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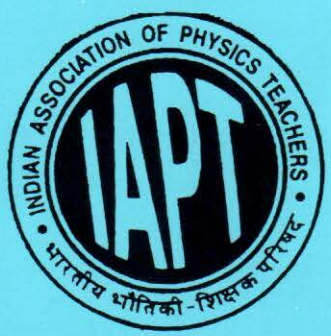

INDIAN ASSOCIATION OF PHYSICS TEACHERS

STUDENT JOURNAL OF PHYSICS

This is a quarterly journal published by Indian Association of Physics Teachers. It publishes research articles contributed by Under Graduate and Post Graduate students of colleges, universities and similar teaching institutions, as principal authors.

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C O N T E N T S

First IAPT National Student Symposium on Physics

A new dimension has been added to the multidimensional IAPT. The first IAPT National Student Symposium has been held during February 25-27, 2013, at Chandigarh in collaboration with the Department of Physics, Panjab University, Chandigarh. It was a resounding success with 150 students applying from all over India, of which 80 (30 girls) were selected for the event. A detailed report appears in this issue of the Bulletin.

Twenty-first century has been called the Knowledge Century where innovation is being considered to be of supreme importance driving the activities in all spheres of human activity. Education systems in all countries are being remodelled towards this objective. Unfortunately rote learning and excellence in examination still continues to the mainstay of our education system. However in recent years, our country has taken a series of measures to induce the spirit of innovation and creativity into our education system. Projects and dissertations have become an integral part of UG and PG curricula. New kinds of teaching institutions like Indian (or National) Institute of Science Education and Research and new programmes like National Initiative in Under-Graduate Science have been launched. Research has been adopted as a criterion in the evaluation of UG and PG institutions by the National Assessment and Accreditation Council of UGC.

To spread the awareness of the above new ethos of education, and take another concrete step forward in this direction, IAPT had resolved to institute an annual symposium on physics exclusively for the UG and PG students termed National Student Symposium on Physics (NSSP) which would serve as a forum for presentation of their innovative ideas in a formal manner and bring new enthusiasm and spirit of creativity and cooperation among the student mass in the country.

Now that a beginning has been made, and successfully so, it is hoped that NSSP will help in a modest way in the creation of a new kind of mindset by instilling faith and confidence in the students on their creative ability. It

is worthwhile to be reminded that C. V. Raman published two papers in Philosophical Magazine while studying B.Sc. in Presidency College Madras. His nephew Nobel laureate astrophysicist S. Chandrasekhar repeated this feat later. It is imperative that the faculty of creativity should be cultivated consciously by the students at an early age from the plus-two level. Hope this symposium will help to inaugurate a new culture in the method of studying physics in the UG and PG classes in the country.

L. Satpathy

1st IAPT National Student Symposium on Physics

(25 27 February 2013)

Organised by

Indian Association of Physics Teachers

and

Department of Physics
Panjab University, Chandigarh

Twenty-first century is the knowledge century. The innovations are supreme. To foster a culture of innovation and creativity among the young students, IAPT has instituted the annual National Student Symposium on Physics to provide a national forum to young students to present their new ideas and innovative work at an early stage, which will lead to their growth as creative and original researchers.

First IAPT National Student Symposium on Physics was held in collaboration with the Department of Physics, Panjab University, Chandigarh from February 25 to 27, 2013. The announcement with all the necessary information was carried in November 2013 issue of the Bulletin prominently on its last cover page. In order to give wider publicity, about 300 posters were sent to prominent colleges, university Physics departments and other institutions all over the country encouraging the UG and PG students to take part in it. They were invited to present their innovative ideas through poster and oral presentations. An overwhelming response was observed and nearly 150 applications were received. In few cases there were as many as 8-10 applications from the same institution and many from the same region. Due to logistic, budgetary and administrative reasons only 80 (30 girls and 50 boys) participants were chosen out of them. The selection thus made, gave representation to students from all over India.13 students were selected for oral contribution and 23 were asked to make a poster presentation. The rest of them were allowed to take part as the participants only. The lodging was provided at NITTTR guest house/hostel in sector 26 Chandigarh. Registration fee of Rs. 300/- was collected. All participants who gave oral/poster presentations were given 100% travel support (II class sleeper/bus fare) and all others 70% travel support. Local hospitality to all participants and resource persons was provided by the hosts.

The format of the symposium consisted of invited talks by experts and oral and poster presentations by the students. In addition, there were several special lectures by eminent teachers and scientists on topics of current interest.

The symposium was inaugurated by Prof. S.D. Mahanti, Senior Professor, Univ of Michigan, USA, and a very senior member of IAPT, who delivered a talk entitled Energy and Nanoscience on this occasion. Earlier, Prof. Manjit Kaur, Coordinator NSSP, welcomed the participants and the

guests; Prof. C.S. Aulakh, Chairman, Department of Physics, briefed the audience about the Department and its activites; Prof. U.S. Kushwaha, Chief Editor, IAPT Bulletin, gave an introduction to IAPT and its activites; Prof. L. Satpathy, formerly of Institute of Physics, Bhubaneswar, a very senior IAPT member and Convener NSSP, spoke about the objective of the sympsium; Prof. Satya Prakash, immediate past President of IAPT and Chairman NSSP, gave a motivational talk to the participants. The inaugural was attended by IAPT members from the city and the region in large numbers. It was graced by the presence of two earlier presidents of IAPT, Prof. H.S. Hans and Prof. H.S. Virk, and by the two ex-Chief Editors of the Bulletin, Prof. S.P. Puri and Prof. M.P. Khanna.

The first session of the day-1 was chaired by Prof. Satya Prakash in which six oral presentations by the participants were given. Prof. A. K. Grover, Vice Chancellor of Panjab University, Chandigarh, the Patron of the NSSP-2013 gave a talk entitled "Rare earths based spin ferromagnets with net-zero magnetization for niche applications." After his talk he interacted with the participants and resource persons during lunch. This was followed by a group photograph of all the participants with the Vice-Chancellor, resource persons and organizers. In the post- lunch session Prof. Sudipta Mukherji, IOP Bhubaneswar (IOPB), gave a complete black-board talk, titled Phase Transitions with Black Holes which was followed by 3 oral presentations by the participants. This session was chaired by Prof. L. Satpathy. A poster session was conducted from 3.30 -5.00 p.m. in which 12 posters were displayed by the participants. A talk by Dr. S. Sahijpal of Dept. of Physics, P.U. on the Origin and evolution of our universe followed by the sky-watch, till late in the night using Astronomical Telescope Facility available in the department. The talk was as well the sky-watch was liked by one and all.

On Day-2, first session was chaired by Prof. Sudipta Mukherji. In this session Prof. L. Satpathy (IOPB) delivered a talk on How to Learn / Teach Newtons Laws of Motion and Prof. A. M. Srivastava (IOPB) on Investigating the Universe in a Simple Table-top Liquid Crystal Experiment and second poster session was conducted. In the session after lunch, an educational visit to Terminal Ballistic Research Laboratory (TBRL), Ramgarh Range of DRDO, Chandigarh was organized; where the participants were shown the equipments used for the defence purposes and had interactions with the scientists. In the evening, a cultural program showcasing the rich cultural heritage of the region was presented by the students of the Department of Physics, Panjab University. Some of these students were also the participants of the symposium.

The Day-3, the last day of symposium began with a talk by Prof. Manjit Kaur on Standard Model, followed by the remaining oral presentations of the participants. This session was chaired by Prof. Satya Prakash. The second session of the day was chaired by Prof. Manjit Kaur in which Prof. J. S. Bagla (IISER, Mohali) spoke on Clusters of Galaxies Dr. Mandip Singh (IISER, Mohali) delivered the talk Exploring quantum physics with Bose Einstein condensates and Photons. A valedictory ceremony was organized where the participants were given the certificates, copy of Student Journal of Physics (formerly PRAYAS) and the book Wings of Fire- an autobiography of Dr. A.P.J. Abdul Kalam, ex-President of India. The books were donated by an anonymous donor. A feedback from the participants was also taken so as to improve upon the shortcomings for the next time. With the

hope that energy and brilliant ideas of vibrant students will find a right direction, the Symposium came to an end.

The symposium was well attended and appreciated by all participants. This was made possible with the financial support of IAPT, Dept. of Physics, P.U, DST-U.T, Chandigarh, PSCST, Chandigarh, OST electronics limited & Pyramid Electronics, Parwanoo and a generous donation by Prof. S.D. Mahanti. This financial support helped the organizers to take care of T.A./ lodging and local hospitality of the participants and resource persons. This report was compiled with the help of faculty and students. A soft copy of the booklet with abstracts of the student presentations and some photographs are available at the symposium website: http://www.physics.puchd.ac.in/events/nssp2013

Invited Speakers and their Talks

1. **S.D. Mahanti**
   ENERGY & NANOSCIENCE
   There are many challenges facing the humanity in the 21st Century. Among them are Energy, Global warming, Climate change, and Poverty. In fact energy plays an important role in the other three. The world power use in 2008 was 15 TW and is expected to at least double to 30 TW by 2050. Compounding the challenge presented by this projection is the growing need to protect our environment. There is therefore a great current interest in developing clean energy sources with high efciency. Thus we have not only to look at renewable sources of energy but also to increase the efficiency of their energy production. In this talk I will discuss how the current ideas and developments in nano-science and nano-technology are playing important roles in producing novel materials in attacking these difficult problems and challenges.

2. **Sudipta Mukherji**
   PHASE TRANSITION WITH BLACK HOLES
   First order phase transition involving black holes can be qualitatively understood in terms of a simple toy model. Following the work of a first year M.Sc. student of Utkal University, I will review this model in my talk.

3. **Prof. Arun K. Grover**
   RARE EARTHS BASED SPIN FERROMAGNETS WITH NET-ZERO MAGNETISATION FOR NICHE APPLICATIONS

4. **Prof. L Satpathy**
   HOW TO LEARN/TEACH NEWTONS LAWS OF MOTION

5. **Sandeep Sahijpal**
   THE ORIGIN AND EVOLUTION OF OUR UNIVERSE

6. **Ajit Mohan Srivastav**
   INVESTIGATING THE UNIVERSE IN SIMPLE TABLE TOP LIQUID CRYSTAL EXPERIMENTS

Oral Presentations

1. **THE DYNAMICS OF FALLING PAPER**
   Nandita Chaturvedi
   St. Stephens College, University Enclave, Delhi
   Abstract: We discuss how a mathematical model based on three simple forces; gravity, lift and drag, captures the complex behavior of falling paper. While work of this kind has been done before, we make the model more realistic by introducing a new drag model. We also subject the model to experimental verification. Estimates for the values of frictional coefficients for the paper-air system are determined through an indirect experiment using scaling and geometry arguments. We find that for the frictional coefficients determined, the model provides a sound quantitative description of the path of a falling paper. Finally, we make predictions for the behaviour of the paper in different fluids by varying drag coefficients.

2. **QUANTUM KEY DISTRIBUTION**
   Tabish Shilbi
   S.G.T.B Khalsa College, Delhi University, Delhi
   Abstract: We study a Quantum Key Distribution for a 3-particle system and then generalize it to a n-particle system. In this protocol, we take a 2-dimensional system of particles in an entangled state so that we can share a common key for firstly 3 different parties and then between n different parties. Then we also study some of the eavesdropping techniques used by Eve and the advantages of our systemover some of those techniques.

3. **A LASER BASED LOW COST TECHNIQUE TO MEASURE CELL SIZE**
   Nisha Narasinha Kelkar
   R.E.Societys R.P. Gogate College of Arts & Science and R.V. Jogalekar College of Commerce, Ratnagiri, Mumbai
   Abstract: It has been observed that periodic structure of plant cells effectively acts as a diffraction grating. The grating element of such system is obtained optically by shining the plant cells particularly in Onion peel by LASER. The measurement of diffraction pattern results into accurate determination of the columnar width of the periodic plant cell structure. This paper attempts to report an interdisciplinary approach to gauge the size variation in plant cell using diffraction. Keywords: Diffraction, plant cell, Laser.

4. **CONSTRUCTION OF OPTICAL BENCH TO CALCULATE AND VERIFY OPTICAL PARAMETERS**

S. Anil Purohit

G.J. College, Ratnagiri, Maharashtra

Abstract: The project concerns about making a single device that will fulfill the need of doing all experiments from Optics. Using bench conventional optical bench we cannot perform all the experiments of optics, as the surface is not used there for experimentation. So I made the bench capable of using the surface so the surface related experiments can be performed more easily than conventional optical bench. This optical bench is cost efficient (1/10th) cost of conventional optical bench. Also the use of LASER makes it a perfect and precise instrument. The probability and handiness are the key factors of this design of optical bench.

5. **NONLINEAR DYNAMICS IN ARGON GLOW DISCHARGE PLASMA**

Chiranjit Mitra[1] **and Bapun Kumar Giri**[1]**, P.K. Panigrahi**[1]**, A.N. Sekar Iyengar**[3] [1] **Department of Physical Sciences, IISER, Kolkata**

[3] **Plasma Physics Division, SINP Kolkata**

Abstract: Plasma is a typical nonlinear system with a large number of degrees of freedom. The present work investigates the nonlinear dynamics in argon glow discharge plasma from the perspective of Fourier and Wavelet based methods. The generalized Hurst exponent was obtained from Wavelet Based Multi Fractal Detrended Fluctuation Analysis (WBMFDFA), Multi Fractal Detrended Fluctuation Analysis (MFDFA), Continuous Wavelet Transform (CWT), power spectrum and Fourier analysis. We have shown periodic behavior in non-stationary time series of the discharge of potential fluctuations of plasma discharge. By analyzing several signals generated by the argon dc discharge plasma we show that the WBMFDFA can reliably determine the multi-fractal scaling behavior of time series.

6. **ATOMIC STREET LIGHT CONTROL SYSTEM**

Chimnay Manoj Kolhatkar

R. B. Kulkarni, Junior College of Science, Ratnagiri, Maharashtra

Abstract: Present manually operated street lights are not properly switched off after the sunrise and also not switched on after the sunset. In sunny and rainy days, ON time and OFF time differ significantly which is one of the major disadvantage of using timer circuits. Automatic street light control system is a simple, very useful and powerful concept, which uses transistor as a switch to ON and OFF the street light automatically. By using this system manual work is removed. It automatically switches light ON when the sunlight goes below the visible intensity and automatically switches light OFF when the sunlight goes above the visibility intensity. This is done by a Light Dependent Resistor (LDR) which senses the intensity of light. Automatic streetlights need no manual operation of switching ON and OFF. The system itself detects whether there is need for the light or not. When darkness rises to a certain value then automatically streetlight is switched ON and when there is other source of light, the street

light gets OFF. The extent of darkness at which the street lights to ne switched on/off can also be changed using the potentiometer provided in the circuit.

7. **UNDERSTANDING THE TRAJECTORY OF AN ELECTRON UNDER THE INFLUENCE OF MAGNETIC FIELD USING BOHMIAN MACHINERY**
Sanmoy Mondal
IISER, Kolkata
Abstract: Wave function of a freely propagating electron can be denoted as a Gaussian wave packet which naturally spreads with time in all three dimensions. Exploiting the machinery of the Bohmian model of quantum mechanics, one can show that even after a small time away from its initial state the system of electron under a magnetic field is a diverging system. Also I would like to discuss a possible protocol to test bohmian trajectory experimentally.

8. **VALENCE BAND STUDY OF POLY CRYSTALLINE SILVER SAMPLE USING ULTRAVIOLET PHOTOELECTRON SPECTROSCOPY**
S. Hui[1], Dr.B. R Sekhar[2] [1]School of Physics, Sambalpur University, Odisha
[2]Institute of Physics, Bhubaneswar, Odisha
Abstract: The following paper outlines the techniques and requirements of Ultraviolet Photoelectron Spectroscopy (UPS). The different vacuum condition and instrumentation are also studied extensively. UPS is utilized to study the valence band of polycrystalline Silver (Ag) sample and Fermi edge is obtained experimentally. The experimentally obtained data matches with theory to a good extent.

9. **INFLUENCE OF STATIC MAGNETIC FIELD ON THE GROWTH OF PLANTS**
Kartika N. Nimje
Somalwar Junior College, Nikalas, Nagpur, Maharashtra
Abstract: Over many years, numerous experiments on the effects of magnetic field on plant growth have been performed with seedlings of different plant species placed in static and alternating magnetic fields. In both cases the magnetic exposure disclosed the stimulatory influence on the growth (parameters such as germination rate, growth rate and yield of the plant) of plants. Similar results were found in higher areas of study such as significant enhancement of the fresh tissue mass, assimilatory pigments level as well the chlorophyll ratio, average nucleic acids level, increase of the average plants length (exception: the dry substance mass accumulation). Also it was found that the difference in growth rate between treated and control plants decreased after the field was removed. The removal of the magnetic field also weakened the plant stem, suggesting the role of magnetism in supplying plants with energy.

10. **IS UNIVERSE REALLY BARYON ASYMMETRIC?**
Nishant Gupta
Dayalbagh Educational Institute, Agra

Abstract: Over the years theoretical physicists have tried to explain the origin of baryon asymmetry but the topic of baryon asymmetry still remains mysterious to all of us. I have attempted to explain that what we call baryon asymmetry may as well be the matter dominant region of our observable universe, with antimatter dominant region residing beyond our future visibility limit having no interaction with the former.

11. **ROGUE WAVES**

Monu Sharma and Varun Sharma

Department of Physics, Panjab University, Chandigarh

Abstract: Rogue waves are the large-amplitude waves appearing suddenly on the sea surface without any prior warning(Waves that appear from nowhere and disappear without a trace). The marine folklore contains many colourful names like freak, giant, monster, killer, holes in the sea, walls of water, three sisters for such phenomenon. These waves appear, sometimes alone as a giant crest (Walls of Water), or preceded/succeeded by deep troughs (Holes in The Sea), or as several successive high waves (Three Sisters).

What confirms the significance of the sea wave dynamics is that, though large waves are usually expected to appear during rough sea state, rogue waves are observed at calm sea conditions as well. This phenomenon has found potential applications in various other branches of physics (e.g. nonlinear optics, plasma and super-conductivity, geophysics),that is why the words Freak Waves and Rogue Waves that came from marine folklore are now intensively used in these disciplines as well. A great progress is achieved in the understanding the physical mechanisms of the rogue wave phenomenon during the last fifteen years and this presentation contains the review of these physical mechanisms of rogue waves.

12. **CORRELATION AND PERIODICITY IN A BOUNCING BALL MOTION THROUGH WAVELETS**

Abhinna Kumar Behera[1], A. N. Sekar Iyengar[2], Prasanta K. Panigrahi[1]

[1]Department of Physical Science, IISER-Kolkata, [2]Plasma Physics Divison, SINP-Kolkata

Abstract: The dynamics of bouncing ball is analyzed through wavelet transform. Multiscalte analysis on the time series of bouncing ball reveals clear signature of nonlinearity. The scale dependent variable window size aptly size with the transient and non-stationary periodic behavior quite well. Importantly, the multifractal parameter, the generalized Hurst exponent obtained by Wavelet Based Multifractal Detrended Fluctuation Analysis (WBMFDFA), Multifractal Detrended Fluctuation Analysis (MFDFA), continuous wavelet transform (CWT) and power spectrum fourier analysis of the chaotic motion of the bouncing ball, shows interesting results in the field of non-smooth dynamics. The optional time-frequency localization of the continuum morelet wavelet is found to delimit the scale dependent Periodic Modulation efficiently; where as the discrete Daubechies (DB) basis set has been applied effectively for

detrending the temporal behavior to reveal the multifractal behavior underlying the dynamics. We relate our wavelet based MFDFA method to the standard partition function-based multifractal formalism as well as power spectrum fourier analysis of the non-stationary time series, and prove that each approach is equivalent for stationary signals.

Poster Presentations

1. **TEMPERATURE DEPENDENT ELECTRICAL CONDUTIVITY OF GUAVA JUICE DURING OHMIC HEATING**

Amanjot Kaushal, Kanupriya and P.S. Tarsikka

Department of Mathematics, Statics and Physics, Punjab Agricultural University, Ludhiana

Abstract: Ohmic heating is an advanced food processing technique in which heat is generated internally within the food by the passage of alternating electrical current. Conventional heating process essentially consists of heat-transfer mechanisms of conduction, convection and radiation. But this leads to loss of product quality and low energy efficiency. To overcome these problems an alternative technology was developed which utilizes the inherent electrical resistance of the food material known as ohmic heating. Ohmic heating has been derived from Ohms law. The advantages of ohmic heating are the rapid, uniform volumetric heating, high energy conversion efficiency. The important parameter in ohmic heating of liquid food product is its electrical conductivity behavior. For the study of ohmic heating an ohmic heater is designed of known dimensions. Guava juice is studied for ohmic heating treatment. Guava juice is rich in vitamic C which helps to fight against any infection and improves the immune system. Although several studies have been performed on the ohmic heating rates of liquid food, data on concentration is limited. In this study, Guava juice having 20-50% soluble solid is ohmically heated by applying three different voltage gradients (6.0, 10, 13.5 V/cm). Measurements were made in the temperature heating, leads to the determination of electrical conductivities at various temperature range from 20-80oC. The instantaneous values of current and voltage are recorded during ohmic heating, leads to the determination of electrical conductivities at various temperatures. The dependence of electrical conductivities on temperature, voltage gradient and concentration has also been studied. It was observed that the electrical conductivity of guava juice is significantly affected by temperature and concentration. The changes in viscosity and total soluble solids have also been observed with ohmic heating. Temperature time and electrical conductivities temperature graphs have been plotted. The electrical conductivity shows a linear dependence upon the temperature.

2. **FORMATION OF PLANETARY SYSTEMS: A STUDY REVIEWING FORMATION AND EVOLUTION**

Honey Arora, Ramandeep Kaur and Parveen Bala

Department of Mathematics, Statistics and Mathematics, Punjab Agricultural University, Ludhiana

Abstract: Many hypothesis and theories have been given so far to explain the formation of planetary system. The first proposed being the nebular hypothesis which was first proposed in 1734 by Emanuel Swedenborg, Immanuel Kant, and Pierre-Simon Laplace. Over the course of the 20th century, this model came to be challenged by a number of theorists who proposed numerous models in an attempt to replace it, like gas drag theory, gravitational instability model and core accretion theory to name a few. However, none of these attempts were successful and it was not until the 1970s with Soviet astronomer Victor Safronov that the modern (and widely accepted) Solar Nebular Disk Model (SNDM) came into being. Recent model to this study has been given which is named as sequential accretion model, suggested in 2012 (ref). These provide us insight into how we reached where we are today and help to answer certain questions about formation of our own solar system too via a scientific explanation. The theory which describes the formation of the solar system in particular is the condensation theory. In this poster review of developments in our understanding of the formation and evolution of planets is presented along with the ongoing work in this field. Reference: Fortier, Y. Alibert, F. Carron, W. Benz, K.-M. Dittkrist Planet formation models: the interplay with the planetesimal disc. arXiv:1210.4009[astro-ph.EP]

3. **ESTIMATION OF AGE OF CLUSTER M67**

Saba Hasan Ansari and Dr.R.V Dabhade

Department of Physics, Fergusson College, Pune

Abstract: Photometryis a technique of astronomy concerned with measuring theflux,or intensity of an astronomical object's electromagnetic radiation. When using a CCD camera to conduct photometry there are a number of possible ways to extract a photometric measurement (e.g. the magnitude of a star) from the raw CCD image. The simplest technique, of aperture photometry is performed by using the software IRAF on individual stars by adding up the pixel counts within a circle centered on the object and subtracting of an average sky count. However the photometry in a very crowded field, such as a globular cluster, where the profiles of stars overlap significantly is achieved by using the software MIDAS. It gives an advantage of getting the magnitude of maximum stars in a cluster at once. Photometry is applied to study the open cluster m67. The two main purposes of this study were to compare the color- magnitude diagram using photometric techniques with the standard one and to determine the age of the cluster and meanwhile compare different techniques involved in finding the age. Since each technique has got its degree of uncertainty, sometimes the uncertainty even lead to a result that depict the age of the cluster greater than the age of universe.

Thus, the challenge is to prevent such mystification and hence conclude an appropriate result by using any convenient techniques.

4. **DETERMINATION OF MAGNETIC FIELD STRENGTH OF WHITE DWARFS USING SPECTROSCOPIC DATA**

Sherry Chhabra

Department of Physics, Fergusson College, Pune

Abstract: White Dwarfs are extremely interesting objects to observe and analyze, especially the ones that constitute a part of the Cataclysmic Variables. These stars are present in a binary system with a secondary main sequence star, from which they accrete mass via an accretion stream. Some of these cataclysmic variables exhibit extraordinary magnetic fields which cause a distortion in the accretion disk and the infalling matter is directly taken through the poles of the white dwarf following the magnetic field lines. The spectra of such stars exhibit many features such as cyclotron humps, Zeeman wingsetc. Here, the spectra of such stars were extracted from the Sloan digital sky survey and then analyzed to determine their magnetic fields by studying the Zeeman split spectral line components arising due to the high magnetic fields while calculating the values for the cyclotron frequency.

5. **COMPARATIVE STUDY OF ACOUSTICS OF AUDITORIUM AND TEMPLE**

Supriya Suhas Date

R.E.Societys R.P. Gogate College of Arts & Science and R.V. Jogalekar College of Commerce, Ratnagiri, Maharashtra

Abstract: Now a days temples and auditoriums are built as per acoustics science with the help of modern technology. But in old era auditoriums, temples were found in dome structure. We have made an attempt to do comparative study of old structures and new structures of auditorium and temple. An auditorium is considered to be good if it has flat frequency response over all audio frequencies. To study the frequency response of auditorium and temple we used frequency generator to produce the signals having frequencies corresponding to notes SA, PA, and NI of the middle octave. Readings of sound intensity were taken at various positions in the auditorium and temple. The analysis shows that modern auditorium as well as old temples have fairly flat frequency response, which indicates that even the old temple were acoustically good.

6. **CP VIOLATION AT KEK B-FACTORY**

Nitika Goyal, Monika Karday and Rajeev Kumar

Department of Mathematics, Statics and Physics, Punjab Agricultural University, Ludhiana

Abstract: The visible universe is composed of matter particles protons, neutrons and electrons rather than their antimatter partner antiprotons, antineutrons and positrons. If the moon were composed of antimatter, then lunar probes and astronauts would have vanished in a fire-

ball of energy as soon as they touched the lunar surface. The solar wind and cosmic rays do not destroy us, implying that the sun and the Milky Way are also made of matter. The big bang should have produced equal amounts of matter and antimatter if C P symmetry was preserved. As such there should have been total cancellation of both- protons should have been cancelled with antiprotons, electrons with positrons, neutrons with antineutrons and so on. This would have been resulted in a sea of radiation with no matter. Since this is not the case, after big bang physical laws must have acted differently for matter and anti-matter, i.e. violating CP-symmetry. Charge-Parity (CP) violation an obscure effect seen only with certain kind of elementary particles could provide answer. In particle physics, CP violation is the violation of the postulated CP symmetery: the combination of C-symmetry (charge conjugation symmetry) and P-symmetry (parity symmetry). CP symmetry states that the laws of physics should be the same if a particle were interchanged with its antiparticle and then the left and right were swapped. In 1964, Christenson Cronin, Fitch and Turley unexpectedly discovered CP violation in the decay of neutral K-mesons. Recently, a new generation of experiments, the Belle experiment at KEF, Japan and the high energy linear accelerator center (SLAC), USA have observed CP violation using B mesons. Results presented by both experiments in July 2001 successfully established the presence of CP violation in B meson system and subsequently lead to Noble Prize to Cabbibo, Kobayashi and Maskawa in 2008 for their theory of CP violation. The Belle experiment has collected nearly 1ab data during its 10 years if operation from 1999-2010 and probed many new decays, resonances and particles etc.

7. **COSMIC RAY SETUP USING PLASTIC SCINTILLATOR DETECTOR FOR TESTING EFFICIENCY OF RESISTIVE PLATE**

Sourav Jain

Department of Physics, Panjab University, Chandigarh

Abstract: RPC is a parallel plate gas detector employed for the detection of minimum ionization particles and in our case muons. These scintillators detectors were tested for their performance in details. We fabricated scintillator detectors for finding the efficiency of RPCs using cosmic ray muons. The operational performances of RPCs in the two operating modes depending upon the different mixture of gases send into the gas gap of RPC have been studied. Efficiency measurement of a prototype RPC will be presented. Study of efficiency of the prototype RPC using VME hardware and software will be presented.

8. **ITERAS FUTURE SOURCE OF ENERGY**

Neha Goyal and Parveen Bala

Department of Mathematics, Statics and Physics, Punjab Agricultural University, Ludhiana

Abstract: The development of controlled nuclear fusion is a source of high energy. In a fusion reactor, two Hydrogen atoms are brought together to form a helium atom, a stream of neutrons and energy. The theory of nuclear fusion was first developed by Robert Atkinson

and Fritz Houterman in 1929. There are several types of nuclear fusion reactions, most of which involve deuterium and tritium which are isotopes of hydrogen. A proton-proton chain reaction is the process by which stars like the sun generate energy. The temperature of fusion reactor has to be about 100 million degrees Kelvin or about six times the temperature of the Sun's core. At this temperature, the hydrogen is a plasma, a state of matter in which electrons are stripped from atoms and move about freely. There are plans to construct a new fusion facility at Cadarache in France, called the ITER acronyms of International Thermonuclear Experimental Reactor. It has been finalized as a joint project of the United states, the European Union, Japan, China, Russia and South Korea. ITER is a step between todays studies of fusion energy and future electricity-producing fusion power plants. Fusion has beneficial features which must be demonstrated on ITER and by all future plants to be widely applicable. One of the goals of ITER is to achieve ten times the energy from a fusion reaction than has been achieved. It is designed to develop the technologies necessary for commercial fusion plants that will generate electricity, hopefully by the mid 21st century. In this presentation, an idea of ITER as future of energy has been projected.

9. **PREDICTION OF VARIABLE STARS AS BINARY STAR IN COMPARISON WITH THE BINARY STAR ALGOL**

Chetan Thakur

Fergusson College Pune

Abstract: Study of binary star systems, through the variability of their combined luminosity, can give us important information about the celestial dynamics of these stars. The objective of this project is to study different variable stars and check whether they are binary star or not. Initially a variable star binary system Algol was studied, and its light curve was obtained after observations over a period of 2 days. This was then used as a reference for studying other variable stars. By doing a comparative study of other unknown variable stars with the reference star we predict whether the star under study is in a binary system or not. The present work is ongoing at the Inter University Center for Astronomy and Astrophysics (IUCAA, Pune), where we are using Solid State Photometer attached with Celestron 8 Telescope and the task will be accomplished in 2 months. The Presentation includes the comparative study of variable stars by taking Binary star Algol as a reference.

10. **STUDY OF TRANSITING EXOPLANETS WASP-12 B AND HAT-P-7 B**

Asmita Bhandare and Firoza Sutaria*

Department of Physics, Fergusson College, Pune, *Indian Institute of Astrophysics, Bangalore

Abstract: Defocused Photometry is an extremely sensitive method which allows precision photometry with sub-milli magnitude accuracy. We report here on transits of two such systems (WASP-12 b and HAT-P-7 b), both of which are in short period orbits around their hosts. The extrasolar planet WASP-12 b, in orbit around WASP-12 (G0V), is a 1.41 0.10 MJ gas

giant with radius 1.79 0.09 RJ. The high effective temperature of the central star (6300 K) and short orbital period (1.09142 days) make WASP-12 b one of the most intensely irradiated extrasolar planets and one of the most well studied ones. The extrasolar planet HAT-P-7 b, in orbit around GSC 03547-01402 (F8V) is a 1.8 0.63 MJ ,1.42 0.144 RJ gas giant which is significantly less dense than Jupiter (0.62 J). With an orbital period of 2.2047299 4e-05 days, it is found to have a retrograde orbit, raising questions as to the origin and survival of the system. We report on 3 transits taken over a period of 14 months. Our observations reproduce the observed parameters of these two systems but suggest a timing variation.

11. **AMPLIFICATION OF SMALL SIGNALS USING WEAK MEASUREMENTS**

Anirban Ch Narayan Chowdhury

IISER Pune, Pune

Abstract: The notion of a weak measurement was introduced in the late 1980s by Aharonov et al as a modification of the von Neumann measurement scheme. In this scheme, we measure a particular property of a system by coupling to a known pointer device and then inferring the systems property from the resulting shift in pointer state. In the modified weak-measurement scenario, the system is first initialized in a particular state (pre-selection), followed by interaction with the pointer, and finally a detection of the system in a state that is different from the initial one(post-selection). The pointer shifts induced by this procedure can be much larger than that obtained by a standard measurement scheme. Therefore, weak measurements can be used to amplify and detect very small signals. This has been demonstrated experimentally, for example in detecting a tiny spin-hall effect, for measuring small deflections of a mirror in an interferometer etc. The initial device states used in weak measurements are typically Gaussians. We have shown that by using orbital angular momentum states, or Laguerre-Gauss modes as initial device states, it is possible to enhance the sensitivity (as measured by the signal-to-noise ratio) of amplification. This has been calculated approximately for weak measurement using a parametric-down-conversion(PDC) interaction, and exactly for observables of the type A2 = I in a Stern-Gerlach like setup.

12. **DESIGN AND DEVELOPMENT OF A LOW COST COMPUTERIZED LASER RAMAN SPECTROMETER AND REDUCING THE NOISE IN THE SIGNAL BY FUZZY LOGIC**

Akhileshwar Mishra, Sachin Pandey, Jewel Aggarwal, Abhishek Pandey, Sarim Ali, Vishakha Kashyap, Anshul Aggarwal, Ankur, Meenal Gupta, Akansha Kapoor, Ajay Arora, Priti Sehgal, Divya Haridas, K. Sreenivas

Keshav Mahavidyalaya, University of Delhi, Delhi 1Department of Physics & Astrophysics, University of Delhi, Delhi

Abstract: Raman spectroscopy provides key information about the structure of molecules and gives a characteristic fingerprint for chemical analysis. The theory of Raman spectroscopy is taught in theory classes for undergraduates but there is a perceived lack of suitable experi-

ments in the teaching laboratories that provide practical training. Thereby undergraduates are only cramming the concepts of Raman spectroscopy without understanding the importance of it despite being the fact that Sir C.V.Raman and Krishnan had done marvelous research in this field which had bought the Nobel Prize in Physics for India. Raman spectroscopy experiment at the undergraduate level in India is neither explained in detail, nor is the experiment done due to the lack of an inexpensive Raman spectrometer. Such equipment is still not available from commercial sources in India, and need to be imported. Research grade Raman spectrometers are available by importing at a huge cost, therefore the main problem in implementing Raman spectroscopy is its cost.

The aim in the present work is to design a low cost Raman spectrometer which would be indigenously designed for undergraduate students. The technique traditionally requires a grating monochromator, photomultiplier-tube detector, and an intense monochromatic light source. The spectrometer uses a green laser pointer (=532 nm) to illuminate the sample via a microscope objective. Backscattered Raman radiation is collimated by the same objective, green-laser light is blocked by a filter, and the remaining Raman radiation focused into a glass fiber that is connected to a visible spectrometer with a grating monochromator and a linear diode array CCD detector. Signals are transferred via the USB connection to a computer where the signals are processed and displayed. During data acquisition of the spectrum with CCD, noise superimposes on the signal. Image processing and fuzzy technique is used to remove the additive noise to extract the pure signal. It is a great challenge to develop algorithms that can remove noise from the image without disturbing its content. The neighborhood averaging and smoothing by image averaging are the classical image processing techniques for noise removal. Fuzzy logic provides the mathematical model for approximate reasoning, which mimics human reasoning and can be therefore very powerful. Hence we have used the concepts of fuzzy logic to remove noise and extract pure signal. Raman analysis of benzene and Carbon tetrachloride has been done successfully with our designed Raman spectrometer.

13. **ECO FRIENDLY PHYSICS**

Ruchi Srivastava, Vanita Srivastava, Rudrani Bhardwaj

M.P.G. College, Hardoi

Abstract: Now a days pollution and global warming are the biggest problem for the earth. Polluting environment has become our habits. Today the use of polymers, electronic equipments and other industrial products are causes of pollution our earth. Usually we think that science gives us a dirty and polluted atmosphere besides providing us great comfort but it is not true. Every coin has two faces, it depends on us that we see either head or tail. Likely, about use of science, it totally depends on its user whether they use it for good results or not. Today where the great industrial development pollutes air and causes global warming while physics also provides many techniques through which we can achieve our requirements without polluting or destroying the nature. Here we have some shown some techniques which can be used to

make physics eco-friendly.

14. **A STUDY ABOUT THREE COMMON FORMS OF PLASMA**

Honey Arora, Ramandeep Kaur and Parveen Bala

Department of Mathematics, Statistics and Physics,Punjab Agricultural University, Ludhiana

Abstract: We are surrounded by plasma, since 99% of the universe is in the plasma form. Our sun and all the stars are made of plasma, much of interstellar space and intergalactic space is filled with plasma. Plasma is the fourth state of matter other than solid, liquid and gas. Plasma is a quasi-neutral medium of positive and negative particles which responds strongly to electromagnetic fields. Although these charged particles are unbound, these are not free. When these charges move they generate electrical currents with magnetic fields, and as a result, they are affected by each other's fields, that is we can say that they show collective behaviour. We live in 1% of that universe which is not actually plasma. The reason being high temperature conditions required for its quasi-neutral existence. The common forms of plasma include artificially produced, terrestrial plasmas and space and astrophysical plasma. Artificially produced plasmas are found in plasma displays, inside fluorescent lamps, plasma balls etc. Terrestrial plasmas include lightning, sprites, polar aurorae etc while space and astrophysical plasmas includes solar wind, interstellar medium, intergalactic medium, interstellar nebulae etc. In this presentation, a study of these forms of plasma has been conducted and explained with the help of pictures.

15. **RELATIVISTIC APPROACH AND DE BROGLIE HYPOTHESIS**

Dnyanesh Tikhe and Mayur Arsade

KZS Science College, Nagpur, Maharashtra

Abstract: The matter wave concept found by de Broglie can be applied to photon, electron, neutron, atom and molecule. Evidence of wave nature of macroscopic objects can never be seen. The group velocity of matter waves related to relativistic particle and non relativistic particle can be calculated using de Broglie hypothesis.

16. **MOTION**

Vijayakumar Gidad,, Karibasaiah Devaramane and Mithun

Laxmi Venkatesh Desai college Raichur, Karnataka

Abstract: The world is filled with things in motion, things as small as dust and as large as galaxies, all are continually moving. Your book may seem to be lying quietly on the desk, but each of its atom is constantly vibrating. The still air around you consists of molecules tumbling wild at various speeds, most of them moving as fast as rifle bullets. Light beams dart through the room covering the distance from wall to wall in about a hundred millionth of a second and making about ten million vibrations during that time. The whole earth, our spaceship itself, is moving at about 29 km/s around the sun.

17. **PERMANENT MAGNET- THE SUPER BATTERIES**

Ramanpreet Singh

Department of Physics, Panjab University, Chandigarh

Abstract: Arranging magnets on rotor system in such a way that magnets on rotor are repelled and continuous rotational motion is obtained and that motion can be used to obtain electricity through generators. Energy obtained from system will cause loss in magnetization of magnets, which is very less ranging from 10 to 100 years. Thus, the super batteries.

18. **IMPROVING EFFICIENCY OF BUILDING AIR CONDITIONERS USING PEOPLE COUNTING SENSORS**

Vishal Goyal

Department of Physics, Panjab University, Chandigarh

Abstract: Prototype of People counting sensors based control for Building Air conditioner is developed and discussed and improvement of efficiency is also discussed. Every human entity emits an approximately definite amount of heat energy to atmosphere, which disturbs temperature equilibrium made by Air conditioner. So we prototyped a control to Air conditioner based on people in area.

19. **NEGATIVE INDEX META MATERIALS**

Anjali, Neha, Maninderjeet Kaur

Department of Physics, Panjab University, Chandigarh

Abstract: We will be presenting the concept of NEGATIVE INDEX METAMATERIALS in our poster, which was introduced by Russian Physicist, Vaselago, in 1967. Negative index metamaterials are the materials with negative refractive index due to simultaneous negative permittivity and permeability in a certain frequency range. These materials have various properties different from the normal (positive index) materials like reversed Snells law, reversed Doppler effect, obtuse angle Cherenkov radiation etc. Negative index metamaterials also have varied applications like with these materials resolution below diffraction limit becomes possible. Other potential applications for negative index materials are soltions, optical nanolithography, nanotechnology circuitry, as well as a near field superlens that could be useful for biomedical imaging and subwavelength photolithography. Also electromagnetic waves travel differently in these materials which earn them a name left handed materials. So our poster will include some basic theory regarding metamaterials, the various properties distinguishing metamaterials from, basic wave propagation characteristics in these media and their applications.

20. **FLEXIBLE ELECTRONICS**

Nitisha Sharma and Anurag Seth

Department of Physics, Panjab University, Chandigarh

Abstract: Imagine the world with computers as thin sheet of paper, iphones which can be

folded, skullcaps which can sense force of impact on an athletes head, and extremely small sized sensor stickers which can measure your body temperature! No one would have ever thought of printing big circuits on just a thin sheet of insulator until the discovery of the core of the todays electronic technology, i.e. Printed circuit boards (PCBs), in early 20th century. These have not only reduced the size of the big wire wrap circuits but also the operating voltage required for them. It is hard to satisfy humans curiosity! Now we wish to incorporate the whole circuitry including electronic components and conducting path ways on a flexible insulated substrate. All these can now be made possible with the very new technology called Flexible electronics on substrate such as transparent conductive polyester film using Photolithography. Due to the introduction of this technology, long existed problems like limited space or board thickness, in electrical connections where space is the deriving factor can be effectively managed. Through this poster presentation, we would like to share this new interesting and highly appreciable technology, and its implementation.

21. **FORCE SENSORS AND ITS APPLICATIONS**

Richa and Kavita

Department of Physics, Panjab University, Chandigarh

Abstract: I will present poster on some applications of electronic sensor an method of how to improve accuracy of experiments performed in labs. Lets take an example of experiment determination of the co-efficient of viscosity of various liquids by using Strokes method it can be made more accurate using electronic sensors. We use stop watch to measure the time that the steel ball takes to travel certain vertical distance. This may include manual errors and the results will not be accurate. If we use sensors, errors will be reduced to much lower value or it may include no error at all. So in the poster such sensors and their working will be discussed with their more useful applications.

List of Oral Presentations

S.No.	Author(s)	Title
O-1	Nandita Chaturvedi	The Dynamics Of Falling Paper
O-2	Tabish Shilbi	Quantum key distribution
O-3	Nisha Narasinha Kelkar	A laser based low cost technique to measure cell size
O-4	Chiranjit Mitra, Bapun Kumar Giri, P.K. Panigrahi and A.N. Sekar Iyengar	–

O-5	S. Anil Purohit	Construction of optical bench to calculate and verify optical parameters
O-6	PTS College Science, Surat	Aurora borealis
O-7	Chimnay Manoj Kolhatkar	Automatic street light control system
O-8	Sanmoy Mondal	Understanding the trajectory of an electron under the influence of magnetic field using bohmian machinery
O-9	S. Hui, Dr.B. R Sekhar	Valence band study of poly crystalline silver sample using ultraviolet photoelectron spectroscopy
O-10	Kartika N. Nimje	Influence of static magnetic field on the growth of plants
O-11	Nishant Gupta	Is universe really baryon asymmetric?
O-12	Monu Sharma and Varun Sharma	Rogue waves
O-13	Abhinna Kumar Behera, A.N. Sekar Iyengar, and Prasanta K. Panigrahi	Correlation and periodicity in a bouncing ball motion through wavelets

List of Poster Presentations

S.No.	Author(s)	Title
P-1	Amanjot Kaushal, Kanupriya and P.S. Tarsikka	Temperature dependent electrical conductivity of guava juice during ohmic heating
P-2	Honey Arora, Ramandeep Kaur and Parveen Bala	Formation of planetary systems: a study reviewing formation and evolution
P-3	Saba Hasan Ansari and R.V. Dabhade	Estimation of age of cluster m67

P-4	Sherry Chhabra	Determination of magnetic field strength of white dwarfs using spectroscopic data
P-5	Supriya Suhas Date	Comparative study of acoustics of auditorium and temple
P-6	Nitika Goyal, Monika Karday and Rajeev Kumar	Cp violation at kek b-fectory
P-7	Sourav Jain	Cosmic ray setup using plastic scintillator detector for testing efficiency of resistive plate
P-8	Neha Goyal and Parveen Bala	iteras future source of energy
P-9	Chetan Thakur	Prediction of variable stars as binary star in comparison with the binary star algol
P-10	Asmita Bhandare and Firoza Sutaria	Study of transiting exoplanets wasp-12 b and hat-p-7 b
P-11	Anirban Ch Narayan Chowdhury	Amplification of small signals using weak measurements
P-12	Akhileshwar Mishra, Sachin Pandey, Jewel Aggarwal, Abhishek Pandey, Sarim Ali, Vishakha Kashyap, Anshul Aggarwal, Ankur, Meenal Gupta, Akansha Kapoor, Ajay Arora, Priti Sehgal, Divya Haridas, K. Sreenivas	Design and development of a low cost computerized laser raman spectrometer and reducing the noise in the signal by fuzzy logic
P-13	Ruchi Srivastava, Vanita Srivastava, and Rudrani Bhardwaj	Eco friendly physics
P-14	Honey Arora, Ramandeep Kaur, and Parveen Bala	A study about three common forms of plasma
P-15	PTS College Science, Surat	Magnetohydrodynamics theory
P-16	Dnyanesh Tikhe And Mayur Arsade	Relativistic approach and de broglie hypothesis
P-17	Vijayakumar Gidad, Karibasaiah Devaramane and Mithun	Motion

P-18	Ramanpreet Singh	Permanent magnet- the super batteries
P-19	Vishal Goyal	Improving efficiency of building air conditioners using people counting sensors
P-20	Nitisha Sharma and Anurag Seth	
P-21	Anjali, Neha, Maninderjeet kaur	Negative index meta materials
P-22	Richa and Kavita	Force sensors and its applications

About IAPT

A voluntary organization of Physics Teachers (at all levels), Scientists, professionals and other interested in physics (Science) education in the country

Indian Association of Physics Teachers (IAPT) was established in 1984 by dedicated physics teacher and visionary (Late) Dr. D.P. Khandelwal with active support from likeminded features with the aim of upgrading quality of physics teaching at all level in the country. Since then it has grown into a major organisation with about 6000 members spread over throughout the country and abroad, besides annual members, student members and sustaining members. All IAPT work in voluntary, no remuneration is paid to members for any IAPT activity.

The Association operate through its 20 Regional Councils (RCs) grouped into 5 zones. These is a central Executive Council (EC) which controls and coordinates all its activities.Regional Councils also have a similar structure.

Current Activities of IAPT

Publications

- **Bulletin** a monthly (32 pages) with the record of uninterrupted publication since 1984. Besides reporting IAPT activities it also carries articles on developments in physics and physics education. Free to the members, it also serves as a vehicle of expression and communication amongst them.
- **Journal of Physics Education** The IAPT has taken over the publication of this quarterly (previously published by UGC) publication since April 2001 (volume 18). Life members of IAPT can get it at concessional rate. It carries research articles on Physics education.

- **Prayas** A quarterly journal carries out articles and research reports by UG/PG students. It also carries invited articles from physicists of repute, now rechristened as Student Journal of Physics.

- **Pragami Trang** This bilingual (Gujarati & Partly English), has been started since 2009 by Gujarat RC. Horizons of Physics In a book series brought out for physics teachers and students. Each volume contains about 15 review articles written by experts, taking off from the B.Sc. level and leading to the frontiers of the field.

National Standard Examinations

National Standard Examinations are held at 3 levels with the objectives: to enable the student judge him/herself against a national standard; to present correct perspective of physics; to enhance the students-teacher interaction through discussion on the Q-paper. Members or students are identified, duly honoured and awarded medals and token prizes. These examinations constitute the first step towards participation in International Olympiads in respective subjects. The responsibility of selecting and sending the Indian team to the international Olympiads rests with the Homi Bhabha Centre for Sciences Education (HBCSE) with whom IAPT works in close collaboration.

Evaluation of experimental skills

IAPT started this evaluation with NSEP and NGPE, examinations since 1992, essentially to stress the point that no evaluation of a science student is complete without inclusion of an evaluation of experimental skills.

Extra Low-Cost Book (ELCB) programme

Under this programe life members are offered quality physics books at a considerable discount, under arrangement with publishers. The aim is to help teachers build up their personal libraries.

For teachers

- **National Competition for Innovative Experiments in Physics (NCIEP)**: This programme is being held since 2003, to encourage Physics Teachers to conceive and set up original innovative experiments in Physics. The Competition is held every year at the venue of The Annual Convention. The high quality of entries shows the usefulness of the programme.

- **National Competition for Computational Physics** (started 2011). Essay Competition: Gujarat RC of IAPT organizes a National Essay Competition for all teachers for the last few years.

- **Anveshikas (Experimental Physics Centres)** : The first such centre was established at SGM Inter College, Indira Nagar, Kanpur in 2001. It provides a base for generating interest in

Experimental Physics in young students. upto +2 level through learning by doing. Facilities exist for conducting Teachers Orientation Programmes for encouraging them to undertake class room teaching through demonstrations. A mobile unit gives demonstrations in schools by prior appointment. Each demonstration session is of about 2-3 hour duration. This programme generates interest is students for Physics and clarifies the basic principles. A number of such centres are now coming up in the country.

- **National Anvashika Network of India (NANI)**: It has been decided to establish a National Anvashika Network of India (NANI) of 100 Anveshikas. Already (2011) nearly 15-20 Anveshikas have come into existence others are in the offering.

- **Centre for Scientific Culture (CSC)**: The Centre established at Midnapore CoIlege, Midnapore (WB), provides an year round exclusive facility, of working experiments in Physics. It is also engaged in developing laboratory experiments exercises in physics at school level.

Orientation Programmes/Seminars/Workshops for Teachers

These are organised regularly by Regional Councils in both, theoretical and Experimental Physics. A number of such programmes have been carried out with the support from MHRD, Infosys Foundation and other such agencies.

Conventions

A 3-day National Convention is organised every year, since 1984 on some specific theme. Papers are presented by members and lectures are delivered by experts in the field. Presentation of innovations in teaching methods, demonstrations and lab experiments is a regular feature in all conventions.

Regional Councils also organise regional conventions at their convenience. Teachers talent in various aspects of Physics education is identified and rewarded by organizing contests during conventions.

About Department of Physics, PU

The Department of Physics was established in 1947, in Govt. College, Hoshiarpur (Punjab). In August 1958, the department was shifted to the present campus. At that time, the department was headed by Prof. B.M. Anand who had worked with Nobel laureate C.F. Powell. The faculty numbered about a dozen and Prof. Anand soon established a high-energy particle physics group (nuclear emulsion) and optical UV spectroscopy group. The experimental nuclear physics group and mass spectrometry section came into existence soon after. With Prof. H.S. Hans joining the department in the late sixties, the research activities got a major fillipcyclotron was installed. Three major research groups in nuclear physics, particle physics and solid-sate physics including both

theory and experiments were strengthened and mass spectroscopy laboratory was modernised. Since then the department never looked back. It has UGC Special Assistance Programme (SAP) from 1980 to 1988 and College Science Improvement Programme from 1984 to 1991. With the success of the above programs and of research activities in particle physics, nuclear physics and solid-state physics through national and international collaborations, the department became a major research centre amongst Indian universities.

In 1988, the department was accorded the status of Centre of Advanced Study (CAS) by UGC with three major thrust areas, particle physics, nuclear physics and solid-state physics, which is a unique feature in itself. The department is now in CAS forth phase. At present the department has a strength of 29 faculty members, 47 non-teaching/administrative staff, around 120 research students, 15 M.Phil. students, 10 Post-M.Sc. Course in Accelerator Physics students and about 350 graduate and undergraduate students. Our students clear various entrance examinations, like GRE, BARC, TIFR, DRDO, UGC/CSIR test for research and career in teaching, besides entering professional courses, like M.Tech., MCA, etc. About 30 research projects worth eight crore rupees under national/international collaborations are operating in the department.

Besides imparting quality education to the department students, the faculty also teach specialisation subjects, like nano-technology, nuclear medicine and medical physics to name a few.

The department participates in various national and international research initiatives and also hosts various conferences, seminars, meetings etc. of research interest regularly. The department has an 11-inch telescope to encourage/inculcate the scientific temper among public and with particular emphasis on college and school students. The department houses Indian Association of Physics Teachers (IAPT) office and actively leads in IAPT and Indian Physics Association (IPA) activities.

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- Department of Physics, Panjab University, Chandigarh
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- Punjab State Council for Science & Technology, Chandigarh
- Prof. S.D. Mahanti, Michigan State University, USA
- OST Electronics Limited, Chandigarh
- Pyramid Electronics, Parwanoo

APPENDIX I: COMMITTEES

National Advisory Committee

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The list includes some teachers and others who registered

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The Dynamics of Falling Paper

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Abstract.

We discuss how a mathematical model based on three simple forces; gravity, lift and drag, captures the complex behaviour of falling paper. While work of this kind has been done before[9], we make the model more realistic by introducing a new drag model. We also subject the model to experimental verification. Estimates for the values of frictional coefficients for the paper-air system are determined through an indirect experiment using scaling and geometry arguments. We find that for the frictional coefficients determined, the model provides a sound quantitative description of the path of a falling paper. Finally, we make predictions for the behaviour of the paper in different fluids by varying drag coefficients.

1. INTRODUCTION

Paper, as it falls through air under the influence of gravity, follows complex and seemingly unpredictable paths. The rich dynamics of its motion has inspired several theoretical and experimental studies.

Models proposed to desribe its behaviour follow one of two main methods. In the first, the object's motion is described by studying the behaviour of the fluid itself. For this, one of the several forms of the Navier-Stokes equations is solved numerically with respect to the boundary conditions of the system [7] [3]. In the second, laying less emphasis on the fluid itself, the path is determined by numerically solving the object's equation of motion.

In their model [9], Kaneko and Tanabe follow the latter method. Three forces are considered—gravity, lift and drag. However, the drag model used in [9] is unrealistic for the paper-air system [6] and has not been verified via experiment. Other experimental studies have been carried out for fluids such as water or glycerine [1] [4] with higher densities and viscosities.

We are specifically interested in studying the motion of paper in air. We introduce a new drag model, proportional to square of velocity, and conduct an experiment to test it. The values of frictional coefficients cannot be determined by making measurements directly for paper. The lift force on paper is significant and this leads to a complex dependence of velocity and position on the object's rotation. We calculate the frictional coefficients indirectly, by first making measurements for a heavier object. For a heavier object, lift force may be neglected as it is inversely proportional to mass, and its path is a simple fall. Frictional coefficients are numerically back calculated from

experimental measurements. Using scaling arguments, we calculate the frictional coefficients for paper. We substitute these values in the simulations and test the validity of the model.

2. THE MODEL

We describe the system using the paper's equation of motion assuming that the paper is subjected to three main forces– gravity, drag and lift. To simplify the problem, we work in only two dimensions and ignore elastic deformations in the paper. The paper is modelled as a rigid line characterised by two quantities; length, l and mass, m.

The coordinates of its centre of mass are given by (x, y), u and v denote its velocities in the x and y directions respectively. Let θ be the angle the paper makes with the positive x direction and ω the angular velocity of the paper about its center of mass.

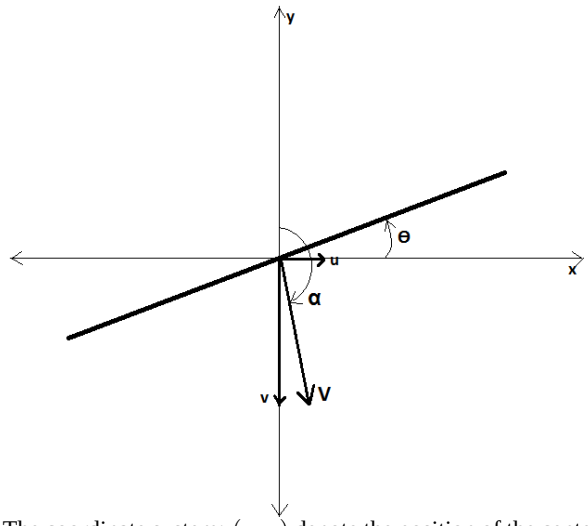

Figure 1. The coordinate system: (x, y) denote the position of the center of mass, and θ is the angle the paper makes with the positive x axis. V is the velocity of the paper, with components u and v in the x and y directions, respectively. The angle α is made by the velocity vector and the positive y direction.

The system we are trying to model has a Reynolds number given by

$$\Re = \rho_f v l/\eta. \tag{1}$$

At 30° C, density of air ρ_f is of the order of $1kg/m^3$, velocity of the object v is about $1m/s$, length of paper l is of the order of 10^{-1} m and viscosity of air η is around 10^{-5} kg/m s. Substituting these values, we find that $\Re$ will be of the order of 10^5.

At high values of Reynolds number such as 10^5, drag force is best modelled as proportional to the square of velocity of the object

$$F = \frac{1}{2} C \rho_f A V^2 \tag{2}$$

Here, A is the effective area of the object perpendicular to the flow, and C is a constant that depends only on the shape of the body. In terms of frictional coefficient per unit mass, k

$$F = mkV^2. \tag{3}$$

Where

$$k = \frac{C\rho_f A}{2m}. \tag{4}$$

Since drag depends on the area of the body transverse to the direction of flow, we introduce two such constants, $k_\perp$ and $k_\parallel$. When the fluid flow is perpendicular to the plane of the paper, $k_\perp$ is the relevant frictional coefficient and drag force is given by $F_\perp = mk_\perp V^2$. Using these two coefficients, the velocity of the fluid is easily split into components parallel and perpendicular to the plane of the paper. The drag forces in the x and y directions are thus

$$F_x = mV[-(k_\perp sin^2\theta + k_\parallel \cos^2\theta)u + (k_\perp - k_\parallel) sin\theta \cos\theta v], \tag{5}$$

$$F_y = mV[-(k_\perp sin^2\theta + k_\parallel \cos^2\theta)v + (k_\perp - k_\parallel) sin\theta \cos\theta u]. \tag{6}$$

So far we have modelled the force the fluid exerts on the paper parallel to the direction of flow. The force the paper feels in a direction perpendicular to the direction of flow, lift, is usually modelled using the Kutta Joukowski theorem. When the theorem is applied to the system in question, the lift in the x and y directions, and the torque acting on the paper are obtained as

$$Ł_x = \mp l\rho_f \pi V^2 \cos(\alpha+\theta)\cos\alpha, \tag{7}$$

$$Ł_y = \pm l\rho_f \pi V^2 \cos(\alpha+\theta)\sin\alpha, \tag{8}$$

$$\tau = -l^2 \rho_f \pi V^2 \cos(\alpha+\theta)\sin(\alpha+\theta)/4. \tag{9}$$

Here, $V^2 = (u^2 + v^2)$ and $\alpha = \tan^{-1}(u/v)$ is the angle between the velocity vector of the paper and the positive y direction. The upper signs are valid in the conditions ($v < 0$ and $0 < \alpha + \theta < \pi$) or ($v > 0$ and $-\pi < \alpha + \theta < 0$) while the lower signs are valid if ($v > 0$ and $0 < \alpha + \theta < \pi$) or ($v < 0$ and $-\pi < \alpha + \theta < 0$) .

The gravity, lift and drag forces may be put together to get the following equations of motion.

$$\dot{u} = -(k_\perp sin^2\theta + k_\parallel \cos^2\theta)Vu + (k_\perp - k_\parallel) sin\theta\cos\theta V v \mp \pi\rho V^2 \cos(\alpha+\theta)\cos\alpha, \tag{10}$$

$$\dot{v} = (k_\perp - k_\parallel) sin\theta\cos\theta V u - (k_\perp \cos^2\theta + k_\parallel sin^2\theta)Vv \pm \pi\rho V^2 \cos(\alpha+\theta) sin\alpha - g, \tag{11}$$

$$\dot{\omega} = -k_\perp \omega - 3\pi\rho V^2 \cos(\alpha+\theta)\sin(\alpha+\theta), \tag{12}$$

$$\dot{\theta} = \omega, \tag{13}$$

where $\rho = \frac{\rho_{\text{fl}}}{m}$ is the ratio of the density of the fluid to that of the paper.

3. EXPERIMENT

Through the above model, we may study the motion of paper sheets of various dimensions. For this study, we restrict our attention to strips of thick paper (business cards) with length, l_p = 12 cm, width, w_p = 2.7 cm and thickness, t_p = 0.29 mm. Since $k_\perp$ and $k_\parallel$ are arbitrarily added constants, an estimate of these for the air-paper system is required. For this, an experiment was carried out.

From equation (4),

$$k_\perp = C\rho_f A_\perp/2m, \tag{14}$$

$$k_\parallel = C\rho_f A_\parallel/2m. \tag{15}$$

Thus, the two frictional coefficients, $k_\perp$ and $k_\parallel$ only differ because of the different reference areas, $A_\perp = l_p w_p$ and $A_\parallel = w_p t_p$ respectively. We may then write

$$k_\parallel = (A_\parallel/A_\perp)k_\perp \tag{16}$$

Thus, we only need to determine $k_\perp$, and $k_\parallel$ will automatically be fixed. For the paper strip taken, $A_\perp/A_\parallel = 100$.

We aim to determine the frictional coefficients for the paper-air system by measuring the paper's time of descent, then back calculating their values numerically using the simulation. However, it is not possible to do this directly for paper. Lift force acting on paper is large and this causes its path to be complex. The paper rotates and flutters as it falls. We choose to determine $k_\perp$ for the paper indirectly, by first determining it for an object with simpler motion. A plastic ruler was chosen for this purpose. Due to the larger mass of the ruler, the ratio of fluid density to object density, ρ is much smaller. This causes the lift force on the ruler to be negligible. Thus, the only forces on the ruler are gravity and drag and the ruler undergoes a simple perpendicular fall.

Let l_r, w_r, t_r be the length, width and thickness of the ruler. m and m^* are the masses of the paper and ruler respectively and $k^*_\perp$ is the perpendicular coefficient of friction for the ruler. $A_\perp = l_p b_p$, $A^*_\perp = l_r b_r$ are the areas of the paper and the ruler respectively. From equation (4) we obtain

$$k_\perp m/A_\perp = k^*_\perp m^*/A^*_\perp = C\rho_f \tag{17}$$

Using this relation, we may obtain the coefficients for paper if coefficients for the ruler are known.

We measure the time of descent of the ruler and then back calculate the values of frictional coefficients numerically using the simulation.

Table 1. Time of Descent.

Distance(m)	Time(s)
2.330	0.83
2.330	0.85
2.330	0.87
2.330	0.85
2.330	0.84

The ruler was hung using a thread with its plane parallel to the ground. Its height from the ground was measured to be 2.330 m using a meter tape. To avoid disturbing its orientation, the ruler was dropped by burning the thread above it using a candle. An ordinary stop watch was used to measure time of descent. It was observed that the ruler undergoes a simple fall, with no rotation. Further, its motion in the x direction amounts to only a few centimeters as it falls through a distance of 2.330 m in the y direction. A sample of the observations taken is given in Table 1.

The dimensions of the ruler are $l_r = 15.90$ cm, $w_r = 2.70$ cm, $t_r = 0.9$ mm. However, since each reading of time has a large error of about 0.1 s due to reaction time, we take time in the range 0.75–0.95 s. These values were substituted into the simulation to determine the value of $k_\perp^*$ for which the object fell through 2.33 m in the given time range. As there was no rotation, we put $\dot{\omega} = 0$ by hand. It was observed that the condition was satisfied for $k_\perp^*$ in the range 0.7– 0.9.

Using equation (16) we obtain $k_\perp$ to lie in the range 2.1–2.7.

4. SIMULATION

Since we have confirmed the validity of the model, we may now make predictions for the behaviour of the paper in different fluids. Using $\rho = 0.3$ and $l = 0.12$, when the simulations are run, mainly two main regimes of motion emerge.

For $k_\perp < 0.16$, rotation or tumbling of the object is observed. The object initially flutters with an increasing maximum value of θ, θ_m, till its value reaches $\pi/2$. At this stage, the object begins to tumble. It is noted that as $k_\perp$ is increased steadily from 0 to 0.16, the switch from flutter to tumble is successively delayed. At$k_\perp = 0.01$, tumbling starts at about 0.8s while at $k_\perp = 1.5$, tumbling does not set in till around 2.8s. At 1.6, the object does not rotate and flutters with a constant amplitude after transients have died out.

For $0.16 < k_\perp < 5.1$, we observe a regular fluttering motion. However, θ_m decreases as $k_\perp$ is increased. At $k_\perp = 1.6$, θ_m is 1.52 radians. At 1.0, it decreases to 0.80 radians and 0.77 radians at $k_\perp = 1.5$. As $k_\perp$ is increased still further, θ_m begins to slowly increase again. At $k_\perp = 2.0$, it increases to 0.80 radians again. The value of θ_m reaches 1.0 radian at $k_\perp = 4.5$, and steadily keeps increasing.

It is observed that as $k_\perp$ is increased, it takes more time for the paper to achieve regular oscillations. The amplitude of oscillation, bot of θ and the x coordinate increases for a longer time before becoming constant.

When $k_\perp > 5.1$, it is observed that the paper does not achieve constant amplitude. Amplitudes of both θ and x increase till a certain value followed by a sudden change in the x coordiate. It is observed that the paper undergoes oscillation about this new mean value of x. Motion is then characterised by periodic fluttering about different mean positions seperated by sudden changes in x.

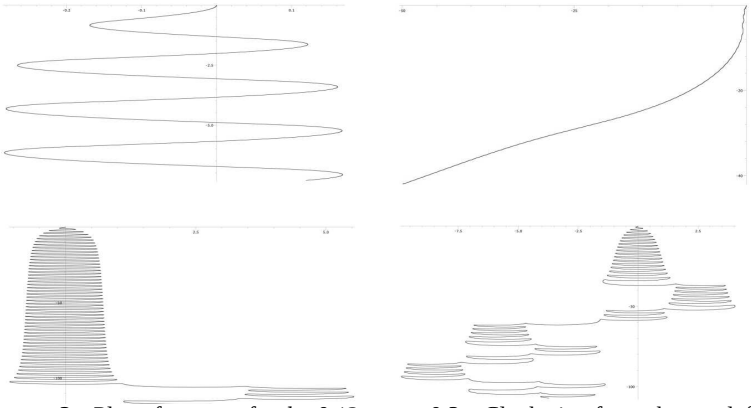

Figure 2. Plot of y vs x for l_p=0.12m, ρ =0.3. Clockwise from the top-left: At $k_\perp = 2.6$ regular fluttering motion is observed. At $k_\perp = 0.13$ the paper shows rotation while steadily moving towards one side. The last two plots are for $k_\perp = 5.1$ and $k_\perp = 6.2$ respectively.

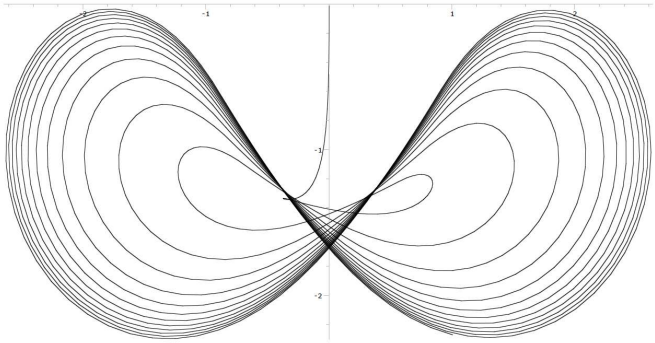

Figure 3. Plot of v vs. u at $k_\perp = 5.0$, $l_p = 0.12m$, $\rho = 0.3$

5. Conclusion

The model in [9] was improved with the introduction of a more realistic drag model. We conducted an experiment to determine the values of frictional coefficients for the paper- air system. Using the relevant values and the results of a computer simulation, the validity of the model was tested. It was found that the model is successful in qualitatively reproducing the behaviour of a falling paper. Lastly, we made predictions about the paper's behaviour in fluids with different values of drag.

Acknowledgements

I am grateful to Dr. A. D. Gangal for encouraging me to work on this problem, and thankful to Mr. Archishman Raju for several useful discussions. I acknowledge support from a KVPY fellowship.

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Laser Based Low Cost Technique to Estimate Onion Cell Size

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Abstract.

It has been observed that periodic structure of plant cells effectively acts as a diffraction grating. The grating element of such system is obtained optically by shining the plant cells particularly in Onion peel by LASER. The measurement of diffraction pattern results into estimation of the cell size of the periodic plant cell structure. This paper attempts to report variation in cell size of onion from core to outward petals. The effect on the size of the cells during the treatment of onion with pesticide is also reported.

Keywords. Diffraction, Plant Cell, Laser.

1. INTRODUCTION

The plant physiology starts with study of plant cells. The cell is basic structural and functional unit in any living organism. Plant cells have three additional structures not found in animal cells; cell wall, vacuoles, and plastids that are important to plant function. The plant cells have periodic structure. Cells are covered by a rigid cell wall that lies outside the membrane. This cell membrane is nearly transparent and sandwiched between adjacent cells. The rigidity of cell walls helps to support and protect the plant cell. Thus, the estimation of cell size is basic requirement of study of plant cell structure. Study of growth rate, osmosis, photosynthesis etc. requires the knowledge of cell size. [2] The microscopic view of cell sample reveals that the cell walls are opaque to light and middle membrane is nearly transparent to light. The cell wall has dimensions of the order of 10-10 m. which is comparable to wavelength of light. Because of these features, the plant cell structure acts as diffraction grating; in particular transmission grating. When we shine it by LASER light the diffraction pattern is obtained. In life sciences various techniques like oculometry are used to estimate the size of cell. These techniques are complicated as well as time consuming. Since plant cell structure acts as diffraction grating, we can estimate the size of cells by diffraction technique. We employed a novel LASER based diffraction method to estimate the cell size.

2. DIFFRACTION AND DIFFRACTION GRATING

2.1 Diffraction

The bending of waves around the edges of An Obstacle is called as diffraction. [1]

2.2 Diffraction Grating

Diffraction grating consists of large number of parallel, narrow and evenly spaced slits. Typical gratings have hundreds or thousands of slits per unit length. We can calculate the separation using relation

$$d \sin = n\lambda \tag{1}$$

Where n is order of maximum, λ is the wavelength of light and $\sin$ is the angle subtended by the n^{th} order maximum with central maximum, d is the separation between slits. [1]

2.3 Plant Cell as Grating

The periodic cell structure of plant acts as grating. In natural condition middle part of cell is transparent to light and walls of cell are opaque [2]. These cell walls act as obstacle for light, when cell structure is shined by laser the diffraction pattern.

3. PHOTOGRAPHS

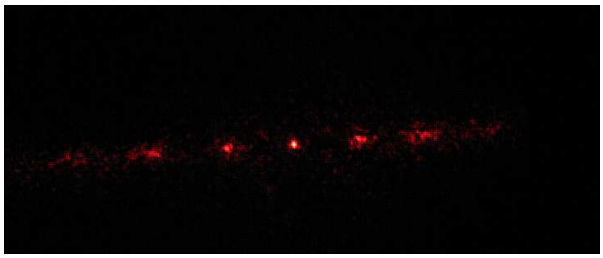


Figure 1. Photographs of diffraction grating and diffraction pattern.

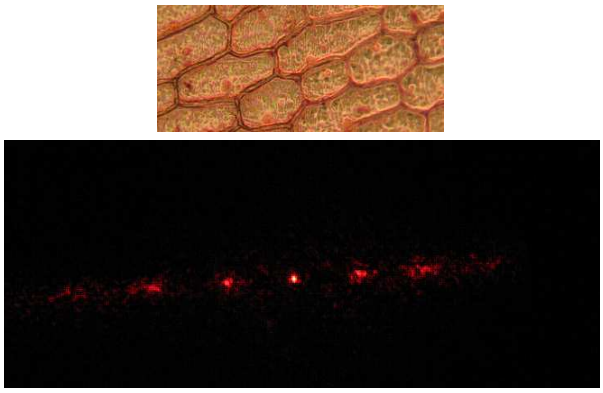


Figure 2. Photographs of plant cell diffraction grating and diffraction pattern.

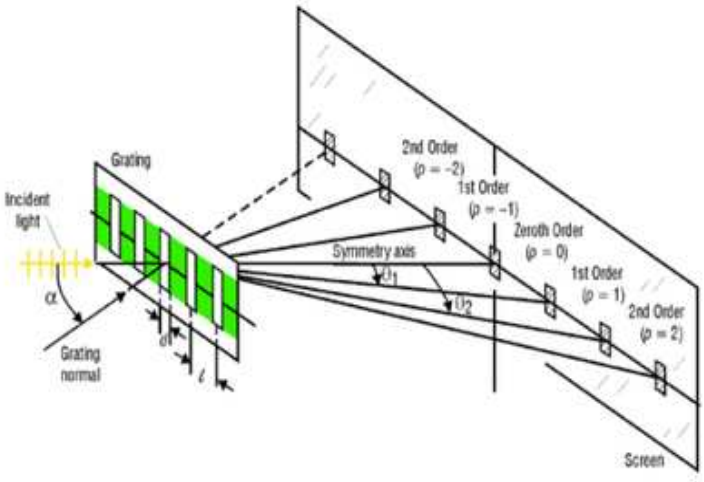


Figure 3. Schematic representation of diffraction experiment.

4. EXPERIMENTAL PROCEDURE

4.1 Preparation of Diffraction grating using Plant Cell

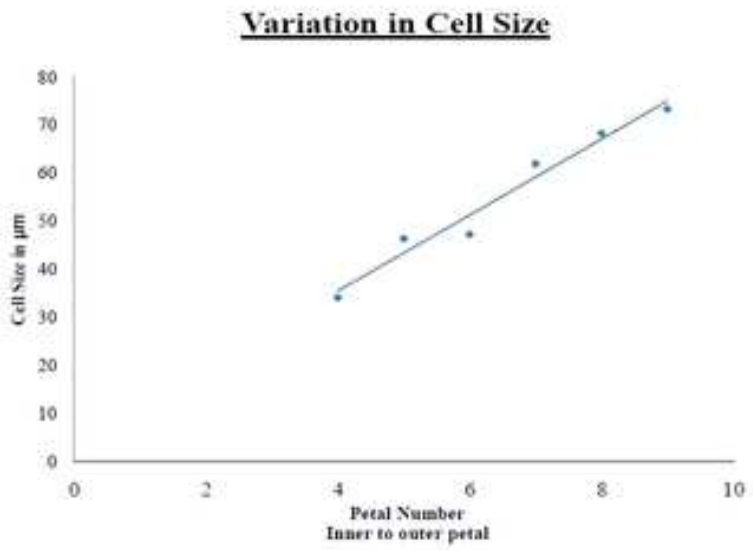
We used peel of onion cell to construct plant cell diffraction grating. The slide of cell samples is made by taking proper precautions.

4.2 Set up and Measurements

This plant cell diffraction grating is shined by laser and the diffraction pattern is recorded on the screen as shown in Fig1.1. The angle subtended by the nth order maximum with central maximum is calculated using simple geometry of diffraction pattern recorded on the screen. Then using Eqn (1) size of the cell is calculated.

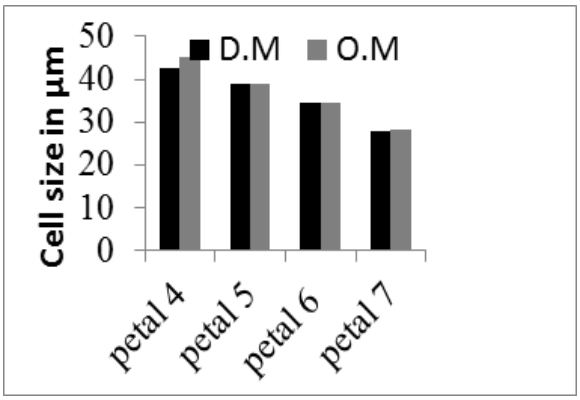
5. OBSERVATIOS

5.1 Variation in cell size from inner to outer petal



Petal No. (Inner to outer)	4	5	6	7	8	9
Mean Cell Size in μm	34.1	46.4	47.3	62.0	68.3	73.4

5.2 Comparative representation of oculometric and LASER diffraction measurements of cell size



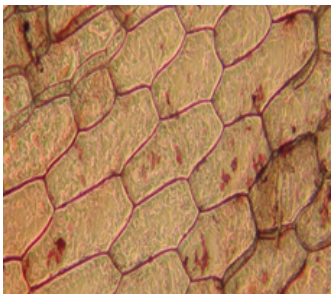
Petal Number (Inner to outer)	4	5	6	7
Cell Size using Diffraction in μm	42.52	38.85	34.64	27.82
Cell Size using oculometer in μm	45.15	38.15	34.53	28.10

6. APPLICATION

6.1 Effect of Pesticide on Cell Size

The onion cell samples are treated with pesticide Chlorpyrifos. Chlorpyrifos pesticide is a toxic organophosphate. After treatment, plant cell diffraction Grating is prepared.And; the diffraction patterns are observed and recorded on the screen. With the help of simple geometry we calculated angle ’. Finally, the cell size is estimated using eqn (1).

6.2 Comparison of cell size between untreated onion and onion treated with pesticide.



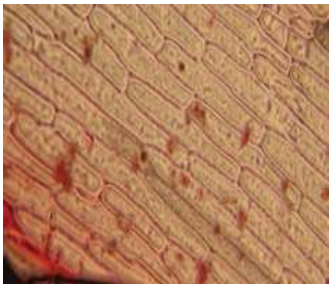


Figure 4. Microscopic view of untreated and onion treated onion.

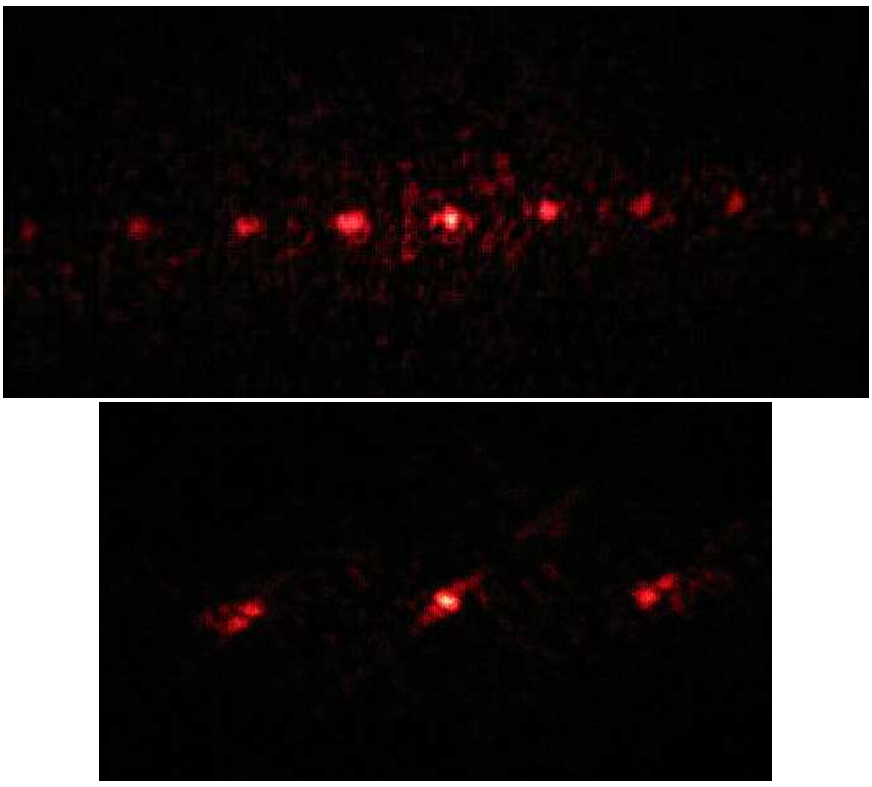


Figure 5. Diffraction patterns of untreated onion and treated onion.

7. RESULT AND DISSCUSION

The diffraction technique can be used to estimate the cell size of biological samples. The results obtained by LASER diffraction technique are in good agreement with the results obtained by Oculometric technique. The cell size increases linearly from inner petal to outer petal of onion which is in accordance with theory of grown plant cells. The diffraction pattern of treated onion cell sample changed significantly therefore, pesticide alters the cell size. The pesticide penetrates inside treated

onion, up to the fourth inner most petals. In the fourth petal (inner) decrement in cell size is about 20% and for ninth petal (outer) decrement is about 40%. The variation in cell size is not linear after the treatment.

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Comparative Study of Acoustics of Auditorium and Temple

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Abstract.

Now a days temples and auditoriums are built as per acoustics science with the help of modern technology. But in old era auditoriums, temples were found in dome structure. We have made an attempt to do comparative study of old structures and new structures of auditorium and temple.

An auditorium is considered to be good if it has flat frequency response over all audio frequencies. To study the acoustics of auditorium and temple we have beamed sound signals having frequencies corresponding to notes SA, PA, and NI of the middle octave. Sound intensity at various positions in the auditorium and temple were recorded separately.

The analysis shows that modern auditorium as well as old temples have fairly flat frequency response, which indicates that even the old temple were acoustically good.

Keywords. Acoustics, Dome structure, Auditorium, Temple.

1. INTRODUCTION

Success of a musical program in an auditorium not only depends upon the skills of the performers, quality of the musical instruments used and on the amplifier system in the hall but also upon the acoustic quality of the auditorium. An attempt has been made here to study the response of various places in the auditorium, to the signals having frequencies corresponding to the notes Shadja- 'Sa', Pancham- 'Pa' and Nishad- 'Ni' of the middle octave- 'Madhya Saptak'. The sound intensity is measured at various places and intensity against a function of position is plotted.

2. PROCEDURE

1. The temple of Goddess "Jogeshwari" at Ratnagiri (Maharashtra) & auditorium of our college was chosen to study the acoustics.
2. We draw the matrix of 1m by 1m on the floor of temple & auditorium.
3. The signal was given to audio system speakers of constant frequency.
4. Mike was kept on various points on drawn matrix to measure the intensity of sound.

5. Observations of sound intensity in the matrix form were recorded.

3. THE WAVE EQUATION

$$Y_k = A_k \sin(\omega t + \Phi_k)$$

Where,

$$A_k = (C1)(1/d_k), d_k = [(x - (xo + ia)^2 + (y - (y_o + jb))^2 + Z_0^2]^{1/2}$$

$$\Phi_k = (2\pi f d_k/v), v = 340m/s$$

$$Y_{\text{resultant}} = (y_1 + y_2 + \cdots y_{18})$$

$$f_1 = 256Hz(Sa); f_2 = 348Hz(Ga); f_3 = 384Hz(Pa); f_4 = 480Hz(Ni)$$

4. SCHEMATIC REPRESENTATION

Fig. 1 shows experimental setup of our study. In diagram doted lines represent matrix form. We have drawn a matrix of 50×50 cm on the floor of the temple and auditorium. There are 3 array of 6 speakers situated at the ceiling of the auditorium and done structure at each and every point on the matrix. With the help of function generator sound waves of required frequencies were sent.

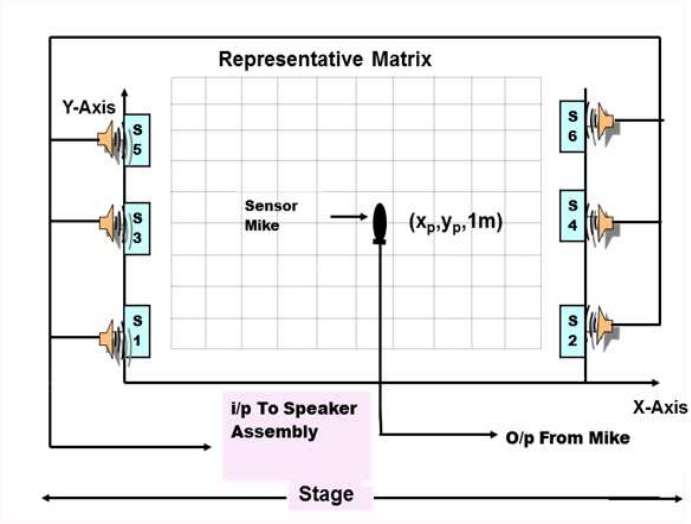
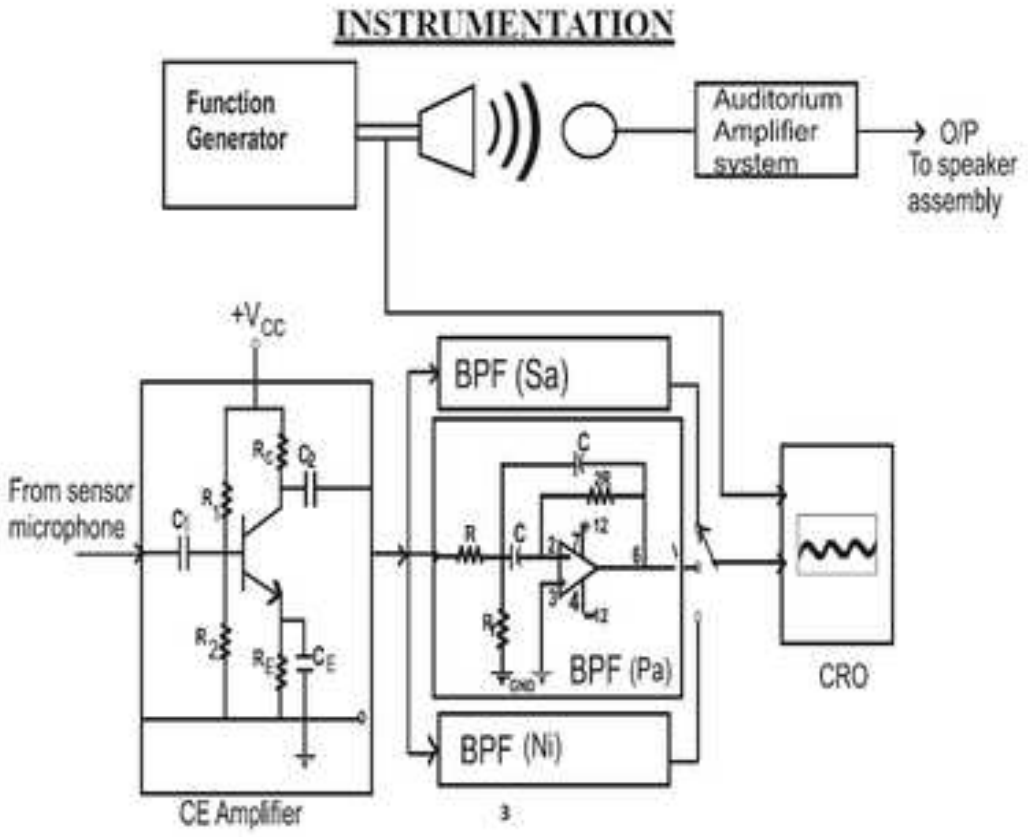


Figure 1. Experimental Setup.



We used very simple laboratory apparatus to check the acoustic of temple and auditorium. Apparatus used are function generator, CRO, two mikes, speaker system, CE amplifier, band pass filters.

At first function generator is used to produce desired frequencies. Function generator is connected to CRO as well as one mike with the help of speaker system (speaker system is used to produced and maintain sound intensity sufficiently loud). This mike sends waves in all direction. There is one another sensor mike kept at each and every point on the matrix connected to the CE amplifier.

CE amplifier amplifies all the frequencies as noise also get amplified with this amplifier. To avoid noise amplification and to get desire frequency only band pass filter (BPF)is used. Output of CE amplifier connected to input of BPF. Most important feature of BPF is that it passes only selected frequencies which are in its pass band. We have design BPF at 256Hz(SA), 480Hz(NI). Further BPF is connected to CRO and CRO shows peak to peak amplitude of reflected waves which we measure in our observations.

5. PHOTOGRAPHS

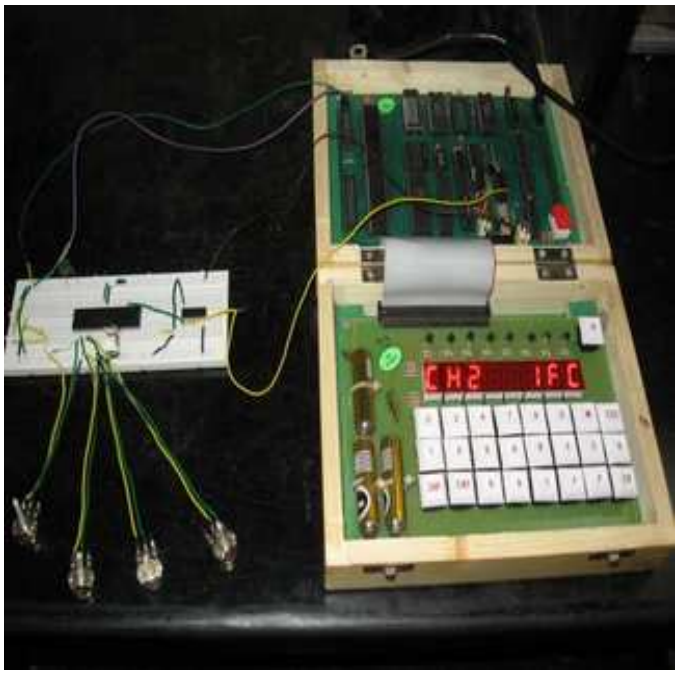
Before renovation

After renovation

Before renovation

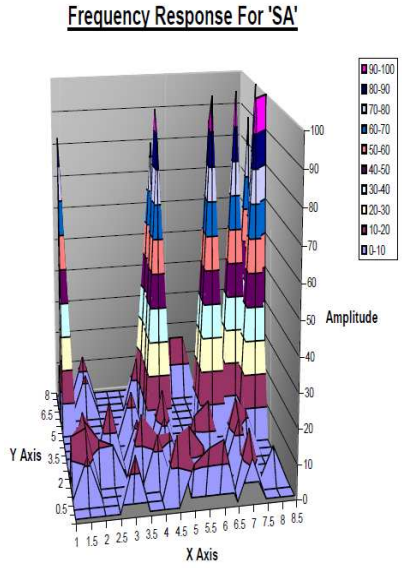
After renovation

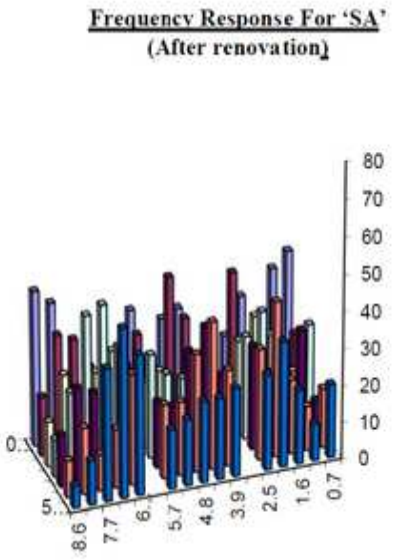
Before renovation

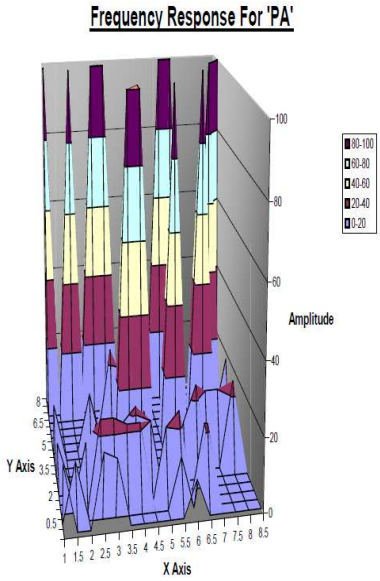


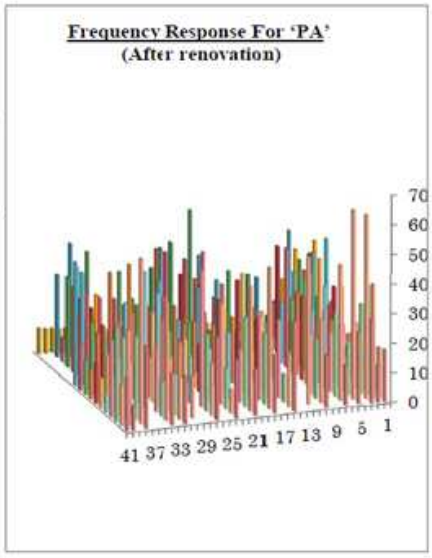
After renovation

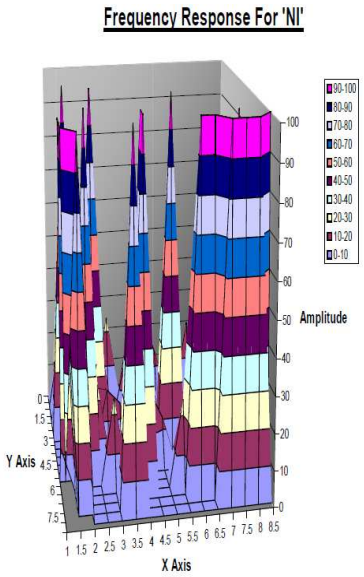
6. COMPARISON BETWEEN GRAPHS FOR FREQUENCY RESPONSE OF AUDITTORIUM BEFORE AND AFTER RENOVATION

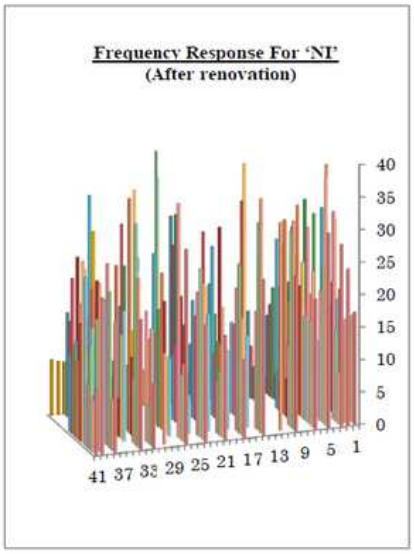





Frequency Response For 'PA'
80-100
60-80
40-60
20-40
0-20
Amplitude
Y Axis
X Axis


Frequency Response For 'PA'
(After renovation)





7. RESULT AND DISCUSSION

In the view of auditorium before renovation there was no false ceiling therefore volume was bigger. There were only three speakers mounted on the longer sided walls. During renovation false ceiling was constructed and three arrays of siz speakers mounted on ceiling. Thuse the effective volume of hall has reduced significantly.

Effect of renovation reflects in our study as in entire autitorium frequency response is fairly uniform for all the frequencies we studied (Sa, Pa, Ni) which is according to acoustics, sign of good auditorium.

8. ACOUSTICS FOR TEMPLE

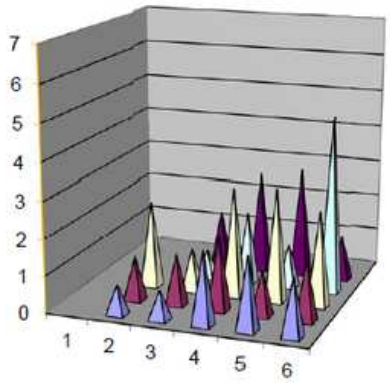
Now as a application part of our study we check acoustics of temple.

Above photograph shows temple of Goddess "JOGESHWARI". Temple is situated at 'KOTWADE' in Ratnagiri district (Maharashtra). We select this temple for our study due to dome structure of this temple. There are 3 domes present. In 1st dome statues of Goddess Jogeshwari is situated. In 2nd dome cultural programs are conducted. And dome 3 is the hall of that temple where sitting arrangement for people have done during cultural program.

9. GRAPHS FOR OBSERVATON OF TEMPLE

Dome 1

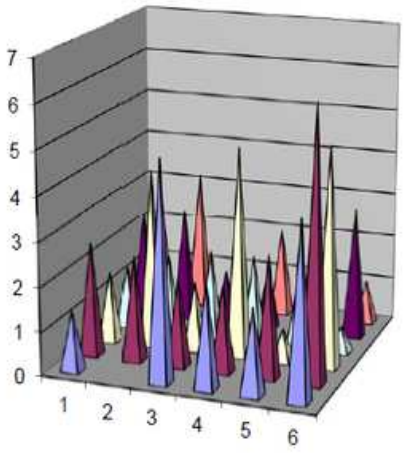
X/Y	0.56	1.12	1.68	2.24	2.8
0.56	1.6	2	2	0.8	0.8
1.12	1.6	1.2	2	1.4	1.2
1.68	2.6	3.1	3	1.2	2.4
2.24	4.8	1.2	2	0.8	-
2.8	1.2	3	2.8	1.6	-



Graph and observations shows reponse of frequency for temple in dome 1. It is graph of ampliture of sound intensity against position. X-axis for legnth, y-axis for breadth and z-axis for height of dome 1. For dome 1 frequency response is fairly uniform for frequency 'SA'.

Dome 2

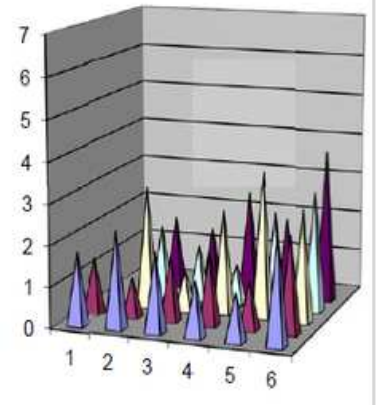
X/Y	0.5	1	1.5	2e	2.5	3
0.5	4	2	2.4	5	-	1.4
1	6.2	2.8	2	2	2.4	2.6
1.5	5	0.8	4.8	1.6	4.1	1.6
2	0.6	1.4	2	2	1.8	1.4
2.5	3	2	1.4	1.2	2.6	2.4
3	1	1.4	2	1	3.2	3



Graph and observations shows response of frequency for temple in dome 2. For dome 2 frequency response is almost uniform for 'SA'.

Dome 3

X/Y	0.5	1	1.5	2	2.5	3
0.5	2.6	1.2	1.4	2	2.4	1.8
1	2.4	1.2	1.8	1.6	1	1.4
1.5	2.8	3.6	2.6	1	3	-
2	3	2.4	1	1.4	1.8	-
2.5	3.8	2	2.6	1.6	1.8	-



Graph and observations shows response of frequency for temple in dome 3. For dome 3 frequency response is almost uniform for 'SA'.

10. RESULT AND DISCUSSION

Dome structure is the special characteristics of traditional temple. In old era modern techniques of acoustics were not available but still these building were constructed with good acoustics. The study shows that frequency response is almost uniform over three domes especially for the middle dome.

We conclude that cultural programs of temple must be conducted in middle dome (dome 2). It is also confirmed with the local people that the programs are conducted in the middle dome.

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Influence of Static Magnetic Field on Growth of Plants

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Abstract.

The present paper talks about the effect of static magnetic field on growth of plants. Experiment was conducted on pea plants (selected due to its availability and fast growth) and the magnetic field was produced by two circular permanent magnets. There were two parameters measured, height and girth of the plant. As a record, it was found that the growth rate of plants under magnetic field is higher than the controlled plants. The comparative result was analyzed by the means of average values.

1. INTRODUCTION

Over many years, numerous experiments on the effects of magnetic field on plant growth have been performed with seedlings of different plant species placed in static and alternating magnetic fields. In both cases the magnetic exposure disclosed the stimulatory influence on the growth (parameters such as germination rate, growth rate and yield of the plant [1-3]) of plants. Similar results were found in higher areas of study such as significant enhancement of the fresh tissue mass, assimilatory pigments level as well the chlorophyll ratio, average nucleic acids level, increase of the average plants length (exception: the dry substance mass accumulation) [2]. Also it was found that the difference in growth rate between treated and control plants decreased after the field was removed [1]. The removal of the magnetic field also weakened the plant stem, suggesting the role of magnetism in supplying plants with energy [3].

2. RESEARCH METHOD

2.1 Design of the Experiment

Already germinated seeds (6) of Pea were chosen as subjects to study the effect of magnetic field on growth of plants. The value of magnetic field (for the samples), though unknown, was kept constant, during 11 days. Two circular permanent magnets of diameter 5.6 cm and width 1 cm, procured from speakers, were used to induce magnetic field around the samples. The two magnets were kept at a distance of 6 cm. In this experiment, growth refers to height and maximum girth attained by the plant at that height. In order to measure the height of the plantlets, threads were tied on the plumule,

just above the point of intersection of radical and plumule, of each germinated seed to indicate zero-mark. All the plantlets were kept under same environmental conditions, like temperature ($26^{\deg}C \pm 0.5^{\deg}C$), sunlight, and type of soil and were supplied with same amount of water (20 ml). Heights and girths of the plants were measured with the precision of 1 mm and 0.02 mm respectively.

2.2 Tools Used

- Vernier Calliper with precision of 0.02 mm; to measure the girth of the plantlets.
- Ruler; to measure the length of the threads.

3. OBSERVATIONS

On Day I the bud of third plantlet (under the influence of magnetic field) was accidently detached. Hence, the readings of this plant were not compared to the controlled plants.

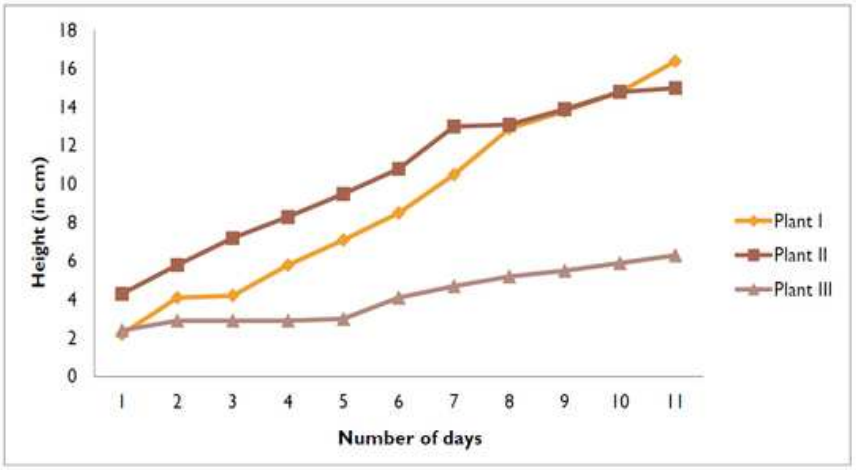

Figure 1. Height of plants under the influence of magnetic field.

4. ANALYSIS OF OBSERVATIONS

The set of data showed that the plants under the influence of magnetic field grow taller (measured by the height of the plant) and healthier (measured by the girth of the plant). For instances, the mean height of the plants on day 2 was 4.95 cm in the samples whereas 3.3 cm in the controls, also the mean maximum girth attained by the plants on day 2 was 1.98 mm in the samples whereas 1.33 mm in the controls. Perhaps, the analogy, as shown in the graphs, proposes that the plants under magnetic field grew better.

It may be explained by this- that the polarity of magnetic field arrange the ions in the plants in such a way that the growth is rapid. It is also to be observed that the plant whose bud was accidentally detached took three days to recover and start growing all over again.

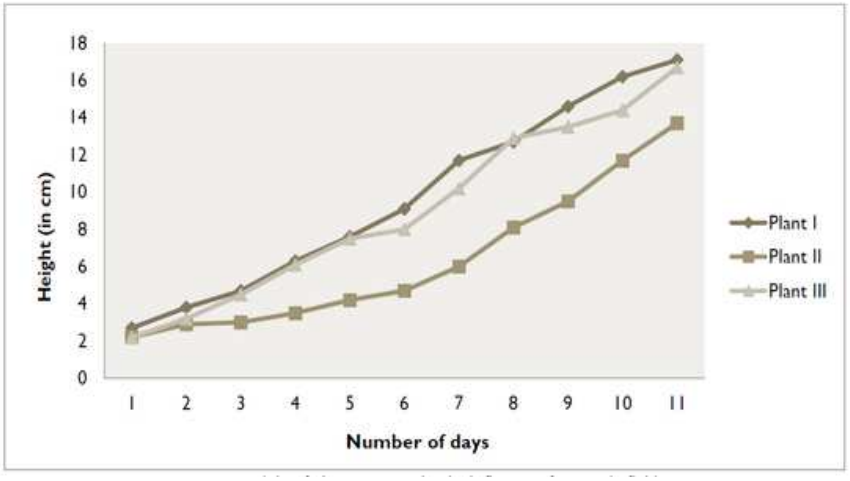

Figure 2. Height of plants NOT under the influence of magnetic field.

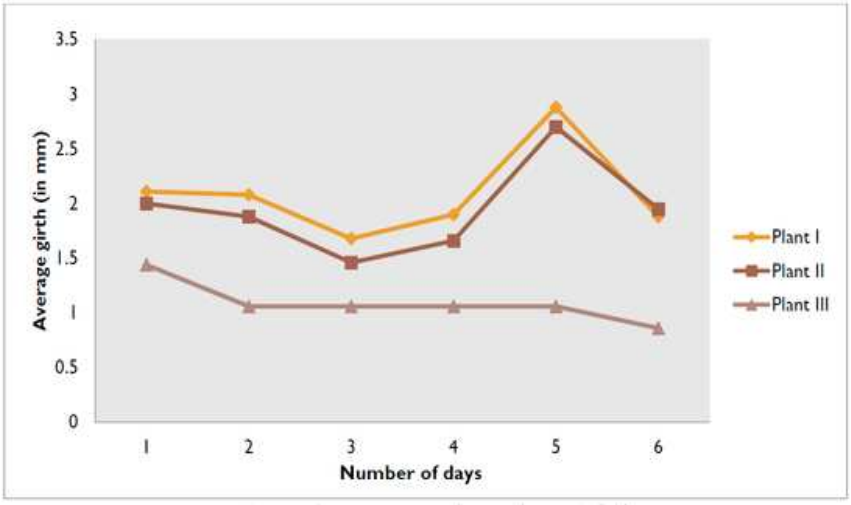

Figure 3. Girth of plants under the influence of magnetic field.

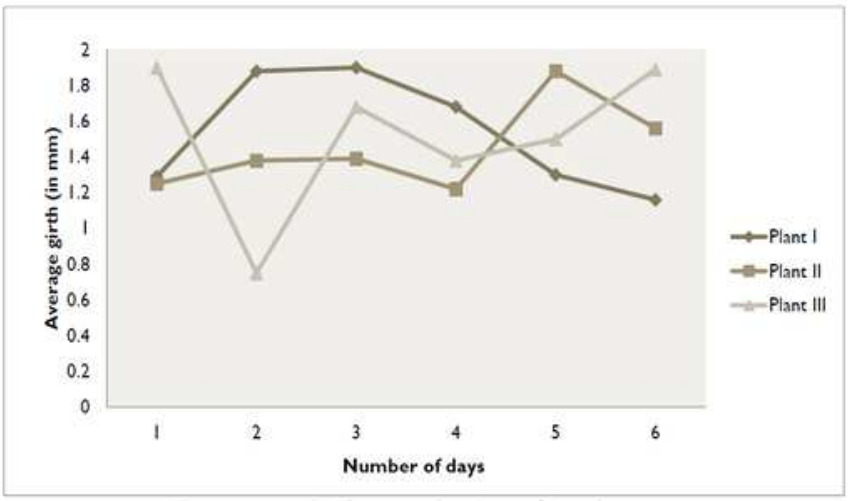

Figure 4. Girth of plants NOT under the influence of magnetic field.

5. INFERENCES

The above experiment inferred that, initially, the growth of the plants under the influence of magnetic field accelerates. At later phase, these plants revealed inhibitory effects on the growth. Thus, magnetic field affected the growth of plants as shown by their structure, that is, height and girth. No inimical effects of static magnetic field on the growth of plants were observed.

ACKNOWLEDGEMENT

The author expresses gratitude, firstly, to Prof. Vivek Wagh (Centre for Scientific Learning) under whose guidance the present research problem was chosen and family members who supported immeasurably.

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Valence Band Study of Poly Crystalline Silver Sample using Ultraviolet Photoelectron Spectroscopy

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Abstract.

The following paper outlines the techniques and requirements of Ultraviolet Photoelectron Spectroscopy(UPS). The different vacuum condition and instrumentation are also studied extensively. UPS is utilized to study the valence band of polycrystalline Silver (Ag) sample and Fermi edge is obtained experimentally. The experimentally obtained data matches theoretically to a good extent.

1. INTRODUCTION

The photoelectric effect provides the backbone of Ultraviolet Photoelectron Spectroscopy (UPS) study. In the photoelectric effect, electrons are emitted from matter (metals and non-metallic solids, liquids or gases) as a consequence of their absorption of energy from electromagnetic radiation of very short wavelength, such as visible or ultraviolet radiation. Electrons emitted in this manner may be referred to as photoelectrons. First observed by Heinrich Hertz in 1887, the phenomenon is also known as the Hertz effect. The photoelectric effect requires photons with energies from a few electron-volts to over 1 MeV in high atomic number elements. Study of the photoelectric effect led to important steps in understanding the quantum nature of light and electrons and influenced the formation of the concept of waveparticle duality.[1] The first part of the paper discusses the fundamentals of photoelectron spectroscopy along with the instrumentation involved in the process. The last part of the paper consists of photoemission experiment on polycrystalline silver sample and its analysis.

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2. BASIC CONCEPTS IN PHOTOELECTRON SPECTROSCOPY

The photons of a light beam have a characteristic energy proportional to the frequency of the light. In the photoemission process, if an electron within some material absorbs the energy of one photon and acquires more energy than the work function (the electron binding energy) of the material, it is ejected. If the photon energy is too low, the electron is unable to escape the material. Increasing the intensity of the light beam increases the number of photons in the light beam, and thus increases the number of electrons excited, but does not increase the energy that each electron possesses. The energy of the emitted electrons does not depend on the intensity of the incoming light, but only on the energy or frequency of the individual photons. It is an interaction between the incident photon and the outermost electron.Electrons can absorb energy from photons when irradiated, but they usually follow an "all or nothing" principle. All of the energy from one photon must be absorbed and used to liberate one electron from atomic binding, or else the energy is re-emitted. If the photon energy is absorbed, some of the energy liberates the electron from the atom, and the rest contributes to the electron's kinetic energy as a free particle. The kinetic energy of ejected electrons is given by

$$KE = hf - BE - \phi \tag{1}$$

The maximum kinetic energy of an ejected electron is given by

$$K_{max} = hf\varphi \tag{2}$$

Here h is the Plancks constant and f is the frequency of the incident light or photon the term ϕ is the work function. Work function satisfies the formula

$$\varphi = hf_0 \tag{3}$$

Where f_0 is the threshold frequency for the metal. From Eq.(1) and (2) we can say that the kinetic energy and velocity of the photoelectron only depends upon the difference of incident photon energy and the work function.

Thus UPS technique provides the scope to study the band structure of a given metal by observing the energies of emitted electrons when the metal is radiated with photon source of sufficient energy.

2.1 Statistics Of Electron

From the theoretical analysis we know that electrons are Fermions and they obey the Fermi- Dirac statistics. According to the Fermi Dirac statistic the average number of fermions with energy ε_i can be found by multiplying the FD distribution n_i by the degeneracy g_i (i.e. the number of states with energy ε_i), is

$$\bar{n}(\varepsilon_i) = g_i\bar{n}_i = \frac{g_i}{e^{(\varepsilon_i-\mu)/kT}+1} \tag{4}$$

So, the distribution of photoelectrons emitted in UPS should abide by Eq. (3).

3. INSTRUMENTATION

In any experimental photoemission system the three most basic requirements are a photon source, detector to collect the outgoing photoelectrons and a facility for cleaning and moving the sample. In this subsection we briefly mention the generalrequirements in terms of sample preparation, electron energy analysers and photon sources [2]. The high degree of surface sensitivity in photoemission means that the ability to control the cleanliness and degree of crystallinity is of major importance. Obviously this requires ultra-high vacuum techniques and pressures of around $10^{-}10 - 10^{-11}$ torr. Clean surface can be obtained by sputter cleaning the surface of sample.

3.1 Sputter Gun (Argon ion)

Sputtering is a process whereby atoms are ejected from a solid target material due to bombardment of the target by energetic particles. The incident ions set off collision cascades in the target. When such cascades recoil and reach the target surface with an energy above the surface binding energy, an atom can be ejected.The source material is called the target and the emitted atoms or molecules are said to be sputtered off. Sputtering is very necessary as it cleans the surface of the sample of any impurities that may have been there due to contact with the room environment. To achieve the above vacuum condition (i.e. UHV) we have to use collection of three vacuum pumps connected in such a way to the analysis chamber that UHV is achieved.

3.2 Vacuum Pumps

Mainly three types of vacuum pumps are used in series to achieve the condition for UHV. These are Oil sealed rotary pump, turbomolecular pump and Sputter-ion pump.[3]-[4]

1 Oil Sealed Rotary Pump

This is the most widely used to establish the necessary fore vacuum for high vacuum pumps. The simplest vane pump is a circular rotor rotating inside of a larger circular cavity. The centers of these two circles are offset, causing eccentricity. Vanes are allowed to slide into and out of the rotor and seal on all edges, creating vane chambers that do the pumping work. On the intake side of the pump, the vane chambers are increasing in volume. These increasing volume vane chambers are filled with fluid forced in by the inlet pressure. Often this inlet pressure is nothing more than pressure from the atmosphere. On the discharge side of the pump, the vane chambers are decreasing in volume, forcing fluid out of the pump. The action of the vane drives out the same volume of fluid with each rotation.

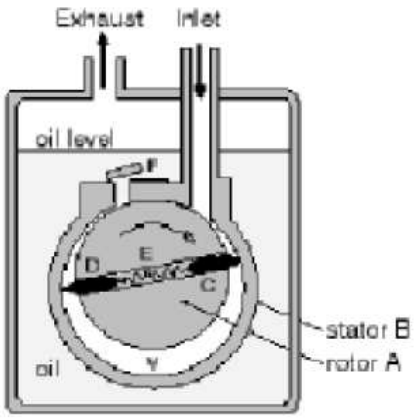

Figure 1. A oil filled rotary pump.

Multistage rotary vane vacuum pumps can attain pressures as low as 103mbar (0.1 Pa). Pumping speed s = 2V n, where, V is the volume between vanes A and B, n is the number of rotation per unit time.

2 Turbomolecular Pump

Most turbomolecular pumps employ multiple stages consisting of rotor/stator pairs mounted in series. Gas captured by the upper stages is pushed into the lower stages and successively compressed to the level of the fore-vacuum (backing pump) pressure. As the gas molecules enter through the inlet, the rotor, which has a number of angled blades, hits the molecules. Thus the mechanical energy of the blades is transferred to the gas molecules. With this newly acquired momentum, the gas molecules enter into the gas transfer holes in the stator. This leads them to the next stage where they again collide with the rotor surface, and this process is continued, finally leading them outwards through the exhaust. Because of the relative motion of rotor and stator, molecules preferably hit the lower side of the blades. Because the blade surface looks down, most of the scattered molecules will leave it downwards. The surface is rough, so no reflection will occur. A blade needs to be thick and stable for high pressure operation and as thin as possible and slightly bent for maximum compression. For high compression ratios the throat between adjacent rotor blades is pointing as much as possible in the forward direction. For high flow rates the blades are at 45 and reach close to the axis.Ar,Ne,He can be removed efficiently with the help of this pump.In Turbo pump the narrow clearence between rotor and stator is about 0.02mm.the pumping speed of rotor is 60000 rpm. The turbomolecular pump can be a very versatile pump. It can generate many degrees of vacuum from intermediate vacuum 104mbar(102Pa) up to ultra-high vacuum levels 1010mbar(108Pa).

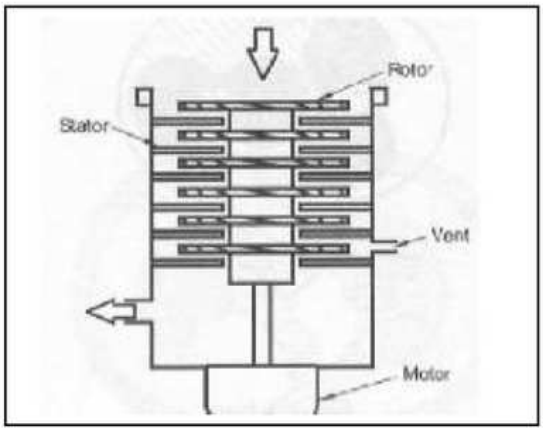

Figure 2. A turbomlecular pump.

3 Sputter Ion Pump

The pumping action of sputter-ion pumps is based on sorption processes that are initiated by ionized gas particles in a Penning discharge (cold cathode discharge). The ions impinge upon the cathode of the cold cathode discharge electrode system and sputter the cathode material (titanium). The titanium deposited at other locations acts as a getter film and adsorbs reactive gas particles (e.g., nitrogen, oxygen, hydrogen). The energy of the ionized gas particles is not only high enough to sputter the cathode material but also to let the impinging ions penetrate deeply into the cathode material (ion implantation). This sorption process pumps ions of all types, including ions of gases which do not chemically react with the sputtered titanium film, i.e. mainly noble gases. The above arrangement is used to produce the ions: stainless-steel, cylindrical anodes are closely arranged between, with their axes perpendicular to, two parallel cathodes. The cathodes are at negative potential (a few kilovolts) against the anode. The entire electrode system is maintained in a strong, homogeneous magnetic field of a flux density of B= 0.1 T, (T = Tesla = 104 Gauss) produced by a permanent magnet attached to the outside of the pumps casing. The gas discharge produced by the high tension contains electrons and ions. Under the influence of the magnetic field the electrons travel along long spiral tracks until they impinge on the anode cylinder of the corresponding cell. The long track increases ion yield, which even at low gas densities (pressures) is sufficient to maintain a self- sustained gas discharge.

Genarally, vacuum of about 104mbar to 108mbar is created using this pump.

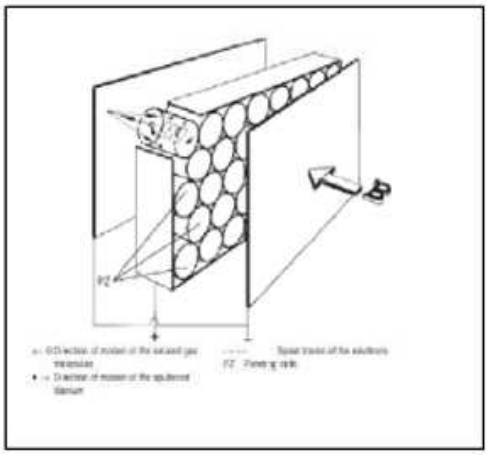

Figure 3. A sputter ion pump.

3.3 Source For UV Radiation

Commonly used UV line have energies in between 16.6 to 40.8 ev. And for these the favourable ionization sources are Ne I(16.6eV),Ne II(26.8eV)and He I(21.2eV),He II(40.8eV). These lines are produced by cold cathode capillary discharge. They are the resonance fluorescence produced when the gas is excited in the discharge and the anode decays back to its ground state.
Ilight emitted from neutral atoms
IIlight emitted by singly ionized atoms

The resonance line produced by transition from the first excited state to the ground state is usually the most intense (called raieul time). He I line is at 584$\mathring{A}$ or 21.22eV and He II line at 304$\mathring{A}$ or 40.8eV.

3.4 Electron Energy Analyser

A concentric hemispherical analyser (CHA) is used to measure the energy of the photoelectron during the study. The CHA is also called the spherical sector analyzer and the spherical deflection analyzer. It was the type of analyzer chosen in the earliest days of UPS as the most suitable for that technique, and it has remained so ever since. The basic form of a CHA consists of two hemispheres of radii R_1 (inner) and R_2 (outer) positioned concentrically. Potential $-V_1$ and $-V_2$ are applied to the inner and outer hemispheres respectively, with V_2 greater than V_1 . The medium equipotential surface between the hemispheres has radius Ro, and the source S and focus F are collinear with the centre of curvature. The potential $-V_0$ along the median surface is

$$V_0 = \frac{(V1R1 + V2R2)}{2R} \tag{5}$$

If electrons of energy $e = Ev_0$ are injected tangentially to the median surface at radius R_0 they will describe circular orbits of radius R_0 and will follow the equation

$$e\Delta V = E\left(\left(\frac{R2}{R1}\right) - \left(\frac{R1}{R2}\right)\right) \tag{6}$$

And the relative resolution is

$$\frac{\Delta E_b}{E} = \left(\frac{\pi^2 T^2}{2\beta^2}\right) \tag{7}$$

where β is the semi-angular acceptane of electrons and T is the transmission of the instrument.

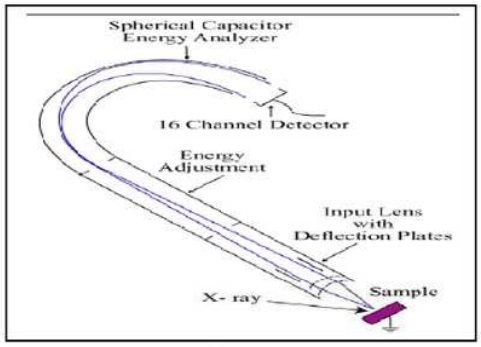

Figure 4. CHA.

Usually, a retarding mesh or gri is added in front of the entrance to retard the electrons to the same pass energy. The CHA helps us in obtaining the plot of Intensity vs. Binding energy.

4. EXPERIMENT

The experiment was done on Polycrstalline silver sample with the help of Ultraviolet photoelectron spectrometer Omicron at Institute of Physics, Bhubaneswar. Sample was sputter cleaned by IQE 11/35 sputter gun in the preparation chamber. Parameters of Argon ion gun during sputtering process:
Pressure(preparation chamber): 4.5e -5 mbar
Energy: 3 Kev
Time of sputtering: 15 min

After sputtering the sample for about 15 mins under the above condition the sample is then transferred to the analysis chamber with the help of the moving rod. EA 125 concentric hemispherical analyser was used to collect the photoelectrons. The position of the sample is then calibrated with

respect to the UV source , so as to get the optimized result(i.e. where the maximum intensity is obtained). After the optimal position is obtained the experiment was carried out under the following parameters, and the readings are taken.
Base pressure: 2e 10 m bar(UHV)
Working pressure: 1.3e-7 m bar
Temperature: 300K
He 1 source energy: 21.2 eV
Note: Base pressure is the pressure of the analysis chamber before lighting of the ultraviolet lamp.

5. RESULT AND DISCUSSION

Figure (5) shows the valence band photoemission spectra of silver (Ag) sample with binding energy along X axis and intensity along Y axis. The left side of zero in x- axis is taken to be positive and to the right is taken to be negative.

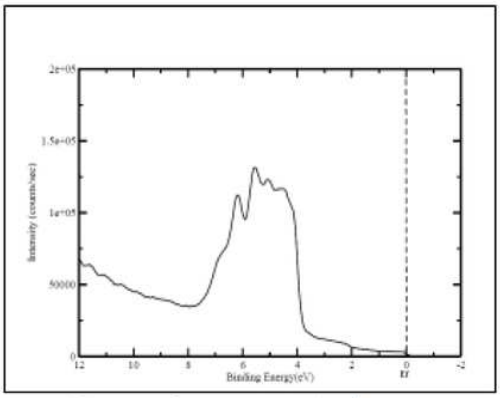

Figure 5. Binding energy vs. intensity.

Fig. (5) shows that at 0 eV binding energy there is a step in the intensity. The dotted line near the zero binding energy gives us the Fermi edge for the Ag sample that we have taken. Figure (6) shows the Fermi edge more clearly. Fermi edge seems like a step function. This step function shows that electrons obey Fermi-Dirac statistics i.e. The distribution of electrons in the valence band depends on the temperature. Hence as we increase the temperature the step goes on broadening due to thermal fluctuations. According to the Fermi Dirac statistics the average number of fermions with energy ε_i can be found by multiplying the FD distribution n_i by the degeneracy g_i (i.e. the ε number of states with energy i), is given by Eq.(3).

This shows the dependency of the no. of fermions with energy E has a temperature dependency as per the above formula. Hence the electrons are half integral spin particles which obeys Fermi Dirac statistic (they are fermions). From Figure (7) the features seen between 0eV and 7.8eV is the valence band of silver. The features between 3.8 eV-7.8 eV comprises the 4d orbital of silver.

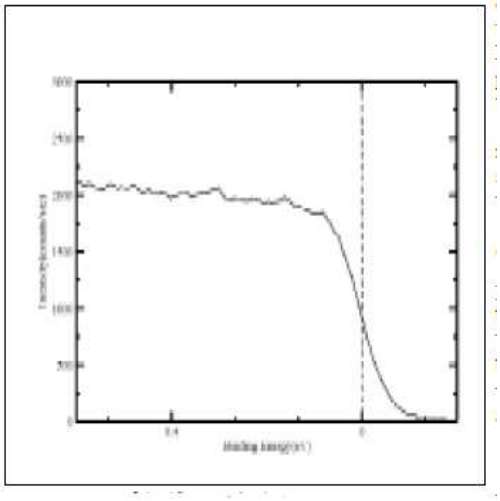

Figure 6. Fermi edge.

On the other hand the features seen between the region 0eV (Fermi edge) to 3.8eV is due to the 5s and 4p orbitals. The region below 7.8eV is the secondary emission.

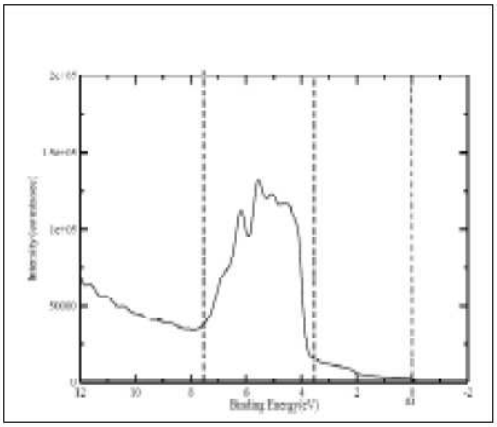

Figure 7. Binding energy vs intensity.

The valence band configuration of silver atom is 4d10, 5s1. To accommodate these 11 electrons six bands are required as electrons obey Paulis exclusion principle. Five bands lie in a relatively narrow range of energies from about 4 to 6.5 eV below Fermi energy and a sixth within an energy anywhere from about 7 eV above to 9 eV below Fermi energy as per theoretical band structure calculation. So, we expect higher density of state in a narrow range 3 to 5.5 eV below Fermi energy. Our experimental spectra shows 5 peaks with higher density of states from 4 - 6.5 eV (two narrow peaks at 5.5 eV and 6.2 eV) due to the contribution from 4d band. The lower density of state from 4 eV to Fermi energy which corresponds to the 5s band is also found. Thus our experientally obtained

spectra matches with the theoretical calculations. From the above discussion it is clear that the electron is a fermion which obeys the Fermi Dirac statistic and Paulis exclusion principle. This is in accordance to the theory where the electrons are taken to be fermions. So from the study of the above experimental results we can say that ultraviolet photoelectron spectroscopy is a powerful technique to study the valence band of metals.

6. CONCLUSION

In this article, I have attempted to overview the basic phenomena instrumentation and working of UPS. The use of UPS in extracting the valence band of metals like silver is discussed in detail. The valence bands and the Fermi edges are in good accordance with the theoretical bands.

ACKNOWLEDGEMENTS

This work was done with the help of Pramita Mishra and Himanshu Lohani who are deeply acknowledged for their kind support and worthful discussions.

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Universe Really Baryon Asymmetric?

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Abstract.

Over the years theoretical physicists have tried to explain the origin of baryon asymmetry but the topic of baryon asymmetry still remain mysterious to all of us. I have attempted to explain that what we call baryon asymmetry may as well be the matter dominant region of our observable universe, with antimatter dominant region residing beyond our future visibility limit having no interaction with the former.

1. INTRODUCTION

Generations of physicists have well established one fact through their theories that nature loves symmetry, yet the issue of baryon asymmetry remains baffling to cosmology. The complete dominance of matter over antimatter in our observable universe has engaged physicists for long time. Though it may seem trivial but the very fact that everything around us in our observable universe exists provides the evidence of Baryon asymmetry. According to cosmology, big bang produced equal amount of matter and antimatter (even if it started with some net baryon asymmetry then any asymmetry of this type would have been diluted during cosmic inflation as suggested by cosmic inflationary model thus maintaining a symmetric universe in its initial condition). From our laboratory experiments we know that matter and antimatter annihilate on interaction but the situation is rather different in present observable universe and here there has been no annihilation catastrophe indicating the absence of antimatter. Further Direct and Indirect observations have rule out the possibility of antimatter in our observable universe [1-3].

Those who are trying to find the answer of this puzzle prefer to do so in accordance with the well defined Sakharov conditions given by Andrei Sakharov who gave three necessary conditions that a baryon generating interaction should have to undergo Baryogenesis (which is a hypothetical process that occurred at some time in early universe and has been established as the cause of baryon asymmetry in present scenario). These three necessary conditions are [4],

1. Baryon number violating process

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2. C and CP violation

3. Deviation from thermal equilibrium

As a result of conditions mentioned above a small imbalance in the quantity of matter and anti-matter was established since some antimatter particles converted to matter particles and thus after mass annihilation the observable universe consisted of just that residual matter that survived the annihilation.

1.1 Baryogenesis within standard model

Although the standard model conserve baryon number but it can be violated under quantum effects. The process that can accommodate such anomalies is called Sphaleron process which has never been observed experimentally but theoretically it is plausible. Through a quantum tunneling process, the system can move to a different vacuum substate which has non zero baryon number. In such process Lepton number L and Baryon number B are not conserved separately but the quantum number B-L is. This tunneling is suppressed at energies/temperature below 10Tev (the Sphaleron mass) and occurs at high temperature which would have been only possible in early universe.[5]

C violation was first demonstrated in the decay of muons and anti-muons and the experimental observation of CP violation is also confirmed in the decay of neutral K mesons and reactions involving weak interactions [6].

Interactions outside thermal equilibrium can be achieved during the spontaneous electroweak symmetry breaking that occurs in first order phase transition in the cooling early universe such as Electroweak Phase Transition (at T=100Gev) where it is carried out at the boundary of the early universe in which symmetry is broken.

In spite of the standard model incorporating all the Sakharov conditions it cannot be taken as the final model of Baryogenesis because of few drawbacks such as that the CP violation in the weak interaction is not enough to account for the present baryon asymmetry and secondly for electroweak phase transition, there must be a new undiscovered particle besides the Higgs boson which must be relatively light and have quite large couplings to the Higgs field. This hypothesis along with Sphaleron process is not experimentally concluded and to test them in foreseeable future is out of reach.

The other proposed models like GUT Baryogenesis, PLANCK Baryogenesis, Affleck Dine mechanism, Leptogenesis require experiments involving high energies that are not feasible and possible to recreate in laboratory and therefore the experimental proof of these models have yet not been possible. So at present it is safe to say that there are no full proof conclusive theories giving us insight into this asymmetry.

In this paper I propose the change in perception towards baryon asymmetry. It could very well be that till today nature has zero baryon number and equal amounts of matter and antimatter. The fact that we see only matter in our observable universe can be explained with the help of cosmic inflation , which could have caused the antimatter region to reside out of our observable universe. In

section 1.1 and 1.2 I have briefly mentioned about the observable universe and value of asymmetry respectively. Section 2 contain theory and also include inferences that can be drawn from Cosmic rays and annihilating gamma rays which provides experimental support to the theory. In section 2.2 I discuss the role played by theory of relativity in preventing any detection of signals from antimatter domain.

1.2 Observable universe

The observable universe is a term referring to the volume of space that we are physically able to see or detect from the Earth. It forms the tiny portion of universe whereas rest part of universe we are not physically able to see simply because light travelling from them hasnt reached us yet. Observable universe forms a spherical volume and the distance from the earth to the edge of observable universe is same in all directions. The region beyond observable universe is considered casually unconnected to observable universe. The diameter of the observable universe is estimated to be 28 billion parsec (93 billion light years) putting the edge of the observable universe at about 46-47 billion light years [7]. The universe according to theoretical calculations is about 10^{23} times the observable universe owing its size to the inflationary model of big bang [8].

1.3 Measure of asymmetry

The Baryon Asymmetry of Universe (BAU) can be defined as the difference between the number of baryons NB and anti-baryons NB divided by their sum (or the entropy) just before antiprotons disappeared from the primordial plasma. Since the end products of annihilation processes are mostly photons and there are no anti-baryons in the universe today, the BAU can be estimated by the baryon to photon ratio.

It can be determined independently in two different ways, first from the abundances of light elements in the Inter Galactic Medium (IGM) which can be calculated by solving network of Boltzmann equations for a given and secondly from the power spectrum of temperature fluctuations in the CMB since the acoustic oscillations of baryon photon plasma are sensitive to and cause changes to the height of peaks in power spectrum. Both consistently give values $\sim 10^{-10}$ (precise value being $6.176 \pm 0.148 \times 10^{-10}$ [9].

2. ANTIMATTER OUTSIDE OBSERVABLE UNIVERSE

The small value of asymmetry and the fact that gamma ray photons of large magnitude from annihilation of matter and antimatter has not been detected could account for the separation of antimatter domain from matter domain over large distance with former residing out of observable universe keeping the total baryon number of the universe as constant i.e. B=0, in which case these homogeneous domain could be separated by walls filled with radiations only. According to inflationary

cosmology there was a time in early universe (10^{-36} to 10^{-32} seconds after the big bang) where the universe underwent rapid expansion caused by negative pressure vacuum energy and expanded to a factor of approx. 10^{78} in volume. This theorized expansion is called cosmic inflation and that epoch is known as inflationary epoch. Any initial baryon asymmetry if present prior to the inflation would have diluted because of the rapid expansion.

At the end of cosmic inflation universe whose size was small relative to the present scales was roughly divided into two regions, one was matter dominated and other was anti-matter dominated, the chances of which are very high given the scale of asymmetry. In both of these regions asymmetry was of the order of 10^{-10}. (Imaging the universe at that time as an ellipse, inner region of which is matter dominated and outer region i.e. at periphery antimatter dominated) (shown in the figure:1)

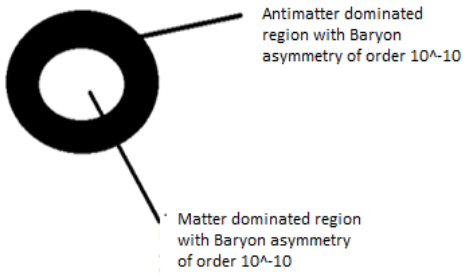

Figure 1. Distribution of early universe after cosmic inflation.

At the boundary separating these two domains there still be constant annihilation due to some of the matter and antimatter interaction but the density at the interface between two domains would remain constant due to simultaneous pair production preventing the diffusion of any new matter or antimatter particles from their domains in the interface. Since the properties of matter and antimatter are same therefore each of these regions would have undergone same phase transition and state transformation (such as conversion of quarks and anti-quarks into baryon and anti baryons, constant annihilation and pair production in both of these regions and formation of hydrogen and anti hydrogen nuclei. At about 10-6 seconds after the Big bang temperature dropped down to a critical value and was no longer high enough for pair production so a mass annihilation followed and we got region totally containing matter and another region containing antimatter. This era is called as hadron epoch. As shown in [3] the uniformity in Cosmic Microwave Background rules out any voids and leads to conclusion that matter and anti-matter domains must have been in touch at least between the times of recombination epoch to the onset of structure formation. After the structure formation, the matter and anti-matter domains may have been separated by sufficiently large voids to suppress annihilation at the domains wall and avoid a detectable gamma ray flux [9] .As the expansion continued all the anti-matter would have shifted out of observable universe and thus what we account as baryon asymmetry in our observable universe could pretty well be just the matter dominated region.

If it is to be believed that all the conservation laws hold true for both matter and antimatter and that symmetry is the underlying principle of Nature than one must admit that somewhere there should be

antimatter that balances the matter existing in our observable But if the Antimatter domain is of the scale of galaxies or galaxy cluster, we may detect Antimatter Cosmic Rays (CR) coming from the nearest domains in universe. If this is true than the parameter of BAU calculated in early universe represents the value of local fluctuation in the quantity of matter and antimatter in that epoch.

2.1 Inference from Experiments

1 CMB Distortions and CDG Spectrum

The annihilation produced during the period of Recombination and non linear structure formation leaves distinguished marks in two forms first the distortion in the CBR spectrum which is caused by the annihilation electrons of energy about 320 MeV which scatters some of the CBR photons to higher energy and these same electrons also affects the spectrum by heating the medium, Secondly the annihilation photons from that time would though be red shifted will still contribute to the Cosmic Diffuse Gamma Ray Flux (CDG).

The conservative estimate of the relic CDG flux far exceed its measured value and therefore B=0 universe with domains smaller than a size comparable to that of the observable universe is not possible [3].

2 Annihilation Gamma Rays Probing

The most useful probe of antimatter is the annihilation gamma rays. But since gamma rays do not provide a unique signature of annihilation, it is therefore most reasonable to use the gamma-rays observations simply to set the upper limits to the annihilation rate and hence derive upper limits to the possible anti-matter fraction.

The absence of annihilation gamma rays which would have been emitted as a result of interaction when the solar wind sweeps the whole solar system strongly restricts the presence of significant amounts of anti-matter in the solar system [1].

Any anti-matter initially present in the diffuse interstellar medium would have long since annihilated before the galaxy is formed (due to the collapse of a proto-galactic gas cloud); because the annihilation time is always shorter than the collapse time as a result of this any antimatter present in the galaxy formed wouldnt survived to the present epoch. This same can be assumed in general for all the galaxies. The observed Galactic gamma rays indirectly limit the ratio of antimatter to matter in the Inter Stellar Medium (ISM) $< 10^{-15}$ [1]. The observed X-ray flux from the cluster of galaxies produced as a result of two body collisions would ensure the production of high energy gamma rays because of the matter and antimatter annihilation if these intra-cluster gas in these clusters contain the fraction f of this antimatter mixed with the matter. The ratio of F to Fx provides an upper bound to f where [1]

$$F_x = 1.4 \times 10^{-23} T_8^{1/2} \int \frac{n_B^2 dv}{4\pi R^2}$$

$$F_y = 5.4 \times 10^{-14} \frac{f}{T_8^{1/2}} \int \frac{n_B^2 dv}{4\pi R^2}$$

F_x and F being x-ray flux and -ray flux respectively, R is the distance to the cluster, v is the volume $T_8 = T/10^8 K$.

The observations limit the fraction of mixed matter and antimatter on the scale of cluster of galaxies to be smaller than $f < 1* \times 10^{-6}$ [10]. For galaxy cluster such as Perseus the antimatter fraction is found to be $f < 9 \times 10^{-9}$ and for Virgo cluster the upper bound of $f < 5 \times 10^{-9}$ is derived. For larger scales of the Coma and Ophiucus clusters the constrain $f < 3 - 4 \times 10^{-8}$ is derived. The upper bound of antimatter fraction for all 55 galaxy cluster leads to the conclusion they are likely to consists entirely of matter thus inferring that if there are significant antimatter dominated regions in the universe they must be separated from matter dominated regions on scales greater than the $\sim$ Mega parsec scale of cluster of galaxies.

The possibility of antimatter galaxy clusters is studied through the annihilation gamma rays which are emitted when matter and antimatter clusters (known as Bullet clusters) collides. Observation limits the antimatter fraction to $f_{bullet} < 3 \times 10^{-6}$ suggesting that regions of antimatter in the universe should be separated from the regions of ordinary matter by distances of the order of tens of Mega parsec [11]. Further studies of bullet clusters will help to probe these scales in the future.

3 Cosmic Rays

The fraction of positrons and anti-protons present in cosmic rays is the only primary source of antimatter found outside the laboratory to date, but given their relatively low pair creation threshold, they can be generated by various astrophysical process and thus can exist in universe made entirely of matter. Now according to our understanding although the origin of Cosmic Rays is yet unidentified, but it is known that these CR sweeps through all the galaxy clusters and hit us from all the sides. Since the possibility of producing heavier anti-nuclei in cosmic rays by collisions is completely negligible the existence of heavier anti-nuclides would confirm the traces of anti-matter within our galaxy but an upper limit on the flux ratio of anti helium to helium of $< 1.1 \times 10^{-6}$ in the rigidity of 1 to 140 GV is established and no anti helium nuclei was found (findings done by Alpha Magnetic Spectrometer (AMS)) [12] concluding that there is no antimatter on the large scale of galaxies and clusters.

Besides these, there have been ongoing searches for the detection of theoretical Weakly Interacting Massive Particles (WIMPS) which interact through gravity and weak force and is one of the contenders of dark matter [13]. Now from Dirac theory we can predict the existence of Weakly Interacting Massive Anti Particles (WIMAPS) but the fact that they do not interact with the electromagnetism (which prevents them from seeing directly) and do not react strongly with atomic

nuclei makes them very hard to detect experimentally [14][15]. The detection of WIMAPS along with WIMPS will provide great insight into the antimatter source in the observable universe but the experimental non-confirmation will give basis to the theory that antimatter domain reside out of observable universe.

2.2 Role Played by Theory of Relativity

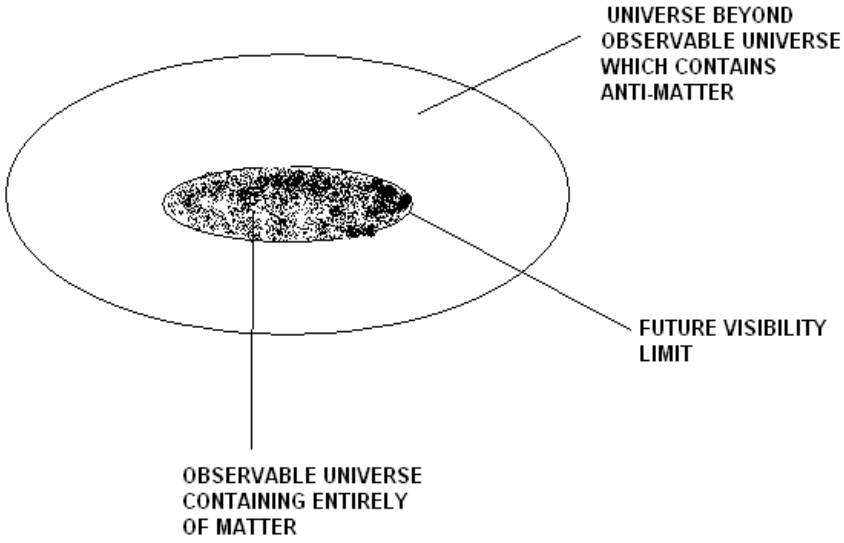

Figure 2. State of the universe after undergoing million years of expansion.

Special relativity constraint objects in the universe from moving faster than the speed of light with respect to each other but General Theory of Relativity places no theoretical constraint on changes to the scale of space as a result of which two stationary objects or objects moving at speed below that of light are able to become separated in a space by more than the distance light could have travelled between them suggesting that objects travelled faster than speed of light [16][17]. According to Hubbles Law velocity of a cosmic object is proportional to the distance of it from the point of observation. Thus farther the distance greater is the velocity. Therefore in our universe regions sufficiently away from us are expanding much faster than the speed of light and this expansion appears to be accelerating due to the presence of dark energy. If the magnitude of dark energy remains constant, there is a future visibility limit beyond which objects will never be observed from earth [18][19].This future visibility limit is calculated to be at a comoving distance of 19 billion parsecs from the point of observation i.e. Earth.[20] According to the theory if anti-matter domain is sufficiently away from the point of observation then due to the expansion of the universe light from them will never enter in the future visibility limit of the observable universe (as shown in the figure: 2) thus excluding the possibility of observing or detecting any anti-matter and the newly

created annihilation radiations from the interaction of matter with anti-matter

3. CONCLUSION

The data from Cosmic Microwave background and diffuse Gamma Ray spectrum enables us to infer the fact that anti-matter and matter domain must be of size comparable to observable universe which agrees well with the theory and as our current observable universe is composed of matter hence by all means there is a possibility that outside our observable universe there exist domain of antimatter of the size comparable to our observable universe.

The annihilation gamma rays prove to be a valuable asset in constraining the amount of antimatter in our observable universe. The measure of gamma ray flux from x-ray emitting galaxy clusters and bullet clusters provide with the scale that matter and antimatter domain should be separated which is of the order of mega parsec. The fact that universe is expanding with the speed greater than that of light puts restriction on our experimental abilities to detect any signals from this anti-matter domain. Therefore one should not deny the possibility of presence of anti-matter in large parts of universe which are yet to be explored. The detection of Weakly Interacting Massive Anti Particles (WIMAPS) with the help of several direct and indirect experiments will be path breaking in giving support to the theory of anti-matter domains outside the observable universe playing an important role in solving the mystery of baryon asymmetric universe.

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Thermal Wind-Tree Models

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Abstract.

We consider the well-known Wind-Tree model where the speed of the particles is Maxwellian distributed. For these models, which we call as the thermal wind-tree model, we find that the distribution functions relax to equilibrium values as $t\exp(-\alpha t^2)$ as $t \to \infty$. For short times, the behaviour is $\sim -t$.

1. INTRODUCTION

The fundamental problem of statistical physics is related to understanding the approach to equilibrium. One needs to invoke the hypothesis of molecular chaos (stosszahlansatz), illustrated beautifully (for instance) in the case of Kac's ring [1]. The other model of great interest and didactic value is the Wind-Tree model introduced by the Ehrenfests [2]. This model consists of a two-dimensional gas in which the particles ("wind") are distributed homogeneously in space at a time t, and, scatterers ("trees"). On scattering from the trees, the directions in which the particles can move are labelled anticlockwise: 0(east), 1(north), 2(west), 3(south). The scatterers are square-shaped (sidelength, a) whose diagonals lie in the initial direction of motion. They are distributed randomly in space. Owing to these simple dynamical rules, this model is completely deterministic. The wind particles do not interact among each other. Let us denote the number of wind particles at $\mathbf{r}$ moving in direction i at time t by $F_i(\mathbf{r},t)$. For obtaining the equation of motion for evolution of $F_i(\mathbf{r},t)$, we need to incorporate the reflections off the scatterers. Let the density of the scatterers be ρ_s. If the number of trees per unit area is n, we assume that $na^2 \ll 1$.

As seen in Fig. 1, the number of particles changing direction from 0 to 1 in time δt is

$$N_{01}\delta t = \rho_s \frac{a}{\sqrt{2}} v F_0 \delta t := k F_0 \delta t. \tag{1}$$

The quantity k contains the information regarding the speed of the particles and the orientation of the square with respect to the incident direction.

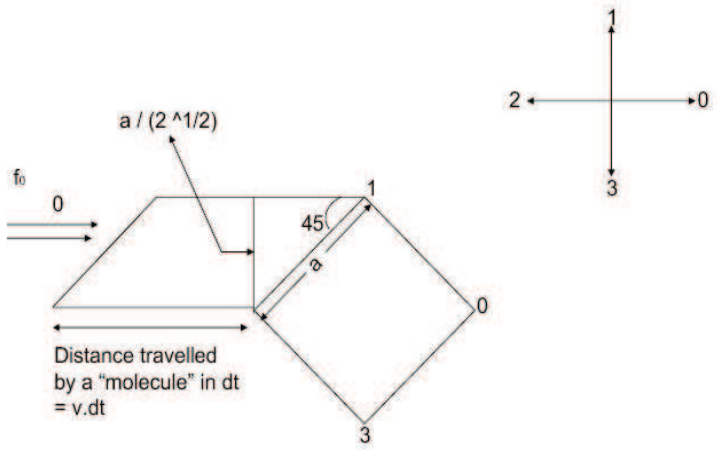

Figure 1. Particles incident along "0" on a scatterer, reflecting away towards "1" or "3".

Similar to (1), we can write generally: $N_{i,i+1}\delta t = kF_i\delta t$. The rate of change of F_0 is found by noting that the particles are scattered in direction 1 and 3. Thus, by detailed local balance, we have

$$\frac{dF_i}{dt} = k(F_{i+1} + F_{i-1} - 2F_i), \qquad (i = 0, 1, 2, 3). \tag{2}$$

These equations are valid if we neglect all correlations and memory effects. After each collision, the validity of above equations inherently assumes that each free "flight + scattering" is independent from the next/previous one. It can be shown that the solution to this set of equations obeying our initial conditions that $F_0(0) = 1$ is given by [3]

$$\begin{aligned} F_0(t) &= \frac{1}{4}[1 + \exp(-2kt)]^2, \\ F_1(t) &= F_3(t) = \frac{1}{4}[1 + \exp(-2kt)][1 - \exp(-2kt)], \\ F_2(t) &= \frac{1}{4}[1 - \exp(-2kt)]^2. \end{aligned} \tag{3}$$

All these functions approach a common value as time becomes large. This shows that all the ensuing directions are equiprobable (equilibrium). In matrix form, these equations can be represented as

$$\frac{df}{dt} = \mathbf{MF} \tag{4}$$

where

$$\mathbf{M} = \begin{bmatrix} -2k & k & 0 & k \\ k & -2k & k & 0 \\ 0 & k & -2k & k \\ k & 0 & k & -2k \end{bmatrix}. \tag{5}$$

These equations can be algebraically manipulated to give the following expression

$$\frac{d}{dt} \log \left(\frac{F_2 - F_0}{F_3 - F_1} \right) = 0 \tag{6}$$

Note that the matrix $\mathbf{M}$ is a cyclic matrix. An $N \times N$ cyclic matrix can be diagonalized, the diagonalizing matrix has elements

$$U_{jl} = \frac{1}{\sqrt{N}} \exp \left[\frac{2\pi i}{N} (j-1)(l-1) \right]. \tag{7}$$

The distinct eigenvalues of $\mathbf{M}$ and the corresponding orthogonal eigenvectors are

$$\begin{aligned} &\lambda_1 = 0, \psi_1 = F_0 + F_1 + F_2 + F_3, \\ &\lambda_2 = -4k, \psi_2 = -F_0 + F_1 - F_2 + F_3, \\ &\lambda_3 = -2k, \psi_3 = F_3 - F_1, \\ &\lambda_4 = -2k, \psi_4 = F_2 - F_0. \end{aligned} \tag{8}$$

The eigenvectors or eigendistributions evolve independently, according to $d\psi_i/dt = \lambda_i \psi_i, i = 1, 2, 3, 4$. The above equation implies that the quantity ψ_1 is constant in time, expected condition is $F_0 + F_1 + F_2 + F_3 = 1$. The other eigendistributions evolve as: $\psi_2(t) = \psi_2(0) \exp(-4kt)$, $\psi_3(t) = \psi_3(0) \exp(-2kt)$, $\psi_4(t) = \psi_4(0) \exp(-2kt)$.

Recall that $k = (a\rho_s v)/\sqrt{2}$. Here we consider the case when v is not the same for each particle. Specifically, v may be distributed in a Maxwellian form, that is, the number of particles of mass m with speed $v \in [v, v + dv]$ is

$$n(v)dv = mNv \exp \left[\frac{-mv^2}{2k_B T} \right] dv \tag{9}$$

which is the Maxwell-Boltzmann distribution for an ideal gas in two dimensions. N, k_B, and T are respectively number of particles, the Boltzmann constant, and temperature.

Now, we want to see how ψ_i behaves over long time when v is drawn from $n(v)$. Let us consider ψ_2 as a function of t and v for illustration. The matrix $\mathbf{M}$ becomes a cyclic random matrix, similar to the one found in the study of random walk [4,5]. Then $\psi_2(t, v)$ becomes

$$\psi_2(t, v) = \psi_2(0) \exp \left[-(4av \sin\theta \rho_s)t \right] \tag{10}$$

where $\psi_2(0) = -F_0(0) = -1$, and $\theta = \pi/4$. Now, averaged over v,

$$\Psi_2(t) = \int_0^\infty \psi_2(t,v)n(v)dv$$

$$\Psi_2(t) = \psi_2(0)\frac{mN}{k_BT}\int_0^\infty v\exp(-4atv\sin\theta\rho_s)\exp(-mv^2/(2k_BT))dv \tag{11}$$

The integral in this expression is

$$I = \int_0^\infty v\exp[-(Pv+Qv^2)]dv$$

$$I = \int_0^\infty v\exp[-Q(v^2+Rv)]dv, \qquad P/Q = R, \text{and on completing the squares,}$$

$$I = e^{\frac{QR^2}{4}}\int_{R/2}^\infty u\exp(-Qu^2)du - \frac{R}{2}e^{\frac{QR^2}{4}}\int_{R/2}^\infty \exp(-Qu^2)du. \tag{12}$$

The integral is

$$I = \frac{1}{2Q} - \sqrt{\frac{\pi}{Q}}\frac{R}{4}\exp\left(\frac{QR^2}{4}\right)erfc\left(\sqrt{\frac{QR^2}{4}}\right). \tag{13}$$

Here, $erfc[z]$ is the complementary error function defined as: $erfc[z] = 1 - erf[z]$, $erf[z] = \frac{2}{\sqrt{\pi}}\int_0^z e^{-x^2}dx$.

Substituting this, we obtain finally (see Fig. 2)

$$\frac{\psi_2(t)}{\psi_2(0)N} = 1 - 2a\rho_s\sqrt{\frac{\pi k_BT}{m}}t\exp\left[\frac{4a^2\rho_s^2k_BTt^2}{m}\right]erfc\left[2a\rho_s\sqrt{\frac{k_BT}{m}}t\right]. \tag{14}$$

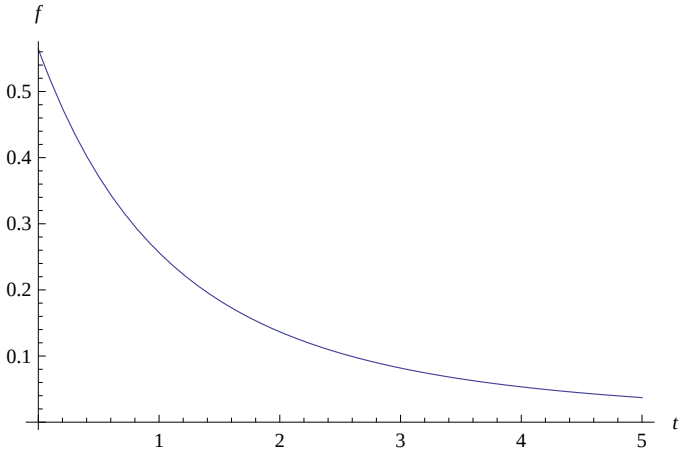

Figure 2. $\psi_2(t)/(\psi_2(0)N)$ is plotted against time for some representative values taken for various parameters. We see that the ratio approaches zero, which is consistent with the fact that all the F_i's become equal, at equilibrium.

2. VAN HOUTEN - VAN SARLOOS VARIATION

There has been an interesting variant of the original model (discussed above). In this variation [6], there are two kinds of scatterers - one of these type(I) is as in the original model, the other type is rotated by an angle $\pi/4$ (II), thus it reverses their direction on collision. There is a further dynamical feature wherein the scatterers turn by an angle $\pi/4$ after a particle collides with them. This means that they are turned into each other. For this model, the rate equations for the number of wind particles in four directions were obtained in [6]. Let the number of trees of type I and II be Z_I and Z_{II}. The average time taken by a wind particle to strike a tree is $\Delta = \Omega/2av$. The collision frequencies corresponding to the particle striking a tree of type I (II) is Z_I/Δ ($Z_{II}/\sqrt{2}\Delta$). The rate equations can be written in a matrix form, which is very convenient for further calculations. The rate equations

$$\frac{dN_i}{dt} = \frac{Z_I}{\Delta}\left(-N_i + \frac{1}{2}N_{i+1} + \frac{1}{2}N_{i-1}\right) + \frac{Z_{II}}{\sqrt{2}\Delta}(N_{i+2} - N_i) \tag{15}$$

can be cast as $d\mathbf{N}/dt = \mathcal{S}\mathbf{N}$ where

$$\mathcal{S} = \begin{bmatrix} -(c+d) & c/2 & d & c/2 \\ c/2 & -(c+d) & c/2 & d \\ d & c/2 & -(c+d) & c/2 \\ c/2 & d & c/2 & -(c+d) \end{bmatrix}. \tag{16}$$

$\mathbf{N}$ is the four-component vector with components N_i, $i = 0, 1, 2, 3$; $c = Z_I/\Delta$, $d = Z_{II}/\sqrt{2}\Delta$.

Since total number of trees is conserved: $Z = Z_I + Z_{II}$,

$$\frac{dZ_I}{dt} = -\frac{N}{\Delta}Z_I + \frac{N}{\sqrt{2}\Delta}Z_{II} \tag{17}$$

implying $Z_I(t) = Z_I^{eq} + [Z_I(0) - Z_I^{eq}]e^{-t/T}$ with $T = \frac{N}{1+1/\sqrt{2}}\Delta$, and $Z_I^{eq} = \frac{Z}{1+\sqrt{2}}$. We know that the ratio $\frac{Z_I I^{eq}}{Z_I^{eq}}$ is $\sqrt{2}$. Defining $c^{eq} = \frac{2avZ_I^e q}{\Omega}$, $d^{eq} = \frac{\sqrt{2}avZ_I^e q}{\Omega}$, their ratio is one. Thus we can assume that the matrix elements are distributed according to the same two dimensional Maxwell Boltzmann distribution for c and d.

The eigenvalues of the matrix $\mathcal{S}$ are 0, $-2c$, $-c-2d$, $-c-2d$.The eigenfunctions are $\phi_1 = N_1 + N_2 + N_3 + N_4$, $\phi_2 = -N_1 + N_2 - N_3 + N_4$, $\phi_3 = -N_2 + N_4$, $\phi_4 = -N_1 + N_3$. The eigenvalue=0 corresponds to the conservation of number of particles. Other eigenfunctions satisfy $\phi_2(t) = \phi_2(0)e^{-2ct}$, $\phi_{3,4}(t) = \phi_{3,4}(0)e^{-(c+2d)t}$. Since c and d have v-dependence, the rate at which ϕ_i will relax to their equilibrium values will be obtained by averaging the above expressions over Maxwell-Boltzmann distribution. However, we note that the form of the integrals are exactly the same as encountered in (14).

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