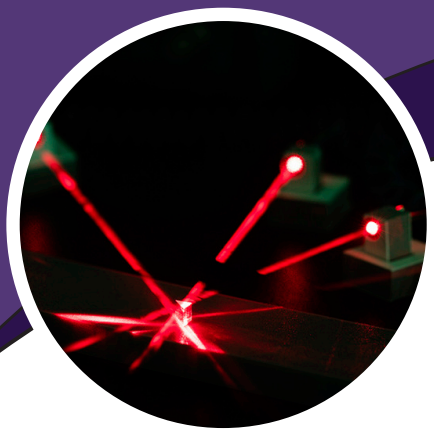
SCI SYNOPSIS



International Conference on

Laser, Optics and Photonics

&

International Conference on

Quantum Physics and Nuclear Technology

March 27-28, 2023

Millennium Hotel Paris Charles De Gaulle, Paris, France

Scisynopsis LLC
Atlanta, GA 30326
USA

Contact us:
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Exhibitor

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Conference Programme

Conference Programme

March 27-28, 2023, Millennium Hotel Paris Charles De Gaulle, Paris, France

Day 1, March 27, 2023

Meeting Hall: Lilienthal-Johnson

8.00 - 8.45	**Registrations**
8.45 - 9.00	**Introduction**

Keynote Presentations

9.00 - 9.45 — **Sergey Suchkov,** Institute for Biotech & Global Health of Ros Biotech, Russia

Title: Personalized and Precision Medicine (PPM) as A Unique Healthcare Model to Be Set Up *via* Biodesign, Bio- and Chemical Engineering, Translational Applications, and Upgraded Business Modeling to Secure the Human Healthcare, Wellness and Biosafety

Oral Presentations

Session Chair:	**Peter G. Gyarmati,** Stanford University, Hungary
Session Co-chair:	**Natan S. Kopeika,** Ben-Gurion University of the Negev, Israel

Sessions: Quantum Physics | Nuclear Technology | Quantum Mechanics | Quantum Spintronics | Condensed Matter Physics | Cosmology | Nuclear Physics | Pure and Applied Physics | Quantum Computing | Quantum Dot Applications | GeoPhysics | Quantum Materials | Quantum Topology | Microwave Photonics | Optoelectronic Devices | Non-Linear and Ultrafast Optics | Microwave Photonics | Quantum Thermodynamics

9.45 - 10.30 — **Patrick Dupré,** University of Burgundy, France

Title: Overtone Sub-Doppler Spectroscopy of HD

Group Photo: 10.30 - 10.45

Networking and Refreshments @ Foyer: 10.45 - 11.15

11.15 - 11.40 — **Alexander Khmaladze,** University at Albany, USA

Title: A Novel Method to Study Drug-Induced Cellular Apoptosis: Raman Spectroscopy and Phase Imaging

11.40 - 12.05 — **Leonardo De Carlo,** Luiss Guido Carli di Roma, Italy

Title: On Magnetization in Wavefunction Ensembles

12.05 - 12.30 **Carole D. Thomas,** Curie Institute, France

Title: Enhanced Efficacy of PDT When Combined with Nitroglycerin Ointment Administration on Xenografted Retinoblastoma in Mice

12.30 - 12.55 **Sumita Datta,** Alliance University, India

Title: On The Quantum Simulation of Fractional Gross-Pitaevskii Equation in Bose Einstein Condensation

Lunch @ Restaurant: 12.55 - 14.00

14.00 - 14.25 **Peter G. Gyarmati,** Stanford University, Hungary

Title: The Gauss'S, Theorema Egregium

14.25 - 14.50 **Angelos Liapis,** Konnektable Technologies Ltd, Greece

Title: HYDRA-Q An Open Quantum Computing Software Ecosystem

14.50 - 15.15 **Salman Noach,** Jerusalem College of Technology, Israel

Title: Tunable Tm-YAP based Laser for Bio-medical Applications

15.15 - 15.40 **Ruggero Loi,** X-Celeprint, Ireland

Title: Micro-transfer-printing for Wafer Level Integrated Photonics

Networking and Refreshments @ Foyer: 15.40 - 16.10

16.10 - 16.35 **Andrea Zifarelli,** University of Bari, Italy

Title: Quartz Tuning Fork as Infrared Photo detector in Tunable Diode Laser Absorption Spectroscopy

16.35 - 17.15 **Benedykt Michal Josef Campbell Biezanek,** Unaffiliated and Independent Natural Philosopher, UK

Title: Quantum Relativity; The Last Tango of the Finite Graviton

17.15 - 17.40 **Naylya Djumaeva,** Scientific Research Institute of Virology, Uzbekistan

Title: Unusual Properties of a Field Formed by Low-Level Laser Radiation Used in Therapy of Infection Pathology including Hepatitis C Virus and New Coronavirus Infection

Day 1 Concludes

Day 2, March 28, 2023

Meeting Hall: Lilienthal-Johnson

Keynote Presentations

10.00 - 10.45 — **Abhijit Ray,** Pandit Deendayal Energy University, India

Title: Non-plasmonic Novel Light Trapping for Solar Cells

10.45- 11.30 — **Irfan Ahmed,** City University of Hong Kong, China

Title: Hybrid Communication Assisted by Coherent Oscillator using Resonant Excitation

Networking and Refreshments @ Foyer: 11.30-12.00

Oral Presentations

Session Chair: **Patrick Dupré,** University of Burgundy, France

Sessions: Laser Optics | Photonics | Metamaterials | Ophthalmology | Space Photonics | Laser Science and Technology | Optofluidics | Biphotonics | Bio and Medical Optics | Atto Science | Optics and Biophysics | Photonics In Artificial Intelligence | Optics and Lasers in Medicine | Quantum Optics | Quantum Plasmonics | Matter waves and Particle beams | Lasers in Defense Systems | Atomic Physics | Holography and Fiber Devices | Astrophysics

12.00 - 12.30 — **Natan S. Kopeika,** Ben-Gurion University of the Negev, Israel

Title: Review and Status Report on Inexpensive Millimetres Wave/THz Imaging and Communication Using Neon Indicator Lamps as Detectors

12.30 - 13.00 — **Worawat Traiwattanapong,** Kasetsart University, Thailand

Title: Analysis of Optical Integration between SiN Waveguide and A Ge-Based Optical Modulator Using A Lateral Amorphous GeSi Taper for Optical Communication

13.00 - 13.30 — **F. C. Hoh,** Sweden

Title: Scalar Strong Interaction Hadron Theory (SSI)

Lunch @ Restaurant: 13.30 - 14.30

14.30 - 15.00 — **Khan Muhammad Shehzad,** City University of Hong Kong, China

Title: Glymphatic Clearance of Simulated Silicon Dispersion in Mouse Brain Analyzed by Laser Induced Breakdown Spectroscopy

15.00 - 15.30 **Hilda Demirjian,** Hilda Demirjian Laser & Skin Care Center, USA

Title: Collagen Laser Skin Rejuvenation

15:30 - 16:00 **Prashant Kumar,** Indian Institute of Science, India

Title: Light Sheet Based Volume Flow Cytometry (VFC) Imaging System

16.00 - 16.30 **Zhyrair S. Gevorkian,** Alikhanyan National Laboratory, Armenia

Title: Light Absorption by Weakly Rough Metal Surfaces

16.30 - 17.00 **Nazanin Shafiee,** Avantes, Netherlands

Title: Advances In Optical Spectroscopy Paving The Way for New Technical Possibilities

Networking & Refreshments @ Foyer: 17.00 - 17.15

Day 2 Concludes followed by Panel Discussion - Awards & Closing Ceremony

Virtual Programme

Virtual Programme

March 27-28, 2023, Virtual Program

Day 1 March 27, 2023 GMT (London Time: 10.00 - 16.25)

Keynote Presentation

10.00 - 10.30 — **Yang Yue, Xi'an Jiaotong University, China**

Title: Si_3N_4-based integrated functional devices

Oral Presentations

10.30 - 10.55 — **Mujahid Mustaqeem,** National Taiwan University, Taiwan

Title: Spin-Polarized Flexible Photodetector With Ultrahigh Sensitivity Based On Chiral Metal-Organic Framework (CMOF)

10.55 - 11.20 — **Aristotle G. Koutsiaris,** University of Thessaly, Greece

Title: Optical Technologies & Imaging in Microcirculation Studies

11.20 - 11.45 — **Rui Li,** Deggendorf Institute of Technology, Germany

Title: Computational Fluid Dynamics with Quantum System

11.45 - 12.10 — **Vladimir G. Chigrinov,** Hong Kong University of Science and Technology, China

Title: Photoalignment and Photopatterning by Nanosize Azodye Layers: Physics and Applications

12.10 - 12.35 — **Ardhendu Pal,** S.N. Bose National Centre For Basic Sciences, India

Title: Investigation of Λ-Type Splitting of Nitric Oxide Using Cavity Ring-Down Spectroscopy

12.35 - 13.00 — **Praveen Kumar.** C, Indian Institute of Technology (BHU), India

Title : Application of Monte Carlo Methods in Nuclear Medicine and Radiotherapy

Lunch (13.00 - 13.30)

13.30 - 13.55 — **S. Srinivasu,** Indian Institute of Technology, India

Title: Spin-Orbit-Interaction (Soi) in the Confined Graded-Index (Grin) Fiber for Higher-Order Oam Modes of Light

13.55 - 14.20 **Dhouha Makhlouf,** University of Monastir, Tunisia

Title : Enhancement of the Nonlinear Optical Rectification in Vertically Coupled InGaAs/GaAs Quantum Dots Under Applied Electric Field

14.20 - 14.45 **Michael I. Tribelsky,** Lomonosov Moscow State University, Russia

Title: Recent Advances in Resonant Light Scattering by Small Particles

14.45 - 15.10 **H Cristina Vasconcelos,** University Of Azores, Portugal

Title : Physics and Material Technologies Applied to the Challenge of Radioisotope Production for Medical and Research Purposes

15.10 - 15.35 **Mara Lúcia Gonçalves Diogo,** Universidade Nove de Julho, Brazil

Title: Effect of Blue and Red Led on Inflammatory Acne: Case Studies

15.35 - 16.00 **Anton A. Lipovka,** Sonora University, Mexico

Title: Geometrical Foundation of Quantum Mechanics

16.00 - 16.25 **Brandon Lucke-Wold,** University of Florida, USA

Title: Focused Ultrasound for Treatment of Peripheral Brain Tumors

16.25 - 16.50 **Prasanta K Panigrahi,** Indian Institute of Science Education and Research, India

Title: Comparison between Compass State and Squeezing of the Displaced Number State

16.50 - 17.35 **Helena Liebelt,** Deggendorf Institute of Technology, Germany

Title: Quantum Technologies: Areas of Improvement or How not to Slide into Quantum Winter

Day 1 Concludes

Day 2 March 28, 2023 GMT (London Time: 10.00 - 14.30)

Keynote Presentations

10.00 - 10.30 — **Sukhdev Roy,** Dayalbagh Educational Institute, India

Title: Controlling the Brain and Heart with Light

Oral Presentations

10.30 - 10.55 — **Alain Djazet,** University of Bamenda, Cameroon

Title: Self-Trapped Moving Cavity Solitons, Solution of the (2+1) - Dimensional Cubic-Quinticcomplex Ginzburg-Landau Equation

10.55 - 11.20 — **Biswajit Panda,** S N Bose National Centre for Basic Sciences, India

Title: Simultaneous Detection of Dual-Species (CH_4/N_2O) Using Wavelength Modulation Spectroscopy for Atmospheric Monitoring and Breath Diagnostics Applications

11.20 - 11.45 — **Rajkumar Santra,** Variable Energy Cyclotron Centre, India

Title : Modelling of Very Low Energy Capture Reaction for Nuclear Astrophysics

11.45 - 12.10 — **Mohsen Choubani,** University of Monastir, Tunisia

Title : Optimization of the Second Harmonic Generation in $In_xGa_{1-X}As$/GaAs Lens-Shaped Quantum Dots for Tera-Hertz Applications: Impact of Pressure, Temperature, Electric Field, Indium Segregation, and In/Ga Inter-Diffusion

12.10 - 12.35 — **Osman Adiguzel,** Firat University, Turkey

Title : Crystallographic Aspects of Shape Reversibility in Shape Memory Alloys

12.35 - 13.00 — **Nabil Benzerroug,** University of Monastir, Tunisia

Title : Electric Field, Pressure and Temperature Effects on the Optical Absorption Coefficient in $In_xGa_{1-x}As$/GaAs Strained Quantum Dots: Under Indium Segregation and In/Ga Intermixing Phenomena

13.00 - 13.25 — **Orchidea Maria Lecian,** Sapienza University of Rome, Italy

Title: A Novel Lemma of the Optical Equivalence Theorem: Analytical Formulation and Applications.

Poster Presentation

13.30 - 13.45 — **Antonieta Marques Caldeira Zabeu,** Universidade do Vale do Paraíba, Brazil

Title: Growth Analysis of *Pantherophis Guttatus* in Bioterium Breeding With Phototherapy Treatment

13.45 - 14.00 — **Antonieta Marques Caldeira Zabeu,** Universidade do Vale do Paraíba, Brazil

Title: Ilib Transcutaneous Domestic Animals - A Review

14.00 - 14.15 — **Marina Glina De Capitani,** Universidade Nove de Julho, Brazil

Title: The Use of Phototherapy In The Treatment of Lesion Caused by *Habronema Spp.* In Equid

14.15 - 14.30 — **Louiza Hamada,** IUT de Colmar, France

Title: The New Coding Algorithm using Li-Fi Signal

Day 2 Concludes Followed by Vote of Thanks

Exhibitor

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PHOTON IS OUR BUSINESS

Hamamatsu Photonics is a world leader in manufacturing optoelectronic components, modules and systems. Since our inception in 1953, in Hamamatsu City, Japan, we have expanded to enjoy a global presence with production facilities, business locations and associated companies throughout Asia, Europe and North America with over 5,000 staff worldwide.

Hamamatsu Photonics' sources, detectors and imaging products are designed to cover the entire optical spectrum. Combining deep understanding and experience in light generation, our optical devices deliver at the highest levels of performance and stability while our sensors cover a broad spectral range from the infrared through the visible, ultraviolet, to the X-rays region.

Staying a step ahead to address any customer challenges, our components, modules and systems are conceived to target even the most demanding of applications.

Present and needed across a multitude of industries, our photonic solutions are found in the medical, automotive, science research, environmental and analytical industries. Also central to industrial processes, our integrated photonics are designed to achieve greater efficiency in control and operations in markets like food, semiconductors, machinery and manufacturing.

Skillfully providing a unique approach to each customer, our expert sales team will advise and answer any technical queries you may have, every step of the way.

Day 1

Laser Optics & Quantum Physics 2023

Keynote Presentations

PERSONALIZED AND PRECISION MEDICINE (PPM) AS A UNIQUE HEALTHCARE MODEL TO BE SET UP *via* BIODESIGN, BIO- AND CHEMICAL ENGINEERING, TRANSLATIONAL APPLICATIONS, AND UPGRADED BUSINESS MODELING TO SECURE THE HUMAN HEALTHCARE, WELLNESS AND BIOSAFETY

Sergey Suchkov
Institute for Biotech & Global Health of Ros Biotech, Russia

Abstract:

Traditionally a disease has been defined by its clinical presentation and observable characteristics, not by the underlying molecular mechanisms, pathways and systems biology-related processes specific to a particular patient (ignoring persons-at-risk). A new systems approach to subclinical and/or diseased states and wellness resulted in a new trend in the healthcare services, namely, personalized and precision medicine (PPM).

To achieve the implementation of PPM concept, it is necessary to create a fundamentally new strategy based upon the biomarkers and targets to have a unique impact for the implementation of PPM model into the daily clinical practice and pharma. In this sense, despite breakthroughs in research that have led to an increased understanding of PPM-based human disease, the translation of discoveries into therapies for patients has not kept pace with medical need. It would be extremely useful to integrate data harvesting from different databanks for applications such as prediction and personalization of further treatment to thus provide more tailored measures for the patients and persons-at-risk resulting in improved outcomes and more cost effective use of the latest health care resources including diagnostic (companion ones), preventive and therapeutic (targeted molecular and cellular) etc.

Translational researchers, bio-designers and manufacturers are beginning to realize the promise of PPM, translating to direct benefit to patients or persons-at-risk. For instance, companion diagnostics tools and targeted therapies and biomarkers represent important stakes for the pharma, in terms of market access, of return on investment and of image among the prescribers. At the same time, they probably represent only the generation of products resulting translational research and applications. So, developing medicines and predictive diagnostic tools requires changes to traditional clinical trial designs, as well as the use of innovative (adaptive) testing procedures that result in new types of data. Making the best use of those innovations and being ready to demonstrate results for regulatory bodies requires specialized knowledge that many clinical development teams don't have. The areas where companies are most likely to encounter challenges, are data analysis and workforce expertise, biomarker and diagnostic test development, and cultural awareness. Navigating those complexities and ever-evolving technologies will pass regulatory muster and provide sufficient data for a successful launch of PPM, is a huge task. So, partnering and forming strategic alliances between researchers, bio-designers, clinicians, business, regulatory bodies and government can help ensure an optimal development

program that leverages the Academia and industry experience and FDA's new and evolving toolkit to speed our way to getting new tools into the innovative markets.

Healthcare is undergoing a transformation, and it is imperative to leverage new technologies to support the advent of PPM. This is the reason for developing global scientific, clinical, social, and educational projects in the area of PPM and TraMed to elicit the content of the new trend. The latter would provide a unique platform for dialogue and collaboration among thought leaders and stakeholders in government, academia, industry, foundations, and disease and patient advocacy with an interest in improving the system of healthcare delivery on one hand and drug discovery, development, and translation, on the other one, whilst educating the policy community about issues where biomedical science and policy intersect

What will audience learn from your presentation?

(Try to list 3-5 specific items)

- Explain how the audience will be able to use what they learn?
- How will this help the audience in their job?
- Is this research that other faculty could use to expand their research or teaching?
- Does this provide a practical solution to a problem that could simplify or make a designer's job more efficient?
- Will it improve the accuracy of a design, or provide new information to assist in a design problem?
- List all other benefits.

Biography

Sergey Suchkov was born in the City of Astrakhan, Russia, in a family of dynasty medical doctors. In 1980, graduated from Astrakhan State Medical University and was awarded with MD. In 1985, Suchkov maintained his PhD as a PhD student of the I.M. Sechenov Moscow Medical Academy and Institute of Medical Enzymology. In 2001, Suchkov maintained his Doctor Degree at the National Institute of Immunology, Russia.
From 1989 through 1995, Dr Suchkov was being a Head of the Lab of Clinical Immunology, Helmholtz Eye Research Institute in Moscow. From 1995 through 2004 - a Chair of the Dept for Clinical Immunology, Moscow Clinical Research Institute (MONIKI). In 1993-1996, Dr Suchkov was a Secretary-in-Chief of the Editorial Board, Biomedical Science, an international journal published jointly by the USSR Academy of Sciences and the Royal Society of Chemistry, UK.
At present, Dr Sergey Suchkov, MD, PhD, is:

- Professor and Chair, Dept for Personalized Medicine, Precision Nutriciology and Biodesign, the Institute for Biotech & Global Medicine of RosBioTech, Moscow, Russia
- Professor, Dept for Clinical Immunology, A.I. Evdokimov Moscow State University of Medical and Dentistry, Moscow, Russia
- Member, New York Academy of Sciences, USA
- Secretary General, United Cultural Convention (UCC), Cambridge, UK
- Dr Suchkov is a member of the:
- American Chemical Society (ACS), USA;
- American Heart Association (AHA), USA;
- European Association for Medical Education (AMEE), Dundee, UK;
- EPMA (European Association for Predictive, Preventive and Personalized Medicine), Brussels, EU;
- ARVO (American Association for Research in Vision and Ophthalmology);
- ISER (International Society for Eye Research);
- Personalized Medicine Coalition (PMC), Washington, DC, USA

Day 1

Laser Optics & Quantum Physics 2023

Oral Presentations

OVERTONE SUB-DOPPLER SPECTROSCOPY OF HD

Patrick Dupré
University of Burgundy, France

Abstract:

Molecular hydrogen is the quantum molecular system to benchmark for challenging the fundamental physics, i.e., the Quantum ElectroDynamics (QED), and the molecular Hamiltonians. Soon or later, the accurate determination of the vibrational sequences of the molecular hydrogen isotopologues will open new perspectives for challenging the proton-to-electron mass ratio, the proton radius size, etc..

Recent experimental developments involve optical high-finesse cavities to challenge weak transitions and/or the low pressure regime. These cavities allow 'amplifying' the intensity of the electromagnetic field (EMF) at level high enough to induce coupling between energy levels even of weak transitions.

We will show Sub-Doppler spectroscopy of weak dipole transitions (forbidden in the Born-Oppenheimer approximation) of the first overtone mode of HD at λ~1.38 m by using the Noise-Immune Cavity- Enhanced Optical Heterodyne Molecular Spectroscopy (NICE-OHMS) technique locked against a Cs-clock referenced Optical Frequency Comb (OFC).

Transition center with accuracy of the order of 20 kHz is demonstrated.However, the shape of the observed NICE-OHMS resonances suffers from abnormal asymmetry (like Fano profiles) which may have several origins like the level hyperfine structure. For this purpose, we have developed an effective Hamiltonian modeling the hyperfine structure of the rotational levels (derived from ab-initio quantum chemistry calculations). An analytical new saturated absorption model based on the interference of 2 counter-propagating EMFs has been developed (in the electric dipole plane-wave approximation) by solving the Liouville/von Neumann equation (3 level systems). The V- and Λ- configurations, encompassing the Lamp-dips, the crossover resonances, and the photon recoil effects, between Zeeman sub-levels have been considered to deal with the EMF polarizations (linear and circular).

If the profile asymmetry cannot be explained by the sole interference, additional other possible origins will be discussed, as those due to collisions. Furthermore, the finite transit-time interaction requires for considering EMF beyond the wave-plane approximation, i.e., Gaussian shape.

Biography

The author has a long experience in high resolution spectroscopy, building up setups in different laboratories and in different countries. He faced diverse kinds of spectroscopy covering multiple spectral ranges. He had to analyze all sorts of spectra requiring for calculating effective molecular Hamiltonians. He has a background in high-sensitive techniques involving high-finesse optical cavity, targeting from diatomic to large polyatomic molecules, in cell and supersonic jet expansions. He recently made a lot of efforts to understand the saturated absorption in different molecular systems involving hyperfine structures. This involves ab-initio molecular calculations, and modeling 3-energy level systems coupled by 2 counter-propagating beams under saturated absorption. Furthermore, he considered the saturated absorption involving non wave-planes, i.e., systems with a finite time of interaction.

A NOVEL METHOD TO STUDY DRUG-INDUCED CELLULAR APOPTOSIS: RAMAN SPECTROSCOPY AND PHASE IMAGING

Alexander Khmaladze
University at Albany, USA

Abstract:

Non-invasive live cell measurements are important in biomedical research. I will present a combined phase imaging/Raman spectroscopy technique to study live cell cultures during methamphetamine-induced apoptosis. Our phase imaging work had been done by several methods: Digital Holographic microscopy (DHM) and Transport of Intensity Equation (TIE) and diffraction optical tomography. The measurement of live cell cultures by phase microscopy yields information about cell cycle and cell death mechanisms, since these processes are correlated with individual cell volume and shape. Raman spectroscopy, on the other hand, is sensitive to rotational and vibrational molecular transitions, and intermolecular vibrations. Thus, Raman spectroscopy provides complementary information about cells, such as protein, lipid and nucleic acid content, and, particularly, the spectral signatures associated with structural changes in molecules. I will present the analysis of cell cultures obtained by these two methods. Our Raman data indicate that the chemical changes in proteins preceded morphological changes, which were seen with phase imaging. Our study also emphasizes that phase imaging and Raman spectroscopy can be utilized for noninvasive simultaneous monitoring of morphological and chemical changes in cells during many dynamic processes.

Biography

Alexander Khmaladze is an Associate Professor in the Physics Department at State University of New York (SUNY) at Albany. He received his Ph.D. from the University of South Florida, where he published a number of papers on digital holographic phase imaging. He then accepted a postdoctoral position at the University of Michigan, where he worked on the application of near-infrared Raman Spectroscopy to monitoring of tissue constructs implanted in mice, with the ultimate goal of applying this technique to human patients. Dr. Khmaladze joined the Physics Department of SUNY at Albany in September 2014. Currently, his lab has several digital holographic microscopic setups, 3D Cell imaging tomographic microscope, and a portable Raman microscopic system. His research interests include Raman spectroscopy and microscopy, three-dimensional digital holographic imaging, microscope design, hyper spectral imaging of live cells and biological tissue imaging.

ON MAGNETIZATION IN WAVEFUNCTION ENSEMBLES

Leonardo De Carlo and William David Wick
Luiss Guido Carli di Roma, Italy

Abstract:

In a wave function-only philosophy, thermodynamics must be recast in terms of an ensemble of wavefunctions, rather than classical particle configurations or "found" val-ues of Copenaghen Quantum Mechanics. In this perspective we study how to construct Gibbs ensembles for magnetic quantum spin models. We show that with free boundary conditions and distinguishable "spins" there are no finite-temperature phase transitions because of high dimensionality of the phase space. Then we focus on the simplest case, namely the mean-field (Curie-Weiss) model, in order to discover whether phase transitions are even possible in this model class. This strategy at least diminishes the dimensionality of the problem. We found that, even assuming exchange symmetry in the wavefunctions, no finite-temperature phase transitions appear when the Hamiltonian is given by the usual energy expression of Quantum Mechanics (in this case the analytical argument is not totally satisfactory and we helped ourself with computer analysis). But a variant model with additional "Wavefunction Energy" does have a phase transition to a magnetized state. The three results together suggest that magnetization in large quantum spin chains appears if and only if we consider indistinguishable particles and for large we block macroscopic dispersion (i.e. macroscopic superpositions) by energy conservation. Our principle technique involves transforming the problem to one in probability theory, then applying results from Large Deviations, particularly the Gärtner-Ellis Theorem. Finally, we discuss Gibbs *vs*. Boltzmann/Einstein entropy in the choice of the quantum thermodynamic ensemble, as well as open problems.

Biography

Leonardo De Carlo main research experience is about Markovian interacting particle systems on lattice gases and the introduction of the so called "discrete exterior calculus" in this context. The topics of the study are their hydrodynamics and stationary states. In the last two years they developed a new research line: we started to recast thermodynamics in terms of ensembles of wavefunctions, rather than classical particle configurations or Copenhagenist "found" values. In the stationary case they developed some techniques to translate the problem into one in probability theory, particularly in terms of large deviations theory and statistical sampling.

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SCI SYNOPSIS

ENHANCED EFFICACY OF PDT WHEN COMBINED WITH NITROGLYCERIN OINTMENT ADMINISTRATION ON XENOGRAFTED RETINOBLASTOMA IN MICE

Carole D Thomas[1,4,5], Mihaela Lupu[1-4], Florent Poyer[1-4], Philippe Maillard[1-4] and Joël Mispelter[1-4]

[1]*Institut Curie, France*
[2]*U1196 INSERM, France*
[3]*UMR 9187 CNRS, France*
[4]*Université Paris-Sud, France*
[5]*U1288 INSERM, France*

Abstract:

The aim of the study was to assess the efficacy of a treatment protocol that combines photodynamic therapy (PDT) and nitroglycerin (NG) on human retinoblastoma tumors xenografted on nude mice.

PDT uses a non-mutagen photosensitizing agent (PS: glycoconjugated porphyrin derivative) activated by red light exposure. Absorption of light initiates photochemical reactions leading to the generation of cytotoxic photoproducts (ROSs: oxygen reactive species) responsible for the therapeutic effects. We propose to increase the PDT efficiency (on our least responsive retinoblastoma line to treatment) with a better PS delivery in the tumor generated by NG which is known to dilate vessels and enhance the permeability and retention of macromolecules in solid tumors.

Methods: *In vivo* follow-up of the therapeutic effects was performed by sodium MRI which directly monitors variations of sodium concentrations in a non-invasive way and can be used to follow-up the tumor response to therapy. NG ointment was applied one hour before PDT. The PDT protocol implied a double tumor targeting, cellular and vascular. A first PS dose was injected followed by a second one, separated by a 3 h interval. The time lapse allowed the PS molecules to penetrate into tumor cells. Ten minutes after the second dose, the PS was red light activated using a laser.

Results: The PDT efficacy (increase of necrosis, decrease of the tumor volume) was enhanced by applying NG ointment on the skin of tumor-bearing animals.

Conclusion: NG increases the PDT efficacy by enhancing the intratumor concentration of PS inducing a more significant production of ROSs on the illuminated region increasing thus the propagation of cellular death signalling deeper into the tumor (bystander effect).

Biography

Carole D. Thomas is a researcher who works about cancer. Her experience in the Institut Gustave Roussy provided her strong competences in radiotherapy and also in radiopathology of solid tumors in xenograft tumors and in patient too. The integration of the Institut Curie since 1999 permitted her to develop knowledge of MRI and more precisely the MRI sodium imaging which is a novel and completely non-invasive imaging technique for tumors detection and treatment assessment. For several years, Dr Thomas has been working on photodynamic therapy applied to different types of cancers and in particular to ocular tumours like retinoblastoma.

ON THE QUANTUM SIMULATION OF FRACTIONAL GROSS-PITAEVSKII EQUATION IN BOSE EINSTEIN CONDENSATION

Sumita Datta
Alliance University, India

Abstract:

We propose a new path integral simulation based on Feynman-Kac path integral method [KAC51]] [FH65] for space fractional Schrodinger equation with some application to Bose Einstein Condensation. Recently it has been theoretically shown that at the mean field level the strongly interacting many particle systems can be well described [KLEINERT12, 13] by fractional Gross-Pitaevskii equation (FGP). While a lot of work has been done in connecting these FGP equations arising in BEC to standard path integrals, not much work has been done in solving them numerically. Even though the relative motion of the strongly interacting particles can be described by FGP, the quantum effect in relative motion is not captured in this mean field approach. We found that to put a Quantum flavour to the calculations we need to apply a Quantum Monte Carlo technique based on Feynman-Kac path integral method. As a matter of fact, the FGP equation can be mapped to a generalized fractional Schrodinger equation and the underlying stochastic process is *Le´vy* stable distribution as opposed to usual Gaussian random walk. This generalized s *Le´vy* Schroedinger equation [PP09] is applied to strongly interacting Bose-Einstein Condensate and simulated by Feynman-Kac path integration.

Biography

Sumita Datta is working in the Alliance School of Applied Mathematics, Alliance University, India. Datta received her M. Sc in Physics from the Indian Institute of Technology, Kharagpur, India in 1987, and her Ph.D. from The University of Texas at Arlington, the USA in 1996. Her research interest includes Quantum gases, Computational Condensed Matter Physics, and Nonlinear Dynamics. She has successfully completed several research projects funded by the Department of Science and Technology, India. Currently, she is working on a fractional Gross-Pitaevskii equation. She is the author of two book chapters and several research papers in international journals.

THE GAUSS'S, THEOREMA EGREGIUM

Peter G. Gyarmati
Emeritus Professor of Computer Science at Stanford University, Hungary

Abstract:

To understand Gauss's theory about the non-Euclidean geometry we have to reestablish some definitions of the coordinate system, and introduce the so-called Gaussian coordinates. We show here that the two points distance as a postulate can establish a metric geometry. If we can show the validity of this postulate on any surface than it has his geometry, and not necessarily Euclidean. Gauss showed in The Theorema Egregium that a surface might have such attributes. The different geometries of the regular surfaces written here are Euclidean, spherical, and hyperbolic. This theorem presented in 1827. (Based on the lectures of K. Lanczos: Department of Physical Sciences and Applied Mathematics, North Carolina State University, Raleigh, 1968.) The importance of this lecture is to make clear and understandable how and why the physicians use non-Euclidean geometry.

Biography

Peter G. Gyarmati received his engineering (electrical) and later the mathematical degree in Hungary than doctorate (1971) at Manchester University in computer science. Worked for IBM and ICL at their research center for networking: Aloha net and later on TCP/IP protocol. Also, have patents (1980) with portable computers. For invitation at 1998 went to the Stanford University to lead the introduction of the STEM type education. His mentor Edward Teller call his attention to the interdisciplinary of mathematics and physics. After some years (2008-2012) at Cambridge University, GB retired to Hungary. He wrote 18 books, and more than 50 research papers. His idea to make understandable and to show the importance of the non-Euclidean geometry.

HYDRA-Q AN OPEN QUANTUM COMPUTING SOFTWARE ECOSYSTEM

Angelos Liapis
Konnektable Technologies Ltd, Greece

Abstract:

Quantum computing promises to overcome computational limitations by providing faster solutions for optimization, simulation, and machine-learning problems. Europe is advancing the technology ecosystem and industrialization in order to ensure digital sovereignty and security as well as competitiveness. Such an ecosystem includes hardware/software solution providers, system integrators, and users from research institutions, start-ups, and industries. Quantum ecosystems and markets are still in their infancy; however as the technology matures, there will be greater adoption of quantum computers within business applications by companies across all industry sectors. To fully realise the potential of quantum computing and reap its benefits, algorithms and software need to be developed alongside the hardware. HYDRA-Q is a software ecosystem by means of a platform that facilitates the development of quantum software stacks, libraries, from a high-level description of algorithms to a low-level implementation with quantum gates, for solving concrete problems and applications demonstrating the advantages of quantum computing to end-users as well as the broader scientific community, relevant stakeholders and general public. HYDRA-Q focuses on specifically unveiling the hidden potential that is been researched or in development in various application domains and to organise it in autonomous Quantum application development Building Blocks that will be made reconfigurable and Integra-table in open architectures. This way existing and new Quantum computing technological achievements will be open to be repurposed and reused for the development of new applications and quantum computing-based solutions to existing markets.

Biography

Liapis is currently the CEO of Konnekt-able Technologies Ltd. and Manager of EU Research & Innovation Development at the Decision Support Systems Laboratory of the National Technical University of Athens. His areas of interest and expertise include: Innovation Management, Big Data, Quantum Computing, Semantics, Web 2.0, CSCW, eHealth, Crisis Management, Cloud Computing and Enterprise Systems Interoperability. Since 2004, he has worked in several relevant posts in both academia and industry, and in 2009 he was honoured with the position of associate professor / senior research fellow from the Robert Gordon University in Aberdeen, Scotland. Aggelos Liapis – was a Marie Currie Postdoc, holds a PhD in Computer Mediated Collaborative Design Environments from the Robert Gordon University in Aberdeen, two Masters Degrees from the Universities of Sunderland and Hull in Network Systems and Computer Graphics and Virtual Environments, respectively, and a Bachelor's degree in Software Development from Lincoln University in Hull. Beyond his academic and industrial duties Liapis has authored several papers, journals, and books in the areas of CSCW, Collaborative Design, Semantics, etc.

TUNABLE Tm-YAP BASED LASER FOR BIO-MEDICAL APPLICATIONS

Salman Noach, Daniel.Sebbag, Uzziel Sheintop, Eytan Perez and Rotem Nahear
Jerusalem College of Technology, Israel

Abstract:

A Pulsed, narrow-band, tunable, end-pumped Tm:YAP laser for Bio-medical application is demonstrated. Continuous tunability ranges from 1926 to 1961 nm, at mJ level per pulse, was archived, having a spectral linewidth of 0.15 nm FWHM. The tuning and spectral band narrowing were obtained using a pair of YAG Fabry-Perot Etalons. The laser was actively Q-switched using an acousto-optic modulator (AOM). At a repetition rate of 1 kHz, maximum energy per pulse of 2.3 mJ and pulse duration of 29.5 ns were achieved, corresponding to a peak power of 80 kW. Pulse energy of mJ level was measured along with the whole laser tunability range. Slope efficiency of 31% was obtained for an absorbed pump power of 11.5 W. The combination of high pulsed energies and tunability in this special wavelength region with narrow bandwidth, allows this laser to be a suitable tool for biomedical, ablation results of different penetration depths versus wavelength will be presented.

Biography

Salman Noach received his PHD in physics at 2003 from the Hebrew University Jerusalem ISRAEL. Since 2003 he is a faculty member at Jerusalem College of Technology. During 2007 he founded the Solid State Lasers Laboratory there. The lab is mainly engaged in applied research and development of CW and pulsed solid-state lasers, nonlinear optics, Raman wavelength shifting and Optical amplifiers in the SWIR -NIR range. Results of the lab research were the object of many publications in high-ranked journals in the optics and laser community and two patents. He is a senior member of OPTICA and SPIE member.

MICRO-TRANSFER-PRINTING FOR WAFER LEVEL INTEGRATED PHOTONICS

Ruggero Loi, Ron Cock and David Gomez
X-Celeprint, Ireland

Abstract:

Micro-transfer-printing (µTP) is the most scalable and flexible integration technology for integrated photonics. µTP enables heterogeneous integration of completely pre-fabricated known good devices or dies of material onto rigid or flexible substrates. The micro-devices can be arranged in high density arrays of thousands of elements per cm2 on the source wafer improving material usage. The devices can be attached at the top of the target substrate or inside recesses with or without adhesive layers depending on the flatness and roughness of the mating surfaces. The technology provides <0.5 µm alignment accuracy along the printing plane combined with high-throughput parallel transfer.

Transfer printable devices require a sacrificial layer at the bottom of the epitaxial structure. A wet-etching technology selectively etches the sacrificial layer, while tether structures physically connect the devices to the original substrate during the undercut and break neatly when picking up the released devices.

III-V materials for lighting, amplification, modulation and detection in the telecommunication wavelength domain have been integrated onto silicon photonics by µTP; electronic integrated circuits (EIC)have also been transfer printed onto silicon photonics by µTP for co-packaged optics applications.

In this work we will present recent advances of µTP in the field of integrated photonics.

Biography

Ruggero Loi is a process development scientist at X-Celeprint. His research deals with the heterogeneous integration of photonics and electronics devices and materials at the microscale onto different platforms by using the micro transfer printing (TP) technology. He was familiar with microfabrication in a clean-room environment and the electro-optical characterization of semiconductor lasers. He has good skills in data analysis and excellent problem-solving skills, which he has acquired over a period of several years of study and job experiences. He received a PhD in Engineering Science at Tyndall National Institute, a Master's Degree in Applied Physics, and a Bachelor's Degree in Computational Physics at the University of Cagliari. He studied Mechanics when younger. He is interested in research and development for industrial applications.

QUARTZ TUNING FORK AS INFRARED PHOTODETECTOR IN TUNABLE DIODE LASER ABSORPTION SPECTROSCOPY

Andrea Zifarelli
University of Bari, Italy

Abstract:

In the past decade, the rapid development of infrared laser technology has led to an increasing demand for photodetectors with high sensitivity and a wide operative spectral range suitable for spectroscopic applications. In this work, we report on the study of light-induced thermo-elastic effects occurring in quartz tuning forks (QTFs) when exploited as light detectors in Tunable Diode Laser Absorption Spectroscopy (TDLAS) sensors. The induced photothermal processes and the temperature distribution following the absorption of laser beam upon the crystal quartz was studied by using finite-element-analysis with COMSOL Multiphysics. The electromagnetic energy release and the induced thermal distribution were related to the absorbance curve of the quartz crystal. In the spectral region with high absorption, the radiation travels few tens of micrometers in the quartz crystal, while in the spectral region with low absorption, the radiation is trapped at the interface between the chromium film and the highly reflective gold layer.

The spectral response of the QTF-based photodetector was investigated by using a custom QTF with a resonance frequency of 9.78 kHz and quality factor of 11500 at atmospheric pressure. Five interchangeable laser sources operating at different wavelengths from 1.6 up to 10.35 μm were employed within TDLAS sensors. A spectrally flat responsivity of 2.2 kV/W was demonstrated, corresponding to a noise-equivalent power of 1.5 $nW/Hz^{1/2}$, without employing any thermoelectrical cooling system.

Biography

Andrea Zifarelli received the M.S. degree (cum laude) in Physics in 2018 from the University of Bari and his Ph.D. in Physics from the University of Bari in 2022. His research activities were mainly focused on the development of spectroscopic techniques based on laser absorption for the analysis of complex gas mixtures by employing quartz tuning forks as sensitive elements. This investigation was performed by using innovative laser sources as well as developing new algorithms for multivariate analysis approaches. Currently, his research activities are carried out at the PolySenSe Lab, joint-research laboratory between Technical University of Bari and THORLABS GmbH.

QUANTUM RELATIVITY; "THE LAST TANGO OF THE FINITE GRAVITON".

Benedykt Michal Josef Campbell-Biezanek
Unaffiliated and Independent Natural Philosopher, UK

Abstract:

The Universe is made up of energy quanta that each have the property of magnitude and phase. These quanta are observed to exist within a large (actually infinite) domain that we refer to as the space-time domain. Space seems to be quite simple to understand and has the dimensions of simple time, that is "the light-time-of-flight". Time itself seems to be much harder to understand because while it has an apparently continuous history, it is asymmetrical in that it has no future. The time continuum seems to stop dead at the present instant. In order to count space-time, we need to use numerical counting units that are compatible with the domain that we wish to describe. One needs to think of the historic dimension of space as extending backwards from the present instant into an imaginary historical space-domain. The apparent wave velocity (c) in this model is 1/(-1i(1)), the square of which (c^2) is simply minus-one. This was actually predicted by Albert Einstein himself in 1905, because he explained that $E_0 = mc^2$, which, as c^2 is minus-one, means that the graviton must have an effective radius of zero. Matter consists of quantized energy packets in harmonic resonance; each proton (or neutron) existing within its own apparently private infinite gravitational energy hole. Light quanta jump instantly between such energy holes and this was first demonstrated by Clauser and Freedman in 1972. The obvious proof of this model lies with the observed gamma wavelength of about one thousand times the apparent proton charge face radius. The proton charge face exists at about 250-times spatial compression with respect to free space. This subject requires a deeply intuitive understanding of Einstein's General Theory, it fully explains why light appears to slow in glass; there is much more space near matter than we had imagined there to be of course.

Biography

The author is 72-years-old; he is happily married (but also happily separated) with four sons and ten grandchildren. The author discovered the key solution that led to what he only now calls Quantum-Relativity (qr) at nine years of age. It was too great a burden for a nine-year-old to deal with and the author decided to leave the issue until later in his life. The author became an electrical engineer with his own company designing and manufacturing highly specialized electronic instruments for the energy industry. In 2007, the author sold his company and at the age of 57, he took up the full-time theoretical work that led, as a mere by-product of that overall work, to the development of what he now names as the Unified Theory of Finite Natural Numbers (or uFNN theory), which new approach to number theory trivialises the apparently great puzzle of Quantum-Relativity.

UNUSUAL PROPERTIES OF A FIELD FORMED BY LOW-LEVEL LASER RADIATION USED IN THERAPY OF INFECTION PATHOLOGY INCLUDING HEPATITIS C VIRUS AND NEW CORONAVIRUS INFECTION.

Naylya Djumaeva
Scientific-research Institute of Virology, Uzbekistan

Abstract:

Since the end of 2019, the world has been shaken by an infection that has claimed the lives of more than six and a half million patients. Currently, SARS-CoV-2 not only causes acute damage, but has long-term consequences affecting every organ and has brought a wave of a new chronic disabling condition called Long-Covid..This preliminary study describes an application of un-explored properties of low-level laser radiation with laser-light emitter in the field of which is placed Copegus (Ribavirin) with the aim of treatment of patients with Long-Covid syndrome. The difference from the traditional use of the drug is that Copegus was not prescribed to the patient by the traditional method - orally or intravenously, and the medicinal properties of the drug were introduced into the patient's body using the un-explored properties of low-power laser radiation. One hundred twenty seven patients with Long- Covid syndrome were observed. The obtained findings suggest that under the influence of field formed into the laser- light emitter with a Copegus placed inside the field, the remote transfer of pharmacological properties of Copegus occurs. Conclusions about the produced effect of exposure were made based on improvement in the condition of patients, disappearance of complaints, and positive changes in various diagnostic tests performed by the patients.

Biography

Naylya Djumaeva is an expert in medicament testing and the application of special properties of low-level lasers with more than 25 years of experience in these areas. The results obtained by her allowed the development of unique approaches in the treatment of various infectious pathologies, including viral pathology.

OVERTONE SUB-DOPPLER SPECTROSCOPY OF HD

Patrick Dupré
University of Burgundy, France

Abstract:

Molecular hydrogen is the quantum molecular system to benchmark for challenging the fundamental physics, i.e., the Quantum ElectroDynamics (QED), and the molecular Hamiltonians. Soon or later, the accurate determination of the vibrational sequences of the molecular hydrogen isotopologues will open new perspectives for challenging the proton-to-electron mass ratio, the proton radius size, etc..

Recent experimental developments involve optical high-finesse cavities to challenge weak transitions and/or the low pressure regime. These cavities allow 'amplifying' the intensity of the electromagnetic field (EMF) at level high enough to induce coupling between energy levels even of weak transitions.

We will show Sub-Doppler spectroscopy of weak dipole transitions (forbidden in the Born-Oppenheimer approximation) of the first overtone mode of HD at λ~1.38 m by using the Noise-Immune Cavity- Enhanced Optical Heterodyne Molecular Spectroscopy (NICE-OHMS) technique locked against a Cs-clock referenced Optical Frequency Comb (OFC).

Transition center with accuracy of the order of 20 kHz is demonstrated.However, the shape of the observed NICE-OHMS resonances suffers from abnormal asymmetry (like Fano profiles) which may have several origins like the level hyperfine structure. For this purpose, we have developed an effective Hamiltonian modeling the hyperfine structure of the rotational levels (derived from ab-initio quantum chemistry calculations). An analytical new saturated absorption model based on the interference of 2 counter-propagating EMFs has been developed (in the electric dipole plane-wave approximation) by solving the Liouville/von Neumann equation (3 level systems). The *V*- and Λ- configurations, encompassing the Lamp-dips, the crossover resonances, and the photon recoil effects, between Zeeman sub-levels have been considered to deal with the EMF polarizations (linear and circular).

If the profile asymmetry cannot be explained by the sole interference, additional other possible origins will be discussed, as those due to collisions. Furthermore, the finite transit-time interaction requires for considering EMF beyond the wave-plane approximation, i.e., Gaussian shape.

Biography

The author has a long experience in high resolution spectroscopy, building up setups in different laboratories and in different countries. He faced diverse kinds of spectroscopy covering multiple spectral ranges. He had to analyze all sorts of spectra requiring for calculating effective molecular Hamiltonians. He has a background in high-sensitive techniques involving high-finesse optical cavity, targeting from diatomic to large polyatomic molecules, in cell and supersonic jet expansions. He recently made a lot of efforts to understand the saturated absorption in different molecular systems involving hyperfine structures. This involves ab-initio molecular calculations, and modeling 3-energy level systems coupled by 2 counter-propagating beams under saturated absorption. Furthermore, he considered the saturated absorption involving non wave-planes, i.e., systems with a finite time of interaction.

Day 2

Laser Optics & Quantum Physics 2023

Keynote Presentations

NON-PLASMONIC NOVEL LIGHT TRAPPING FOR SOLAR CELLS

Abhijit Ray
Pandit Deendayal Energy University, India

Abstract:

Plasmonic light trapping is well known mechanism and has a strong potential to improve photo-absorption in indirect band gap semiconductor based photovoltaics, such as c-Silicon solar cells. However, a commercialization of this technique has not been possible due to the use of precious (noble) metals like gold, silver etc. On the other hand, there are various non-plasmonic enhancement possible with the help of nanotechnology. For example, rainbow light trapping, using nano-cavities, whispering gallery resonance (WGR), 2D material based complementary meta-surfaces etc. The talk accounts for all such important mechanisms, related materials and their performance and a perspective of future photovoltaics.

Biography

Abhijit Ray is an Associate Professor at Pandit Deendayal Energy University (PDEU) and currently heading the Department of Solar Energy. Dr. Ray obtained his doctoral degree in the field of experimental condensed matter physics from Indian Institute of Technology, Kharagpur (India) in 2003. He was post-doctoral researcher with Department of Atomic Energy (India) during 2003-04 following which he served Birla Institute of Technology, Mesra as Lecturer in Physics before joining PDEU as Assistant Professor in 2007. He has been visiting professor at Nagoya Institute of Technology, Japan during 2015-16. His current research is focused on the development of commercially viable materials and devices for photovoltaic and green hydrogen generation. He has been principal investigator of various funded research projects from DRDO, DST and MNRE (Govt. of India); published more than 95 papers in SCI indexed journals and have four Indian patents.

HYBRID COMMUNICATION ASSISTED BY COHERENT OSCILLATOR USING RESONANT EXCITATION

Irfan Ahmed
City University of Hong Kong, China

Abstract:

We propose the multi-channel hybrid communication assisted by a coherent oscillator, by configuring the diamond Nitrogen–vacancy center using spontaneous parametric four-wave mixing. For one-channel hybrid communication, composite signal of fluorescence (information) and Stokes (carrier) is sent to the receiver; information is recovered by subtracting intensities of composite signal and reference coherent signal (from coherent oscillator) at demodulator. Further, we achieved two-channel and three-channel hybrid communication through two-mode and three-mode intensity–noise correlation, respectively. Two-mode correlation of hybrid signal (produced through photon subtraction) and anti-Stokes demonstrates the nonclassical behavior by violating Cauchy–Schwarz inequality, verified through corresponding squeezing (−5 dB). Such phenomenon of non-classical behavior was also verified by non-Gaussian negativity of Wigner function. Our hybrid communication model is based on temporal width- and coherence time-contrast, which can be controlled by wavelength (power) of input beams. The coherence time-contrast is about 90%.

Biography

Irfan Ahmed is a Research Fellow in the Department of Physics at the City University of Hong Kong, and Visiting Fellow at School of Electronic Science and Engineering, Faculty of Electronics and Information, Xi'an Jiaotong University. He received his MS from Xi'an Jiaotong University, Xi'an China, and PhD degrees from the City University of Hong Kong. He has extensive expertise in nonlinear optics and biomedical optics dating back to his PhD and MS studies. He has published many related scientific papers in top journals. Dr Irfan has 10+ years of research experience and teaching.

Day 2

Laser Optics & Quantum Physics 2023

Oral Presentations

REVIEW AND STATUS REPORT ON INEXPENSIVE MILLIMETER WAVE/ THz IMAGING AND COMMUNICATION USING NEON INDICATOR LAMPS AS DETECTORS

Natan S. Kopeika, Yitzhak Yitzhaky, Amir Abramovich, Daniel Rozban and Arun Ramachandra Kurup

Ben-Gurion University of the Negev, Israel

Abstract:

Millimeter wave (MMW)/terahertz (THz) radiation proved to be a versatile regime in the electromagnetic spectrum that can be employed in a wide range of applications in imaging systems, communication systems, and space technology. A novel technology using a very inexpensive detector element to generate faster MMW/ THz images and for communication purposes has been developed. The neon indicator lamp alternatively known as the glow discharge detector (GDD) is used as the sensor element that can be configured either in the electrical or up-conversion detection mode. The focal plane arrays (FPA) constructed using GDDs as pixel elements proved to be an inexpensive method for MMW/THz imaging and communication systems. The weakly ionized plasma (WIP) in GDDs was found to be more sensitive to incident MMW/THz radiations while operating in the abnormal glow mode of operation. An improved version of the detection circuit based on the electrical mode of detection was recently developed and proved to be simpler, inexpensive, and more responsive than the previous FPAs based on GDDs. As a prototype, we currently developed a row detector circuit comprising 8 GDDs that was configured to perform oversampling, thereby generating MMW/THz images similar to those achieved by employing larger FPAs. Oversampling or sub-pixel imaging was performed by mounting the row detector on a step motor assembly. User-friendly GUI was also designed to suitably select the step size depending on the required matrix size of the resultant MMW/THz image. A suitable digital algorithm that can provide strong noise filtering was utilized here and hence it exhibits a better detection capability even under very low radiation exposure. By using image processing methods, performance enhancement and expansion of the detection system can be achieved.

Biography

Natan S. Kopeika was born in Baltimore in 1944. He received B.Sc., M.Sc., and Ph.D. degrees in Electrical Engineering from the University of Pennsylvania in 1966, 1968, and 1972, respectively. He joined the Ben-Gurion University of the Negev in 1973. He chaired the Department of Electrical and Computer Engineering [1989-1993], and in 1994 was named Reuven and Francis Feinberg Professor of Electro-optics. He was the first chair of the Department of Electro-optics and Photonics Engineering 1999-2005, which grants graduate degrees only. He and Shlomi Arnon were awarded the JJ Thomson Award by the IEE in 1999. In 2001 he was awarded the Glant Prize for excellence in teaching. He is a Fellow of SPIE (2000). He has published over 200 papers in international reviewed journals, over 160 papers at various conferences, and 3 books. Recent research involves the development of a novel inexpensive focal plane array camera for MMW/THz imaging. Other areas of research include: interactions of electromagnetic waves with plasmas, the opto-galvanic effect, environmental effects on optoelectronic devices, imaging system theory, propagation of light, images, and wireless communication through the atmosphere, image processing and restoration from atmospheric, motion and vibration blur, lidar, and target acquisition.

ANALYSIS OF OPTICAL INTEGRATION BETWEEN SiN WAVEGUIDE AND A Ge-BASED OPTICAL MODULATOR USING A LATERAL AMORPHOUS GeSi TAPER FOR OPTICAL COMMUNICATION

Worawat Traiwattanapong, Kazumi Wada and Papichaya Chaisakul
Kasetsart University, Thailand

Abstract:

We propose and present theoretical analysis on the use of a compact amorphous GeSi lateral taper to facilitate the optical coupling between a SiN waveguide and Ge-based FKE optical modulator by using 3D Finite-Different Time-Domain (3D-FDTD) simulation. A large difference in refractive index and optical mode size mismatch between SiN waveguides and Ge-based modulator are huge challenges for the coupling structure. We use the amorphous GeSi lateral taper to achieve the optical coupling between SiN waveguide and Ge-based FKE optical modulator because the refractive index can be gradually changed. Hence, the optical mode can propagate from SiN waveguide through Ge-based FKE optical modulator via amorphous GeSi lateral taper. For integrated optical modulator performance, the value of extinction ratio (ER) and insertion loss (IL) are calculated by varying the Ge-based FKE optical modulator length. The simulation shows ~6.7 dB ER and ~5.8 dB IL at 20 μm long device. Thus, the integration of SiN waveguide with Ge-based on Si shows good prospect for optical interconnect applications with a compact footprint.

Biography

Worawat Traiwattanapong was born in Bangkok, Thailand, in 1991. He received the B.S. (Physics) with Second Class Honours, and M.S. (Physics) from Kasetsart University, Thailand. He has received scholarship from Development and Promotion of Science and Technology Talents project (DPST), Thailand since 2013. In master's degree, his research concerns vacancy defects and small polaron in barium titanate ($BaTiO_3$) perovskite. At the moment, he is a Ph.D. student at Kasetsart University, Thailand. His research concerns the study of low-energy germanium-silicon based photonic devices. In 2022, he is a Visiting Student in Prof. Kimerling group at MIT. He designs the sensing waveguide.

SCALAR STRONG INTERACTION HADRON THEORY (SSI)

F. C. Hoh
hoh@telia.com, Sweden

Abstract:

The material of this talk comes from my book "Scalar Strong Interaction Hadron Theory III" published a few months ago. This theory (SSI) is aimed at providing a far more viable theory for elementary particles than does the current mainstream standard model (SM). In the Dirac equation for the quark in a meson in SM, the gluon fields are replaced by a scalar interaction potential *V* with its source in the accompanying antiquark wave functions. Interchanging the quark and the antiquark, the corresponding antiquark equation is obtained. These equations are then converted into two sets of manifestly Lorentz covariant van der Waerden two spinor equations of motion for a quark at xI and an antiquark at xII. Multiply together these both sets, generalize the product quantities to be functions of non-separable (xI, xII). The transformations x=xII −xI and X= $(1-a_m)$ xI+a_mxII, where a_m is a real constant and x refers to a "hidden" relative space, leads to a set of 3 equations of motion for mesons. Using 6 0^- meson masses as input, 4 quarks masses, one zero point and one quark confinement constants are obtained. The remaining 0^- meson masses are then largely correctly predicted. Let xI be the position of the diquark and xII that of the quark in a ground state nucleon, 3 equations of motion can similarly be constructed. Some of the integration constants can be determined from neutron beta decay data. Let the rest frame nucleon wave functions be of the form $\Psi(X, x) \rightarrow \exp(-iE_0X^0+i\omega_0x^0)\ \Psi(\underline{x})$), where $-\omega_0$ is the invisible relative energy between the quarks in the hidden x but can interact with external gravitation as does the nucleon mass E_0. The transformed wave equations contain the unknown a_m and ω_0 which cancel out when $a_m=1/2+\omega_0/E_0$. Apply this to the proton in an interstellar hydrogen atom, its a_m can be changed when this atom happens to collide with another hydrogen atom *via* their electrons which in its turn drags the proton along in the X or laboratory space without affecting, at first, the quarks. If $a_m>1/2$, the relative energy $-\omega_0<0$ or dark matter with mass a_mE_0 is produced. If $a_m<-1/2$, $-\omega_0>0$ and positive relative energy corresponding to antigravity dark energy is created. Dark matter is also produced when a neutron falls inside a neutron star. It tends to cancel the energy gained in the fall and thereby prevent the creation of a singularity in such a black hole.

Biography

F. C. Hoh Born in Shanghai, China, 1933 BSEE Royal Inst. Techn. Stockholm, Sweden, 1957 MS, PhD in plasma physics, same school, 1961, 1963, Prof. B Lehnert, H. Alfvén Post doc U Calif San Diego, 1963-64, Prof. M. Rosenbluth. He became interested in particle physics when M. Gell Mann came down from Cal Tech and talked about his quarks. Sr. Research Scientist, Boeing Co., Seattle, USA, 1964-71. He was asked to do a feasibility study on fusion power and concluded that it is not commercially viable. He then left plasma physics, worked in electric industry and took up particle physics in spare time and fulltime after retirement. More details in "Who's Who in the World", e. g. 2004.

GLYMPHATIC CLEARANCE OF SIMULATED SILICON DISPERSION IN MOUSE BRAIN ANALYZED BY LASER INDUCED BREAKDOWN SPECTROSCOPY

Khan Muhammad Shehzad
City University of Hong Kong, China

Abstract:

To capture electrical impulses from cerebral tissue, electrodes are increasingly being manufactured out of silicon-based devices such as brain probes. This allows for more accurate readings. It has been claimed that neural probes, when used repeatedly, might cause inflammation, and provoke an immune response. The current research studies the detection and measurement of silicon dispersion emerging from a concentrated source within the mouse brain. This investigation is carried out using Laser-Induced Breakdown spectroscopy (LIBS).

The element lines for Si (I) were found at the injection site at around 288 nm at 3 hours post-implantation. This finding indicates that there was most likely infusion into neural tissue. At 24 hours and one-week post-implantation, there was no evidence of silicon lines, confirming that clearance had occurred. After an injection, a CD68 macrophage response was measured 24 hours later to determine whether an isolated immune response was present. The present type of protocol, coupling laser induced breakdown spectroscopy, neuroimaging, histology, immunohistochemistry, and determination of clearance could be used to investigate the glymphatic system and different tissue states such as in disease (e.g. Alzheimer's).

Biography

Muhammad Shehzad Khan is a highly accomplished PhD in Biophysics with extensive experience in the field. With a passion for understanding the fundamental principles of living systems, he dedicates his career to advancing his knowledge of biophysics and its applications. He obtained his PhD in Biophysics from the City University of Hong Kong, where he conducted research on the application of biophysics to study the dynamics of biological systems. During his PhD, he developed new methods and techniques for studying the structure and function of biomolecules using advanced microscopy and spectroscopy techniques. After completing his PhD, Dr.MUHAMMAD works as a postdoctoral researcher at Hong Kong Science Park where he continues to investigate the dynamics of biological systems at the molecular level. His contributions to the field include developing new approaches for measuring protein-protein interactions and studying the mechanics of biomolecules. He is also an active participant in the scientific community, serving as a reviewer for numerous scientific journals and presenting his work at national and international conferences. He has published extensively in top-tier scientific journals, including Bipolar Disorder, Immunology, Neuroscience, etc. He is a distinguished biophysicist who has made significant contributions to the field. His expertise and experience in single-molecule biophysics, advanced microscopy, and spectroscopy techniques make him an asset to any research team. he dynamics of biological systems at the molecular level. His contributions to the field include developing new approaches for measuring protein-protein interactions and studying the mechanics of biomolecules. He is also an active participant in the scientific community, serving as a reviewer for numerous scientific journals and presenting his work at national and international conferences. He has published extensively in top-tier scientific journals, including Bipolar Disorder, Immunology, Neuroscience, etc. He is a distinguished biophysicist who has made significant contributions to the field. His expertise and experience in single-molecule biophysics, advanced microscopy, and spectroscopy techniques make him an asset to any research team.

COLLAGEN LASER SKIN REJUVENATION

Hilda Demirjian
Hilda Demirjian Laser & Skin Care Center, USA

Abstract:

Laser Collagen Skin Tightening/Skin Rejuvenation is an important aesthetic laser technique in treating the most damaged skin including cystic acne, scars, stretch marks, melasma, discoloration, fine lines, wrinkles, and loose skin. After the age of 35, the skin loses 75% of its collagen and elastin. Many people notice signs of aging when skin begins to sag around the face and neck. Laser skin tightening is appropriate for men and women of all skin types and skin tones who wish to achieve dramatic results without painful surgery and lengthy recovery times. Laser skin tightening is a minimally invasive, non-surgical process that uses an infrared light source (a laser) to tighten skin by heating the collagen under the skin's surface, causing the skin to contract (tighten). Facial skin tightening is noticeable immediately after the treatment, and there is no downtime, making this an increasingly popular procedure. As this procedure is performed with an aesthetic laser, which is approved by the United States Food and Drug Administration, it is appropriate for all skin types and complexions. Additional skin tightening occurs over the next few months, but optimal results usually require two or three treatments about a month apart.

Biography

Hilda Demirjian, owner of Hilda Demirjian Laser & Skin Care Center, created a skin care product line through many years of scientific research with 100% botanical sources, including fruit stem cells. With a mission and passion to promote skin health and to help people simplify the way they care for their skin, Hilda used her skills and advanced knowledge of the industry and transformed many faces and bodies around the world by aesthetic laser over the last 25 years. She worked with a gynecological surgeon with lasers from Candela, the industry world leader for surgical and aesthetic lasers.

Hilda's love of skin care developed in her native country, Persia, where skin wellness is considered highly valuable. As an adult, her love for healthy skin grew into a driving passion. Hilda has traveled to many countries, learned from specialists, and taught students in such places like Canada, Mexico, the Middle East, Europe (Italy, UK, and France), the Far East (Japan), and the United States of America. As a national and international speaker, Hilda Demirjian is the pioneer of aesthetic laser in the tri-state area.

LIGHT SHEET BASED VOLUME FLOW CYTOMETRY (VFC) IMAGING SYSTEM

Prashant Kumar
Indian Institute of Science, India

Abstract:

Light sheet microscopy is fast emerging as a technique for interrogating live specimens (ranging from a single cell to multicellular organisms). Recent advances have enabled many studies in diverse disciplines from developmental biology to plant research. We developed a volume imaging cytometry (VFC) system that can interrogate cells with near diffraction-limited resolution on the go. It applies to both macro and micro-organisms. Very less phototoxicity effects led to this module famous in imaging techniques of biological samples where it remained a big concern. Light sheet based different fast volume imaging systems now put it parallel to various existing imaging techniques. New advanced flow cytometry(Parallel iLIFE Imaging Cytometry) based imaging techniques integrated with light sheet enable us to look at picture outside and inside the cellular system spanning from micro to macro bio-organism with statistical information.

Parallel iLife imaging cytometry system basically based on three main subsystems: illumination arm, detection arm, and microfluidic platform for the dynamic specimen. The illumination techniques' performance can be based on two different modules: (1) point illumination-based excitation module or (2) Plane illumination-based excitation module. Existing interrogation systems are built on illumination-based module spans very less field of view (FOV) to screen specimen leading to one-by-one cell screening. On the other side Plane illumination based excitation module integrated with a Microfluidic platform and emerging Light sheet technique has the capability to span large FOV for cell screening making a high-throughput cell screening and macro-organism interrogation facilitate scientists to perform various new research and applications in the field of Biomedicine, Applied Physics, Pharmaceutical.

Biography

Prashant Kumar is pursuing a Ph.D. at the Department of Instrumentation and Applied Physics, Indian Institute of Science, Bengaluru, India. He has a background in Physics. His current research interest lies in the development of Light sheet based imaging techniques. He has developed light sheet-based imaging techniques integrated with a microfluidics platform (VFC). It applies subcellular to the multicellular organism and adds new capabilities to existing cytometry imaging systems like organelle count, and biophysical parameters and lifts the constraints like hydrodynamic focusing. This imaging technique has a vast range of applications from Physical Science, Chemical Science, Life Science, pharmaceuticals, etc. Currently, he is involved in another light sheet based imaging techniques at Mondal Lab, Dept. Of IAP, Indian Institute of Science Bengaluru, India. He has an interest in both experimental and theoretical research in other fields of optics like Light-matter interaction, spectroscopy, single-molecule imaging techniques, and optical tweezer and trying to learn and contribute at his best.

LIGHT ABSORPTION BY WEAKLY ROUGH METAL SURFACES

Zhyrair S Gevorkian, Ludvig S Petrosyan and Tigran V Shahbazyan
Alikhanyan National Laboratory, Armenia

Abstract:

We study light absorption by weakly rough metal surfaces with the roughness amplitude and correlation length smaller than the skin depth in metal. We develop a systematic perturbative approach for calculation of the absorptance in such systems and find that roughness-related absorptance variations are determined by an interplay between several system parameters which can result, in particular, in a greater absorption for smaller roughness amplitudes. We show that, for small-scale roughness, the absorptance variations are mainly caused by roughness-induced increase in effective volume of the surface layer, in which the incident light is predominantly absorbed. We argue that such absorptance fluctuations between different samples, even though not related to any electron scattering processes, can appear as sample-to-sample variations of the Drude scattering rate reported in recent measurements of the metal dielectric function.

Biography

Zhyrair Gevorkian was born at January 28, 1958 in Yerevan, Armenia. After finishing highschool he has entered Physical Department of Yerevan State University in1974. In 1982 he becomes a Ph.D. student of Institute of SpectroscopyRussian Academy of Sciences, Moscow. He has got PhD degree in 1987. In1987-2000 years he was a Scientific Researcher in Institute of Radiophysicsand Electronics of Armenian Academy of Sciences. Since 2000 he was aSenior Leading Scientific Researcher in Alikhanian National Laboratory, Yerevan Armenia. In 2000-2010 he was visiting professor in Institute ofPhysics, Academia Sinica, and Taiwan.

ADVANCES IN OPTICAL SPECTROSCOPY PAVING THE WAY FOR NEW TECHNICAL POSSIBILITIES.

Nazanin Shafiee
Avantes, Netherlands

Abstract:

There has been significant development in the field of optical spectroscopy. Major improvements from the historical devices and enhanced specifications have led to a host of new applications and use cases.

A number of sectors have been able to take advantage of such developments and innovations and are currently heavily depending on these technologies in ways that have enabled and propelled their technologies forward. New spectroscopic techniques have been leading to new technological capabilities, tools and creating new research areas. With varying sectors and markets taking advantage of these developments in optical spectroscopy, it's important to understand the core technologies and further learn about the new innovations. In this talk, we'll discuss some of these core technologies as well as the new innovations and developments. We will further scan through the different sectors and explain how such developments are opening new areas of research. Lastly we'll peak in to the future needs for more accurate models and algorithms improving engineering efficiency impacting every corner of our lives.

Biography

Nazanin Shafiee has a background in Materials Chemistry and after working in academia has spent most of her career interacting with technical teams across different industries. She has worked on products and interfaced with clients in a broad range of industries in varying roles such as Process Integration Engineer, Project Manager, Business Development Manager, Head of Technical Sales and Marketing and is currently working with companies globally looking into the current needs and future trends. The range of industries she has interfaced with include: semicon, medical (implants & surgical devices), space, telecom/datacom, automotive, agriculture, horticulture.

Virtual Presentations

Laser Optics & Quantum Physics 2023

Keynote Presentation

Si_3N_4-BASED INTEGRATED FUNCTIONAL DEVICES

Yang Yue
Xi'an Jiaotong University, China

Abstract:

Photonic Integrated Circuit (PIC) is an active research field nowadays. Silicon nitride (Si_3N_4) is a promising platform for PIC since it is compatible with CMOS technology. Among different materials, Si_3N_4 has reasonably high Kerr nonlinearity and negligible two-photon absorption (TPA) for wavelength beyond 500 nm. Due to the advantages of Si_3N_4 platforms, we design some Si_3N_4-based integrated functional devices for optical communication systems. With the additionally introduced slot layer of Si_3N_4 waveguide, chromatic dispersion can be efficiently tailored to be either high or low over broad bandwidth. The broadband flattened low dispersion provides a good chance to generate supercontinuum, which has the potential application in integrated broadband light source. Flat and high dispersion could be utilized to realize the broadband dispersion compensation in optical communication system. In addition, polarization splitter is widely used to overcome the polarization randomness problem in optical communication systems.

In this talk, we will review our recent work based on Si_3N_4 slot waveguide. First, we investigate the supercontinuum generation in the Si_3N_4 slot waveguide with flat and low all-normal dispersion over a 3270-nm wavelength range from 1170 to 4440 nm, covering a 1.9-octave bandwidth. A three-octave highly coherent supercontinuum from 504 to 4229 nm can be generated using a 5-mm long waveguide. Second, we propose a Si_3N_4/SiO_2 horizontal-slot-waveguide-based polarization beam splitter (PBS) for on-chip high-power systems. The coupling length of the PBS was 281.5 μm. Compared to PBS based on the Si_3N_4 strip waveguide, the coupling length became 22.6% shorter. Third, the silicon nitride horizontal slot waveguide with silicon dioxide cladding is designed to achieve flat negative dispersion (<-600 ps/(nm•km)) over an octave-spanning bandwidth (782 to 2100 nm), which can be used as a key dispersion compensation element in an on-chip chirped pulse amplification system.

Biography

Yang Yue received the B.S. and M.S. degrees in electrical engineering and optics from Nankai University, China, in 2004 and 2007, respectively. He received the Ph.D. degree in electrical engineering from the University of Southern California, USA, in 2012. He is a Professor with the School of Information and Communications Engineering, Xi'an Jiaotong University, China. Dr. Yue's current research interest is intelligent photonics, including optical communications, optical perception, and optical chip. He has published over 240 journal papers (including Science) and conference proceedings with >10,000 citations, five edited books, two book chapters, >60 issued or pending patents, >200 invited presentations (including 1 tutorial, >30 plenary and >50 keynote talks). Dr. Yue is a Fellow of SPIE, a Senior Member of IEEE and Optica. He is an Associate Editor for IEEE Access and Frontiers in Physics, Editor Board Member for four other scientific journals, Guest Editor for >10 journal special issues. He also served as Chair or Committee Member for >100 international conferences, Reviewer for >70 prestigious journals.

CONTROLLING THE BRAIN AND HEART WITH LIGHT

Sukhdev Roy
Dayalbagh Educational Institute, India

Abstract:

Optogenetics has made a strong impact in neuroscience by providing unprecedented spatiotemporal resolution in reading and writing neural codes with relatively lower invasiveness. In optogenetics, a genetically encoded light-sensitive protein is introduced into cells to make them sensitive to light. The expressed protein generates either inward or outward current in the presence of light, and can reversibly change the cell membrane voltage. Thus, the activity of these cells can be controlled and monitored with light. Optogenetics also enables all-optical control and recording of cellular activity in living tissue and opens up exciting prospects for optical neural prostheses. Recently, the first successful human trial of optogenetic retinal prostheses and promising results in cardiac optogenetics has been demonstrated.

Computational modelling of optogenetic systems has made significant contributions in developing a better understanding of the photocurrent dynamics in opsin molecules and the change in membrane potential in opsin-expressing cells in response to light. Computational models help in quick virtual testing of newly developed light-sensitive proteins in different cell types within realistic tissue and organ-level settings.

The talk would focus on our recent research in computational optogenetics for low-power, high-fidelity and high-frequency excitation, inhibition and bidirectional control of different neurons in the brain and cardiomyocytes in the heart, with newly discovered light-sensitive proteins and opsin pairs. The study not only provides a better understanding of the mechanism to efficiently control different cells but also allows optimization of their response. Desensitization of photocurrent is a fundamental problem while using faster opsins. Under sustained illumination, the photocurrent in fast opsins desensitizes with time and results in spike failure below a certain threshold. Recently, we have shown that co-expressing stepfunction opsins with fast channelrhodopsins can overcome this challenge. It has also been shown that ultra-low power deep sustained optogenetic excitation or suppression of electrical activity in cardiomyocytes can be achieved with the newly discovered ChRmine opsin. The future prospects of optogenetics will also be discussed.

Biography

Sukhdev Roy received the B.Sc. (Hons.) Physics from Delhi Univ. in 1986, M.Sc. Physics from DEI, in 1988, and PhD. from IIT Delhi in 1993. He joined the Dayalbagh Educational Institute in 1993, where he is at present a Professor in the Department of Physics and Computer Science. He has been a Visiting Professor at many universities that include, Harvard, Waterloo, Würzburg, Regensburg, Osaka, City University, Queen Mary University of London, TIFR, Mumbai and IISc. Bangalore and Associate of ICTP, Trieste. He is a Member of the Global Panel of MIT Technology Review. Prof. Roy has made significant contributions in Photonics that encompass nano-bio-photonics, silicon and neuro photonics, fiber optics, and optical computing. He is the recipient of AICTE Career Award for Young Teachers, JSPS Invitation Fellowship, Japan, H.C. Shah Research Endowment Prize by Sardar Patel University, 1st IETE B.B. Sen Memorial Award, IETE-Conference on Emerging Optoelectronic Technologies Award, IETE-M. Rathore Memorial Award, the National Systems Gold Medal, and the Distinguished Alumni Award by the Dayalbagh Educational Institute.

QUANTUM TECHNOLOGIES: AREAS OF IMPROVEMENT OR HOW NOT TO SLIDE INTO QUANTUM WINTER

Helena Liebelt
Deggendorf Institute of Technology, Germany

Abstract:

The talk provides a short overview of QT history leading up to current times. Let's have a hard look at where we are in terms of QT and what major pitfalls to expect. The presentation will focus particularly on the issue of the growing talent gap.

Biography

Helena founded her first digital start-up company at the age 18, while still studying Computer Science. She started her Intel career in 2005 as an Application Engineer within the Software and Solutions Group (SSG), developing good understanding of software products and the ISV market. She moved on building a SW lab supporting internal engineering community as well as external customers. Since 2010 Helena was leading the HPC Market in Germany for almost a decade. In 2018 Helena received the prestigious Intel Achievement Award, Intel's highest Honour, for her contribution to HPC. She has Doctorate in Economics ("Strategic change management in post crisis environment") as well as formal education in Business Administration and Computer Science. In 2018 Helena received a tenured position as a Professor of Computer Science at her Alma Mater, the Deggendorf Institute of Technology (DIT), where she build the first European "HPC and Quantum Computing" master program at the DIT in autumn 2021 with a high demand of students followed by a new bachelor Program on "Data Centre Management" starting in 2022. Helena is also the CISO and Director of the IT-Centre in charge of University IT.

Laser Optics & Quantum Physics 2023

Oral Presentations

SPIN-POLARIZED FLEXIBLE PHOTODETECTOR WITH ULTRAHIGH SENSITIVITY BASED ON CHIRAL METAL-ORGANIC FRAMEWORK (CMOF)

Mujahid Mustaqeem
National Taiwan University, Taiwan

Abstract:

Spin-optoelectronics uses unpolarized or circular polarized light (CPL) to interact with electron spin, generating corresponding devices for practical applications, such as circular polarization ellipsometry-based tomographic scanning, spin information and optical communication, and quantum-based optical computation and data processing. One of the most possible ways to achieve high-performance spin optoelectronic devices is based on chiral materials. Chiral metal-organic frameworks (CMOFs), an emerging class of chiral hybrid materials, have sparked interest due to their structural variety, flexibility, and unique chirality features. CMOFs have played a vital role in numerous research areas, such as asymmetric catalysis, sensing, nonlinear optics, and optical device. Herein, we have developed CMOF based on achiral building blocks [(9,10-adc)] to detect circularly polarized light (CPL) with ultrahigh sensitivity. Their application in spin-polarized flexible detectors gives a maximum responsivity (R), photogain, and detectivity (D*), 9.4 × 103 (A/W), 2.8 × 104, and 9.1 × 1010 jones, greater to all reported heterochiral MOF-based detectors. Meanwhile, the anisotropy factor (gIph) is up to 0.38 for the CPL detection. Additionally, after 100 cycles of bending, photocurrent and anisotropy factor (glph) exhibited a slight deterioration, showing the minor effect of external bending force on the device performance, the mechanically flexible and durable, manifesting a vital feature for chiral optoelectronics. Our findings of achieving high-performance and flexible spin photodetector based on CMOFs thus play a key step in opening a useful approach for developing future spin optoelectronic devices.

Biography

Mujahid Mustaqeem is a material chemist and multifaceted professional with an extensive background in research and development involving Synthesis, structural characterizations, and Nano & optoelectronic systems. Efficient in facilitating laboratory, supervising team, and administrating research activities in any multicultural research environment. He has expertise in the Synthesis and characterization of porous materials like metal-organic framework (MOF) and their application in optoelectronic devices. He has experience in research, evaluation, and teaching. He has expertise in devices fabricating for semiconducting, transistors, memory devices, LEDs, Spin-photodetectors, and their optical (photonic) characterizations like, IV, PL, TRPL, CD, EL, and CPL-EL.

OPTICAL TENHNOLOGIES & IMAGING IN MICROCIRCULATION STUDIES

Aristotle G. Koutsiaris
University of Thessaly, Greece

Abstract:

Much of the progress in medicine and biological sciences over the past 20 years is due to technological advances in lasers and optics. Some of the areas with important progress are in-vivo and in-vitro spectroscopy, optical microscopy, confocal microscopy, optical coherence tomography (OCT), capillary electrophoresis, flow cytometry, optoacoustic tomography, photodynamic therapy (PDT), ophthalmic refractive surgery and DNA sequencing.

Optical technologies have contributed enormously to the development of our understanding of microcirculation both *in-vitro* and *in-vivo.* Regarding *in-vitro* applications, the main instrument is the optical microscope, and many setups were built based on it. One of the most classical *in-vitro* imaging techniques for the fluid-dynamics study of microcirculation is micro Particle Image Velocimetry (μPIV) which was developed in the last 20 years. The basic parts of a μPIV experimental set-up are going to be described and results from recent literature are going to be discussed.

Regarding *in-vivo* applications, there is a wide palette of techniques for animals and humans. In humans, the most frequently used tissues for microcirculation studies are located in the eye, the tongue, and the finger nail fold. This presentation will focus on the eye conjunctiva and fundus, presenting recent developments in imaging techniques and optical technologies related to conjunctival biomicroscopy (CBM) and optical coherence tomography angiography (OCTA).

Biography

Aristotle G. Koutsiaris is currently an Assistant Professor in the Department of Medicine, School of Health Sciences, University of Thessaly, Biopolis, Larissa, Greece. His postgraduate work was on the application of optical techniques on microvessels *in-vitro* and *in-vivo* and since then he has worked and taught at several academic institutions. His research work on biofluid dynamics, hemodynamics, microcirculation, biomedical imaging, and bio-microscopy, both *in-vitro* and *in-vivo* (in animals and humans) includes more than 20 papers in international scientific journals with a good scientific impact.

COMPUTATIONAL FLUID DYNAMICS WITH QUANTUM SYSTEM

Rui Li and Helena Liebelt
Deggendorf Institute of Technology, Germany

Abstract:

Transport phenomena is nowadays still the most challenging unsolved problem in computational physics, though the high-performance computing has been applied. As the future's technology, quantum computing opens a grand new perspective for numerical simulations for transport phenomena. Taking computational fluid dynamics as a concrete application, the possible quantum algorithms are intensive reviewed. One concrete application with Lattice Boltzmann Method is implemented using Intel Quantum Software Development Kit (SDK). For the implementation, one simple 1-Dimensional advection-diffusion equation is solved with the highlight to involve quantum walk. The calculation procedures and quantum circuits are showed and discussed with details to present the work process. In the end the opportunities and challenges of quantum computing for fluid dynamics are foreseen.

Biography

Rui Li has been a tenured professor at the Deggendorf Institute of Technology since 2018. He was a scientific researcher (2012–2018) at the Institute of Nuclear and Energy Technology (IKET) at Karlsruhe Institute of Technology (KIT). He received his Ph.D. in nuclear engineering from Tokyo Institute of Technology (2012) with the topic "Computational fluid dynamics study on liquid droplet impingement erosion in a bent pipe". Li has many years of experience in the fields of computational fluid dynamics, heat transfer enhancement, two-phase flow, turbulence modelling, erosion and corrosion, reactor physics and thermal hydraulic analysis, high performance computing. He has been involved in and contributed to the major European Commission FP-7 projects for fast reactor safety study. Li has written/contributed to 24 professional archival peer-reviewed journal papers, 23 conference proceeding papers and 20 technical deliverables to European Commission, and Japan Nuclear Regulation Authority. Current research is quantum computational fluid dynamics.

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PHYSICS AND MATERIAL TECHNOLOGIES APPLIED TO THE CHALLENGE OF RADIOISOTOPE PRODUCTION FOR MEDICAL AND RESEARCH PURPOSES

H Cristina Vasconcelos[1], Luis F Metello[2] Lidia A Cunha[3], Ana R Roda[4], Marina A Sousa[5], William Z Gelbart[6] and Richard R Johnson[7]

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[6]A.S.D. Inc., Garden Bay, BC, Canada
[7]University of British Columbia, Vancouver, BC, Canada

Abstract:

Nuclear Medicine is an independent medical specialty since 1970, increasingly used and related to diagnostic and/or therapeutic activities, using small amounts of radioactive products in the diagnosis, or more relevant amounts in "radiometabolic therapy". Among the main restrictions is the adequate availability of radiopharmaceuticals (biomolecules emitting radiation, previously administered to patients, which metabolize and/or process them in some way before being detected by specific equipment - called "scanners"). Therefore, without radiopharmaceuticals to administer to patients, scanners are no longer relevant in Nuclear Medicine activities. For this reason, systems for the direct production of radiopharmaceuticals in cyclotrons using solid targets are very important. The production of radioisotopes is carried out essentially by accelerated irradiation of particles of stable elements and/or their compounds in the gaseous and liquid states, and residually in the solid state. The medical radioisotopes produced by the accelerator are used in thousands of medical procedures, both for diagnostic imaging and for therapeutic treatment. However, an increasing number of clinically relevant radioisotopes are available to be produced in interesting quantities by irradiating solid materials ("targets"), mainly metallic elements. This work presents some of the current challenges used in radioisotope production, establishing links between radioisotope production and the physics of materials.

Biography

Helena Cristina Vasconcelos is Associate Professor at the Faculty of Science and Technology of Azores University. She is a research member of the Laboratory for Instrumentation, Biomedical Engineering and Radiation Physics (LIBPhys). She has received her bachelor's degree in Physics and Materials Engineering in 1990, obtaining, in 1999, the PhD in Materials Engineering. Her main research interests are in optical materials, fluorescence, and photonics (rare-earth doped glasses). Other interests include the development of materials for commercial use in solid targets to produce radioisotopes in low/medium energy cyclotrons.

INVESTIGATION OF Λ-TYPE SPLITTING OF NITRIC OXIDE USING CAVITY RING-DOWN SPECTROSCOPY

Ardhendu Pal
S.N. Bose National Centre for Basic Sciences, India

Abstract:

The study of the spectroscopic features of nitric oxide (NO) is of great interest due to its paramagnetic nature. The Λ-type doublet is particularly crucial to study as it provides various spectroscopic informations. In this study, we examined the spectroscopic features of the Λ-type doubling of the fine structure lines of NO in the mid-infrared fingerprint region, specifically in the $(^2\Pi_{1/2}, 1)\leftrightarrow(\ ^2\Pi_{1/2}, 0)$ and $(^2\Pi_{3/2}, 1)\leftrightarrow(\ ^2\Pi_{3/2}, 0)$ vibrational transitions. High-resolution continuous-wave external-cavity quantum cascade laser (cw-EC-QCL) coupled with cavity ring-down spectroscopy (CRDS) was utilized to measure the rotationally resolved Λ-type doublet of NO in the R-branch, involving parity sub-states e and f corresponding to $^2\Pi_{1/2}$ and $^2\Pi_{3/2}$ states. The spectroscopic parameters, such as the Λ-type doublet splitting and the Λ-type doubling constants, were determined for both states. The pressure broadening effect on the Λ-type doublets and the dependency of pressure broadening coefficients on the rotational quantum number J of NO in the presence of three perturbing gases were also investigated. Lastly, the vibrational transition dipole moment value and the Herman-Wallis coefficients were determined from the experimental data. These spectroscopic parameters, obtained through experiments, enhance our fundamental understanding of this diatomic molecule.

Biography

Ardhendu Pal has completed his BSc (2016) and MSc (2018) from University of Calcutta. Presently, he is working as a senior research fellow in the group of Prof. Manik Pradhan at S.N.Bose National Centre for Basic Sciences, India. For the past few years he is working in cavity ring down spectroscopy and also involved in the development of multipass cell based wavelength modulation spectroscopy strategy. Currently he is working to develop a setup for trace gas detection exploiting incoherant broadband cavity enhanced absorption spectroscopy. I have published seven articles in various peer reviewed journals. He has received best paper presentation award in International Conference on Advanced Physics IEMPHYS-22.

APPLICATION OF MONTE CARLO METHODS IN NUCLEAR MEDICINE AND RADIOTHERAPY

Praveen Kumar C and Neeraj Sharma
Indian Institute of Technology (BHU), India

Abstract:

Nuclear medicine and Radiotherapy are defined as the widely accepted modalities for the diagnosis and treatment of cancer. Treatment planning systems are used by medical physicists to determine optimal beam arrangements, energies, field sizes and fluence patterns to bring about safe dose distribution in the treatment of cancer. Present dimensions of research do not focus on the nature of radiation transport within the tumour tissue, tumour bed and healthy tissues encircling it. The linear Boltzmann Radiation transport equations (BRTE) have been used widely in the study of particle transport for several decades. The BRTE equations describe the conservation of radiation particles during transport through a medium. Deterministic BRTE solvers and Monte Carlo simulation are seen as the two alternative methods of solving the same fundamental transport equations, the BRTE solvers with a deterministic approach and the Monte Carlo simulations using a stochastic approach. This research focuses on the development of Monte Carlo methods for assessing the nature of energy deposition within the cancerous and healthy tissues using the novel proposed Mathematical Anthropomorphic (MA) phantoms. MA phantoms are tissue-equivalent phantoms which represent a replica of the organs within the human body. Energy deposition within the tissues is quantified as total dose, primary dose and scatter doses. Monte Carlo method of solving BRTE proceeds via simulating the entire physical process thus eliminating discretization errors. Higher accuracy for predicted dose value could be claimed with a greater number of simulated particle histories, conversely affecting the computation time. Particle interaction effects such as Compton, Mott and Moller scattering events are taken into consideration in formulating the transport equations for photons and electrons within the MA phantom. The photon fluence act as a source of electrons within the transport equation. Both colliding and non-colliding photon scatter flounces are taken into consideration for particle transport inside the MA Phantom Simulated dose values could be analysed using statistical tools for determining the effectiveness of dose deposition at the tumour site and the radiation-induced damage to healthy tissues surrounding the tumour bed.

Biography

Praveen Kumar C is a research scholar in the School of Biomedical Engineering, Indian Institute of Technology (BHU), Varanasi, Uttar Pradesh, India. He has worked as Assistant Professor in the Electrical and Electronics department of NSS College of Engineering, Palakkad, and Kerala, India. His research area is Nuclear Radiation and he started working on computational modelling of energy transport within cancer systems using phantoms for quality assurance in Radiotherapy and Diagnostic Radiology. His sphere of interest includes Electromagnetic Spectrum interaction on biological and non-biological materials, Nuclear Medicine Physics, MRI Physics and Cold Plasma application in cancer therapy.

SPIN-ORBIT-INTERACTION (SOI) IN THE CONFINED GRADED-INDEX (GRIN) FIBER FOR HIGHER-ORDER OAM MODES OF LIGHT

S Srinivasu and H Wanare
Indian Institute of Technology, India

Abstract:

The angular momentum of light has been explored for myriad applications, such as classical optical communications and quantum cryptography. More specifically, spin-angular momentum (SAM) and orbital angular momentum (OAM) of light provide additional degrees of freedom (DoF) to enhance information capacity in optical communications. So far, various specialty optical fibers have been developed to carry the angular momentum states of light. Among them, graded-index fiber is one such possibility that supports Laguerre-Gaussian (LG) beams, which carry both OAM and SAM. When such a beam propagates in the GRIN fiber, SAM and OAM interact with each other and the beam acquires an additional spin-orbit dependent phase, which lifts the degeneracy between the handedness of OAM/SAM modes. Furthermore, the SOI allows two counter-rotating OAM/SAM beams to travel at different phases. In this work, we quantified the strength of SOI in the GRIN fiber analytically and studied enhancement of this effect in the confined GRIN fibre for higher-order OAM modes. Lastly, the results are compared with the other fibers such as vortex fiber and a few-mode fiber. This effect can be experimentally observed as the rotation of the superposition beam containing both handed OAMs along the propagation length of the GRIN fiber.

Biography

Srinivasu is from India. He has been pursuing a doctorate in photonics at the Indian Institute of Technology, Kanpur. He completed his bachelor's degree in electronics and communications. His research interests are in the angular momentum aspects of light. Most of his focus is on designing efficient devices to control and developing methods to study orbital angular momentum (OAM) states of light both in the classical and quantum regimes. His targeted areas of applications are OAM-based optical fiber communications, optical computing, structured light imaging, and quantum key distribution (QKD).

ENHANCEMENT OF THE NONLINEAR OPTICAL RECTIFICATION IN VERTICALLY COUPLED InGaAs/GaAs QUANTUM DOTS UNDER APPLIED ELECTRIC FIELD

Dhouha Makhlouf, Nabil Ben Zerroug and Mohsen Choubani
University of Monastir, Tunisia

Abstract:

In this work, the energy levels and the nonlinear optical rectification (NOR) of vertically coupled InGaAs/GaAs quantum dots were theoretically calculated using an iterative procedure based on the finite difference method (FDM) combined with the effective mass approximation. The vertical and radial In-composition profiles resulting from segregation and intermixing effects were considered. Obtained results demonstrated that the indium segregation in the wetting layer and the inter-diffusion inside the quantum dots play a significant role and should be considered whenever an accurate simulation of the nonlinear optical properties of such nanostructures is required. In addition, our findings indicate a critical spacer width when the NOR reaches its maximum value at resonant energy in the Tera-Hertz domain. Therefore, the magnitude of the NOR and the associated resonant energy are affected by the spacer width and external proofs such as an applied electric field applied along the growth axis. Consequently, our findings could be applied to the design and improvement of nonlinear optical devices based on vertically coupled lens-shaped InGaAs/GaAs quantum dots.

Biography

Dhouha Makhlouf was born on 20th, 1992 in MONASTIR city, TUNISIA. She has earned her Doctor degree (PhD) in physics in 2020. In 2021, she joined the Department of Physics at the Scientific Faculty in MONASTIR, University of MONASTIR, Tunisia as a contractual assistant. Her research interests lie in the area of studding the linear and nonlinear optical properties in III-V semiconductor materials.

SYNERGY OF LASER RADIATION AND MECHANICAL SPECTROSCOPY OF SiO_2 + Si , NANOCOMPOSITES OF MULTIWALLED CARBON NANO-TUBES AND POLYAMIDE, POLYVINYLCHLORIDE, POLYETHYLENE

Anatoliy Petrovich Onanko
Kyiv National University, Ukraine

Abstract:

After stopping of the laser radiation action of fusion solidification begun exactly from the surface, but the crater underbody is extended (molten) and created the additional squeezing mechanical tension σ_i, that „pull" the central part of crater surface in depth with the liquid crater fusion. The pressure dynamics $P_i(t)$ is following: at the beginning of destruction P_i grows quickly, and on the completion of impulse action diminishes instantly on the value of the light pressure created by the laser. Then the diminishing pressure Pi becomes slower, for nanosecond times of laser influence the appearance of acoustic emission (AE) review is important in time range $\tau \approx 0.2$ nanosec. Effects of AE after nanosecond neodymium and ruby laser irradiation in fluid SiO_2 are investigated.

The fusion depth as result of photothermal elastic strains σi at large time $\partial T/\partial t = (55 \pm 100).10^9$ K/sec and spatial $\partial T/\partial x = (1 \pm 2).10^4$ K/sm temperature gradients on the SiO_2 surface was appraised $\Delta h \approx 10000$ nm. The quantity of reflections $N = \tau/t \approx 0.2$ nsec/0.02 nsec = 10, approximately 10 times forward-back in specimen.

The crater fusion depth Δh at constant intensity I and laser irradiation time t is limited by the local heat-conducting and establishment of "time-equilibrium" distribution of temperature gradients ΔT perpendicular to the crater axis and along it. Outcomes of the evaluation of dynamic characteristics interstitial atoms Si_j, vacancy V and O-complexes can be applied for account of a condition of an annealing with the purpose of deriving specific structural defects in SiO_2 + Si after laser radiation.

Biography

Anatoliy Onanko studied Physics at the physical department Kyiv national university, Ukraine and graduated as MS in 1977. He received his PhD degree in 1989 at the same physical department. After postdoctoral fellowship he obtained the position of the Senior Science Researcher at the Kyiv national university, physical department, faculty of physics functional materials. He received Senior Science Researcher (PhD - physical-mathematical science) in 2003. He is Manager of radiation physics laboratory physics department Kyiv national university. He studies on the mechanisms of internal friction Q^{-1}. Research interest: 1Mechanical properties, Mechanical spectroscopy, Internal friction Q^{-1}.

PHOTOALIGNMENT AND PHOTOPATTERNING BY NANOSIZE AZO-DYE LAYERS: PHYSICS AND APPLICATIONS

Vladimir G Chigrinov
Hong Kong University of Science and Technology, Hong Kong

Abstract:

Photoalignment and photopatterning has been proposed and studied for a long time. Light is responsible for the delivery of energy as well as phase and polarization information to materials systems. It was shown that photoalignment liquid crystals by azodye nanolayers could provide high quality alignment of molecules in a liquid crystal (LC) cell. Over the past years, a lot of improvements and variations of the photoalignment and photopatterning technology has been made for photonics applications. In particular, the application of this technology to active optical elements in optical signal processing and communications is currently a hot topic in photonics research. Sensors of external electric field, pressure and water and air velocity based on liquid crystal photonics devices can be very helpful for the indicators of the climate change.

We will demonstrate a physical model of photoalignment and photopatterning based on rotational diffusion in solid azodye nanolayers. We will also highlight the new applications of photoalignment and photopatterning in display and photonics such as: (i) fast high resolution LC display devices, such as field sequential color ferroelectric LCD; (ii) LC sensors; (iii) LC lenses; (iv) LC E-paper devices, including electrically and optically rewritable LC E-paper; (v) photo induced semiconductor quantum rods alignment for new LC display applications; (vi)100% polarizers based on photoalignment; (vii) LC smart windows based on photopatterned diffraction structures; (vii) LC antenna elements with a voltage controllable frequency.

Biography

Vladimir G. Chigrinov is Professor of Hong Kong University of Science and Technology since 1999. He is an Expert in Flat Panel Technology in Russia, recognized by the World Technology Evaluation Centre, 1994, and SID Fellow since 2008. He is an author of 6 books, 31 reviews and book chapters, about 322 journal papers, more than 677 Conference presentations, and 121 patents and patent applications including 38 US patents in the field of liquid crystals since 1974. He got Excellent Research Award of HKUST School of Engineering in 2012. He obtained Gold Medal and The Best Award in the Invention & Innovation Awards 2014 held at the Malaysia Technology Expo (MTE) 2014, which was hosted in Kuala Lumpur, Malaysia, on 20-22 Feb 2014. He is a Member of EU Academy of Sciences (EUAS) since July 2017. He got A Slottow Owaki Prize of SID in 2018.

EFFECT OF BLUE AND RED LED ON INFLAMMATORY ACNE: CASE STUDIES

Mara Lúcia Gonçalves Diogo, Renata Santos Schimidit, Lara Ferreira Dourado, Samantha Patrícia Matuck and Lara Jansiski Motta

Universidade Nove de Julho, Brazil

Abstract:

Inflammatory acne is a dermatosis that affects a large number of teenagers, causing low self-esteem and serious psychological disorders. Medications used in the treatment of dermatosis include topical retinoids and antibiotics and, in more severe cases, systemic retinoids and antibiotics. In view of the great microbial resistance reported in recent studies, we verified the need for new treatments in order to avoid as much as possible the use of antibiotics and drugs that cause greater inconvenience to their users. The use of blue LED is already established as an adjuvant therapy in the treatment of acne due to its antibacterial effect. Few studies have been done to identify actual results with red light in cases of inflammatory acne. We studied twenty cases, within a research that is still in progress, of the use of blue, red and combined LED, in comparison to the 20% salicylic acid peeling, and the results were very positive, with a significant improvement in the appearance and reduction of the lesions of the acne.

Biography

Mara Diogo is a researcher in the field of dermatology, especially in acne, and has been researching for some years the use of LED and laser lights in inflammatory acne so that the use of antibiotics and aggressive medications that cause other health disorders is limited to the maximum your users.

GEOMETRICAL FOUNDATION OF QUANTUM MECHANICS

Anton A. Lipovka
Sonora University, Mexico

Abstract:

As shown by Einstein and Debye, the free electromagnetic (EM) field is quantized by itself, regardless of the presence or absence of charges near the point of observation. However, the EM field quantization scheme proposed by Gupta and Bleuler 40 years later (in 1950) cannot be considered satisfactory, since, on the one hand, it does not include correctly set boundary conditions, and on the other hand, in this model, the value of Planck's constant is postulated. The reason for these failures is that all quantization schemes were implemented on a stationary manifold. However, the photon propagates in the expanding Universe, which generates the corresponding boundary conditions for the Sturm-Liouville problem and leads to the quantization of the EM field, to the Aharonov-Bohm effect and other observed quantum phenomena. Quantum Mechanics (QM) was created long before the quantization of the EM field, and therefore it is forced to be based on a number of axioms. So, in QM, based on the Schrödinger equation, the Klein-Gordon equation and the Dirac equation, the values of the coefficients in the basic equations (the value of the Planck constant) are postulated, the existence of the wave function is postulated, as well as the very form of the equations. This presentation shows how and why the electromagnetic field is quantized. The value of Planck's constant was obtained from the geometry of space (as an adiabatic invariant of a free electromagnetic field propagating along a variable manifold), which made it possible to remove the first postulate. Then the wave functions are derived, thereby removing the second postulate. Removing these two postulates, the QM equations are derived from first principles as equations describing the interaction of charged particles with the quantized EM field on an adiabatically varying manifold.

Biography

Anton A. Lipovka has experience in theoretical physics, astrophysics, and cosmology since 1990. After successfully completing his PhD program, he has been working at the University of Sonora since 1999 (to date). He conducted research in such areas of modern physics as general relativity, quantum physics, physics of low-dimensional structures, nanotechnology, astrophysics, cosmology, and several others. Under his leadership, several PhD theses were defended. He delivered various courses of lectures in master's and postgraduate studies, among which were QFT, general relativity, mathematical physics, quantum optics, astrophysics, and many others. Many years of research and teaching experience at the university made it possible for him in 2013 to calculate Planck's constant from first principles (as an adiabatic invariant of free electromagnetic field propagating through an adiabatically changing manifold). After obtaining this result, it also became possible to construct a complete quantum theory (2016) without the need to introduce wave functions.

FOCUSED ULTRASOUND FOR TREATMENT OF PERIPHERAL BRAIN TUMORS

Brandon Lucke-Wold
University of Florida, USA

Abstract:

Malignant brain tumors are the leading cause of cancer-related death in children and remain a significant cause of morbidity and mortality throughout all demographics. Central nervous system (CNS) tumors are classically treated with surgical resection and radiotherapy in addition to adjuvant chemotherapy. However, the therapeutic efficacy of chemotherapeutic agents is limited due to the blood-brain barrier (BBB). Magnetic resonance guided focused ultrasound (MRgFUS) is a new and promising intervention for CNS tumors that has shown success in preclinical trials. High-intensity focused ultrasound (HIFUS) has the capacity to serve as a direct therapeutic agent in the form of thermoablation of the tumor. Low-intensity focused ultrasound (LIFUS) has been shown to disrupt the BBB and enhance the uptake of therapeutic agents in the brain and CNS. We present a review of MRgFUS in the treatment of CNS tumors. This treatment method has shown promising results in preclinical trials including minimal adverse effects, increased infiltration of the therapeutic agents into the CNS, decreased tumor progression, and improved survival rates.

Biography

Brandon Lucke-Wold was born and raised in Colorado Springs, CO. He graduated magna cum laude with a BS in Neuroscience and distinction in honors from Baylor University. He completed his MD/PhD, Master's in Clinical and Translational Research, and the Global Health Track at West Virginia University School of Medicine. His research focus was on traumatic brain injury, neurosurgical simulation, and stroke. At West Virginia University, he also served as a health coach for the Diabetes Prevention and Management program in Morgantown and Charleston, WV, which significantly improved health outcomes for participants. In addition to his research and public health projects, he is a co-founder of the biotechnology company Wright-Wold Scientific, the pharmaceutical company CTE cure, and was a science advocate on Capitol Hill through the Washington Fellow's program.

He has also served as president of the WVU chapters for the American Association of Pharmaceutical Scientists, Neurosurgery Interest group, and Erlenmeyer Initiative Entrepreneur group. In addition, he has served as vice president for the graduate student neuroscience interest group, Nu Rho Psi Honor Society, and medical students for global health. He was an active member of the Gold Humanism Honor Society and Alpha Omega Alpha Honor Society. He is currently a member of the UF House Staff Council, Positive Culture Committee, Quality Improvement Committee, Board of Directors Alachua County Medical Society, and Accreditation Requirements Review Committee. He is married to Noelle Lucke-Wold and has two children. As a family, they enjoy running with their dogs, rock climbing, and traveling. In his spare time, Brandon frequently runs half marathons and 10ks together with is wife. Brandon also enjoys reading, playing piano, discussing philosophy, and playing chess. He is currently a Pgy5 neurosurgery resident at University of Florida with pursuing endovascular enfolded training and was awarded the Dempsey Cerebrovascular Research Fellowship.

RECENT ADVANCES IN RESONANT LIGHT SCATTERING BY SMALL PARTICLES

Michael I. Tribelsky
Lomonosov Moscow State University, Russia

Abstract:

Resonant light scattering by nanoparticles provides a unique opportunity to concentrate a high-amplitude electromagnetic field in a subwavelength area of space as well as to tailor and control its pattern. In addition to purely academic interest, this is extremely important for numerous applications ranging from medicine and biology to telecommunication and data processing. Despite more than a hundred years of extensive study, the problem is still far from completion. In this contribution, the author presents a review of his results in this field. In many cases, despite the smallness of the scattering particles, their light scattering has very little in common with the conventional Rayleigh case. New, counterintuitive effects, especially those related to the violation of the quasi-static description of the scattering occurring at the action of (ultra)short laser pulses, are pointed out and inspected, discussed, and classified.

Biography

Michael I. Tribelsky received his MS from Lomonosov Moscow State University in 1973, a Ph.D. from Moscow Institute of Physics and Technology in 1976, and a Dr. of Sci. (habilitation) from Landau Institute in 1985. He received numerous national and international awards: Leninsky Komsomol Prize (1979); COE Professorship, the University of Tokyo (2006, 2008) and Kyushu University (2007), Japan; Honorary Ph.D., Yamaguchi University, Japan (2016), etc. Now he heads a laboratory at Lomonosov Moscow State University. His field is theoretical and mathematical physics. Presently, his interest lies in subwavelength optics. He is the author of several books, book chapters, review articles, and more than 100 research papers.

SIMULTANEOUS DETECTION OF DUAL-SPECIES (CH_4 / N_2O) USING WAVELENGTH MODULATION SPECTROSCOPY FOR ATMOSPHERIC MONITORING AND BREATH DIAGNOSTICS APPLICATIONS

Biswajit Panda
S N Bose National Centre for Basic Sciences, India

Abstract:

We have designed and developed at 7.8 μm mid-IR region by coupling a room-temperature operated continuous wave (CW) external-cavity quantum cascade laser (EC-QCL) with an astigmatic multipass cell. We have utilized wavelength modulation spectroscopy with a second harmonic detection strategy (2*f*-WMS) for the simultaneous and real-time quantitative measurements of nitrous oxide (N_2O) and methane (CH_4) in ambient air and human exhaled breath in parts per billion (ppb) levels via extremely narrow single QCL scan of ~ 0.06 cm-1. The high-resolution rotational-vibrational interference-free 2*f*-WMS spectra of CH_4 and N_2O centred at 1297.8192 cm^{-1} and 1297.8314 cm^{-1}, respectively, were acquired with 0.20 s data acquisition time in the optimized experimental conditions. The experimental system has achieved minimum detection limits of 6 ppb for N_2O and 30 ppb CH_4, thus opening its broad applications in environmental monitoring and non-invasive biomedical diagnostics.

Biography

Biswajit Panda is currently working in Prof. Manik Pradhan's group and is interested in spectroscopic studies of different molecular species for application in atmospheric monitoring. In the last 4 years, Mr. Biswajit Panda has been involved in developing spectroscopic experimental setups and has expertise in wavelength modulation and cavity ring-down spectroscopy techniques. He has published 9 scientific papers in well-reputed international journals and received the best oral presentation award in IEMPHYS-2021.

MODELING OF VERY LOW ENERGY CAPTURE REACTION FOR NUCLEAR ASTROPHYSICS

Rajkumar Santra
Variable Energy Cyclotron, India

Abstract:

Indirect techniques have evolved as an alternative to direct measurements in nuclear astrophysics. The present work is to explore some of the experimental techniques of nuclear reactions as indirect methods for extraction of quantities relevant to modeling astrophysical capture cross sections. Modeling based on quantum theory of three different astrophysical capture reactions *viz*. ^{22}Ne (p,γ)^{23}Na of NeNa cycle, ^{68}Zn(n,γ)^{69}Zn of s-process nucleo synthesis path and neutron source reaction ^{22}Ne(α, n)^{25}Mg will be presented.

Biography

His research work deals with some indirect techniques in nuclear astrophysics. He have worked on the modelling of the single-particle transfer reaction for extraction of asymptotic normalization constant/particle decay width to describe the proton & α-capture reaction. He have performed an experiment to extract the nuclear level density using the particle-gamma coincidence technique, the statistical model description of the neutron capture process.

OPTIMIZATION OF THE SECOND HARMONIC GENERATION IN $In_xGa_{1-x}As$/GaAs LENS-SHAPED QUANTUM DOTS FOR TERA-HERTZ APPLICATIONS: IMPACT OF PRESSURE, TEMPERATURE, ELECTRIC FIELD, INDIUM SEGREGATION AND In/Ga INTER-DIFFUSION

Mohsen Choubani, Nabil Ben Zerroug and Dhouha Makhlouf
University of Monastir, Tunisia

Abstract:

In this work, the Second Harmonic Generation (SHG) in $In_xGa_{1-x}As$/GaAs lens-shaped quantum dots is investigated, taking into account simultaneous effects of indium segregation, In/Ga intermixing, temperature, pressure, external electric field, strains, and structure dimensions. Our theoretical results were correlated with experimental data from photoluminescence spectra. In addition, results show a red or blue shift of the SHG peak in the Tera-Hertz domain with adjusted magnitude. Also, it is found that the nonlinear optical properties suffer a prominent stark- effect, and the resonant energy shift to the red or blue depending on the electric field orientation. As well, obtained results reveal that the resonant energy of the SHG decrease (increase) with increasing the temperature (pressure), and a red or blue shift is achieved. Thus, this theoretical study will serve as good literature for controlling and tuning the nonlinear optical properties for Tera-Hertz applications.

Biography

CHOUBANI Mohsen obtained his MPhys in physics from the University of Monastir in 1997 and his Ph.D. in physics from the Scientific Faculty of Tunis in 2011. Since 2010, he has been an accredited Assistant professor in Physics at the Scientific Faculty of Monastir, University of Monastir. In 2022, CHOUBANI obtained the graduate of an Associate Professor at the Scientific Faculty of Monastir. He leads an active research group at the same university that focuses on III–V semiconductor materials and heterostructures (quantum wells, quantum dots, droplets), as well as modeling nonlinear optical properties in nanostructures.

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CRYSTALLOGRAPHIC ASPECTS OF SHAPE REVERSIBILITY IN SHAPE MEMORY ALLOYS

Osman Adiguzel
Firat University, Turkey

Abstract:

A series of alloy systems take place in class of advanced smart materials with adaptive properties and stimulus response to the external changes. Shape memory alloys take place in this group, with the shape reversibility behaviour and capacity of responding to changes in the environment. These alloys exhibit a peculiar property called shape memory effect, which is characterized by the recoverability of two certain shapes at different temperatures. This phenomenon is initiated on cooling and deformation processes and performed thermally on heating and cooling, with which shape of the materials cycles between original and deformed shapes of material in reversible way. Therefore, this behaviour can be called thermoelasticity. This is plastic deformation, with which deformation energy is stored in material and releases on heating, by recovering the original shape. The basis of this phenomenon is the stimulus-induced crystallographic transformations, thermal and stress induced martensitic transformations, which govern the remarkable changes in internal crystalline structure and physical properties of the materials. Thermal induced martensitic transformation occurs in atomic scale in the material on cooling, with cooperative movements of atoms in <110 > -type directions on the {110} - type planes of austenite matrix, along with lattice twinning reaction and ordered parent phase structures turn into twinned martensite structures. The twinned structures turn into detwinned martensite structures by means of stress induced transformation by stressing the material in the martensitic condition. These alloys exhibit another property called superelasticity, which is performed in only mechanical manner with stressing and releasing material in elasticity limit at parent phase region just over austenite finish temperature, and shape recovery occurs immediately upon releasing, by exhibiting elastic material behaviour. Therefore, this behaviour can be called Mechanical Memory. Stress-strain profile is nonlinear, stressing and releasing paths are different at stress-strain diagram and hysteresis loops refers to the energy dissipation. Copper based alloys exhibit this property in metastable β-phase region, which has bcc-based structures. Lattice twinning is not uniform in these alloys and give rise to the formation of layered structures, like 3R, 9R or 18R depending on the stacking sequences on the close-packed planes of the ordered lattice. The unit cell and periodicity are completed through 18 layers thorough z-axis in 18R martensite.

In the present contribution, X-ray diffraction and transmission electron microscopy (TEM) studies were carried out on copper based CuZnAl and CuAlMn alloys. X-ray diffractograms and electron diffraction patterns exhibit super lattice reflection. A series of x-ray diffractions were taken in a long-time interval. It was observed that peak locations and intensities change with the aging time, and this result refers to the redistribution of atoms in diffusive manner.

Biography

Adiguzel graduated from Department of Physics, Ankara University, Turkey in 1974 and received PhD- degree from Dicle University, Diyarbakir-Turkey. He has studied at Surrey University, Guildford, UK, as a post- doctoral research scientist in 1986-1987, and studied were focused on shape memory effect in shape memory alloys. His academic life started following graduation by attending an assistant to Dicle University in January 1975. He became professor in 1996 at Firat University in Turkey, and retired on November 28, 2019, due to the age limit of 67, following academic life of 45 years. He supervised 5 PhD- theses and 3 M. Sc- theses and published over 80 papers in international and national journals; He joined over 120 conferences and symposia in international level with contribution. He served the program chair or conference chair/co-chair in some of these activities. Also, he joined in last six years (2014 - 2019) over 60 conferences as Keynote Speaker and Conference Co-Chair organized by different companies. Additionally, he joined over 120 online conferences in the same way in pandemic period of 2020-2022. Adiguzel served his directorate of Graduate School of Natural and Applied Sciences, Firat University, in 1999-2004. He received a certificate awarded to him and his experimental group in recognition of significant contribution of 2 patterns to the Powder Diffraction File – Release 2000. The ICDD (International Centre for Diffraction Data) also appreciates cooperation of his group and interest in Powder Diffraction File.

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ELECTRIC FIELD, PRESSURE, AND TEMPERATURE EFFECTS ON THE OPTICAL ABSORPTION COEFFICIENT IN $In_xGa_{1-x}As/GaAs$ STRAINED QUANTUM DOTS: UNDER INDIUM SEGREGATION AND In/Ga INTER-MIXING PHENOMENA

Nabil Benzerroug, Dhouha Makhlouf and Mohsen Choubani
University of Monastir, Tunisia

Abstract:

In this work, we theoretically studied the linear, nonlinear and total absorption coefficients of the lens-shaped $In_xGa_{1-x}As/GaAs$ QD under combined effects of Indium segregation, In/Ga intermixing, strain, pressure, temperature, electric field, and QD dimensions. Indium segregation inside the wetting layer is modeled by the Muraki model; however, atoms inter-diffusion inside the QD by a Gaussian function. Inter-band-transition energies are calculated by solving the 3D Schrödinger equation using the Finite Difference Method (FDM) method. Based on the achieved results, the combined effects mentioned above are crucial to correlate the experimental Photo-luminescence (PL) data. Therefore, it is found that indium segregation causes a blue shift of the total absorption spectrum. However, the intermixing effect causes a red shift with a decrease in the absorption magnitude by a factor of 64%. Although, the absorption coefficient spectrum experiences a red or a blue dress depending on the applied electric field orientation. In addition, under the increase of the pressure (temperature), the absorption coefficient reveals a blue (a red) shift with a decrease (an increase) in magnitude. Hence, obtained results would be helpful as literature for controlling and adjusting the nonlinear optical properties of optoelectronic devices.

Biography

N. Benzerroug is a Ph. D student at the Scientific Faculty, University of Monastir, Tunisia. He received his Bachelor and Master's degrees in physics of matter from University Mohamed El Bachir El Ibrahimi of Bordj Bou Arreridj, Algiers. He is interested in Quantum Physics, Nanostructures, DFT and Optoelectronics.

A NOVEL LEMMA OF THE OPTICAL EQUIVALENCE THEOREM: ANALYTICAL FORMULATION AND APPLICATIONS.

Orchidea Maria Lecian
Sapienza University of Rome, Italy

Abstract:

A new lemma of the Optical equivalence Theorem is found. The new analytical formulation is expressed.

New applications are achieved with very intense laser fields; opto-mechanical systems (long-time limit of the error estimation); quantum limits of the states; quantum-mechanical noise in interferometry; opto-mechanically-induced lights; laser phase stabilization and frequence stabilization of optical resonators; cold atomic ensembles; cold atomic trapped ions; jump processes within states; quantum correlation of muti-spatial modes of Gauss-Markoff models; metrologies; Ramsey spectroscopy; Gaussian white noise.

New extensions of the standard quantum limit of noisy metrology are newly provided with, also in non-Hermitian quantum sensing.

The calculations of the limits of non-diagonal elements of non-Hermitian-matrices systems are newly refined.

Biography

Orchidea Maria Lecian graduated in Theoretical physics from Sapienza University of Rome (Rome, Italy). She defended her PhD Thesis in Relativistic Astrophysics at Sapienza University of Rome and ICRA- International Center for Relativistic Astrophysics. She was awarded of international postdoctoral grants and was postdoctoral Fellow at IHES(Bures-sur-Yvette, France), AEI-MPI (Potsdam-Golm, Germany), Sapienza University of Rome. She participated in Intensive Research Programmes at Fields Institute (Toronto, Canada), AEI-MPI and IHES. She was International Researcher as SAIA grantee at Comenius University (Bratislava, Slovakia). She was Teaching Assistant at Sapienza University of Rome. She is Professor of Applied Physics and Fundamentals of Mathematics at Sapienza University of Rome. She is now Visiting Professor at Kursk State University (Kursk, Russia) within the Education in Russia Programme.

COMPARISON BETWEEN COMPASS STATE AND SQUEEZING OF THE DISPLACED NUMBER STATE.

Prasanta K Panigrahi
Indian Institute of Science Education and Research, India

Abstract:

We study broad class of the non-classical states in comparison to the compass state. We propose two states, the superposition of the squeezed and displaced Fock states, showing closeness with the properties of the compass state for the variation in the parameters. These states are analytical investigated in the context of phase space structure, number distribution and fidelity. For the appropriate choice of squeezing and the displacement parameter, fidelity is found more than 0.99 with the compass state for the coherent amplitude $|\beta| > 0.5$. Number variance of the compass state being small for low coherent amplitude, suggests its potential to estimate damping parameter of the cavity. Therefore, formation of sub-Planck structures and high co-relation with the compass state will allow alternate preparation and find uses on the optical platform for quantum metrology and sensing, and in the microwave regime for quantum error correction.

Biography

Prasanta K. Panigrahi completed his doctoral work in 1988 at the University of Rochester. After Post-doctoral stints in U.S.A and Canada, he joined the School of Physics, University at Hyderabad in 1993. Subsequently, he moved to the Physical Research laboratory, where he headed the division of Quantum Optics and Quantum computation till 2007. Since then he has been a Professor of Physics at Indian institute of Science Education and Research Kolkata. Prof. Panigrahi's current research interests lie in the areas of nonlinear dynamics, Quantum Optics, Quantum Computation and Large-scale data analysis involving wavelet Transform and tools of Artificial Intelligence (AI).

SELF-TRAPPED MOVING CAVITY SOLITONS, SOLUTION OF THE (2+1) - DIMENSIONAL CUBIC-QUINTICCOMPLEX GINZBURG-LANDAU EQUATION

Alain Djazet
University of Bamenda, Cameroon

Abstract:

In this work, considering the vector (2+1)-dimensional cubic-quintic complex Ginzburg–Landau equation ((2+2)D VCQ-CGLE), the stability of the moving dissipative solitons in

It is also well known that laser systems are made of several components; Models can be vectorial when the polarization nature of light is involved. The Maxwell–Bloch (MB) equations describing the propagation of a slowly varying field envelope through a collection of two-level atoms when the interaction of an electromagnetic field with the matter in a laser cavity is considered, without the assumption of a fixed direction of the transverse electric field have been the started point. Further, helped by the nonlinear perturbation method, we have derived the following vectorials form of the nonlinear (i) polarization P_3=υ(E.E^*)E+ρ(E.E) E^*+ς(E.E)E, which corresponds to materials possessing a higher degree of spatial symmetry (isotropic material). With υ, ρ, and ς depend on the laser parameters, and in terms of the energy level diagram. The first contribution with parameter υ has the vector of nature E and illustrates one-photon-resonant contribution to the nonlinear coupling, the second contribution with parameter ρ has the vector nature of and illustrates two-photon-resonant processes, produces a nonlinear polarization with the opposite handedness, and the third contribution with parameter ς illustrates the process of third-harmonic generation. (ii) A (2+1) D VCQ-CGLE.

Furthermore, based on the variational approach, with a symmetric gaussians ansatz we discussed, theoretically and numerically, the dynamical properties of the moving vector dissipative solitons for several dynamical regimes of the (2+1)D VCQ-CGLE. The analysis of the effective potential presented a good agreement with the direct numerical simulation.

Biography

Orchidea Maria Lecian graduated in Theoretical physics from Sapienza University of Rome (Rome, Italy). She defended her PhD Thesis in Relativistic Astrophysics at Sapienza University of Rome and ICRA- International Center for Relativistic Astrophysics. She was awarded of international postdoctoral grants and was postdoctoral Fellow at IHES(Bures-sur-Yvette, France), AEI-MPI (Potsdam-Golm, Germany), Sapienza University of Rome. She participated in Intensive Research Programmes at Fields Institute (Toronto, Canada), AEI-MPI and IHES. She was International Researcher as SAIA grantee at Comenius University (Bratislava, Slovakia). She was Teaching Assistant at Sapienza University of Rome. She is Professor of Applied Physics and Fundamentals of Mathematics at Sapienza University of Rome. She is now Visiting Professor at Kursk State University (Kursk, Russia) within the Education in Russia Programme.

Laser Optics & Quantum Physics 2023

Poster Presentations

ILIB TRANSCUTANEOUS DOMESTIC ANIMALS - A REVIEW

Antonieta Marques Caldeira Zabeu
Universidade do Vale do Paraíba, Brazil

Abstract:

Among the laser therapies applied to animals, transcutaneous ILIB therapy is a practice extrapolated from human protocols. The objective of this review is to verify what there is in the literature on the application of modified ILIB therapy in animal diseases.

The review developed was qualitative and descriptive, with a search for articles available in PubMed and Google Scholar databases, over a period of 10 years, with descriptors: veterinary medicine, animals, ILIB, intravascular, percutaneous laser. The inclusion criteria were only studies that addressed the main theme in the treatment of diseases in animals.

Among the different applications of light in the animal organism, transcutaneous ILIB therapy is a photobiomodulation technique that has been applied in the treatment of animals, with the objective of obtaining the same benefits that it promotes in the human body. The results of this review proposal revealed that there are no studies that demonstrate the use of this therapy in the treatment of pathologies that affect the animals themselves. The unavailability of data regarding the conditions of application of transcutaneous ILIB in animals is highlighted, such as: extravascular bed more suitable for therapy; time required for exposure of blood flow; volume of circulating blood, thickness of the stratum corneum, in order to guarantee the efficient delivery and absorption of light energy in the animal's body to obtain the benefits of ILIB, similarly to what happens in the human body. However, it is essential that the veterinarian understands the physical properties of the laser to define the correct dosage, the light parameters and, thus, guarantee the therapeutic effectiveness of this therapy in the different pathologies of the different animal species treated. We conclude that there is a lack of recognized scientific studies on the use of ILIB therapy in animals and shows the need to validate this technique in different animal species.

Biography

Graduated in Veterinary Medicine from Universidade Paulista -UNIP (1997), PhD in Biomedical Engineering (2022) by the Research and Development Institute -IP&D -of the University of Vale do Paraíba -UNIVAP (area of concentration of Phototherapy and Photobiomodulation). Active in the breeding and medical clinic of small ruminants; in the medical clinic of dogs, cats and exotic animals. Specialized in physiotherapy and rehabilitation of small animals by Instituto Quallitas -São Paulo/SP (2010). Consultant for veterinary products companies for regulatory affairs (MAPA, ANVISA, CETESB) for 12 years; developing activities to monitor clinical trials of drugs, development of technical dossiers for product registration, research and development of veterinary products, auditing and qualification of suppliers and outsourced workers. in the manufacturing, packaging and distribution of veterinary products. He is currently a professor in the Veterinary Medicine course at the University of Vale do Paraíba -Univap (São José dos Campos, SP).

GROWTH ANALYSIS OF *Pantherophis guttatus* IN BIOTERIUM BREEDING WITH PHOTOTHERAPY TREATMENT

Antonieta Marques Caldeira Zabeu
Universidade do Vale do Paraíba, Brazil

Abstract:

Among the laser therapies applied to animals, transcutaneous ILIB therapy is a practice extrapolated from human protocols. The objective of this review is to verify what there is in the literature on the application of modified ILIB therapy in animal diseases.

The review developed was qualitative and descriptive, with a search for articles available in PubMed and Google Scholar databases, over a period of 10 years, with descriptors: veterinary medicine, animals, ILIB, intravascular, percutaneous laser. The inclusion criteria were only studies that addressed the main theme in the treatment of diseases in animals.

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Biography

Graduated in Veterinary Medicine from Universidade Paulista -UNIP (1997), PhD in Biomedical Engineering (2022) by the Research and Development Institute -IP&D -of the University of Vale do Paraíba -UNIVAP (area of concentration of Phototherapy and Photobiomodulation). Active in the breeding and medical clinic of small ruminants; in the medical clinic of dogs, cats and exotic animals. Specialized in physiotherapy and rehabilitation of small animals by Instituto Quallitas -São Paulo/SP (2010). Consultant for veterinary products companies for regulatory affairs (MAPA, ANVISA, CETESB) for 12 years; developing activities to monitor clinical trials of drugs, development of technical dossiers for product registration, research and development of veterinary products, auditing and qualification of suppliers and outsourced workers. in the manufacturing, packaging and distribution of veterinary products. He is currently a professor in the Veterinary Medicine course at the University of Vale do Paraíba -Univap (São José dos Campos, SP).

THE USE OF PHOTOTHERAPY IN THE TREATMENT OF LESION CAUSED BY *Habronema spp.* IN EQUID

Marina Glina De Capitani
Universidade do Vale do Paraíba, Brazil

Abstract:

Cutaneous habronemosis is characterized by difficult to heal, inflammatory wounds that present exuberant granulomatous tissue in the skin, mucous membranes and genitalia of equids. Its etiological agents are Habronema spp. nematodes, whose vectors are flies. The present case report demonstrates the phototherapy effectiveness as an alternative treatment for this pathology in cases of recurrence and drug resistance.

Horse, castrated male, mixed breed, 12 years old, treated in Sao Jose dos Campos, Brazil, presented a recurrent lesion of cutaneous habronemiasis in the labial commissure region. The initial treatment was a systemic therapy with ivermectin and pyrantel pamoate every 7 days for 30 days, and local curative with ointment manipulated with ivermectin, dexamethasone, enrofloxacin and zinc, which was not successful in the lesion regression and its healing process, was not established. Therefore, it was recommended 1 session every 72 hours totalizing 10 sessions of a treatment with 660 nm Laser diode (120 mW power and 6 Joules of energy) associated with 470 nm LED (400 mW power and 48 Joules of energy). The animal showed significant improvement in the initial sessions with laser therapy and complete tissue healing afterwards.

The infection of habronemiasis has as predisposing environmental factors the open manure and high temperatures, since the vector has higher proliferation levels under these conditions. Also, poor epithelial healing, due to different causes, and resistance to antiparasitic drugs contribute to the maintenance of this parasite. In consequence of the wound scarring, the animal's condition, and the failure of the pharmacotherapy initially recommended, the treatment with phototherapy was chosen to stimulate the epithelial cells' metabolism, modulate the inflammatory process and activate the tissue repair cascade, thus, accelerate the healing process. When closing the wound, besides recovering the animal's health, there is a rupture of the nematode's biological cycle, and incidence control of the parasitosis.

Biography

Marina De Capitani holds a degree in biological sciences with a concentration in health and a minor in chemistry from the University of Mobile, Al, USA. She is currently enrolled in veterinary medicine at the University of Vale do Paraí ba, Sa o Jose dos Campos, SP, Brazil. Her objective is to continue integrative medicine studies in order to use these methods in the medicine of wild animals that for some reason are delivered to rehabilitation centers, thus, using these means to accelerate treatments and enable a more adequate rehabilitation.

THE NEW CODING ALGORITHM USING Li-Fi SIGNAL

Louiza Hamada and Pascal Lorenz
IUT de Colmar, France

Abstract:

Li-Fi comes from the words "light fidelity", a wireless technology that was still part of science fiction a few years ago, and like most wireless networks the subject of security and prevention against cyber-attacks is primordial. The problem we posed is how to send a message confidentially through the Li-Fi signal and correct transmission errors while guaranteeing a secure aspect. The idea cited is to use the Berlekamp-Massey algorithm for the generation of pseudo-random keys, whose algorithm has been modified by adding a degree of security. These pseudo-random keys will depend on the value of k, which represents a prime number different from "one", and which is chosen by the sender of a message, this value is used afterward to encode and decode the message. We will be able to improve the algorithm in such a way that the value of k varies with each communication and key creation, guaranteeing that the method will never be interrupted on the network because our concept depends on the value of k. The encryption key will be the sequence of values of "d'" obtained during the running of the algorithm. The sender and the receiver will use the same protocol to encode and decode the message during the transmission.

Biography

Louiza Hamada, a young researcher in the field of computer science. She defended her PhD in computer science, speciality "Networks & Telecommunications" in June 2022 at the University of Haute Alsace in France. HAMADA also defended her master's degree in "Computer Systems and Networks" in July 2014 from the University of Science and Technology of Oran in Algeria. Currently, she continues her research work with the team of "Networks & Telecommunications" of the IUT of Colmar.

Laser Optics & Quantum Physics 2023

Accepted Abstracts

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STUDY OF REACTOR GRAPHITE SURFACE PROPERTIES TO OPTIMIZE THE ION-PLASMA DEACTIVATION TECHNOLOGY PARAMETERS

AS Petrovskaya[1], AB Tsyganov[1], SV Surov[2] and DA Blokhin[2]

[1]InnoPlasmaTec LLC, Russia
[2]"Science and Innovations", Scientific Division of The State Atomic Energy Corporation "Rosatom", Russia

Abstract:

We are developing the ion-plasma technology for the deactivation of irradiated reactor graphite containing active isotopes ^{14}C, ^{60}Co, ^{134}Cs, ^{137}Cs and others on the surface. The technology is also used for the deactivation of nuclear power plant structural elements: pipelines, pumps and other metal structures of the primary circuit. The ion-plasma technology implements plasma and thermal sputtering of selected areas of the irradiated reactor graphite surface by "shortened" discharge in atmosphere pressure in inert gas (argon) with the transfer and condensation of sputtered atoms (active isotopes) on the tantalum substrate. The high pressure "shortened" discharge is ignited between the reactor graphite surface under the treatment (the cathode) and the tantalum plate (the anode) in argon under condition: discharge gap (0.1–2 mm), voltage (100–1000) V, current (0.01–1) A/cm^2, argon pressure (76–600) Torr. We have studied morphological properties of the reactor graphite by means of Scanning Electron Microscopy with X-ray microanalysis, Brunauer–Emmett–Teller and Barrett-Joyner-Halenda methods. It was found that the specific surface area of GR-280 reactor graphite ~ 2.11 m^2/g, the pore average volume ~ 0.004 cm^3/g, and the pore average radius ~ 19.4 Angstrom. The data obtained are of interest for understanding properties of the near-surface reactor graphite layers during its operation and possible graphite deactivation in dismantling period. The technology can be used to produce the concentrate enriched by the ^{14}C isotope, with subsequent use in nuclear medicine.

THE SPATIAL DISCS MODEL (SDM), SINGULARITY, AND THE RELATIVITY OF SPACETIME CURVATURE

Mohamed Magueramane
University of Michigan-Flint, USA

Abstract:

This paper is based on a proposition concerning the origins of the universe and a theorization about spacetime that would not hold without the following principles: (1) the big bang did not emerge from nothing, without a primordial cause; (2) Isaac Newton's laws of inertia are unempirical because of the impossibility to test the motion of objects outside absolute space; (3) gravity is a function of celestial objects falling and rotating around other objects because their inherent motion gets obstructed; (4) Albert Einstein's curvature of spacetime is not uniform. It follows that the massive cosmic explosion from the singularity event neither started spacetime, nor did it generate matter from nothing. The Spatial Discs Model (SDM) proposed here argues that all matter in our universe is finite, unstationary, and contained within interconnected spatial discs, that sequentially transfer matter to each other. Hence, the big bang-empowered explosion. Finally, because the nature of spatial discs is discrete and plastic, the universe will not expand forever.

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ASYMMETRIC LIPSS FORMATION ON SILICON AND THEIR IMPACT ON THE EVOLUTION OF 2D NANOSTRUCTURE BY FEMTOSECOND LASER PULSES.

Hardik Vaghasiya[1,2]

[1]*Martin Luther University Halle-Wittenberg, ZIK Sili-nano, Germany*
[2]*Fraunhofer Center for Silicon Photovoltaics CSP, Germany*

Abstract:

This work investigates the formation of the 1D LIPSS (laser-induced periodic surface structures) and 2D LIPSS structures by femtosecond laser irradiation on the silicon surface. The distinctive orthogonally superimposed 2D LIPSS is achieved by employing a double-step technique that relies on irradiation with two temporally delayed and cross-polarized femtosecond-laser pulses (180 fs duration, 100 kHz repetition rate). It was found that 1D LIPSS formed in the initial stage is asymmetric and elliptical. With increasing the number of pulses, the ellipticity of the LIPSS vanishes, and it becomes circular. The change in the periodicity of the LIPSS with wavelength is investigated experimentally, and it is revealed that the ellipticity of the LIPSS is higher at 515 nm compared to 1030 nm. The effect of the elliptical asymmetric LIPSS on the 2D LIPSS formation has been studied. This paper demonstrates the generation of homogeneous 2D-LIPSS over large areas by systematically studying the process parameter. The morphology of 2D LIPSS can be tuned by controlling the number of pulses irradiation, the initial shape of the 1D LIPSS, and applied laser fluence. This work presents a novel, multi-scale periodic patterns with two-dimensional symmetry generated on the silicon surface for the sensor application.

A NEW (MOM) APPROACH OF THE (OLPT) MODEL APPLICATION TO THE (AC) CONDUCTIVITY IN ZnS CHALCOGENIDE MATERIAL

Henda Abassi, N Bouguila, J Koaib, N Amdouni, H Bouchriha
Université Tunis El Manar, Tunisia

Abstract:

In this work, we have proposed a theoretical investigation of the complicated Overlapping Large Polaron Tunneling (OLPT) conduction mechanism. In fact, in previous works, some approximations have been made in the aim of adopting the (OLPT) model to the experimental data. These approximations are not convincing and lead to reviewing the (OLPT) model. Thus, in order to avoid these disagreements between experimental and theoretical results, we have proposed a new "methodology" which has allowed us to explore in depth this mechanism of conduction not well investigated. A fundamental step is to adopt a new approach to fit theoretical parameters to experimental data: the Advanced Second order Fitting (ASF). This numerical approach allowed us to discover the existence of relevant term appearing in the expression of the trapping potential. The corresponding physical interpretation reveals an original and unexpected behavior. The modified OLPT model (MOM) highlights two competitive and spectacular phenomena: the thermal effect and the resonance phenomena. For T > Tc, the thermal effect has been omitted due to the resonance of the charge carriers with the lattice vibrations. This resonance phenomenon makes it possible the change of the carriers' nature. Indeed, the ions are strongly coupled with the lattice vibrations forming new charged entities which we have adopted the name: phonions (phonon dressed ion). These later no longer see the added thermal effect and they have an activation energy reaching the value of Wp which is the energy associated with the lattice deformation. The "phononic" ions behave at high temperatures like small polarons as given in the (AC) conduction mechanism (SPT) model but with activation energy equal to two times the small polaron activation energy. This behavior can explain the increasing variation of the frequency exponent s as a function of temperatures for T > Tc.

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SCI SYNOPSIS

TEMPERATURE-DEPENDENT MAGNETIC AND ELECTRICAL PROPERTIES OF Cr-DOPED $AlFeO_3$ CERAMICS

Imen Raies[1], Sharah A. Al Dulmani[2], Lamia Ben Farhat[1,2], Etemad E. Fadlallah[2] and Mongi Amami[1,2]

[1]Laboratoire des Materiaux et de l'Environnement Pour le Development Durable, Tunisia
[2]King Khalid University, Saudi Arabia

Abstract:

The solid-state reaction method was selected to prepare polycrystalline $AlFe_{1-x}Cr_xO_3$ (x = 0, 0.02, 0.05, 0.07 and 0.1) samples. The Samples were found to be pure phases possessing the orthorhombic space group $Pna2_1$. The unit cell volume decreased with increases in the Cr content. The magnetic transition temperature and the saturation magnetization of the ceramics decreased due to dilution of the magnetic interaction with Cr content. The Dielectric responses were systematically investigated by temperature-dependent dielectric/impedance spectroscopy from 160 K to 500 K. It was noticed that incorporation of Cr^{3+} in the structure led to an increase in the dielectric constant up to x = 0.05 before decreasing, whereas the dielectric loss decreased. Two different dielectric relaxation processes that occurred in the grain interior of $AlFe_{1-x}Cr_xO_3$ polycrystals were clarified. One relaxation process was thought to be associated with localized transfer of electrons between Fe^{3+} and Fe^{2+}, while the other arising at low temperature was assigned to interplay between lattice and polaronic defects such as oxygen vacancies.

QUANTUM FREQUENCY CONVERSION

Isa Ahmadalidokht
National University of Singapore (NUS), Singapore

Abstract:

Distribution of entangled photons will enable the future quantum internet that can deliver improved security or sensing precision compared to using conventional technology. Building on existing investment in infrastructure, a natural choice for the quantum channel are optical fibres. However, intrinsic losses within fibres prevent very long-range networks; one way to enable global scale networks is *via* quantum communication satellites equipped with free space links. Furthermore, networks with moving nodes such as aircraft or drones will also require free space links.

To date, most proof-of-concept free-space quantum communication experiments have used visible (VIS) or near-infrared (NIR) wavelengths. These demonstrations were most often carried out in the night where the noise due to solar radiation is avoided. Moreover, one needs to take care of urban background light as well. Therefore, it is imperative to look for solutions to supress the background solar or urban background light to enable daytime operation of the quantum network. This can be achieved *via* careful mode engineering, or selection of appropriate wavelengths, such as the light in the O- or C-bands regularly used in fibre-based communication. A major advantage of using telecom wavelengths is the large number of commercial-off-the-shelf (COTS) components that could be used in building optical communication systems.

Given the advantages of operating in the telecom bands, it may seem curious why these wavelengths are not already widely adopted in free-space entanglement distribution projects. The main reason why quantum engineers have avoided using telecom wavelengths is the fact that COTS single photon detectors in the telecom regime are not very effective. In this study we develop quantum receiver using frequency up-conversion to extend the Si based detector to telecom band while keep the noise level in Dark count rate and increase the detection efficiency and detection count rate.

POSSIBILITIES OF THE LASER IN THE TREATMENT OF TELANGIECTASIAS (SPIDER VEINS) OF THE LOWER EXTREMITIES.

Oleg Kovchur, Kovchur OI and Kovchur PI Petrozavodsk
Petrozavodsk State University, Russia

Abstract:

The problem of reticular varicose veins in phlebology is given much attention. First of all, this is a cosmetic problem, which is more often observed in women and is manifested by the expansion of small intradermal vessels and the appearance of telangiectasias on the lower extremities. Quite often, telangiectasias can be a manifestation of more serious venous lesions - varicose or post-thrombotic disease. There are three types of intracutaneous varicose veins: linear (lines form on the surface of the skin), stellate (beams extend from the darker center, similar to a cobweb or mesh) and tree-like (vessels have a branching appearance). According to the literature, they suffer from 30 to 45% of the population under 45 years of age. The reticular veins of the skin of the lower extremities are more common in women than in men. (80% of women *versus* 20% of men).

The purpose of our study is to explore the possibilities of using the IPLTM Quantum DL device, a neodymium yttrium aluminum garnet laser system operating at a wavelength of 1064 nm. in the treatment of telangiectasias (spider veins) of the lower extremities. Materials and methods. The analysis of the results of laser treatment of 79 patients on outpatient treatment for the period from 2019 to 2022 at the age of 25 to 53 years was carried out. Women - 57 (72.2%), men - 22 (27.8%). 49 (62.1%) patients had previously undergone sclerotherapy of the reticular veins of the lower extremities. Results. In the treatment of telangiectasias of the lower extremities in all 79 patients, a laser system was used.

A thin layer of cooling gel was applied to the area of telangiectasias, and the laser head was applied to the area of interest. We used 3 programs of the laser system with successive triggering of pulses with programmed parameters for the laser nozzle. The treatment was selected individually depending on the type of vessel - a tree-like form (many vessels branch from one base to the left and right); cobwebs or stars (vessels depart from the center in different directions); or lines (smooth stripes of blood vessels). The course of treatment is 4-5 procedures with an interval of 2-3 weeks. After the procedure, phlebotonics were prescribed (Detralex 1000 mg or Phlebodia 600 mg) 1 tab. per day for 2 months, panthenol aerosol was applied to the treated skin areas 2-3 times a day for 1-2 days or advantan. Long-term results were studied in 76 patients (96.2%) in terms from one to 3 years. Good results were noted in 95%. There were no complications.

Conclusion: Thus, the use of a laser system on yttrium-aluminum garnet with neodymium, operating at a wavelength of 1064 nm, is the method of choice for the treatment of telangiectasias of the lower extremities, and in some cases serves as an addition to sclerotherapy. Percutaneous laser treatment of telangiectasias (spider veins) of the lower extremities is a non-invasive, highly effective method for correcting this pathology. The use of this technique is cosmetic, and practically does not lead to complications.

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EFFICIENCY OF LASER TREATMENT OF CERVICAL OF INTRAEPITHELIAL NEOPLASIA OF THE CERVIX AND THE POSSIBILITY OF THEIR MOLECULAR DIFFERENTIAL DIAGNOSIS

Pavel Kovchur and Oleg Kovchur
Petrozavodsk State University, Russia

Abstract:

Federation Practical secondary prevention of cervical cancer (CC) is the solution to 2 main problems in oncogynecology. The first problem deals with molecular differential diagnosis of cervical intraepithelial neoplasia (CIN), the solution of which contributes to the accurate choice of treatment tactics with preservation of reproductive function (along with traditional methods) for patients. The second problem is to choose an effective treatment for CIN, which improves the results of treatment and reduces the incidence of cervical cancer. Goal: To propose a method for molecular differential diagnosis of CIN 1, 2, 3 degree with venous blood as a biomaterial, and multiparametric flow cytometry as a method for its analysis. To evaluate and study the results and effectiveness of laser treatment using locally produced devices "Lancet-2" and "Allod-01" in the complex therapy of CIN of the cervix.

Material and Methods: 3 groups were distinguished: 1 - patients with complicated ectropion, condylomatosis and leukoplakia of the cervix (n=145); 2 - with CIN 1-2, 2, 3 degree (n=96). In 63 (43.4%) patients of group 1 and 100% of group 2, HPV genotypes of high carcinogenic risk (HPV 16, 18, 31, 33, etc.) were detected in epithelial scrapings and cervical biopsies before treatment. 3rd group (n=30) was a control group (without cervical pathological conditions and HPV). In groups 1 and 2, an immunological examination was performed. The expression of PD1, TIM3, and LAG3 markers in the general population of CD3+CD8+ T-lymphocytes, characterizing dysfunctional T-cells that appear in the blood during the development of CIN, was assessed. Studies were performed using a flow cytometer MACSQuant Analyzer (Miltenyi Biotec, Germany). The result was expressed as a percentage (%) characterizing the presence in the blood of cells typed by markers PD1 and TIM3, or PD1 and LAG3, in the total population of CD3+CD4+ T-lymphocytes. In groups 1 and 2, the cervix was treated using the Lancet-2 and Allod-01 surgical device according to the standard method. In the second phase, patients with HPV additionally received a course of «Allokin-alpha" after laser treatment (glycine - histidine - glycine - glutamine - histidine - glycine - valine - histidine - glycine) 1 mg 6 times on alternate days, subcutaneously. Evaluation of the effectiveness of cervical treatment was carried out using PCR control of HPV, cytological and colposcopic studies 3 months after the start of treatment. Results: In group 1 (n=145) in women with complicated ectropion, condylomatosis and leukoplakia of the cervix and HPV (n=63) 3 months after complex treatment (laser destruction + Allokin-alpha), the effectiveness of treatment was 96.8% (61) of cases; In 3.2%, incomplete epithelialization and iodine-negative zones and HPV in clinically insignificant concentrations of the virus were observed. In the remaining patients without HPV (n=82), the effectiveness of laser treatment was 85.4% (14.6% - incomplete epithelization). In group 2 (n= 96) in patients with CIN 1-2, 2, 3 degree and HPV after complex treatment, the effectiveness was 93.1%. The examination revealed significant

differences in immunological parameters in patients with CIN 1, 2 and 3 degree of the cervix. Comparison of the results of histological examination and the level of expression of PD1, TIM3 and LAG3 markers in the total population of CD3+CD4+ T-lymphocytes showed that in CIN of 1st degree the number of cells with the phenotype CD3+CD4+PD1+TIM3+ and CD3+CD4+PD1+LAG3+ in each of the variants does not exceed 2% of the total population of CD3+CD4+ T-lymphocytes. The number of cells with the phenotype CD3+CD4+PD1+TIM3+ and CD3+CD4+PD1+LAG3+ in each of the variants with CIN of 2nd degree ranged from 2% to 5% of the total population of CD3+CD4+ T-lymphocytes. While with CIN of 3rd degree, the number of such cells in each of these cases is more than 5%. All patients (n=96) were treated using different methods of treatment: CIN 1 active observation, laser treatment using locally produced surgical devices "Lancet-2", "Allod-01" according to the standard method, surgical treatment using radio wave generator "Fotek EA 141". The effectiveness of laser treatment in group 2 (n= 96) in patients with CIN grades 1-2, 2, 3 and HPV after complex treatment was 93.1%.

Findings: 1. A method for molecular differential diagnosis of CIN I, II, III degree of the cervix is proposed, which contributes to the accurate choice of treatment tactics with preservation of reproductive function of patients and the basis for the development of an express method for diagnosing cervical cancer. 2. The effectiveness of complex treatment (laser therapy + immunotherapy) in patients with cervical intraepithelial neoplasia of the cervix is high and amounts to 96.8% and 93.1%, respectively, in the study groups. The combined use of laser technologies and Allokin-alpha in patients with HPV and CIN of the cervix improves the quality of treatment. Antiviral treatment is mandatory, since the persistence of HPV is a key factor in the development of cervical cancer.

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LOW-DIMENSIONAL SYSTEMS: PROMISING CANDIDATES FOR ENERGY CONVERSION, LIGHTING, AND OPTOELECTRONICS APPLICATIONS

Radouane En-nadir
University of Sidi Mohamed Ben Abdullah, Morocco

Abstract:

Due to their unique electronic and optical properties, low-dimensional systems, such as quantum wells and quantum dots, have become promising candidates for energy conversion, lighting, and optoelectronics applications. These systems are characterized by their ability to confine electrons and holes in a two-dimensional plane or a zero-dimensional point, respectively, leading to quantized energy levels and enhanced electron-hole interactions. In energy conversion, low-dimensional systems are used to improve the efficiency of photovoltaic cells by enhancing the absorption of light and the separation of photo-generated charge carriers. Quantum dots, on the other hand, can be incorporated into the active layer of solar cells to improve charge carrier transport and reduce recombination losses. In lighting, low-dimensional systems have been employed to develop highly efficient light-emitting diodes (LEDs) and laser diodes. Quantum wells are commonly used as the active region in LED structures, where the recombination of electrons and holes generates light. The size and composition of the quantum wells can be tuned to produce different colors of light, enabling the development of full-color displays. Quantum dots have also been used to improve the color gamut and efficiency of LEDs, as they can emit light at narrow spectral bandwidths. In optoelectronics, low-dimensional systems are used to develop high-speed and high-performance photodetectors, modulators, and switches. Quantum wells can be used as the active region in photodetectors, where incident light is converted into an electrical signal. Quantum dots, on the other hand, can be used as the active region in modulators and switches, where an external electric field can control the absorption and emission of light.

Overall, low-dimensional systems have shown great potential in a variety of energy conversion, lighting, and optoelectronics applications. Ongoing research in the field aims to develop new materials and device architectures to further enhance their performance and enable new applications.

ACHIEVING ULTRA-BRIGHT POLARIZATION ENTANGLED PHOTONS THROUGH TIME-REVERSED HONG-OU-MANDEL INTERFERENCE

Rana Sebak
Friedrich Schiller Universitiy and Farunhofer IOF, Germany

Abstract:

Entangled photon pairs are crucial components in various quantum optical applications, such as quantum computing, quantum metrology, and quantum communication. The most well-established technique for generating entangled photon pairs is the use of spontaneous parametric down-conversion (SPDC) in second-order bulk nonlinear crystals. While lab experiments are progressing towards an optimal performance and design, practical applications demand robust, compact, and readily available devices which are currently not available through state-of-the-art lab devices.

This ongoing project aims to achieve a highly efficient ultra-bright polarization entangled photon source through the use of time-reversed Hong-Ou-Mandel (HOM) interference. This method enables the efficient splitting of identical photon pairs with matching frequency, polarization, and creation time. The source consists of two non-linear crystals oriented orthogonally to each other and placed within a Sagnac interferometer. This configuration provides very high counts of indistinguishable entangled photons that are crucial for space applications and the implementation of quantum key distribution for unbreakable communication security. One key advantage of this approach is that it has the potential to meet the criteria of practical applications, including compactness and turnkey availability, that current state-of-the-art lab devices lack.

SHOCK-INDUCED MESOSTRUCTURE FORMATION IN SOLIDS AS A QUANTUM EFFECT

Tatiana Khantuleva
St. Petersburg State University, Russia

Abstract:

Experimentally observed shock-induced structure formation in solids on the mesoscale is a highly non-equilibrium process that cannot be described within the concepts of continuum mechanics. The emergence of the mesoscopic structures during high-rate deformation of solid materials sometimes having a turbulent character can be considered as self-organization, which is accompanied by the creation of new information and a decrease in entropy. In order to describe such processes, the new self-consistent nonlocal approach developed on the base of non-equilibrium statistical mechanics and control theory of adaptive system is applied. Modeling the spatiotemporal correlation dynamics included into macroscopic transport equations makes it possible to trace structural evolution of the system and predict its future transformations using close-loops with feedback. It was shown that the shock-induced self-organization is the quantum effect of the capture of the shock-induced mesoparticles (wave packets) by the potential well with negative entropy production. From a practical point of view, the control of such a process will help develop new technologies for creating materials with predetermined properties.

TOPOLOGICAL QUANTUM FIELD THEORIES WITH NON- COMPACT GAUGE GROUPS.

Tony Mbambu Kakona
East African Institute for Fundamental Research, EAIFR, Italy

Abstract:

The main purpose of Topological Gauge Theories is the computation of topological invariants either of the manifolds on which they are defined or of associated structures, such as target spaces or moduli spaces. Topological Gauge theories offer an arena where one may have non-compact gauge groups without the issues of unitarily and renormalizability. However, Topological Gauge Theories do have their own problems that one must contend with, in particular the presence of zero modes, which may correspond to singularities in the moduli spaces that arise. For this talk, I consider the non-compact variant of the well-known Chern-Simons theory, namely the so-called BF theory on 3-dimensional manifolds. The first part of the talk is devoted to the analytic Ray-Singer Torsion in any dimension. These theories have a non-compact shift type gauge symmetry. Being a key ingredient in the evaluation of the BF partition function, I address the issues of zero modes related to such an object and introduce a new type of regularization of the Ray-Singer Torsion which consists of a product of determinants of Laplacian twisted by a mass term. As a result, one is able to follow the singular behaviour and extract meaningful quantities. A number of general properties of this massive Ray- Singer Torsion will be given. The second and last part of this talk focuses on BF theories in 3-dimensions. The non-compact symmetry of the Ray-Singer Torsion theories of the first part now combine with the compact gauge group G to give a TG gauge invariance for the BF theory. Here emphasis will be given to the evaluation of the BF theory path integral partition function in the cases of Integral and Rational Homology 3-Spheres.

EFFECT OF STRUCTURAL DEFECTS ON THE DISPERSION CHARACTERISTICS OF 1D ARRAY OF COUPLED MICROCAVITIES CONTAINING QUANTUM DOTS

Vladimir V Rumyantsev
A.A. Galkin Donetsk Institute for Physics and Engineering, Ukraine

Abstract:

The theoretical study of the photonic band structure of non-ideal lattices of tunnel-coupled micro cavities shows that introduction of structural defects is an effective tool for altering its Eigen mode structure and optical properties. Physical realization of corresponding devices requires the ability to manipulate the group velocity of propagation of electromagnetic pulses, which is accomplished by the use of the so-called polaritonic crystals. The latter represent a particular type of photonic crystals featured by a strong coupling between quantum excitations in a medium (excitons) and optical field. The report is devoted to elucidation of the effect of point-like defects on electromagnetic excitations (polaritons) dispersion in a coupled 1D microcavity (microresonator) array with embedded one-level quantum dots. It is shown that the presence of vacancies in the microcavity and atomic (quantum dots) subsystems results in a substantial renormalization of polariton spectrum and thus in a considerable alteration of optical properties of the structure. Introduction of defects leads to an increase in the effective masses of polaritons and hence to a decrease of their group velocity. Our model is primarily based on the virtual crystal approximation, which is often employed to examine quasiparticle excitations in sufficiently simple disordered superstructures. More complex systems usually require the use of more sophisticated methods such as the (one- or multinode) coherent potential approximation, the averaged T-matrix method and their various modifications. The obtained numerical results help to obtain new composite polariton structures and expand the prospects for their use in the construction of solid-state devices with controlled propagation of electromagnetic waves.

DEFECTIVES OPTICS AND PHOTONICS SYSTEMS FOR WAVES GUIDING, MULTIPLEXING, DEMULTIPLIXING AND FOR DETECTION

Y Ben-Ali[1,2], F Z Elamri[2], I El Kadmiri[2] and D Bria[2]

[1]USMBA, Morocco
[2]UMP, Morocco

Abstract:

In this conference, we investigate the propagation of the electromagnetic waves (light or photon) in the defectives periodical 1D photonics and optics structures, for the aim of guiding, waves separation, filtering by transmission or reflection, demultiplixing and detection use.

Firstly, we consider the propagation of light in the defectives 1D periodical optical system. The perfect optics system presents the photonic band gaps that allowed us to control and manipulate light over a wide frequency range. For introduced the localized photonic states in the band gaps, we introduce a defects or cavity inside the perfect photonic system. These localized defect states characterized by a higher transmission rate and very important quality factor.

Secondly, the propagation of electromagnetic waves in the defectives 1D periodical photonics waveguides system is studied. The perfect structure present the photonic band gaps that allowed us to control and manipulate electromagnetic waves over a wide energy range. The insertion the defect inside this perfect system. Introduced a localized defect states inside the band gaps. These localized electronic states characterized by a higher transmission rate and quality factor values.

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Note:

Forthcoming Events

International Conference on **Biomaterials and Biodevices**
September 25-26, 2023 | Paris, France

2nd International Conference on **Neurology and Brain Disorders**
November 2-3, 2023 | London, UK

Internarional Conference on **Hematology and Blood Disorders**
November 6-7, 2023 | Paris, France

European Conference on **Human Genetics**
November 6-7, 2023 | Paris, France

International Conference on **Gynecology and Obstetrics**
November 6-7, 2023 | Dubai, UAE

International Conference on **Biomedical Science and Engineering**
November 6-8, 2023 | Dubai, UAE

International Confernce on **Clinical Case Reports**
November 8-9, 2023 | Dubai, UAE

2nd International Conference on **Materials Science & Engineering**
November 8-9, 2023 | Dubai, UAE

2nd European Congress on **Chemistry and Applied Sciences**
November 9-10, 2023 | Paris, France

2nd International Conference on **Catalysis & Chemical Engineering**
November 9-10, 2023 | Paris, France

European Congress on **Renewable Energy and Sustainable Development**
November 16-17, 2023 | Rome, Italy

European Congress on **Biopolymers and Bioplastics**
November 16-17, 2023 | Rome, Italy

2nd International Conference on **Nanomaterials and Nanotechnology**
November 20-21, 2023 | Vienna, Austria

2nd European Congress on **Microbiology**
November 20-21, 2023 | Vienna, Austria

2nd International Conference on **Infectious Diseases**
November 20-21, 2023 | Vienna, Austria

2nd International Conference on **Addiction & Psychiatry**
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