Qu-PIC

Quantum Universal Photonics Integrated Circuit Platform

PROJECT PRESENTATION

Qu-PIC - Addressing the need for a universal photonic integrated platform to operate from the UV to the mid-IR for a broad range of quantum applications.

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No #101135845. This result only reflects the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

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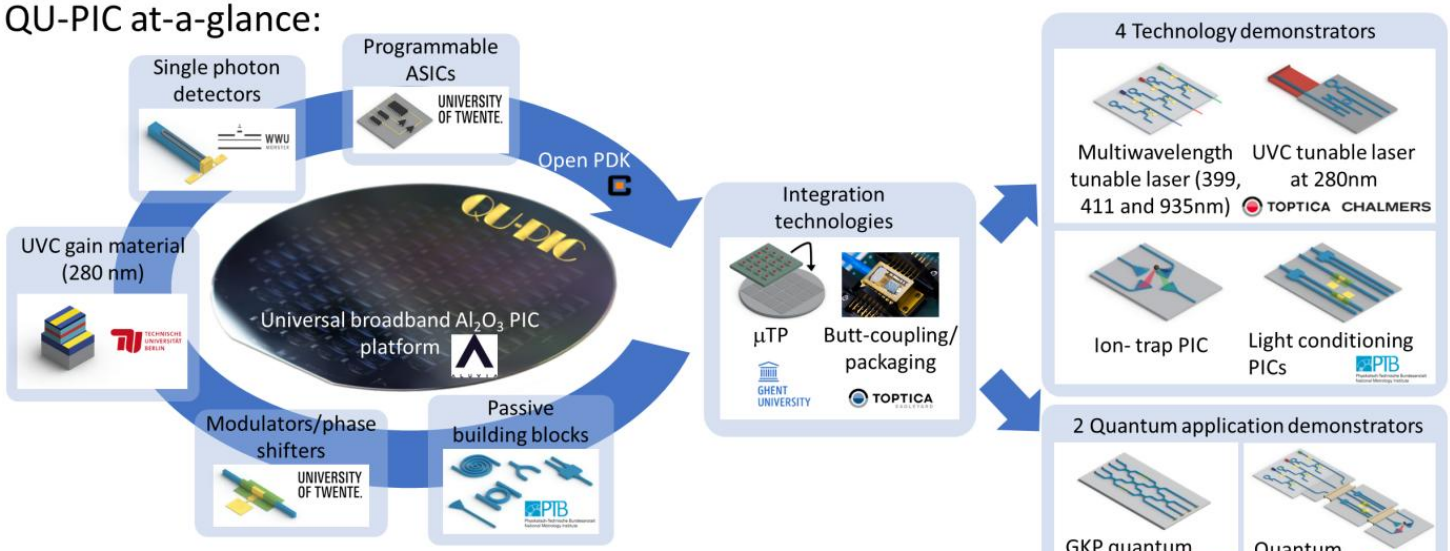
OBJECTIVES – TOWARDS SCALABILITY OF PIC BUILDING BLOCKS FOR QUANTUM APPLICATIONS

QU-PIC's main objective is to develop a toolkit of photonic integrated circuit (PIC) quantum building blocks to accelerate the development of complex quantum systems, from idea to packaged systems. Many of the technologies required in the supply chain will be developed to ensure their availability in Europe, which is key to establish European sovereignty in the emerging quantum field.

QU-PIC at-a-glance:



Unique selling points:

- Broadband backbone PIC platform capable of serving all quantum PIC applications: towards scalability
- European supply chain of PIC building blocks for quantum
- Wafer-level integration technology
- Open PDK of quantum building blocks: acceleration of innovation process
- Validation in state-of-the-art quantum systems
- Strong consortium of both academics and industry with expertise from research to exploitation

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DETAILED OBJECTIVES

MATERIALS/DEVICES

1. Development of optical gain material emitting at 280 nm (in the UVC)
2. Superconducting nanowires detectors integrated on Al_2O_3 waveguides
3. Development of a programmable ASIC
4. Development of fast, low-power modulators
5. Passive PIC building blocks for quantum
6. Process Design Kit (PDK) of basic PIC building blocks for quantum

ASEMBLY/PACKAGING

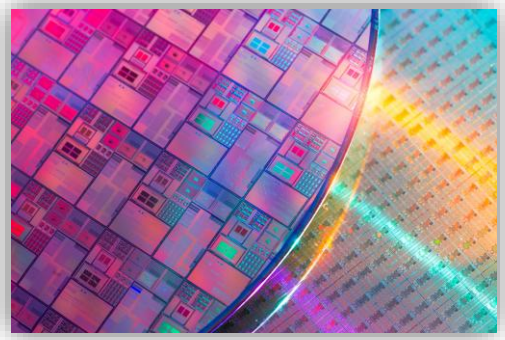
7. Development of a µTP printing technology for 280 nm AlGaN gain material onto Al_2O_3 platform
8. Development of packaging/assembly for UV waveguides, compatible with cryogenic operation

TECHNOLOGY DEMONSTRATORS

9. Demonstrate a multiwavelength tunable laser
10. Demonstrate a 280 nm external cavity UV laser
11. Demonstrate a light distribution PIC
12. Demonstrate an ion trap chip

APPLICATION DEMOS

13. Quantum processor for generating GKP states
14. Quantum sensing based on atomic clocks



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ABSTRACT

Quantum technology holds the promise of enabling next generation computing, communications, and sensing systems. However, the size, cost, and scalability of current devices prevents them from reaching their full potential. Photonics is one of the key enabling technologies for quantum technology. In particular, photonics integrated circuits (PICs) with their wafer-level manufacturing based on microfabrication technologies can provide the reduction in size and cost and enable next generation scalable quantum technologies. To fully achieve this goal, a universal PIC technology that can serve most quantum applications is needed.

In QU-PIC, we selected the Al2O3 integrated photonics platform as backbone technology for the development of quantum PICs thanks to its excellent low propagation loss performance and wide operating spectral region from the ultraviolet (200 nm) until the mid-infrared.

A large range of PIC building blocks will be developed in QU-PIC, focusing on areas where materials or integration technologies are not yet available. Several light sources, including multiwavelength tuneable lasers with operation at 399 nm, 411 nm, and 935 nm on the PIC, UVC external cavity lasers emitting at 280 nm, sources of squeezed photons, single photon detectors, programmable ASICs, and the required packaging and assembly technologies will be investigated. An open PDK will group all the developed quantum building blocks to accelerate innovation from the initial idea to an actually manufactured system.

Two application demonstrators will be implemented using the developed building blocks, namely a source of GKP states for quantum processing and an atomic clock based on Yb+ ions for quantum sensing. It is the ambition of QU-PIC to secure a full European supply chain to establish Europe's sovereignty and manufacturing capabilities in photonics integrated circuits for quantum.

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General information

- **Programme:** HORIZON.2.4 - Digital, Industry and Space - HORIZON.2.4.7 - Advanced Computing and Big Data
- **Topic(s):** HORIZON-CL4-2023-DIGITAL-EMERGING-01-40 - Quantum Photonic Integrated Circuit technologies (RIA)
- **Grant agreement ID:** 101135845
- **Start date:** 1 January 2024
- **End date:** 31 December 2027
- **EU contribution:** € 5 947 868
- **More information:**
  https://www.qu-pic.eu
  https://cordis.europa.eu/project/id/101135845

No	Participant organisation name	Country
1	UNIVERSITEIT TWENTE (Coordinator)	
2	UNIVERSITEIT GENT	
3	QUIX QUANTUM BV	
4	TEMATYS	
5	TOPTICA PHOTONICS AG	
6	Aluvia Photonics BV	
7	WESTFAELISCHE WILHELMS-UNIVERSITÄT MUENSTER	
8	TECHNISCHE UNIVERSITÄT BERLIN	
9	CHALMERS TEKNISKA HOGSKOLA AB	
10	PHYSIKALISCH-TECHNISCHE BUNDESANSTALT	
11	EAGLEYARD PHOTONICS GMBH	
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