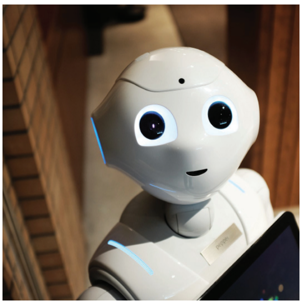
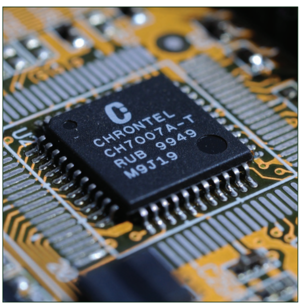
Keynote Forum
April 15, 2019

Physics & Laser Tech 2019



International Conference on
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April 15-16, 2019 | Frankfurt, Germany

Markus Pollnau

University of Surrey, UK

The laser linewidth - Fairy tales and physical evidence

By understanding the Fabry-Perot resonator, one can better understand the laser that oscillates in such a resonator. Recently, we clarified various aspects of the Fabry-Perot resonator, namely the existence of two counter-propagating modes at each resonance frequency and polarization, the relation between mode profiles and airy distributions, the Lorentzian and Airy linewidths and finesses, and the spectral response under frequency-dependent mirror reflectivities and under intrinsic gain or loss.

Based on the assumption that stimulated emission occurs in phase with the incident field, whereas spontaneous emission occurs under an arbitrary phase difference with respect to an incident field, Lax and Haken derived quantum-mechanically the Schawlow-Townes laser linewidth and predicted its narrowing by a factor of two around the laser threshold, and Henry predicted its re-broadening due to amplitude-phase coupling, resulting in the α-factor. However, Maxwell's equations suggest that both stimulated and spontaneous emission would violate the law of energy conservation. We have shown that the phase of the emitted field is 90° in lead of the incident field. When combining Weisskopf's idea that vacuum fluctuations trigger spontaneous emission with Einstein's semi-classical rate-equation approach to Planck's law of blackbody radiation, a direct consequence is that an optical mode contains a vacuum energy of *hv*. This result contradicts with Heisenberg's proof that a quantum-harmonic oscillator contains a zero-point energy of ½ *hv*. We show that this factor-of-two difference and the factor-of-two narrowing of the laser linewidth have the same origin. Finally, we derive straight-forwardly the general laser linewidth and the Schawlow-Townes approximation in a semi-classical manner.

Speaker Biography

Markus Pollnau received MSc and PhD in physics from the University of Hamburg, Germany in 1992 and the University of Bern, Switzerland in 1996, respectively. In 2004, he became a full professor at the University of Twente, The Netherlands. Currently, he works as a full professor in photonics at the University of Surrey, UK. He has contributed to more than 600 reviewed journal and international conference papers and 14 book chapters. He served as program and general co-chair of the conference on Lasers and Electro-Optics (2006/2008) and the conference on Lasers and Electro-Optics Europe (2009/2011), inaugurated the Europhoton conference (2004), and served as topical editor for the Journal of the Optical Society of America B and Laser Physics Letters. He is a fellow of the Optical Society of America and the European Physical Society.

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Ruth Houbertz

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Multiphoton Optics GmbH, Germany

Quo vadis - Industrial scale high precision 3D printing

The demand of sophisticated components is continuously increasing, driven by big data, IoT, and Industry 4.0. Reducing cost and time to market impacts all levels in a vast majority of products. 3D printing is typically restricted to additive fabrication within one material class, structures are limited in size, shape, surface finish, often requiring supporting structures. However, 3D printing is increasingly used in an industrial environment: It provides fast and low-cost prototyping. Many 3D printers are based on laser processing such as selective laser sintering or melting (SLS/SLM), or stereo lithography (SLA). These techniques have in common that they are restricted to a layer-by-layer fabrication of workpieces in additive working steps, thus resembling a more 2D bottom-up method. For high precision structures and high surface quality with an industrial scale throughput as required for photonics packaging and for optics for imaging, illumination, sensor, or medical purposes, respectively, their precision is by far not good enough. This prevents to use 3D printing for high quality photonic components.

High precision 3D printing (HP3DP) is a powerful tool for rapid prototyping of miniaturized designs in automated, scalable processes, providing a real 3D technique suitable for the fabrication of optically high-quality surfaces with industrial scale throughput, highest resolution and a unique degree of freedom of structure generation. Most of the legacy processes nowadays needed for complex structure fabrication can be simply avoided, enabling a significant reduction of resources, of production cost and time to market. The usefulness of HP3DP to be implemented in industrial work flows will be demonstrated by discussing different application scenarios, ranging from LED to laser die packaging, micro optical elements and arrays for rapid prototyping of novel designs up to the manufacturing level. Finally, the step from prototyping to volume production will be demonstrated, providing a sophisticated level of manufacturing.

Speaker Biography

Ruth Houbertz is the cofounder of Multiphoton Optics GmbH, founded in September 2013 and current function as CEO from August 2014. From 2013 to July 2014, she was CTO of MPO and from 2000 to 2012, she held different technical and management positions at Fraunhofer ISC, where she focused on materials, processes, and technology/equipment development for photonic and biomedical applications. From 1999 to 2000, she worked at Sandia National Labs, Livermore, CA (USA). She invented more than 100 patents, evaluator and referee for international ministries, journals, etc. She has received many awards and nominations, amongst which are the Best of Industry Award 2018, finalist in the Prism Award 2015 and 2017, Cowin Award of Entrepreneurship 2014, Green Photonics Award 2013, Fraunhofer Award in 2007. Active member in SPIE, EPIC, OSA, IEEE, VDI, Bayern Photonics, SPIE fellow, session chair since more than one decade in optical interconnects and emerging technologies at Photonics West, participation in Industrial and Women in Optics Panels, keynote and invited speaker, Senator of Economy.

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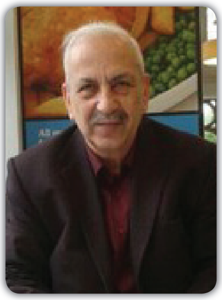

Riyadh Mirza

UK-Scientific Ltd, UK

Optical applications of Fourier transform

This speech will cover our work on the application of Fourier optics in different areas. Many researches done in the field of applied Fourier transform in optics as; image processing, transformation, representation and coding, smoothing and sharpening images. In data analysis, we used Fourier transform as high, low and band pass filters. We focused our research in the application of Fourier optics to image analysis as the Fourier optics is an important image processing tool which is often two dimensional Fourier transform. Our research started from simple lens and its Fourier transform to complex systems including spatial filters, character recognition, pattern recognition and image enhancement and noise reduction methods using coherent an incoherent optical processing.

Real time optical Fourier transform is one of our interest and works done on static and dynamic images. Restoring transmitted images through inhomogeneous media, images transmitted by laser beam in free space that faces distortion, the image restoration done using Fourier transform optically in real time and off line digitally. In UK-scientific ltd. We introduced seven experiments using Fourier transform and its application to image processing, image convolution, image pass filtering, special filtering, imaging addition, image subtraction, image differentiation, 4f system, image recognition, optical correlation. And using liquid crystal as an image input.

Through those kits student can get a better understanding of the principles of optical image differentiation. And also those kits can be used by researchers too.

Speaker Biography

Riyadh Mirza has a PhD in applied physics. He worked as chief researcher in applied optics, and as a professor of fourier optics in the institute of laser for post graduate studies in the university of Baghdad/Iraq. He is a director of UK-Scientific ltd which he formed in 2009 investing his over forty five years' experience in new education kits in optics and photonics. He is also a member of the institute of laser board in the University of Baghdad, Iraq.

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Charles Hirlimann

IPCMS - CNRS, France

Pioneering days in ultrafast optics

Charles V Shank and his team invented the Colliding Pulse Modelock (CPM) femtosecond laser at the very beginning of the 1980's. This started a rush on the study of ultrafast phenomena. These studies yielded very many new understandings in various fields, of which, this talk will underline new results in the fields of semiconductor physics, laser physics, non-linear optics, and quantum optics. Did you know that it takes silicon only 300 fs to melt down when hit by a short light pulse? This experimental observation seeded the field of ultrafast electron dynamics in semiconductors that in this talk will be further highlighted by the measurement of the time it takes to a pocket of out-of-equilibrium electrons to cool down to a Boltzmann distribution.

It has been very early recognized that light absorption saturates when the flux of photons impinging an absorbing material exceeds the number of electrons available in their energy ground state. But it needed the use of short optical pulses, convoying little energy, to demonstrate the saturation of the two-photon absorption effect. This experiment was performed in Cadmium Sulfide (CdS). It is also using two-photon luminescence excitation in Rhodamine B that the very existence of photonic jets generated by micro-dielectric spheres was demonstrated. For the first time, the non-linear effect of self-steepening of an optical pulse was observed, when propagating through a transparent material. In 2001, Bardou and Boose theoretically demonstrated that the tunneling probability of an electron can be enhanced by an ad hoc pitch at the time it reflects on a potential barrier. This new quantum effect was demonstrated using an optical transposition of the effect using short femtosecond pulses.

Speaker Biography

Charles Hirlimann was born in Paris in 1947. He majored in solid-state physics and later acquired competence in laser physics. He pioneered the use of femtosecond lasers applied to ultrafast spectroscopy of solids being at the time assistant professor at University Pierre and Marie Curie in Paris. He then joined CNRS and moved to the Institute for Physics and Chemistry of Materials in Strasbourg (IPCMS) where he initiated femtosecond studies. His interest spanned from the ultrafast spectroscopy of electrons in semiconductors to basics researches in non-linear optics. In the recent past, he served two years as a scientific expert in nanomaterials for the European Commission in Brussels and three years at the CNRS headquarters in Paris in charge of the European scientific policy of CNRS and the International policy for Physics. He is presently interested in the fast developments taking place in the field of electron microscopy.

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Jeroen Duis

PHIX Photonics Assembly, The Netherlands

Packaging of photonic ICs

Europe is at the threshold of a technological revolution - the application of the power of light to solve our greatest global challenges. As a fast, compact, energy efficient and therefore sustainable option, photonic integrated chips (PIC's) have been developed initially to solve challenges in the power consumption and speed requirements for telecommunications and datacenters. However, it is expected that will tap into world markets like 5G, military, medical, sensors for strain, and gas detection and LIDAR. Volume manufacturing of PIC's is rapidly becoming widespread available through foundries that have evolving process design kits with more extensive building blocks in their libraries. Success depends on the possibility of assembling the chips in large quantities for the various markets. Up to now these have all been labor-intensive production steps, the high cost of which has posed a barrier to large-scale introduction.

The keynote will address topics like: State of the art in the packaging field, automation assembly requirements, cost drivers, why hybrid integration is sometimes inevitable, do's and dont's when designing chips for assembly.

Speaker Biography

Jeroen Duis received his bachelor's degree from the Technical University of Rijswijk in 2001. After his study he worked 16 years within TE Connectivity. Within the fiber optic business unit and corporate technology team he held several positions in engineering, research, technology scouting and management. During this time, he gained a broad experience in laser processing of glass fibers, WDM multiplexing, low loss optical interconnects, next generation photonic chip packaging for applications in mobile phones, automotive and high-speed computing applications. In March 2017, he accepted a position at SMART Photonics, a scale up in Indium Phosphide wafer manufacturing where he was responsible for the business development. November 2018, he accepted a position as chief commercial officer at PHIX Photonics Assembly where he is responsible for the commercial activities and the strategic direction for the hybrid packaging. He is the author and co-author of several publications and holds 15 patent applications in the field of optical interconnection technology.

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Zhengying Wei

Yu Xiang and Junfeng Li

Xi'an Jiaotong University, China

Forming and defect analysis for single track scanning in selective laser melting of Ti6Al4V

Selective laser melting (SLM) is one of the most promising additive manufacturing (AM) processes. Each single track in SLM may affect the forming defects and the resultant relative density of final SLM parts. A three-dimensional randomly distributed powder bed model of Ti6Al4V was established to study the forming process of single track. The numerical model is verified by experimental tests. The numerical results show that—the typical metallurgical defects associated with SLM such as balling effect is significantly affected by line energy density (LED). The optimal LED range is given by numerical and experimental results.

Speaker Biography

Zhengying Wei has completed her PhD in 2003 from Xi'an Jiaotong University, China. She is the professor and doctorial tutor at Xi'an Jiaotong University, China. Her research interests are in the microstructure designing and rapid manufacturing. In 2008, she won the province award for Youth Science and Technology. She is also the author of several international publications.

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Hideaki Shirota

Chiba University, Japan

Intermolecular vibrations of room temperature ionic liquids studied by femtosecond Raman-induced Kerr effect spectroscopy

Room temperature ionic liquids (RTILs) purely consist of cations and anions (without solvent), but they are liquids at room temperature. RTILs possess characteristic features, such as low melting point, negligible vapor pressure at ambient temperature and pressure (and thus less flammable), and so on. Such unique properties are mainly attributed to the complex intermolecular interactions in RTILs. Because the intermolecular vibrations reflect the microscopic structure and intermolecular interactions in condensed phases, it is essential to study them to understand RTILs in detail. Femtosecond Raman-induced Kerr effect spectroscopy (fs-RIKES) detects the molecular motions in the low-frequency or THz region (~0.3–700 cm-1 or ~0.01–20 THz) where the intermolecular vibrational bands in most condensed phases locate. Therefore, fs-RIKES is useful to study condensed phases including RTILs. In this talk, I am going to show some results of fs-RIKES studies of RTILs, such as temperature dependent low-frequency spectral features and effects of aromatic ring on the low-frequency spectrum.

Speaker Biography

Hideaki Shirota received his PhD from the Graduate University for Advanced Studies, Japan. He is an associate professor of chemistry in Chiba University. His current research interests include molecular spectroscopy, laser spectroscopy, time-resolved spectroscopy, molecular dynamics in condensed phases, reaction dynamics in solutions, and solution chemistry.

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