The Optical Society of India
NEWSLETTER

Number 3 **March, 2005**

Optics and Photonics in Kerala:
A Brief History

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Optical technology in Kerala has interestingly a long history. The world-renowned metal mirrors come from a place near central Travancore and these are known as "Aranmula Mirrors", referring to the place of their origin. These mirrors have a history of many centuries and they were prized items in the collection of the kings and the queens and the rich landlords of the erstwhile period. The Aranmula Mirrors could rival the imported Belgian mirrors in terms of their ruggedness, longevity and usefulness. These mirrors are even now being cast using an alloy composition, the details of which were passed on from generation to generation of traditional craftsmen and artisans. They also make use of polishing methods using locally available sand in the riverbanks (remember, the cerium oxide is processed in India from the monazite sand from the beaches of Kerala). The freshly polished surface of the metal flat is finally treated with certain herbal juices, which helps to prevent the tarnishing process. The finished mirrors are superbly flat and oxidation resistant so that the surface reflection is unaffected by aging over the years of use. The Regional Research laboratory at Trivandrum has in recent years carried out a scientific study of the optical and metallurgical properties Aranmula Mirrors.

In the year 1837 Swathi Thirunal Maharaja of Travancore established the first observatory in South India at Trivandrum. The observatory was fitted with optical telescopes (4 inch refractors) imported from England mainly for stellar and planetary sightings. The princely state of Travancore also established near its capital an optical and general workshop during the early part of the following century for repairing and maintaining land survey equipment like the theodalite. The workshop had facilities for grinding and polishing lenses and prisms needed for these instruments.

Research in optics in the sense we understand it today, can be said to have started in Kerala with the attempts made by Prof. S. Gopala Menon and Prof. A.O. Mathai in the University College, Trivandrum (which was part of the then Travancore University which later became University of Kerala), with their efforts to produce and use optical elements like gratings and biprisms. Prof. Gopala Menon studied the diffraction patterns from coarse gratings while Prof. Mathai invented a method to produce two biprisms simultaneously in a single grinding process in early 1950's.

Later Prof. C. S. Venkateswaran (a disciple of Sir C.V. Raman) in the same college imported a two prism Hilger Spectrograph complete with mercury arc sources to study Raman spectra. Also it must be mentioned here that in 1930's the Maharaja's College at Ernakulam in the princely state of Cochin was offering Astronomy as a subsidiary subject for the B.A. degree course in Mathematics. The practicals for the subsidiary involved stellar observations with optical telescopes imported from Great Britain.

Serious and systematic research in optics related subjects could be considered to have begun with the establishment of Department of Physics at Cochin in 1962 as a part of the Ernakulam University Centre (of University of Kerala) which in 1971 became University of Cochin to be renamed as Cochin University of Science and Technology (CUSAT). In 1965 Prof. K. Venkateswarlu who founded this Department imported a Carl Zeiss three-prism spectrograph along with a Zeiss microdensitometer and using these instruments the present author started Raman Spectral studies of phase transitions. The exciter unit for the Hg arc lamps was designed and fabricated by this author using locally available components. Studies of ultrasonic diffraction in liquids were another line of experiments started in this Department at that time.

What is outlined above summarizes optical related activities in Kerala in the pre-laser era. The first He-Ne laser in Kerala was built by Dr. V. Unnikrishnan Nayar in 1972 during his period in University of Cochin. He got the resonator and discharge tube made at IIT, Kanpur and assembled the system at Cochin. Prof. K. Sathianandan took over the Physics Department at Cochin in 1976 and started experimental research in thin film optics and laser physics in a major way. Fabrications of nitrogen lasers and Nd-glass laser were attempted during this time. A current controlled CO_2 laser using solid-state circuitry was built by this author in 1983. Dr. C. Purushothaman started elliptometric studies of thin film surfaces and also set forth to fabricate the experimental systems for holographic measurements. By 1990 the laser laboratories at CUSAT were well equipped with commercial Ar lasers, Dye lasers and Nd-YAG laser. An M.Tech. Degree course in Optoelectronics and Laser Technology was started in CUSAT during this year. A short account of the laser related research and developmental activities of more recent times at Cochin has been given by this author in Laser News (a publication of Indian Laser Association) Vol.9, 1998.

A major impetus to Photonics education and research was given when the International School of Photonics (ISP) was established in 1995 at CUSAT by the then Vice Chancellor Dr. K.G. Adiyodi. The International assistance received by the ISP under the Dutch MHO programme caused a significant upward shift in the level and quality of research being carried out here in the field of Photonics. Effective and meaningful collaborations were established with foreign institutions, the main foreign partner being the Eindhoven Technological University (TU/e) in Eindhoven, the Netherlands. A complete account of ISP and its activities including the research publications can be obtained from its website: *www.photonics.cusat.edu*.

In the mean while the Department of Physics of the University of Kerala at Trivandrum, had been concentrating on research in the area of laser Raman Spectroscopy by acquiring a Spex Ramalogue. Prof. V.U. Nayar started a separate Department of Optoelectronics in Trivnadrum in 1997.

The efforts made on the academic field had a direct impact in the industrial scene in Kerala. The R & D programmes of ISP in the field of fibre optics have a direct relevance to Nest Photonics at Cochin, which is major collaborator and beneficiary of the activities at CUSAT. ISP also transfers know how and technology to other small-scale industries engaged in the manufacturing of optics and Photonics related products. Holmarc Slides and Controls, Prompt Engineering Co. etc. are examples of such catalytic role played by ISP in relation to the Optical industry in Kerala. The recent conduct of the International Conference PHOTONICS 2004 at Cochin jointly by ISP and Nest Photonics has established the fact that Cochin in Kerala has become an important location in the country for Optics and Photonics.

Author's Note: It is well known that history always has different versions depending on the history of the historian. I have attempted to be as much objective as possible in the above narrative. Many names and events might be missing from this brief account of history of optics in Kerala and I sincerely apologize to the readers for the omissions, which are not intentional.

Recent Ph.D. Theses

Arti Agrawal, *Paraxial and non-paraxial beam propagation through optical waveguides* (Indian Institute of Technology, Delhi, 2005); supervisor: Prof. Anurag Sharma.

Dinesh Kumar V., *Analysis and Simulation of Photonic Crystal Components for Optical Communication*, (Indian Institute of Science, Bangalore, 2005); supervisor: Dr. T. Srinivas.

Naveen Kumar Nishchal, *Investigations on Optical Image Encryption Using Fourier and Fractional Fourier Domain Techniques* (Indian Institute of Technology, Delhi, 2005); supervisors: Prof Kehar Singh & Dr Joby Joseph

Member News

Prof. B.P. Pal (IIT Delhi) has been selected as one of the 5 new "Distinguished Lecturers for 2005-06" of IEEE/LEOS of USA.

Prof. R.S. Sirohi has been appointed the Vice-Chancellor of Barkatulla University, Bhopal.

From the Editor

The third issue of the OSI NEWSLETTER is in your hands. We have received some encouraging response to its first two issue. However, it seems that not many members have received or read it. Did you get these issues? If you would like to receive the PDF copy by email, please send an email to the Editor (*asharma@physics.iitd.ac.in)*. The Society would like to see the OSI NEWSLETTER become a vibrant forum for discussion and dissemination of information among the members. At present it contains only two pages and is issued quarterly. We should aim to increase both size and frequency in the near future. This can happen only if the members want it that way and contribute accordingly.

- *EDITOR*

Forthcoming Events

International Conference on Optics and Optoelectronics (ICOL-2005)
(XXXI OSI Symposium)
Dehradun, December 12-15, 2005
Contact: Dr. Ashok Kaul, Convener, ICOL-2005, IRDE, Dehradun – 248 008
URL: http://www.icol2005.com

International Conference on Electronic and Photonic Materials, Devices and Systems (EPMDS – 2006)
Kolkata, January 4-6, 2006
Contact: Convener, EPMDS-2006, Department of Electronic Science, University of Calcutta, 92 A.P.C. Road, Kolkata – 700 009
URL: http://www. ElectronicScience-EPMDS.org

XXVIII General Assembly of International Union of Radio Science (URSI)
New Delhi, October 23-29, 2005
URL: http://www.ursiga2005.org

National Conference on Optics and Related Phenomena- Jyothirgamaya 05
Kollam, Kerala, August 29-30, 2005
Contact: Dr. Predeep, Cond. Matter Physics Lab Sree Narayana College, Kollam 691001, Kerala
URL: http://ernakulam.sancharnet.in/ppredeep

Reports on Events held

XXX OSI Symposium on Optics and Optoelectronics (SOOP-05)

January 19-21, 2005, New Delhi

The XXX Optical Society of India Symposium on Optics and Optoelectronics (SOOP-05) was organized at the National Physical Laboratory, New Delhi during January 19-21, 2005. It was aimed at bringing together all the researchers (from academic and R&D institutions as well as from industries) on a single platform and to mobilize the intellectual resources for exchanging the ideas for possible collaborations in various programmes,

Prof. K. Singh delivered the keynote address covering the latest developments in the area of *Holographic Data Storage and Encrypted Memories*. The technical programme consisted of plenary lectures, invited lectures, oral contribution and posters. The six plenary lectures were given by Prof. V. Sarafis (University of Queensland, Australia) on *Subtractive superresolution with the 4pi microscope in fluorescence*, Dr. A.K. Aggarwal on *Development of security holograms, digital and HOE based interferometry at CSIO*, Prof. R.S. Sirohi on *Optical metrology*, Mr. J.A.R. Krishnamurthy on *Night vision devices*, Prof. A.K. Ghatak on *Fibre optics and basic physics* and Prof. L.N. Hazra on *Misconceptions, myth and reality in instrumental optics*. In addition, ten invited talks were presented covering a wide variety of topics such as optical diagnostics, computational guided wave optics, designs of optical fibers, optical amplifiers, digital photoelsticity, image processing, photonics for military applications, optical interferometry with diluted apertures, optical techniques for biological materials and measurement of the local field effects. About forty oral presentations were organized in 11 technical sessions (with two sessions running in parallel) and 56 posters presentations were divided in two poster sessions. Over 200 participants from all over the country attended the symposium. To encourage the poster presentation five best posters were selected for the award.

In addition to the technical content of the symposium an impressive exhibition was also organized in which a number of prominent establishments participated and displayed their scientific products. These included SIMCO Global, Optiregion, Laser Science, Laser Spectra Services, Dynotech Instruments, Specialized Instruments, Scientific Solutions, Surya Roshni, Newage Instruments and Advanced Photonics. To provide relaxation in the evening, a cultural programme followed by a banquet was also included in the programme. The Symposium was supported financially was the CSIR, DST, DRDO and IIT Delhi. The Director and the staff of NPL planned and executed organization of the Symposium very well. The OSI and the participants expressed their gratitude to them in the concluding session of the Symposium. (*with inputs from* R. MEHROTRA)

International Topical Conference in Applied Photonics on Superresolution and Photonics

February 15-16, 2005, Kolkata

The International Topical Conference in Applied Photonics entitled "Superresolution and Photonics" was organized by the Department of Applied Physics, University of Calcutta, in collaboration with the Optical Society of India during February 15-16, 2005. It was held at Saha Institute of Nuclear Physics (SINP), Kolkata. The convener and co-convener of the conference were Prof. L. N. Hazra, University of Calcutta, India and Prof. V. Sarafis, University of Queensland, Australia, respectively.

The conference was held in Kolkata where the three giants of modern optics in India, namely, J.C. Bose, C.V. Raman and S.N. Bose carried out their scientific investigations. This conference was the first one ever held in India on the topic of Superresolution, and scientists from different parts of the world provided encouraging support by their participation. Approximately 150 participants attended the conference. The resolution enhancement techniques constitute an important theme of today's science and technology. The objective of the conference was to motivate active researchers in this important interdisciplinary topic of research through interactions with scientists and technologists actively engaged in the frontier areas of superresolution.

Prof. A. K. Banerjee, Vice Chancellor, University of Calcutta, delivered the inaugural address and Prof. S. Duttagupta, Director, Satyendra Nath Bose National Centre for Basic Science, was the Guest of Honour. Both of them dwelt upon the importance of developing trained manpower in optics and photonics and mentioned the current initiatives undertaken in their respective institutions.

The two-day conference had five technical sessions. There were nine plenary talks and eleven invited talks. Plenary talks were on *Fundamentals of superresolution* (Prof. C.J.R. Sheppard, Singapore), *Microscopy & single molecule spectroscopy* (Prof. L. Nedbal, Czech Republic), *Superresolution in X-ray imaging* (Prof. K. Nugent, Australia), *Superresolution – an array processing perspective* (Prof. D. Gray, Australia), *Optically sectioning in combined excitation and emission spectral imaging* (Prof. R. Heintzmann, Germany), *High accuracy simulations of optical propagation in nanophotonic devices* (Prof. J.B. Cole, Japan), *Radial polarization and spiral phase* (Prof. S. Lipson, Israel), *Exploitation of radial polarization in annular pupils for superresolution* (Prof. A. Choudhury, Tezpur) and *Video confocal microscopy: principles and applications* (Prof. P.A. Benedetti, Italy). The invited talks were on polarized autofluorescence spectroscopy for cancer diagnosis, optical second harmonic generation microscopy under circularly polarized beam, reconstruction methods for diffuse optical tomography, Walsh filters: bags of riches for tailoring resolution, measurement of the spatial response of detector pixels, AFM images of human erythrocyte architecture enteric cells of a molluscan embryo, coherent superresolution microscopy via laterally structured illumination, localization of high aperture beams, subtractive superresolution with the 4pi microscope in fluorescence, high resolution imaging with diluted aperture interferometry and super-resolution through application of annular & sub wavelength apertures.

In addition, participants from various institutions within the country and abroad contributed poster papers. Each presenter also made a short oral presentation highlighting the contributions in the poster. Some representatives from industries in India and abroad shared their first hand experiences on the twists and turns in the process of developing successful ventures in the high-tech area of optics and photonics in a session entitled *Optics Industry Focus*.

There were displays of advanced optical equipments by Optiregion, Delhi. SIMCO, Kolkata also set up an information counter. The conference was sponsored by the UGC, DST, CSIR, BRNS, Universities of Western Sydeny and Queensland, Australia. It was also co-sponsored by Optiregion, SIMCO Global Technologies and Systems Ltd., LR Group and Infinite, Holoflex Ltd. and KBM International.

The conference ended with a valedictory session, during which participants from different institutions/organizations exchanged their views on necessary follow up actions to pursue investigations in this basic area of science and technology.

- ANURADHA DE and L.N. HAZRA

Final Call for Optics Directory of India

The Executive Committee of the OSI decided in its meeting on 16.9.2003 that a directory of optics activity in India should be compiled and the responsibility of this work was given to the undersigned. For this purpose all the scientists, researchers, engineers, developers and industrialists involved in any area of optics are requested to send the information for inclusion in the Directory. The format for sending the information was published in the two previous issues of OSI NEWSLETTER and can be had from the editor. The directory will have two sections: one devoted to the Groups & Industries and the other to the individuals.

The Directory is scheduled for publication by the end of this year. Information received by the end of August, 2005 will be included. Information should be sent preferably by email to *asharma@physics.iitd.ac.in* or by post to

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The support and inputs are required from all those engaged in optics activity to make this effort successful and all the contributions would be invaluable. This information may be brought to the notice of those who may not receive it otherwise.

- ANURAG SHARMA

Suggestions & Contributions

A regular publication this OSI NEWSLETTER can be sustained only through active participation of the members and we seek suggestions to improve its contents and presentation. We also seek contributions from members to various columns of the OSI NEWSLETTER. In additions to the columns in this and the earlier issues, the future issues will also have interesting anecdotes/incidents involving optics or members, historical notes and any other information that could be useful or interesting to the members. Readers are particularly urged to send their responses/reactions to this and earlier issues. Contributions and proposals may please be sent to the editor. The next issue is scheduled for March, 2005. Members who want to receive the future issues of the OSI NEWSLETTER by email may send their email addresses to the editor.

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Published by The Optical Society of India, Department of Applied Physics, Calcutta University, 92, Acharya Prafulla Chandra Road, Kolkata 700009 (Fax: 033-23522411)