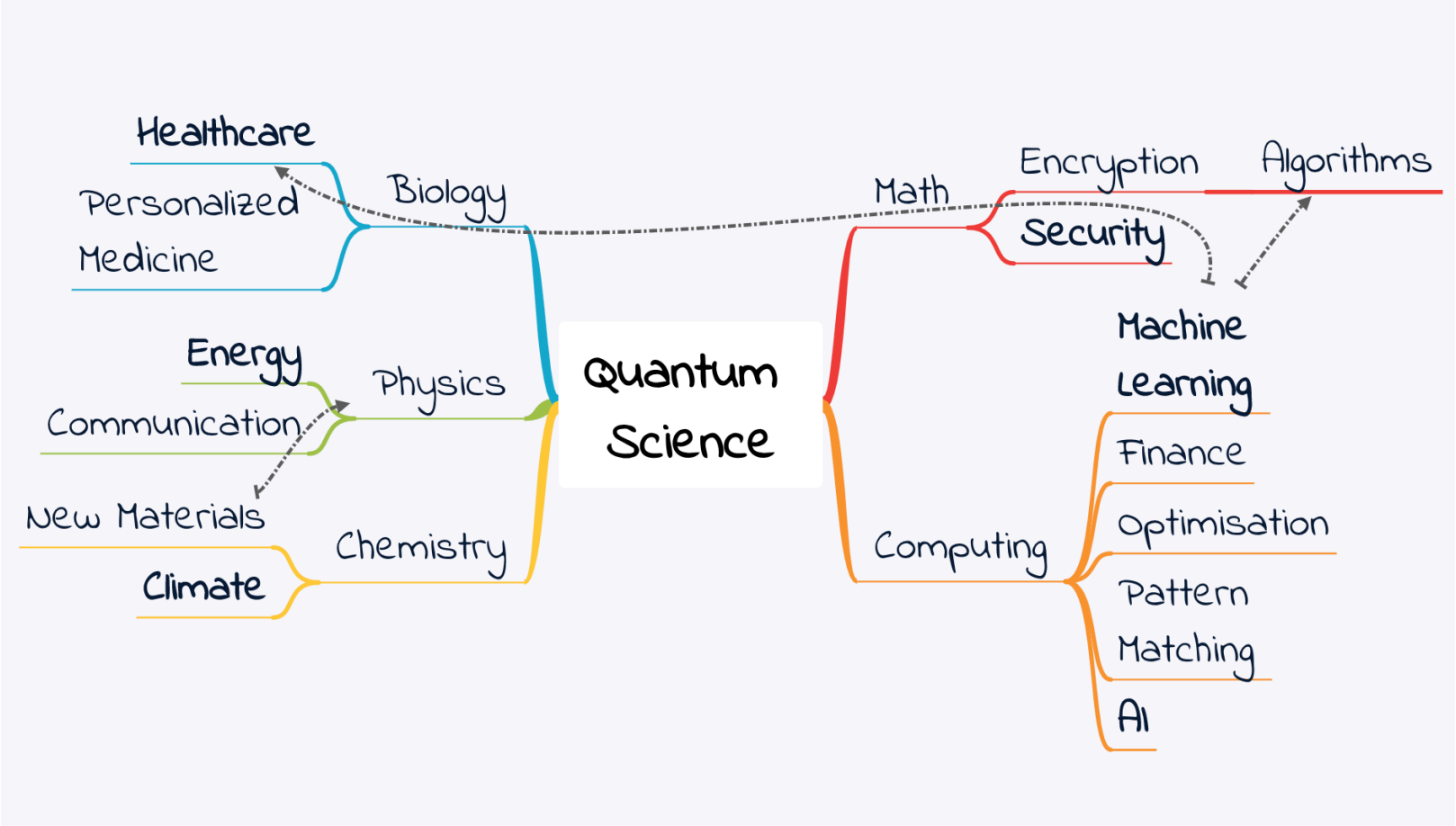

We are looking for **industry partners, start-ups, research partners** to explore the world of quantum science – towards manufacturable quantum computers and more applications!

- Rapid prototyping – Customized fab runs -