SCHOLARS CONFERENCES

**Joint Event**

Scholars International Conference on

# Optics, Photonics and Lasers & Physics and Quantum Physics

22-24 JUNE 2022

NH POTSDAM, BERLIN, GERMANY

**Hosted By:**
David Bishop | Program Manager
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# SCIENTIFIC PROGRAM

Day 1 | June 22, 2022 | In-person | Voltaire

08:00-09:00 Registrations

09:00-09:15 Opening Ceremony

**KEYNOTE FORUM**

| | |
|---|---|
| 09:15-09:50 | Title: From Dipolar to Rydberg Photonics: Harnessing Atom-Atom Interactions<br>**Hadiseh Alaeian,** Purdue University, USA |
| 09:50-10:25 | Title: Nonlinear Femtosecond Optics<br>**Lubomir Kovachev,** Institute of Electronics at the Bulgaria Academy of Sciences, Bulgaria |
| 10:25-11:00 | Title: High-Order of Near Coherent States<br>**Anas Othman,** Taibah University, KSA |

**Networking and Refreshments Break @ Foyer 11:00-11:20**

| | |
|---|---|
| 11:20-11:55 | Title: Developments of high power solid state Tm based laser and their applications<br>**Salman Noach,** Jerusalem College of Technology, Israel |
| 11:55-12:30 | Title: Quantum randomness in spin measurement: A unitary approach<br>**Thomas Dittrich,** Universidad Nacional de Colombia, Colombia |

**Scientific Sessions**

| | |
|---|---|
| 12:30-13:00 | Title: Photobiomodulation Therapy Improves Quality of Life, Wound Healing and Pain Scores of Diabetic Patients from Brazilian Public Hospital<br>**Camila Squarzoni Dale,** University of Sao Paulo, Brazil |

**Lunch @ Restaurant 13:00-13:40**

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|---|---|
| 13:40-14:10 | Title: Hybridization of two organic materials with polaritonic metasurfaces<br>**Antoine Bard,** Claude Bernard University Lyon 1, France |
| 14:10-14:40 | Title: Broad-Band Cnoidal Waves and Influence of Third-Order Dispersion and Self-Steepening Effect<br>**Aneliya Dakova,** Institute of Electronics at the Bulgaria Academy of Sciences, Bulgaria |
| 14:40-15:10 | Title: Generation of Vortex Structures in Optical Fibers with Spatial Dependence of the Linear and Nonlinear Refractive Index<br>**Valeri Slavchev,** Institute of Electronics at the Bulgaria Academy of Sciences, Bulgaria |
| 15:10-15:40 | Title: Are we wrong about the Michelson Morley experiment?<br>**Hans Deyssenroth,** Uni Basel, Germany |

**Networking and Refreshments Break @ Foyer 15:40-16:00**

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|---|---|
| 16:00-16:30 | Title: Non-radiative transitions in excited states of NV--center indiamond crystals<br>**Yury M. Belousov,** Moscow Institute of Physics and Technology, Russia |
| 16:30-16:50 | Title: Nonparaxial Optics and Broad-Band Optical Solitons<br>**Zara Kasapeteva,** Institute of Electronics at the Bulgaria Academy of Sciences, Bulgaria |
| 16:50-17:20 | Title: Using Quantum Coherence for Remote Sensing<br>**Zhenhuan Yi,** Texas A&M University, USA |
| 17:20-17:50 | Title: Real-time reconstruction using electro-optics modulator and galvanometers-based structured illumination microscopy<br>**Youhua Chen,** NingboTech Universit, China |

Day 01 Ends

Day 2 | June 23, 2022 | Virtual | GMT +2

11:00-11:10 : Opening Ceremony

## Keynote Forum

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|---|---|
| 11:10-11:40 | Title: Precision Frequency Measurement of Molecules<br>**Masatoshi Kajita,** National Institute of Information and Communications Technology, Japan |
| 11:40-12:10 | Title: Wedge Angle and Direction Identification of Muti-opening Object Using Machine Learning<br>**Yang Yue,** Xi'an Jiaotong University, China |
| 12:10-12:40 | Title: Paradigm Shift in High-Speed Interface Technology<br>**Karlheinz Muth,** Broadcom Inc., USA |

**Networking and Refreshments Break @ 12:40-13:00**

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|---|---|
| 13:00-13:30 | Title: Is there a 4th Law for Systems that to Work to Construct Their Expanding Phase Space<br>**Stuart A Kauffman,** University of Pennsylvania, USA |
| 13:30-14:05 | Title: Reformulating the Basics of Conventional Newtonian Physics, Quantum Physics and the Einstein Theories of Relativity Through the Newly Discovered Topology Bridging Theory Of Quantum Gravity<br>**Chinmoy Bhattacharya,** Austin Paints & Chemicals Private Limited, India |

## Scientific Sessions

| | |
|---|---|
| 4:05-14:30 | Title: Investigating dense baryonic matter in light of nuclear saturation parameters and astrophysical observables<br>**Monika Sinha,** Indian Institute of Technology Jodhpur, India |
| 14:30-14:55 | Title: Efficacy and safety of a device used to prevent fogging andresidue buildup on surgical optics during video-assisted thoracic surgical procedures (LacrimaSurg): A pilot *in vivo* study in 30 patients<br>**Igor Renato Louro Bruno de Abreu,** Hospital Leforte Morumbi - Rede DASA, Brazil |
| 14:55-15:20 | Title: New Approach for Measuring Halo of LCDs and OLEDs<br>**Karlheinz Blankenbach,** Pforzheim University Display Lab, Germany |

**Networking and Refreshments Break @ 15:20-15:35**

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|---|---|
| 15:35-16:00 | Title: Monomeric ($VO^{2+}$) and Dimeric Mixed Valence ($V_2O_3^{3+}$)Vanadium Species at the Surface of Shape Controlled $TiO_2$ Anatase Nano Crystals<br>**Anna Maria Ferrari,** University of Torino, Italy |
| 16:00-16:25 | Title: Non-equilibrium physics of Loewner evolution based on morphological complexity<br>**Yusuke Shibasaki,** Nihon University, Japan |
| 16:25-16:50 | Title: Updated Soon<br>**Belhadj Soraya,** University Amar Telidji of Laghouat, Algeria |

**Day 02 Ends**

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Joint Event

Scholars International Conference on

# OPTICS, PHOTONICS AND LASERS & PHYSICS AND QUANTUM PHYSICS

KEYNOTE SPEAKERS Day 1

**Hadiseh Alaeian**
Purdue University, USA

## Biography

Hadiseh Alaeian got her Ph.D. in Electrical Engineering and Physics from Stanford University in 2015. After her graduation, she moved to the University of Bonn in Germany as a Humboldt postdoctoral fellow in 2016 to work on Bose-Einstein condensation of photons in an optical cavity. During 2017-2020 she was a group leader in the Integrated Quantum Science and Technology center in Max Planck Institute of solid-state systems and the University of Stuttgart, Germany. Her interdisciplinary research interest is at the interface of atomic physics, quantum optics, and Nano-photonics. There, she aims to utilize strongly-interacting photons for studying many-body quantum phenomena. Hadiseh is the recipient of the silver graduate award from the Materials Research Society of America in 2015, the Humboldt postdoctoral fellowship in 2016, and the early researcher award from the Baden-Württemberg Foundation, Germany in 2018 and 2019.

## From Dipolar to Rydberg Photonics: Harnessing Atom-Atom Interactions

Light-induced atom-atom interactions at densities higher than 1 atom per cubic wavelength give rise to density shifts and broadenings. When confined in less than a wavelength size, such dipolar interaction leads to collective blockade phenomena, which mostly have been studied in the context of strongly interacting Rydberg states.

Here we study these phenomena for low-lying excited atomic states confined in thin atomic clouds that are generated via pulsed Light-Induced Atomic Desorption (LIAD) technique. For the first few nanoseconds, the transient light-induced dipolar interaction of the low-lying lines of Rubidium leads to shifts and broadenings well beyond the well-known Lorentz-Lorenz limit. In the second experiment, we benefit from highly controllable fields of Nano-photonic devices to manipulate the many-body dipolar interactions. We interface the atoms with the tightly-confined field of a slot waveguide, where the Purcell enhancement modifies the interactions and the shifts, further. The latter experiments are done at telecom wavelength where one can integrate the collective quantum effects such as the blockade to create deterministic on-demand single-photon emitters. Towards the end of my talk, I will introduce our novel quantum material, thin-film cuprite, that allows us to realize strongly interacting Rydberg excitons in a solid-state platform that is inherently suitable for scalable and integrable quantum photonic technologies.

**Lubomir Kovachev**
Nonlinear and Fiber Optics Laboratory, Institute of Electronics, Bulgarian Academy of Science, Bulgaria

## Biography

L. M. Kovachev is Head of Nonlinear and Fiber Optics Laboratory in Institute of Electronics, Bulgarian Academy of Sciences (BAS). He graduated from Sofia University in 1981 and starts to work in BAS. From 1988 to 1991 he was PhD student in Institute of General Physics (Prokhorov Institute), Moscow and obtains PhD degree in 1991. Up to now he works in Institute of Electronics, BAS, initially on position as physicist and now as Head of Laboratory. His scientific interests are in the fields of the nonlinear optics, optical solitons and nonlinear field theory.

## Nonlinear Femtosecond Optics

The recent experiments with femtosecond and attosecond pulses, propagates in gases and solid, demonstrate a lot of new physical phenomena. In linear regime the attosecond and phase-modulated 20-30 fs pulses diffract in $\lambda_{(3)}$ regime, quite different from the standard paraxial diffraction. In nonlinear regime, when we work with intensities near to the critical for self-focusing, asymmetrical spectral broadening to the short wavelengths, supercontinuum generation and coherent GHz and THz signals was observed. In addition, instead self-focusing, stable filament type propagation can be seen up to kilometers range. Obviously, in femtosecond and attosecond region, new unknown physical effects appear and destroy the well-studied linear and nonlinear pictures observed with nanosecond and picosecond pulses. What could be these new effects? What kind are the equations which describe them? In my presentation I will try to answer on these questions.

**Anas Othman**
Taibah University, KSA

## Biography

Anas Othman is Assistant Professor at the physics department of the Taibah University. My research is mostly in the field of theoretical quantum optics and mathematical physics. In particular, I have general interest in the area of controlling/manipulating quantum optics applications, emerging phenomena of light-matter interactions, and new quantum states/operators/definitions. I received my master degree at the University of Alberta (Canada) in the physics major in 2014, and received my PhD at the University of Waterloo (Canada) in the physics major in the field of theoretical quantum optics in 2018. I have published more than 11 peer-reviewed articles.

## High-Order of Near Coherent States

Superposing two semi-identical variable states is recently defined and applied to the coherent state, and has been named the near coherent state [1]. It has quite interesting features and possibly the most important one of them is that it provides a classical-to-quantum transition. Plus, it carries many nonclassical properties. Also, its characteristics are in-between the regular coherent state and Schrodinger cat states.

Although the definition of the near coherent state seems complicated (superposing two states), it yields direct and relatively simple mathematical formula. For example, the resultant superposition becomes a superposition of the derivative of the coherent state and the coherent state itself. Based on that and the emerging nonclassical features of the near coherent state, we here apply the near superposition technique to the near coherent state for an arbitrary number of times. This high-order of near coherent states generates a zoo of phases, we here are interested in the choice of phases that generates the high-order derivatives of coherent states.

We showed that these high-order derivatives of coherent states have many interesting

mathematical formulas. They can be written in more than one relatively straightforward formula that each explains something physical about the state itself. Also, they have a seed state that is a superposition of only odd or even Fock states but never both. Interestingly, although there is not a clear connection between this proposed state and the Mth coherent state [2], we found that they share the same operator of their eigenvalue equation. Moreover, these states have nonclassical features such as sup-Poissonian statistics. The squeezing parameter is also studied and yield wiggling behaviour without evidence of squeezing.

In conclusion, we proved that the high-order derivative of the coherent state is one possible limit to the high-order of near coherent states. We obtained the direct formulations and operations of these states.

**Salman Noach**
Jerusalem College of Technology, Israel

## Biography

Professor Salman Noach, Jerusalem College of technology, Head of the solid state lab at Jerusalem College of technology. The lab mainly deals with the development of microchip 2um lasers, nonlinear optics, Raman Lasers in the SWIR-MIR and optical amplifiers. He is a senior Optica member and SPIE member.

## All Passive KGW / Tm Based Raman lasers

Short Wave Infrared Red (SWIR) coherent sources have drawn much attention, as is evident from the recent efforts to develop high power lasers that cover this spectral range, due to several potential applications, including LIDAR, biomedicine, polymer material processing, defense applications, and gas sensing. Solid-state Raman lasers are an efficient and useful way to get such high-brightness sources that extend the spectral span of existing lasers. Potassium gadolinium tungstate ($KGd(WO_4)_2$ or KGW) is one of the most popular Raman gain mediums owing to its good optical and thermal properties. Moreover, because KGW is biaxial, it has Raman interaction with two different vibrational modes (901 $cm^{-1}$ and 768 $cm^{-1}$), yielding the option to obtain two different stokes wavelengths by controlling the polarization direction of the pump source.

We present an all-passive efficient KGW Raman laser with an external-cavity configuration in the 2 μm spectral regime. The Raman lasers was pumped by a passively Q-switched Tm based lasers. Due to the bi-axial properties of the KGW crystal, the laser exhibits stimulated Raman emission at two separate spectral lines. For the KGW/Tm:Yap, the spectral emission were at 2272 nm, and 2343 nm. The output energies achieved at these two lines are 340 μJ/pulse, and 450 μJ/pulse accordingly. The seed to Raman laser conversion efficiencies achieved of 19.2 % and 23.5 %, respectively, are superior to comparable actively Q-switched laser arrangements. To the best of our knowledge, the laser presented here is the first demonstration of Raman conversion in the SWIR using KGW crystal.in a completely passive configuration.

**Thomas Dittrich**
National university of Colombia, Colombia

## Biography

Thomas Dittrich studied physics and philosophy in Hamburg. His research on complex quantum dynamics started with his Ph.D. in Essen and continued during postdoctoral stays at the Weizmann Institute, University of Augsburg, and MPI for the Physics of Complex Systems. In parallel with his position as professor of theoretical physics at Universidad Nacional de Colombia in Bogotá, which he has held since 2000, he has enjoyed research stays in Germany, Israel, Mexico, India, and Brazil. He publishes on quantum chaos, semiclassical methods, quantum information, and randomness.

## Quantum randomness in spin measurement: A unitary approach

Spin measurement is studied as a unitary time evolution of the spin coupled to an environment representing the meter and the apparatus. Modelled as a heat bath comprising only a finite number of boson modes and represented in a basis of coherent states, the environment can be fully included in the quantum time evolution of the total system. We numerically simulate standard measurements of the polarization of spins, initially prepared in an unpolarized pure state. The likewise pure initial state of the environment is constructed as a product of coherent states of the boson modes with their centroids distributed thermally around the origin of phase space. With a corresponding time-dependent modulation of the self-energy of the spin and the coupling to the heat bath, we observe the outcome of the measurement in terms of the long-time behaviour of the spin. Owing to the interaction with the heat bath, the spin gets entangled with it and loses coherence, reproducing the “first collapse of the wavefunction”. The expected quantum randomness in the final state is manifest in our simulations as a tendency of the spin to approach either one of the two eigenstates of the measured spin operator, recovering most of its initial purity. The unitary time evolution allows us to reproducibly trace these random final states back to the respective initial states of the environment. We record this evolution also in terms of the mutual entropy of the two subsystems. Quantum randomness in this approach is thus revealed as a manifestation of the thermal randomness of the macroscopic measurement apparatus.

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SPEAKERS
Day 1

**Camila Squarzoni Dale**
University of Sao Paulo, Brazil

## Biography

Camila Squarzoni Dale is a Associate Professor at the Departament of Anatomy of the University of São Paulo working mostly on the effects of complimentary therapies for pain treatment. In this aspect we have been working on the effects and mechanisms envolved on the analgesia induced by photobiomodulation in experimental models of dental hypersensitivity and also we have been working on an experimental model of diabetic neuropathy that was recently published at J Biophotonics. 2018; this data supported the use of photobiomodulation on diabetic patients so now we are working on a project that evaluates the effects and mechanisms involved on photobiomodulation-induced analgesia in those patients. Moreover, to work on human subjects lead us to develop another project that aims to understand the different pain pattern of neuropathic pain-diabetic patients, through exteroeptive evaluation using quantitative sensory testing.

## Photobiomodulation Therapy Improves Quality of Life, Wound Healing and Pain Scores of Diabetic Patients from Brazilian Public Hospital

**Background:** Diabetic Foot ulcers represents 40-70% of non-traumatic lower limb amputations with great socioeconomic impact and high morbidity and mortality and losses on quality of life. Conventional treatments are restricted, painful and usually uneffective. Photobiomodulation (PBM) is a low-cost therapy which promotes analgesia and tissue repair in diabetic patients (DP).

**Aim:** Evaluate PBM-effect son wound healing, pain and quality of life of DP from the University Hospital of USP/BR.

**Methods:** transversal and interventional study including 14 DP submitted to clinical evaluation, pain (BPI, DN4 and McGill), quality of life (HADS and PCS) screening before, immediately after and 6 months after 14 applications of PBM therapy (660 nm, 1.4 J, 2x/week).

**Results:** Most of DP presented foot sensitivity and history of amputation. 42.8% of DP presented wounds >12 months with lower limbs symptoms as numbness (57.1%), burning (63.3%) and tingling (57.1%) with worsening of symptoms at night (57.1%). After PBM, total or partial wound retraction ($p=0.001$) were obtained, with permanent recovery in 71.4% of DP even after 6 months. A decrease in pain impact were observed (41%, $p=0.050$), improving patient´s social relationships ($p=0.068$), added to significant reduction in neuropathic pain scores ($p=0.031$) and albeit not significant, PBM slightly improved emotional aspects of DP. Wilcoxon test ($p<0.05$, SPSS).

**Conclusion:** PBM therapy promoted significative and permanent wound retraction and improved quality of life and pain screening of DP, reinforcing the use of this adjuvant tool in the clinical treatment of painful symptoms and in the wound healing process of DP.

**Antoine Bard**
Claude Bernard University Lyon 1, France

## Biography

Antoine Bard is a PhD student since October 2019 in the Materials and Nanostructures Group of the Institute of Light and Matter of Lyon (France). The group develops research devoted to strong light-matter coupling in hybrid metal/semiconductor structures. Antoine Bard trained in physics and chemistry before specializing in condensed matter and optics during his master's degree. During his first year of PhD, he worked on multi-stacked J-aggregated dyes to characterize energy transfer before working on structured metasurfaces for the same purpose. He has also worked on core-shell nanoparticles for applications in catalysis chemistry. He is involved in the doctoral association and the institute council.

## Hybridization of two organic materials with polaritonic metasurfaces

The strong light matter coupling occurring when the light matter interaction overcome the damping, has found recently applications beyond the domain of optics, in chemistry or transport. These advances make crucial the development of various structures in strong coupling. In this talk we describe a new way to hybridize two materials and transfer energy through a surface plasmon over micrometric distances. Two patterned interlocked dyes arrays, one donor and one acceptor, are deposited on a silver surface by successive micro contact printing, leading to a pattern of 5 microns' period. The dispersion relation of the structure is measured with reflectometry experiments and evidence the hybridization with the plasmon, and the formation of states mixing both excitons and the plasmon with similar weights. The mixing in these polaritonic metasurfaces enables an energy transfer mechanism in strong coupling, which is observed with luminescence experiments. As the donor and acceptor are spatially separated by a distance larger than the diffraction limit, the excitation transfer is directly measured and evaluated by comparison with dyes arrays without silver. The transfer from one material to the other in strong coupling could find applications in the excitation of organic devices with an efficient transfer and an easy access to the in-plane separated structures. Multimaterial polaritonic metasurfaces can also be extended to the vibrational strong coupling where the control of the energy states could find applications in strong coupling chemistry.

**Aneliya Dakova**
Institute of Electronics at the Bulgaria, Academy of Sciences, Bulgaria

## Biography

Aneliya Dakova earned her PhD degree in Physics of wave processes from the Institute of Electronics at Bulgarian Academy of Sciences in 2016. Subsequently, she carried out her Post-Doctoral studies at Faculty of Physics and Technology, University of Plovdiv "Paisii Hilendarski" where she is currently a chief assistant professor of Physics. Her area of scientific interests includes linear and nonlinear optics, photonics, optical solitons, vortex structures and filamentation.

## Broad-Band Cnoidal Waves and Influence of Third-Order Dispersion and Self-Steepening Effect

Periodical cnoidal waves are usually presented by Jacobi elliptic functions. Their application covers scientific areas from hydrodynamics to optics.

In the present work the conditions for generation of broad-band cnoidal waves under the influence of third-order of linear dispersion (TOD) and self-steepening effect (SSE) are studied. For ultrashort pulses TOD is significant even when group velocity dispersion is nonzero. This effect makes the shape of the pulse asymmetrical with oscillatory structure on one of its edges. SSE is a higher-order nonlinear phenomenon, resulting from the intensity dependence of group velocity. It shifts the peak of the pulse toward its trailing edge. Broad-band (femtosecond) pulses cannot be described within the standard nonlinear Schrödinger equation. For this reason we use in our investigations the nonlinear amplitude equation (NAE). For optical pulses with one or two periods of oscillations under the envelope, the influence of TOD and SSE is considerable. These effects are taken into account in NAE and new analytical solutions in the form of Jacobi elliptic functions are found. They are reduced to optical solitons at certain value of the modulus of ellipticity ($\kappa=1$). The conditions for the formation of soliton and the connection between the parameters of the fiber and the pulse are derived. Solitons are stable wave packets. Regarding to the dispersion (anomalous or normal), two types of optical solitons exist - bright and dark. The last ones admit deep gap of the intensity.

The obtained results are important for the better understanding of signal transmission in telecommunications systems.

**Valeri Slavchev**
Institute of Electronics, Bulgarian Academy of Science, Bulgaria

## Biography

Valeri Slavchev got his PhD degree in Physics of wave processes from the Institute of Electronics, Bulgarian Academy of Sciences in 2016. After his doctoral training, he spent one year as postdoctoral researcher in Department of Medical Physics and Biophysics, Medical University of Plovdiv where he is currently a chief assistant professor of Biophysics. His area of scientific interests includes linear and nonlinear optics, photonics, optical vortex structures and biophotonics.

## Generation of Vortex Structures in Optical Fibers with Spatial Dependence of the Linear and Nonlinear Refractive Index

In the last two decades, optical vortices, generated in different waveguides have attracted significant interest, providing new opportunities for modern communication systems and sensors. Optical vortex is referred to a beam or pulse that has singularity in the phase or in the components of the amplitude of the electrical field.

The aim of the present research is to investigate the formation of new type vortex structures with dislocations in x and y components of the intensity profiles of the electrical field. Such type of vortices can be obtained in optical fibers with spatial dependence of the nonlinear refractive index. Their evolution is described by a system of amplitude equations for the components of the electrical field. We solved this system of equations and new class of analytical vortex solutions are found. These optical vortices admit only amplitude type singularities. Their stability is a result of the balance between the effects of diffraction and nonlinearity, as well as nonlinearity and angular distribution. For these singularities a depolarization in the vector field in the laser spot is observed.

**Hans Deyssenroth**
Uni Basel, Germany

## Biography

Hans Deyssenroth studied electrical engineering at the TH Karlsruhe in Germany and physics with a Diploma degree at the University of Basel in Switzerland. He worked as an IT manager and biometrician in the Pharma industry in Switzerland and was the co-author of about 20 publications. After retirement he studied again the basics of physics and got increasing doubts that the existing models are correct, though they have been verified by many and manyfold experiments. Now he is proposing new experiments that could confirm these doubts and is thinking about alternative models that can explain the observed facts better.

## Are we wrong about the Michelson Morley experiment?

The answer could be yes, because of a small detail that has been overlooked for decades and that was not known in 1905. Lorentz, Poincaré and Einstein assumed that photons behave like tennis balls shot onto a moving 45° board and get a lateral moment in the direction of motion along the x-axis. Therefore, the light beam in the Michelson Morley experiment (MME) from the half transparent mirror to the upper mirror in the y-axis is oblique (observed from a rest frame). But R. Feynman concluded that a mirror is a light source where new photons are emitted, and together with the second postulate of the STR this light beam should therefore be perpendicular to the direction of motion and parallel to the y-axis.

In this case there is no time dilation due to Pythagoras and the postulated length contraction would destroy the null result of the MME. Therefore, the application of the Lorentz transformation would be wrong, and the observed relativistic effects must have another cause, e.g. by an interaction with the non-empty space. A time dilation without a length contraction would have great impacts to the Theories of Relativity, though there are overwhelming confirmations by complex experiments, because the physical basis to the mathematical space-time modelling by the Lorentz transformation would be wrong.

Several experiments with the newest technology are proposed to test this alternative view on the fundamental MM-experiment.

**Yu. Belousov**
Moscow Institute of Physics and Technology, Switzerland

## Biography

Yury M. Belousov (Dr. habil.) graduated from Moscow Institute of Physics and Technology and currently is a Professor of Theoretical Physics Department in MIPT. His work focuses on the magnetic relaxation and muon studies of condensed matter (μSR-Method), spin-systems dynamics, quantum chemistry and quantum measurements. He is the author and co-author of more the 100 scientific publications. The results are outlined in two monographs: The Muon Method in Science (1993, NY, Nova Science) and Study of High-Tc Superconductors By μSR-Technique (2003, London and New York, Taylor & Francis). He is also the author and co-author of many books among them Problem Solving in Theoretical Physics (2020, Willey-VCH).

## Non-radiative transitions in excited states of NV-center in diamond crystals

There are many point defects (impurities) in diamond crystals, and their classi_cation and electronic properties are described in detail in the review. The greatest interest among them was caused by the vacancy color center formed by the nitrogen atom, NV-, which is associated with the possibilities of its application in various areas of quantum technology physics. These applications are mainly related to the observed optical transitions between the electronic energy levels of the center. In particular, the optical properties of the NV- center are supposed to be applied to the implementation of quantum gates and keys for quantum cryptography.

The ground energy level of the center $^3A^2$ is a spin triplet. Therefore, first of all, there is an optical transition from the excited triplet energy level $^3E$ to the main one, which corresponds to a change in energy $\Delta E$ =1.945 eV. In addition to this main transition, an optical transition between spin singlet levels $^1A^1 \rightarrow 1E$ is also observed and corresponds to a change in energy $\Delta E$ = 1.190 eV. No spin-singlet energy levels cannot be excited by optical interaction from the ground spin-triplet level. So, nonradiative transition from the excited triplet energy level to the excited singlet level should exist.

A mechanism of nonradiative transition between the excited energy levels of NV--centers in diamond crystals is proposed. A nonradiative transition between the spin triplet and singlet levels is possible as a result of spin-orbit interaction with simultaneous excitation of vibrational (vibronic) states of the cluster and excitations of lattice phonons. Therefore, such a transition can be obtained in the second order of perturbation theory. To describe this process, the spin-vibronic interaction operator is obtained, and non-zero matrix elements providing non-radiative transitions are calculated. It is obtained that matrix elements are proportional to the overlap integrals of one-electron wave functions. It is shown that the transition rates $^3E \rightarrow {}^1A^1$ and $^1E \rightarrow {}^3A^2$ are determined by the same expressions. Thus, the nonradiative transitions under consideration are determined not by a multiphonon process, but by the excitation of the vibrational states of the NV--center atoms. Numerical estimates give good agreement with experimental data

**Zara Kasapeteva**
Institute of Electronics, Bulgarian Academy of Science, Bulgaria

## Biography

Zara Kasapeteva is currently a PhD student in the Institute of Electronics at Bulgarian Academy of Sciences. The topic of her scientific degree is "Nonlinear parametric processes in isotropic media". She is also an assistant professor in Physics at Technical University Sofia - Branch Plovdiv since 2021. The area of her scientific interests and research spreads across photonics, linear and nonlinear optics, optical solitons, parametric processes and filamentation.

## Nonparaxial optics and broad-band optical Solitons

In recent decades the interest of scientists in the study of phenomena resulting from the evolution of broad-band laser pulses in different waveguide systems increases significantly. Nowadays, it is easy to obtain phase-modulated femtosecond pulses or to reach the attosecond regions where the spectral bandwidth of the optical pulses is of order of the carrying frequency ($\Delta\omega \approx \omega 0$). Such kind of light pulses we call broad-band ones.

The well-known (1+1D) nonlinear Schrödinger equation (NSE) governs the propagation of narrow-band laser pulses ($\Delta\omega << \omega 0$) in optical fibers and planar waveguides. For the investigation of the evolution of broad-band optical pulses with femtosecond or attosecond duration, it is needed to use the general nonlinear amplitude equation (GNAE). It differs from NSE with two additional non-paraxial terms. The advantage of GNAE is that it can be applied successfully for both type of pulses - narrow-band and broad-band ones. That is why, it is important to make clear the difference between the solutions of NSE and GNAE.

We found new analytical soliton solution of GNAE and compare it with the well-known soliton solution of NSE. For the fundamental soliton it is shown that the main difference between the two solutions is in the phases of the pulses. This changes considerably the evolution of laser pulses in multi-soliton regime of propagation. Thus, the GNAE solitons admit a behavior different from that of the NSE ones.

**Youhua Chen**
NingboTech University, China

## Real-time reconstruction using electro-optics modulator and galvanometers-based structured illumination microscopy

Structured illumination microscopy (SIM), a super-resolution technology, has a wide range of applications in life sciences. SIM improves the resolution by continuously imaging of the sample under patterned illumination. It has the advantages of fast imaging speed, low excitation light intensity, less photobleaching, and no need for special fluorescent dyes. In this study, we present an electro-optic high-speed phase-shift super-resolution microscopy imaging system capable of live-cell imaging, including 2D SIM, total internal reflection fluorescence-SIM (tirf-SIM), and 3D SIM modes. This system uses galvanometers and an electro-optic modulator to flexibly and quickly control the phase and direction of structured illumination patterns, resulting in improved signal-to-background ratio and optical slice ability. We demonstrate our microscope's lateral and axial resolution of 90 nm and 275 nm. Moreover, different from most current SIM microscopes, its design consists of precise timing for improved acquisition speed and software architecture for real-time reconstruction. The highest acquisition rate achieved was 151 frames/s, while the highest real-time super-resolution reconstruction frame rate achieved was over 25 frames/s. We prove these by imaging nanoscale rulers and Mitochondria of huFIB cells. These characteristics enable our galvanometer-based SIM system to broaden the accessible imaging content of microscopes and further facilitate their applications in life sciences.

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# OPTICS, PHOTONICS AND LASERS & PHYSICS AND QUANTUM PHYSICS

KEYNOTE SPEAKERS
Day 2

Virtual

**Masatoshi Kajita**
National Institute of Information and Communications Technology, Japan

## Biography

Masatoshi Kajita Ph. D at U. of Tokyo with physics. After working at Institute of Molecular Science as a Post Doctor, he joined Communications Research Laboratory (present National Institute of Information and Communications Technology) at 1989. He was guest professor of Province University (France).

## Precision Frequency Measurement of Molecules

The developments in physics are well correlated with the developments of new types of clocks; for example, the establishment of Newtonian mechanics is within 100 years after the drastic improvement of accuracy of clocks by the discovery of the periodicity of pendulums. The standard of the time & frequency is currently defined by the hyperfine transition frequency of Cs atoms (microwave), whose uncertainty is of the order of 10-16. The uncertainty of 10-18 has been obtained with the optical transition frequencies of ions (trapped in a narrow area using rf-electric field) or neutral atoms (trapped by a standing wave of a laser light). The precision measurement of the atomic transition frequency is useful to develop physics beyond the standard model. For example, the precision measurement of the ratio between different atomic transition frequency is useful to detect the variation in fine structure constant.

It is also useful to detect the variation in the proton-to-electron mass ratio. For this purpose, precision measurement of the molecular vibrational-rotational is useful. Particularly the pure vibrational transition frequencies (without change of any angular momentum quantum numbers), because the cancellations between energy shift at higher and lower states induced by the electric or magnetic fields are significant. The attainable uncertainties of pure vibrational transition frequencies of 15N2+ and 16O2+ molecular ions (trapped in a linear trap and sympathetically cooled with atomic ion, which is co-trapped) were estimated to be 10-18. The precision measurement of the vibrational transition of 40Ca19F molecules, which are laser cooled and trapped by a standing wave of a laser light, is also useful.

**Karlheinz Muth**
Broadcom Inc., USA

## Biography

Karl Muth is currently Senior Principal Systems Architect at Broadcom San Jose, CA. He is a member of the silicon photonics founding team at Broadcom and is leading the architecture and design of integrated terabit optics. During his career he has worked with industry leading companies on the design of wireless and optical transceivers and numerous chipsets for RF and high speed optical communications. He received the 2021 Charles Kao Award for Best Optical and Networking Paper. Mr. Muth is a member of the Optical Society of America, a member of the IEEE and the IEEE-SA.

## Paradigm Shift in High-Speed Interface Technology

The exponential growth in data center traffic is driving an increase in demand for cost and energy efficient interface bandwidth scaling. This creates a need for a paradigm shift in I/O technology that meets future connectivity requirements within data centers. Silicon Photonics (SiPh) based optical interfaces significantly improve I/O density by optimizing solutions along three vectors independently: Packaging density, speed per lane, and number of wavelengths per channel. SiPh platforms efficiently leverage the high speed interface ecosystem that is evolving towards silicon and hybrid chiplet platform integration (heterogeneous integration). Simulation, design, and packaging tools from leading EDA vendors enable electro- optical co-design. The validation of the devices and subsystems follow standard techniques on wafer level, package and PCB level and provide full correlation from device to system level. Backend semiconductor activities still need to develop to support fiber handling and die level optics testing capability. Legacy optical transceiver module platforms being unique has prevented volume scaling and high reliability. Additionally, optical modules have routinely lagged silicon availability in networking. An integrated, on-substrate optical I/O platform utilizing the tested and proven high-volume semiconductor manufacturing and packaging ecosystem can overcome the variation and uncertainty inherent in the optical I/O market today. This paper recommends a SiPh based optical I/O solution that merges mature silicon chiplet packaging and fiber connectivity to achieve the highest I/O efficiency for networking applications with highest density, lowest power and cost. A Broadcom prototype system with a 25.6Tbps optical switch is demonstrated and main performance parameters are reported.

**Stuart A. Kauffman**
University of Pennsylvania, USA

## Biography

Kauffman presently holds a joint appointment at the University of Calgary in Biological Sciences and in Physics and Astronomy, and is an Adjunct Professor in the Department of Philosophy. He is also an iCORE chair.

He graduated from Dartmouth in 1960, was awarded the BA (Hons) by Oxford University in 1963, and completed a medical degree (M.D.) at the University of California, San Francisco in 1968. After a brief medical career, he moved into developmental genetics, holding appointments first at the University of Chicago, then at the University of Pennsylvania from 1975 to 1995, where he rose to Professor of Biochemistry and Biophysics. Kauffman held a MacArthur Fellowship, 1987-1992.

Kauffman rose to prominence through his association with the Santa Fe Institute (a non-profit research institute dedicated to the study of complex systems), where he was faculty in residence from 1986 to 1997, and through his work on models in various areas of biology. These included autocatalytic sets in origin of life research, gene regulatory networks in developmental biology, and fitness landscapes in evolutionary biology.

In 1996, Kauffman started BiosGroup, a Santa Fe, New Mexico-based for-profit company that employs complex systems methodology to attempt to solve business problems. BiosGroup was acquired by Nu-Tech Solutions in early 2003.

## Is There a Fourth Law for Non-Ergodic Systems That Do Work to Construct Their Expanding Phase Space?

Substantial grounds exist to doubt the universal validity of the Newtonian Paradigm that requires a pre-stated, fixed phase space. Therefore, the Second Law of Thermodynamics, stated only for fixed phase spaces, is also in doubt. The validity of the Newtonian Paradigm may stop at the onset of evolving life. Living cells and organisms are Kantian Wholes that achieve constraint closure, so do thermodynamic work to construct themselves. Evolution constructs an ever-expanding phase space. Thus, we can ask the free energy cost per added degree of freedom. That cost is roughly linear or sublinear in the mass constructed. However, the resulting expansion of the phase space is exponential. Thus, the evolving biosphere does thermodynamic work to construct itself into an ever-smaller sub-domain of its ever-expanding phase space at ever less free energy cost per added degree of freedom. Entropy really does decrease.

A testable implication of this, termed here the Fourth Law of Thermodynamics, is that at constant energy input, the biosphere will construct itself into an ever more localized subregion of its ever-expanding phase space. This is confirmed. The energy input from the sun has been roughly constant for the 4 billion years since life started to evolve. The localization of our current biosphere in its protein phase space is at least $10^{-2540}$. The localization of our biosphere with respect to molecules of CHNOPS comprised of up to 350,000 atoms is extremely high. Entropy has decreased. The universality of the Second Law fails.

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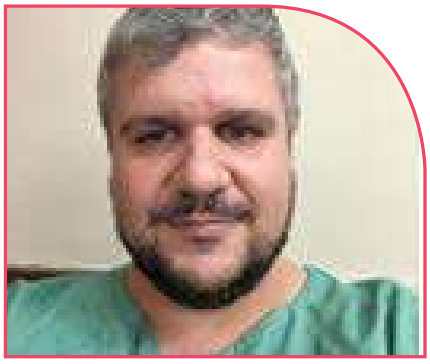
**SPEAKERS**
**Day 2**

**Virtual**

**Monika Sinha**
Indian Institute of Technology Jodhpur, India

## Investigating dense baryonic matter in light of nuclear saturation parameters and astrophysical observables

The detection of gravitational waves (GWs) from the merger of binary neutron star (NS) events (GW170817 and GW190425) and subsequent estimations of tidal deformability play a key role in constraining the behavior of dense matter. In addition, massive NS candidates (~ 2MO) along with NICER mass-radius measurements also set sturdy constraints on the dense matter equation of state. Strict bounds from GWs and massive NS observations constrain the theoretical models of nuclear matter comportment a large density regimes. On the other hand, model parameters providing the highly dense matter response are bounded by nuclear saturation properties with the recent update in nuclear symmetry energy aspect from PREX-2 data. This work analyzes coupling parametrizations from two classes based on covariant density functional models: nonlinear and density-dependent schemes. Considering these constraints together, we study possible models and parameterization schemes with the feasibility of exotic degrees of freedom in dense matter which go well with the astrophysical observations as well as the terrestrial laboratory experiments. We show that most parametrizations with nonlinear schemes do not support the observations and experiments while density-dependent schemes go well with both. Astrophysical observations are well explained if the inclusion of heavier non-strange baryons is considered as one fraction of the dense matter particle spectrum.



**Igor Renato Louro Bruno de Abreu**
Hospital Leforte Morumbi - Rede DASA, Brazil

## Efficacy and safety of a device used to prevent fogging and residue buildup on surgical optics during video-assisted thoracic surgical procedures (LacrimaSurg): A pilot in vivo study in 30 patients

**Introduction:** Nowadays the majority of the surgical procedures are video surgeries. Despite technological advances, some problems remains. The buildup of residues in front of the lens are examples of this problems. To solve it, Abreu et. al. (2015) developed LacrimaSurg, which works as a lacrimal duct in the optics preventing fogging and residues buildup on it. This had 98.1% of efficiency in an experimental study.

**Objectives:** Study feasibility and safety of the device under real surgical conditions.

**Materials and Methods:** A pilot study included 30 patients undergoing thoracic procedures using LacrimaSurg. Procedures were recorded for further analysis by investigators. The characteristics of patients (age, sex, body mass index, Charlton comorbidity index), data of environment (Temperatures variances) and data of procedures (type of surgery and duration of it) were recorded. The investigators watched the videos and recorded the residue buildup and fogging events that impaired surgeon's vision. The number of times the optics got dirty, need for further jets of crystalloid solution and need for mechanical cleaning were collected to evaluate efficacy. Comparative serum measurements of electrolytes before and after surgery were studied. Data were organized and analyzed by simple linear correlations and t test for continuous variables and Fisher's test for categorical variables.

**Results:** The use of the device allowed 97% of the procedures to be performed without interruption. No characteristics inherent to the patients or to the procedures that lead to fogging or filth of the optics were identified. There were no statistically significant differences between pre- and postoperative serum ions, and no postoperative complications related to the use of the device were observed.

**Conclusion:** The device was effective in preventing interruption of surgical procedures due to dirt or fogging, its use was considered safe and did not cause postoperative complications.

**Karlheinz Blankenbach**
Pforzheim University, Germany

## Biography

Karlheinz Blankenbach has three decades of experience in displays. From 1988 until 1995 he was with AEG-MIS (a Mercedes subsidiary) in Germany, developing display electronics and LCDs. In 1995 he was appointed to full professor at Pforzheim University, Germany, where he founded the university's Display Lab. His R&D activities are display topics such as optical measurements, display systems, evaluations, HMI, LEDs, electronics and software. Blankenbach is a member of the Society for Information Display ("Automotive/Vehicular Displays and HMI Technologies" and "International Committee for Display Metrology"). He has served as a member of the board of the Displayforum (DFF) since 2000.

## New Approach for Measuring Halo of LCDs and OLEDs

**Introduction:** Halo mura (or blooming) is an effect of electronic displays where bright pixel spread light into dark surrounding areas. This reduces the visual quality of (automotive) displays especially during night drive. Up to now, there is no suitable method to measure this halo on pixel level.

**Method and Results:** We introduce a five-step method on halo measurements using a luminance imager with macro lens. First, the luminance of ON (white) pixels are measured and the surrounding area. In the second step, the lit area is blocked by black mask and the luminance line profile in the halo area is measured. This is performed for various luminance values and normalized in the third step. Those measurements are repeated for lit lines of a few up to hundred display pixels. The luminance of the OLED was independent of the number of on pixels while the luminance of the local dimming LCD increases with the number of lit pixels. In the fourth step, the measured profiles are fitted to an exponential decay function and single pixel halo is then extracted by simulation (5th step). This method was tested with several displays. LCD halo is typically 10x larger than for OLEDs.

**Conclusion:** We have successfully measured and evaluated halo effects on LCDs and OLEDs. Halo is typical in the range of less than 1% of the bright luminance. Even high end LCDs show an amount of halo which is clearly noticeable and an order of magnitude higher than for OLEDs.

**Anna Maria Ferrari**
University of Torino, Italy

## Biography

Anna Maria Ferrari is associated professor at the Chemistry Department of the University of Torino. She works on DFT simulations of materials, surface and interfaces, adsorption and catalysis

## Monomeric ($VO^{2+}$) and Dimeric Mixed Valence ($V_2O3^{3+}$) Vanadium Species at the Surface of Shape Controlled $TiO_2$ Anatase Nano Crystals

Metal atoms and ions at well-defined anatase $TiO_2$ crystals with exposed (101) and (001) facets represent a promising platform for fundamental studies in catalysis using model systems of high complexity for the development of novel catalytic systems exhibiting higher than usual activities. Herein, we report the geometric and electronic structures of supported paramagnetic vanadium catalysts obtained by reaction of $VCl_4$ vapors with shape controlled anatase $TiO_2$ supports with preferential (101) and (001) facets. Electron Paramagnetic Resonance (EPR) spectroscopy and Density Functional theory (DFT) calculations reveal the presence specific monomeric ($VO^{2+}$) and dimeric mixed valence ($V_2O_3^{3+}$) species with molecular structures dependent on the $TiO_2$ surface termination.

**Yusuke Shibasaki**
Nihon University, Japan

## Biography

Yusuke Shibasaki is a Ph. D candidate at Nihon University, Japan. He is also a research fellow of the Japan Society for the Promotion of Science (JSPS). He majors in non-equilibrium statistical physics, dynamical theory, and its biomedical applications. The current works of him focus on the physical theorization of the stochastic/chaotic Loewner evolution and its applications to the real biological systems. Inspired by complex phenomena in nature and arts, he is always seeking for the law governing the "living" state.

## Non-equilibrium physics of Loewner evolution based on morphological complexity

Complexity in non-equilibrium and nonlinear systems is a fundamental topic in contemporary physics. Recently, in this context, the author investigated the statistical physical properties of Loewner Evolution (LE) and developed some application methods. The LE has been recognized by physicists due to the suggestion of stochastic Loewner Evolution (SLE) by Schramm in 2000. Since its discovery, it has been demonstrated to provide the random curves describing the geometry of various 2D statistical physics models. The LE is expressed by Loewner differential equation, that determines a family of the time-dependent conformal maps, to depict a growth process of curve-like morphology.

However, the LE as a non-equilibrium dynamical process has not been theoretically formulated completely, even though the LE itself provides an interesting information-theoretic framework. In this presentation, I demonstrate a close relationship between dynamical system theory and LE, and then suggest a perspective on non-equilibrium statistical physics of LE, which constitutes a physics based on *morphological complexity*. Although the present study is work in progress, I will introduce the significant results concerning my past and current research.

**C Bhattacharya**
Austin Paints & Chemicals Private Limited, India

## Biography

Chinmoy Bhattacharya is a PhD in Polymer Physics from India in the year 1988. He then did his post doctoral studies on Polymer physics of liquid crystals in Laval University, Canada and be back to India in the year 1991, he joined paint Industry ICI INDIA LTD. He continued his research work on quantum gravity and theory of relativity and has recently come up with an altogether new unified quantum gravity theory. He has about 12 publications in Polymer national/international journals and his work on Cosmology, Theory Quantum gravity Dark Matter

## Reformulating The Basics Of Conventional Newtonian Physics, Quantum Physics And The Einstein Theories Of Relativity Through The Newly Discovered Topology Bridging Theory Of Quantum Gravity

The Newtonian physics , quantum physics and the theories of relativity suffer from a major incompleteness on the ground of being unable to offer the topologies and the dimensionalities of the numerous physical variables. Out of the three very familiar dimensions of physical variables in conventional physics length(L) , mass (M) and time(T) , the two variables, namely mass and time are fully arbitrary and abstract. In Newtonian physics, L, M and T are fully independent variables since no mathematical equation linking the said three variables have been proposed. It is an established fact and a matter of everyday experience that L,M and T are very much linked to each other and otherwise which , the universe could have taken either the infinite number of shapes of desire arising out of endless permutations and combinations of L,M and T or could have merged to fully length ( $L\ M^0\ T^0$) or fully mass ($L^0MT^0$) or fully time ( $L^0\ M^0\ T$).

Max Planck tied up the five numbers of basic physical variables, length, time, mass, electric charge and temperature to the same source by linking all of them to the Newton's Gravitational constant , G and Planck constant ,h. However, this attempt was also incomplete since the topologies of G and h , could not be put forward. Later on, the quantum physics even, could not erase the stamp of 'abstractness' as put on the physical variables like mass, time , temperature, gravitation , photon waves and many others . Neither the Newtonian physics nor the quantum physics can depict the dimensionalities of entropy, force, energy , acceleration, black hole, plasma state...etc. and as well cannot also tell us how a ' photon' looks alike or what the 'gravitons' are in reality.

The recently discovered topological theory of quantum gravity ( TTQG) revealed the following:

1. The phenomenon of gravitation is being linked to the intermolecular attractive forces.
2. Have defined all the above said physical variables as 'gravitons' in regard to entropy .
3. Presented the topologies and dimensionalities of the physical variables. ( Figure 1)
4. Introduced the inverse dimensionality concept in physics.
5. Proposed the mathematical equation relating L,M and T
6. Reformulated the basics of Newtonian physics, quantum physics and the special and general theories of relativity.
7. All the cosmic phenomena of the universe has been represented by a singularity graviton originated universal graviton cycle.

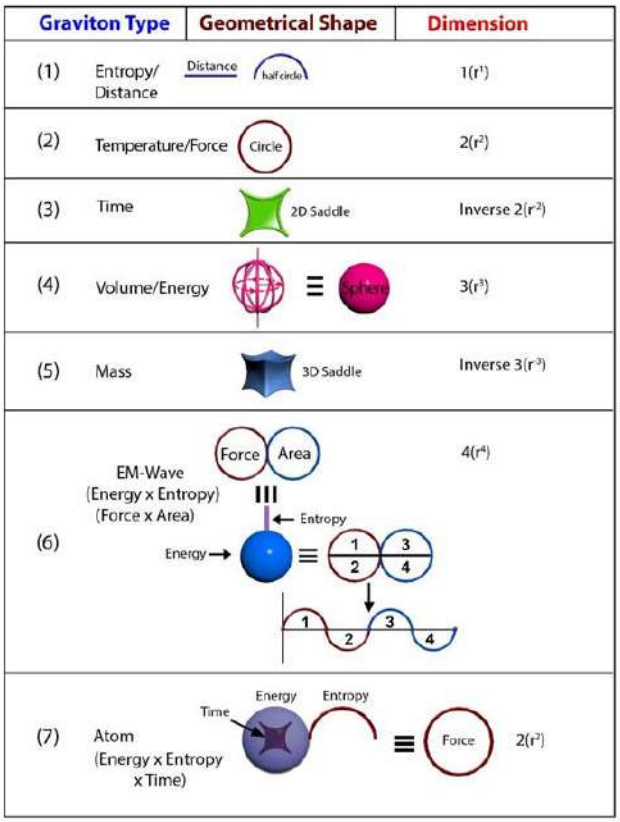



Figure 1 : Topological presentations of the physical variables of the universe

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ACCEPTED ABSTRACTS

**A A Savelyeva**
Institute, Town, Country1IPSI, Russia
Samara National Research University, Russia

## Fourier-invariant laser vortex Laguerre-Gauss beams squared

It is shown that a vortex Laguerre-Gauss (LG) beam "squared" is Fourier-invariant and retains its structure at the focus of a spherical lens. In the Fresnel diffraction zone, this kind of beam is transformed into a superposition of conventional LG beams, the number of which is equal to the number of rings in the LG beam "squared". If there is only one ring, then the light beam is structurally stable. Also, a more general beam produced by the "composition" of two LG beams is considered. Such a beam will be Fourier-invariant if the number of rings of the two LG beams in the "composition" is the same. The considered beams supplement the well-known basis of LG beams, which are intensively studied due to their stability while propagation in turbulence.

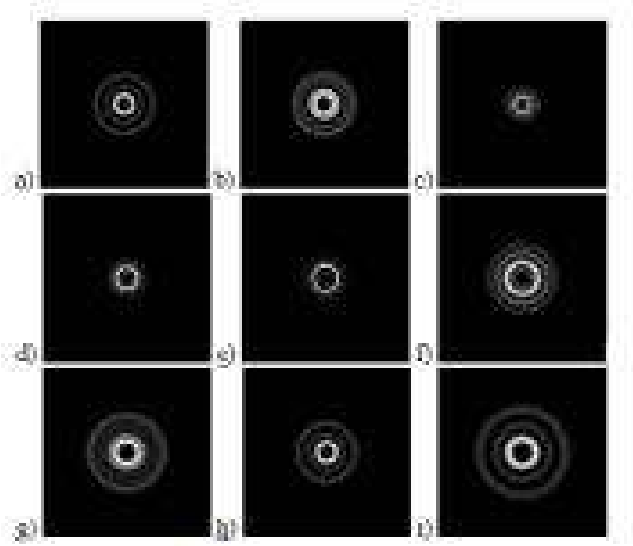


Figure 1 – Beam density distributions (LG)2 at λ = 532 nm, w = 0.5 mm (z0 ≈ 1.476 m), n = 3, m = 2 at distances z = 0 (a), z = z0/4 (b) z = z0/2 (c) z = 3z0/4 (d) z = z0 (e) z = 2z0 (f) z = 5z0 (g) z = 10z0 (h) z = 15z0 (i). Region area |x|, |y| ≤ R, where R = 5 mm (a), R = 5 mm (b), R = 10 mm (c), R = 10 mm (d), R = 10 mm (e), R = 10 mm (e ) , R = 20 mm (w), R = 50 mm (h), R = 50 mm (i).

**Angelo Plastino**
National University La Plata, Argentina

## Pauli Principle and Cosmological Inflation

We will introduce simple, quantum micro-canonical statistical considerations purporting to show that, on account of Pauli's principle, N fermions cannot be accommodated in an arbitrarily small volume V, as bosons can. We will statistically determine a minimum critical volume-value for N fermions. We will extrapolate the above findings to a cosmological setting and predict a numerical value for the temperature prevailing at the end of the Big Bang's inflationary period. Our prediction will turn to agree with current estimates.

**D Gonzalez Diaz**
Universidad Catolica del Norte, Chile

Banco Itaú-Corpbanca, Chile

**Sampling and Modelling Quasi-stationary states paths in the d-HMF model by using Maximum Caliber Framework**

Molecular dynamics simulations are performed for a mean field model, the maximum caliber principle is used to find a probability distribution for the orientation and momentum trajectories for a dipole-type Hamiltonian mean-field (d-HMF) model. Then the time slicing equation is used for finding the time-dependent probability distribution that describes the model in time. The objective of the data processing of the simulations is to obtain a theoretical description of the system based on the results of the simulations performed.

**Liming Zhang**
College of Nuclear Energy Science and Technology, Naval University of Engineering, China

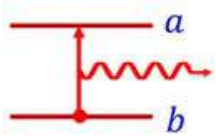
**Rolling Wheel Abrasion Condition Monitoring of Control Rod Drive Mechanism in Nuclear Reactor**

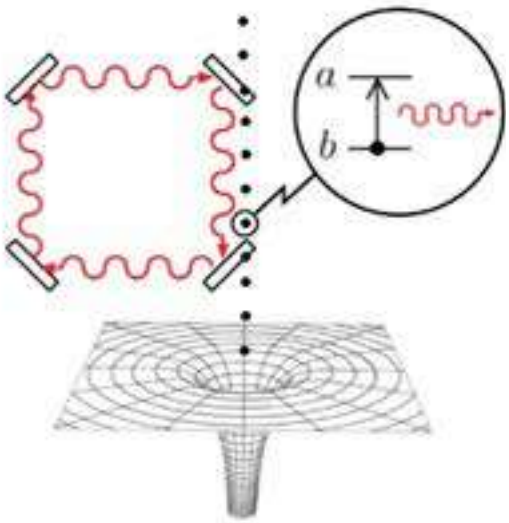
During the operation of in nuclear reactor, the reliability is largely influenced by the changes of working states of control rod drive mechanism. The abrasion of rolling wheel is one of the most serve faults leading to the control failure. To monitor the rolling wheel in the control rod drive mechanism in nuclear reactor, a new recognition method based on complexity of the singular spectrum entropy has been introduced. In this method, the singular spectrum entropy of vibration signal of the system is firstly calculated. Then an index of brain wave information complexity is used to define the singular spectrum entropy complexity. The complexity index is more sensitive to the uncertainty of the signal and it can effectively reflect the intensity of the random shock signal by abrasion which makes it possible to assess the abrasion condition. Through the control rod drive mechanism of whole life test, it is proved that this method can be used in nuclear reactor control rod drive mechanism rolling wheel abrasion condition monitoring with proper accuracy.

**Marlan O Scully**
Texas A&M University, USA

## Virtual Photons: from Lamb and Raman to Hawking and Unruh

The Lamb shift and Raman scattering are quintessential virtual effects in quantum photonics. Less appreciated but very real are virtual photon effects in Hawking black hole radiation and Unruh acceleration radiation. In particular, we find the entropy of the Unruh acceleration radiation via a simple laser-like analysis. Furthermore, two-mode squeezing as it appears in quantum optics has an interesting analog with Unruh radiation involving entangled light appearing in different regions of space-time.

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Acceleration radiation: When virtual photons become real [1] (Left) The counter-resonant virtual processes in which an atom is excited as it simultaneously emits a photon. (Right) In a thought experiment, atoms in the ground state |b⟩ are accelerated through small holes in the corner reflectors of a microwave or optical cavity by (for example) a strong gravitational field.

**Norbert Kroo**
Wigner Research Center of Physics, Hungary

## Femtosecond laser assisted high field plasmonics (room temperature Cooper pairs and transmutation)

The performance of femtosecond pulsed lasers has been significantly improved in the last few years, opening a broad spectrum of potential (also high field) applications. The present lecture presents two surface plasmon related examples to demonstrate this development.

The first illustrative set of experiments used laser intensities up to 1012 W/cm$^2$. Surface plasmons were resonantly excited by femtosecond laser pulses on gold films at room temperature. Measuring the response of a surface plasmon near field scanning tunneling microscope (STM) to the short pulse excitation of the plasmons, laser intensity dependent anomalies were found in both the temporal response and magnetic field dependence of the STM signal with resonance around ~80 GW/cm$^2$. The analysis of the experimental data indicates the formation of Cooper pairs and the Meissner effect has also been observed in this intensity range. Surface plasmon assisted electron emission has also been studied on the same gold films and with the same laser. A time-of-flight electron spectrometer has been used to measure the energy spectra of these electrons. Anamaly in these spectra has also been found in the same laser intensity range where the STM measurements have found it, confirming the formation of Cooper-pairs.

Our second set of experiments covered a laser intensity range up to 1017 W/cm$^2$ and the target was a transparent polymer, with resonant gold nanoparticles embedded into it. The aim was to transmute an as large as possible part of the hydrogen atoms of the polymer into deuterium, by exploring the field amplification effect of the localized plasmons on the gold nanoparticles. Different techniques have been used for deuterium detection, namely LIBS, Raman and infrared spectroscopy, each proving the order of magnitude increase of the deuterium concentration due to transmutation.

The theoretical explanation of observations in both cases is also briefly described in the lecture.

**Rawa Muayad**
WIPNET, Universiti Putra Malaysia, Malaysia

### Effect of phase imbalance on the mm-wave signal in the DWDM-RoF system

Dense wavelength division multiplexing (DWDM) and radio over fiber (RoF) are promising technologies that are able to provide unlimited transmission capacity, which meets the growing demands of bandwidth in communication systems. In this paper, an architecture for DWDM-RoF access networks uses a single Mach Zehnder modulator (MZM) to generate the mm-wave signal. This paper aims to study the effect of phase imbalance on the mm-wave signal to reduce the insertion loss in the system. It is found that the phase imbalance affects the insertion loss and the amplitude of the mm-wave signal. By decreasing the phase imbalance of the mm-wave signal, the insertion losses can be decreased. The phase imbalance can be controlled by adjusting the injected phase, and the best result is collected at π/3 and 5π/12 phases. Additionally, the phase imbalance of the mm-wave signal can be decreased by achieving a splitting ratio of 0.5 in the system.

**Sergio Curilef**
Universidad Catolica del Norte, Chile

### Thermodynamics, Complexity and other entropic and information measures for the d-HMF Model

In the present contribution, we investigate some entropic and information measures such as the complexity, disequilibrium, and entropy of the dipole-type Hamiltonian mean-field model (d-HMF model). Besides, for non-equilibrium quasi-stationary states (QSS), which occur while the system evolves towards equilibrium, we present a theoretical background based on a family of Vlasov equation solutions constructed by non-Gaussian distributions. Proposing a transformation, we connect the Vlasov stationary solutions to a non-standard theoretical perspective. Analytical solutions for measures in equilibrium are found, together with the analytical description of non-equilibrium, giving a complete theoretical helpful framework to understand the behavior of this model. Such one is suitable to describe the QSS involved in the d-HMF model. Our results complement the notion of Tsallis formalism and represent input on a theoretical description of the system's behavior with long-range interactions in equilibrium and out of equilibrium.

**Suddhasatwa Chakraborty**
Jadavpur University, India

## An Eeg Based Approach For Identifying Processing Difference of Yellow and White Spectrum In Road Lighting

**Motivation, specific objective:** With the development of latest technologies in lighting engineering, a good amount of effort have been made to address the challenge of making an elegant road lighting solution based on different parameters like illuminance, luminance, uniformity, threshold increment etc. A technically sound lighting solution designed on the basis of these parameters may evoke differential perceptual experiences among pedestrians and drivers. A wide range of perceptual experiences have been reported by the road user under different road lighting conditions. Behavioural results of different perceptual experiments, done in different road lighting conditions also fail to give a clear picture of this situation. Detection of objects under different lighting conditions is affected majorly by subjectivity in perceptual experience. Further, majority of studies account for rod and cone activation and how it affects the spectral luminous efficiency V(λ) of the human eye . But how the lighting condition triggers higher level brain processes and cortical circuitry is still unknown. Hence, human cognition under lighting conditions present a complex yet scarcely investigated scenario. Added to this is the colour appearance of streetlights such as metal halide (MH) and high pressure sodium vapour (HPSV) lamps. As a result even simple object detection becomes highly complex. In the present study, we use EEG to compare the object detection ability of human participants under MH and HPSV. The results suggest distinct brain activations for MH and HPSV.

The objective of the study is to test and evaluate the processing differences in object detection under MH and HPSV using electroencephalography study.

**Methods:** Substantial portion of the literature in road lighting experiments investigated the preference bias in object detection under metal halide (MH) and high pressure sodium vapour (HPSV) lamps. On the basis of these perceptual experiments it is well evident that preferences in both the conditions exists in different experimental set-ups, and this is probably because of a difference in that, how human brains perceive these lighting conditions from the context of object detection. Thus the situation demands more temporal detailing, i.e. a time course activity study of on-going brain processes under MH and HPSV. Dynamic changes occur during object detection under both types of light sources with two different spectral compositions. Hence, this event related potential based study may reveal the dynamic changes associate with a series of events while detecting an object with respect to its background. It may serve as a more potent approach to analyze the ability of an observer to detect an object under two different light sources.

This paper presents a subject detection task under two different lighting conditions i.e., MH and HPSV lamps. During the task, ongoing electrical potentials of the participants were measured to evaluate the processing differences under MH and HPSV. Hence, the entire study has been divided in two segments behavioural study and EEG based study

**Results:** From our experiment it was found that for the MH matched condition the mean response time of the all participant is 1517 millisecond which is less than the mean response time (1553ms) for the HPSV matched condition. It was also found that the accuracy of right object detection is more under MH matched condition than HPSV matched condition. The total number of inaccurate responses for MH matched condition is 21 and for HPSV is 26. It can also be found that 55% of the total wrong responses are occurred under HPSV and one-third 45% under MH. So, it can be said that participant are more accurate to recognize an object under MH than HPSV in this study. Grand averaged Event Related data shows difference in early activity in the time interval 150-200ms. For MH there is a larger negative contour at 150-200 ms ($p< 0.05$) over right occipital and parieto-occipital electrodes. The area classically houses the primary and secondary visual cortex of the right hemisphere of the cortex. For HPSV, the occipital and occipito-parietal electrodes activate bilaterally.

**Conclusions:** In the present study, behavioural response and perceptual processing of the participants under two light sources, i.e. HPSV and (MH), have been observed. In the present study, no significant difference was found in the behavioural response un-

der two light sources. However, this study reveals a significant difference in brain processes during object detection under MH and HPSV. These differences are evident from the EEG results. Bilateral activity in the occipital and occipito-parietal electrodes is observed in the time interval 150-200 ms ($p < 0.05$) under HPSV. Under MH, a large negative peak appears at 150-200 ms ($p < 0.05$) only over right occipital and parieto-occipital electrodes. The current result indicates that perceptual processes differ under different lighting sources.

This experiment can also be done for the LED based road lighting systems to find out how these spectral compositions affect perceptual processes. The technical parameters like illuminance, luminance, visibility level, contrast, glare etc. can also be verified for perceptual processes.

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## From the Past to the Future

Light has been an enigma for eons. Primary questions have been what is it and what are its properties. This brief presentation views the history of light and optics and acknowledges the contributors who have made modern optics, photonics, and lasers possible. Questions and answers appeared in ancient Egypt, Mesopotamia, Asia, the Middle East, Africa, and Europe. The history is at least millennia-long and begins with crude lenses and ends with wave optics, laser communications, and quantum optics. Innovative technology breakthroughs are likely because of the productivity of this past.

# INDEX

# Upcoming Conferences

3rd Edition Scholars World Congress on
**Cancer Research and Oncology**
14-16 Nov 2022 | Dubai, UAE
cancerscience@scmeetings.org
https://scholarsconferences.com/cancer-oncology/

Scholars International Conference on
**Personalized and Precision Medicine**
14-16 Nov 2022 | Dubai, UAE
personalizedmedicine@scmeet.org
https://scholarsconferences.com/personalized-medicine/

Scholars International Conference on
**Gynecology, Obstetrics & Women's Health**
14-16 Nov 2022 | Dubai, UAE
gynecology@frontiersevents.com
https://scholarsconferences.com/gynecology-obstetrics/

Scholars World Congress on
**Diabetes, Obesity and Endocrinology**
14-16 Nov 2022 | Dubai, UAE
diabetes@frontiersevents.com
https://scholarsconferences.com/diabetes-endocrinology/

5th Edition **Scholars World Heart Congress**
November 14-16 , 2022 | Dubai, UAE
heartcongress@scmeetings.org
https://scholarsconferences.com/heartcongress/

**Scholars World Nursing and Healthcare Summit**
14-16 Nov 2022 | Dubai, UAE
healthcare@scholarsconferences.org
https://scholarsconferences.com/healthcare/

2nd Edition Scholars International Conference on **Optics, Photonics and Lasers**
May 22-23, 2023 | Paris, France
https://scholarsconferences.com/optics-photonics-lasers/

2nd Edition Scholars International Conference on
**Physics and Quantum Physics**
May 22-23, 2023 | Paris, France
https://scholarsconferences.com/physics/

5th Edition Scholars **Frontiers in Chemistry Forum**
May 22-23, 2023 | Paris, France
https://scholarsconferences.com/chemistry-frontiers/