CFEL SCIENCE

SEMINAR

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DESY Building 49 - Seminar Room (108)

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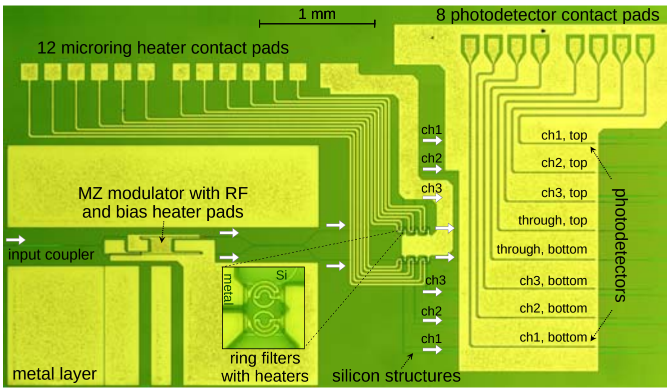
Photonic Analog-to-Digital Converters and Electronic-Photonic Integrated Circuits

Silicon photonics studies how silicon – the material of choice of modern electronics – can be used to create high-performance devices for guiding and processing light. The vision for this actively developing area of research is joining the powers of electronics and optics on a single silicon chip, fabricated with standard CMOS technology. It is expected that electronic-photonic integration will enable next-generation energy-efficient data transmission links and signal processing devices, needed to overcome interconnect bottleneck facing modern computer systems. Moreover, electronic-photonic integration will make it possible to create devices operating on completely new principles. An example of such device is a high-speed photonic analog-to-digital converter (ADC), which has potential to improve ADC performance by orders of magnitude. Such systems can be also used for precision microwave generation and characterization in advanced accelerator systems.

The first part of the talk describes progress towards an integrated photonic ADC. The photonic approach was demonstrated by building a discrete-component ADC and digitizing a 40 GHz signal with 7.0 effective bits – a 5-10 times improvement over the best electronic ADCs which exist today. An integrated silicon chip containing key components of a photonic ADC – an electrooptic modulator, filter banks, and photodetectors – was fabricated; the chip was shown to digitize a 10 GHz signal with 4.7 effective bits. Several novel devices were developed in course of this project, including a linearized silicon modulator, a dual 20-channel filter bank, and a fiber-to-chip coupler. These devices are expected to have impact in many areas of silicon photonics.

The second part of the talk discusses challenges on the way towards electronic-photonic integration and presents a monolithic photonic integration platform that leverages the existing state-of-the-art CMOS foundry infrastructure. This platform enables intimate integration of large numbers of nanophotonic devices alongside high-density, high-performance transistors. This approach is demonstrated by fabricating microring-resonator filter banks using an unmodified 28 nm bulk-CMOS process by sharing a mask set with standard electronic projects.



Host: Franz X. Kärtner – CFEL, Ultrafast Lasers & X-Rays Division