XII Biennial National Conference of Physics Academy of North East (PANE2021)

15-17 December, 2021

ABSTRACT VOLUME

Department of Physics

त्रिपुरा विश्वविद्यालय
TRIPURA UNIVERSITY
(केन्द्रीय विश्वविद्यालय) (A central University)

XII Biennial National Conference of Physics Academy of North East (PANE2021)

15 - 17 december, 2021

Abstract Volume

Organized by

Department of Physics
Tripura University (A Central University)
Suryamaninagar - 799022
Tripura, India

Our Sponsors:

Science and Engineering Research Board (SERB), Government of India
Bipin Pal Das Trust, Guwahati, Assam
Physics Academy of North East (PANE)
Tripura University (A Central University)

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Preface

The Physics Academy of the North East (PANE) is an organization of physics researchers, especially from the North Eastern India. The first meeting of the PANE was inaugurated by the well-known educationist and physicist, late Professor G C Deka at the Indian Institute of Technology (IIT), Guwahati on April 6, 1998 in a function chaired by Dr D N Buragohain, the then director of the institute.

PANE organize biennial national conference periodically. This time the biennial National conference of Physics Academy of the North East (PANE), the 12th in the series, is going to be held during 15-17 December, 2021 at the Department of Physics, Tripura University, Suryamaninagar 799022, India. In this regard I would like to mention that the sixth of the series was also organized by our department during 2 – 4 April, 2009. Eleventh conference was organized by Assam University Diphu Campus during 21-23 November, 20218. Due to ongoing pandemic this year we are organizing the conference in ONLINE mode. I am happy to share that despite of the odd situations we have more than 225 participants and 150 contributory research papers will be presented in Oral and Poster Sessions during the Conference. Apart from that there will be one keynote and seventeen Invited talks by several distinguished researchers.

During this conference the organizing committee and PANE are going to felicitate eight distinguished physicists working in the institutions of North Eastern states for their contribution towards development of Physics. Also ten PANE Young Researchers Awards will be given to the young researchers for best presentation of his/her research work under oral and poster category. This is mainly to motivate and encourage the young researchers of this region. I believe that the PANE2021 conference will provide opportunities for young researchers to actively engage in research discussions, information about current funding opportunities, new research interests, research ethics and professional development. Tripura is one of the remote states in North-Eastern region and this type of conference can be an opportunity to create a new door for collaborative research activities in the subject throughout the North-Eastern region as well as also across the country and abroad.

Nowadays, there is a decline in enrolment of bright youngsters in the research and developments in the basic sciences. I am sure that this conference will motivate and encourage the young generation towards research and development in material science as well as basic sciences.

We take the opportunity to thank the sponsors of the conference, especially the Science and Engineering Research Board, DST, Government of India, Bipin Pal Das Trust, Guwahati, Physics Academy of North East and Tripura University.

We are thankful to all of our colleagues, scholars, students and staffs of the Department as well as the University and others, who have accorded their kind help in all regards for bringing out this abstract volume and making the conference a successful one.

We hope that you all will be benefited professionally by attending different technical sessions during the conference.

Prof. Syed Arshad Hussain
Convener
PANE2021 Conference

प्रो. गंगा प्रसाद प्रसाईं
कुलपति
Prof. Ganga Prasad Prasain
Vice-Chancellor

त्रिपुरा विश्वविद्यालय
(केन्द्रीय विश्वविद्यालय)
सूर्यमणिनगर-799022, त्रिपुरा, भारत
Tripura University
(A Central University)
Suryamaninagar-799022, Tripura, India

MESSAGE

I am very happy to know that Department of Physics, Tripura University is going to organize the XIIth Biennial National Conference of Physics Academy of North East (PANE2021) during 15-17 December, 2021.

The Physics Academy of the North East (PANE) is a prestigious organization of physicists especially from the North Eastern India working for the promotion of Physics especially within North Eastern part of this country since 1998.

A good number of renowned scientists from India and abroad will deliver talks during the conference. Young researchers especially Ph.D. students and young faculty members will get an opportunity to interact with them. I believe that this National Conference can help to exchange new ideas, knowledge, and potentials to perform better research in national and international levels. This surely can open a new window for collaborative research in accordance with the national and international level to our research scholars and faculty members.

I am also very happy to know that participants will get opportunity to publish their research papers in two journals including one from Elsevier.

I thank the organizers and wish this PANE 2021 conference a grand success.

(Prof. Ganga Prasad Prasain)
Vice-Chancellor

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♦ वेबसाइट **Website :** www.tripurauniv.in, www.tripurauniv.ac.in

Message from President, PANE 2021

I am glad that a SOUVENIR has been brought out highlighting the forthcoming "**XII Biennial Conference of the Physics Academy of North East**", to be held at Tripura University during 15-17 December, 2021. I am sure this booklet will be able to capture the interest of the young researchers of this region under one platform. Such a great responsibility taken up by Tripura University during the present crisis due to COVID pandemic, is the most important decision in the history of PANE.

I convey my best wishes to the Convener and his team for a very successful upcoming event.

(**Prof. N. Nimai Singh**)
Professor, Manipur University
President, Physics Academy of North East (PANE)

Message from former President and Executive President, PANE 2021

It is a great pleasure to learn that XII Biennial Conference of Physics Academy of North East (PANE) will be held at Tripura University, Agartala during 15-17 ,December,2021.
Twelve years back , during April 2-4,2009, 6th of the series (PANE 2009) , was held in the same venue, which ,I was fortunate enough to participate as the Executive President of the Academy. The Conference was a great success, as I recall even now:
Professor Arunodoi Saha ,then Vice Chancellor of Tripura University inaugurated the Conference in the presence of delegates coming from various institutes of North East India and beyond. The Key note address dedicated as the second Bipinpal Memorial Oration was delivered by Professor G B Talapatra, a noted condensed matter physicist from Indian Association of Cultivation of Science, Kolkata on " Langmuir –Blodgett: : A unique Thin Film Technology Tool." It is to be noted that Bipinpal Das (1920-2005),a Physics Professor , was a parliamentarian from Assam and a fund is created by the family to sponsor the lecture since 2007, under the banner of PANE. The Convener (Professor D Bhattacharjee) , The Secretary (Professor Barin K De) and their team members (which included the PANE 2021 Convener) really worked hard to make conference a big success. And it was really so!
I have no doubt, PANE 2021 will be equally and even more successful and make the spirit of twenty three years old (2021-1998)PANE more stronger.

Dilip Kumar Choudhury
Former President and Executive President, PANE
&
Former Professor of Physics, Gauhati University
December 1, 2021

Message from Secretary, PANE 2021

The Physics Academy of North East (PANE) was inaugurated by the well known edicationist and physicist, late Prof G. C. Deka at the Insititute of Technology (IIT), Guwahati on 6th April, 1998 in a function with the chairmenship of Dr. D.N. Boragohain, the then Director of the institute. The Academy was the brainchild of a gathering of eminent physicists of North East India, on November 11, 1997, at IIT Guwahati, celebrating hundred years of discovery of electron. The genesis of the program led by Prof. K. M. Pathak, the former Vice-chancellor of Tezpur University, gave a wake up call of extablishing such an academy with the aim of promoting physics research and education, wide dissemination of physics information, physics thoughts and culture, placement of physics graduates of North East region.

The main office and headquarter of the Academy was initially located at IITG. But later on after leaving of the Prof. Y.V. G. Murti from IITG after his retirement, the executive body of PANE, held on November 27, 1999 decided to elect Prof. D. K. Choudhury of Gauhati University to officiate as the Executive President of PANE and Prof. Barin Kumar Sarma of GU as member of executive body. For operational ease, it was also decided to shift its office to the Department of Physics, GU. Later on Prof. N. Nimai Singh, Prof. B. Bhattacharjee, Dr. Ranjita Deka (Prajyotish College) took the lead as executive committee members to assist the Exeecutive President of the PANE. Since then the Gauhati University has become the head office of PANE.

The first of the conference series was held at IIT, Guwahati on October 17, 1998; then onwards the PANE conferences were held consecutively like PANE 2000: Cotton College, PANE 2002: Dibrugarh University, PANE 2004: G C College, Silchar, 5th PANE conference of PANE were held in Physics Department, Gauhati University during 1-2 March, 2007, 6th National conference of PANE held in Tripura University during 2-4 April, 2009, 7th PANE National conference held in Manipur University during 5-6 December 2010 , 8th PANE 2012: Mizoram University, 9th National conference of PANE held in North Estern Regional Insitute of Science & Technology, Itanagar, AP on 18-20 December 2014, 10th PANE National conference held in St. Anthonys College, Shillong in 2016 and 11th National conference was held by Assam University Diphu Campus during 21-23 November, 2018. The 12th **Biennial National conference of Physics Academy of the North East (PANE) is going to be held in Department of Physics, Tripura University (A Central University) during 15-17 December 2021.**

Some of the main activities of PANE includes

Organising regular biennial regional conference
Conduct of foundation day lecture
Felicitation of the distinguished and senior physicists of NE
Publishing PANE Newsletter, Research journals
Organising theme based short term conference/seminar/workshop
Keynote speech by eminent personalities
Selection of young scientists award
Conduct of awareness program for wide dissemination of knowledge
conduct outreach programs for undergraduate students
encourage collaborating research works among the NE states.
write monograph or book by the life members of PANE.
hold talk or webinar by its members to show cash their talents.

The newly elected Executive body members of Physics Academy of North East (PANE) for the present term (2021-2023) are

President:
Prof N Nimai Singh, Manipur university

Executive President:
Prof A Gohain Barua, Gauhati University

Vice Presidents:
Prof. Subrata Hazarika, AUS(Diphu Campus)
Prof. Debajit Sharma, Cotton University

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Prof. Kushal Kalita, Gauhati University

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Prof. Angom Dilip Kumar Singh, MU, Manipur
Prof. Dr. Ramesh Chandra Tiwari, Mizoram U, Mizoram
Prof. D. K. Choudhury, Gauhati University, Assam

In future the Academy is planning to expand its activities in relevant areas in order to achieve its aims and objectives as envisioned during its formation of its new official bearers of PANE.

Prof. Kushal Kalita,
General Secretary, PANE

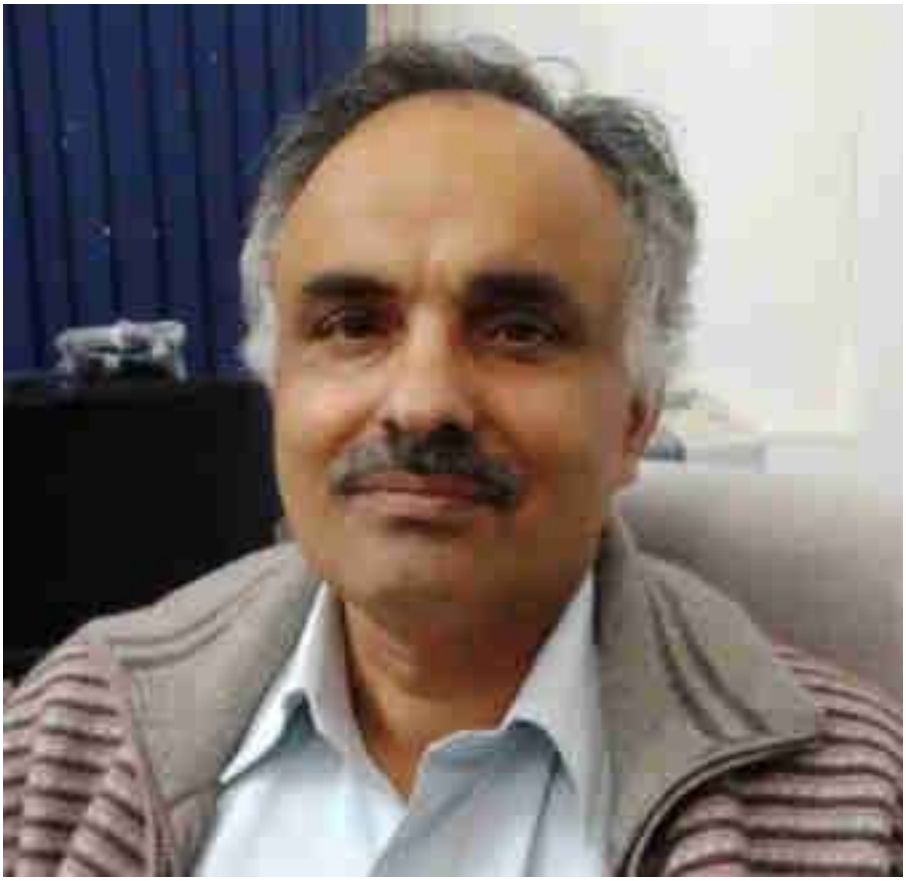
Message from HOD, Department of Physics

Physics Academy of North-East (PANE-2021)
Organized by
Department of Physics, Tripura University during 15-17 December, 2021

It is my great pleasure that our Department is going to organize XII-th Biannual National Conference of Physics Academy of North-East (PANE-2021) from 15-17 December 2021. This is an auspicious ground for integration of national and international physicists of different branches. This Conference has received about several hundred abstracts from all over the country and few from abroad. Large number of eminent scientists from our country and few from abroad has been invited in this conference and provided their kind consent to deliver their talks over different important aspects of physics. This Conference will provide a premier platform for the presentation of different aspects of physics in terms of experiments and theory. In addition, valuable discussions and interactions among the eminent researchers around the country will be able to highlight on key areas of future researches on different branches of physics.I wish a grand success of XII-th Biannual National Conference of Physics Academy of North East (PANE-2021) and hope that it will open a new window for collaborative research between the researchers of our country.

(**Prof. Surya Chattopadhyay**a)
Head, Department of Physics,
Tripura University
Date: 29.11.2021

Obituary



Prof Ashok Kumar
(01.02.1964 to 06.04.2020)

Professor Ashok Kumar was born on 1st February 1964, in the family home of his late father shri Sukhveer Singh in Vivek Vihar, which is located in a rural area of Shamli village of Muzaffarnagar district in Uttar Pradesh (U.P.), India.

Although he lost both his parents at a very tender age, and had to struggle through life, Professor Kumar never allowed adversaries to obstruct his goals in life. He was not only the topper, and hence the gold medallist, in both matriculation and higher secondary examinations from U.P. board of education, but later on he was also the gold medallist in his B.Sc examination under Agra University in UP. He then attended Meerut University in UP from where he got his Master of Physics degree with specialization in electronics. After this he joined the M.Tech programme in Material Science of IIT Kanpur and obtained his M.Tech degree in 1988. He then joined the Ph.D programme of IIT Kanpur and with the guidance of Professor K. Sahi, he finally got his doctorate degree in 1994 in the area of fuel cell electrolytes.

After a few years as Lecturer in Birla Institute of Technology, Pilani in Rajasthan, he joined as Reader in the Department of Physics, Tezpur University in 1999. In 2008 he became Professor and finally became senior Professor in 2019. Along with his academic duties, he never hesitated to offer his support parallelly in

various other administrative capacities. He was the Head of the Department for three years, Dean of the school of science for a period, in-charge of the post of controller of examinations for some time, Chairman of the Tezpur University Entrance Examination Cell for a year, and lately from April 2018, he was holding the three year period post of Head of the Sophisticated Analysis & Instrumentation Centre (SAIC) in Tezpur University.

Being an extremely brilliant, humble and well-mannered teacher, Professor Kumar was immensely liked by all his students. He was very meticulous and sincere in his teaching and left no stone unturned when it came to explaining ideas to his students. On the research front, he was an exemplary figure. His hard-working nature and tenacity were something to admire and learn from. Eighteen students already got PhD degree with his guidance and about six students were continuing their work with him. In his own research lab, he knew how to inspire with his original scientific temper and keep his research students engaged in work. He was also instrumental in setting up some of the other key experimental infrastructure of the Department of Physics, especially related to material science and nanoscience research and teaching.

Professor Kumar's work on fuel cell research, Ionics, development of nano-materials, conducting polymers, ion irradiation of nano-materials, etc., is well known in the scientific circle. His monumental collection of research papers in highly prestigious peer reviewed national and international journals, which is more than 160 in number, stands testimony to his efforts. Nobody can ever forget his contribution towards development efforts of Polymer redox supercapacitors, Phosphoric acid and molten carbonate electrolytes based H_2-O_2 fuel cells, lithium based gel polymer electrolytes, conducting polymer based nanocomposites for actuators, polymer-silicate nanocomposite electrolytes for lithium ion rechargeable batteries, biologically functionalized conducting polymer nanostructures for biosensing applications, recent research in graphene based nanocomposites, etc. His collaborations with Inter University Accelerator Centre (IUAC) in New Delhi, Queen's University in Belfast, UK, Centre for Mathematical Modelling & Simulation (CMMACS) in Bangalore, yielded benefits for the entire research community and also for Tezpur University in particular. His versatility was such that he could also guide research in earth sciences too, parallelly with his research on material science. A number of his PhD students used to work with Global Positioning System (GPS) based units for studying kinematics and crustal deformation of north-eastern India for correlation with seismic activity.

For his confident authority over his research work and his caring supportive nature, Professor Kumar was always welcomed by the leading academic institutions and scientific bodies of not only Assam, but the north eastern region as a whole, other parts of the country and even abroad, to chair sessions and deliver talks. He was a life member of Society for Advancement of Electrochemical Science & Technology, Electron Microscope Society of India, Indian Physics Association, Assam Science Society, Physics Academy of the North East, Materials Research Society of India and Indian Society for Solid State Ionics. He was also the Vice president of Indian Society for Solid State Ionics. He was the principal investigator of 12 completed projects, funded by government bodies like DST, DAE, UGC, IUAC, etc., and was running another 3 projects till his untimely demise. He was invited to deliver talks in USA, Europe, Australia, UK, etc. to present his research work and form collaborations. The honour bestowed upon him in this manner was indeed a matter of prestige for Tezpur University and our country as a whole. Recently, Professor Kumar was admitted by the Council to the Royal Society of Chemistry, as Fellow and was entitled to use FRSC after his name. He was also selected for the Leadership for Academicians Programme (LEAP) which included a visit to Monash University, Melbourne, Australia.

Written by **Dr. Gazi Ameen Ahmed**, Tezpur University

LOCAL ORGANIZING COMMITTEE

c

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Department of Physics, Manipur University
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XII Biennial National Conference of Physics Academy of North East (PANE2021)

15-17 December, 2021

Inauguration of the program will be in **hybrid mode (offline + online).**
Participants from Tripura University will join the inauguration program physically.
Venue: Seminar Hall, Department of Physics, TU.
Registration for Tripura University participants will take place during **9.30 – 10.00 AM.**
Participants outside Tripura University will join the inauguration function online via **GoogleMeet**.
Keynote lecture, Invited Talk and oral presentations will be presented live as per schedule.

GoogleMeet link for joining the program (Outside Tripura University participants):
https://meet.google.com/atj-iwji-pjd

Inauguration Program:

Date: 15.12.2021 (Wednesday); Time: 10.30 AM – 11.45 AM

10.30 AM – 10.35 AM: Welcome address by **Prof Debajyoti Bhattacharjee**, Chairman, Local Organizing Committee, PANE 2021 Conference

10.35 AM – 10.40 AM: Address by **Prof. Syed Arshad Hussain**, Convener, Local Organizing Committee, PANE 2021 Conference

10.40 AM – 10.45 AM: Address by **Prof. Kushal Kalita**, General Secretary, Physics Academy of North East (PANE)

10.45 AM – 10.50 AM: Address by **Prof. N. Nimai Singh**, President, Physics Academy of North East (PANE)

10.50 AM – 10.55 AM: Address by **Prof. Badal Kumar Dutta**, Dean Faculty of Science, Tripura University & **Guest of Honour** of the inauguration function

10.55 AM – 11.00 AM: Address by **Dr. Deepak Sharma**, Registrar, Tripura University & **Special Guest** of the inauguration function

11.00 AM – 11.30 AM: Felicitation of eminent Physicists of North East

11.30 AM – 11.40 AM: Address by **Prof. Ganga Prasad Prasain**, Hon'ble Vice Chancellor of Tripura University and **Chief Guest** of the inauguration program.

11.40AM – 11.45AM: Vote of thanks by **Prof. Surya Chattopadhyaya**, HOD, Department of Physics.

11.45 – 12.00 AM: High Tea (Outside the seminar hall, for physical mode participants)

12.00 PM onwards Technical program will start **ONLINE** with Keynote Address by Prof. Sabu Thomas, Vice Chancellor, Mahatma Gandhi University as per program schedule.

Guideline for participating PANE 2021 conference:

Inauguration of the program will be in **hybrid mode (offline + online). All participants from Tripura University must attend the inauguration program physically at Seminar Hall, Department of Physics, TU at 10.00 AM.** Registration for Tripura University participants will take place during 9.30 – 10.00 AM.
Participants outside Tripura University will join the inauguration function online via **GoogleMeet**. After the inauguration all the lectures will be held online via **Googlemeet.**
Live streaming of the program (all three days) will also be arranged via **YouTube**.
Keynote lecture, Invited Talk and oral presentations will be presented live as per schedule.

GoogleMeet link for joining the program:

https://meet.google.com/atj-iwji-pjd

YouTube Streaming link for joining the program:

Will be provided through whatsapp group/website by 14th December, 2021.

Issuance of certificate:

There are nine sessions including three poster sessions. Feedback will be collected for each session via **google form**, which will also be considered as attendance.
Registered participants with **attendance ≥80% are eligible for certificate** and certificate will be issued accordingly. No certificate will be issued to the participants with attendance <80%. Oral presenter must present their paper according to schedule. Poster presenters must attend the concern poster session.

Poster presentations along with the presentation and interaction guideline:

Videos / PPT related to all posters have already been uploaded in the conference website and can be accessed in the link below.

https://pane2021.wordpress.com/poster-presentations/

All interested participants are requested to go through the poster presentations (PPT/video) by clicking to the link provided with the each paper in right most column in the webpage.

Any quarry / questions / suggestions on any poster (video/PPT) may be noted down along with poster number. During the poster sessions questions with poster number may be put across the chat box during that slot, Chairman of the session will read it and the concern poster presenter will answer the quarries accordingly.

Poster sessions:

15.12.2021 (Wednesday)
12.30 PM – 1.30 PM: Poster Session-I: **2CMPS to 48CMPS**

16.12.2021 (Thursday)
02.30 PM – 3.40 PM: Poster Session-II:
1AC to 19AC; 1AP to 7AP; 1AMP to 5AMP; 2IR to 18IR

17.12.2021 (Friday)
12.00 PM – 1.00 PM: Poster Session-III
50CMPS to 64CMPS; 2NPHEP to 26NPHEP; 1CI to 10CI
Respective poster presenters must attend the sessions.

Program Schedule

XII Biennial National Conference of Physics Academy of North East (PANE 2021)

15.12.2021 (Wednesday)

10.30 AM – 11:45 AM : Inauguration

11:45 AM – 12.00 PM: Hi Tea

12.00 PM – 12.30 PM: Keynote address

Prof. Sabu Thomas
Vice-Chancellor, Mahatma Gandhi University, India
Title: New Opportunities in Sustainable Nano Materials from Agrowaste

12.30 PM – 1.30 PM: Poster Session-I: 2CMPS to 48CMPMS

Chairman: Prof. R. C. Tiwari, Department of Physics, Mizoram University

1.30 PM – 2.30 PM: LUNCH

2.30 PM – 05.00 PM: Technical Session – I

Condensed Matter Physics & Material Science (CMPMS)

Chairman: Prof. D. Bhattacharjee, Dept. of Physics, Tripura University

2.30 PM – 02.50 PM: Invited Lecture (IL-1)
Prof. Mrinal Pal
CSIR-Central Glass and Ceramic Research Institute, Kolkata, West Bengal
Title of topic: Multicolored emission from pristine ZnO nanostructure by tailoring defect states: A possible single source white LED phosphor

2.50 PM – 03.10 PM: Invited Lecture (IL-2)
Prof. Somobrata Acharya
School of Applied & Interdisciplinary Sciences
Indian Association for the Cultivation of Science, Kolkata, West Bengal
Title of topic: Fabrication of Two-dimensional Molecular Crystals at the Air-Water Interface with Photoluminescence Functionalities

3.10 PM – 03.30 PM: Invited Lecture (IL-3)
Prof. Ajay Kumar Kushwaha
Department of Metallurgy Engineering and Materials Science (MEMS), IIT Indore, India.
Title of topic: Nanostructured films for PhotoelectrochemicalWater Splitting

3.30 PM – 03.50 PM: Invited Lecture (IL-4)
Prof. Y. Sundarayya1
Department of Physics, Nagaland University, India
Title of topic: Temperature Assistedtuning Of The Structure And Magnetic Properties Of Rare-Earth And Chromium Oxides Nanoparticles

03.50 PM – 04.00 PM: Oral-1 (1CMPMS)
Molongnenla Jamir
NIT Nagaland
Title of topic: Chitosan modified Fe3O4 nanoparticles for hyperthermia application

04.00 PM – 04.10 PM: Oral-2 (3CMPMS)
Bandana Gogoi, D.N. Govt. College, Itanagar
Title of topic: Magnetization Dynamics of Iron Oxide Superparamagnetic Nanoparticles above Blocking Temperature

04.10 PM – 04.20 PM: Oral-3 (9CMPMS)
Thoudam Basanta Singh, Don Bosco (Autonomous) College, Maram, Senapati - 795015, Manipur, India
Title of topic: A comparative study on five different methods of analysis of complex thermoluminescence data: A short review

04.20 PM – 04.30 PM: Oral-4 (31CMPMS)
Moirangthem Nara Singh, Dr. B Borooah Cancer Institute, Guwahati
Title of topic: Studies on Electron Traps in NaI: Tl scintillating crystal by thermoluminescence

04.30 PM – 04.40 PM: Oral-5 (41CMPMS)
Ningthoukhongjam Kirtimala Devi, Presidency College, Motbung, Manipur
Title of topic: Study of dielectric properties and ac conductivity of zinc ferrite synthesized by chemical coprecipitation technique.

04.40 PM – 04.50 PM: Oral-6 (43CMPMS)
K M S Dawngliana, Mizoram University
Title of topic: Optical basicity and electronic polarizability of Sm3+-doped silica glass prepared by sol-gel process

04.50 PM – 05.00 PM: Oral-7 (44CMPMS)
Dr. Manisha Bajpai, Siddharth University
Title of topic: Frequency and composition dependent impedance analysis of PFO: MEH-PPV polymer blends

16.12.2021 (Thursday)

10.00 AM – 12.00 PM: Technical Session – II

Astrophysics and Cosmology (AC)

Chairman: Dr. Ratan Das, Department of Physics, Tripura University

10.00 AM – 10.20 AM: Invited Lecture (IL-5)
Prof. Archan S. Majumdar
S. N. Bose National Centre for Basic Sciences,Kolkata, India
Title of topic: Dark energy from the perspective of cosmological backreaction

10.20 AM – 10.40 AM: Invited Lecture (IL-6)
Prof. Vikram Rentala
Department of Physics, Indian Institute of Technology Bombay, India
Title of topic: New frontiers in the search for Dark Matter

10.40 AM – 11.00 AM: Invited Lecture (IL-7)
Prof. Asoke K Sen
Department of Physics, Assam University, Silchar, India
Title of topic: Our solar system with its comets and recent space missions

11.00 AM – 11.20 AM: Invited Lecture (IL-8)
Prof. Kalyan Bhuyan
Department of Physics, Dibrugarh University, Assam
Title of topic: f(R) Theories of Gravity: A Dynamical Systems Approach

11.20 AM – 11.30 AM: Oral-8 (10AC)
SAMIK MITRA, IIT GUWAHATI
Steady-state analysis of General Relativistic Magnetohydrodynamics (GRMHD) accretion flows around black hole space-time

11.30 AM – 11.40 AM: Oral-9 (11AC)
Dr. Debika Kangsha Banik, Department of Physics, Barnagar College, Sorbhog, Barpeta, Assam
Î›CDM Model in Born Infeld f(R) gravity in the background of Bianchi I Cosmology

11.40 AM – 11.50 AM: Oral-10 (14AC)
Barun Maity, NCRA-TIFR
Efficient Modelling of Cosmic Reionization using SCRIPT

11.50 AM – 12.00 PM: Oral-11 (17AC)
BISWAJIT DEB, ASSAM UNIVERSITY
Inflation in f(R,T) gravity with Double-Well Potential

12.00 PM – 01.40 PM: Technical Session – III

Condensed Matter Physics & Material Science (CMPMS)

Chairman: Prof S Dorendrajit Singh, Department of Physics, Manipur University

12.00 PM – 12.20 PM: Invited Lecture (IL-9)
Prof. A. Srinivasan
Department of Physics, Indian Institute of Technology Guwahati, India
Title of topic: Development of low dimensional Heusler alloys

12.20 PM – 12.40 PM: Invited Lecture (IL-10)
Prof. Samina Husain
Centre for Nanoscience and Nanotechnology, Jamia Millia Islamia, New Delhi, India
Title of topic: Polyaniline based nanocomposites for supercapacitor electrode application

12.40 PM – 12.50 PM: Oral-12 (61CMPMS)
Hritinava Banik, Tripura University
Title of topic: Transient WORM Memory Device Using Biocompatible Protamine Sulfate with Very High Data Retention and Stability

12.50 PM – 01.00 PM: Oral-13 (49CMPMS)
Dr. Mousumi Bhuyan, Rangia College
Title of topic: eon assisted damage studies on Tungsten for next generation fusion reactor

01.0 PM – 01.10 PM: Oral-14 (54CMPMS)
Dr. J. Marin Sam Gnanaraj, Ssn Research Centre, Ssn College Of Engineering, Kalavakkam
Title of topic: Extraction of Transition Metals from Furnace Dust and Facile synthesis of Metal Oxide nanoparticles for optical limiting applications

01.10 PM – 01.20 PM: Oral-15 (55CMPMS)
Reshma Perayil, S.N.Polytechnic College, Kanhangad
Title of topic: Quantum Systems - A Pedagogic Approach

01.20 PM – 01.30 PM: Oral-16 (59CMPMS)
Prasanth P, Government Engineering College, Thrissur, Kerala
Title of topic: Defining Temperature

01.30 PM – 01.40 PM: Oral-17 (46CMPMS)
Dr S Sundaram Nehru Institute of Technology, Coimbatore, Tamilnadu, India
Title of topic: THEORETICAL (DFT) INVESTIGATION ON HYDROGEN BONDED BINARY LIQUID CRYSTAL MIXTURE (4MCA:6OBA)

01.40 PM – 02.30 PM: LUNCH

02.30 PM – 3.40 PM: Poster Session-II:

1AC to 19AC; 1AP to 7AP; 1AMP to 5AMP; 2IR to 18IR

Chairman: Dr. Samrat Dey, Department of Physics, Pragjyotish College, Guwahati

03.40 PM – 05.00 PM: Technical Session – IV

Atomic and Molecular Physics (AMP)

Chairman: Prof. Anurup Gohain Barua, Department of Physics, Gauhati University

03.40 PM – 04.00 PM: Invited Lecture (IL-11)
Prof. Sangam Chatterjee
Institute of Experimental Physics I and Center for Materials Research (LAMA),
Justus-Liebig-University Giessen, Germany
Title of topic: Towards tailoring layered white-light emitters: recent developments in mixed organic-inorganic halide perovskites

04.00 PM – 04.20 PM: Invited Lecture (IL-12)
Prof. Dilip Angom
Department of Physics, Manipur University, India
Title of topic: Supersolid phases in optical lattices

04.20 PM – 04.40 PM: Invited Lecture (IL-13)
Prof. Prashant Kumar
Physical Research Laboratory, Ahmedabad
Title of topic: Synthetic spectrum method for laser induced breakdown spectroscopy

04.40 PM – 04.50 PM: Oral-18 (2AMP)
Aravind, A.V. Abdurahiman Haji Arts & Science College (Affiliated to the University of Calicut)
Title of topic: Understanding the relationship between the two theorems: Virial and Equipartition

04.50 PM – 05.00 PM: Oral-19 (3AMP)
Amlan Jyoti Borah, Department Of Physics, Gauhati University
Title of topic: Light from the firefly Luciola praeusta at very low temperatures

17.12.2021 (Friday)

10.30 AM – 12.00 PM: Technical Session – V

Nuclear Physics & High Energy Physics (NPHEP)

Chairman: Prof. Betylda Mary Jyrwa, Department of Physics, NEHU

10.30 AM – 10.50 AM: Invited Lecture (IL-14)

Dr. Faizuddin Ahmed
Department of Physics, University of Science & Technology, Meghalaya, India
Title of topic: Effects of Coulomb-type Potential with Uniform Magnetic Field on Generalized Klein-Gordon Oscillator using the Kaluza-Klein theory

10.50 AM – 11.10 AM: Invited Lecture (IL-15)

Prof. Mrinal Kumar Das
Department of Physics, Tezpur University, India
Title of topic: Phenomenological consequences of neutrino masses and mixing

11.10 AM – 11.20 AM: Oral-20 (1NPHEP)
Nayana Gautam, Tezpur University
Title of topic: Impact of texture zeros on leptogenesis within minimal inverse seesaw framework

11.20 AM – 11.30 AM: Oral-21 (4NPHEP)
Tapashi Das, Madhab Choudhury College
Title of topic: Two and Three Loop Effects in the RMS radii of Heavy Flavored Mesons in a QCD Potential Model

11.30 AM – 11.40 AM: Oral-22 (12NPHEP)
Paramita Deka, Gauhati University
Title of topic: Impact of Transverse Enhancement in neutrino oscillation measurements using NOvA

11.40 AM – 11.50 AM: Oral-23 (14NPHEP)
Manoranjan Dutta, Indian Institute of Technology Hyderabad
Title of topic: Self-interacting Dark Matter via Right Handed Neutrino Portal

11.50 AM – 12.00 PM: Oral-24 (24NPHEP)
Jodie T. Ryngnga, North Eastern Hill University
Title of topic: Covariance analysis of efficiency calibration of NaI(Tl) detector

12.00 PM – 1.00 PM: Poster Session-III

50CMPS to 64CMPS; 2NPHEP to 26NPHEP; 1CI to 10CI

Chairman: Prof. Kushal Kalita, Gauhati University

1.00 PM - 2.00 PM : LUNCH

02.00 PM – 03.40 PM Technical Session – VI

Atmospheric Physics (AP)

Chairman: Dr. Anirban Guha, Department of Physics, Tripura University

02.00 PM – 02.20 PM: Invited Lecture (IL-16)

Prof. Colin Price
Environmental Studies Department, Tel Aviv University, Israel
Title of topic: Lightning, Biology, and Evolution

02.20 PM – 02.40 PM: Invited Lecture (IL-17)

Prof. Ramesh Chandra Tiwari
Department of Physics, Mizoram University, India
Title of topic: Study of mechanical, optical and electrical attributes of X ray machines to understand radiation hazard

02.40 PM – 02.50 PM: Oral-25 (2AP)
Parminder Kaur , Tripura University
Title of topic: SEM-EDX based morphological and chemical characterization of aerosols generated during wood burning

02.50 PM – 03.00 PM: Oral-26 (1IR)
ARCHANA BORA, Gauhati University
Title of topic: Application of Artificial Neural Network to determine the thickness profile of thin film samples

03.00 PM – 03.10 PM: Oral-27 (5IR)
Dr. Jhuma Biswas, Pandu College
Title of topic: Effects of COVID-19 pandemic lockdown: A satellite data-based appraisal of air quality in Guwahati, Assam

03.10 PM – 03.20 PM: Oral-28 (7IR)
Thokchom Premkumar Meitei, National Institute of Technology Manipur
Title of topic: Transport properties of polydiperse hard sphere system

03.20 PM – 03.30 PM: Oral-29 (13IR)
Nurul Alam Mazumder, National Institute of Technology Silchar
Title of topic: Amino functionalized coal fly ash: A green and efficient heterogeneous solid base catalyst for Knoevenagel condensation reaction

03.30 PM – 03.40 PM: Oral-30 (15IR)
Dr. Sarangthem Nabadwip Singh, Oriental College (Autonomous), Takyel, Imphal, Manipur
Title of topic: Analysis of thermoluminescence of natural salt by simplified General One Trap differential equation.

03.40 PM – 04.30 PM: Valedictory session

04.30 AM – 05.00 PM: PANE General body meeting

Note: IL = Invited Lecture

Publication of full papers

Full papers of all the presentations (Invited/oral/poster) of PANE conference will be considered for publication in the following journals after peer review process. Each journal will publish a special issue consisting of papers presented during PANE2021 conference.

1. Materials Today: Proceedings (Elsevier)
2. International Journal of Engineering Research & Technology (IJERT)

Deadline for full paper submission as well as guideline of full paper preparation will be updated in the conference website at https://pane2021.wordpress.com/proceedings/

PANE Young Researcher Award (ORAL)

Organizing Committee of PANE2021 conference and PANE have decided to award five "**PANE Young Researcher Award**" for ORAL presentations. This is mainly to motivate and encourage the young researchers of this region. A panel of judges has been proposed accordingly. Based on their recommendation five best presenters (oral) will be selected for this award.

Judges for PANE Young Researcher Award (ORAL)
Prof. Bosanta R. Boruah, Indian Institute of Technology Guwahati
Prof. D. Bhattacharjee, Department of Physics, Tripura University
Prof. Dambarudhar Mohanta, Tezpur University
Dr. Manos Pratim Chakrapani Kalita, Gauhati University
Dr. Ratan Das, Department of Physics, Tripura University
Dr. Samrat Dey, Department of Physics, Pragjyotish College, Guwahati

PANE Young Researcher Award (POSTER)

Organizing Committee of PANE2021 conference and PANE have decided to award five "**PANE Young Researcher Award**" for POSTER presentations. This is mainly to motivate and encourage the young researchers of this region. A panel of judges has been proposed accordingly. Based on their recommendation five best presenters (poster) will be selected for this award.

Judges for PANE Young Researcher Award (POSTER)
Prof. S. Chattopadhyaya, Department of Physics, Tripura University
Prof. R. C. Tiwari, Department of Physics, Mizoram University
Prof. B. Indrajit Sharma, Assam University
Dr. Anirban Guha, Department of Physics, Tripura University
Dr. Sulochana Deb, Gauhati University
Dr. Dr. Rizwin Khanam, Tezpur University
Dr. Abu Mohd Pharhad Hussain, Cotton University

Felicitation

The organizing committee of PANE -2021 conference and Physics Academy of North East (PANE) are very happy to felicitate the following eminent physicist working in different institutions in North East India for their contribution towards development of Physics.

Prof. Dilip Kumar Choudhury
Retired Professor, Guwahati University, Assam
Former Executive President, PANE

Prof. R. C. Tiwari
Professor, Mizoram University, Mizoram

Prof. Th. Jekendra Singh
Retired Professor, Manipur University, Manipur

Prof. Barin Kr De
Retired Professor, Tripura University, Tripura

Prof. Hiralal Durah
Retired Professor, Gauhati Univerity
Ex-Vice-Chancellor of Gauhati University, Assam

Prof. B. M. Jyrwa
Profesoor , NEHU, Meghalaya

Prof. Tado Karlo
Professor, NERIST, Aurunachal Pradesh

Dr. Imtiwati Jamir
Principal , Jubilee Memorial College, Nagaland

Central Instrumentation Center (CIC)
Tripura University

Tripura University has established a Central Instrumentation Center (CIC). The instruments available in the center are being used by research scholars and faculty members of different departments of this University as well as researchers from different institutions of India.

List of Instruments available in Central Instrumentation Centre:

1) Atomic Force Microscope (AFM) (INOVA, Bruker)
2) Field Emission Scanning Electron Microscope with EDS & Sputter Coater, (Sigma 300, Carl Zeiss)
3) 400 MHz NMR (Bruker)
4) Liquid Nitrogen Plant, (StirLITE, Stirling Cryogenics)
5) Gas Chromatography-Mass spectrum (GCMS) (Varian 220-MS / 450-GC, 230V Agilent service)
6) High performance liquid chromatography (HPLC) (Dionex U3000)
7) GSV4004B GPS Ionospheric Scintillation & TEC Monitor (GISTM)
8) Lifetime Spectrofluorometer, (FluroLog-3, Horiba)
9) CHEMIDOC
10) Immunofluorescence Microscope (Carl Zeiss)

Website of CIC:

https://cictu.wordpress.com/
https://www.tripurauniv.ac.in/Page/InstrumentationCentre

Contact:

Prof. S. A. Hussain
Coordinator
Central Instrumentation Center (CIC)
Tripura University

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Keynote Address

Keynote Address

New Opportunities in Sustainable Nano Materials from Agrowaste

SABU THOMAS
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Abstract: Green chemistry started for the search of benign methods for the development of nanoparticles from nature and their use in the field of antibacterial, antioxidant, and antitumor applications. Bio wastes are eco-friendly starting materials to produce typical nanoparticles with well-defined chemical composition, size, and morphology. Cellulose, starch, chitin and chitosan are the most abundant biopolymers around the world. All are under the polysaccharides family in which cellulose is one of the important structural components of the primary cell wall of green plants. Cellulose nanoparticles (*fibers, crystals and whiskers*) can be extracted from agrowaste resources such as jute, coir, bamboo, pineapple leafs, coir etc. Chitin is the second most abundant biopolymer after cellulose, it is a characteristic component of the cell walls of fungi, the exoskeletons of arthropods and nanoparticles of chitin (*fibers, whiskers*) can be extracted from shrimp and crab shells. Chitosan is the derivative of chitin, prepared by the removal of acetyl group from chitin (*Deacetylation*). Starch nano particles can be extracted from tapioca and potato wastes. These nanoparticles can be converted into smart and functional biomaterials by functionalization through chemical modifications (*esterification, etherification, TEMPO oxidation, carboxylation and hydroxylation etc*) due to presence of large amount of hydroxyl group on the surface. The preparation of these nanoparticles includes both series of chemical as well as mechanical treatments; crushing, grinding, alkali, bleaching and acid treatments. Transmission electron microscopy (*TEM*), scanning electron microscopy (*SEM*) and atomic force microscopy (*AFM*) are used to investigate the morphology of nanoscale biopolymers. Fourier transform infra-red spectroscopy (*FTIR*) and x ray diffraction (*XRD*) are being used to study the functional group changes, crystallographic texture of nanoscale biopolymers respectively. Since large quantities of bio wastes are produced annually, further utilization of cellulose, starch and chitins as functionalized materials is very much desired. The cellulose, starch and chitin nano particles are currently obtained as aqueous suspensions which are used as reinforcing additives for high performance environment-friendly biodegradable polymer materials. These nanocomposites are being used as biomedical composites for drug/gene delivery, nano scaffolds in tissue engineering and cosmetic orthodontics. The reinforcing effect of these nanoparticles results from the formation of a percolating network based on hydrogen bonding forces. The incorporation of these nano particles in several bio-based polymers have been discussed. The role of nano particle dispersion, distribution, interfacial adhesion and orientation on the properties of the ecofriendly bio nanocomposites have been carefully evaluated.

References:

***Sabu Thomas et al. ACS Appl. Mater. Interfaces*, 10 (23), pp 20032–20043,2018**
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R Augustine, A Augustine, N Kalarikkal, S Thomas, Progress in Biomaterials 5 (3-4), 223-235, 2016
SS Babu, S Mathew, N Kalarikkal, S Thomas, Biotech 6 (2), 249,2016

Invited Lecture

Condensed Matter Physics & Material Science

Multicolored emission from pristine ZnO nanostructure by tailoring defect states: A possible single source white LED phosphor

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E-mail: palm@cgcri.res.ina

Abstract: Light emitting diodes based on wideband gap semiconductor have drawn much attention due to its potential applications. We have tried with success to generate for the first-time multiple emission havingtuneable PL intensity, shade, and color temperature in pristine zinc oxide. The ZnOnanopowder was prepared by a facile and cost-effective aqueous solution-precipitation method. The as-synthesized nanopowder was annealed at different temperatures ranging from 150 _C to 850 _C and all these samples were characterized by XRD, FESEM, EDX, BET, Raman spectroscopy, and UV-Vis spectroscopy to have insight into their microstructural, compositional, and band-structure details. Optical studies of the samples were conducted using PL and s-PL spectroscopy. Color coordinates of the samples were obtained from the CIE plots derived from the PL spectra. The CIE coordinates were further used to calculate the CCT values of the samples and they are found to be suitable in cold light applications.These nanostructured zinc oxide particles being sufficiently large in size are extremely stable and expected to show photoluminescence for a longer period of time than nanorods and quantum dots. PL studies of the samples revealed that various emission is originating from crystalline point defects, viz. zinc interstitial (Zni), and oxygen interstitial (Oi). Annealing at different temperatures triggered changes in the defect concentrations leading to the corresponding changes in the intensity, shade, and color temperature of the blue phosphorescence.

Suggested references:

1). S. Das, C.K. Ghosh, R. Dey and M. Pal*,*RSC Advances*, **6** (2016) 236
2). F. Rahman, *Optical. Eng.*, **58** (2019) 010901
3). S. Das, U.K. Ghorai, R. Dey, C.K. Ghosh and M. Pal*, *Phys. Chem. Chem. Phys.*, **19** (2017) 22995
4). X.L. Wu, G.G. Siu, C.L. Fu and H.C. Ong, *Appl. Phys. Lett.*, **78** (2001) 2285
5). S. Das, U.K. Ghorai, R. Dey, C.K. Ghosh and M. Pal*,*RSC Advances*,**11** (2021) 335

Fabrication of Two-dimensional Molecular Crystals at the Air-Water Interface with Photoluminescence Functionalities

Somobrata Acharya*
School of Applied & Interdisciplinary Sciences
Indian Association for the Cultivation of Science
(Email: camsa2@iacs.res.in)

Abstract: Owing to the monolayer or few-layered thickness, two-dimensional (2D) molecular crystals represent an important class of materials for advanced optoelectronic applications. Unique properties can be realized from the 2D crystals which are different from the bulk organic crystals. Designing 2D molecular crystals with precise molecular conformation is a challenging tusk. We introduce a promising strategy to fabricate noncovalent free–standing 2D crystals of aggregation-induced-emission active

complexes. The molecular thick, micron long, yet stable 2D crystals are formed in a controllable and efficient way at the flat air–water interface having small roughness.A marked enhancement of luminescence in comparison to the solution is observed from the confined 2D crystals (1, 2).The inherent mechanism of photoluminescence enhancement is understood from in-situ grazing incidence X-ray diffraction measurements at the air-water interface and density functional theory calculations. The critical conformation of molecules within the unit cells concomitantly leads to the reduced singlet-triplet energy gap and strong spin–orbit coupling for effective mixing of the singlet and triplet states for efficient intersystem crossing, which results in room temperature phosphorescence.Although room temperature phosphorescence in 2D molecular crystals is promising for a variety of applications, the availability is limited because of inefficient design strategy of luminescence control. Understanding the complexities of the luminescence pathways in 2D molecular crystals may be useful for designing efficient illumination-based devices.

References and Notes:

1. Maji, S.; Alam, P.; Sandeep Kumar, G.; Biswas, S.; Sarkar, P. K.; Das, B.; Rehman, I.; Das, B.; Jana, N. R.; Laskar, I. R.; Acharya, S.* *Small***2017**, 11, 1603780.
2. Biswas, S.; Manna, G.; Das, B.; Bhattacharya, A.; Pal,A. K.; Datta, A.;Alam, P.;Laskar, I. R. Mondal, P.; Mukhopadhyay, M. K.; Sanyal,M. K.*; Acharya, S.**Small***2021**, (Accepted).

Nanostructured films for PhotoelectrochemicalWater Splitting

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Keywords: nanomaterials, photoelectrochemical, solar energy, metal oxide, surface area

Abstract: Hydrogen as fuel is gaining popularity due to its environmentally friendly nature and high energy per mass. Therefore, cleaner hydrogen production has become an important area of research in which solar driven water splitting has shown excellent potential. However, the design and synthesis of suitable materials for solar driven water splitting is still challenging and numerous efforts are going on worldwide. Herein, we discuss these issues with some possible steps to develop a highly efficient materials. The role of nanorod based photoelectrodes is very crucial for designing a better performing material. However, limitations in harvesting the wider spectrum of solar every is hindering the performance of the metal oxide nanorod based photoanode. The surface modification ofthese nanorodcan further improve the light harvesting capability leading to better performance in solar driven water splitting.

Brief Introduction:

Dr. Kushwaha is Assistant Professor at IIT Indore. He joined IIT Indore in Department of Metallurgy Engineering and Materials Science in July 2016. Prior to join IIT Indore, he worked as a Scientist-I in Institute of Materials Research and Engineering, A*STAR, Singapore. He received M.Sc. degree in Physics (Electronics) from C.S.J.M.University, Kanpur and Ph.D. degree in Physics (Nanomaterials) from IIT Bombay. He is the recipient of DST-INSPIRE Faculty Award (2016) and SERB-Early Career Research Award (2017) from Government of India.Dr. Kushwaha is life-member of Indian Physics

Association (IPA), Electron Microscope Society of India (EMSI) and Luminescence Society of India (LSI). Dr. Kushwaha leads the research group '*Nano & Energy Materials'* at IIT Indore. The group isworking on the synthesis of various functional nanomaterials and the investigation of fundamental properties of nanoscale materials/devices. At present the group work is funded by DST, SERB, CSIR and TEQIP-III etc.

TEMPERATURE ASSISTEDTUNING OF THE STRUCTURE AND MAGNETIC PROPERTIES OF RARE-EARTH AND CHROMIUM OXIDES NANOPARTICLES

Oimang Borang[1], S. Srinath[2], and S. N. Kaul[2], **Y. Sundarayya**[1,*]
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[2] School of Physics, University of Hyderabad, Prof. C.R. Rao Road, Gachibowli, Hyderabad – 500046, India
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Abstract: We report the synthesis of homogeneous single-phase nanoparticles of $RCrO_4$ and $RCrO_3$ (R = Sm, Gd, Dy and Er) by a modified sol-gel hydrothermal method. Heat treatment of the as-synthesized amorph powder at 773 K favours the crystallization of zircon-type tetragonal $RCrO_4$(S.G.*I41/amd*, D_{4h}^{19} symmetry) with Chromium stabilized in unusual Cr^{5+} state ($4s^1 3d^0$)while at973 K results the of formation orthorhombic $RCrO_3$(S.G. *Pbnm*, symmetry) with a stable Cr^{3+}($4s^0 3d^3$)at ambient pressure. The high pressure involved during the hydrothermal synthesis facilitates the stabilization of the metastable Cr^{5+} resulting the monodisperse single phase $RCrO_4$ which is unstable at high temperature. It has been observed that the formation of $RCrO_4$ nanoparticles with smaller sizes while an increase of particle has been observed in respective $RCrO_3$ nanoparticles. DC magnetic measurements suggest that the presence of competing ferromagnetic and antiferromagnetic interactions in $RCrO_4$due to the ordering of Cr^{5+} and R^{3+} near the magnetic transition that causes a magnetic frustration to exhibit metamagnetism. The magnetism of $RCrO_3$manifests Cr^{3+} undergoes a paramagnetic – antiferromagnetic transition with canting of spins at Cr sublattices at Néel temperature (), as a consequence of antisymmetricDzyaloshinsky-Moriya (DM) Cr–O–Cr superexchange interaction with a possible antiferromagnetic (AFM) ordering of the rare-earth at low temperature, .

Keywords: Sol-gel processing, Nanocrystalline materials, Antiferromagnetics
PACS: 81.20.Fw, 73.63.Bd, 75.50.Ee

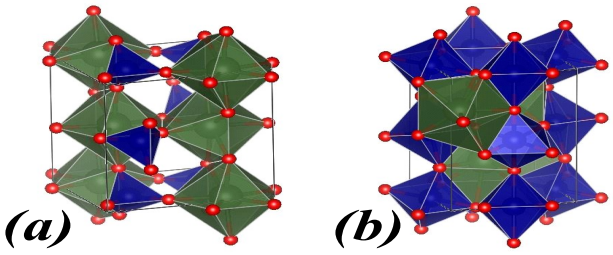

Figure 1. Polyhedral structure of (a) $RCrO_4$ and (b) $RCrO_3$ compounds (R = Rare-earth)

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4. E. Jiménez, J. Isasi, M.T. Fernández, R. Sáez-Puche, *J. Alloys Comp.***344**, 369–374 (2002).
5.0A. Morales-Sánchez, F. Fernández and R. Sáez-Puche, J. Alloy. Comp. **201** (1993) 161.

Polyaniline based nanocomposites for supercapacitor electrode application

Dr. Samina Husain
Centre for Nanoscience and Nanotechnology, Jamia Millia Islamia, New Delhi – 110025, India

Recent years have seen prodigious interest in polymeric nanocomposites especially in usingconducting polymers (CPs) like Polyaniline. Researchers all over the world are doping CPs with fillers to enhance specific properties of polymers for various applications. Also, the rising requirement for development of miniaturized, and light weight supercapacitive devices is insisting researchers to fabricate ecologically friendly and highlyefficient electrode materials. Polymer based nanocomposite, in this regard, have gained massive attention because they act as a bridge between conventional supercapacitors to form elements that can operate to give high performance. In addition, the synthesis and fabrication of such nanocomposites is very economically and they possess thermal stability which is an important requirement for electrode material.

Polyaniline (PANI)are the new next generation pseudo-capacitors which have been immensely used in storing and conversion energy devices. But their inherent limitation of poor cyclic stability limits them to be effectively used as electrode materials for supercapacitors. This disability of PANI can be reduced by using them as nanocomposites with fillers such as carbon materials or metal oxides which introduces small amount impurity in their polymeric chain. This slow down the degradation of PANI, thus, giving relatively high energy and high working potentials of the PANI electrode.

The talk will focus on Polyaniline nanocomposites with the inclusion of carbon materials and metal oxides such as TiO_2 and, different morphologies of PANI which improves the specific capacity of PANI where the structure facilitates an efficient access to electrolyte ions to the electrode surface and shorten the ion diffusion path.

Development of low dimensional Heusler alloys

A. Srinivasan
Department of Physics, Indian Institute of Technology Guwahati, Guwahati-781039, India

Abstract: Full and half Heusler alloys with chemical formula of X_2YZ and XYZ which are prototype ternary ferromagnetic alloys have diversified applications due to their multifunctional properties. Since most of the device applications of these magnetic materials require them in low dimensional (2-d, 1-d and 0-d) forms, there is a lot of interest in preparing and assessing their properties in their low dimensional forms. While the 2-d form is well developed by the industrial R&D sector, the 1-d and 0-d forms have not yet been well developed so far. In this lecture, preparative routes for 1-d and 2-d forms of Heusler alloys will be discussed and compared. Apart from conventional methods such as ball milling, new techniques such as template-less chemical route, electrodeposition and electrospinning will be explored. Challenges in characterizing these low dimensional Heusler alloys will also be discussed with examples.

Atmospheric Physics

Lightning, Biology, and Evolution

Prof. Colin Price
The Jose Goldenberg Chair in Planetary Physics
Head of the Environmental Studies Department
The Porter School of the Environment and Earth Sciences
Tel Aviv University
Ramat Aviv, 69978, Israel
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Abstract: Most electrical activity in vertebrates and invertebrates occurs at extremely low frequencies (ELF), with characteristic maxima below 50 Hz. The origin of these frequency maxima is unknown and remains a mystery. We propose that over billions of years during the evolutionary history of living organisms on Earth, the natural electromagnetic resonant frequencies in the atmosphere, continuously generated by global lightning activity, provided the background electric fields for the development of cellular electrical activity. In some animals, the electrical spectrum is difficult to differentiate from the natural background atmospheric electric field produced by lightning. In this paper, we present evidence for the link between the natural ELF fields and those found in many living organisms, including humans.

Study of mechanical, optical and electrical attributes of X ray machines to understand radiation hazard

Jonathan Lalrinmawia[1], Kham Suan Pau and Ramesh Chandra Tiwari[1,*]
Department of Physics, Mizoram University, Aizawl,Mizoram 796004, India
Mizoram State Cancer Institute, Zemabawk, Aizawl,Mizoram 796017, India
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Present study is first of its kind for Mizoram, which addresses the aspects of prevention against radiation health hazard to the workers, patients and general public. Many unique and important benefits to human life are realized through the utilization of radiation and its various sources. In the present times, diagnostic radiology facilities are widely available across India as well as the present study area, Mizoram. More than 50% of conventional diagnostic X-ray equipment is installed during the past five years. Large number of people undergoes diagnostic X-ray procedures every year. Knowledge of the image quality as well as dose level and the reasons behind poor quality and higher doses provides a basis for setting corrective actions to optimize the protection of the patient in an effective manner. Based on our study and analysis, we have recommended strategies for effective implementation of the quality assurance programs.

Astrophysics and Cosmology

Title: Dark energy from the perspective of cosmological backreaction

Dr. Archan S. Majumdar
Senior Professor & Dean(Faculty)
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Abstract: The present universe is undergoing a phase of accelerated expansion, as evident from multiple observations. One of the widely propagated mechanisms to explain this acceleration is through dark energy, though the physical structure of dark energy is still not understood. The present universe is also very clumpy at large scales, and this may lead to modification of the uniformly homogeneous and isotropic Robertson-Walker ansatz used for studying cosmological evolution. In the present talk we discuss how backreaction of inhomogeneities may have a bearing on the dark energy problem. In particular, we show that in some models such backreaction may cause the universe to exit from this accelerated expansion in the future, thus avoiding the big-rip problem.

Title: New frontiers in the search for Dark Matter

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Abstract: Astrophysics and cosmology provide a wealth of evidence that a significant fraction of the energy budget of the universe is in the form of a mysterious "Dark Matter". However, none of the known particles in the Standard Model of particle physics can explain the astrophysical properties of dark matter. Thus, dark matter must be in the form of some
undiscovered new particles! I will discuss several search strategies and experiments at the frontier that are looking for a particular class of dark matter particles called WIMPs or Weakly Interacting Massive Particles.

Our solar system with its comets and recent space missions

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Abstract:
• It is generally agreed upon by Solar System Physicists that Sun along with all its planets, asteroids , comets and other sub-planets were formed some 4.6 billion years ago out of a single massive body called *primordial solar nebula*. All the current theories about the evolution of our solar system suggest that, the comets were formed near the Jupiter and later due to perturbation by the giant planet, were transported out to a shell like structure called Oort cloud (at 10 ^5 to 10 ^6 AU from Sun). This process had an efficiency of 10 percent and rest 90 percent of the comets were lost into the interstellar medium.
• As we understand the Sun should be a typical star and there are many planetary systems like ours in our galaxy, so the stars in our galaxy together should have contributed a large of comets into the

interstellar medium. Such comets would not be gravitationally bound to any individual star, move like free particles and may occasionally get intercepted by our Solar system. From earth as we observe, we can distinguish these interstellar comets from our own solar system ones, by their hyperbolic orbits. The recent detections of two such interstellar comets Oumuamua and Borisov have now confirmed the theoretical predictions made by Sen and Rana in this regard, way back in 1993.

• These interstellar comets should carry the materials from other exosolar systems and stars, into our own solar system. We can even conduct in-situ and sample return missions to study such comets. These comets have a lot of significance in the study of our own solar system.

• Apart from the remote ground based observations, since 1985 comets are being studied by close fly-byes and in situ observations. Very recently we have also carried out sample return missions to comets. After such space missions we have understood many details about the evolution of our solar system, but at the same time a new set of questions about the formation mechanism of our solar system has come up. The details will be discussed.

f(R) Theories of Gravity: A Dynamical Systems Approach

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Abstract: In cosmology, the presence of the Big Bang singularity, together with the flatness, horizon, and monopole problems has pointed to the fact that the standard cosmological model based on GR and on the Standard Model of particle physics may not be adequate to describe the universe at extreme regimes. Over the past few decades, f(R) theories of gravity have drawn considerable attention of the scientific community as one of the simplest extension of General Relativity. In this talk, we shall discuss the motivation behind the formulation of such theories and also the results of various investigations carried out using the Dynamical Systems Approach to understand the cosmological implications of different f(R) theories of gravity.

Nuclear Physics & High Energy Physics

Eûects of Coulomb-type Potential with Uniform Magnetic Field on Generalized Klein-Gordon Oscillator using the Kaluza-Klein theory

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Abstract: In the background of Kaluza-Klein theory, we analyze interactions of Klein-Gordon oscillator and Coulomb-type potential in the presence of a uniform magnetic ûeld in the ûve-dimensional topological defects space-time geometry. Due to the dependence of global parameters on the energy eigenvalues and the wave function of a charged particle, the gravitational analogue of the Aharonov-Bohm eûect is seen. In addition, we see a quantum eûect because of the dependence of the magnetic ûeld on the quantum numbers of the relativistic system.
keywords: Kaluza-Klein theory, Relativistic wave equation, AharonovBohm eûect, special functions.

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Phenomenological consequences of neutrino masses and mixing

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Abstract: We know that elementary particles play an important role in our universe as they are the basic building blocks of all visible matter. Among them, neutrinos play very important role as they are the second most abundant particle after the photon. We will discuss about the elementary particles, four fundamental forces, standard model of particle physics and its drawbacks etc. Then we will discuss the importance of neutrinos and how the standard model fails to explain the neutrino masses. We will also discuss how the seesaw mechanism is successful in describing the origin of neutrino mass beyond the standard model. Finally, phenomenology of neutrino masses and mixing will be discussed in the context of recent neutrino and cosmology data.

Atomic and Molecular Physics

Towards tailoring layered white-light emitters: recent developments in mixed organic-inorganic halide perovskites

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Various classes of materials are currently discussed for the next-generation of optoelectronic devices. Prominently, these include so-called 2D materials, i.e., atomically thin, layered materials including graphene as well as various transition-metal di-chalcogenides, and hybrid perovskites. Low-dimensional organic-inorganic perovskites synergize the virtues of the two by Allowing for tailorable, quasi-two-dimensional building blocks while providing enhanced light harvesting and emitting capabilities.

This talk covers both, recent developments in hybrid perovskites towards lead-reduced materials are presented.[1] Furthermore, we report a quasi-one-dimensional organic-inorganic perovskite [C H N] [BiCl]Cl.[2] It surpasses the paradigm that atomically thin materials require in-plane covalent bonding: its one-of-a-kind 1D-2D structure enables single layers and the formation of self-trapped excitons. This shows intense white light emission which is extremely thickness dependent. These findings enable a much more general construction principle for tailoring and identifying two-dimensional materials that are no longer limited to covalently bonded 2D sheets.

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Synthetic spectrum method for laser induced breakdown spectroscopy

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Laser induced breakdown spectroscopy(LIBS) has revolutionized the field of analytical chemistry in the last two decades. The ease of operation combined with minimal sample preparation and versatility of the technique makes it an ideal choice for analytical applications [1,2]. The present talk is aimed to give a flavor of this evolving technique. A brief overview of the basic underlying principles of this technique will be presented first along with significant improvements achieved in the last two decades. This will be followed by discussion on a calibration free approach(CF-LIBS) we have developed for

elemental estimation using synthetic spectrum generation[3]. A general discussion on the three basic assumption of CFLIBS, viz, local thermodynamic equilibrium, stoichiometric ablation and plasma homogeneity will be presented. The suitability of the method for analyzing optically thick plasmas and retrieval of elemental composition from different samples will be presented. Possible use of this method to other applications such as determining detection limits in LIBS, sensitivity studies and Stark parameters determination in LIBS plasma will be presented.

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Title: Supersolid phases in optical lattices

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Abstract: The long sought supersolid phase of quantum matter was recently observed in ultracold atoms with long-range interactions. Here, ultracold could mean as low as a few nanoKelvins. At such temperatures a dilute gas of atoms is quantum degenerate and forms a giant matter wave. The supersolid phase is a unique form of quantum matter. It is superfluid but endowed with properties attributed to solids. We have investigated the supersolid phases which can emerge when the ultracold atoms are subjected to a lattice potential. We also examine the effects of thermal fluctuations and find that the supersolid phases in such a system are fragile.

Contributory Papers

Condensed Matter Physics & Material Science

Effect of variationof reaction time upon synthesized PVA/CdS/ZnS core/shell Nanoparticles

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Abstract: In recent times due to the uniqueproperties exhibited bysemiconducting nanomaterials,they are receiving immense attention from the researchers all over the world. These properties cannot beobtained in other conventional materials. Examples of such nanomaterials are CdS, ZnS etc. where both CdS and ZnS belong to group II-VI of the periodic table. CdS nanoparticles have a direct band gap of 2.42 eV[1] whereas ZnS nanoparticles have direct band gap of 3.68 eV. Both CdS and ZnS nanoparticles show physical, chemical and structural properties which are quite different from the corresponding bulk materials [2,3].The structure where over the surface of one semiconducting nanomaterial, a layer of another semiconducting nanomaterial is deposited is known as the core/shell nanostructures.Due to the shell boundary over the simple quantum dot core, the core/shell quantum dot exhibits improved optical properties over simple quantum dots which increase the stability and photoluminescence efficiency of the material [4].

In his present work, CdS/ZnS core/shell nanoparticles have been synthesized adopting a wet chemical precipitation technique. Five different samples of CdS/ZnS nanoparticles have been synthesized, varying the reaction time.For the synthesis of CdS nanoparticles, cadmium chloride ($CdCl_2$) and sodium sulfide (Na_2S) were used as the precursors and polyvinyl alcohol (PVA) was used as the matrix.The synthesis has been done at 60-80^{0}C. The ZnS shell have been grown over the CdS core, adopting one pot synthesis technique using $ZnCl_2$as the precursor.Thesynthesized CdS/ZnSnanoparticleswere characterized by UV-visible spectroscopy (UV-vis), Photoluminescence spectroscopy (PL), X-ray diffraction (XRD), SEM and EDAX analysis.Moreover to study the lattice spacing as well as particle size distributionof the CdS/ZnS core/shell nanomaterials TEM and HRTEM analysis were performed. From the UV-vis spectra, the position of absorption edges were estimated and hence band gaps of the samples were calculated using Tauc's method which confirms formation of the respective nanostructures. The emission spectra showed well defined emission bands. The XRD peak positions matches well with the standard JCPDS data.

Keywords: CdS, CdS/ZnS, chemical precipitation method,Tauc's method, one pot synthesis technique.

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Magnetization Dynamics of Iron Oxide Superparamagnetic Nanoparticles above blocking temperature

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Abstract:
Magnetic characterizations of synthesized superparamagnetic Iron-Oxide nanoparticles have been carried out at various constant temperatures. As magnetization vs magnetic field (M-H) curve verifies the superparamagnetic nature of nanoparticles, M-H curve has been analysed to verify the superparamagnetic behavior of synthesized nanoparticles. Further, the M-H curve has been analysed to fit the Langevin function and also the size distribution of nanoparticles has been studied. The experimentally measured magnetization curve found to fit the theoretically calculated Langevin function satisfactorily. The typical intrinsic magnetization of prepared nanoparticles show superparamagnetism and observed to follow the sigmoid function with negligible remenence and coercivity value. The particles are found to be agglomerated with a size distribution of 10-30 nm.

Keywords: Blocking temperature, Magnetic nanoparticle, Single domain, Superparamagnetism.

Visible Light Driven Photocatalytic Activities of Metal Sulfides Synthesized by Simple Co-Precipitation Method

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Simple co-precipitation method was employed for the successful preparation of metal sulfide nanostructures (ZnS and CdS). The structural properties of the samples were investigated using X-Ray Diffraction (XRD) technique. The crystallite size of CdS and ZnS were observed to be 3.2nm and 3.3nm respectively. The optical band gaps of the samples wereexamined using UV-Visible spectroscopy. The photocatalytic activities of the nanostructures were studied and compared towards the degradation of Malachite green dye under visible light irradiation. It was observed that CdS shows higher photocatalytic efficiency which degrades 95% of the dye under 2 hours of visible light irradiation as compared to ZnS which degrades only 35% of the dye under 2 hours of visible light irradiation. Optimized condition for the degradation process can be further investigated by examining the effect of operational parameters on the degradation activity.
Keywords: Metal sulfide, Photocatalysis, visible light, malachite green.

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Optical basicity and electronic polarizability of Sm^{3+}-doped silica glass prepared by sol-gel process

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Abstract: The SiO_2-doped with Sm^{3+} of various concentrations (100-x) SiO_2:x$SmO_{3/2}$ (where x = 0.5, 1.0, 1.5, 2.0 mol%) have been prepared by sol-gel method and non-linearity properties are studied. The physical parameters like density, molar volume, total molecular weight, refractive index, reflection loss, molar refractivity, energy gap, molar electronic polarizability, dielectric constant, optical dielectric constant, electronic polarizability, ionic concentration, polaron radius, inter ionic distance, field strength and optical basicity were obtained. The structural information was acquired through Fourier transform infrared (FTIR). FTIR spectra suggested the structure of the present glasses. On the basis of the measured values of the density and refractive index, the Sm^{3+} ion concentration in glasses, the polarizability of oxide ions and optical basicity were found to increases with rare earth (RE) ions concentration. Theoretically the oxide ion polarizability increases with the refractive index and decrease with energy gap. The theoretical value of molar refraction, electronic polarizability, oxide ion polarizability and metallization criterion were calculated by using Lorentz-Lorenz equation. Theoretical optical basicity of the glasses is evaluated based on equation proposed by Duffy and Ingram. The dielectric constant and optical dielectric constant were found to increase with increase in RE ions concentration.

Keywords: Samarium, Optical Basicity, Electronic Polarizability, Metallization Criterion, Non-linearity.

SECTION: CONDENSED MATTER PHYSICS AND MATERIALS SCIENCE

UV light illuminated photodegradation of Malachite green dye using ZnO/CuO nanocomposites

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The present study involves the successful synthesis of ZnO/CuO nanocomposites in different composition ratio (4:1, 3:2, 2:3, 1:1 and 4:1) by hydrothermal method. The synthesized samples were characterized by X-ray diffraction (XRD) and UV-Visible Absorption techniques. The XRD analysis confirms the formation of composite phase of hexagonal wurtzite structure of ZnO and monoclinic phase of CuO. The photocatalytic activities of the samples on the degradation of Malachite green (MG) dye were analyzed under the illumination of UV light and their corresponding kinetic modeling was also studied. It is observed that ZnO/CuO in the ratio 3:2 shows better activity towards the degradation of MG degrading 97.6% within 4 hrs. of irradiation.
Keywords: Photocatalytic Activity, ZnO/CuO nanocomposites, Malachite Green dye

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Synthesis, Characterization and Application of Sb_2Se_3 in Solar Cells

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Abstract: Antimony selenide (Sb_2Se_3) thin films were deposited at room temperature by thermal evaporation on SLG (soda-lime glass) substrates. The Sb_2Se_3 material was prepared by using the solid-state reaction route. The prepared Sb_2Se_3 material is having a single crystal structure. The effect of the annealing on the film microstructure was studied. Various characterizations including XRD, UV-

Vis spectroscopy and Raman spectra were done to check the phase, morphology and optical properties of material.The results suggest that the thin films have the same composition as the Sb_2Se_3 powder but the structure was amorphous. The thin films were deposited at room temperature and annealed at 200°C and 300°C. The crystallinity of the Sb_2Se_3 thin films improved after annealing at various temperatures. Sb_2Se_3 thin film parameters such as band gap and absorption coefficient achieved from experimental results are used for the numerical study of solar cells by using SCAPS-1D software and a higher efficiency is achieved by using this material.

Concentration effect on the luminescent and structural properties of YPO_4: Eu^{3+}

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Abstract: Different concentrations of Eu^{3+} doped YPO_4 samples were prepared using co-precipitation reaction. The prepared samples were characterised by using XRD, PL(Photoluminescence) and FTIR. The crystallite size of the samples are found to be in the range of 10-18 nm. Photoluminescence studies give information about the excitation and emission spectra of the synthesized samples. Among the different concentrations of Eu^{3+} doped samples 5% doped sample gives the highest emission spectrum as compared to other. Two intense emission peaks were found at 593 nm and 618 nm. These peaks are due to $^5D_0$ $^7F_1$ (magnetic dipole transition) and $^5D_0$ $^7F_2$ (electric dipole transition) transitions of Eu^{3+} respectively. The average lifetime of the synthesized samples are found to be 3.52 ms.
Keywords: YPO_4, PL (Photoluminescence), excitation, emission, lifetime.

Neon assisted damage studies on Tungsten for next generation fusion reactor

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Abstract: Tungsten and graphite samples are is being proposed are very important for the plasma facing component material of next generation fusion reactor because of its superior thermo-physical and mechanical properties. It is essential to study the ion material interaction for its response to severe conditions of fusion reactor. In this work, an ingenious ion source namely plasma focus is used to study the effect of neon irradiation on tungsten as well as graphite under various experimental conditions. To observe the structural changes of exposed and reference tungsten and graphite samples were analyzed using X –ray diffractometer. X-ray diffraction pattern which confirms the development of compressive stress on the samples due to thermal load and formation of other phases or some expanded phases. Surface analyses confirm the formation of micro-cracks, bubbles, blisters, holes etc

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Unique aggregation pattern of Perylene Bisimide based U shaped liquid crystal of PBI-Se on Langmuir-Blodgett thin film.

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Abstract: The liquid crystal molecule, synthesised, short-named as PBI-Se (derivatives of Perylene bisimide) is U shaped bay-annulated one. As a part of previous work, PBI-Se was prepared. Starting from Perylene-3,4,9,10-tetracarboxylic acid dianhydride to the final product PBI-Se, the important steps were bay anulation with Selenium powder and treatment with tris-dodecyloxy benzyl amine[1]. The PBI-Se pack into columns with enhanced intermolecular interactions. PBI-Se molecules exhibited lower melting and clearing temperature, with good solubility.
The symmetrical eight rings flat-core mesogen molecule, NN‖p-bis[(2,3,5-tridodecyloxyphenyl)methyl]-(6,7-μ-Se)3,4,9,10-Perylenetetracarboxylic Diimide (i.e., PBI-Se) was taken for preparing Langmuir Blodgett isotherm study and film preparation. Though the molecule is amphiphilic, it did not give good Langmuir thin layer. This is the reason why we employed Arachidic acid, $CH_3(CH_2)_{18}COOH$, (AA) as supporting material to make a thin layer. Several ultrathin LB layers were fabricated taking amphiphile PBI-Se mixed with AA. The isotherm characteristics of different mole fractions revealed the perfection of thin layer formation. The UV-Vis absorption spectra and fluorescence spectra of its solution and thin films showed the tendency to form *J*-aggregates. Scanning Electron Microscopic pictures have showed the PBI-Se molecules form flower like structure on LB film.

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Structural, Optical, and dispersive parameters of (Gd, Mn) co-doped $BiFeO_3$ thin film.

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Abstract: Nanocrystalline bismuth ferrite thin films co-doped with Gd and Mn were successfully fabricated via sol-gel spin coating method onto the corning glass substrate. The effect of Gd and Mn incorporation at A and B site of bismuth ferrite perovskite on its structural, microstructural, and optical properties was studied systematically. The starting material for the synthesis of the samples was bismuth nitrate, ferrite nitrate, gadolinium nitrate and manganese acetate. These precursors were dissolved in 2-methoxy ethanol to prepare the sol, which was spin-coated at an optimized rate of 3000 rpm for 30 s on corning glass substrate. The samples were heated subsequently at 350^0C for 5min on a hot plate in open air and further annealed at 550^0C for 2h at a muffle furnace for crystallization of the as-prepared thin film. X-ray diffraction analysis reveals the existence of distorted rhombohedral perovskite structure with preferred orientations along the (101) plane. The incorporation of Gd and Mn in bismuth ferrite perovskite was confirmed from Raman spectra measured at room temperature. Surface morphology and microstructural studies were carried out using Atomic Force Microscopy (AFM) and Field Emission Scanning Electron Microscopy (FESEM). Several optical parameters like bandgap energy, Urbach energy, Extinction co-efficient, Near Edge Absorption ratio were determined from Ultraviolet-Visible spectra of the film prepared. The variation of refractive index, permittivity, loss tangent as a function of wavelength were plottedand discussed. Real and imaginary parts of dielectric functions as a function of photon energy were reported. The correlation between the structural and the microstructural parameters with the optical parameters was investigated in this work.
Keywords: Spin coated; bandgap; refractive index.

Structural and dielectrical analysis of rare earth doped Bismuth Ferrite Nanoparticle at high frequency.

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Abstract : Pure and rare earth doped Bismuth ferrite ($Bi_{0.85}R_{0.15}FeO_3$ with R = Gd and Sm) were fabricated by a modified sol-gel auto-combustion method. The precursors used were [$Bi(NO_3)_3.5H_2O$], [$Fe(NO_3)_3.9H_2O$], [$Gd(NO_3)_3.6H_2O$] and [Sm $(NO_3)_3.6H_2O$].The pure phaserhombohedral bismuth ferrite structure with preferred orientation along (1 1 0) was confirmed by X-ray diffraction (XRD) pattern after annealing at 550ºC for 2 hrs.The structural and microstructural properties of the samples prepared wereinvestigated by X-ray diffractometer. Williamson-Hall Plot is used to calculate the crystallite size and microstrain from theXRD data. Dielectric measurement werecarried out at room temperature in a wide frequency range ranging from 100Hz to 1GHz. The variation of dielectric constant and loss tangent in the frequency range of 100Hz to1GHz were investigated. The variation of dielectric constant with temperature were also studiedat low frequency .
Keyword: sol-gel auto-combustion, dielectric constant, loss tangent

Sketchy synthesis of MnO_2, MnO_2/CNT, MnO_2/AC composites for application of/in Energy cache

With the growing treat of environmental issues and depletion of fossil fuels, the generation of renewable sources wind, solar, thermal and hydro power are of great importance to the sustainable development of human society. To empower energy structure evolutions, trusty energy storage systems such as fuel cells, batteries and supercapacitors portray an important role. Current enlargement in the ground of wearable and transferable devices augmented their reputation and requirement through worldwide. Cycling life span and charging/discharging property of supercapacitor make it suitable to perform unique properties of instant high amount of power supply related with high energy density. For constantly changing technology SC's with low manufacturing costs are persistent. SC's structure involves two nonreactive porous plates known as electrodes containing electrolyte, within two current collectors in which voltage is applied divided by separator. Because of larger surface area of the active material in the electrode region commonly accomplished by using carbon.Selecting and designing the electrode materials for energy cache and it's competence to conduct the faradic charge is vital to increase the overall capacitance value. In the present work, Sol-Gel method is engaged for the synthesis of active material composites MnO_2, MnO_2/CNT, MnO_2/AC which are applied to the energy storage. Commixing the carbon allotropes into MnO_2 matrix boosts conductivity. Analytical techniques such as XRD, FE-SEM, FTIR, UV-Vis Spectroscopy are accomplished.
Keywords: Energy cache, Supercapacitors, carbon allotropes, Sol-Gel method.

Effect on the conductivity of ZnO nanoparticle dopped in PVC films

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Abstract: ZnO Nanoparticle doped on PVC solution at different concentrations and made films with different thicknesses. The conductivity is measured for different applied fields and temperatures for ZnO nanoparticle doped and undoped films. The $ln\sigma$ versus $\frac{1}{T} \times 10^{-3}$K is doped and shows the nonlinear nature. From the plot, it is found that the conductivity increases more sharply for the doped sample than the undoped sample within an intermediate range of temperature. The activation energy is calculated for different regions from the plot and found to increase with an increase of doping.
Key Words: ZnO nanoparticles, Arrhenious equations, PVC films, and Activation energy.

ANALYSIS OF LiF: Mg, Cu, P IN THE NEW GENERAL-ORDER KINETICS

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Abstract: Thermoluminescence(TL) curve of LiF:Mg,Cu,P dosimeter was analyzed using the new general-order kinetics model. The new general-order kinetic equation is based on the temperature-dependent frequency factor. The analysis shows that the TL curve of LiF:Mg,Cu,P dosimetercomprises three individual TL peaks. The Computerised Glow Curve Deconvolution (CGCD)study shows that the activation energies of the three TL peaks are 1.3eV, 1.485eV, and 2.51 eV. The value of frequency factors for the three peaks are 1.39×10^{11}, 1.88×10^{11} and 3.1×10^{20} s^{-1} respectively. The value α are 0.2, 0.5, and 0.13. The valuesuggests that mostly recombination center surrounds the trap corresponding to the main TL peak.

Effects of doping of zinc and mercury composition-dependent opto-electronic properties of $Cd_{1-x-y}Zn_xHg_yS$ quaternary alloys: A First-principles investigation

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Abstract: First principle calculations have been carried out to explore zinc and mercury composition-dependent electronic and optical properties of zinc-blend specimens under the $Cd_{1-x-y}Zn_xHg_yS$ triangular quaternary system employing DFT[1, 2] oriented FP-LAPW[3] approach. Each quaternary alloy shows thermodynamic stability. Calculations with modified-Becke-Jonhson (mBJ)-GGA [4], and GGA+U[5] schemes show that each quaternary alloy is a direct band gap (Γ-Γ) semiconductor. Carrier transportation in each specimen is significantly dominated by electrons due to their much lower effective mass compared to holes. Electronic transitions from occupied S-3p state of the valence band to unoccupied Zn-5s, Cd-6s, Hg-7s states of conduction band are exclusively or collectively responsible for the occurrence of intense peaks in the $\varepsilon_2(\omega)$ spectra of the considered specimens. Semiconductor specimen with higher band gap possesses lower $\varepsilon_1(0)$, $n(0)$, and $R(0)$, but requires higher critical point energy in the $\varepsilon_2(\omega)$, $k(\omega)$, $\sigma(\omega)$, and $\alpha(\omega)$ spectra and vice versa. Moreover, their fundamental optical absorption edge can be varied as a function of compositions x and y substantially over the entire range of infrared spectrum. Such attractive optoelectronic properties lead these semiconductors as potential materials for manufacturing infrared optoelectronic devices, infrared detectors, and sensors etc.

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Chitosan modified Fe_3O_4 nanoparticles for hyperthermia application

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Magnetic fluid hyperthermia, a modular strategy for disease treatment have received a lot of attention in biomedical application, owing to its lower clinical symptoms and likelihood specifically in harmful malignancy tumour [1-2]. In recent times many researchers have been working on biocompatible, non-toxic, and chemically stable magnetic nanoparticles for hyperthermia applications however few attention have been given on ferrites nanoparticles.

In this work, Chitosan coated Magnetite nanoparticles (Fe_3O_4) were synthesized using solvo-thermal method. The structural characterization of the samples was performed by using x-ray diffraction (XRD) technique. The crystallite size of both bare and chitosan coated Nanoparticles were calculated from Scherrer's formula [3] and W-H plot which are found to be in the range of 20 to 30 nm. The magnetization (M_s) values obtained from VSM study at room temperature of both Fe_3O_4 and Chitosan coated Fe_3O_4 are 71.871 emu/g and 60.275 emu/g respectively. The reduction in M_s for the coated samples is expected as surface functionalization with organic compounds like chitosan and dextran increases the quantity of non-magnetic material, resulting in a reduction in M_S [4]. The surface absorption rate (SAR) was also determined for both the nanoparticles using the following equation [5]. The specific absorption rate (SAR) is used to calculate the efficiency of magnetic hyperthermic. The efficiency of Magnetic hyperthermic ability is also measured by calculating specific absorption rate (SAR) for both nanoparticles. At 187.09 Oe, Fe_3O_4 nanoparticles (NPs) show maximum SAR of 173.6 W/g, while Chitosan coated Fe_3O_4 NPs show a SAR of 161.16 W/g.

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Optical and Structural Characteristics of PANI capped PbS nanoparticles

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The modern research communities are now-a-days immensely attracted towards the semi-conductor nanoparticles due to their budding application in both traditional optical devices and new generation of Nano-electronic and Nano-optoelectronic devices because of their unexpected chemical and physical properties. In this present work a wet Chemical technique have been adopted to synthesize PbS nanoparticles capped in polyaniline (PANI) matrix in a non-acidic medium. The precursors used here are Lead Nitrate ($Pb(NO_3)_2$))/Lead Acetate ($Pb(CH3COO)_2$) and Sodium Sulphide (Na_2S). Polyaniline (PANI) has been used as a conductive capping agent. PbS is synthesized by varying the concentration of conducting matrix PANI while keeping the reaction time constant (i.e 3 hrs). The PANI concentration has been changed from 0.5 gm to 2.5 gm in 5 different samples. Finally the synthesized samples are characterized by using various characterization techniques such as UV-Vis Spectroscopy (UV), Photoluminescence Spectroscopy (PL), X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM) and Energy Dispersive X-RAY Analysis (EDAX) and Tunneling Electron Microscope (TEM).

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A DFT study on the reactions of ruthenium anticancer drug KP1019 with DNA Bases

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Ruthenium (Ru)-based drugs have attracted a great deal of interests of various researchers as promising anticancer compounds over the last three decades for their favorable toxicity and drug resistance. Four Ru-compounds, namely, NAMI-A, KP1019, NKP1339 and TLD1433 have entered the clinical trials. However, a clear-cut understanding to their mechanisms of action and molecular targets is still lacking

and is of much interest. Herein, we have studied the reactions of mono-aquated KP1019 with different sites of DNA bases at the M06-2X/(LanL2DZ+6-311+G**)//M06-2X/(LanL2DZ+6-31G**) level of density functional theory (DFT) in gas phase and aqueous media. The conductor-like polarizable continuum model (CPCM) was used for solvation calculations in aqueous media. The computed reaction free energy ("G_f) and reaction enthalpies ("H_f) in aqueous media shows that all the reactions are exothermic and would occur spontaneously. It is noted that the bond distances of Ru-DNA bases site are comparatively shorter than the Ru-Cl distances which indicate that ruthenium is tightly attached to the reaction sites of DNA bases. It is found that the mono-aquated KP1019 would react more favorable with adenine as compared with any other base. Further, the N3 site of adenine is found to be the most favorable site for reaction with KP1019.

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Studies on Electron Traps in NaI: Tl scintillating crystal by thermoluminescence

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Abstract: Thermoluminescence(TL) has often been used to characterise materials used in numerous practical uses like dosimetry, dating, persistence luminescence, scintillation. Following the same, in this work, we present the trap spectroscopy of a NaI: Tl single crystal used in an old commercial (discarded) detector.

Our rigorous analysis by deconvolution shows the presence of three discrete trap levels of depth 1.05±0.01, 1.27±0.00 and 1.31±0.01eV with the lifetime of an electron trapped 7.85±4.3 hours, 1.44± 0.6 months and 8.08±2.9 months, respectively. For a heating rate of 5 !/sec, the peaks are located at 115±7, 149±5 and 163±5 !.

A critical discussion on the physics of TL in NaI: Tl is presented that may help develop a better scintillator in NaI activated not only Thallium (Tl) as activator but also other activator couples with co-activators, something that is being used recently in novel phosphor.

Keywords: Scintillator, Thermoluminescence, Electron Trap, Afterglow

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A comparative study on five different methods of analysis of complex thermoluminescence data: A short review

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Abstract: In this short review we examine the potentialities and limitations of five independent methods of analysis of complex thermoluminescence (TL) data. We feel it is time to critically scrutinize the five methods namely the Urbach's rule, the initial rise (IR) method, various heating rates (VHR) method, the peak shape (PS) method and the Glow Curve Deconvolution (GCD) method as used by numerous workers spread over the last seven decades or so.

In this short but critical review we discuss the myths and misconceptions that has crept into the literature in the last two decades or so by researchers of the field of materials science who have taken a casual approach to the use of the technique. The main purpose of the review is to expose the serious flaws in the documented data on trapping parameters that violates the physical basis of the phenomenon. Finally, some simple examples are provided so that future workers make proper use of TL in characterization of their novel materials.

Effect of deposition time on the structural and optical properties of CdSSe/PVA thin films prepared by chemical bath deposition technique

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Abstract: The compound Cadmium sulpho selenide (CdSSe) belongs to the chalcogenide semiconductor group and finds wide applications in solar cells, optoelectronic devices, field effect transistors, light emitting diodes, etc. In this work, Cadmium sulpho selenide (CdSSe) thin films were fabricated on chemically cleaned glass substrates within polyvinyl alcohol (PVA) polymer matrix via a facile and cost-effective chemical bath deposition (CBD) method. PVA, cadmium chloride, thiourea, sodium selenosulphite and liquid ammonia were the precursors which were used during the deposition process.

All the samples were deposited on the glass substrates in a basic bath solution at a bath deposition temperature of 75 °C keeping the other deposition parameters constant. The samples were deposited for 1 hr, 2 hr and 3 hr respectively and were coded as S1, S2 and S3 respectively. The pH of the solution was maintained at around 10. The physical properties of the thin films were found to depend on the duration of deposition. The effect of deposition time on the structural and optical properties of the CdSSe/PVA thin layers were investigated by X-Ray diffraction (XRD), UV-Vis spectroscopy, photoluminescence (PL) spectroscopy and FTIR spectroscopy. XRD patterns indicated that the CdSSe/PVA thin films possessed hexagonal phase structure and were preferentially oriented along the (002) plane. Lattice parameter, crystallite size and microstrain were calculated. Optical studies were carried out through UV-Vis spectroscopy and the absorbance and transmittance spectra of the films were studied. Band gap of the deposited films were determined by analysing the UV-Vis spectra results. PL spectra of the thin films were obtained using PL spectroscopy. Finally, the FTIR analysis of the deposited CdSSe/PVA thin films were also carried out.

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Can we have efficient molecular hydrogen adsorption on Mg clusters?

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The limited abundance of the fossil fuels and their noxious by-products are some serious threats to deal with in the field of energy. However, being a safe, clean and renewable energy carrier, hydrogen has tremendous possibility to be used as a suitable alternative for the fossil fuels in future mobile and stationary power stations. We have studied the structural and electronic properties of transition metal (TM) atom doped magnesium (Mg) clusters in neutral as well as cationic states using Density Functional Theory (DFT) method with dispersion corrected ωB97X-D functional. Our study shows that doping of TM atoms into Mg clusters changes the electronic properties. The NBO and DOS analyses shows that the stability of the doped clusters is governed by the charge transfer processes as well as the nature of interaction among the atomic orbitals. The TM(*d*) orbital contribution to the frontier molecular orbitals of the clusters indicates that the doped clusters are capable of absorbing molecular H_2 via Kubas interaction.

Approach with DFT for Non-Linear Optical Properties of Organic Molecular Complexes

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Abstract: Studies of non-Linear optical phenomena are prominent in present day technologies in terms of molecular properties and electronic properties. In particular properties of organic molecules gained sufficient impact in transition arising between coherent states influencing intrinsic geometry that arise due to interactions with stability.

In the present work distinct benzaldehydes like H1and H2 influenced with chloro-aniline (G1) that changes the geometry for molecular and electronic properties using density functional theory.

Density functional theory (DFT) is implemented with B3LYP hybrid method the Beeck's three exact exchange-function combined with the Lee-Yang-Parr correlation function with focus on nonlinear phenomena in terms of molecular geometry, vibrational frequencies and density of states exchange and correlations functions. Interpretation of these depends on appropriate selection of basis set. In the present work 6-311++** basis set is selected with Gaussian 16 package and Gauss view 6.1 for analysis as polarizing and diffusion functions.

Computational method is effectively implemented in formation of optimized molecular complexes with host molecules H1 and H2 and guest molecule G1 with energy minima of typical complex is -3590.0569 Hartree. Studies of these optimized structures provide Fourier Transform Infrared Spectra (FTIR) and Fourier Transform Raman spectra. Molecular mechanism is attributed with changes in wavenumbers between host and guest molecules that indicate formation of bonding. Studies with Raman spectra indicated the presence of shift towards lower side in complexes with increased intensities.Quantum mechanical descriptors the electronegativity, electron affinity and electrophilicity index influenced factors responsible for transition between coherent states influencing nonlinear properties in terms of energy gap, dipole moment, polarizability, hyperpolarizability, molar refractivity, optical frequency and reflectivity.These descriptors influenced nonlinear optical properties due to (i) formation of Schiff base compounds with lower shifts in C=N regions (ii) Fluorine molecules are more electronegative than chlorine and bromine molecules governed in electrophilicity index (iii) enhancement of 10 units in first order hyperpolarizability with complexes of fluorine(iv) reduced optical frequency of 5 units (v) reduction in reflectivity.

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Wide range tunability of surface plasmon resonance of nanostructured Ag deposited by off-axis magnetron sputtering

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Abstract: In this work, nanostructured Ag showing size distribution dependent tunable surface plasmon resonance (SPR) are grown on glass substrate using off-axis DC magnetron sputtering at a sputtering power of 74 W. Argon gas pressure is set at 8.0 Pa and the deposition time is varied in the range 5–300 s. The structural, morphological, and optical properties are examined by using X-ray diffractometer (XRD), field emission scanning electron microscope (FESEM), and UV-Visible spectrophotometer. XRD patterns of all samples reveal characteristic (111) and (200) peaks of fcc Ag. Broad XRD peaks suggest formation of nanosized Ag crystallites with mean crystallite size of 3 nm. FESEM images depict near spherical Ag grains up to 120 s deposition time and elongated grains with greater substrate coverage with extended deposition time of 300 s. SPR features are well distinct in the optical absorption spectra which are highly sensitive to the deposition time. Within a short deposition time of 5–60 s, nanostructured Ag demonstrates wide range SPR tunability from 438 nm to 530 nm. It is observed that the variations in the size distribution as estimated from FESEM images are crucial to observe systematic red shift of SPR with increasing deposition time. Nanosized Ag produced by off-axis magnetron sputtering may be used as a vital component in plasmonic devices and sensors.

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Structural, optical and electrical properties ofCuO nanostructures prepared by reactive DC magnetron sputtering

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Copper oxide (CuO), a transition metal oxide, has a monoclinic lattice structure having narrow energy band gap (1.2-2.1 eV) and generally recognised for its p-type conductivity. An attempt is made to explore the CuO nanostructures and its attributes in this work. CuO nanostructures are deposited on

glass substrates using DC reactive magnetron sputtering using Cu target in argon (84%) and oxygen (16%) environment. These nanostructures are deposited at sputtering power 70 W, different sputtering pressures in the range 1.0-8.0 Pa for 10 min and 40 min. X-ray diffraction (XRD) technique is used to determine the oxide phase of the deposited nanostructures. The XRD pattern matches CuO standard diffraction data (ICDD file 00-005-0661), confirming that no additional oxide phases appeared in the nanostructure coated for 40 min. Due to the very low content of CuO, no peaks attributable to CuO are observed in the nanostructures deposited for 10 min. Thenanostructure deposited for 40 min hascrystallite size of 13 nm. Field emission scanning electron microscopy ((FESEM) is used to analyse the morphologies of the nanostructures. Isolated nanograins of CuO are observed in nanostructures that have been deposited for 10 min, when the deposition time is extended to 40 min, an almost film-like structure is formed. Sputtering pressure of 8.0 Pa produces highly isolated nanograins; lowering the pressure results in less isolated nanograins. UV-Visible absorption spectroscopy is utilized for optical studies. Transmittance and absorbance spectra are recorded in the wavelengthrange 200-1100 nm. The nanostructures absorb light strongly in the 280-400 nm region and it is observed that decrease in the sputtering pressure (from 8.0 Pa to 1.0 Pa) enhance the absorption capacity in this range (280-400 nm) as well as in the visible range. The nanostructures have transmittance of more than 80% in the wavelength range 780-1100 nm. The sheet resistance of the nanostructures is estimated to be between 0.5 and 25 k&!/sq. Hall measurement confirms p-type conductivity of CuO nanostructures and sheet carrier concentration reaches the order of $10^{12}/cm^2$. These nanostructures might be combined with other metal/semiconductors to form efficient heterostructuresand p-n heterojunctions for possible application in photodetection and photocatalysis.

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Simulations on Ion assisted sputtering for silicon target

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Abstract: Magnetron sputtering is an efficient technique for thin films preparation because of its ability to prepare a variety of thin films with relatively high purity and at low cost. Magnetron sputtering is extensively used in industries to deposit thin films of a large number of materials for countless applications. For understanding the complex dynamics occurring during a typical film deposition process, different experimental and computational works are carried out by different researchers to improvise the thin film quality. Silicon thin film has attracted considerable attention as a potential material for electronic

devices such as solar cells, thin-film transistors and MOSFETs. By close control of the deposition technique, it is possible to tailor the electrical and optical properties of the film. In a landmark paper published in the Journal of Applied Physics, 2017, Dipendra Adhikari et.al. reported the effect of hydrogen gas concentration during RF sputtering on the resultant film's structural and optical properties. They have found that the growth evolution of Hydrogenated silicon, Si:H showed phase transformation from amorphous to mixed-phase to single-phase nano-crystalline(nc).[1] The nc-Si:H produced was of reasonable quality similar to the Chemical Vapor Deposition (CVD) processes. Hence RF sputtering has the potential to be used as a deposition technique in place of CVD. It also helps in avoiding the use of hazardous precursor gases (i.e. SiH_4, Si_2H_6) associated with PECVD.[2]However, in the present study, a systematic computational study is carried out to understand the various parameters involving the ion-target interaction in order to attain an efficient sputtering yield. The simulation study for silicon target in magnetron sputtering technique is carried out using TRIM (Transport of Ions in Matter). TRIM is a Monte- Carlo software program that can easily calculate the stopping potential and range of ions by studying the various interactions which take place between the energetic ions and targets. The angle-dependent sputtering yields, the role of ion incidence angle on the energy of the sputtered atom, angular distribution of sputtered particles and collision events for silicon target material are discussed in the present work.

Keywords: Magnetron sputtering, Silicon, Simulation

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Photoresponse performances of UV-visible photodetectors based on as-prepared and annealedZnO-PS:p-Si heterostructure: a comparative study

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Abstract: Present article reports comparative study on photoresponse performances of as-prepared and annealed (200 ^{0}C) ZnO-PS: p-Si metal semiconductor metal photodiode.Field emission scanning electron microscope analyses confirm no change in mean grain size of ZnO nanostructures and thicknessof uniform ZnO and PS layersupon annealing at 200 ^{0}C.Optical band gap energy of nanostructured ZnO changes from 3.30 to 3.23 eV upon annealing, due to modification in density of defect states.As-prepared and annealed device performalmost symmetric rectification due to formation of identical Schottky barriersunder forward and reverse biasing.Photoresponsivities of the annealed device are found to enhanceup to 51 and 30 AW^{-1}as compared to that of the as-prepared one (1.8 and 2.8 AW^{-1}) at -2 V biasing for illumination wavelengths of 365 and 400 nm respectively. Furthermore, the annealed device shows improved response time (0.35 and 0.39 s) in comparison to that of the as-prepared one (0.87 and 0.42 s) at -2 V biasing for illumination of 400 nm.

Crystallite size and band gap variation of tungsten trioxide dihydrate nanocrystals prepared under different conditions

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Abstract: Tungsten trioxide dihydrate is a direct band gap n-type semiconductor that has potential applications in various fields. In this work, nanocrystals have been prepared using sodium tungsten dihydrate , hydrochloric acid (HCl) and capping agent/oxidizing agent. 2-mercapto ethanol (ME) and hydrogen peroxide (HP) were used as capping agent and oxidizing agent, respectively. X-ray diffraction (XRD) patterns of the as-prepared materials reveal the formation of . The average crystallite sizes of the materials prepared using ME and HP have been found to be 53 nm and 21 nm, respectively. The band gaps of the materials have been obtained from the UV-visible absorption studies and the values are found to be 2.44 eV and 2.62 eV for the materials prepared using ME and HP, respectively. Thus, the presented work provides a way to prepare with different crystallite sizes and band gaps.

Structural, Optical and Antibacterial Properties of CdS Nanoparticles Prepared by Using Edible Oyster Mushroom Extract: A Green Synthesis Approach

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Abstract: A green synthesis method is used for the preparation of CdS quantum dots using edible oyster mushroom extract. XRD and FTIR confirm the presence of cubic CdS nanoparticles that are capped with proteins. TEM analysis reveals the presence of spherical particles measuring about 6 nm. UV-Visible study shows quantum confinement. Synthesized CdS nanoparticles exhibit significant antibacterial activity against gram negative bacteria which is comparable with standard antibiotic.
Keywords: Green Synthesis, CdS NPs, TEM, XRD, Antibacterial activity.

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DEFINING TEMPERATURE

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Abstract: We all know that temperature is a measure of hotness or coldness of a body. In literature there are various definitions for temperature. There are thermodynamic temperature as well as temperature in statistical mechanics. In some cases we find out dynamic temperature. Using this we can also check the validity of ergodic hypothesis. Here we study the dynamic temperature and statistical temperature for some linear and non linear harmonic oscillators.

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Effect of Fe Substitution on the Properties of Sodium Bismuth Titanate

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Abstract: Lead free sodium bismuth titanate(NBT) is widely being studied as an emerging room temperature multiferroic [1] and also because of its potential to replace toxic lead based ceramics. Various elements are substitutedin the A-site or B-site to improve its electrical and magnetic properties [2]. In this work, pure and Fe substituted NBT having the chemical formula $Na_{0.5}Bi_{0.5}Ti_{(1-x)}Fe_xO_3$ (x=0.00, 0.02) was synthesized using sol gel auto ignition method to study the effect of Fe substitution on its properties. XRD analysis confirmed the rhombohedral symmetry of the synthesized samples and the crystallite size of the samples were calculated usingScherrer's formula. The morphological properties of the samples were studied from the SEM images. UV-Visible Spectroscopy method was employed

to study the optical properties of the samples. The dielectric properties of the samples were measured in a frequency range of 100Hz to 1 MHz at different temperatures (25^0C – 200^0C) using an Agilient HP4284 LCR meter. Usual dispersive behavior of dielectric constant was observed for both the samples at the studied temperature range with the substituted sample showing enhanced values. The recorded dielectric loss was found to be very small as compared to the high dielectric constant making the compound a good dielectric material for device applications. Study of frequency and temperature dependence of the AC conductivity suggested that the conduction process in the materials is thermally activated. Jonchers' universal power law was used to fit the AC conductivity curves to describe the dynamics of charge carrier with suitable conduction mechanism.

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Study on structural, optical and magnetic properties of cobalt substituted magnetite nanoparticles for ferrofluid applications

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Cobalt substituted magnetite nanoparticles having the composition $Co_xFe_{3-x}O_4$ (0.0 d" x d" 0.4 in steps of 0.2) have been prepared using co-precipitation method. Various structural, microstructural, optical and magnetic characterizations have been carried out using X-ray diffraction (XRD), Field emission scanning electron microscope (FESEM), UV- Visible spectroscopy and Vibrating sample magnetometer (VSM) respectively. The spinel structure of the synthesized nanoparticles has been confirmed using XRD and Rietveld refinement techniques. Crystallite size calculated from Scherrer's and Williamson – Hall (W-H) methods are in agreement and found to decrease from 15 nm to 10 nm with increase in cobalt substitution. The ultrafine nano crystallite is desirable for ferrofluid preparation. Lattice strain is obtained from the slope of the linear fit in the W-H plot. FTIR spectra reveals two absorption bands around 550 cm^{-1} to 400 cm^{-1} which corresponds to the vibrations of the M-O bonds at the tetrahedral and octahedral sites respectively, and is characteristic of the ferrite samples. FESEM depicts the microstructural morphology of the nanoparticles and Energy dispersive X-ray analysis (EDAX) gives the elemental composition of the samples. UV-Visible spectroscopy shows maximum absorption around 400 nm to 340 nm. Optical band gap of the samples estimated using Tauc plot is found to be in the range 2.10 eV to 2.62eV. The M-H loop and magnetic parameters are obtained from VSM measurements. The saturation magnetisation of the samples are found to be in the range 56 emu/g to 60 emu/g. Stable aqueous ferrofluids of the nanoparticles have been obtained using tetramethyl ammonium hydroxide as the ionic surfactants.

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Transport of a particle driven periodically in a time-varying friction

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Brownian motion is the building block of all stochastic processes. The transport of Brownian particles in a periodic potential differs from system to system(1,2,3). When subjected to an asymmetric periodic potential, the Brownian particles exhibit net directional motion even if the space-averaged force is zero(4). Such a phenomena of obtaining net transport in a system even in the absence of a bias is called ratchet effect and the current so obtained is called ratchet current. In this work, we inspect particle transport in a non-homogeneous system driven by an external periodic force in a noisy environment. Considering the potential of the system to be symmetrically periodic, resistance offered by the system to be time dependent and the external periodic force (whose average is zero), we have obtained ratchet current and calculated some physical quantities like trajectories, variance, etc.

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Zn Based Metal Organic Framework For Adsorption of Anionic and Cationic Dye.

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Environmental issues related to water pollution adversely affects the growth, health, and reproductive development of humans, animals and plants, and their survival activities[1]. The effluents and solid wastes are continuously discharged from industrial sectors, which contain the extensive quantity of pollutants and interact with freshwater bodies or agricultural lands to a great extent. Organic or inorganic pollutants such as dyes are present in these effluents, which are very harmful to aquatic and terrestrial species[1,2]. In this study, Zn based Metal Organic Framework (MOF) ZIF-8 was synthesized using co-precipitation method under varying Zn concentration ($Z^{0.8}$, $Z^{2.0}$, $Z^{2.4}$ and $Z^{3.6}$). The structural and optical analysis were carried out using XRD, FTIR and PL. Changes in crystalline phase and bond length was found as Zn Conc. increase. The prepared samples ($Z^{0.8}$, $Z^{2.0}$, $Z^{2.4}$ and $Z^{3.6}$) shows fast adsorption process (sorption saturation is achieved within 15 min) for anionic dye Methyl Blue (MB)

(50ppm) with a high adsorption capacity of ~ 195 mgg^{-1} whereas slow adsorption were observed for cationic dye Methyl violet 10B (20ppm) with a very low adsorption capacity of 20 mgg^{-1}. The adsorption kinetics and isotherms were analysed in detail. The finding shows that the high adsorption capacity of MB dye on the prepared samples $Z^{0.8}$, $Z^{2.0}$, $Z^{2.4}$ and $Z^{3.6}$ is due to the ionic interaction between the Zn^{2+} and $–SO_3É$ group of the MB. Further, the selective adsorption capacity of MB dye with Methyl Violet 10B dye was examined to understand the charge effect of the anionic and cationic dye.

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Zeolite incorporated iron oxide nanoparticles for congo red dye adsorption

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Adsorption is one of the physicochemical techniques to remove dyes from effluence and is found to be the most simple and economical [1].The catalytic material for removal of congo red dye is prepared by the incorporation of zeolite (0.1, 0.2 and 0.3 g) in the process of precipitating iron oxide nanoparticles. Iron oxides are suitable material due to its photocatalytic properties, chemical stability, nontoxicity and easy separations methodology in waste-water treatment. Zeolites an alumino silicate with imbalance charge is a good option to nucleate the nanoparticles which itself is a good candidate for waste water treatment [2]. The incorporation of zeolite during the synthesis confines the growth of the nanoparticles on the surface and pores. These materials have been characterized using XRD, FTIR, Raman spectroscopy and UV spectrophotometry. The crystallite sized and magnetization of the sample decreases with the increase in zeolite concentration as calculated from the XRD and VSM studies. Mössbauer studies shows the formation of superparamagnetic behavior with the increase in zeolite concentration. Congo red, an anionic organic compound diversely affects the organisms of different trophic levels. This dye when mixed with water becomes toxic or harmful to living organisms. In the present study, the congo red dye removal or adsorption is performed with catalyst loading of 500 mg l^{-1}. The calculated adsorption capacities of pure Fe_3O_4, and composites of Fe_3O_4 and 0.1g, 0.2g, 0.3g zeolite are respectively 19.48, 14.6, 19.84 and19.3 mg g^{-1} . The adsorption of dye follow pseudo 2nd order kinetics where adsorption is mostly govern by chemisorption. Intra particle diffusion of dyes on the surface as well as into the pores of the nanoparticles as indicated from the diffusion kinetics model. The

iron oxide nanoparticle and its composite with zeolite shows good efficiency in terms of adsorption of congo red dye with a percentage removal of ~98%. However, the reusability of the sample increases with the increase in zeolite concentration.

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Study of electrochemical properties of $LiFePO_4$ by varying H_3PO_4 concentration and the $LiFePO_4$/zeolite composite

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The triphylite ($LiFePO_4$), having olivine crystal structure and space group Pnmb, is one of the most promising cathode materials used in rechargeable lithium batteries. This is due to factors like high capacity at moderate current densities, low cost, non-toxic properties and high thermal stabilities.[1] Despite many advantages associated with $LiFePO_4$, major drawbacks for this material are its poor rate capability owing to its low intrinsic conductivity and slow diffusion of lithium ions due to long diffusion length[2].In this study, $LiFePO_4$ with varying H_3PO_4concentration (0.86g, 1g and 1.5g) and $LiFePO_4$/ zeolite composites were synthesized using solvo-thermal method and they were characterized by XRD and Mossbauer spectroscopy. Electrochemical studies were also carried out for these materials.
XRD analysis and Mossbauer study confirm the formation of olivine structure of$LiFePO_4$. It is found that the crystallite size of the samples decreases with the increase in the concentration of phosphoric acid (H_3PO_4) resulting in the decrease of diffusion length of Li^+ ion thereby enhancing their electrochemical properties. It is observed that the Sample with H_3PO_4 (1.5g) shows the best performance in terms of coulombic efficiency, with an average CE of around 99 % in the region of cycle 25 to cycle 100 Also, sample with 0.86 g with Zeolite 1ghas higher discharge capacity than that of the other samples. The correlation with the lattice variation and the electrochemical properties is addressed in details.

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Molecular dynamic simulation study of size polydispersed Ionic liquid: effects on static properties

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Ionic liquid mixtures with a large number of components will give a system with polydispersity in size. A molecular dynamic simulation is performed to study the effect of ion size polydispersity on the static properties of ionic liquid. By changing the polydispersity index, we investigate the effect of polydispersity on static properties such as thermal hysteresis, transition temperatures, spatial ordering, and charge ordering in the system.

THEORETICAL (DFT) INVESTIGATION ON HYDROGEN BONDED BINARY LIQUID CRYSTAL MIXTURE (4MCA:6OBA)

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Abstract: In this present paper, novel hydrogen bonded liquid crystal (HBLC) binary mixture has been designed and optimized through density functional theory (DFT) calculation with B3LYP/6-311G (d, p) basis set. The present HBLC binary mixture is derived from mixtures of two carboxylic acids, liquid crystalline 4-methoxycinnamic acid (4MCA) and 4-hexyloxybenzoic acid (6OBA) which shows distinct mesophase namely nematic and smectic C phases. Theoretically predicted vibrational IR assignments of 4MCA+6OBA HBLC binary mixture compared with experimental FTIR data and validated. The electrophilic/nucleophilic charge distribution and chemical reactivity of 4MCA+6OBA HBLC binary mixture is explored by molecular electrostatic potential (MEP) analysis. The possible intermolecular hyper conjugative interaction and stability of HBLC binary mixture is elucidated by natural bond orbital (NBO) study. The impact of molecular association, dipole moment, hydrogen bond length/ angle, stability, reactivity and other physic-chemical properties of 4MCA+6OBA HBLC binary mixture has been investigated using DFT calculation. The highest occupied molecular orbital energy and lowest unoccupied molecular energy (HOMO–LUMO) study shows charge transfer phenomena between 4MCA and 6OBA compounds. The Mulliken population analysis reveals the interaction and

charge distribution in the HBLC binary mixtures. The electron localization function (ELF) and localized orbital locator (LOL) studies reveals the delocalized electronic region, electron localization, bonding and non-bonding electrons of 4MCA+6OBA HBLC binary mixture. The HOMO-LUMO, intermolecular hydrogen bonding, molecular electrostatic potential, NBO studies of 4MCA+6OBA HBLC binary mixture provides reasonable electronic properties consistent with molecular dynamics.
Keywords: HBLC binary mixture, Nematic, MEP, NBO, HOMO-LUMO

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Study of dielectric properties and ac conductivity of zinc ferrite synthesized by chemical coprecipitation technique

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In this paper, zinc ferrite has been synthesized by chemical coprecipitation technique. The sample has been conventionally sintered at different sintering temperatures 600^0C, 750^0C and 900^0C. The samples were characterized by X-Ray Diffraction, Fourier Transform InfraRed Spectroscopy and dielectric measurement. XRD pattern shows the formation of cubic spinel and increase of crystallite size with the increase of sintering temperatures. FTIR spectroscopy shows the presence of absorption bands due to metal-oxygen vibration at tetrahedral and octahedral sites[a,b]. The dielectric properties were studied in the frequency range of 20Hz to 2MHz. The dielectric constant decreases with increase in frequency. The usual dielectric behavior of ferrites is also observed in this ferrite. Dielectric properties can be explained by Koop's phenomenological theory[c] in agreement with Maxwell Wagner interfacial polarization[d]. Ac conductivity increases with increase in frequency.
Keywords: Coprecipitation technique, XRD, FTIR, Dielectric behavior, AC conductivity.

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QUANTUM SYSTEMS - A PEDAGOGIC APPROACH

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As the 21st century do discusses about remarkable advances in quantum research and developments, our attempt in this paper lies in outlining the pedagogic approach towards a study on quantum systems related to its thermodynamics [1], statistical approach [2] and phase transition phenomenon [3]. The word "quantum" comes from the Latin for "how much" and reflects a world involving something coming in discrete amounts. Often confined to the atomic scale and fundamental particles, one deals with small masses and velocities but larger wavelengths. When the thermal de Broglie wavelength is on the order of or larger than the inter particle distance, quantum effects will dominate and the gas must be treated as a Fermi gas or a Bose gas, depending on the nature of the gas particles. The studies were moved in understanding of different quantum systems starting from the process of Bose Einstein Condensation [4], application of the BE statistics and understanding the thermodynamic features of the phase transition. The investigation of properties of a black body radiation [5] which can be taken as the most important application of Bose-Einstein statistics is being studied. Further studies move into the most fascinating phase of matter Quark Gluon Plasma [6] often considered to be existed within microseconds of the early universe.

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Frequency and composition dependent impedance analysis of PFO: MEH-PPV polymer blends

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Abstract: Present study investigates the electrical properties of thin film using impedance spectroscopy in the frequency range of 0.1 Hz to 1 MHz. From the analysis of complex impedance data, we found that in the PFO: MEH-PPV polymer blend structure, the best way to describe the conductivity is a single relaxation process. An improved conductivity of the blended PFO polymer thin film was also obtained on the basis of different concentrations of MEH-PPV. Plots of Cole-Cole blend devices are characterized with a single network of parallel resistors R_P and capacitors C_P having series resistors R_S. The resistance R_p decreases when a bias is applied, however the capacitance C_P remains substantially constant. AC conductivity was also calculated for the entire frequency ranges. At high frequencies, the AC line of the film follows the universal power law, and the onset frequency increases with the bias increased.

Ab-initio Study on the CoZrVIn Equiatomic Quaternary Heusler Alloy for Spintronic and Thermoelectric Applications

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Owing to its large Curie temperature (T_C), 100% spin-polarization, tunable electronic structure, high figure of merit, and low thermal conductivity, Heusler alloys are of particular interest in the disciplines of spintronics and thermoelectrics [1]. Spin gapless semiconductors (SGSs) are an exciting new class of materials with a narrow or gapless band gap in one spin direction and a large band gap in the opposite spin direction [2]. It benefits from requiring small energy to excite electrons from the valence to the conduction band, exhibiting extremely high electron mobility, and being accessible to both charge carriers, electrons, and holes [3]. Due to the 100% spin polarization at the Fermi level (E_F) of both kinds of charge carriers, transport properties of SGS exhibit disruptive behavior [4,5]. In this study, we used density functional theory with various schemes such as GGA-PBE, GGA-mBJ, GGA+U, and GGA+SOC to investigate physical properties of CoZrVIn Equiatomic Quaternary Heusler Alloy (EQHA). The electronic structure of CoZrVIn EQHA affirms a spin-gapless semiconductor. We have determined the formation energy and elastic constants to determine the structural and mechanical stability of the present alloy. The mean-field approximation was used to estimate Curie temperature. The transport properties imply that this alloy is n-type, and can also exhibit a reasonably high thermoelectric efficiency. Due to its gapless nature and efficient thermoelectric properties, CoZrVIn EQHA is suitable for spin devices and energy conversion applications.

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Structural and optoelectronic properties of cubic $Zn_{1-x-y}Be_xMg_ySe$ quaternary alloys nearly lattice matched to GaAs substrate: A density functional investigation.

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Density functional calculations of structural and optoelectronic properties of cubic $Zn_{1-x-y}Be_xMg_ySe$ quaternary alloys are carried out considering their nearly lattice matching to GaAs substrate. Calculations ensure that each quaternary alloy is a direct band gap (Γ- Γ) semiconductor. The mBJ-GGA based computed minimum band gap of each alloy is larger than with EV-GGA scheme. Enhancement in beryllium or magnesium composition nonlinearly reduces the lattice constant, but enhances the bulk modulus and minimum band gap of quaternary alloys. Lower effective mass of electrons compared to holes confirms dominant role of electrons in carrier transportation in each specimen. Electronic transitions from occupied Se-4p state of valence band to unoccupied Zn-5s, Mg-3p, Mg-4s, Be-2p and Be-3s states of conduction band collectively contribute intense peaks in $\varepsilon_2(\omega)$ spectra of each quaternary alloy. Quaternary semiconductor with higher band gap possesses lower value of zero-frequency limits in $\varepsilon_1(\omega)$, $n(\omega)$ and $R(\omega)$ spectra, but requires higher critical point energies in $\varepsilon_2(\omega)$, $k(\omega)$, $\sigma(\omega)$ and $\alpha(\omega)$ spectra and vice versa. Computed oscillator strength of each quaternary alloy confirms the presence of sufficient number (>200) of electrons in the unoccupied states of conduction band above 27.0 eV of incident photon energy during any optical excitation.

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First-principle study on thermoelectric properties of mercury-beryllium-chalcogenide for thermoelectric device applications

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Solid-state thermoelectric power generators are now attracting enormous attention to the researchers as new renewable energy generation technology to convert heat to electrical energy. First-principle calculations [1-3] are carried out to investigate theoretically the thermoelectric properties of ternary alloys under $Hg_xBe_{1-x}S$, $Hg_xBe_{1-x}Se$ and $Hg_xBe_{1-x}Te$ system at Hg-compositions $x = 0.25$, 0.50 and 0.75 using semi-classical Boltzmann theory based BoltzTraP code [4, 5] over the constant relaxation time. To investigate the thermoelectric performance of these ternary alloys, we have computed Seebeck coefficient (S), electrical conductivity (σ/τ), electronic thermal conductivity (k_e/τ), power factor ($S^2\sigma/\tau$) and hence the electronic figure of merit Z_eT ($=S^2\sigma T/k_e$) at different temperatures T in between 200K and 1200 K at a fixed chemical potential () close to the Fermi energy (of the respective specimen. Each ternary alloy shows p-type conductivity due to positive value of Seebeck coefficient. Calculated Z_eT of ternary alloys larger than 0.70 in the temperature range 400-1200 K indicates that they would be considered as suitable materials for thermoelectric applications in the temperature range 400-1200 K.

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Structure-optical property relationship of sputtered AgNP/ZnOμR heterostructure

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We report on the deposition of silver nanoparticle (AgNP) zinc oxide microrod (ZnOμR) heterostructure on glass and silicon substrates previously coated with ZnO (seed layer) by using magnetron sputtering. X-ray diffraction (XRD) and field emission scanning electron microscopy (FESEM) studies confirm the formation of ZnOμRs with hexagonal wurtzite phase and spherical AgNPs in the vicinity of ZnOμRs. Ag NPs have a narrow size distribution, which peaks ~ 100 nm. In the UV-Vis absorption spectra, a wide peak around 538 nm is attributed to the surface plasmon resonance (SPR) of large-sized AgNPs – the bathochromic shift of the SPR of AgNPs is observed in the case of AgNP/ZnOμR heterostructure. Near band edge (NBE) excitonic emission at 380 nm dominates the photoluminescence spectra of ZnOμRs. Interestingly, in the AgNP/ZnOμR heterostructure, coupling of the plasmons of AgNPs with

excitons of ZnOμRs leads to a nearly 3-fold enhancement in the NBE emission from this wide band gap semiconductor in presence of metal nanoparticles. The resonant exciton-plasmon coupling modifies the interband transition of ZnOμRs in the near-UV region due to the presence of the scatterer (AgNPs) in proximity to the emitter (ZnOμRs). AgNP/ZnOμR heterostructure in thin film form can be a candidate material for optoelectronic devices and biosensors due to its improved near-UV emission and modified SPR.

Insight view of mechanical and thermodynamic properties of double perovskite Ba_2GdSbO_6 from DFT calculations

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In this work, mechanical and thermodynamic properties of cubic double perovskite Ba_2GdSbO_6 have been investigated using full potential linearized augmented plane wave (FP-LAPW)[1] approach within density functional theory (DFT) [2, 3]. Optimized ground state parameters of the compound were found to be in good resemblance with the respective available experimental data [4]. Cubic2-elastic package, in association with the WIEN2K, is used to explore the elastic/mechanical properties of the double perovskite compound under investigation [5]. Calculated elastic constants and moduli revealed the mechanical stability, anisotropy and significant stiffness of the compound. Quasi harmonic Debye model [6,], as incorporated in GIBBS code, has been used for the study of temperature and pressure dependent variation of thermodynamic properties of the said double perovskite. From this thermodynamic property study, we found that specific heat capacity at constant volume (C_V) is found to increase very fast under the low temperature values up to 400 K, above which a very sluggish increase in C_V can be observed, and finally attains a constant value at 1000 K. Thus C_V is strictly found to follow T^3 law and Dulong-Petit law under low and high temperatures, respectively. Variation of all other thermodynamic parameters also showed satisfactory character.

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Incorporation of Bile-salt and Laser Dye Using Layer by Layer self-assembled technique

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Interaction of bio-surfactant with laser dyes are now gaining immense interest due to their potential biological application. From the biotechnological & biomedical applications point of view, bio-surfactants have shown promise for solubilization of drug & the development of advanced devices for controlled drug delivery systems. Based on their eco-friendly, lowtoxic, biodegradable nature, they are extremely valuable & widely used for designing antimicrobial coating and biosensors. In order to construct an organized biomaterials in two- or three-dimensional space from the nanobiotechnological perspective, various techniques have been developed. Among these, layer by layer (LbL) self-assembly is one of the most promising ways for fabricating multilayered thin film with precisely controlled thickness & architecture on a nanometer scale.

The present work is focused on experimental investigation of the interaction of Nile Blue A with a bio-surfactant by LbL self-assembly.The bio-surfactant used in this case was Sodium Deoxycholate which actually an amphiphilic bile salt with steroidal skeleton derived from cholesterol in the lever & stored in gall-bladder whereas the laser dye Nile Blue A monocationic in nature useful to studying many biological processes. The objective of this study is to examine the factors affecting the bile salt-dye complex monolayer formation when the two components were interacted. The interaction of Nile blue A with Sodium Deoxycholate triggered the formation of monomeric & H-aggregate thin film of the dye.The presence of H-aggregate in the film quenched the fluorescence intensity than the monomeric dye film. The number of deposited layers, concentration, & the effect of temperature, pH, on H-aggregate of Nile blue thin film was also monitored by spectroscopic technique such as Ultraviolate-visible spectroscopy& Steady-state Fluorescence spectroscopy. The morphological variation in the thin film was investigated by Scanning Electron Microscopy. The morphological analysis of the thin film revealed that the thin film including H-aggregate was predominant in lamellar like structure while the monomeric dye thin film shows the granular cluster like morphology.

Keywords : Bio-surfactant, bile salt, H-aggregate, lamellar structure.

First-principle investigation of structural, electronic and optical properties of hexagonal wurtzite $Mg_xZn_{1-x}Te$ ternary alloys

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Abstract: Structural, electronic and optical properties of wurtzite $Mg_xZn_{1-x}Te$ ternary alloys have been computed at some specific magnesium concentrations $x = 0.0, 0.25, 0.50, 0.75$ and 1.0 employing density functional theory (DFT) [1, 2] based full-potential linearized augmented plane wave (FP-LAPW) approach [3]. Exchange-correlation potentials for structural properties are computed with WC-GGA

[4], while that for electronic & optical properties with the mBJ-GGA [5] schemes. Calculations of structural properties disclose that lattice constants (*a, c*) increases and bulk modulus (B_0) decreases marginally with increasing magnesium content. The ZnTe and MgTe as well as their ternary alloys are direct band-gap (Γ-Γ) semiconductors and fundamental energy band-gap increases with increase in magnesium content. Optical properties of the specimens are calculated by computing the frequency responses of dielectric function, extinction coefficient, normal incidence reflectivity, refractive index, optical conductivity and optical absorption. Each compound is found to be optically anisotropic in nature. Electronic transitions from chalcogen-*p* of valence band to different empty *s* and *p* orbitals of Mg & Zn of the conduction band solely or collectively contribute in formation of intense peak(s) in each dielectric function spectra. Our calculated results for binary compounds show well agreement with the corresponding experimental findings.

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Noise assisted particle transport and particle diffusion in an under-damped inhomogeneous periodic potential system

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Abstract: In this work, the dynamics of particle in an under-damped inhomogeneous periodic potential system in presence of random fluctuation or noise which forms a classical model in understanding different physical and biological processes in the microscopic scale is studied. The particle undergoes directed transport aided by noise when system is driven out of equilibrium by unbiased periodic force. This process, known as ratchet effect is a counterintuitive phenomenon in which noise play a constructive role in the particle dynamics in the microscopic scale. Also, the particle undergoes diffusion aided by random thermal fluctuation or noise in which the amount of diffusion can be control by controlling the different parameters of the system which can have important technological applications.

Structural, optical and frequency dependent dielectric properties of solid-state derived complex perovskite $Na_{0.5}Bi_{0.5}TiO_3$ (NBT) nanostructured system

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In this report, we demonstrate structural, optical band gap, and radiative emission featuresof solid-state derived $Na_{0.5}Bi_{0.5}TiO_3$ (NBT) nanoscale systems. While electron microscopic imaging has revealed presence of nearly spherical particles, XRD analysis depict rhombohedralcrystal structure of the NBT nanosystems. From the analysis of UV-visible absorption spectra, the optical band gap of NBT is predicted to be of direct type. The significant band tailing in the absorption spectra is characterized by Urbach energy which is nearly 3 fold smaller than the Taucband gap. The broad luminescence response of nano-NBT system is discussed in the light of quantum confinement effect, near band-edge features, defects states, and self-trapped excitons. Further, the frequency dependent dielectric as well as impedance features of the NBT systems have been discussed in details.
Keywords: $Na_{0.}$ $Bi_{0.5}TiO_{3,}$ crystal structure, Urbach energy, Tauc gap, *Cole-Cole* plots

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Extraction of Transition Metals from Furnace Dust and Facile synthesis of Metal Oxide nanoparticles for optical limiting applications

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Abstract: Electric Arc Furnace dust collected from iron and steel manufacturing industries was employed as the raw material for the synthesis ofsome potential transition metal oxide nanoparticles.The suitability of the as-synthesized nanoparticles in optical device fabrications was confirmed through various characterization analyses post refining of the raw material followed by annealing. Crystallinity of the nanoparticles was validated through XRD analysis and other parameters such as grain size, dislocation density, lattice strainwasalso acquired. Linear optical analysis revealed that the title material is transparent in the visible region without any strong absorption which is the key feature of a nonlinear optical material. The characteristic absorption edge was observed around the wavelength of 250 nm. Nominal difference

in surface morphologies was observed in the samples through SEM analysis. A morphological transformation from hexagonal shaped structures to Flower shape was observed as the impact of microwave irradiation and annealing. The third order nonlinear optical property of nanoparticles was examined by Z-Scan analysis which established that the material is self- defocusing in nature. The experimental data highlighted the proficiency of nanoparticles as a prospectivecandidate for optical limiting applications. The results thus suggest that a hazardous waste material which is dumped in the atmosphere can be recycled and used for the fabrication of protective layers that actively limit the laser radiation.

Color tunable $Gd_2O_3:Dy^{3+}$ nanophosphors under different excitation wavelengths

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Abstract: Color tunable Dy^{3+} doped Gd_2O_3 nanophosphors were synthesized using chemical precipitation method. The crystallite sizes of the samples were found to be in the range of 11-17 nm. The luminescent properties of the samples were studied under different excitation wavelength namely 234 nm and 278 nm. The optimum concentration of dopant for maximum emission intensity was found to be 2 at.% of Dy^{3+} which was independent of excitation wavelength. The emission intensity due to 234 nm excitation wavelength was much stronger which showed the energy transfer due to host absorption was more efficient. The change in color emission of 2at.% Dy^{3+} doped Gd_2O_3 nanophosphor under different excitation wavelength were observed from calculated CIE coordinates and CCT values.

The influence of ZnOnanoparticles on the Structural, Optical and Dielectric properties of Polyvinyl Alcohol films

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Polyvinyl alcohol/Zinc oxide (PVA/ZnO)nanocomposite filmswith various wt% of ZnO nanoparticles(0 wt%, 5 wt%, 10 wt%, 15wt%, 20 wt%)were prepared bysolution casting method. The structural and optical properties of the synthesized samples were characterized byX-ray diffraction (XRD),UV-Visible spectroscopy and Fourier transform Infrared spectroscopy (FTIR).X-ray diffraction patternsconfirms the formation of PVA/ZnOnanocomposites. With the increase in ZnOwt %, the optical band gap energy were reduced and its transmittance in the visible region decreases and completely blocked in the UV region.These resultsimply that the samples can be used in shielding of UV radiations. The FTIR spectra indicates physical interaction between hydroxyl group of PVA and ZnO.Room temperature dielectric measurement in the frequency range of 100Hz to 1MHz revealsthemaximumdielectric constant at 5wt%ZnO nanocomposites.AC conductivitywas found to followthe Jonscher's power law.Temperature dependent dielectric measurement shows the transition from 19 ^{o}Cto21^{o}C. The results obtained from

the dielectric measurement were analysed for possible applications.
Keywords: Polyvinyl alcohol/Zinc Oxide, nanocomposites, X-ray diffraction,dielectric properties.

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Size dependence of force extension behaviour in energy polydisperse polymers

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The force extension behaviour of linear energy polydisperse chains, in which the interaction strengths between the monomers are drawn from a particular distribution, at small polydispersity value are investigated by means of computer simulations. We perform coarse-grained molecular dynamics simulations in an implicit solvent condition and a comparative study with that of the corresponding homopolymers is carried out. In this study, we focus our attention in understanding the size dependence in energy polydisperse polymers.

Study on structural and electrical transport properties of $YMn_{0.9}Cr_{0.1}O_3$

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In this work, the structural, micro-structural, dielectric, AC conductivity and complex impedance analysis of rare earth manganite $YMn_{0.9}Cr_{0.1}O_3$ have been reported. The compound is synthesized by sol-gel auto-combustion route. The X-ray diffraction study confirms the formation of hexagonal structure along with the onset of few orthorhombic peaks. The morphological study using scanning electron micrographs shows homogeneous distribution of particles with average particle size of 185nm. Raman spectroscopy shows the A_1 Raman scattering line at <" 676 cm"[1] to be much stronger than the other Raman modes. The nature of frequency dependence of dielectric constant has been described by Maxwell-Wagner model. The frequency dependence of the conductivity at different temperature as described by Jonscher's plot suggests that the conduction phenomenon in the material obeys the correlated barrier hopping

(CBH) model. The activation energy of the intrinsic charge carriers has been calculated by using the Arrhenius equation at different frequency. The contribution of grain and grain boundary to the impedance of the material has been obtained from the Nyquist plot. Study of both AC conductivity and impedance analysis reveals that the sample exhibit negative temperature co-efficient of resistance (NTCR) indicating the semiconducting nature of the material.

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Structural and Optical Parameters of Sol-Gel Derived Barium Strontium Titanate (BST) Thin Film

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Abstract: Multilayered Barium Strontium Titanate ($Ba_{0.6}Sr_{0.4}TiO_3$) thin film was fabricated successfully on corning glass substrate via sol-gel process technique. The as-prepared film was found to be amorphous which crystallizes after annealing at 550°C. Structural characterization of the samples was done by X-Ray Diffractometer (XRD). The XRD data analysis revealed that $Ba_{0.6}Sr_{0.4}TiO_3$ has a cubic structure (a=3.9526Å, cell volume=61.7553 $Å^3$), belonging to space group *Pm-3m* with preferred orientation along (110) plane. The crystallite size and micro-strain of the sample were calculated from XRD data using Williamson-Hall Plot. Ultraviolet-Visible spectroscopy technique was used to determine various optical parameters such as transmittance, absorption co-efficient, optical band gap, refractive index, complex dielectric functions, optical conductivity and Urbach energy of the fabricated thin film. The optical band gap of the crystalline sample was found to be 3.50eV approximately. Optical transmittance spectra in the wavelength range 200 ~1100 nm shows good optical transparency of the BST thin film. The variation of the dielectric properties and refractive index as a function of frequency have been discussed and reported. Optical parameters of the prepared thin film suggest its potential application in optoelectronic devices. The experimental results are discussed and analyzed in the light of reported results in the literature.
Keywords: Williamson-Hall Plot; Refractive index; Dielectric function; Optical conductivity; Urbach Energy.

Microstructural, Structural and Peak Profile Analysis of Chemically Grown Bougainvillea Flower-like Zinc Oxide Nanostructures

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We have followed a simple wet chemical method to synthesize Bougainvillea flower-like ZnO nanostructures. The morphology of the synthesized material was observed in field emission scanning electron microscope revealing the formation of flower-like nanostructures comprising of bunch of leafy patterns. X-ray diffraction (XRD) was used for structural analysis of the synthesized ZnO. The XRD pattern suggests the formation pure ZnO nanostructures. Rietveld study along with peak profile analysis were carried out for determine various structural parameters of the synthesized nanostructures.

Studies on the silver incorporated titania aerogel nanostructure as a photoanode in Quasi Solid Dye Sensitized Solar Cells

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Abstract: Dye-sensitized solar cells (DSSC) have a significant impact on photovoltaic technology because of its quick, low-cost manufacture, light weight, and high power conversion efficiency (PCE). TiO_2 aerogels are promising 3-D mesoporous materials which has high specific surface area, high porosity which employed as a photoanode material for energy conversion devices. Here, we reported the quasi solid DSSC performance of the silver-incorporated titania aerogel nanostructure. Silver-incorporated titania aerogel was synthesized by the facile sol-gel route. Structural, optical, photovoltaic properties and cell stability of a prepared photoanode material were measured. PXRD revealed that the anatase phase is retained after the incorporation of silver. HRSEM images and EDS spectra confirmed the interconnecting network of titania aerogel and the presence of silver respectively. Due to the Localized Surface Plasmonic Resonance (LSPR) effect, the absorption spectra of the composite exhibited the red-shift around 650 nm. PL spectra showed the decreasing intensity in composites which is the evidence of suppressing electron-hole recombination and improving electron injection. Incorporation of silver has improved the photon absorption capability of the photoanode tends to enhanced photocurrent density as well as PCE of QS-DSSC. The details will be presented.
Keywords: Titania aerogel, QS-DSSC, SPR effect, Silver, Sol-gel

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Analysis of single XRD peak of single crystal ZnS for microstructural study through single line Voigt method

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Abstract: In this work, single nanocrystal ZnS has been prepared through a wet chemical method using Zinc Nitrade (Zn(No3)2), and Sodium Sulfide (Na2S) where 3-MPA has been used as a capping agent. Morphological study of ZnS through SEM and TEM analysis shows that the average particle size is approximately 7 nm. XRD analysis shows that the prepared sample is single crystals and from this single peak different structural properties of ZnS nanoparticles has been obtained. Further, using the single line Voigt method based on the diffraction peak broadening, average size and intrinsic strain in the sample have been determined from the single peak.

Keywords: Single crystal; TEM; XRD analysis; single line voigt method; Intrinsic strain

A comparative DFT study of the impact of anionic variations on the thermoelectric properties of $Pb_{0.25}Mg_{0.75}Y$ (Y = S, Se, Te).

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The thermoelectric properties of $Pb_{0.25}Mg_{0.75}Y$ (Y=S, Se, Te) semiconductor ternary alloys in their rock-salt (B1) crystallographic phase have been calculated using the full-potential linearized augmented plane wave (FP-LAPW) method under the framework of density functional theory (DFT). Using the Wu-Cohen generalized-gradient approximation (WC-GGA) induced exchange-correlation potential scheme, the ground state structural parameters have been calculated. In thermoelectric (TE) properties studies it has been found that Seeback coefficient (S) increases with increase in temperature due to electron- phonon scattering. Thermal conductivity (κ) is increased with increasing temperature and it is

due to phonon-phonon interactions. The electrical conductivity (σ) is decreased with increasing temperature due to change in mobility.

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Transient WORM memory device using biocompatible material Protamine Sulfate with high data retention and stability

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Abstract: Green Electronics have got its momentum in recent decades due to its biodegradability and transient nature with a vast application towards the biomedical devices and sustainable solution to the disposal of tons of hazardous e-wastes. In this research work we employed a biocompatible material Protamine Sulfate (PS) as the active layer to demonstrate biodegradable transient resistive memory devices. Au/PS/ITO device exhibits non-volatile resistive switching with write-once-read-many (WORM) memory behaviour. The WORM memory performance of the device was very good with high memory window (4.57×10^3), data retention (experimentally $> 10^6$ s, extrapolated $> 10^8$ s), device yield (~ 87.5%), read endurance ($>3.6 \times 10^4$), device stability (>210 days). Bias induced charge trapping followed by conducting filament formation was the key behind such switching. Electronic as well as optical behaviour were completely disappeared after 8 minutes' dissolution of the device in aqueous solution. As a whole this work suggests that PS based WORM memory device could play a key role for the development in designing biodegradable transient memory device.
Key Words: Biodegradable, Green Electronics, WORM, Resistive switching, Protamine Sulfate.

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Non-volatile memory applications using Langmuir-Blodgett (LB) film of Indolyl derivative

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Abstract: Organic electronics is very promising due to the flexibility, modifiability as well as variety of the available organic molecules. Efforts are going on to use organic materials for the realization of memory devices. In this regard switching behaviour of organic molecules made them an essential candidate for making organic resistive memory devices, where organic materials posses at least two stable resistance states. LB technique is one of the best suitable methods to prepare thin film based organic switching devices, which may be the key for the development of molecular electronics.

Here we present LB film based resistive switching devices, using organic materials-1,4-bis(di(1H-indol-3-yl)methyl)benzene (Indole1). Pressure - area per molecule isotherm (ð – A), Brewster Angle Microscopy (BAM), Atomic Force Microscopy (AFM) and Scanning Electron Microscopy (SEM) were used to have idea about organization and morphology of the organic material onto thin film. Based on the device structure and measurement protocol we observed that the device made up on Indole1 molecule shows non-volatile Resistive Random Access Memory (RRAM) characteristics with very high memory window, data sustainability and repeatability. Oxidation-reduction process as well as electric field driven conduction are the key behind such switching behaviour. Our investigations suggested that switching device using Indole1 derivative with very good data retention, repeatability, stability and high device yield may be a prominent candidate for memory applications.

Keywords: Resistive switching; Langmuir-Blodgett (LB); RRAM; Oxidation-reduction.

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Interaction of biomembrane and a coagulating agent

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Abstract: A biomembrane is an enclosing or separating membrane that acts as a selectively permeable barrier within living things with two basic components lipid and protein. Proteins have a disturbing effect on lipid biomembranes by electrostatic as well as non-electrostatic forces viz. hydrophobic association and hydrogen bonding [1]. Langmuir- Blodgett (LB) technique is one of the essential techniques for mimicking biomembrane artificially [2, 3]. Using this technique, we can get the opportunity to have ideas about different phenomena occurring within biomembrane in a changed environment. Here, we present our preliminary investigation on the interaction of a coagulating agent Protamine Sulfate with a phospholipid 1,2-dioleoyl-sn-glycero-3-phosphocholine (DOPC). Main interest is to have idea about the physical processes occurring during coagulation process within cell membrane. Surface pressure-area (ð- A) isotherm, Surface pressure- time (ð- t) curve, and fluorescence micrographs were used to investigate the interaction. Investigation shows that Protamine Sulfate binds strongly with DOPC biomembrane. However, the interaction strongly depends on the micro environment as well as the amount of Protamine Sulfate. Incorporation of Protamine Sulfate decreases the fluidity of biomembrane. Our results help to have insight into the interaction of the coagulating agent with the biomembrane.
Keywords: Coagulating agent; Biomembrane; Phospholipid; Protamine Sulfate; DOPC

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Resistive Switching using Biomaterials and its application towards Neuromorphics Computing.

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Abstract: Resistive Switches (RS) commonly referred to as resistive memory (RRAM) devices, are modeled as memristors, and a developed nanoscale technology that can transfigure data storage and computing approach. And nowadays it has been a great attention due to its high speed, enhanced storage density, non-destructive read out, retention time, device yield and excellent scalability etc. With

the intensive growth of material science, resistive switching is one of the emerging tools to have an idea about the next generation computing device. The existing Von Neumann Architechture has a separate space for memory and computing element , requires a significant energy and time to perform operations and constant movement of data. Hence an alternating computing approach has been found in biological system which operate at a very highly constraint power budget. Therefore new computing paradigms known as 'neuromorphic computing' come into picture. The principle of neuromorphic computing is a device that uses biological approach to perform computation and data on a device. This approaches the achievement of parallel computation with the power that has been implemented on conventional silicon transistor-based hardware. The enhancement of highly efficient neuromorphic computing systems lies in the improvement of electronic devices that can firmly mimic biological synapsis. Based on the literature survey, the recent progress in analog type RRAM along with the application regarding neuromorphic computing has been reviewed. And our goal is to give a brief overview of biomaterial-based RRAM devices and their future interdisciplinary research towards neuromorphic computing.
Keywords: Resistive switching, RAM, neuromorphic computing, biological synapsis.

Study of Polydiacetylens films for colorimetric and resistance based sensors

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Abstract: Polydiacetylenes (PDAs) are a unique class of smart materials that have been used extensively in diverse sensing applications due to their salient photophysical properties. Here,, we report on development of a new hybrid PDA system/network consisting of diacetylene monomer 10,12-pentacosadyinoic acid and a synthesized diacetylene derivative N-(benzo[d]thiazol-2-yl)pentacosa-10,12-diynamide using spin coating and Langmuir-Blodgett technique. We have investigated the structural, morphological, optical, and electrical properties of newly constructed PDA configuration by means of surface pressure-area isotherm, atomic force microscopy, scanning electron microscopy, optical and electrical characteristics. The presence of modified head groups in the hybrid films strongly affects the optical and electrical properties of the mixed films AFM and SEM studies reveal a dramatic structural modulation of the mixed film compared to the structure of pure counterparts. Our spectroscopic and electrical characteristics study reveal that the hybrid films show a dramatic two-step colorimetric transformation (blue to and purple to red) when it is perturbed by UV-irradiation followed by temperature. Furthermore, we have observed an increase in electrical conductivity of the mixed film compared to the pure film upon UV-irradiation followed by temperature in blue phase. Thus, this work introduces a new PDA system that expands the library of PDA and may opens up the window to the molecular optoelectronic device applications as well as colorimetric and resistive sensors based on PDA systems.

Atmospheric Physics

Interaction of radiation with atmospheric constituents and consequent dark heating of the atmosphere

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Abstract: The Eastern Himalayan Foothills region (EHF), comprising of the North-East Indian states and adjoining areas, is crucial in terms of interaction of radiation with the atmospheric constituents and resultant implications on the climate. In general, the atmospheric composition of the region is found to be altered under the influence of dust advection from the Indian deserts through westerlies, anthropogenic emissions from the Indo Gangetic plains (IGP), marine emissions from the Bay of Bengal and local biogenic emissions from large vegetation cover, including primary and secondary bioaerosols as well as local anthropogenic emissions (e.g., biomass burning, fossil fuel burning, oil and gas fields etc.). Being a tropical region, the radiation available is conducive for various heterogeneous chemical reactions in atmosphere, thus altering the instantaneous atmospheric composition. For example, oxidation of CO in presence of visible radiation results into the chemical products like CO_2, CH_4, tropospheric O_3. All these are greenhouse gases (GHGs) contributing to present day global warming through dark heating in the atmosphere. The continuous increase in these species over the region is associated with observed increasing temperature trends, thus resulting the region vulnerable to the climate change.

Ionospheric signatures associated with Sudden Stratospheric Warming (SSW) episodes over Okinawa

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Abstract: Sudden stratospheric warmings (SSWs) are large and rapid temperature increases in the winter polar stratosphere associated with reversal of the climatological wintertime westerly winds. A comparative study of Major and Minor SSW events which occurred in the Northern Hemisphere has been carried out in this work. We have considered four winters each having single major, single minor, one major-one minor, and two minor events respectively. Era5 and MERRA2 reanalysis data for Zonal Mean Zonal Wind (ZMZW) and Temperature, and MIMOSA model data for Potential Vorticity (PV) have been used to characterize the SSW events. The temperature profiles for altitude range 30-90 km have been obtained from Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) onboard Thermosphere-Ionosphere-Mesosphere Energetics and Dynamics (TIMED). Among various ionospheric profiles, we have used critical frequency of F2 layer (foF2) and base height of ionosphere (h'F) to study the ionospheric response to these events over Okinawa (26.21N, 127.68E). Ionospheric

parameters have different response depending on whether the stratospheric wind remains westerly (Minor SSW) or becomes easterly (Major SSW) during the warming. Polar vortex conditions are also noticed to be another reason for difference in ionospheric variability.

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Influence of the remote celestial event like gamma ray burst GRB 190114C on the total electron content of the earth's ionosphere: A case study

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Abstract: When a high-mass star implodes to form a neutron star or a black hole, during a supernova or super luminous supernova, an intense gamma radiation is released, known as Gamma Ray Burst (GRB). Besides the sun, the burst events with energetic photons at cosmological distances, especially X-ray or γ-ray bursts, may also influence the total electron content (TEC) of the ionosphere. Brown (1973) found that a γ-ray burst at cosmological distance had a very large effect on the propagation of radio waves. Fishman et al (1988) experimentally observed the ionization of the bottom of the ionosphere caused by GRB. A bright gamma-ray burst (GRB 190114C) was detected on the earth by Swift-BAT, Fermi-GBM and Konus -Wind at 20:57 UT on the 14th January,2019,which was originated from a galaxy 4.5 billion light years away near the Fornax constellation. According to Hubble's observations a star, sitting in a very dense environment, collapsed and caused such powerful gamma ray emission. GRB 190114C was the first identified long duration GRB. The extremely strong gamma-radiation swept across the earth. The influence of this GRB 190114C on the total electron content (TEC) of the

earth's ionosphere is studied using the data provided by the international GPS service network (IGS) for the stations at high, middle and low latitudes in both hemispheres in Asian-Australian region. Evident effects are found at many stations of both hemispheres. The day of the event and it's following day were geomagnetically quiet as observed from the values of geomagnetic parameters and the associated curve for their temporal variations. Possibility of ionospheric disturbance due to cloud activity was least as it was winter season in this region. More over the event was detected in the late night time when the solar radiation is absent at the longitude range of the stations considered. Just after the time of spectroscopic detection of GRB in late night, due to prompt emission remarkable unusual variations (maximum 2 TECU) are observed in diurnal TEC curves mainly at high latitude stations in both hemispheres, which don't follow the monthly mean curves. In the following day due to afterglow effect (X-ray) isotropic influences are observed in both the hemisphere i.e. TEC at almost all the stations from low to high latitudes are influenced by (1-3) TECU in diurnal maxima. There are very few studies on GRB prompt emission effect and no study on afterglow effect. The influence of such long duration GRB is reported for the first time. This study answers an important question for scientists regarding the possible potentially harmful influence of the remote celestial event on the terrestrial space.

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Global Climate Feedback Studies of Cirrus Reflectance, Specific Humidity in Relation with Lightning

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Abstract: The variation of Upper Tropospheric Water Vapor (UTWV) can impact cirrus cloud formation in the upper troposphere. Cirrus clouds are having considerable scientific interest because of their impact on the Earth's radiation budget and climate. On the one hand, cirrus clouds cool the atmosphere by scattering or reflecting solar radiation that reaches the surface and the atmosphere. Optically thin cirrus clouds potentially involved in the dehydration process is critical for understanding the mechanisms that control entry-level stratospheric water vapor. For example, if a cirrus cloud forms as an air parcel is cooled; total water remains constant while water vapor decreases. On the other hand, if the source of a cirrus cloud is an anvil, there is no constraint on the total water in the cirrus cloud relative to the water vapor in the surrounding cloud-free air (Weinstock et al. 2006). So the distribution of cirrus clouds may affect the overall Earth's atmospheric radiative energy budget, the variability of cloud microphysical properties, and climate feedbacks. The UTWV also arrives in the upper troposphere primarily via deep convection, and hence lightning activity has also been shown to be related to changes in UTWV (Price and Asfur, 2006). In our analysis, we have used monthly mean lightning data from the Lightning Imaging Sensor (LIS) onboard the TRMM satellite, for the period of 1998-2013, UTWV obtained from the ECMWF reanalysis product, Cirrus Reflectance from MODIS TERRA. Our best correlations

occur when comparing lightning activity to water vapor (r=0.49) and lightning activity to the cirrus reflectance (r=0.5) at the 125 hPa level. Therefore given the increased observations of lightning from global ground networks, and geostationary satellites, we propose that lightning may be a useful parameter to monitor for studying climate feedbacks related to UTWV, Cirrus Clouds.

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Impact of Acedelia Strom Track (AST) in Martian Atmosphere during MY 33 and 34

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Abstract: Martian storms can potentially impact the lower/upper atmospheres through dust aerosol radiative heating/cooling and atmospheric circulation. Notably, the planet-encircling dust storm is the most dynamic phenomenon that substantially alters the temperatures and circulation patterns of the Martian lower atmosphere. Here we present the attempt to investigate how the dust impact transfers from the neutral upper atmosphere to the ionosphere over the Acedelia Strom Track (AST). Our results show that the main ionospheric layer (below ~250 km altitude) undergoes an overall upwelling or enhancement. Our analysis shows that during the dust storm season, ionosphere density varies from $1.8x10^6$ cm^{-3} to $5x10^6$ cm^{-3}, and during non-dust storm season, it varies from $1.3x10^5$ cm-3 to $9x10^5$ cm^{-3}, much less than dust storm season. Further, the impact of regional and global dust storms is determined by accounting for predictable sources of ionospheric variability like EUV Flux, SZA, and neutral densities. This study suggests that significant dust activity can cause disturbances in ionospheric densities. These disturbances are tied to perturbations in the thermosphere caused by aerosol heating of atmospheric dust. The expansions of the atmosphere during the dust storms and the solar wind electron precipitation are considered plausible mechanisms for explaining the observed results. The effects of the lower atmospheric dust storms on the altitude of the Martian ionosphere are studied using a topside radar sounder (MARSIS) aboard the Mars Express spacecraft. For this purpose, we considered oblique echoes observed during Martian years 33 and 34. Our results consistently indicate that the altitude of the Martian ionosphere is higher during the dust storm period than before the onset of the dust storm. Also, we tried to investigate the compositional variation of the Martian ionosphere during the Martian storms, using the ion density measurements made by the Neutral Gas and Ion Mass Spectrometer (NGIMS) onboard the Mars Atmosphere and Volatile Evolution. At the height of 170 km, the variations of ionospheric species during the GDS show enhancement in CO_2^+, Ar^+, H_2O^+ and depletion in O_2^+, O^+, N_2^+/CO^+ and OH^+. These results will open a new window to study the atmosphere loss from the red planet.

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SEM-EDX based morphological and chemical characterization of aerosols generated during wood burning

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Abstract: Smoldering and Flaming combustion phases are very important combustion phases in biomass burning due to their different burning characteristics and their impacts on both environment and human health. This study aims to identify the chemical elements generated during burning of different woods used by the rural people in home kitchens. We used scanning electron microscope (SEM) to characterize the surface morphology of the samples collected during burning of different woods and branches (Bamboo, Teak, Coconut shell, Jackfruit, Arjun, Akashi, Mango, Blackberry, Guava, and dry leaves) under flaming and smoldering combustion phases. We used the energy dispersive X-ray (EDX) coupled with SEM for the chemical characterization of samples collected during different combustion phases. We noticed a variation in morphology of particles for both the combustion phases. We identified different shapes of particles varies from regular to irregular including and clusters of particles like chain like structure, soot structure, and other irregular structures. We noticed a presence of difference toxic elements present in the in the sample We noticed the major contribution by Carbon (C) in both the combustion phases but during smoldering, we noticed an increase in C than the flaming samples. We identified the different toxic elements (Al, Br, C, Ca, Cl, Cu, Fe, K, Mg, Na, and Rb) with change in their elemental weight percentage. We observed the maximum contribution by element C with 41% and 32% during smoldering and flaming phases respectively. We found the presence of common elements like C, Ca, Na, Cl, and K and their average percentage contribution with 27%, 3%, 3%, 2%, and 1% during smoldering and 18%, 6%, 2%, 1%, and 2% during flaming phase. Details will be presented.

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Multi model predictability assessment of TEC during solar minimum around 100°E

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The prediction efficiency of the International Reference Ionosphere extended to Plasmasphere (IRI-Plas) model under solar minimum quiet time period around 100°E is examined by comparing with the total electron content (TEC) obtained from a chain of Global Navigation Satellite Systems receivers. The IRI data is generated by assimilating the TEC derived from GPS (GPS-TEC) into the model code. The "no input" option of the model is used as a reference to study the effect of data assimilation on the model's efficacy. It is observed that with "no input" option the model overestimates the quiet time TEC in all stations. However, the assimilation of GPS TEC into the model code reproduces TEC quite well for all the quiet days considered. IRI-Plas simulation is then compared with SAMI2 is Another Model of the Ionosphere (SAMI2) simulation for the same space time configuration. SAMI2 also overestimates the quiet time observed TEC during daytime peak hours in all northern and southern stations. Based on observed results changes are made to the SAMI2 model inputs. By changing the ionizing EUV, neutral density and scaling the vertical drift, a good agreement between the simulated and measured data is obtained. Of the two models, IRI-Plas with assimilation mode provides better results than SAMI2.This may be attributed to the plasmaspheric contribution as well as the capability of assimilating measured TEC values into the IRI-Plas model.

Astrophysics and Cosmology

Study of the standing shock in the accretion flow around KTN black-hole

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Abstract: We study the standing shock properties in the relativistic accretion flow in a generic stationary axisymmetric space-time ,i.e. Kerr-TAUB-NUT (KTN) space-time. Here we consider an effective potential ($Ö_{eff}$), proposed by Dihingia et.al in 2018. This KTN space-time contains the spin parameter or the Kerr parameter (a_k) and the NUT parameter (n) along with the mass. Depending on the value of a_k and n, the space-time represents either black-hole or naked singularity. The flow is coming from the outer edge to the horizon, and there is a competition between the centrifugal force and gravitational force. Sometime the two forces may be comparable to each other and we get the shock transition in the accretion flow. So, using the relativistic shock conditions and the relativistic equation of state we find the solutions for which we get the shock . Then we see that how the solution looks like if it contains shock and then we study how the shock location varies with Kerr parameter and NUT parameter for different values of energy and angular momentum. We calculate the surface density and the disc luminosity. Then we investigate how the surface density varies in the presence of the Kerr parameter and the NUT parameter. Thereafter we show how the disc luminosity varies with the Kerr parameter and the NUT parametr for different values of energy and angular momentum. We also compare them between shock solution and without shock solution. Finally we discuss the reasons behind them.

A Study on the effect of Particle Creation in the framework of Saez-Ballester theory of gravity

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Abstract: We study particle creation in the evolution of spatially homogeneous and anisotropic Bianchi type-I cosmological model within the framework of scalar tensor theory of gravitation developed by Saez and Ballester. Particle creation are taken as an irreversible process and eventually we have modified energy momentum tensor to accommodate the creation pressure. We have used special law of variation of Hubble parameter proposed by Berman; which produce a constant value of deceleration parameter and using this we have obtained two types of solutions of the average scale factor for Bianchi type I model. And this two distinct solution of scale factor provides singular and non- singular behavior with power law and exponential form. We study particle creation in the both form. Also the cosmological parameters are discussed in detail.

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Echoes of gravitational waves in GR with non-vanishing Lambda

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Abstract: High density compact stars generally provide excellent natural ideal laboratories to study matters in extreme conditions and even to test or constrain modified theories of gravity under such conditions that cannot be expected from the earth based laboratories. One of such high density star is the strange star. Such compact object has a much more stable configuration compared to a neutron star. In recent studies [1, 2] it is shown that strange stars can echo gravitational waves. In this work we are considering strange star to calculate echo frequencies emitted by them in general relativity with non-vanishing lambda [3]. In order to depict strange star's behaviours we have chosen MIT Bag model and linear EoS. For both de Sitter and anti-de Sitter space corresponding to positive and negative values of lambda, we have calculated the characteristic echo times and corresponding gravitational wave echo frequencies. Our results clearly shows that the properties of strange star such as mass and radius as well as gravitational wave echoes change with non-zero lambda values. Also for the considered pressure-density relations and lambda values compactness of strange stars crosses the photon sphere limit and eventually give echoes.

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Inflation in f(R,T) gravity with Double-Well Potential

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Abstract: In this piece of work, we studied the inflation [1] in the context of f(R,T) theory of gravity [2]. We assumed the functional form of f(R,T) to be R+lT, where R is the Ricci scalar, T is the trace of the Energy-Momentum tensor and l is the model parameter. The cosmological observable parameters like scalar spectral index, tensor spectral index and tensor-to-scalar ratio are estimated for Double-Well potential. For l = 115 and 60 no of e-folding, scalar spectral index is 0.9653, tensor spectral index is -

0.0000177 and tensor-to-scalar ratio is 0.000141 which are in good agreement with PLANCK 2018 data [3]. Further, considering the vacuum expectation value in Double-Well potential to be Planckian, we derived the admissible range of model parameter to be $101 < l < 130$ for which this model remains consistent with PLANCK 2018 data.

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Traversable Wormholes in f(R) Gravity

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Abstract: Traversable wormhole solutions in general relativity (GR) require exotic matter sources that violate the null energy condition. f(R) gravity has been studied extensively as a viable alternative to GR, and traversable wormhole solutions in f(R) gravity have been discussed extensively. In this study, we present a spherically symmetric traversable Morris-Thorne wormhole solution in a cosmologically viable f(R) gravity theory. We analyze the different energy conditions of our solution, and discuss the nature of the obtained space-time geometry.

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Traversable Wormholes in f(R) Gravity

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Abstract: Traversable wormhole solutions in general relativity (GR) require exotic matter sources that violate the null energy condition. f(R) gravity has been studied extensively as a viable alternative to GR, and traversable wormhole solutions in f(R) gravity have been discussed extensively. In this study, we present a spherically symmetric traversable Morris-Thorne wormhole solution in a cosmologically viable

f(R) gravity theory. We analyze the different energy conditions of our solution, and discuss the nature of the obtained space-time geometry.

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A STUDY ON IMPACT OF PROTON CAPTURE REACTION TO THE ABUNDANCES OF NEON, MAGNESIUM AND ALUMINIUM IN B-TYPE AND HgMn STARS

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Abstract: The impact of p-capture reaction cycles has been studied on the abundances of Neon, Magnesium and Aluminium considering nuclear chain reaction of neon-sodium-magnesium-aluminium in stars in stellar conditions of temperature range 0.02×10^9 to 0.10×10^9 K and typical density of 100 gm cc^{-1}. We have estimated abundances of neon, magnesium, and aluminium with respect to H, which are assumed to be ejected from those stars because of stellar rotation reaching a critical limit. These ejected abundances of elements are then compared with their counterparts which has been observed in B-type and HgMn stars. We observe an excellent agreement with abundances between the estimated and observed values for B-type stars and HgMn stars with a correlation coefficient above 0.9.

Quasinormal modes of non-linear Electrodynamic Black holes in Rastall gravity surrounded by Dark Energy fields

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Abstract: The Rastall gravity is one of the important modifications of General Relativity (GR). It shows significant deviations from GR in presence of non-zero curvature in many aspects. In a recent work, quasinormal modes of black holes in Rastall gravity have been studied, which showed that quasinormal modes can be different from those in GR [1]. In this work, we study the quasinormal modes of black holes with electrodynamic sources in presence of dark energy fields in Rastall gravity and found that the quasinormal modes of black holes for both linear and non-linear electrodynamic sources in presence of dark energy fields deviate notably from that of GR [2]. With increase in black hole charge, the Gravitational Waves (GWs) from such black holes decay more rapidly. Similarly, a higher value of Rastall parameter also increases the GWs decay rate. Moreover, it is also seen that the type of dark energy fields can

have noticeable impacts on the decay rate of GWs [2]. We also confirm the possibilities of existence of regular black holes surrounded by dark energy fields in Rastall gravity in presence of non-linear electrodynamic source.

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Testing and Constraining a new f(R) gravity model in Palatini formalism

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Abstract: Recent studies show that viable f(R) gravity models can pass the constraints put by Gravitational Wave (GW) events observed at LIGO and Virgo in both metric and Palatini formalism [1, 2]. Thus f(R) gravity has passed another observational constraint and projected itself as a promising alternative of General Relativity (GR). In this work we have studied the behaviour of a new f(R) gravity model defined in Ref. [1] in the Palatini formalism. We have used Statefinder diagnostics and Om(z) test to see the uniqueness as well as the viability of the model. To get a better visualization of the model behaviour, we have compared the model with two other known models viz. Power law model and reduced Starobinsky type model. We have also constrained the new model using OHD (Observed Hubble Data) by implementing chi-square minimization method. We observe that the new model can mimic LCDM model and reduced Starobinsky model in high z regime [3]. Especially in the present regime and in the far past universe, the new model behaves identically with the LCDM universe.

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Steady-state analysis of General Relativistic Magnetohydrodynamics (GRMHD) accretion flows around black holespace-time

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Abstract: Magnetic fields play a crucial role in driving the accretion flows around black holes (BHs). However, the underlying mechanisms that govern accretion flow are not well understood. In this study, we investigate advective transonic accretion flows (ADAF) around a BH and analyze the flow dynamics in the presence of radial and toroidal magnetic fields. We consider the disk to be thin, and axisymmetric in the equatorial plane (è <“ ð/2). Here, we present the first-ever analytical study of the steady-state general-relativistic magneto-hydrodynamics (GRMHD) accretion flows around BHs to the best of our knowledge. We connect the flow properties with the global constant of motion of the accreting fluid, namely the energy (E), angular momentum (L), and the local magnetic fields, respectively. We use the GRMHD flow equations to find critical points and obtain the global transonic accretion solutions. The thermodynamical counterpart is taken care of by the relativistic equation of state (REoS). We find that even a weakly magnetized flow (â >> 1) can transport angular momentum outwards. Additionally, we define a model viscosity parameter ($á_{tot}$) that develops within the disk due to the magnetic stress and find it to be radially varying in a ‘U’ shape, which was not reported earlier. Interestingly, our 1.5D analytical study confirms that magnetic fields are dynamically important (several thousand Gauss for a 10M BH, (â <“ 1)) in the near horizon region, which is in favor of the recent observations by the Event Horizon Telescope (EHT).

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Efficient Modelling of Cosmic Reionization using SCRIPT

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Abstract: The ionization and thermal state of the intergalactic medium (IGM) during the epoch of reionization has been of interest in recent times because of their close connection to the first stars. In this work, we present a semi-numerical code which computes the large-scale temperature and ionized hydrogen fields in a cosmologically representative volume accounting for the patchiness in these quantities

arising from reionization. The code is an extension to a previously developed version for studying the growth of ionized regions, namely, Semi Numerical Code for ReionIzation with PhoTon Conservation (SCRIPT). The main addition in the present version are the inhomogeneous recombinations which are essential for temperature calculations. This extended version of SCRIPT also implements physical consequences of photoheating during reionization, e.g., radiative feedback. These enhancements allow us to predict observables which were not viable with the earlier version. These include the faint-end of the ultra-violet luminosity function of galaxies (which can get affected by the radiative feedback) and the temperature-density relation of the low-density IGM at z ~6. We study the effect of varying the free parameters and prescriptions of our model on a variety of observables. The conclusion of our analysis is that it should be possible to put constraints on the evolution of thermal and ionization state of the IGM using available observations accounting for all possible variations in the free parameters. A detailed exploration of the parameter space will be taken up in the future.

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Shadow of Rotating Charged Morris Thorne Wormhole

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Abstract: Wormholes (WHs) are solutions of General relativity field equations that allow a passage between two different regions of spacetime which needs exotic mater that do not satisfy energy conditions (ECs). The notion of Charged WHs (CWHs) in general Morris-Thorne [1] wormhole ansatz is introduced by Sung-Won Kim and Hyunjoo Lee [2] and further studied in f (R, T)-extended theory of gravity by Moraes, Paula and Correa [3]. In this article we take the metric introduced by Kim and Lee, find the Rotating CWH metric using the Newman Janis algorithm and then find the shadows of the resulting metric. We have considered various sub families of CWH and showed some novel features arise due to parameter tunings. The cusp [4] formation of the shadows has been studied also to bring better comparisons with the standard results available in the literature.

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ËCDM Model in Born Infeld *f*(*R*) gravity in the background of Bianchi I Cosmology

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Abstract: We performed an investigation on the ËCDM model considering the anisotropic Bianchi I cosmology. We combined the theory of *f*(*R*) gravity with Born Infeld theory and explore the dynamics of the model using a very useful approach known as the Dynamical System Approach (DSA). Using DSA, we investigate the equilibrium points representing different eras of cosmic evolution and study the solutions as well as physical behaviour associated with each of the fixed points. We also study the evolution of shear parameter in the background of Bianchi I cosmology.

Landau–Lifshitz pseudotensor in the presence of Cosmological Constant

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Abstract: When the Landau–Lifshitz pseudotensor was formulated, it was commonly assumed that the cosmological constant was zero. In late 1990 Cosmological constant was discovered to be non-zero, suggesting the fact that our universe is currently expanding. In gravitational field, the four momenta of matter alone must not be conserved, rather the four momenta of matter plus gravitational field should be conserved. In the theory of general relativity, stress–energy–momentum pseudotensor, such as the Landau–Lifshitz pseudotensor, is an extension of the non-gravitational stress–energy tensor that incorporates the energy-momentum of gravity. It allows the energy–momentum of a system of gravitating matter to be defined. In particular it allows the total of matter plus the gravitating energy–momentum to form a conserved current within the framework of general relativity, so that the total energy–momentum crossing the hypersurface (3-dimensional boundary) of any compact space–time hypervolume (4-dimensional submanifold) vanishes. We try to incorporate the cosmological constant into Landau-Lifshitz pseudotensor with the help of spacetime dependent terms.
The approach applied here to calculate Landau-Lifshitz pseudotensor is similar as used by'Classical Theory of Fields' by Landau-Lifshitz.

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A study of the effects of histogram binning on the accuracy of finding flux distribution of X-ray Binaries

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Abstract: X-ray binaries are consist of a normal star and a collapsed star (a white dwarf, neutron star, or black hole) and X-ray emission from them exhibits strong variability at time scales from milliseconds to years. The variation in ûux across the electromagnetic spectrum over a wide range of timescales ranging from fractions of a second to years is an important characteristic of astrophysical objects powered by the compact source. Flux distribution is an important tool to understand the variability processes in X-ray binaries. Multi-wavelength flux distribution of sources with broadband stochastic variability is a unique tool to understand and probe the nature of physical processes eg. A normal flux distribution suggests additive processes while a log normal refers to cascade/multiplicative processes. Histogram fitting is one of the statistical methods which could be implemented to study this distribution. We will be presenting our results of the flux distribution study of black hole X-ray binary Cygnus X-1 and neutron star X-ray binary Scorpius X-1. We will also discuss how the binning of histogram has an effect on flux distribution study.

Contribution of Proton Capture Reactions to the Abundances of Phosphorus and Sulfur in FGK Stars

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Abstract: Elemental abundance pattern is one of the key components which gives clues for understanding not only the cluster formation but also the chemical evolution. But the origin of the abundance pattern is yet to be completely perceived. In this study, we carried out the impact of p-capture reaction cycles on the abundances of phosphorus (P) and sulfur (S) considering nuclear burning cycles of PCl in stars of temperature range 0.1×10^9 to 0.6×10^9 K and density of 10^2 gmcc^{-1}. Such kind temperature density situations are going to be dominant within the H-burning shell of evolved stars. We have estimated abundances of P and S in 22 FGK dwarfs and giants that span -0.55 < [Fe/H] < 0.2. We observe an excellent agreement of [P/Fe] and [S/Fe] between the estimated and observed abundance values with a correlation coefficient above 0.7 and above 0.8 respectively for all 22 FGK stars. Possible sources of these discrepancies are discussed.

Wide-band view of High Frequency QPOs of GRS 1915+105 in 'softer' variability classes observed with AstroSat

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Abstract: We present a comprehensive temporal and spectral analysis of the 'softer' variability classes (i.e., ä, ñ, ê, ù and ã) of the source GRS 1915+105 observed by AstroSat during 2016-2018 campaign. Wide-band (3 " 60 keV) timing studies reveal the detection of High Frequency Quasi-periodic Oscillations (HFQPOs) with frequency of 68.14 " 72.32 Hz, significance of ~ 3 " 10, and rms amplitude of 1.54 " 2.66 % in ä, ê, ù and ã variability classes. Energy dependent power spectra impart that the HFQPOs are detected only in 6 " 25 keV energy band and the rms amplitude is found to increase (~ 2 " 8%) with energy. The dynamical power spectra of ê and ù classes demonstrate that the HFQPOs seem to be correlated with the high count rates. We observe that the wide-band (0.7 " 50 keV) energy spectra can be described by the thermal Comptonization component (nthComp) with photon index $\tilde{A}_{nth}$ ~ 1.83 " 2.86 along with an additional steeper ($\tilde{A}_{PL}$ ~ 3) powerlaw component. The electron temperature (kT_e ~ 1.93 " 3.07 keV) and optical depth (ô ~ 7.48 " 14.35) indicate the presence of a cool and optically thick corona. In addition, nthComp components ($\tilde{A}_{nth}$ ~ 2.02 " 2.4, F_{nth} ~ 1.06 " 3.57×10^{-8} erg cm^{-2} s^{-1}) are found to dominate in presence of HFQPOs. Overall, these findings infer that the HFQPOs are possibly resulted due to the modulation of the 'Comptonizing corona', revealed by the nthComp component. Further, we find that the bolometric luminosity (0.3"100 keV) of the source lies within the sub-Eddington (0.06"0.29 L_{Edd}) regime. Finally, we discuss and compare the results of the present work in the context of existing models on HFQPOs.

Asteroseismology of strange star in GR with non-vanishing Lambda

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Abstract: In this work we explore the asteroseismic behaviour of one type of compact stars called strange stars in Einstein-Ë gravity. The radial oscillation modes, fundamental f-mode and first 22 pressure

p-modes are calculated for strange stars for two equations of state, viz. MIT Bag model and linear equations of state. To calculate the oscillation modes we first integrate the TOV equations with non-zero cosmological constant using shooting method, and the radial and pressure perturbation equations are solved eventually. We also studied the mass as a function of radial distance for different values of Ë. Our results show that for strange stars, the effective range of cosmological constant is 10^{-15} cm^{-2} d" Ë d" $3 \times 10^{"13}$ $cm^{"2}$.

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Perturbation Spectra in Warm Chromo-Natural Inflation

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Abstract: We examine the chromo-natural inflation which is an axionic inflationary model with sub-Planckian axionic decay constant in the context of warm inflation. The dynamical equations of this model are obtained. We investigate the cosmological perturbation theory and calculate the perturbation spectra in this model. The sources of density fluctuations in this model are mainly the thermal fluctuations of the inflaton field like general warm inflationary model. Finally, cosmological observables, namely, the spectral index, the running spectral index and tensor to scalar ratio are calculated. We find that the tensor to scalar ratio is smaller than that in the chromo-natural inflation and other cosmological observables consistent with observational data.

Nuclear Physics & High Energy Physics

Impact of Transverse Enhancement in neutrino oscillation measurements using NOvA

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Abstract: NOvA is a long baseline neutrino oscillation experiment designed to measure muon neutrino disappearance and electron neutrino appearance using Fermilab's NuMI beam. Two functionally equivalent detectors are placed Off-Axis from the centre of the NuMI beam, separated by 810 km oscillation baseline. NOvA is able to address neutrino mass hierarchy, CP violation and the octant of large mixing angles, and can help to improve our understanding about neutrinos. In this work, we study the impact of transverse enhancement in Quasielastic-like processes and corresponding effect in neutrino oscillation measurements using GENIE neutrino event generator in NOvA experiment.

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Investigation of fusion suppression and projectile breakup using classical trajectory method

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Abstract: Fusion suppression from below to above barrier are studied for the reactions $^{7}Li + ^{27}Al$, $^{8}Li + ^{208}Pb$ inthis work. Fusion suppression can be explained by a two-dimensional classical trajectory model. Using this model of the projectile nucleus, the equations of orbits were categorized into two different trajectories, that is, breakup and no-breakup. The breakup fraction acts as a function of impact parameter whose cut-off value is determined through the corresponding sharp cut-off model according to which there is an angular momentum limit for the fusion. Due to this breakup there is hindrance of fusion cross section and to understand fusion hindrance(suppression), we present a formula which is a ratio between the sum of the products of breakup fraction and impact parameter and probability to the sum of the products of impact parameter and probability at various impact parameter ranges from head on collision to the sharp cut-off impact parameter. The calculated fusion cross section of the systems considered in this work nearly matched with the corresponding measured cross section. We found that the fusion suppression of our selected reactions are 28.8% and 29.7% respectively.

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Subsisting oxidizing material and parting agent selection in the fabrication of nuclear target

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Abstract: In heavy ion nuclear reaction experiments; self-supporting, thin and pure targets of uniform thickness are required for the studies like measurement of fusion excitation function, barrier distribution and recoil range distributions using different heavy ion projectile. But it is not always possible due to its inconsistencies and instabilities. Obtaining such target foil (especially for high Z materials) becomes a very tedious job, due to certain experimental limitations. To avoid these, target materials are evaporated on a thin lower Z backing material, especially carbon. Fabrication of targets of materials which get readily oxidized also poses lot of challenges in experiments. To avoid oxidation, appropriate capping along with backing is provided. To avoid contamination in the target, environmental condition and the proper selection of parting agent is also important. The enriched targets of stable isotopes 61,62Ni [1], 116Sn [2], 154,144Sm [3] and 142,148Nd [3,4] have been fabricated by adapting physical vapour deposition technique at IUAC, New Delhi using a high vacuum evaporation chamber facility. Role of encapsulation in minimizing the oxidation and the contamination level from parting agents in the targets is reported in this work. The thicknesses of the targets are verified using profilometer, á-energy loss, and RBS technique. They were found to be in good agreement. The purity and the uniformity of the fabricated targets are further confirmed after verification using RBS, EDS and XRD techniques.

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Pinpointing Octant of the atmospheric mixing angle, è$_{23}$ for a linear seesaw model under A_4 symmetry

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Abstract: The measurements of long baseline neutrino oscillation experiments are inflicted by Octant degeneracy problem [1], [2] . In this work, we aim to resolve the Octant degeneracy using a linear seesaw model under the framework of A_4 flavour symmetry. The light neutrino mass matrix obtained from our A_4 model is compared to the light neutrino mass matrix based purely on neutrino oscillation parameters. This leads to six real equations from which we can obtain the equations of triplet and singlet flavons. Choosing various vacuum alignments of the triplet scalar flavon field, we solve this set of equations and obtain the unknown free parameters of neutrino mixing, i.e., lightest neutrino mass, Dirac CP violating phase, δ and two Majorana phases, α and β, for a full parameter scan given by 3σ global fit values. It is possible to pinpoint the favourable Octant of the atmospheric angle, θ_{23} and mass hierarchy by these solutions.

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Covariance analysis of efficiency calibration of NaI(Tl) detector

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Abstract: The efficiency of NaI (Tl) detector is analyzed using standard γ-ray sources namely ^{22}Na, ^{137}Cs, ^{60}Co and ^{133}Ba. The error in experimental observations, obtained by gamma ray spectrometry, are estimated by considering partial uncertainties in the attributes such as γ-ray abundance, γ-ray counting of source, half-life of the radioactive source nuclide and source activity, that influence the detector's

efficiency towards specific gamma energy. Information of these attributes are carefully accounted for in the propagation of error and the covariance matrix is generated by considering the correlations among the attributes. Covariance matrices corresponding to each source, provide information about net uncertainties in detector efficiency towards specific photon energy. The detector efficiencies for the sources ^{22}Na (1.274 MeV), ^{137}Cs (0.662 MeV), ^{60}Co (1.173 MeV) and ^{133}Ba (0.356 MeV) are evaluated to be 0.02822±0.00031, 0.00149±0.00015, 0.00197±0.00012 and 0.00068±0.00002 respectively. Precise estimation of detector efficiency is essential in measurements that involve several observed variables. Hence, proper analysis of covariance and evaluation of uncertainty is necessary to assess the quality of results.

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A comparative study of some Parton Distribution Function sets

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Abstract: Parton distribution functions (PDFs) reflect the underlying structure of the proton and thus the dynamics of the interaction of quarks and gluons inside it. PDFs are instrumental in the QCD analysis of high energy processes. We study some PDF sets in a wide range of momentum fractions x and different Q^2 ranges also. The numerical values of all PDFs have been taken from LHAPDF library, which is an easy-to-use interface to PDF sets. Various fitting groups produce sets of PDFs of the nucleon, some of which are MSTW, CT10, NNPDF and HERAPDF. The main feature that distinguishes them is the data on which they are based. In our present work, we obtain the plots using APFEL and compare the PDF sets. A comparative analysis of gluons extracted from different global fits has also been done.
Keywords: Parton distribution functions, QCD, Momentum fraction x.

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Statistical Analysis of Natural Radioactivity Measurements for the Soil of Tiruvannamalai District, Tamilnadu, India

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Abstract: Natural radionuclides activity concentrations of ^{238}U, ^{232}Th and ^{40}K in soil and statistical analysis of these radionuclides were carried out in Tiruvannamalai District, Tamilnadu using a gamma spectrometry based NaI(Tl) detector. The average activity concentrations of ^{238}U, ^{232}Th and ^{40}K were found within the range usually measured worldwide[1]. Radiological hazard indices have also been evaluated in comparison with the world average values. In this work, conventional statistical analysis (Basic statistics and Frequency histogram), and multivariate statistical analysis (Pearson correlation coefficient analysis, Factor analysis and Cluster analysis) are employed[2].

Pearson correlation, Principal Component Analysis (PCA) and Cluster analysis are carried out in order to clarify the relationship among the variables, especially the influence of soil parameters on the distribution of natural radionuclides.

The results show that there is no potential radiological health hazard associated with the soil samples of the study area according to the world acceptable value.

Keywords: Natural Radioactivity, Soil, Radiation Hazard, Statistical Analysis.

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Non-zero $\ddot{Y}_{13}$, Deviation of Tri-bimaximal neutrino mixing and A_4 discrete flavor symmetries

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Abstract: We study the tri-bimaximal mixing for the present data of neutrino mixing angles. The deviation from the tri-bimaximal mixing is discussed numerically in the framework of the A_4 model with the extension with an additional flavon. We also use extra symmetry to constrain the unwanted terms in our Lagrangian. The inclusion of this additional flavon leads to the deviation of exact tri-bimaximal neutrino mixing pattern by producing a nonzero $\ddot{Y}_{13}$ which is consistent with the recent experimental results. We tried to discuss all three mixing angles, mass squared differences, as well as the Dirac CP-violating phase in terms of our model parameters. We studied the neutrino-less double beta decay and Jarlskog parameter which is consistent with the recent experimental results.

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Lepton flavor violation in flavor symmetric scotogenic model

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Abstract: In this work, we have considered the scotogenic model which is a simple extension of the Standard Model and realized the model by using discrete symmetries A_4 and Z_4. In this flavor symmetric scotogenic model the non-zero $è_{13}$ is produced by assuming a non-degeneracy in the loop factor. We have analysed different lepton flavor violating (LFV) processes such as $l_á$'! $l_â$ã and $l_á$'!3$l_â$, and studied their impact on neutrino phenomenology.

Impact of one zero textures on baryogenesis in a flavor symmetric scotogenic model

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Abstract: We have realized a A4 —" Z4 discrete flavor symmetric scotogenic model in our work. As widely known, the scotogenic model is a significant model as it can accommodate small neutrino mass along with dark matter candidate. Phenomenology such as baryogenesis and neutrinoless double beta decay(0íââ) can also be very well explained in this model with appropriate choice of parameters. Our work mainly focuses on obtaining one zero textures of the Yukawa coupling matrix from the flavor symmetric model. By consideration of different vev alignments, we get three different structures of one zero texture Yukawa coupling matrices from the model. Further, we analyze the impact of these structures on baryogenesis and 0íââ and compare their results with constraints from Planck data and KamLAND-Zen experiment respectively.

Impact of texture zeros on leptogenesis within minimal inverse seesaw framework

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Abstract: We study the prediction of maximal zeros of the Dirac mass matrix on neutrino phenomenology and baryon asymmetry of Universe (BAU) within the framework of an inverse seesaw ISS (2,3). In ISS (2,3) two right handed neutrinos instead of three are added along with three gauge singlet fermions to the standard model. The model leads to two pairs of quasi-Dirac particles and one sterile state in keV scale along with three active neutrinos. Implementing texture zeros in the framework of minimal inverse seesaw reduces the free parameters. The decay of the quasi-Dirac pairs create lepton asymmetry that can be converted to baryon asymmetry of the Universe by sphaleron process. We carry out a detailed numerical analysis to obtain neutrino masses and BAU both for normal ordering and inverted ordering. The viability of different two zero textures within the framework has been verified with the latest cosmology data on BAU.

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Dark matter in the Extended Hyperchargeless Higgs Triplet Model

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Abstract: We perform an exclusive study on the Feebly Interacting Massive Particle (FIMP) dark matter candidate in an extended hyperchargeless (Y=0) Higgs triplet model. The additional Z2 odd neutral fermion singlet plays the role of dark matter with support from two other vector-like fermion doublets. The mixing between the neutral component of a doublet and singlet fermions controls the current relic density through the Freeze-in mechanism, whereas the additional doublet fermion helps to get the neutrino mass and mixing angles. A broad region of the parameter spaces satisfying the current relic density and neutrino mass and mixing angles is obtained for a specific choice of coupling parameters.

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Masses of Heavy Flavour Mesons in a potential Model Approach with Wave Function containing Airy's Infinite Series.

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Abstract: We report the masses of B and D sectors heavy-flavoured mesons obtained by using our recently developed meson wave function employing potential model approach with linear confinement term in potential as parent in the perturbation method. As the wave-function involves infinite Airy's polynomial series, in carrying out the mass calculation, to avoid divergences, we have introduced some cut-off parameter for inter-quark separation. Our results for ground state masses of heavy-flavoured B and D sector mesons are reasonably closer to the PDG masses.

Key words : Cornell potential , Airy's function , schrodinger equation.
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Minimally modified A_4 model for neutrino masses and mixings

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Abstract: We present a minimally modified A_4 symmetry model for neutrino masses. The model exploits the unique possibility of multiple allowed, yet qualitatively different, contractions of fields charged under the A4 discrete symmetry. The model is designed to provide tight predictions for the measurements of $\sin^2\theta_{12}$, $\sin^2\theta_{13}$, δ_{cp} and the neutrinoless double-beta decay parameter $|m_{ee}|$.

A semi-analytical study of Earth's interior with the help of Ultra-High energy Neutrinos

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Abstract: The interaction between cosmic-ray and the nuclei of Earth's atmosphere produce neutrinos with energies in the TeV scale. In this ultra-high energy range, the charged-current neutrino- nucleon (vn) cross-section is large enough and there is a small probability that such high energy neutrinos can be absorbed as they pass through the earth's interior. The study of this process can reveal useful information of earth's interior. In this paper we investigate the behaviour of ultra-high energy neutrino nucleon cross-section (σ^{cc}) for a wide range of x and Q^2, where x is the Bjorken scaling and Q^2 is four momentum transferred square in the Deep Inelastic Scattering(DIS) vn cross-section. We have also computed the attenuation factor (F) for a ultra-high energy neutrino beam when it pass through the interior of the earth from a given point N(d) through a path P(d). It is interesting to note that the probability of neutrino absorption by the Earth's interior is sensitive to the QCD dynamics at ultra-high energies.

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Dark matter phenomenology and Higgs vacuum stability in a Scotogenic extension of Inert Higgs Doublet Dark Matter Model

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Abstract: In this work we study the dark matter phenomenology and the condition of Higgs vacuum stability of the Inert Higgs Doublet Dark Matter Model with scotogenic extension. Apart from dark matter candidate candidate, this model also allows the possibility of radiative neutrino mass in a scotogenic framework. We sample over the parameter space consistent with experimental constraints, satisfying the constraints of dark matter relic abundance and direct detection searches. We use one-loop renormalization group equations to explore the stability of the Higgs vacuum in this model and its effects on the viable regions of parameter space.

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Minimal extension of seesaw mechanism in A4 symmetry and its phenomenological consequences

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Abstract: This work focuses on the minimal extension of the canonical type-I seesaw mechanism by introducing a new singlet fermion field S along with three singlet right-handed neutrinos. In our model, the flavor structures of the mass matrices are obtained by invoking the non-abelian discrete symmetry A4. Another symmetry group Z4 is used to give a desired structure of mass matrices. We use a minimum number of extra flavon fields with different flavon alignments. We draw the correlation plots among different model parameters and use it to predict the possible active-sterile mixing of neutrinos. We also discuss the possibility of a dark matter candidate particle within our model. Lastly, the phenomenology of baryogenesis via leptogenesis is studied through the decay of a right-handed heavy Majorana neutrino in the model.
Keywords: A4 symmetry, minimal extended seesaw

Two and Three Loop Effects in the RMS radii of Heavy Flavored Mesons in a QCD Potential Model

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Abstract: The RMS radii of the bound states of quark and anti quark like mesons are defined by their radial wave functions. In the present work, we first report the results of such wave functions for heavy flavored mesons using the linear cum Coulomb QCD potential in a perurbative Dalgarno method with leading order strong coupling constant. We then incorporate two and three loop effects in it and study their numerical consequences. To that end, we use the work of Smirnov et. al (Phys. Rev. Lett. 104, 112002 (2010)).

Keywords: RMS radius, Quantum Chromodynamics.

Effects of variation of m_s scale with different values of tan(beta) for neutrino parameters

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Abstract: By using renormalisation group analysis,we study different models of neutrino mass patterns like NH case ,IH case and tribimaximal neutrino mixing at GUT scale,considering two Majorana phases to be same. The method we use is the top-down approach which leads to the low energy values of the neutrino parameters. For all cases, we vary susy breaking scale from 1TeV to 13 TeV at tan(60),tan(50) and tan(40).It is found that outputs of neutrino parameters are within 2 sigma range for NH case. Tribimaximal neutrino mixing for inverted case at tan(60) is ruled out since dirac phase is out of range. Solar mixing angle has the strongest running effect among three leptonic mixing angles.

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Quantum gravity effects on Hawking radiation of fermion particles from rotating BTZ black hole

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Abstract: The Generalized Dirac equation obtained by using the Generalized Uncertainty Principle is used to study the quantum gravity effects on Hawking radiation of vector particles from rotating BTZ black hole. The WKB approximation method is used to determine the tunneling rate of vector particles across the event horizon of the black hole. Corrections to the Hawking temperature due to quantum gravity effects are studied.

Symmetry realization of neutrino mass matrix with one vanishing minor and vanishing trace using Froggatt-Nielsen Mechanism

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Abstract: In this work we study the neutrino mass matrix with one vanishing minor and sum zero condition of the mass eigen values. There are six textures of neutrino mass matrix with one vanishing minor. Here we have studied only two cases of vanishing minor i.e. C_{11} and C_{12} . Considering the two constrained equations for vanishing minor and vanishing trace we calculate the neutrino mass ratios ($x = m_2 e^{2i\acute{a}}/m_1$, $y = m_3 e^{2i\hat{a}}/m_1$) in terms of the Dirac CP phase (ä). We consider only those two pairs of solution which satisfies the constrained condition of zero trace. Then we obtained the expressions of Majorana phase (á and â) wrt ä. Here we have constrained the Dirac CP phase ä after calculating J_{cp}. Further we have constrained ä calculating R_i for which it is consistent with the experimental data at 3ó C.L. Consequently we have studied the range of Majorana CP Phases (á and â) for the considered cases. We find that case C_{11} and C_{12} are allowed for Normal Hierarchy(NH) for both the pairs of solution. While both the cases are allowed only for a single pair under IH. Finally we do the symmetry realization of the textures using Froggatt-Nielsen mechanism.

Intermolecular interaction study, Bioactivity score, Quantum chemical calculation and Spectroscopic study of L-Threonine in Polar Aprotic Solvent.

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Abstract: The vibrational spectroscopic techniques (Raman and FTIR) accounts to the interacting nature of C=O, C-H and O-H vibrational modes of L-Threonine in polar aprotic solvent Dimethyl Formamide(DMF). The DFT, IEFPCM and M062X computational methods under the basis set 6-311++G (d, p) is utilized to compliment the experimental data and to predict the propitious interacting sites of the two molecules. The variation in peak frequencies of the mixture have been explained at different concentrations (0.1M, 0.3M, 0.5M, 0.7M and 0.9M), which further shows a redshift for all the stretching modes (C=O, C-H and O-H). The NBO analysis, MEP and FMO study is performed under the DFT method to determine the electronic charge distribution and active sites of the compounds. The intensity of hydrogen bonding and the topological parameters of the intermolecular hydrogen bond at the bond critical points have been analysed using AIM theory under DFT and M062X methods. The bioactivity and drug likeness property confirms an excellent pharmacological profile of the titled compound. Molecular docking analysis is carried out to study the interaction mechanism of the titled compounds with the best binding sites of 3bu3 protein receptors.
Keywords: L-Threonine-DMF mixtures; Raman; FTIR; Molecular docking.

Optical Model Analysis of ^{6}Li+^{40}Ca Using Double Folding and Wood-Saxon Potential

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Abstract: The elastic scattering angular distributions of ^{6}Li from ^{40}Ca have been analyzed at various incident energies ranging from 20 MeV to 240 MeV. Theoretical results have been calculated using the online code available at the website nrv.org.ru with different potential formalism in the framework of optical model (OM). In the first approach, the double folding (DF) potential and Wood Saxon (WS) volume potentials have been used for real and imaginary part of the interacting nuclear potential. BDM3Y-Paris potential is used as a candidate of double folding potential. In the second approach, DF potential is replaced by WS volume potential whereas the imaginary part is either WS volume or surface. At low energies, theoretical data obtained using WS formalism is found to be in good agreement with experimental data. However, data obtained using BDM3Y-Paris potential agree with experimental

data at very high energies. From these two approaches, new set of OM parameters are extracted. We have also examined the dependence of WS volume term in this analysis.

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Self-interacting Dark Matter via Right Handed Neutrino Portal

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Abstract: We propose a self-interacting dark matter (DM) scenario with right handed neutrino (RHN) portal to the standard model (SM). The dark sector consists of a particle DM, assumed to be a Dirac fermion, and a light mediator in terms of a dark Abelian vector boson to give rise to the required velocity dependent self-interactions in agreement with astrophysical observations. Irrespective of thermal or non-thermal production of such a DM, its final relic remains under-abundant due to efficient annihilation rates of DM into light mediators by virtue of large self-interaction coupling. We then show that a feeble portal of DM-SM interaction via RHN offers a possibility to fill the relic deficit of DM via the late decay of RHN. As RHN also arises naturally in seesaw models explaining the origin of light neutrino masses, we outline two UV complete realizations of the minimal setup in terms of scotogenic and gauged B-L frameworks where connection to neutrino mass and other phenomenology like complementary discovery prospects are discussed.

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Correlation of *in-situ* Online Generated $^{222}Rn/^{220}Rn$ Data With the Anomaly Period of a Distance Continuous Data as an Indirect Revelation To Geophysical Process of the Region

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Abstract- The study presents possible application of radon and thoron data as a premonitory gas for impending earthquakes, particularly for rainy season of the region when influenced due to meteorological factors was supposed to be maximum. The data were generated *in-situ* online for 6 months (May, 2018-October, 2018) at Mat fault, Mizoram (India) located at close proximity to the Indo-Burman subduction line. A ZnS(Ag) based alpha scintillation counter (Model: BARC, Mumbai, India) was deployed for assessing the isotope pair data at different sampling depths. The correlation analysis shows that precipitation, pressure and air temperature influenced the exhalation process of the isotope pair. Masking effect of meteorological factors upon one another has been also observed. It was observed that in 56%, 89% and 67% of the sampling spots at 5 cm, 50 cm and 1 m depths respectively, the radon concentrations was higher during geophysical phenomena. No geophysical related thoron anomaly was observed. The study suggest that monitoring of radon data as a premonitory gas to impending earthquakes will be an optimistic approach for sound knowledge of seismicity of the region.
Keywords: Mat fault; $^{222}Rn/^{220}Rn$; ZnS(Ag) alpha scintillation; meteorological factors; geophysical phenomena; correlation.

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Correlation of *in-situ* Online ^{222}Rn Data at Mat Fault with Geophysical Phenomena

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Abstract. ^{222}Rn exhalation rate of four different sampling depths (soil-air interface, 5 cm, 50 cm, and 1 m depths) was measured between May, 2018 and October, 2018 with a frequency of once in a month at Mat fault, Mizoram, India. Simultaneously, the ^{222}Rn production rates of each measuring spots were assessed from the collected soil sample within 5 cm from the ground surface. A ZnS(Ag) based scintillation counter named SMARTRnDuo (Model: SMARTRnDuo, BARC, India) was deployed for all ^{222}Rn measurements in the present study. When correlates the ^{222}Rn production rates with its exhalation rates of the four sampling depths, the correlation coefficient was distinctively weak at 5 cm depth during geophysical phenomena and uncertain at the other three depths. While the correlation coefficient of the two rates remains strong for all the measuring occasions during the non-geophysical phenomena in all the measuring depths. The observation reveals the possibility of identifying geophysical phenomena of the region by observing the correlation coefficient between the ^{222}Rn production rate and its exhalation rate at the sub-soil.
Keywords: Mat fault; ZnS(Ag) scintillation; ^{222}Rn exhalation rate; soil sample; Geophysical process; Correlation

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EFFECTS OF MAGNETIC FIELD ON THERMAL CONDUCTIVITY AND SHEAR VISCOSITY OF STRONGLY COUPLED DUSTY PLASMA IN PRESENCE OF ASYMMETRIC ION FLOW

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Thermal conductivity and shear viscosity are two important transport properties of dusty plasma. In dusty plasma asymmetric ion flow towards the sheath gives rise to a well known attractive oscillatory wake potential. The effect of ion flow induced wake potential and external magnetic field on thermal conductivity and shear viscosity in strongly coupled dusty plasmas have been reported in the present paper. Green-Kubo formalism along with Langevin dynamics simulation has been used to estimate thermal conductivity and shear viscosity of strongly coupled dusty plasma in presence of external magnetic field and attractive wake potential super-imposed with repulsive *Debye – Hückel* potential for a wide range of Coulomb coupling parameter (Γ), screening parameter (κ), neutral pressure (N_n) and magnetic field B. The study gives interesting results of transport properties of strongly coupled dusty plasma system.

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Communication and Instrumentation

Implementation of Optical Subtractor using Micro Ring Resonator loaded Mach–Zehnder Structure

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Abstract: In today's technological scenario, one of the most important features is the calculation of digital combinational and sequential logic capabilities in the optical domain, which opens the door to rapid, safe, and efficient switching and communication activity [1]. In recent years, silicon photonics has been shown to be one of the most promising photonic integration platforms. This is due to the availability of CMOS fabrication technology and the combination of a high index contrast, which allows photonic circuitry to be made using electronics capabilities. Ring resonators are critical to the development of silicon photonics because silicon allows for micro-sized ring resonators [2]. Presently optical micro-ring resonators are widely used as power optical switching devices. The aim of this paper is to design a microring resonator-based optical half-subtractor, and the design looks like a microring resonator-loaded Mach Zehnder structure. The designed circuit consists of a two-microring ring resonator on the two arms of the Mach Zehnder structure and a phase shifter.

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Design of a compact UWB MIMO-Diversity Antenna for wireless communication application

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Abstract: In this communication, a compact ultra-wideband (UWB) multiple-input multiple-output (MIMO) antenna with band notch characteristics is presented for wireless communication application. It consists of two unique monopole antenna elements which share a similar ground plane. To reduce the coupling between antenna elements, a modified T-shaped stub equipped with Minkowski fractal shape elements are introduced on the ground plane which in turn establish a good isolation between radiating elements. A band notch is achieved at 5.45 GHz by adding two additional rectangular stubs at 45 degree where symmetric slots have been etched. Results show that the designed antenna delivers widest impedance bandwidth ("10 dB) throughout the operating band of 3.1–20 GHz which covers

UWB as well as Ku-band. The antenna also produces -18dB isolation for most of the operating band and -16dB up to 6 GHz. The optimized antenna is fabricated and tested showing $|S_{11}|$ characteristics below -10 dB from 3.1 GHz to 20 GHz band. The dimension of the proposed antenna is 18×26×1.6 mm^3. Results show that the simulated characteristics are in good agreement with the measured counterpart. The designed MIMO antenna is an appropriate candidate for UWB and other wireless communication applications.

A Comparative Review on the Application of Arduino for Gas & Water Sensing

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Abstract: With the advancement of microprocessor chips, comparatively simple hardware platforms such as Arduino is getting more importance due to its various advantages. Arduino is being used extensively for various purposes ranging from sensing various components to being retrofitted to higher complex systems. During the last decade, Arduino platforms have been used extensively for developing various home automation and safety setups as well as for determination of various water parameters thereby helping in estimating the quality of drinking water. Such simple systems which when developed effectively using Arduino platforms will provide a safe and sustainable environment for the wellbeing of human race. Thus, the current work emphasizes on bringing together the various applications of Arduino platforms for various gas sensing as well as for estimating some of the important water parameters.

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Arduino Microcontroller Based Sensor for Effective Drinking Water Monitoring

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Abstract: Water is indeed a necessary component for our existence. Because of its many applications, its demand is in an ever-increasing trend. Various sources of water such as ponds, rivers, and oceans fulfil majority of the water demands in addition to underground water sources. The water directly from these sources is not drinkable. In order to consider water drinkable, it's very important to keep an eye on various water parameters. Water testing is generally done in conventional laboratories which is a complex and time-consuming process. The various common parameters such as TDS, conductivity, pH, turbidity etc. must be estimated and should be within permissible limits before consumption. Therefore, this study seeks to examine how feasible an Arduino-based simple water quality monitoring system using TDS sensor may be implemented. The prototype for estimating the water TDS consists of Arduino-UNO microcontroller connected with TDS sensor and a display panel for showing the data and have been made very portable which can be carried very easily anywhere. The system can thus give a simple framework for TDS estimation using IOT.

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Benchmarking of Representative DNN Architectures for Detection of Various Types of Optical Noise

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Abstract: It will be an unending demand for greater network capacity throughout the coming millennium. The massive growing number of users and the time of every user, and thereby the bandwidth, is a significant factor. For many years, Internet traffic has expanded dramatically. These factors have resulted in the development and, unexpectedly, rapid deployment of high-capacity optical grid systems to commercial installations. In this work, we will look at noises that occur in optical fiber communication. Due to the effects of noise and distortion, linear fiber-optic connections are responsible for guaranteeing conformity with physics principles, design standards, and established engineering practice. The following are typical types of noise difficulties encountered in optical signal propagation: Phase noise, ASE noise and dispersions. Here, these 3 types of noise are extracted from the optical signal using variational mode decomposition [1],[2] (VMD) and Wavelet Transform. In this paper, we present a comparison between different deep neural models [3],[4] used to detect optical noise. Here we also showed the performance

analysis of each model and the execution time. The suggested technique outperforms the competition and has the potential to be a contender for automatic noise detection in a fiber communication link.

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Proposal of microring resonator based PAM-4 modulator with variable ER

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Abstract: Due to the ongoing rise of bandwidth-hungry applications like high-definition television, online social networks, and cloud computing, the variety of high-speed network infrastructure adapters is increasing in modern times. The ability to establish variable channel width and Users implement multiple modulation schemes to enhance frequency impact while also providing different transmission speeds for end-users is a significant benefit of this technology. The power of simple modulation technology is lower than that of higher modulation formats. QPSK, DQPSK, 4QAM, 4PAM, DPSK, 8PSK, and 16QAM are a few of the higher-order modulation schemes used for optical fiber. Several modulation formats, such as 4 flat PAM/PAM-4, are being studied in order to understand their capabilities, strengths, and weaknesses so that they can be used over next methods to improve throughput and frequency impact. Various pulse modulation signals can be synthesized via PAM, and the pieces of data can be transmitted simultaneously. Transmission and receiving do not need complex circuitry. For impact, high amplitude technology can play like four-level pulse-amplitude modulation is recommended because it allows for faster rates without additional extra complexity. Although multilayer modulation improves spectral efficiency, it also necessitates a higher received optical power for the detectors to achieve the error-free threshold. PAM-4 increases the amplitudes of equally spaced pulses according to the sample values of a continuous message signal. As a result, the system is the fastest to use. As a result, both generation and detection are simple. There is a need for inter-data unit connections to carry speeds across distances, and we calculated that there is up to 25 km between them. We show that PAM-4 is only a good signal choice for bandwidth-constrained systems running at a high pace. In this paper, we have examined the transmission of PAM-4 (Pulse Amplitude Modulation) signals through a 5 channel WDM (Wavelength-Division Multiplexing) structure in optic fiber communication. We'll go over optical signals, optical modulation techniques, optical signal multiplexing systems, where we change OSNR (optical signal to noise ratio) and examine BER (bit error rate) under beck to beck (B2B) conditions

and with differences in distance of five kilometers, eight kilometers, ten kilometers, twelve kilometers, fifteen kilometers, twenty kilometer's, and twenty-five kilometers, correspondingly. We have achieved success from hare BER carvings concerning different OSNR and also eye diagrams. It's a protocol that's used in Ethernet and chip-to-chip communication. That is, we may generalize that this work can be used to improve signal quality at varying fiber lengths.

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A Review on the Design Of An X-NOR Gate Using Micro-ring Resonator

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Abstract: A logic gate is an idealistic model of computing or a practical electronic device that implements a Boolean function, which is a logical operation that creates a single binary output from one or more binary inputs. Optical gates (or logic gates) are devices used in optical computing that perform a logical computation or operation on one or more optical inputs (or signals) to produce a single output. The term "optical signal processing" is known as the ultimate aim of photonics and various attempts have been made to achieve it with each passing day. Researchers from all over the world are working diligently to complete all signals of optical processing on a single chip. Optical signal processing is a crucial technology that is commonly employed in optical network switching systems. A micro-ring resonator is an optical waveguide device that consists of a ring waveguide that serves as the resonant cavity and one or two bus waveguides that serve as the input and output ports. The evanescent coupling between the ring and neighboring bus waveguide is the coupling mechanism used in this device. The XNOR plays an important role in encoding and decoding techniques and it can also be utilized in label processing, parity checking, and pseudorandom number generator, data encryption/decryption generation, and so on. For the development of fundamentals of optical logical functions (i.e.XNOR) by using different schemes like quantum dot SOA, SOA-MZI based PLD, terahertz optical asymmetric demultiplexer (TOAD) based interferometric devices, directed logic, dark-bright soliton conversion effect in ring resonators, a lot of efforts has been put in. A micro-ring resonator is usually a round-waveguide that is connected with bus waveguides to allow optical fields to be coupled in the ring. This paper describes how to use the micro-ring resonator as a switch in an efficient manner. The appropriate

method for designing the optical EX-NOR digital logic gate using a micro-ring resonator is also demonstrated in this study.

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4. All-optical simultaneous AND & XOR logic gates based on nonlinear micro-ring resonatorZahra Mohebbi,Najmeh Nozhat &Maryam Khodadadi

ML Based Modulation Format Identifier using K-NN Algorithm

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Abstract: The optical communication network has become increasingly complicated over the years due to the introduction of higher modulation formats, which necessitate detecting the incoming signal at the receiving end. Advanced modulation schemes mainly play a critical role in improving data aggregation speeds and efficiently utilizing spectrum capacity for the long-distance transmission of digital information over optical fiber. So, detecting and identifying the modulation format of the signal correctly at the receiving end plays a vital role in making a self-adaptable autonomous next-generation optical network [1][2]. To mitigate this network complexity and to introduce intelligence in the system, the incorporation of machine learning recently proved to be a promising approach [3]. This paper uses Machine Learning (ML) to detect PSK signals using a supervised learning model based on K-Nearest Neighbor (K-NN) algorithm. In this scenario, the information source sends an electrical signal to a transmitter, which consists of an electrical stage that drives an optical source to modulate the light-wave carrier. A semiconductor laser or a light-emitting diode (LED) can supply the optical source for the electrical–optical conversion. The transmission channel is an optical fiber cable through which the modulated signal transmits to the receiving end. The receiver comprises an optical filter and an optical detector that drives another electrical stage, demodulating the optical carrier [4]. The Machine Learning model has been applied after the receiver block. The incoming signal constellation created has been compared to the training data by the K-NN algorithm to determine the modulation format of the received information [5]. By calculating the Euclidean distance over the whole training set for K occurrences of the nearest data points, we correctly predicted four PSK signals: BPSK, QPSK, 8-PSK, and 16-PSK. By providing additional training data sets, the ML model can be used to predict various modulation schemes.

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Implementation of Wireless communication Using (HC-05) Bluetooth Module With MATLAB GUI

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Abstract: With the increasing development of modern technology, Bluetooth has brought a revolutionary change. Bluetooth technology, which aims to exchange data wirelessly within a range of short distance by providing a necessary platform to create convenience and controllability. Wireless communication is an emerging tool of today's era to several wireless communication protocols, being wireless, it has a wide range of applications. Having the characteristics of low power consumption, low cost, peer to peer communication, short range communication become more advantageous to others. In this paper we presented one of its applications i.e.., Wireless Communication using HC-05 module, which is controlled by using Software based system MATLAB, used for transferring the data from one device to another device but also used to control the device wirelessly. Nowadays, almost every electronic device has Bluetooth capability, therefore including Bluetooth control in your embedded programme is a sensible decision. It is a working prototype of a wireless communication system that uses data commands to control ON and OFF LED. The control of the LED ON and OFF is achieved by the simple use of an efficient control system based on the Arduino microcontroller board, the HC-05 and the MATLAB GUI. The results indicate that by using simple wireless communication as a control mechanism. It works on nominal voltage 5v with 2.1 Mbps transmission data rate within an operating range of 10 meters.

Arduino based RF Compact Module for Short Range Wireless Communication using nRF24L01

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Abstract: With the rising development of communication technology, wireless communication is an emerging tool of today's era leading to several wireless communication protocols. Communication established between two modules in a short range opens a wide area of research work and can be implemented with IoT for many other applications. Having the characteristics of low power consumption, low cost, peer to peer communication short range communication becomes more advantageous in comparison to others. Connecting wirelessly over a distance opens lots of possibilities like remotely monitoring sensor data, controlling robots, home automation and many more. And when it comes down to having inexpensive yet reliable 2-way RF solutions, no one does a better job than nRF24L01 transceiver module. Transceiver modules used in such cases comes on a very easy to handle as well as of low cost. RF transmitter and receiver, used in this project, plays a vital role when it comes to communicating over short ranges with a faster transmission data rate. nRF24L01 2.4GHz transceiver module is wireless radio frequency module in which each module can both send as well as receive data. It works on nominal operating current 250mA with 250-2 Mbps transmission data rate within an operating range of 100meters.

Atomic and Molecular Physics

Understanding the relationship between the two theorems: Virial and Equipartition

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Abstract: Virial theorem and Equipartition theorem are two of the most fundamental concepts in classical statistical thermodynamics. While virial theorem provides a general equation that relates the average over time of the total kinetic energy of a stable system of discrete particles, bound by potential forces, with that of the total potential energy of the system, equipartition theorem states that energy is shared equally amongst all energetically accessible degrees of freedom of a system. In this paper, we try to mathematically establish that the equipartition theorem is a special case of the virial theorem for quadratic potentials using Tolman's generalized expression (originally provided for the equipartition theorem).

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Light from the firefly *Luciola praeusta* at very low temperatures

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Abstract: Light emissions from a few Indian species of firefly at different temperatures have been investigated in recent times. Changes observed in the emission spectra and flashes in those investigations have pointed towards some interesting aspects of their light-emitting system in the live condition. Here we report steady-state and pulse emissions from both male and female specimens of the species *Luciola*

praeusta at temperatures much lower than the ones at which they normally emit. When the temperature is decreased to 11°C for males or 15 °C for females, the wavelength peaks show shift towards blue and the pulses show abnormal increase in their durations. These changes are reversible, which point towards possible cold denaturation of the enzyme luciferase catalysing the chemiluminescent reaction that produces the light of the firefly. We propose that this happening is the reason of the females generally disappearing a bit earlier than the males at the onset of the winter.

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DFT study on the structural and chemical properties of Janus kinase inhibitor drug Baricitinib

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Abstract: Baricitinib is a small molecule used to treat moderate to severe rheumatoid arthritis (RA) in adults. It is an inhibitor of Janus kinase (JAK)1 and JAK2. It has also been repurposed as a potential treatment for Covid 19. The current study has been carried out to understand the structural and chemical properties of this molecule. The molecule is optimized by using density functional theory (DFT) method. The DFT calculations are performed using Gaussian 09W software package. The bond lengths and bond angles between atoms in the molecules are investigated. The intramolecular interaction within the molecule is identified using the natural bond orbital (NBO) study. The atom in molecule (AIM) study is performed using Multiwfn software. All the calculations are performed at B3LYP /6311G++ (d, p) level of theory. The molecular parameters, such as molecular vibration, first-order hyperpolarizability, HOMO-LUMO energy gap, global electrophilicity index, dipole moment, chemical potential, hardness, ionization energy and electron affinity are determined from the calculation.

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Raman Spectroscopy, AIM analysis, Drug-likeness and Molecular docking study of the hydrogen-bonded complex of Carmustine with Melatonin

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Abstract: Melanoma is the most fatal form of skin cancer, which primarily develops in the pigment producing cells melanocytes with a higher tendency to metastasize. Over the last few years, several attempts have been made to develop promising new drugs to treat metastatic melanoma; however, no significant improvements have been achieved on response rate and survival of patients. In this work, we investigate the combined therapeutic efficacy of Carmustine, an anti-cancer drug, and Melatonin, a hormone having antioxidant and anti-inflammatory properties for the treatment of metastatic melanoma with low side effects. We study the nature of hydrogen bonding interaction between Carmustine and Melatonin by using atoms in molecules (AIM) analysis at the bond critical point under DFT, and its influence on the spectral fingerprint is discussed by using Raman spectroscopy technique. The oral bioactivity score and the drug-likeness properties of the Carmustine + Melatonin complex are evaluated by using Molinspiration and Swiss ADME software. The molecular docking study of the complex is also performed to validate its activity as a promising candidate for the treatment of metastatic melanoma.

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Spectroscopic Studies of RhB Dye in Silica Matrix

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Abstract: In this report, we have studied the spectroscopic properties of RhB dye in the silica matrix and optical properties of CdS donor and RhB dye acceptor as FRET pair. Sol-gel process was utilized for preparing the samples. The molecular extinction coefficient, ! , absorption cross-section, ó$_a$, fluorescence cross-section, ó$_e$, were obtained. The absorption intensity is increased with increasing the concentration of RhB, so red shift occurred. The fluorescence spectra occurred in blue shift as the wavelength increases as the dye concentration increases. The spectrum shows a good FRET pair between CdS and RhB dye.

Keywords: Sol-gel method, Rhodamine B, Cadmium Sulfide, Fluorescence resonance energy transfer

Interdisciplinary Research

Physico-chemical analysis and antioxidant properties of tinctures of *Diospyros melabarica* (Desr.) Kostel: A Preliminary Report

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Abstract: Plants may be considered as renewable sources of economically important neutraceuticals. Diospyros is a large genus of trees or shrubs, belonging to family Ebenaceae, which are widely distributed in both the hemispheres. From *Diospyros montana* Roxb. (Local name: Bangaub) a drug diospyrin (anti-leishmanial, anti-tumor) has been developed. From a preliminary field study of south Tripura district it was observed that most of the Uchai community use another species of Diospyros (*Diospyros malabarica* Desr. Kostel.) to cure dyspepsia and Cough with a fidelity level of 100%. However, there is no report on the scientific validation on medicinal use of this species of *Diospyros.* So, to fulfil the gap noticed in the available literature the present investigation was undertaken to explore the physico-chemical and antioxidant properties of different tinctures of leaves and fruits of *Diospyros malabarica* by standard techniques. A 12% tincture of each plant part was prepared in Ethanol and Water. The pH, conductivity, extract volume, extract yield, soluble protein, insoluble protein, total crude protein, soluble sugar, insoluble sugar, total carbohydrate, Alkaloids, total phenol and total flavonoids were determined by standard techniques. Most of the phytochemicals studied was found more in fruit tincture than the leaf tincture in both solvent systems. The antioxidant activity was assessed by ferric reducing power assay. The result of the antioxidant property of leaves and fruits of *Diospyros malabarica* had clearly shown that both are effective regarding the antioxidant activities. However, the fruits were more effective in mitigating ROS than the leaves. So, the present study established the rationality of using *Diospyros malabarica* as the source of Neutraceutical materials.

Key Words: Neutraceuticals, *Diospyros malabarica,* Tincture, Physico-chemical, Antioxidant

Analysis of flood and drought years between 1901-2020 in seven Northeastern states of India

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Abstract: Northeast India (NEIN) is one of India's wettest areas. Due to its geographical location, this region is vulnerable to water-related calamities (Jain et al. 2013). Because of the heavy precipitation, NEIN is subject to severe natural disasters such as sporadic flooding, erosion, and so on. These natural disasters are common among the people of NEIN and act as a barrier to agricultural growth, economic development, and industry development. The presence of flood and drought years influenced the overall development of this region, which is heavily reliant on agriculture. This study used rainfall data from the National Water Informatics Centre India to investigate flood and drought years in seven Northeastern states, namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura, from 1901 to 2020. The Normalized index (NI) has been utilized to determine the flood and drought years (Pal and Al-Tabbaa 2011; Kundu and Singh 2019). Flood and drought years are also classified based on their severities for each state.

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Application of Artificial Neural Network to determine the thickness profile of thin film samples

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Abstract: In this paper, we introduce a novel artificial neural network (ANN) based scheme to estimate the thickness of thin films deposited on a given substrate. Here we consider visible interference pattern between a plane wave and a diverging wave reflected from the thin film surface that records the thickness information of the thin film. We assume uniform thickness profile of the film. However, the thickness increases as the deposition takes place. We extract the intensity data along a line through the center of

the interference pattern. We train our network by using a number of such line information of known thickness profiles. The performance of the trained network is then tested by estimating the thickness of unknown surfaces. The numerical simulation results show that the proposed technique can be very much useful for automated measurement of thickness, quickly and in real time, during deposition.

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Physics of Edakka

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Abstract: The construction, and sound producing mechanism is peculiar in Edakka in comparison with other pitched drums in India. There is no loading to stretch the membrane on the drum head. The instrument player moves the body made with jack wood upward and downward with left hand to stretch the circular membrane that produces the pitched sound. As the tension on the drum head can be varied to large extent, a wide range tones are produced on the drum. The presence of many higher harmonics produces the richness for the tones produced by the instrument. The air inside the wooden cavity of the drum is pushed inward and outward during the vibration of the membrane through small hole at the central region of the wooden body.

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Synthesis, Structure determination, Hirshfeld surfaces and Energy frameworks analysis, and Molecular Docking studies of a chalcone derivative: (2*E*)-2-[(2,4-dimethoxyphenyl)methylidene]-3,4 dihydronaphthalen-1(2*H*)-one - a potential inhibitor of breast cancer activity

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Abstract: Chalcones exist in many diets as well as in traditional medicine, and their synthetic analogues are effective in fighting various diseases especially cancer [1]. A new chalcone derivative (2*E*)-2-[(2,4-dimethoxyphenyl)methylidene]-3,4 dihydronaphthalen-1(2*H*)-one was synthesized using Claisen-Schmidt condensation reaction [2] and crystallized by a slow evaporation method, as a potential cancer inhibitor against breast cancer cells. The structure of the title compound was determined using single-crystal XRD and it revealed that the title compound crystallizes in a monoclinic crystal system with $P2_1/n$ space group. The structure was solved by direct methods using SHELXS-97 [3] and refined by Full matrix least-squares on F^2 using SHELXL-2018/3 [4]. Hirshfeld surfaces were mapped over d_{norm}, electrostatic potential, shape index, curvedness, and fragment patches to represent the molecular interactions visually. The red spots on the d_{norm} surface indicate the presence of short contacts and this can be visualized as red regions (electronegative) on the electrostatic potential surface. The presence of C-H…ð stacking can be seen as adjacent red and blue triangles on the shape index which is confirmed by flat areas on the curvedness. 2D fingerprint plots were generated and analyzed, in which the contribution due to H…H contact was found to be most significant with 54.1% to the total Hirshfeld surface. Inter-molecular energies were calculated and represented with their magnitude using the Energy frameworks. The cytotoxicity assay proved that the compound is almost non-toxic to the normal Vero cell line with IC_{50} value greater than 1000ìg/mL. The anticancer activity affirms the potentiality of the compound to inhibit the growth of MCF-7 cell line with 52.46% of cell viability at IC_{50} value of 7.8ìg/mL. In silico molecular docking simulation of the title compound revealed that the ligand (title compound) fits well at the active site of the target protein with PDB ID: 1M17. In-silico pharmacokinetic studies reveal that the synthesized compound demonstrates a good pharmacokinetic profile and can be considered as a drug candidate after pre-clinical testing.

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Preparation of fly ash-Ag2O nanoaggregates as highly capable photocatalyst for malachite green dye degradation under solar irradiation

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Abstract: Fly ash-Ag_2O nanoaggregates photocatalyst (FA-Ag_2O NAP) has been effectively synthesized by a green technique using silver nitrate and F-type fly ash. The physico-chemical properties of synthesized FA-Ag_2O NAP were studied by a number of techniques such as FE-SEM-EDS, XRD, FT-IR and UV-visible spectroscopy. The photocatalytic activity of the synthesized FA-Ag_2O NAP has been evaluated by performing the degradation of malachite green (MG) dye in aqueous solution under solar irradiation. The photocatalyst was associated with a band gap energy of 3.84 eV. The ash provided a strong support of the silver oxides accountable for the photocatalytic degradation. FA-Ag_2O NAP was associated with excellent photocatalytic activity towards the degradation of malachite green dye, in aqueous solution, within only 75 min under direct sunlight. The photocatalyst could be effectively regenerated and reused up to four runs. The synthesized FA-Ag_2O NAP may be used for purification of polluted water released from various textile, dye and pharmaceutical industries.

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Amino functionalized coal fly ash: A green and efficient heterogeneous solid base catalyst for Knoevenagel condensation reaction

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Abstract: A green and efficient solid base catalyst has been prepared upon treatment of thermally activated fly ash with 2-chloroethylamine hydrochloride. The properties of synthesized amino functionalized coal fly ash (AFCFA) were investigated using various characterization techniques such as FT-IR, XRD, FE-SEM and BET surface area analysis. AFCFA possessed excellent catalytic activity

for Knoevenagel condensation reaction of benzaldehyde and diethylmalonate to produce diethyl benzalmalonate (DBM), a very important pharmaceutical intermediate. The yields of the reactions were excellent and the catalyst was easily regenerated. AFCFA could be efficiently reused for four runs without significant loss of its catalytic activity confirming high stability of the catalyst. High yields, short reaction times and solvent-free reaction conditions are the major advantages of the present method. The stability and simple recyclability without losing catalytic activity make this catalyst a good replacement to literature methods of catalyzing industrially important organic transformation.

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Comparative Review Of Inorganic Membranes By Sol-Gel Method For Water Purification

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Abstract: Ceramic membranes play a key role in the water purification sector. Some of the important properties such as thermal, chemical, and microbial stability of ceramic membranes make them an ideal choice for water purification over polymeric membranes. Moreover, ceramic membranes have a longer lifespan too. There are various methods of making ceramic membranes, such as sol-gel, chemical extraction, solid-state sintering, phase-inversion, CVD, etc. Whereas the method of preparing thin, porous layers on a variety of chemically resistant macroporous substrates is one of the most widely used techniques for both ceramic and polymeric membranes which improves the membrane purification performance further. This article mainly deals with the different aspects of the sol-gel method being used in the manufacture of various types of inorganic membranes and compares ceramic materials such as Titania-Silica, Alumina-Titania, Zirconia, and Perovskite-Alumina membranes based on their thermal analysis, phase analysis, functional group analysis, morphological analysis as well as BET surface area analysis, etc. The comparative review of all these materials used in the manufacture of ceramic membranes using the Sol-Gel method will further help in the selection of appropriate raw material

and process conditions for use in the feed water-specific ceramic membrane-based water purification process.

Keywords: Water purification, Ceramic membranes, sol-gel method, membrane characterization

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Water Quality Assessment Of Different Samples Collected From Various Locations Of Tripura University Campus And Selection Of Appropriate Point Of Use Water Purification Technology

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Abstract: The present work investigated the water quality from various departments and important buildings of Tripura University campus which are used for various purposes including drinking. The feed water is centrally treated by an Iron Removal Plant before supplying it to all the overhead storage tanks present on the campus which are either used directly for various washing and cleaning purposes or for drinking using either a resin-based filter or a combination of both resin and RO based purifiers. A total of around 36+2 samples were collected from various important locations of Tripura University campus which includes both tap water and drinking water which are used daily by campus dwellers. The additional two samples have been collected from the central Iron Removal Plants which constitutes of the feed stream going into the plant and the product stream coming out of the plant which are supplied to the reservoirs. The samples were analyzed with reference to the Bureau of Indian Standards (BIS). The analysis was carried out for pH, turbidity, conductivity, TDS, COD and metals such as iron, calcium and magnesium. The interpretation of the analytical data shows that most of the collected samples met the BIS standards for drinking water except for a few and a comprehensive idea has been presented for selection of a suitable point of use water purifier suitable for the campus.

Keywords: Water quality, Tripura University, Water purification, BIS standards, pH, Turbidity, TDS, Conductivity, Metal Content, Point of use purifier, Campus

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Transport properties of polydiperse hard sphere system

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Abstract: A model polydisperse fluid represents many real world fluids like colloidal suspensions and polymer solutions in which the approximation by assuming uniformity in parameters like size and mass is an oversimplification. Many continuous distribution functions can be used to describe the polydispersity in the particle parameters. A hard sphere system is the most widely used model system to describe the equilibrium as well as non-equilibrium properties. In this study, three distribution functions - uniform, normal and lognormal are used to represent the size polydispersity of a hard sphere system to explore the effect of polydispersity and distribution functions on the transport property like viscosity. A simple analytical solution based on the Boltzmann transport equation is used to calculate the viscosity of the model hard sphere system with the aforementioned size distributions. A parallel investigation is also carried out through molecular dynamics simulation. In the monodisperse limit, the known Enskog result was recovered. The analytical as well as simulated results agree well with the Enskog's result with less than 1 percent error for polydispersity index upto 25 percent. Though the different distributions tend to have similar effects on the viscosity, it decreases on increasing polydispersity.

Effect of mechanical milling of fly ash powder on compressive strength of geopolymer

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Abstract: In this present investigation, the fly ash powder (raw material) was collected from the National Thermal Power Corporation Limited (NTPC), Bongaigaon, Assam, India. For particle size reduction, milling operation was carried out on as received fly ash powder by laboratory attrition mill. Raw and

milled fly ash powder were characterized by scanning electron microscopy (SEM), particle size distribution (PSD), Xray diffraction (XRD) and Fourier transmission infrared spectroscopy (FTIR) technique as well. Geopolymer specimens were prepared by raw and milled fly ash powder by mixing with alkaline solution (14 M NaOH solution along with Na_2SiO_3 solution) followed by artificial curing. Compressive test of geopolymer samples were carried out by a digital compression testing machine and the fracture surfaces of the tested specimens were characterized by SEM.

STRUCTURAL AND BIOLOGICAL CHARACTERIZATION OF A BIOMOLECULE: (3E)-3-(2,3,4-TRIMETHOXYPHENYL) METHYLIDENE) - 2,3-DIHYDRO-4H-1-BENZOPYRAN-4-ONE

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Abstract: Chalcones are one of the major classes of naturally occurring compounds and are highly exploited in the field medicinal chemistry due to their remarkable pharmacological activities. A new chalcone derivative (3*E*)-3-(2,3,4-trimethoxyphenyl)methylidene)-2,3-dihydro-4H-1-benzopyran-4-one (TMDB) has been synthesized by following the Claisen-Schmidt condensation reaction method [1] at ambient temperature using the slow evaporation technique. The 3D crystal structure of the compound was elucidated using the single-crystal X-ray diffraction method (XRD). XRD intensity data reveal that the title compound crystallizes in an monoclinic crystal system with centrosymmetric space group $P2_1/c$. The crystallographic parameters such as bond lengths, bond angles, and torsion angles were estimated. The unit cell packing of the molecules shows that the adjacent molecules are linked via C-H…O hydrogen bonds. Hirshfeld surfaces analysis, which authorizes visualization of the different types of interactions present within a crystal structure and the topology of the intermolecular interactions representing the network of nearest neighbour energies, was studied using Crystal Explorer 17.5 software [2]. Hirshfeld surfaces mapped over d_{norm}, electrostatic potential, shape index, and curvedness were analyzed to visualize and to evaluate the weak intermolecular interactions, positive and negative potential regions, C-H…ð, and ð…ð stacking interactions, respectively. The 2D fingerprint plots for the whole and delineated interactions were generated and analyzed to estimate their contributions to the total Hirshfeld surfaces. The pairwise intermolecular interactions were calculated as the sum of four scaled energy components namely electrostatic (E_{ele}), polarization (E_{pol}), dispersion (E_{dis}), and exchange-repulsion (E_{rep}) and graphically represented as energy frameworks. The energy frameworks analysis reveals that the total stabilizing energy is highly influenced by dispersion (E_{dis}) energy than the other components. In-silico investigations have also been performed for the title molecule which discloses the efficacious for use as a drug in inhibiting breast cancer cells without affecting the normal cells. The MTT assay procedure was followed to evaluate the anticancer activity of the synthesized chromenone analogues on MCF-7 cell lines, a breast carcinoma [3]. The material has been screened for its cytotoxic effect on

normal cell lines (VERO) and anticancer activity on breast cancer cell lines (MCF-7). The obtained results exhibit less cytotoxic effect and highly potential anticancer ability and thus the material can be a potential candidate for pharmaceutical applications.

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Assessment of Radon Content in Water of oil exploration areas Using Smart RnDuo in Mizoram, india

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Abstract: The measurement of Radon content in water have been carried out from all the oil exploration areas in Mizoram, India using Smart RnDuo. Two available water source each were collected from all the six oil exploration areas. Water samples for assessment were collected mainly from stream water and spring water. The radon content in water collected from all the areas ranges between 0.34Bq/L at Meidum-1 location to 4.33Bq/L at Maubuang-2 location. The overall average content of radon in water was found to be 1.26 Bq/L. The radon content were found to be well within the range which is considered safe (EPA 1998).

Key words: RnDuo, water source, radon content in water.

Durability study of geopolymer synthesized from industrial waste

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Abstract: Geopolymers are a class of inorganic polymer that can be formed by the reaction between an aluminosilicate sources material and an alkaline solution. In this present investigation, geopolymeric materials are prepared by mixing fly ash powder with combination of 14M sodium hydroxide (NaOH) and sodium silicate (Na_2SiO_3) solution as alkaline activator followed by artificially curing. The mass ratios of Na_2SiO_3/NaOH were maintained at 1.0 and the mass ratio of alkaline activator/ fly ash was kept at 0.30. Compressive strength was determined by a digital controlled compression testing machine. Further, the tested specimens were characterized by various techniques such as FTIR, SEM, and XRD to correlated mechanical testing data. Finally, durability study of prepared geopolymer specimens was done by immersion test of the specimens in acidic, alkaline and salt solutions.

Effects of COVID-19 pandemic lockdown: A satellite data-based appraisal of air quality in Guwahati, Assam

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Abstract: Moderate Resolution Imaging Spectroradiometer (MODIS) and Ozone Monitoring Instrument (OMI) based data are used to evaluate the effects of the COVID-19 lockdown on the concentrations of pollutants such as aerosol optical depth (AOD) and tropospheric columns of nitrogen dioxide (NO_2) along with sulfur dioxide (SO_2) respectively for the period of January 2017 to September 2021 over the capital city of Assam, Guwahati. In India lockdown due to COVID-19 was first imposed from 24th March to 14th April as phase I and then it extended from 15th April to 3rd May as phase II in the year 2020. The concentration of all pollutants was usually fall during the lockdown period as compared to their average during the 5-year period over the study area. The results showed that Pre-monsoon (March-May) seasonal AOD for the pandemic year 2020 was decreased by ~23% after lockdown as compared to same season of normal years over the study location. The seasonally averaged AOD reached its maximum value in pre-monsoon (0.78 ± 0.14), followed by winter (0.59 ± 0.22) and monsoon (0.52 ± 0.19), with the minimum taking place in post-monsoon (0.38 ± 0.10) season. The monthly average AOD varies from its highest value (0.82 ± 0.18) in May to its lowest value (0.36 ± 0.10) in October for the study period over Guwahati. Tropospheric column NO_2 exhibits same seasonality as AOD with highest value (0.21×10^{16} molecules cm^{-2}) in pre-monsoon and lowest value (0.13×10^{16} molecules cm^{-2}) in post-monsoon season which may be due to same source of origination of both NO_2 and AOD. Conversely, SO_2 does not vary much from the five-year average value during the lockdown period. The air quality over the study area little bit improved due to the COVID-19 lockdown.

Keywords: AOD, MODIS, OMI, Air Quality, COVID-19

Title: Ageing and corrosion behaviour study of 6061 Aluminium alloy

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Abstract: In this present investigation, ageing and corrosion study on 6061 (Al-Mg-Si) aluminium alloy were carried out. The 6061 alloy was solution treated at 530°C for 2 hours, quenched in cold water, followed by artificial ageing at 180°C for various time to obtain alloy tempers. The ageing behaviour was studied by hardness measurements. Microstructural feature of alloy was done by optical microscopy and scanning electron microscopy (SEM) techniques. Further, corrosion testing of various alloy tempers was carried out by measuring open circuit potential with time and potentiodynamic polarization in 3.5 wt.% NaCl solution. Finally, authors observed studied the corrosion behaviour of the alloy tempers and the results has been explained with the help of the SEM micrographs, and optical micrographs.

Analysis of thermoluminescence of natural salt by simplified General One Trap differential equation.

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Abstract: Alkali halides are thermoluminescence (TL) sensitive phosphors. Natural salt was extracted from Ningel Thumkhong, one of the important saline springs of Manipur. Their TL glow curves were measured after gamma irradiation to different doses. The trapping parameters of the phosphors were measured using the recently formulated simplified General One Trap (GOT) differential equation. The analysis of the TL glow curves in this simplified GOT equation gives detailed information about the empty and filled traps in the phosphor. The result of the analysis shows each curve can be fitted by four constituent peaks the activation energy of the natural salt is in the range 0.773 to 1.159 eV and the frequency factor is in the range 10^8 to $10^{11}s^{-1}$. The number of trap concentrations of the different peaks is almost the same which is ~ 10^5.

Key Words: Trapping parameter, Activation energy, deconvolution, frequency factor

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Correlation between ground level Gamma Radiation and Radon gas concentration in soil at different baptism depth of oil exploration areas within Aizawl district of Mizoram, India

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Abstract: Gamma Radiation at ground level and Radon gas concentration at different baptism depth beneath the ground surface of oil exploration areas in Mizoram, India is studied and correlation graph is drawn. The oil exploration areas including Maubuang(MB), Keifang(KF) and Phulmawi(PL) in Aizawl district, are studied. The main instrument utilized for the study was RnDuo machine devised to survey Radon 222 (^{222}Rn) connected to soil probe of 1mtr long to be baptised at different depth. Background gamma radiation survey at ground level is conducted with Russian base Gamma Survey Meter (PM 1405). The background gamma radiation at ground level varies from 162 nSv/hr at PL-3 to 190 nSv/h at MB-3 location with an average of 176 nSv/h. An in-situ measurement of soil gas was carried out at three different spots at four different depths each, namely, 10cm, 30cm, 50cm and 70cm. The radon gas concentration beneath the soil, within the study area ranges from 0.10 kBq/m^3 at KF-2 to 1.60 kBq/m^3 at MB-2 location. The Radon gas concentration obtained in these areas are below the worldwide average of 35-40 kBq/m^3 (UNSCEAR 2000).

Keywords : Soil Probe, in-situ measurement, Gamma survey meter PM-1405.

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He represented India in the UN twice participating in a debate in 1971 and addressed plenary session in 1986. He was in Socialist party with Joy Prakash Narayan and Ram Monohor Lohia and was elected General Secretary of SP in 1955 at the period when this party was in the political horizon.

A person of brilliant academic career , stood first in matriculation from Jorhat Govt high school in 1938, B.Sc. Physics from Presidency college Calcutta and topped the list in MSc from BHU in 1945.

After a brief stint in Ashutosh college Calcutta as lecturer Physics he joined as lecturer Darrang College and subsequently as principal steered Darrang college to a centre of excellence before he moved over to Gauhati University as Inspector of colleges.

He joined politics in 1971as member of parliament thrice and rose to be Minister of External Affairs with Indira Gandhi in 1974.

He continued his association with the academic side and helped numerous colleges, university and also Tezpur university in various ways due to his strong presence and influence in both centre and state.

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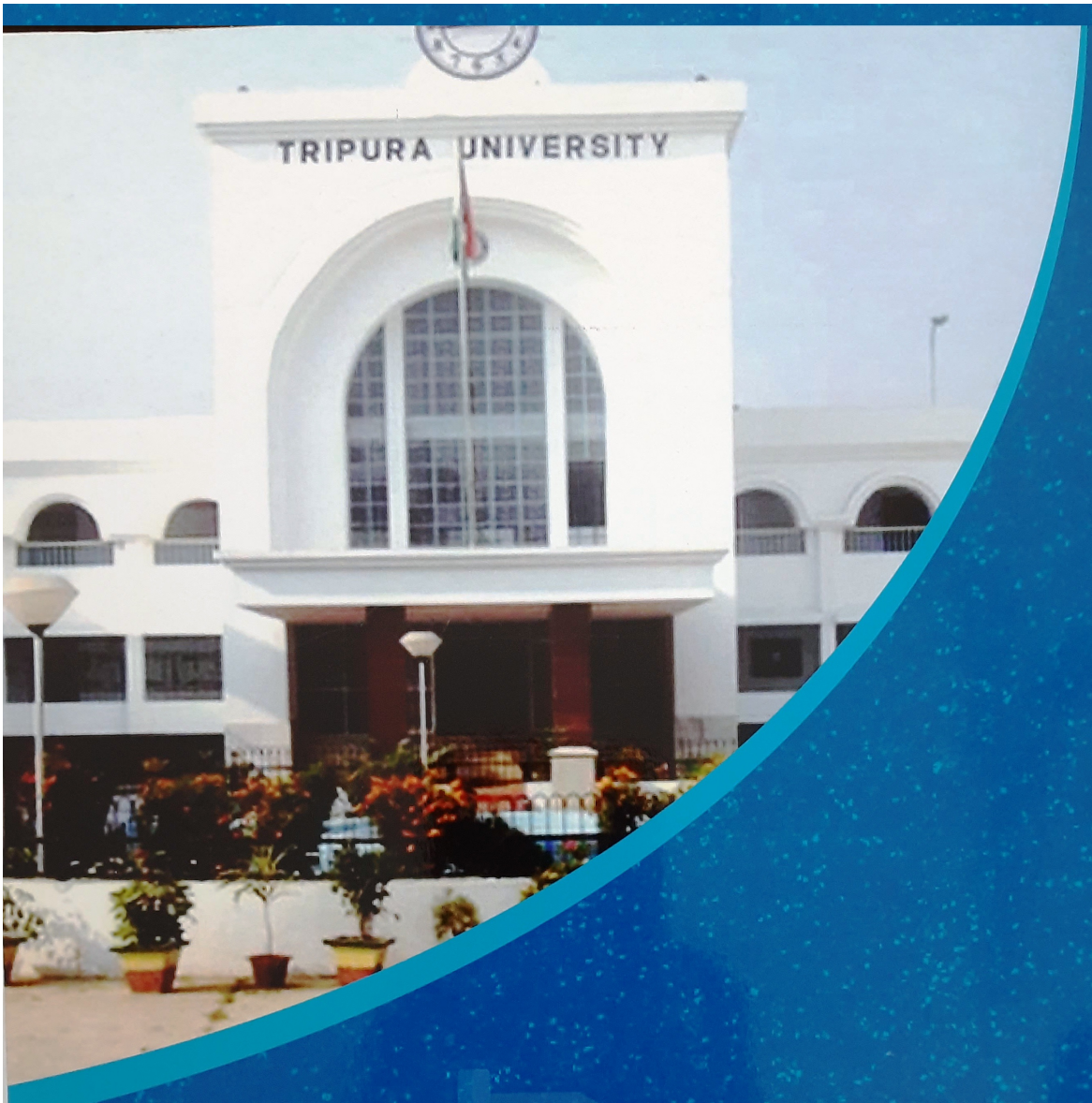

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