Short Abstract

Technical Session – I **Morning** **Date: 17/03/2021**

Nonlinear optics: the good, the bad and the esoteric

Prof. Krishna Thyagarajan

Department of Physics, School of Engineering and Applied Sciences, Bennett University, Greater Noida, UP

The 1961 experiment of the generation of ultraviolet light from red light by Peter Franken and workers is usually considered to be the birth of the very important field of nonlinear optics. This led to an ever-growing field with applications pervading many branches of science and technology. Nonlinear optical effects are used today for the generation of coherent light at different frequencies for numerous applications in science and technology. At the same time nonlinear optical effects produce cross talk among the propagating signals and limit the information carrying capacity of optical fiber communication systems. With the recent interest in quantum information science and technology, nonlinear optical effects provide us with the principal technique for the generation of non-classical states of light such as squeezed states and entangled states for applications in quantum computation, quantum cryptography, quantum sensors etc. The talk throws some light on the three interesting aspects of nonlinear optics namely: the *good*, the *bad* and the *esoteric*.

Technical Session – II **Afternoon** **Date: 17/03/2021**

Nonlinear pulse shaping in optical fibers: a versatile tool for ultrafast photonics and fundamental wave propagation studies

Christophe Finot
LICB - Laboratoire Interdisciplinaire Carnot de Bourgogne [Dijon]

Abstract: The study of the combination of Kerr nonlinearity with dispersion in optical fibers has been stimulating much interest since the 80s. If such a combination can seriously impair the quality of high speed optical transmissions, it can on the contrary become an attractive solution to generate new temporal and spectral waveforms. We explain in this talk how to take advantage of the progressive temporal and spectral reshaping that occur upon propagation. We base our discussion on several experimental results obtained in the last decade at the Laboratoire Interdisciplinaire Carnot de Bourgogne. Examples exploiting both the normal and anomalous regimes of dispersion will be analyzed in the theoretical context of the nonlinear Schrödinger equation. In order to provide a rapid but pedagogical overview of the vast possibilities of nonlinear shaping in optical fibers, we will more precisely describe the following experiments carried out at telecommunication wavelengths: -The generation of parabolic and triangular temporal waveforms in normally dispersive fibers. - The generation of high-quality ultrashort pulses in the regime of anomalous dispersion. - The generation of optical rogue events

Technical Session – III **Evening** **Date: 17/03/2021**

Space-Time Duality in Optics and its Applications

Govind P. Agrawal

The Institute of Optics, University of Rochester, Rochester, NY 14627 USA

The concept of space-time duality, known since the 1960s, is attracting attention in recent years in the context of temporal imaging. In this talk I first review these advances and discuss how a time lens can be used for optical signal processing in a variety of applications. I then focus on my group's work on the temporal analog of reflection and refraction of optical pulses inside a dispersive medium whose refractive index changes across a temporal boundary. As an optical pulse approaches this boundary, it splits into two parts that propagate at different speeds because of their widely different spectra. An analog of the total internal reflection also occurs when the refractive index change at the boundary is large enough. This phenomenon can be used to make a temporal waveguide that confines optical pulses within a temporal window. I also discuss how the nonlinear phenomenon of cross-phase modulation can be used for making such a temporal waveguide by employing a pump-probe configuration.

Technical Session – IV **Morning** **Date: 18/03/2021**

Plasmon Enhanced 2D Semiconductor based Photonic Devices

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Tunable light-matter couplings in dissimilar constituents (metal & semiconductors) play a leading role in the development of two-dimensional (2D) quantum hybrids along with their applications in Si-compatible photonics. Wafer scale, vertical 2D/3D hybrid heterojunctions using 2D metal dichalcogenides layers and nanocrystals have been realized on 3D Si platforms. The heterojunctions exhibit excellent photodiode characteristics suitable for multifunctional devices with significantly enhanced spectral response, making them attractive for Si CMOS compatible photonic devices. The integration of PbS QDs with MoS_2 leads to a hybrid heterostructure exhibiting two color band and tunable infrared photoresponse using a single device. On the other hand, novel PVP coated Ag° intercalation induced synthesis has led to the formation of an intercalated impurity-free n-WS_2 layer with reversed conductivity and plasmonic enhancement. Stabilized Ag- nanoparticles embedded n-WS_2 has been used to fabricate plasmon enhanced silicon compatible broadband heterojunction photodetector. On the other hand, the detailed pump-probe investigations demonstrate the ultrafast generation and evolution of individual bright exciton-plasmon polaritons (bright plexcitons) in self-assembled size-tunable Au nanostructure-layered WS_2 hybrids. A remarkably robust Rabi-splitting energy (~ 250 meV) and comparatively higher stable plexciton formation time (~ 7.0 ps) are realized for both the plexcitons, validating the strong-coupling conditions of polariton formation. The diverse ultrafast light-matter coupling phenomena for layered TMDs and their plasmonic hybrids are attractive for next generation quantum photonic devices.

Technical Session – IV **Morning** **Date: 18/03/2021**

Practical insights into Graphene synthesis on copper using hi-tech indigenous CVD

Prof. Deshdeep Sahdev

IIT, Kanpur, India

We explore the synthesis of graphene on our fully computer-controlled QRYSTAL Chemical Vapor Deposition System, which can be programmed to run any user-defined recipe. We analyze our results using our sub-atomic resolution nanoREV Scanning Tunneling Microscope. Both instruments have been completely designed, developed, fabricated and commercialized by QuazarTech. We make close contact with the associated literature through an interleaved series of experiments and insights. The talk will cover all aspects of this work --- experimental, theoretical and instrumentational.

Technical Session – V **Afternoon** **Date: 18/03/2021**

Optical Fiber Tip-An Innovative Platform for Advanced Photonics Research

Prof. Samir Mandal

CSIR - CSIO, Chandigarh, India

Optical fiber has been proven to be very effective platform for numerous optical instrumentation and fundamental research for its excellent light guiding capacity since the inception. Structural and functional manipulation of optical fiber and its optical properties are the core of many such developments. Besides light guiding capacity one can take the advantage of its small core diameter which strongly influences the optics of the fiber. One such example could be structuring the optical fiber tip and playing with its optics, specially modified optical fiber tips, such as nano-antenna, axicon. Modified optical fiber tip shows exemplary promises as optical tool for advanced research like beam shaping, optical trapping/tweezing, imaging etc. This talk will highlight the fabrication and development of optical fiber tip as a cost effective and efficient tool for advanced photonics research and development for multidisciplinary research objectives.

Technical Session – V **Afternoon** **Date: 18/03/2021**

Photo-luminescence Spectroscopy in pulsed high magnetic fields.

Dr. Bhavtosh Bansal

IISER, Kolkata

The highest magnetic fields (>100 tesla) used for experimental research are generated using pulsed magnets. In the first part of the talk, I will introduce the concept of a pulsed magnet. I will then take you through our journey of making a modest 35 tesla pulsed magnet at IISER Kolkata, with the aim of encouraging you to take up similar initiatives in your laboratories. In the second part of the talk, I will discuss some recent photoluminescence experiments we have done in high fields.

Technical Session – VI **Morning** **Date: 19/03/2021**

Synthesis and Characterization of Thermoelectric Materials

Prof. Chia-Jyi Liu

Changhua University of Education, Taiwan

This talk will start with introduction of thermoelectric phenomenon, followed by its application and the criteria of potential thermoelectric materials. I will then then introduce some results on potential thermoelectric materials. In particular, energy-efficient synthesis of thermos-electrical materials will be discussed.

Technical Session – VII **Afternoon** **Date: 19/03/2021**

Quantum Silicon Photonics

Prof. Lorenzo Pavesi

University of Trento, Italy

We are on the dawn of the second quantum revolution, where single particles, quantum superposition and quantum entanglement are used to enable new technologies and devices. In this talk, I will review few devices, which are based on these concepts. In addition, I will show that Silicon Photonics is the proper platform to integrate quantum photonics. Indeed, Silicon Photonics is the technology to fabricate photonics devices with standard silicon microelectronics processing. By using Silicon Photonics, I will discuss:

1. a tiny, low cost, high performance fully silicon device to generate random numbers for security applications,

2. a source of single photon entanglement which can be used as a resource for quantum information applications such as quantum key distribution or as certified quantum random number generator,

3. a heralded single photon sources which works in the MIR and can be used for ghost imaging or undetected photon spectroscopy,

4. a near-ideal spontaneous photon sources in silicon quantum photonics which could enable a silicon quantum computer

Technical Session – VIII **Evening** **Date: 19/03/2021**

Noise signatures in novel correlated systems

Prof. S. Ganpathy

Professor, SUNY@ Buffalo, USA

Correlated electron materials exhibit interesting electronic and magnetic phenomena as a result of the interplay of various degrees of freedom and this gives rise to an array of potential applications from Mott-FET to magnetic storage. Electrical transport and conductivity fluctuation measurements in pure, single crystalline materials help us understand the microscopic charge transport mechanisms in competing ground states as the phase diagram of these materials are explored. In this talk, results from transport and conductivity noise measurements across metal-insulator and Neel transitions in a series of novel correlated materials will be presented.