OSA
Optical Society of America

META

Photonic Metamaterials: From Random to Periodic

Topical Meeting and Tabletop Exhibit

June 5-8, 2006

Grand Bahama Island, The Bahamas
Westin Grand Bahama Island Our Lucaya Resort,
Grand Island, The Bahamas

Hotel Reservation Deadline: May 2, 2006
Pre-Registration Deadline: May 12, 2006
Postdeadline Paper Submission Deadline: May 26, 2006, 12:00 p.m. noon EDT (16.00 GMT)
Plan to submit your paper soon!

2006 Participants

Metamaterials 2006

Connect with the most accomplished international scientists, researchers, engineers and business leaders as they shape the future of optics, photonics and laser science.

Conference Co-Chairs

- Azriel Genack, *Queens College of CUNY, USA*
- Vladimir Shalaev, *Purdue Univ., USA*

Topics to be considered include:

- Fundamental and applied aspects of waves in structured, periodic and disordered metamaterials and in natural materials as well as those synthesized using traditional techniques of crystal growth, organic and inorganic chemistry.
- Fabrication and photonic properties of metamaterials including photonic and plasmonic band gap materials, negative-index materials and novel composites with unusual optical properties.
- Scattering and imaging in turbulent and static disordered media.
- The statistical nature of wave propagation and localization in random media.
- Partial coherence, coherent backscattering, random lasing, and temporal, spectral and spatial correlation within the speckle pattern.
- Advances in remote sensing, propagation, and active imaging in the atmosphere and in bodies of water, and scattering from aerosols as well as multiple scattering from dilute cold gases.
- The role of diffusing photons and of residual optical coherence in medical and biological tissues.
- Exploration of analogies with the propagation of acoustic, electronic and matter waves and with dynamical localization and chaos.

Don't Miss This Important Event!

"The meeting on Photonic Metamaterials: from Random to Periodic aims to capture the excitement of research on the rapidly growing number of optical phenomena in newly structured and disordered materials fashioned from subwavelength elements. The rapid advance of materials

science makes it possible to design materials with tailored optical characteristics that will provide the basis for emerging photonic technologies."

– Azriel Genack,
Conference Co-Chair

Technical Program Committee

Organizing Committee

- Azriel Genack, *Queens College of CUNY, USA*, Co-chair
- Vladimir Shalaev, *Purdue Univ., USA, Co-chair*

Program Committee

- Carlo W. J. Beenakker, *Univ.of Leiden, Netherlands*
- Hui Cao, *Northwestern Univ., USA*
- Yeshaiyahu Fainman, *Univ. of California at San Diego, USA*
- Satoshi Kawata, *Osaka Univ., Japan*
- Ad Lagendijk, *Univ. of Twente, Netherlands*
- Evgenii Narimanov, *Princeton Univ., USA*
- John Pendry, *Imperial College, UK*
- David J. Pine, *New York Univ., USA*
- Ping Sheng, *Univ. of Science and Technology, Hong Kong*
- John Sipe, *Univ. of Toronto, Canada*
- Bart A. van Tiggelen, *CNRS/Univ. of Joseph Fourier, France*
- Yurii Vlasov, *IBM, USA*
- Arjun Yodh, *Univ. of Pennsylvania, USA*

About Photonic Metamaterials: from Random to Periodic

The development of the full potential of photonics, with revolutionary influence in many areas of science, technology and everyday life, strongly depends on the availability of advanced materials. However, the physical and optical properties of multiple-phase engineered photonic materials, or *photonic metamaterials*, remain to a large degree undiscovered and unutilized. Photonic metamaterials are expected to open a gateway to unprecedented electromagnetic properties and functionality unattainable from naturally existing materials. The structural units of metamaterials can be tailored in shape and size; the composition and morphology can be artificially tuned, and inclusions can be designed and placed at desired locations. At the same time, the clarification of challenging questions regarding optical propagation in natural materials and in materials synthesized using traditional techniques of crystal growth, organic and inorganic chemistry can lead to enhanced imaging and communication, control over the natural environment, and a deeper understanding of propagation of other classical and quantum waves. This meeting focuses on advancing our understanding of the electromagnetic properties of both novel photonic metamaterials and complex natural media and considers a broad range of structures, from disordered to periodic.

Meeting Topics

This meeting will feature presentations on timely and exciting topics within the scope of the Topical Group on Waves in Random and Periodic Media. The meeting will consider fundamental and applied aspects of waves in structured, periodic and disordered metamaterials and in natural materials as well as those synthesized using traditional techniques of crystal growth, organic and inorganic chemistry. The meeting will discuss the fabrication and photonic properties of metamaterials including photonic and plasmonic band gap materials, negative-index materials, and novel composites with unusual optical properties. These materials can provide subwavelength focusing of light and precise light guiding within micro- and nano-fabricated structures. They afford control of spontaneous emission and lasing in fabricated and self-assembled structures. The meeting will also deal with scattering and imaging in turbulent and static disordered media. The meeting will treat the statistical nature of wave propagation and localization in random media. Partial coherence, coherent backscattering, random lasing, and temporal, spectral and spatial correlation within the speckle pattern will also be discussed. Advances in remote sensing, propagation, and active imaging in the atmosphere and in bodies of water, and scattering from aerosols as well as multiple scattering from dilute cold gases will be of interest. The role of diffusing photons and of residual optical coherence in medical and biological tissues will be considered as well. Because of the strong parallels between electromagnetic radiation and other classical as well as quantum waves, the meeting will explore analogies with the propagation of acoustic, electronic and matter waves and with dynamical localization and chaos.

Photonic Metamaterials Invited Speakers

Metamaterials I: Superlens and Optical Magnetism

MA1, **Metamaterials - An Overview,** *John Pendry; Imperial College, UK.*

MA2, **Plasmonic MetaMaterials and Optical Super Lens,** *Xiang Zhang; Univ. of California at Los Angeles, USA.*

Localization and Dynamics of Light in Random Media

MB1, **The Path of Light in Random Media,** *Ad Lagendijk; FOM Inst. for Atomic and Molecular Physics, The Netherlands.*

MB2, ***In vivo*** **Tissue Measurements Combining Diffuse Near-Infrared Absorption and Correlation Spectroscopies,** *Arjun Yodh; Univ. of Pennsylvania, USA.*

Photonics Crystals I

MC1, **New Directions in Optical Lithography and Functional Architectures,** *Sajeev John; Univ. of Toronto, Canada.*

MC2, **Manipulation of Photons Based on Various Engineering in Photonic Crystals,** *Susumu Noda; Kyoto Univ., Japan.*

Plasmonics I: Imaging and Cloaking

TuA1, **Photonic Planar Meta-Materials: Spectral Selectivity, "Invisible Metals", Magnetic Mirrors and Asymmetric Transmission,** *Nikolay Zheludev; Univ. of Southampton, UK.*

TuA2, **Engineering Materials with Extreme Optical Properties,** *Javier Garcia de Abajo; Ctr. Mixto CSIC-UPV/EHU, Spain.*

Photonic Crystals II: Negative Refraction and Imaging

TuB1, **To Be Announced,** *Yurii Vlasov; IBM, T. J. Watson Res. Ctr., USA.*

TuB2, **Photonic Crystal-Assisted Light Extraction from a Colloidal Quantum Dots/GaN Hybrid Structure,** *Frédéric Diana, Pierre Petroff; Univ. of California at Santa Barbara, USA.*

Negative-Index Materials, Super-Resolution and Nonlinear Optics

TuC1, **Super-Resolution Imaging and Performance Optimisation for Single- and Multi-Layer Silver Superlenses,** *Richard J. Blaikie; Univ. of Canterbury, New Zealand.*

TuC2, **Optical "Hyperspace": Negative Refractive Index and Subwavelength Imaging in Anisotropic Media,** *Evgenii Narimanov, Leonid Alekseyev; Princeton Univ., USA.*

Localized and Diffusive EM Modes

WA1, **Quasimodal Decomposition of the Spatially Extended Field within a Nominally Localized 1D Open Random Waveguide,** *Patrick H. Sebbah[1,2], B. Hu[1], J. M. Klosner[2], A. Z. Genack[2]; [1]CNRS, France, [2]Queens College of CUNY, USA.*

Plasmonics II: Negative-Index Materials

WB3, **Microwave and Infrared Transmission through Normally Opaque Objects,** *Ping Sheng; Hong Kong Univ., Hong Kong Special Administrative Region of China.*

Mesoscopic Random Lasers

WC1, **Lasing in Disordered Photonic Crystals,** *Hui Cao, Alexey Yamilov, Xiaohua Wu; Northwestern Univ., USA.*

WC2, **Multi-Mode Lasing Theory for Complex or Random Lasers,** *A. Douglas Stone, Hakan E. Tureci; Yale Univ., USA.*

WC3, **Cold Atoms: Towards Localization and Random Lasing,** *Robin Kaiser; CNRS, France.*

WC4, **Superradiance and Mesoscopic Transport of Diffusing Photons in Cold Atoms,** *Eric Y. Akkermans, Ohad Assaf, Aharon Gero; Technion - Israel Inst. of Technology, Israel.*

Metamaterials III

ThA1, **Optical Nanoelectronics with Metamaterials,** *Nader Engheta; Univ. of Pennsylvania, USA.*

ThA6, **Negative Index Materials in GHz and THz Frequencies,** *Costas Soukoulis[1,2], Jiangfeng Zhou[1,3], Lei Zhang[1,3], Thomas Koschny[1,2]; [1]Iowa State Univ., USA, [2]Inst. of Electronic Structure and Laser – FORTH, and Dept. of Materials Science and Technology, Univ. of Crete, Greece, [3]Dept. of Electrical and Computer Engineering and Microelectronics Res. Ctr., Iowa State Univ., USA.*

Photonics in Tunable, Scattering and Absorbing Materials

ThB1, **Light Propagation in Tunable Photonic Materials,** *Diederik S. Wiersma; European Lab for Non Linear Spectroscopy and INFM-Matis, Italy.*

Closing Session

ThE1, **Wrap-Up of Metamaterials — An Overview,** *Sir John Pendry; Imperial College London, UK.*

ThE2, **Wrap-Up of the Path of Light in Random Media,** *Ad Lagendijk; FOM Inst for Atomic & Molecular Physics, The Netherlands.*

ThE3, **Wrap-Up of New Directions in Optical Lithography and Functional Architectures,** *Sajeev John; Univ. of Toronto, Canada.*

ThE4, **From Meta I to Meta II,** *Azriel Z. Genack[2], Vladimir Shalaev[2]; [1]Dept. of Physics, Queens College of the City Univ. of New York, USA, [2]School of Electrical and Computer Engineering, Purdue Univ., USA.*

Publications

Conference Program

The *Conference Program* will be available on the web in May 2006. Authors submitting papers, past meeting participants and current committee members will be notified by email when the *Conference Program* is available.

Technical Digest

The *META Technical Digest* on CD-ROM will contain PDFs of paper summaries presented during the meeting as they were submitted by the authors; the *Technical Digest* will be produced only on CD. At the meeting, each registrant will receive a copy of the Technical Digest on CD-ROM.

Exhibitors

Topical Meeting:
June 5 – June 8, 2006

Tabletop Exhibit:
June 5 – June 7, 2006

Photonic Metamaterials 2006 Exhibit Space Reservation Contract

Photonic Metamaterials 2006 Exhibit Space Reservation Contract (PDF, 120KB)

Note: You need Adobe Acrobat to view the PDF files above. If you do not already have this software, you can download Adobe Acrobat for free from Adobe's web site.

Tabletop exhibit space will be $940 for Corporate Members and $990 for non-members and will include:

- One complimentary registration list
- One complimentary technical registration and two exhibit personnel registrations
- One copy of the meeting's proceedings

If you have questions about exhibiting at this topical meeting, please contact our exhibit sales staff at 202.416.1957 or exhibitsales@osa.org.

Sponsorship Opportunities at Photonic Metamaterials 2006

Increase your company's visibility among qualified attendees with a sponsorship at the event.

Current Photonic Metamaterials Sponsorship Opportunities include:

- Coffee Break Sponsorships
- Reception Sponsorships
- Attendee Tote Bag Sponsorship
- Registration Material Inserts
- Advertising Signage Placements

Plus other customizable promotional opportunities

To find out more about one of the sponsorship opportunities listed above or to discuss a customized promotional package or sponsorship, please contact Melissa Russell at 202.416.1957 or email exhibitsales@osa.org.

Agenda of Sessions

Monday, June 5, 2006

7:00 a.m.–12:45 p.m.	**Registration**	*Royal Palmer Foyer*
8:00 a.m.–10:00 a.m.	**MA • Metamaterials I: Superlens and Optical Magnetism**	*Royal Palm*
10:00 a.m.–10:30 a.m.	**Coffee Break**	*Bonds Cay*
10:30 a.m.–12:45 p.m.	**MB • Localization and Dynamics of Light in Random Media**	*Royal Palm*
12:45 p.m.–7:00 p.m.	**Afternoon Break (On Your Own)**	
6:30 p.m.–9:00 p.m.	**Registration**	*Royal Palmer Foyer*
7:00 p.m.–9:00 p.m.	**MC • Photonics Crystals I**	*Royal Palm*

Tuesday, June 6, 2006

7:00 a.m.–12:45 p.m.	**Registration**	*Royal Palmer Foyer*
8:00 a.m.–10:00 a.m.	**TuA • Plasmonics I: Imaging and Cloaking**	*Royal Palm*
10:00 a.m.–10:30 a.m.	**Coffee Break**	*Bonds Cay*
10:30 a.m.–12:45 p.m.	**TuB • Photonic Crystals II: Negative Refraction and Imaging**	*Royal Palm*
12:45 p.m.–7:00 p.m.	**Afternoon Break (On Your Own)**	
6:30 p.m.–9:00 p.m.	**Registration**	*Royal Palmer Foyer*
7:00 p.m.–9:00 p.m.	**TuC • Negative-Index Materials, Super-Resolution and Nonlinear Optics**	*Royal Palm*

Wednesday, June 7, 2006

7:30 a.m.–5:30 p.m.	**Registration**	*Royal Palmer Foyer*
8:00 a.m.–10:00 a.m.	**WA • Localized and Diffusive EM Modes**	*Royal Palm*
10:00 a.m.–10:30 a.m.	**Coffee Break**	*Bonds Cay*
10:30 a.m.–12:30 p.m.	**WB • Plasmonics II: Negative-Index Materials**	*Royal Palm*
12:30 p.m.–2:00 p.m.	**Lunch Break (On Your Own)**	
2:00 p.m.–4:00 p.m.	**WC • Mesoscopic Random Lasers**	*Royal Palm*
4:00 p.m.–6:00 p.m.	**WD • Poster Session I / Refreshment Break**	*Bonds Cay*
6:00 p.m.–8:00 p.m.	**Conference Reception**	*Pavilion*

Thursday, June 8, 2006

7:30 a.m.–6:00 p.m.	**Registration**	*Royal Palmer Foyer*
8:00 a.m.–10:00 a.m.	**ThA • Metamaterials II**	*Royal Palm*
10:00 a.m.–10:30 a.m.	**Coffee Break**	*Bonds Cay*
10:30 a.m.–12:30 p.m.	**ThB • Photonics in Tunable, Scattering and Absorbing Materials**	*Royal Palm*
12:30 p.m.–2:00 p.m.	**Lunch Break (On Your Own)**	
2:00 p.m.–4:00 p.m.	**ThC • Postdeadline Papers**	*Royal Palm*
4:00 p.m.–6:00 p.m.	**ThD • Poster Session II / Refreshment Break**	*Bonds Cay*
6:00 p.m.–7:30 p.m.	**ThE • Closing Session**	*Royal Palm*

Abstracts

●Sunday, June 4, 2006●

Royal Palmer Foyer
2:00 p.m.–6:00 p.m.
Registration Open

●Monday, June 5, 2006●

Royal Palmer Foyer
7:00 a.m.–12:45 p.m.
6:30 p.m.–9:00 p.m.
Registration Open

MA • Metamaterials I: Superlens and Optical Magnetism

Royal Palm
8:00 a.m.–10:00 a.m.
MA • Metamaterials I: Superlens and Optical Magnetism
Vladimir M. Shalaev; Purdue Univ., USA, Presider
Richard Hammond; ARL, USA, Presider

MA1 • 8:00 a.m. **●Grand Talk●**
Metamaterials - An Overview, *John Pendry; Imperial College, UK.* Metamaterials owe their electromagnetic properties to their physical structure rather than to their chemical composition, a characteristic they share with photonic crystals.

MA2 • 8:45 a.m. **●Invited●**
Plasmonic MetaMaterials and Optical Super Lens, *Xiang Zhang; Univ. of California at Los Angeles, USA.* I'll discuss a few experiments that demonstrated intriguing metamaterials magnetic properties and optical superlens which breaks down so called diffraction limit. I'll also discuss tunable nano plasmonics applications for imaging and bio-sensing.

MA3 • 9:15 a.m.
Negative Refraction in Si-Based 2-Dimensional Slab Photonic Crystal Structures, *Won Park[1], Ethan Schonbrun[1], Qi Wu[1], Y. Yamashita[2], C. J. Summers[2], Mark Tinker[3], Yonghao Cui[3], Jeong-Bong Lee[3]; [1]Univ. of Colorado, USA, [2]Georgia Tech, USA, [3]Univ. of Texas at Dallas, USA.* Si-based 2-dimensional slab photonic crystal structures were designed to exhibit negative refraction in the near-infrared region. Negative index imaging was experimentally observed in the integrated device structures including in- and out-coupling waveguides.

MA4 • 9:30 a.m.
"Artificial Magnetism" and Low-Loss Negative-Index Metamaterials at Telecommunication Frequencies, *Stefan Linden[1], Costas M. Soukoulis[2], Gunnar Dolling[3], Nils Feth[3], Christian Enkrich[3], Matthias W. Klein[3], Martin Wegener[3]; [1]Forschungszentrum Karlsruhe, Germany, [2]Ames Lab and Dept. of Physics and Astronomy, Iowa State Univ., USA, [3]Univ. Karlsruhe, Germany.* We present metamaterials featuring "artificial magnetism" at telecommunication frequencies. The combination of cut-wire pairs as "magnetic atoms" and a diluted metal yields a negative refractive index at 1.4 μm wavelength, with a transmittance exceeding 50%.

MA5 • 9:45 a.m.
Spatial Dispersion in Metallic Meta-materials, *Gennady Shvets[1], Dmitry Korobkin[1], Yaroslav A. Urzhumov[1], Michael Shapiro[2]; [1]Univ. of Texas at Austin, USA, [2]MIT, USA.* We investigate spatial dispersion in periodic meta-materials and its implication for NIMs. Three meta-materials are investigated for spatial dispersion: 2-D arrays of nanorods, nanoholes in a SiC membrane (experiment), and 3-D metallic mesh.

Bonds Cay
10:00 a.m.–10:30 a.m.
Coffee Break

MB • Localization and Dynamics of Light in Random Media

Royal Palm
10:30 a.m.–12:45 p.m.
MB • Localization and Dynamics of Light in Random Media
Azriel Z. Genack; Dept. of Physics, Queens College of the City Univ. of New York, USA, Presider
Ping Sheng; Hong Kong Univ., Hong Kong, Presider

MB1 • 10:30 a.m. **●Grand Talk●**
The Path of Light in Random Media, *Ad Lagendijk; FOM Inst. for Atomic and Molecular Physics, The Netherlands.* New ideas, new materials and new experiments have led to an ever growing understanding of propagation of light in random media. We will shortly review the modern developments and lighten some of the new directions.

MB2 • 11:15 a.m. **●Invited●**
***In vivo* Tissue Measurements Combining Diffuse Near-Infrared Absorption and Correlation Spectroscopies,** *Arjun Yodh; Univ. of Pennsylvania, USA.* I will describe experiments probing tissue hemodynamics. Diffuse photon density waves measure blood oxygenation and total hemoglobin concentration, and diffusing temporal correlation functions measure tissue blood flow. The combination is sensitive to tissue oxygen metabolism.

MB3 • 11:45 a.m.
Dynamics of Photon Localization, *Andrey A. Chabanov[1], Azriel Z. Genack[2]; [1]Univ. of Texas at San Antonio, USA, [2]Queens College of the City Univ. of New York, USA.* Steep fall-off of leakage rate of electromagnetic waves with photon transit time as well as rise of fluctuations and correlation are observed in localized samples and compared to models of transport of localized waves.

MB4 • 12:00 p.m.
Observation of the Critical Regime Near Anderson Localization of Light, *Christof M. Aegerter, Martin Störzer, Peter Gross, Georg Maret; Univ. Konstanz, Germany.* In this paper we present time resolved measurements of optical transmission, which show clear deviations from classical diffusion. These deviations increase with increasing turbidity, providing experimental evidence for the onset of Anderson localization of light.

MB5 • 12:15 p.m.

Self-Consistent Theory of Anderson Localization in Open Random Media, *Sergey E. Skipetrov[1,2], Bart A. van Tiggelen[1,2]; [1]Ctr. Natl. de la Recherche Scientifique, France, [2]Univ. Joseph Fourier, France.* Self-consistent theory of localization is adapted to open media by introducing a position-dependent renormalized diffusion coefficient. Non-exponential decay of time-dependent transmission and new power-law scaling of time-dependent reflection are found for random waveguides and slabs.

MB6 • 12:30 p.m.
Scaling Behavior of Classical Wave Transport at the Mobility Edge, *Zhao-Qing Zhang, Sai-Kit Cheung; Dept of Physics, Hong Kong Univ. of Science and Technology, Hong Kong Special Administrative Region of China.* Scaling behavior of classical wave transport at the mobility edge can be different from that of electron. For slab geometry, the transmission is shown to scale like ln L/L^2, different from $1/L^2$ obtained for electrons.

MC • Photonics Crystals I

Royal Palm
7:00 p.m.–9:00 p.m.
MC • Photonics Crystals I
Yurii Vlasov; IBM, TJ Watson Res. Ctr., USA, Presider
Concita Sibilia; INFM at Dept. di Energetica, Univ. di Roma, Italy, Presider

MC1 • 7:00 p.m. **•Grand Talk•**
New Directions in Optical Lithography and Functional Architectures, *Sajeev John; Univ. of Toronto, Canada.* I discuss the utility of 3D PBG materials for light localization based integrated optics, the novel effects of frequency selective control of spontaneous emission, and a new method for microfabrication called "optical phase mask lithography".

MC2 • 7:45 p.m. **•Invited•**
Manipulation of Photons Based on Various Engineering in Photonic Crystals, *Susumu Noda; Kyoto Univ., Japan.* Recent progresses and future prospects of manipulation of photons based on bandgap and defect-, band edge-, and band-engineering in photonic crystals will be reviewed. Spontaneous emission control, ultrahigh Q nanocavity, novel lasers, etc, will be discussed.

MC3 • 8:15 p.m.
Three-Dimensional Silicon Photonic Crystals from Polymer Templates: Single versus Double Inversion, *Martin Hermatschweiler[1], Markus Deubel[1], Martin Wegener[1], Fabian Pérez-Willard[2], Nicolas Tétreault[3], Geoffrey A. Ozin[3], Georg von Freymann[4]; [1]Inst. für Angewandte Physik, Univ. Karlsruhe, Germany, [2]DFG-Ctr. for Functional Nanostructures (CFN), Univ. Karlsruhe, Germany, [3]Dept. of Chemistry, Univ. of Toronto, Canada, [4]Inst. für Nanotechnologie, Forschungszentrum Karlsruhe in der Helmholtz-Gemeinschaft, Germany.* We present recent progress in converting polymer templates into three-dimensional silicon photonic crystals by using double (single) inversion. This has led to woodpiles (inverse woodpiles) with improved structural and optical quality.

MC4 • 8:30 p.m.
Plasmonic Resonances in Photonic Crystal Fibres with Coated Inclusions, *Karrnan Pathmanandavel, Boris T. Kuhlmey, Ross C. McPhedran; CUDOS--Univ. of Sydney, Australia.* We extend the multipole method for photonic crystal fibers (PCF) to geometries containing coated inclusions, accurate even with metallic coatings. We exhibit resonant dispersion and loss characteristics associated with plasmonic effects in the coated inclusions.

MC5 • 8:45 p.m.
Tunneling through Photonic Bandgaps: A Reexamination of Superluminal Group Velocities, *Herbert G. Winful; Univ. of Michigan, USA.* It is widely believed that photons tunnel through bandgaps with group velocities exceeding *c*. Here we examine the experimental evidence and show that the measured group delays are photon lifetimes as opposed to transit times.

●Tuesday, June 6, 2006●

Royal Palmer Foyer
7:00 a.m.–12:45 p.m.
6:30 p.m.–9:00 p.m.
Registration Open

TuA • Plasmonics I: Imaging and Cloaking

Royal Palm
8:00 a.m.–10:00 a.m.
TuA • Plasmonics I: Imaging and Cloaking
Richard Blaikie; Univ.of Canterbury, New Zealand, Presider
Ruben G. Barrera, Sr.; Univ. Nacional Autonoma de Mexico, Mexico, Presider

TuA1 • 8:00 a.m. **●Invited●**
Photonic Planar Meta-Materials: Spectral Selectivity, "Invisible Metals", Magnetic Mirrors and Asymmetric Transmission, *Nikolay Zheludev; Univ. of Southampton, UK.* Planar metal films patterned on the sub-wavelength scale show stop bands and may be invisible, mimic negative index materials, exhibit gyrotropy, act as magnetic mirrors and enforce asymmetry of light's propagation in the opposite directions.

TuA2 • 8:30 a.m. **●Invited●**
Engineering Materials with Extreme Optical Properties, *Javier Garcia de Abajo; Ctr. Mixto CSIC-UPV/EHU, Spain.* Metamaterial designs with unique optical properties based upon micropatterning over various lengthscales will be introduced. Their potential for left-handed media and quasi-invisible metal designs that operate in the NIR with minimum absorption will be discussed.

TuA3 • 9:00 a.m.
Cloaking: Science Fiction or Reality? *Graeme W. Milton[1], Nicolae-Alexandru P. Nicorovici[2]; [1]Univ. of Utah, USA, [2]Univ. of Technology, Australia.* Making an object invisible through some cloaking device is commonly regarded as science fiction. But we have found that objects near superlenses, or at least finite collections of polarizable line or point dipoles become cloaked.

TuA4 • 9:15 a.m.
Limit to the Performance of Optical Components, *David A. B. Miller; Stanford Univ., USA.* We show a general limit to performance of dispersive optical components based on a limit to the number of orthogonal beams or pulses that can be generated by a strongly scattering object of given composition.

TuA5 • 9:30 a.m.
Near-Field Image Transfer through a Plasmonic Nanorod-Array, *Jun-ichi Kato[1], Atsushi Ono[1,2], Satoshi Kawata[1,2]; [1]Nanophotonics Lab, RIKEN, Japan, [2]Dept. Applied Physics, Osaka Univ., Japan.* We proposed a way for near-field imaging using a metallic nanorod-array. Plasmonic resonance along the rod-axis plays important roles. We simulated the image-transfer process and estimated the image formations features with the FDTD algorithm.

TuA6 • 9:45 a.m.
Anisotropy in Photonic Crystals and Plasmonic Materials, *Arkadii Krokhin, David McNeil, Arup Neogi; Univ. of North Texas, USA.* We propose to use 2D photonic crystal as a substrate in plasmonic devices. Due to strong anisotropy of the substrate, the propagation range of surface plasmon increases as compared to the case of isotropic substrate.

Bonds Cay
10:00 a.m.–10:30 a.m.
Coffee Break

TuB • Photonic Crystals II: Negative Refraction and Imaging

Royal Palm
10:30 a.m.–12:45 p.m.
TuB • Photonic Crystals II: Negative Refraction and Imaging
Sajeev John; Univ. of Toronto, Canada, Presider
Susumu Noda; Kyoto Univ., Japan, Presider

TuB1 • 10:30 a.m. **●Invited●**
TBA, *Yurii Vlasov; IBM, T. J. Watson Res. Ctr., USA.*

TuB2 • 11:00 a.m. **●Invited●**
Photonic Crystal-Assisted Light Extraction from a Colloidal Quantum Dots/GaN Hybrid Structure, *Frédéric Diana, Pierre Petroff; Univ. of California at Santa Barbara, USA.* In this presentation, we will briefly introduce colloidal QDs structure and optical properties, explain the process of light conversion in GaN-based LEDs, including phosphors or colloidal QDs, and highlight the main causes of losses of light, emitted by both internal sources (usually InGaN QWs) and external ones (phosphors or QDs.

TuB3 • 11:30 a.m.
Light Diffraction in Nanoshell Colloidal Metal-Dielectric Photonic Crystals, *Sergei G. Romanov[1], Igor E. Protsenko[1], Clivia M. Sotomayor Torres[1], Andrei Susha[2], Dayang Wang[3], Frank Caruso[4]; [1]Tyndall Natl. Inst., Univ. College Cork, Ireland, [2]Univ. of Munich, Germany, [3]Max Plank Inst. of Colloids and Interfaces, Germany, [4]Univ. of Melbourne, Australia.* Incorporation of gold nanoparticles in 3-dimensional photonic crystals has been used to change the dispersion of optical eigenmodes. A polariton band has been observed at the overlap of diffraction and localised surface plasmon bands.

TuB4 • 11:45 a.m.
Infrared Antenna Using a Photonic Crystal Slab, *Marine Laroche, Rémi Carminati, Jean-Jacques Greffet; Ecole Centrale Paris, France.* We show that a photonic crystal film can emit coherent thermal radiation. We demonstrate the key role of leaky waves existing at the interface air-photonic crystal.

TuB5 • 12:00 p.m.
Negative Refraction, Imaging, Beam Collimation and Subwavelength Concentration in Photonic Crystals, *Juan Luis Garcia-Pomar, Manuel Nieto-Vesperinas; Inst. de Ciencia de Materiales de Madrid, Consejo Superior de Investigaciones Científicas, Spain.* We calculate imaging through negative refraction, as well as collimation and subwavelength beam concentration, of high index contrast dielectric photonic crystal slabs. Characterization of the transfer function and rigorous requirements for subwavelength imaging are given.

TuB6 • 12:15 p.m.

Sub-Wavelength Imaging at Optical Frequencies Using a Periodic Layered Metal-Dielectric Structure Operating in the Canalization Regime, *Pavel A. Belov, Yang Hao; Queen Mary, Univ. of London, UK.* Imaging with sub-wavelength resolution using a periodic metal-dielectric layered structure is demonstrated. The structure operates in canalization regime as a transmission device and it does not involve negative refraction and amplification of evanescent modes.

TuB7 • 12:30 p.m.
Compact Left-Handed Metamaterial Based on Double-Layer Planar Metal Strip Arrays, *Kaan Guven, Deniz Caliskan, Ekmel Ozbay; Bilkent Univ., Turkey.* The existence of a left-handed transmission peak of a metamaterial consisting of double-layer planar metal strip arrays at 15 GHz is demonstrated. This design is very suitable to submicron scales required at communication wavelengths.

TuC • Negative-Index Materials, Super-Resolution and Nonlinear Optics

Royal Palm
7:00 p.m.–9:00 p.m.
TuC • Negative-Index Materials, Super-Resolution and Nonlinear Optics
John Pendry; Imperial College, UK, Presider
Harald Giessen; Univ. of Bonn, Germany, Presider

TuC1 • 7:00 p.m. **•Invited•**
Super-Resolution Imaging and Performance Optimisation for Single- and Multi-Layer Silver Superlenses, *Richard J. Blaikie; Univ. of Canterbury, New Zealand.* Super-resolution imaging has been achieved in a lithography environment using both single- and multi-layer silver superlenses. The performance of these systems is compared here, and analytical and simulation methods are used to optimise performance.

TuC2 • 7:30 p.m. **•Invited•**
Optical "Hyperspace": Negative Refractive Index and Subwavelength Imaging in Anisotropic Media, *Evgenii Narimanov, Leonid Alekseyev; Princeton Univ., USA.* We develop a new approach to materials with negative refractive index and subwavelength imaging systems based on anisotropic dielectric constant in planar and cylindrical geometries, leading to low losses and high tolerance to fabrication imperfections.

TuC3 • 8:00 p.m.
Optical Negative-Index Metamaterials: From Low to No Loss, *Vladimir M. Shalaev, T. A. Klar, V. P. Drachev, A. V. Kildishev; Purdue Univ., USA.* Practical optical negative index materials based on coupled plasmon resonances must overcome reflection and absorption. Simulations show that matched impedance and compensated losses due to optimized design and gain material lead to 100% transmission.

TuC4 • 8:15 p.m.
Second-Harmonic Generation and Parametric Amplification in Negative-Index Metamaterials, *Alexander K. Popov[1], Vladimir M. Shalaev[2]; [1]Univ. of Wisconsin at Stevens Point, USA, [2]Purdue Univ., USA.* Extraordinary nonlinear-optical properties originating from contra-directed wave vector and Poynting vector are investigated. The feasibility of light-controlled transparency, cavityless oscillation and generation of counter-propagating entangled right- and left-handed photons is shown.

TuC5 • 8:30 p.m.
Optical Experiments on Second-Harmonic Generation with Metamaterials Composed of Split-Ring Resonators, *Matthias W. Klein[1], Christian Enkrich[1], Martin Wegener[1], Jens Förstner[2], Jerome V. Moloney[2], Walter Hoyer[3], Tineke Stroucken[3], Torsten Meier[3], Stephan W. Koch[3], Stefan Linden[4]; [1]Univ. Karlsruhe (TH), Germany, [2]Univ. of Arizona, USA, [3]Univ. Marburg, Germany, [4]Forschungszentrum Karlsruhe, Germany.* We study optical second-harmonic generation from planar arrays of magnetic split-ring resonators at 1.5 microns resonance wavelength. We obtain by far the largest signals when exciting the magnetic-dipole resonance.

TuC6 • 8:45 p.m.
Towards a Negative Index Material Using Pairs of Nanowires, *Frank Garwe[1], Carsten Rockstuhl[2], Christoph Etrich[2], Uwe Hübner[1], Ulf Bauerschaefer[3], Frank Setzpfandt[2], Markus Augustin[2], Arkadi Chipouline[2], Thomas Pertsch[2], Falk Lederer[2]; [1]Inst. for Physical High Technology, Germany, [2]Friedrich-Schiller Univ., Germany, [3]GmBU, Germany.* By controlling the distance between parallel nanowires the electric and magnetic resonances of this structure are forced to spectrally coincide. Measurements of amplitude and phase of fabricated samples are provided together with theoretical results.

●Wednesday, June 7, 2006●

Royal Palmer Foyer
7:30 a.m.–5:30 p.m.
Registration Open

WA • Localized and Diffusive EM Modes

Royal Palm
8:00 a.m.–10:00 a.m.
WA • Localized and Diffusive EM Modes
Presiders To Be Announced

WA1 • 8:00 a.m. **●Invited●**
Quasimodal Decomposition of the Spatially Extended Field within a Nominally Localized 1D Open Random Waveguide, *Patrick H. Sebbah[1,2], B. Hu[2], J. M. Klosner[2], A. Z. Genack[2]; [1]CNRS, France, [2]Queens College of CUNY, USA.* The microwave field is measured *inside* a random waveguide to reveal multiple peaks in space whenever spectral features are not Lorentzian. The wave is then decomposed into underlying Lorentzian quasimodes which dominate transmission.

WA2 • 8:30 a.m.
Optical Necklace States in Anderson Localized 1D Systems, *Jacopo Bertolotti[1], Stefano Gottardo[1], Riccardo Sapienza[1], Diederik S. Wiersma[1], Mher Ghulinyan[2], Lorenzo Pavesi[2], Matteo Galli[3], Lucio C. Andreani[3]; [1]European Lab for Nonlinear Spectroscopy and INFM-Matis, Italy, [2]Dept. of Physics, Univ. of Trento, Italy, [3]INFM-Dept. di Fisica, Univ. of Pavia, Italy.* We report on the observation of nonlocalized modes, known as necklace states, in Anderson localized multilayers with positional disorder. Multiple resonant tunnelling transport, characteristic of these modes, was studied both through time-resolved and phase-resolved measurements.

WA3 • 8:45 a.m.
Coexistence of Localized and Delocalized Surface Plasmon Modes in Semicontinuous Metal-Dielectric Films, *Katyayani Seal[1], Dentcho Genov[2], Andrey Sarychev[3], Heeso Noh[1], Vladimir M. Shalaev[4], Charles Ying[5], Xiang Zhang[2], Hui Cao[1]; [1]Northwestern Univ., USA, [2]Univ. of California at Berkeley, USA, [3]Ethertronics Inc., USA, [4]Purdue Univ., USA, [5]Natl. Inst. of Standards and Technology, USA.* Detailed studies of the near-field intensity statistics in semicontinuous metal films provide the first experimental evidence for the coexistence of localized and delocalized surface plasmon modes in metallic random systems.

WA4 • 9:00 a.m.
Light Enhancement and Formation of Photonic Band Gaps in Aperiodic Waveguide Structures, *Marianne Hiltunen[1,2], Luca Dal Negro[1], Ning-Ning Feng[1], Lionel C. Kimerling[1], Jurgen Michel[1]; [1]MIT Dept. of Materials Science and Engineering, USA, [2]Technical Res. Ctr. of Finland, Finland.* Novel design of complex waveguide structures that guide light due to the excitation of multiple resonant transmission states induced by aperiodic Thue-Morse environment is presented. We illustrate bandgaps and localization states formed into these structures.

WA5 • 9:15 a.m.
Electromagnetic Wave Localization in 3D Fractal Structures, *Yoshinari Miyamoto[1], Yusuke Nakahata[1], Soshu Kirihara[1], Mitsuo Wada Takeda[2], Katsuya Honda[2]; [1]Joining and Welding Res. Inst., Osaka Univ., Japan, [2]Faculty of Science, Shinshu Univ., Japan.* Dielectric 3D fractals were fabricated by stereolithography. Transmission and right angle scattering spectra of microwave showed the localizations in GHz range. The localization frequencies showed good agreements with the calculated ones using the empirical equation.

WA6 • 9:30 a.m.
Transport and Anderson Localization in 2-Dimensional Photonic Lattices, *Tal Schwartz, Guy Bartal, Shmuel Fishman, Mordechai Segev; Technion, Israel.* We present a new approach for studying localization effects in 2-dimensional disordered lattices in linear and nonlinear regimes. We demonstrate experimentally diffusive transport and show that our method can provide direct observation of Anderson Localization.

WA7 • 9:45 a.m.
From Diffusive to Coherent Light Propagation in Disordered Nonlinear Fiber Arrays, *Thomas Pertsch[1], Arkadi Chipouline[1], Stefan Nolte[1], Falk Lederer[1], Ulrich Röpke[2], Jens Kobelke[2], Kay Schuster[2], Hartmut Bartelt[2], Ulf Peschel[3], Andreas Tünnermann[4]; [1]Friedrich-Schiller-Univ., Germany, [2]Inst. für Physikalische Hochtechnologie e.V., Germany, [3]Max-Planck-Forschungsgruppe, Optik, Information und Photonik, Germany, [4]Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany.* We observe experimentally the transition from diffusive to coherent (ballistic) light propagation in arrays of mutually coupled optical fibers with an adjustable degree of disorder. Nonlinearity causes mobility and localization for the two respective cases.

Bonds Cay
10:00 a.m.–10:30 a.m.
Coffee Break

WB • Plasmonics II: Negative-Index Materials

Royal Palm
10:30 a.m.–12:30 p.m.
WB • Plasmonics II: Negative-Index Materials
Nikolay Zheludev; Univ. of Southampton, UK, Presider
Javier Garcia de Abajo; Ctr. Mixto CSIC-UPV/EHU, Spain, Presider

WB1 • 10:30 a.m.
Metal-Dielectric Composites as Materials for Nonlinear Phase Accumulation, *Nick N. Lepeshkin[1], Aaron Schweinsberg[2], Giovanni Piredda[2], Robert W. Boyd[2]; [1]San Francisco State Univ., USA, [2]Inst. of Optics, Univ. of Rochester, USA.* We discuss whether multi-layer metal-dielectric composites could be utilized as materials for efficient nonlinear phase accumulation. We present our experimental results and compare them with the existing numerical models.

WB2 • 10:45 a.m.
Extraordinary Light Transmission through Quasicrystal Arrays of Holes in a Metal Film, *F. Javier Garcia de Abajo[1], Yifang Chen[2], Vassili A. Fedotov[3], Nikitas Papasimakis[3], Alexander S. Schwanecke[3], Nikolay I. Zheludev[3]; [1]Ctr. Mixto CSIC-UPV/EHU, Spain, [2]Central Microstructure Facility, Rutherford Appleton Lab, UK, [3]EPSRC NanoPhotonics Portfolio Ctr., School of Physics and Astronomy, Univ. of Southampton, UK.* We report on the first observation of extraordinary transmission

exhibited by arrays of holes arranged in a 2D quasicrystal in both microwave and optical parts of the spectrum, indicating a non-plasmon nature of the effect.

WB3 • 11:00 a.m. **•Invited•**

Microwave and Infrared Transmission through Normally Opaque Objects, *Ping Sheng; Hong Kong Univ., Hong Kong Special Administrative Region of China.* Metallic fractals are known to possess localized electromagnetic resonances. The log-periodic localized resonances on H-fractals are shown to induce micro- and infrared wave transparency through normally opaque objects. This is illustrated in three different contexts.

WB4 • 11:15 a.m.

Electromagnetic Field Enhancement at Electrochemical Interface Due to Surface Defects on a Metallic Electrode, *Antonio Mandatori[1], Emanuele Castagna[1,2], Vittorio Violante[2], Concita Sibilia[1], Mario Bertolotti[1]; [1]Dept. di Energetica, Univ. di Roma, Italy, [2]ENEA sulla Fusione, Italy.* Strong electromagnetic field localization can be obtained at the electrode/electrolyte interface of dielectric inclusions in a metal foil. The enhancement is driven by the strong electrostatic field present close to the metal surface.

WB5 • 11:30 a.m.

Tuning Localized Plasmons in Nanostructured Metamaterials for Surface-Enhanced Raman Scattering Applications, *Jeremy J. Baumberg[1], Nicolas M. B. Perney[1], Tim Kelf[1], Robin Cole[1], Yoshihiro Sugawara[1], Mamdouh E. Abdelsalam[1], Susan Cintra[1], Andrea E. Russell[1], Philip N. Bartlett[1], Majd E. Zoorob[2], Martin D. B. Charlton[2], Caterina M. Netti[2]; [1]Univ. of Southampton, UK, [2]Mesophotonics Ltd, UK.* Reflectivity measurements of gold nanostructures graded in pitch and aperture size allow investigation of localized plasmons. A simple model confirmed by simulations explains the plasmon resonances. Such arrays demonstrate highly unusual and enhanced Raman scattering.

WB6 • 11:45 a.m.

On the Non-Local Character of the Electromagnetic Response of Colloidal Systems, *Ruben G. Barrera, Augusto García-Valenzuela; Univ. Nacional Autónoma de México, Mexico.* We show the non-local nature (spatial dispersion) of the effective electromagnetic response of a colloidal system. We derive closed expressions and display numerical results for both, the effective non-local electric permittivity and the magnetic susceptibility.

WB7 • 12:00 p.m.

Photo-Induced Voltage across Negative Index Metamaterials, *Teruya Ishihara[1], Young-Geun Roh[1], Yusaburo Segawa[1], Nikolay A. Gippius[2], Sergei G. Tikhodeev[2]; [1]Frontier Res. System, RIKEN, Japan, [2]General Physics Inst., RAS, Russian Federation.* Photo-induced voltage across a metallic wire in thin film of negative index material is discussed. Electromagnetic and Poynting vector fields in a perforated metallic bi-layer structure are numerically calculated by the scattering matrix formalism.

WB8 • 12:15 p.m.

All-Angle Negative Refraction for Surface Plasmon Waves Using a Metal-Dielectric-Metal Structure, *Hocheol Shin, Shanhui Fan; Stanford Univ., USA.* We show all-angle negative refraction of surface plasmon, using a metal-dielectric-metal structure at optical frequencies. Using finite difference time domain simulations, we demonstrate the imaging operation of the structure with realistic material parameters.

WC • Mesoscopic Random Lasers

Royal Palm
2:00 p.m.–4:00 p.m.
WC • Mesoscopic Random Lasers
Diederik S. Wiersma; European Lab for Nonlinear Spectroscopy, Italy, Presider
Ad Lagendijk; FOM Inst for Atomic & Molecular Physics, Netherlands, Presider

WC1 • 2:00 p.m. **•Invited•**

Lasing in Disordered Photonic Crystals, *Hui Cao, Alexey Yamilov, Xiaohua Wu; Northwestern Univ., USA.* Experimental and theoretical studies on lasing disordered photonic crystals are presented. We demonstrate that structural disorder could improve optical confinement in photonic crystals and reduce the lasing threshold.

WC2 • 2:30 p.m. **•Invited•**

Multi-Mode Lasing Theory for Complex or Random Lasers, *A. Douglas Stone, Hakan E. Tureci; Yale Univ., USA.* We reformulate the steady-state multi-mode lasing equations using biorthogonal modes of the open cavity. The theory is convenient for treating the mode competition, emission patterns and output power of complex or random laser cavities.

WC3 • 3:00 p.m. **•Invited•**

Cold Atoms: Towards Localization and Random Lasing, *Robin Kaiser; CNRS, France.* We discuss how the observation of coherent backscattering of light by cold atoms has opened new ways towards the study of Anderson localization and random lasers with narrow resonances.

WC4 • 3:30 p.m. **•Invited•**

Superradiance and Mesoscopic Transport of Diffusing Photons in Cold Atoms, *Eric Y. Akkermans, Ohad Assaf, Aharon Gero; Technion--Israel Inst. of Technology, Israel.* Effects of superradiance and angular correlations of speckle patterns resulting from transport of diffusing as well as nearly localized photons in cold atomic gases are studied. Those are new mesoscopic effects.

WD • Poster Session I

Bonds Cay
4:00 p.m.–6:00 p.m.
WD • Poster Session I/ Refreshment Break

WD1

Slow Light Modes in Non-Magnetic Negative Refractive Index Waveguides, *Leonid Alekseyev, Evgenii Narimanov; Princeton Univ., USA.* We demonstrate the possibility of slow light in strongly anisotropic dielectric waveguides. Sufficiently strong anisotropic response produces negative refractive index in the waveguide core, which enables low group velocity modes.

WD2
Microscopic Disorder in Metamaterials, *Maxim Gorkunov[1,2], Sergey A. Gredeskul[1,3], Ilya V. Shadrivov[1], Yuri S. Kivshar[1]; [1]Australian Natl. Univ., Australia, [2]Inst. of Crystallography, Russian Acad. of Sciences, Russian Federation, [3]Ben-Gurion Univ., Israel.* We analyze the effect of microscopic disorder on macroscopic properties of composite metamaterials. We demonstrate that 10% deviation in the parameters of resonators leads to substantial suppression of wave propagation in a wide frequency range.

WD3
Second-Harmonic Generation in Left-Handed Metamaterials, *Ilya V. Shadrivov[1], Maxim Gorkunov[1,2], Alexander A. Zharov[1,3], Yuri S. Kivshar[1]; [1]Australian Natl. Univ., Australia, [2]Inst. of Crystallography, Russian Acad. of Sciences, Russian Federation, [3]Inst. for Physics of Microstructures, Russian Acad. of Sciences, Russian Federation.* We study the second-harmonic generation in left-handed metamaterials with a quadratic nonlinear response and demonstrate a novel type of the phase matching. We also suggest binary metamaterials for resonantly enhanced second-harmonic generation.

WD4
Propagation in Absorptive and Dispersive Metamaterials: A Hamiltonian Approach, *Navin A. R. Bhat, J. E. Sipe; Dept. of Physics and Inst. for Optical Sciences, Univ. of Toronto, Canada.* We present a Hamiltonian approach to pulse propagation in structured materials with absorptive and dispersive response obeying the Kramers-Kronig relations. The method uses effective fields based on the polariton modes of the system.

WD5
Guided Waves in a Bilayer Film Made of Right- and Left-Handed Materials, *Cédric Vandenbem[1], Stavroula Foteinopoulou[1], Jean-Pol Vigneron[1], Virginie Lousse[1,2]; [1]Facultés Universitaires Notre-Dame de la Paix, Belgium, [2]Stanford Univ., USA.* We study the guided modes of a composite positive and negative refractive index bilayer film. We find such modes can have very low energy velocities, leading to a cavity-like behavior.

WD6
Surface Plasmon Resonance in a Metallic Pillar Array on a Metallic Substrate in the Terahertz Frequency Region, *Takayuki Okamoto[1], Satoshi Kawata[1], Hiroaki Minamide[2], Hiromasa Ito[2,3], Keishi Ohashi[4]; [1]RIKEN, Japan, [2]RIKEN Sendai, Japan, [3]Tohoku Univ., Japan, [4]NEC Corp., Japan.* We propose a new structure, consisting of a two-dimensional metallic pillar array on a metallic substrate, to support surface plasmons in the terahertz frequency region. We experimentally observed a surface plasmon resonance at 1.56 THz.

WD7
Observation of Fast Light in a Microsphere, *Kouki Totsuka, Makoto Tomita; Shizuoka Univ., Japan.* We observed -4.9 ns negative delay in optical pulse propagation in resonant Whispering Gallery Mode of microsphere. The observed fast light can well be explained by a directional coupling theory on the under coupling condition.

WD8
Dynamical Electric Metamaterial Response at Terahertz Frequencies, *Willie J. Padilla[1], Antoinette J. Taylor[1], Clark Highstrete[2], Mark Lee[2], Richard D. Averitt[1]; [1]Los Alamos Natl. Lab, USA, [2]Sandia Natl. Lab, USA.* Utilizing terahertz time domain spectroscopy, we characterized the electromagnetic response of planar Split Ring Resonators fabricated on GaAs. Optical excitation is sufficient to turn off the electric resonance demonstrating the potential of SRR terahertz switches.

WD9
Dispersion and Scattering of Resonant Nanoparticle Chains, *A. Femius Koenderink, René de Waele, Albert Polman; FOM Inst. for Atomic and Molecular Physics, The Netherlands.* Coupled resonant nanoparticles may help to realize subwavelength control over photons. We claim that metal nanoparticle chains show an unexpected polariton splitting in the dispersion relation and discuss consequences for scattering and subwavelength optical confinement.

WD10
Light-Wave Guidance through Stratified Photonic Crystal Metamaterials Synthesized by Super-Inductive Layers of Metallic Nano-Strips, *Nikolaos J. Florous, Kunimasa Saitoh, Masanori Koshiba; Div. of Media and Network Technologies, Hokkaido Univ., Japan.* We theoretically demonstrate the possibility of strong light-wave guidance through a novel class of photonic crystal metamaterial platform entirely synthesized by ultra-low refractive index suspended nano-strips. Basic waveguiding structures can be realized on the nano-scale.

WD11
Nano Optical Modes of a Gap Structure in a Left-Hand-Metamaterial Waveguide, *Noam Kaminsky, Yinon Satuby, Meir Orenstein; Technion - Israel Inst. of Technology, Israel.* A dielectric gap in a metamaterial is employed for simultaneous transport of right and left hand optical fields. The metamaterial is implemented by elongated nano-metallic inclusions, to generate negative refractive index by the waveguide anisotropy.

WD12
Hetero-Structure Photonic Crystal Demultiplexer Based on Ultra-Low Refractive Index Nano-Wires: Towards Temperature-Insensitive Metamaterial Platforms, *Nikolaos J. Florous, Kunimasa Saitoh, Masanori Koshiba; Div. of Media and Network Technologies, Hokkaido Univ., Japan.* We propose and numerically investigate the thermal-insensitive properties of a novel type of wavelength selective filter based on heterostructure photonic crystals entirely synthesized by ultra-low refractive index metallic nanowires, for efficient demultiplexing of visible frequencies.

WD13
A Possible Route for Left-Handed Meta-Materials Using Ferromagnetic-Metal Nanocomposite Films, *Satoshi Tomita[1], Haruhiko Yashiro[2], Takanari Kashiwagi[2], Masayuki Hagiwara[2], Chiharu Mitsumata[3], Hidemi Nawafune[4], Kensuke Akamatsu[4]; [1]Japan Science and Technology Agency, Japan, [2]Osaka Univ., Japan, [3]Hitachi Metals Ltd., Japan, [4]Konan Univ., Japan.* Ferromagnetic-metal nanocomposite films as a candidate for left-handed meta-materials in microwave regions were experimentally studied. Electron magnetic resonance study suggests that the film microstructure influences resonance frequency around which the negative permeability may be obtained.

WD14

Perfect Transparency in Opaque Optical Systems, *Ivo M. Vellekoop, Allard P. Mosk; Univ. of Twente, The Netherlands.* We shape the wavefront of light incident on disordered, multiply scattering systems. Using computer controlled modulators and feedback-based learning algorithms we strive to find the perfectly transparent modes that theory predicts.

WD15
Lumped Circuit Model for an Active Right-Handed Medium with Negative Refractive Index, *Bertil Nistad, Johannes Skaar; Dept. of Electronics and Telecommunications, Norwegian Univ. of Science and Technology, Norway.* Active, right-handed media exist for which the refractive index is negative in a finite bandwidth. We propose a lumped circuit model for such media, based on a resonant transmission line with negative shunt resistance.

WD16
Spin-Dependent Ultrafast Optical Nonlinearities in Bragg Spaced Quantum Wells, *Wesley J. Johnston[1], John P. Prineas[1], Arthur L. Smirl[1], Hyatt M. Gibbs[2], Galina Khitrova[2]; [1]Univ. of Iowa, USA, [2]Univ. of Arizona, USA.* We observe spin-dependent ultrafast blue shifts, transient gain, and the opening of spectral transmission windows in the forbidden gap of the photonic band structure of Bragg-spaced InGaAs/GaAs quantum wells.

WD17
Laser Threshold of Mie Resonances, *Karen L. van der Molen[1], Peter Zijlstra[1], Ad Lagendijk[2], Allard P. Mosk[1]; [1]Univ. of Twente, The Netherlands, [2]FOM Inst. for Atomic and Molecular Physics (AMOLF), The Netherlands.* We present work on laser resonances in dielectric spheres. Experimentally, the fluorescence line width of a dye-doped microsphere decreases with increasing pump intensity. Theoretically, we corroborate this observation and derive a new laser threshold criterion.

WD18
Magneto-Optical Kerr Effects of Magnetic Garnet Thin Films Including Plasmonic Noble-Metal Nanoparticles, *Satoshi Tomita[1], Takeshi Kato[2], Shigeru Tsunashima[2], Satoshi Iwata[2], Minoru Fujii[3], Shinji Hayashi[3]; [1]Japan Science and Technology Agency, Japan, [2]Nagoya Univ., Japan, [3]Kobe Univ., Japan.* We report an experimental study on magneto-optical (MO) Kerr effects of yttrium iron garnet (YIG) films incorporating plasmonic Au nanoparticles. The results indicate a possible coupling between the MO Kerr effects and localized surface plasmons.

WD19
Negative Index Composite Metamaterials as One Dimensional Single Negative Stacks, *Alexandru I. Cabuz, Didier Felbacq, David Cassagne; Univ. Montpellier II, France.* We show that negative index metamaterials can be realized using one dimensional single negative stacks. Homogenization theory shows that the effective parameters of such structures can become unbounded. We discuss consequences of this remarkable fact.

WD20
Role of Localized Waveguide Resonances in the Enhanced Transmission through Periodic Arrays of Subwavelength Holes, *Zhichao Ruan, Min Qiu; Royal Inst. of Technology (KTH), Sweden.* It is shown that the localized waveguide resonance exists in both the perfectly electronic conductivity film and the Au film with subwavelength holes, and plays an important role in the enhanced transmission.

WD21
Ring-Shaped Molecules as Split Ring Resonators of a Molecular Metamaterial, *Frank Brechtefeld, Norbert Lindlein, Gerd Leuchs, Ulf Peschel; Inst. of Optics, Information and Photonics, Univ. of Erlangen-Nuremberg, Germany.* We analytically analyse the magnetic response of ring shaped molecules. We find that circular symmetry must be broken and that transitions between higher order states have to be enabled to obtain a reasonable magnetic response.

WD22
Effective Electromagnetic Properties of Structured Chiral Metamaterials, *Ouail Ouchetto[1], Said Zouhdi[1], Alain Bossavit[1], Bernadette Miara[2]; [1]Lab de Génie Electrique de Paris-Supélec, France, [2]ESIEE, Lab de Modélisation et Simulation Numérique, France.* A novel methodology to evaluate the effective parameters of a three-dimensional lattice of chiral inclusions is presented. The homogenization is based upon mathematical arguments. The finite element technique is used to compute the constitutive parameters.

WD23
Conservation of Electromagnetic Momentum and Shear Radiation Forces Exerted on Left-Handed Material Interfaces, *Spilios Riyopoulos; SAIC, USA.* A reversal in the parallel-to-the-surface electromagnetic momentum direction occurs at at left-handed material interfaces. The parallel-to-the-surface shear force resulting from the imparted change in EM momentum, unique to left-handed interfaces, is computed.

WD24
Chemical Route Prepared Magnetic Structure at Infrared Frequencies, *Xiao P. Zhao, H. Liu; Dept. of Applied Physics, Northwestern Polytechnical Univ., China.* We propose a novel quasi-periodical dendritic model, which can be prepared using chemical electro-deposition method, for the realization of negative permeability. The simulation and experimental results confirmed the magnetic response at infrared frequencies.

WD25
Resonances in Light Scattering by Small Magnetic Particles, *Braulio García-Cámara[1], Francisco González[1], Fernando Moreno[1], José M. Saiz[1], Gorden Videen[2]; [1]Univ. de Cantabria, Spain, [2]ARL, USA.* Light scattering resonances in small particles are analyzed either exactly or by approximate expressions for the most important Mie coefficients. Materials with different optical properties, incluiding Double Negative (as corresponding to LHM), are considered.

WD26
A First Attempt to Assess Marine Particles Composition from Femote Sensing: Exploitation of the POLDER Polarized Radiances, *Hubert Loisel, Lucile Duforet, David Dessailly, Philippe Dubuisson; Univ. du Littoral-Côte d'Opale, France.* The particulate backscattering coefficient and the degree of polarization provide a means to study and characterize the nature of suspended marine particles. Here, we show that such information may be retrieved from remote sensing.

WD27
A Novel Metamaterial Structure with High Dielectric Resonators, *Jaewon Kim, Anand Gopinath; Univ. of Minnesota, USA.* Wave propagation in a novel metamaterial structure with high dielectric resonators embedded periodically in a low dielectric material is simulated. We demonstrate by simulation that this structure without any metal is a double negative material.

WD28
Negative Capacitance Effect in Impedance Spectroscopy, *Harry L. Kwok[1], Xingming Wang[1], J. B. Xu[2], L. W. M. Lau[2]; [1]Univ. of Victoria, Canada, [2]Chinese Univ. of Hong Kong, China.* "Universality of Photocurrent Transients" was shown to apply to Alq_3 thin films when the real part and the imaginary part of the carrier mobility had the same magnitude. We verify this also applies to CuPc.

WD29
A Grating-Bicoupled Plasmon-Resonant Terahertz Emitter Fabricated with GaAs-Based Heterostructure Metamaterial Systems, *Taiichi Otsuji[1], Yahya M. Meziani[1], Mitsuhiro Hanabe[1], Takuma Ishibashi[1], Tomohiro Uno[1], Eiichi Sano[2]; [1]Tohoku Univ., Japan, [2]Hokkaido Univ., Japan.* A grating-bicoupled plasmon-resonant terahertz emitter was fabricated using GaAs-based heterostructure metamaterial systems. Photo-excited electrons, injected to the two-dimensional plasmon cavities, promoted the plasmon instability, resulting in the first observation of terahertz emission at room temperature.

Pavilion
6:00 p.m.–8:30 p.m.
Conference Reception

●Thursday, June 7, 2006●

Royal Palmer Foyer
7:30 a.m.–6:00 p.m.
Registration Open

ThA • Metamaterials III

Royal Palm
8:00 a.m.–10:00 a.m.
ThA • Metamaterials III
Evgenii Narimanov; Princeton Univ., USA, Presider
Graeme W. Milton; Dept. of Mathematics, USA, Presider

ThA1 • 8:00 a.m. **●Invited●**
Optical Nanoelectronics with Metamaterials, *Nader Engheta; Univ. of Pennsylvania, USA.* We give an overview of the fundamental properties of optical "lumped" circuit elements and components, utilizing optical metamaterials. We will discuss how these elements can be the building blocks for more complex optical nanoelectronics.

ThA2 • 8:30 a.m.
Subwavelength Imaging by Full 3D Negative Refraction Using a 3D Photonic Crystal, *Dennis W. Prather, Zhaolin Lu, Janusz A. Murakowski, Shouyuan Shi, Caihua Chen, Christopher A. Schuetz, Garrett J. Schneider; Univ. of Delaware, USA.* A 3D body-centered cubic photonic crystal was designed and fabricated to achieve full 3D negative refraction by dispersion engineering. Three-dimensional subwavelength resolution imaging was experimentally demonstrated using this photonic crystal in microwave regime.

ThA3 • 8:45 a.m.
Radiative and Nonradiative Decay of Near-Infrared Excitations in Split-Ring Resonator Metamaterials, *Harald Giessen[1], Thomas Zentgraf[2], Carsten Rockstuhl[3], C. Etrich[3], Hongcang Guo[1], Na Liu[1], Todd Meyrath[1], Heinz Schweizer[1], Stefan Kaiser[1], Jürgen Kuhl[2], Falk Lederer[3]; [1]Univ. of Stuttgart, Germany, [2]Max Planck Inst. for Solid State Res., Germany, [3]Friedrich-Schiller Univ., Germany.* The influence of the specific split-ring resonator geometry on the electromagnetic resonances and especially their spectral width is analyzed experimentally and theoretically. Furthermore, we separate radiative and nonradiative contributions to the linewidth of the resonances.

ThA4 • 9:00 a.m.
Observation of Magnetoinductive Waves in Metamaterials, *Ilya V. Shadrivov[1], Alexander N. Reznik[1,2], Alexander A. Zharov[1,2], Nina A. Zharova[1,3], Yuri S. Kivshar[1]; [1]Australian Natl. Univ., Australia, [2]Inst. for Physics of Microstructures, Russian Acad. of Sciences, Russian Federation, [3]Inst. of Applied Physics, Russian Acad. of Sciences, Russian Federation.* We develop the theory and study experimentally the propagation of linear magnetoinductive waves in composite metamaterials. We present results of the first experimental observation of magnetoinductive waves in one-dimensional arrays of resonators.

ThA5 • 9:15 a.m.
Novel Electric Metamaterials Studied at Terahertz Frequencies, *Willie J. Padilla[1], Marie T. Aronsson[1], Clark Highstrete[2], Mark Lee[2], Antoinette J. Taylor[1], Richard D. Averitt[1]; [1]Los Alamos Natl. Lab, USA, [2]Sandia Natl. Lab, USA.* We present new designs for metamaterials that exhibit a tailored resonant electrical response, investigated with THz time domain spectroscopy. These electric metamaterials will significantly ease the burden of construction for future negative index metamaterial devices.

ThA6 • 9:30 a.m. **●Invited●**
Negative Index Materials in GHz and THz Frequencies, *Costas Soukoulis[1,2], Jiangfeng Zhou[1,3], Lei Zhang[1,3], Thomas Koschny[1,2]; [1]Iowa State Univ., USA, [2]Inst. of Electronic Structure and Laser – FORTH, and Dept. of Materials Science and Technology, Univ. of Crete, Greece, [3]Dept. of Electrical and Computer Engineering and Microelectronics Res. Ctr., Iowa State Univ., USA.* We present new designs, fabrication and experiments on metamaterials that give a negative index of refraction, with low imaginary part, form GHz to THz frequencies.

Bonds Cay
10:00 a.m.–10:30 a.m.
Coffee Break

ThB • Photonics in Tunable, Scattering and Absorbing Materials

Royal Palm
10:30 a.m.–12:30 p.m.
ThB • Photonics in Tunable, Scattering and Absorbing Materials
Ross McPhedran; Univ. of Sydney, Australia, Presider
Jean Jacques Greffet; Ecole Centrale Paris, France, Presider

ThB1 • 10:30 a.m. **●Invited●**
Light Propagation in Tunable Photonic Materials, *Diederik S. Wiersma; European Lab for Nonlinear Spectroscopy and INFM-Matis, Italy.* We will discuss light transport in complex photonic structures like random lasers and photonic crystals. In particular we will focus on tuning and switching via liquid crystal infiltration and discuss various models of random lasing.

ThB2 • 11:00 a.m.
Photon Diffusion Coefficient in Absorbing Random Media, *Remi Carminati, Romain Pierrat, Jean-Jacques Greffet; Ecole Centrale Paris, France.* We present a derivation of the photon diffusion coefficient in scattering and absorbing (or amplifying) media, valid for both steady-state and time-dependent transport. Our results resolve a recurrent controversy concerning its dependence on absorption.

ThB3 • 11:15 a.m.
Disorder-Induced Resonances in One-Dimensional Lossy Samples: Detection and Characterization, *Konstantin Bliokh[1], Yuri Bliokh[2], Valentin Freilikher[3], Bing Hu[4], John Klosner[4], Azriel Genack[4], Patrick Sebbah[5]; [1]Inst. of Radio Astronomy, Ukraine, [2]Technion Univ., Israel, [3]Bar-Ilan Univ., Israel, [4]Queens College of the City Univ. of New York, USA, [5]Univ. de Nice, France.* Localized states in one-dimensional disordered samples with losses have been observed experimentally and interpreted theoretically. An algorithm is developed of the detecting and characterizing the resonances via measurements of the reflection coefficient.

ThB4 • 11:30 a.m.
Disordered Wave-Guides with Absorption: Transmittance Distribution at the Diffusive-Localized Crossover, *Luis S. Froufe-Pérez[1], Pedro García-Mochales[1], Juan José Sáenz[1], Pedro A. Serena[2]; [1]Univ. Autónoma de Madrid, Spain, [2]Inst. Ciencia de Materiales de Madrid, CSIC, Spain.* An analysis, from calculations of a "tight-binding" model, of

the behavior of transmittances distributions on the diffusive-localize regimens crossover in disordered wave-guides with absorption is presented. Findings resemble results found in microwaves-guide experiments.

ThB5 • 11:45 a.m.
Stochastic Modeling of Coherent Effects in Multiple Scattering, *Vladimir L. Kuzmin[1], Dmitry Y. Churmakov[2], Igor Meglinski[2]; [1]St.-Petersburg Inst. of Commerce and Economics, Russian Federation, [2]Cranfield Univ., UK.* Based on the iteration procedure of Bethe-Salpeter equation, the Monte Carlo technique is generalized for the simulation of coherent effects in respect of polarization of the electromagnetic field of scattered radiation.

ThB6 • 12:00 p.m.
Anisotropic Multiple Scattering of Light, *Riccardo Sapienza[1], Diederik S. Wiersma[1], Cecil Cheung[2], Arjun G. Yodh[2], Dominique Delande[3]; [1]European Lab for Nonlinear Spectroscopy and INFM-Matis, Italy, [2]Dept. of Physics and Astronomy, Univ. of Pennsylvania, USA, [3]Lab Kastler-Brossel, Univ. Pierre et Marie Curie, France.* We report on the first observation of anisotropy in weak localization of light from ordered nematic liquid crystals and on vectorial Monte Carlo simulations of anisotropic multiple scattering and weak localization using anisotropic Rayleigh scatterers.

ThB7 • 12:15 p.m.
Synchronization of Optical Polarization Conversion and Scattering in Chiral Fibers, *Azrial Z. Genack[1, 2], Victor I. Kopp[2], V. M. Churikov[2], J. Singer[2], N. Chao[2], C. Draper[2], D. Neugrosch[2]; [1]Queens College of CUNY, USA, [2]Chiral Photonics, Inc, USA.* Polarization conversion and scattering are synchronized in birefringent fiber twisted with nonuniform pitch so that one incident polarization eigenstate is strongly scattered while the other is freely transmitted. This makes possible a broadband linear polarizer.

ThC • Postdeadline Papers

Royal Palm
2:00 p.m.– 4:00 p.m.
ThC • Postdeadline Papers
ThC • 2:00 p.m.– 4:00 p.m.
David A. B. Miller; Stanford Univ., USA, Presider
Douglas Stone; Yale Univ., USA, Presider

Results announced on-site.

ThD • Poster Session II

Bonds Cay
4:00 p.m.–6:00 p.m.
ThD • Poster Session II/ Refreshment Break

ThD1
Dual Quarter-Wave Retardation Based Polarization Beam Splitting in Photonic Crystal Slabs, *Onur Kilic, Shanhui Fan, Olav Solgaard; E. L. Ginzton Lab, Stanford Univ., USA.* We demonstrate theoretically and experimentally that a photonic crystal slab with form birefringence can act as a dual quarter-wave retarder based polarizing beamsplitter, which separates an incoming wave into two orthogonal polarizations.

ThD2
Probing Minimal Scattering Events in Coherent Backscattering of Light Using Low-Coherence Induced Dephasing, *Young L. Kim, Prabhakar Pradhan, Hariharan Subramanian, Yang Liu, Min H. Kim, Vadim Backman; Northwestern Univ., USA.* We exploit low spatial coherence illumination to dephase time-reversed partial waves outside its finite coherence area, which isolates the minimal scattering events (i.e., double scattering) from higher order scattering in coherent backscattering of light.

ThD3
Observation of Discrete Nonlinear X-waves, *Yoav Lahini[1], Eugene Frumker[1], Yaron Silberberg[1], Sotiris Droulias[2], Kyriakos Hizanidis[2], Roberto Morandotti[3], Demetrios N. Christodoulides[4]; [1]Weizmann Inst. of Science, Israel, [2]Natl. Technical Univ. of Athens, School of Electrical and Computer Engineering, Greece, [3]Inst. Natl. de la Recherche Scientifique, Canada, [4]College of Optics and Photonics, CREOL, Univ. of Central Florida, USA.* We present experimental evidence for the formation of nonlinear X-waves in AlGaAs waveguide arrays. These results agree with numerical simulations based on the discrete nonlinear Schrödinger equation with an appropriate temporal dispersion term.

ThD4
Broken Symmetry in Photonic Crystals: Resonant Zener Tunneling of Light Waves, *Costanza Toninelli[1], Diederik S. Wiersma[1], Mher Ghulinyan[2], Zeno Gaburro[2], Lorenzo Pavesi[2], Claudio J. Oton[3]; [1]European Lab for Nonlinear Spectroscopy and INFM-Matis, Italy, [2]Dept. of Physics, Univ. of Trento, Italy, [3]Dept. de Fisica Basica, Univ. of La Laguna, Spain.* We report on the observation of Zener tunnelling of light waves in spectral and time-resolved transmission measurements, performed on an optical superlattice of porous silicon with broken translational symmetry.

ThD5
Metamaterials for Omnidirectional Reflectors and Hollow-Core Waveguides, *Mark Bloemer[1], Giuseppe D'Aguanno[1], Michael Scalora[1], Nadia Mattiucci[1,2,3]; [1]Dept. of the Army, USA, [2]Universita "RomaTre" Dept. di Fisica, Italy, [3]Time Domain Corp., USA.* We show that metamaterials have omnidirectional reflecting properties in the frequency region between the magnetic plasma frequency and the electric plasma frequency. These properties are useful for reflectivity control, low loss mirrors, and hollow-core waveguides.

ThD6
Stretchable Photonic Crystals Based on Polymers, *Otto L. J. Pursiainen[1], Jeremy J. Baumberg[1], Holger Winkler[2], Benjamin Viel[3], Tilmann Ruhl[3]; [1]Univ. of Southampton, UK, [2]Merck KGaA, Germany, [3]Deutsches Kunststoff-Inst. (DKI), Germany.* Novel optical properties of stretchable polymer-based opals are presented. Nanoparticle doping strongly enhances the sharpness and depth of transmission filtering. Angle-dependent chromatic scattering exhibits unusual dispersion characteristics beyond the Bragg scattering regime.

ThD7
Bandgap Guidance in Two-Dimensional Light-Induced Photonic Lattices , *Xiaocheng Wang[1,2], Igor Makasyuk[1,2], Zhigang Chen[1,2], Jianke*

Yang[3,4]; [1]San Francisco State Univ., USA, [2]Nankai Univ., China, [3]Univ. of Vermont, USA, [4]Tsinghua Univ., China. We report the demonstration of two-dimensional square-shaped and ring-shaped photonic lattices optically-induced with a single-site negative defect. Bandgap guidance of light in such a defect is observed in experiment and studied in theory.

ThD9

Transport Mean-Free-Path in $K_5Bi_{1-x}Nd_x(MoO_4)_4$ Crystal Powders, *Maria Asuncion Illarramendi, Mohamed Al-Saleh, Ibon Aramburu, Rolindes Balda, Joaquin Fernández; Univ. del Pais Vasco, Spain.* The transport mean-free-paths in $K_5Bi_{1-x}Nd_x(MoO_4)_4$ laser crystal powders were determined by using the diffuse reflectance and transmittance of the powders and the absorption coefficient of the crystal materials. Similar results were obtained from both methods.

ThD10

All-Optical Tuning of the Superprism Effect Near Band Edges of Nonlinear Waveguide Arrays , *Yoav Lahini, Daniel Mandelik, Yaron Silberberg; Weizmann Inst. of Science, Israel.* We investigate experimentally nonlinear effects near the photonic band edges of periodic waveguide arrays. We find that near resonance, nonlinearity results in strong beam shifts due to the high curvature of the diffraction curves.

ThD11

Tamm and Shockley Surface States in Photonic Crystal, *Natalia Malkova, Cun-Zheng Ning; NASA Ames Res. Ctr., USA.* The Shockley surface states in photonic crystals are demonstrated for the first time. In crystals with simple unit cell, surface states are shown to be the Tamm-like rather than the Shockley states as commonly believe.

ThD12

Spectra of ZnO Random Lasers under Nanosecond Pumping, *Mikhail V. Ryzhkov[1], Valery M. Markushev[1], Charus' M. Briskina[1], Hui Cao[2]; [1]Inst. of Radio Engineering and Electronics of RAS, Russian Federation, [2]Dept. of Physics and Astronomy, Northwestern Univ., USA.* The study of ZnO random lasing spectra showed that they are significantly different from obtained under picosecond pumping ones. The lines in the spectra are noticeable wider and their positions change from shot to shot.

ThD13

Quasiperiodic Photonic Crystals: A Structure between Random and Periodic, *Carsten Rockstuhl, Falk Lederer; Inst. of Condensed Matter Theory and Solid State Optics, Germany.* The optical response (band gaps, effect of disorder, defect modes) of quasiperiodic crystals made of high-index dielectric cylinders is explained in terms of Mie resonances. Moreover, these studies are extended towards random photonic crystal.

ThD14

Selective Modification of Opal Photonic Crystals Using Atomic Layer Deposition, *Zachary A. Sechrist, Brian T. Schwartz, Jin H. Lee, Jarod A. McCormick, Wounjhang Park, Rafael Piestun, Steven M. George; Univ. of Colorado, USA.* We report on 3D opal photonic crystal modification by atomic layer deposition (ALD). Alumina ALD was used to coat silica opals with conformal films and hence tune the position and intensity of the Bragg peak.

ThD15

The Modelling of Fano Resonances in Photonic Crystal Slabs, *Lindsay C. Botten[1], Ross C. McPhedran[2], Michael A. Byrne[1], Ara A. Asatryan[1], Nicolae A. Nicorovici[1], Andrew H. Norton[1], C. Martijn de Sterke[2]; [1]Univ. of Technology, Australia, [2]Univ. of Sydney, Australia.* A Bloch mode theory for diffraction of plane waves by planar PC slabs is outlined. The theory provides physical insight into the origin of Fano resonances, allowing a simple pole model to be deduced rigorously.

ThD16

Solitary Waves in Photonic Structures: Analytical Solutions of the Nonlinear Kronig-Penney Model, *Yannis Kominis, Kyriakos Hizanidis, Ilias Tsopelas, Nikolaos Moshonas, Panagiotis Papagiannis, Nikolaos Efremidis, Sotirios Droulias, Lambros Halastanis, Georgios Papazisimos; Natl. Technical Univ. of Athens, Greece.* A novel method is presented for the construction of analytical solitary wave solutions of the nonlinear Kronig-Penney model in a photonic structure. The solutions correspond to gap solitons and are obtained under generic conditions.

ThD17

Energy Transport by Classical Waves through Multilayers of Diffusing Slabs, *Sijmen Gerritsen, Gerrit E. W. Bauer; Kavli Institute of Nanoscience, Delft Univ. of Technology, The Netherlands.* We describe the effect of interfaces on classical wave propagation through diffusing layered media. A series resistor model for wave energy transport is introduced and we derive a microscopic expression for the interface resistance.

ThD18

Polarization Selective Devices Embedded in Glass Fabricated by Femtosecond Laser Induced Nanogratings, *Ariel R. Libertun, Wenjian Cai, Timothy Gerke, Rafael Piestun; Univ. of Colorado, USA.* We demonstrate polarization selective devices for visible light operation fabricated in glass by a femtosecond laser. The devices are composed of arrays of micro-waveplates which are tailored by the laser formation of nanogratings in glass.

ThD19

A Periodic Structure of Coupled Double Quantum Wells for Significant Light Slowing, *Pavel Ginzburg, Meir Orenstein; Technion-Israel Inst. of Technology, Israel.* Novel periodic metamaterial, having a unit cell comprised of 2 coupled quantum wells, exhibits unusual refractive index dispersion and is supporting light propagation with low group velocity and absorption cancellation at a very narrow peak.

ThD20

The (Quasi) Natural Mode Description of the Scattering Process by Dispersive Photonic Crystals., *Bernhard J. Hoenders; Univ. of Groningen, Inst. for Theoretical Physics and Materials Science Ctr., The Netherlands.* A scattering theory for finite photonic crystals in terms of the natural modes of the scatterer is developed. This theory generalizes the classical bilinear expansions of the propagator to a bilinear expansion into natural modes.

ThD21

Threshold of Random Lasers with Incoherent Feedback, *Remi Carminati, Romain Pierrat; Ecole Centrale Paris, France.* We study random lasers with incoherent feedback using the Radiative Transfer Equation and rate equations. Dynamics and spectral signatures of

the lasing threshold are observed that are not connected to Anderson localization.

ThD22
Extraordinary Optical Reflection and Resonant Absorption from Sub-Wavelength Cylinder Arrays, *Marine Laroche[1], Juan José Saenz[1], Raquel Gómez-Medina[2]; [1]Univ. Autonoóma de Madrid, Spain, [2]Donostia Intl. Physics Ctr. (DIPC), Spain.* An analytical multiple scattering study of the reflectance and absorption of a periodic array of sub-wavelength cylinders is presented. The conditions for perfect reflection and resonant absorption are discussed.

ThD23
Extraordinary Transmission of Terahertz Electromagnetic Waves through 2-Dimensional Metallic Photonic Crystal, *Yosuke Minowa, Taishi Nishihara, Koshin Hosoki, Koichiro Tanaka; Dept. of Physics, Kyoto Univ., Japan.* We demonstrate extraordinary THz transmission thorough free-standing metal wire meshes using THz time-domain spectroscopy measurement. We treat the meshes as metamaterial slabs and show that the extraordinary transmission is occurred at the reduced plasma frequency.

ThD24
Polarization Dependent Functionality of Optical Elements Based on (Quasi) Periodic Two-Dimensional Structures, *Eugen Foca[1], Juergen Carstensen[1], Helmut Foell[1], Vladimir V. Sergentu[2], Ion M. Tiginyanu[2], Frank Daschner[3], Reinhard Knoechel[3]; [1]Christian-Albrechts-Univ. of Kiel, Germany, [2]Inst. of Applied Physics, Acad. of Sciences of Moldova, Republic of Moldova, [3]Microwave Lab, Christian-Albrechts-Univ. of Kiel, Germany.* Quasi-periodic miniaturized structures are explored for optical elements and measured in the microwave spectral range. Enticing focusing properties and real potential for radiation manipulation are demonstrated. The polarization dependent operation of the device is characterized.

ThD25
Second Harmonic Generation in KDP Micro-Powder by Femtosecond Pulses, *Ibon Aramburu, Joaquin Fernández, Rolindes Balda, Maria Asuncion Illarramendi; Univ. del Pais Vasco, Spain.* Second harmonic generation with ultrahigh intensity femtosecond pulses has been studied experimentally and theoretically in KDP micro-powder. The second harmonic pulse intensity shows a quadratic dependence on the fundamental intensity with a noticeable spectral broadening.

ThD26
Ultrafast Dynamics of Surface Plasmon Polaritons in a Subwavelength Nanohole Array, *Tigran V. Shahbazyan[1], Arman S. Kirakosyan[1], Minghong Tong[2], Valy Vardeny[2]; [1]Jackson State Univ., USA, [2]Dept. of Physics, Univ. of Utah, USA.* The ultrafast dynamics of surface plasmon polaritons photogenerated on the surfaces of an Al film perforated with 2D subwavelength hole array is studied by the pump-probe correlation spectroscopy.

ThD27
The Effect of Disorder on Photonic Crystal Pipe Lattices, *Daniel R. Solli[1], Jandir M. Hickmann[2]; [1]Univ. of California at Berkeley, USA, [2]Univ. Federal de Alagoas, Brazil.* Using finite-element simulations, we study the effect of imperfections in two-dimensional photonic crystals lattices of pipes. We discuss the stability of certain special transmission properties of pipe lattices against disorder.

ThD28
Relationship of Speckle Statistics in Single Configuration and in Ensemble of Random Configurations, *Sheng Zhang[1], Bing Hu[1], Azriel Z. Genack[1], Andrey A. Chabanov[2], Patrick Sebbah[3]; [1]Queens College of City Univ. of New York, USA, [2]Univ. of Texas at San Antonio, USA, [3]CNRS and Univ. de Nice-Sophia Antipolis, France.* The equivalence of localization in the time domain and mesoscopic fluctuations in the frequency domain is demonstrated in the comparison of measurements of the statistics of microwave field in single configurations and in random ensembles.

ThE • Closing Session

Royal Palm
6:00 p.m.–7:30 p.m.
ThE • Closing Session
Vladimir M. Shalaev; Purdue Univ., USA, Presider
Azriel Z. Genack; Dept. of Physics, Queens College of the City Univ. of New York, USA, Presider

ThE1 • 6:00 p.m. **•Invited•**
Wrap-up of Metamaterials-An Overview, *Sir John Pendry; Imperial College London, UK.*

ThE2 • 6:25 p.m. **•Invited•**
Wrap up of the Path of Light in Random Media, *Ad Lagendijk; FOM Inst for Atomic & Molecular Physics, The Netherlands.*

ThE3 • 6:50 p.m. **•Invited•**
Wrap up of New Directions in Optical Lithography and Functional Architectures, *Sajeev John; Univ. of Toronto, Canada.*

ThE4 • 7:15 p.m. **•Invited•**
From Meta I to Meta II, *Azriel Z. Genack[1], Vladimir Shalaev[2]; [1]Dept. of Physics, Queens College of the City Univ. of New York, USA, [2]School of Electrical and Computer Engineering, Purdue Univ., USA.*