SYLA 2: Laser Sources for Emerging Technologies – Enabling the Future

Time: Wednesday 14:30–16:30 Location: HS 20

Invited Talk SYLA 2.1 Wed 14:30 HS 20

Low-Noise Quantum Frequency Conversion for NV-Based Quantum Network Nodes — •Bernd Jungbluth[1], Fabian Geus[1], Ludwig Hollstein[1], Hans Huber[1], and Florian Elsen[1,2] — [1]Fraunhofer-Institute for Laser Technology ILT, Aachen, Germany — [2]RWTH Aachen University, Aachen, Germany

We present two low-noise quantum frequency converters enabling telecom-band photon emission from NV centers. The NORA-QFC, deployed in the Q.Link demonstrator (Delft-The Hague), achieves >48% efficiency with less than 2 noise counts per second and per picometer filter bandwidth. A second, compact two-stage converter developed in the BMBF-funded HIFI project was implemented in Aachen for integration into a local NV-center node for scalable photonic interface testing.

Invited Talk SYLA 2.2 Wed 15:00 HS 20

ZEISS Innovation: EUV lithography, a European Success story — •Dirk Heinrich Ehm — Rudolf-Eber-Strasse 2 73447 Oberkochen; Germany

More than 80% of all microchips manufactured worldwide today are produced with ASML lithography systems with ZEISS optics as their central core. In the field of EUV lithography the share is even 100%, together with a strong growth expectation in the coming years driven e.g. by artificial intelligence applications. Already in 2020 ZEISS, together with TRUMPF, and Fraunhofer IOF, have been awarded with the *Deutscher Zukunftspreis* for their contributions in the field of EUV lithography.

Invited Talk SYLA 2.3 Wed 15:30 HS 20

Advancements in Infrared Spectroscopy with Undetected Photons — •Chiara Lindner and Frank Kühnemann — Fraunhofer Institute for Physical Measurement Techniques IPM, Freiburg, Germany

Correlated photon pairs offer innovative approaches to infrared spectroscopy, allowing for high-resolution measurements using only visible light detection. This technique addresses the limitations of traditional infrared detectors, such as speed, cost, and noise. Key element is the quantum interference effects of correlated photon pairs created by spontaneous parametric down-conversion (SPDC) within a nonlinear interferometer. Combining this quantum technology with established Fourier-Transform Infrared Spectroscopy methods (then referred to as Q-FTIR) enables high-performance infrared spectroscopy. This research paves the way for future applications and new research fields such as quantum hyperspectral imaging. In this talk, we will cover the fundamentals of measurements with undetected photons, discuss recent implementations for infrared spectroscopy and take an outlook.

Invited Talk SYLA 2.4 Wed 16:00 HS 20

Ultrafast 2μm fiber lasers for scientific and industrial applications — Tobias Heuermann, Christian Kern, Ziyao Wang, Evgeny Shestaev, •Oliver Herrfurth, Christian Gaida, and Tino Eidam — Active Fiber Systems GmbH

Tm-based fiber lasers have emerged as compelling ultrafast sources in the 2-μm spectral region. We report recent progress on a thulium-doped fiber chirped-pulse amplification system aiming to deliver 200 W average power, 2 mJ pulse energy, and 150 fs pulse duration at 2μm. Key challenges, including atmospheric water absorption, high thermal load and nonlinear effects in fiber amplifiers, are mitigated through a novel fiber module design and a sealed system enclosure enabling dry or vacuum operation. Further peak-power scaling is achieved via spectral phase and amplitude optimization of the seed pulses.

Furthermore, we present results on a >500W / 5mJ source featuring between 10ns to 500ns pulse duration. A potential application can be EUV plasma generation, but also other applications seem feasible. In summary, we show different system architectures in the ultrafast and ns-regime that represent record values in the commercial sector.