PHOTONICS NEWS

VOLUME 12 ISSUE 1 FEBRUARY 2010 INTERNATIONAL SCHOOL OF PHOTONICS

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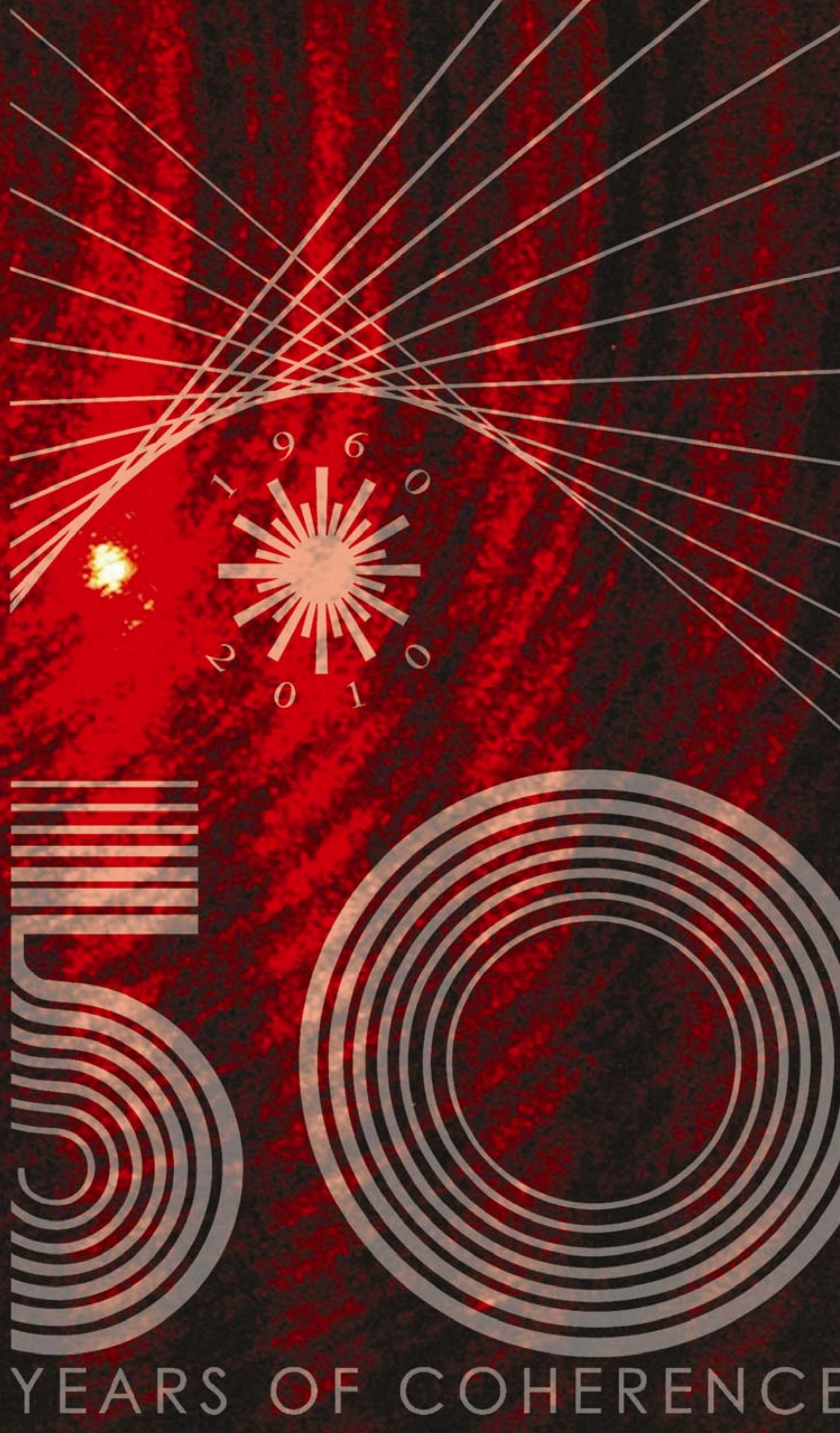

From Editor's Desk

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It is with great pleasure that we are bringing out the 2010 edition of Photonics News. The academic year 2009 – 2010 will be remembered as the special period due to number of innovative programme initiated in the University with the help of State and Central Governments.

At the outset let us welcome our new Vice Chancellor, Dr.T.Ramachandran who took charge on 4th January 2010. He is a laser scientist and is an alumi-nous of CUSAT . The first official programme he took part was in ISP when he formally inaugurated the ISP-ERUDITE Programme on 4th January as a part of the Laser Year Celebration. It was an apt event when the function organized by ISP to celebrate the Laser Year along with the rest of the world was inaugurated by the Laser Scientist – Vice Chancellor .

Another important point to be noted in the higher education scenario in the Kerala State is the introduction of variety of programmes envisaged by the Government of Kerala. We should congratulate our Minister of Education and Culture for this unique gesture enabling the introduction of progammes like ERUDITE, INCULCATE and ASPIRE. Visits of Nobel Laureates, under ERUDITE programme were unforgettable events for cusatians when they heard Professor Alferov and Professor Tsien Programme envisaging interaction between a University and school students under INCULCATE is unique and is worth imitating by other states also.

During the Laser Golden Jubilee year we congratulate research scholars, teachers, PG students and our alumni along with all the supporting staff of the University, especially those of ISP and CELOS who made CUSAT visible in the world of Lasers.

Erudite Programme at ISP

Erudite Programme is one of the innovative concepts introduced by the Government of Kerala which will rejuvenate the field of higher education in Kerala. This programme which was envisaged by the Kerala Higher Education Council receives special attention from the Minister of Education and Culture Sri M A Baby Under this unique programme, Two Nobel Laureates Prof. Afarov (2000 Nobel Prize in Physics) and Prof. Roger Tsein (2008 Nobel Prize in Chemistry) visited CUSAT during the month of January.

ISP , while Celebrating the Golden Year of Laser , invited Professor Kishan Dholakia of St Andrews University , Scotland and Professor Ajoy Kumar Kar of Heriot – Watt University, Edinburgh under Erudite programme. The two Photonics specialists were in ISP spending one week with staff and students .They gave lectures on diverse photonics related lectures like biophotonics, optical tweezers, nonlinear optics, photonics with ultrafast optical pulses and recent trends in Photonics research.

Golden Year of Lasers – Year long Celebration at ISP and CELOS

ISP and CELOS , CUSAT join hands with other institutions all over the world to mark celebrate the fifty years of lasers. ISP and CELOS have envisaged variety of programme during the year long celebration which was initiated in January 2010. The Laser Year Celebration in CUSAT was inaugurated by Professor Kishan Dholakia of St Andrews University, Scotland. Some of the other programmes which will be conducted during 2010 are Optics Fair, Quiz Competition for College students, Optics to School Programme, Optics Talent Search Examination, Workshop on Recent Trends in Raman Spectroscopy, Fifty laser lectures to be delivered in schools and poster design competition. These programmes are being organized with the help of ISP-OSA and ISP-SPIE Student Chapters.

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"It is possible to fly without motors, but not without knowledge and skill."
Wilbur Wright

Fifty Years of Laser

Theodore Maiman

In 2010, fifty years after Maiman's team created the first man-made burst of laser light on Earth, we are commemorating that achievement in a celebration called Laser Fest. People loved the mystery around this new kind of light that was soon recognized as a symbol of our entry into the future. During the period we honor the original laser pioneers, both scientists and entrepreneurs. Also this period aims at highlighting for the general public the laser as one of the best examples of innovation; basic scientific research translating into technology resulting in great economic benefit. Yet another goal is inspiring young people to pursue careers in optical science and engineering. The laser is ubiquitous to modern technology, which is why the physics community is celebrating Laser Fest all this year.

Laser Odyssey : Important fundamentals of the lasers have been laid already in 1917 by Albert Einstein by introducing the Einstein coefficient for stimulated emission. Theodore Maiman was certainly instrumental in the breakthrough. On 16 May 1960, he ushered in a new age by crossing the threshold of laser oscillation and demonstrating the world's first laser. Theodore Maiman was the first presenting a working laser by using a spring-shaped high-power flash lamp to stimulate emission in a silver coated synthetic ruby crystal rod. Remarkably, his laser worked first time and was reproduced by others within a few weeks from incomplete information. However, his vital role was often over looked in the decades-long battle that raged over who should be credited for 'inventing' this influential device. Immediately after the birth of the first laser, scientists and engineers started working on improving and developing this concept further. Within a short time laser beams at 694 nm wavelength could be witnessed as bright spots on the walls of research laboratories. Beside the excitement of this new invention there was also some moment of uncertainty and many scientist joked the laser was *a solution looking for a problem*. It didn't take long for new types of laser to appear on the scene, which quickly solved that problem. The laser revolution continues, with ultrafast lasers, quantum cascade lasers, and other innovations, each enabling a brand new host of applications

Nobel prize 2009 for Masters of Light

Charles K. Kao

The inventor of optical fibres, the veins of modern communication, and the two physicists who developed Charge-Coupled Device (or CCD) have received the 2009 Nobel Prize for Physics. China-born Charles K. Kao made a discovery in 1966 that would lead to today's fiber optics. While working in Standard Telecommunications Laboratories, Harlow, England he discovered that by removing impurities and creating a more pure type of glass, the fiber could be made more efficient and absorb less of the light over great distances. In particular, he showed that fused silica (SiO_2) had the purity required for optical communication. The second half of the 2009 prize has gone to two physicists, Willard Sterling Boyle and George Smith, from Bell Labs in New Jersey, US, for developing the CCD. A CCD can record a scene by accumulating light induced charges over its semiconductor surface, and by transporting them to be read out at the edge of the light sensitive area. The invention utilized the properties of the then new MOS (Metal Oxide Semiconductor) technology to create an integrated and simple device to record and read out a scene. CCD's have been the backbone of the commercial digital camera industry. The first consumer camera with a CCD was designed in 1981, leading to a revolution in digital photography.

Willard S. Boyle, left, and George E. Smith of Bell Labs invented charged-coupled devices (CCDs). In this photo, they are demonstrating an experimental TV camera that contains a CCD substitute for the vacuum tube of a conventional TV camera.

ALUMNI COLUMN

Biological applications of Optofluidics

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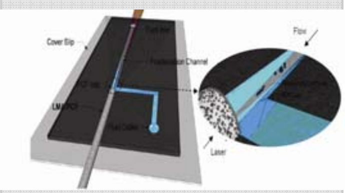


Fig.1 Design of the integrated optical chromatography chip. The pressure driven flow from inlet to outlet was achieved by syringe pumps. The laser beam was delivered to the chip by capped LMA PCF inserted to the predefined fiber channel [Inset] Closer view of the fractionation channel where a binary sample is fractionated based on size.

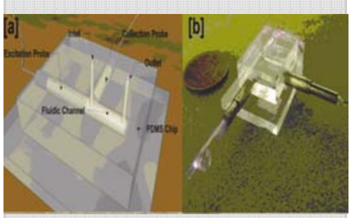


Fig. 2 [a] Design of the chip for integrated microfluidic Raman spectroscopy. [b] Photograph of the PDMS based chip where

Manipulation and sorting of cells in a sterile environment in order to culture the recovered cell is very important for many biological applications. The idea of miniaturising the macroscopic analysis and synthesis modalities in chemistry and biology and integrate them into a single chip lead to the emergence of the field of microfluidics and nanofluidics. Combining microfluidics with optics results in an emerging multidisciplinary field called optofluidics. Light can act as a sterile tool for efficient manipulation and detection of biological particles. The optical trapping group of University of St. Andrews is involved in the research of developing *Lab on a chip* devices for cell manipulation and bio-sensing by incorporating optical manipulation techniques into microfluidic technology.

Soft Lithography for easy fabrication of microfluidic devices

We mainly use soft lithography to fabricate our microfluidic devices. Compared to conventional photolithographic technique. Soft lithography offers desirable features which are ideal for the fabrication of microfluidic chips. The stamp moulding method used in soft lithography makes it easier to convert a concept into device and once the mould is made it is easy to create any number of replicas. In soft lithography, a silicon elastomer called Polydimethylsiloxane (PDMS) is used for fabrication of chips and features in the order of microns can be obtained. PDMS is a biocompatible so PDMS chips can be used for experiments involving biological samples. Also it is optically transparent and reversibly deformable allowing it to be pealed from the delicate features of a mould without damaging the mould or itself.

Optofluidic sorting and manipulation of cells

It is always a big challenge to sort out a particular cell population from a mixture of cell population containing thousands of types of cells. It is possible to use optofluidic technologies to achieve passive cell sorting with the use of radiation pressure of light. Optical chromatography is one such simple and promising passive sorting technique, which combines the microfluidic drag force and the optical radiation force to achieve fractionation of microparticles. Due to the balance of optical radiation force and viscous drag force fractionation of various samples based on its size, shape or refractive index could be achieved. In order to enhance the portability we developed a PDMS based chip on a soft lithography platform for on-chip delivery of fractionation beam using a specially capped large mode area photonic crystal fiber.

Similar integrated approach was used to achieve dual beam optical trap by incorporating two single mode fibers into a microfluidic chip. This device has been used for various studies such as optical binding, optical stretching, micro-Raman analysis of single cells etc. The fiber based optical trap and guiding designs offers to achieve flexible, optical alignment free devices for various applications as mentioned above. Another approach is to monolithically integrate the trapping or guiding laser and detectors into the chip, so as to achieve a truly portable *Lab on a chip* device for optical manipulation.

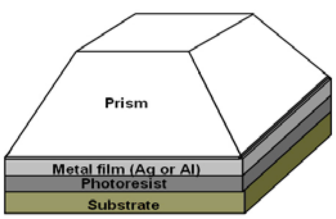
Integrated microfluidic Raman spectroscopy

To date, Raman fibre probe designs have been mainly restricted to process monitoring probes endoscopic detection and diagnosis probes. We implemented first integrated Raman detection device on a microfluidic platform by embedding a novel fibre based split Raman probe directly into a PDMS based microfluidic system. This system could be used for various bio-analyte detection both online and offline.

In short with the perfect coalition of light and microfluidics, optofluidics could offer solutions for various biological and clinical problems through miniaturized *Lab on a chip* devices.

Nanoscale patterning based on surface plasmon interference

The growing importance of the nanotechnology research leads to the need for patterning technique with the capability to fabricate nanometer scale features and one such technique is optical lithography. Due to the diffractive nature of the light, the resolution of conventional optical lithography is limited to the wavelength of the illumination light. The surface plasmon resonance effect offers a unique solution to solve this problem. Surface plasmons are the collective electron oscillation at the interface between a metal and a dielectric. The basic principle of the method is that with the aid of a periodic corrugation (grating) or a prism, illumination light can couple with surface plasmon to produce surface plasmon polariton (SPP), which has high intensity and



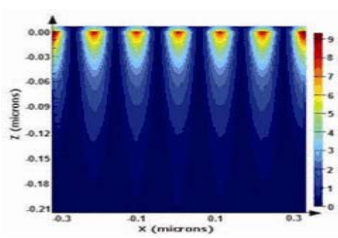
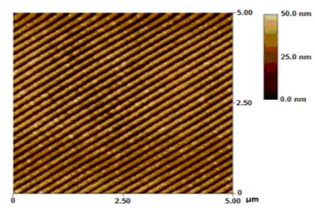


Fig. 3 [a] Prism layer configuration for plasmonic lithography [b] simulated SP interference patterns on the photoresist layer using FDTD method.

a much shorter wavelength compared to that of illumination light.

We demonstrate a maskless single step two- and four-beams surface plasmon interference lithographic technique so as to obtain interference pattern with resolution several orders less than the illumination source wavelength. A prism layer configuration is used to pattern both one dimensional and two dimensional periodic nanostructures on the recording medium. The prism layer configuration is shown in Fig. 3[a], which comprises a high refractive index (1.939) 60° triangular prism with flat top as the upper layer; bottom surface of the prism is coated with Aluminium film of thickness 50 nm and in intimate optical contact with a thin positive tone photoresist layer on silica substrate. Fig. 3[b] represents the simulated SP interference pattern generated on the photoresist layer at the incident wavelength of 364 nm using FDTD method. In the figure, Z-axis is considered as the decay direction and metal/photoresist interface is taken as the origin of the decay direction.

To obtain the experimental data, a conventional set up consisting of a continuous wave UV Argon Ion laser of wavelength 364 nm, electronic shutter, 2D diffraction grating and polarizer were used. The atomic force microscopy images of exposed patterns transferred on the photoresist layer using two beams SP interference lithography is shown in Fig. 4[a]. Large area uniform periodic grating lines with period 172 nm and minimum line width of 89 nm were obtained at the exposure time of 15s. The exposed patterns transferred on the photoresist layer using four beams SP interference lithography is shown in Fig. 4[b]. It is evident from the figure that large area periodic dot array with minimum spot size of 93 nm and



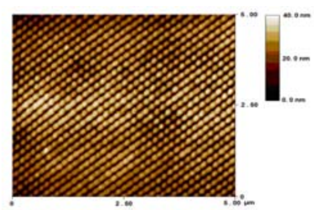


Fig.4 AFM images of resist features patterned at the exposure time 15s (a) from two beams SP interference (b) from four beams SP interfer-

minimum period of 173 nm is patterned on the photoresist layer. In short, this approach opens up a practical way for nanolithography to provide a convenient route for patterning high throughput nanometer scale structures, that can find potential applications in lab-on-chip, biomedical imaging and sensing, photonic crystal fabrication etc.

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The limitation of conventional Optical Lithography due to the diffractive nature of light can be solved using Surface Plasmon Resonance Effect.

We hear that……………..

One Step closer to Invisibility

Scientists demonstrate the so called carpet cloak at optical frequencies for the first time.

Scientists report the experimental demonstration of cloaking at optical frequencies for the first time. A group of scientists from Nano-scale Science and Engineering Center (NSEC), University of California and Material Science and Engineering Center, Berkeley National Laboratory demonstrate the so called carpet cloak with metamaterials. Published in Nature Materials April 2009, the optical *carpet* cloak is designed using quasi-conformal mapping to conceal an object that is placed under a curved reflecting surface by imitating the reflection of a flat surface. The light reflected form the uncloaked bump shows three distinct spots at the output grating due to the scattering of the bump. The flat surface shows the expected Gaussian beam profile, similar to that of the incident wave. To hide the bump on the surface, the designed cloak pattern was placed around the bump . Subsequently, the beam profile at the output grating resembles a single reflected beam as is seen with the flat reflecting surface. This demonstrates that the cloak has successfully transformed the curved surface into a flat surface, giving the observer the impression that the beam was reflected from a flat surface. Owing to the fact that there is no penetration of light into the bump (through the metal layer), any object could be placed behind it and effectively hidden, making the object invisible. This discovery may boost up the search for invisibility devices in the coming years.

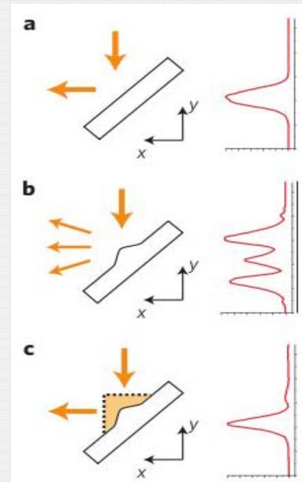

Fig. 1 Carpet cloak gives the impression that the beam was reflected from a flat surface.

World's Smallest Laser

Researchers from Norfolk State University, Virginia, Purdue- University, Indiana and Cornell University, New York have created the tiniest laser since its invention nearly 50 years ago. Because the new device, called a "spaser," is the first of its kind to emit visible light, it represents a critical component for possible future technologies based on "nanophotonic" circuitry. Spaser stands for surface plasmon amplification by stimulated emission of radiation. To act like lasers, they require a "feedback system" that causes the surface plasmons to oscillate back and forth so that they gain power and can be emitted as light. Conventional lasers are limited in how small they can be made because this feedback component for photons, called an optical resonator, must be at least half the size of the wavelength of laser light. The researchers, however, have overcome this hurdle by using not photons but surface plasmons, which enabled them to create a resonator 44 nm in diameter, or less than one-tenth the size of the 530 nm wavelength emitted by the spaser. The newly developed spacer consists 44-nm diameter nanoparticles with a gold core and dye-doped silica shell which can overcome the loss of localized surface plasmons by gain and the researchers could couple the surface plasmon oscillations to photonic modes.

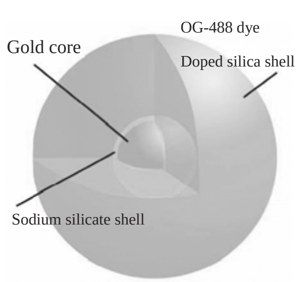

Fig. 2 Diagram of the hybrid nanoparticles architecture, indicating dye molecules throughout the silica shell.

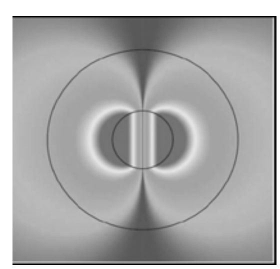

Fig. 3 Spaser mode with wavelength 525 nm and Q=14.8. The inner and outer circles represent the 14 nm core and 44 nm shell.

We hear that……………...

Single molecule optical transistor

Researchers from ETH Zurich have recently managed to create an optical transistor from a single molecule in what is yet another important achievement on the road to quantum computing. They used a small hydrocarbon molecule called dibenzanthanthrene (DBATT). The molecules are doped in n-tetradecane, an organic solvent. The experiment is performed at 1.4 K, under these conditions, quantum mechanical phenomena can be observed much more easily than at room temperature, and particularly to increase a parameter known as *coherence time*, the time during which the phase between the "0" and the "1" states remain well-defined. The single dye molecule coherently attenuate or amplify a tightly focused laser beam, depending on the power of a second *gating* beam that controls the degree of population inversion. By using a laser beam to impose the quantum state of a molecular transistor, the research team demonstrated control of a second laser beam, which reflects the way in which a conventional transistor works. Such a quantum optical transistor has also the potential for manipulating non-classical light fields down to the single-photon level. The molecule itself is about 2 nanometers in size, over ten times smaller than standard transistor. Dr. Hwang, who was part of the research team and lead author of the paper that appeared on the journal Nature detailing the experiment explains *Our single-molecule optical transistor generates almost negligible amount of heat. When a single molecule absorbs one photon, there is some probability (quantum yield) that the molecule emits a photon out. The rest of the energy absorbed turns into heat in the matrix. For the case of the specific hydrocarbon molecule that we use, the quantum yield is near 100%. So almost no heat is generated.*

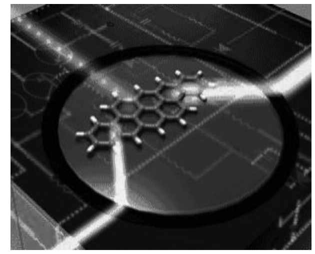

Fig. 4: An artist's impression of a molecule acting as a transistor that makes it possible to use one laser beam to tune the power of another (Image: Robert Lettow)

Countdown for Laser Fusion

Physicists are close to demonstrating laser fusion in the lab. The National Ignition Facility (NIF) at Lawrence Livermore National Laboratory (LLNL) has successfully delivered more than 1 megajoule(MJ) of laser energy to a target in a few billionths of a second. NIF is a Laser-based Inertial Confinement Fusion (ICF) research device, consisting of 192 pulsed laser beams with a total energy of 1.8 MJ, more than 60 times more energetic than those from any machine currently in existence. Each laser pulse starts out as a 1 μm infrared beam that is split into 48 beams and fed into preamplifiers that increase their energy 10 billion times. Each beam is then split into four and passed repeatedly through main amplifiers. After converting the wavelength into the ultraviolet, the total energy of the 192 beams is 1.8 MJ. When the combined laser pulse hits the 2 mm sphere, it explodes, causing an implosion on the inside that forces the fuel into the centre and compresses it to a density 100 times that of Lead and a temperature of 10^8 K. The tiny target is called the hohlraum. It is a gold-plated cylinder intended to contain the hydrogen isotopes Deuterium and Tritium, which would fuse together during a potential fusion reaction. The construction of the NIF was certified complete on 31 March 2009 by the U.S. Department of Energy, and a dedication ceremony took place on 29 May 2009.

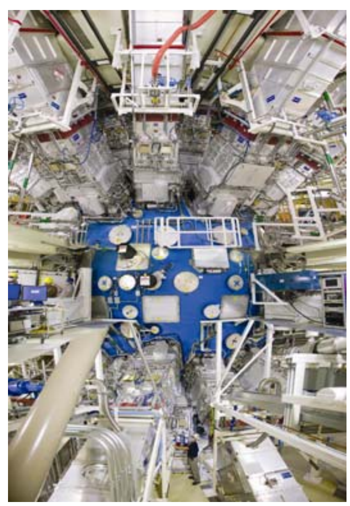

Fig 5: Composite photo shows all three floors containing the 264,000-pound, 10-meter diameter target chamber. Diagnostic instruments will be attached to the round hatches.

The NIF and LLNL has successfully delivered more than 1 MJ of laser energy to the target in a few billionths of seconds.

From ISP labs……………..

Selective mode excitation in the dye –DNA Polyvinyl alcohol thin film

Nithyaja B

The continued development of photonics technology is crucially dependent on the availability of suitable optical materials. Biomaterials are emerging as an important class of materials for a variety of photonic applications. From the rich world of organic materials, biomaterials are of particular interest as they often have unusual properties that are not easily replicated in conventional organic or inorganic materials in the laboratory. Furthermore, natural biomaterials are a renewable resource and are inherently biodegradable. The most important and famous biomaterial known to man is DNA (De-oxyribo Nucleic Acid), the polymeric molecule that carries the genetic code in all living organisms. It is clear that the unique structure of DNA results in many optical and electronic properties that are extremely interesting for photonic applications.

Thin solid film of DNA has been fabricated treating with polyvinyl alcohol and used as host for the laser dye Rhodamine 6G. The edge emitted spectrum clearly indicated the existence of laser modes and amplified spontaneous emission Lasing was obtained by pumping with a frequency doubled Nd:YAG laser at 532 nm. For a pump energy of 6mJ/pulse,an intense line with FWHM 0.2 nm was observed at ≈566 nm due to selective mode excitation

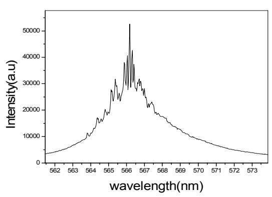

Fig. 1 Laser modes with a spacing of 0.2 nm from a dye doped DNA –PVA thin film.

Thermal diffusivity measurement using photothermal technique- Fractal approach

Lyjo K. Joseph

Rare earth titanates(RET) of nanometer size are prepared by the self propagating high temperature synthesis method. Photothermal deflection (PTD) has proved to be an effective method for finding the thermal diffusivity (TD) of ceramic materials in global scales. The approximate thermal diffusivity values of these rare earth titanates are obtained using laser induced photothermal deflection studies and an attempt is made to describe the possible fractal nature of the samples using photoacoustics. The TD measurement gives an indirect way to investigate the structural aspects of the ceramics. The local measurement of thermo-physical parameters of the ceramics using photothermal techniques is an effective tool to measure some of the inherent properties of ceramics, which are hard to measure using conventional methods. The thermal properties of ceramics are basically determined by the composition, the structure and arrangement of the phases.

The PTD characterization of the RET samples gave a rough estimation of the TD values. Appropriately managed use of modulated photothermal method is well suited to measure the effective TD at global scales. Their low TD values indicate the possibility of using them as thermal barrier coatings.

An attempt is made to explain the possibility of fractal nature of RETs by using PTD and Photo Acoustics. The photoacoustic amplitude spectrum shows frequency dependence near to -1 which is a natural behaviour of samples with small grains.

Photo induced studies on Chalcogenide glasses

Tintu R

Chalcogenide glasses belong to an important class of photonic materials which assure importance due to their high refractive index, high transparency in the IR region, low phonon energies, large optical nonlinearities, ability to be directly patterned by exposure to near-band gap light, and ability to incorporate relatively high concentrations of rare-earth dopants with minimal clustering. Due to these properties chalcogenide glasses are promising materials for optical applications such as infrared power delivery, thermal imaging, all optical switching Raman amplification, optical limiting etc.

Chalcogenide glasses are highly photosensitive and the

From ISP labs……………...

photosensitivity mechanisms in these materials are complex due to transformations involving local electronic, electro-optic, thermal, photostructural, and photochemical phenomena etc. The role of each mechanism depends upon different factors, such as the method of sample preparation and the excitation wavelength etc. The photo-induced changes exhibited in chalcogenide glasses are in the physical thickness (volume changes like photo-expansion or photocontraction), photo-darkening (red shift in the band gap) and photo-induced changes in the phase state. These changes are accompanied by variations in the electronic band gap, and in optical parameters like refractive index and absorption coefficient.

The exposure time dependent kinetics of photo induced studies on $Ga_5Sb_{10}Ge_{25}Se_{60}$ thin films samples exposed to continuous wave laser radiations of different wavelength and intensity has been studied. It is found that the magnitude of photo darkening can be enhanced by exposure time. A low power radiation is sufficient enough to provide a shift in the absorption edge and a change in the refractive index. The refractive index, the optical band gap, optical conductivity and dielectric properties found to change with exposure. Exposure time dependent change in band gap with exposure to continuous wave laser radiations is given in fig. 2. This property of the photo induced effects in this glasses can be used for the production of photo resists, optical bitable components, diffraction elements, optical waveguides, optoelectronic elements and devices.

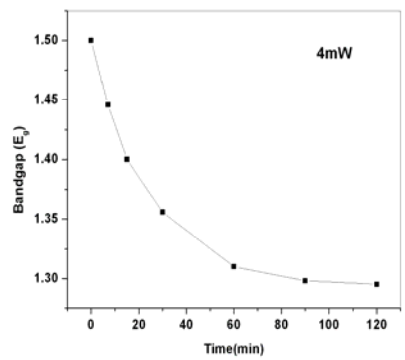

Fig. 2 Spectral dependence of band gap of Ga-Sb-Ge-Se thin film with laser exposure time.

Periodically Tapered Long Period Fiber Grating

Linesh J

The Long Period Fiber Grating (LPFG) are a periodic modulation in the fiber optical properties with long spatial periods (100-700μm), which couples light from the fundamental core propagation mode to co-propagating cladding modes. The large spatial period of logs has enabled the development of different fabrication techniques. In fact, for instance, Logs can be obtained using ultraviolet (UV) irradiation, infrared CO_2 laser radiation, electric-arc discharges, and mechanical pressure. The writing processes that use the point to point technique can produce a complex pattern in the refractive index modulation along the fiber since, after each point, the writing parameters can be changed. Although the UV-based fabrication method is a well-established technology, it has problems. It requires complex and time-consuming processes, including hydrogen loading, UV writing, and annealing. The need for a large number of photo masks with various periods is also a practical problem.

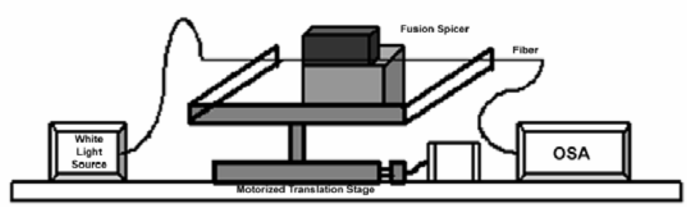

Fig 3: LPG writing setup

In our lab we were able to fabricate LPFG using electric arc from a fusion splice using the point-to-point writing method. Using periodic tapering along with arc we were able to reduce the arc current and duration for writing, which enabled the formation of LPG with high mechanical endurance. LPFG was written in SMF-28 single mode fiber an arc discharge using the fusion splice

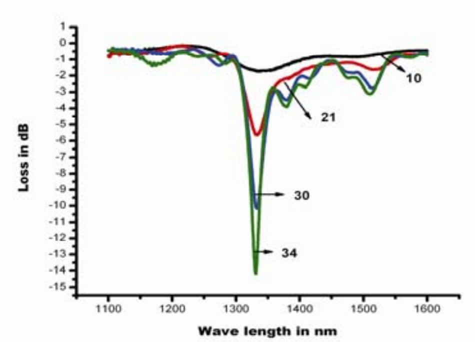

Fig 4: Evolution of LPG spectrum

machine (Fujikura FSM-50S). After each arc the fiber was moved by the translation stage along a distance equal to the grating period and also tapering is done using the machine. . Since high current arc for a long time reduces the strength of the grating, our method of inducing tapering for every arc can substantially reduce arc current and time, and hence the LPG formed have high mechanical strength.

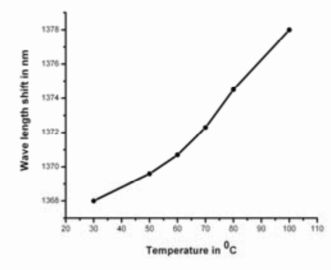

Fig 5: Wavelength shift for temperature

Imaging studies on propagation dynamics of laser blow off plasma plume

Sony T. George

Generation of collimated laser ablated plasma plume is of great interest because of its importance in several fundamental and applied researches. It can play a crucial role in development of extreme ultraviolet (EUV) lithography source, thin film deposition, synthesis of nanoparticles, metallic atomic beam source for accelerators and probing neutral atomic beam in plasma environment. Plasma plume formed by laser-blow-off (LBO) technique, where the laser beam interacts with a thin film of target material supported on a thick transparent substrate, is used to generate short bursts of high intensity, neutral atomic/ionic beams. In view of above, we have conducted a systematic experiment to understand the expansion dynamics of the LBO plume formed by two different laser systems having different intensity profiles *via* Gaussian (GP) and top hat (THP). We have used fast time resolved imaging (ICCD), which is better-suited diagnostic tool for such aspects. This study will help in understanding and controlling the geometrical aspect of the LBO generated atomic/ionic beam. Results clearly show the dependence of characteristic expansion of the LBO plume on the laser beam intensity profile. The geometrical shape, velocity and directionality of the plumes formed by the GP and THP laser are significantly different. One of the important observations in the present work is very low divergence of the plume produced by the GP in comparison to the plume generated by THP.

[Collaborative work being carried out at International School of Photonics and Laser Diagnostic Group, Institute for Plasma Research, Gujarat]

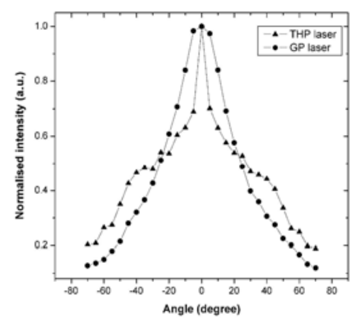

Fig 6: Angle of divergence of plume with two laser profiles.

Dual Amplified Spontaneous Emission in MEH-PPV solution

Sreelekha G

Conjugated organic systems are attracting great interest due to their unique electronic and optical properties. Above two decades ago the initial objectives in the investigation of conjugated polymers focused on the study of their electric and transport properties. With the improvements of organic chemistry, conjugated polymeric materials with quantum yields equivalent to that of laser dyes are now available with a wealth of chemical derivatives. Consequently, they can be used as gain media for lasers and optical amplifiers that are tunable throughout the visible spectrum.

The laser action of a semiconducting polymer, poly(2-methoxy,5-(2'-ethylhexyloxy)-p-phenylenevinylene (MEHPPV) in the liquid state, operating in the yellow/red wavelength region, was achieved for the first time in 1992. The reported lasing performance of this polymer was comparable to that of the most efficient laser dye, Rhodamine 6G. We observed dual wavelength amplified spontaneous emission from the solutions of a conjugated polymer poly[2-methoxy-5-(2-ethylhexyloxy)-1,4-

phenylenevinylene] (MEH:PPV) in tetrahydrofuran. The evolution of amplified spontaneous emission with increasing polymer concentration is presented. For intermediate polymer concentrations, narrow emission was observed at 0-0 and 0-1 vibronic peaks. An energy transfer between the 0-0 and 0-1 vibronic peaks was also observed for increased concentrations, where the first peak was completely suppressed.

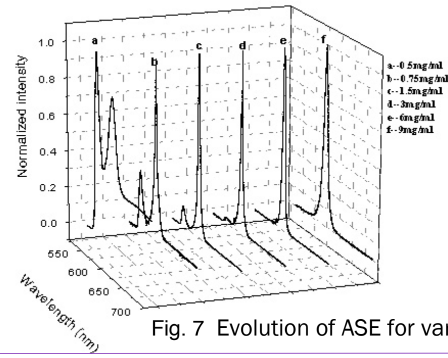

Fig. 7 Evolution of ASE for various concentrations

Publications from ISP

1) Fast imaging of laser blow off plume: lateral confinement in ambient environment, Sony George, Ajai Kumar, R.K.Singh, V.P.N.Nampoori, *Appl Phy Lett 94, 141501 (2009)*
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3) Thermal diffusivity of rhodamine 6G incorporated in silver nanofluid measured using mode-matched thermal lens technique, Santhi Ani Joseph, Misha Hari, S. Mathew, Gaurav Sharma, Soumya, V.M. Hadiya, P. Radhakrishnan, V.P.N. Nampoori, *Optic. Comms; 283(2010) 313–317.*
4) Photothermal characterization of nanogold under conditions of resonance excitation and energy transfer, Santhi Ani Joseph, S. Mathew, Gaurav Sharma, Misha Hari, P. Radhakrishnan, V.P.N. Nampoori, *Plasmonics (2010) DOI: 10.1007/s11468-009-9116-0*
5) Laser induced Bessel beams can realize fast all-optical switch in gold nanosol prepared by pulsed laser ablation, Santhi Ani Joseph, Gaurav Sharma, Misha Hari, S. Mathew, P. Radhakrishnan, V. P .N. Nampoori, *JOSA B (in press 2010)*
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8) Hopf bifurcation in parallel polarized Nd:YAG laser, M.R. Parvathi, Bindu M. Krishna, S. Rajesh, M.P. John and V.M. Nandakumaran, *Chaos, Solitons and Fractals*, *Vol.42, Issue 1, 2009, pp. 515-521*
9) Effect of a fluctuating parameter mismatch and the associated time-scales on coupled Rossler oscillators, Manu P. John , P. U. Jijo and V. M. Nandakumaran, *Pramana, Vol.72, No.3, 2009, pp.495-503*
10) Identification of spectral lines of elements using artificial neural networks, M. Saritha, and V.P.N. Nampoori**,** *Microchemical Journal, Vol.91, Issue 2, 2009, pp. 170-175.*
10) Liquid Level Sensor using etched silica fiber, J. Linesh, K. Sudeesh, P. Radhakrishnan,and V. P. N. Nampoori, *Microwave Opt. Technol. Lett., 52, 883*

Annual Photonics Workshop 2009

Annual Photonics Workshop (APW – 2009) was held during 27th and 28th of February, 2009. The theme of the workshop was *Nanophotonics*. The National Workshop was inaugurated by the Vice Chancellor of Cochin University of Science and Technology, Dr. Gangan Prathap. The visiting professor of ISP, Dr. V. Unnikrishnan Nair, was the chief guest for the event. The two day event also witnessed the presentation of the *Nalanda Endowment Award* instituted by Prof. N. G. Devaki for the student who gets highest mark in the first semester of MSc. In Photonics. The main attraction of the workshop was the special talk on Nanophotonics by Dr. C. Vijayan, Professor, IIT Madras. He also released the annual magazine of the photonics department *Photonics News 2009*. Apart from that about 50 to 60 participants including professors, researcher, students and scientists also took part in the workshop.

"Knowledge comes, but wisdom lingers."

Alfred Lord Tennyson

New Doctorates from ISP

Sheeba M has received her PhD for the thesis titled *Fabrication and characterization of polymer optical fibers for photonic device applications*. She has completed her doctoral work from the Fiber Optics division of ISP under the guidance of Prof. P. Radhakrishnan. Presently, she is working as Post-Doctoral Researcher at Micro and Nano Scale Engineering Department, Eindhoven University of Technology (TU/e), Eindhoven, Netherlands. Her current Research is concentrated on fabrication of optical waveguides and microfluidic channels in glass using femtosecond lasers.

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Dann V. J. has received his PhD for the thesis titled *Characterization and imaging diagnostics of laser induced plasma from solid targets*. He has completed his doctoral work in the Laser division of ISP under the guidance of Prof. V. P. N. Nampoori and Prof. V. M. Nandakumaran as co-guide. Now he is working as Lecturer in Physics at Government Polytechnic , Kottayam, Kerala.

Parvathi M. R has received her PhD for the thesis titled *Nonlinear Dynamics of Nd:YAG lasers: Hopf bifurcation, Multistability and Chaotic synchronization*. She has completed her doctoral work from the theoretical division under the guidance of Prof. V. M. Nandakumaran. Now she is working as lecturer at Rajdhani Institute of Engineering and Technology, Thiruvananthapuram, kerala.

Jayasree V. K. has received her PhD for the thesis titled *Selected Cardiovascular Studies based on Photoplethysmography Technique*. She has completed her doctoral work under the guidance of Prof. P. Radhakrishnan. Now she is working as Asst. Professor at Govt. Engineering College, Thrikkakara, Kerala.

Samuel Varghese , received his PhD for the thesis titled *Fabrication and Characterization of All-Fiber Components for Optical Access Networks*. he has completed his doctoral work from ISP under the guidance of Prof. V. P. N. Nampoori and Prof. C.P. Girijavallabhan as co-guide. Now he is working as Project Manager at NeST Research and Development Centre, Kakkanad,

Distinguished Visitors

Professor Kishan Dholakia

Department of Physics & Astronomy

University of St. Andrews, Scotland.

Professor Kishan Dholakia is one of the world-leading researcher behind breakthroughs in using optical forces to manipulate cells and other biological structures. He is the winner of European Optics Prize 2003 for work on optical micromanipulation. Prof. Dholakia was awarded the International Tan Chin Tuan Visiting Fellowship at National Technical Univ., Singapore . He is the Honorary Adjunct Professor at the Center for Optical Sciences, University of Arizona, USA and the fellow of the Royal Society of Edinburgh. Prof. Dholakia delivered special lectures on *An overview of biophotonics* and *Light forces in action: optical micromanipulation of atoms, molecules, colloids and cells* in January 2010. The lecture was organized as a part of Erudite programme.

- August 26,2009: "*Polymers in Fibre Optics-Activities at CGCRI*" by Dr. Dikshit A K ,Scientist, CGCRI, Calcutta
- October 14, 2009: "*Quantum Zeno Effect*" by Dr. Anil Shaji, IISER, Trivandrum

Prof. Ajoy K. Kar

Director of M.Sc Photonics and Optoelectronics,

Heriot-Watt University, Edinburgh.

Professor Ajoy Kar is an eminent scientist in the field of nonlinear optical properties of materials and their applications. His current projects involve large gain EDWAs, ultrafast all-optical switching in novel chalcogenide glasses, ultrafast optical nonlinearities in II-VI semiconductors, generation and propagation of white light continuum through atmosphere for novel LIDAR applications. He delivered a special lecture on *ultrafast nonlinear optics* in February 2010 under Erudite programme.

- December17,2009:"*Applications of High intensity Laser Fields*" by Prof. Arie Zigler, Hebrew University, Jerusalem
- December 28, 2009: "*Fiber optic Communication– An Overview*" by Prof. B. P Pal, IIT, Delhi
- January 4, 2010:"*3D photonic Structures Using 3D Interference*" by Dr.J oby Joseph, IIT, Delhi.

Achievemennts

Niraj Kumar Singh who was the president of ISP Students chapter for the year 2009 represented the annual SPIE leadership meet held at San Diego in August 2009. In the meeting he received the first prize for ISP Students chapter for the video Competition which was organized by university of Brussels and was funded by SPIE. Niraj Kumar Receiving the Certificate and Cheque for the Nemo-Kit Video award from SPIE President Prof. Maria Yzuel

Rohit K R (M.Tech 2007-09 Batch) won the Best Paper Award for his paper "Optical Micro Ring Resonators-A Novel Amplification Approach" (authors: Ramapati Mishra, Laxmikant Singh, Rohit K Ramakrishnan) at the International Conference ELECTRO 2009 (Emerging Trends In Electronic And Photonic Devices& Systems) held at IT-BHU (Institute of Technology-Banaras Hindu University)

Obituary

Prof. Ramavarma Pratap

The death of Prof. R. Pratap on 15 February 2010 is a great loss to the scientific community in India and especially to the staff and students of ISP with whom he had maintained a very warm and endearing relationship. With the death of Prof. Pratap a doyen among the scientists who emerged as the first generation Physicists in free India is no more. Though he worked in Kerala, his native state, only at the fag end of his productive life, he left a lasting impression among the teachers and students here. He was a very refined and cultured person who exuded the old world charm, but held a much advanced and progressive view of the world and the society.

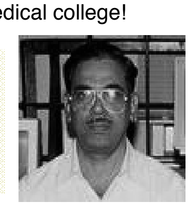
Prof. Ramavarma Pratap was born in 1923 in a quiet village of Chendamangalam, in the Princely state of Cochin. He had his school education in the NSS High School in Changanassery. Under the influence of his elder brother who was then teaching in the same school, young Pratap became fascinated by mathematics and became an ardent devotee of the subject. After completing his B.A. Degree in Physics from Maharajas College, Ernakulam in 1942, he went to Bombay and started teaching at the Sidharth College while finishing his M.Sc. Degree by research from Wilson College. Former Union Minister Madhu Dantavate was his class mate and many political leaders of yesteryears with character and integrity like Madhu Limaye became his friends through his work in Congress Socialist Party.

Prof. Pratap started serious research under Prof. Subodh Chakraborty who was then collaborating with Homi J. Bhabha and studied cascade showers in cosmic ray physics and related geomagnetic effects. He earned his Ph.D. degree from Bombay University in 1952 and in 1955 he left Bombay to take up a PDF position in Dominion Observatory in Ottawa under a NRC fellowship from Canada. He returned to India in 1959 and joined TIFR and worked in the field of statistical mechanics where he introduced the concept of *functional* in the context of Bogolibov theory. This paper took him to Brussels to work with Ilya Pregogine (who later won Nobel Prize in Chemistry) and together they worked on non equilibrium thermodynamics and both migrated to University of Austin in Texas where Prof. Pratap became an Associate Professor. On his return to India in 1969, he joined Matscience, Chennai, but finally chose to settle down at Physical Research Laboratory at Ahmedabad from where he retired in 1983. He became a UGC Emeritus Professor at the Physics Department in CUSAT in 1984 and later worked as a Visiting Professor at ISP when it was established in 1995 and maintained close academic relationship with the photonics community from the very beginning.

Prof. Pratap was instrumental in introducing the research community in Kerala to the novel and fast progressing field of nonlinear dynamics, the success of which he demonstrated through his work in the areas of plasma physics and neural network analysis. His work on the Ripple Raman Laser in modulated plasmas has attracted world- wide attention.

Even as an octogenarian he continued to work tirelessly from his home in Thripunithura and enjoyed writing research papers for journals like Physical Review Letters. He was a sincere, charming and honest personality and his enthusiasm and optimism were infectious. Young students used to flock around him to listen to his hilarious jokes and anecdotes relating to scientists of the bygone era. Prof Pratap is survived by his wife Ammini Amma and son Dr. Pramod and daughter Dr. Preeti. Dr. Pramod is a professor of Bio-Physics at the University of North Carolina, and Dr. Preeti works as an astrophysicist at MIT Observatory in Boston. Prof. Pratap is the younger brother of the illustrious Lakshmi N. Menon who was the Minister of Foreign affairs in Pt. Nehru's Government . Even after his death he wanted his dead body to be useful to the community and hence he arranged it to be donated to the medical college!

Prof. C. P. Girijavallabhan
Professor Emeritus
International School of Photonics



Awards

PSI prize to Asha Prasad

Mrs. Asha Prasad who topped the M.Tech Degree Examination in Optoelectronics and Laser Technology conducted by CUSAT, receives the Photonics Society of india prize. The PSI prize is given every year to the student who bags first rank in M.Tech Degree Examination (OE& LT) of Cochin University of Science and Technology. This prize is instituted by Prof. C.P. Girijavallabhan, former Director, CELOS. The prize which in cash, momento and merit certificate will be presented during the inaugural function of APW 2010.

Ajan P R Receives the Nalanda Endovment prize.

The 2010 Nalanda Endowment Prize will be presented to Mr. Ajan P R during the inaugural function of APW-2010. 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.

Dr. Ramachandran Thekkedath- New Vice Chancellor for CUSAT

Dr. T. Ramachandran took charge as the new Vice Chancellor on 11th January 2010. Dr. T. Ramachandran is a laser technologist by training and was associated with the technology commercialization office of the University of Utah at Salt Lake City in the United States. His experience of university industry interaction may help CUSAT in its venture to establish strong link with industries. Dr.Ramachandran took his PhD in 1987 in Laser technology from CUSAT. From 1987 to 1997 he worked as scientist in Sri Chitra Tirunal Institute of Medical Science Technology, Trivandrum. In 1997 Dr. Ramachandran migrated to the United States. Dr. Ramachandran has a number of Patents to his credits including one on the system and method for measuring fluid properties.

SPIE Students Chapter activities

Blood Donation Camp 2009

Despite advancement in modern medicine, there seems to be no substitute for human blood. The chapter in association with ISP-OSA student chapter and Indian Medical Association had organized a blood donation camp in memory of our beloved senior Sibilathullah Aloor Mubarack. This was done as a part of the social out reach program of the chapter. This invoked a sense of commitment for the society among the chapter members.

Optics Fair 2009

Optics Fair 2009 was held on the 4th and 5th of December 2009 for school students. The main idea behind this fair was to introduce kids to the magnificent field of Optics manner involving visual aids. Three instructional units were prepared to address the students of different levels; the kids section for the students of class 4 to 7, the high school section for the students of class 8 to 10, and the higher secondary section for the students of class 11 and 12. Apart from these sections one general section was also there in place with some interesting experiments and optical illusions for all age groups students.. This year Optics Fair was a grand success as it witnessed the participation of 1709 students from different schools around Kerala. The feedback received was overwhelming. It was during this fair that our latest and modified version of optics kit (Version 3.0) was also released. Some new experiments were included in the newer version.

Raman Day Celebration

To commemorate the birthday of Nobel Laureate Sir C. V. Raman, a small function was organized at International School of Photonics. Raman day lecture was delivered by Dr. V.P.N Nampoori, Director, ISP.

Autueorcracy 2009

The chapter members are involved in many creative programs in the university. Some of the members were involved in the making of a short film titled *folie a deaux.* This film was screened in the Nirzar International Film Festival making it to the list of the best seven short films. This achievement was celebrated by the chapter members by organizing our very own film festival named *Auteuorcracy.*

ISP and CELOS community

Lecture on Biophotonics by Prof. Kishan Dholakia

Optics Fair

Blood donation camp

The Audience – Laser Fest

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The International School of Photonics (ISP) was established on February 27, 1995 by delinking the erstwhile Laser Division of the Dept of Physics of Cochin University. Within its 15 years old existence, ISP has become one of the leading research centers 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 & Laser Technology and Ph.D Degrees in Photonics and related areas.

ISP is one among the three participating departments in the UGC sponsored Centre of Excellence in Lasers and Optoelectronic Sciences.

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PHOTONICS Society of India

ISP-OSA Student Chapter

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