Photonics News

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ANNUAL PHOTONICS WORKSHOP 2007

The Annual Photonics Workshop (APW- 2007) was held during 27-28 February 2007. The focal theme of the Workshop was "Recent Trends in Nonlinear Optics". The Work shop was inaugurated by the Vice Chancellor Dr. P K Abdul Azis. About 40 participants from various parts of the country participated in the programme. Prof. V P N Nampoori spoke on "Nonlinear optics and optical computing".

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His lecture was followed by a lecture on "Fluorescence Techniques to probe Photonic Materials" by Prof. V Ramakrishnan from Madurai Kamaraj University. Prof. K Porsezian from the Pondicherry University spoke on "Nonlinear Properties of Optical Fibre". "Fundamentals of Nonlinear Optics" was introduced by Dr. N V Unnikrishnan, M.G.University.

On the second day there were four lectures. Commodore Nambiar of Indian Navy (retd.) gave a lecture on "Lasers and Applications", Dr. T Ramesh Babu, Physics Dept., CUSAT on "Cavity QED", and Dr. K G K Warrier from R.R.L, Thiruvananthapuram on "Mesoporous silica aerogels". In the evening the Science Day Lecture was delivered by Prof. V Unnikrishnan Nair, Dean Faculty of Science, CUSAT. There was one session for poster presentation. The event came to a close with Karnatic musical program and other cultural activities.

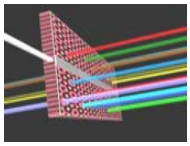
Lighting the innovation…
Inaugural session of APW 2007

Distinguished visitor

Dr. Sajeev John , Department of Physics , University of Toronto, Canada. Raman Chair Professor.

Professor Sajeev John is one of the world's leading Condensed Matter Physicists whose work on Localization of Light in Random media similar to Anderson Localization of electrons has led to what is known as Semi Conductors of Light or Photonic Band Gap Materials. His name is synonymous with the field that has come to be known as "photonic crystals". The basic concept was developed in a series of papers by Professor John during 1980's. Dr. Sajeev is the winner of the Institute of Electrical and Electronics Engineers (IEEE) LEOS International Quantum Electronics Award in 2007 for **"the invention and development of light- trapping crystals and elucidation of their properties and applications".** He is the current holder of the C. V. Raman Chair Professorship of the Indian Academy of Sciences.

"engineering of the fundamental properties of electro magnetic waves"



Prof. Sajeev John delivered a special lecture on **"Photonic Band Gap Materials – Semiconductors of Light"** on 29th October 2007. The lecture was sponsored by SPIE, The International Society for Optical Engineering.

Photonic Band Gap (PBG) materials are artificial, periodic, dielectrics that enable engineering of the most fundamental properties of electromagnetic waves. PBG materials are of great practical importance for all-optical communications, information processing, and the use of lasers in clinical medicine.

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⇒ For private circulation only.

"Whenever science makes a discovery, the devil grabs it while the angels are debating the best way to use it" ~Alan Valentine

FROM THE EDITOR'S DESK

The year that was 2007...

The year two thousand seven was a period of hectic activities as far as International School of Photonics and Centre of Excellence in Lasers and Optoelectronics Sciences were considered. At the outset let us welcome Dr. Gangan Prathap, who took charge as the Vice Chancellor of Cochin University of Science and Technology on 4th February 2008. Dr. Prathap, a specialist in Aerospace Engineering, is a Bhatnagar Award Winner and has excellent academic achievements. Under the leadership of the new Vice Chancellor, CUSAT will get evolved into one among the top institutions of the world.

The first batch of five year integrated M.Sc. (Photonics) students came out in July 2007. More than ninety percent of the students who have successfully completed the course have joined prestigious institutions for research in India and abroad. Some of them preferred research programme over placements in industries. Let us congratulate the future photonians and wish them bright future.

ISP and CELOS jointly with ISP-SPIE and ISP-OSA Student Chapters organized several programme during 2007 and they should be proud of arranging special lectures by distinguished visitors like Professor Ghatak , Professor Sajeev John , Professor Lakshmanan, Professor Thanu Padmanabhan , Dr. Rajaram Nithyananda and Dr. Reji Philip covering wide spectrum of topics like Astrophysics , Photonic crystals and Adaptive Optics.

The present issue of Photonics News is a chronicle of various activities which took place in ISP and CELOS. We take this opportunity to congratulate Mr. Jinesh Mathew whose paper on humidity sensor figured in one of the most downloaded.

Let us thank all those who worked silently behind the curtain to bring ISP and CELOS to the forefront of the academic activities in CUSAT.

New Vice Chancellor for CUSAT

Dr.Gangan Prathap

Dr Gangan Prathap is the new Vice Chancellor of CUSAT. Dr Gangan Prathap, a renowned scientist, took over as the new Vice-Chancellor of the Cochin University of Science and Technology on February 04/2008. Dr. Prathap was formerly scientist-in-charge, CSIR Centre for Mathematical Modelling and Computer Simulation, Bangalore. A winner of Bhatnagar Award in 1990, Dr. Prathap belongs to Mayyanad in Kollam. Sociologist Latha Sukumaran is his wife and their son Rahul is an engineer with L&T, Baroda.

Dr. Pratap has published more than 300 research papers, including the book "Finite Element in Structural Mechanics," which was published from Holland. He is also member of the editorial boards of many scientific journals. Dr. Prathap completed his schooling in Singapore and took his B.Tech, in Aerospace Engineering with first rank from IIT Madras in 1974. He took his doctorate from IIT Madras in 1978. He was accorded fellowships by various research institutions like Jawaharlal Nehru Centre for Advanced Scientific Research and Indian Academy of Science.

Editor-in-Chief

V. P. N. NAMPOORI

Editors

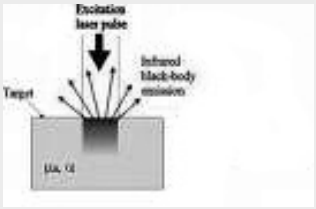
MATHEW . S

SREELEKHA . G

SUDEESH . K

Dyes modify thermal properties of clay

The thermal diffusivity (TD) measurements of montmorillonite clays intercalated with the cationic dyes like methylene blue, malachite green and auramine O, which are commonly used in the textile industry, are carried out using photoacoustic technique. The TD of dye adsorbed clays is observed to change with variation in dye concentration. The repeatedly adsorbed samples show a lesser TD than the single adsorbed samples. The TD values of the sintered samples are also experimentally obtained. The sintered samples show a higher TD though they show similar trend as unsintered pellets. A variation in dye concentration and sintering temperature can be used for tuning the TD value of the clay to the desired level. (NHTEP 2007 India, NLS-2007). The laser induced non-destructive photo acoustic technique has been employed to measure the thermal diffusivity of dental resin. The thermal diffusivity value was evaluated by knowing the transition frequency between the thermally thin to thermally thick region from the log–log plot of photo acoustic amplitude versus chopping frequency. Analysis of the data was carried out on the basis of the one-dimensional model of Rosencwaig and Gersho. The present investigation reveals that amount of monomer has great influence on the propagation of heat carriers and hence on the thermal diffusivity value. (ICIAS 2007, Malaysia).



Photothermal process.

"The TD of dye adsorbed clays is observed to change with variation in dye concentration"

Raman study of polymer optic fibers

Polymethyl methacrylate (PMMA) optical fibres are fabricated by preform drawing process. The Raman spectra of PMMA fibers are recorded using a diode pumped solid state laser 532 nm and a CCD-Spectrograph in the 400-3800 cm^{-1} range. The variation of the Raman intensity with the length of the optical fibre is studied. Investigations are carried out on the variation of FWHM of Raman peak at 2957 cm^{-1} with the length of the optical fibre and at different pump powers. The Fabrication of nanosilver doped polymer fibres and its characterisation are being studied .

Polymer optical fibre

Laser Produced Plasma

The laser induced breakdown study (LIBS) of materials in transverse magnetic fields and their emission behavior was the focal study of our laser plasma group. Neutral species in plasma show a strange response with splitting in the field and such multiple structures throw light into some of the complex process taking place in plasma. Our newly adopted probe based technique to successfully utilize the electrical signals generated by planar targets forming plasma is also found to be suitable for studying plasma dynamics in magnetic field.

Presently, the studies are being extended to a collaborative level and are being pursued at the LD group of IPR, Ahamedabad. We have extended the investigation to the forward plasma formation by Laser Blow Off of thin flms under magnetic fields using multiple diagnostics, including ICCD imaging. Efforts have been made to reconstruct the emmissivity profiles of plasmas interior through topographic techniques (pixel method). Digital interferometric method used in our lab for the in situ monitoring of the radial density profiles of plasmas as also needs special mention.

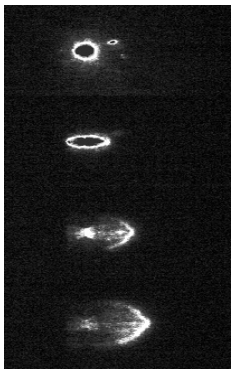
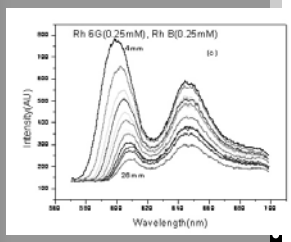


Image captured using ICCD

Li target film used for forward plasma generation

Up conversion lasing process in polymer optical fiber



Energy transfer in Rh 6G doped fibre

Two photon excited fluorescence studies in Rh6G, Rh B and Rh6G-Rh B dye mixture doped POF is carried out in our lab using 800nm, 80 fs laser beam from a modelocked Ti: Sapphire laser 'Tsunami'. The studies illustrate that the combination of a well designed mixtures of organic chromophores incorporated into a fiber geometry is appealing for the development of an up conversion polymer fiber laser which can be tunable over a broader wavelength region. Rhodamine 6G and rhodamine B dye mixture doped polymer optical fiber (POF) amplifier which can operate in a broad wavelength region (60nm) has been successfully fabricated and tested. Tunable operation of the amplifier over a broad wavelength region is achieved by mixing different ratios of the dyes. The dye doped POF amplifier (POFA) is pumped axially using 532 nm, 10ns laser pulses from a frequency doubled Q-switched Nd: YAG laser and the signals are taken from an optical parametric oscillator (OPO). A maximum gain of 22 dB at 617nm wavelength has been obtained for a 7cm long dye mixture doped POFA.

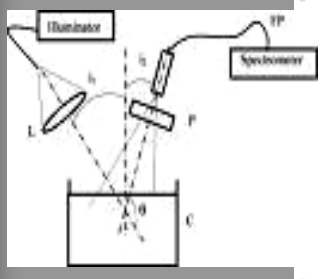
"Rhodamine 6G and rhodamine B dye mixture doped polymer optical fiber (POF) amplifier which can operate in a broad wavelength region (60nm) has been successfully fabricated and tested"

Synchronization in Chaotic systems:

Different routes to synchronization have been established in various chaotic systems. Transition from phase to complete synchronization through lag synchronization in coupled chaotic Nd:YAG lasers with a parameter mismatch is studied. The effect of delayed feedback on the dynamics of a single Nd:YAG laser and also on a coupled system is also under investigation

Lorenz attractor

Laser induced fluorescence based optical fiber probe for analyzing bacteria



An optical fiber based arrangement as a sensor element

Laser induced fluorescence has been shown to be a very sensitive analytical tool for biological studies. There are lots of applications using LIF technique. The quantum efficiency of fluorophores can change as a function of variations in the local environment of the fluorophore molecule like viscosity, temperature, refractive index, etc. Measuring fluorescence quantum efficiency is one of the experimental techniques to characterize biological samples. Usually, fluorescing dyes are also chosen for LIF based studies apart from the fluorophores present in the cells or tissues.

Optical fiber has been utilized effectively in various LIF based studies Optical fiber based laser induced fluorescence (LIF) measurements were carried out using Rhodamine B to analyze two different species of bacteria, a Gram-positive bacteria namely *Bacillus smithii*, and *Vibrio alginolyticus*, a Gramnegative bacteria. The fiber sensor was clearly able to distinguish between the two species of bacteria.

Quenching effect of the dye Rhodamine B by *Bacillus smithii* was observed. The effect of dye on the samples was also studied in detail.

Design and fabrication of Photoplethysmograph

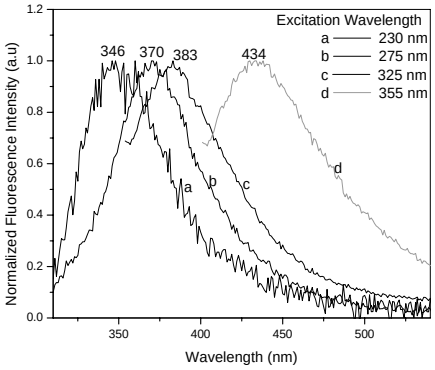
A high sensitivity, low power, low cost sensor has been developed for sensing the blood volume pulse using transmission mode photoplethysmography (PPG) from the finger tip. A heart rate meter was designed with a PIC as its heart. For heart rate (HR) estimate comparison, PPG signals are evaluated by comparing their beat-to-beat estimates with the corresponding R-R intervals from an electrocardiogram (ECG). The main advantages of the proposed approach are the reduction in cost, dimensions and power consumption. The probe can be well tolerated by the subject and is self contained and portable Work has also been carried out to study noninvasively the systolic and diastolic characteristics of the resting peripheral volume pulse using a normalized mean pulse as a function of age using an indigenously developed hardware setup. Evaluation of the minimum rise time (MRT), Stiffness index (S.I) and the ratio between the pulse height at the dicrotic notch of the blood volume pulse (P0) and the systolic peak (P1) demonstrated strong correlations with age. The younger age group had lower MRT, S.I, and P_0/P_1 values when compared to the older group. This study establishes the usefulness of the blood volume pulse contour analysis in determining the changes in the elastic properties of the vascular system with age. The study of the relationship between the blood volume pulse signals and blood pressure is currently under progress

PPG measurement taken at ISP

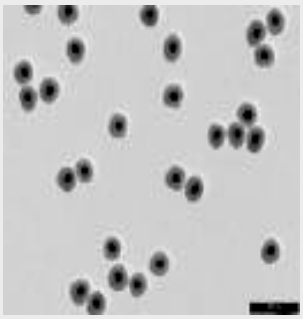
"A heart rate meter was designed with a PIC as its heart. For heart rate (HR) estimate comparison, PPG signals are evaluated by comparing their beat-to-beat estimates with the corresponding R-R intervals from an electrocardiogram (ECG)"

Fluorescence spectroscopy of nano colloids of ZnO

Fluorescence spectra of ZnO consist of two principal bands: UV and visible. Apart from the known band gap 380 nm and impurity 530 nm emissions, emissions at 420 and 490 nm are developed with particle size. The blue luminescence in ZnO is by the mechanism of the transition from near band edge to deep acceptor level and the green luminescence is by the mechanism of the transition from deep donor level to valence band. The fluorescence behaviour of nano colloids of ZnO has been studied as a function of the excitation wavelength and there is a red shift in emission peak with excitation wavelength. This observation has been attributed to the presence of energetically different associated forms of the constituent molecules and slow rate of the excited state relaxation process in these media. In essence, the inefficient energy transfer between the upper and the lower vibrational levels of the excited state of these particles owing to short fluorescence lifetime is primarily responsible for the excitation wavelength dependent spectral shift of ZnO nano colloids.



Fluorescence shift of ZnO nano particles



SEM of ZnO Nano colloids

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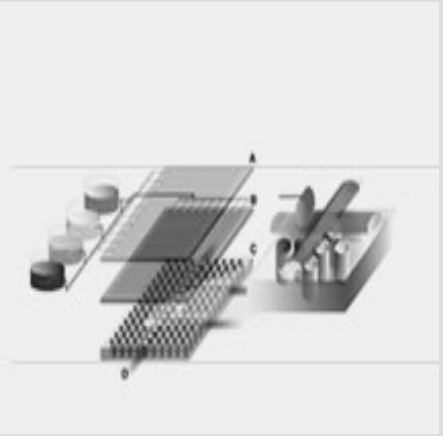
"In the context of integrated bio-chemical sensing, fluidics can be used to carry substances to be analyzed through highly sensitive micro photonic circuits"

Optofluidics – Marriage of light with fluids

Quest for miniaturized devices using photonic industry and fundamental properties of fluids has created a new path of scientific research, popularly now known as Optofluidics. Optofluidics fundamentally aims at manipulating fluids and light at the microscale and exploiting their interaction to create highly versatile systems, ranging from optical lenses to optofluidic microscopes. The introduction of liquids in the optical structure enables flexible fine-tuning and even reconfiguration of circuits such that they may perform tasks optimally in a changing environment

The potential applications of optofluidic devices are twofold. In the context of integrated biochemical sensing, fluidics can be used to carry substances to be analyzed through highly sensitive micro photonic circuits. Conversely, microfluidics can be exploited to control microphotonic devices, making them tunable, reconfigurable and adaptive.Current investigation into optofluidic intergration is still in very formative stage. Most research thus far has approached optofluidics from standpoint of enhancing photonic device functionality. However, progression can be made on further integration of sophisticated nano/micro fluidic platforms and fluid actuation techniques. Further employment of liquid crystals and nonlinear fluids will enable dynamically configurable photonic devices with wide range of applications. Surface chemistry modulation of fluidics also can be used to manipulate the properties of system. In short, optofluidics offer a new area of research which can potentially result in low cost diagnosing devices and analytical tool with perfect marriage of light and fluids.

A schematic diagram that summarizes our approach is shown above, where a nanostructured optical substrate is integrated with a microfluidic structure that performs functions such as reconfiguration of functionality, adaptation of properties, distribution of chemicals to be analyzed, and temperature stabilization

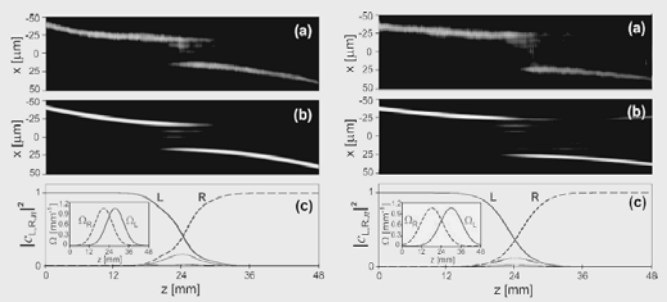


details @ http://www.optofluidics.caltech.edu/optofluidics/index.html

Optical wave mimicking of coherent population transfer in multilevel atomic systems

Quantum–classical analogies provide useful insights into basic physical phenomena that play a fundamental role in as diverse physical fields as quantum computing, nano-engineering and the search of new techniques to manipulate and control light waves in photonic structures. The present intertwining of apparently unrelated fields is as a result of this new engineering. Optical analogues of quantum effects like Bloch oscillations, Zener tunnelling, dynamic localization, coherent enhancement and destruction of tunnelling, adiabatic stabilisation of atoms in strong fields etc were successfully investigated in engineered photonic systems. These studies not only give a new insight into the corresponding quantum phenomena, enabling a direct access to the wave packet dynamics, but open new ways to manipulate the flow of light drawing concepts and methods from the quantum physics context.

The recent report is based on the optical analogue of Stimulated Raman Adiabatic Passage (STIRAP), via dressed states in optical waveguide arrays. Prof. Stefano Longhi, Dr.G.Della Valle, Prof. Paola Laporta et al. have earlier demonstrated the analogue of Coherent Tunnelling by Adiabatic Passage (CTAP) in a triplet of tunneling coupled optical waveguides in which light waves tunnels from the first waveguide to the last one without appreciably populating the middle one. But the extension of STIRAP to a multilevel system (i.e. an array of waveguides) is a nontrivial task owing to the non-existence of a dark state with no populations in all the intermediate levels (i.e. waveguides). Hence on a theoretical basis, explained as dressed state approach, the transfer process may be basically reduced to a three level STIRAP scheme (straddle STIRAP). It can be shown that a complete population transfer from the level |L› to level |R›, without appreciably populating all the intermediate states, is possible by a counterintuitive sequence of pump and Stokes pulses, provided that the Rabi frequency W_0 is strong



Light transfer via a dressed state in the waveguide array with N=3 and N=5 with input excitation of waveguide L (a) Direct visualisation (b) BEAMprop simulation (c) Coupled-mode equation analysis.

enough and the numbers of intermediate levels N is odd.

The studies were conducted using arrays corresponding to N=3 and N=5 intermediate waveguides. Using the coupled mode equations via a dressed state approach yielding

$$i\dot{\alpha} = -\Omega_p c_L - \Omega_s \dot{c}_R, i\dot{c}_L = -\Omega_P \alpha, i\dot{c}_R = -\Omega_s \alpha$$

Where W_P and W_S are the Rabi frequencies of the pump pulse and the Stokes pulse and c_L, c_R are the mode amplitudes of left, right waveguides respectively.

The waveguide structures were fabricated in an erbium-doped phosphate substrate using an ion exchange technique carefully designed to satisfy adiabatic evolution of the system in its dark state as well as small excitation of all out-of-resonance dressed states. The dark state is given by

$$c_L = \frac{\Omega_s}{\sqrt{\Omega_s^2 + \Omega_p^2}}, \alpha = 0, c_R = \frac{-\Omega p}{\sqrt{\Omega_s^2 + \Omega_p^2}}$$

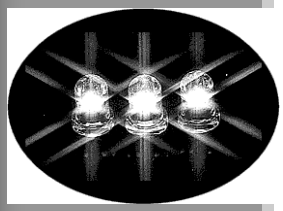
In the experiment, light transfer among coupled waveguides were visualized using a fluorescence imaging technique. An almost complete light transfer from the left to the right waveguides is observed for both N=3 and N=5 intermediate waveguide, in good agreement with the light pattern evolution predicted by the numerical simulations using BeamPROP5.0 and coupled mode equations. (APL 92, 011106(2008))

Toney Teddy Fernandez
Research student, under the guidance of Dr. N.V.Unnikrishnan, Reader ,School of Pure and Applied Physics, MG University.

Currently in a collaborative work at Dipartimento di Fisica and Istituto di Fotonica e Nanotecnologie del CNR, Politecnico di Milano, Milano, Italy.

"Optical analogues of quantum effects were successfully investigated in engineered photonic systems"

High-brightness LEDs offer energy-efficient lighting solutions



A brightness of technology?

The efficacy of white LEDs—defined as lumens out divided by wall plug watts in—has already surpassed that of incandescent technology and is now about the same as fluorescent lamp technology. One of the most common LED packages was the T 1-3/4 thru-hole package (above left). The 1-3/4 designates the package diameter in eighths of an inch, so the lens has an outside diameter of roughly 5 mm. The die that emits light was only 0.3 x 0.3 mm and was nominally used with a maximum current of 20 milliamps. Larger sizes and higher currents were not typically used because the T 1-3/4 package used leads that were not able to handle the higher thermal load.

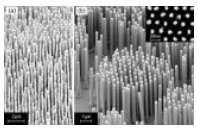
To provide more light, the size of the light emitting die was increased, with a 1 x 1 mm die becoming a fairly common size. These larger die use higher currents (e.g., >350 mA), and that has required changes to the thermal design of both the die and the LED package. Some packages can handle currents greater than 1 A for a 1 x 1 mm die. The increase in the die size and the increase in LED efficiency have both contributed to the improvement in LED package output. Researchers at Lamina demonstrated a 28,000-lumen solid-state white light engine

"To provide more light, the size of the light emitting die was increased, with a 1 x 1 mm die becoming a fairly common size"

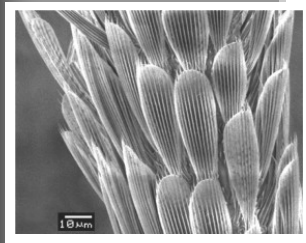
Zinc oxide nano lasers stand out

Researchers in Germany have fabricated nano rods made from zinc oxide that have been shown to emit laser light. Arrays of well ordered, vertically aligned zinc oxide nanorods have been shown by scientists at the University of Karlsruhe to emit laser light. By focusing the laser excitation down to a spot size smaller than 1 µm, the researchers found that even single nanorods standing on a substrate could lase.

Zinc oxide (ZnO) is a wide bandgap semiconductor that emits laser light in the ultraviolet range up to room temperature. The uniform size of the nano rods is crucial for nanolaser applications, since the ability of the rods to lase depends strongly on the rod geometry.



Mosquito legs show how to walk on water



Nothing but mosquito legs!

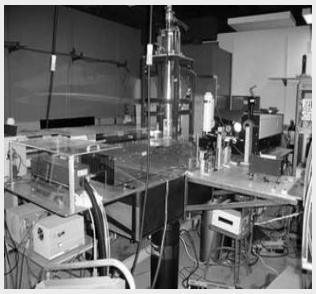
Researchers at Dalian University of Technology in China and Simon Fraser University in Canada have characterized the microstructure of mosquito legs. They have found that the insect's ability to alight on water and solid surfaces is intimately related to the anatomy of their legs.

Using scanning electron microscopy, the team discovered that the legs of *Culex quinquefasciatus* and *C. fatigans* species have seven sections, each covered by a large number of teardrop-shaped scales about 15 µm wide and 50 µm long. Ten ridges 200–250 nm thick extend longitudinally along the scales and are connected by numerous fine transverse ribs.

The researchers measured the force a mosquito leg could support on the surface of water by plunging legs attached to a force-extension apparatus into water at a slow constant rate and at different entry angles. Chen Wei Wu and coworkers determined that a mosquito can support 23 times its body weight on the surface of water. The contact angle of a water droplet on a mosquito leg is 153°, indicating that the scales are relatively hydrophobic. They explain that the mosquito is able to adjust the angle and contact length with the water surface to optimize its floatation, which arises from surface tension.

Femtosecond pulses kill viruses, leave human cells alone

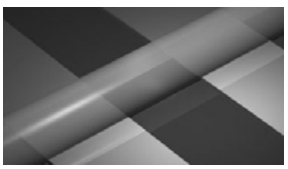
Kong-Thon Tsen and his collaborators used an off-the-shelf femtosecond laser in this experimental setup to inactivate viruses in liquid. The technique offers a means to cleanse microbes from infected blood. Shaw-Wei Tsen, a biology student at Johns Hopkins University (Baltimore, MD), and his father, Kon-Thon Tsen, a laser expert at Arizona State University (Tempe, AZ).developed a virus-killing system using a commercially available femtosecond laser. A Ti:sapphire laser produces 80 fs pulses at a wavelength of 850 nm and a repetition rate of 80 MHz. The beam passes through a frequency-doubler and gets converted to violet (425 nm) light in pulses with a duration of 100 fs and a spectral width of about 60 cm^{-1}. A lens focuses the light beam onto the virus sample. They spiked saline solution with known concentrations of virus, and then irradiated the samples. The treatment reduced the amount of live virus in the sample by 100- to 1000-fold. They found a steep dropoff in surviving viruses at an excitation-laser power density of greater than 50 MW. It is the first time that low-power lasers have been shown to inactivate viruses.



Lighting the nanoworld with nanolamps

To help light up the nanoworld, a Cornell interdisciplinary team of researchers has produced microscopic "nanolamps" -- light-emitting nanofibers about the size of a virus or the tiniest of bacteria.Using a technique called electrospinning, the researchers spun the fibers from a metallic element, the ruthenium, and a polymer. These nanofibers are so small that they are less than the wavelength of the light they emit. Apparently, these nanofibers are easy to produce. But before they can be integrated into our increasingly smaller electronic devices, there still is a need to know how long these nanolamps can last.

The fibers, made of a compound based on the metallic element ruthenium, are so small that they are less than the wavelength of the light they emit. Such a localized light source could prove beneficial in applications ranging from sensing to microscopy to flat-panel displays.

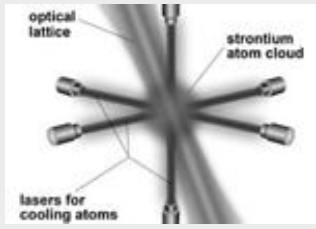


An illustrated closeup of an electrospun fiber. During experimentation the organic devices gave off an orange glow

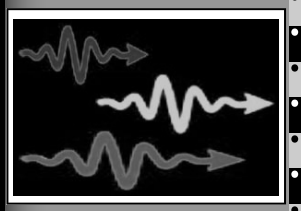
"These nanofibers are so small that they are less than the wavelength of the light they emit"

Optical lattice beats atomic-clock accuracy

Researchers in the US have built a new optical clock from strontium atoms that they claim is the world's most accurate clock to use neutral atoms. According to the team, the time piece is accurate to about one part in 10^{16} and would neither gain nor lose a second in more than 200 million years. The clock, which was built by Jun Ye and colleagues at JILA and the University of Colorado in Boulder, is based on thousands of strontium atoms that are trapped in an "optical lattice" made from overlapping infrared laser beams. The atoms are bathed in light from a separate red laser at a frequency corresponding to an atomic transition in strontium — which causes this light to lock into the precise frequency of the transition. The oscillation of this light is just like the ticking of a clock — the first neutral-atom timekeeper to be more accurate than the standard cesium-fountain atomic clock. The team determined the clock's accuracy by sending its time signal via a 3.5-km underground optical fiber from JILA to the National Institute of Standards and Technology (NIST) in Boulder, where the signal was compared to that from an optical clock based on neutral calcium atoms.



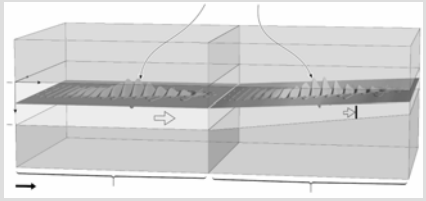
Optical clock



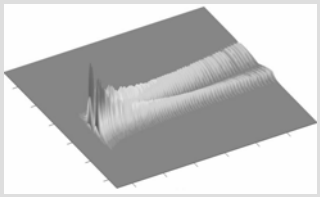
"In quantum networks, information optically transmitted over the network is converted into matter, processed, and then converted back into light"

Trapped rainbow storage of light in metamaterials

Recent research has examined the possibility of modifying the way the light travels by taking a normal transparent dielectric and inserting tiny metallic inclusions of various shapes and arrangements. As light passes through these structures, oscillating electric currents are set up that generate electromagnetic field moments; these can lead to dramatic effects on the light propagation, such as negative refraction. Possible applications include lenses that break traditional diffraction limits and 'invisibility cloaks'. Significantly less research has focused on the potential of such structures for slowing, trapping and releasing light signals. Surprisingly, our analysis reveals a critical point at which the effective thickness of the waveguide is reduced to zero, preventing the light wave from propagating further. At this point, the light ray is permanently trapped, its trajectory forming a double light-cone that we call an 'optical clepsydra. Each frequency component of the wave packet is stopped at a different guide thickness, leading to the spatial separation of its spectrum and the formation of a 'trapped rainbow'.



A guided wave packet is efficiently injected from the ordinary waveguide to the LHH inside which it propagates smoothly owing to the slow (adiabatic) reduction in the thickness of the core.

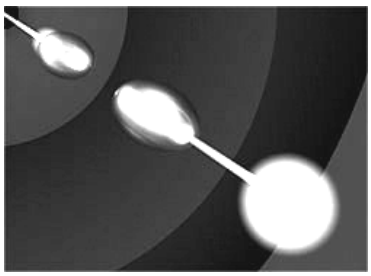


Light Changed to Matter, Then Stopped and Moved

By converting light into matter and then back again, physicists have for the first time stopped a light pulse and then restarted it a small distance away. This "quantum mechanical magic trick" provides unprecedented control over light and could have applications in fiber-optic communication and quantum information processing.

In quantum networks, information optically transmitted over the network is converted into matter, processed, and then converted back into light. The physicists at Harvard University hope that their discovery could provide a possible way to do this, since matter, unlike light, can easily be manipulated.

The amplitude and phase of the light pulse stopped and extinguished in the first cloud are imprinted in this traveling component and transferred to the second cloud, where the recaptured information can recreate the original light pulse. The period of time when the light pulse becomes matter, and the matter pulse is isolated in space between the condensate clouds, could offer scientists and engineers a tantalizing new window for controlling and manipulating optical information; researchers cannot now readily control optical information during its journey, except to amplify the signal to avoid fading.



In a "quantum mechanical magic trick" devised by Harvard University physicists, a light pulse is extinguished in one ultracold atom cloud (purple), converted to matter and then revived in another before being allowed to exit the second cloud in its original state.

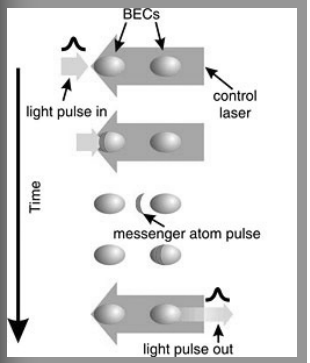


Diagram showing the time line for the Harvard research.

Praveen Cheriyan Ashok represented ISP-SPIE Student Chapter in SPIE Leadership Meeting -2007 at Sandiego

Praveen Cheriyan Ashok who was the President of ISP student chapter for the year 2007 represented the chapter in the annual SPIE leadership meet held at San Diego. During SPIE Optics +Photonics Conference, he presented the work of chapter impressively in the meeting.

He attended the SPIE scholarship committee meeting and discussed the practical problems faced by Indian students applying for SPIE scholarships. He also presented a paper on Optical metrology during Optics + Photonics conference

Placements of the first batch of Integrated M.Sc. (Photonics) 2007 students from CELOS

1. Aneesh Alex
PhD student,
School of Optometry and Institute of Vision,
Cardiff University, United Kingdom.

2. Harish Natarajan Swaha Krishnamoorthy
Department of Physics,
Queens College of CUNY,USA.

3. Jithin Jose
University of Twente, Biophysical Engi neering (BPE), The Nether lands.

4. Sujith Manjooran
Department of Experimental Physics,
National University of Ireland,
Republic of Ireland.

5. Ranjini Raghunandan
PhD student,
Department of Chemistry,
University of Basel, Switzerland.

6. Bejoy Varghese
Ph.D student,
University of Cameraino,
Italy.

7. Priya Rose .T
Ph.D student,
University of Naples,
Italy.

8. Jaya Mathews
Project Associate,
Experimental Optics (EXPO) lab,
IIT Madras, Chennai-600 036.

9. Aparna Das
PhD student
Sungyunwan University,
South Korea.

10. Deepak Vijayakumar
Ph.D student
DTU – Fotonik, Department of Photonics Engineering,
Technical University of Denmark,
Denmark.

11. Sreeja Thampi
Ph.D student
Gwaugju Institute of Science and technology,
South Korea.

12. Nimi Gopalakrishnan
Junior Research Fellow
C/O Dr. Kaustubh Rau
Lab 22,
National Centre for Biological Sciences,
TIFR,GKVK Campus,
Karnataka, India-560065.

PSI-2007prize to Shaija P.J.

Mrs. Shaija Johnson receives the Photonic Society of India Prize of the year 2007 who became first rank in M.Tech Degree Examination in Optoelectronics and Laser Technology conducted by CUSAT. The PSI prize is given every year to the student who stands first in M.Tech Degree Examination (OE&LT) of Cochin University Of Science and Technology. This prize is instituted by Prof. C.P Girijavallabhan, Director, CELOS. The prize which in cash, memento and merit certificate will be presented duringthe inaugural function of APW 2007. Mrs. Shaija is at present working as a lecturer in Model Engineering College, Thrikkakara.

Harikrishnan S.B. Receives the Nalanda Endowment Prize-2008

The 2008 Nalanda Endowment Prize will be presented to Mr. Harikrishnan S.B during the inaugural function of APW-2008. The Nalanda Endowment Prize is instituted by Prof. N. G. Devaki of Department pf Hindi, CUSAT. This prize includes cash, memento and merit certificate and is given every year to the student who stands first in the First Semester Examination of Integrated M. Sc (Photonics) Degree of CUSAT.

The ISP-SPIE Student Chapter activities in the year 2007

The ISP-SPIE Student Chapter was established in 2005 with an aim to be the part of the largest international force for the exchange, collection and dissemination of knowledge in Optics, Photonics and Imaging. The present office bearers were elected on January 18, 2007. Then the chapter was on the move. The chapter has organized many activities to enhance the scientific and social attitudes of the chapter members.

The chapter activities were given a kick-off with the blood donation camp which was a success, with the whole support and contribution. After this, many events have taken place, which exhibited the power and imagination of the chapter members. The two 'optics to school' held to Bhavans Girinagar and Rural high school Thumpur proved that the members are capable of explaining to the school children the miraculous world of light in a simple and attractive manner.

The regular activities were complemented by the teachers' day celebration (Sept-5), Environmental day celebrations (Jun-5), Yoga Class, and Neuro linguistic Program which all enhanced the personalities of the chapter members. The Tuesday seminars, was a venue for all the members to speak on scientific topics which later became hot discussions. This was a good event to enhance the scientific inquisitiveness of the students.

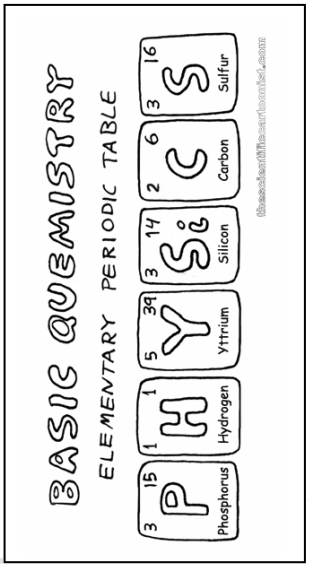
The lecture series by Prof. Rajaram Nityananda, Prof. M. Lakshmanan and Prof. Ajoy Ghatak was very useful to the student community as a whole as it gave a good understanding of the specified topics in an elegant manner. The 'Optics Fair' was a huge success with the school students welcoming such a noble move. Their acknowledgment has motivated us to design and plan for a better Optics fair in the coming years. All the volunteers played their part well in the optics. This effort has been acclaimed by the SPIE. Now the Chapter is respected globally. This respect endowed on us is a mark of achievement of the Chapter.

We would like to mention with Gratitude the contribution of Mr. Jijo P.U., Mr. Rajesh M, Mr. Thomas Johny in shaping the Chapter. Special mention to Mr. Jenu V. Chako for designing the posters, for schools and Mr. Siddarth Joshi for designing the website of the chapter, www.spie.in. A new post of Joint secretary is being made to make the working smoother.

"The chapter activities were given a kick-off with the blood donation camp which was a grand success"

Optics Fair 2007 was organized by the ISP-SPIE Student Chapter

Optics Fair 2007 was organized by the ISP-SPIE Student Chapter on 17-18 October 2007. The program was a big success with more than 1300 school students participating in the two day event. The feedback we received was overwhelming. The enthusiastic and motivated faces of the school students told us directly of the success of the program. The Optics Fair was the largest event conducted by the chapter in its three year history. Chapter members were enthusiastic about this event from the beginning and excited to get a feel for teaching school students the real world of Optics and Light. The fair was open to a wide range of student ages, so activities had to be designed that were appropriate for all abilities. The main idea behind this fair was to introduce the younger kids to the magnificent field of Optics in a simple manner. High School students were exposed to more facts with the goal to motivate the higher secondary students to pursue the field of Optics. The event also proved a good occasion to teach the topics taught in the schools in a better way.



Seminars by visitors

18-01-2007: "Laser based technologies for detection of trace", by Dr. Jaipal Dudeja, Laser science and Technology Centre, New Delhi.

02-02-2007: "Optical Networks", by Mr. George Mathew, Deputy General Manager, Southern Telecom Region, BSNL, Ernakulam.

13-03-2007 to 15-03-2007: Lecture series on "Linear and Nonlinear Dispersive Waves: Solitary Waves, Optical solitons vs computing". By Prof. M Lakshmanan, Centre for Non linear Dynamics, Bharathidasan University, Tiruchirappally.

28-06-2007: "Dynamics of Coupled Cellular oscillators: Applications to Circadian System", by Dr. P Indic, Medical School, University of Massachusetts.

19-07-2007: "Imaging advances in radiation therapy", by Ms. Geetha Menon, Medical Physicist, Cross Cancer Institute and University of Alberta, Edmonton, Canada.

16-08-2007: "Elements in Image Processing", by Dr. T P Sasikumar, Scientist, ADRIN, Department of Space Secunderabad.

24-09-2007 to 26 -09-2007: Lecture series on "Optics and Quantum mechanics", by Prof. Ajoy Ghatak, Emiretus Professor, Indian Institute of Technology, Delhi.

29-10-2007: "Photonic Band Gap Materials: Semiconductors of Light", by Prof. Sajeev John, Department of Physics, University of Toronto, Canada.

06-12-2007: "Laser Speckle Imaging and Analysis for Functional and Anatomical Imaging of Brain", by Dr. Suresh Paul Joseph, TOCH Institute of Technology.

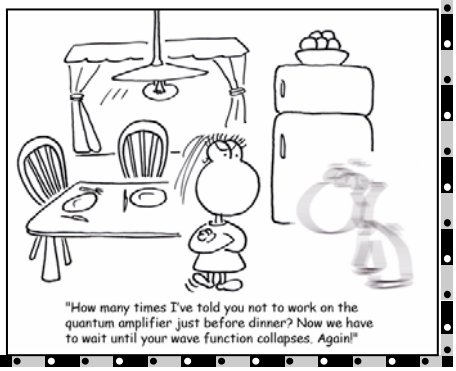
10-12-2007: "Structural, Electrical, Thermal and Spectroscopic characterization of $LiMn_2O_4$", by Dr. Thomas Lee, Departamento de Fisica, Universidad de Conception, Casilla-160C, Conception, Octava Region, Chile.

10-12-2007: "Photo thermal Radiometry: A tool for subsurface studies", by Dr. Jyotsna R, Departamento de Fisica, Universidad de Conception, Casilla-160C, Conception, Octava Region, Chile.

31-12-2007: "Understanding the Universe : New insights and Challenges", by Prof. T Padmanabhan, IUCAA, PUNE.

10-01-2008: "Femtosecond lasers and Ultra fast processes", by Dr. Reji Philip, Raman Research Institute, Bangalore.

18-01-2008: "Ultra fast nonlinear spectroscopy", by Prof. Ajoy Kumar Kar, School of Engineering and Physical sciences, Heriot-Watt University, Edinburgh, UK.



New Doctorals from ISP

Pramod Gopinath has received his PhD for the thesis titled 'Studies on Optical and X-ray Emission Processes in Laser Produced Plasma'. He has completed his doctoral work under the guidance of Prof. V P N Nampoori.
Now he is working as Reader in Physics Faculty of Applied Sciences Indian Institute of Space Science and Technology.

Santhi.A.Joseph has received her PhD for the thesis titled 'Investigations of optical interaction processes in certain photonic materials using z-scan and thermal lens techniques'. She has completed her doctoral work under the guidance of Prof. V P N Nampoori. and Prof. P Radhakrishnan as co-guide.

Now she is working at Service d'Optique et d'Acoustique, Université Libre de Bruxelles, Belgique.

Sr.Ritty J.Nedumpara has received her PhD for the thesis titled 'Studies on ASE, Lasing and NLO Characteristics in Certain Laser Dyes'.

She has completed her doctoral work under the guidance of Prof. P Radhakrishnan. Now she is working as a lecturer at Vimala College, Thrissur.

"The only source of knowledge is experience"...

Photonics Community of CUSAT Mourns the Demise of Sibilathullah A.M.

Sibilathullah A.M's unexpected death took away one of the exceptional promise from the family of Photonics. At the time of his untimely death, he was a student in the third batch of Integrated M. Sc (Photonics). He was very active in all the events that tookplace at International School of Photonics and CELOS. He was native of Calicut district and joined CELOS in the year 2003.

Publications...

Recent publications from ISP

1. Achamma Kurian, Sajan D. George, C.V. Bindhu, V.P.N. Nampoori and C.P.G. Vallabhan, **"Thermal lens technique to study the effect of pH on electronic energy transfer in organic dye mixtures"**; Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy, **67**, Issues 3-4, July 2007, Pages 678-682

2. Annieta Philip K, Lyjo K. Joseph, Litty M. Irimpan, Bindu Krishnan, P. Radhakrishnan, V. P. N. Nampoori and Raghu Natarajan; **"Thermal Characterization of Ceramic Tapes using Photoacoustic Effect"**; Physica Status Solidi (a), 204 (3), 737 (2007).

3. Jayasree V.K, Shaija P.J, Manu P. John, P. Radhakrishnan; **"An Optoelectronic Sensor Configuration for the Determination of Age Related Indices Using Blood Volume Pulse"**; Sensors & Transducers, vol.87, Jan.2008, pp 39-45.

4. Jayasree V.K, Shaija P.j, V.P.N Nampoori, C.P. Girijavallabhan, P. Radhakrishnan; **"A simple and novel integrated opto-electronic system for blood volume pulse sensing and heart rate monitoring"**; International Journal of Optomechatronics, 1: 359-368, 2007.

5. Jinesh Mathew, K. J. Thomas, V. P. N. Nampoori and P. Radhakrishnan, **"A Comparative Study of Fiber Optic Humidity Sensors Based on Chitosan and Agarose"**; Sensors & Transducers Journal, Vol.84, Issue 10, October 2007, pp. 1633-1640.

6. Litty Irimpan, Bindu Krishnan, A. Deepthy, V.P.N Nampoori and P. Radhakrishnan; **"Size dependent enhancement of nonlinear optical properties in nano colloids of ZnO"**; Journal of applied physics, 103, 033105 (2008).

7. Litty Irimpan, Bindu Krishnan, A Deepthy, V.P.N Nampoori and P. Radhakrishnan; **"Excitation wavelength dependent fluorescence behaviour of nano colloids of ZnO"**; J. Phys. D: Appl. Phys. 40, 5670 (2007).

8. Litty Irimpan, A. Deepthy, Bindu Krishnan, V.P.N Nampoori and P. Radhakrishnan; **"Size dependent fluorescence spectroscopy of nanocolloids of ZnO"**; J. Appl. Phys. 102, 063524 (2007).

9. M Kailasnath, P.R. John, P.Radhakrishnan V.P.N Nampoori and C.P.G Vallabhan, **"A comparative study of energy transfer in dye mixtures in monomer and polymer matrices under pulsed laser excitation"**; Journal of Photochemistry and Photobiology A:Chemistry, (2007).

10. Mandamparambil Rajesh, Mavila Sheeba, Karinjamanna Geetha, Chakkalakkal P.G. Vallaban, Padmanabhan Radhakrishnan, and Vadakkedathu P.N. Nampoori; **"Fabrication and characterization of dye-doped polymer optical fiber as a light amplifier"** Applied Optics**.** 2007, **46**, Issue 1, pp. 106-112**.**

11. M. Sheeba, K.J. Thomas, M. Rajesh, V.P.N. Nampoori, C.P.G. Vallabhan, P.Radhakrishnan; **"Multimode laser emission from dye doped polymer optical fiber."**; Applied Optics, Vol 46, 8089-8094, 2007.

12. P.M. Sandeep, S.W.B. Rajeev, M. Sheeba, S.G. Bhat and V.P.N. Nampoori; **"Laser induced fluorescence based optical fiber probe for analyzing bacteria"**; Laser Physics Letters, 1-5 (2007).

13. Ritty J. Nedumpara, Geetha K, Dann V. J., V. P. N Nampoori, C.P.G. Vallabhan and P. Radhakrishnan; **"Light amplification in dye doped polymer films"**; J.of Opt.A:Pure and Appl.Opt.9 (2007) 7-14.

14. Ritty J. Nedumpara, Thomas K. J., Jayasree V. K., C.P. Girijavallabhan, V.P.N. Nampoori, P. Radhakrishnan; **"Study of solvent effect in laser emission from Coumarin 540 dye solution"**; Applied Optics 2007.

15. Samuel Varghese, Muhammed Iqbal, Suresh Nair, V.P.N. Nampoori and C.P.G. Vallabhan; **"Fabrication and Characterization of Monolithically Fused Wavelength-Independent1X4 Couplers"**; Fiber and Integrated Optics 26, 245–254 (2007).

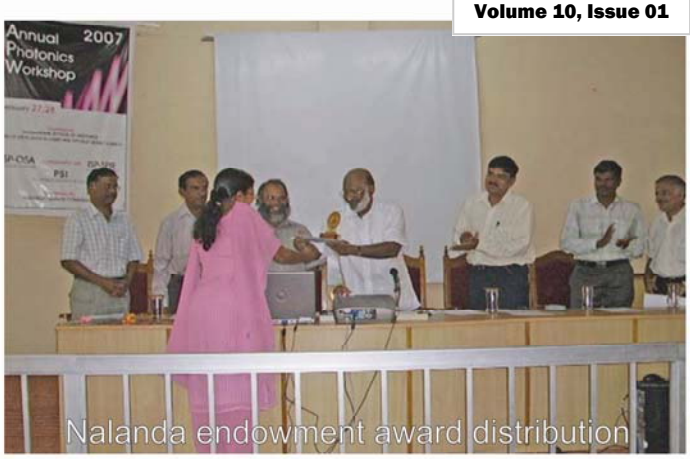
16. Sajan D. George, A.K. George, P. Radhakrishnan, V.P.N. Nampoori and C.P.G. Vallabhan; **"Photo acoustic studies on thermal parameters of liquid crystal mixtures"**; Smart Materials and Structures 2007.

17. V.J. Dann, Manoj V. Mathew, V. P. N. Nampoori , C.P.G. Vallabhan, V.M. Nandakumaran, P. Radhakrishnan; **"Spectroscopic Characterisation of Laser Induced Plasma from Titanium Dioxde"**;Plasma Science and Technology, 9(4), 456- 459 (2007).

And the last word… **" Live as though you will die tomorrow but learn as though you live for ever" -Gandhiji**

PICTURE PARLARE


APW Inaugration

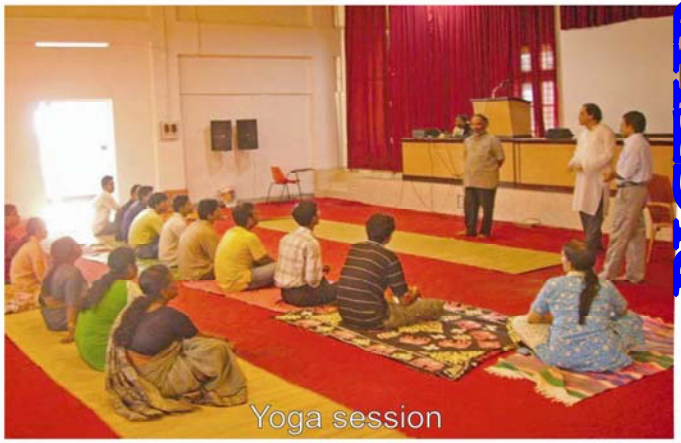


Nalanda endowment award distribution


Theodore Maimann memeorial lecture


Raman Day celebration


Cultural Programme


Yoga session


Farewell


Optics Fair

International School of Photonics

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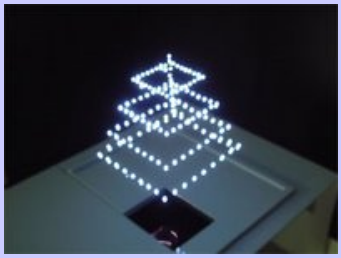

Light matters……..

International School of Photonics (ISP) came into existence in 1995 by restructuring and delinking the laser laboratories along with the faculty members of the laser group from the Department of Physics at Cochin University of Science and Technology. Manpower development and establishment of research activities in photonics and related fields are the major objectives of ISP. We have a four semester M.Tech course in Optoelectronics and Laser Technology . In 2001 we also started an M.Phil. course in Photonics with an objective to train teachers in the area of Photonics.

ISP is a one among the three participating departments in the UGC sponsored Centre for Excellence in Lasers and Optoelectronic Sciences (CELOS)

visit us @ www.photonics.cusat.edu

Indo –UK Workshop on Fibre optics and Applications

International School of Photonics, CUSAT is organizing Indo-UK Workshop during September 2008. Photonics specialists from various R&D institutions and Universities from India and UK will take part in the Workshop.

Details will be available in www.photonics.cusat.edu by the month of March.

CALL FOR PAPERS

PHOTONICS - 2008

International Conference on Fiber Optics and Photonics INDIAN INSTITUTE OF TECHNOLOGY DELHI New Delhi, India, December 13-17, 2008.

Photonics-2008 is the ninth in the series of biennial international conference in the general area of Photonics held in India since 1992. It provides a forum for interaction and exchange of ideas among scientists, engineers, researchers, and users actively engaged in the area of Photonics. Inauguration would be held at the Convocation Hall of IIT Delhi on the evening of December 14 while main conference (December 15-17, 2008) would be held at the Habitat World Convention Center. On December 13-14, tutorial courses on some of the conference topics would be held at IIT Delhi. A technical exhibition would also be organized concurrently with the conference. In addition a techno-commercial evening session would be organized on day 2 of the conference in which manufacturers and service providers related to Optical Telecommunication and Photonics in general could make presentations of their company profile and advertise at a nominal fee for the time and the venue.

Do you dream optics and photonics? Be a member of **OSA** and **SPIE** where science and technology innovators in optics and photonics come together.
Login @ http://www.osa.org/membership/join.aspx & http://spie.org/x1720.xml

OSA The Optical Society of America

SPIE Connecting minds. Advancing light.

Printed and published by Prof. VPN Nampoori, Director, International School of Photonics, CUSAT, Kochi-682022