INTERNATIONAL SCHOOL OF PHOTONICS

# Photonics News

VOLUME 08, ISSUE 1 FEBRUARY 2006

## ABOUT THIS BULLETIN:

- **Released in association with: Photonics Society of India, ISP—SPIE Student Chapter.**
- **For private circulation only.**

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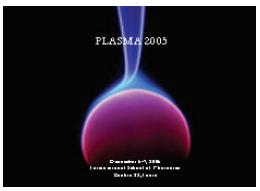
# CUSAT hosts PLASMA 2005

**ISP CUSAT hosted PLASMA 2005 conference during December 5-7, 2005. This conference was organized by International School of Photonics (ISP) and Plasma Science Society of India (PSSI) in collaboration with the Centre of Excellence in Lasers and Optoelectronic Sciences (CELOS), CUSAT.**

Plasmas are conductive assemblies of charged particles, neutrals and fields that exhibit collective effects. They respond to electric and magnetic fields and find applications in diverse areas like space, fusion, plasma processing, plasma based lighting, display systems, environmental and health applications transportation and national security. Study of plasma is important since plasmas are the most common form of matter comprising more than ninety nine percentage of the visible universe.

The twentieth national symposium on plasma science and technology (plasma 2005) was organized by International School of Photonics (ISP), Cochin University of Science and Technology (CUSAT) and Plasma Science Society of India (PSSI) in collaboration with the Centre of Excellence in Lasers and Optoelectronic Sciences (CELOS), CUSAT. The focal theme of the symposium was Laser produced Plasma. The symposium was organized to provide a scientific forum for the presentation of new results and to discuss recent developments in various fields of Plasma Science and Technology.




Plasma Science Society of India is a professional organization which promotes research and development activities in the field of plasma science. It organizes Plasma conference every year in collaboration with various institutions. It is for the first time that the conference was organized in Kerala. International School of Photonics CUSAT, contributes substantially in the field of Laser produced Plasma and hence the focal theme of the conference was accepted as Laser produced Plasma.

The symposium was inaugurated by Professor Abdul Azis, Vice-Chancellor, Cochin University of Science and Technology on 5th December, 2005 at 9.30 a.m. In the inaugural session, keynote address was given by Professor Abhijit Sen, Dean, Institute of Plasma Research, Ahmedabad. The technical programme comprised of keynote address, plenary talks, invited talks, and contributed oral and poster presentations in various fields of Plasma Science and Technology. Participants from various academic institutions from India, abroad and scientists from National Laboratories and various industries took part in the symposium. One session of the symposium was dedicated to presentations by researchers competing for the Buti Foundation Awards for 2005. This year's award was given to Mr. Suraj K. S from IPR. The symposium was preceded by two tutorial sessions on 4th December, giving an overall exposure of the fundamental aspects of laser plasma and their characterization to the students/scientists who have just entered into this area.

## World Year of Physics Celebrations

The Photonics community in CUSAT joined millions all over the world in celebrating the 100th Anniversary of Einstein's *Annus Mirabilis*. The World Year of Physics (WYP) was celebrated at ISP by organizing seminars and tutorial lectures. The Grand Finale of the celebration was organized during 21st and 22nd December 2005 by ISP in collaboration with the Academy of Physics Teachers, CELOS, Physics Kerala Group and ISP-SPIE and ISP-OSA Student Chapters. Kerala State Council of Science, Technology and Environment sponsored this programme. The conclusion of WYP celebration was marked by Einstein Film Festival in which eight films on Einstein were screened including *Einstein's Universe* produced by ISP-SPIE Students Chapter. Two special lectures were also arranged during the concluding session of the WYP Celebration. Dr V P Nair of City University of New York and Dr Virendra Mahajan of Aerospace Corporation, California gave lectures on *Dreams of Unified Field Theories* and *Recent Trends in Optics* respectively.



# From the Editor's Desk

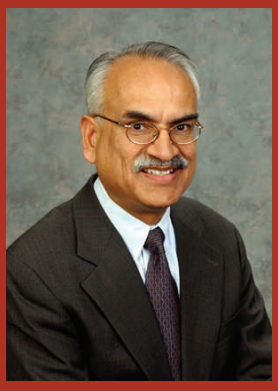
It is with great pleasure that we bring out this edition of Photonics News. The year 2005 was quite eventful as far as the ISP and PSI ware concerned. It was the year which saw new ventures in academic as well as extramural activities of staff and students of ISP and CELOS in collaboration with ISP – SPIE student chapter. It is a matter of pride for photonians that the ISP-SPIE Students Chapter is the number one chapter with respect to memberships as well as the activities. We take this opportunity to congratulate the executive committee and the chapter members for these remarkable achievements. Another important event to be mentioned is the establishment of a film production centre called *Photonium* with the lead taken by ISP – SPIE students Chapter. Photonium produced two documentary films *Einstein's Universe* and *A Sentient Sequel* (documentary on CUSAT). The Einstein film was screened before audiences all over India as a part of the WYP celebration Einstein Film Festival was organized in ISP as well as in Trivandrum under the sponsorship of KSCTE. We congratulate the ISP-SPIE Student Chapter President Mr. Jijo P Ulahannan who effectively presented the activities of the Chapter during SPIE Meeting at San Diego, USA. Activities like Open house, School Outreach, Blood Donation Camp, Spectra 2005, Plasma 2005, Einstein Film Festival and WYP celebrations provided busy year of 2005 to Photonians.

ISP laboratory produced some notable results in various fields of Photonics. Fibre amplifier using dye doped polymer fiber is one of the important contributions from ISP laboratory. It also made ISP to enter into the field of Polymer Photonics. We also take this opportunity to congratulate the Integrated MSc Photonics Student Mr. Rajesh Kumar who won the IPA prize for his project as well as for getting selected for KVPY fellowship. This will be a boost to the academic pursuit of the young Photonian.

We thank all those who contributed to this issue of Photonics News.

**V. P. N. Nampoori**

**Editor-in-Chief**



**ISP SPIE Student Chapter was fortunate to host Dr. Virendra N. Mahajan, Fellow of SPIE:**

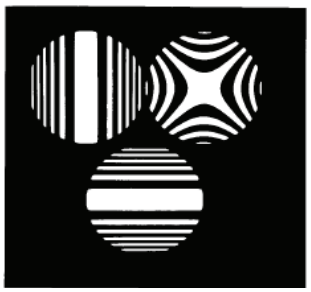
# ISP Hosts SPIE Visiting Lecturer

ISP Student Chapter of SPIE organized a Visiting Lecture series by Dr. Virendra N. Mahajan from the Aerospace Corporation, California, USA. Dr. Mahajan, who is also an adjunct Professor at the College of Optical Sciences of the University of Arizona, Tucson, delivered scholarly lectures on 'Exploring Optical Aberrations'. The lecture was sponsored by SPIE, the International Society for Optical Engineering.

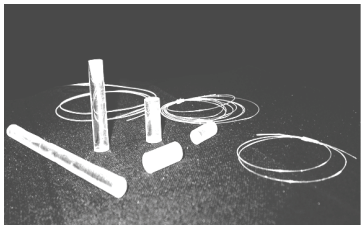
Prof. Mahajan visited ISP during 19-24 December, 2005 and also delivered a general talk on 'Recent Trends in Optical Imaging'. All his lectures were a masterly treat, describing the physical basis and the mathematical formalism giving illustrative examples of both ideas and the methods of the commonly heard about 'aberrations'. His expertise in the field is obvious by the fact that he has authored three books on optical imaging and aberrations, all published by SPIE Press.

Prof. Mahajan taught the CUSAT community about the significance of understanding optical aberrations in the modern era. His lectures were noted for their strong basis and fundamentals. It was a real honour for the ISP-SPIE Student Chapter to host a visiting lecturer of the caliber of Dr. Mahajan, who is Fellow of SPIE and a team leader at the Aerospace Corporation in the area of satellite imaging.

An excerpt from his talk showing Interferograms of Primary Aberrations is shown below.



# ISP Develops Polymer Fiber Amplifiers

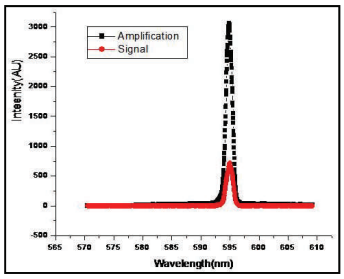


**Left : Polymer optical preforms and fibers**

Polymer fibers doped with organic dyes have proved to be potential candidates for use in fiber lasers and amplifiers in the visible region.

Researchers in ISP fabricated Rhodamine 6G doped polymer performs. Three types of graded index polymer preforms are made by interfacial gel polymerization technique. This is achieved by incorporating high refractive index molecules during the second phase of polymerization. An indigenously fabricated, completely automated fiber drawing tower is used for drawing polymer optical fibers from these preforms.

For fiber amplification studies, this optical fiber is pumped with a pulsed Nd:YAG laser beam at 532nm. Since the subsequent fluorescence emission is at 595nm, this wavelength (from wavelength tunable MOPO) is used as the signal for the fiber amplifier. The signal is fed into the fiber axially and the output is observed using a CCD Monochromator or a 1 ns photo detector. An amplification of nearly 20 dB is observed.




**Amplification observed in the fiber spectrum.**

# Photothermal and Photoacoustic Studies

Photopyroelectric technique is one of the important photothermal techniques involving detection of temperature change as a result of modulated excitation and subsequent de-excitation. The voltage or current signal obtained as a result of temperature change from the sensor (PVDF) can easily be related to the optical and thermal properties of the sample. Currently, the pulsed pyroelectric signal is used for the evaluation of excited state absorption and life time of the excited state.

Laser pulses of 8 ns from an Nd: YAG laser operating at a wavelength of 532 nm is used to excite Rhodamine 6G dissolved in water. Experiments are done for different intensities at different wavelengths. The experimental results are analyzed on the basis of a five level model.

Photoacoustic spectroscopic technique is used for the evaluation of optical and thermal properties of rare-earth titanates sintered at various temperatures. The porosity of the samples decreases with increasing sintering temperature thereby yielding enhanced thermal diffusivity.

The researchers at ISP have also come up with a novel idea for checking the purity of gold samples using this technique.

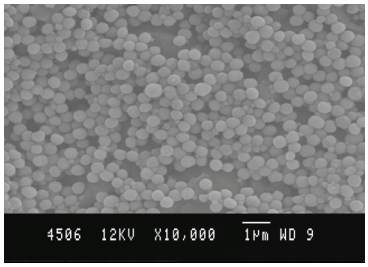
**"Photopyroelectric technique is one of the important photothermal techniques involving detection of temperature changes as a result of modulated excitation and de-excitation."**

# Nonlinear Optics and Nanophotonics

Our researchers use z-scan, a conventional tool for probing the nonlinear optical parameters of photonic materials, to evaluate the thermal and nonlinear optical properties simultaneously. Excited state absorption cross-section and the wavelength dependence of the imaginary part of third order nonlinear optical susceptibility of metal phthalocyanines is investigated. Thermal parameters of the samples such as diffusivity, conductivity, etc. are also evaluated from the intensity dependent transmittance curve.

Photonic Crystals (PC) show a great deal of promise for applications in numerous types of devices in 1, 2, and 3D structures. One of the simplest techniques of fabricating PCs involves colloidal self-assembly. Zinc Oxide is a promising candidate for optically-active self-assembled photonic crystals. PCs are produced from the ZnO colloidal spheres by the technique of drop casting.

Third order optical nonlinearity studies of these self assembled spheres as well as the colloidal solution show that the magnitude of nonlinearity of the material changes from saturable absorption behaviour in self assembled ZnO to reverse saturable absorption in colloidal ZnO. This behaviour is attributed to the changing nano particle filling factor when the colloidal solution is transformed into self assembled mono layers.




**SEM micrographs of monodisperse ZnO powders produced using a two-stage hydrolysis.**

Optical sensors that use photons as sensing elements are becoming increasingly important and relevant in the field of noninvasive diagnostics."

## Synchronization of Chaos

The effect of parameter fluctuation on the synchronization of coupled chaotic systems is studied. This holds relevance in the realm of nonlinear dynamics because the parameters of actual physical systems can fluctuate due to various reasons. It is observed that the fluctuation rates or the number of modifications to the parameter in unit time is the most important factor which determines the stability of synchronization. The effect of parameter modulations is also studied wherein it is seen that the frequency of modulation plays a similar role to fluctuation rates on the stability of synchronization.

## Biomedical Optics

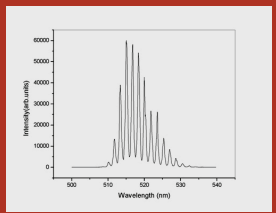
Optical sensors that use photons as sensing elements are becoming increasingly important and relevant in the field of noninvasive diagnostics. Photoplethysmography (PPG) is a noninvasive method of detecting the blood volume pulse. The hardware for picking up the blood volume pulse from human finger is developed by using the principle of transmission mode of photoplethysmography. The type of probe developed belongs to the category of contact type. Analysis of the signal is done after interfacing the pulse to a computer. The recent investigations are focused on how the obtained PPG signal can be used for early diagnostic cardiovascular studies, in the field of biometrics, etc. A fabrication of a non contact photoplethysmographic probe will also be undertaken in future.

## Laser Produced Plasmas

Laser Produced Plasma studies are significant in understanding various processes taking place during the interaction of powerful laser pulses with matter, subsequent plasma generation and evolution. The time and space resolved studies of the plasma plume generated from the laser ablated material surface give valuable information on various laser plasma parameters and their temporal and spatial fluctuations. Such investigations help in the development and control of technologies such as Extreme Ultra Violet (EUV) lithography, bioactive thin film coatings etc. Also, the emission spectra analysis of the laser plasma plume gives the elemental composition of the ablated material, which forms the basis of Laser Induced Breakdown Spectroscopy (LIBS), a compact and powerful tool in elemental analysis.

In our investigations various diagnostic aspects for the characterization of plasmas are used for spectroscopic analysis of emissions from Titanium Dioxide plasma. Data collected via time resolved and space resolved optical emission spectroscopy as well as time integrated analysis are used to compute various parameters and to investigate the plasma evolution. Probe based investigations are in progress. A probe signal which may serve as a complimentary signal for all possible probe voltage ranges is being studied. Complex biological compounds like corals are specimens for LIBS. LIBS in laser dyes and colloidal solutions of Zinc Oxides have been performed recently.

## From ASE to Laser Emission

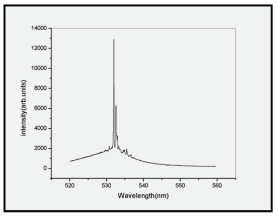



Discrete resonant peaks in the fluorescence spectrum

Amplified spontaneous emission is a common phenomenon observed in laser dyes at higher incident light intensities. It is a purely random process relying on chance interaction of fluorescent photons with excited states along the optical path. When optical losses are low and the optical path is sufficiently long, amplification and line narrowing may be observed for arbitrarily small pump intensities.

Though laser emission requires an optical cavity, researchers at ISP observed lasing and well resolved resonant modes from pure Coumarin 540 dye solution taken in a quartz cuvette without any external cavity. This emission and the number of resonant modes depend strongly on the quantum yield and the mode volume of the dye solution. The feedback necessary for the high gain is obtained by the reflections from the well polished surfaces.

An emission line width of 0.1nm has been observed in dye doped polymer thin films also. The wave guiding effect confines the emitted light within the film which enhances the gain.




**Spectral line narrowing and mode selection**

# A 75-kilometer-long Laser

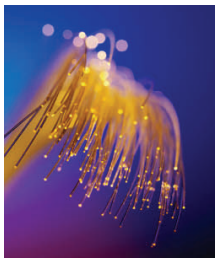
Juan Diego Ania-Castañón and his colleagues at Aston University in England have demonstrated the longest laser ever built, using an optical fiber that could stretch from Washington, DC, to Baltimore. Their 75-kilometer laser can transmit light signals with hardly any loss of power over that distance. The technique could offer a huge improvement for voice and data transmissions over long distances.

When data is transmitted through an optical fiber, the signals typically lose five percent of their power for every kilometer they travel. Hence, long fiber cables require amplification systems to periodically restore the signal power.

One technique uses the *Raman effect*: A "pump" laser injects light into a fiber segment that excites some of the fiber's atoms to higher energy. A part of this absorbed energy is then re-emitted as photons of a longer wavelength before being excited again. Introducing another longer wavelength at the same time as the pump light, increases the efficiency of Raman process and produces an amplified signal. But this Raman amplification is not uniform throughout the fiber.

This team came up with a novel solution to this problem. Using the same Raman-based scheme they could use an extremely long fiber for a single segment--75 kilometers ! At each end of their fiber the team placed a mirror that reflected only light of a single wavelength, 1455 nanometers, which was longer than the pump wavelength but shorter than the signal wavelength. These photons bounced back and forth between the mirrors in a giant laser cavity and stimulated more Raman emission at the same wavelength. This 1455-nanometer laser light then acted as a source of pump light spread throughout the fiber, and it Raman-amplified the 1550-nanometer signal uniformly--the second step of a two-stage Raman amplification process.

Besides providing lower noise and better performance, this new Raman laser amplifier might replace a number of conventional amplifiers because the technique works for such a long distance.



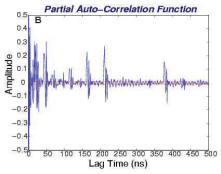
**Wired for light. Researchers transmitted a light signal through a 75-kilometer optical fiber like one from this bundle, and the signal remained nearly constant throughout its trip. In the process, they made the world's longest laser.**

# Chaotic Communication

The seemingly random behaviour of chaotic phenomena would appear to have little to do with the ordered discipline required to send a sequence of 0s and 1s in a way that can be accurately and reliably received. But researchers in Europe are doing just that: communicating with chaos. In November, 2005, they had used chaos to send digital messages at gigabit-per-second speeds over 115 km of commercial optical fiber beneath the streets of Athens, Greece.

"It's interesting, because they did it through a commercial fiber system for the first time," says Rajarshi Roy, director of the Institute of Physical Science at the University of Maryland, in College Park, USA.

The demonstration, performed by a pan-European team led by Apostolos Argyris of the University of Athens, depended on a somewhat counterintuitive property of chaotic systems: although they look disorganized, the systems are somewhat predictable. When two such systems are synchronized, they effectively become part of the same chaotic circuit. A message can be embedded in a transmitted chaotic signal and recovered through another synchronized system at the receiver's end. A chaotic signal is harder for an eavesdropper to identify because it is difficult to distinguish from background noise, which a similar system could decipher. As it happens, there is growing evidence that nature may also employ chaos to send information. Besides allowing for the more secure exchange of data, says Roy, the European work could provide "new insight into living systems."



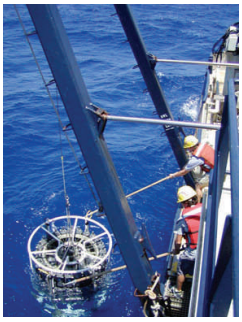

**"It's interesting, because they did it through a commercial fiber system for the first time"**

**-Dr. Rajarshi Roy, University of Maryland.**

# Out of Food? Try Eating Light

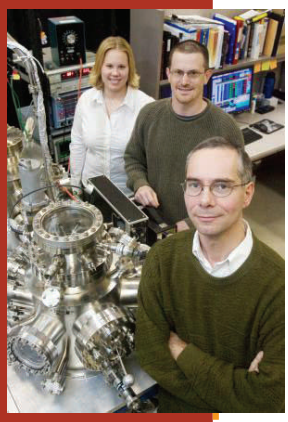
When the going gets tough, the tough may feed on light. New research indicates that the most abundant bacteria in the ocean possess a gene that could let them harness light to generate energy in the absence of food. Such light-harvesting microbes could answer a long-standing puzzle about how some bacteria thrive in nutrient-poor ocean "deserts." Bacteria in the oceans generally get energy by munching on organic carbon. However, some bacteria mysteriously thrive in nutrient-poor parts of the ocean, where little food is available. Or is it? In 2000, a team of scientists led by marine microbiologist Edward DeLong, now at the Massachusetts Institute of Technology, isolated a gene belonging to a widespread group of marine bacteria called SAR86. The gene encodes a type of protein called a proteorhodopsin, which uses light energy to pump ions out of the cell. That creates an ion gradient, which generates energy for the cell as the protons flow back in. Now researchers have found a proteorhodopsin in another common marine bacterium SAR11.

A team led by marine microbiologist Stephen Giovannoni of Oregon State University in Corvallis made the surprising discovery while sequencing the genome of SAR11, a microbe that makes up about 25% of the cells in the ocean. The current study is "a big step forward," says DeLong. "It's illuminating to find in one of the most ubiquitous bacteria in the ocean's surface." And now there's growing evidence that photo proteins may turn up in additional marine microbes, he adds. "All notions about ... its potential importance seem to be bearing out."



**Watery desert: Researchers found SAR11 thriving in nutrient-poor ocean regions such as the North Atlantic's Sargasso Sea.**

# Single molecule absorption spectroscopy



Joseph Lyding and his colleagues at the Beckman institute.

A powerful new tool for probing molecular structure on surfaces has been developed by researchers at the University of Illinois at Urbana-Champaign. Single molecule absorption spectroscopy can enhance molecular analysis, surface manipulation and studies of molecular energy and reactivity at the atomic level.

"This new measurement method combines the chemical selectivity of optical absorption spectroscopy with the atomic-scale resolution of scanning tunneling microscopy," said Martin Gruebele, a professor of chemistry, physics and biophysics and corresponding author of a paper accepted for publication in the journal Nano Letters, and posted on its Web site. "The method literally feels how a molecule changes shape when it absorbs energy."

Unlike single molecule fluorescence spectroscopy, which is now a commonly used measurement technique, single molecule absorption spectroscopy has been an elusive goal. "Single molecules don't absorb much light, making detection difficult to begin with," said Gruebele, who also is a researcher at the university's Beckman Institute for Advanced Science and Technology. "An even bigger problem, however, is that light-induced heating in the sample and in the microscope tip can produce so much noise that the signal is lost."

"Single molecule absorption spectroscopy is an extremely sensitive technique for analytical chemistry, for measuring electrical properties of molecules, and for studying energy transfer on surfaces," Gruebele said. "While most molecules don't fluoresce -- limiting the usefulness of single molecule fluorescence spectroscopy -- all molecules absorb, making single molecule absorption spectroscopy a much more general approach."

# Language colours vision

**"You get this language-based enhancement of differences or similarities -but you only get that in one half of the brain."**

**Richard Ivry**
**University of California, Berkeley**

**The left brain may view the world through the prism of language.**

Our perception of colours can depend on whether we view them from the left or the right, scientists have found. They say this demonstrates how language can alter the way we see the world. The idea that language can affect cognition is not new. In the 1930s, the American linguist Benjamin Lee Whorf proposed the controversial hypothesis that the structure of language affects the way people think. Later studies have hinted that this may be true in some circumstances. But whether language affects our perception of the world has remained an open question.

Richard Ivry of the University of California, Berkeley, and colleagues suspected that separating out the effects of visual input to the right and left brain hemispheres might yield some clues. Language is processed mainly in the left hemisphere of the brain, which also deals with signals from the left side of the retinas in both our eyes.

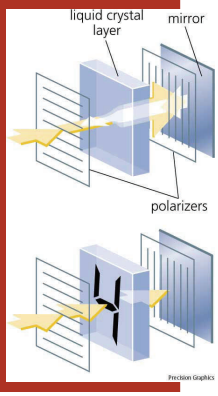
Because light from objects to our right falls mainly into the left-hand area of our retinas, the researchers hypothesized that colours to the right would feel the influence of language more keenly. Conversely, objects on our left side activate the right hemisphere of the brain, so the effect of language would be minimal.

References:

Gilbert A. L. et al. *proceedings of the National Academy of Sciences*, USA published online, doi: 10.1073/pnas.0509868103 (2005).

# Scientists unlock the mystery of liquid crystal

**The behaviour of liquid crystal alignment in an electric filed is not a mystery anymore.**



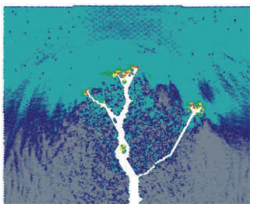

The alignment of liquid crystals in devices such as lap-top computers and palm pilots makes the displays on these devices readable. For more than 30 years, scientists have worked to understand the exact mechanism responsible for liquid crystal alignment, to no avail - until now. A group of researchers at Kent State University, headed by Dr. Satyendra Kumar, professor of physics, have finally uncovered the mechanisms of liquid crystal alignment.

The results of a Kent State study of a variety of glass substrates of the type used in liquid crystal displays (LCDs) revealed for the first time the way liquid crystals align. All substrates used in LCDs have anisotropic surface roughness. Such a surface is smooth along the grooves but rough in the perpendicular direction. When liquid crystal molecules in LCDs find themselves near such a surface, they orient parallel to the "smooth" direction. This is true of all surfaces, irrespective of the nature of the surface and the treatment method used to prepare it. The results show that even when the surface is untouched but exposed to polarized UV, it develops a structure that is anisotropic and rough. This research was performed over the past 10 years and appeared as a report in the prestigious journal Physical Review Letters.

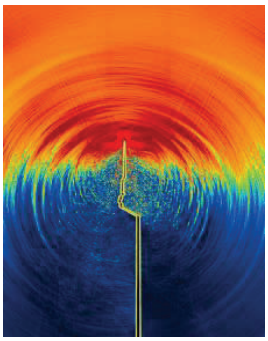
# From Mirror to Mist: Cracking the Secret of Fracture Instabilities

**Researchers from Max Planck Institute for Metals Research and Massachusetts Institute of Technology have performed atom-by-atom investigations of how cracks propagate in brittle materials.**

When materials break and cracks propagate, bonds between atoms are broken, generating two new material surfaces. Experiments have shown that cracks moving at low speeds create atomically flat mirror-like surfaces, whereas cracks at higher speeds leave increasingly rough fracture surfaces. Scientists from the Max Planck Institute for Metals Research in Stuttgart, Germany and the Massachusetts Institute of Technology in Cambridge, Massachusetts have simulated the atomistic details of how cracks propagate in brittle materials and gained significant insight into the physics of dynamical fracture instabilities. They have shown quantitatively that fracture instabilities are controlled by the properties of materials under extreme deformation conditions near a moving crack tip (Nature, January 19, 2006). Their study further shows that in rubber-like materials that stiffen with strain, cracks can move at speeds faster than the Rayleigh-wave speed while creating mirror-like surfaces. These findings may have significant implications on the understanding of fracture in different materials at different scales, from nano-materials to airplanes, buildings or even earthquake dynamics.



**Complex crack patterns occur when a crack spreads further through the material.**



**Dynamic instability occurring on the crack tip. As the crack velocity increases, its forward motion becomes more and more unstable: the crack changes direction and leaves behind an increasingly irregular surface.**

# Nanoparticles pinpoint brain activity

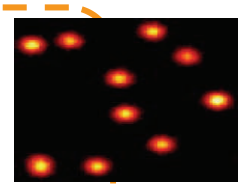
**Scientists could be a step closer to unraveling the mysteries of human memory, thanks to a nanoparticle-based imaging technique developed at Bordeaux University.**

The team is observing how biomolecules change position within a cultured rat synapse, the junction between nerve cells, by labeling the biomolecules with tiny gold particles.

The nanoparticle absorbs the light from the laser and almost all of the energy absorbed will be released as heat to the surroundings. This so-called photothermal effect modifies the refractive index of the adjacent media and was used to pinpoint the nanoparticle.

"This gold nanoparticle technique is very important, because it means that we can now study non-fluorescent nano-objects," explained group leader, Brahim Lounis. "The resolution is limited by the optical set-up, but we have the sensitivity to detect particles that are as small as 2.5 nm."

Based on a closed-loop scanning platform, the Bordeaux technique involves the use of two lasers. The first, a time-modulated (100 kHz - 15 MHz) Nd:YAG laser (532 nm) is used to heat the nanoparticle. The second, a He-Ne laser (633 nm) aimed at the sample and coupled to a fast photodiode detector, tracks the position of the nano-object by locking on to the characteristic beat frequency in the reflected signal.



**"This gold nanoparticle technique is very important, because it means that we can now study non-fluorescent nano-objects,"**

***Brahim Lounis, Bordeaux University***

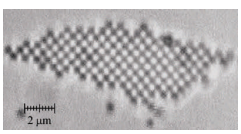
# Matter Bound by light

**Scientists in the UK have made 2D arrays of particles that are held together by nothing except light.**

The "optical matter" arrays developed by Colin Bain of Durham University and Christopher Mellor, now at the National Institute for Medical Research, consist of polystyrene nanospheres that are trapped by light that has been scattered off a prism. The arrays provide a new way of assembling matter on the nanoscale, and could also shed light on the processes inside crystals that take place at even smaller scales. Bain and Mellor began by overlapping two laser beams on the surface of a silica prism. The beams were made to strike the surface above the critical angle, so that only the evanescent fields penetrate out into the space beyond the prism. Next, the researchers placed a drop of water containing a dilute solution of polystyrene beads about 300 to 600 nm in diameter on the surface of the prism. The spheres are attracted by the evanescent field and spontaneously assemble into 2D arrays.

The most surprising result in this new work is the formation of a square array of 390 nm particles with orthogonally polarized laser beams.

The new optical matter arrays are distinct from optical tweezers, in which spatially varying electric fields are used to control the positions of particles. According to Bain and Mellor, the 2D ordering in optical arrays comes from the scattering of the evanescent light field by the particles themselves and not from an imposed field gradient.

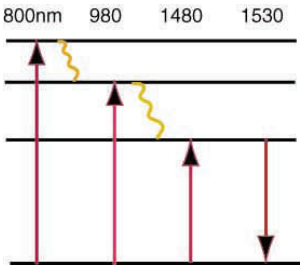



**A chessboard array of 460nm Polystyrene nano beads**

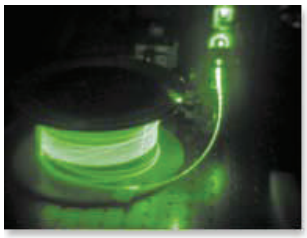
# Recent Developments in Fiber Amplifiers & Lasers

**Dr. Thomas Lee is currently a post-doctoral fellow in the Fiber Optics & Integrated Optics Group at the University of Nice, France. In India, he is affiliated to the Department of Physics, St. Thomas College, Palai. He did his Ph. D in fiber optics at ISP during 1999-2003.**

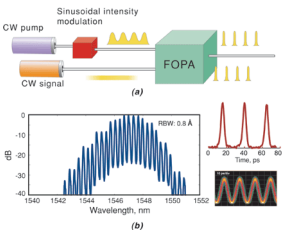
Since its first demonstration at University of Southampton in 1989, Erbium Doped Fiber Amplifier (EDFA) has revolutionized the field of Fiber Optic Communications. It has many advantages compared to Semiconductor Optical Amplifier and Stimulated Raman or Brillouin Amplifiers in terms of temperature stability or source availability for optical pumping or signal to noise ratio. Usually, EDFA operates in the C-band (1530 – 1565 nm) or in the L-band (1565 – 1625 nm) regions. They have been replacing the electronic repeaters in long haul fiber optic networks that at present span 100s of millions of km. Using EDFA, data bit rates of several Tera Bits per second, carrying 10s of millions of voice signals over 1000s of km, has been achieved by the simultaneous operation of 64 Wavelength Division Multiplexing channels of 40 Giga Bits per Second rate. In addition to Erbium, other dopants such as Thulium, Praseodymium etc from the Rare-Earth family and Chromium, Antimony etc from the Transition Metal family are also doped to complement the EDFAs, in the S-band (1460 – 1530 nm) or in the O-band (1260 – 1360 nm) and in eye-safe higher wavelengths.




**"Usually, EDFAs operate in a narrow band at 1550 nm but can be modified to operate in the C-band and the L-band regions."**



In order to increase the efficiency and cost effectiveness of EDFA (costs typically around $10000) the size and complexity of the device has to be reduced. Moreover, the demand for Planar Amplifiers in multifunctional Integrated Optical Components also calls for smaller components. A straightforward way to increase fluorescence intensity is by increasing the dopant concentration in silica-glass matrix which is the most widely used host material. However, as the concentration level exceeds a few 100s of ppm, the rare-earths tend to form chemical clusters because of their poor solubility in Silica Matrix. This clustering effect reduces their fluorescence efficiency by various radiative and non-radiative processes such as Cross Relaxation, Diffusion Limited Relaxation, Excited States Absorption, Donor-Acceptor Up-Conversion etc. However, it has been found that other glass systems such as Fluoride Glass, Chalcogenide Glass etc have better fluorescence efficiency due to their lower Phonon Energy (≈ 500 $cm^{-1}$) than that of silica glass (≈ 1100 $cm^{-1}$), and have wider gain curves for fluorescing ions.

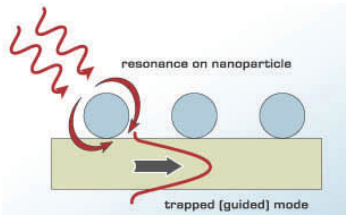



However, their long term reliability is still to be resolved and fibers based on them are difficult to splice to conventional silica fibers. Another method of increasing the fluorescing efficiency of erbium ions has been demonstrated by Ytterbium co-doping which has better optical absorption efficiency. Recently, it has been shown that in some multi-component silica glasses, like Alumino-Silicate system, the fluorescence efficiency is higher than that in pure Silica Glass due to the reduction of clustering in the former matrix. Moreover, some of them show phase-separation with lower phonon energies where the dopants have higher affinity of occupation. Another method for increasing the fluorescence efficiency has been demonstrated by doping glass with Noble-Metal Nano-Particles which increase the absorption cross-section of glass by virtue of Surface Plasmon Resonance and the subsequent enhancement of the local electric field around the nano-particles. Very recently, researchers at University of Southampton have demonstrated a single-frequency, single-mode, large-core Fiber Master Oscillator Power Amplifier Laser System capable of generating 125 W of output that can be continuously tuned from 1546 to 1566 nm. All these recent developments in fiber lasers and amplifiers are directed towards a faster world.

**Thomas Lee S.**

# Surface Plasmons: The Waves of Future in Circuitry

Surface plasmons are density waves of electrons—picture bunches of electrons passing a point regularly—along the surface of a metal. They propagate along the surface of a conductor. By altering the structure of a metal's surface, the properties of surface plasmons—in particular their interaction with light—can be tailored, which offers the potential for developing new types of photonic device. This could lead to miniaturized photonic circuits with length scales that are much smaller than those currently achieved. Surface plasmons are being explored for their potential in sub wavelength optics, data storage, light generation, microscopy and bio-photonics.




Plasmons have the same frequencies and electromagnetic fields as light, but their sub-wavelength size means they take up less space. Surface Plasmons, then, is the technology of transmitting these light-like waves along nanoscale wires.

For researchers in the field of optics, one of the most attractive aspects of SPs is the way in which they help us to concentrate and channel light using sub wavelength structures. This could lead to miniaturized photonic circuits which would first convert light into SPs, which would then propagate and be processed by logic elements, before being converted back into light. To build such a circuit one would require a variety of components: waveguides, switches, couplers and so on. Currently much effort is being devoted to developing such SP devices. An appealing feature is that, when embedded in dielectric materials, the circuitry used to propagate SPs can also be used to carry electrical signals. Developments such as this raise the prospect of a new branch of photonics using SPs, sometimes called plasmonics.

**Ranjan Singh**

**Ranjan Singh is a doctoral student at Photonics department of Oklahoma State University, USA, working on Surface Plasmon Studies. He has a M Tech degree in OE&LT from ISP.**

# Optical Imaging: A Powerful Tool in Brain and Cognitive Neuroscience

Optical Imaging of brain functions by non-invasive methods is one of the thrust areas of research in the present scenario. Several traditional approaches for imaging depth resolved information from the living brain include techniques such as PET, EEG, MEG, f-MRI, ultrasound imaging, light and electron microscopy. Of these, modern optical imaging techniques are capable of observing unique functional and structural features of cells and tissues at increasingly greater depths and higher spatial resolution than before.

Intra operative optical imaging techniques based on voltage sensitive dyes and intrinsic signals are well established neuro-imaging modalities. Here, the functional cortical activity is mapped by detecting activity related changes in cortical light fluorescence and reflectance respectively. Extrinsic imaging is based on optical measurements related to changes in the wavelength of reflected light, physical properties of dyes, stimulation of tissues, etc. The primary advantage of these techniques is that they provide an overview of functional organization from multiple sites at a fine spatial resolution.

Another advance is the development of new types of microscopes that form images of cells deep inside brain tissue, using the principle of confocal microscopy. The most advanced of these devices uses a quantum effect known as two-photon microscopy. The principle of the two-photon microscope is that photons of light within a powerful illuminating beam combine at the focal point within the tissue to form photons at half the wavelength of the original.

Near-infrared absorption spectroscopy (NIRS) and Diffused Optical Imaging (DOT) are relatively new non-invasive methods, in which changes in the amounts of oxy-hemoglobin and deoxy-hemoglobin can be measured from two-wavelength absorption data obtained by employing near-infrared light absorption characteristics. Photoacoustic tomography (PAT) based on optical contrast analysis can be used to visualize dynamic and functional properties of the nervous system. Optical coherence tomography (OCT) is another newly developed imaging technique that permits high-resolution cross-sectional imaging of highly scattering media. OCT uses light that is backscattered off tissues to provide image contrast. Analogous to forms of ultrasound imaging, OCT offers inherent optical sectioning by tracking photons' round-trip time of flight from source to tissue and back to detector.

Recently instruments capable of performing Wide Field Coherence-Gated Imaging (WCGI) have been developed for functional imaging of intact brain. Its unique feature is the use of one mechanical translation for depth scanning, whereas conventional serial OCT uses fast movement along two directions which may introduce artifacts in the image due to vibrations. Also, WCGI can do simultaneous acquisition of all the pixels of the sample in one shot thus allowing one to synchronize the acquisition of a complete image to physiological events for *in vivo* studies.

Hrebesh M S

**Hrebesh MS is a doctoral student at Yamagata University, Japan, working the field of Optical Coherence Tomography. He received his M Phil degree in Photonics from ISP.**

# Optics & Photonics at IIT Bombay

**Dr. Vijaya Ramarao's contributions are well appreciated by the optics and photonics community all over the world. She is Associate Professor at the department of Physics of the Indian Institute of Technology, Bombay.**

***"Self-assembled systems such as synthetic opals with spatial periodicities of 300-400 nm, hold a lot of promise for applications in the visible and near-IR***

Dr. (Ms.) R. Vijaya and her group members at the Physics department of IIT Bombay work in the areas of nonlinear fiber optics and Photonic band gap materials. They were featured on the cover of the SPIE Women in Optics calendar for the year 2006 in recognition of their professional expertise and to encourage young women to choose optics as a career.

There has been an accelerated need in the last few years to transport information at very high data rates due to the widespread use of the Internet. Presently existing facilities for transmitting voice channels are fast becoming obsolete since they cannot support data, voice and video simultaneously, as required today. Most of the communication links in India are not yet fiber-optics-based and the rates of transmission are below the 10 Gbit/s range. In order to improve the transmission rates, it is essential to invest research efforts in the hardware development, which can give rich dividends. In this background, experimental research work was initiated in April 1999 towards the development of a multi-Gbit/s all-fiber-optic wavelength division multiplexed (WDM) source. The research required the development and standardization of a 10 Gbit/s picosecond pulse source centered around 1550 nm, based on the beat-signal switching in a nonlinear optical loop mirror followed by a super-continuum generator for creating several WDM channels.

Some of the advantages of the design are: all-fiber-optic nature of the source, scalable data rates due to the beat signal frequency and the reduced cost of two DFB lasers used in this design as compared to the need for multiple transmitters for each wavelength in the conventional design.

In a second project, the demonstration of a high power erbium doped fiber amplifiers (EDFA), in a bi-directional pumping configuration, capable of an amplified signal power output of 100 mW and multi-channel generation due to propagation in low-dispersion fiber has been reported. The high-power EDFA design is expected to have multiple applications, such as for CATV, apart from its use in spectral enrichment studies. These application-oriented efforts have led to more basic studies about four wave mixing characteristics of low dispersion fibers. In an on-going work (2005-2008), efforts are on to design and develop an actively mode-locked fiber laser at 10 GHz frequency.

It is now well established that periodic dielectric structures, called photonic band-gap materials or photonic crystals, have the ability to control the propagation of electromagnetic waves. These photonic crystals exhibit frequency ranges (referred to as photonic band gaps) where the electromagnetic waves cannot propagate. This range is governed by the periodicity of the structure. The presence of a photonic band gap in the visible range can have profound impact on the efficiency of several optical devices including LEDs, lasers and optical switches. The presence of a photonic band gap in the visible range can have profound impact on the efficiency of several optical devices including LEDs, lasers and optical switches. Photonic band gap at visible wavelengths requires the dielectric constant to vary with a spatial periodicity of 300-400 nm.

Self-assembled systems such as synthetic opals which can give such periodicities, hold a lot of promise for applications in the visible and near-IR wavelengths. In this context, experimental research in the area of Photonic band gap materials was started at IIT Bombay in May 2004. High-optical-quality thin film samples with self-assembled colloids of $SiO_2$ and polymers have been synthesized in-house, and the structural and optical characterization results show good three-dimensional ordering. Preliminary experimental work on band gap tuning and computational work have given encouraging results. More work is in progress to study the modified physics of well-known bulk-optical processes in nano-ordered photonic lattices.

Theoretical work was initiated in June 2004, to understand and model the origin of second harmonic generation at surfaces and interfaces. Second harmonic generation (SHG) will be absent in bulk centro-symmetric materials, but, at the surface of any material, or at the interface between two materials, there is a break in symmetry. Hence the SHG from surfaces will differ from the SHG in bulk in most materials. The aim of this work is not to identify materials with large SHG efficiency but to phenomenologically model SHG from surfaces and quantify it for non-destructive surface characterization. An interesting interplay of electric dipole, electric quadrupole and magnetic dipole terms contributing to the effective dipole moment is to be modeled for some well-known bulk centro-symmetric materials and then, subsequently, in molecular crystals.

## CELOS Student Wins IPA Prize and KVPY Scholarship

Third semester Integrated Photonics ( CELOS) M. Sc. student Mr. Rajesh Kumar received the prestigious National Physics Project Competition Prize conducted by the Indian Physics Association. He was one among the top ten selected for the prize among students who took part in the National Competition conducted by IPA to mark the World Year of Physics. Mr. Rajesh Kumar has also won the Kishore Vigyanik Protsahan Yojana (KVPY) Scholarship instituted by the Ministry of Human Resources Development, Government of India. Mr. Rajesh Kumar will receive monthly scholarship of Rs. 4000/ - and a contingency amount of Rs 10,000/- per year. The recognition is based on a student project he has carried out at the International School of Photonics.

## PSI Prize to Manoj Mathew

Mr. Manoj Mathew receives the Photonics Society of India Prize for the year 2005. He stood first in the 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 the M. Tech. Degree Examination (OE& LT) of CUSAT. This Prize is instituted by Prof C P Girijavallabhan, Director of CELOS. The prize which includes cash, memento and merit certificate will be presented during the inaugural function of APW 2006. Mr. Manoj is at present a doctoral student at the Institute of Photonic Sciences, Barcelona, working on high resolution nonlinear microscopy for biological applications.

## Gopika Ramanandan Receives the Nalanda Endowment Prize of 2005

The 2005 Nalanda Endowment Prize will be presented to Ms. Gopika Ramanandan during the inaugural function of APW-2006. The Nalanda Endowment Prize is instituted by Prof N. G. Devaki of Department of 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.

## Digital Articulation Club Starts Functioning in CUSAT

*Photonium*, a digital articulation club was inaugurated by Prof. K G Nair, Director of Centre for Science in Society, CUSAT on 21st December 2005. The objective of the Club is to produce Science related Documentary films and conduct film appreciation programmes through screening Classics apart from conducting seminars and discussions for popularizing Science through Visual media. *Photonium* is a wing of ISP-SPIE Student Chapter. The Club has already embarked on the venture by producing two documentaries, namely, *Einstein's Universe* and *A Sentient Sequel* - a documentary on Cochin University of Science and Technology.

# MSc Photonics Students Make a Documentary on Einstein

ISP-SPIE Chapter explored the creative talents of students in their attempt to produce a documentary film on the life and work of Albert Einstein. The film was scripted by Prof V P N Nampoori. The members of the Production Crew include Adil Masood, Praveen Cherian Ashok, Aneesh Krishnan, Sibilathullah, Saurabh Raj, Sreeparvathi and Gopika (the M Sc (Photonics) students of CUSAT). The film was screened in the Campus Film Festival as well as in Einstein Film Festivals organized at CUSAT and at Priyadarshini Planetarium, Trivandrum. The film was well appreciated by the scientific community during its screening at IIT Madras and in VIT, Vellore (during NLS-2005).

The production crew has several ambitious projects in mind which include Documentaries on Ramanujan, Sir C. V. Raman and S. N. Bose apart from a story on the Scientific Tradition of India.

**The Creative Team behind the Project.**

# ISP Student Chapter Activities

A snapshot from 'Optics to School'

Student chapters in ISP saw brisk activities in the year gone by. The chapter was formally inaugurated on 27th February, 2005, the founding day of the ISP, by Prof. R. Pratap, Emeritus Professor of CUSAT. The ISP-SPIE student chapter was quite successful in organizing research seminars, lectures, invited talks, workshops and special events.

The chapter was also fortunate to enroll more than 100 members to become the largest SPIE student chapter in the world. The chapter has joined hands with ISP in organizing Annual Photonics Workshop (APW 2005), focused on 'one hundred years of photons' in ISP on the 27th and 28th of February, 2005. Chapter members were enthusiastic to conduct a voluntary blood donation camp in collaboration with Indian Medical Association (IMA) on the 'World Health Day' on the 7th of April, 2005. In a 'Rendezvous with Industry' Dr. Ir. Peter J.T van der Donk of the International Research Center of Akzo Nobel India Pvt. Ltd, introduced various novel ideas about the field of Colorimetry. The talk held on 6th of May, 2005, drew overwhelming interest from the students and teachers.

On the 9th of May, 2005, the doors of ISP were opened for the young school children spending their summer vacation in the University doing many projects in various fields of science. November 7, Sir C. V. Raman's birthday, was celebrated as '*Spectra 2005*', with Physics quiz and colloquia marking the days' importance.

The World Year of Physics celebrations were jointly organized by the ISP - OSA student chapter, the Academy of Physics Teachers (APT), Kerala and ISP from December 21 to 23, 2005. Prof. V. P. Nair from City University of New York and Prof. Virendra N. Mahajan of The Aerospace Corporation, California delivered illuminating lectures to the students.

The chapter has opened a section in the School library to contribute and accommodate SPIE journals, magazines and periodicals. The chapter has co-sponsored the workshop on Fiber Optics held from December 8-10 at the Central Glass & Ceramic Research Institute (CGCRI), Kolkata, India.

**"The chapter was fortunate to enroll more than 100 members to become the largest SPIE student chapter in the world"**

# Spectra 2005

Spectra 2005 was organized in the CUSAT Campus during 6th and 7th of November 2005 to commemorate Raman Day - the birthday of the legendary figure in the field of Indian physics - Sir C V Raman. The event was noted for its competitions such as the Physics Quiz and Colloquium held for college and university students from South India. The subject for the colloquium was *The Signature of Optics in various branches of Science and Technology*. The girls duo team from Vimala College, Thrissur won the Quiz competition. Attractive prizes including cash awards, merit certificates and books were presented to the winners. The event also had the ***Raman Memorial Lecture*** along with several video and poster presentations. Prof V. Unnikrishnan Nair, Dean, Faculty of Science, CUSAT delivered the Raman Lecture.

# ISP Organizes Einstein Film Festival

To mark the grand finale of the World Year of Physics celebrations at CUSAT, the ISP –SPIE Student Chapter, organized the Einstein Film Festival during 21st and 22nd of December, 2005. The film festival screening commenced with the in-house production - *"Einstein's Universe"* - the brain child of Prof. V P N Nampoori and the Integrated M.Sc students of CELOS. The other movies screened for the festival included *E=Mc², Einstein's Equation of Life and Death, Einstein's Wife, Einstein – the Philosopher Scientist, Einstein's Unfinished Symphony, Einstein Revealed Part I and Part II, Stephen Hawking's Universe.*

Another film screening session was organized at the Science and Technology Museum, Trivandrum on 31st December, 2005. The Trivandrum Festival was co-organised by Kerala State Council for Science, Technology and Environment and was inaugurated by the famous Film Director Shaji N. Karun. Noted film directors, writers and critics attended the festival and appreciated this venture of the Photonics community at CUSAT.

# Seminars by Visitors

**March 16, 2005:** 'Emerging Nanostructured Optoelectronic Materials – the CAT Experience' by Dr. L. M. Kukreja, Scientist, the Centre for Advanced Technology (CAT), Indore, India.

**May 6, 2005**: An Invisible Repair of Effect Coatings: Matching the Optical Properties of Paint, by Dr. Ir. Peter J.T van der Donk, Akzo Nobel Car Refinishes, The Netherlands.

**May 26, 2005:** "Two – Photon Absorption and Polariton Propagation in ZnO Nanowire", by Dr. R. Prasanth, Debye Institute, Universiteit Utrecht, the Netherlands.

**June 9, 2005:** "Photonic Building Blocks for Quantum Information", by Dr. Vinod Menon, Assistant Professor, Queen's College of CUNY, New York.

**June 15, 2005:** "Remembering Kunchunni Raja: The Indian Theory of Meaning", by Dr. Murali Madhavan, Sanskrit Department, Sree Sankara University, Kalady.

**June 14, 2005:** "Temporal Speckle Interferometry", by Dr. Charles Joenathan, Professor and Chair, Department of Physics and Optical Engineering, Rose-Hulman Institute of Technology, Indiana, USA.

**July 2, 2005:** "Physiology of Vision" by Dr. R Biju, Renjini Eye Hospital, Cochin & Consultant Ophthalmologist, Amrita Institute of Medical Sciences, Cochin.

**July 25, 2005**: "Globalization: Opportunities for Indian Professionals in the USA" by Prof. R Unnikrishnan, Dean of Engineering and Computer Science, California State University, Fullerton, CA, USA.

**July 28, 2005:** "Membrane Energetics" by Dr. Pramod Pratap, University of North Carolina, USA.

**September 1, 2005**: 'Nonlinear Microscopy using Femtosecond Lasers' by Mr. Manoj V Mathew, PhD Student, ICFO, Barcelona, Spain.

**September 28, 2005:** 'Construction of a Frequency Tripler and its Application to Photosynthesis' by Ms. Shalini Sitaraman, University of Ohio, USA.

**October 5, 2005:** 'What is Physics?' by Prof. K. H. Bhatt, Mississippi University, USA.

**October 27, 2005:** 'Emerging scenario of Patents' Protection, Valuation and Commercialization' by Dr. V. Raghuram, Regional Manager, National Research Development Corporation, Bangalore, India.

**December 22, 2005:** 'Dreams for Unified Fields' by Dr. V. P. Nair, City University of New York (CUNY), New York.

**December 22, 2005:** 'Trends in Modern Optical Imaging' by Dr. Virendra N. Mahajan, The Aerospace Corporation, Los Angeles.

**"Every year ISP invites several scientists from India and abroad to speak on various aspects of science"**

# New Doctorates from ISP

**Dr. P. Suresh Kumar** has received his PhD for the thesis titled 'Design and Development of Fiber Optic Sensors for Trace Detection of Certain Environmental Pollutants'. He has completed his doctoral work from the Fiber Optics division under the guidance of Prof. P. Radhakrishnan. This research work has led to the development of several fiber based sensors for the detection of various chemicals and pollutants. Dr. Suresh is now the Principal of IHRD Engineering College at Alappuzha, Kerala.

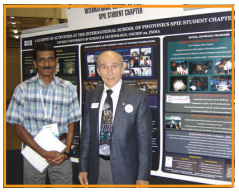
**Dr. Annieta Philip K**, received her doctoral degree for the work titled 'Characterization of Selected Photonic Materials and Systems Using Photoacoustic Technique'. She did her thesis work in the Laser Division of ISP under the guidance of Prof. P. Radhakrishnan. The work concentrated on laser induced photoacoustic studies and thermal characterization of materials. Dr. Annieta is now lecturer in physics at the Cochin College, Kerala.

# SPIE's 50th Anniversary Celebrations in San Diego

ISP-SPIE Student Chapter activities were internationally acclaimed and a special invitation was extended to the chapter for attending the 50th Annual Meeting of the International Society for Optical Engineering, SPIE, held in San Diego, California. Mr. Jijo P. Ulahannan, the 2005 President of the ISP-SPIE Student Chapter represented the student community at the annual meeting and the Optics & Photonics Conference, held during July 30-August 4 at the San Diego Convention Center.

Yet another feather was added to the cap of glory when Mr. Jijo was selected to attend the Education Committee Meeting which is the decisive body of the SPIE educational activities. Apart from this, several meetings were organized to herald the SPIE Golden Jubilee year celebrations. This included Lunch with Masters, Student Leadership Workshops, etc. The chapter had put up a stall at the SPIE Exhibition Hall, highlighting the chapter activities. ISP-SPIE student chapter won accolades at the venue where it was rated as one of the best chapters in the world. Chapter activities got special mention in SPIE's Golden Jubilee banners and exhibition.

In summary, the meeting provided a platform for building friendship and inviting international attention.



**Mr. Jijo with Dr. Paul F. McManamon, the 2006 President of SPIE at the chapter stall in San Diego.**

**Dr. Gargi will be remembered for her talent and enthusiasm.**

## Photonics Community Mourns the Demise of Dr. Gargi Vishnoi (1969-2005)

Dr. Gargi Vishnoi's unexpected death took away one of the exceptional promise from the family of Photonics. She worked in the area of biomedical optics and biophotonics. At the time of her untimely death, Gargi was a faculty member in the biophotonics research group at the Indian Institute of Science. A Ph D in fibre optic sensors from IIT Delhi, Dr Gargi was with IIT Bombay and IIT Guwahati prior to joining IISc. She had also been a research associate at the University of Pennsylvania.

# Recent Publications from ISP

1. **Control of bistability in a directly modulated semiconductor laser using delayed optoelectronic feedback**

S. Rajesh and V M Nandakumaran, Physica D, 213, 113, 2006.

2. **Laser emission from transversely pumped dye-doped free-standing polymer film.**

K Geetha, M Rajesh, V P N Nampoori, C P G Vallabhan and P Radhakrishnan, *J. Opt. A: Pure Appl. Opt.8*, 189, 2006.

3. **Characterization of Rhodamine 6G doped polymer optical fiber by side illumination fluorescence.**

M Rajesh, K Geetha, M Sheeba, P Radhakrishnan,C P G Vallabhan and V P N Nampoori, *Optics and Lasers in Engineering*, (in Press)

4. **Propagation characteristics and wavelength tuning of amplified spontaneous emission from dye doped polymer film waveguide**

K Geetha, M Rajesh, V P N Nampoori, C P G Vallabhan and P Radhakrishnan, *Appl Opt.* (in press)

5. **Dual beam thermal lens and z scan studies of the thermo optical properties of some non linear materials.**

A. Santhi, Vinu V N, M R P Kurup, J Kesavayya, P Radhakrishnan and V P N Nampoori, *Proceedings of SPIE*, Vol. 5710 , 91-98 , 2005

6. **Line narrowing effects and enhanced back scattering from ZnO colloids.**

Bindu Krishnan and V P N Nampoori, J. Material Science, (in press).

7. **Optothermal depth profiling by neural network infrared radiometry Signal recognition.**

Jyotsna Ravi, Yuekai Lu, and Stéphane Longuemart, Stefano Paoloni, Helge Pfeiffer, Jan Tho and Christ Glorieuxa, Journal of Applied Physics 97, 014701, 2005.

8. **Photoacoustic study on the photostability of polymethyl methacrylate films doped with Rodhamine 6G – Rhodamine B dye mixture system.**

Annieta Philip, Lyjo K Joseph, Litty Mathew Irimpan, P Radhakrishnan and V P N Nampoori Journal of physics: D Applied Physics, 38, 2904, 2005

9. **Spectroscopic characterization of laser induced tin plasma**

S S Harilal, Beau O' shey, Mark S Tillack and Manoj V Mathew, Journal of Applied Physics, 98, 013306,2005

10. **Study on the determination of molecular distance in organic dye mixtures using dual beam thermal lens.**

Achamma Kurian, Sajan D George, V P N Nampoori, C P G Vallabhan, Spectrochimica Acta A, 61, 2799, 2005.

11. **Screen printed nanosized ZnO thick film**

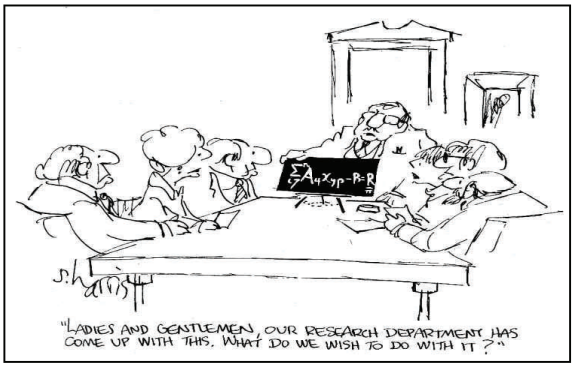
Bindu Krishnan and V P N Nampoori, Bulletin of Material Science, 28, 239, 2005.

12. **Loss characterization in Rodhamine 6G doped polymer film waveguide by side illumination fluorescence**

K Geetha, M Rajesh, V P N Nampoori, C P G Vallabhan and P Radhakrishnan, *J. Opt. A: Pure Appl. Opt.*, 379, 2004.

13. **Fiber Optic sensor for the detection of adulterant traces in coconut oil**

M Sheeba, M Rajesh, K Geetha, C P G Vallabhan and P Radhakrishnan, Measurement Science and Technology, 16, 2247, 2005.

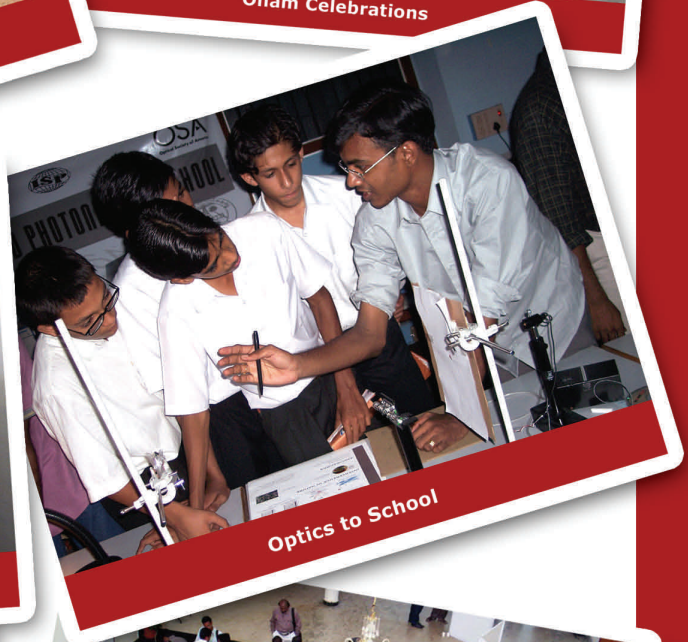


# INTERLUDES


International School of Photonics

Onam Celebrations


CUSAT DAY - Open House




Optics to School


Blood Donation Camp

Plasma 2005

A visit to Holgraphic Studio, C-DIT


Cultural Programme

## International School of Photonics

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***Light Matters....***

**The International School of Photonics (ISP) was established on February 27, 1995 by delinking the erstwhile Laser Division of the Dept of Physics of the Cochin University. Within its decade long existence, ISP has become one of the leading research centres in the country in the field of optics and photonics. The department has produced many talents through various courses such as the M Tech in Optoelectronics and Laser Technology, M Phil in Photonics and Ph D degrees in Photonics and related areas.**

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

# Indo-UK Workshop on Fibre Optics & Applications

An Indo – UK workshop on fibre optics and its applications is being organized by International School of Photonics, CUSAT, during the last week of August 2006. Prof. Ken Gratten, Dr. Tong Sun, Prof. B M A Rahman, Dr. M Rararajan, Prof. Muhammed Basheer, Prof. Andy Augustic and Prof. Vipul Rastogi are some of the speakers. Applications of FOS in variety of fields such as Civil Engineering structures, Life Sciences, Biomedicine, Industry and Pollution Monitoring will be discussed during the workshop.

Details can be had from Prof V P N Nampoori, ISP, CUSAT (nampoori@gmail.com).

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Printed and Published by Prof. P. Radhakrishnan, Director, International School of Photonics, CUSAT, Kochi - 682022