Symposium 50 Years of Lasers (SYLA)

jointly organized by all divisions of the section AMOP

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Overview of Invited Talks and Sessions

(lecture room E 415)

Invited Talks

SYLA 1.1	We	14:00–14:30	E 415	**How the laser happend** — •Herbert Welling
SYLA 1.2	We	14:30–15:00	E 415	**The origin of the quantum theory of lasing** — •Fritz Haake
SYLA 1.3	We	15:00–15:30	E 415	**Lasers for precision measurements** — •Thomas Udem
SYLA 1.4	We	15:30–16:00	E 415	**Short, Ultra Short, Atto Short** — •Dietrich von der Linde
SYLA 2.1	We	16:30–17:00	E 415	**Our Daily Life with Semiconductor Lasers** — •Dieter Bimberg
SYLA 2.2	We	17:00–17:30	E 415	**Power to the Industry - the story of Laser upscaling** — •Reinhart Poprawe
SYLA 2.3	We	17:30–18:00	E 415	**The Outstanding Qualities of Fiber Lasers and Thin Disk Lasers** — •Adolf Giesen
SYLA 2.4	We	18:00–18:30	E 415	**Solid State Lasers:meeting the challenges of the 21st Century** — •Robert L. Byer

Sessions

SYLA 1.1–1.4	We	14:00–16:00	E 415	**50 Years of Lasers I**
SYLA 2.1–2.4	We	16:30–18:30	E 415	**50 Years of Lasers II**

SYLA 1: 50 Years of Lasers I

Time: Wednesday 14:00–16:00 Location: E 415

Invited Talk SYLA 1.1 We 14:00 E 415
How the laser happend — •Herbert Welling — Leibniz Universität Hannover

After the realization of masers, microwave oscillators with an entirely new concept of amplification -namely by stimulated emission of radiation, scientists around Charles Townes at Columbia University and Arthur Schawlow at Bell Telephone Laboratories started to think how the new concept could be transferred to oscillators in the infrared and even visible region to generate there coherent radiation. However it turned out that a tremendous amount of research had to be done to achieve in an atomic or molecular ensemble a population inversion and to develop optical resonators with adequate size and Q-values.

The first laser was realized in July 1960 at the Hughes Aircraft Research Laboratories by T. H. Maiman using ruby as the active material; his achievement came entirely as a surprise, but it was not an accidental discovery. The laser is just a new light source but his radiation shows superiority in coherence in space and time and offers the potential of high intensity. After Maimans invention in 1960 in many famous laboratories all over the world research was intensified to find new laser materials, to find atomic and molecular systems suited to generate population inversion, and theoretical and experimental work was concentrated to understand the spatial and temporal coherence of the laser radiation.

Invited Talk SYLA 1.2 We 14:30 E 415
The origin of the quantum theory of lasing — •Fritz Haake — Universität Duisburg-Essen

The realization of the laser in 1960 was followed by intensive theoretical work worldwide. Hermann Haken and his Stuttgart school pioneered the quantum treatment in terms of nonlinear Langevin equations. A Schrödinger-picture description by master equations followed.The qualitative picture of slow phase diffusion and a rather stable modulus of the light-mode amplitude emerged. The near-threshold behavior was captured by a Fokker-Planck equation for a van der Pol type oscillator.

The analogy of the laser threshold with critical points of second-order phase transitions was discovered and the field of non-equilibrium phase transitions thus inaugurated. Further ramifications included the extension of the basic ideas towards chemical, biological, and even social systems.

The quantum theory of lasing came into new blossom when in the nineties lasers were pushed to the quantum noise limit and light squeezing was implemented.

Invited Talk SYLA 1.3 We 15:00 E 415
Lasers for precision measurements — •Thomas Udem — Max-Planck-Institut für Quantenoptik

From the very beginning the laser was used as a valuable tool for research. A large amount of precision data about atoms and molecules has been obtained with narrow band single mode lasers. For the utmost precision frequency stabilization and counting techniques have been key ingredients. In 1983 the possibility to count optical cycles was used to re-define the meter in terms of the speed of light. The purpose was to remove an artefact from the SI units. Improved laser spectroscopic techniques have led to some of the best tests of quantum electrodynamics and the possibility to operate optical atomic clocks. These clocks are now taking over the lead as the most precise instruments enabling new tests of fundamental theories such as general relativity. As one of the latest developments lasers are getting used as calibration tools for precision astronomy and might help to find Earth-like extra solar planets. Eventually the precision might be sufficient to directly observe or rule out cosmic acceleration that is believed to be due to the prevalence of dark energy.

Invited Talk SYLA 1.4 We 15:30 E 415
Short, Ultra Short, Atto Short — •Dietrich von der Linde — Universität Duisburg-Essen

One of the major lines of development that started off with the invention of the laser was the search for ever shorter and more intense laser pulses. Due to a succession of new ideas and techniques the attainable laser pulse duration has dropped in several steps all the way to femtoseconds (10-15 s) and is entering today the attosecond (10-18 s) time regime. The spectacular progress in time resolution and also in peak intensity has provided new research tools and opened up exciting new applications in science and technology.

SYLA 2: 50 Years of Lasers II

Time: Wednesday 16:30–18:30 Location: E 415

Invited Talk SYLA 2.1 We 16:30 E 415
Our Daily Life with Semiconductor Lasers — •Dieter Bimberg — TU Berlin

Semiconductor Lasers present an exceptional success story of brakethroughs in fundamental physics. A fundamentally new effect - stimulated emission from a p-n-diode - was observed at the time of discovery and quite some time afterwards at low temperatures only. By intelligent band structure engineering, however, the door was opened in 1970 by Alferov and Krömer for room temperature operation (Nobel Prize 30 years later in 2000). The following 25 years double heterostructure lasers became the enabling devices for intercontinental optical communication,the basis of the internet.50 years after discovery, 2010, vertical and edge emitting semiconductor lasers, based on an ever increasing variety of material systems and nanostructures, operating from the UV to the middle IR, at very small mW or very large kW output power, present a backbone of modern energy efficient technology, being omnipresent in our daily life. DVDs, the optical mouse, the Terabus,the 100 G Ethernet, material processing, medical applications,.. exemplify the ever increasing economic importance of the discovery of an orchid 50 years ago.

Invited Talk SYLA 2.2 We 17:00 E 415
Power to the Industry - the story of Laser upscaling — •Reinhart Poprawe — Fraunhofer Institut für Lasertechnik

Even first lasers were diffraction limited, single mode operation lead to fast applications in measurement and spectroscopy. However, it took quite a wile to scale up power simultaneously maintaining the beam quality for good reasons. Especially in Gas - and Solid State Lasers the process lasted many years and is not finished, even today. After the presentation of CO2-Lasers with average powers of up to 40 kW in the 90s, the challange was passed on to the solid state community. The response was a whole series of variants ranging from Rod-, Disk- to Slab- and Fiberlasers, also allowing short pulse power scaling. The simultaneous approach of power, time, wavelength and quality allows new sources for new applications not only by increased production speed, but even more important by advancement in the most relevant and general category: value.

Invited Talk SYLA 2.3 We 17:30 E 415
The Outstanding Qualities of Fiber Lasers and Thin Disk Lasers — •Adolf Giesen — Deutsches Zentrum für Luft- und Raumfahrt

In this summery the properties of fiber lasers and thin disk lasers are discussed in detail, showing that both designs are optimized solutions for building solid state lasers with outstanding properties. The advantages and also the disadvantages of each design will be explained and it will be shown that depending on the application the one or the other design will be advantageous. There is no either or, the question is what design is the best solution for which application. Some latest results and demonstrations will support this conclusion.

Invited Talk SYLA 2.4 We 18:00 E 415
Solid State Lasers:meeting the challenges of the 21st Century — •Robert L. Byer — Stanford University

In the fifty years since the demonstration of the laser, coherent light has changed the way we work, communicate and play. The generation and control of light is critical for meeting important challenges of the 21st century from fundamental science to the generation of energy.

A look back at the early days of the laser will be contrasted to the recent breakthroughs in solid state lasers and the applications to fundamental science of gravitational wave detection, remote sensing, and laser induced fusion for energy production.