PHOTONICS NEWS

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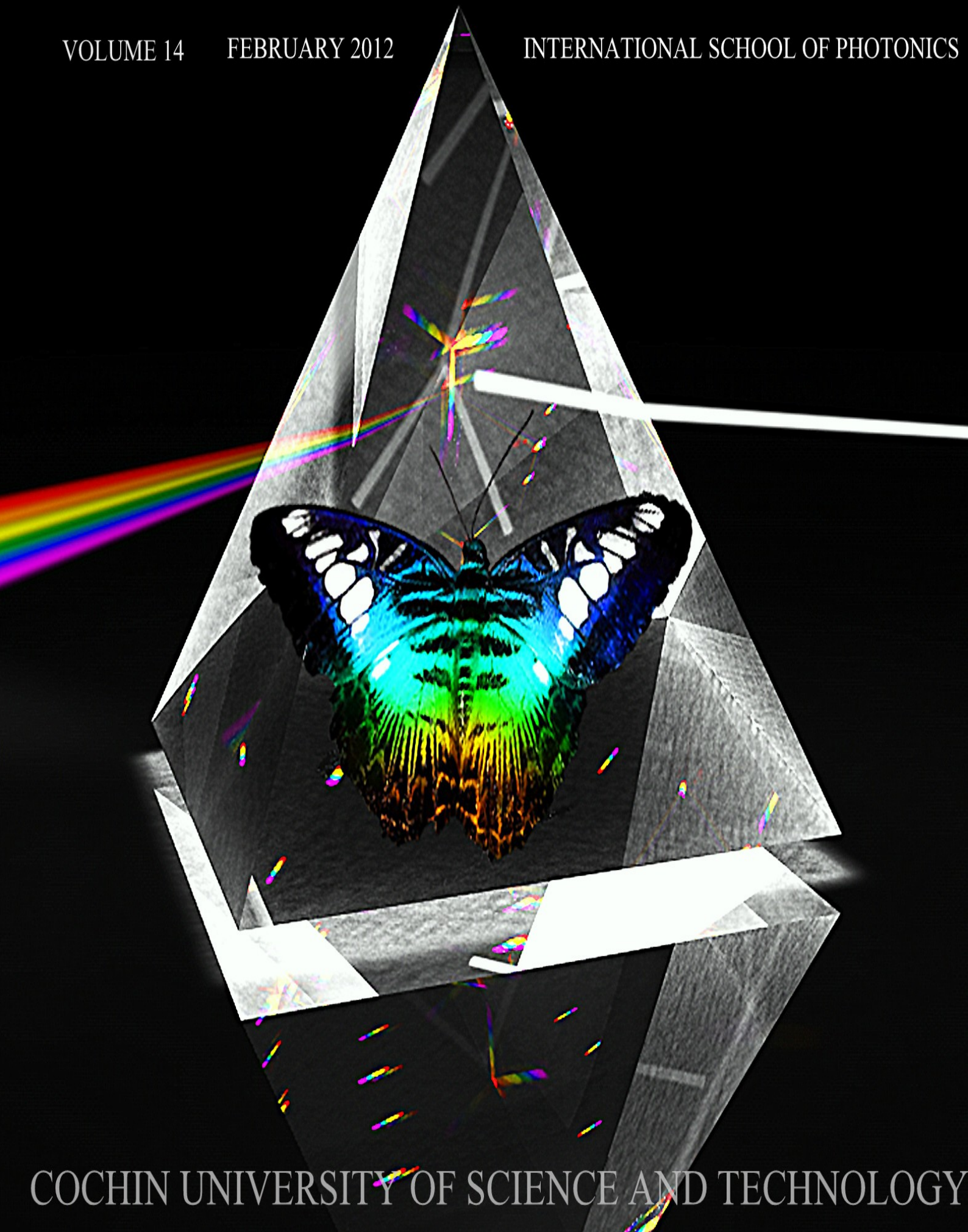


COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

FROM EDITOR'S DESK...

Chief Editor
Prof V.P.N Namboori

Dear Photonians,

It is with great pleasure and satisfaction that we bring out the 2012 edition of Photonics News. The subject of Photonics has strong footing in the field of science and technology. There does not exist any field of human activity which is not influenced by photonics technology. In India and abroad research and developmental activities in this branch of science and technology are getting enhanced on annual basis. Most of the countries have established institutes which are dedicated to photonics and related fields. In India there are institutes like TIFR where Photonics related fields have received special attention. Government of India has several programme like Annual Photonics Fellowship scheme to attract students for taking up Photonics as their future career. International School of Photonics of CUSAT is one of such academic establishment where manpower training in the field of Photonics is given an important thrust. Its programme of five year integrated M Sc degree in Photonics through CELOS has received well by national and international communities of science and technology. We take this opportunity to request the administration wing of CUSAT for proper continued support for the sustainability of such unique programme in coming years. This is important since the UGC support of this programme under CELOS will be only up to 31st March 2012..

The current volume of Photonics News documents academic achievements of ISP during 2011-2012. New areas of research in the field of fibre optic sensors and biophotonics have been opened up during this period. An important field in which ISP should take up for research is in the nonconventional energy systems. One should remember that about 35% of electrical energy is used for internal lighting . One should realize that we receive energy from the sun which has to be utilized through novel schemes. One can think of guiding sun light to internal structures of building using optical fibres . If this is realized one will have a paradigm shift in energy production and distribution.

The year 2011 witnessed one startling discovery of neutrinos defeating light in running race. No official confirmation is available on this as a journal paper.

ANNUAL PHOTONICS WORKSHOP 2011

Annual Photoincs workshop 2011 was held on 27th & 28th of February, 2011. The focal theme of this year's workshop was 'Recent Trends in Fiber Optics and its Applications'. As many as 75 researchers from the various parts of the country came down to become a part of the annual event. The chief guest of the event was the Pro vice chancellor of Cochin University of Science and Technology Mr. Godfrey Louis. The two day event also witnessed the presentation of the 'Nalanda Endowment Award' instituted by Prof. N.G Devaki for the student who gets the highest marks in the first semester of the Integrated M.Sc. course in Photonics. This year's award went to chapter Mr. Vikas R. The chief guest released the annual magazine of the Photonics Department 'Photonics News – 2011' during the event. The participants were provided with a platform to strongly interact with all the speakers of the workshop during the intervals. Posters related to the topic were also exhibited in the courtyard of the Institute for the participants. One section of the workshop was earmarked for lab visit. The workshop was organized in collaboration with ISP-SPIE Students Chapter,ISP-OSA student chapter and Photonics Society of India (PSI).

NEW CENTRES IN CUSAT

Interuniversity Centre for Studies on Kerala Legacy on Astronomy and Mathematics

Indian contributions to astronomy and mathematics from 8th century BC to current period are well known. Contributions to this field by Kerala mathematicians and astronomers have come to light only by the second half of 20th Century. Sangama Grama Madhavan who lived in Irinjalakkuda during 1350-1425 AD established a lineage of mathematicians (called Kerala School of Mathematics) extending from 14th century to 19th century. Some of the renowned names are Neelakanta, Jyeshtadeava and Sankara Varman. In order to carryout research and studies on Kerala School, CUSAT has established Inter University Centre for Studies on Kerala Legacy of Astronomy and Mathematics (IUKLAM) with the financial assistance from the Government of Kerala through the Higher Education Council. The Centre which functions in Centre for Science in Society was inaugurated on February 17, 2011 by the then Minister for Education and Culture Sri M A Baby. IUKLAM envisages several programme like workshops, students visiting fellowship, visiting scientist fellowships and Ramanujan Fellowship.

AWARDS 2012

PSI Prize to Alok Kumar Jha :

Mr. Alok Kumar Jha 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 includes cash, memento and a merit certificate.

Ms.Melbi Johny receives the Nalanda Endowment prize:

The 2010 Nalanda Endowment will be presented to Ms. Melbi Johny during APW 2012. The Nalanda Endowment prize is instituted by Prof. N.G. Devaki of Department of Hindi, CUSAT. The 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.

WE HEAR THAT……

PROFESSOR MOHANAN WINS THE SCIENCE AND TECHNOLOGY AWARD OF GOVERNMENT OF KERALA FOR 2011

Professor P Mohanan of Electronics Department, CUSAT won the Dr S Vasudev award of 2011 for his work on COMPACT DUAL BAND DIELECTRIC RESONATOR FOR MOBILE PHONE ANTENNA WITH REDUCED RADIATION HAZARDS. With the growing awareness on the health hazards of mobile radiation, professor Mohanan's invention of the antenna with modified design is highly significant. Dr Vasudev Award is instituted by Government of Kerala to be given every year for the best research project funded by Kerala State Council for Science Technology and Environment (KSCSTE). Professor Mohanan received the award from Professor V N Rajasekharan Pillai, the Executive Vice President of the Council.

The wide spread use of the hand-held mobile phones indicate that many people routinely place radio frequency transmitter against their head. Recently there have been a lot of speculations regarding the ill effects of these radiations up on user's health. Hence there arises a need for a mobile phone antenna emitting lesser radiation towards the user. At this juncture the KSCSTE came up with a project for developing such an antenna. The main objectives put forward were to develope better antennas with nearly Omni directional radiation characteristics and reduced user exposure with low transfer of electromagnetic energy towards human tissues. The dielectric resonator materials with BaTiO3 and SiC absorbing section were developed by Professor Mohanan's group with the help of RRL, Trivandrum. Various types of characterisations of the antenna were studied including one photonics based experiment. It is worth mentioning that this project has altogether produced 5 research papers and one PhD. We congratulate professor Mohanan and his group for the invention which fetched the award.

HONOUR TO CUSAT

Gangadharan Ajith Kumar an alumini of CUSAT has brought laurels to the entire institution by winning the prestigious GREEN PHOTONICS AWARD organized by International Society for Optics and Photonics (SPIE) .The award was presented at the `Photonics West 2012' meet held in San Francisco.

Ajith Kumar from Erumeli, Kottayam, is working as research associate in Texas University of San Antonio in US. Ajith Kumar after gaining Ph D from MG University had his higher education from Japan and America. He has presented more than 120 research thesis.

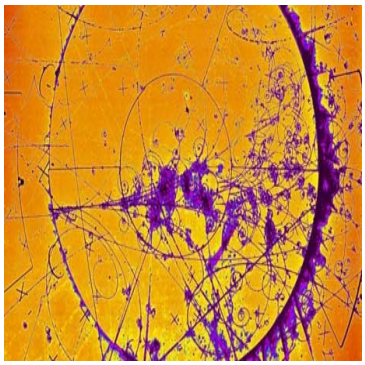
The award has been presented in the area of Solid State Lighting and Displays . They worked on Infrared excited Yb: Er: Y_2O_2S phosphors with intense emission for lighting applications. His research area includes fabrication of fluorescent materials suitable for the application ranging from computer displays, LED , mobile communication, communication networks, LASER and so on.

Materials coated with phosphorous when irradiated with high energy Infrared radiations emit light .Usually IR sources are mercury lamps which have an efficiency of about 21% but these mercury lamps pose environmental hazards .The material discovered by Dr. Ajith Kumar is having highest efficiency attained so far. They are also eco-friendly.

NEUTRINOS STILL FASTER THAN LIGHT IN LATEST FINE TUNED EXPERIMENT

If the findings are true, a new field of research will open up namely high energy area where even Einstein's theory will break down One can think of low energy, medium energy and high energy physics where Newtonian, Einsteinian and non-Einsteinian theory of relativity have to be invoked respectively.

The discovery that neutrinos travel faster than light is the latest sensation in the world of science.The scientists who appeared to have found in September that neutrinos can travel faster than light have performed a second, fine-tuned version of their experiment and confirmed the earlier result.that neutrinos, sent through the ground from Cern near Geneva to the Gran Sasso lab in Italy 450 miles (720km) away seemed to travel faster than light.



The finding that neutrinos might break one of the most fundamental laws of physics sent scientists into a shock when it was first reported in September. Not only because it appeared to go against Albert Einstein's theory of special relativity but, if correct, the finding opened up the troubling possibility of being able to send information back in time, blurring the line between past and present and wreaking havoc with the fundamental principle of cause and effect.

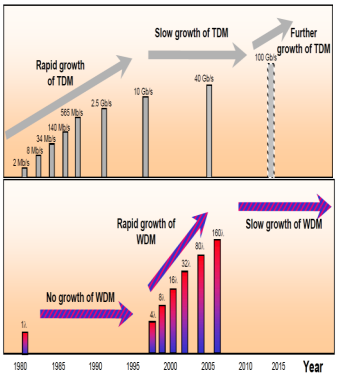
In their original experiment scientists fired beams of neutrinos from Cern to the Gran Sasso lab and the neutrinos seemed to arrive sixty billionths of a second earlier than they should if travelling at the speed of light in a vacuum.

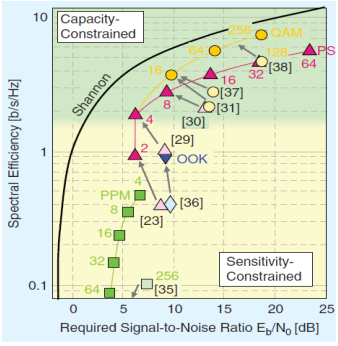
One potential source of error pointed out by other scientists was that the pulses of neutrinos sent by Cern were relatively long, around 10 microseconds each, so measuring the exact arrival time of the particles at Gran Sasso could have relatively large errors. To account for this potential problem in the latest version of the test, the beams sent by Cern were thousands of times shorter – around three nanoseconds – with large gaps of 524 nanoseconds between them. This allowed scientists to time the arrival of the neutrinos at Gran Sasso with greater accuracy.

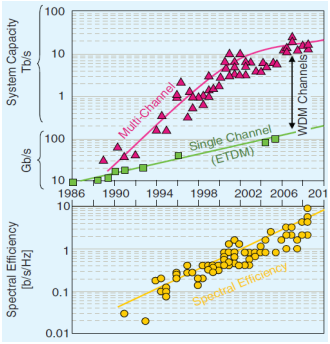
If the findings are true, a new field of research will open up namely high energy area where even Einstein's theory will break down One can think of low energy, medium energy and high energy physics where Newtonian, Einsteinian and non-Einsteinian theory of relativity have to be invoked.

COHERENT TECHNIQUES IN DWDM FIBER NETWORKS FOR 40G, 100G AND 400G SPEEDS

Dr. Thomas Lee S
Technical Consultant
Tech Mahindra
Banglore







The global IP traffic doubles every year which has put tremendous pressure on the telecom service providers (TSPs) and Telecom Equipment Manufacturers (TEMs) to develop fast and cost-effective network solutions. This phenomenal bandwidth requirement has resulted in the upgrade of the field deployed 2.5 Gbps and 10 Gbps with 40 Gbps and 100 Gbps deployments. However, the crossover from 10 Gbps to 40 Gbps and subsequently to 100 Gbps was not similar to the speed improvement that had happened till then. The throughput/ capacity (bps) of a DWDM transmission system can be improved by either using a spectrally broader transmitter (Hz) or by increasing the spectral efficiency (bps/Hz) of the transceiver. Although the fiber spectral bandwidth is ~ 500nm (1100-1600nm), the bandwith of Erbium Doped Fiber Amplifier (EDFA) sitting in the fiber network limits the fiber network bandwidth to 35 nm (4.4 THz). Therefore, the only option remaining for a faster communication system is to have a better spectral efficiency.

Hartley-Shannon theorem on Information Theory states that the information capacity rate, C over a communication channel is proportional to the capacity rate, C over a communication channel is proportional to the channel bandwidth (channel spacing in DWDM system), B and the log of signal to noise ratio, S/N or SNR.

$$C = B * log_2\left(1 + {}^{S}/_{N}\right)$$

Therefore the ratio of C over B, spectral efficiency h (bps/Hz), is dependent on the SNR and hence the signal level at the receiver. However, the signal level transmitted through an optical fiber cannot be arbitrarily raised for spectral efficiency improvement because of nonlinear effects in the fiber. The spectral efficiency is again connected to the signal modulation format through the relationship

$$\eta = \frac{R_s * log_2 M}{B}$$

where R_s is the symbol rate (baud rate) and M is the number of levels in the symbol (2 for On Off Keying). OOK is employed in all fiber transmitters up to 10G along with direct detection at the receiver.

When the modulation rate of a 10G system is quadrupled to 40 Gbps, polarization mode dispersion (PMD) quadruples and chromatic dispersion (CD) increases by a factor of 16. In addition, the spectral bandwidth occupation of a 40 Gbps signal is four times that of a 10 Gbps signal, meaning fourfold increase in noise that is detected at the receiver. This translates into a 6-dB penalty in optical performance (due to SNR reduction) for a given transmission power, or approximately four times less distance that the wavelength can traverse in the network without electrical regeneration. A fourfold spectral spread also results in reduced spectral efficiency, meaning fewer wavelengths can be transmitted down a fiber pair. Furthermore, tighter channel spacing (for more l's) will lead to increased non-linear inter-channel cross talk through either Cross-Phase Modulation (XPM) or Four-Wave Mixing (FWM). Therefore, to improve the spectral efficiency and reduce these transmission impairments for high-speed Fiber Optic Communication system (>10 Gbps), new modulation and detection schemes are needed.

The various modulation format options include Amplitude, Phase and Frequency. As there is limitation with ASK, phase shift keying (PSK) with its wide application in wireless technology, is increasingly becoming useful. Log_2M gives the bits/ symbol which is one in the case of OOK and Binary PSK. Quaternary PSK has 2 bits/symbol and 8-PSK has 3 bits/symbol. 16-Quadrature Amplitude Modulation (QAM) and its higher orders along with 2-ASK/4-PSK and higher orders represent a combination of ASK and PSK.

The use of PSK technique becomes attractive for several reasons. Phase modulation schemes can provide better resilience against nonlinear effects when compared to traditional ASK modulation because signal amplitude remains almost constant in time. In addition, phase modulation schemes become attractive as a means of lowering the overall effective transmission symbol rate (or baud rate), where multiple bits (that is, more information) are encoded per symbol. This means that the signal travels at a lower overall speed relative to its nominal 40 Gbps or 100 Gbps rate and, as such, it does not suffer the effects of increased PMD, CD or optical noise, by virtue of its narrower spectral characteristics. Two of the conventionally used PSK are Binary phase-shift

keying (BPSK) and Quaternary phase-shift keying (QPSK).

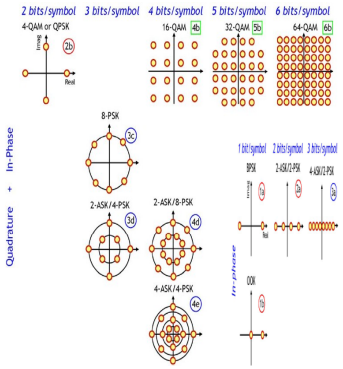
To pack even more bits per transmitted symbol, the two orthogonal polarizations in the optical fiber can be used to encode more information. Such a technique, known as polarization division multiplexing (PDM) or dual polarization (DP), enables doubling the number of transported bits while keeping the same symbol rate compared to a standard single polarization signal. In PDM one sends two independent signals on both orthogonal polarizations supported by a single-mode optical fiber. In order to recover these polarization-multiplexed bit streams, one either uses a polarization beam splitter whose axes are constantly kept aligned with the signal polarizations ('polarization control'), or one detects two arbitrary orthogonal polarizations ('polarization diversity') using coherent detection. Since upon fiber transmission the polarization axes at the receiver will be randomly rotated compared to the transmitter, one electronically back-rotates the detected signals using the (estimated) inverse Jones matrix of the transmission channel, which is the approach taken by modern coherent receivers.

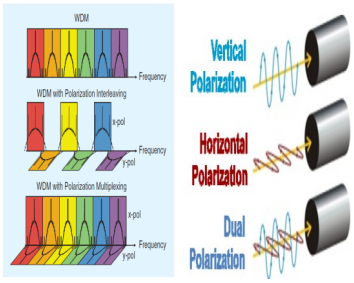
By combining the information into a phase-domain and polarization-domain modulation format, effective and reliable high speed transmission can be achieved with a high degree of quality and performance. This situation, however, calls for the introduction of a different type of receiver with respect to conventional optical transmission. The receiver design complexity increases and sensitivity decreases in the order Direct Detection, Differential Detection (one bit delay Mach-Zehnder interferometer for direct detection) and Coherent Detection (Homodyne or Heterodyne). Although, the benefits of Coherent Detection techniques was known for quite some time in Wireless systems and through optical lab research, it was put in the backburner till 2005 due to the stringent optical component requirements (kHz stabilized local oscillator and optical phase locked loop). However, the advent of ever powerful Digital Signal Processing (DSP) ICs rekindled the interest in phase modulation and coherent detection schemes. With the modern DSPs the stringency on local oscillator (laser) wavelength and spectral width is relaxed and the optical PLL is replaced with a PLL on the DSP.

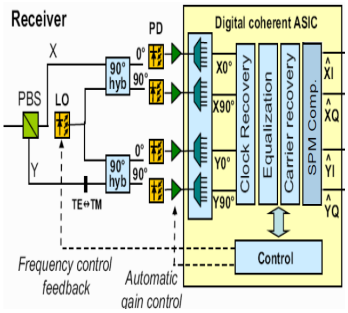
DWDM transport with per-channel bit rates of 100 Gbps has started rollout from 2010 with Coherent Dual-Polarization Quaternary Phase-Shift Keying (Co-DP-QPSK) as the modulation format of choice. It supports 100 Gbps transmission on the standard 50-GHz DWDM grid and increases spectral efficiency by a factor of 10 (h=2 bps/Hz) as compared to the well-established transport of 10 Gbps per 50-GHz-spaced channel (h=0.2 bps/Hz).

There is some ambiguity regarding the next generation fiber optic transmission speeds; whether the industry will go ahead with 400 Gbps or 1 Tbps channel. The 400 Gbps speed seems to be more optimal and easier as the system complexity (eg: electronic data speed) and spectral width requirement involved in creating a 1 Tbps system are acting as deterrents. 50 GHz grid in DWDM networks is able to handle speeds up to 100 Gbps. However, for 400 Gbps or 1 Tbps, spectral width of the signal spills over the 50 GHz grid and hence larger grids, known as super channels are needed for these next generation networks. The present interest is in achieving Flexigrid Wavelength Selective Switch ROADMs which can dynamically adjust its Add/Drop grids with respect to the speed of the signal.

The ever growing internet traffic is pushing the scientists all over the world for coming up with faster and more efficient fiber optic systems, not only in the core networks (Optical Transport Networks) but also in the metro networks (Carrier Ethernet). This tough environment will definitely be the breeding ground for new inventions and scientific revelations.







PHTONIC APPLICATION OF CHALOGENIDE GLASS QUARTER WAVE STACK STRUCTURES

Tintu R completed her PhD from ISP CUSAT in 2012 in the field of calcogenide glasses.

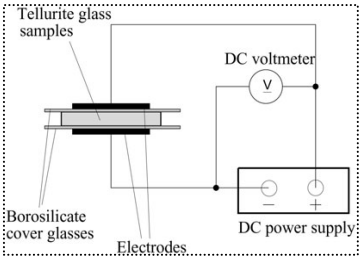
Multilayer structures of alternating dielectric layers have been used in optics for many decades for mirrors and filters. Dielectric mirrors are simple one-dimensional photonic structures made using quarter wave stacks (QWS). In recent days they are getting lot of importance because they can be designed to reflect combinations of incident wavelength, polarization and angular range with nearly zero loss. The one-dimensional photonic bandgaps are created in the dielectric multilayers if optical constants and thicknesses of films meet the Bragg resonance condition. Their bandgap structure can be predicted according to the theory of the light propagation through stratified dielectric media and their optical properties then adjusted appropriately. It has been recently discovered that that appropriately designed stacks exhibit omnidirectional reflection (near unity reflectance for all incidence angles and polarization states) within one or more bands of wavelength. The omnidirectional total reflection from such quarter wave stacks (QWS) allows the designing of the reflectors that can reflect the light at any angles and polarizations. Such optical components are critical in designing spectrometers, military applications and chemical and biological sensors at the IR region. A common goal in current QWS device design is then a maximization of a bandwidth of the omnidirectional bandgap by using materials having a high refractive index difference. Since chalcogenide glasses have unique properties such as high refractive indices and transparency at IR region, they are brilliant materials to be used in omnidirectional photonic applications. Most significantly, they have infinite potential of compositional alloying which enables application-specific tailoring of glass properties such as thermo-optic coefficient, optical response (damage resistance, photoinduced nonlinear response). The possibility of varying the refractive index of thin chalcogenide films in a wide range by changing their composition makes them prospective candidates for fabrication of 1D and 2D photonic crystals, diffraction gratings and holographic optical elements. Multimode planar chalcogenide waveguides can be applicable for spatial interferometry, which implies the use of components working in the far infrared for the detection and the spectroscopic study of extra solar planets and environmental metrology. Possibilities of chalcogenide and polymer films as an alternative to dielectric materials have been developed recently. The omnidirectional QWS devices can be fabricated as multilayers using thermal evaporation of high index chalcogenide glasses and the spin-coating of polymers which form a low index films. A combination of highly transparent chalcogenide and polymer films enables these QWS elements to cover the wavelength ranges reaching from the visible to the infrared spectral regions including telecommunication wavelengths. In order to fabricate the above mentioned mirrors and filters certain conditions have to be contented. For example assume n_H, d_H, and n_L, d_L are the refractive index and thickness of the high and low index layers, respectively, $\Lambda=d_L+d_H$ is the period of the stack and n_0 is the refractive index of the incident medium. The reality of an omnidirectional band requires that both $\delta n_0=n_L/n_0$ and $\delta n_1=n_H/n_L$ are relatively large. When these two parameters go over some minimum threshold, the Brewster line lies outside the acceptance angle for light rays incident on the mirror from the external medium and there are finite ranges of wavelength for which no propagating modes be present inside the dielectric stack. Chalcogenides provide an excellent platform for integrated devices for mid-infrared applications, promising to greatly simplifying existing optical systems. The main challenge for all applications is to identify glasses that have the required stability together with adequate transparency and processability from numerous chalcogenide glass compositions currently available. If achieved, this intriguing range of optical glasses will have a promising bright future.

Thermal poling in TeO_2-ZnO glass

Rose Leena Thomas

Tellurite glasses are very much used in the optoelectronic research due to its attractive properties such as high refractive index, low phonon energy, low transition temperature, excellent infrared transmission and very high optical nonlinearities.

TeO_2-ZnO glasses were prepared and third order nonlinearity of ZincTellurite glass is determined using a single-beam z-scan technique with Q-switched Nd: YAG laser (Spectra Physics LAB-1760, 532 nm, 7 ns, 10 Hz) with nanosecond laser pulses. On analyzing the result using Sheik Behave *et al*,it was clear that tellurite glasses are highly nonlinear and so second order polarizations can also be studied. But in centro symmetric media like glasses even order polarization is absent and so we are making use of a technique called thermal poling, to induce some asymmetry in the glass samples.



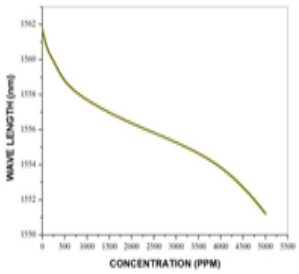
. Thermal poling is done by heating and applying a potential across the glass. Second order polarization induced glasses, are finding various applications like difference frequency

A fiber optic Biosensor for the detection and estimation of Cholesterol levels.

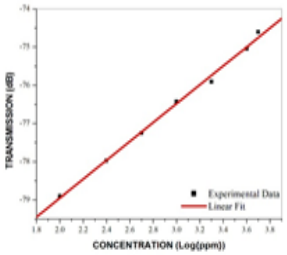
Bobby Mathews

Cholesterol is a kind of lipid and a vital substance for animal life. Cholesterol is present in practically all cells of mammals, and is highly essential for the functioning of some glandules and interacts with many compounds such as the lipids from the membrane and other cell components. In addition, they are the basic components of nerve and brain cells and are the precursors for other biological materials, such as bile acid and steroid hormones. The cholesterol concentration in the blood of healthy people is in the range of 1400 to 2000ppm. When in excess, cholesterol may cause a number of health problems.

Hypercholesterolemia is one of the many independent risk factors for coronary heart diseases. Public concern about the risks of high cholesterol levels in blood began to rise in the 1980s. In the last three decades, numerous studies have brought out the relationship between increased cholesterol concentration and the occurrence of cardiovascular diseases like arteriosclerosis and hypertension. In quality control, determination of cholesterol and its derivatives in food is important as they may increase its level in the blood. For these reasons, cholesterol has become one of the main parameters to be determined in routine clinical, pharmaceutical, biomedical research and food processing laboratories. Consequently, a growing demand for cholesterol testing technology has been noticed in the last few years.



Resonant Wavelength as a function of different levels of cholesterol



Transmission at Resonant Wavelength as a function of different

. Enzymatic procedures have practically replaced these chemical methods, as enzymes ensure the specificity and selectivity required for these kinds of assays. Such enzymatic monitoring of cholesterol makes use of oxygen consumption or the production of hydrogen peroxide during the above mentioned enzymatic reaction. But the use of these enzymes makes the fabrication and handling of the sensor head difficult and is costlier. Hence, development of simple, inexpensive, direct and real-time cholesterol sensors is of continuous interest, as the traditional methods for cholesterol measurement require costlier laboratorial analyses. In this context, fiber optic sensors offer very attractive solutions due to their intrinsic merits like high sensitivity, immunity to electromagnetic interference, small size, fast response etc. In recent years, Optical Fiber Long Period Grating (LPG) technology has gained great attention due to its numerous applications in fiber optic sensor and communication systems. LPGs are fabricated by inducing a refractive index (RI) modulation in the core of a fiber with periodicities typically of hundreds of micrometers. Various features of LPGs are made used in its applications as sensors with high degree of stability and reliability. The advantage of this type of grating sensor are their simple fabrication, ease of implementation, wavelength coded information, easy interrogation and the fact that it does not involve the use of toxic chemicals. A cholesterol biosensor has been developed; exploiting the sensitivity of LPGs to the concentration of the sample solution under test. As the cholesterol concentration levels are changed, a RI variation occurs which inturn induce shifts in the resonant wavelength and change the depth (amplitude) of the loss bands in the LPG transmission spectrum. Cholesterol levels can be detected and measured by analyzing these spectral or amplitude changes.

Studies on optical interferometric techniques for Industrial/Engineering applications

Retheesh Raj

. Optical interferometric techniques are used in vast range of applications, including metrology, surface profiling, vibration analysis, velocimetry, high resolution stellar studies, non destructive testing etc. The major advantages of these techniques are remote analysis, non-contact measurements, wholefield visualization and no need for sample preparation. The principal interferometric techniques used for optical NDT includes Moiré Interferometry, Holographic Interferometry and Electronic Speckle Pattern Interferometry (ESPI).The present study proposes a non contact optical technique (Electronic Speckle Pattern Interferometry) for thermal deformation measurement without any surface preparation and compensating process. Thermal expansion is a very important parameter to investigate durability of electronic components and printed circuit boards (PCB).Experience has shown that most of the malfunctions in electronic systems are

produced by a mismatch in the thermal expansion coefficient(TCE) of the different types of materials typically used in electronic assemblies . The mismatch often generates high forces and stresses, which produce fractures and cracks in electronic components and assemblies. The work proposes to develop a low cost interferometric setup using ESPI to evaluate thermal expansion of electronic components. ESPI being a non contact full field and three dimensional measurement methods combined with high resolution suits deformation measurements on microsystems and electronic components with a submicron resolution. In view of this ESPI can certainly help to understand the better complicated failure mechanisms exhibited by electronic components.

Fiber Optic Sensor for the Adulteration Detection of Edible Oils

Libish T M

Analysis of the quality of edible oils is of paramount importance in most of the countries. Edible oils are mixed with low-priced and sub-standard oil and are then palmed off to unwary consumers. This unethical and filthy practice of edible oil adulteration results in the formation of harmful substances in the human organism. The most common adulteration is addition of paraffin oil to expensive edible oils like coconut oil and sunflower oil. Paraffin oil is used as the common adulterant, because of its low price, easy availability and miscibility. Long term usage of paraffin oil is extremely hazardous to human health as it may lead to liver disorder or even cancer. In recent times, various analytical techniques are used to detect adulteration in different oils. Among them are chromatographic methods, differential scanning calorimetry, fourier transform infrared spectroscopy, photopyroelectric detection etc. These techniques have the disadvantage that they are expensive, time consuming, require considerable analytical skill and produce hazardous chemical waste. Due to increased public concern and legal requirements, the need for more reliable, rapid and less expensive monitoring and quality checking of edible oil is growing continuously. Fiber -optic sensors based on Long Period Grating (LPG) offer very attractive solutions in this respect due to their intrinsic merits such as high sensitivity, immunity to electromagnetic interference, small size, fast response etc. LPGs are formed by inducing a refractive-index (RI) modulation in the core of a fiber with periodicities typically of hundreds of micrometers. An LPG couples light from the fundamental core mode to the forward propagating cladding modes and results in a transmission spectrum consisting of distinct resonant loss peaks. An exceptional feature of LPG, which makes them useful as sensors, is the sensitivity of the transmission spectrum to changes in different environmental factors such as strain, bending, temperature and ambient refractive index. So LPG can be used as an ambient index sensor or a chemical concentration indicator with high stability and reliability. The RI sensing is

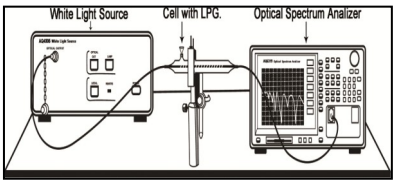


Fig. 1. Experimental setup.

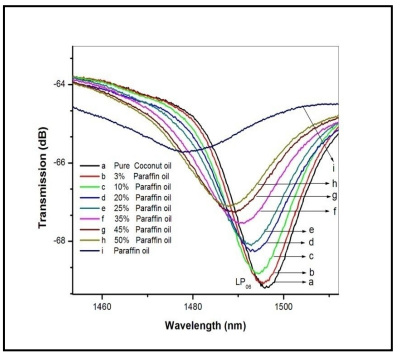


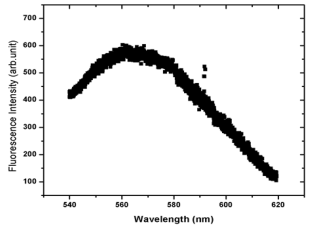
Fig. 2. Transmission spectra of the LPG

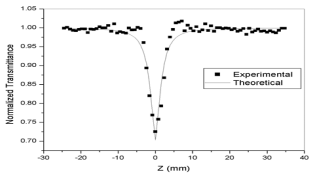
very important for biological, chemical and biochemical applications as a number of substances can be detected through the measurements of refractive index.

When the edible oils are subjected to adulteration, a change in its original refractive index occurs. Such changes cause corresponding shifts in the resonance wavelength and change in depth (amplitude) of the loss bands in the LPG. Adulteration levels can be detected by analyzing these spectral changes. The device performance is analyzed in terms of its sensitivity and resolution. This LPG based sensor possesses the advantages of requirement of small volumes of sample for analysis and provides the response

Optical nonlinearity of CdS Quantum dots

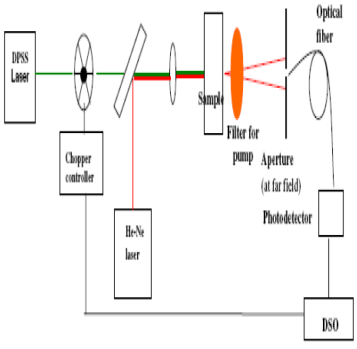
Mathew S





CdSe quantum dots prepared by micro emulsion technique shows quantum confinement effect and broad emission at 532nm. These quantum dots have about 4.35nm size, and they exhibit good nonlinear effects which are measured using z-scan measured using z-scan. Broad luminescence band around 532nm is observed for these quantum dots. The nonlinear properties of these nanoparticles are found out by z-scan method. Nonlinear optical properties of these CdSe quantum dots are investigated . The optical nonlinearity of these quantum dots is found to be arising from free-carrier absorption as well as quantum confinement.

Effect on mobile phone radiation on DNA, its harmful effects and possible solution



setup for thermal diffusivity

The present study is aimed at shedding light on thermal effect of mobile radiation on Deoxyribonucleic Acid (DNA). A DNA sample is radiated with a modified mobile antenna and the thermal diffusivity of the sample is calculated before and after the radiation. The antenna is a monopole strip fed by coplanar waveguide feed having a single null point There is a 20dB reduction in radiated power at beam minima, with appreciable power in all other directions.

We observe the variation in thermal diffusivity of the DNA sample due to the mobile antenna radiation using thermal lens technique. The study is conducted by radiating the sample from the null point(low power end) and the opposite end(high power end) of the antenna for a certain period of time.

The thermal diffusivity shows a gradual decrease when radiated from the null point of the antenna whereas it shows a sharp decrease

when radiated from any other direction of the antenna.The reduction in thermal diffusivity is a measure of the increase in heat trapping associated with the sample.

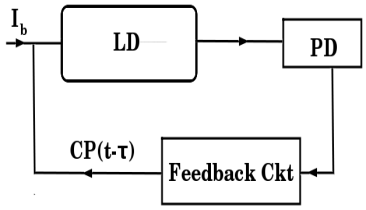
With an irradiation time of 30 minutes, thermal diffusivity shows a reduction of 20% when radiated with the high power end of the modified antenna while it shows only a 2% reduction when radiated with the low power end of the modified antenna.This shows that heat trapping occurs in DNA in presence of mobile phone radiation.

We can conclude that the use of mobile phone in presence of heat environment (sunlight) is harmful.

Dynamics of delay differential systems

Bijoy Rosily

Time delay is involved in all kind of coupling and feedback mechanisms. Since such systems have infinite dimensional phase space, the dynamics can become quite complex. We study nonlinear or piece-wise linear systems with delay feedback and coupling. The diagram shows an optoelectronic feedback scheme for a semiconductor laser. The system is mathematically represented by nonlinear delay differential equations. The characteristic equation is of a second degree transcendental equation which admits several roots. Analysing the characteristic equation to find the nature of the roots, we identify the stability islands of the fixed point in the feedback strength – delay parameter space. For the simulation we use RK3 algorithm with suitable polynomial interpolation for the delay argument. Hopf bifurcations predicted from theory are verified in simulation. Bistable behavior is also demonstrated where laser can exist in fixed point or oscillatory states.



SPECIAL SEMINARS…….

- **24 March 2011** Seminar on "**Frequency, Sruthy and Raga"** by **Dr. K. N. James, KVM College**
- **28 July 2011** seminar on **"Intelligent Microbes and their Socialization"** by **Prof. V. P. N. Nampoori, ISP, CUSAT**
- **9 Aug 2011** Seminar on **"Creation of nanostructures via self assembly and their application to bio-nano fusion technology"** by **Dr. Toru Maekawa, Toyo University**
- **25 Aug 2011** Seminar on **" Imaging Stimulus induced neuronal activity in the visual cortex"** by **Dr. Manu Punnen John, Frankfurt Institute for Advanced Studies**
-
- **20 Oct 2011** Seminar on **"X-Ray Image Enhancement-Some New approaches"** by **Shri. V. A.Menon**
- **27 Oct 2011** Seminar on **"Cosmic Origins of Life"** by **Prof.Wickramasinghe N.C**.
- **27 Oct 2011** Seminar on **"Ultra Intence Laser Driven New Generation Electron accelerator and Applications"** by **Dr. Riju Issac**
- **1 Dec 2011** Seminar on "**Laser Safety"** by **Prof. P. Radhkrishnan**

Marine derived DNA enhances fluorescence of dyes

Pradeep Chandran

Deoxyribonucleic acid (DNA), the "**molecule of life**" had made way into the field of photonics and display technology. Many devices such as optical waveguides, bio-organic LED, bio FET and bio sensors are at the research table with promising results. Research from this lab is focussed on DNA based OLED and optical waveguides and sighting a suitable fluorescing dyes for these applications. It was found that the addition of DNA enhances the fluorescence. This enhancement was due to the intercalation of dye molecules between the aromatic bases, thereby increasing the disassociation of the molecules. Studies showed that a higher concentration of the dye required large amount of DNA to attain maximum fluorescence peak intensity. At this maximum point it is presumed that all the dye molecules has successfully intercalated between the DNA base pairs. However at higher concentration of the dye showed an initial decrease in fluorescent peak intensity when the DNA was added.

NEW DOCTORATES FROM ISP

Dr. M. Kailasnath has received his PhD for the thesis titled "Fabrication and Characterisation of Dye-Doped Polymer Optical Fibers" . He has completed his doctoral work under the guidance of Prof. P. Radhakrishnan

Dr. Tintu R. has received her PhD for the thesis titled " Fabrication and Characterisation of Chalcogenied based-Nanocomposites for Photonic Devices Application" .She has completed her doctoral work under the guidance of Dr. Sheenu Thomas.

PUBLICATIONS FROM ISP

Refractive index and temperature dependent displacements of resonant peaks of long period grating inscribed in hydrogen loaded SMF-28 fiber T. M. Libish, M. C. Bobby, J. Linesh, S. Mathew, C. Pradeep, V. P. N Nampoori ,and P. Radhakrishnan, *OPTOELECTRONICS LETTERS*, Vol.8 No.2, 1 March 2012, PP. 0101-0104.

♦**Glucose Concentration Sensor Based on Long Period Grating Fabricated from Hydrogen Loaded Photosensitive Fiber,** T. M. Libish, M. C. Bobby, J. Linesh, S. Mathew, B. Nithyaja, C. Pradeep, V. P. N Nampoori ,and P. Radhakrishnan, *Sensors & Transducers Journal, Vol. 129, Issue 6, June 2011, pp. 142-148.*

♦**The Effect of Grating Period on Refractive Index Sensitivity of Long Period Gratings Written in Hydrogen Loaded SMF-28 Fiber,** T. M. Libish, M. C. Bobby, J. Linesh, P. Biswas, S. Bandyopadhyay, K. Dasgupta, P. Radhakrishnan, *Journal Of Optoelectronics and advanced Materials*, Vol. 13, Issue 5, May 2011, pp. 491-496.

♦**Optical Non-linearity in ZnO Doped TeO2 Glasses, Rose Leena Thomas**, Vasuja, Misha Hari, V. P.N. Nampoori, P. Radhakrishnan, Sheenu Thomas, *Journal Of Optoelectronics and advanced Materials, Vol. 13, Issue 5, May 2011, pp. 523-527*.

♦**Saturable and reverse saturable absorption in aqueous silver nanoparticles at off-resonant wavelength**: **Misha Hari**, S. Mathew, B. Nithyaja, Santhi Joseph, V. Nampoori, P. Radhakrishnan,*Optical and Quantum Electronics* (27 November 2011), pp. 1-10., doi:10.1007/s11082 -011-9502-7 .

♦**Linear and nonlinear optical properties of gold nanoparticles stabilized with polyvinyl alcohol** : Misha hari, Santhi
Ani Joseph, nithyaja balan, mathew s, ravi kumar, Giridhar Mishra, R. Yadhav, P. Radhakrishnan and VPN. Nampoori *journal of nonlinear optical physics and materials,volume:* 20, issue: 4 (december 2011) ,page: 467-475.

♦**Optical Nonlinearity in Lead Iodide Di Hydrate grown with UV and IR radiations using Z-scan Technique** I.Rejeena, B.Lillibai, Roseleena Toms, V.P.N.Nampoori, and P.Radhakrishnan *(AIP- 1391, 691 -693 (2011)*

♦ **Nonlinear optical absorption studies of sol - gel derived Yttrium Iron Garnet (Y3Fe5O12) nanoparticles by Z-scan technique** Raneesh, I.Rejeena, Rehana P. Ummar, Nandakumar kalarikkal, P.Radhakrishnan *(Elsevier, Ceramics International, CERI 4688)*

♦ **Optical Limiting In TeO2–ZnO Glass From Z-Scan Technique,Rose Leena Thomas**, Vasuja, Misha Hari, B. Nithyaja, S. Mathew, I.Rejeena, Sheenu Thomas, V. P. N. Nampooriand P. Radhakrishnan, *Journal of Nonlinear Optical Physics & Materials (JNOPM),Volume:20,Issue:3* (September2011),*DOI*

SPIE STUDENT CHAPTER ACTIVITIES

Optics Fair 2011:

Optics fair happens to be the most popular student outreach program of the chapter every year. Optics fair 2011 was held on the 8th and 9th of December 2011. Students from more than 13 schools across the city participated in the two day event. The fair was divided into four sections: Kid section (class 4 to 7), high school section (class 7 to 10), higher secondary section (class 11th and 12th) and general section. The main idea behind this fair was to take optics to the masses. The 5th version of the optics kit with some new experiments was also released during the event. We received an overwhelming response from the students as well as teachers.

Optics to School : :

The motto of the chapter has always been to spread the wonder of optics around especially to the underprivileged. With this in mind the chapter members organized its 'optics to school' program in ***KTM Higher Secondary School, Mannarkkad, Palakkad*** for tribal students on January 11, 2011. The chapter members spend an entire day demonstrating experiments and explaining the optics behind them to- about 200 students from in and around Mannarkkad. The basic optics behind interference, polarization, diffraction etc. was explained to the students along with demonstrating the same.

was explained to the students along with demonstrating the same.

Thursday Seminars:

Students and research scholars from ISP and CELOS also took seminars on different topics. These seminars have proved to be great help for both student and audience. The purpose behind conducting this program is to enhance the interactive skills among the students.

Optics Kit:

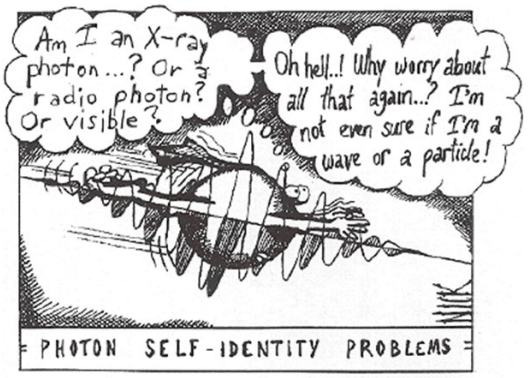
The fifth edition optics kit was released during optics fair 2011. Some new experiments were added to make it more attractive. The overwhelming response to the fifth edition has only increased the expectation from the next optics kit team. We have been regularly receiving enquiries about the latest version of optics kit from various institutions across India.

SPIE Scholarship:

Hari Krishnan S B received the SPIE Scholarship award in 2011.

ISP- CELOS SPIE student chapter :

Upkar Kumar, represented ISP- CELOS SPIE student chapter in the SPIE Optics + Photonics conference held at San Diego in August 2011. The chapter's outreach programs were highly appreciated in the conference. The Optics kit designed by the chapter members was presented in the "Optics Outreach Olympics by Upkar Kumar for which he won Silver Medal in the event.



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