Institute of Applied Physics
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MAX PLANCK SCHOOL of photonics

Quantum computing on an integrated photonic platform

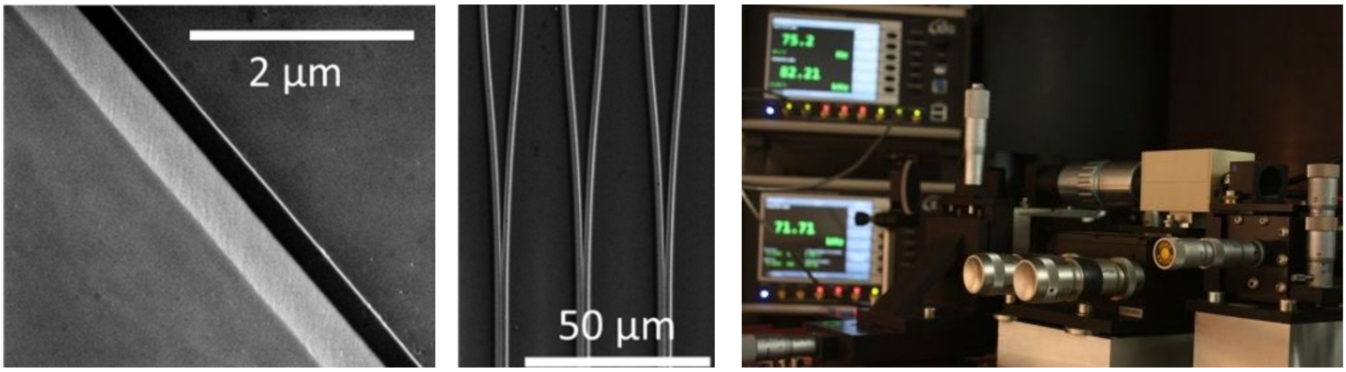
Nanoscale waveguides in lithium niobate on insulator systems are an emerging platform for integrated quantum computing that offers unrivalled properties like small absorption losses in a wide spectral range, high optical nonlinearities, and the ability for ultrafast modulation of material properties. Based on these exceptional properties, a number of basic elements for integrated quantum computing, e.g. entangled photon sources, low-loss quantum interference elements, fast modulators, and nonlinear frequency converters have been demonstrated. All these demonstrations used waveguides with cross-sections in the range of a few hundred nm, showing the large potential of this platform to realize integrated and scalable quantum computers.

We aim to use this platform to move quantum optics to the nanoscale by implementing sources for photonic quantum states, optical elements to modify and control these quantum states as well as single-photon detectors in a single optical chip. This will enable to realize different quantum functionalities in lithium niobate nanowaveguides, with the final aim to build a full-scale photonic quantum computer.

The project comprises the development, optimization, and test of individual quantum elements in such circuits, the implementation of basic quantum interference experiments to gauge the performance of complex lithium niobate quantum circuits and the design and realization of large-scale circuits that perform applicable functionalities.

Depending on the abilities and preferences of the candidate the following subjects would be covered

- Theoretical quantum optics and numerical simulations
- Experimental characterization and nanostructuring technology
- Development and demonstration of quantum computing applications



Left: Lithium niobate rib waveguide. Center: Y waveguide splitters. Right: Setup for characterization of integrated quantum circuits.

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