Photonic quantum technologies group

Prof. Dr. Michael Kues
Hannover Center for Optical Technologies, Leibniz University Hannover
Quantum photonic systems for technology applications

Bulk based systems

Photonic chips
On-chip quantum frequency comb: time bin

On-chip quantum frequency comb: frequency bin

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Integrated/fiber-based photonic systems

Quantum-enhanced measurement concepts

Quantum algorithms for optimization problems
Quantum metrology and sensing

→ Enhanced resolution, precision, sensitivity

Exploring and developing **quantum frequency combs** for ...

- Integrated/fiber-based quantum-enhanced measurement systems

- New quantum metrology concepts based on frequency comb nature and new processing scheme

- Imaging and spectroscopy
  Quantum optical coherence tomography
  Sub-shot-noise spectroscopy
Quantum machine learning

Accelerating machine learning e.g. classification and clustering tasks

No universal processing ...

... but static defined manipulations

“Photonic quantum technologies” Research Lab

Quantum optics laboratory with cutting-edge equipment operational after 6 months

First on-chip quantum frequency comb in Germany/Europe

FSR=55 GHz
Bachelor and master thesis

• Detection of 4 photon states: building photon generation setup and develop quantum state analysis codes

• Quantum random number generator: Building up a chip coupling stage and photonic chip control

• Photonic machine learning: developing and simulating a photonic based setup for machine learning tasks

• High-dimensional quantum random walk: performing simulations and designing the experiment

• ....
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More details related to this work:

Quantum computing

Machine learning

Application fields:

- Finance
- Cyber security
- Drug development
- Medicine
- Autonomous vehicles
- Robotics

Current approaches: neuronal networks and large scale vectors → large overheads