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Field of specialization 12: Photonics

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Language
English

Institutes

Institute of Photonics and Quantum Electronics (IPQ)

In a nutshell

Photonics is a key technology of high-speed communications, advanced sensing, and ultra-fast signal processing. In this field of specialization, our curriculum and research activities span from device technology and nanofabrication to the fundamentals of wave propagation and optical sensing, and further to high-speed communications, ultra-fast signal processing and biophotonics.

Fields of application

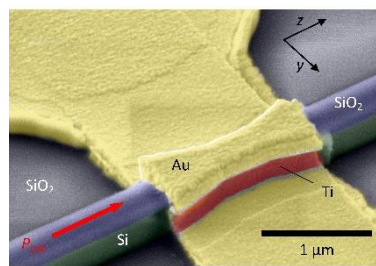
Photonic devices and systems are at the heart of modern information technology. The enormous information capacity provided by fiber-optic communication networks has led to arguably the most significant technological evolution of the past decades – the global internet. Every E-Mail, every streaming video, every online order, and every voice and video call, be it mobile or landline, is transmitted via optical fibers made of ultra low-loss glass using light emitted by infrared lasers.

Moreover, photonic technologies are the foundation of a wide range of applications in sensing and metrology. Optical sensors have revolutionized industrial applications and biophotonics has become an invaluable tool for life sciences and medical diagnostics. As examples, 3D laser scanners based on lidar are essential for autonomous cars; optical coherence tomography allows ophthalmologists to obtain detailed images of the human retina.

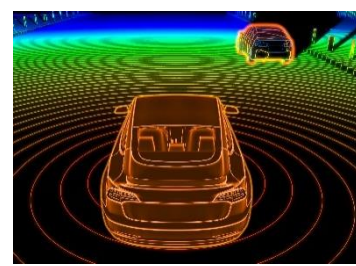
The combination of photonic and latest radio-frequency- and digital-electronic signal processing techniques opens a wide range of new opportunities across different industries. Specifically, ultra-fast photonic-electronic signal processing will not only drive 6th generation mobile communications but also creates new possibilities in scientific applications. From a technology perspective, advanced nanofabrication makes it possible to combine hundreds of optical components on a single microchip thereby enabling systems of unprecedented compactness and performance.



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Photonics covers a wide range of topics such as high-speed energy-efficient communications (left), advanced device technologies (center), and high-performance sensors for scientific, industrial, and consumer applications (right).

Content and Background

In this field of specialization, you will enter a highly dynamic field of engineering. You will strengthen your theoretical foundations and learn how leverage photonic technologies in use-cases of high technical relevance. Examples are the propagation of electromagnetic fields in waveguides or the principle and design of semiconductor devices such as lasers and photodiodes which are key building blocks of any photonic system. You will gain insight into the wide field of nonlinear optics, which is key to ultra-fast optical signal processing and to the understanding of the capacity limitations of optical communications networks.

Furthermore, you will be taught about optical communication systems and networks in which photonic technologies are combined with advanced communications engineering and digital-signal processing. The field of photonics is characterized by a tight connection of theory and experiments with practical applications in vividly evolving markets.