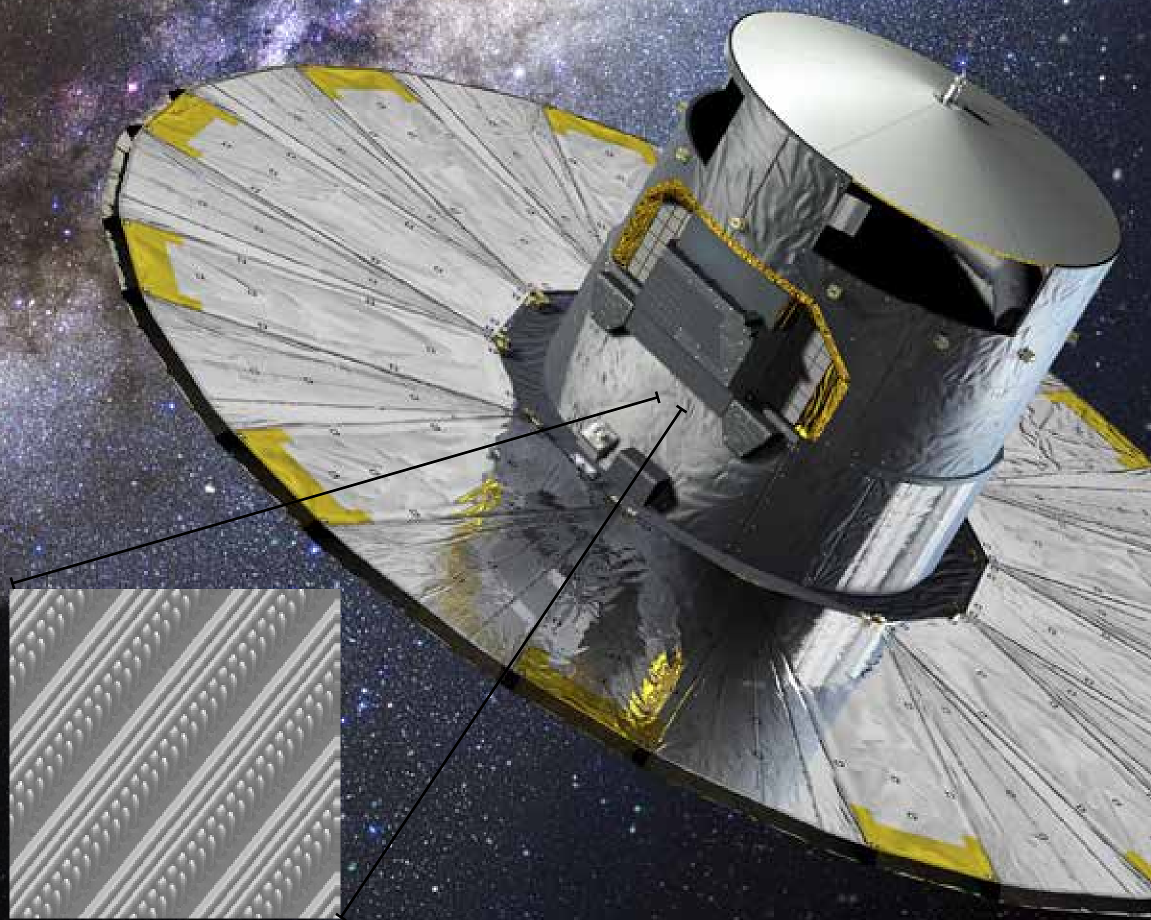
Institute of Applied Physics

Friedrich-Schiller-Universität Jena



2014 Annual Report

Imprint

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EDITORIAL
Dipl.-Ing. Ira Winkler M.Sc., Pat.-Ing.
Dr. Falk Eilenberger
Dr. Frank Schrempel

PHOTOS/GRAFICS
Institute of Applied Physics (IAP), Fraunhofer IOF and
Friedrich Schiller University Jena [J.-P. Kasper]
front cover: Europan Space Agency (esa & IAP)
p.66: aboutpixel.de/Lektüre©marshi, p.87 René Heilmann

Content

PREFACE

The year 2014 has been an extraordinary year for Photonics. Its role as a key enabling technology, driving social change on a global scale is underlined by this year's Nobel Prices awarded to Akasaki, Amano and Nakamura for the development of the blue LED and to Betzig, Hell and Moerner for their work in superresolution microscopy and the circumvention of the Abbe Limit.

I am particularly proud to present some of the research breakthroughs and highlights that the dexterous and enthusiastic expects of the Institute of Applied Physics have achieved in the course of the last year. With their unfaltering creativity and unfailing skills they have once again underlined the Institute's role as the vibrating heart of the Photonics megahub, which Jena is recognized as, on a global scale. As the head of the institute I am extraordinarily grateful to have the privilege work with the outstanding staff on a daily basis and would like to take the opportunity to thank each and every member of the institute for his or her contribution to its success.

Among the particularly outstanding achievements of 2014 I would like to mention the "Deutscher Zukunftspreis", which was awarded to a team around Stefan Nolte, for his contribution in transferring fundamental research of ultrafast laser processes into an industrial manufacturing tool, whose potential is just about to unfold. October 2014 saw the opening of a hands-on exhibit on the topic in the "Deutsches Museum" in Munich and was the just cause to celebrate the occasion. Jens Limpert was awarded an extremely prestigious and highly competitive ERC consolidator grant in January 2014 for his ongoing work and groundbreaking achievements in the development of pulsed fiber lasers. His lasers surpass prior designs in every aspect imaginable. At the same time they are extremely economic and contribute to the bid for a more resource efficient society. Alexander Szameit, who has basically single-handedly established the discipline of optical quantum simulations, has been honoured for his achievements with OSA's Adolph Lomb Medal in recognition for his noteworthy contributions to optics at an early age and with the Rudolf-Kaiser-Preis for his outstanding contributions to experimental physics.

At the very end of 2013, the work of our researchers and technicians were topped by a very special event: a here designed and manufactured grating has been used at the Gaia mission of the European Space Agency (ESA) in a specrometer to measure our galaxy. This is certainly one of the most dazzling evidence of the applicability of our research work for the clarification of still unanswered questions, such as the evolution of the Milky Way.

The maturation of the Beutenberg campus to a global player in photonics has also had very down-to-earth consequences. The physical shell of the Abbe-Center-of-Photonics has been cast into concrete and is topped out to soon become the modern home of the multidisciplinary heart of photonics in Jena.

I am particularly proud that the institute's excellence is not limited to research. This contribution to the education of young scientists has boosted the Abbe-School-of-Photonics, currently lead by institute-member Thomas Pertsch, into the ivy-league of Photonics education worldwide. The ongoing success is supported by the instalment of the first German-Canadian graduate school on photonics by the DFG and the launch of the graduate school of the 3Dsensation research alliance, both of which are hosted by the Abbe-School-of-Photonics.

The significance of Photonics and its potential to address some of the most pressing challenges humanity faces in the 21st century is even appreciated by the United Nations who declared 2015 to be the "International Year of Light". It will "raise awareness of how optical technologies promote sustainable development and provide solutions to worldwide challenges in energy, education, agriculture, communications and health." I am very excited to announce a vivid and rich set of events that will be hosted in Jena for the occasion, which will bolster existing outreach efforts and strengthen awareness and enthusiasm for optics as a whole.

Let me also take the opportunity to express my gratitude for the ongoing and wholehearted support that we experienced by the vast network that the institute is embedded in, among them countless partner institutions, research agencies, public foundations and industrial partners.

With 2015 dawning, we cannot be certain of the shifting tides that lie ahead. But what I am certain of is, that IAP's excellent crew will again boldly sail the institute to where no one has gone before.

So I would like to thank all active participants; thanks to the technicians, scientists and employees who have contributed to these successes, not to forget the numerous partners from industry and research as well as the ministries of the Federation and the State of Thuringia for their support in implementing our research objectives for future solutions with light.

Prof. Dr. Andreas Tünnermann

The Institute of Applied Physics (IAP) at the Friedrich Schiller University Jena (FSU Jena) has a long-standing tradition and competence in design, fabrication and application of active and passive optical photonic elements for both optical and opto-electronical devices. Collaborative projects with companies ensure practical relevance and feasibility.

Research Profile

The Institute practices in fundamental and applied research in the fields of micro- and nano-optics, fiber and waveguide optics, ultrafast optics as well as optical engineering.

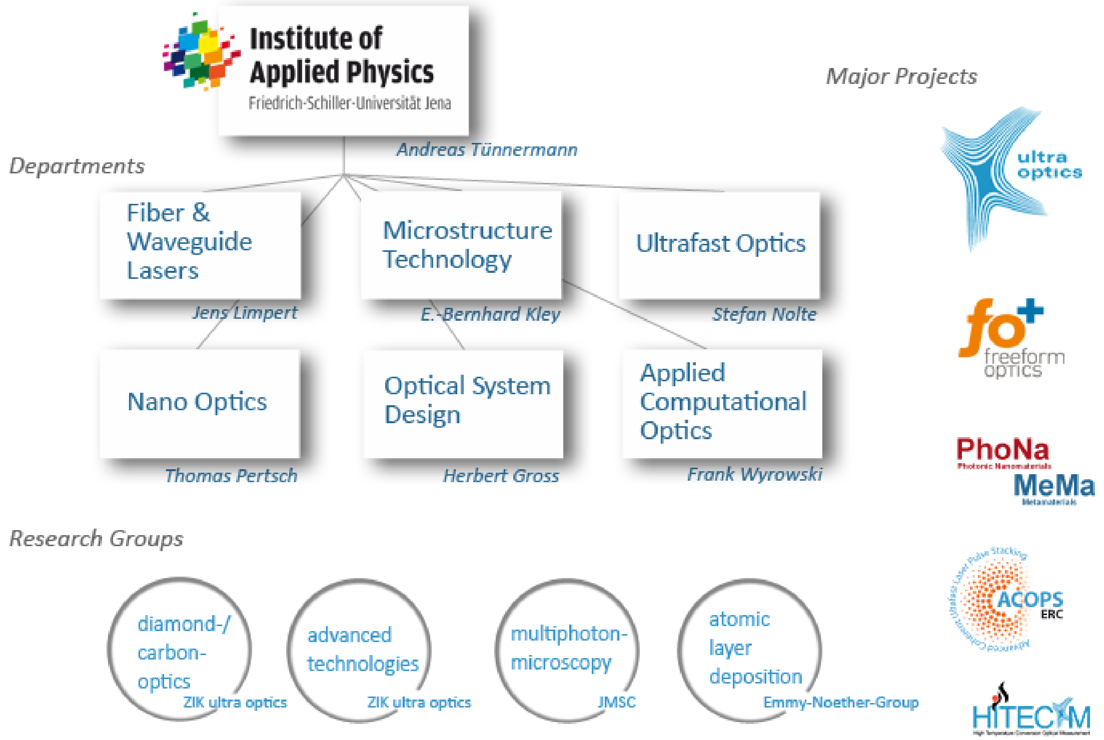
It develops novel optical materials, elements and concepts for information and communication technology, life science and medicine, security and mobility, environment and energy as well as process technology including material processing and optical measurement techniques.

Current research topics - treated by over 160 scientists - concern design of optical systems, as well as function, design and production of micro-and nano-optical elements. Those are e.g. resonant grating structures, metallic and dielectric polarizers, all-optical switching processes in integrated photonic elements and effective media for reduced reflection losses of surfaces. Also light propagation and nonlinear light-matter interaction in micro- and nano-structures, optical metamaterials and photonic crystals are investigated for their inherently novel fundamental physics. Further research fields are the application of femtosecond laser pulses, e.g. for material processing and micro- and nano-structuring, the development of new concepts for solid-state lasers such as fiber lasers, fiber-optic pulse shaping and the amplification of ultrashort laser pulses. Aim of other research efforts are the fundamental understanding of the propagation of optical waves in different systems, whose material parameter and structure are based on the different macroscopic manifestations of carbon. The usage of freeform optical key components due to their inherent advantages is also aim of the IAP. The design, fabrication and integration of such elements represent a scientific and technological challenge, which the scientists faces up.

By investigating these fields of research, particularly in close cooperation with the Fraunhofer Institute of Applied Physics and Precision Engineering (IOF) as well as many partner companies, the IAP covers numerous parts of the innovation chain - from interdisciplinary fundamental research to the presentation of prototypes. This expertise offers remarkable contributions to solve issues in emerging fields like energy, environment, health and communication.

Excellence in research is confirmed by the establishment of the Competence Centre ultra optics (www.ultra-optics.de) as a driver of innovation in the research fields the two areas of laser physics and nano-optics, the awarded ERC Consolidator Grant for "Advanced Coherent Ultrafast Laser Pulse Stacking (ACOPS)", the research initiative on Photonic Nanomaterials PhoNa (www.phona.uni-jena.de) and also the Innovative Regional Growth Core« fo+ (freeform optics plus, www.fo-plus.de), which combines fundamental and applied research in a unique way.

But not only excellent research makes the Institute splendid, also outstanding laboratory equipment, an excellent staff and a high commitment in the training of students and scientists in cooperation with the Abbe School of Photonics (www.asp.uni-jena.de) belongs to the self-understanding of the IAP.



Research Facilities / Resources

Excellence in research requires high quality equipment for experimental questions and analysis. The state-of-the-art technical infrastructure is driven constantly forward by acquired adaptions for scientific questions.

- 860 m² class 10,000 to 10 clean room area
- Electron beam and laser lithography
- Dry etching facilities
- Electron and ion beam microscopy, scanning electron microscopy
- Photolithography
- Helium ion microscopy
- Interference optical surface profilometry
- Photoemission electron microscopy
- Scanning nearfield optical microscopy
- Nonlinear optical waveguide characterization
- UV-VIS spectrometry
- FTIR spectrometry
- Rigorous optical simulation
- Ultrashort pulse laser technology
- Laser micro-structuring technology
- Field tracing techniques

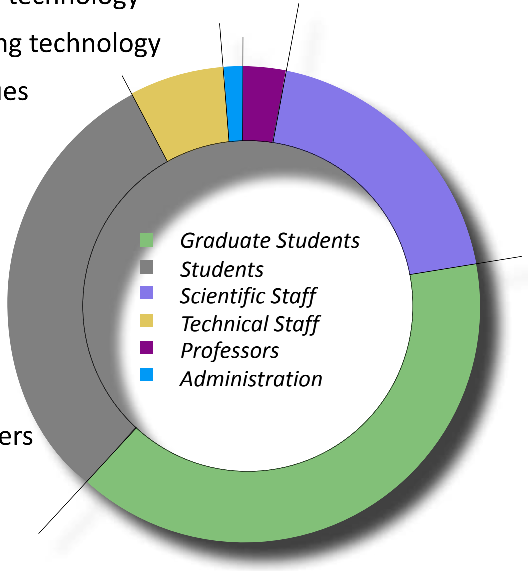
Staff

public budgetarily funded:

3,0	university professors
5,2	research associates
9,6	technical staff members

externally funded:

1,0	university professor
1,0	endowed professor
2,0	assistant professors
98,0	research associates & Ph.D. students
4,8	technical staff members



ABBE Sylvia
ACKERMANN Roland
AHMAD Muhammad
APPELFELDER Michael
ASOUBAR Daniel
BADAR Irfan
BALADRON ZORITA Olga
BAUMGARTL Martin
BECKER Nils
BEIER Franz
BEIER Matthias
BERGNER Klaus
BINGEL Astrid
BLUMRÖDER Ulrike
BOURGIN Yannick
BÖSEL Christoph
BRAHM Anika
BREITBARTH Andreas
BREITKOPF Sven
BRÖMEL Anika
BURKHARDT Thomas
BURMEISTER Frank
CHIPOULINE Arkadi
DEMMLER Stefan
DIENER Romina
DIETRICH Kay
DIZIAIN Séverine
DÖRING Sven
DREISOW Felix
DUNKEL Jens
ECKSTEIN Wiebke
EICHELKRAUT Toni
EIDAM Tino
EILENBERGER Falk
FALKNER Matthias
FASOLD Stefan
FLOC´H Kevin
FRANKE Christian
FUCHS Benjamin
FUCHS Frank
FUCHS Hans-Jörg
FÜSSEL Daniel
GAIDA Christian
GEBHARDT Martin
GEISS Reinhard
GENEVÉE Pascal
GEROLD Marcel
GHAZARYAN Lilit
GIREE Achut
GOTTSCHALL Thomas
GRÄF Waltraud
GRÄFE Markus
GRANGE Rachel
GROSS Herbert
HÄDRICH Steffen
HARTUNG Holger
HEIDLER Nils
HEILEMANN Martin
HEILMANN René
HEIST Stefan
HERFFURTH Tobias
HEUSINGER Martin
HOFFMANN Armin
HOLLAND-MORITZ Henry
JANSEN Florian
JANUNTS Norik
JAUREGUI MISAS Cesar
JOBST Paul-Johannes
JOCHER Christoph
KAISER Thomas
KAMMEL Robert
KÄMMER Helena
KÄSEBIER Thomas
KEIL Robert
KEMPER Falk
KIENEL Marco
KINAST Jan
KLEIN Angela
KLENKE Arno
KLEY Ernst-Bernhard
KLUGE Anja
KRÄMER Ria
KRAUSE Sylvio
KREBS Manuel
KROKER Stefanie
LANGE Nicolas
LEBUGLE Maxime
LEHNEIS Reinhold
LEHR Dennis
LIMPERT Jens
LUDWIG Henning
LUTZKE Peter
MARTIN Bodo
MATTHÄUS Gabor
MENZEL Christoph
MINARDI Stefano
MODSCHING Norbert
MÜLLER Michael
NARANTSATSRALT Bayarjargal
NATHANAEL Anne
NOLTE Stefan
OLESZKO Mateusz
ORNIGATTI Marco
OTTO Christiane
OTTO Hans-Jürgen
PABST Oliver
PABST Reinhold
PEREZ LEIJA Armando
PERTSCH Thomas
PFEIFER Kristin
POL RIBES Pleguezuelo
PREUßER Henry
PSHENAY-SEVERIN Ekaterina
PUFFKY Oliver
RATZSCH Stephan
REIG ESCALÉ Marc
REINHOLD Jörg
RLEGUEZUELO Pol Ribes
RICHARDT Tim
RICHTER Daniel
RICHTER Jessica
RICHTER Sören
ROCKSTROH Sabine
ROCKSTROH Werner
ROSENSTENGEL Diana
ROTHHARDT Carolin
ROTHHARDT Jan
SARAVI Sina
SCHEIDING Sebastian
SCHELLE Detlef
SCHMIDT Carsten
SCHMIDT Holger
SCHREMPEL Frank
SCHULZE Marcel
SCHWINDE Stefan
SEISE Enrico
SERGEEV Natali
SERGEEYEV Anton
SETZPFANDT Frank
SHAMIR Yariv
SHESTAEV Evgeny
SHI Rui
SIEFKE Thomas
SINGH Amit
SISON Miguel
SPERRHAKE Jan
STEGLICH Martin
STEINBERG Carola
STEINBRÜCK Andrea
STEINER Stefan
STEINERT Michael
STEINMETZ Alexander
STEVANIOVIC Igor
STÜRZEBECHER Lorenz
STÜTZER Simon
STUTZKI Fabian
SZAMEIT Alexander
SZEGHALMI Adriana
TESSMER Manuel
THIELE Illia
THOMAS Jens
TISCHNER Katrin
TSCHERNAJEW Maxim
TROST Marcus
TÜNNERMANN Andreas
ULLSPERGER Tobias
VETTER Christian
VETTER Julia
VOIGT Daniel
VOIGTLÄNDER Christian
VON GRAFENSTEIN Lorenz
WALTHER Benni
WANG Xiaohang
WANG Xiaolong
WARZESCHKA Sandra
WEBER Thomas
WEICHELT Tina
WEIMANN Steffen
WEIRAUCH Wieland
WINKLER Ira
WONDIMU Selam
WUNDERLICH Stefano
WYROWSKI Frank
YANG Liangxin
ZEITNER Uwe
ZEUNER Julia
ZHANG Site
ZHANG Xu
ZHONG Huiying
ZHONG Minyi
ZHONG Yi
ZILK Matthias
ZIMMERMANN Felix

Guests

Guests indicate the national and international visibility of research results and enrich the structures of the Institute of Applied Physics with new thinking and perspectives - not only in research and teaching, but also open eyes to other cultures and strengthen the network by personal relations.

AKHMEDIEV Nail	Australian National University, Canberra, Australia
ANCONA Antonio	Istituto di Fotonica e Nanotecnologie (CNR-IFN), Bari, Italy
BUTSCH Anna	Max-Planck-Institute for Science of Light, Erlangen, Germany
CAMPER Antoine	Ohio State University, USA
CHAN Chia-Hua	National Central University, Jhongli, Taiwan
CHEN Yen-Hung	National Central University, Jhongli, Taiwan
CLUBE Francis	Eulitha AG, Althau, Suisse
CONTI Claudio	University Sapienza, Rome, Italy
DAI Qiang	Harbin Engineering University, China
DENZ Cornelia	Westfälische Wilhelms-Universität, Münster, Germany
EGGLETON Benjamin	University of Sydney, Australia
ERDMANN Andreas	Fraunhofer Institute for Integrated Systems and Device Technology IISB, Erlangen, Germany
FLEUROV Victor	Tel Aviv University, Israel
GAUDIOSO Caterina	Istituto di Fotonica e Nanotecnologie (CNR-IFN), Bari, Italy
HENDRICKS Nicholas	University of Massachusetts, Amherst, USA
HERMAN Peter	University of Toronto, Canada
HORN Alexander	University of Applied Sciences Mittweida, Germany
JOURLIN Yves	Université Jean Monnet, Saint-Etienne, France
KIP Detlef	Helmut Schmidt University, Hamburg, Germany
LAUDE Vincent	FEMTO-ST Institute, Besancon, France
MITCHELL Arnan	RMIT University Melbourne, Australia
MORANDOTTI Roberto	Institut national de la recherche scientifique (INRS), Varennes, Canada
MORTENSEN Asger	Denmarks Tekniske Uniersitet, Lyngby, Denmark
NEUENSCHWANDER Beate	Bern University of Applied Sciences, Suisse
PARTANEN Henri	University of Eastern Finland, Joensuu, Finland
PARTEL Stefan	FH Vorarlberg University of Applied Sciences, Dornbirn, Austria
PESCHEL Ulf	Friedrich-Alexander Universität, Erlangen-Nürnberg, Germany
RECHTSMANN Mikael	Technion, Haifa, Israel
SOLNTSEV Alexander	Australian National University, Canberra, Australia
STAUDE Isabelle	Australian National University, Canberra, Australia
TIMOFFEEVA Maria	Sankt-Petersburg Academic University, Russia
VAHIMAA Pasi	University of Eastern Finland, Joensuu, Finland
VALLÈ Réal	Université Laval, Québec, Canada
WALTER Philip	Universität Wien, Vienna, Austria
WEINFURTNER Silke	University of Nottingham, UK
WIENKE Andreas	Laserzentrum Hannover (LZH), Germany
ZÜRCH Michael	Institute of Optics and Quantum Electronics, Jena, Germany

Research Stay

BALADRON-ZORTIA Olga	University of Eastern Finland, Joensuu, Finland Universidad Politecnica de Madrid, Spain
DREISOW Felix	Günter-Köhler-Institut GmbH, Jena, Germany University of Sydney, CUDOS, Australia
GEIß Reinhard	National Central University, Jhongli, Taiwan
KROKER Stefanie	Institute for Cosmic Ray Research, Tokyo, Japan Tokyo Institute of Technology, Japan
LEHR Dennis	Australian National University (ANU), Canberra, Australia University of Melbourne, Australia CSIRO, Clayton Laboratories, CMSE/CCEF, Melbourne, Australia
PSHENAY-SEVERIN Ekaterina	Australian National University (ANU), Canberra, Australia
PERTSCH Thomas	Università di Brescia, Brescia, Italy
SETZPFAND Frank	Australian National University (ANU), Canberra, Australia
STEGLICH Martin	Australian National University (ANU), Canberra, Australia University of Sydney, CUDOS, Australia University of Melbourne, Australia CSIRO, Clayton Laboratories, CMSE/CCEF, Melbourne, Australia
THOMAS Jens	Colorado School of Mines, Golden, USA

Cooperations

The IAP is cooperating with all departments of the Faculty of Physics and Astronomy at Friedrich Schiller University, in particular with the Institute of Solid State Theory and Condensed Matter Op-tics, the Institute of Optics and Quantum Electronics and also with individual departments within the Faculty of Chemistry and Earth Sciences.

In addition, for special research projects more than 100 external partners in science and industry are standing by. Of special importance are regional cooperation's with the Leibniz Institute of Pho-tonic Technology Jena (IPHT) and the Fraunhofer Institute for Applied Optics and Precision Engi-neering (IOF). On the basis of the close intermeshing between IOF and IAP, one major goal is to develop an outstanding international center of excellence for micro- and nano-structured optics as well as optical systems.

Within the Collaborative Research Center (SFB) „Gravitational Wave Astronomy“ the IAP works to-gether with groups from Hannover, Tübingen, Garching, Potsdam and Jena on issues of reflective optical components for interferometer-based gravitational wave detectors.

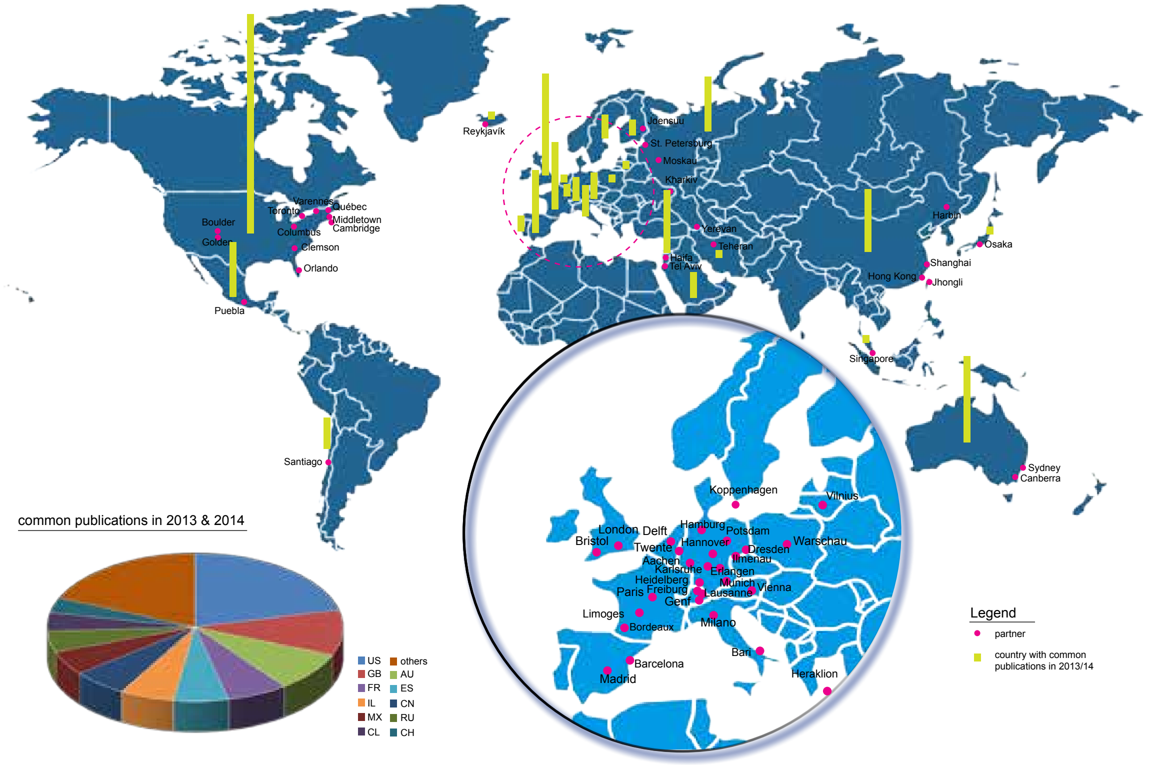
The collaboration with the Max-Planck-Institute for Quantum Optics in Garching and the Ludwig-Maximilian University in Munich combines the expertise in Jena in the generation of femtosecond pulses with high average power with the competence in Garching regarding cavity enhancement and the generation of high harmonics (HHG).

The Institute's competence for the production of high-energy few-cycle pulses with high repetition rates is linked with the possibility of the application of these pulses at the free electron laser (FEL) in Hamburg (FLASH) in cooperation with the German Electron Synchrotron (DESY). The aim of that cooperation is to develop laser systems for seeding of the FEL.

The IAP research group Applied Computational Optics cooperates with different national and inter-national institutions, but the collaboration with LightTrans GmbH is of particular importance. To-gether, new theoretical models of Field Tracing and an optics modeling software (VirtualLab™) have been developed. A long-standing cooperation exists with the University of Eastern Finland and the University of Delft and Brussel. In addition, cooperation with the Shanghai Institute of Optics (SIOM) in the modeling of lithographic lighting systems as well as the Harbin Institute of Technology (HIT) in the field of diffractive optics has been strengthened. Within the project "Advanced Optical System Design" (ADOPSYS) the group is working together amongst others with OSRAM GmbH, Carl Zeiss AG, University ITMO, Russia and CNRS, France.

For years, major international collaborations exist with the College of Optics and Photonics, CREOL & FPCE, Florida, United States, the ICFO-Institute of Photonic Sciences in Barcelona, Spain, and the Australian Research Council Centre of Excellence for Ultrahigh-Bandwidth Devices for Optical Sys-tems (CUDOS) and the Nonlinear Physics Centre, Australian National University in Canberra, Aus-tralia.

Other important partners in education include the Imperial College, UK, Warsaw University, Poland, the Delft University, The Netherlands, and the Institut d'Optique (Orsay-Palaiseau, Paris), France, in the international Erasmus Mundus Master's program OpSciTech as well as the University of Bor-deaux, the College of Optics and Photonics , CREOL & FPCE, Florida and Clemson University in South Carolina in the international master program „MILMI: Master International in Lasers, Materials Sci-ence and Interactions" in context of the EU-US Atlantis program together with the Abbe School of Photonics here in Jena.



Partners of the IAP and a quantitative figure of common publications in 2013/14.

Outline of Cooperations with Joint Research Topics

Centre d'Optique, Photonique et Laser
Université Laval
Québec, Canada
Réal Vallée

College of Optics and Photonics, CREOL&FPCE
University of Central Florida
Orlando, USA
Kathleen Richardson &
Martin Richardson

Centre of Ultrahigh Bandwidth
Devices for Optical Systems (CUDOS)
MQ Photonics Research Centre
Department of Physics and Astronomy
Macquarie University
Sydney, Australia
Michael Withford

Department of Electrical & Computer
Engineering
University of Toronto
Toronto, Canada
Peter Herman

Department of Physics
Colorado School of Mines
Golden, USA
Jeff Squier

Department of Physics
Oxford University, UK
Simon Cooker

Devision Attosecond Physics
Max Planck Institute of Quantum Optics
Garching, Germany
Joachim Pupeza

Devision Molecular Imaging
Leibnitz Institute of Photonic Technology
Jena, Germany
Tobias Meyer

Énergie, Matériaux et Télécommunications
Research Center
Institut National de la Recherche
Scientifique (INRS)
Varennes, Canada
Roberto Morandotti

Fraunhofer Institute for Applied Optics
and Precision Engineering (IOF)
Jena, Germany
Thomas Schreiber

GSI Helmholtzzentrum für Schwerionen-
forschung GmbH
SPARC Collaboration, Darmstadt, Germany
Reinhold Schuch

International center on Zetta-Exawatt
Science and Technology (IZEST)
Ecole Polytechnique, Paris, France
Gerard Mourou

ICFO-Institute of Photonic Sciences
Castelldefels, Spain
Lluis Torner

Institut de Chimie Moléculaire et
des Matériaux d'Orsay (ICMMO),
Laboratoire de Physico-Chimie de
L'Etat Solide (LPCES)
Université de Paris Sud 11 Orsay, France
Matthieu Lancry

Institute for Optics and Quantum
Electronics
Friedrich Schiller University
Jena, Germany
Christian Spielmann

Institute of Energy Process Engineering
and Chemical Engineering
TU Bergakademie Freiberg, Freiberg,
Germany
Stefan Guhl

Institute of Photonic Sciences (ICFO)
Barcelona, Spain
Yaroslav Kartashov

Institute of Optics, Information
and Photonics
Friedrich-Alexander University
Erlangen-Nürnberg, Germany
Ulf Peschel

Instituto Nacional de Astrofísica, Óptica
y Electronica (INAOE) Puebla, Mexico
Hector Moya-Cessa

Laboratoire Ondes et Matière
d'aquitaine (LOMA)
University Bordeaux, Bordeaux, France
Lionel Canioni

Laser-Zentrum-Hannover e.V. (LZH)
Hannover, Germany
Dietmar Kracht

Nonlinear Optics Group
Institute of Photonic Sciences (ICFO)
Barcelona, Spain
Yaroslav Kartashov

Nonlinear Optics Group
Universidad de las Americas
Puebla, Mexico
Victor Vysloukh

Nonlinear Optics Group
Wesleyan University
Middletown, USA
Dr. Tsampikos Kottos

Nonlinear Physics Center
Australian National University
Canberra, Australia
Dragomir Neshev

Nonlinear Solid-State Optics Group
Technion, Haifa, Israel
Mordechai Segev

Optical Sciences Center
National Central University
Jhongli, Taiwan
Wei-Kun Chang

Physics Department
University of Queensland
Brisbane, Australia
Andrew White

Quantum information sciences and
quantum computation
Universität Wien, Vienna, Austria
Prof. Philip Walther

Quantum Optics Group
Instituto Nacional de Astrofísica
Óptica y Electrónica
Puebla, Mexico
Hector Moya-Cessa

TEACHING

TEACHING

An essential part of the IAP is the training of young scientists at the interface of physics, chemistry and material science. Additively to this purpose, interdisciplinary international Master´s degree and graduation programs, like Master International in Laser, Material science and Interation (MILMI) as well as Green Photonics, have been integrated into the Abbe School of Photonics (ASP).

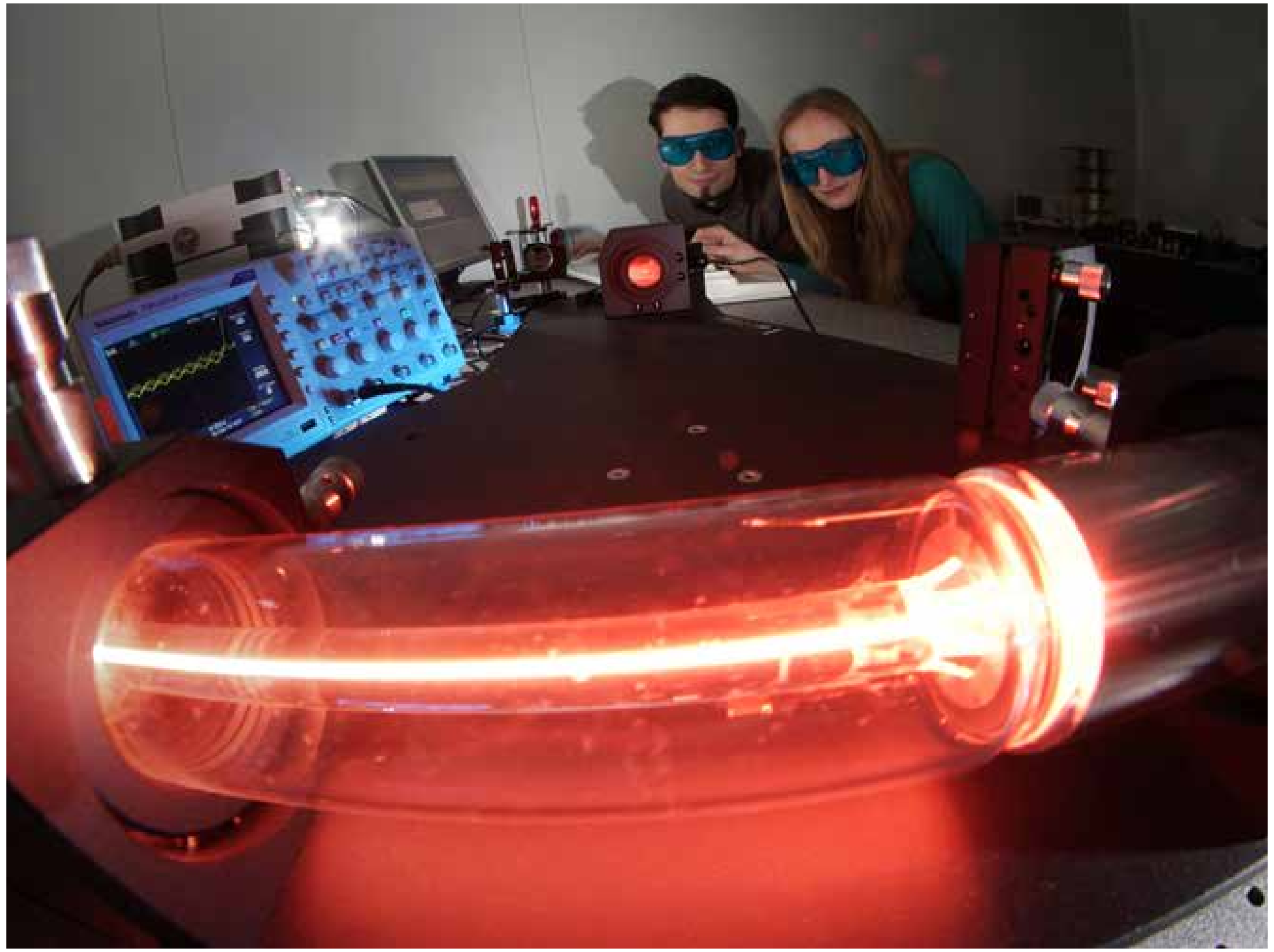
Lectures

Elective & Special Courses (Lectures & Seminars)

- Advanced Lens Design
- Astrophotonics
- Computational Photonics
- Design & Correction of Optical Systems
- Diffractive Optics
- Experimentelle Methoden der optischen Spectroskopie
- Fundamentals of Microscopic Imaging
- Fundamentals of Modern Optics
- Fundamentals of Quantum Optics
- Grundlagen der Laserphysik
- Imaging and Aberration Theory
- Introduction to Optical Modeling
- Micro/Nanotechnology
- Nanomaterials for Photonics
- Optical Design with Zemax
- Optical Modeling & Design I
- Optical Modeling & Design II
- Physical Optics Simulation with Virtual Lab
- Thin Film Optics
- Ultrafast Optics

Seminars of the Institute & Devisions

- ASP-Seminar Applied Photonics together with IFTO and FhG-IOF
- Applied Physics Prof. Tünnermann, Prof. Nolte, Prof. Pertsch, Jun.-Prof. Limpert
- Design of Optical Systems Prof. Gross
- Fiber Lasers Jun.-Prof. Limpert
- Field Tracing Prof. Wyrowski
- Diamond Optics Jun.-Prof. Szameit
- Microstructure Technologies - Microoptics Dr. Kley, Dr. Schrempel
- Nano Optics Prof. Pertsch
- Ultrafast Optics Prof. Nolte



Jan Sperrhake instructs a student in practical work at one of the Abbe School of Photonics Labortory.

Bachelor Theses

Thorsten Albert Goebel
Femtosekundenpuls-Laser geschriebene Faser-Bragg-Gitter

Simon Grosche
Goos-Hänchen and Imbert-Fedorov shifts in photonic graphene

Robert Hecht
Untersuchung der Temperaturverteilung in Festkörpern bei Bestrahlung mit Femtosekunden-Laserpulsen

Tobias Heuermann
Aufbau eines Experiments zur kohärenten Anti-Stokes-Raman-Spektroskopie mittels ultrakurzer Pulse

Friedrich Horschig
Untersuchung zur Optimierung des optischen Durchbruchs in Wasser mittels zeitlicher Formung ultrakurzer Laserpulse

Mark Kremer
Topological Bound States in Non-Hermitian Systems

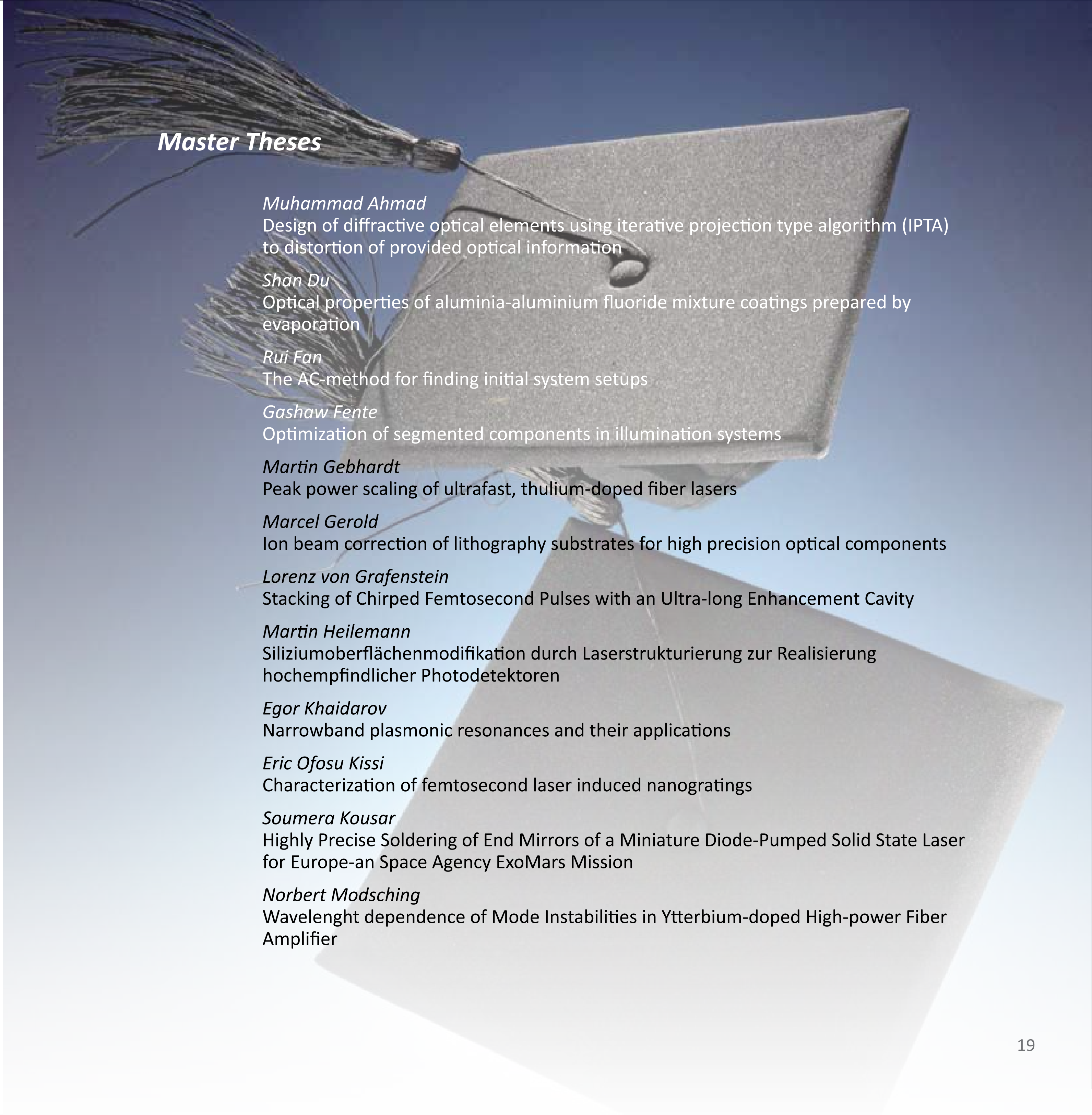
Annika Tamara Schmitt
Ramanspektroskopie von ultrakurzpuls-induzierten Nanostrukturen in transparenten Materialien

Stephan Schuhmann
Spektrale Verbreitung und zeitliche Kompression ultrakurzer Pulse hoher Leistung

Diploma Theses

Benjamin Fuchs
Schattenfotographische Untersuchung an Doppelpuls-Laserinduzierten optischen Durchbrüchen in Wasser

Soheil Mehrabkhnai
Solving transport of intensity equation using Fourier method



Master Theses

Muhammad Ahmad
Design of diffractive optical elements using iterative projection type algorithm (IPTA) to distortion of provided optical information

Shan Du
Optical properties of aluminia-aluminium fluoride mixture coatings prepared by evaporation

Rui Fan
The AC-method for finding initial system setups

Gashaw Fente
Optimization of segmented components in illumination systems

Martin Gebhardt
Peak power scaling of ultrafast, thulium-doped fiber lasers

Marcel Gerold
Ion beam correction of lithography substrates for high precision optical components

Lorenz von Grafenstein
Stacking of Chirped Femtosecond Pulses with an Ultra-long Enhancement Cavity

Martin Heilemann
Siliziumoberflächenmodifikation durch Laserstrukturierung zur Realisierung hochempfindlicher Photodetektoren

Egor Khaidarov
Narrowband plasmonic resonances and their applications

Eric Ofosu Kissi
Characterization of femtosecond laser induced nanogratings

Soumera Kousar
Highly Precise Soldering of End Mirrors of a Miniature Diode-Pumped Solid State Laser for Europe-an Space Agency ExoMars Mission

Norbert Modsching
Wavelenght dependence of Mode Instabilities in Ytterbium-doped High-power Fiber Amplifier

Sergii Morozov
Relaxation dynamics of quantum systems in the vicinity of plasmonic structures

Michael Müller
Multidimensional coherent pulse addition of ultrashort laser pulses

Mateusz Oleszko
Simulation of the Stress induced birefringence in mounted optical elements

Ivan Fernandez de Jauregui Ruiz
DSP based mitigation of fiber non-linearity in fiber optic coherent communication systems

Kristin Pfeiffer
Atomlagenabscheidung von Vanadiumdioxid mit thermochromem optischem Effekt

Illia Thiele
Investigation of nonlinear effects in plasmonic nanostructures by finite difference time domain simulations

Selam Wondimu Habtegiorgis
Investigation of human adpatation

Qian Xu
Characterization of magnetron-sputtered amorphous silicon layers

Huiying Zhong
Modelling of surface scattering by ray tracing and field tracing

Yi Zhong
Imaging with Scheimpflug setup

Master Theses (Teacher)

Stefanie Böttcher
Entwicklung einer Experimentierreihe zum Thema Optik in der Sekundarstufe I

Doctoral Theses

Dominik Bartl
Indirekte Ablationsprozesse mit ultrakurzen Laserpulsen am Beispiel des Dünnschichtsystems Glas-Molybdän

Lars Dick
Spritzgießen hochpräziser freiformoptischer Komponenten

Sven Döring
Untersuchungen zur Bohrlochentwicklung beim Ultrakurzpulslaserbohren

Hans-Christoph Eckstein
Modenkontrolle in Halbleiterlasern durch monolithisch integrierte mikrooptische Elemente

Falk Eilenberger
Raumzeitlich-nichtlineare Optik und die Untersuchung diskreter Light Bullets

Florian Jansen
Very-Large-Mode-Area Fibers for High-Power Laser Operation

Maria Oliva
High efficiency blazed gratings in resonance domain

Stefanie Kroker
Siliziumbasierte resonante Wellenleitergitter für rauscharme Resonatorkomponenten

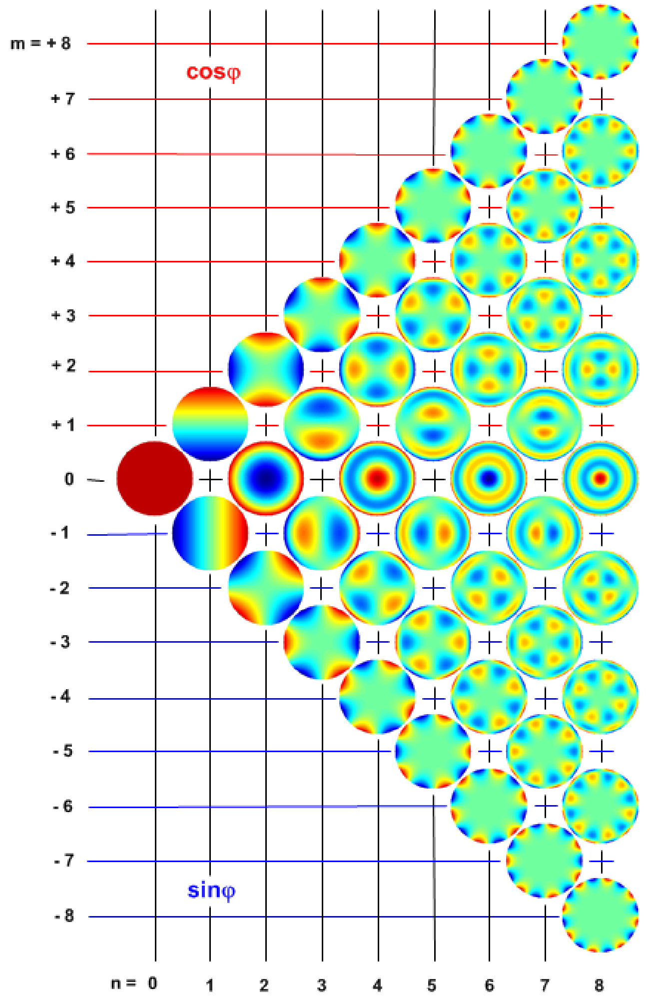
Oliver Pabst
All Inkjet Printed Piezoelectric Polymer Actuators for Microfluidic Lab-on-a-Chip Systems

Miroslaw Rekas
High power scaling of optical amplifiers on the basis of the Stimulated Raman Scattering in optical fibers

Sören Richter
Direct laser bonding of transparent materials using ultrashort laser pulses at high repetition rates

Marcel Schulze
Stochastische Antireflexstrukturen in Kieselglas

Thomas Weber
Drahtgitterpolarisatoren für Anwendungen im UV-Spektralbereich



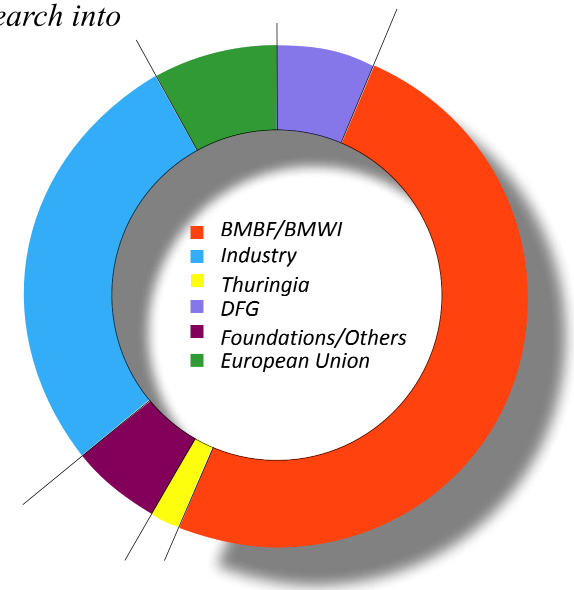
Sorting of the Zernike polynomials to display and later calculation of free-form surfaces of the Project Freeform optics plus fo+.

PROJECTS

"Applied Physics" is implemented in numerous projects in different application fields that contain fundamental research as well as application specifics. Accordingly, strong partners were explored and cooperations expanded. Thus, the IAP can continuously link the results at the value chain and transfer these results from basic research into innovative and novel demonstrators.

External funding

DFG (German Research Society)	€	560 k
BMBF/BMWI (Federal Ministries)	€	4,384 k
State of Thuringia	€	163 k
Foundations	€	496 k
Industry/Others	€	2,461 k
European Union	€	701 k
Total:	**€**	**8,765 k**



DFG - German Research Foundation

„Optisch erzeugte Sub-100-nm-Strukturen für biomedizinische und technische Zwecke“

„Optische Beschichtung mittels Atomic Layer Deposition. Beschichtung nanostrukturierter Substrate und Adsorption von Flüssigkristallen an dünnen Schichten“
(Emmy Noether-Programm)

SFB Transregio "Gravitationswellenastronomie"

„Lineare und nichtlineare Lichtausbreitung in Wellenleiterarrays bei komplexen Anregungsprofilen“

„Ultrakurzpuls–induzierte Erzeugung periodischer Nanostrukturen im Volumen transparenter Festkörper“

„Aktive Mikrooptik: Adaptierbare plenoptische Kameras: Design, Herstellung, Integration“

„Design und Herstellung nanostrukturierter optischer Schichtsysteme zur Optimierung des Wirkungsgrades photovoltaischer Elemente“

European Union

„ADOPSYS - Advanced Optical System Design“

ACOPS - Program „Ideas“, ERC Consolidator Grant: „Advanced coherent ultrafast laser pulse stacking"

„NimNil - Large Area Fabrication of 3D Negative Index Materials by Nanoimprint Lithography“

PECS - Program „Ideas“, ERC Starting Grant: „Powerful and Efficient EUV Coherent Light“

PICQUE - Marie Curie Initial Training Network: „Photonic Integrated Compound Quantum Encoding“

BMBF/ BMWI

Federal Ministry of Educaion and Research/Federal Ministry for Economic Affairs and Energy

Ultra Optics 2015 – research group „Fertigungstechnologien für hoch entwickelte Mikro- und Nano-Optiken“

Ultra Optics 2015 – junior research group „Design und Realisierung komplexer mikro- und nanostrukturierter photonischer Systeme basierend auf Diamant- und Kohlenstoffoptiken“

Verbund-ZIK Hitecom „Spektroskopietechniken zur Untersuchung der Vergasung von Kokspartikeln in einer strömenden, heißen Gasatmosphäre“

„Photonische Nanomaterialien“- project part ZIK and project part IAP & strategical investitions“

Wachstumskern „fo+ - Untersuchung ultrapräziser Freiformsysteme“

„Tailored for next PV (T4nPV), UKP-Laserstrukturierung von dünnen Schichten für PV-Anwendungen“

„NEXUS - Kompakte Ultrakurzpulslaser basierend auf kohärenter Kombination“

„iPLASE - Grundlegende Untersuchung zur zeitlichen Kompression passiv gütegeschalteter Laser in den sub-10 ps Bereich“

„MEDUSA - Mehrdimesionale Ultrakurzpulssynthese für Faserlaser der TW-Klasse“

„Einführung von Field Tracing Verfahren für anisotrope und nichtlineare Medien“

„NanoInt - Verbundprojekt Integrierte Nanooptik“

Optische Mikrosysteme für ultrakompakte hyperspektrale Sensorik (OpMiSen) -
Teilprojekt: „Mikrostrukturierte Filter“

„ALSI - Advanced Laser-writing for Stellar Interferometry“

„SITARA - Selbstadaptierende intelligente Multiaperturkamera-Module“

„Infrarot-optische Nanostrukturen für die Photovoltaik (InfraVolt) -
Teilvorhaben: Photonmanagment im infraroten Spektralbereich“

„Montagegerechte Fertigungstechnologie für gefasste Optik (Justierfräsen)“

State of Thuringia

Thuringian Ministry of Education, Science and Culture (TMBWK) &
Thuringian Ministry of Economics, Labour and Technology (TMWAT)

SpaceTime „Nichtlineare Raum-Zeit-Dynamik in nanostrukturierten optischen Systemen“

OptiMi 2020-Graduate Research School „Green Photonics“

Coordination of the Initiative „PhoNa – Photonische NanoMaterialien“ at Bundesprogramm „Spitzenforschung und Innovation in den Neuen Ländern“

Foundations/Other Sources

Carl-Zeiss-Scholarships

Endowed Professorhip

Contract Research

„Anorganisch-organische Hybridschichten für die Optik“

„Design, Verschaltung und Charakterisierung von photosensorischen Elementen“

„Einfluss der Abscheidebedingungen auf die optischen und mechanischen Eigenschaften amorpher Funktionsschichten“

„Einfluss der Plasmachemie und -energetik auf die Zusammensetzung und Kristallstruktur gesputterter Metall-Dielektrischer Schichten“

„Entspiegelung von SiON-Schichten“

„Entwicklung eines synchronisierten OPA Systems“

„Entwicklung keramischer Gasdurchführungen für Atmosphären- und Vakuumanwendungen“

„Entwicklung und Analyse einer athermalen Werkstoffkombination für formstabile Metall-optiken“

„Entwicklung von THz-Tomographiesystemen“

„Entwicklung und Untersuchung eines Aktuators mitsamt Fertigungsprozess für direkt in Schicht-technologien integrierbare elektrostatische Aktorik zur Verstellung von Mikrolinsen in einem abgeschlossenen und volumenminimierten Optiksystem“

„Entwicklung von Methoden für das 3D-Messen mit strukturierter Beleuchtung in Bewegung“

„Erforschung der Möglichkeiten und Grenzen von Strukturen in kombinierten dieelektrischen / metallischen Schichten bezüglich deren polarisierenden Wirkung“

„Funktionale Oberflächen mit spezifischen optischen, haptischen und Benetzungseigenschaften“

„Grundlegende Untersuchungen zu Hochleistungsfaserlasern“

„Herstellung hochpräziser optischer Schichten mittels Magnetronsputtern“

„Herstellung von ultraleichten Metalloptiken auf der Basis additiver Fertigungsverfahren“

„Magnetorheological Finishing (MRF) als Formkorrekturverfahren für metallische Freiformspiegel“

„Neuartige Laserquellen für schmalbandige faserbasierte Verstärkung im nahen IR“

„Optimization of a laser beam soldering process for optical components with respect to precision and stability“

„Streulichtcharakterisierung Optischer Oberflächen und Materialien “

„Streulichtmechanismen an optischen Oberflächen“

„Steigerung des Wirkungsgrades von Nano-SIS Solarzellen sowie Entwicklung und Anpassung von TCO-Materialien für nano-SIS Bauelemente“

„Synchronisiertes Ultrakurzpuls-Faserverstärkersystem“

„Theoretische und experimentelle Untersuchung zur Entwicklung einer Leichtgewichtsausführung von Metallspiegeln für weltraumtaugliche Teleskope“

„Ultrakurzpulsstrukturierung von elektronischen Komponenten auf hochelastischen metallisierten Polymerfasern“

„Ultrakurzpulsstrukturierung von Siliziumsolarzellen auf textilen Substraten“

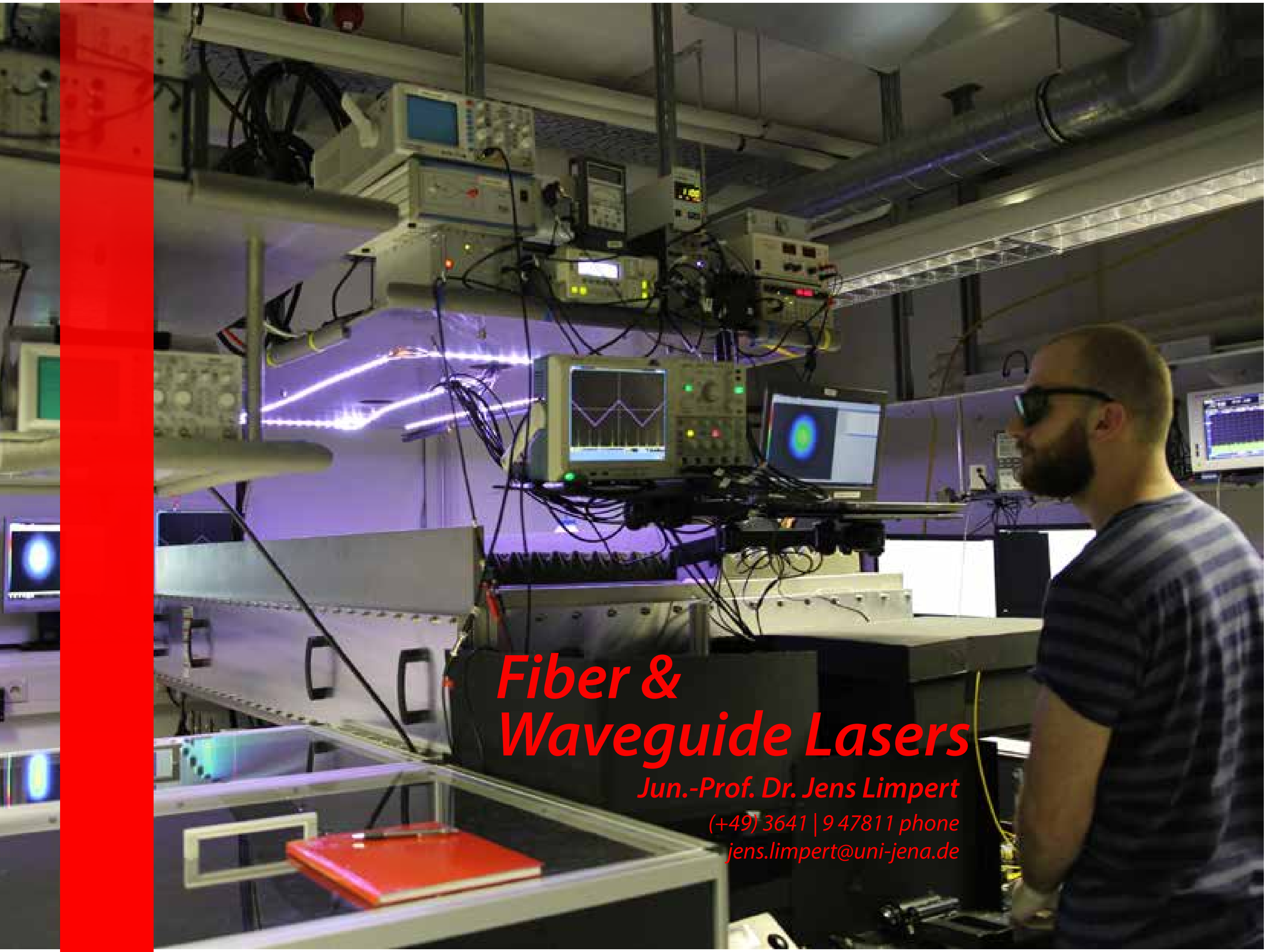
„Unterstützung bei der Entwicklung kohärent kombinierter Ultrakurzpuls-Laser“

„Verfahren für hochdynamische 3D-Messungen mittels Arrayprojektion“

This nano-optical grating is a part of the spectrometer, which currently is en route with the space orbiter Gaia (European Space Agency esa) to generate data for modelling the Milky Way. For this purpose, about a billion stars in our solar system will be recorded - only 1% of the stars in our galaxy.

RESEARCH - Achievements & Results

Evidence of intense engagement with research topics of the institute is the spezialization of the separate research groups on key challenges. In turn, these groups contribute with their results to the solution of partial tasks of the other work groups. This constantly self-fertilising approach itself leads to remarkable results. Measurably honored are such results by success in granting research contracts, the strong interest in cooperation with the IAP and the number of scientists and students who would like to work at IAP scientifically.



Fiber & Waveguide Lasers

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Stefano Wunderlich works on passive enhancement cavity for pulse stacking of an ultrashort-pulse fiber-laser system.

This research group is working on the development of new concepts for solid-state lasers with focus on fiber laser technology.

Scientific focus lies on:

- Fiber optical amplification of ultra-short laser pulses
- Ultra-short pulse oscillators, few-cycle pulse generation and amplification
- Conception of novel large core diameter fibers
- Simulation of non-linear effects and amplification dynamics in active fibers
- Fiber optical frequency conversion
- Picosecond µ-chip-lasers
- Generation of high harmonics

Authors:
Jens Limpert, Tino Eidam, Arno Klenke and Marco Kienel

Coherent Addition of ultrashort pulses

Fiber-laser systems emitting ultrashort pulses have proven to be an indispensible tool for a large number of applications. These systems are distinguished by their excellent beam-quality, efficient operation, compact footprint and high average power. Additionally, in recent years outstanding progress has been made in increasing the maximum peak-power. Thus, today's fiber lasers are able to compete with any other architecture. However, although further power scaling is still possible, it becomes more and more demanding due to fundamental physical limitations. One solution is to use parallelization, i.e. the coherent addition of multiple laser amplifiers [1]. Thus, laser power is not limited by physics any more, but only by size and cost of the envisioned system.

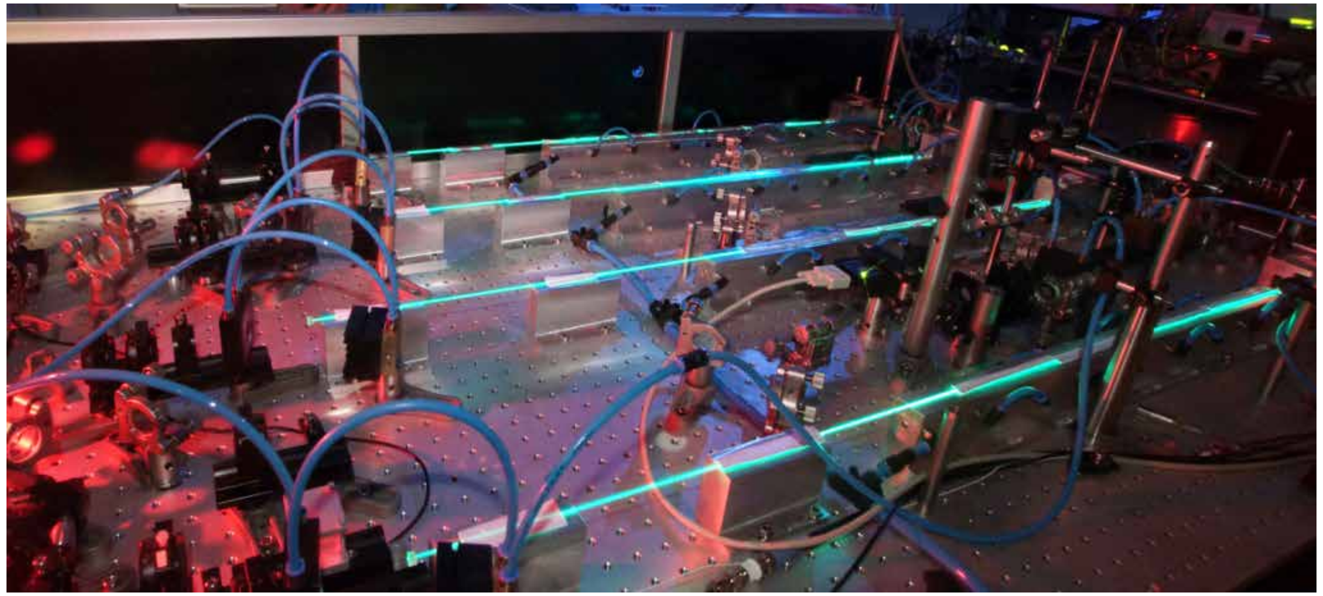

Figure 1: Main amplifier of an ultrashort-pulse fiber-laser system employing four parallel channels.

In the setup, the output beam of the last pre-amplifier in a high-power laser system is split into four parallel channels. Large-mode-area fiber amplifiers employing large-pitch fibers developed at IAP/IOF [2] are located in each of the channels. Afterwards, the output beams of all the channels are recombined into a single beam. The combination requires a high-precision temporal overlap of the corresponding laser pulses with a variation of less than an optical cycle and employs, therefore, an active optical-path-length stabilization.

The properties of the combined laser pulses are comparable in beam quality and duration to a single-channel system. However, dramatically higher pulse energies and average powers are achievable. In experimental conditions, 200 fs pulses with an energy of 5.7 mJ, a peak-power of 22 GW and an average power of 230 W were realized, which represents a new record for fiber laser systems [3].

There are a large number of applications for such laser sources. For example, coherent light pulses in the XUV wavelength range can be produced. In a first experiment, an average power for these short wavelengths comparable to a synchrotron has been achieved [4]. With additional power scaling, e.g. by increasing the number of parallel channels, these systems might even be used for applications like laser particle acceleration.

[2] J. Limpert et al.:
"Performance Scaling of Ultrafast Laser Systems by Coherent Addition of Femtosecond Pulses"
IEEE J. Sel. Top. Quantum Electron. 20 (5), 0901810 (2014).

[3] J. Limpert et al.:
"Yb-doped large-pitch fibres: effective single-mode operation based on higher-order mode delocalisation"
Light Sci. Appl. 1, e8 1-5 (2012).

[4] A. Klenke et al.:
"22 GW peak-power fiber chirped-pulse-amplification system"
Opt. Lett. 39 (24), 6875-6878 (2014).

[5] S. Hädrich et al.:
"High photon flux table-top coherent extreme-ultraviolet source"
Nat. Photonics 8 (10), 779–783 (2014).

Microstructure Technology & Microoptics

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This Black Silicon structure (so called Moth-Eye) has been used for light-trapping to enhance the absorptance of a sensor.

This research group concentrates fundamentally on function and design of micro- and nano-optical elements as well as applications and technology developments for micro structuring.

The following research priorities have been edited:

- Plasmonic resonant nanometric structures
- Resonant reflective monolithic gratings
- Transmissive, reflective and diffractive elements based on effective media
- Metallic and dielectric polarizers from IR to DUV range
- 3D nano-structuring of crystals with ion beam
- Optical and opto-electronic applications of antireflective fused silica and silicon surfaces
- Material-scientific aspects

Authors:
Martin Steglich, Thomas Käsebier, Matthias Zilk, Frank Schrempel and Ernst-Bernhard Kley

Black Silicon enhanced Ge-on-Si photodiodes

Fast internet access is a crucial economic factor in the modern knowledge society. An even more rapid development of the persistent telecommunication infrastructure fails due to the prohibitively high investments costs. Cheaper photodiodes for the conversion of fiber-delivered light signals into electrical signals would significantly contribute to their reduction.

A promising detector concept is represented by Germanium photodiodes being epitaxially integrated on a silicon chip. However, Germanium is only weakly absorbing in the relevant spectral range from 1300 nm to 1700 nm, thus necessitating high layer thicknesses of a few µm for a sufficient photocurrent yield. On the other hand, application in fast telecommunication systems requires very high detector bandwidths (> 10 GHz). This, in turn, can only be achieved by application of thin Germanium layers of a few 100 nm thickness because of the truncated photocarrier transit time.

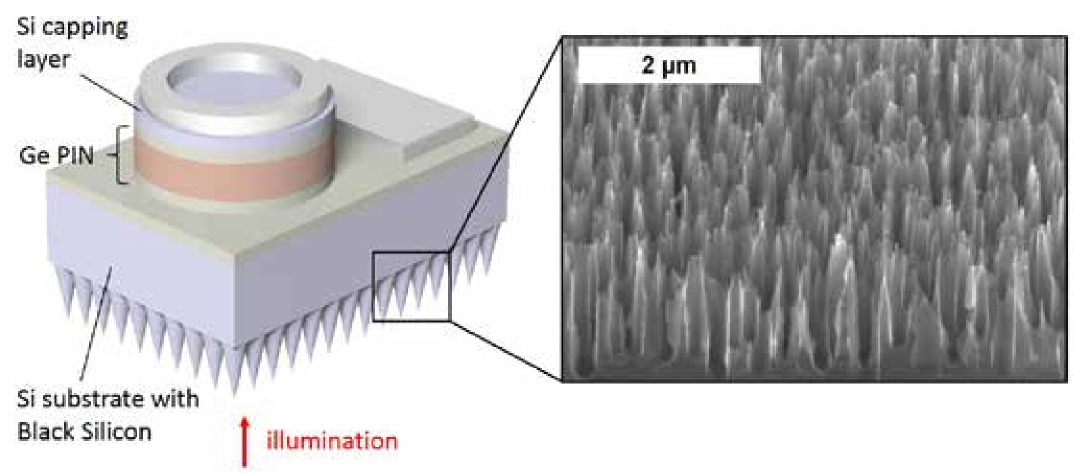


Figure 1:
Ge-on-Si detector concept with Black Silicon light-trapping for enhancement of intrinsic Ge absorptance. An epitaxial Ge PIN photodiode is arranged on the silicon substrate. Illumination is performed over the Black Silicon structured rear side of the device.

Application of Black Silicon, a needle-like, self-organized and thus cost-efficiently manufacturable silicon nanostructure, can solve this problem. Placed on the rear of the silicon chip – which is transparent in this wavelength range – a light-trap is implemented that strongly increases light absorptance in thin Germanium (Fig. 1). By that, the responsivity of ultrafast Ge-on-Si detectors with bandwidths of up to 100 GHz can be increased by a factor of 3 to 10.

In particular, common problems that are related to the application of silicon nanostructures are circumvented with this approach. Since photocurrent generation takes place in the Germanium, the raised surface recombination velocity of the silicon nanostructures imposes no drawback. Thus, theoretically predicted absorptance enhancements through the applied Black Silicon light-trapping can be directly transferred into equivalent responsivity enhancements (Fig. 2). Furthermore, the fabrication of Black Silicon can be carried out uncomplicated on the chip’s rear during back-end processing.

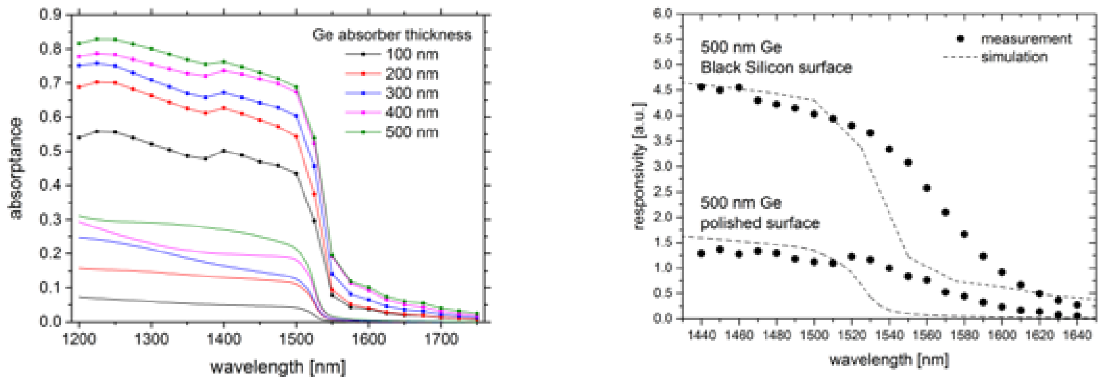


Figure 2:
Theoretically predicted absorptance increase due to rear Black Silicon light-trapping for different absorber thicknesses (left) and proven responsivity increase at the device (right).

Authors:
Dennis Lehr, Jörg Reinhold, Illia Thiele, Kay Dietrich and Christoph Menzel

Enhancement of optical effects by plasmonic nanorings

Metallic nanorings are key structures for photonic nanomaterials. Their high degree of symmetry and their intriguing plasmonic properties have led to the development of many applications, such as spectroscopic filters, surface enhanced sensing and nanoantennas. At resonance, nanorings provide the unique advantage of a pronounced plasmonic field enhancement inside their core (Fig. 1) that should significantly enhance light-matter interactions, if filled with a polarizable medium.

We validate this concept by filling gold nanorings with lithium niobate (LN) to significantly enhance second harmonic generation (SHG) in sub-wavelength volumes.

The implemented fabrication process allows efficient fabrication of the nanostructure with a throughput of dm² per hours. The main process steps comprise the creation of crystalline LN pillars by character projection electron beam lithography, i.e. imaging of a shaped aperture in the plane of the resist, and ion beam enhanced etching. Later, double patterning is utilized to form the gold nanorings around the LN pillars.

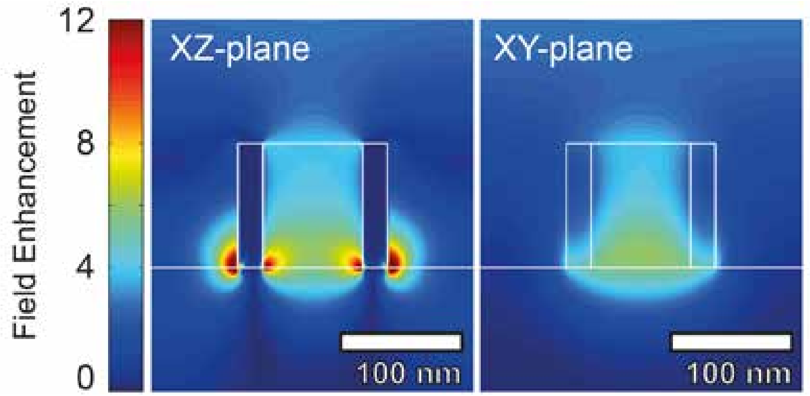


Figure 1:
Normalized E_x Component of the electric field at resonant illumination of gold nanorings filled with lithium niobate.

The fabricated nanorings with an inner diameter of 80 nm, an outer diameter of 120 nm, and a height of 100 nm are arranged periodically on a square lattice with a period of 260 nm on top of a crystalline LN substrate (Fig. 2). Such small dimensions allow excitation of the nanostructure at NIR wavelength and second harmonic generation at visible wavelength.

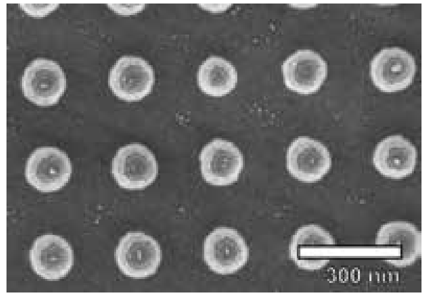


Figure 2:
Raster-electron-micrographs of fabricated samples: gold nanorings filled with lithium niobate.

As predicted by simulations we obtained an enhancement of the second harmonic signal by a factor of 20 at oblique incidence (Fig. 3). In future experiments we will achieve a factor of 50 to 60 at normal incidence.

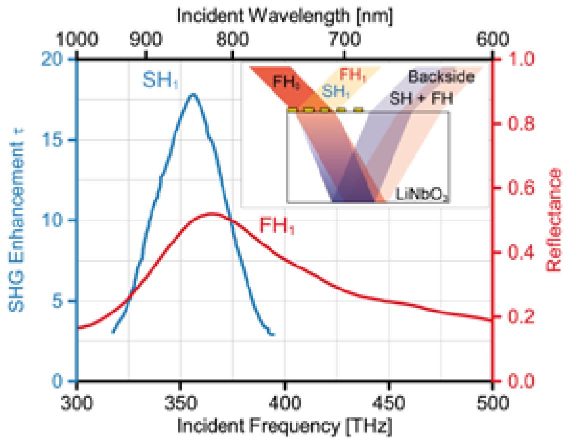
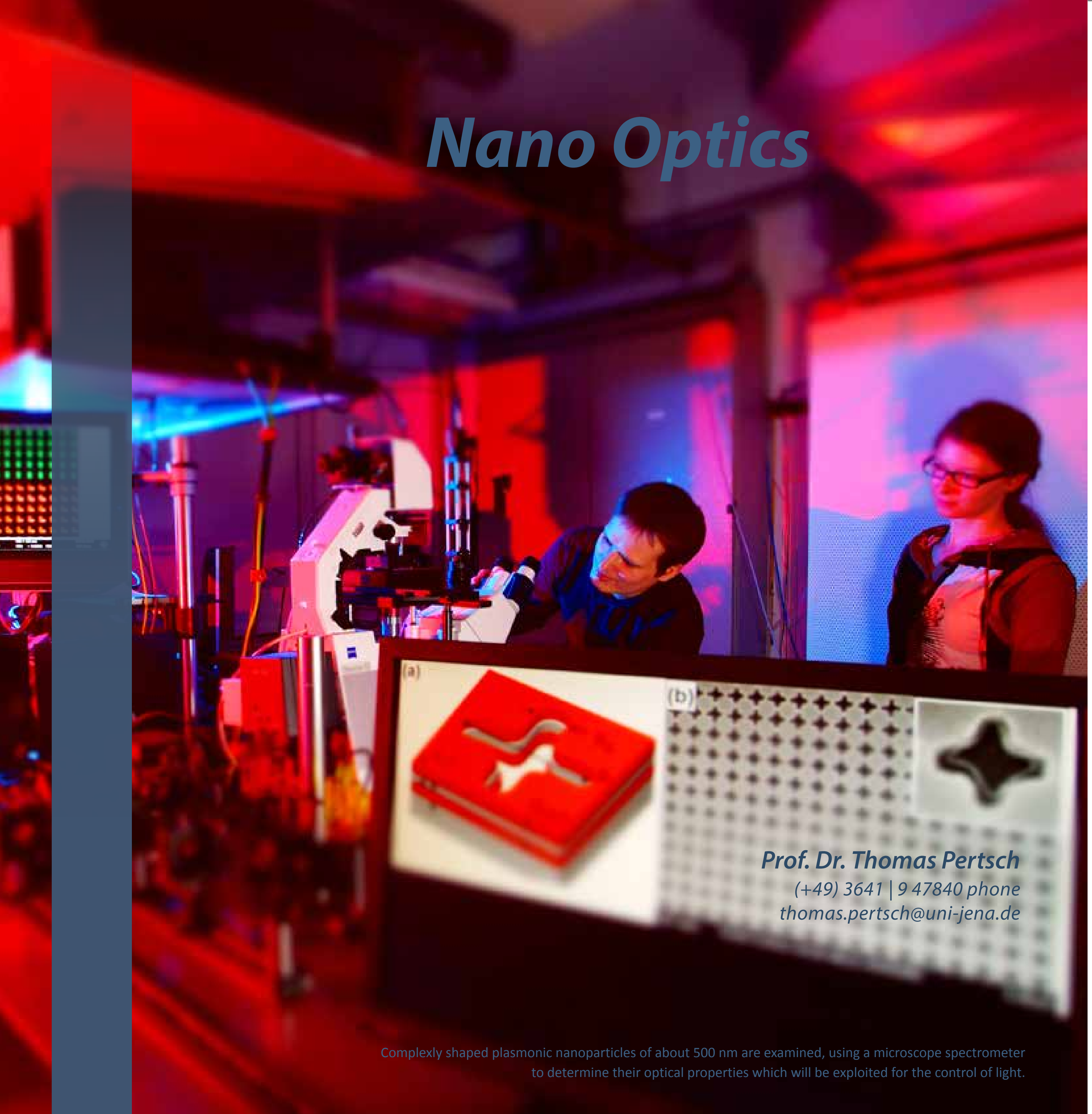


Figure 3:
Measured SHG enhancement (SH_1) and linear reflection spectrum (FH_1). The inset depicts the chosen measurement geometry.

Nano Optics



Prof. Dr. Thomas Pertsch
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Complexly shaped plasmonic nanoparticles of about 500 nm are examined, using a microscope spectrometer to determine their optical properties which will be exploited for the control of light.

The research group Nano Optics deals with light propagation and nonlinear light-matter interaction in micro and nano structures, optical metamaterials as well as photonic crystals.

The scientific emphasis lies on:

- Plasmonics and near-field optics, scanning optical nearfield microscopy (SNOM)
- Nanostructured optical metamaterials
- Nonlinear light-matter interaction at high optical intensities in micro- and nanostructures, nonlinear space-time-dynamics
- Nonlinear optical micro resonators
- Nonlinear nano markers for high-resolution microscopy
- Opto-optical switching processes in integrated optics
- New optical technologies for astronomical instruments
- Application of nanostructures to the enhance efficiency of photovoltaic elements

Important results in 2014 are: generation of nonclassical biphoton states through cascaded quantum walks on a nonlinear chip • plasmonic nanoparticle clusters with tunable plasmonic resonances in the visible spectral region • polarization-resolved near-field mapping of plasmonic aperture emission by a dual-SNOM system • ultra broadband phase measurements on nanostructured metasurfaces • demonstrating extreme plasmonic coupling: a route towards local magnetic metamaterials • highly resonant and directional optical nanoantennas • data transmission in long-range dielectric-loaded surface plasmon polariton waveguides • realization of photonic crystals in lithium niobate by combining focused ion beam writing and ion-beam enhanced etching • new understanding of the energy deposition dynamics of femtosecond pulses in water

Authors:
Angela E. Klein, Norik Janunts and Thomas Pertsch

Dual-SNOM characterization of nanooptical devices

In photonic circuits, information can potentially be processed faster than in current electronic microchips. Nanooptical plasmonic devices are the building blocks of compact photonic circuits due to their ability to localize light within small volumes.

To microscopically characterize such devices, a method is necessary which can map the near-fields which are localized at the sample surface and which surpasses the diffraction limit of resolution.

In scanning near-field optical microscopy (SNOM), a sharp, metal-coated tip fabricated from a tapered optical fiber is scanned along the sample surface. The metal coating features a small aperture at the apex. The aperture diameter is chosen between 50 nm and 200 nm in most cases. The sample can either be locally excited by the aperture’s near-field, or the sample is illuminated from the far-field while the tip serves to locally collect light.

Usually either the illumination or the collection is done in the far-field and with diffraction-limited resolution. Thus hampering the characterization of plasmonic devices.

We succeeded in combining two SNOMs with fiber tips into a Dual-SNOM setup. With this setup, the samples can be near-field illuminated at a freely chosen position by the first tip, while the second tip scans the sample surface and maps the optical near-fields [1]. A specially developed closeness approach-warning mechanism serves to prevent collisions [2].

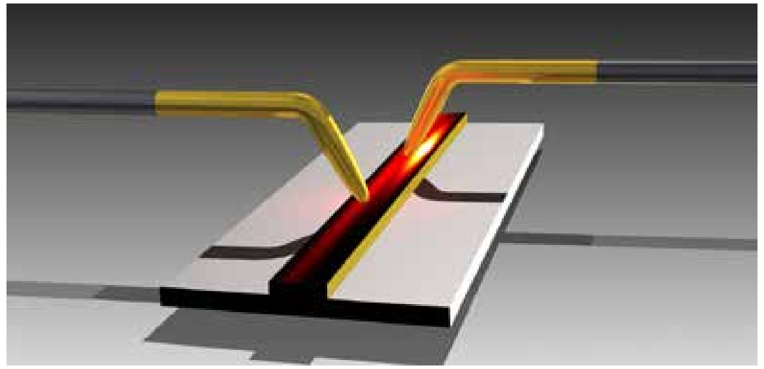

Figure 1:
The two tips of a Dual-SNOM on a gold stripe waveguide (artist’s view).

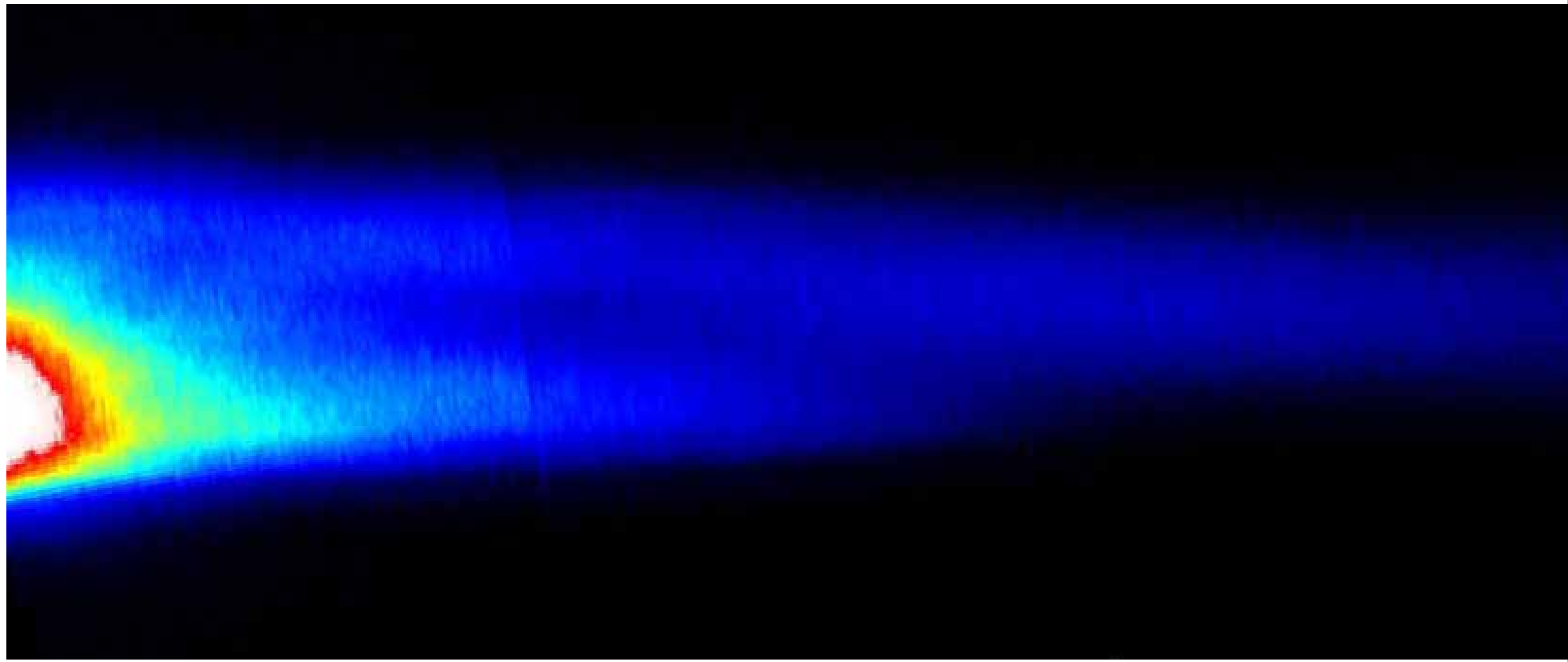

Figure 2:
Dual-SNOM image of a gold strip waveguide (width: 2.5µm, light wavelength: 663 nm). The illumination tip is near the left edge of the image.

The Dual-SNOM was used to investigate plasmonic leaky modes in gold strip waveguides. In waveguides which support several leaky modes, mode beating patterns were observed. By varying the excitation position, the relative excitation strengths of the different modes could be finely tuned.

The capability to selectively and locally excite modes and to map their optical near-fields at the same time makes the Dual-SNOM a valuable and versatile tool for the characterization of a wide range of micro- and nanooptical devices and structures. In particular, coupling and transport phenomena can advantageously investigated via simultaneous near-field excitation and near-field detection with subwavelength resolution.

[1] A. E. Klein, N. Janunts, M. Steinert, A. Tünnermann, T. Pertsch: "Polarization-Resolved Near-Field Mapping of Plasmonic Aperture Emission by a Dual-SNOM System" Nano Lett. 14 (9), 5010-5015 (2014).

[2] A. E. Klein, N. Janunts, A. Tünnermann, T. Pertsch: "Investigation of mechanical interactions between the tips of two scanning near-field optical microscopes" Appl. Phys. B 108, 737 (2012).

Applied Computational Optics

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Intensity distributions Transition from normal double refraction into conical refraction when incident light gradually goes in parallel with the optical axis of a biaxial crystal.

The Applied Computational Optics Group deals with various optical modeling techniques, ranging from geometrical optics to rigorous solutions like the Fourier modal method. By combining different techniques, a unified modeling concept -field tracing- is established.

In 2014, the following research and development (R&D) topics have been investigated, among others:

- Spatio-temporal simulations of ultrashort pulses
- Light propagation through anisotropic media
- Fully vectorial laser resonator analysis and its acceleration with vector extrapolation
- Generalized iterative projection type algorithm for DOE design
- Rigorous solution for general field interaction with periodic/aperiodic microstructures
- Rigorous simulation of optical prisms, plates, and Etalons
- Thin Element Approximation (TEA) used for parabasal incident fields
- Geometrical optics modeling of freeform surfaces
- Ray-tracing in inhomogeneous media
- Numerical representation of smooth functions in modeling
- Efficient light propagation techniques by using smooth decompositions
- Semi-analytical handling of smooth phase terms in modeling with N log N operators

Several topics have been developed in cooperation with LightTrans GmbH using the optics software VirtualLab. The cooperation with Shanghai Institute of Optics (SIOM) and Harbin Institute of Technology (HIT) has been strengthened.
In addition, we hosted two visiting scholars, one from Harbin Engineering University (HAREU) and the other from the University of Eastern Finland (UEF).

Author:
Frank Wyrowski

Laser resonator modeling by field tracing – including birefringence effects caused by anisotropic crystals

To fulfill the tasks of various laser applications, a wide range of optical components are used inside laser cavities. Anisotropic crystals, as an important group of intracavity components, show significant influence on the transversal mode and polarization-state of the light.

We developed a generalized Fox and Li approach, which takes the vector nature of light fully into account. In this manner, a round trip operator could be used to describe a single pass through the cavity and by repeatingly applying such an operator, the multiple-reflection process inside the cavity is included. Within the framework of field tracing, a round trip can be described as a sequence of optical component operators and propagation operators for the space between components.

To simulate birefringence effects, a fast Fourier transformation (FFT)-based angular-spectrum-of-plane-waves approach is developed to deal with light propagation through an anisotropic crystal, as a component operator. Such an operator handles both the refraction at isotropic-anisotropic interfaces and the propagation inside anisotropic crystals. It should be emphasized, that this technique is valid for general anisotropic media, including biaxial crystals. From experiments it is known that when the light comes along the optical axis of a biaxial crystal, the conical refraction effect happens. The related simulation obtained by our crystal modeling technique is shown in Fig. 1.

In 2006, Yonezawa et al. introduced a way to generate radially polarized light by using a c-cut Nd:YVO_4 crystal (uniaxial), as shown in Fig. 2. A difference in the optical paths of the extraordinary wave and the ordinary wave appears. When the length of the cavity is properly chosen, the round trip loss for one wave is higher than for the other. By choosing the ordinary wave to have higher loss, the extraordinary wave, which corresponds to radial polarization, remains as the output.

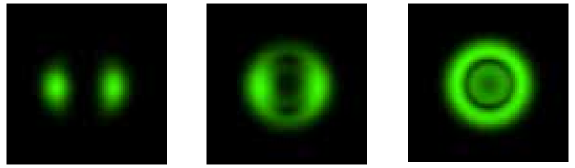


Figure 1:
(Intensity distributions) Transition from normal double refraction into conical refraction when incident light gradually goes in parallel with the optical axis of a biaxial crystal.

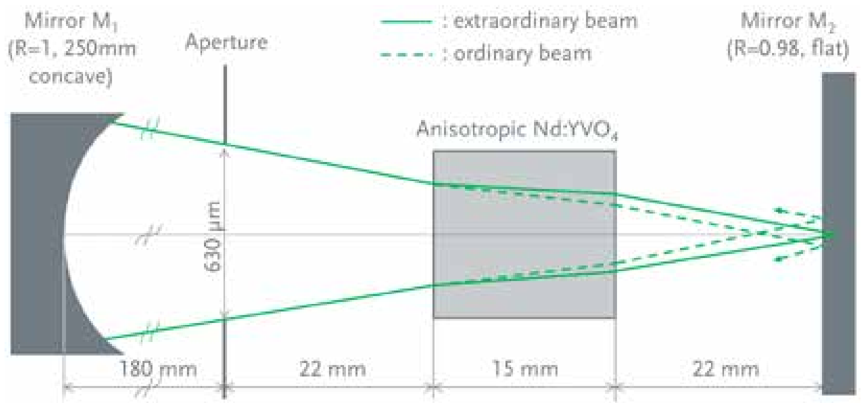


Figure 2: A laser resonator used to generate radially polarized light.

With the generalized Fox and Li approach and the propagation technique through anisotropic media, the cavity in Fig. 2 can be well described and then an eigenvalue problem can be formulated. We use a vector extrapolation method – minimal polynomial extrapolation (MPE) – to solve it and a much faster convergence is achieved in comparison to the power method. Simulation results of the dominant resonator mode are shown in Fig. 3 and they are in good agreement to the measurements found in literature. With the generalized Fox and Li approach and the propagation technique through anisotropic media, the cavity in Fig. 2 can be well described and then an eigenvalue problem can be formulated. We use a vector extrapolation method – minimal polynomial extrapolation (MPE) – to solve it and a much faster convergence is achieved in comparison to the power method. Simulation results of the dominant resonator mode are shown in Fig. 3 and they are in good agreement to the measurements found in literature.

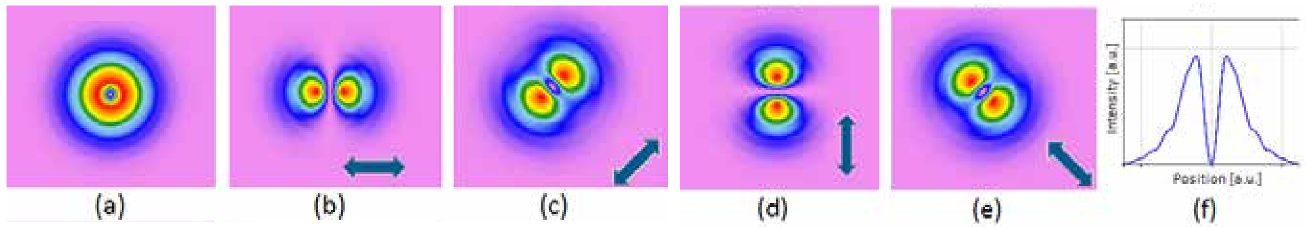
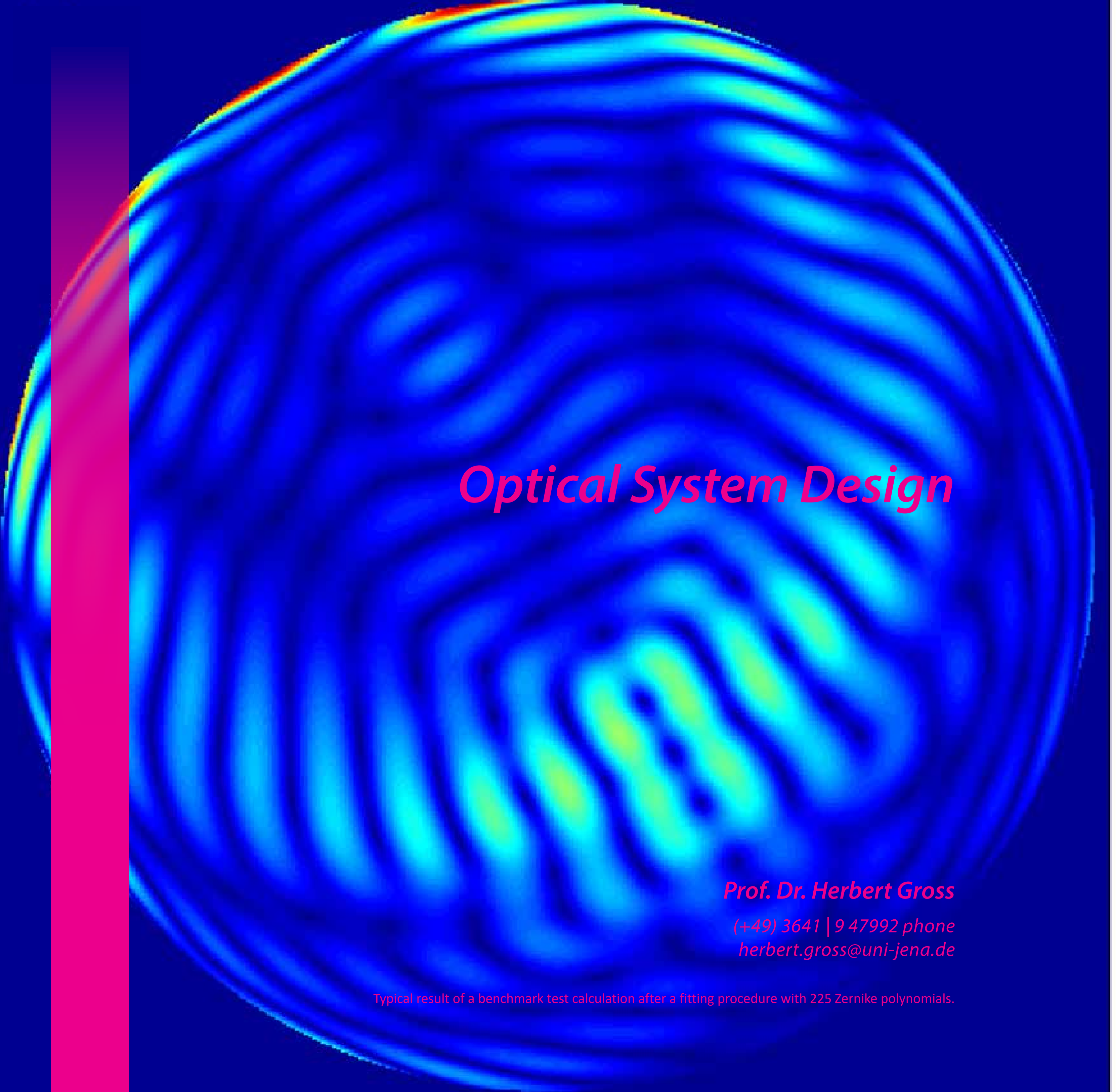


Figure 3:
Intensity distribution of the dominant transversal resonator mode at the output. (a) Overall intensity distribution. (b)-(e) Intensity distributions after a linear polarizer with different directions, with the arrows indicating the polarizer directions. (f) Intensity profile along the vertical line through the center of (a).



Optical System Design

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Typical result of a benchmark test calculation after a fitting procedure with 225 Zernike polynomials.

Since April 2012, the new endowed professorship Theory of Optical Systems could be assigned by Prof. Herbert Gross. Thirteen companies of the region have launched this facility along with the STIFT Thuringia and the Ernst Abbe Foundation. It is thought to extend this facility to a reseach group with the aim to support small and medium-sized optical companies of the region around Jena in their development and training. The group has now reached a size of 10 co-workers.

The research priorities of this working group can be divided into two main areas. In classical optics design, especially the following topics will be adressed:

- Design of modern optical system
- Aberration theory
- Quality evaluation of optical systems
- Measurement of the performance of optical systems
- Design of laser and delivery systems
- Design and evaluation of freeform optical systems for imaging and illumination
- Optimization methods in optical design
- Tolerancing of optical systems.

In somewhat more general physical issues relating to optical systems, in particular the following topics of interest are:

- Simulation of diffraction effects
- Microscopic image formation
- Calculation algorithms of wave propagation
- Straylight and scattering in optical systems
- Modelling of illuminations systems
- Partial coherent imaging and beam propagation
- Point spread function engineering and Fourier optics.

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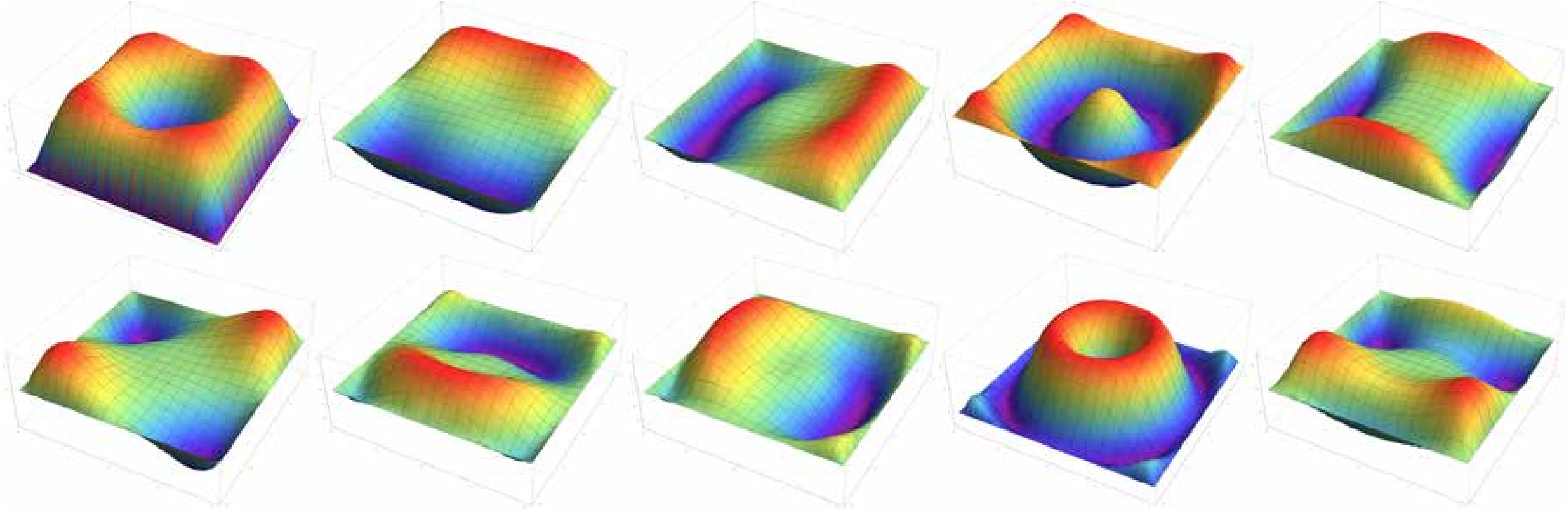
New Descriptions of Optical Freeform Surfaces



Historically optical surfaces are plane, spherical or circular symmetric aspherical in shape. In recent years, more general freeform shapes are investigated to be able to control the quality of very compact optical systems without any symmetry or to generate very special functionalities. Especially arbitrary shaped smooth surfaces are of growing interest for applications with high quality requirements in imaging. But there are many unsolved problems in the development of these components. One of the challenges is the mathematical description of the surface. In mechanical design freeform surfaces typically are described by Splines of the NURBS type. In optical applications there are several requirements on the representation, in particular a good performance and fast convergence in optimization, a fast raytracing and a good manufacturability. Considering these goals splines have proven to be unsuitable and alternative solutions are necessary. Expansions into orthogonal basis functions have some advantages. They allow a reduced number of parameters in optimization. Due to the special properties of the light deflection it is feasible to use functional systems, which are orthogonal in slope. This gives quite faster convergence in optimization and better final results. On the other hand, the problems of manufactured surfaces with local errors typically cannot be described well with expansions of global support with high accuracy. Thus several representations are necessary in practice. Depending on the remaining symmetry and the shape of the boundary several new types of surface descriptions are developed.

Figure 1:
Low order shapes of a new developed expansion description for freeform surfaces for rectangular boundaries.

For an objective assessment of the various properties a benchmark with different options is defined and the performance of several formulations is tested under different aspects.

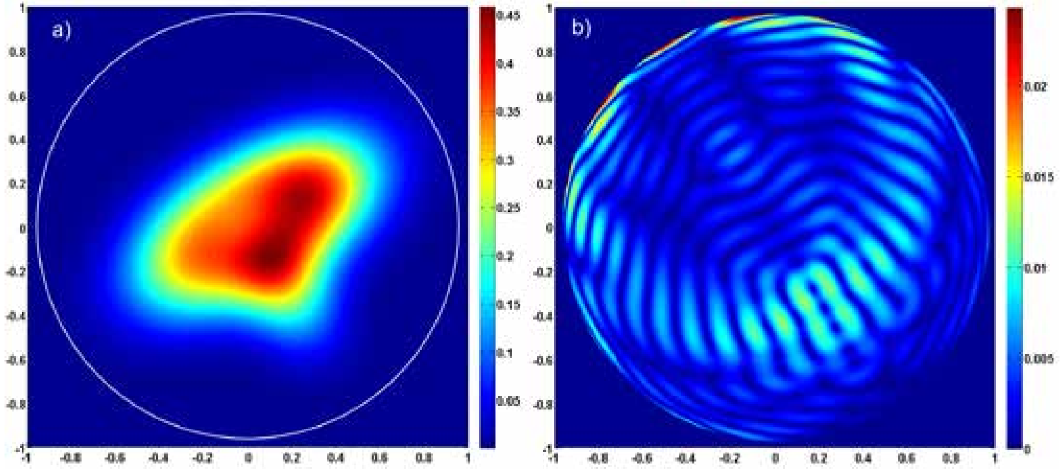


Figure 2:
Typical result of a benchmark test calculation. a) given shape on a normalized quadratic area, b) result of the residual slope deviations after a fitting procedure with 225 Zernike polynomials.

Ultrafast Optics

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The price money of the Deutscher Zukunftspreis has been mostly donated to the Deutsche Museum Munich to establish an experimental area for students and families. The main idea is to foster interests for physics and engineering.Opening will be later in 2015.

The group Ultrafast Optics works on applications of femtosecond laser pulses, such as materials processing and micro/nano structuring of optical materials.

The scientific topics are:

- Linear and nonlinear interaction processes between light and matter
- Micro- and nanostructuring with ultrashort laser pulses
- Sub-wavelengths structuring
- Fiber Bragg Gratings (FBG), Volume Bragg Gratings (VBG)
- Linear and nonlinear optics in discrete systems
- Medical laser applications in ophthalmology
- THz technology
- Spectroscopic methods for gas analysis

In 2014, some outstanding results were: simultaneous spatial and temporal focusing for improved precision in medical and materials processing applications • spatial and temporal resolved measurement of temperature evolution inside bulk glass after fs-pulse irradiation • demonstration of narrow-linewidth stabilization of diode lasers with fs-written VBGs in fused silica • realization of a fiber mode modulator by femtosecond direct-writing • ultrastable bonding of dissimilar glasses • structural analysis of laser induced nanogratings • realization of broadband THz antireflection structures by fs processing • laser shock experiments simulating impact events in debris disks in space • realization of fs-laser written integrated photonic quantum circuits • demonstration of arbitrary photonic wave plate operations on chip for polarization qubits • demonstration of supersymmetric mode converters • analysis of unconventional edge states in photonic graphene

Authors:
Robert Kammel, Stefan Nolte and Andreas Tünnermann

Enhanced Material processing using spatiotemporal pulse shaping

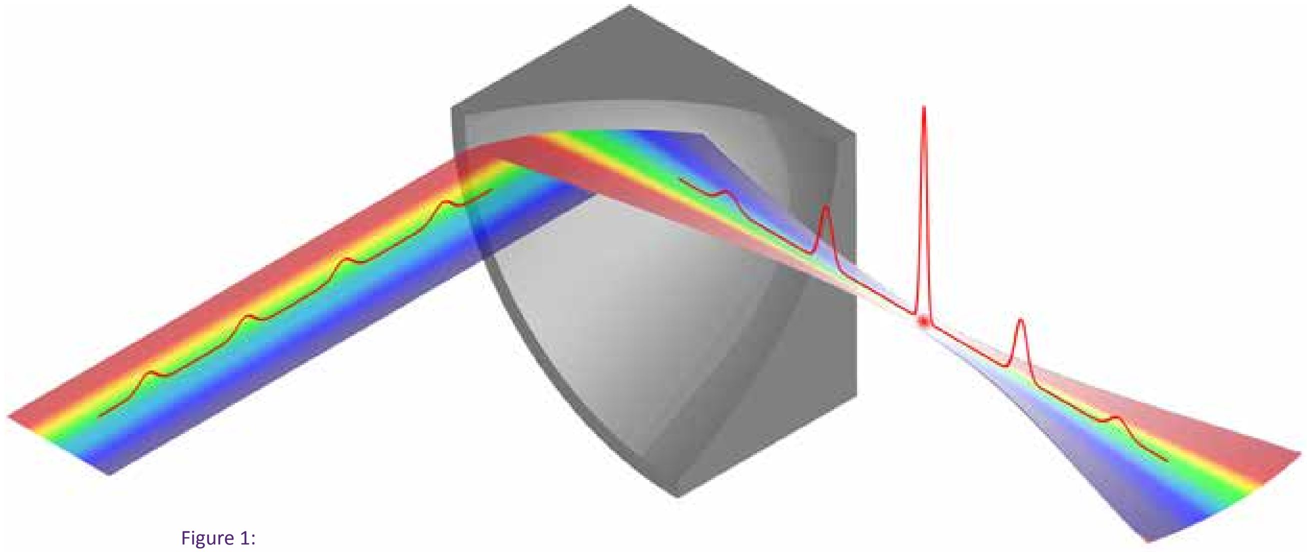

Figure 1:
Schematic illustration of simultaneous spatial and temporal focusing (SSTF).

Precise processing of transparent materials using ultrashort laser pulses has enabled various applications ranging from structuring, cutting and welding of glass to ophthalmology. While in the past mainly bandwidth-limited pulses were applied, innovative treatment strategies aim at tailoring the nonlinear modification processes using spatiotemporally shaped pulses.

For laser processing deep within the bulk material, the limited numerical aperture of the focusing optics results in high intensities and detrimental nonlinear pulse-material interactions already far in front of the geometrical focus [1]. Simultaneous spatial and temporal focusing (SSTF) was applied to strongly confine the extreme intensities to the focal region. In SSTF the laser pulse possesses its ultrashort duration only in the vicinity of the focal plane [2]. Outside of the focal region the intensity dramatically drops owing to both the geometrical divergence and temporal prolongation of the pulse.

To investigate the laser-induced optical breakdown, the formation of the plasma and the subsequent evolution of the shock waves were studied in water as a model system. SSTF and conventional focusing were compared using focusing conditions typical for intraocular surgery. Moreover, detailed simulations have been realized in collaboration with the 'Max Planck Institute for the Physics of Complex Systems', Dresden, Germany.

In excellent agreement with the theoretical investigations, the experimentally detected length of the plasma channels induced with SSTF was reduced by a factor of 2 compared to conventional focusing [3]. Moreover, the enhanced intensity confinement of SSTF prevented the formation of extended plasma filaments and sprawling plasma side-lobes observed with conventional focusing, which strongly reduced the precision of the applied modifications. In addition, while the long propagation of conventionally focused pulses within the transparent media resulted in intense white-light generation, the localization of the nonlinear interaction by SSTF nearly entirely suppressed spectral broadening.

Significant advantages for eye surgery and precision processing of glasses and crystals result from the more precise localization of the induced modifications.

[1] Bergé et al.: "Ultrashort filaments of light in weakly ionized, optically transparent media"
Reports on Progress in Physics 70 (10) 1633-1713 (2007).

[2] Zhu et al.: "Simultaneous spatial and temporal focusing of femtosecond pulses"
Opt. Express 13 (6) 2153-2159 (2005).

[3] Kammel et al.: "Enhancing precision in fs-laser material processing by simultaneous spatial and temporal focusing"
Light-Sci. & Appl. 3, e169 (2014).

The Centre for Innovation Competence ultra optics makes fundamental contributions to understand the physical and technological possibilities and limitations of monitoring and controlling the properties of light that form the basis for the representation of future optical systems. It will create the requirements for basic elements of an optical system technology which allows the step from discrete components to fully integrated functional units.

Manufacturing Technologies for Advanced Micro-and Nano-Optics

Due to the scheduled upgrade of the electron beam lithography the research group Manufacturing Technologies for Advanced Micro- and Nano-Optics is now able to a flexible exposure of high-resolution structures with the highest efficiency. For the diffractive mask aligner lithography a special technology was developed for the realization of double-sided masks. Various strategies for highly accurate positioning of the front and back side structures to each other have been developed and successfully demonstrated. Furthermore, very good results in improving the resolution limit could be achieved. Thus, inter alia, the exposure of gratings with 250 nm period has been shown with a mask aligner.

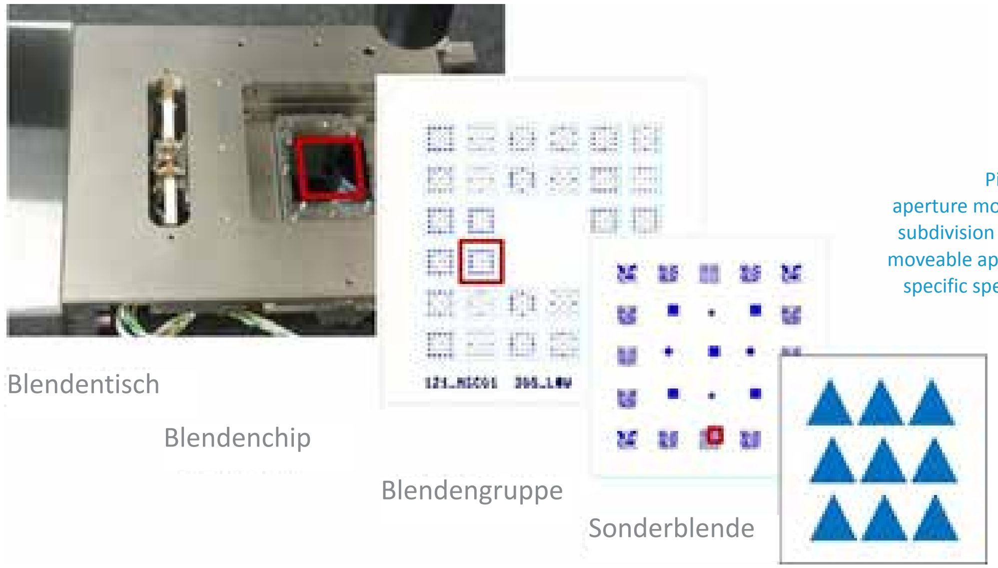

Figure 1:
Picture of one of the new aperture module. Right: hierarchical subdivision of the structures on the moveable aperture chip down to the specific special aperture geometry.

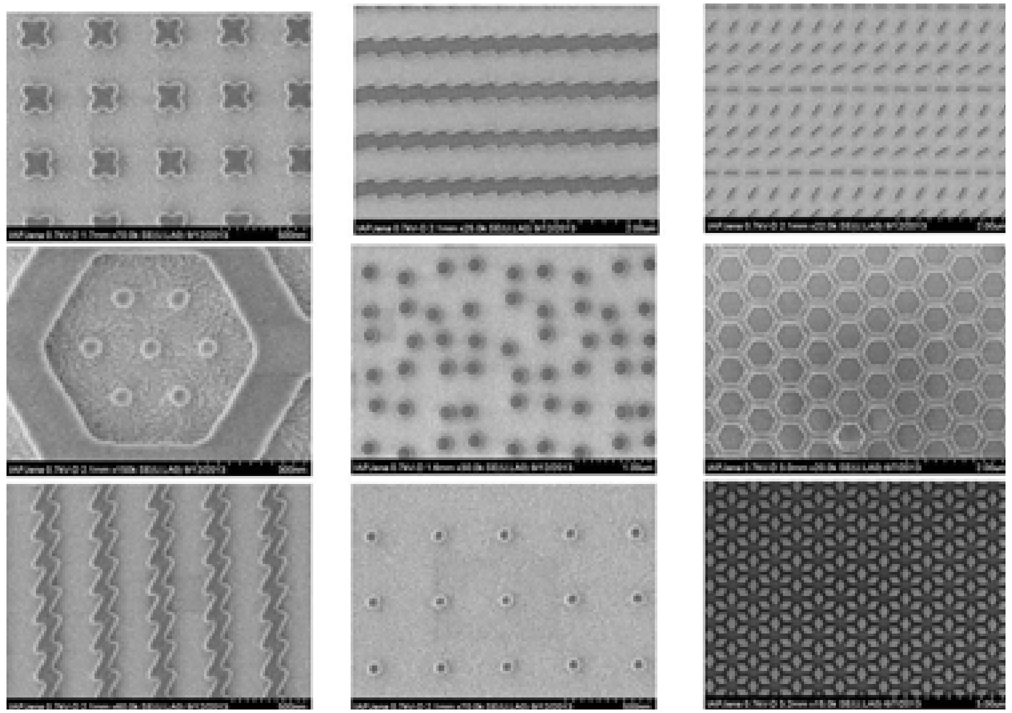

Figure 2:
Gratings for ultra-short pulse compression applications realized by diffractive mask-aligner lithography in a wafer scale technology. The grating period is 800 nm and the achieved diffraction efficiency is in the range of 97 %.

New imaging strategies with diffractive photomasks for the generation of three-dimensional light distributions were also developed as part of the development of the diffraction lithography.

The work has been started for structuring diamond films. First high-resolution structures with dimensions evident < 500 nm have already been demonstrated. For the first time also so called "Black Diamond" structures for broadband reflection sup-pression on silicon have been demonstrated.

A number of sample applications have been also already successfully implemented. This includes diffractive masks for photonic crystal structures for the light extraction from LEDs, high-efficiency sub-micron gratings for laser pulse compression, double-sided masks for metallic strip polarizer and structure template for plasmonic absorber.

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Diamond-/Carbon-based Optical Systems

Integrated Photonic Quantum Computing

In the research group Diamond-/Carbon-based Optical Systems one of the outstanding results in 2014 is the first demonstration of the Floquet topological insulator. On the basis of coupled photonic waveguides, we managed to realize a new type of material in which the light is guided only along the edge using so-called "one-way edge states".
With the aid of such a medium, which can also be regarded as a surface superconductor for light, the basis for a number of new applications of photonic is defined in which light has to be controlled and influenced specifically [1].

Furthermore, we have succeeded in to produce photonic structures on a glass chip, whereby the electronic properties, particularly in the edge structures of graphene crystal, could be simulated accurately. In this way the first time ever, surface states at the beard shaped graphene edge could be verified. In addition, it was possible to demonstrate a heretofore completely unknown surface state. This means that the previous theoretical description of the electron motion along the edges of the graphene crystal was incomplete and we now closed this gap [2].

[1] M.C. Rechtsmann, et.al.: "Photonic Floquet topological insulators" Nature 496, (7444) 196-200 (2013).

[2] Y. Plotnik, et. al.: "Observation of unconventional edge states in ‘photonic graphene’" Nat. Mater.13, (1) 57-62 (2014).

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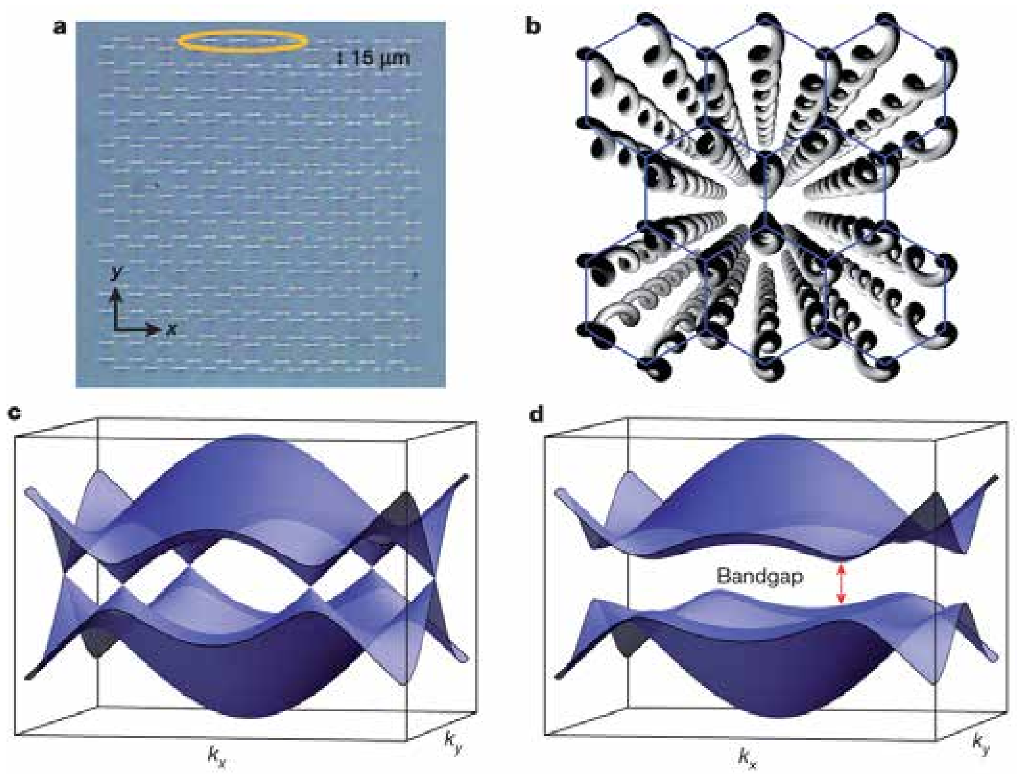

Figure 1:
Microscope image of the input facet of the photonic lattice, showing honeycomb geometry with ‘zig-zag’ edge terminations on the top and bottom, and ‘armchair’ terminations on the left and right sides. Scale bar at top right, 15 µm. The yellow ellipse indicates the position and shape of the input beam to this lattice. b, Sketch of the helical waveguides. Their rotation axis is in the z direction, with radius R and period Z. c, Band structure (β versus (kx, ky)) for the case of non-helical waveguides comprising a honeycomb lattice (R = 0). Note the band crossings at the Dirac point. d, Bulk band structure for the photonic topological insulator: helical waveguides with R = 8 µm arranged in a honeycomb lattice. Note the bandgap opening up at the Dirac points (labelled with the red, double-ended arrow), which corresponds to the bandgap in a Floquet topological insulator [1].

Author:
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Junior Research Group: Multiphoton Microscopy

Research Areas

Research focuses on the synthesis, characterization and manipulation of semiconductor and oxide-nanomaterials for bioimaging applications, and their combination with plasmonic structures to enhance their optical properties.

Main scientific areas include:

- Bottom-up chemical synthesis of oxide core and gold shell nanowires for imaging and lab-on-a-chip applications
- Top-down fabrication of oxide nanowaveguides for nonlinear ultrafast photonic devices
- Nonlinear imaging of semiconductor and oxide nanomaterials
- Plasmonic nanoparticles integrated in optofluidic devices

Research Methodes

The key facilities are femtosecond lasers ranging from the visible to the near- infrared, coupled to home-built wide illumination microscopes with sensitive electron-magnified charge-coupled device (CCD) cameras. Furthermore, chemicals for the bottom-up synthesis of nanomaterials and soft lithography for optofluidic chip fabrication are utilized. The nanomaterial research involves access to electron-beam lithography, high-resolution microscopy (AFM, SEM, TEM), powder x-ray diffraction and dynamic light-scattering.

Funding

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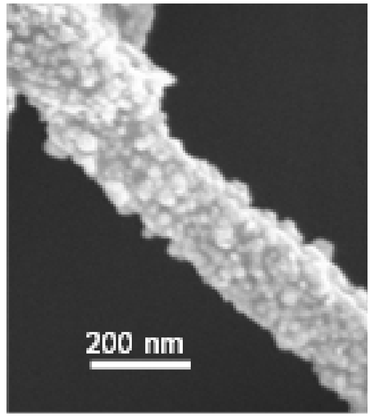
Highlights in 2014

We demonstrate the synthesis and the optical characterization of core-shell nanowires. The wires consist of a potassium niobate ($KNbO_3$) core and a gold shell. The nonlinear optical properties of the core are combined with the plasmonic resonance of the shell and offer an enhanced optical signal in the near infrared spectral range (Fig.1 a).

We also investigate local laser-induced heating in fluids with gold nanodot arrays prepared by electron-beam lithography that cover resonances in the near infrared spectral range from 750 nm to 880 nm (Fig.1 right). We utilize two approaches to demonstrate thermal effects, solvent evaporation and flow stop, with a thermosensitive polymer solution. We show that with fluences as low as 4 µJ/cm^2, significant heating of the nanostructures occurs in their immediate vicinity. Using wavelengths about 20 nm away from the plasmonic resonance peak, the heating already drops drastically, and 30 to 40 nm away, there is mostly no more thermal effect. Therefore, working close to the threshold laser power offers the possibility of multiplexed reactions or sensing without cross-talk even though a typical full width at half maximum of a plasmonic resonance spectrum can be as broad as 200 nm.

[1] J. Richter, A. Steinbrück, M. Zilk, A. Sergeyev, T. Pertsch, A. Tünnermann, R. Grange: "Core-shell potassium niobate nanowires for enhanced nonlinear optical effects" Nanoscale, 6 (10) 5200 (2014).

[2] A. Steinbrück, J.-W. Choi, S. Fasold, C. Menzel, A. Sergeyev, T. Pertsch, R. Grange: "Plasmonic Heating with Near Infrared Resonance Nanodot Arrays for Multiplexing Optofluidic Applications" RSC Adances, 4, 61898 (2014).



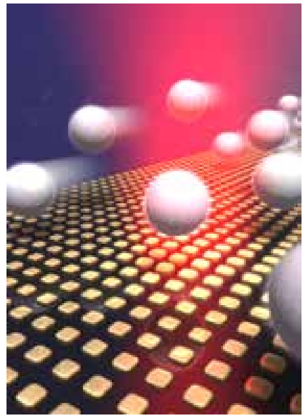


Figure 1:
(left) Typical SEM images of $KNbO_3$ nanostructures with gold shell. (right) Art view of the plasmonic carpet device with gold nanodots at the bottom of the channel and polystyrene beads to watch the liquid flow (not to scale).

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Stephan Ratzsch

Junior Research Group: Atomic Layer Deposition

- Emmy-Noether group -

Research Areas

The group Atomic Layer Deposition of Optical Coatings aims to establish this coating technology in the development of novel and improved optical elements.
They currently focus on ALD coatings for:

- Low refractive index/ porous materials
- Monitoring nucleation and ALD growth
- Advanced nano structuring technologies
- Metal wire grid polarizers
- High efficiency compressor gratings
- Guided mode resonance gratings

Research Methodes

Two plasma-enhanced atomic layer deposition reactors are available.
These are located in the clean room and are equipped with in situ monitoring techniques for experimental characterization by means of spectroscopic ellipsometry in the 245 nm - 1700 nm spectral range. The equipment comprises:

- OpAL PEALD, Oxford Plasma Technologies
- Sunale R200, Picosun Oy
- J. A. Woollam spectroscopic ellipsometer

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Highlights in 2014

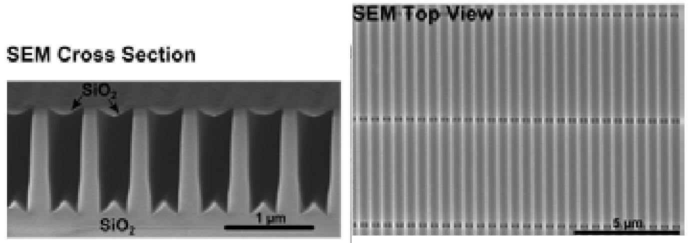


Figure 1:
42 nm thin SiO_2 film on top of a grating,
left: SEM cross section, right: SEM top view.

Generating thin flushed layers on structured surfaces

Small fragile grating structures benefit from their encapsulation due to the enhancement of their mechanical stability and / or improvement of their optical performance. Therefore, reliable and damage – free encapsulation processes are highly desired. We are developing and investigating encapsulation processes based only on available microstructuring and coating technologies without relying on direct bonding.

Here, we discuss an encapsulation process based on selective wet etching a sacrificial layer. First, the grating structure is embedded in alumina (Al_2O_3) that serves as sacrificial layer by atomic layer deposition (ALD). Afterwards, the excess material on top of the grating is removed by selective ion beam etching and a thin cover layer (SiO_2) is deposited thereafter. The sacrificial material is selectively removed by wet etching (H_3PO_4) through a pattern generated in the cover layer. As a pattern, periodically arranged slits were chosen with an opening width of 300 nm which were rotated by 90° towards the basic grating.

The wet etching process was optimized to obtain an ultra-high etch selectivity between the substrate and the sacrificial material in order to lengthen the period of the pattern. Additionally, the coating process for the sacrificial material was evaluated to increase the etch rate and thus shorten the etch time. In the optimum regime, a etch selectivity of 1:50000 and a etch rate of 10 µm/h were achieved for alumina in aqueous (85%) H_3PO_4 at 80°C etch temperature. Hence, 300 µm pattern period was selected to structure the cover layer diminishing the effect on the optical function of basic grating. Finally, the pattern in the cover was closed with an anti-reflection coating (ARC) to minimize the reflectivity using physical vapor deposition. The total ARC thickness was approximately 700 nm and it was deposited directly on top of the grating.

The encapsulation process is demonstrated for high efficiency transmission gratings. The measured diffraction efficiency reaches 97.5% in the -1st order for TM – polarized light. Non-optimal grating parameters limit the measured efficiency as proven by rigorous coupled wave analysis.

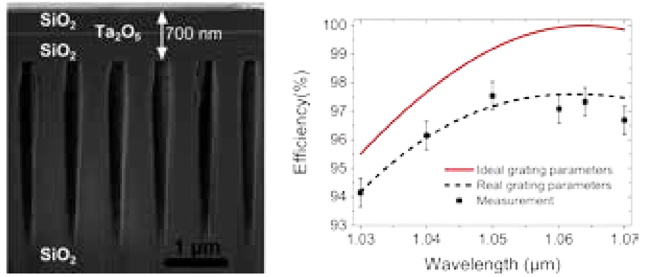


Figure 2:
left: SEM cross section of encapsulated grating with a 700 nm thick triple layer stack ,
right: Transmission efficiency in the -1st order.

PUBLICATIONS

Aim of applied research is the implementation of the results and thus to make contributions to overcome certain problems of the future. For this reason, the research actually not only ends in itself, but their results must be discussed and adjusted with further findings. In the end again, new ideas and scientific approaches can be developed.

Journals

A. Brahm, A. Wilms, M. Tymoshchuk, C. Grossmann, G. Notni, A. Tünnermann: Optical Effects at projection measurements for Terahertz tomography, Opt. Laser Technol., 62, 49-57 (2014).

A. Brahm, A. Wilms, R. J. B. Dietz, T. Goebel, M. Schell, G. Notni, A. Tünnermann: Multichannel terahertz time-domain spectroscopy system at 1030 nm excitation wavelength, Opt. Express, 22 (11), 12982-12993 (2014).

A. Brahm, M. Tymoshchuk, F. Wichmann, S. Merx, G. Notni, A. Tünnermann: Wavelet Based Identification of Substances in Terahertz Tomography Measurements, J. Infrared Millim. Terahertz Waves, 35 (11), 974-986 (2014).

A. Brahm, S. Döring, A. Wilms, G. Notni, S. Nolte, A. Tünnermann: Laser-generated broadband antireflection structures for freeform silicon lenses at terahertz frequencies, Appl. Optics, 53 (13), 2886-2891 (2014).

A. Cumming, L. Cunningham, G.D. Hammond, K. Haughian, J. Hough, S. Kroker, I. W. Martin, R. Nawrodt, S. Rowan, C. Schwarz, A. A. van Veggel: Silicon mirror suspensions for gravitational wave detectors, Class. Quantum Gravity, 31, 025017 (2014).

A. E. Klein, C. Schmidt, M. Liebsch, N. Janunts, M. Dobynde, A. Tünnermann, T. Pertsch: Highly sensitive mode mapping of whispering-gallery modes by scanning thermocouple-probe microscopy, Opt. Lett., 39 (5), 1157-1160 (2014).

A. E. Klein, N. Janunts, M. Steinert, A. Tünnermann, T. Pertsch: Polarization-Resolved Near-Field Mapping of Plasmonic Aperture Emission by a Dual-SNOM System, Nano Lett., 14 (9), 5010-5015 (2014).

A. E. Minovich, A. E. Klein, D. N. Neshev, T. Pertsch, Y. S. Kivshar, D. N. Christodoulides: Airy plasmons: non-diffracting optical surface waves, Laser Photon. Rev., 8 (2), 221-232 (2014).

A. Klenke, S. Hädrich, T. Eidam, J. Rothhardt, M. Kienel, S. Demmler, T. Gottschall, J. Limpert, A. Tünnermann: 22 GW peak-power fiber chirped-pulse-amplification system, Opt. Lett., 39 (24), 6875-6878 (2014).

A. Klenke, S. Haedrich, M. Kienel, T. Eidam, J. Limpert, A. Tünnermann: Coherent combination of spectrally broadened femtosecond pulses for nonlinear compression, Opt. Lett., 39 (12), 3520-3522 (2014).

A. S. Solntsev, F. Setzpfandt, A. S. Clark, C. Wen Wu, M. J. Collins, C. Xiong, A. Schreiber, F. Katzschmann, F. Eilenberger, R. Schiek, W. Sohler, A. Mitchell, C. Silberhorn, B. J. Eggleton, T. Pertsch, A. A. Sukhorukov, D. N. Neshev, Y. S. Kivshar: Generation of nonclassical biphoton states through cascaded quantum walks on a nonlinear chip, Phys. Rev. X, 4, 031007 (2014).

A. Steinbrück, J. W. Choi, S. Fasold, C. Menzel, A. Sergeyev, T. Pertsch, R. Grange: Plasmonic heating with near infrared resonance nanodot arrays for multiplexing optofluidic applications, RSC Adv, 4 (106), 61898-61906 (2014).

C. Gaida, F. Stutzki, F. Jansen, H.-J. Otto, T. Eidam, C. Jauregui, O. de Vries, J. Limpert, A. Tünnermann: Triple-clad large-pitch fibers for compact high-power pulsed fiber laser systems, Opt. Lett., 39 (2), 209-211 (2014).

C. Goedeker, U. Schulz, N. Kaiser, A. Tünnermann: Antireflection coating for sapphire with consideration of mechanical properties, Surf. Coat. Technol., 241, 59-63 (2014).

C. Menzel, E. Hebestreit, R. Alaee, M. Albooyeh, S. Muehlig, S. Burger, C. Rockstuhl, C. Simovski, S. Tretyakov, F. Lederer, T. Pertsch: Extreme coupling: A route towards local magnetic metamaterials, Phys. Rev. B, 89 (15), 155125 (2014).

C. Menzel, E. Hebestreit, S. Muehlig, C. Rockstuhl, S. Burger, F. Lederer, T. Pertsch: The spectral shift between near- and far-field resonances of optical nano-antennas, Opt. Express, 22 (8), 9971-9982 (2014).

C. Rothhardt, J. Rothhardt, A. Klenke, T. Peschel, R. Eberhardt, J. Limpert, A. Tünnermann: BBO-sapphire sandwich structure for frequency conversion of high power lasers, Opt. Mater. Express, 4 (5), 1092-1103 (2014).

C. Vetter, T. Eichelkraut, M. Ornigotti, A. Szameit: Generalized Radially Self-Accelerating Helicon Beams, Phys. Rev. Lett., 113 (18), 183901 (2014).

D. Asoubar, S. Zhang, F. Wyrowski, M. Kuhn: Efficient semi-analytical propagation techniques for electromagnetic fields, J. Opt. Soc. Am. A-Opt. Image Sci. Vis., 31 (11), 591-602 (2014).

D. Asoubar, S. Zhang, M. Kuhn, F. Wyrowski: Laser resonator modeling by field tracing: a flexible approach for fully vectorial transversal" eigenmode calculation, J. Opt. Soc. Am. B-Opt. Phys., 31 (11), 2565-2573 (2014).

D. Guzman-Silva, C. Mejia-Cortes, M. A. Bandres, M. C. Rechtsman, S. Weimann, S. Nolte, M. Segev, A. Szameit, R. A. Vicencio: Experimental observation of bulk and edge transport in photonic Lieb lattices, New J. Phys., 16, 063061 (2014).

D. Lehr, R. Alaee, R. Filter, K. Dietrich, T. Siefke, C. Rockstuhl, F. Lederer, E.-B. Kley, A. Tünnermann: Plasmonic nanoring fabrication tuned to pitch: Efficient, deterministic, and large scale realization of ultra-small gaps for next generation plasmonic devices, Appl. Phys. Lett., 105 (14), 143110 (2014).

D. Stumpf, U. D. Zeitner: Extending standard mask lithography exposure technique to spherical surfaces, Appl. Phys. B-Lasers Opt., 115 (3), 371-377 (2014).

E. Block, J. Thomas, C. Durfee, J. Squier: Integrated single grating compressor for variable pulse front tilt in simultaneously spatially and temporally focused systems., Opt. Lett., 39(24), 6915-6918 (2014).

E. Pshenay-Severin, M. Falkner, C. Helgert, T. Pertsch: Ultra broadband phase measurements on nanostructured metasurfaces, Appl. Phys. Lett., 104 (22), 221906 (2014).

F. Beier, H.-J. Otto, C. Jauregui, O. de Vries, T. Schreiber, J. Limpert, R. Eberhardt, A. Tünnermann: 1009 nm continuous-wave ytterbium-doped fiber amplifier emitting 146 W, Opt. Lett., 39 (13), 3725-3727 (2014).

F. Eilenberger, K. Prater, S. Minardi, R. Geiss, U. Röpke, J. Kobelke, K. Schuster, H. Bartelt, S. Nolte, A. Tünnermann, T. Pertsch: A twister of light bullets, Nat. Photonics, 8, 169 (2014).

F. Kretschmer, M. Fruhnert, R. Geiss, U. Mansfeld, C. Höppener, S. Hoeppener, C. Rockstuhl, T. Pertsch, U. S. Schubert: Plasmonic nanoparticle clusters with tunable plasmonic resonances in the visible spectral region, J. Mater. Chem. C, 2, 6415-6422 (2014).

F. Kretschmer, S. Muehlig, S. Hoeppener, A. Winter, M. D. Hager, C. Rockstuhl, T. Pertsch, U. S. Schubert: Survey of Plasmonic Nanoparticles: From Synthesis to Application, Part. Part. Syst. Charact., 31 (7), 721-744 (2014).

F. Setzpfandt, A. S. Solntsev, D. N. Neshev, T. Pertsch, W. Sohler, R. Schiek: Temporal dynamics of spatially localized waves in quadratic nonlinear waveguide arrays, Phys. Rev. A, 89 (3), 033863 (2014).

F. Stutzki, C. Gaida, M. Gebhardt, F. Jansen, A. Wienke, U. Zeitner, F. Fuchs, C. Jauregui, D. Wandt, D. Kracht, J. Limpert, A. Tünnermann: 152 W average power Tm-doped fiber CPA system, Opt. Lett., 39 (16), 4671-4674 (2014).

F. Stutzki, F. Jansen, H.-J. Otto, C. Jauregui, J. Limpert, A. Tünnermann: Designing advanced very-large-mode-area fibers for power scaling of fiber-laser systems, Optica, 1 (4), 233-242 (2014).

F. Wagner, C. P. Joao, J. Fils, T. Gottschall, J. Hein, J. Koerner, J. Limpert, M. Roth, T. Stoehlker, V. Bagnoud: Temporal contrast control at the PHELIX petawatt laser facility by means of tunable sub-picosecond optical parametric amplification, Appl. Phys. B-Lasers Opt., 116 (2), 429-435 (2014).

F. Zimmermann, A. Plech, S. Richter, A. Tünnermann, S. Nolte: Ultrashort laser pulse induced nanogratings in borosilicate glass, Appl. Phys. Lett., 104 (21), 211107 (2014).

F. Zimmermann, A. Plech, S. Richter, S. Döring, A. Tünnerman, S. Nolte: Structural evolution of nanopores and cracks as fundamental constituents of ultrashort pulse-induced nanogratings, Appl. Phys. A-Mater. Sci. Process., 114 (1), 75-79 (2014).

G. Mourou, T. Tajima, M. N. Quinn, B. Brocklesby, J. Limpert: Are fiber-based lasers the future of accelerators?, Nucl. Instrum. Methods Phys. Res. Sect. A-Accel. Spectrom. Dect. Assoc. Equip., 740, 17-20 (2014).

H. Carstens, N. Lilienfein, S. Holzberger, C. Jocher, T. Eidam, J. Limpert, A. Tünnermann, J. Weitenberg, D. C. Yost, A. Alghamdi, Z. Alahmed, A. Azzeer, A. Apolonski, E. Fill, F. Krausz, I. Pupeza: Megawatt-scale average-power ultrashort pulses in an enhancement cavity, Opt. Lett., 39 (9), 2595-2598 (2014).

H.-J. Otto, A. Klenke, C. Jauregui, F. Stutzki, J. Limpert, A. Tünnermann: Scaling the mode instability threshold with multicore fibers, Opt. Lett., 39 (9), 2680-2683 (2014).

H.-J. Otto, F. Stutzki, N. Modsching, C. Jauregui, J. Limpert, A. Tünnermann: 2 kW average power from a pulsed Yb-doped rod-type fiber amplifier, Opt. Lett., 39 (22), 6446-6449 (2014).

I. Pupeza, M. Hoegner, J. Weitenberg, S. Holzberger, D. Esser, T. Eidam, J. Limpert, A. Tünnermann, E. Fill, V. S. Yakovlev: Cavity-Enhanced High-Harmonic Generation with Spatially Tailored Driving Fields, Phys. Rev. Lett., 112 (10), 103902 (2014).

J. Bidinger, R. Ackermann, G. Cattaneo, R. Kammel, S. Nolte: A Feasibility Study on Femtosecond Laser Thrombolysis, Photomed. Laser Surg., 32 (1), 17-22 (2014).

J. Gonzalez-Julian, O. Cedillos-Barraza, S. Döring, S. Nolte, O. Guillon, W. E. Lee: Enhanced oxidation resistance of ZrB2/SiC composite through in situ reaction of gadolinium oxide in patterned surface cavities, J. Eur. Ceram. Soc., 34 (16), 4157-4166 (2014).

J. Limpert, A. Klenke, M. Kienel, S. Breitkopf, T. Eidam, S. Haedrich, C. Jauregui, A. Tünnermann: Performance Scaling of Ultrafast Laser Systems by Coherent Addition of Femtosecond Pulses, IEEE J. Sel. Top. Quantum Electron., 20 (5), 0901810 (2014).

J. M. Zeuner, M. C. Rechtsman, S. Nolte, A. Szameit: Edge states in disordered photonic graphene, Opt. Lett., 39 (3), 602-605 (2014).

J. Qi, T. Kaiser, R. Peuker, T. Pertsch, F. Lederer, C. Rockstuhl: Highly resonant and directional optical nanoantennas, J. Opt. Soc. Am. A-Opt. Image Sci. Vis., 31 (2), 388-393 (2014).

J. Richter, A. Steinbrück, M. Zilk, A. Sergeyev, T. Pertsch, A. Tünnermann, R. Grange: Core-shell potassium niobate nanowires for enhanced nonlinear optical effects, Nanoscale, 6 (10), 5200-5207 (2014).

J. Rothhardt, M. Krebs, S. Haedrich, S. Demmler, J. Limpert, A. Tünnermann: Absorption-limited and phase-matched high harmonic generation in the tight focusing regime, New J. Phys., 16, 033022 (2014).

J. Rothhardt, S. Haedrich, A. Klenke, S. Demmler, A. Hoffmann, T. Gotschall, T. Eidam, M. Krebs, J. Limpert, A. Tünnermann: 53 W average power few-cycle fiber laser system generating soft x rays up to the water window, Opt. Lett., 39 (17), 5224-5227 (2014).

J. Rothhardt, S. Haedrich, S. Demmler, M. Krebs, S. Fritzsche, J. Limpert, A. Tünnermann: Enhancing the Macroscopic Yield of Narrow-Band High-Order Harmonic Generation by Fano Resonances, Phys. Rev. Lett., 112 (23), 233002 (2014).

K. Dietrich, C. Menzel, D. Lehr, O. Puffky, U. Hübner, T. Pertsch, A. Tünnermann, E.-B. Kley: Elevating optical activity: Efficient on-edge lithography of three-dimensional starfish metamaterial, Appl. Phys. Lett., 104, 193107 (2014).

K. Keskinbora, A.-L. Robisch, M. Mayer, U. T. Sanli, C. Grevent, C. Wolter, M. Weigand, A. Szeghalmi, M. Knez, T. Salditt, G. Schutz: Multilayer Fresnel zone plates for high energy radiation resolve 21 nm features at 1.2 keV., Opt. Express, 22 (15), 18440-18453 (2014).

K. Poulios, R. Keil, D. Fry, J. D. A. Meinecke, J. C. F. Matthews, A. Politi, M. Lobino, M. Graefe, M. Heinrich, S. Nolte, A. Szameit, J. L. O'Brien: Quantum Walks of Correlated Photon Pairs in Two-Dimensional Waveguide Arrays, Phys. Rev. Lett., 112 (14), 143604 (2014).

L. Stuerzebecher, F. Fuchs, T. Harzendorf, U. D. Zeitner: Pulse compression grating fabrication by diffractive proximity photolithography, Opt. Lett., 39 (4), 1042-1045 (2014).

M. Albooyeh, S. Kruk, C. Menzel, C. Helgert, M. Kroll, A. Krysinski, M. Decker, D. N. Neshev, T. Pertsch, C. Etrich, C. Rockstuhl, S. A. Tretyakov, C. R. Simovski, Y. S. Kivshar: Resonant metasurfaces at oblique incidence: interplay of order and disorder, SCIENTIFIC REPORTS, 4, 4484 (2014).

M. Golshani, S. Weimann, K. Jafari, M. K. Nezhad, A. Langari, A. R. Bahrampour, T. Eichelkraut, S. M. Mahdavi, A. Szameit: Impact of Loss on the Wave Dynamics in Photonic Waveguide Lattices, Phys. Rev. Lett., 113 (12), 123903 (2014).

M. Gräfe, R. Heilmann, A. Perez-Leija, R. Keil, F. Dreisow, M. Heinrich, H. Moya-Cessa, S. Nolte, D. N. Christodoulides, A. Szameit: On-chip generation of high-order single-photon W-states, Nat. Photonics, 8(10), 791-795 (2014).

M. H. Teimourpour, R. El-Ganainy, A. Eisfeld, A. Szameit, D. N. Christodoulides: Light transport in PT-invariant photonic structures with hidden symmetries, Phys. Rev. A, 90 (5), 053817 (2014).

M. Heinrich, M. C. Rechtsman, F. Dreisow, S. Nolte, M. Segev, A. Szameit: Enhancement of the ensemble-averaged coupling between defects in random environments, Opt. Lett., 39 (12), 3599-3602 (2014).

M. Heinrich, M.-A. Miri, D. N. Christodoulides, S. Stützer, S. Nolte, A. Szameit: Supersymmetric Mode Converters and Transformation Optics, Opt. Phot. News, 25(12), 40 (2014).

M. Heinrich, M.-A. Miri, S. Stuetzer, S. Nolte, D. N. Christodoulides, A. Szameit: Observation of supersymmetric scattering in photonic lattices, Opt. Lett., 39 (21), 6130-6133 (2014).

M. Heinrich, M.-A. Miri, S. Stutzer, R. El-Ganainy, S. Nolte, A. Szameit, D. N. Christodoulides: Supersymmetric mode converters, Nat. Commun., 5, 3698 (2014).

M. Kienel, A. Klenke, T. Eidam, S. Haedrich, J. Limpert, A. Tünnermann: Energy scaling of femtosecond amplifiers using actively controlled divided-pulse amplification, Opt. Lett., 39 (4), 1049-1052 (2014).

M. Kienel, M. Mueller, S. Demmler, J. Rothhardt, A. Klenke, T. Eidam, J. Limpert, A. Tünnermann: Coherent beam combination of Yb: YAG single-crystal rod amplifiers, Opt. Lett., 39 (11), 3278-3281 (2014).

M. Mayer, K. Keskinbora, C. Grevent, A. Szeghalmi, M. Knez, M. Weigand, A. Snigirev, I. Snigireva, G. Schuetz: Efficient focusing of 8 keV X-rays with multilayer Fresnel zone plates fabricated by atomic layer deposition and focused ion beam milling (vol 20, pg 433, 2013), J. Synchrot. Radiat., 21 (3), 640-640 (2014).

M. Ornigotti, A. Szameit: Quasi PT-symmetry in passive photonic lattices, J. Opt., 16 (6), 065501 (2014).

M. Steglich, D. Lehr, S. Ratzsch, T. Käsebier, F. Schrempel, E.-B. Kley, A. Tünnermann: An ultra-black silicon absorber, Laser Photon. Rev., 8 (2), L13-L17 (2014).

M. Steglich, T. Käsebier, M. Zilk, T. Pertsch, E.-B. Kley, A. Tünnermann: The structural and optical properties of black silicon by inductively coupled plasma reactive ion etching, J. Appl. Phys., 116 (17), 173503 (2014).

M. Trost, T. Herffurth, S. Schroeder, A. Duparre, A. Tünnermann: Scattering reduction through oblique multilayer deposition, Appl. Optics, 53 (4), A197-A204 (2014).

M. Trost, T. Herffurth, S. Schroeder, A. Duparre, M. Beier, S. Risse, A. Tünnermann, N. Bowering: In situ and ex situ characterization of optical surfaces by light scattering techniques, Opt. Eng., 53 (9), 092013 (2014).

M. Zurch, J. Rothhardt, S. Hadrich, S. Demmler, M. Krebs, J. Limpert, A. Tünnermann, A. Guggenmos, U. Kleineberg, C. Spielmann: Real-time and Sub-wavelength Ultrafast Coherent Diffraction Imaging in the Extreme Ultraviolet., SCIENTIFIC REPORTS, 4, 7356-7356 (2014).

O. Pabst, S. Hoelzer, E. Beckert, J. Perelaer, U. S. Schubert, R. Eberhardt, A. Tünnermann: Inkjet printed micropump actuator based on piezoelectric polymers: Device performance and morphology studies, Org. Electron., 15 (11), 3306-3315 (2014).

O. Stenzel, S. Wilbrandt, X. Chen, R. Schlegel, L. Coriand, A. Duparre, U. Zeitner, T. Benkenstein, C. Waechter: Observation of the waveguide resonance in a periodically patterned high refractive index broadband antireflection coating, Appl. Optics, 53 (14), 3147-3156 (2014).

R. Buschlinger, S. Nolte, U. Peschel: Self-organized pattern formation in laser-induced multiphoton ionization, Phys. Rev. B, 89 (18), 184306 (2014).

R. Geiss, S. Diziain, M. Steinert, F. Schrempel, E.-B. Kley, A. Tünnermann, T. Pertsch: Photonic crystals in lithium niobate by combining focussed ion beam writing and ion-beam enhanced etching, Phys. Status Solidi A-Appl. Mat., 211 (10), 2421-2425 (2014).

R. Heilmann, M. Graefe, S. Nolte, A. Szameit: Arbitrary photonic wave plate operations on chip: Realizing Hadamard, Pauli-X, and rotation gates for polarisation qubits, SCIENTIFIC REPORTS, 4 (4118) (2014).

R. Heilmann, R. Keil, M. Graefe, S. Nolte, A. Szameit: Ultraprecise phase manipulation in integrated photonic quantum circuits with generalized directional couplers, Appl. Phys. Lett., 105 (6), 061111 (2014).

R. Kammel, R. Ackermann, J. Thomas, J. Goette, S. Skupin, A. Tünnermann, S. Nolte: Enhancing precision in fs-laser material processing by simultaneous spatial and temporal focusing, Light-Sci. Appl., 3, e169 (2014).

R. Lehneis, A. Steinmetz, J. Limpert, A. Tünnermann: All-fiber pulse shortening of passively Q-switched microchip laser pulses down to sub-200 fs, Opt. Lett., 39 (20), 5806-5809 (2014).

R. Lehneis, C. Jauregui, A. Steinmetz, J. Limpert, A. Tünnermann: Smoothed spectra for enhanced dispersion-free pulse duration reduction of passively Q-switched microchip lasers, Opt. Lett., 39 (3), 505-508 (2014).

R. Riedel, J. Rothhardt, K. Beil, B. Gronloh, A. Klenke, H. Hoppner, M. Schulz, U. Teubner, C. Krankel, J. Limpert, A. Tünnermann, M. J. Prandolini, F. Tavella: Thermal properties of borate crystals for high power optical parametric chirped-pulse amplification, Opt. Express, 22 (15), 17607-17619 (2014).

R. Ye, Y.-H. Ye, H. F. Ma, L. Cao, J. Ma, F. Wyrowski, R. Shi, J.-Y. Zhang: Experimental imaging properties of immersion microscale spherical lenses, SCIENTIFIC REPORTS, 4, 3769 (2014).

S. Breitkopf, T. Eidam, A. Klenke, L. von Grafenstein, H. Carstens, S. Holzberger, E. Fill, T. Schreiber, F. Krausz, A. Tünnermann, I. Pupeza, J. Limpert: A concept for multiterawatt fibre lasers based on coherent pulse stacking in passive cavities, Light-Sci. Appl., 3, e211 (2014).

S. Hädrich, A. Klenke, J. Rothhardt, M. Krebs, A. Hoffmann, O. Pronin, V. Pervak, J. Limpert, A. Tünnermann: High photon flux table-top coherent extreme-ultraviolet source, Nat. Photonics, 8 (10), 779–783 (2014).

S. Kharitonov, R. Kiselev, A. Kumar, I. F. d. J. Ruiz, X. Shi, K. Leosson, T. Pertsch, S. Nolte, S. Bozhevolnyi, A. Chipouline: Data transmission in long-range dielectric-loaded surface plasmon polariton waveguides, Opt. Express, 22 (22), 26742-26751 (2014).

S. M. Hooker, R. Bartolini, S. P. D. Mangles, A. Tünnermann, L. Corner, J. Limpert, A. Seryi, R. Walczak: Multi-pulse laser wakefield acceleration: a new route to efficient, high-repetition-rate plasma accelerators and high flux radiation sources, J. Phys. B-At. Mol. Opt. Phys., 47 (23), 234003 (2014).

S. Minardi, C. Milian, D. Majus, A. Gopal, G. Tamosauskas, A. Couairon, T. Pertsch, A. Dubietis: Energy deposition dynamics of femtosecond pulses in water, Appl. Phys. Lett., 105 (22), 224104 (2014).

S. P. Scheeler, D. Lehr, E.-B. Kley, C. Pacholski: Top-up fabrication of gold nanorings., Chem.-Asian J., 9 (8), 2072-2076 (2014).

S. Rojas-Rojas, L. Morales-Inostroza, U. Naether, G. B. Xavier, S. Nolte, A. Szameit, R. A. Vicencio, G. Lima, A. Delgado: Analytical model for polarization-dependent light propagation in waveguide arrays and applications, Phys. Rev. A, 90(6), 063823 (2014).

S. Weimann, A. Kay, R. Keil, S. Nolte, A. Szameit: Photonic coherent state transfer with Hamiltonian dynamics, Opt. Lett., 39 (1), 123-126 (2014).

S. Weimann, Y. V. Kartashov, V. A. Vysloukh, A. Szameit, L. Torner: Observation of asymmetric solitons in waveguide arrays with refractive index gradient, Opt. Lett., 39 (12), 3694-3697 (2014).

S. Zhang, D. Asoubar, R. Kammel, S. Nolte, F. Wyrowski: Analysis of pulse front tilt in simultaneous spatial and temporal focusing, J. Opt. Soc. Am. A-Opt. Image Sci. Vis., 31 (11), 2437-2446 (2014).

T. Eichelkraut, C. Vetter, A. Perez-Leija, H. Moya-Cess, D. N. Christodoulides, A. Szameit: Coherent random walks in free space, Optica, 1(4), 268-271 (2014).

T. Eichelkraut, S. Weimann, S. Stützer, S. Nolte, A. Szameit: Radiation-loss management in modulated waveguides, Opt. Lett., 39(1), 6831-6834 (2014).

T. Gottschall, T. Meyer, M. Baumgartl, B. Dietzek, J. Popp, J. Limpert, A. Tünnermann: Fiber-based optical parametric oscillator for high resolution coherent anti-Stokes Raman scattering (CARS) microscopy, Opt. Express, 22 (18), 21921-21928 (2014).

T. Herffurth, M. Trost, S. Schroeder, K. Taeschner, H. Bartzsch, P. Frach, A. Duparre, A. Tünnermann: Roughness and optical losses of rugate coatings, Appl. Optics, 53 (4), A351-A359 (2014).

T. Siefke, D. Lehr, T. Weber, D. Voigt, E.-B. Kley, A. Tünnermann: Fabrication influences on deep-ultraviolet tungsten wire grid polarizers manufactured by double patterning, Opt. Lett., 39 (22), 6434-6437 (2014).

T. Weber, S. Kroker, T. Käsebier, E.-B. Kley, A. Tünnermann: Silicon wire grid polarizer for ultraviolet applications, Appl. Optics, 53 (34), 8140-8144 (2014).

T. Weichelt, U. Vogler, L. Stuerzebecher, R. Voelkel, U. D. Zeitner: Resolution enhancement for advanced mask aligner lithography using phase-shifting photomasks, Opt. Express, 22 (13), 16310-16321 (2014).

U. Blumröder, M. Steglich, F.Schrempel, P. Hoyer, S. Nolte: THz emission from argon implanted silicon surfaces, Phys. Status Solidi B-Basic Solid State Phys., 252(1), 105-111 (2014).

W. S. Brocklesby, J. Nilsson, T. Schreiber, J. Limpert, A. Brignon, J. Bourderionnet, L. Lombard, V. Michau, M. Hanna, Y. Zaouter, T. Tajima, G. Mourou: ICAN as a new laser paradigm for high energy, high average power femtosecond pulses, EPL, 223 (6), 1189-1195 (2014).

X. Chen, L. Zhao, X. Fu, L. You, O. Stenzel, H. Kämmer, F. Dreisow, S. Nolte, L. Song: Effect of oxygen vacancies on the laser-induced damage resistance of Y0.26Hf0.74Ox thin films, Opt. Lett., 39 (22), 6470-6473 (2014).

Y. Bourgin, T. Kasebier, U. D. Zeitner: 250nm period grating transferred by proximity i-line mask-aligner lithography., Opt. Lett., 39 (6), 1665-8 (2014).

Y. Plotnik, M. C. Rechtsman, D. Song, M. Heinrich, J. M. Zeuner, S. Nolte, Y. Lumer, N. Malkova, J. Xu, A. Szameit, Z. Chen, M. Segev: Observation of unconventional edge states in 'photonic graphene', Nat. Mater., 13 (1), 57-62 (2014).

Books

M. Heinrich, S. Nolte, A. Szameit: Nonlinear light propagation in laser-written waveguide arrays, G. Marowski, Planar waveguides and other confined geometries: Theory, Technology, Production and Novel Applications, 2014.

S. Richter, M. Heinrich, F. Zimmermann, C. Vetter, A. Tünnermann, S. Nolte: Nanogratings in Fused Silica: Structure, Formation and Applications, Sakabe, Lienau, Grunwald, Linear and Nonlinear Nanooptics, 2014.

Conference Contributions

Invited Talks

A. Chipouline: Narrowband resonances for biosensing applications, Days on Diffraction, St. Petersburg, Russia, 26 -30 May 2014.

A. Chipouline: Qualitative models in nanophotonics, International Conference on Metamaterials, Photonic Crystals and Plasmonics (META), Singapore, Singapore, 20 -23 May 2014.

A. Chipouline: Narrowband plasmonic structures for biosensors, Days on Diffraction, St. Petersburg, Russia, 26 -30 May 2014.

A. Szameit: Photonic Graphene: Ultrastrong magnetic fields and Floquet topological insulators, Bose-Einstein Condensates in Waveguide - Curvature meets Nonlinearity workshop, Hamburg, Germany, 14 -16 May 2014.

A. Szameit: Photonic Floquet Topological Insulators, Coherent Control of Complex Quantum Systems conference, Okinawa, Japan, 14 -17 April 2014.

A. Szameit: Light evolution in photonic waveguide arrays, Geometric Methods in Classical and Quantum Lattice Systems workshop, Caputh, Germany, 29 Sept. 2014.

A. Szameit: Photonic Floquet Topological Insulators, SINOGFOS conference, Kunming, China, 20 -23 March 2014.

A. Szameit: Photonic Topological Insulators, Status Seminar, Jena, Germany, 27 March 2014.

A. Szameit: Photonic Floquet topological insulators, Topological Matter Out of Equilibrium workshop, Dresden, Germany, 27 -29 March 2014.

A. Szameit, J. M. Zeuner, M. C. Rechtsman, Y. Plotnik, S. Nolte, M. Segev: Photonic Floquet Topological Insulators in Discrete and Analogue Quantum Simulators, Heraeus Seminar, Bad Honnef, Germany, 10 -12 Febr. 2014.

A. Szameit, J. M. Zeuner, M. C. Rechtsman, Y. Plotnik, S. Nolte, M. Segev: Photonic Floquet Topological Insulators, The Nonlinear Meeting 2014, Edinburgh, GB, 17 -22 May 2014.

A. Veltri, A. Chipouline, A. Aradian: Time-dynamical model for the optical response of a plasmonic nanoparticle immersed in an active gain medium, International Conference on Metamaterials, Photonic Crystals and Plasmonics (META), Singapore, Singapore, 20 -23 May 2014.

A. Zagoskin, A. Chipouline, E. Il'ichev, R. Johansson, F. Nori: Electromagnetic wave propagation and lasing in a toroidal quantum metamaterial, International Conference on Metamaterials, Photonic Crystals and Plasmonics (META), Singapore, Singapore, 20 -23 May 2014.

F. Dreisow, S. Döring, S. Richter, F. Zimmermann, A. Tünnermann, S. Nolte: Lokales Fügen transparenter Werkstoffe mit ultrakurzen Laserpulsen, Bearbeitung von Glaswerkstoffen mit innovativen Verfahren, Düsseldorf, Germany, 20 Oct. 2014.

F. Dreisow, S. Nolte: Volumenbearbeitung von Gläsern mit hochrepetierenden UKP-Lasern, Spectaris - Ultrakurzpuls-Laser zur industriellen Präzisionsbearbeitung von transparenten und sprödharten Materialien, Kaiserslautern, Germany, 17 Sept. 2014.

F. Dreisow, S. Nolte: Recent developments and applications of ultra short pulse-lasers, Trends and new developments in Laser Technology 2014, Dresden, Germany, 25 -28 Aug. 2014.

F. Wyrowski, C. Hellmann: Field tracing for simulation of locally-polarized light fields and fs pulses, SPIE Photonics West, San Francisco, USA, 1 -6 Febr. 2014.

G. Kalkowski, C. Rothhardt, S. Risse, S. Richter, F. Zimmermann, R. Eberhardt, S. Nolte: Integriert-Optische Module durch neue Bondtechnologien (Opti-Bond), F.O.M.-Konferenz 2014: „Gemeinsam Zukunftstechnologien gestalten“, Berlin, Germany, 4 Nov. 2014.

J. A. Squier, J. U. Thomas, E. K. Block, C. G. Durfee, S. J. Backus: Spatial and temporally focused femtosecond laser pulses for material processing, SPIE Photonics West, San Francisco, USA, 1 -7 Febr. 2014.

J. A. Squier, E. Block, M. Greco, M. Young, C. G. Durfee, J. Thomas, J. Field, R. Bartels: Multiphoton imaging and manipulation of biological systems, CLEO: Applications and Technology (CLEO-AT), San José, USA, 8 -13 June 2014.

J. Limpert: Performance scaling of femtosecond fiber-laser systems, Advanced Lasers and their Applications (ALTA), Jeju, Korea, 24 -31 May 2014.

J. Limpert: A path towards Joule-class high repetition rate ultrafast fiber laser systems, Europhoton, Neuchatel, Switzerland, 24 -29 Aug. 2014.

J. Limpert: Performance Scaling of Ultrafast Fiber Laser Systems, IMPRS monthly meeting, Erlangen, Germany, 1 -30 Nov. 2014.

M. C. Rechtsman, J. M. Zeuner, Y. Plotnik, Y. Lumer, M. Segev, A. Szameit: Photonic Topological Insulators, SPIE Photonics Europe, Brussels, Belgium, 14 -17 April 2014.

M. C. Rechtsman, J. M. Zeuner, Y. Plotnik, Y. Lumer, M. Segev, A. Szameit: Aspects of photonic topological insulators, OSA Incubator Meeting on Topological Order with Photons, Washington DC, USA, 2 -4 April 2014.

M. C. Rechtsman, J. M. Zeuner, Y. Plotnik, Y. Lumer, M. Segev, A. Szameit: Aspects of photonic topological insulators, Photonics North conference, Montreal, Canada, 28 -30 May 2014.

M. Gräfe, R. Heilmann, A. Perez-Leija, S. Nolte, A. Szameit: Fs-laser-written integrated photonic quantum circuits, Congress of the International Commission for Optics, Santiago de Compostela, Spain, 26 -28 Aug. 2014.

M. Kumkar, M. Kaiser, J. Kleiner, D. Grossmann, D. Flamm, K. Bergner, S. Nolte: Cutting of Transparent Materials by Tailored Absorption, Advanced Solid State Lasers (ASSL), Shanghai, China, 16 -21 Nov. 2014.

M. Richardson, I. Mingareev, S. Nolte, A. Tünnermann, I. Kelbassa, R. Poprawe: From Femtosecond Laser-Materials Processing to 3D Printing – Laser-Based Technologies that Will Transform Manufacturing, The 15th International Symposium on Laser Precision Microfabrication (LPM), Vilnius, Lithuania, 2014.

M. Segev, M. C. Rechtsman, Y. Plotnik, Y. Lumer, J. M. Zeuner, A. Szameit: Photonic topological insulators, International Conference on Metamaterials, Photonic Crystals and Plasmonics (META), Singapore, Singapore, 20 -23 May 2014.

M. Segev, Y. Plotnik, M. Rechtsman, Y. Lumer, M. A. Bandres, J. M. Zeuner, A. Szameit: Photonic Topological Insulators, Conference on Lasers and Electro Optics (CLEO), San José, USA, 8 -13 June 2014.

R. Grange: Coherent nanoprobes for new multiphoton imaging modalities, International Workshop on New Frontiers in Nonlinear Raman Microscopy, Heidelberg, Germany, 8 -9 Aug. 2014.

R. Heilmann, M. Gräfe, A. Perez-Leija, S. Nolte, A. Szameit: Laser-written integrated photonic quantum circuits, Frontiers in Optics, Tucson, USA, 19 -23 Oct. 2014.

R. Heilmann, M. Gräfe, S. Nolte, A. Szameit: Integrated laser-written photonic quantum circuits, Photonics North conference, Montreal, Canada, 28 -30 May 2014.

S. Diziain, R. Geiss, M. Zilk, F. Schrempel, E.-B. Kley, A. Tünnermann, T. Pertsch: Enhancement of second harmonic generation in self-suspended lithium niobate photonic crystal cavites, ICTON, Graz, Austria, 6 -10 July 2014.

S. Döring, S. Richter, F. Zimmermann, A. Tünnermann S. Nolte: Lokales Fügen transparenter Werkstoffe mit ultrakurzen Laserpulsen, 2. Innovationsforum MikroLas, Rostock, Germany, 4 -5 March 2014.

S. Kroker, E.-B. Kley, A. Tünnermann: Thermal noise of silicon based grating reflectors for high-precision metrology, IEEE Metrology for Aerospace, Benevento, Italy, 30 May -1 June 2014.

S. Kroker, R. Nawrodt: On behalf of the Einstein Telescop Science Team: The Einstein Telescope, IEEE Metrology for Aerospace, Benevento, Italy, 30 May -1 June 2014.

S. Minardi: 3D photonics for astronomy: a tutorial, LFIB Workshop, Nizza, France, 23 -24 June 2014.

S. Minardi: Advanced photonics for nulling techniques, Workshop “Photonics for planets” Convitto della Calza, Firenze, Italy, 6 -7 Nov. 2014.

S. Minardi, F. Eilenberger, K. Prater, T. Pertsch: Three-dimensional spatiotemporal solitary waves in multicore fibers, Workshop “Rogue waves, dissipative solitons, plasmonics, supercontinuum and special fibres” ICFO-The Institute of Photonics Science, Castelldefels, Spain, 25 -26 July 2014.

S. Nolte: Ultrashort pulse lasers for precise processing: overview on a current German research initiative, SPIE Photonics West, San Francisco, USA, 1 -6 Febr. 2014.

S. Nolte, F. Zimmermann, S. Richter, A. Plech: Ultrashort pulse induced nanogratings inside glass – fundamentals and applications, ALT'14, Cassis, France, 5 -10 Oct. 2014.

S. Nolte, F. Zimmermann, S. Richter, A. Plech, U. Peschel, A. Tünnermann: Ultrashort pulse induced nanogratings – fundamentals and applications, The Nonlinear Meeting, Edinburgh, GB, 17 -22 May 2014.

S. Nolte, S. Richter, A. Tünnermann: Ultrastable Bonding of Glass with Femtosecond Laser Pulses, Classical Optics Conference, Kohala Coast, Hawaii, USA, 22 -27 June 2014.

PUBLICATIONS

Posters

S. Weimann, M. Heinrich, F. Dreisow, R. Keil, S. Nolte, A. Szameit: Nonlinear spatial photonics in laser-written photonic structures, Workshop on the cutting edge problems on nonlinear photonics, Castelldefels, Spain, 25 July 2014.

U.D. Zeitner, F. Fuchs, E.-B. Kley, A. Tünnermann: High-refractive-index gratings for spectroscopic and laser applications, High Contrast Metastructure III, San Francisco, USA, 1 -7 Febr. 2014.

U.D. Zeitner, T. Harzendorf, T. Paul, D. Michaelis, F. Fuchs, E.-B. Kley: Bringing Photonic Sub-Wavelength Structures to Application, Topical Meeting on Metamaterials, Photonic Crystals and Plasmonics, Berlin, Germany, 16 -18 Sept. 2014.

V. Pustovit, A. Chipouline, D. Brown, T. Shahbazyan, A. Urbas: A loss compensation condition and SPASER frequency for plasmonic nanoshell assisted by optical gain media, International Conference on Metamaterials, Photonic Crystals and Plasmonics (META), Singapore, Singapore, 20 -23 May 2014.

A. E. Klein, N. Janunts, C. Schmidt, M. Liebsch, A. Minovich, D. Neshev, Y. Kivshar, T. Pertsch: Scanning probe techniques for optical near-field microscopy below the diffraction limit, JSMC Symposium, Jena, Germany, 2 -3 Sept. 2014.

C. Rothhardt, J. Rothhardt, A. Klenke, T. Peschel, R. Eberhardt, J. Limpert, A. Tünnermann: A bbo-sapphire sandwich structure for high power frequency conversion, SPIE Photonics West, San Francisco, USA, 1 -6 Febr. 2014.

C. Rothhardt, J. Rothhardt, A. Klenke, R. Eberhardt, J. Limpert, A. Tünnermann: BBO-sapphire sandwich structure for frequency conversion of high power lasers, Advanced Solid State Lasers (ASSL), Shanghai, China, 16 -21 Nov. 2014.

F. Zimmermann, A. Plech, S. Richter, A. Tünnermann, S. Nolte: Formation and evolution of ultrashort pulse-induced nanogratings in Borosilicate glass, SPIE Photonics Europe, Brussels, Belgium, 14 -17 April 2014.

H. Zhong, S. Zhang, F. Wyrowski, H. Schweitzer: Parabasal thin element approximation for the analysis of the diffractive optical elements, SPIE Photonics Europe, Brussels, Belgium, 14 -17 April 2014.

H.-J. Otto, C. Jauregui, F. Stutzki, F. Jansen, J. Limpert, A. Tünnermann: kW average power from a Yb-doped rod-type large-pitch fiber, SPIE Photonics West, San Francisco, USA, 1 -6 Febr. 2014.

H.-J. Otto, C. Jauregui, N. Modsching, J. Limpert, A. Tünnermann: Mode instabilities and photodarkening in high power fiber lasers, Advanced Solid State Lasers (ASSL), Shanghai, China, 16 -21 Nov. 2014.

J. Rothhardt, S. Hädrich, S. Demmler, M. Krebs, D. Winters, T. Kuehl, Th. Stöhlker, J. Limpert, A. Tünnermann: Prospects for laser spectroscopy of highly charged ions with high harmonic XUV and soft X-ray sources, International Conference on Nuclear Physics at Storage Rings (STORI), St. Goar, Germany, 28. Sept. -3 Oct. 2014.

M. Gräfe, R. Heilmann, A. Perez-Leija, R. Keil, F. Dreisow, M. Heinrich, S. Nolte, D. N. Christodoulides, A. Szameit: High-order single-photon W-states for random number generation, Heraeus Seminar, Bad Honnef, Germany, 2014.

M. Gebhardt, C. Gaida, F. Stutzki, C. Jauregui, J. Limpert, A.Tünnermann: Tm-doped fiber oscillator for high performance fiber CPA systems, Advanced Solid State Lasers (ASSL), Shanghai, China, 16 -21 Nov. 2014.

R. Errmann, S. Minardi, L. Labadie, F. Dreisow, S. Nolte, T. Pertsch: Integrated optics interferometric four telescopes nuller, SPIE Conference on Astronomical Instrumentation, Montreal, Canada, 22 -27 June 2014.

R. Errmann, S. Minardi, T. Pertsch: A broadband scalar optical vortex coronagraph, SPIE Conference on Astronomical Instrumentation, Montreal, Canada, 22 -27 June 2014.

S. Hauber, S. Döring, D. Harries, S. Nolte, F. Langenhorst: Laser shock experiments on olivine, 92nd Annual Meeting Deutsche Mineralogische Gesellschaft, Jena, Germany, 21 -24 Sept. 2014.

S. Minardi, D. Majus, A. Gopal, G. Tamosauskas, C. Milian , A. Couairon, T. Pertsch, A. Dubietis: Imaging Ultrafast Light-Matter Interaction with Inverse Raman Scattering, Nonlinear Photonics (NLP), Barcelona, Spain, 27 -31 July 2014.

S. Stützer, M. Heinrich, M. Miri, S. Nolte, D. N. Christodoulide, A. Szameit: Optical Supersymmetry: A fundamental approach to a new kind of mode converters, Heraeus Seminar, Bad Honnef, Germany, 2014.

S. Zhang, F. Wyrowski, J. Tervo: Efficient grating simulation for general incident beam, SPIE Photonics West, San Francisco, USA, 1 -6 Febr. 2014.

S. Zhang, F. Wyrowski, R. Kammel, S. Nolte: A brief analysis on pulse front tilt in simultaneous spatial and temporal focusing, SPIE Photonics West, San Francisco, USA, 1 -6 Febr. 2014.

Posters & Talks

A. Perez-Leija, A. Szameit, D. N. Christodoulides: Entanglement of single-photon W-eigenstates, Quantum Information and Measurement conference, Berlin, Germany, 18 -20 March 2014.

A. Perez-Leija, M. Gräfe, R. Heilmann, R. Keil, S. Stützer, S. Weimann, D. N. Christodoulides, A. Szameit: Eigenstate-Assisted Longitudinal Quantum State Transfer and Qubit Storage in Photonic and Spin Lattices, Meeting of the APS Division of Atomic, Molecular and Optical Physics (DAMOP), Madison, USA, 2 -6 June 2014.

A. Perez-Leija, M. Gräfe, R. Heilmann, R. Keil, S. Weimann, D. N. Christodoulides, A. Szameit: Highly Efficient Eigenstate-Assisted Long-Distance Quantum State Transfer in Photonic Lattices, Conference on Lasers and Electro Optics (CLEO), San José, USA, 8 -13 June 2014.

C. Vetter, T. Eichelkraut, M. Ornigotti, A. Szameit: Radially Self-Accelerating Beams, Conference on Lasers and Electro Optics (CLEO), San José, USA, 8 -13 June 2014.

J. M. Zeuner, M. C. Rechtsman, Y. Lumer, Y. Plotnik, S. Nolte, M. Segev, A. Szameit: Bulk optical measurement of topological numbers in photonic lattices with a non-Hermitian system, Conference on Lasers and Electro Optics (CLEO), San José, USA, 8 -13 June 2014.

J. U. Thomas, E. K. Block, A. K. Meier, M. J. Greco, C. G. Durfee, J. A. Squier, S. Nolte: Simultaneously spatially and temporally focusing light for tailored ultrafast micro-machining, Proc. SPIE 9135, Laser Sources and Applications II, San Francisco, USA, 1 -7 Febr. 2014.

L. Martin, G. di Giuseppe, A. Perez-Leija, R. Keil, A. Szameit, A. F. Abouraddy, D. N. Christodoulides, B. E. A. Saleh: Two-Photon Discrete Speckle in Anderson-Disordered Lattices, Conference on Lasers and Electro Optics (CLEO), San José, USA, 8 -13 June 2014.

M. A. Bandres, M. C. Rechtsman, A. Szameit, M. Segev: Lieb Photonic Topological Insulator, Conference on Lasers and Electro Optics (CLEO), San José, USA, 8 -13 June 2014.

M. Gräfe, R. Heilmann, A. Perez-Leija, R. Keil, F. Dreisow, M. Heinrich, H. Moya-Cessa, S. Nolte, D. N. Christodoulides, A. Szameit: Scalable Generation of High-Order Single-Photon W-states, Quantum Information and Measurement conference, Berlin, Germany, 2014.

M. Gräfe, R. Heilmann, A. Perez-Leija, R. Keil, F. Dreisow, M. Heinrich, S. Nolge, D. N. Christodoulides, A. Szameit: High-Order Single-Photon W-states for Random Number Generation, Conference on Lasers and Electro Optics (CLEO), San José, USA, 8 -13 June 2014.

M. Gräfe, R. Heilmann, A. Perez-Leija, R. Keil, F. Dreisow, M. Heinrich, S. Nolte, D. N. Christodoulides, A. Szameit: High-Order Photonic W-states for Random Number Generation, Meeting of the APS Division of Atomic, Molecular and Optical Physics (DAMOP), Madison, USA, 2 -6 June 2014.

M. Gräfe, R. Heilmann, A. Perez-Leija, R. Keil, F. Dreisow, M. Heinrich, S. Nolte, D. N. Christodoulides, A. Szameit: Single-Photon W-states of High-Order for Random Number, Quantum Information and Measurement conference, Berlin, Germany, 18 -20 March 2014.

M. Heinrich, S. Stützer, M. Ali-Miri, R. El-Ganainy, S. Nolte, S. N. Christodoulides, A. Szameit: Supersymmetric mode converters, Conference on Lasers and Electro Optics (CLEO), San José, USA, 8 -13 June 2014.

M. Mohaupt, A. Kamm, E. Beckert, P. Schreiber, S. Fischer, R. Eberhardt, F. Dreisow, S. Nolte, T. Ullsperger, S. Pause, R. Hebel: Manipulation of metalized textile fibers for laser structuring, Proc. of the 14th euspen International Conference - Dubrovnik, Dubrovnik, Croatia, 2 June 2014.

M. Ornigotti, T. Eichelkraut, A. Szameit: Quasi-PT Symmetry in Waveguide Optical Directional Couplers, Conference on Lasers and Electro Optics (CLEO), San José, USA, 8 -13 June 2014.

M.-A. Miri, S. Stützer, M. Heinrich, R. El-Ganainy, S. Nolte, D. N. Christodoulides, A. Szameit: Observation of supersymmetric dynamics in photonic lattices, Frontiers in Optics, Tucson, USA, 19 -23 Oct. 2014.

M. J. Greco Jr., E.K. Block, C. G. Durfee, J. A. Squier, A. K. Meier, J. U. Thomas: In situ spectral phase characterization of simultaneous spatially and temporally focused pulses, SPIE Photonics West, San Francisco, USA, 1 -7 Febr. 2014.

R. A. Vicencio, A. Szameit, M. Bandres: Bulk and edge transport in photonic Lieb lattice, Nonlinear Photonics (NLP), Barcelona, Spain, 27 -31 July 2014.

R. Heilmann, M. Gräfe, S. Nolte, A. Szameit: Arbitrary photonic wave plate operations on-chip: Realizing Hadamard and Pauli-X gates for polarization encoded qubits, Conference on Lasers and Electro Optics (CLEO), San José, USA, 8 -13 June 2014.

R. Heilmann, M. Gräfe, S. Nolte, A. Szameit: Realization of Hadamard, Pauli-X, and rotation gates for polarization-encoded qubits on chip, Meeting of the APS Division of Atomic, Molecular and Optical Physics (DAMOP), Madison, USA, 2 -6 June 2014.

R. Heilmann, M. Gräfe, S. Nolte, A. Szameit: Hadamard, Pauli-X, and rotation operation for polarization encoded qubits on chip, Quantum Information and Measurement conference, Berlin, Germany, 18 -20 March 2014.

R.A. Vicencio, A. Szameit: Observation of linear properties in a Sawtooth photonic lattice, Nonlinear Photonics (NLP), Barcelona, Spain, 27 -31 July 2014.

S. Stützer, A. S. Solntsev, S. Nolte, J. E. Sipe, A. A. Sukhorukov, A. Szameit: Simulation of two-mode squeezing in photonic waveguide lattices, Conference on Lasers and Electro Optics (CLEO), San José, USA, 8 -13 June 2014.

S. Stützer, M. Heinrich, M. Ali-Miri, R. El-Ganainy, S. Nolte, D. N. Christodoulides, A. Szameit: A new class of optical structures: Supersymmetric mode converters, Meeting of the APS Division of Atomic, Molecular and Optical Physics (DAMOP), Madison, USA, 2 -6 June 2014.

S. Weimann, A. Perez-Leija, A. Szameit: Measuring the Geometric Phase of the Driven Harmonic Oscillator, Meeting of the APS Division of Atomic, Molecular and Optical Physics (DAMOP), Madison, USA, 2 -6 June 2014.

T. Eichelkraut, C. Vetter, A. Perez-Leija, D. N. Christodoulides, A. Szameit: Quantum random walks in free space, Conference on Lasers and Electro Optics (CLEO), San José, USA, 8 -13 June 2014.

T. Eichelkraut, C. Vetter, A. Perez-Leija, D. N. Christodoulides, A. Szameit: Continuous time quantum random walks in free space, Meeting of the APS Division of Atomic, Molecular and Optical Physics (DAMOP), Madison, USA, 2 -6 June 2014.

T. Eichelkraut, C. Vetter, A. Perez-Leija, D. N. Christodoulides, A. Szameit: Coherent Random Walks in Free Space, Quantum Information and Measurement conference, Berlin, Germany, 18 -20 March 2014.

T. Eichelkraut, R. Heilmann, S. Weimann, S. Stützer, D. N. Christodoulides, A. Szameit: Mobility transition between ballistic and diffusive transport in PT-symmetric lattices, Meeting of the APS Division of Atomic, Molecular and Optical Physics (DAMOP), Madison, USA, 2 -6 June 2014.

Y. Plotnik, M. C. Rechtsman, S. Stützer, Y. Lumer, S. Nolte, A. Szameit, M. Segev: Rashba Effective Spin-Orbit Coupling In Photonic Lattices, Conference on Lasers and Electro Optics (CLEO), San José, USA, 8 -13 June 2014.

Talks

A. S. Shorokhov, M. R. Shcherbakov, J. Reinhold, C. Helgert, T. Pertsch, A. A. Fedyanin: Static and dynamic properties of third harmonic generation in fishnet metamaterials, SPIE Optics & Photonics, Brussels, Belgium, 14 -17 April 2014.

A. Sergeyev, R. Geiss, A. Solntsev, E.-B. Kley, T. Pertsch, R. Grange: Dye excitation with generated and guided second harmonic in lithium niobate nanowires, EOSAM, Berlin, Germany, 15 -19 Sept. 2014.

A. Sergeyev, R. Geiss, E.-B. Kley, T. Pertsch, R. Grange: Local fluorescent dye excitation with guided second-harmonic in lithium niobate nanowires, CLEO, San Jose, USA, 8 -13 June 2014.

A. Shorokhov, M. Shcherbakov, J. Reinhold, A. A. Fedyanin, T. Pertsch: Subpicosecond relaxation of the third-order nonlinear susceptibility in fishnet metamaterials, SPIE Optics & Photonics, San Diego, USA, 17 -21 Aug. 2014.

A. Steinbrück, J.-W. Choi, S. Fasold, C. Menzel, A. Sergeyev, T. Pertsch, R. Grange: A plasmonic optofluidic device for multiplexing heat-induced applications, EOSAM, Berlin, Germany, 15 -19 Sept. 2014.

A. Klenke, J. Rothhardt, T. Eidam, S. Demmler, M. Kienel, T. Gottschall, S. Hädrich, J. Limpert, A. Tünnermann: 22GW peak-power femtosecond fiber CPA system, Advanced Solid State Lasers (ASSL), Shanghai, China, 16 -21 Nov. 2014.

A. Klenke, J. Rothhardt, T. Eidam, S. Demmler, M. Kienel, T. Gottschall, S. Hädrich, J. Limpert, A. Tünnermann: 22GW peak-power femtosecond fiber CPA system, Europhoton, Neuchatel, Switzerland, 24 -29 Aug. 2014.

A. Klenke, S. Hädrich, M. Kienel, T. Eidam, J. Limpert, A. Tünnermann: Spatially Separated Non-linear Pulse Compression, Conference on Lasers and Electro Optics (CLEO), San Jose, USA, 8 -13 June 2014.

A. Klenke, S. Hädrich, T. Eidam, M. Kienel, S. Breitkopf, J. Limpert, A. Tünnermann: Spatial-temporal multiplexing for overcoming limitations in non-linear compression, International Conference on Ultrahigh Intensity Lasers (ICUIL), Goa, India, 12 -17 Oct. 2014.

C. Gaida, F. Stutzki, M. Gebhardt, A. Wienke, F. Fuchs, D. Wandt, D. Kracht, C. Jauregui, J. Limpert, A. Tünnermann: 152 W Tm-based fiber CPA system, Advanced Solid State Lasers (ASSL), Shanghai, China, 16 -21 Nov. 2014.

C. Gaida, F. Stutzki, M. Gebhardt, F. Jansen, C. Jauregui, J. Limpert, A, Tünnermann: 200 MW peak power from a Tm-doped fiber CPA system, Advanced Solid State Lasers (ASSL), Shanghai, China, 16 -21 Nov. 2014.

C. Menzel, E. Hebestreit, S. Mühlig, C. Rockstuhl, S. Burger, F. Lederer, T. Pertsch: The spectral shift between near- and far-field resonances of optical nanoantennas, Metamaterials, Kopenhagen, Denmark, 25 -28 Aug. 2014.

C. Menzel, K. Dietrich, D. Lehr, O. Puffky, U. Hübner, A. Tünnermann, E.-B. Kley, T. Pertsch: Elevating optical activity by On-Edge Lithography, Metamaterials, Kopenhagen, Denmark, 25 -28 Aug. 2014.

C. Voigtländer, R. Krämer, J. Thomas, D. Richter, S. Nolte: Tuning the FBG period with a spatial light modulator, Proc. of Bragg gratings, photosensitivity, and poling in glass waveguides (BGPP), Barcelona, Spain, 27 -31 July 14 2014.

C. W. Wu, A. S. Solntsev, F. Setzpfandt, A. Boes, C. Will, A. Mitchell, D. N. Neshev, A. A. Sukhorukov: Nonlinear adiabatic couplers for Bell state generation with spatial pump filtering, Australian Institute of Physics Congress, Canberra, Australia, 7 -11 Dec. 2014.

C. Jauregui, H.-J. Otto, F. Jansen, F. Stutzki, N. Modsching, J. Limpert: Thermal effects and mode instabilities in high-power fiber laser systems, International Meeting on Fiber Lasers and Applications (IFLA), Tel Aviv, Israel, 23 -24 June 2014.

C. Gaida, F. Stutzki, F. Jansen, H.-J. Otto, C. Jauregui, J. Limpert, A. Tünnermann: Short-length Ge-pedestal large-pitch fiber, SPIE Photonics West, San Francisco, USA, 1 -6 Febr. 2014.

D. Asoubar, F. Wyrowski, H. Schweitzer, C. Hellmann, M. Kuhn: Resonator modeling by field tracing: a flexible approach for fully vectorial laser resonator modeling, SPIE Photonics Europe, Brussels, Belgium, 14 -17 April 2014.

D. Lehr, R. Filter, R. Alaee, K. Dietrich, C. Rockstuhl, F. Lederer, E. Kley, A. Tünnermann: Enhancing the Efficiency of Upconversion by Double-Resonant Plasmonic Nanorings, OSA Congress: Light, Energy and the Environment, Canberra, Australia, 2 -5 Dec. 2014.

E. Khaidarov, A. Chipouline, A. Kabashin, I. Nazarenko: Narrow bandwidth resonances in periodic plasmonic structures, Metamaterials, Kopenhagen, Denmark, 25 -30 Aug. 2014.

E. Kim, A. Steinbrück, M. T. Buscaglia, V. Buscaglia, T. Pertsch, R. Grange: Coherent nanoprobes down to 22 nm diameter for turbid media imaging, EOSAM, Berlin, Germany, 15 -19 Sept. 2014.

F. Setzpfandt, A. Solntsev, A. A. Sukhorukov: Dipole-like biphoton emission in waveguide arrays with nonlocal nonlinearity, Australian Institute of Physics Congress, Canberra, Australia, 7 -11 Dec. 2014.

F. Stutzki, C. Gaida, M. Gebhardt, A. Wienke, F. Fuchs, D. Wandt, D. Kracht, C. Jauregui, J. Limpert, A. Tünnermann: 88 W Tm-based fiber CPA system, Europhoton, Neuchatel, Switzerland, 24 -29 Aug. 2014.

F. Zimmermann, A. Plech, S. Richter, A. Tünnermann, S. Nolte: Morphological evolution of nanopores and cracks as fundamental components of ultrashort pulse laser-induced nanogratings, SPIE Photonics West, San Francisco, USA, 1 – 6 Febr. 2014.

F. Stutzki, F. Jansen, C. Jauregui-Misas, J. Limpert, A. Tünnermann: Breaking the symmetry for enhanced higher-order mode delocalization, SPIE Photonics West, San Francisco, USA, 1 -6 Febr. 2014.

H. Gross: Analysis of freeform optical systems, Ultraprecition manufacturing, Jena, Germany, 8 -9 Sept. 2014.

H. Gross: Generalized aberration surface contributions, European optical society annual meeting, Berlin, Germany, 16 -19 Sept. 2014.

H. Zhong, S. Zhang, F. Wyrowski: Parabasal thin element approximation for the analysis of the diffractive optical elements, SPIE Photonics West, San Francisco, USA, 1 -6 Febr. 2014.

H.-J. Otto, Arno Klenke, C. Jauregui, F. Stutzki, J. Limpert, A. Tünnermann: Mode instabilities in high-power fiber lasers, Rank Prize Funds Opto-electronic Materials for the New Millenium Conference, Grasmere, GB, 14 – 16 June 2014.

H.-J. Otto, A. Klenke, C. Jauregui, F. Stutzki, J. Limpert, A. Tünnermann: Increase of the mode-instabilities threshold in a multi-core fiber, Conference on Lasers and Electro Optics (CLEO), San Jose, USA, 8 -13 June 2014.

H.-J. Otto, C. Jauregui, F. Stutzki, N. Modsching, J. Limpert, A. Tünnermann: Yb-doped rod-type fiber amplifier emitting 2 kW average power, Europhoton, Neuchatel, Switzerland, 24 – 29 Aug. 2014.

H.-J. Otto, F. Stutzki, N. Modsching, C. Jauregui, J. Limpert, A. Tünnermann: High-power Yb-doped rod-type fiber amplifier, Conference on Lasers and Electro Optics (CLEO), San Jose, USA, 8 -13 June 2014.

H.-J. Otto, A. Klenke, C. Jauregui, F. Stutzki, J. Limpert, A. Tünnermann: 4-fold increase of the mode instability threshold with an Yb-doped multi-core fiber amplifier, Europhoton, Neuchatel, Switzerland, 24 -28 Aug. 2014.

I. Staude, M. Decker, M. Falkner, J. Dominguez, D. N. Neshev, I. Brener, T. Pertsch, Y. S. Kivshar: All-dielectric Huygens' Metasurfaces for High-Efficient Wave Manipulation, Australian Institute of Physics Congress, Canberra, Australia, 7 -11 Dec. 2014.

I. Staude, M. Decker, M. Falkner, J. Dominguez, D. N. Neshev, I. Brener, T. Pertsch, Y. S. Kivshar: High-Transmittance All-Dielectric Huygens' Metasurfaces, SPIE Optics & Photonics, San Diego, USA, 17 -21 Aug. 2014.

J. Limpert: A path to Joule-class high repetition rate ultrafast lasers, SPIE Photonics West, San Francisco, USA, 1 -6 Febr. 2014.

J. Limpert: Performance scaling of ultrafast laser systems by coherent addition of femtosecond pulses, Conference on Lasers and Electro Optics (CLEO), San Jose, USA, 8 -13 June 2014.

J. Limpert: High-Flux Fiber-Laser Driven Table-top EUV sources (High Performance few-cycle pulses), International Conference on Ultrahigh Intensity Lasers (ICUIL), Goa, India, 12 -17 Oct. 2014.

PUBLICATIONS

J. Limpert: Israel Performance Scaling of Ultrafast Fiber Laser Systems, International Meeting on Fiber Lasers and Applications (IFLA), Tel Aviv, Israel, 23 -24 June 2014.

J. Limpert: Performance Scaling of Ultrafast Fiber Laser Systems, Rank Prize Funds Opto-electronic Materials for the New Millenium Conference, Grasmere, GB, 14 -16 June 2014.

J. Limpert, J. Rothhardt, S. Hädrich, M. Krebs, A. Tünnermann: Ultrahigh photon flux XUV source by high harmonic generation of a high power fiber laser, International Conference on Ultrahigh Intensity Lasers (ICUIL), Goa, India, 12 -17 Oct. 2014.

J. Rothhardt, M. Krebs, S. Hädrich, S. Demmler, J. Limpert, A. Tünnermann: Absorption-limited high harmonic generation in the tight focusing regime, High-Intensity Lasers and High-Field Phenomena (HILAS), Berlin, Germany, 18 -21 March 2014.

J. Rothhardt, M. Zürch, S. Hädrich, S. Demmler, M. Krebs, A. Guggenmos, U. Kleineberg, C. Spielmann, J. Limpert, A. Tünnermann: CDI with high photon flux table-top XUV and soft X-ray sources, Coherence, Evanston, USA, 26 Aug. 2014.

J. Rothhardt, S. Hädrich, A. Klenke, S. Demmler, T.Eidam, A. Hoffmann, J. Limpert, A. Tünnermann: Generation of sub-10 fs, 0.4 mJ pulses at 100 kHz repetition rate, Europhoton, Neuchatel, Switzerland, 24 -29 Aug. 2014.

J. Rothhardt, S. Hädrich, S. Demmler, M. Krebs, S. Fritzsche, J. Limpert, A. Tünnermann: Enhanced high harmonic generation by Fano- resonances, High-Intensity Lasers and High-Field Phenomena (HILAS), Berlin, Germany, 18 -21 March 2014.

K. Dietrich, C. Menzel, D. Lehr, O. Puffky, U. Hübner, A. Tünnermann, T. Pertsch, E.-B. Kley: Elevating optical activity by On-Edge Lithography, Metamaterials, Copenhagen, Denmark, 25 -28 Aug. 2014.

K. Dietrich, D. Lehr, T. Siefke, E.-B. Kley, A. Tünnermann: Efficient methors of nanopatterning to realize deterministic metallic optical nanostructures, DGaO-Tagung, Karlsruhe, Germany, 10 -14 June 2014.

K. Dietrich, T. Käsebier, O. Puffky, E.-B. Kley, A. Tünnermann: Chrial nanomaterial fabrication by means of on-edge lithography, SPIE Advanced Lithography, San José, USA, 23 -27 Febr. 2014.

M. Eßlinger: Simulation of Shift-Variant Differential Interference Contrast, Focus on Microscopy, Sydney, Australia, 13 -16 April 2014.

M. R. Shcherbakov, A. S. Shorokhov, A. A. Fedyanin, J. Reinhold, C. Helgert, T. Pertsch, J. Dominguez, I. Brener, D. Neshev, I. Staude, A. Miroshnichenko, Y. Kivshar: Third harmonic generation in metamaterials: a probe for optical magnetism, Days on Diffraction, St. Petersburg, Russia, 26 -30 May 2014.

M. Tessmer: Feldpropagation auf schiefe Ebenen und Transmission mit verallgemeinerten Fresnelkoeffizienten im Frequenzraum, DGaO-Jahrestagung, Karlsruhe, Germany, 10 -14 June 2014.

M. Krebs, J. Rothhardt, S. Hädrich, A. Klenke, S. Demmler, T. Eidam, A. Hoffmann, J. Limpert, A. Tünnermann: 53 W Average Power Energetic Few-Cycle Pulses for High-Field Physics, Advanced Solid State Lasers (ASSL), Shanghai, China, 16 -21 Nov. 2014.

M. Krebs, S. Hädrich, A. Hoffmann, A. Klenke, J. Rothhardt, J. Limpert, A. Tünnermann: Compact 10 MHz, 140 MW Peak Power Source Enabling Bright High Harmonic Generation, Advanced Solid State Lasers (ASSL), Shanghai, China, 16 -21 Nov. 2014.

M. Kienel, M. Müller, A. Klenke, T. Eidam, J. Limpert, A. Tünnermann: Multi-dimensional Amplification of Ultrashort Pulses, Advanced Solid State Lasers (ASSL), Shanghai, China, 16 -21 Nov. 2014.

M. Kienel, M. Müller, S. Demmler, J. Rothhardt, A. Klenke, T. Eidam, J. Limpert, A. Tünnermann: Energy Scaling of Femtosecond Yb:YAG Single-Crystal Rod Amplifiers using Coherent Beam Combination, Europhoton, Neuchatel, Switzerland, 24 -29 Aug. 2014.

M. Kienel, A. Klenke, S. Hädrich, T. Eidam, J. Limpert, A. Tünnermann: Analysis of divided-pulse amplification for high energy extraction, SPIE Photonics West, San Francisco, USA, 1 -6 Febr. 2014.

M. Steglich, T. Käsebier, M. Zilk, E.-B. Kley, A. Tünnermann: Black Silicon by ICP-RIE and its prospects in photovoltaics, OSA Congress: Light, Energy and the Environment, Canberra, Australia, 2 -5 Dec. 2014.

R. Alaee, M. Albooyeh, C. Menzel, S. Fasold, N. Janunts, M. Falkner, T. Pertsch, C. R. Simovski, F. Lederer, C. Rockstuhl: Magneto-electric Response in Coupled Plasmonic Nanoparticles, Metamaterials, Kopenhagen, Denmark, 25 -28 Aug. 2014.

R. Lehneis, C. Jauregui, A. Steinmetz, J. Limpert, A. Tünnermann: All-fiber concept for ultrashort pulses from a passively Q-switched Nd:YVO4 microchip laser, SPIE Photonics West, San Francisco, USA, 1 -6 Febr. 2014.

S. Fasold, C. Menzel, M. Falkner, C. Etrich, T. Paul , E.-B. Kley , C. Rockstuhl, A. Tünnermann, T. Pertsch: Near-Field Imaging with Subwavelength Resolution by a Plasmonic Moiré Magnifier, Metamaterials, Kopenhagen, Denmark, 25 -30 Aug. 2014.

S. Hädrich, A. Klenke, A. Hoffmann, T. Eidam, T. Gottschall, J. Rothhardt, J. Limpert, A. Tünnermann: High pulse energy and average power ultrashort laser pulses via nonlinear compression of coherently combined fiber CPA systems, SPIE Photonics West, San Francisco, USA, 1 -6 Febr. 2014.

S. Hädrich, J. Rothhardt, A. Klenke, M.Krebs, A. Hoffmann, O. Pronin, V. Pervak, J. Limpert, A. Tünnermann: High Harmonic Generation of Fiber Laser Systems with more than 100 µW Average Power per Harmonic, Conference on Lasers and Electro Optics (CLEO), San Jose, USA, 8 -13 June 2014.

S. Hädrich, J. Rothhardt, A. Klenke, M.Krebs, A. Hoffmann, O. Pronin, V. Pervak, J. Limpert, A. Tünnermann: Efficient HHG of High Average Power Fiber Laser Yields More than 100 µW per Harmonic, Europhoton, Neuchatel, Switzerland, 24 -29-Aug. 2014.

S. Kroker, T. Käsebier, E.-B. Kley, A. Tünnermann: Investigation on the angular dependent reflectance of coupled high-contrast gratings, SPIE Photonics West, San Francisco, USA, 7 -12 Febr. 2014.

S. Minardi, A. Saviauk, F. Dreisow, S. Nolte, T. Pertsch: 3D-integrated beam combiner for optical spectro-interferometry, SPIE Conference on Astronomical Instrumentation, Montréal, Canada, 22 -27 June 2014.

S. Zhang, F. Wyrowski, R. Kammel, S. Nolte: A brief analysis on pulse front tilt in simultaneous spatial and temporal focusing, SPIE Photonics Europe, Brussels, Belgium, 14 -17 April 2014.

S. Breitkopf, T. Eidam, A. Klenke, H. Carstens, S. Holzberger, I. Pupeza, E. Fill, T. Schreiber, J. Limpert, F. Krausz, A. Tünnermann: Stack-and-Dump: Approaching TW-Peak Powers at >10 kHz Repetition Rate by Multi-Dimensional Coherent Combining of Femtosecond Fiber Lasers, SPIE Photonics West, San Francisco, USA, 1 -6 Febr. 2014.

S. Breitkopf, T. Eidam, L. von Grafenstein, A. Klenke, H. Carstens, S. Holzberger, I. Pupeza, E. Fill, T. Schreiber, J. Limpert, F. Krausz, A. Tünnermann: Stack-and-Dump: Approaching TW-Peak Powers at >10 kHz Repetition Rate by Temporal Combining of Femtosecond Fiber Lasers in a Stack and Dump Cavity, International Conference on Ultrahigh Intensity Lasers (ICUIL), Goa, India, 12 -17 Oct. 2014.

T. Kaiser, X. Wang, C. Helgert, S. Diziain, C. Rockstuhl, T. Pertsch: Waveguides containing double cut-wire metamaterials – properties and applications, Metamaterials, Kopenhagen, Denmark, 25 -30 Aug. 2014.

T. Gottschall, C. Jauregui, T. Meyer, B. Dietzek, J. Popp, J. Limpert, A. Tünnermann: High fidelity fiber-based optical parametric oscillator for coherent anti-stokes Raman (CARS) microscopy, SPIE Photonics West, San Francisco, USA, 1 -6 Febr. 2014.

T. Gottschall, M. Baumgartl, T. Meyer, B. Dietzek, J. Popp, J. Limpert, A. Tünnermann: Fiber-based Optical Parametric Oscillator for CARS Microscopy, Europhoton, Neuchatel, Switzerland, 24 -29 Aug. 2014.

T. Gottschall, M. Baumgartl, T. Meyer, B. Dietzek, J. Popp, J. Limpert, A. Tünnermann: Fibre-based Optical Parametric Oscillator for CARS Microscopy, Rank Prize Funds Opto-electronic Materials for the New Millenium Conference, Grasmere, GB, 16 June 2014.

T. Eidam, A. Klenke, M. Kienel, F. Stutzki, H.-J. Otto, T. Gottschall, C. Jauregui, S. Hädrich, J. Rothhardt, J. Limpert, A. Tünnermann: Entwicklungen auf dem Gebiet der UKP Faserlaser, Workshop "Innovative Strahlungsquellen", Nürnberg, Germany, 9 Dec. 2014.

T. Eidam, A. Klenke, M. Kienel, S. Breitkopf, J. Limpert, A. Tünnermann: A path towards Joule-class femtosecond pulses at >10kHz repetition rate, International Conference on Ultrahigh Intensity Lasers (ICUIL), Goa, India, 12 -17 Oct. 2014.

T. Eidam, J. Limpert, S. Breitkopf, M. Kienel, A. Klenke, Fabian Stutzki, H.-J. Otto, T. Gottschall, C. Jauregui, J. Rothhardt, T. Schreiber, A. Tünnermann: Coherent combination as performance scaling concept of ultrafast lasers, SPIE Defense and Security, Amsterdam, Netherlands, 22 -26 Sept. 2014.

U. Hübner, M. Falkner, U. D. Zeitner, M. Banasch, K. Dietrich, E.-B. Kley: Multi-stencil character projection e-beam lithography – a fast and flexible way for high quality optical metamaterials, 30th European Mask and Lithography Conference, Dresden, Germany, 24 -25 June 2014.

U.D. Zeitner, T. Harzendorf, F. Fuchs, M. Banasch, H. Schmidt, E.-B. Kley: Efficient fabrication of complex nano-optical structures by E-beam lithography based on character projection, Advanced Fabrication Technologies for Micro/Nano Optics and Photonics VII, San Francisco, USA, 1 -7 Febr. 2014.

Colloquia

A. Szameit: Photonic Graphene - the physics of honeycomb photonic lattices, Chalmers University of Technology Gothenburg, Gothenburg, Sweden, 2014.

A. Szameit: Photonic Graphene - the physics of honeycomb photonic lattices, Universität Regensburg, Regensburg, Germany, 2014.

A. Szameit: Symmetries in photonic waveguide lattices, Friedrich-Schiller-Universität Jena, Jena, Germany, 2014.

H.-J. Otto: Mode instabilities in high-power fiber laser, Abbe School of Photonics, FSU, Jena, Germany, 2014.

S. Nolte: Ultrashort pulse laser materials processing, Arbeitskreis Produktionstechnik (OptoNet), Jena, Germany, 3. June 2014.

S. Nolte: Ultrakurze Laserpulse – neue Möglichkeiten für hochpräzise Mikrostrukturierung, Sommerschule der Chemisch-Geowissenschaftlichen Fakultät, Friedrich-Schiller-Universität Jena, Jena, Germany, 14. July 2014.

S. Nolte: Ultrashort pulse laser processing: physics and technological applications, Internationales Kolloquium zum fünfjährigen Bestehen des Zentrum für Innovationskompetenz (ZIK) SiLi-nano, Halle, Germany, 17. July 2014.

S. Nolte: Ultrashort laser pulses for industrial mass production - manufacturing with laser flashes, Festvortrag LANE, Bamberg, Germany, 9. Sept. 2014.

S. Nolte: Ultrakurzpulslaser – ein universelles Werkzeug für die hochpräzise Mikromaterialbearbeitung, Industriegespräche Jena - Chemnitz, Jena, Germany, 24. Sept. 2014.

S. Nolte: Ultrakurzpulslaser – universelles Werkzeug in der hochpräzisen Mikromaterialbearbeitung, 60 Jahre Fertigungstechnik Dresden, Dresden, Germany, 20. Nov. 2014.

Patents

Applications

A. Klenke, H.-J. Otto, J. Limpert, A.Tünnermann:
Optische Anordnung mit Strahlaufteilung
(DE 10 2014 001 252.2)

A. Szameit, M. Gräfe, R. Heilmann, A. Perez-Leija, S. Nolte:
Verfahren und Vorrichtung zur Generierung von Zufallszahlen
(DE 10 2014 202 312.2)

A. Tünnermann, A. Szeghalmi, E.-B.Kley, S. Ratzsch:
Gedeckelte Gitter
(DE 10 2014 218 016.3)

C. Jáuregui, A. Tünnermann, J. Limpert, C. Gaida:
Multicore crystalline waveguides for high power laser systems
(DE 10 2014 014 315.5)

E.-B. Kley, U. Zeitner:
Beugungsgitter und Verfahren zu dessen Herstellung
(EP 13 70 8714.4)

L. Coriand, A. Duparré, G. Notni, N. Felde:
Beschichtung für Glasoberfläche, Verfahren zu deren Herstellung und Glaselemente
(DE 10 2014 112 133.3)

M. Beier, D. Stumpf, A. Gebhardt, S. Risse, U. Zeitner:
Verfahren und Anordnung zur interferometrischen Form- und Lageprüfung mehrerer funktionsrelevanter Optikflächen in einer gemeinsamen Anordnung
(DE 10 2014 117 511.5)

M. Gottschall, M. Baumgartl:
Vorrichtung und Verfahren zur Erzeugung von kurzen Strahlungspulsen
(PCT/EP 2014/073079)

N. Felde:
Beschichtung für eine Glasoberfläche, Verfahren zu deren Herstellung und Glaselement
(DE 10 2014 112 133.3)

N. Felde, L. Coriand, A. Duparré, P. Dannberg, G. Notni:
Mikrostrukturierte Oberfläche mit nanorauer Beschichtung für mechanisch stabile Funktionsflächen
(DE)

S. Nolte, S. Döring, A. Brahm, A. Willms, G. Notni:
Verfahren und System zur Erzeugung von breitbandigen Antireflexstrukturen für den Terahertz-Frequenz-Bereich
(DE 10 2014 200 742.9)

S. Schwinde, M. Schürmann, N. Kaiser:
Optisches Element mit einer reflektierenden Beschichtung
(DE 10 2014 108 679.1)

U. Zeitner, T. Paul, D. Hopp:
Gangfehlerkompensation bei polarisationsoptischer Winkelmessung
(DE)

PUBLICATIONS

Issuances

A. Tünnermann, G. Kalkowski, R. Eberhardt, S. Nolte:
Verfahren zum Lasergestützten Bonden, derart gebondete Substrate und deren Verwendung
(US 8,778,121 B2)

A. Tünnermann, T. Kämpfe, E.-B. Kley:
Dielektrische Pinhole zur Ortsfrequenzfilterung von Laserstrahlen
(DE 10 2004 058 044 B4)

C. Bruchmann, E. Beckert, T. Peschel, C. Damm:
Adaptiver deformierbarer Spiegel zur Kompensation von Fehlern einer Wellenfront
(US 8,708,508 B2)

C. Eckstein, U. Zeitner, W. Schmid:
Kantenemittierender Halbleiterlaser
(JP 5529151)

D. Nodop, J. Limpert, A. Tünnermann:
Faserverstärkersystem
(US 2014/0002893)

E.-B. Kley, F. Brückner, T. Clausnitzer:
Monolithischer dielektrischer Spiegel
(DE 10 2007 047 681)

E.-B. Kley, T. Kämpfe, A. Tünnermann:
Ortsfrequenzfiltervorrichtung und Verfahren zur Ortsfrequenzfilterung von Laserstrahlen
(DE 10 2004 058 044)

F. Fuchs, U. Zeitner:
Reflexionsbeugungsgitter und Verfahren zu dessen Herstellung
(DE 10 2012 103 443 B4)

J. Limpert, A. Tünnermann, D. Schimpf:
Vorrichtung zum Verstärken von Lichtimpulsen
(EP 2 324 543 B1; US 8,659,821B2)

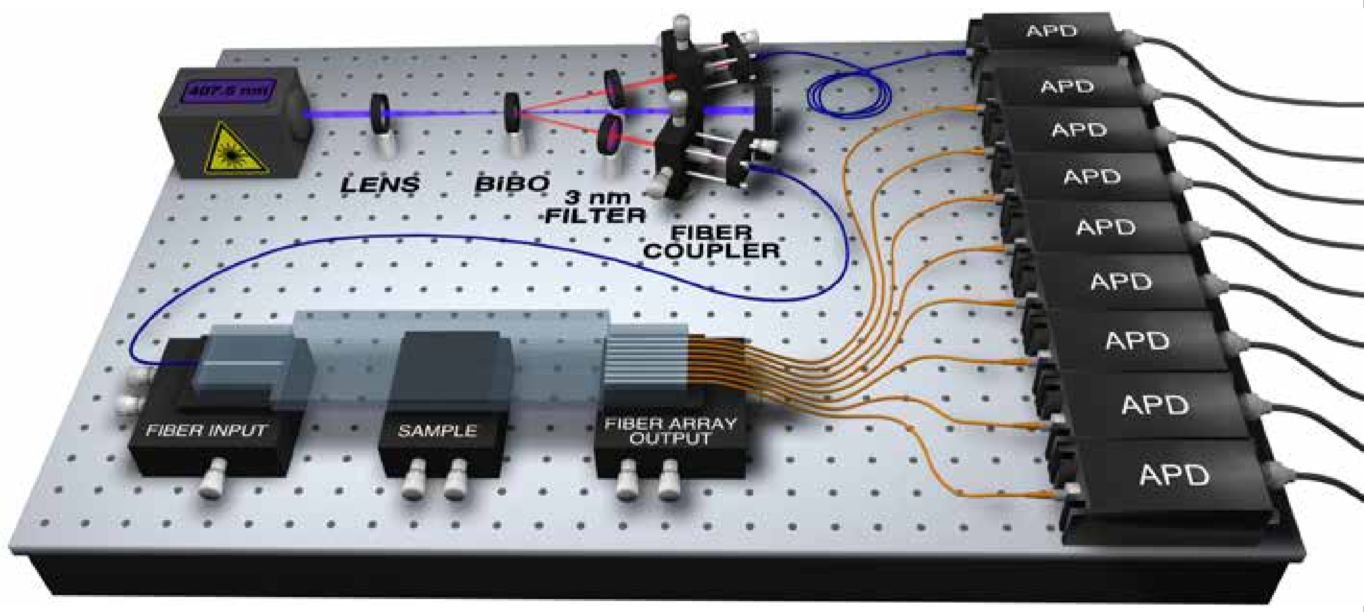
J. Limpert, A. Tünnermann, D. Schimpf, E. Seise, F. Röser:
Vorrichtung und Verfahren zum Verstärken von Lichtimpulsen
(US 8,760,753 B2)

J. Limpert, A. Tünnermann, E. Seise, T. Eidam, D. Schimpf, F. Röser:
Vorrichtung zum Verstärken und/oder Transportieren von elektromagnetischer Strahlung
(US)

J. Limpert, F. Stutzki, J. Cesar, J. Thomas, S. Nolte, C. Voigtländer, A. Tünnermann:
Transversalmodenfilter für Wellenleiter
(EP)

P. Kühmstedt, C. Bräuer-Burchardt, S. Zwick, A. Gebhardt, M. Beier:
Verfahren und Vorrichtung zur Messung der Position und Justage eines asphärischen Körpers
(DE 10 2012 023 377 B3)

S. Böhme, T. Peschel, R. Eberhardt, A. Tünnermann, J. Limpert:
Vorrichtung zum Bearbeiten von zylindrischen Werkstücken
(JP-5596021)



Schematic illustration of the experimental setup for testing the optical chip. With this, it should be possible later to create quantum computers.

Close interconnections and collaborative schemes with partners in science and industry have always contributed to IAP´s success. In 2014, Prof. T. Pertsch (ACP/IAP) and Prof. B. Eggleton (CUDOS) signed a Memorandum of Understanding between the ARC Center of Excellence CUDOS (Australia) and the Abbe Center of Photonics to add value along the whole chain of research and development of future photonic components supported by the partner´s complementary expertise.

ACTIVITIES

A key feature of the IAP is the active and engaged exchange of its employees within the scientific community. This commitment can be measured in both the participation at conferences and at cooperation in projects with other institutions. Such community projects are the fruits of compulsory networking and strengthen the reputation of the Institute within the research society and industrial associations. Appreciation of these efforts are also the call-ups of particular scientists in committees and editorial positions of academically approved journals.

Awards

Alexander Szameit
Rudolf-Kaiser-Preis 2014
Alexander Szameit
OSA Adolph Lomb Medal

Sven Breitkopf
Best Student Talk Award, OSA Confernce Advanced Solid State Lasers (ASSL) in Paris, France
“Non-steady-state enhancement cavities using pulse-dumping as power scaling concept of femtosecond lasers”
Student Award ICUIL Conference 2014 in Goa, India
“Approaching TW-Peak Powers at >10 kHz Repetition Rate by Temporal Combining of Femtosecond Fiber Lasers in a Stack and Dump Cavity”

Luisa Coriand
Foundation for Technology, Innovation and Research Thuringia (STIFT) Green Photonics Special Award Thuringia - Best Dissertation
„Entwicklung einer Mess- und Auswertemethodologie zur komplexen Charakterisierung der Struktur-Eigenschaftsbeziehung hydrophober und hydrophiler Funktionsflächen bis hin zur Superhydrophobie und zu Anti-Beschlageffekten“

Christian Gaida
Best Student Talk (1st Place), Photonics West 2014: “Fiber Lasers XI: Technology, Systems, and Applications (LASE)”
“Short-length Ge-pedestal large-pitch fiber”
Faculty Award, sponsored by Rohde & Schwarz - Best Master Thesis
" Peak power scaling of nanosecond pulses in thulium based fiber lasers"

Alexander Szameit receives the Rudolf-Kaiser-Award at a ceremony in the assembly hall of the Friedrich Schiller University.

Rachel Grange
Abbe Center of Photonics Research Alumni Fellow

Robert Keil
Doctoral Award of the Society of Friends and Supporters of the Friedrich Schiller University
"Quantum random walks in waveguide lattices"

César Jáuregui Misas
Abbe Center of Photonics Fellow for Teaching of Research
"Herausragendes persönliches Engagement als Tutor für die Studierenden des Masterprogramms Photonik"

Arno Klenke
Best Student Paper (1st Place), Photonics West 2014:
“Fiber Lasers XI: Technology, Systems, and Applications (LASE)”
“2.1mJ, 210W femtosecond fiber CPA system”

Marina Merker
Foundation for Technology, Innovation and Research Thuringia (STIFT) Green Photonics Special Award Thuringia - Best Bachelor Thesis
„Experimentelle Untersuchungen zur Durchtrennung des Glaskörpers mittels Femtosekundenlaser“

Sören Richter
Science Award for Application-oriented Theses of the Friedrich Schiller University, Category: Dissertation
„Fügen transparenter Werkstoffe mit ultrakurzen Pulsen“

ACTIVITIES

Organizing Activities

Rachel Grange

Referee for several scientific journals

Herbert Gross

Reviewer of the Baden-Württemberg Foundation

Reviewer for Carl Zeiss Foundation

Board of Trustees of Physics Journals

Program commitee for SPIE conference Optical Systems Design in Jena 2015

Referee for several international journals

E.-Bernhard Kley

Member of the Program Committee SPIE Photonics West Conference "Advanced Fabrication Technologies for Micro / Nano Optics and Photonics"

Referee for several scientific journals

Member of the Program Committee SPIE Photonics West Conference "High Contrast Metastructures"

Member of the GMM-Technical Committee meeting FA 4.7 Micro-Nano Integration

Jens Limpert

Member of the Program Committee SPIE Photonics West Conference "LASE 2014"

Member of the Program Committee High-Power, High-Energy, and High-Intensity Laser Technology

Member of the Program Committee International Ultrafast Optics Conference

Referee for several scientific journals

Stefan Nolte

Conference Chair of the SPIE Photonics West Conference "Frontiers in Ultrafast Optics: Biomedical, Scientific and Industrial Applications (LASE)"

Person responsible for EU-US Atlantis Program, Cooperation in higher Education and Training, „MILMI“ - International Master Degree in Laser, Material Science and Interaction, Univ. BORDEAUX (France), FSU Jena, Univ. Central Florida und Clemson Univ. (USA)

Chair of the Faculty´s Budget Commission and member of the Budget Board of the Senate

Member Optical Society of America (OSA)

Member of Deutsche Physikalische Gesellschaft (DPG)

Member of Scientific Committee “Lasers in Manufacturing (LIM)”, 2015

Member of SPIE

Coordinator of the BMBF Association "Ultrashort Pulse Laser for High Precision Machining"

Referee for several scientific journals

Member of jury “Jugend forscht”

Thomas Pertsch

Vice Dean of the Faculty

Council member of the Faculty

Director of the Abbe Center of Photonics and member of its Executive Board

Spokesman of the Abbe School of Photonics

Spokesman of the research initiative "Photonic Nanomaterials PhoNa"

Coordinator of the study progam "Master of Science in Photonics"

Fellow of the Optical Society of America

Referee for several international journals

Member of conference program committees: EUPROMETA doctoral school on "Photonic nanostructures and metamaterials," Jena, Germany, 2014 / OSA Optics & Photonics Congress: Advanced Photonics, Barcelona, 2014

Local coordinator of Erasmus Mundus Program – NANOPHI – Nonlinear Nanophotonics

Andreas Tünnermann

Council member of the Faculty

Member of program committee „Optische Technologien“, BMBF

Member of the technical council Fraunhofer Gesellschaft

Member of the steering committee Fraunhofer Gesellschaft

Member of the VDI / VDE-GMA Advisory Board FB 8 "Optical Technologies of the Society for Measurement and Automation"

Board of trustees MPA, Heidelberg

Board of trustees IOM, Leipzig

Board of trustees MPQ, Garching

Chairman „AG Naturwissenschaften“, Wissenschaftliche Gesellschaft Lasertechnik

Member of acatech „Deutsche Akademie der Technikwissenschaften“

Editor Applied Physics B

Member of Honor „International Society of Optics and Photonics SPIE“

Stakeholder Photonics 21-Plattform

Spokesman Abbe Center of Photonics, FSU Jena

Member of the executive Board OptoNet e. V.

Referee for several scientific journals

Frank Schrempel

Coordinaton of the IAP at the Beutenberg Campus e.V.

Member of the Faculty Board

Referee for several scientific journals

Alexander Szameit

Program committee for CLEO/QELS conference FS5: Nonlinear optics and novel phenomena

Member Optical Society of America (OSA)

Member of Deutsche Physikalische Gesellschaft (DPG)

Referee for several scientific journals, including Nature, Nature Photonics, and Nature Physics

Frank Wyrowski

Visiting Professor at the Chinese Academy of Science, China

Visiting Professor at the Institute of Technology (HIT), China

Conference Co-Chair: SPIE Conference on Optical Modelling and Design

Member of the Technical Program Committee SPIE Conference on Optics and Photonics for Information Processing

Member of the Technical Program Committee: SPIE Conference on Modelling Aspects in Optical Metrology

Member of the Technical Program Committee: OSA Conference on Digital Holography and Three-Dimensional Imaging

Member of the Technical Program Committee: EOS Topical Meeting on Diffractive Optics

Referee for several scientific journals

Study Advisor of the Fakulty od Physics and Astronomy

President of the LightTrans GmbH

President of Wyrowski Photonics UG

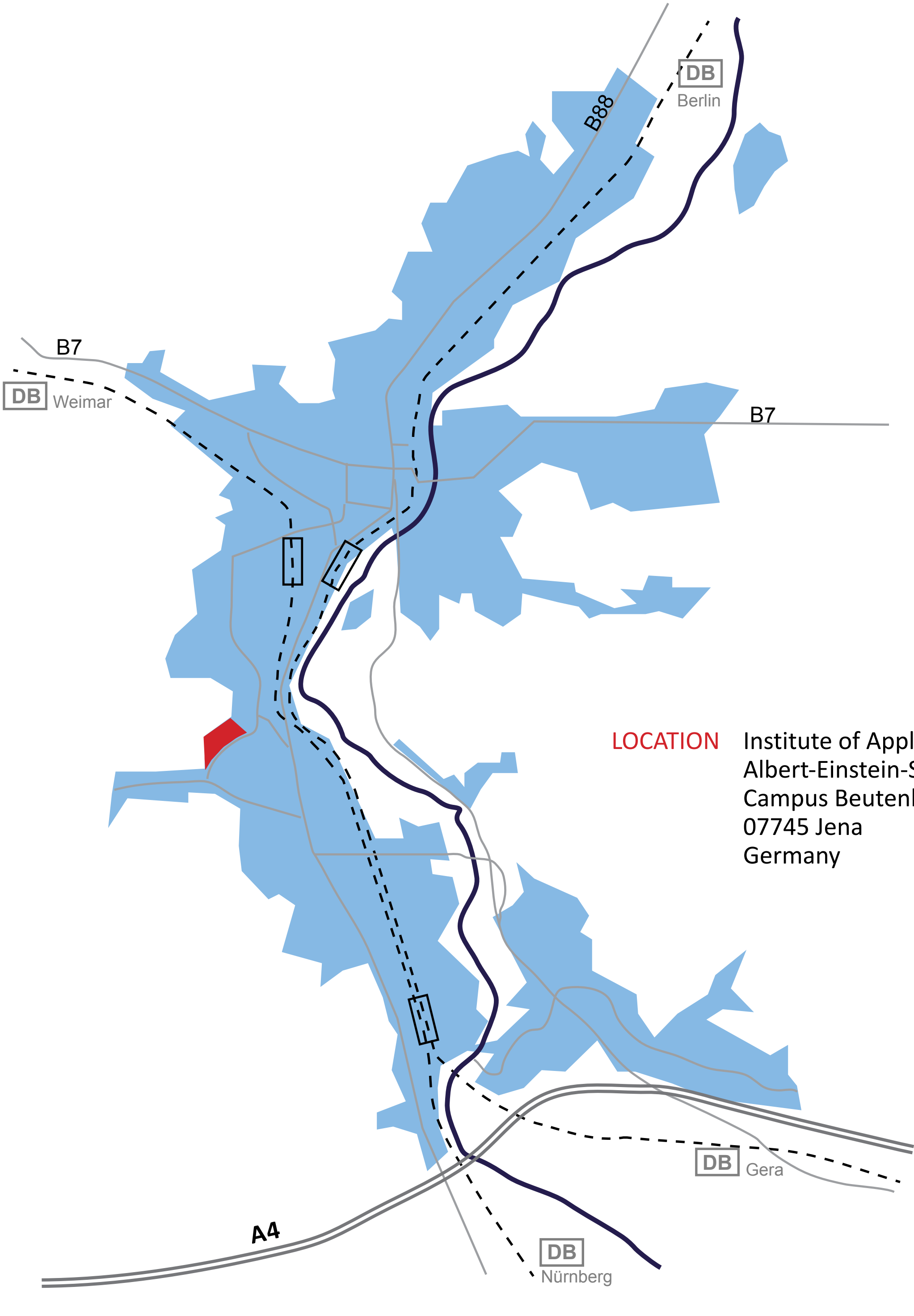
Uwe D. Zeitner

Organizer of the Workshop “Centre for Innovation Competence ultra optics”

Member of the Program Committee EOS

Topical Meeting “Diffractive Optics”, part of EOS Annual Meeting 2014

Referee for several scientific journals



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