AES 2024 Rome - Italy

The 10th International Conference on Antennas and Electromagnetic Systems

June 25 – 28, 2024
Rome - Italy

Program Booklet

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The 10th International Conference on Antennas and Electromagnetic Systems

Edited by

Stefan Wabnitz | Sapienza Università di Roma, Italy
Said Zouhdi | Paris-Saclay University, France

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The world most important university rankings place Sapienza at the national top for quality of research, education and international dimension ; moreover, Sapienza excels and leads as a benchmark in many subject areas.

Université Paris-Saclay is a research university based in Paris, France. Université Paris-Saclay offers a comprehensive and varied range of Undergraduate, Master's and PhD degrees, renowned internationally thanks to the University's reputation for research excellence and the commitment of its academic staff. The University's constituent faculties, institutes and component institutions all contribute to the curricula with cutting-edge specialised courses in Science and Engineering, Life Sciences and Health, and Social Sciences and Humanities.
Université Paris-Saclayis ranked 1st in France and 16th in the world according to the Academic Ranking of World Universities (ARWU).

DIET the Department of Information Engineering, Electronics and Telecommunications was established on 1st of July 2010 by joining the former Department of Electronic Engineering and the Department of Information Science and Technique (known with its acronym INFOCOM) in the frame of reorganization of Sapienza University. Research at DIET is carried out in the frame of several national and international projects focussed on the development of both cabled and wireless transmission systems and networks, radar systems, remote sensing systems, electronic measurements, sensors, multimedia and bioengineering applications.

AEM - Advanced Electromagnetics is a free, peer-reviewed, Gold Open Access journal. It covers recent international research results in the general field of Electromagnetic Waves, Antennas and Propagation. Authors of articles published in Advanced Electromagnetics retain the copyright of their articles and are free to reproduce and disseminate their work (under a Creative Commons Attribution License). AEM is widely indexed and has a Scopus CiteScore of 2.3 (2023).

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The IEEE Antennas and Propagation Society (AP-S) strives for advancement of the theory and practice of electrical and electronics engineering. The field of interest includes analysis, design, measurement and testing of antennas, radiation, propagation, and the interaction of electromagnetic waves with various applications.

IEEE AP-S Young Professionals is a vibrant group with various activities to encourage young professionals to pursue research in antennas and propagation as well as nurture them to be future leaders of AP Society. Learn more about IEEE AP-S Young Professionals at :
https ://ieeeaps.org/committees/yp.

PLENARY SPEAKERS

Andrea Alù

City University of New York, USA

Extreme Wave Control with Space-Time Metamaterials

Andrea Alù is a Distinguished Professor at the City University of New York (CUNY), the Founding Director of the Photonics Initiative at the CUNY Advanced Science Research Center, and the Einstein Professor of Physics at the CUNY Graduate Center. He received his Laurea (2001) and PhD (2007) from the University of Roma Tre, Italy, and, after a postdoc at the University of Pennsylvania, he joined the faculty of the University of Texas at Austin in 2009, where he was the Temple Foundation Endowed Professor until Jan. 2018. Dr. Alù is a Fellow of the National Academy of Inventors (NAI), the American Association for the Advancement of Science (AAAS), the Institute of Electrical and Electronic Engineers (IEEE), the Materials Research Society (MRS), Optica, the International Society for Optics and Photonics (SPIE) and the American Physical Society (APS). He is the President of Metamorphose, a Highly Cited Researcher since 2017, a Simons Investigator in Physics, the director of the Simons Collaboration on Extreme Wave Phenomena Based on Symmetries, and the Editor in Chief of Optical Materials Express. He has received several scientific awards, including the NSF Alan T. Waterman award, the Blavatnik National Award for Physical Sciences and Engineering, the IEEE Kiyo Tomiyasu Award, the ICO Prize in Optics, the OSA Adolph Lomb Medal, and the URSI Issac Koga Gold Medal.

Extreme Wave Control with Space-Time Metamaterials
Metamaterials offer a powerful platform to manipulate wave propagation and gain control over waves, from radio-frequencies to light and sound. In this talk, I will discuss our recent progress in developing new metamaterial technologies, introducing time as an additional dimension for wave control.

Alexandra Boltasseva

Purdue University, USA

Tailorable Materials for Dynamic Photonics : From Metasurfaces to New Physical Phenomena

Alexandra Boltasseva is a Professor at the School of Electrical and Computer Engineering at Purdue University. She received her PhD in electrical engineering at Technical University of Denmark, DTU in 2004. Boltasseva specializes in nanophotonics, nanofabrication, optical materials, plasmonics and metamaterials. She is 2018 Blavatnik National Award for Young Scientists Finalist and received the 2013 IEEE Photonics Society Young Investigator Award, 2013 Materials Research Society (MRS) Outstanding Young Investigator Award, the MIT Technology Review Top Young Innovator (TR35), the Young Researcher Award in Advanced Optical Technologies from the University of Erlangen-Nuremberg, Germany, and the Young Elite-Researcher Award from the Danish Council for Independent Research. She is a Fellow of the Optical Society of America (OSA) and Fellow of SPIE. She served on MRS Board of Directors and is Editor-in-Chief for OSA's Optical Materials Express.

Tailorable Materials for Dynamic Photonics : From Metasurfaces to New Physical Phenomena
Transparent conducting oxides and transition metal nitrides have attracted attention for photonic applications as they exhibit enhanced light-matter interactions, particularly in their metallic/plasmonic regime and near the so-called epsilon near zero (ENZ) region. Here, we explore the static and dynamic tailorability and tunability of optical properties in TCOs and TMNs.

Stefano Maci

University of Siena, Italy

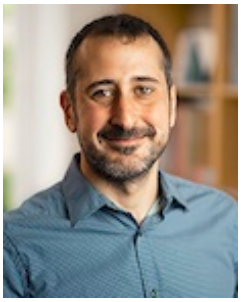
The New Generation of Metasurface Antennas

Stefano Maci received the Laurea Degree cum Laude at University of Florence in 87 and from '97 is a Professor at the University of Siena. His research interest includes high-frequency and beam representation methods, computational electromagnetics, large phased arrays, planar antennas, reflector antennas and feeds, metamaterials and metasurfaces. Since 2000 he was member the Technical Advisory Board of 12 international conferences, member of the Review Board of 6 International Journals. He organized 25 special sessions in international conferences, and he held 10 short courses in the IEEE Antennas and Propagation Society (AP-S) Symposia about metamaterials, antennas and computational electromagnetics. In 2004-2007 he was WP leader of the Antenna Center of Excellence (ACE, FP6-EU) and in 2007-2010 he was International Coordinator of a 24-institution consortium of a Marie Curie Action (FP6). He has been Principal Investigator from 2010 of 6 cooperative projects financed by European Space Agency. In 2004 he was the founder of the European School of Antennas (ESoA), a post graduate school that presently comprises 34 courses on Antennas, Propagation, Electromagnetic Theory, and Computational Electromagnetics and 150 teachers coming from 15 countries. Since 2004 is the Director of ESoA.

Professor Maci is IEEE Fellow since 2004, he has been a former member of the AdCom of IEEE Antennas and Propagation Society (AP-S), associate editor of AP-Transaction, Chair of the Award Committee of IEEE AP-S, and member of the Board of Directors of the European Association on Antennas and Propagation (EurAAP). From 2008 to 2015 he has been Director of the PhD program in Information Engineering and Mathematics of University of Siena, and from 2013 to 2015 he was member of the National Italian Committee for Qualification to Professor. He has been former member of the Antennas and Propagation Executive Board of the Institution of Engineering and Technology (IET, UK). He is presently the director of the consortium FORESEEN, presently involving 48 European Institutions, and principal investigator of the Future Emerging Technology project "Nanoarchitectronics" of the 8th EU Framework program. He was co-founder of 2 Spin-off Company. He is a Distinguished Lecturer of the IEEE Antennas and Propagation Society (AP-S), and recipient of the EurAAP Award in 2014, of the IEEE Shelkunoff Transaction Prize 2015, and of the Chen-To Tai Distinguished Educator award 2016. In 2020 will be TPC Chair of the METAMATERIAL conference. In the last ten years he has been invited 25 times as key-note speaker in international conferences. The research activity of Professor Maci is documented in 150 papers published in international journals, (among which 100 on IEEE journals), 10 book chapters, and about 400 papers in proceedings of international. These papers have received around 6800 citations with h index 41.

The New Generation of Metasurface Antennas

This presentation will focus on the control of surface waves, showcasing examples such as the design of high-gain, low cross-polarization antennas, multibeam antennas, and scanning beam flat lenses. Emphasis will be given to space applications. The presentation will also concern the third generation of adaptive metasurfaces (MTSs).



Oscar Quevedo-Teruel

KTH Royal Institute of Technology, Sweden

Geodesic Lens Antennas for 5G/6G and Satellite Communications

Oscar Quevedo-Teruel received his Telecommunication Engineering and Ph.D. Degrees from Carlos III University of Madrid, Spain in 2005 and 2010. From 2010-2011, he joined the Department of Theoretical Physics of Condensed Matter at Universidad Autonoma de Madrid as a research fellow and went on to continue his postdoctoral research at Queen Mary University of London from 2011-2013. In 2014, he joined the KTH Royal Institute of Technology (Stockholm, Sweden), where he is presently a Full Professor in the Division of Electromagnetic Engineering and Fusion Science. He is also the Responsible for the Antenna Laboratory and Director of the Master Programme in Electromagnetics Fusion and Space Engineering.

He was an Associate Editor of the IEEE Transactions on Antennas and Propagation (IEEE TAP) since 2018-2022, and he acts as Track Editor in IEEE TAP since 2022. He was a distinguished lecturer of the IEEE Antennas and Propagation Society for the period of 2019-2022. He is an IEEE Fellow for his contributions to glide symmetry based metasurfaces and lens antennas. He has been a member of the European Association on Antennas and Propagation (EurAAP) Board of Directors since January 2021. Since January 2022, he is the vice-chair of EurAAP. He is the co-author of more than 140 papers in international journals and more than 240 at international conferences.

Geodesic Lens Antennas for 5G/6G and Satellite Communications

In this talk, we present the development of massive MIMO antenna technologies for the emerging 6G and associated challenges. The overall system performance and antenna design-choice in terms of spectrum and channel propagation properties are discussed. We explore the centimeter wave spectrum for the 6G massive MIMO. The candidate frequency range is from 7GHz to 15GHz, we discuss the new propagation properties and ultra-large antenna element array architecture, namely, the 1K-element-array paradigm for both base-station and user-equipment.

KEYNOTE SPEAKERS

Che Ting Chan

HKUST, Hong Kong

Scalar wave solutions to a 3D electromagnetic vector wave problem

Che Ting Chan received his PhD degree from the University of California at Berkeley in 1985. He is currently serving as the Associate Vice-President for Research and Development at HKUST. He is also concurrently the Daniel C K Yu Professor of Science, Chair Professor of Physics, and the Director of Research Office of HKUST. He has been elected a Fellow of the American Physical Society and the Physical Society of Hong Kong and a member of the Hong Kong Academy of Sciences.

Scalar wave solutions to a 3D electromagnetic vector wave problem
We showed that some 3D photonic crystals have scalar-wave-like band dispersions. These crystals feature topological surface states with high-Q within the light cone continuum. As such, the surface states in our 3D nested crystals can be exposed directly to air, making such systems well-suited for practical applications.

Tommaso Isernia

Università Mediterranea di Reggio Calabria, Italy

A X-Words Play into 2-D Phase Retrieval Problems

Tommaso Isernia is a Full Professor of Electromagnetic Fields at Università Mediterranea di Reggio Calabria (Italy) where he leads the "LEMMA" Group, ranked amongst the best research groups in Italy according to the last national evaluation of the quality of research (all "class A" products). From October 2018 to January 2023 he has been the Head of "Dipartimento di Ingegneria dell'Informazione, delle Infrastrutture e della Energia Sostenibile" (DIIES), which has been included in the restricted list of "Dipartimenti di eccellenza" by the Italian Ministry for Research. The scientific activities of Tommaso Isernia have considered non linear inverse scattering problems in electromagnetics, with particular reference to the problem of the possible occurrence of false solutions when solving the considered non-linear retrieval problems. He is an IEEE Fellow since 2022 for contributions to Antenna Synthesis and inverse scattering solution methods. Main research results include definitive solution procedures for a number of antenna synthesis problems, for the 2D phase retrieval problem, as well as the introduction of a number of effective approaches for the solution of inverse scattering problems.

A X-Words Play into 2-D Phase Retrieval Problems

Phase retrieval is a challenging problem of interest in very many electromagnetic problems. We report about a recent approach, emulating the solution of crosswords puzzles, which, opposite to common schemes, is able to use a single set of data, and still avoid false solutions.

Mona Jarrahi

University of California Los Angeles, USA

Chip-scale terahertz optoelectronics

Mona Jarrahi is a Professor of Electrical and Computer Engineering at the University of California Los Angeles. She has made significant contributions to the development of ultrafast electronic and optoelectronic devices and integrated systems for terahertz, infrared, and millimeter-wave sensing, imaging, computing, and communication systems by utilizing novel materials, nanostructures, and innovative plasmonic concepts. Her scientific achievements have been recognized by several prestigious awards including the Presidential Early Career Award for Scientists and Engineers ; Friedrich Wilhelm Bessel Research Award from Alexander von Humboldt Foundation ; Moore Inventor Fellowship from the Gordon and Betty Moore Foundation ; Kavli Fellowship by the USA National Academy of Sciences, Grainger Foundation Frontiers of Engineering Award from the USA National Academy of Engineering ; Breakthrough Award from Popular Mechanics Magazine ; Research Award from Okawa Foundation ; Early Career Award in Nanotechnology from the IEEE Nanotechnology Council ; Outstanding Young Engineer Award from the IEEE Microwave Theory and Techniques Society ; Booker Fellowship from the USA National Committee of the International Union of Radio Science ; Lot Shafai Mid-Career Distinguished Achievement Award from the IEEE Antennas and Propagation Society ; Early Career Award from the USA National Science Foundation ; Young Investigator Awards from the USA Office of Naval Research, the Army Research Office, and the Defense Advanced Research Projects Agency. Prof. Jarrahi is a Fellow of IEEE, OSA and SPIE societies and has served as a distinguished lecturer of IEEE, traveling lecturer of OSA, and visiting lecturer of SPIE societies.

Chip-scale terahertz optoelectronics

We introduce a new scheme for realizing chip-scale terahertz optoelectronics, enabling the scalable implementation of complex terahertz imaging, spectroscopy, and communication systems through a compact platform.

Yongmin Liu

Northeastern University, USA

Accelerating Photonic Design by Deep Learning

Yongmin Liu obtained his Ph.D. from the University of California, Berkeley in 2009. He joined the faculty of Northeastern University in Boston in fall 2012, and currently he is an associate professor in the Department of Mechanical and Industrial Engineering and the Department of Electrical and Computer Engineering. Dr. Liu's research interests include nano optics, nanoscale materials and engineering, plasmonics, metamaterials/metasurfaces, biophotonics, and artificial intelligence for photonic design. He has authored and co-authored more than 120 journal papers, including Science, Nature, Nature Photonics, Nature Nanotechnology, Advanced Materials, Physical Review Letters and Nano Letters. Dr. Liu was a recipient of NSF CAREER Award, Office of Naval Research Young Investigator Award, SPIE DCS Rising Researcher Award, 3M Non-Tenured Faculty Award, as well as the Faculty Fellow of College of Engineering and Søren Buus Outstanding Research Award at Northeastern University. He has served as an editorial board member for Nano Convergence, PhotoniX, EPJ Applied Metamaterials, and Scientific Reports. He is a Fellow of Optica (formerly OSA) and SPIE.

Accelerating Photonic Design by Deep Learning

Deep learning is instrumental in computational electromagnetics as it excels at capturing intricate patterns and complex relationships within vast datasets, enabling more efficient and accurate modeling of electromagnetic phenomena. This capability is particularly beneficial in photonics design, leading to the discovery of innovative and optimized configurations for desired functionalities.

Junsuk Rho

POSTECH, Korea

Low-cost and scalable manufacturing of optical metasurfaces in the visible using engineering optical materials

Junsuk Rho is a Mu-Eun-Jae Endowed Chair Professor at Pohang University of Science and Technology (POSTECH), Korea, with a double appointment in the Department of Chemical Engineering and the Department of Mechanical Engineering. He received his Ph.D. at the University of California, Berkeley (2013), M.S. at the University of Illinois, Urbana-Champaign (2008) and B.S. at Seoul National University, Korea (2007) all in Mechanical Engineering. Prior joining POSTECH, he conducted postdoctoral research in Materials Sciences Division and Molecular Foundry at Lawrence Berkeley National Laboratory, and also worked as a principal investigator (Ugo Fano Fellow) in Nanoscience and Technology Division and the Center for Nanoscale Materials at Argonne National Laboratory.

Prof. Rho has authored and co-authored more than 300 high-impact journal papers including Science, Nature, Nature Nanotechnology, Nature Materials, Nature Photonics and Chemical Reviews. He is also the recipients of several notable honors and awards such as Samsung Lee Kun-Hee fellowship (2008-2013), US Department of Energy Argonne Named fellowship (2013-2016), Korean Presidential Early Career Award for Scientists and Engineers (2019), Springer-Nature MINE Young Scientist Award (2020), Elsevier MEE/MNE Young Investigator Award and Lectureship (2020), MDPI Micromachines Young Investigator Award (2020), Member of the Young Korean Academy of Science and Technology (2020), Associate Member of the National Academy of Engineering of Korea (2022), NAEK Young Engineers Award (2022), Hong Jin-Ki Creator Award (2022), Fulbright Visiting Scholar Fellowship (2022), Simpson Fellowship (2022) and Eshbach Fellowship (2023), Clarivate Highly Cited Researcher (2023). He serves 14 editorial positions including Light : Science and Applications (Springer-Nature), Microsystems and Nanoengineering (Springer-Nature), npj Nanophotonics (Springer-Nature) and Nanophotonics (De Gruyter).

Low-cost and scalable manufacturing of optical metasurfaces in the visible using engineering optical materials

Here, we demonstrate low-cost, scalable manufacturing of optical metasurfaces with three approaches : increasing a refractive index of resin with dielectric particle embedding for single-step nanoimprinting, 2) suppressing optical losses of hydrogenated amorphous silicon (a-Si :H) to apply complementary-metal-oxide-semiconductor technologies, and 3) high-index atomic layer deposited (ALD) structural resin.

Vladimir M. Shalaev

Purdue University, USA

Extreme Space-Time Optics and Quantum Meta-Photonics

Vladimir M. Shalaev, Scientific Director for Nanophotonics at Birck Nanotechnology Center and Distinguished Professor of Electrical and Computer Engineering at Purdue University, specializes in nanophotonics, plasmonics, and optical metamaterials. Vladimir M. Shalaev has received several awards for his research in the field of nanophotonics and metamaterials, including the Max Born Award of the Optical Society of America for his pioneering contributions to the field of optical metamaterials, the Willis E. Lamb Award for Laser Science and Quantum Optics, IEEE Photonics Society William Streifer Scientific Achievement Award, Rolf Landauer medal of the ETOPIM (Electrical, Transport and Optical Properties of Inhomogeneous Media) International Association, the UNESCO Medal for the development of nanosciences and nanotechnologies, OSA and SPIE Goodman Book Writing Award. He is a Fellow of the IEEE, APS, SPIE, MRS and OSA. Prof. Shalaev has authored three books, thirty invited book chapters and over 500 research publications.

Extreme Space-Time Optics and Quantum Meta-Photonics

We discuss all-optical modulation with single photons using electron avalanche, resulting in record-high nonlinearities. Then we show that transparent conducting oxides (TCOs) operating in the near-zero index regime can provide strong single-cycle modulation, enabling novel photonic time crystals. Finally, we discuss scalable quantum photonics with single-photon emitters in silicon nitride.

David R. Smith

Duke University, USA

Large-Area, Reconfigurable Metasurface Apertures for Synthetic Aperture Radar and Other Applications

David R. Smith is the James B. Duke Distinguished Professor of the Electrical and Computer Engineering Department at Duke University, where he also serves as Director for the Center for Metamaterial and Integrated Plasmonics. Dr. Smith is also the Founding Director of the Metamaterials Commercialization Center at Intellectual Ventures in Bellevue, Washington. Dr. Smith received his Ph.D. in 1994 in Physics from UCSD. Dr. Smith's research interests include the theory, simulation and characterization of unique electromagnetic structures, including photonic crystals, metamaterials and plasmonic nanostructures. Smith and his colleagues demonstrated the first left-handed (or negative index) metamaterial at microwave frequencies in 2000, and also demonstrated a metamaterial "invisibility cloak" in 2006. In 2005, Dr. Smith was part of a five-member team that received the Descartes Research Prize, awarded by the European Union, for their contributions to metamaterials and other novel electromagnetic materials. In 2006, Dr. Smith was selected as one of the "Scientific American 50." Since 2009, Dr. Smith has continually been named a "Citation Laureate" by ISI Web of Knowledge for having among the most number of highly cited papers in the field of Physics. Dr. Smith is a co-recipient of the McGroddy Prize for New Materials, awarded by the American Physical Society, for "the discovery of metamaterials" (2013). In 2016, Dr. Smith was elected to the National Academy of Inventors. Dr. Smith has recently been active in transitioning metamaterial concepts for commercialization, being a co-founder of Evolv Technology, Echodyne Corporation, Pivotal Commware, and advisor to Kymeta Corporation—all companies devoted to developing metamaterial products.

Large-Area, Reconfigurable Metasurface Apertures for Synthetic Aperture Radar and Other Applications

Metasurfaces are an excellent fit for large-area, reconfigurable apertures due to their use of passive tuning components rather than the active (externally powered) phase shifters and amplifiers integrated into traditional phased arrays. We discuss the advantages of metasurfaces for extremely large, reconfigurable antennas in the context of space-based systems.

Marin Soljačić

MIT, USA

Nanophotonic scintillators and various topics in AI for topology

Marin Soljačić is a Professor of Physics at MIT. He is a founder of a few companies, including WiTricity Corporation (2007) and Lightelligence (2017). His main research interests are in artificial intelligence as well as electromagnetic phenomena, focusing on nanophotonics, non-linear optics, and wireless power transfer. He is a co-author of more than 300 scientific articles, more than 100 issued US patents, and he has been invited to give more than 100 invited talks at conferences and universities around the world. He is a recipient of the Adolph Lomb medal from the Optical Society of America (2005), and the TR35 award of the Technology Review magazine (2006). In 2008, he was awarded a MacArthur fellowship “genius” grant. He is an international member of the Croatian Academy of Engineering since 2009. In 2011 he became a Young Global Leader (YGL) of the World Economic Forum. In 2014, he was awarded Blavatnik National Award, as well as Invented Here ! (Boston Patent Law Association). In 2017, he was awarded "The Order of the Croatian Daystar, with the image of Ruđer Bošković", the Croatian President’s top medal for Science. In 2017, the Croatian President also awarded him with "The Order of the Croatian Interlace" medal. He was a Highly Cited Researcher according to WoS for 2019, 2020, 2021, 2022 and 2023. In 2023, he was awarded Max Born award of Optica.

Nanophotonic scintillators and various topics in AI for topology

Nanophotonic methods provide intriguing options for manipulating scintillation phenomena. We will outline recent developments in this domain, along with our general theoretical framework for modeling these occurrences, supported by our experimental findings. We will also cover novel numerical techniques for discovery of topological phenomena in photonics.

Jelena Vuckovic

Stanford University, USA

Scalable semiconductor photonic systems

Jelena Vuckovic (PhD Caltech 2002) is the Jensen Huang Professor in Global Leadership in the School of Engineering, and Professor of Electrical Engineering and by courtesy of Applied Physics at Stanford, where she leads the Nanoscale and Quantum Photonics Lab. She is also the Fortinet Founders Chair of the Electrical Engineering Department at Stanford, and was the inaugural director of Q-FARM, the Stanford-SLAC Quantum Science and Engineering Initiative. Vuckovic has received many awards and honors including recently the Vannevar Bush Faculty Fellowship (2022), the Mildred Dresselhaus Lectureship from MIT (2021), the James Gordon Memorial Speakership from the OSA (2020), the IET A. F. Harvey Engineering Research Prize (2019), Distinguished Scholarship of the Max Planck Institute for Quantum Optics (2019), the Hans Fischer Senior Fellowship from the Institute for Advanced Studies in Munich (2013), and Humboldt Prize (2010). She is a Fellow of the APS, of the Optica (OSA), and of the IEEE, and an associate editor of the ACS Photonics.

Scalable semiconductor photonic systems

Recent breakthroughs in photonics design, along with new nanofabrication approaches and heterogeneous integration play crucial roles in building photonics for applications including optical interconnects and quantum technologies.

TUTORIALS

Lorenzo Crocco

National Research Council, Italy

Wednesday 26th June
14:00 - 15:00 — Room1

Virtual experiments and alternative formulations for effective solution of inverse scattering problems

Lorenzo Crocco is a Research Director at the Institute for the Electromagnetic Sensing of the Environment, National Research Council of Italy (IREA-CNR), Naples. His scientific interests mainly concern electromagnetic scattering, with a focus on diagnostic and therapeutic uses of EM fields, non-invasive electromagnetic inspections, through-the-wall radar and GPR. On these topics, he has published more than 120 papers, given keynote talks and lectures, and led or participated to national and international research projects. He is associate editor for the IEEE Journal of Electromagnetics, RF and Microwaves in Medicine and Biology (IEEE J-ERM) and has edited two books on medical electromagnetic technologies. He is member of the board for the European School of Antennas (ESOA), member of the Scientific Board of the Italian Electromagnetic Society (SIEm) and a member of the Italian URSI Commission (International Union of Radio Science). Since 2019, he is member of the Scientific Board of the Engineering Department (DIITET) of CNR. Since 2024, he has been elected in the EurAAP Delegate Assembly (Delegate Group 3 : Italy, San Marino, Vatican City). Dr. Crocco is a fellow of the Electromagnetic Academy (TEA) and a URSI Senior Member.

Virtual experiments and alternative formulations for effective solution of inverse scattering problems

Description : Electromagnetic inverse scattering problems are one of the most exciting topics in applied electromagnetics, due to the broad range of applications in which they are involved and the methodological challenges they pose. In this tutorial, an overview of the difficulties inherent to the non-linear and ill-posed nature of the inverse scattering problems will be given first. Then, some recent results aiming at addressing the challenges posed by the non-linearity will be reviewed. The focus will be on the use of alternative formulations of the basic equations and on the virtual experiments framework, which allow to deal with “simpler” problems by means of simple – but tailored - manipulations of the scattering equations and of the data, respectively.

GUIDELINES FOR PRESENTERS

Oral Presentations

Each session room is equipped with a stationary computer connected to a LCD projector. Presenters must load their presentation files in advance onto the session computer. Technician personnel will be available to assist you.

Scheduled time slots for oral presentations are 15 mn for regular, 20 mn for invited presentations, 30 mn for keynote talks and 35 mn for plenary talks, including questions and discussions. Presenters are required to report to their session room and to their session Chair at least 15 minutes prior to the start of their session.

The session chair must be present in the session room at least 15 minutes before the start of the session and must strictly observe the starting time and time limit of each paper.

Poster Presentations

Presenters are requested to stand by their posters during their session. One poster board, A0 size (118.9 x 84.1 cm), in portrait orientation, will be available for each poster. Pins or thumbtacks are provided to mount your posters on the board. All presenters are required to mount their papers 30mn before the session and remove them at the end of their sessions. Posters must prepared using the standard AES poster template (available on the conference website).

USEFUL INFORMATION

Venue

AES 2024 will be held at :
Faculty of Civil and Industrial Engineering, Sapienza University of Rome
Via Eudossiana 18, 00184 Rome (Italy)

https://www.ing.uniroma1.it/

Housed in the former convent of San Pietro in Vincoli, the Faculty is positioned on the Esquiline Hill, offering breathtaking views of the Colosseum and the Imperial Forum. It is adjacent to the Basilica di San Pietro in Vincoli (St Peter in Chains), which houses one of Michelangelo's magnificent sculptures, the tomb of pope Julius II, including the marble statue of Moses (1513-1515).

Getting to Venue

How to reach the venue

The site is less than 20 minutes walking distance from Roma Termini rail Station and a few minutes walking distance from the metro stations of “Cavour” and “Colosseo” (Blue line B).

How to reach Rome

Rome is served by two airports : Leonardo Da Vinci Airport (also known as Fiumicino Airport) and G. B. Pastine Airport (also known as Ciampino Airport).

Arriving at Fiumicino Airport

Leonardo Da Vinci is the main italian hub and it has direct flights to more than 200 destinations, including all the european capitals and major european cities, major cities of the US, Canada, Brazil, Mexico, Japan, Middle-east and Asia.

Train “Leonardo Express” (see here for further information) that has a direct connection to Rome Termini Station (Rome main railways station), where you can take the underground Line A (direction Anagnina), exit to Manzoni station and then walk for some meters (approximately 45 min). The train schedule is frequent and the entire trip takes around 30 minutes, tickets can be bought near the train departure site at the airport. Leonardo Da Vinci Airport is connected to Rome also by frequent busses.

Arriving at Ciampino Airport

G. B. Pastine Airport is a smaller airport used mainly by low cost companies, it has connections to many european cities. Terravision shuttle bus from Ciampino Airport to Rome Termini Station (Rome main railways station) where you can take the underground Line A (direction Anagnina), exit to Manzoni station and then walk for some meters (the time depends on the traffic, because Rome is a city with a lot of traffic, but approximately 60 min).

Taxi

The official cabs of the City of Rome are white, with the word “TAXI” on the roof and the symbol of the City of Rome and the license number clearly visible on the doors. You will find cabs both at Terminal 1 and Terminal 3 arrivals at Fiumicino Airport.

From Fiumicino airport to Rome Center, i.e. inside the Aurelian Walls (including Rome Termini station), and back there is a fixed cost rate of €50,00.

If you intend to reach Fiumicino airport by cab from Rome, know that all trips departing from inside the Grande Raccordo Anulare, can not and will never exceed the amount of €73,00.

From Ciampino airport to Rome Center, i.e. inside the Aurelian Walls (including Rome Termini station), and back there is a fixed cost rate of €31,00.

TECHNICAL PROGRAM

Monday 24th June, 2024

Registration

Reception Desk

15:00 - 17:30

Tuesday 25th June, 2024

Registration

Reception Desk

08:00 - 17:30

Opening Address

Room 38

08:45 - 09:00

09:00 - 10:10 — Room 38

Session 1A1

Plenary Session I

Chaired by: Stefano Maci

09:00 : Plenary talk
Tailorable Materials for Dynamic Photonics: From Metasurfaces to New Physical Phenomena
Alexandra Boltasseva
Purdue University (USA)

Transparent conducting oxides and transition metal nitrides have attracted attention for photonic applications as they exhibit enhanced light-matter interactions, particularly in their metallic/plasmonic regime and near the so-called epsilon near zero (ENZ) region. Here, we explore the static and dynamic tailorability and tunability of optical properties in TCOs and TMNs.

09:35 : Plenary talk
Extreme Wave Control with Space-Time Metamaterials
Andrea Alu
City University of New York (USA)

Metamaterials offer a powerful platform to manipulate wave propagation and gain control over waves, from radio-frequencies to light and sound. In this talk, I will discuss our recent progress in developing new metamaterial technologies, introducing time as an additional dimension for wave control.

Coffee Break

Session 1P1
Poster Session I
10:10 - 10:50

P1: Shortened Conical Horn Antennas Loaded by Lenses
Jose M. Gil[1], M. A. González[1], R. Gómez[2], J. Rubio[2], J. García[1]
[1] *Universidad Politecnica de Madrid (Spain),* [2] *Universidad de Extremadura (Spain)*

At this work we present a procedure of designing ultra-short conical horns corrected by single and double lenses for wireless communication systems. We show some compact and shortened prototypes at 60 GHz, achieving a reasonable directivity and radiation parameters as well as low return losses within a broad bandwidth.

P2: Bi-CMOS Design of Miniature BP-NGD Circuit with RLC-Parallel Network
M. Guerin[1], S. Ngoho[2], F. Haddad[1], H. Du[3], F. Wan[3], W. Rahajandraibe[1], Blaise Ravelo[3]
[1] *Aix-Marseille University (France),* [2] *AFSCET (France),* [3] *NUIST (China)*

This paper studies the Bi-CMOS design of BP-NGD circuit. The study is validated by Cadence® simulation of BP-NGD PoC circuit designed in 130-nm-BiCMOS-technology. Theoretical and simulation results show excellent correlation with -0.2-ns NGD around 5-GHz over 0.46-GHz-NGD-bandwidth. The BP-NGD PoC insertion and reflection losses are 2.53-dB and 12-dB, respectively.

P3: Emission Line Selective Optical Manipulation Using Stimulated Recoil Force
Takao Horai[1], Takudo Wada[2], Yoshiki Saito[1], Masaaki Ashida[1], Hajime Ishihara[1]
[1] *Osaka University (Japan),* [2] *Osaka Prefecture University (Japan)*

In this study, we propose an optical manipulation method to selectively target a particular emission line using the recoil force from induced light under inverted-occupation conditions. We evaluated this recoil force by using a four-level system and indicate the potential of the development of high-performance luminescent materials.

P4: THz Near-field Molecular Fingerprint Sensor for glucose detection
Hyeji Son[1], Jeong-Sik Jo[2], Hyunwoo Park[1], Jae-Won Jang[2], Teun-Teun Kim[1]
[1] *University of Ulsan (Korea),* [2] *Dongguk University (Korea)*

In the terahertz (THz) regime, molecular fingerprint spectroscopy has become feasible, but existing fabrication methods remain costly and challenging for mass production. In this study, we propose an efficient approach with nanogap structure using AFM-based nanolithography to effectively detect target materials in the THz range.

P5: Theoretical study of optical manipulation using electronic resonant light by controlling the triplet state populations
Yoshiki Umekawa[1], Takao Horai[1], Roger Bresolí-Obach[2], Hajime Ishihara[1]
[1] *Osaka University (Japan),* [2] *Universitat Ramon Llull (Spain)*

In recent research, Bresolí-Obach et al. experimentally demonstrated a new approach to controlthe optical force on polystyrene microparticles doped with phenalenone using chemical stimuli. This studytheoretically explains a unique scheme of optical manipulation demonstrated in the above work byconsidering nonlinear optical response of a four-level electronic system.

P6: Broadband dispersion compensation with ultrafhin multiresonant metasurfaces
Odysseas Tsilipakos[1], Thomas Koschny[2]
[1] *National Hellenic Research Foundation (Greece),* [2] *Iowa State University (USA)*

We propose multiresonant metasurfaces exhibiting a broadband and purely quadratic spectral phase to be utilized for dispersion compensation. The proposed metasurfaces require implementing a specific combination of Lorentzian resonances in the electric and magnetic surface conductivities. Our approach aspires to bring broadband dispersion engineering at ultrathin physical scales.

P7: Magnetic permeability investigation of AL800 ferrite by different methods
Saulius Rudys[1], Christine Vollinger[2], Juras Banys[3], Vidmantas Kalendra[3]
[1] *Vilnius Gediminas Technical University (Lithuania),* [2] *CERN (Switzerland),* [3] *Vilnius University (Lithuania)*

The presence of anisotropy in the properties of materials provides challenges for characterization. We suggest extending the frequency range of the classic single-turn inductor method for disc with hole-shaped AL800 ferrite samples to GHz frequency range by using numerical methods, provided by Ansoft HFSS software.

P8: Bifurcation Phenomena in a Circuit with a Three-Level Quantum Memristor
Finlay J. Potter, Alexandre Zagoskin, Sergey Saveliev, Alexander G. Balanov
Loughborough University (United Kingdom)

We study how a model for an anharmonic three-level quantum particle, with dephasing and dissipation, can be considered as part of an artificial neuron circuit. We demonstrate that this undergoes externally controllable bifurcations to generate rich non-stationary behaviour including Andronov-Hopf, Neimark-Sacker, and torus period-doubling bifurcations.

10:50 - 12:40 — Room 38

Session 1A2

Recent Advances in Nanophotonics and Metamaterials

Organized by: Andrea Fratalocchi

Chaired by: Yongmin Liu

10:50 : Keynote talk

Low-cost and scalable manufacturing of optical metasurfaces in the visible using engineering optical materials

Junsuk Rho
POSTECH (Korea)

Here, we demonstrate low-cost, scalable manufacturing of optical metasurfaces with three approaches: increasing a refractive index of resin with dielectric particle embedding for single-step nanoimprinting, 2) suppressing optical losses of hydrogenated amorphous silicon (a-Si:H) to apply complementary-metal-oxide-semiconductor technologies, and 3) high-index atomic layer deposited (ALD) structural resin.

11:20 : Invited talk

Nanophotonics on the Tip of a Fiber: Membrane-on-Fiber Technology

Andrea Fiore, Arthur L. Hendriks, Luca Picelli, Mildred S. Cano-Velázquez, Daan Rabelink, Paco Dreverman, Mathias Dolci, René van Veldhoven, Peter Zijlstra, Ewold Verhagen
Eindhoven University of Technology (The Netherlands)

By transferring nanopatterned membranes on the tip of optical fibers, we combine the power of nanophotonics with the flexibility of fiber sensing. Using this Membrane-on-Fiber technology, we report a variety of fiber-tip sensors of physical and biochemical parameters

11:40 : Invited talk

Metamaterial formalism approach to recognize cancer

Tatjana Gric[1], Vladimir Mityushev[2], Edik Rafailov[3]
[1] *Vilnius Gediminas Technical University (Lithuania),* [2] *Cracow University of Technology (Poland),* [3] *Aston University (United Kingdom)*

Detection of a tumor makes it probable that the patient will recover. The determination of the effective properties of the biological tissues and treating them as metamaterial became possible with the development of effective medium approximation techniques. Identification of the cancerous areas based on their effective medium properties was performed.

12:00 : Invited talk

Enabling new life science tools through visible integrated nanophotonics

Pol Van Dorpe
KU Leuven (Belgium)

The building blocks and circuits of integrated nanophotonics allow for a deep miniaturization and parallelization of optical functionality. Life science applications often require visible wavelengths. For that purpose, silicon nitride nanophotonics offers an ideal platform. We will review recent applications of the platform in molecular sensing, cytometry, optogenetics, and microscopy.

12:20 : Invited talk

Layered Metal-Dielectric-Metal Nanocavities with Vanishing Permittivity: Resonance Coupling and Strong Light-Matter Interaction

Aniket Patra[1], V. Caligiuri[2], Bruno Zappone[3], Antonio De Luca[2], Roman Krahne[1]
[1] *Istituto Italiano di Tecnologia (Italy),* [2] *Università della Calabria (Italy),* [3] *CNR-Nanotec (Italy)*

Layered Metal-Dielectric-Metal nanocavities sustain resonances with vanishing permittivity that modes can be tuned by the thickness of the dielectric. Multiple resonances can be engineered by including higher harmonics, and by stacks of interacting cavities. Integrating such cavity systems with light emitters enables emission enhancement, directional control, and strong light-matter interaction.

10:50 - 12:25 — Room 17

Session 1A3

Advanced Techniques for Computational Electromagnetics

Organized by: Maha Ben Rhouma

Chaired by: Philippe Ben-Abdallah

10:50 : Invited talk
Time domain topology optimization for dispersive nanophotonics inverse design
Johannes Gedeon[1], **Emadeldeen Hassan**[2], **Antonio Calà Lesina**[1]
[1] *Leibniz University Hannover (Germany),* [2] *Umeå University (Sweden)*

We propose a parallel topology optimization method in the time-domain for the inverse design of linear optical materials with arbitrary dispersion and anisotropy. The technique is demonstrated for 3D free-form nanophotonic structures with broadband performance.

11:10 : Invited talk
Fluctuational electrodynamics effects in graphene-based nanosystems
Mauro Antezza
University of Montpellier (France)

We discuss graphene effects on two main fluctuational electrodynamics: Casimir effect and radiative heat transfer.

11:30 : Invited talk
Calculating free-electron nonlinearities in nonclassical plasmonic heavily doped semiconductor systems
Huatian Hu, Cristian Ciracì
Istituto Italiano di Tecnologia (Italy)

Free-electron dynamics have a substantial contribution to the optical nonlinearity in heavily doped semiconductor systems. We applied both frequency- and time-domain approaches based on the finite-element method to explore a significant third-harmonic generation and optical Kerr bistability.

11:50 : Invited talk
Design and simulation of phase-gradient metasurfaces for antenna applications
Alessio Monti[1], **Stefano Vellucci**[2], **Michela Longhi**[2], **Mirko Barbuto**[2], **Mohsen Karamirad**[1], **Davide Ramaccia**[1], **Luca Stefanini**[1], **Alessandro Toscano**[1], **Filiberto Bilotti**[1]
[1] *Roma Tre University (Italy),* [2] *Niccolò Cusano University (Italy)*

In this work, we explore the novel functionalities enabled by transmissive phase-gradient metasurfaces in antenna systems, such as scan-range enhancement and radiation shaping. Several examples for both individual antennas and phased arrays are provided to confirm the versatility of phase-gradient metasurfaces for next-generation wireless systems.

12:10 : An efficient method for calculating resonant modes in biperiodic photonic structures
Nan Zhang, Y. Y. Lu
City University of Hong Kong (Hong Kong)

A new method is proposed for calculating resonant modes in biperiodic structures. We avoid usingPMLs and reduce the Maxwell's equations to a small nonlinear eigenvalue problem that is solved by contourintegral method. Numerical examples show that our method is efficient with respect to memory usage and CPUtime.

10:50 - 12:30 — Room 15

Session 1A4

Nanophotonics and Terahertz Photonics Applications

Chaired by: Hisatake Shintaro

10:50 : Invited talk
Large-area van der Waals heterostructures for photon harversting
Maria Giordano, M. Barelli, M. Gardella, G. Zambito, G. Ferrando, F. Buatier de Mongeot
Università di Genova (Italy)

Large area stacking of van der Waals heterostructure arrays based on two-dimensional (2D) Transition Metal Dichalcogenide semiconductors (TMDs) is achieved by a novel physical deposition approach that also allows maskless confinement of 2D TMDs heterostructures onto flat-optics nanograting templates.

11:10 : Invited talk
Plasmonic-enhanced Fabry-Pérot cavity for photocatalysis application
Ning Lyu[1], Anjalie Edirisooriya[2], Zelio Fusco[2], Fiona Beck[2], Christin David[1]
[1] *Friedrich-Schiller-Universitat Jena (Germany),* [2] *Australian National University (Australia)*

In photocatalysis, it is a significant challenge to selectivity reaction pathways. We concentrate on coupling nanoparticles on cavities to catalyse the N-demethylation reaction. This design, rooted in strong coupling, enables active-control over light-driven photocatalysis through tailored cavity configurations. Through the adjustment, we have achieved a 7-fold enhancement in yield.

11:30 : Invited talk
Real-time Spectroscopy Using Terahertz Parametric Generator and Detector
Kosuke Murate, Sota Mine, Kodo Kawase
Nagoya University (Japan)

Simultaneous terahertz (THz) wave generation of up to 15 wavelengths from injection-seeded THz parametric generator (is-TPG) was achieved using Stokes beams, generated by cascade processes in a nonlinear optical crystal, as the pump and seed beams.

11:50 : Invited talk
Advances in ultrafast terahertz scanning tunneling microscopy
Frank Hegmann
University of Alberta (Canada)

Probing ultrafast phenomena on the nanoscale is essential to our understanding of excitation dynamics in materials. Terahertz scanning tunneling microscopy (THz-STM) is a powerful technique that can image subpicosecond dynamics in materials at the atomic scale. This talk will discuss recent advances, current challenges, and future directions of THz-STM.

12:10 : Invited talk
Nanostructures for Photonic Functionalities and Medical Physics Applications
Mauro Pereira[1], Humaira Zafar[1], V. Vaks[2], A. Ganguly[1], G. Das[1]
[1] *Khalifa University (United Arab Emirates),* [2] *Institute for Physics of Microstructures (Russia)*

In this talk we will summarize our recent theoretical and experimental studies of different types of nanostructures, including semiconductor superlattices, adiabatically bent superlattice-waveguides, nanocylinders and nanocones. We show their applications to THz spectroscopy-based medical diagnostics and new photonics functionalities.

10:50 - 12:25 — Room 7

Session 1A5

Functional Thin Films and Composite Materials

Chaired by: Giuseppe Leo

10:50 : Observation of tunable topological phases of polaritons in a cavity waveguide
Yan Meng[1], Zhen Gao[2]
[1] *Dongguan University of Technology (China),* [2] *Southern University of Science and Technology (China)*

In this talk, we report the experimental demonstration of tunable topological polaritons within a cavity waveguide, achieved by modifying its width. This modification allows control over the photonic environment and the strength of light-matter interactions, enabling the realization of a topological phase transition without altering the material's lattice structure.

11:05 : Invited talk
Direct generation of terahertz cylindrical vector beams in nonlinear crystals
Seigo Ohno, Hiroaki Iwase
Tohoku University (Japan)

A simple way to generate THz vector beams is proposed. We pay attention to the symmetry of nonlinear optical crystals. When the high-symmetry axis on which the THz-wave generation is forbidden is excited with focusing beam, the component deviated from the axis can contribute to generate a vortex beam.

11:25 : Invited talk
Flexible holographic metasurfaces in the visible and mm-wave range
Jianling Xiao, Tomasz Plaskocinski, Mohammad Biabanifard, Andrea Di Falco
University of St Andrews (United Kingdom)

We present flexible holographic metasurfaces that show different images for different substrate shapes, and a self-calibrated curvature sensor.

11:45 : Invited talk
Development of Carbon Fiber Composites with Ferromagnetic Microwire Inclusions for Free Space Microwave Sensing
Valentina Zhukova[1], Mihail Ipatov[1], Johan Malm[2], Christer Johansson[2], Rafael Garcia-Etxabe[3], Francisco Javier Vallejo[4], Peio Olaskoaga[4], Arcady Zhukov[1]
[1] *University of Basque Country (Spain),* [2] *RISE Research Institutes of Sweden (Sweden),* [3] *GAIKER Technology Centre (Spain),* [4] *Ideko Technology Centre (Spain)*

This work focuses on free space microwave measurements of composites made from carbon fibers and ferromagnetic microwires inclusion focusing on the electromagnetic properties. We selected Co-rich microwires with higher magnetoimpedance effect and using a low frequency modulating magnetic field distinguished the microwave signals of ferromagnetic microwires and the carbon fibers.

12:05 : Invited talk
Temperature-dependent properties of amorphous oxide thin films for high-performance distributed Bragg reflectors
Michele Magnozzi[1], Stefano Colace[1], Shima Samandari[1], Massimo Granata[2], Alex Amato[3], Michael Caminale[1], Christophe Michel[2], Gianluca Gemme[4], Laurent Pinard[2], Maurizio Canepa[1]
[1] *Università di Genova (Italy),* [2] *Université de Lyon (France),* [3] *Maastricht University (The Netherlands),* [4] *Istituto Nazionale di Fisica Nucleare (Italy)*

Monitoring the evolution of thin films properties during thermal annealing is instrumental to enhance the performance of Bragg reflectors for different applications, ranging from radiative coolers to gravitational wave detectors. In situ analysis can provide access to the dynamics of amorphous materials when transitioning from 'disordered' amorphous to crystalline state.

Lunch

12:30 - 14:00

14:00 - 16:10 — Room 38

Session 1A6

Recent Advances in Nanophotonics and Metamaterials

Organized by: Andrea Fratalocchi

Chaired by: Mona Jarrahi

14:00 : Keynote talk
Extreme Space-Time Optics & Quantum Meta-Photonics
Vladimir Shalaev
Purdue University (USA)

We discuss all-optical modulation with single photons using electron avalanche, resulting in record-high nonlinearities. Then we show that transparent conducting oxides (TCOs) operating in the near-zero index regime can provide strong single-cycle modulation, enabling novel photonic time crystals. Finally, we discuss scalable quantum photonics with single-photon emitters in silicon nitride.

14:30 : Invited talk
Imaging chirality of optical fields near nano-/micro-structured materials
Hiromi Okamoto, Junsuke Yamanishi
Institute for Molecular Science (Japan)

We demonstrate here micro- and nano-scopic imaging of chiral optical fields with high-accuracy far-field CD microscopy, near-field polarimetry microscopy, and chiro-photoinduced force microscopy, mainly on plasmonic materials.

14:50 : Invited talk
Visualization of photonic band structures of topological and non-Hermitian photonic crystals
Yuto Moritake, Taiki Yoda, Masaya Notomi
Tokyo Institute of Technology (Japan)

Topological and non-Hermitian photonics realize novel photonic phenomena. Momentum space spectroscopy is commonly used to experimentally measure band structures, Q-factors, and topological properties. The paper presents recent our demonstration, including deterministic BIC, dynamic topological phase transitions, nano-scale visualization of topological plasmonic crystals, and observation of chiral exceptional points.

15:10 : Invited talk
Dielectric cylindrical and ring resonators: hot spots and photonic resonances
Kirill Bronnikov, N. S. Solodovchenko, M. F. Limonov
ITMO University (Russia)

The results of theoretical and experimental study of photonic resonances upon the transition from a cylinder to a ring dielectric resonator are presented. The transition is accompanied by the appearance of a hot spot in the hole only for azimuthal harmonics with m = 1, which follows from Mie theory.

15:30 : Invited talk
Algorithm-driven Design of Metasurfaces for Multi-dimensional Light Manipulation
Wei Ma, Bo Xiong
Zhejiang University (China)

We present an algorithm-driven strategy to automatically design metasurfaces for multi-dimensional light manipulation. Our metasurface design pipeline comprises iterative optimization steps, integrating gradient-based optimization or heuristic algorithms enhanced by machine learning models. This approach has been experimentally validated using multi-channel holograms, focusing lenses, and guided light control.

15:50 : Invited talk
Large-area photonic emitters with full spatial control of intensity, phase and polarization compatible with batch fabrication by optical lithography
Vladimir Aksyuk, Chad Ropp, Alexei Azarov, Dhriti Maurya, Alexander Yulaev, Daron Westly

National Institute of Standards and Technology (USA)

A modulated-waveguide photonic metamaterial grating emits millimeter-scale optical beams with arbitrary spatially-varying polarization, intensity and phase. Experiments at blue and near infrared wavelengths illustrate broad continuous dynamic range of emission intensity in a device with large minimum feature sizes, achieved via the continuous translation symmetry breaking approach.

14:00 - 16:00 — Room 17

Session 1A7

Advanced Techniques for Computational Electromagnetics

Organized by: Maha Ben Rhouma

Chaired by: Charles Roques-Carmes

14:00 : Invited talk

2D Quantitative Inverse Scattering via Suitable Reformulations as an Effective Way to Reduce Non-linearity

Martina Teresa Bevacqua, Tommaso Isernia
Università Mediterranea di Reggio Calabria (Italy)

In this contribution, attention is devoted to possibility of reducing the non-linearity of inverse scattering problem by means of effective and smart reformulations of the basic equations, in particular the Lippmann-Schwinger one. Some reformulations proposed in literature are reviewed and discussed under a unitary perspective.

14:20 : Invited talk

Efficient simulation and design of large-scale metasurfaces

Dan-Nha Huynh[1], Jens Niegemann[2], Han-Hsiang (Michael) Cheng[3], Thibault Leportier[2], Federico Duque Gomez[2], Shin-Sung Kim[4], Adam Reid[2]
[1] *Ansys Germany GmbH (Germany),* [2] *Ansys Canada Ltd. (Canada),* [3] *Ansys Japan K.K. (Japan),* [4] *Ansys UK Limited (United Kingdom)*

Optical metasurfaces, made of nano-scale elements that manipulate light locally, present an exciting technology for customizing optical responses. They have garnered significant attention, particularly in the realm of augmented and virtual reality. Here, we present our recent progress in efficiently simulating and optimizing mm-sized and cm-sized metasurfaces.

14:40 : Invited talk

Extreme Dielectric Confinement of Light Inverse Design, Experimental Realization, Applications. Going Beyond the Second Dimension

Rasmus Christiansen, Jesper Mørk, Ole Sigmund
Technical University of Denmark (Denmark)

The talk discusses the use of topology optimization as a nanophotonic inverse design tool to tailor dielectric structures for extreme spatial confinement of light, tailoring and realizing said structures for different material platforms and applications, discussing among others experimental evidence of sub-diffraction limited single-emitter mode-volumes.

15:00 : Invited talk

Inevitable radiation decay of surface plasmon at any metal-dielectric interface

Arkadii Krokhin[1], Kevin Rocapricone[2], Andrey Bozhko[1], Gleb Nazarikov[3], Vladimir Drachev[4]
[1] *University of North Texas (USA),* [2] *Oak Ridge National Laboratory (USA),* [3] *Eindhoven University of Technology (The Netherlands),* [4] *Skolkovo Institute of Technology (Russia)*

A radiative decay of surface plasmon due to existence of a few-nanometer-thick epsilon-near-zero (ENZ) transition layer between metal and dielectric is predicted, calculated, and experimentally demonstrated. The transition layer is formed by spill-out electrons and surface roughness. Radiative losses may exceed Joule losses, thus strongly reducing surface plasmon propagation length.

15:20 : Invited talk
Green's functions for electromagnetism on a lattice
Bastiaan Pieter de Hon
Eindhoven University of Technology (The Netherlands)

Electromagnetic lattice Green's functions on a Yee mesh can be computed via the vector potential 1-form that satisfies a scalar no-neighbours, seventh-order, eighteenth-degree, discrete-time recurrence scheme. Boundary conditions are no longer required, and the scheme allows for very large lattice distances.

15:40 : Invited talk
Programmable Photonic Processor for Chaotic Signal Recovery in the Presence of Atmospheric Turbulence
Heming Huang[1], Sara Zaminga[1], Andres Martinez[2], Francesco Morichetti[2], Andrea Meloni[2], Frederic Grillot[1]
[1] *Institut Polytechnique de Paris (France),* [2] *Politecnico di Milano (Italy)*

We demonstrate the decisive functionality of a silicon photonic mesh as a programmable photonic processor to implement a signal compensation algorithm to recover optical chaos signals after propagation through atmospheric turbulence. This breakthrough is of great potential in optical signal processing applications, like free-space optical chaos communication in impaired environments.

14:00 - 15:45 — Room 15

Session 1A8

Photonic Technologies: From Materials to Applications

Chaired by: Andrea Di Falco

14:00 : Invited talk
Programmable Nanophotonics with Phase-Change Materials: Towards Multilevel Tunability and Low-Loss devices
F. Bentata[1], C. Laprais[1], N. Baboux[1], P. Genevet[2], S. Monfray[3], G. Saint-Girons[1], X. Letartre[1], L. Berguiga[1], Sébastien Cueff[1]
[1] *Universite Claude Bernard Lyon 1 (France),* [2] *Université Côte d'Azur (France),* [3] *STMicroelectronics (France)*

We experimentally demonstrate phase-change materials (PCM) based programmable nanophotonic devices. Specifically, we propose and demonstrate approaches leveraging intermediate states of tunability in various PCM such as VO2, GST and the emerging low-loss PCM Sb2S3.

14:20 : Invited talk
Photonics-based millimeter- and THz wave visualization and its applications
Shintaro Hisatake
Gifu University (Japan)

We are developing a photonics-based system that measures the spatial distribution of the amplitude and phase of electric fields, visualizing fields from 100 MHz to 600 GHz. In this paper, we describe the principle and characteristics of this system and its application to antenna characterization, millimeter-wave EMC, THz imaging, etc.

14:40 : Keynote talk
A X-Words Play into 2-D Phase Retrieval Problems
Tommaso Isernia, Giada Maria Battaglia, Andrea Francesco Morabito, Roberta Palmeri
Università Mediterranea di Reggio Calabria (Italy)

Phase retrieval is a challenging problem of interest in very many electromagnetic problems. We report about a recent approach, emulating the solution of crosswords puzzles, which, opposite to common schemes, is able to use a single set of data, and still avoid false solutions.

15:10 : Invited talk

Low-loss Functional Waveguide Devices Fabricated with a UV-Curable Resin Type 3D Printer, RECILS, and Metal Plating in 200-400 GHz Band
Junji Yumoto
University of Tokyo (Japan)

This study introduces a groundbreaking method for producing waveguide devices in the 200-400 GHz band, utilizing a novel UV-curable resin type 3D printer, RECILS, and metal plating. This method has been experimentally verified to yield low-loss waveguide devices, such as bandpass filters, bent and twisted waveguides, outperforming conventional machining techniques.

15:30 : Planarized Terahertz quantum cascade frequency combs with inverse-designed reflectors and integrated antennas for far field control
Giacomo Scalari, U. Senica, S. Gloor, P. Micheletti, D. Stark, M. Beck, J. Faist
ETH Zürich (Switzerland)

We present a planarized THz QCL with an inverse-designed facet reflector coupled to a surface-emitting patch array antenna, emitting combs of >800 GHz bandwidth at a frequency of 2.9 THz. The components have been optimized for octave-spanning spectral bandwidths between 2-4 THz and monolithically integrated on the same photonic chip.

14:00 - 16:00 — Room 7

Session 1A9

Smart Electromagnetic Skins for the Next Generation of Wireless Network

Organized by: Paola Pirinoli and Angelo Freni

Chaired by: Paola Pirinoli and Angelo Freni

14:00 : Invited talk
Design and Optimization of Active and Passive Quasi-Periodic Structures for Beam Steering
Pasquale Nicolaci, M. M. Bilgic, M. Zhou
TICRA (Denmark)

This paper presents the direct optimization of active and passive reconfigurable quasi-periodic structures for beam steering. Two configurations are considered, an active reconfigurable reflectarray working between 24.5-27.5 GHz for 5G application, and a passive mechanical steered low profile transmitarray working between 19.7-20.2 GHz.

14:20 : Invited talk
Introduction to fewer known properties of glide symmetry
Oscar Quevedo Teruel
KTH (Sweden)

Some attractive properties of glide symmetries, such their ability to produce composite magnetic-dielectric materials, or to enhance the levels of anisotropy were not sufficiently noticed. Here, I will explain their interest for reducing the size of lenses with transformation optics, as well as to reduce the reflections in homogenous lenses.

14:40 : Invited talk
Metasurfaces for Enhanced Wireless Communications
Andrea Alu
City University of New York (USA)

Metasurfaces offer a powerful platform to address the challenges of modern wireless communications, especially when considering the opportunity to integrate conventional metasurface elements with active, nonlinear and time-varying components suitably tailored and controlled in real-time to respond to changes in the background.

15:00 : Invited talk
Design of a Dual-Band Dual-Polarized Smart Electromagnetic Skin with Shaped Anomalous Reflection Considering Phase Shift Constraints in the Unit Cell
Alvaro F. Vaquero[1], Eduardo Martinez-de-Rioja[2], Manuel Arrebola[1]
[1] *Universidad de Oviedo (Spain),* [2] *Universidad Rey Juan Carlos (Spain)*

This work analyzes the design of a Smart Electromagnetic Skin (SES) to enhance millimeter-wave (mm-Wave) communications, working on dual band, at 28 and 39 GHz, as well as in dual-linear polarization. The design is carried out considering a phase-shift limitation in the phase response of the unit cell.

15:20 : Invited talk
An Approach for the Estimation of The Impact of Technological Constraints on Information at the Deep Physical Layer
Marco Donald Migliore[1], Marco Di Renzo[2]
[1] *University of Cassino (Italy),* [2] *Centrale Supelec (France)*

This contribution proposes an approach to estimate the impact of different technological solutions of radiating/scattering systems. The method is based on the ε-Kolmogorov capacity and can be implemented using a statistical approach

15:40 : Invited talk
Liquid Crystal Technology for Implementing Smart Electromagnetic Skins in Next Generations of mm-Waves Wireless Systems
Eduardo Carrasco, Roberto Guirado, Gerardo Pérez-Palomino, Pablo de la Rosa, Morten A. Geday
Universidad Politécnica de Madrid (Spain)

Reflective phase-shifting surfaces bases on liquid crystal (LC) technology allow implementing efficient and low-cost, smart electromagnetic skins. By locally controlling a low-frequency voltage, the coverage of a reflected wave can be dynamically optimized. This is a powerful solution for improving the capabilities of next generation air interface design, in mm-waves.

Coffee Break

16:00 - 16:30

16:30 - 18:20 — Room 38

Session 1A10

Recent Advances in Nanophotonics and Metamaterials

Organized by: Andrea Fratalocchi

Chaired by: Tommaso Isernia

16:30 : Keynote talk
Chip-scale terahertz optoelectronics
Y. Zhao, Mona Jarrahi
University of California (USA)

We introduce a new scheme for realizing chip-scale terahertz optoelectronics, enabling the scalable implementation of complex terahertz imaging, spectroscopy, and communication systems through a compact platform.

17:00 : Invited talk
Low-index nonlinear optics
Wallace Jaffray[1], Sven Stengel[1], Alexandra Boltasseva[2], Vladimir Shalaev[2], Andrea Di Falco[3], Marce-

Ilo Ferrera[1]
[1] *Heriot-Watt University (United Kingdom),* [2] *Purdue University (USA),* [3] *University of St Andrews (United Kingdom)*

Transparent conducting oxides have transitioned from industrial use to a focus for photonic research. This overview covers historical findings, highlights our latest accomplishments, and explores future directions in nonlinear integrated photonics and light acceleration within time-varying media

17:20 : Invited talk
Disorder as a degree of freedom for photonic nanomaterials
Rémi Carminati, Romain Pierrat
PSL University (France)

Engineering the degree of partial order in scattering materials offers the possibility to design and fabricate novel metamaterials for photonics. We will discuss the basic principles of light interaction with correlated disordered materials, and present a few illustrative examples.

17:40 : Invited talk
Integrated Photonics for Quantum Information Processing and Artificial Neural Networks
Imtiaz Alamgir[1], **Luigi Di Lauro**[1], **Stefania Sciara**[1], **Abdul Rahim Aadhi**[1], **Celine Mazoukh**[1], **Hao Yu**[1], **Bennet Fischer**[1], **Nicolas Perron**[1], **Nicola Montaut**[1], **Mario Chemnitz**[1], **Brent E. Little**[2], **Sai T. Chu**[3], **David J. Moss**[4], **Zhiming Wang**[5], **Roberto Morandotti**[6]
[1] *Institut National de la Recherche Scientifique (Canada),* [2] *QXP Technology (China),* [3] *City University of Hong Kong (China),* [4] *Swinburne University of Technology (Australia),* [5] *University of Electronic Science and Technology of China (China),* [6] *Institut national de la recherche scientifique (Canada)*

Integrated photonics advances emerging quantum information processing and artificial neural network technologies. This work employs on-chip, reconfigurable devices for highly efficient, intelligent, and secure classical and quantum information processing. We demonstrate simultaneous operations with high speed, low power consumption, and small footprints, paving the way for next generation telecommunication solutions.

18:00 : Invited talk
Soliton formation in an exciton-polariton condensate at a bound state in the continuum
I. Septembre[1], **I. Fudjo**[1], **V. Develay**[2], **T. Guillet**[1], **S. Bouchoule**[3], **J. Zuniga-Perez**[4], **G. Malpuech**[1], **Dmitry Solnyshkov**[1]
[1] *Université Clermont Auvergne (France),* [2] *Université de Montpellier (France),* [3] *Université Paris-Saclay (France),* [4] *CRHEA-CNRS (France)*

We design a GaN/TiO2 structure hosting a polaritonic BIC with a low condensation threshold. We analyze in detail how the repulsive interaction between exciton-polaritons affects the condensate lifetime. We study the dynamics of the condensation process in a BIC state and optimize the conditions.

16:30 - 18:40 — Room 17

Session 1A11

Advanced Techniques for Computational Electromagnetics

Organized by: Maha Ben Rhouma

Chaired by: Rasmus Ellebæk Christiansen

16:30 : Invited talk
Novel Machine-learning Techniques for Inverse Design and Knowledge Discovery in Electromagnetics
Mohammadreza Zandehshahvar, Mahmoodreza Marzban, mohammad Hadighehjavani, Ali Adibi
Georgia Institute of Technology (USA)

This talk is focused on reducing the complexity of machine-learning approaches for design and knowledge discovery in large-scale nanophotonic structures by optimally integrating manifold-learning, metric learning,

and pruning techniques for dimensionality reduction with a new appraoch for representing the design parameters to study large-scale devices with considerably reduced computation complexity.

16:50 : Invited talk
An overview of spatial spectral methods with complex-plane deformations for the representation of waves in homogeneous and layered media without absorbing boundary conditions
Roeland Dilz
Eindhoven University of Technology (The Netherlands)

We propose using an error-function-windowed Fourier series representing electromagnetic fields for integralequations of finitely sized scatterers. Using a previously developed complex-plane path-deformation, we representthe electromagnetic fields accurately in the spectral domain and quickly transform between spectral and spatial domain. Thisinifinitely differentiable basis leads to quick numerical convergence.

17:10 : Keynote talk
Accelerating Photonic Design by Deep Learning
Yongmin Liu
Northeastern University (USA)

Deep learning is instrumental in computational electromagnetics as it excels at capturing intricate patterns and complex relationships within vast datasets, enabling more efficient and accurate modeling of electromagnetic phenomena. This capability is particularly beneficial in photonics design, leading to the discovery of innovative and optimized configurations for desired functionalities.

17:40 : Invited talk
Implementing Inhomogeneous Broadening in Time Domain Photonic Simulations
Ludmila Prokopeva, Alexander V. Kildishev
Purdue University (USA)

We present new causal generalizations of the classic Lorentz/Sellmeier/Drude/Debye dispersion models that include inhomogeneous broadening with a given probability density function. Conceptual implementations in an FDTD solver based on MiniMax Optimized Semi-analytical Approximation (MiMOSA) are demonstrated with Gaussian statistics and can be extended to other distributions.

18:00 : Invited talk
Observation of multipole-type excitations through nanoscale spatial structure of light: from mesoscopic systems to single molecules
Hajime Ishihara
Osaka University (Japan)

Interaction between multipole-type excitations and light with nanoscale spatial structures gives rise to a variety of physical and chemical functions. This presentation delves into optical response theories addressing nanoscale spatial structures of light and experimental observations of multipole-type excitations across materials ranging from mesoscopic systems to single molecules.

18:20 : Invited talk
A few recent developments in nanophotonic scintillators
Charles Roques-Carmes
Stanford University (USA)

Scintillation is a form of spontaneous emission in materials excited by x-rays or other high energy particles. In this talk, I will review recent developments in the design of nanophotonic scintillators and materials to enhance and control scintillation.

16:30 - 18:30 — Room 15

Session 1A12

Superconducting and High-Frequency Neuromorphic Devices

Organized by: Kaveh Delfanazari and Sergey Saveliev

Chaired by: Kaveh Delfanazari and Sergey Saveliev

16:30 : Invited talk
Superconducting systems for quantum and neuromorphic AI and reservoir computing
Sergey Saveliev
Loughborough University (United Kingdom)

Natural layered superconductors represent an optimal material for realising high-frequency and quantum neuromorphic systems. Within this discussion, I will delve into alternative approaches for using time-series data in training of potential AI superconducting layered systems. I will scrutinise diverse strategies for inputting data into the mesoscopic devices of layered superconductors.

16:50 : Invited talk
Study of aspect ratio effect on radiation characteristics of rectangular shape of high-temperature superconductor Bi2212 terahertz wave emitters
Takanari Kashiwagi, Ryuta Kikuchi, Shungo Nakagawa, Shotaro Yamada, Yuki Enomoto, Yuuki Yamauchi, Yoshihiko Kuzumi, Kentaro Maeshima, Hidetoshi Minami
University of Tsukuba (Japan)

To gain high performance THz-wave emitting devices made of single crystal of high temperature superconductor Bi2Sr2CaCu2O8+d, we studied the emission characteristics of rectangular crystal chips of the same area with different aspect ratios of width and length (w/L). The selectivity of the excitation modes will be discussed.

17:10 : Invited talk
Josephson transmission lines employing granular aluminum
Alexey Ustinov
Karlsruhe Institute of Technology (Germany)

We experimentally demonstrate slowing down relativistic fluxons in Josephson junctions whose superconducting electrodes are replaced by a high kinetic inductance superconductor. Our data show that the characteristic impedance is increased by an order of magnitude, which makes these junctions suitable for a variety of applications in superconducting electronics.

17:30 : Invited talk
Artificial Neuron Circuit with a Two-Level Quantum Memristor
Finlay Potter, Alexandre Zagoskin, Sergey Saveliev, Alexander G. Balanov
Loughborough University (United Kingdom)

We study a neural circuit incorporating a quantum memristive switcher, considering relaxation and dephasing effects. Our research demonstrates that such system is able to demonstrate hysteresis phenomena and self-oscillations. The oscillations occur only under moderate relaxation rates in a quantum environment, absent in purely coherent or highly decoherent scenarios

17:50 : Invited talk
Frequency modulated terahertz radiation from Josephson plasma emitters of a cuprate superconductor
Itsuhiro Kakeya
Kyoto University (Japan)

We achieved to demonstrate sinusoidal signal up to 4.5 GHz superimposed on sub-terahertz carrier waves in two JPE devices. One device radiates at 840–890 GHz with the maximum FM bandwidth of 40 GHz and the other radiates at 400-500 GHz with high- and low bias regions.

18:10 : Invited talk
Superconductor plasmonic nanoantenna array metasurfaces

Kaveh Delfanazari
University of Glasgow (United Kingdom)

The optical information processing at the nanometer scale may be realised by tailoring and manipulating local optical electric fields in a subwavelength domain. Here, we perform numerical modelling and experimental studies to exploit the optical properties of nanoantenna array metasurfaces patterned and fabricated at the surface of superconductive plasmonic materials.

16:30 - 17:10 — Room 7

Session 1A13

Smart Electromagnetic Skins for the Next Generation of Wireless Network

Organized by: Paola Pirinoli and Angelo Freni

Chaired by: Paola Pirinoli and Angelo Freni

16:30 : Invited talk
On the Features of Curved Passive Electromagnetic Skins
Michele Beccaria[1], Agnese Mazzinghi[2], Angelo Freni[2], Paola Pirinoli[1]
[1] *Politecnico di Torino (Italy),* [2] *Università di Firenze (Italy)*

In this communication, the features of curved passive smart electromagnetic skins working at millimeter waves to be mounted on street lights or stop light poles are presented and compared to those of the classic planar solution.

16:50 : Invited talk
A scattering matrix approach for the inverse design of smart devices
Andrea Francesco Morabito, Renat Abdullin, Giada Maria Battaglia, Tommaso Isernia, Roberta Palmeri
Università degli Studi Mediterranea di Reggio Calabria (Italy)

The present contribution deals with the synthesis of smart skin and anomalously reflecting devices by exploiting a new 'inverse design' procedure exploiting the scattering matrix approach.

17:10 - 18:25 — Room 15

Session 1A14

Emerging Applications and Techniques

Chaired by: Orlandino Testa

17:10 : A Drone Mounted Ground Probing Radar for the Characterization of the Buried Ice Deposits on Mars
Orlandino Testa[1], Stefano Pisa[1], Renato Cicchetti[1], Andrea Cicchetti[2], Paolo d'Atanasio[3], Alessandro Zambotti[3]
[1] *Sapienza University of Rome (Italy),* [2] *Istituto Nazionale di Astrofisica (Italy),* [3] *Italian National Agency for New Technologies, Energy and Sustainable Economic Development (Italy)*

A ground probing radar (GPR) to investigate the presence of water ice beneath the surface of Mars is presented. Measurements using the Time Domain Reflectometry (TDR) technique and simulations with the CST software highlighted the feasibility of the proposed GPR system.

17:25 : Local Design of Phase-gradient Metasurfaces robust to Mutual Coupling and Fabrication Errors
Davide Ramaccia[1], Luca Stefanini[1], Alessio Monti[1], Mirko Barbuto[2], Stefano Vellucci[2], Michela Longhi[2], Mohsen Karamirad[1], Alessandro Toscano[1], Filiberto Bilotti[1]

[1] *Roma Tre University (Italy),* [2] *Niccolò Cusano University (Italy)*

Metasurfaces is undoubtedly one of the future disruptive technologies. Despite the current design methodologies are quite accurate, we demonstrate that the design may be affected by unpredictable deviations, that can be considered already during the design process by using a statistically corrected local design approach.

17:40 : Optimization of transient electromagnetic problems using discontinuous Galerkin methods
Fengwen Wang[1], **Tim Warburton**[2], **Niels Aage**[1]
[1] *Technical University of Denmark (Denmark),* [2] *Data Analytics Program (USA)*

The study applies the discontinuous Galerkin finite element method (DG-FEM) to density-based topology optimization in transient electromagnetic problems. A discrete consistent adjoint method is employed to compute the objective sensitivity, while a reverse-time integration avoids storing forward-time solutions. The optimization approach is validated using a benchmark problem.

17:55 : Electromagnetic Routing using a 6-Port Topological Valley Junction
Christian Johnson-Richards[1], **Alex Yakovlev**[2], **Victor Pacheco-Peña**[2]
[1] *School of Mathematics, Statistics and Physics, Newcastle University, Newcastle Upon Tyne, NE1 7RU, United Kingdom (United Kingdom),* [2] *Newcastle University (United Kingdom)*

We design a 6-port junction using topological valley waveguides that exhibits equal power splitting between ports of the same valley type and extract a scattering matrix that enables the further design of linear computing devices.

18:10 : Superfluorescence-induced optical force in metallic nanofiber systems
Hideki Arahari[1], **Hajime Ishihara**[1], **Nobuhiko Yokoshi**[2]
[1] *Osaka University (Japan),* [2] *Osaka Metropolitan University (Japan)*

Superfluorescence is a coherent luminescence phenomenon induced spontaneously by light-mediated interactions among emitters. We theoretically evaluated superfluorescence-induced optical forces enhanced by utilizing surface plasmon modes of Ag nanofibers and proposed optical manipulations reflecting its characteristics. This study leads to novel ordered optical manipulations by designing the emitter arrangement and environment.

Wednesday 26th June, 2024

08:30 - 09:40 — Room 38

Session 2A1

Plenary Session II

Chaired by: Andrea Alu

08:30 : Plenary talk
Geodesic Lens Antennas for 5G/6G and Satellite Communications
Oscar Quevedo Teruel
KTH Royal Institute of Technology (Sweden)

Geodesic lenses have attracted the attention of the antenna community due to their advantageous properties. These lenses are ideal for high-frequency applications, and they are an excellent candidate for new applications in the millimeter frequency regime, especially for antennas with low-scan losses, such as 5G/6G and satellite communications.

09:05 : Plenary talk
Metasurface antennas and RIS in Space and 6G Scenarios
Stefano Maci
University of Siena (Italy)

This presentation will focus on the control of surface waves, showcasing examples such as the design of high-gain, low cross-polarization antennas, multibeam antennas, and scanning beam flat lenses. Emphasis will be given to space applications. The presentation will also concern the third generation of adaptive metasurfaces (MTSs).

Coffee Break

Session 2P1
Poster Session II
09:40 - 10:20

P1: Giant Magnetoimpedance Effect at GHz Frequencies in Amorphous Microwires
Arcady Zhukov, Mihail Ipatov, Paula Corte-Leon, Juan Maria Blanco, Valentina Zhukova
University of Basque Country (Spain)

Studies of the Giant Magnetoimpedance (GMI) effect of amorphous Co-Fe rich microwires reveal that they present GMI effect at GHz frequencies. We observed magnetic softening and improvement of frequency dependence of GMI ratio at high frequencies after approprate annealing of studied microwires.

P2: Investigation of Electromagnetic Properties of Graphene-based nanocomposite materials by using Near-Field Microwave Probe Technique
Hind Bakli[1], Mohamed Moualhi[2], Mourad Makhlouf[3]
[1]Laboratory of Electronics and Electrical Systems Engineering (Algeria), [2]Laboratory of Software Implementation and Validation (Algeria), [3]Laboratory of Combustion, Detonation and Ballistic (Algeria)

Investigation and determination at 18.5 GHz of dielectric permittivity and conductivity of PVC/Graphene/Fe2O3 nanocomposites using near-field microwave probe technique is described in this paper. The proposed method presents a lot of advantages such as local characterization, simplicity, low coast, broadband operation and high sensitivity.

P3: Design of an Antipodal Vivaldi Antenna with upper shell

S. Rudys, Olga Suvorova
Vilnius University (Lithuania)

In the paper we introduce a new design of antipodal Vivaldi antenna. To understand the features of antenna we performed simulation, and optimization procedure has been employed to get the best geometry of antenna. We use covering shell for protecting antenna, also the shell improves the performance of AVA.

P4: The Effective wearable camouflaged UHF antenna

Saulius Rudys, Juras Banys
Vilnius University (Lithuania)

Cavity-backed slot wearable antenna is developed for applications in 400 MHz frequency band. Exclusive properties of an antenna are low thickness (5mm) and low electromagnetic energy absorbing by human body in comparison with conventional hand-held radio antenna.

P5: The Impact of 5G on Human Health

Yahya Khraisat
Al - Balqa Applied University (Jordan)

We will examine the level of 5G electromagnetic energy pattern absorption and penetration into biological tissue (DNA). Two significant features of 5G technology are the extremely huge amount of data that can be transferred in a time throughput (data speed measured in megabits per second) and the lightning-fast transmission delay.

P6: Temporal metastructures enabling multi-mode generation and continuous spectrum radiation

Davide Ramaccia[1], **Luca Stefanini**[1], **Alessio Monti**[1], **Mirko Barbuto**[2], **Stefano Vellucci**[2], **Michela Longhi**[2], **Mohsen Karamirad**[1], **Alessandro Toscano**[1], **Filiberto Bilotti**[1]
[1] *Roma Tre University (Italy),* [2] *Niccolò Cusano University (Italy)*

With the advent of the temporal metamaterials, the time dimension has been exploited to unlock several time-equivalent scattering processes observed in space domain. In this contribution, we present our recent findings on the scattering effects emerging in time-varying metastructures, showing multi-mode generation and radiation of a continuous spatio-temporal spectrum.

P7: An Intermodulation Radar for Sensing Applications

Stefano Pisa[1], **Pietro Monsurrò**[1], **Pasquale Tommasino**[1], **Alessandro Trifiletti**[2]
[1] *Sapienza University of Rome (Italy),* [2] *Sapienza University of Rome (IT)*

A nonlinear target to be used in intermodulation radar sensing applications has been studied. The target responses measured with an experimental setup and simulated with the MWO software were in good agreement. A Volterra series model of the target has been developed and compared with measurements.

P8: Fabry-Pérot and Friedrich-Wintgen bound states in the continuum in photonic triple-stub cavity

Y. Rezzouk[1], **S. Khattou**[1], **M. El Ghafiani**[1], **M. Amrani**[1], **E. H. El Boudouti**[1], **A. Talbi**[2], **B. Djafari-Rouhani**[2]
[1] *Université Mohammed I (Morocco),* [2] *University of Lille (France)*

We investigate theoretically and experimentally the existence of Fabry-Pérot (FP) and Friedrich-Wintgen (FW) bound states in the continuum (BICs) in a photonic triple-stub cavity. By slightly detuning from the BIC condition, the latter transforms to electromagnetic-induced transparency/reflection (EIT/EIR) or Fano resonances. Analytical findings are experimentally validated in the radio-frequency domain.

10:20 - 12:30 — Room 38

Session 2A2

Recent Advances in Nanophotonics and Metamaterials

Organized by: Andrea Fratalocchi

Chaired by: Luca Razzari

10:20 : Keynote talk
Large-Area, Reconfigurable Metasurface Apertures for Synthetic Aperture Radar and Other Applications
David R. Smith
Duke University (USA)

Metasurfaces are an excellent fit for large-area, reconfigurable apertures due to their use of passive tuning components rather than the active (externally powered) phase shifters and amplifiers integrated into traditional phased arrays. We discuss the advantages of metasurfaces for extremely large, reconfigurable antennas in the context of space-based systems.

10:50 : Invited talk
Redox-tunable conducting polymer plasmonics and metasurfaces
Magnus Jonsson
Linkoping University (Sweden)

Conducting polymers can function as redox-tunable plasmonic materials, opening for chemically and electrically controlled nanooptics and metasurfaces. I will present the background to this emerging area of nanooptics and discuss recent results, including based on straining conducting polymers to induce redox-tunable hyperbolic properties.

11:10 : Invited talk
Compact terahertz harmonic generation in the Reststrahlenband in nanophotonic graphene resonators
Miriam Serena Vitiello
CNR-NANO and Scuola Normale Superiore (Italy)

Harmonic-generation is a result of a strong non-linear interaction between light-and-matter. It is a key technology in optics, as it allows the conversion of optical-signals to higher-frequencies. Here, we demonstrate third-harmonic generation at 9.63 THz by optically pumping single-layer graphene, coupled to a circular-split-ring-resonator array, with a 3.21 THz quantum-cascade-laser.

11:30 : Invited talk
Dispersion tuning of spoof surface plasmon polaritons by MEMS-integrated metasurfaces
Lars Franke, Steffen Klingel, Steffen Klingel, Marco Rahm
RPTU Kaiserslautern-Landau (Germany)

Compact plasmonic networks for high-frequency on-chip communication shrink electromagnetic waves to subwavelength scales. Metasurfaces handle spoof surface plasmon polaritons (SSPPs) at microwave and terahertz frequencies, but real-time reconfigurability is challenging. We developed a tunable SSPP low-pass filter that effectively blocks SSPP transmission upon activation at a frequency of 106 GHz.

11:50 : Invited talk
Precision Unleashed: Coherence-Moderated Sensing for Simultaneous Accuracy and High Bandwidth
Johannes Dickmann
Technical University of Braunschweig (Germany)

I present an interferometric approach to length measurement in which interferometer visibility and mid-fringe detection are combined. Numerical simulations and experimental results demonstrate the effectiveness of the proposed method.

12:10 : Invited talk
Transparent Materials with Low Radiative Cooling Efficiency
Kotaro Kajikawa
Tokyo Institute of Technology (Japan)

Radiative cooling (RC) materials have been extensively studied, but transparent materials without RC performance have not been studied. Most transparent materials have a certain high RC performance, but there are cases where it is better to have no RC. We found that metamaterials of silver nanowire-dispersed polymers have such properties.

10:20 - 12:30 — Room 17

Session 2A3

Advanced Techniques for Computational Electromagnetics

Organized by: Maha Ben Rhouma

Chaired by: Karim Achouri

10:20 : Invited talk

Concepts for oblique semi-guided waves: integrated optics with negative effective permittivity

Manfred Hammer, Lena Ebers, Henna Farheen, Samer Alhaddad, Andre Hildebrandt, Jens Förstner
Paderborn University (Germany)

Scattering losses are fully suppressed, if guided waves in a high-contrast dielectric slab encounter anelongated obstacle at a sufficiently large oblique angle. We review the underlying arguments and a series of deviceconcepts, including a step transition, high-contrast gratings, and the evanescent excitation of OAM fiber modes.

10:40 : Simulating photoemission performance of a nanostructured photocathode with a coupled finite difference time domain - Monte Carlo technique

Mikhail Popov, Ilya Valuev, Sergei Belousov
Hipercone Ltd (Israel)

We simulate the photoemission process in nanostructured thin film bialkali antimonide photocathodes on metallic substrates. Utilizing 3D finite difference time domain simulation of the optical excitation, fully coupled with a 3D Monte Carlo simulation of electron generation, transport and emission, we obtain quantum efficiency and emittance of the photocathode.

10:55 : Invited talk

Hybrid Simulation Techniques Combining Finite Difference and Fourier expansions for Nanophotonic Devices

Mondher Besbes, Christophe Sauvan, Henri Benisty
Université Paris-Saclay (France)

The finite difference method is combined with classical horizontal Fourier expansions to provide a quick simulation of nanophotonic devices under illumination, avoiding eigenmode calculations. Thanks to a careful implementation and proper vertical slicing choices, a large reduction of computational time is obtained, compatible with subsequent tools such as reduced models.

11:15 : Invited talk

Connecting antenna and diffraction theory with the radiation of Fisher information in scattering experiments

Jakob Hüpfl[1], F. Russo[1], L. M. Rachbauer[1], D. Bouchet[2], J. Lu[3], U. Kuhl[3], S. Rotter[1]
[1] *Vienna University of Technology (Austria),* [2] *Université Grenoble Alpes (France),* [3] *Université Cote d'Azur (France)*

Electromagnetic waves are used over a wide range of disciplines to precisely estimate a target's properties. We explore how these waves interact with matter to gather Fisher information from an object of interest and transmit it to the far-field. By identifying information sources, we build a connection to antenna theory.

11:35 : Invited talk

Existence of accidental bound states in the continuum in periodically perturbed slabs

Amgad Abdrabou[1], Wangtao Lu[2], Ya Yan Lu[3]
[1] *Purdue University (USA),* [2] *Zhejiang University (China),* [3] *City University of Hong Kong (Hong Kong)*

Bound states in the continuum (BICs) have many applications in photonics, but their existence is only proved for a few simple cases. In this paper, we identify a precise mathematical condition under which certain accidental BICs exist in periodically perturbed slabs and provide a rigorous proof for their existence.

11:55 : Invited talk

Perfect absorption with electric and magnetic lattice resonances

Luis Cerdán[1], **Juan Ramón Deop-Ruano**[2], **Juan José Alvarez-Serrano**[2], **Alejandro Manjavacas**[2]
[1] *IQF-CSIC (Spain),* [2] *IO-CSIC (Spain)*

We present a strategy to overcome the limitation impeding 2D periodic arrays sustaining lattice resonances to absorb more than half of the incident power. We exploit a couple dipole model to design arrays of metallo-dielectric nanoparticles supporting independent electric and magnetic lattice resonances that, once spectrally overlapped, afford perfect absorption.

12:15 : Controlling thermal state in many-body systems

Philippe Ben Abdallah
Université Paris-Saclay d'Optique (France)

We introduce new methods to actively control thermal states in many-body systems. We also explore the adiabatic evolution of thermal states in non-reciprocal systems, highlighting the emergence of a Berry phase that can either speed up or slow down the relaxation process, in contrast to the dynamical phase.

10:20 - 12:20 — Room 15

Session 2A4

Recent Advances in Nanophotonics and Metamaterials

Organized by: Andrea Fratalocchi

Chaired by: Ali Adibi

10:20 : Invited talk

Chip-scale Nanophotonic Technologies and Applications

Yeshaiahu Fainman
University of California San Diego (USA)

Dense photonic integration requires miniaturization of materials, devices, circuits and systems, including passive components (e.g., engineered composite metamaterials, filters, etc.), active components (e.g., modulators and nonlinear wave mixers) and integrated circuits (Fourier transform spectrometer, programmable phase modulator of free space modes, linear algebra processors, etc.).

10:40 : Invited talk

Functional UV metalenses

Thomas Krauss[1], **Augusto Martins**[1], **Roxanne Guenette**[2], **Kezheng Li**[1], **Emiliano R. Martins**[3]
[1] *University of York (United Kingdom),* [2] *University of Manchester (United Kingdom),* [3] *University of São Paulo (Brazil)*

The ability of metalenses to impose arbitrary phase profiles onto an optical wavefront continues to inspire new applications. Here, we explore the extension of the metalens paradigm into the UV and demonstrate two important applications, namely fluorescence detection at 350nm and VUV ($<$ 200nm wavelength) operation for particle physics applications.

11:00 : Invited talk

Metasurfaces in Laser Cooling and Trapping of Neutral Atoms Towards Quantum Information Processing & Quantum Sensing

Thu H. H. Le[1], **R. Takei**[1], **S. Kagami**[2], **A. Takamizawa**[1], **Y. Kurashima**[1]
[1] *The National Institute of Advanced Science and Technology (AIST) (Japan),* [2] *NEC-AIST Quantum Technology Cooperative Research Laboratory (Japan)*

This study reports a novel scheme of using geometric phase metasurfaces to prepare arrays of individual cold atoms. This method exploits the capabilities of metastructures in controlling the phase, amplitude and polarization states of light at sub-wavelength resolution to generate specific wavefronts necessary for cooling and trapping of alkali-metal atoms.

11:20 : Invited talk
Nonlinear generation of optical beams with orbital angular momentum on chi(2) dielectric films and metasurfaces
Laure Coudrat[1], Domenico De Ceglia[2], Rana Tanos[3], Jean-Michel Gérard[3], Costantino De Angelis[2], Aloyse Degiron[1], Giuseppe Leo[1]
[1] *Université Paris Cité (France),* [2] *University of Bresci (Italy),* [3] *Université Grenoble Alpes (France)*

We report on the generation of second-harmonic vortices with either a uniform film or an optical metasurface, fabricated in a hybrid AlGaAs-on-sapphire platform. In the former case we demonstrate spin-to-orbital angular momentum transfer, while in the latter we generate orbital angular momentum with arbitrary topological charge via a nonlinear meta-hologram.

11:40 : Invited talk
Topological phenomena and OAM manipulation in photonic graphene
Zhigang Chen
Nankai University (China)

In this talk, I will present a few examples of our recent demonstrations on topological control and manipulation of OAM modes in photonic graphene-like structures, including topological singularity mapping that leads to stair-wise generation of OAM beams and topological protection of OAM transport.

12:00 : Invited talk
THz metamaterial-based devices and ultrafast modulators
Stelios Tzortzakis
FORTH (Greece)

2D and 3D metamaterial-based devices are shown to control passively and actively the properties of broadband THz radiation. Broadband polarization control and ultrafast self-induced amplitude modulation are demonstrated.

10:20 - 12:35 — Room 7

Session 2A5

Electromagnetic Metasurfaces for Microwave, Terahertz, and Optical Applications

Organized by: Mario Ferraro, Walter Fuscaldo and Fabio Mangini

Chaired by: Walter Fuscaldo and Fabio Mangini

10:20 : Invited talk
Metasurfaces enhanced with 2D photonic materials: Analysis based on quasinormal modes
Thomas Christopoulos[1], Georgios Nousios[2], Emmanouil Kriezis[2], Odysseas Tsilipakos[1]
[1] *National Hellenic Research Foundation (Greece),* [2] *Aristotle University of Thessaloniki (Greece)*

Two-dimensional photonic materials exhibit tunable linear and nonlinear properties. They can be incorporated in metasurfaces to enable novel functionalities. Here, we study 2D-material-enhanced metasurfaces for THz and near-infrared frequencies. The analysis is performed with a novel multimode framework based on the quasinormal modes supported by these non-Hermitian systems.

10:40 : Invited talk
Gradient and Modulated Metasurfaces for Sub-Terahertz Antenna Systems
David Gonzalez Ovejero, Malo Robin, Xavier Morvan, Olivier de Sagazan
Université de Rennes (France)

This paper discusses the application of modulated metasurfaces in the sub-THz range, presenting the motivation for adopting this solution, addressing some of its drawbacks, and exploring possible solutions. In particular, we focus on multi-port architectures for enhancing the bandwidth. The architecture and technological solutions for its implementation are succinctly introduced.

11:00 : Invited talk

Terahertz characterization of thin resistive films and homogenized reactive metasurfaces via reflection time-domain spectroscopy

Dimitrios Zografopoulos[1], Francesco Maita[1], Luca Maiolo[1], Irnik Dionisiev[2], Nikolay Minev[2], Gaetana Petrone[1], Silvia Tofani[1], Tiziana Ritacco[1], Dimitre Dimitrov[2], Vera Marinova[2], Andrea Liscio[1], Valentina Mussi[1], Romeo Beccherelli[1], Walter Fuscaldo[1]

[1] *CNR-IMM (Italy),* [2] *Bulgarian Academy of Sciences (Bulgaria)*

We present a detailed study for the broadband terahertz characterization of thin films and homogenized metasurfaces based on the Gires-Tournois etalon configuration. Particular emphasis is given to two case studies, purely resistive or purely reactive films, and the sensitivity and overall performance of measuring their sheet resistance and reactance, respectively.

11:20 : Invited talk

Gain and Impedance Bandwidth Enhancement in Fabry-Perot Cavity Leaky-Wave Antennas Based on Metasurfaces

Edoardo Negri[1], Walter Fuscaldo[2], Paolo Burghignoli[1], Alessandro Galli[1]

[1] *Sapienza University of Rome (Italy),* [2] *Consiglio Nazionale delle Ricerche (Italy)*

Recently the gain bandwidth of Fabry-Perot cavity antennas (FPCAs) has been greatly enhanced by using metasurfaces with dielectric covers. To ensure the wideband behavior, the impedance bandwidth must be enlarged as well. Thus, an efficient technique is here proposed to design an FPCA with enhanced gain and impedance bandwidths.

11:40 : Invited talk

An overview of advanced techniques for design and synthesis of nondiffractive Bessel beams in near-field

Santi Concetto Pavone

University of Catania (Italy)

In this contribution, an overview of the techniques and methods to synthesize and radiate nondiffractive Bessel beams is presented, spanning from solutions in the optical regime to others at microwaves and millimeter waves, by considering also applications.

12:00 : Invited talk

Modal Analysis Glide-Symmetric Open Structure

Davide Comite[1], Guido Valerio[2], Yuhuan Tong[2]

[1] *Sapienza University (Italy),* [2] *Sorbonne Université (France)*

We propose dispersive studies of an all-metal glide-symmetric corrugated waveguide open with thin slots.

12:20 : Reflective Moiré Metasurfaces: A Frontier of Innovation and Technical Challenges

Shuo Liu, Lei Zhang, Xiaoqing Chen

Southeast University (China)

Reflective Moiré metasurface provides an economical approach for dynamic beamforming in RIS applications, introducing novel methods for far-field scattering synthesis through compact, ultrathin metallic patterns with diverse symmetries. This breakthrough is expected to have widespread impact across the fields of electromagnetics, antenna development, and wireless communication.

Lunch

12:30 - 14:00

14:00 - 15:00 — Room 38

Session 2A6

Conference Tutorial

14:00 : Tutorial
Virtual experiments and alternative formulations for effective of solution inverse scattering problems
Lorenzo Crocco
IREA-CNR (Italy)

In this tutorial, an overview of the difficulties inherent to the non-linear and ill-posed nature of the inverse scattering problems will be given first. Then, some recent results aiming at addressing the challenges posed by the non-linearity will be reviewed.

15:00 - 16:00 — Room 38

Session 2A7

Recent Advances in Nanophotonics and Metamaterials

Organized by: Andrea Fratalocchi

Chaired by: Thomas Krauss

15:00 : Invited talk
Advances in optically-tunable metasurfaces
Dmitrii Pidgaiko, I. Staude
Friedrich Schiller University Jena (Germany)

Here we present our advances with all-optical tunable metasurfaces with different approaches. Tunable metasurfaces, using organic photoswitches or liquid crystals, enable spatially variant optical responses. Additionally, a cascaded meta-optical system achieves ultrafast, all-optical switching for diverse wavefront manipulations, promising advancements in various applications.

15:20 : Invited talk
Integrated Phased Array Antenna Using Phase Change Material
Rahuldas Kutteeri[1], Martino De Carlo[1], Francesco De Leonardis[1], Richard Soref[2], Vittorio Passaro[1]
[1] *Politecnico di Bari (Italy),* [2] *University of Massachusetts (USA)*

Tunable true time delay is achieved by manipulating Bragg grating resonators (BGRs) with phase-changing materials, thereby realizing programmable on/off reflectors. By programming these reflectors placed at specific positions, a time delay in optical signals is induced, enabling $\sim$1550 nm beam steering in microwave phased array antennas.

15:40 : Invited talk
Hybridized Silicon Metasurface with Two-Dimensional Nanomaterials for Perfect Absorption
Junichi Takahara
Osaka University (Japan)

We study hybridized silicon metasurface with atomically-thin two-dimensional nanomaterials to enhance the absorption. We design Mie resonators based on degenerate critical coupling principle and demonstrate the enhancement of absorptivity of exciton mode at visible range in transition-metal dichalcogenide (WS2) as well as perfect absorption of graphene at 1550nm.

14:00 - 16:00 — Room 17

Session 2A8

Advanced Techniques for Computational Electromagnetics

Organized by: Maha Ben Rhouma

Chaired by: Owen Miller

14:00 : Invited talk
Analog computing with nonlinear flat optics
Costantino De Angelis
University of Brescia (Italy)

Digital signal processing has revolutionized many fields of science and engineering, but it still shows critical limits, a long-sought solution is optical analog computing. We demonstrate here that nonlinear phenomena combined with engineered nonlocality in flat optics can be leveraged to synthesize Volterra kernels able to outperform linear devices.

14:20 : Invited talk
Efficient FEM simulation of resonance modes of VCSELs
Lilli Kuen[1], Martin Hammerschmidt[2], Philipp-Immanuel Schneider[2], Lin Zschiedrich[2], Sven Burger[1]
[1] *Zuse Institute Berlin (Germany),* [2] *JCMwave GmbH (Germany)*

We present convergence investigations for VCSELs with rotational symmetry and of full 3D geometries. The aim is to obtain parameters for the numerical setup, that allow for accurate and efficient simulations. These parameters can then be used to reliably find the fundamental mode, which is e.g. required for optimization.

14:40 : Invited talk
All-dielectric epsilon-near-zero Bragg-wall microcavities with tailored coupling efficiency and figure of merit
Mikko Huttunen, Ali Panahpour, Jussi Kelavuori
Tampere University (Finland)

All-dielectric microcavities based on Bragg reflection waveguides (BRWs) operating near their cutoff frequencies are introduced as high figure of merit epsilon-near-zero (ENZ) structures. The structures exhibit ultra-low losses and facilitate coupling of light inside the ENZ media.

15:00 : Invited talk
Chiral waveguides and exceptional points
Alice De Corte[1], Mondher Besbes[2], Henri Benisty[2], Stefanos Koufidis[3], Martin McCall[3], Bjorn Maes[1]
[1] *University of Mons (Belgium),* [2] *Université Paris Saclay (France),* [3] *Imperial College (United Kingdom)*

In chiral waveguides with gain and loss, we report coupling between TE and TM modes leading to interesting dispersion patterns of avoided crossings and symmetry-broken zones. Additionally, even without gain and loss, we obtain backward modes via exceptional points in waveguides with a large chirality.

15:20 : Invited talk
Wave propagation in four-dimensional media: effective media in space and time and cascaded frequency conversion
Victor Pacheco-Peña[1], Nader Engheta[2]
[1] *Newcastle University (United Kingdom),* [2] *University of Pennsylvania (USA)*

We will discuss how effective medium concepts can be translated from space to the time domain and further extended to space and time via space-time interfaces. Cascaded dielectric slab waveguides with induced time interfaces of their cladding will also be discussed along with their potential for cascaded frequency conversion.

15:40 : Invited talk
The Dawn of global optimization in photonics and electromagnetics ?
Pauline Bennet[1], Abdourahman Khaireh-Walieh[2], Denis Langevin[1], Olivier Teytaud[3], Peter Wiecha[2], Antoine Moreau[4]
[1] *Université Clermont Auvergne (France),* [2] *Université de Toulouse (France),* [3] *Meta AI Research (France),* [4] *Clermont Auvergne University (France)*

Optimization is notoriously difficult for wave problems, because of the large number of resonances ineven the simplest structures. However, thanks to Moore's law and progress in rigorous benchmarking of globalalgorithms, it becomes possible to rely on such an approach to provide innovative designs.

14:00 - 16:00 — Room 15

Session 2A9

Advanced Antenna Systems: Modelling and Experiments

Organized by: Tatjana Gric

Chaired by: Tatjana Gric

14:00 : Invited talk
Physics-embedded machine learning method for the prediction of long-range electromagnetic field propagation
Thomas Bonnafont, Abdelmalek Toumi
ENSTA Bretagne (France)

We propose a sequential physics-embedded machine learning method to predict propagation over rural terrain. The training process uses artificial data computed by solving the parabolic wave equation. A fine-tuning strategy is also proposed, rendering the method versatile. Numerical simulations are provided to validate the proposed approach.

14:20 : Invited talk
Excitation of out-of-plane resonances at normal incidence
Juan R. Deop-Ruano[1], Juan J. Alvarez-Serrano[1], Vincenzo Aglieri[2], Andrea Toma[2], Alejandro Manjavacas[1]
[1] *Instituto de Optica (IO-CSIC) (Spain),* [2] *Istituto Italiano di Tecnologia (Italy)*

Out-of-plane resonances are characterized by minimum radiative losses, high quality factors and strong electric field enhancements. Due to their nature, their excitation at normal incidence is elusive. Here, we explore the excitation of out-of-plane lattice resonances at normal incidence in periodic arrays of metallic nanostructures

14:40 : Invited talk
Real-time Spectroscopy of Broadband THz-wave with High Frequency Resolution
Sota Mine[1], Kodo Kawase[1], Chiko Otani[2], François Blanchard[3]
[1] *Nagoya University (Japan),* [2] *RIKEN (Japan),* [3] *École de Technologie Supérieure (Canada)*

By implementing THz parametric detection, wherein THz-waves are converted to a near-infrared beam, we have facilitated the realization of one-shot spectroscopy of broadband THz-waves. The precision of frequency resolution has been augmented significantly via the non-collinear phase matching condition.

15:00 : Invited talk
On the use of the parabolic wave equation to model the electromagnetic propagation in maritime environment
Thomas Bonnafont, Ali Khenchaf
ENSTA Bretagne (France)

Modeling the long-range propagation in a maritime environment is a challenging problem since many physical phenomena shall be accounted for, such as refraction, or waves. Here a model based on the parabolic wave equation solved with split-step wavelet that allows obtaining accurate simulations is proposed.

15:20 : Invited talk
Non-Hermitian Metasurfaces for Sensitive THz Systems
Teun-Teun Kim
University of Ulsan (Korea)

We introduce highly sensitive THz systems, comprising non-Hermitian THz active polarization diodes and

ultra-sensitive biochemical sensors. These systems are realized by combining graphene and microfluidic channels with non-Hermitian metallic metasurfaces with a complex refractive index.

15:40 : Invited talk
Reconfigurable Intelligent Surface as a MIMO
Sotiris Droulias, Giorgos Stratidakis, Angeliki Alexiou
University of Piraeus (Greece)

The Reconfigurable Intelligent Surface (RIS) is often treated as a collection of point scatterers or as a continuous radiating surface. In this work we explore the connection between the two approaches, for applications in near-field wavefront engineering with large apertures, including holographic MIMO technologies and large antenna arrays.

14:00 - 16:00 — Room 7

Session 2A10

Recent Advances in Nanophotonics and Metamaterials

Organized by: Andrea Fratalocchi

Chaired by: Yeshaiahu Fainman

14:00 : Invited talk
Mid-infrared dielectric antennas on epsilon-near-zero material for sensing
Paolo Biagioni[1], Francesco Rusconi[1], Pierre Felhen[2], Fernando Gonzalez-Posada[2], Laurent Cerutti[2], Giovanni Pellegrini[3], Marco Finazzi[1], Thierry Taliercio[2]
[1] *Politecnico di Milano (Italy),* [2] *Montpellier University (France),* [3] *Università di Pavia (Italy)*

We introduce a sensing platform based on mid-infrared dielectric antennas engineered on a heavily doped semiconductor acting as an epsilon-near-zero material, which is employed to improve the conditions for efficient light confinement and sharp localized resonances in dielectric antenna resonators. We benchmark the system with surface-enhanced infrared absorption experiments.

14:20 : Invited talk
Crystallization of Induce Optical Vortex by Bessel Beams
Sahil Sahoo, Yuri Gorodetski
Ariel University (Israel)

The process of optical vortex formation through interference patterns culminates in the creation ofan optical vortex lattice. Our study illustrates the gradual emergence of optical vortices and their crystallizationwithin the array. This phenomenon is exemplified through the implementation of a Bessel beams array on the plasmonic metasurface.

14:40 : Invited talk
The nanofabrication and unique properties of 3D metamaterials
Changzhi Gu
Chinese Academy of Sciences (China)

We develop the focused ion beam stress-induced method for achieving 3D nanofabrication techniques, and realize flexible modulation of photons by utilizing origami metamaterials. The research results have significantly enhanced the processing capacity of 3D nanostructures while providing valuable insights into efficient modulation and broad application possibilities for nanophotonics devices.

15:00 : Invited talk
Liquid Crystal Thin Films for Low-Cost Large-Area Diffractive Optical Gratings with Excellent Efficiency
Kristiaan Neyts[1], M. Stebryte[2], F. Van Acker[2], S. Liu[2], X. Ke[1], I. Nys[2]
[1] *Hong Kong University of Science and Technology (Hong Kong),* [2] *Ghent University (Belgium)*

Liquid crystals are soft materials which self-organize in 3D structures that may have a photonic band gap that in the visible range. Variable boundary conditions at the surfaces that enclose the liquid crystal layer can encode a geometric phase, leading to diffractive optical elements with very high efficiency.

15:20 : Invited talk
Anisotropic polaritons in van der Waals layered crystals
Andrea Mancini, Nicola Melchioni, Giacomo Venturi, Stefano Chiodini, Antonio Ambrosio
Italian Institute of Technology (Italy)

Hyperbolic polaritons, stemming from the hybridization of light and excitations in highly anisotropic materials, exhibit intriguing properties such as directional propagations and negative refraction. Strongly confined polaritons in van der Waals crystals have recently attracted considerable attention for novel applications in energy-efficient photonics, nanoscale routing of light, and vibrational sensing.

15:40 : Invited talk
Finite Difference Numerical Package for Multiphysics Simulations of Nanophotonic Systems
M. Tamagnone, H. Gupta, T. Contino, M. A. Yaqub, M. W. Ashraf
Istituto Italiano di Tecnologia (Italy)

We present a new numerical finite difference numerical package capable of handling periodic driven or eigenvalue linear problems in an arbitrary number of dimensions and with user-defined physical laws (e.g. Maxwell's or Schrodinger's equations). We then illustrate the applications to experimental nanophotonic devices and highly confined polaritons in 2D materials.

Coffee Break

16:00 - 16:30

16:30 - 17:50 — Room 38

Session 2A11

Recent Advances in Nanophotonics and Metamaterials

Organized by: Andrea Fratalocchi

Chaired by: Arkadii Krokhin

16:30 : Invited talk
Tunable Bound States in the Continuum in Magneto-Optic and Graphene Metasurfaces
Jose L. Pura[1], Juan R. Deop-Ruano[2], Diego R. Abujetas[3], Alejandro Manjavacas[2], V. Giannini[2], Antonio Garcia-Martin[2], Jose A. Sanchez-Gil[2]
[1] *Universidad de Valladolid (Spain),* [2] *CSIC (Spain),* [3] *Universidad de Castilla La Mancha (Spain)*

Bound states in the continuum (BICs) emerging in planar particle arrays (metasurfaces) have attracted-much interest lately in photonics. In this work, magnetic and electric means to actively manipulate two kinds ofsymmetry-protected BICs are presented on the basis of either magneto-optic or graphene meta-atoms.

16:50 : Invited talk
Magnetic control of electrically uncharged magneto-optical particles
Manuel Marques[1], Shulamit Edelstein[2], Pedro A. Serena[2], Beatriz Castillo Lopez de Larrinzar[3], Antonio Garcia Martin[3]
[1] *Universidad Autonoma de Madrid (Spain),* [2] *ICMM-CSIC (Spain),* [3] *CSIC (Spain)*

In this work we present a method to perform magnetic control of electrically uncharged particles based on magneto-optical materials illuminated by a spinning monochromatic light field. We analyze the behavior of these particles under different isotropic optical configurations, and we calculate the value of the induced

magnetic charge.

17:10 : Invited talk
Pushing the Limit of Multiplexing Capacity in Optical Metasurfaces
Yongmin Liu
Northeastern University (USA)

We apply both physics-guided and data-driven approaches to push the limit of multiplexing capacity in optical metasurfaces. As a result, a single metasurface can generate distinct functions, such as holograms and focusing lenses, by varying the wavelength and polarization of the incident light.

17:30 : Invited talk
Tailoring the emission and the photodynamics of quantum emitters with simple and optimized high-index dielectric nanostructures
Mélodie Humbert[1], Romain Hernandez[1], Peter R. Wiecha[1], Jonas Muller[1], Etienne Palleau[1], Frank Fournel[2], Vincent Larrey[2], Aurélie Lecestre[1], Guilhem Larrieu[1], Christian Girard[1], Vincent Paillard[1], Laurence Ressier[1], Aurelien Cuche[1]
[1] *Université de Toulouse (France),* [2] *Université Grenoble Alpes (France)*

Through experimental and theoretical methods, we demonstrate the controllable photodynamics of quantum emitters (NV colored centers in nanodiamonds) precisely positioned near silicon dimer nanoantennas using AFM nanoxerography. Then, by designing specific geometries with an evolutionary optimization algorithm, we explore enhancing the directional emission of these quantum sources numerically.

16:30 - 17:50 — Room 17

Session 2A12

Advanced Techniques for Computational Electromagnetics

Organized by: Maha Ben Rhouma

Chaired by: Riccardo Messina

16:30 : Invited talk
The optimal dielectric near-field antenna
Owen Miller
Yale University (USA)

What is the maximum Purcell enhancement of a dielectric antenna? For minimum feature size d, we propose a surprising scaling law $1/d^r$, with $r \leq 2$ strongly dependent on material permittivity. Conventional bowties approach these limits. A novel three-material, dual-polarizability design outperforms the two-material bound, offering orders-of-magnitude improvements.

16:50 : Invited talk
New generation of photonic simulation with hardware accelerated FDTD and automatic differentiation
Zongfu Yu
Flexcompute Inc (USA)

Future research and development will increasingly rely on computer simulation technology. In the field of optics and photonics, a new generation of hardware and software technology is making electromagnetic simulation more powerful than ever.

17:10 : Invited talk
Multi-channel optics: thickness bound, efficiency bound, and designs that reach them
Chia Wei Hsu
University of Southern California (USA)

We show that once the functionality of a multi-channel optical system is specified, one can determine its minimal thickness and maximal transmission efficiency by analyzing its target transmission matrix. By inte-

grating these bounds into the design process, we come up with inverse-designed high-numerical-aperture wide-field-of-view metalenses with record-breaking efficiencies.

17:30 : Invited talk
Metasurfaces with Angular Invariant Scattering
Karim Achouri
EPFL (Switzerland)

We demonstrate that, under specific conditions, the response of a metasurface may become invariant with respect to the angle of wave propagation. This is due to relationships between electric and magnetic responses, reminiscent of the Kerker conditions, that were derived using a zero-thickness model and are supported by numerical verifications.

16:30 - 17:30 — Room 15

Session 2A13

Advanced Antenna Systems: Modelling and Experiments

Organized by: Edik U. Rafailov and Tatjana Gric

Chaired by: Tatjana Gric

16:30 : Invited talk
Tuneable plasmonics and nanoantennas based on in-plane hyperbolic conducting polymers
Yulong Duan, Aiman Rahmanudin, Shangzhi Chen, Nara Kim, Klas Tybrandt, Magnus P. Jonsson
Linköping University (Sweden)

Plasmonic nanoantennas with polarization-dependent resonances have widespread application in photonics, yet their design has been limited to antennas with anisotropic shapes such as nanorods. We proposed an alternative approach to overcome this limitation, wherein shape-symmetric nanoantennas are fabricated from aligned conductive polymer materials possessing anisotropic permittivity.

16:50 : Invited talk
Controllable polarization emission laser based on chiral metasurfaces
Ioannis Katsantonis[1], Anna Tasolamprou[1], Thomas Koschny[2], Maria Kafesaki[1]
[1] *University of Crete (Greece),* [2] *Iowa State University (USA)*

We present an ultracompact lasing structure able to provide dynamically controllable polarization emission, ranging from linear to circular and from left-handed circular to right-handed circular. The structure is based on a properly designed chiral metasurface combined with a gain material (dye molecules).

17:10 : Invited talk
Nano-thermoelectric infrared detectors
A. Varpula[1], A. Murros[1], O. Merchiers[2], K. Sovanto[1], J. Tiira[1], K. Tappura[1], P.-O. Chapuis[1], Mika Prunnila[1]
[1] *VTT Technical Research Centre of Finland (Finland),* [2] *Université de Lyon (France)*

Infrared radiation detection is required in numerous applications from spectroscopic gas sensing to thermal imaging. By combining nano-thermoelectric heat-to-voltage transduction and sub-wavelength absorbers, we demonstrate uncooled IR bolometer technology that provides fast and high sensitivity response to long-wavelength IR (LWIR) and is material-compatible with large-scale CMOS fabrication.

16:30 - 17:50 — Room 7

Session 2A14

Recent Advances in Nanophotonics and Metamaterials

Organized by: Andrea Fratalocchi

Chaired by: Mikko Huttunen

16:30 : Invited talk
Elastic Wave Focusing and Optomechanical Coupling in a Nano-Opto-Electro-Mechanical Device
A. Gueddida, L. Carpentier, G. Lévêque, Y. Pennec, Bahram Djafari Rouhani
IEMN (France)

We study theoretically an optomechanic cavity inside a phoxonic nanobeam. The acoustic cavity mode is excited by an IDT structure in front of the nanobeam. Our results concern the design of a metasurface to focus the acoustic wave into the nanobeam and the search of high frequency (10GHz) cavity phonons.

16:50 : Invited talk
Linear Frequency Generation in Time-Varying Dispersive Interfaces
Carlo Rizza[1], M. A. Vincenti[2], A. Contestabile[1], G. Castaldi[2], V. Galdi[3], M. Scalora[4]
[1] *University of L'Aquila (Italy),* [2] *University of Brescia (Italy),* [3] *University of Sanni (Italy),* [4] *U.S. Army CCDC (USA)*

We suggest a new scheme for linear frequency generation in a time-varying dispersive metasurface. The effect is activated by a temporal boundary enabling the excitation of the system's natural frequencies. Remarkably, the temporal boundary allows the direct far-field excitation of surface-wave modes without additional spatial structuring or prolonged temporal modulations.

17:10 : Invited talk
Electron-Plasmon Interactions in Nanoplasmonics: Fundamentals and Applications
P. André D. Gonçalves, F. Javier García de Abajo
ICFO - The Institute of Photonic Sciences (Spain)

We exploit the interaction between free electrons and surface plasmons to unveil quantum nonlocal effects in nanoplasmonics and retrieve the quantum surface response of metals. In addition, we show that electron-plasmon interactions can be leveraged to resolve the ultrafast dynamics of plasmons imprinted on the photoemission spectrum from nanostructures.

17:30 : Invited talk
Strong termination dependence of quasi-BIC's lifetime and frequency in plasmonic double-nets
Cedric Schumacher, Bilel Abdennadher, Ullrich Steiner, Matthias Saba
University of Fribourg (Switzerland)

Plasmonic double-nets (PDNs) - or interlaced wire media - support broadband, single-mode longitudinal dispersion that gives rise to quasi-BIC resonances with extreme lifetime in PDN slabs. We show why the quasi-BIC resonance frequency and quality factor strongly depend on the slab termination, providing critical insight towards the application of PDNs.

Conference Dinner

20:00 - 22:30

Thursday 27th June, 2024

8:30 - 10:20 — Room 38

Session 3A1

Recent Advances in Nanophotonics and Metamaterials

Organized by: Andrea Fratalocchi

Chaired by: Taiichi Otsuji

08:30 : Keynote talk
Scalable semiconductor photonic systems
Jelena Vuckovic
Stanford University (USA)

Recent breakthroughs in photonics design, along with new nanofabrication approaches and heterogeneous integration play crucial roles in building photonics for applications including optical interconnects and quantum technologies.

09:00 : Invited talk
Cylindrical vector beams for control of light emission of quantum emitters coupled to silicon nanoantennas
M. Montagnac[1], J-M. Poumirol[1], A. Cuche[1], Y. Brûlé[2], G. Colas des Francs[2], J. Müller[1], G. Larrieu[1], V. Larrey[3], F. Fournel[3], O. Boisron[4], B. Masenelli[4], G. Agez[1], Vincent Paillard[1]
[1] *Université de Toulouse (France),* [2] *Université de Bourgogne (France),* [3] *Université Grenoble-Alpes (France),* [4] *Université de Lyon (France)*

Cylindrical vector beams with azimuthal or radial polarization are used to engineer the near field of silicon nanoantennas, thus shaping the photoluminescence of quantum emitters (europium ions) positioned in the vicinity of those silicon nanontennas. The experimental mappings are in good agreement with the calculated near-field.

09:20 : Invited talk
Enhancing Electric and Magnetic Light-Matter Interactions with Plasmonic Nanoantennas
Sebastien Bidault
Université PSL (France)

Using DNA nanotechnology and scanning probe microscopy, we demonstrate that a strong coupling regime can be reached between quantum emitters and a gold nanoantenna at room temperature, but also that the magnetic component of light-matter interactions can be manipulated for lanthanide ions in the near-field of a plasmonic cavity.

09:40 : Invited talk
Moderate-refractive-index nanoantennas for QD fluorescence enhancement
Rafael Ramos, Angela Barreda, Braulio Garcia-Camara
Carlos III University of Madrid (Spain)

Single-photon sources are promising devices due to its importance in applications such as quantum devices. Improvements on the excitation and emission efficiencies are required. In this work, we design resonant nanostructures based on both plasmonic and moderate-refractive-index materials to manage photons at the excitation and emission wavelengths of quantum dots

10:00 : Invited talk
Backward terahertz-wave parametric oscillation and its innovation
Hiroaki Minamide
RIKEN (Japan)

A high-brightness sub-terahertz-wave parametric oscillation with a peak power of 200 W has been successfully demonstrated, which is based on an originally design of slant-stripe-type periodically-poled lithium niobate. It has an ultra-wide frequency tunability of several hundred GHz and can be widely used for nondestructive testing applications.

8:30 - 10:35 — Room 17

Session 3A2

Advanced Techniques for Computational Electromagnetics

Organized by: Maha Ben Rhouma

Chaired by: Costantino De Angelis

08:30 : Invited talk
Fast and Efficient Design-by-Optimization of Complex Microwave Devices Using Novel FEM Techniques
Michał Baranowski[1], Adam Lamecki[1], Lukasz Balewski[2], Michal Mrozowski[1]
[1] *Gdansk University of Technology (Poland),* [2] *EM Invent Ltd. (Poland)*

This paper presents novel techniques for fast and efficient FEM-based optimization of microwave devices of arbitrary shape. These techniques include model order reduction, zero-pole optimization, and mesh deformation. They overcome the challenges of computational cost and geometry representation, and enable a complete design-by-optimization closure of a microwave product development.

08:50 : Invited talk
Optimal design of sub-relativistic dielectric particle accelerators
Roberta Palmeri[1], Giorgio Sebastiano Mauro[2], Giuseppe Torrisi[2], Nunzio Salerno[3], Gino Sorbello[3]
[1] *Università Mediterranea di Reggio Calabria (Italy),* [2] *Istituto Nazionale di Fisica Nucleare (Italy),* [3] *University of Catania (Italy)*

A simple and effective approach is proposed for optimal design of sub-relativistic particle accelerators. It relies on a physics-based procedure guarantying the particle-wave synchronicity in a slot waveguide without introducing approximation on the accelerating field. The final design is compared with a previous design based on constant accelerating field approximation.

09:10 : Keynote talk
Scalar wave solutions to a 3D electromagnetic vector wave problem
Che Ting Chan
Hong Kong University of Science and Technology (Hong Kong)

We showed that some 3D photonic crystals have scalar-wave-like band dispersions. These crystals feature topological surface states with high-Q within the light cone continuum. As such, the surface states in our 3D nested crystals can be exposed directly to air, making such systems well-suited for practical applications.

09:40 : Invited talk
Computational Electromagnetics in Atomic Scale: First-Principles Approach
Takashi Takeuchi[1], Mitsuharu Uemoto[2], Kazuhiro Yabana[3]
[1] *RIKEN (Japan),* [2] *Kobe University (Japan),* [3] *University of Tsukuba (Japan)*

We develop a computational electromagnetics method that describes light propagation in atomic scale coupling first-principles electron dynamics calculation and Maxwell equations for light propagation. We apply the method for various nonlinear and/or nonlocal optical phenomena where quantum electronic motion is significant, including plasmonic and semiconductor meta-surfaces.

10:00 : Excitation engineering-based fault diagnosis of phased antenna arrays
Uday K Khankhoje, Prajosh K P, Sreekar Sai Ranganathan, Francesco Ferranti
Vrije Universiteit Brussel (Belgium)

Recent results in the area of fault diagnosis of phased array antenna arrays will be discussed. These results are based on the use of a single fixed measurement location and the optimization of the excitations of the antenna elements of the array based on compressed sensing concepts.

10:15 : Invited talk
A FEM-IE and FEM-FEM domain decomposition approach to solve non-matching multi-scale domains
Juliano Mologni, Kezhong Zhao
Ansys Inc. (USA)

The presented approach decomposes the original model into an unlimited number of FEM and optionally IE domains. The meshes on the interface can be non-matching, enabling the simulation of multi-scale problems such as an IC on a package on a PCB or an antenna on a platform.

8:30 - 10:25 — Room 15

Session 3A3

Nonlinear Fiber Optics Towards Applications

Organized by: Mario Ferraro and Fabio Mangini

Chaired by: Mario Ferraro and Fabio Mangini

08:30 : Invited talk
Linear and nonlinear optics in hollow-core photonic crystal fibres
Francesco Tani
Max Planck Institute for the Science of Light (Germany)

In the first part, I will present our recent results on the development of soliton-based sources of ultrashort pulses with tunable wavelengths across broad spectral ranges. I will then discuss twisted hollow-core anti-resonant fibres, our latest numerical and experimental findings, and a specific design to enhance the topological properties.

08:50 : Invited talk
Relocation of a Townes soliton dedicated to ultrafast 3D imaging
Nick Bagley[1], Tigran Mansuryan[2], Lucie Chretien[2], Remy Boulesteix[2], Yago Arosa Lobato[3], Mario Ferraro[4], Mario Zitelli[4], Fabio Mangini[4], Yifan Sun[4], Katarzyna Krupa[5], Benjamin Wetzel[2], Vincent Couderc[2], Stefan Wabnitz[4], Alejandro Aceves[1], Alessandro Tonello[2]
[1] *Southern Methodist University (USA),* [2] *Université de Limoges (France),* [3] *University of Santiago de Compostela (Spain),* [4] *Sapienza University (Italy),* [5] *Polish Academy of Sciences (Poland)*

By leveraging the power dependent behavior of the spatial self-focusing, we realize an ultrafast focusing adjustment in a nonlinear microspectroscopy system. Temporal shaping and encoding of incident pulse enable us to construct a 3D image of an object by implementing a single 2D scan.

09:10 : Invited talk
Application of supercontinuum laser system for a $\chi(2)$ and $\chi(3)$ characterization of biomedical structure
Claire Lefort, M. Nafa, T. Mansuryan, C. Carrion, A. Tonnello, Jean-René Duclère, V. Couderc
Université de Limoges (France)

Supercontinuum laser sources are already well established for characterization in the life sciences. In the XLIM laboratory, we are using supercontinuum sources produced by spectral broadening in optical fibers in nonlinear microscopy to characterize second and third order non-linearities in biomedical structures. The main biomedical characterization results are presented.

09:30 : Invited talk
Nonlinear Interactions of Ultrafast Pulses between Higher Order Modes in Step-Index Optical Fibers
Lars Rishøj, Andrea Arduin, Jesper Lægsgaard

Technical University of Denmark (Denmark)

We demonstrate high-energy frequency conversion of ultrafast pulses from an Yb-doped fiber laser by utilizing higher order modes in a simple step-index fiber. Using a combination of soliton self-frequency shifting, soliton self-mode conversion, and dispersive wave generation we generate pulses with wavelengths ranging from 560 nm to 1587 nm.

09:50 : Invited talk
Extension of the fundamental four wave-mixing model to large bandwidth systems
Anastasiia Sheveleva, Pierre Colman, Christophe Finot
Université de Bourgogne (France)

While retaining the nominal three-wave framework used for the fundamental four-wave mixing dynamics, we extend it using second order perturbation theory in order to include the impact of higher order sidebands. We discuss then the mechanisms at the origin of the divergence of intermediate systems from the ideal model.

10:10 : Soliton Self-Frequency Shift in Nitrogen-Filled Hollow Fiber
Yishai Eisenberg[1], Yi-Hao Chen[1], Henry Haig[1], Enrique Antonio-Lopez[2], Rodrigo Amezcua-Correa[2], Frank Wise[1]
[1] *Cornell University (USA),* [2] *University of Central Florida (USA)*

Theoretical and experimental results of femtosecond pulse propagation in anti-resonant hollow-core fiber filled with nitrogen in the anomalous-dispersion regime are presented.

8:30 - 10:30 — Room 7

Session 3A4

Recent Advances in Nanophotonics and Metamaterials

Organized by: Andrea Fratalocchi

Chaired by: Christophe Couteau

08:30 : Invited talk
Nanoresonators and Metasurfaces for Enhanced Infrared/Terahertz Light-Matter Interaction
Luca Razzari
Centre Énergie Matériaux Télécommunications (Canada)

I will summarize our main findings on how structured surfaces can enhance radiation-matter interaction. This includes our studies on terahertz spectroscopy of low-dimensional materials and on infrared nonlinear processes in dielectric metasurfaces.

08:50 : Invited talk
Light-modulated van der Waals Force Microscopy
Benfeng Bai
Tsinghua University (China)

A novel scanning probe technique, named light-modulated van der Waals force microscopy, is developed by detecting the dynamic tip-sample van der Waals force. It can realize compositional imaging of nanomaterials (especially 2D materials) with an ultra-high spatial resolution of $\sim$10 nm far below the optical diffraction limit under ambient conditions.

09:10 : Invited talk
Gain-controlled nonlinearity and interactions in wave-based neuromorphic photonic systems
Giulia Marcucci[1], Luana Olivieri[2], Juan Sebastian Totero Gongora[2]
[1] *University of Glasgow (United Kingdom),* [2] *Loughborough University (United Kingdom)*

In this presentation, we analyse the optimal learning conditions for a gain-controlled, nonlinear wave reservoir computing system based on erbium-doped multimode fibres.

09:30 : Invited talk

Two-photon plasmon induced polymerization for the deterministic integration of single photon sources

Abdelrahman Abdelaal, Ali Issa, Dandan Ge, Aurélie Broussier, Christophe Couteau, Sylvain Blaize, Renaud Bachelot, Safi Jradi
UTT (France)

In this work, we report on the use of a hybrid and functionalized photopolymers to selectively integrate nano-emitters on specific preselected sites of plasmonic nano-antennas and optical waveguides by plasmon induced two-photon polymerization at the nanoscale.

09:50 : Invited talk

Near-field heat transfer in many-body systems: application to thermal management and energy harvesting

Philippe Ben Abdallah
Université Paris-Saclay d'Optique (France)

In this talk I will discuss some peculiarities of many-body systems to control the near-field radiative heat exchanges and to harvest near-field energy using pyroelectric conversion systems.

10:10 : Invited talk

Enhanced Light-Matter Interactions by engineered metal nanoantennas: Applications in Advanced Biosensing

Maria Grazia Manera, A. Colombelli, D. Lospinoso, R. Rella
CNR-IMM Lecce (Italy)

Design, fabrication, and characterization of engineered plasmonic nanostructures is here presented for the realization of sensitive and innovative biosensing transducers. Main attention will be dedicated to the recents results in plasmon-enhanced magneto-optic effects in the realization of innovative sensing platforms.

Coffee Break

Session 3P1
Poster Session III
10:30 - 11:00

P1: Non-contact Bio-molecules Sensing via Exceptional Transitions on Non-Hermitian Metasurfaces

Hyunwoo Park[1], Sodam Jeong[1], Heiji Son[1], Soojeong Baek[2], Teun-Teun Kim[1]
[1] *University of Ulsan (Korea),* [2] *KAIST (Korea)*

We report the detection of trace amounts of amyloid-beta (Aβ) protein using non-Hermitian metasurfaces integrated with microfluidic channels. An abrupt phase transition in cross-polarized transmission, highly sensitive near the exceptional point, introduces a new approach to identifying conductive biomolecules.

P2: New expression for the resonant frequency of rectangular microstrip antenna using genetic algorithm and effective parameters

Tarek Fortaki[1], Siham Benkouda[2], Ahmed Mahamdi[2], Sami Bedra[1]
[1] *University of Batna 2 (Algeria),* [2] *University of Frères Mentouri - Constantine 1 (Algeria)*

In this work, the cavity model for simple rectangular microstrip antenna is extended with some modifications to estimate the resonant characteristics of the antenna. The cavity model in conjunction with the genetic algorithm is using for the design of the antenna. Furthermore, the results are compared with those presented elsewhere.

P3: Resonant Characteristics of a Superconducting Thin Film Resonator Using the Two-Fluid Model and Artificial Neural Networks

Siham Benkouda[1], Tarek Fortaki[2], Abdelkrim Gadda[1], Sami Bedra[2]
[1] *University of Frères Mentouri - Constantine 1 (Algeria),* [2] *University of Batna 2 (Algeria)*

In this work, we are interested to predicted the resonant characteristics of superconducting microstrip resonator. Galerkin's procedure with Gorter-Casimir's theorem have been used for the numerical computation of

resonant frequency. In order to minimize the computing time, a neural approach has been introduced .

P4: Combined thermal and mechanical phenomena induced by the fluctuations of the electromagnetic field
Juan R. Deop-Ruano, Alejandro Manjavacas
Instituto de Optica (IO-CSIC) (Spain)

Casimir interactions and radiative heat transfer originate from the fluctuations of the electromagnetic field. In this work, we study the coupled transfer of momentum and energy in different nanoscale systems. We observe that the movement of the nanostructures allows us to control the heat transfer, and vice versa.

P5: A Variable 60 GHz Liquid Crystal Phase Shifter
Shreya Menon[1], Shahin Salarian[2], Dariush Mirshekar-Syahkal[2]
[1] *Cochin University of Science & Technology (India),* [2] *University of Essex (United Kingdom)*

A novel variable 60 GHz Liquid Crystal Phase Shifter has been proposed and investigated in this paper. Simulations suggest that this three-section phase shifter provides a reasonable differential phase shift of 85°+10° and has a transmission loss of not greater than 1 dB within 6 GHz band (59-64 GHz).

P6: Femtosecond Regenerative Amplifiers Based on Optical Fiber
Henry Haig, Nicholas Bender, Yishai Eisenberg, Frank Wise
Cornell University (USA)

Single-transverse-mode operation of a regenerative amplifier based on highly-multimode fiber is described. This approach to short-pulse generation achieves high performance and offers multiple opportunities for scaling to much higher peak power. In addition, it opens new opportunities to control pulse propagation and generation.

P7: Enhanced Electromagnetic Interference Shielding of Self-Supporting and Ultrathin Ferrite-Decorated Carbon Nanotube Film
Nilufer Cakmakci, Youngjin Jeong
Soongsil University (Korea)

Conventional EMI shielding materials need to be improved for new technologies. This study presents an ultrathin free-standing carbon nanotube film decorated with ferrite nanoparticles, demonstrating high electrical conductivity, good magnetic permeability, and enhanced shielding effectiveness. The film surpasses the commercial level and shielding effectiveness of copper in the same thickness.

11:00 - 12:40 — Room 38

Session 3A5

Recent Advances in Nanophotonics and Metamaterials

Organized by: Andrea Fratalocchi

Chaired by: Benfeng Bai

11:00 : Invited talk
Photonic Neuromorphic Computing
Frank Brueckerhoff-Plueckelmann[1], Jelle Dijkstra[2], Ivonne Bente[1], Wolfram Pernice[1]
[1] *University of Münster (Germany),* [2] *University of Heidelberg (Germany)*

Photonics enables multiple degrees of freedom for parallel data processing and unique circuit designs. We discuss computation schemes based on the incoherent superposition of optical pulses and show different applications. Exemplary, we present a prototype fabricated in the Silicon on Insulator platform for optical convolution processing.

11:20 : Invited talk
Wafer-scale structural coloration using gray-scale lithographic nanofabrication

Wen-Di Li, Z. F. Gan, C. W. Liang, Z. Sun, S. B. Huang
The University of Hong Kong (Hong Kong)

Gray-scale lithographic nanofabrication techniques, including gray-scale interference lithography using patterned secondary exposure, gray-scale etching and thin-film deposition using ultrafine metal masks, etc. are introduced to generate structural coloration over wafer-scale area.

11:40 : Invited talk
Inverse Design for wavelength and polarization multiplexing in optical metasurfaces
Bo Xiong, Wei Ma
Zhejiang University (China)

By introducing the engineered noise to the precise solution of Jones matrix elements, we break the fundamental limit of polarization multiplexing capacity of metasurfaces. We experimentally demonstrate up to 11 independent holographic images using a single metasurface illuminated by different polarizations.

12:00 : Invited talk
Electrochemically-tunable and light-emitting metasurfaces
Vivian Ferry
University of Minnesota (USA)

This talk will discuss two strategies for new, tunable metasurfaces. The first part of the talk will discuss the use of electrolyte gating to control the optical properties of materials, focusing on La1-xSrxCoO3-d as an exemplary case. The second part will discuss large-area fabrication methods for multilayer, flexible devices.

12:20 : Invited talk
System bath approach in nonlinear optical thermodynamics
Konstantinos Makris[1], **Georgios Pyrialakos**[2], **Demetrios Christodoulides**[2]
[1] *University of Crete (Greece),* [2] *University of Southern California (USA)*

In the framework of the new direction of nonlinear optics, that of optical thermodynamics, we provide an equilibrium statistical mechanics approach of weakly nonlinear systems. Moreover, by employing a system-bath approach we formulate a non-equilibrium statistical mechanics approach, based on Langevin, Fokker-Planck type of equations for the modal amplitudes.

11:00 - 12:40 — Room 17

Session 3A6

Advanced Techniques for Computational Electromagnetics

Organized by: Maha Ben Rhouma

Chaired by: Che Ting Chan

11:00 : Invited talk
Long-range super-Planckian heat transfer between nano-emitters in a resonant cavity
Kiryl Asheichyk[1], **Philippe Ben-Abdallah**[2], **Matthias Krüger**[3], **Riccardo Messina**[2]
[1] *Belarusian State University (Belarus),* [2] *Université Paris-Saclay (France),* [3] *Georg-August-Universität Göttingen (Germany)*

We study radiative heat transfer between two nano-emitters placed inside different types of closed cavities by means of a fluctuational-electrodynamics approach. We highlight a very sharp dependence of this transfer on cavity width and connect this to the matching between the material-induced resonance and the resonant modes of the cavity.

11:20 : Invited talk
Ubiquitous Analog Reservoir Computing: Modelling, Optimising, and Controlling Dynamics-Driven Hardware AI
Giulia Marcucci

University of Glasgow (United Kingdom)

This study explores the modelling, optimisation, and control of Analog Reservoir Computing (ARC) systems to advance energy-efficient hardware AI. Utilising complex wave propagation within diverse physical domains - nonlinear, random, and multimodal photonics, hydrodynamics, visual brain-computer interfaces, and quantum optics - this research aims to establish innovative ARC frameworks.

11:40 : Invited talk
From machine learning for design to fabrication of nanophotonic structures
Francesco Ferranti
Vrije Universiteit Brussel (Belgium)

In this talk, machine learning techniques for nanophotonics design will be presented where the concept of response features, adaptive frequency sampling, and feasible design space are discussed. Also, metasurfaces for imaging, communication, and bioimaging applications fabricated by two-photon polymerization and e-beam lithography, will be illustrated for multiple applications.

12:00 : Invited talk
Plasmonic Mid Infrared Photothermal Microscopy
Sahil Sharma[1], Joby Joseph[1], Qammer Abbasi[2], Hasan Abbas[2]
[1] *Indian Institute of Technology Delhi (India),* [2] *University of Glasgow (United Kingdom)*

Here, we introduce a novel mid-infrared photothermal microscopy technique leveraging surface plasmon resonance for heightened sensitivity. Pulsed infrared lasers trigger molecular vibrational absorption in cells, leading to localized temperature shifts and refractive index changes. This method enables high-resolution infrared spectroscopy within living cells, revolutionizing cellular imaging and advancing biomedical research.

12:20 : Invited talk
Variational approaches for light bullets characterization in nonlinear optics
Pedro Parra-Rivas, Yifan Sun, Stefan Wabnitz
La Sapienza University of Rome (Italy)

We show how variational approaches based on Ritz optimization techniques are fundamental for investigating and characterizing the formation and dynamics of spatiotemporal solitons, also known as light bullets, in nonlinear optical waveguides. In this work, we focus on soliton stabilization when considering simultaneously quadratic and quartic chromatic dispersion effects.

11:00 - 12:40 — Room 15

Session 3A7

Nonlinear Fiber Optics Towards Applications

Organized by: Mario Ferraro and Fabio Mangini

Chaired by: Mario Ferraro and Fabio Mangini

11:00 : Invited talk
Fundamental vibration dynamics of soliton complexes in ultrafast fiber laser
Anastasiia Sheveleva, Christophe Finot, Pierre Colman
Université de Bourgogne (France)

Mode decomposition techniques allow decomposing the Dispersive Fourier Transform signal of a soliton molecule in terms of elementary vibration modes. This technique based on correlation permits to aggregate into a global mode the individual evolutions of the pulses which constitute the soliton complexes, hence revealing a much richer dynamics.

11:20 : Invited talk
Breathing Soliton Dynamics in Laser Cavities
Sonia Boscolo[1], Junsong Peng[2], Xiuqi Wu[2], Ying Zhang[2], Christophe Finot[3], Heping Zeng[2]

[1] *Aston University (United Kingdom),* [2] *East China Normal University (China),* [3] *CNRS-Université de Bourgogne (France)*

We review our recent work on the dynamics of breathing solitons in ultrafast fibre lasers, including single breathers and breather molecular complexes, breather explosions, the synchronisation and de-synchronisation of breather complexes, the fractal dynamics of breathers, their transition to chaos, and their control by genetic algorithms.

11:40 : Invited talk
Optical fiber-based devices for sensing torsion, temperature and refractive index: from kW- to micro- and nano- scale applications
L. F. Granados-Zambrano[1], J. Korterijk[1], T. Verouden[1], F. Segerink[1], D. Jauregui-Vazquez[2], H. L. Offerhaus[1], J. A. Alvarez-Chavez[1]
[1] *University of Twente (The Netherlands),* [2] *CICESE (Mexico)*

Active and passive optical fiber-based devices are the core of research and development for a wide range of sensing applications. Results from our scientific developments on strain, temperature and refractive index in these areas will be presented and discussed, using both tapered and non-tapered optical fiber sections.

12:00 : Invited talk
Control and Optimization of Nonlinear Dynamics using Machine Learning
Goery Genty[1], M. Hary[1], L. Salmela[1], M. Mabed[2], A. Ermolaev[2], D. Bruner[2], J. M. Dudley[2]
[1] *Tampere University (Finland),* [2] *University of Franche-Comté (France)*

We review our recent work on the control and optimization of nonlinear dynamics in optical fiber systems using machine learning.

12:20 : Invited talk
Unexpected phase-locked Brillouin Kerr Frequency comb in fiber Fabry Perot resonators
Thomas Bunel[1], Matteo Conforti[1], Julien Lumeau[2], Antonin Moreau[2], Arnaud Fernandez[3], Olivier Llopis[3], Julien Roul[3], Auro M. Perego[4], Arnaud Mussot[1]
[1] *Universite de Lille (France),* [2] *Universite de Toulouse (France),* [3] *Centrale Marseille (France),* [4] *Aston University (United Kingdom)*

We investigate the unexpected phase-locked Brillouin Kerr Frequency comb in fiber Fabry Perot resonators. We show that an interplay between Brillouin and Kerr effect lead to a parametric gain that overlap with the nth cavity mode that trigger the process and lead to a broadband 10 The stable frequency comb.

11:00 - 12:40 — Room 7

Session 3A8

Recent Advances in Nanophotonics and Metamaterials

Organized by: Andrea Fratalocchi

Chaired by: Alessandro Tredicucci

11:00 : Invited talk
Sustainable photocatalysis with scalable plasmonic metasurfaces
Alberto Naldoni
University of Turin (Italy)

I will present recent results on the use of plasmonic metasurfaces in sustainable chemical reactions such ascarbon dioxide reduction, hydrogen production,fuel cell operation. The complex relationship between opticalresonances and chemical reactivity will be critically discussed being key to distinguish the reaction mechanism and toenhance their photochemical performance.

11:20 : Invited talk
Towards a full quantum photonics platform

Christophe Couteau[1], **Roy Konnoth Ancel**[1], **Surena Fatemi**[1], **Christoph Becher**[2], **Régis Deturche**[1], **Sylvain Blaize**[1]
[1] *Université de Technologie de Troyes (France),* [2] *Universität des Saarlandes (Germany)*

We recently witnessed progress in photonic platforms for quantum applications. Advances in material growth, defect passivation methods, and microfabrication technologies lead to the emergence of new materials. Integrated quantum photonics offers a promising avenue for optical quantum circuits. In this context, we describe a new platform based for quantum photonics.

11:40 : Invited talk
Hybrid low loss integrated photonics: from chipscale frequency combs, frequency agile lasers, erbium amplifiers to cryogenic quantum interconnects
Tobias Kippenberg
EPFL (Switzerland)

I will describe a range of novel advances, including photonic integrated circuit based frequency agile lasers with fiber laser phase noise, parametric traveling wave amplifiers, Erbium amplifiers on chip, as well as soliton frequency combs, with applications from coherent communications, LiDAR to cryogenic quantum interconnects.

12:00 : Invited talk
Plasmon-Driven Photografting of Molecularly Imprinted Polymers onto Metal Nanostructures for Enhanced SERS Sensor Performance
A. Khitous, C. Molinaro, K. Haupt, S. Gree, Olivier Soppera
Université de Haute-Alsace (France)

This paper introduces a rapid and versatile method to coat gold nanoparticles (AuNPs) with molecularly imprinted polymers (MIPs) via near-field radical photopolymerization. The resulting AuNPs@MIPs hybrid nanoparticles exhibit exceptional sensitivity and specificity for surface-enhanced Raman spectroscopy (SERS) and localized surface plasmon resonance (LSPR) analyses.

12:20 : Invited talk
Recent Advances in the Research of Graphene-based 2D Heterostructures for THz Plasmonic Device Applications
Taiichi Otsuji
Tohoku University (Japan)

This paper reviews recent advances in the research of graphene-based 2D heterostructures for terahertz plasmonic device applications.

Lunch

12:30 - 14:00

14:00 - 15:55 — Room 38

Session 3A9

Recent Advances in Nanophotonics and Metamaterials

Organized by: Andrea Fratalocchi

Chaired by: Katsuhiko Miyamoto

14:00 : Invited talk
Energy transfer mechanisms in nanophotonic systems for pulsed photocatalysis
Alessandro Alabastri
Rice University (USA)

Upon pulsed illumination, plasmon decay generates a spatially dependent, out-of-equilibrium hot carrier population, enhancing light-matter interaction in the ultrafast regime. This process, crucial for photothermal catalysis, allows for the analysis of hot electrons, thermalized electrons, and lattice effects in driving chemical reactions, offering insights into the mechanisms underpinning photocatalytic efficiency.

14:20 : Invited talk
Nanophotonic paths to enhance the open circuit voltage in perovskite and organic photovoltaic cells
Francisco Bernal Texca, Martina D'andrea, Jordi Martorell
Barcelona Institute of Science and Technology (Spain)

A nanophotonic structuration of perovskite and organic solar cell architectures is considered to enhance the open-circuit voltage. Numerical and experimental results to limit Boltzmann losses and set the path to take the limit efficiency from planar single junction cells from 33 % to 43 % will be presented.

14:40 : Invited talk
Infrared radiation from sub-l antennas and high mobility graphene devices
L. Abou-Hamdan[1], A. Schmitt[1], S. Rossetti[1], R. Bretel[1], S. Bidault[1], V. Krachmalnicoff[1], J.-P. Hugonin[1], C. Voisin[1], R. Haidar[2], P. Bouchon[2], J.-J. Greffet[2], E. Baudin[1], Yannick De Wilde[1]
[1] *Université PSL (France),* [2] *Université Paris-Saclay (France)*

We demonstrate the use of thermal fluctuations to explore the electromagnetic resonances of dimers of infrared metal-insulator-metal antennas and single dielectric resonators. Next, we investigate the radiation from graphene transistors encapsulated in boron nitride and find infrared electroluminescence signatures concomitant with efficient energy transfer via hyperbolic phonon polaritons.

15:00 : Invited talk
Spin and lattice dynamics of FePt nanoparticles at fundamental time and lengthscales
Hermann Durr
Uppsala University (Sweden)

Nanoscale light-matter interaction in magnetic materials is a topic of intense research in view of potential applications in high-density magnetic recording. I will provide an overview of recent advances in probing and understanding the magnetization and lattice dynamics of FePt nanoparticles of ∼10 nm size following ultrafast laser excitation.

15:20 : Invited talk
Probing Terahertz pulses with nonclassical radiation
Dionysis Adamou[1], Lennart Hirsch[1], Taylor Shields[1], Seungjin Yoon[1], Adetunmise Dada[1], Jonathan Weaver[1], Daniele Faccio[1], Lucia Caspani[1], Marco Peccianti[2], Matteo Clerici[3]
[1] *University of Glasgow (United Kingdom),* [2] *Loughborough University (United Kingdom),* [3] *Università degli Studi dell'Insubria (Italy)*

We report on our initial efforts to increase the sensitivity of Terahertz time-resolved sensing using quantum metrology, specifically through squeezed states, exploring discrete and continuous variable methods.

15:40 : Noise-resilient exceptional-point sensors enabled by oscillation quenching phenomena
Arunn Suntharalingam[1], Lucas Fernandez-Alcazar[2], Rodion Kononchuk[1], Tsampikos Kottos[1]
[1] *Wesleyan University (USA),* [2] *IMIT (CONICET-UNNE) (Argentina)*

We develop a self-oscillating nonlinear platform that supports transitions between two distinct neuromorphic functionalities - one having a spatially symmetric steady-state, and the other with an asymmetric steady-state - and displays nonlinear exceptional point degeneracies that can be employed for noise-resilient sensing.

14:00 - 16:00 — Room 17

Session 3A10

Electromagnetic Sensing, Antennas and Radar Technologies

Chaired by: Owen Miller

14:00 : Invited talk
Antenna and interference effects in plasmon-assisted metal photoluminescence
Tigran Shahbazyan
Jackson State University (USA)

We present an analytical model for plasmonic enhancement of metal photoluminescence (MPL) in metal nanostructures. We find that the lineshape of MPL spectrum is determined by the interference between direct carrier recombination processes and those mediated by plasmonic antenna leading to a blueshift of MPL spectral band relative to scattering.

14:20 : Invited talk
A Performance Analysis of Partial LIS for 6G Systems
Mário Marques da Silva[1], Rui Dinis[2]
[1] *Universidade Autónoma de Lisboa (Portugal),* [2] *Universidade Nova (Portugal)*

Large Intelligent Surfaces (LIS) emerges as a pivotal technology, acting as near-field beamformers, facilitating the new requirements of 6G. We analyze the impact of utilizing the entire LIS array versus a subset of its antennas, and we explore different receiver types, with varying complexities.

14:40 : Invited talk
Electric Near-Field Probe Calibration for PCB Emission Scanning
H. Jia[1], F. Wan[1], J. Rossignol[2], V. Mordachev[3], G. Fontgalland[4], D-T. Do[5], Blaise Ravelo[1]
[1] *NUIST (China),* [2] *Université de Bourgogne (France),* [3] *BSUIR (Belarus),* [4] *University of Mount Union (USA),* [5] *University of Mount Union (UMU) (USA)*

A electric (E) near-field (NF) probe modelling/calibration are investigated. The PCB EMC emission can be characterized following IEC-61967-standard uses the relevant E-NF-probe. The analytical approach for calibrating the probe for microstrip PCB is investigated. The calibration effectiveness is assessed with analytical, simulation and experimental investigation of EM radiation around 1-GHz.

15:00 : Invited talk
Range Unlimited Coherent Lidar and Autonomous Self-Localization
Ozdal Boyraz, Ataberk Atalar, Christian Margison, Mustafa Mert Bayer, Xun Li, Ozan Boyraz
University of California (USA)

Current coherent lidar systems face limitations due to the coherence length of the laser, impacting measurement range and accuracy due to laser phase noise. Here, we present a novel coherent technology suitable for lidar and autonomous localization to achieve cm-level accuracies at distances up to 11km with 10 photons/point sensitivity.

15:20 : Invited talk
Progress on Upgrading the HUSIR Radar for Deep-space Satellite Imaging
Michael MacDonald, Donna Grimes, Roy Lee, David Gordon, Mohamed Abouzahra, Melissa Schoenfeld
MIT Lincoln Laboratory (USA)

The HUSIR radar is being upgraded to extend ISAR imagery of satellites from low Earth to geosynchronousorbit. Progress on development of a new W-band (92 - 100 GHz) Gyro TWT transmitter, and upgraded receiverand feed subsystems, increasing peak transmit power from $\sim$1 kW to $\sim$50 kW is presented.

15:40 : Invited talk
Spin wave amplification through superradiance
Xiangrong Wang
Hong Kong University of Science and Technology (China)

An interface between a current-free (normal) ferromagnetic (FM) region and a current-flow (pumped) FM region can be a spin wave super-mirror whose reflection coefficient is larger than 1. The super-reflection is the consequence of current-induced spectrum inversion where phase and group velocities of spin waves are in the opposite directions.

14:00 - 16:00 — Room 15

Session 3A11

Specialty Optical Fibers

Organized by: Ryszard Buczynski and Mario Ferraro

Chaired by: Francesco Tani

14:00 : Invited talk

Gas sensing inside negative curvature hollow-core fibers

Grzegorz Gomółka[1], Patrycja Gronowicz[1], Ryszard Buczynski[2], Michal Nikodem[1]

[1] Wroclaw University of Science and Technology (Poland), [2] University of Warsaw (Poland)

Application of negative curvature hollow-core fibers (HCF) as gas cells in gas sensing systems will be discussed. We will present experiments in which laser spectroscopy inside silica-based fibers is performed in various spectral regions, from visible to mid-infrared. Novel sensing configuration with HCF-based reflective probe will be demonstrated

14:20 : Invited talk

Pedestal-free structured-core thulium-doped fibers for applications in eye-safer fiber lasers

Pavel Peterka[1], Ivan Kašík[1], Adam Filipkowski[2], Michal Kamrádek[1], Dariusz Pysz[2], Marcin Franczyk[2], Jan Aubrecht[1], Martin Grábner[1], Bára Švejkarová[1], Pavel Honzátko[1]

[1] Czech Academy of Sciences (Czech Republic), [2] Institute of Microelectronics and Photonics (Poland)

Review of structured-core fibers for fiber laser is given with emphasis on the proof of concept of pedestal-free thulium-doped fiber. Recent measurements and physical model of temperature dependent thulium cross sections are summarized and effects of such temperature dependence on thulium fiber laser operation are discussed.

14:40 : Invited talk

Dispersion properties of highly birefringent microstructured fibers with germanium doped cores

Tadeusz Martynkien[1], Karol Tarnowski[1], Karolina Stefanska[1], Pawel Mergo[2]

[1] Wrocław University of Science and Technology (Poland), [2] Maria Curie-Skłodowska University (Poland)

We have demonstrated both theoretically and experimentally the flexibility to tailor chromatic dispersion in highly birefringent microstructured fibers with a germanium-doped core. The presented fibers made from a single preform allow for a variety of non-linear applications, ranging from soliton generation to supercontinuum generation under all normal dispersion conditions.

15:00 : Invited talk

Development of soft glass nonlinear optical fibers based on 3D preform printing

Ryszard Buczynski[1], Pawel Wienclaw[1], Przemyslaw Golebiewski[2], Pawel Socha[2], Dariusz Pysz[2], Adam Filipkowski[2], Grzegorz Stepniewski[2], Irenesz Kujawa[2], Olga Czerwinska[3], Andrzej Burgs[3], Rafal Kasztelanic[1]

[1] University of Warsaw (Poland), [2] Lukasiewicz - Institute of Microelectronics and Photonics (Poland), [3] Sygnis S.A. al. (Poland)

We report on the development of highly nonlinear microstructured optical fibers using the 3D printing system devoted to soft glass processing. We used a 3D printer to construct a preform of the fiber based on the deposition of straight, horizontally oriented lines to replace the manual stack-and-draw fiber assembly process.

15:20 : Invited talk

4D optical fibers thermally drawn from shape-memory polymers

Clément Strutynski, Frédéric Désévédavy, Grégory Gadret, Claire-Hélène Brachais, Bertrand Kibler, Frédéric Smektala

Université de Bourgogne (France)

In this work, we demonstrate the elaboration of shape-memory optical fibers from the thermal stretching of additively manufactured preforms. Application of light-guiding multicomponent fiber architectures that are able to switch from temporary configurations back to user-defined programmed shapes are described.

15:40 : Invited talk
X-ray-based techniques for the characterization of specialty optical fibers
Mario Ferraro, Maria Caterina Crocco, Raffaele Filosa, Riccardo Cristoforo Barberi, Raffaele Giuseppe Agostino, Vincenzo Formoso
University of Calabria (Italy)

We report on the characterization of soft glass fibers and polymer optical fibers via X-ray microtomography and small-angle X-ray scattering polymer optical fibers, respectively.

14:00 - 15:20 — Room 7

Session 3A12

Recent Advances in Nanophotonics and Metamaterials

Organized by: Andrea Fratalocchi

Chaired by: Takasumi Tanabe

14:00 : Invited talk
Micro-thermo-mechanical devices for THz detection
B. Bertoni[1], L. Vicarelli[1], S. Zanotto[2], S. Roddaro[1], Alessandro Tredicucci[1], A. Pitanti[1]
[1] *Università di Pisa (Italy),* [2] *CNR Istituto Nanoscienze (Italy)*

Thermomechanical microbolometers are a promising technology for THz detection. To control their absorption, we embed 2D layers/metamaterials, while transduction is performed either through optical probing of the mechanical resonance, or through magnetic flux modulation by an inductive element. The latter allows parallel read-out of large arrays of different mechanical frequencies.

14:20 : Invited talk
Achieving Non-Local Optical Response in Planar Metamaterials
Vassili Fedotov
Skolkovo Institute of Science and Technology (Russia)

We present a recently discovered planar metamaterial, which supports strong collective excitation not found in metasurfaces. The supported non-local mode is virtually dispersionless yet ensures high sensitivity of the metamaterial response to incidence angle and enables non-resonant giant angular Goos-Hänchen shift (up to 1.5°) in specular transmission and reflection.

14:40 : Invited talk
Plasmonic/Excitonic hybrid systems for nanoscale thermometry
Lorenzo Ramò[1], Valentina Venturino[1], Ermes Peci[1], Emma Spotorno[1], M. Magnozzi[1], Maria Caterina Giordano[1], Domenica Convertino[2], Giorgio Orlandini[2], Camilla Coletti[1], Maurizio Canepa[1], Francesco Bisio[3]
[1] *Università degli Studi di Genova (Italy),* [2] *Istituto Italiano di Tecnologia (Italy),* [3] *CNR-SPIN (Italy)*

We report the fabrication and validation of an experimental system that exploits plasmonic Au nanoparticles to generate heat on a nanometric lateral scale, and measures the local temperature increase in the surroundings of these nanoparticles by means of carefully placed monolayers of transition metal dichalcogenide (TMDC).

15:00 : Invited talk
Exploring Fano Resonance and Optomechanics via Thin Film Photonics
Giuseppe Strangi
Case Western Reserve University (USA)

Metal-dielectric thin film layering enables the creation of Fano-resonant optical coatings (FROCs) unveiling semi-transparent thin films with distinct beam-splitting capabilities. Additianally, ongoing theoretical and experimental efforts focuses on optomechanics with epsilon-near-zero materials.

15:20 - 16:00 — Room 7

Session 3A13

Frontiers in Nonlinear Photonics: Optical Thermodynamics of Complex Systems

Organized by: Konstantinos Makris, Ziad Musslimani and Mercedeh Khajavikhan

Chaired by: Konstantinos Makris

15:20 : Invited talk
Spatial localization induced by coupled transport processes
Stefano Iubini[1], **M. Giusfredi**[2], **G. Gotti**[2], **A. Politi**[3], **P. Politi**[1]
[1] *Consiglio Nazionale delle Ricerche (Italy),* [2] *Università di Firenze (Italy),* [3] *University of Aberdeen (United Kingdom)*

A novel phenomenon of spatial localization occurring in nonlinear lattices and in steady out-of-equilibrium conditions is discussed. This mechanism has no analogs in thermal equilibrium and requires the transport of at least two independent quantities.

15:40 : Invited talk
Pressure in optical thermodynamics
Nikolaos Efremidis[1], **Demetrios Christodoulides**[2]
[1] *University of Crete (Greece),* [2] *University of Southern California (USA)*

We examine the thermodynamics, and the exerted optomechanical pressure of weakly nonlinear multimoded optical systems. We extend our analysis to the investigation of composite systems comprising different frequencies and/or polarizations. Our results can be applied to a variety of settings including fibers, waveguides, resonators and their configurations.

Coffee Break

16:00 - 16:30

16:30 - 17:40 — Room 38

Session 3A14

Innovations in Antenna Technologies

Chaired by: Mário Marques da Silva

16:30 : Invited talk
Review of 3D Printed Beam-Steering Dielectric Lens Antennas for Millimeter-Wave Applications
Jose Luis Masa Campos, M. H. Rasekhmanesh, A. Piroutiniya, J. Melendro-Jimenez, E. García Marín, P. Sanchez-Olivares, A. Tamayo-Dominguez, J. M. Fernandez-Gonzalez
Universidad Politécnica de Madrid (Spain)

A review of implemented 3D Printed Beam-Steering Antennas based on Gradient Index Lenses is presented for millimeter-wave . The feeder design in correspondence with the lens parameters is included for optimum efficiency. Several topologies are used to feed lenses in linear and circular polarization from 25 to 95 GHz.

16:50 : Unfoldable fully textile antenna using memory form technology mechanism
Benoit Agnus[1], **Y. Herve**[1], **L. Mercier**[1], **S. Carras**[2]
[1] *SCIENTEAMA (France),* [2] *FILIX SAS (France)*

Scienteama company has developed a new technologic for textile antenna conception. Performances of these

antennas has been tested until X band. Focusing on space applications the interest of these antennas is double due to very low mass and high flexibility and permits to target unfoldable solutions for nanosatellites.

17:05 : Electromagnetically coupled on-chip antenna in CMOS technology for multi-color sensing applications
Alexander Chernyadiev[1], Dmytro But[1], Kęstutis Ikamas[2], Wojciech Knap[1], Alvydas Lisauskas[2]
[1] *Institute of High Pressure Physics, PAS (Poland),* [2] *Vilnius University (Lithuania)*

In this article, we present a design of an antenna coupled to a bright and a dark split-ring resonator atoms. The concept of coupled resonators is promising for multi-color broadband material characterization.

17:20 : Invited talk
Optimizing Antenna and Array Placement on Electrically Large and Complex Structures Using Measured Sources and Simulation
Lars Foged, F. Saccardi
Microwave Vision Group (Italy)

Recent innovations enable the derivation of accurate models from actual antenna measurements for integration into Computational Electromagnetic (CEM) tools. Our presentation experimentally validates the accurate assessment of antenna coupling using multiple measured sources, thus enhancing existing techniques.

16:30 - 17:50 — Room 17

Session 3A15

Recent Advances in Nanophotonics and Metamaterials

Organized by: Andrea Fratalocchi

Chaired by: Alessandro Alabastri

16:30 : Invited talk
Applications on demand with engineered composites
D. A. Pawlak[1], P. Piotrowski[1], M. Tomczyk[1], K. Sadecka[1], K. Bandopadhay[1], N. Aghad[1], K. Markus[1], A. Abbas[1], S. Saha[1], A. Materna[1], A. Bellardini[2], C. Sibilia[2]
[1] *ENSEMBLE3 Centre of Excellence (Poland),* [2] *Sapienza University of Rome (Italy)*

New composite materials and their properties will be shown including various potential applications. The studied materials belong to two types of composites: (i) eutectic composites where two or more crystalline phases can be combined to enable particular functionality, (ii) glass composites where various nanoparticles can be embedded in glass matrices.

16:50 : Invited talk
Optical Spin Waves
Vage Karakhanyan, Roland Salut, Miguel Suarez, Nicolas Martin, Thierry Grosjean
University of Franche-Comté (France)

The precession of the magnetic moments in magnetic materials, forming spin waves, has many applications in magnetism and spintronics. We show that an optical analog of spin waves (OSW) can be generated in arrays of plasmonic nanohelices.

17:10 : Invited talk
Efficient nonlinearities in metasurfaces enabled by bound states in the continuum
Hayk Harutyunyan
Emory University (USA)

We present a novel approach to designing high-quality bound states in the continuum in dielectric metasurfaces using magnetic dipole resonances coupled to a mirror. This simplifies fabrication and enhances practical applications, demonstrated by a record-breaking third harmonic generation efficiency and superior modulation characteristics with a switching time of 100 fs.

17:30 : Invited talk
Quantum metric and non-Hermitian Berry curvature in a plasmonic lattice
Javier Cuerda
Aalto University School of Science (Finland)

We experimentally observe the quantum geometric tensor, namely the quantum metric and the Berry curvature, for a square lattice of radiatively coupled plasmonic nanoparticles. While the quantum metric emerges from the interplay of polarization and the mode structure, the origin of the Berry curvature is due to the system losses.

16:30 - 17:50 — Room 15

Session 3A16

Emerging Applications and Techniques

Chaired by: Blaise Ravelo

16:30 : Invited talk
Photonic filter in the 300 GHz band with SiN microresonator frequency comb
Takasumi Tanabe, Koya Tanikawa, Manto Imamura, Ayaka Yomoda, Satoki Kawanishi, Shun Fujii
Keio University (Japan)

This study introduces a soliton-comb-based photonic filter targeting the 300 GHz band, employing a uni-traveling-carrier photodiode for enhanced terahertz frequency operation. Theoretical and experimental analyses demonstrate its superior stopband suppression, offering significant advancements in high-speed wireless communications through the novel integration of optical and electrical domains.

16:50 : Invited talk
Optical Coherence Tomography vs. X-ray imaging for biomedical applications
Virgil-Florin Duma, Ralph-Alexandru Erdelyi
Polytechnic University of Timisoara (Romania)

Optical Coherence Tomography (OCT) is compared to X-ray radiographies for the assessment capability of dental conditions, and it is used for optimizing the latter imaging technique, which is the gold standard for dentistry.

17:10 : Invited talk
High-order terahertz Bessel beams with an orbital angular momentum
Katsuhiko Miyamoto
Chiba University (Japan)

We demonstrate a frequency tunable terahertz (THz) Bessel beam with an orbital angular momentum by employing the Tsurupica axicon lens in combination with the THz vortex source. THz Bessel beam output was tuned within the frequency range of 3-6 THz.

17:30 : Invited talk
Role of Decoupling Techniques in MIMO Antenna Systems
Mohammed Bait-Suwailam
Sultan Qaboos University (Oman)

Decoupling techniques in Multiple-Input Multiple-Output antenna systems play a crucial role in improving system performance. In such systems, multi-antenna elements are quite often deployed to increase channel capacity without requiring additional bandwidth or power. In this talk, the role of decoupling techniques in antenna systems is explored.

16:30 - 17:50 — Room 7

Session 3A17

Frontiers in Nonlinear Photonics: Optical Thermodynamics of Complex Systems

Organized by: Konstantinos Makris, Ziad Musslimani and Mercedeh Khajavikhan

Chaired by: Konstantinos Makris

16:30 : Invited talk

Optical Thermalization and Applications to High-Power Lasers

Frank Wise[1], **Demetrios Christodoulides**[2]
[1] *Cornell University (USA),* [2] *University of Southern California (USA)*

Experimental measurements of optical thermalization in multimode fibers will be reviewed briefly, and efforts to exploit optical thermodynamics to design short-pulse lasers with enhanced performance will be described.

16:50 : Invited talk

Optical entropy growth accompanies beam clean-up in multimode fibers

Fabio Mangini[1], **Mario Ferraro**[2], **Wasyhun Gemechu**[1], **Yifan Sun**[1], **Vincent Couderc**[3], **Stefan Wabnitz**[1]
[1] *Sapienza University of Rome (Italy),* [2] *University of Calabria (Italy),* [3] *Université de Limoges (France)*

We experimentally verified that beam self-cleaning is consistent with the second principle of thermodynamics: this requires measuring the entropy of a single beam during the evolution from an out-of-equilibrium to the equilibrium state. We demonstrate the growth of entropy which occurs whenever input power or fiber length are increased.

17:10 : Invited talk

Thermalization and Non-Equilibrium Transport in Multimoded Nonlinear Photonic Circuits

Tsampikos Kottos
Wesleyan University (USA)

We analyze the beam thermalization process in multimode photonic circuits when one nonlinear defect enforces thermalization. Furthermore, using a combination of Landauer and kinematics approach, we present a non-equilibrium transport theory of multimode nonlinear photonic circuits attached to optical reservoirs.

17:30 : Invited talk

Thermalization and condensation of light waves: Wave turbulence theory and experiments in multimode optical fibers

Kilian Baudin[1], **Lucas Zanaglia**[2], **Josselin Garnier**[3], **Nicolas Berti**[1], **Adrien Fusaro**[4], **Katarzyna Krupa**[5], **Valerie Doya**[2], **Claire Michel**[2], **Guy Millot**[1], **Antonio Picozzi**[1]
[1] *Université de Bourgogne (France),* [2] *Université Côte d'Azur (France),* [3] *Ecole Polytechnique (France),* [4] *CEA (France),* [5] *Polish Academy of Sciences (Poland)*

We review recent progress on the observation of light thermalization to the Rayleigh-Jeans equilibrium in multimode optical fibers. We develop a nonequilibrium thermodynamic description of light thermalization in multimode fibers on the basis of the wave turbulence theory by taking into account the impact of weak and strong disorder.

Friday 28th June, 2024

9:00 - 10:10 — Room 38

Session 4A1

Advanced Techniques for Computational Electromagnetics

Organized by: Maha Ben Rhouma

Chaired by: Francesco Ferranti

09:00 : Keynote talk
Nanophotonic scintillators and various topics in AI for topology
Marin Soljacic
Massachusetts Institute of Technology (USA)

Nanophotonic methods provide intriguing options for manipulating scintillation phenomena. We will outline recent developments in this domain, along with our general theoretical framework for modeling these occurrences, supported by our experimental findings. We will also cover novel numerical techniques for discovery of topological phenomena in photonics.

09:30 : Invited talk
Limits and opportunities for nonlinear nanophotonics
Alejandro Rodriguez
Princeton University (USA)

In this talk, we review recent advances and applications of large-scale optimization techniques to nonlinear processes, including limitations on the ability of structuring to control spontaneous emission, second harmonic generation, and Raman scattering in resonant media.

09:50 : Invited talk
Advanced optical metasurface design for imaging and sensing
Tian Gu
MIT (USA)

In my talk, I will explore both the opportunities and obstacles associated with employing optical metasurfaces for a wide range of applications. Capitalizing on advanced design techniques, device architectures and materials, we demonstrate metasurface-based optical components and systems with high performance, ultra-compactness and new functions across various uses.

9:00 - 10:05 — Room 17

Session 4A2

Metamaterials and Plasmonics in Antenna Applications

Chaired by: Piotr Piotrowski

09:00 : Invited talk
Plasmonic effects in composites fabricated by crystal growth techniques
Piotr Piotrowski[1], Piotr Paszke[1], Rafał Nowaczyński[2], Hańcza Surma[1], Katarzyna Sadecka[1], Nuttawut Kongsuwan[3], Johann Toudert[1], Ortwin Hess[4], Dorota A. Pawlak[1]
[1] Centre of Excellence Ensemble (Poland), [2] University of Warsaw (Poland), [3] Quantum Technology Foundation (Thailand), [4] Trinity College Dublin (Ireland)

Optical effects that arise from introduction of plasmonic nanoparticles into volumetric systems will be presented, with a particular focus on glass and eutectic materials.

09:20 : Efficient hot-carrier-generation supported by the localization of hybridized plasmon in Au nanoparticle arrays
Soshun Inoue[1], Tomohiro Yokoyama[1], Keiji Sasaki[2], Hiroaki Misawa[2], Hajime Ishihara[1]
[1] *Osaka University (Japan),* [2] *Hokkaido University (Japan)*

Hot-carrier-generation (HCG) via plasmons can boost photoelectric conversion. Our recent research introduced Au-nanoparticle-array/TiO2/Au-film (ATA) structure, enhancing HCG through an antenna effect. In this study, we explore symmetry-breaking nanoparticle arrays on ATA, finding they can support antenna effectabove, underscoring the importance of optimally exciting the localized modes of hybridized plasmon.

09:35 : Planar Wideband Metamaterials Energy Harvester
Mohammed M. Bait-Suwailam[1], Hassan Al-Lawati[1], Thamer Almoneef[2]
[1] *Sultan Qaboos University (Oman),* [2] *Prince Sattam bin Abdulaziz University (Saudi Arabia)*

The design of a wideband metamateirals energy harvester for microwave applications is presented here. The developed electromagnetic harvester is based on the full power absorption that is collected across resistive loads. The simulation results show a wideband electromagnetic energy harvesting with wideband power absorption efficiency above 70 $\%$.

09:50 : Generalizing the Yagi-Uda Antenna: Multi-scale inverse design of disordered metamaterials for radiation pattern shaping
James Capers[1], Leanne Stanfield[1], John Sambles[1], Stephen Boyes[2], Alex Powell[1], Alastair Hibbins[1], Simon Horsley[1]
[1] *University of Exeter (United Kingdom),* [2] *DSTL Porton Down (United Kingdom)*

We present, and experimentally test, a framework based on the coupled-dipole approximation for designing structures composed of a simple emitter with a passive disordered scattering structure of rods that is optimized to provide a desired radiation pattern. Our method enables the design and modelling of otherwise inaccessibly large scattering systems.

The End of the Conference

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