PHYSICS/ Alumni-News

Alumni of Department of Physics, Cochin University Volume 1, August 2008

Editorial

Alumni of Physics Department, Cochin University of Science and Technology is very pleased to release this bulletin. This is a medium to express the views and feelings of the Physics alumni. This is the first edition of the bulletin. Suggestions are invited to improve the set up of the bulletin from next edition onwards. Many from the department and outside extend their help for the preparation of the bulletin. We wish to thank all.

Titus K. Mathew.

From Secretary

by Jayaraj M.K.

It has been a long cherished dream of the physics alumni to bring out a news letter and the hard work has not gone unrewarded. Through the initiative taken by Dr.Titus K. Mathew and Mr. Santhosh Kumar we have succeeded in bringing out this first issue of the news letter though with its own short comings. We aim at creating a common platform for all for discussion and interaction. It also gives an opportunity to walk down the memory lane of those good old times and to get updated with events in the department. We hope your contribution to future newsletters will make it really worthy and take to greater heights. We take this opportunity to invite each one of you to the alumni get together to be held on the 11th October 2008 (second saturday). A two day seminar on nanophotonics is also being held on these days.

Prof. K.Sathianandan - Reminiscences

By Dr. K. Rajeev Kumar,Lecturer, Department of Instrumentation, CUSAT.

When we think about Prof. K. Sathianandan, the first thing that comes to our mind is his untiring patience

Contents of this volume:

and energy. Despite his intellectual superiority and wide and deep knowledge in Spectroscopy, Lasers and Thin film physics, he was an unassuming person who cared for each and everybody in the department. One important personality trait of Prof. Sathianandan was that he was never angry with anybody and no problem was big enough to shadow that ever present smile on his face. Even the junior most student felt that Sathianandan Sir cared for him as if he is the best student in the department. This helped a lot to improve the morale and self confidence of many a student who did research in the Physics department during those days. He used to work up to 11 in the night and was accessible to any body during that time for discussions, despite his busy schedule as the head of the department.

Prof. Sathianandan's active academic life spanned over a period of nearly four decades, covering several Universities in India and abroad. His academic career started as a young research student of the famous physicist Prof.Venkiteswarlu at Annamalai University. As Head of the Department of Physics, of the then Cochin University (present CUSAT) during the latter half of 70s and 80s it was he who raised the department to the present level of sophistication. This he did by raising funds from different sources like DST, UGC, DAE etc by way of research projects and proposals. During this period several lines of research, like design and fabrication of Nd:Glass, Nitrogen and CO2 Lasers, several branches of Thin film studies like Polymer films for capacitors, semi conducting films for solar cell applications etc were started by him. It was the untiring efforts of Prof. Sathianandan which established in the Physics department of CUSAT the best Laser lab in India at that time, which later became the Photonics department. He encouraged and helped the junior faculty members to bring funds by way of research proposals and start such important fields of research as Holography, Thin film displays, Photoacoustics, Superconductivity etc. The University Services and Instrumentation Centre (USIC) of CUSAT also was started due to his effort only. This later became the present Department of Instrumentation. After retiring from CUSAT he worked for a while as a UGC Emeritus Professor in the Physics department of Kerala University campus at Kariavattom. He was also instrumental in setting up a research lab in the Physics department of SN College, Quilon during the last stages of his illustrious academic career. His contributions to Physics departments of different Universities he worked in -especially CUSAT- are immense and he left his foot prints at these places by building modern and sophisticated research labs which stand as a testimony to his vision. Prof. Sathianandan passed away on 1st January 2000 due to cardiac complications at Cochin at the age of 73. He will be remembered as a reputed physicist, affectionate teacher, efficient administrator, caring colleague and above all as a loving person who was a paternal figure and role model for the entire student community.

International Year of Astronomy-IYA2009

by Titus K. Mathew

The International Astronomical Union (IAU) decided to observe and celebrate the year 2009 as the international year of astronomy-IYA2009 with the help of UNESCO, a UN body. The IAU launched "The Universe, Yours to Discover" as the theme of IYA2009. This will be a global celebration of astronomy and its contributions to society, with emphasis on education, public engagement and involvement of young people, with events at national, regional, and global levels throughout the whole year of 2009. IYA2009 is, first and foremost, an activity for everyone around the world. It aims to convey the excitement of personal discovery, the pleasure of sharing fundamental knowledge about the Universe and our place in it. This celebration is because of the fact that year 2009 marks the four hundredth anniversary of the first astronomical observation through a telescope by Galileo Galilei, the great physicist of the 17th century.

The President of the International Astronomical Union (IAU) Catherine Cesarsky says: "The International Year of Astronomy 2009 gives all nations a chance to participate in this ongoing exciting scientific and technological revolution." The world renowned cosmologist and the founder director of Inter-University Centre for Astronomy and Astrophysics (IUCAA) Professor Jayant Narlikar said that "Galileo's use of a telescope for astronomical purposes brought a fundamental and radical improvement in human perception of the cosmos. While celebrating the 400th anniversary of that event we should be guided by the spirit of adventure and

questioning that had motivated Galileo."

The aim of IYA2009 is to stimulate worldwide interest, especially among young people, in astronomy and science under the central theme. The IYA2009 activities will take place at the global and regional levels, and especially at the national and local levels. National nodes in each country have been formed to prepare activities for 2009. These nodes establish collaborations between professional and amateur astronomers, science centres, educators, and science communicators. In India Prof. Ranjeev Misra, Inter-University Centre for Astronomy and Astrophysics, (Post Bag 4, Ganeshkhind Pune -411007, India, Phone: 91-20-25604601 Fax: 91-20-25604699 Email: iya09ind@iucaa.ernet.in http://www.iucaa.ernet.in/ iya09ind.) has been designated as the single point contact for the activities of IYA2009 in India.

Indian National Science Academy (INSA) has recently constituted the national committee of IAU under the Chairmanship of T.Padmanabhan (IUCAA) which, among other tasks, will also be involved in co-ordinating the national level activities for the IYA09 in India. The other members of the INSA-IAU Committee are: J.S.Bagla (HRI), D.Bhattacharya (IUCAA), S.K.Ghosh (TIFR), S.Seetha (ISRO). Under this an academic working group was formed, in which among others Prof. T. Ramesh Babu, from the department of Physics of the Cochin University of Science and Technology is a member.

The major goals of IYA2009 are to:

1. Increase scientific awareness.
2. Promote widespread access to new knowledge and observing experiences.
3. Empower astronomical communities in developing countries.
4. Support and improve formal and informal science education.
5. Provide a modern image of science and scientists.
6. Facilitate new networks and strengthen existing ones.
7. Improve the gender-balanced representation of scientists at all levels and promote greater involvement by underrepresented minorities in scientific and engineering careers.
8. Facilitate the preservation and protection of the world's cultural and natural heritage of dark skies in places such as urban oases, national parks and astronomical sites.

In India the following are the activities planned,

1. Astronomy Populariaztion
   - 1.1 Public events for Astronomy Popularization
   - 1.2 Sky shows and observing Events
   - 1.3 Creation of resource material for Astronomy popularization
   - 1.4 Creation of new facilities for Astronomy outreach
   - 1.5 Support to local and national media to promote Astronomy
2. Astronomy in Education
   - 2.1 Workshops
   - 2.2 Students' Projects
   - 2.3 Lectures and demonstrations in schools / colleges
3. National Level Programmes
   - 3.1 Issue of postage stamp
   - 3.2 An astronomy train that will travel across the contry.
4. Resource Training Programmes
   - 4.1 Programme for Amateur Astronomers
   - 4.2 Training for school and college teachers

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Transparent Electronics Become Reality

by Saji K.J.

Materials exhibiting simultaneous optical transparency and electrical conductivity (Transparent conductors) were a mystery to common man. A good electrical conductor requires a partially filled or overlapped conduction band which renders it opaque to the light photons. Whereas a material become transparent when it possesses a large band gap be-

tween its valence band and conduction band. This band gap must be higher than the photon energies corresponding to the visible region of electromagnetic spectrum. Thus highly transparent materials are insulators which inhibit the flow of electric current through it. In this sense, transparent conductors are mysterious materials. Transparent conductors are generally a thin film of metal oxides which possess a high band gap so that the material is transparent to visible light. The conductivity arises from the non-stoichiometry in the film composition compared to the bulk form. In thin film form, the materials have insufficient oxygen anions to maintain the stoichiometry. This oxygen vacancy and interstitially occupied cations are believed to be the main reason for the n-type conductivity of transparent materials.

Transparent conductors have wide applications in the areas where multifunctional control of optical and electrical properties is required. Transparent conducting oxides are integral components in flat panel displays, solar cells, and smart windows. However, all these applications utilise the transparent metallic behaviour of these materials as a passive component in the circuitry. The development of p-type transparent conductors led to the applications where the transparent conductors function as active components in the circuitry. This directs to the development of transparent diodes, photodetectors, transparent transistors etc and blossomed the 'transparent electronics' or 'invisible electronics'. The backbone in this technology is the transparent thin film transistors. These are the transistors fabricated on a transparent substrate like glass or plastic with wide band gap oxide semiconductors. Different layers like source, drain, channel, gate electrode, gate insulator, all are fabricated from transparent materials. This makes the circuits invisible from an observer. Transparent electronic circuits can be embedded into large areas like windows, walls, desktops and other locations. While a pane of glass might look like an ordinary window, it could actually incorporate a new type of electronics with a range of functions. Displaying video imagery when required on windows, automobile windshields, or eyeglass lenses all these technologies is soon becoming a reality. Transparent transistors will also make an impact in liquid crystal display (LCD) panels, organic light-emitting diode (OLED) panels and other displays. They can provide larger screens with finer definition, high aperture ratio and less power consumption with simpler manufacturing technology. Japanese universities have driven the development of the basic technology behind transparent electronics. But application technology is being developed around the world today. Korea launched the "Smart Window with Transparent Electronic Devices" national project in 2006 to develop window panes with active functions. Industry has already entered into the development of transparent electronic products. Toppan Printing, from Japan, has developed prototypes of flexible electronic papers since 2005 with an active matrix display driven by amorphous indium gallium zinc oxide (a-IGZO) TFTs. In March 2006 the firm announced that it plans to develop a commercial-grade prototype in 2008. LG Electronics revealed a 3.5-inch active matrix OLED panel with a-IGZO TFT drive at E-MRS 2007. Companies like Canon, Hewlett-Packard and Samsung have also entered in the R&D of transparent electronic products.

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Computational Techniques for Physicists

by G. Santhosh Kumar

Matlab is a compact, but powerful language for numerical computations. Matlab is concerned with matrices: rectangular patterns of integer, real, or complex numbers. A number itself is a 1×1 matrix, a row vector a $1 \times n$ pattern, a column an $n \times 1$ matrix. Most Matlab operations affect the entire matrix. Matlab contains and makes available the software treasure of more than 50 years, originally coded in Fortran. Matlab programs, if they avoid repetitive statements, are highly effcient.

Matlab is extensively used by physicists for modeling, computation and even to study the basic concepts by simulation. There are lot of physics books which deals the subject using Matlab examples. Some of the books are *Classical Mechanics with Matlab applications, by Hasbun, Jones and Bartlett Publishers (2009)*; *Applied Quantum Mechanics, by Levi, Cambridge University Press, (2006)*; *Experiments in Modern Physics, by Melissinos / Napolitano, Elsevier Science (2003)*; Numerical Methods for Physics, by Garcia, Prentice Hall (2000).

There is also very good user community who contribute Matlab code for Physicists. You can find them here `http://www.mathworks.com/matlabcentral/`

link_exchange/MATLAB/Physics/index.html

This series article addresses physicists who are used to learn by studying well chosen examples.

1. Getting Started

Matlab is an interpreter. It reads the lines you type and executes them immediately. Here is an example:

» x=1

» is the Matlab prompt. x=1 says: if there is none, create a variable x and assign it the value 1. Since the line does not end with a semicolon, the effect of the command is echoed. Convince yourself of the difference

» x=2;

Now type

» x

With

» x1=[1,2,3];

you may create a row vector with three elements. Type

» x1

» x2=[4,5,6];

generates another row vector. You may combine them to a 2×3 Matrix z by

z=[x1;x2];

Summary

Matlab variables begin with a letter. They need not be declared. The assignment operator is =. Square brackets [...] define a rectangular collection of data, a matrix. The comma operator , assembles data from left to right, the semicolon operator ; from top to bottom. Lines are echoed unless delimited by a semicolon.

Exercises

1. Create a 5×5 matrix
2. Compute *determinant* of the above matrix

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Retired from service

by Titus K. Mathew

Prof. Sarangadharan, retired from our Department on May 31st of 2008. He joined this Department long back in 1978. Some of the present faculties are his students. In this university he has worked in many positions as Senate member, Academic council member, IRAA director and so on. His native place is Vayalar near Chertala in Alappuzha district. At present he lives in Thrikkakkara with of his wife Shylaja and two children, Leksmi and Indhu.

Prof. V C Kuriakose, retired from our Department on June 30th of 2007. He joined this Department long back. Prof. Kuriakose is currently heading a project sanctioned to him by UGC. He lives near UC college Aluva with his wife Leelamma and children.

Giant Magnetoresistance: Future Memory Devices

by Arun Aravind

The 2007 Nobel Prize in Physics is awarded to Albert Fert and Peter Grünberg for their discovery of giant magnetoresistance (GMR). It has revolutionized techniques for retrieving data from hard disk. It also plays a major role in various magnetic sensors as well as the generation of new type of electronics termed as

spintronics. In 1988 Frenchman Albert Fert and the German Peter Grünberg independently discovered a totally new physical effect - GMR. Very weak magnetic changes give rise to major differences in electrical resistance in GMR system. A system of this kind is a perfect tool for reading data from hard disks, where the information registered magnetically has to be converted to electrical current. In 1997 the first read out head based on GMR effect was launched and this soon become the standard technology.

A hard disk stores information in the form of microscopically small areas magnetized in different directions. A read out head based on GMR effect can convert very small magnetic changes into differences in electrical resistance and therefore into changes in the current emitted by the read out head. The current is the signal from the read out head and its different strength represent ones and zeros.

To observe GMR structures consisting of layers that are only few atoms thick have to be produced. In multilayer GMR two or more ferromagnetic (FM) layers are separated by very thin non-ferromagnetic spacer (Fe/Cr/Fe). In the absence of applied magnetic field the direction of adjacent ferromagnetic layers is antiparallel due to weak antiferromagnetic coupling (Ruderman-Kittel-Kasuya-Yosida coupling) between layers, and it decreases to a lower level of resistance when the magnetization of adjacent layers align due to and applied external field.

In spin valve GMR two ferromagnetic layers are separated by a thin non-ferromagnetic spacer without RKKY coupling. We can switch the two ferromagnetic electrodes independently if the coercive fields are different. Hence the parallel and antiparallel alignment can be achieved and the resistance is again higher in the antiparallel case. Now the research are focused focus on increasing the distances over which electrons will retain its spin and by enhancing the polarization effect by ferromagnetic layers. Spin valve GMR configurations is most useful industrially and is the configuration in hard drives.

GMR is extensively used in the read-out heads in modern hard drives and it's another application is magneto resistive random access memory (MRAM), a non-volatile semiconductor memory. Two leading companies, IBM/Infineon and Motorola, plan to introduce first commercial MRAM products. GMR based MRAMs have been developed for aerospace applications; also high density GMR-MRAM for computer applications are in development.

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New Vice Chancellor and Registrar for CUSAT

Dr Gangan Prathap, renowned scientist of international reputation in Computer Simulation and Mathematical Modelling, took charge as the 11th Vice Chancellor of the Cochin University of Science and Technology on 4 February 2008. Winner of Bhatnagar Award in 1990, the topmost award given to Scientists in the country, Dr Prathap belongs to Mayyanadu of Kollam.

Prof. Chandramohanakumar, reputed professor from the Marine Science department of our University, took charge as the new Registrar of the University. Prof. Chandramohanakumar is a known personality among the teachers and student communities.

Recent and Upcoming Events

Alumni Day

Alumni day will be held on every second saturday of the month October. This year the meeting will be held on October 11 2008 in the Department of Physics, CUSAT. Along with this a three day conference on Nanophotonic Materials will be held.

Scope and Awareness - outreach program of the Department for school children.

This year outreach program for school children was held during 16 to 26 of March 2008. The program was particularly for 9th standard students from the surrounding schools. The program consists of set of classes by the faculty of the department and a set of practical classes. The program was coordinated by Dr. M. K. Jayaraj.

The program was inaugurated by the Vice-Chancellor, Dr. Gangan Prathap. Classes on different topics like Special theory of relativity, Semiconductors, Raman effect, Fundamental particles, electronic circuits, Equivalence principle, Magnetism, nanotechnology and Astrophysics were conducted. The classes were taken by the faculty members and Research scholars of the department. As a part, a Telescope making class was also conducted. Next year also we will be organising the work shop for school children.

`http://physics.cusat.ac.in`

Cochin Nano - 2009

Second International Conference on Frontiers in Nanoscience and Technology being organized by the department of Physics from January 3 to 6, 2009. Dr.Anandaraman, Department of Physics is the convenor of the conference. `http://cochinnano2009.cusat.ac.in`

National conference on Nanophotonic Materials

SPIE CUSAT students chapter along with the Department of Physics and SPIE IIT Madras is organizing a three day national conference during October 10-12, October 2008. We are happy to announce that the alumni members can register for the conference at a reduced rate and all efforts are being made to provide accommodation on campus on conference days.

IC-SOLACE

International Conference in Solar Cell organized by the Department of Physics, CUSAT with representation from all over the world was held during 21-23 of January 2008. Prof.K.P.Vijayakumar was the convenor of the conference. `http://physics.cusat.ac.in/ncnm_2008.htm`

Ph.D, thesis submitted and awarded

The Department of Physics constantly produces Ph.D holders. In the year 2007-08 following is the list.

1. Aldrin Antony - Awarded Ph.D for the thesis 'Preparation and Characterization of Certain II-VI, I-III-VI_2 Semiconductor thin films and Transparent conducting oxides'
2. Manoj R - Awarded Ph.D for the thesis 'Characterization of transparent thin films growth by pulsed lased deposition and RF magnetron sputtering'
3. Nisha M - Awarded Ph.D for the thesis 'Growth and characterization radio frequency magnetron sputtered indium Tin oxide thin films'.
4. Asha A.S. Thesis Title: RF Magnetron sputtered perovskite oxide electrodes for ferroelectric RAM (2007)
5. Rahana Yousaf Thesis Title: Optimization of two stage process for the growth of In2S3, CuInSe2 and CuIn (Se1-xS1-x) thin films for solar cell application (2007)
6. Anila E.I.Thesis Title: Luminescent studies of SrS based phosphors for display applications (2008)
7. Mini Krishna K. Thesis Title: Synthesis and characterization of zinc gallate based phosphors for thin film electroluminescent devices (2008)
8. Ajimsha R.S. Thesis Title: Growth and characterisation of ZnO based hetrojunction diodes and ZnO nanostructres by pulsed laser ablation (2008)
9. Beena Mary John - Submitted thesis on 'Fabrication and Characterization of Dye sensitized photopolymer Films for Holographic applications' on January 2008
10. Kishore.V.C.-Submitted thesis on 'Development of photorefractive polymers:Evaluation of photoconducting and Electro optic properties' on June 2008
11. Jayakrishnan - Submitted his thesis entitled "Defect analysis os semiconductor thin films for photovoltaic applications using photoluminescence and photo-conductivity' on April 2008

12. Sreekumar A - Submitted his thesis on "Development of solar air heaters and thermal energy storage system for drying application in food processing industries' on November 2007
13. Subha P A submitted thesis on 'Studies on Spatial and Temporal Solitons with Varying Dispersion, Diffraction and Nonlinearity' on September 2007
14. Jisha C P submitted thesis on 'Studies on some aspects of light beam propagation through certain nonlinear media' on March 2008.

ISRO Young Scientist Award to Renjith

We proud to know that Mr. R. Renjith, an alumni of our Department has been awarded with the ISRO Young Scientist Award for the year 2007. R.Renjith is presently working as Scientist/Engineer in Indian Space Research Organization (ISRO), LEOS, Bangalore. He obtained his M.Sc degree in Physics from Cochin University of Science and Technology in 2002. He is involved in two projects namely development of Lunar Laser Range Instrument (LLRI), one of the payloads for India's first Moon mission, to measure topography of lunar surface and development of Optical Inter-Satellite Communication (OISL) having data rate more than 1 Gbps between Remote sensing satellite and Geostationary satellite. His areas of interest are high-speed electronics and free space communication. He had been awarded with prestigious ISRO Young Scientist award 2007 from His Excellency, Dr A. P. J Abdul Kalam, President of India for his significant contribution to Indian Satellite Programme. He has a few research papers to his credit.

New Publications

ADVANCED QUANTUM MECHANICS

Freeman Dyson et al. (March 2007)

This invaluable volume comprises the legendary, never-before-published, lectures on quantum electrodynamics first given by Dyson at Cornell University in 1951. The late theorist Edwin Thompson Jaynes once remarked "For a generation of physicists they were the happy medium: clearer and motivated than Feynman, and getting to the point faster than SchwingerŤ.

FUNDAMENTAL FORCES OF NATURE: The Story of Gauge Fields

HUANG KERSON. (2007)

Gauge fields are the messengers carrying signals between elementary particles, enabling them to interact with each other. Originating at the level of quarks, these basic interactions percolate upwards, through nuclear and atomic physics, through chemical and solid state physics, to make our everyday world go round. This book tells the story of gauge fields, from Maxwell's 1860 theory of electromagnetism to the 1954 theory of Yang and Mills that underlies the Standard Model of elementary particle theory. In the course of the narration, the author introduces people and events in experimental and theoretical physics that contribute to ideas that have shaped our conception of the physical world.

Bibliography

Freeman Dyson (Institute for Advanced Study, Princeton, USA) and David Derbes (Laboratory Schools, University of Chicago, USA)

Huang Kerson, WSPC (July 2007)