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BOOK OF ABSTRACTS

ICAPE - 2021

16 & 17 SEPTEMBER 2021

1ST INTERNATIONAL CONFERENCE ON APPLIED PHYSICS & ENGINEERING

Organized By:
Department of Physics
NEDUET

BOOK OF ABSTRACTS

1st International Conference on Applied Physics & Engineering (ICAPE-2021)

16-17 September, 2021

Organized by

Department of Physics
NED University of Engineering & Technology, Pakistan

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1st International Conference on
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16-17 September, 2021

Published & Printed by
Pakistan Scientific and Technological Information Centre,
(PASTIC), Islamabad

Message of
Vice Chancellor
NED University of Engineering & Technology

It gives me immense pleasure to welcome you to the 1st International Conference on Applied Physics and Engineering (ICAPE 2021). I congratulate the organizing committee for putting in their best efforts to organize this conference despite the difficulties arising from the pandemic.

The two-day conference is set to share the most recent findings and developments in Applied Physics and Engineering. It will also positively contribute to the research efforts of the Pakistani Academia by motivating a research environment based on networking and collaboration among renowned national and international universities as well as industries.

I am sure that you will enjoy the conference here at NEDUET, which will focus on various areas of Applied Physics and Engineering through tailored thematic sessions. Your participation and contribution will enrich the thought process, in particular of the youth.

My best wishes for a successful event.

Dr. Sarosh Hashmat Lodi
Vice Chancellor & Conference Patron
NED University of Engineering & Technology

Message of
Vice Chancellor
Sir Syed University of Engineering & Technology

At the very outset, I am glad to offer my felicitations to the contributors of research papers contained in this volume. These papers are to be presented during the 1st International Conference on Applied Physics and Engineering 2021 (ICAPE'21), co-partnered by Sir Syed University of Engineering & Technology.

I am confident that the ICAPE'21 will indeed provide an opportunity for the researchers to interact to develop innovative ideas and feasible solutions aiming to address the contemporary needs and the emerging challenges. One can hope that the endeavors of our distinguished researchers will contribute to mankind by creating new knowledge…which they have already shown a talent and potential for. I wish them to move to the greater heights they destined for in their illustrious career as researchers.

On behalf of entire faculty, research scholars and students, I appreciate the organizing committee of ICAPE'21 for their thoughtfulness in selecting Sir Syed University of Engineering and Technology as its partner in organizing this forum.

I look forward to having researchers from around the globe sharing new ideas during this international event. I hope we will find this conference enriching in terms of valuable new knowledge. My best wishes are with the organizing team in making this conference a success.

Last but not the least, congratulations to the editors of this publication, which will serve as a reference book for research scholars in the days to come. May the vision of ICAPE'21 lives on!

Engr. Prof. Dr. Vali Uddin
Vice Chancellor & Conference Co-patron
Sir Syed University of Engineering & Technology

Message Of
Director General - Inspection & Enforcement
Pakistan Nuclear Regulatory Authority

It's an honor and privilege for me to welcome the participants of (ICAPE' 21) organized by the Department of Physics, NEDUET, Pakistan from 16-17 September 2021.

It will positively contribute to the research efforts of the Pakistani academia and by motivating a research environment based on networking and collaboration among renowned national and international universities as well as industries. I will encourage you to openly share your thought-provoking ideas, and innovative research proposals with fellow scientific community.

This conference will enumerate multitude of international and national success stories, as they are bound to multiply by each passing day, only due to strong belief of the NED UET faculty members in its mission statement "Acquire education and research excellence in engineering and allied disciplines to produce leadership and enabling application of knowledge and skills for the benefit of the society with integrity and wisdom".

I extend my special commendation to the contributors of the research papers for their dedicated efforts to produce high quality of research which is to be presented during this conference. I also thanks to the conference organizing team for making this conference a success. Particularly, extend my appreciations for inviting PNRA management for this conference.

I wish that the conference may be successful. I hope that you have a fruitful and pleasant time.

Mr. Khalid Hussain
Director General - Inspection & Enforcement
Pakistan Nuclear Regulatory Authority, Islamabad

Message of
Pro-Vice Chancellor
NED University of Engineering & Technology

As Co-Patron of the 1st International Conference on Applied Physics and Engineering (ICAPE 2021), I am honored to welcome all the participants. The conference is organized around major themes in Applied Physics and Engineering which are vital for Pakistan's industrial and technological development.

I hope that this conference provides a platform to bridge the gaps between the academia and industry resulting in partnerships and stronger alliances for a better future of Pakistan.

Dr. Muhammad Tufail
Pro Vice Chancellor & Conference Co-Patron
NED University of Engineering & Technology

Message Of
Director RNSD-III
Pakistan Nuclear Regulatory Authority

It is indeed a great honor and privilege for me and PNRA to facilitate this wonderful event and welcome all the valuable researchers, academic staff, professionals and students in the First International Conference on Applied Physics and Engineering 2021 (ICAPE'21).

Pakistan Nuclear Regulatory Authority (PNRA) being a technical organization always encourages such forums and looking forward to establish strong relations with the esteemed educational institutes and research organizations in the country. On behalf of PNRA I am really thankful to NED University management for providing us this opportunity to support and participate in such a unique event.

I am confident that this conference will provide a great opportunity to the young scientists and engineers of the country to share their research and ideas with the accomplished experts of different fields. I am sure that these kinds of events are very helpful to bridge the gaps between our academia and industry.

At the end I would like to congratulate the organizing team for their extra ordinary efforts to organize this conference despite the difficult situation of pandemic. I hope that we will see the continuity of such events in coming years.

I extend my best wishes for great success of the conference.

Hazif Muhammad Zubair Arif
Director RNSD-III
Pakistan Nuclear Regulatory Authority, Karachi

Message of
Dean - ISH
NED University of Engineering & Technology

I warmly welcome all the participants and presenting authors to the 1st International Conference on Applied Physics and Engineering (ICAPE 2021). The conference is necessary and overdue for the Physics community of Karachi. It intends to provide a platform for them to connect and collaborate both locally and internationally.

The conference is not only aimed at providing an opportunity for the exchange of knowledge but also to be a transformative experience for its participants as it opens the doors to global and industrial collaborations. It may kindly be noted that we are arranging this conference in very challenging times. However, we hope and pray that the situation will improve so that scholars, researchers and academic community shall be able to come together to reap the full benefits of such conference during the next edition of this series.

I hope that you have a pleasant time and opportunity to connect with the accomplished experts from the scientific community and professionals through their lectures and presentations. You are encouraged to bring forward your thought-provoking proposals and strategies on the traditional and advanced technologies in the field of Applied Physics, Engineering and related disciplines.

Dr. Noman Ahmed
Dean ISH & Dean AMS & Conference Co-Patron,
NED University of Engineering & Technology

Message of
Assosiate Dean
Sir Syed University of Engineering & Technology

It is my pleasure to encourage young researchers, academician, professionals and students all over the Pakistan and rest of the world to contribute their quality research in the 1st International Conference of Applied Physics and Engineering, ICAPE'21.

The ICAPE'21 is intended to share significant knowledge into the state-of-the-art advances and cutting edge technologies, which is expected to acquire tremendous interest with the enormous presence of quality audience. The objective is to unite a multidisciplinary gathering of researchers and engineers not only at the National Level but the International collaboration would help to break through in the ideas relating to physics and engineering. It promotes quality level research and globalizes the quality exploration and spotlight on the new remarkable accomplishments in the respective fields with future trends and alignment with Sustainable Development Goals (SDGs).

As the conference will provide an avenue to all participants in the physical mode (although online option will also remain available). Therefore, we are anticipating a fantastic meet up for sharing new and energizing thoughts.

I welcome all interested to partake in this conference to make it an extraordinary event with productivity.

Prof. Dr. Muhammad Aamir
Associate Dean
Faculty of Electrical & Computer Engineering
Sir Syed University of Engineering & Technology

Message of
Conference Chair
NED University of Engineering & Technology

On behalf of the organizing department, I welcome you to the1st International conference on Applied Physics and Engineering (ICAPE 2021) at NED University of Engineering & Technology.

The conference is scheduled to be held on September 16th and 17th, 2021. It is planned to be organized every alternate year. This year ICAPE has brought around hundreds of participants, invited speakers, distinguished dignitaries from national institutes and professionals from the industries to share their work. The event is enriched with the keynote speeches of accomplished researchers from around the world.

I hope ICAPE will continue to play its role in encouraging and attracting quality research and bridging gaps between academia and industry in future years.

Dr. Irfan Ahmed
Chairman, Department of Physics,
NED University of Engineering and Technology

Message of
Conference Secretary
NED University of Engineering & Technology

It is my proud privilege to welcome you all to the 1st International Conference on Applied Physics and Engineering, ICAPE 2021. The conference is based on multiple thematic sessions with an idea to bring together latest knowledge, research and development efforts from the scientific community and professionals from industry to contribute towards better future of both academia and industry.

I would like to thank our committee members, partner, sponsors, authors, invited speakers, keynote speakers and volunteers for their valuable contribution towards the event. I hope this conference will further strengthen the fruitful interaction between industry, academia and scientific community.

Dr. Hira Ashfaq Lodhi
Assistant Professor, Department of Physics,
NED University of Engineering & Technology

Message of
Focal Person of SSUET
Sir Syed University of Engineering & Technology

First of all, I would like to thank the organizers for including Sir Syed University of Engineering and Technology as a part of its esteemed conference. I am honored and pleased to welcome you to the 1st International Conference of Applied Physics and Engineering, ICAPE'21.

This conference is particularly timely in view of the tremendous importance of scientific and technological development. I look forward to the unique opportunity to learn about the latest trends in engineering technology and network with leading professionals from the platform of NED University. I hope the conference will provide personal and professional benefits to all of us.

Once again, I am pleased to invite you all to take part in this conference and also make this conference a great and prolific success.

Dr. Lubna Farhi
Chairperson, Electronics Engineering Department
Sir Syed University of Engineering & Technology

TABLE OF CONTENTS

ORGANIZING COMMITTEE

Steering Committee

Dr. Sarosh H. Lodi	Patron, VC, NEDUET
Dr. Muhammad Tufail	Co-Patron, Pro VC, NEDUET
Engr. Prof. Dr. Vali Uddin	Co-Patron, VC, SSUUET
Dr. Noman Ahmed	Co-Patron, Dean ISH, NEDUET

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Dr. Ali Dad Chandio	NEDUET, Karachi
Dr. Saqib Anjum	NEDUET, Karachi
Syed Mishkat Ali Jafri	PNRA, Islamabad

Publication Co-Chairs

Dr. Maryam Ibrar, Add. Dir.	PASTIC

PREFACE

Department of Physics, NED University of Engineering and Technology is pleased to announce 1st International Conference on Applied Physics and Engineering (ICAPE-2021), being organized in hybrid mode on 16th and 17th September 2021. It is aimed to stimulate engagement, networking and collaboration among academia, research institutes and industries to encourage knowledge and technology exchange by sharing strengths for mutual benefit. The conference will contribute in promoting innovation and knowledge sharing on related theme in the country and beyond.

The world is adapting to necessary changes due to COVID-19 pandemic. The Conference Organizing Committee has also planned to conduct the event in hybrid mode while strictly following COVID-19 SOPs. Inauguration ceremony will be followed by thematic technical sessions. Each technical session will have at least one keynote speech by an eminent researcher, followed by technical talks (oral and poster). The event will facilitate a varied community of researchers, industrialists, professors and students to share their research experiences.

On 15th September, a pre-conference workshop on Cyber-knife is planned in collaboration with Pakistan Nuclear Regulatory Authority (PNRA) which will enable the students to get hands-on experience on Medical Physics.

Conference program includes 6 keynote talks by international researchers, 3 invited talks by international and national speakers. Technical sessions are dedicated to emerging research trends in the field of Applied Physics and Engineering such as Space Physics, Electronics, Medical Physics, Material Sciences and Modelling and Simulation. A special session, "Women in Physical Sciences," highlights the contributions and importance of women working in the area through its esteemed invited speakers.

The response to "Call for Papers" was overwhelming. We received more than 100 research abstracts from authors affiliated with national and international universities and research institutes. Abstract review committee comprising of national and international highly respected researchers shortlisted the abstracts for oral and presentation in relevant technical sessions. The selected papers will be published in the reputable Sir Syed University Journal of Engineering and Technology after due peer review process.

Organizing such a big conference and linking onsite and online audience is not possible without dedicated IT support and monetary input. IT Team of NEDUET is working hard to make it a smooth event and our industrial partners such as PNRA, Amreli Steels and Watson LEDs have made it possible by their generous sponsorships.

Entire faculty and students of Department of Physics are working together to make ICAPE 2021, a memorable learning experience for all participants.

ABOUT PASTIC

Pakistan Scientific & Technological Information Centre (PASTIC) is a subsidiary organization of Pakistan Science Foundation (PSF), under the umbrella of Ministry of Science and Technology (MoST). PASTIC is a specialized premier organization in the field of S&T information handling and dissemination responsible for catering to information needs of R&D and industrial community across the country. The PASTIC National Centre is housed at Quaid-e-Azam University Campus, Islamabad having a network of 6 Sub-Centres at Karachi, Lahore, Peshawar, Quetta, Faisalabad and Muzaffarabad.

To begin with PASTIC supported research community across the country when S&T research infrastructure in Pakistan was at a nascent stage and provided facilities including supply of scientific and technical documents, abstracts and indexes, bibliographies, translations, patent information and patent indexes, science reference library service, technological information transfer service, dissemination of computer-based information services, reprographic and publication services.

PASTIC Objectives

- National S&T/R&D Information Repository of indigenous information resources (databases)
- S&T/R&D information dissemination through contemporary reference information tools
- Strengthen National Science Reference Library for resource sharing & Inter-library collaborations (consortium) and empowerment of information professionals.
- Promotion of R&D based industrial development
- Facilitate printing of S&T/R&D Publications
- Capacity/skill development of researchers & entrepreneurs
- Develop collaborations with national and international information networks

PASTIC Activities/Functions

PASTIC Online databases

Pakistan Science Abstracts (PSA): National research published in Pakistani S & T Journals & Conference Proceedings etc.

PakCat: Union online Public Access Catalogue (OPAC) of Books available in Science and technology Libraries of Pakistan.

DSpace full text digital repository of indigenous S&T literature.
Database of R & D Projects executed in Pakistan.
Industy related databases.

S&T Publications

- *Pakistan Journal of Computer & Information Systems (PJCIS):*A biannual Open Access primary Journal meant for researchers from Computer Science & Engineering, Information & Communication Technologies (ICTs), Information Systems, Library and Information Science.
- *Technology Roundup:* Publish bi-monthly bulletin by repackaging of latest global Trade and Technology information.
- *Union Catalogue:* Provide information on research materials (books/journals/conference proceedings/reports, etc) available in different S&T libraries of Pakistan.
- *Scientific Periodicals of Pakistan***:** A handy guide of scientific periodicals published in Pakistan.
- *Abstract Books of Conferences:* PASTIC support publication/printing of Abstract Books organized by various S&T universities (on request).

Promotion of Commercializable Technologies & Industrial Products

Organize STEM and IT Expo to promote local Research and Development, SMEs, technologies/products/services/industrial R&D challenges/issues as well as empowering youth and general public on new and faster ways of delivering and accessing information.

National Science Reference Library Facility

A state of the art Traditional Library facilitating the researcher through following services: Reference & Referral Services; Reader Service; Internet Service, Journal Listings; Photocopying & Scanning Services.

Human Resource Development (Capacity Building)

Organize Seminars/Workshops /Trainings/ for capacity building of:

- Young Researchers on Data Analysis and Bibliographic Citation Tools (SPSS, EndNote, Mendeley)
- Women Entrepreneurs on e-marketing and e business skills
- Library Professionals on Library Information Management Tools & techniques (Koha, D-space etc)
- Researchers and entrepreneurs on Intellectual Property Rights, Media Information Literacy

CONFERENCE PROGRAMME

Time	**Pre-Conference day: 15th September 2021**		
10:00-13:00	Workshop on Medical Physics		
Day 1: 16th September 2021			
08:30-09:00	Registration		
Inauguration Ceremony			
09:00-09:10	Recitation of verses from Holy Quran		
09:10-09:20	Conference Briefing Address by Chair		
09:20-09:30	Welcome Address by Dean ISH		
09:30-09:40	Address by VC NEDUET		
09:40-09:50	Address by VC SSUET		
09:50-10:00	Speech by Chief Guest, Chairman PNRA		
10:00-10:20	Speech by Guest of Honor, DG NCP		
10:20-10:30	Presentation of momento		
Morning Tea Break			
Session I: Space Physics		**Session II: Modelling and Simulation**	
11:00-12:00	Keynote talks	11:00-11:30	Keynote talks
12:00-13:00	Session presentations	11:30-13:00	Session presentations
Lunch and Prayer Break			
Session III: Medical Physics		**Poster Session**	
14:00-15:00	Keynote talks	14:00-16:00	Poster presentations
15:00-16:00	Session presentations		
Day 2: 17th September 2021			
Session IV: Electronics		**Session V: Materials**	
09:00-09:30	Keynote talks	09:00-10:00	Keynote talks
09:30-11:15	Session presentations	10:00-11:15	Session presentations
Tea Break			
Session VI: Women in Physical Sciences		**Poster Session**	
11:30-13:00	Invited Speakers talks	11:30-13:00	Poster presentations
Lunch and Prayer Break			
14:30-14:40	Conference hi-lights by Chair		
14:40-15:00	Address by PVC, NEDUET		
15:00-15:10	Presentation of momento		
15:10-15:20	Vote of thanks		
15:20-15:40	Award for Poster/ Certificate distribution		
Tea and Refreshment			

** Tentative*
*** Detailed conference programme is available on conference website*

KEYNOTE SPEAKERS

(BIOGRAPHIES)

Dr. Wazir Muhammad

Wazir Muhammad received MSc degree in Physics in 2000 from the University of Peshawar and MS in Medical Physics (US Equivalence – Master of Science in Medical Physics) in 2004 from the Institute of Engineering and Applied Science (PIEAS), Islamabad. He had completed his Ph.D. in Radiation Physics from Kyungpook National University (KNU), Daegu, Republic of Korea, in 2013. He has authored and co-authored several research papers and published them in various journals, books, and conferences of international repute. He was honor with various grants and awards due to his collaboration in Medical Physics. He had supervised the installation of Radiotherapy Simulator HMD-IA at the Institute of Nuclear Medicine, Oncology and Radiotherapy (INOR) Abbottabad Pakistan from China Nuclear Energy Industry Corporation (CNEIC). He had also got Travel Grant awarded by Varian in 2005. He is being greatly involved in Medical & Radiation Physics, Computational Physics, Big Data, Machine Learning, Artificial Intelligence, and Cancer Risk Estimation. He has more than four years of teaching experience. He is currently associated with the Florida Atlantic University, Boca Raton, FL, as an Assistant Professor in the Department of Physics (Medical Physics).

Dr. Hamid Saeed Raza

Dr. Hamid Saeed Raza has a Master's degree in International Nuclear Safety. He did his doctoral and post doctoral research at Quantum Beam Engineering Lab, Republic of Korea. His Ph.D. thesis research was on the Monte Carlo analysis of carbon-nanotube-based miniature X-ray tubes. He is currently working at Centre for Nuclear Safety, Pakistan Nuclear Regulatory Authority. His responsibilities include review and assessment of licensee's submissions related to nuclear installations and radiation facilities. He has about twenty research articles published in peer reviewed International & National journals and conferences. He is also a reviewer of well reputed International journal. He was among top essays voices for NextGen of Science journal. He was the panelist from Pakistan on Asian and Oceanic Workshop on Radiation Protection Culture in 2010. He delivered lectures at Karachi University, as well as at International Scientific School National Centre for Physics, Islamabad, and was External examiner for MS-Nuclear Engineering projects at PIEAS. He frequently delivers lectures at National School of Safety and Security, PNRA on radiation safety, imaging modalities, and radiotherapy. He is going to present '*A Review of Artificial Intelligence Applications in Medical Physics'*. The purpose of this research is to assess current perceptions, practices and needs pertaining to artificial intelligence (AI) in the field of medical physics.

Prof. Dr. Sultana Nurun Nahar

Professor Sultana Nurun Nahar is a US citizen. She has authored and co-authored around 180 research papers published in various journals, books, and conferences of international repute. She has done around 32 publications in STEM research and education. She is also an author of the graduate book named Atomic Astrophysics and Spectroscopy" By: A.K. Pradhan, S.N. Nahar (Cambridge Univ Press, 2011). She has implemented the on-line database analysis (NORAD Atomic Data) on Energies, Oscillator Strengths, Photoionization Cross Sections, Electron-Ion Recombination rates, Lifetimes, etc. She has attended various national and international teaching and computational workshops. She is also a founding member of different societies, networks, and trusts. She is greatly involved in Atomic Astrophysics, Photoionization, Electron-Ion Recombination, Photo-Excitations of ions, and Electron Impact Excitations of ions, Dielectronic Satellite Lines, and Theoretical Spectroscopy. She is also a member of International collaborations, "the Opacity Project" & "the Iron Project" - develop a theory to study characteristics & compute high accuracy large scale data for radiative and collisional atomic processes in astrophysical plasmas. She is also a co-leader Multi-disciplinary (Astronomy, Physics, Chemistry, Pathology, Radiation Oncology) Biomedical Nanoscience program "Resonant Nano-Plasma Theranostics" (RNPT). Currently, she is associated with Ohio State University in the Department of Astronomy as a Research Professor, Co-director of Indo-US APJ Adbul Kalam Center and an Adjunct Professor in Aligarh Muslim University, India and Cairo University, Egypt.

Dr. Yarjan Abdul Samad

Dr. Yarjan Abdul Samad, a Ph.D. holder, is a Senior Research Scientist and a Senior Teaching Fellow at The University of Cambridge. His research work is based on Space-based technologies. He was among the team of scientists on the European Space Agency (ESA)'s Zero Gravity flight who were the first to test Graphene, a modern-day marvel material, in Zero Gravity. Dr. Abdul Samad and his team are slated to take their experiments to the International Space Station in collaboration with the Microgravity Research Center in Brussels, ESA, and other European partner institutions and private sector organizations. He is also a member of the Mohammad Bin Rashed Space Center's Moon Mission that will be launched in 2022. International media have covered his invention on cooling devices in Space, including Reuters, Techradar, CNET, InnovaSpace, etc. He has won several awards for his research work such as The Innovator of the Year by the technology development company, The Outstanding Research Reviewer of the year 2017 by the Royal Society of Chemistry UK, YPS Young Leader Award 2020, Nano Today Best Scientific Presentation and many other Best Scientific Talks awards at international scientific conferences. Also, towards research, he teaches graphene technology at the University of Cambridge and supervises numerous masters and Ph.D. students. He has also delivered lectures at several other international academic institutions (e.g., Chalmers Institute of Technology, University of Manchester, Lincoln University). He has authored a book and about 60 internationally refereed scientific journal articles, conference proceedings, and presentations. He is a guest editor of a scientific journal called Sensors. Before moving abroad, he obtained his bachelor's degree in engineering from Ghulam Ishaq Khan Institute (GIKI) in Pakistan. He holds 4 patent applications. He is graduated from GIKI with two gold medals.

Dr. Syed Naeem Ahmed

Syed Naeem Ahmed received MSc degree in Physics in 1986 from the University of Karachi and MSc in Nuclear Engineering in 1992 from Quaid-e-Azam University, Islamabad. He had completed his Ph.D. in High Energy Physics from University Siegen, Germany in 2000. He has authored and co-authored more than 60 research papers and published them in various journals, books, and conferences of international repute. He is also an author of the book "Physics and Engineering of Radiation Detection, which was published in 2007. He is a member of the Institute of Physics (London, England), the Canadian Association of Physicists, Institute of Particle Physics (Canada). Also, he is the president of "Clickmox Solutions" located in Sudbury, Ontario that is currently focusing on 3D mapping and managed the development of several algorithms and turn-key solutions for the mining industry including Expert Systems and fuzzy+AI integrated solutions. He has worked in some of the most renowned physics laboratories in the world. He has been employed both as a researcher at several of these laboratories, including the Max-Planck Institute for Physics in Munich, Germany, the Fermi National Accelerator Laboratory in Batavia, Illinois, the Radbound University in Nijmegen, The Netherlands, and the Sudbury Neutrino Observatory in Sudbury, Ontario, Canada. He is currently associated with Laurentian University as an Adjunct Professor in the Department of Physics and also working as a senior research scientist in the engineering department of Laurentian University, also located in Sudbury.

Dr. Talat Rahman

Dr. Talat Shahnaz Rahman received M. Phil degree in Physics in 1970 from Islamabad University and a Ph.D. in 1977 from the University of Rochester in Physics. She had completed her Postdoc in Surface Physics from the University of California, Irvinei, in 1979. She has organized and contributed to various professional workshops. She has authored and co-authored more than 250 research papers in refereed high-impact journals. She has played a significant role in organizing various international events related to Physical, Medical, and Material Science. Her research domain includes Multi-scale modeling of chemical reactions, nanomaterials, Predictive modeling of functional two-dimensional transition metal dichalcogenides, etc. She is also an approved supervisor for undergraduate students, Post-Doctoral Advisees, and Research Associates. She had played an important role in the research collaboration of various domains. Some examples include UCF PhysTEC Comprehensive Site, SusChEM Defect-laden 2D Catalysts for Carbon Sequestration and Safer Hydrogenation, and Surface Coordination Chemistry: Toward Novel Functionality.

Additionally, she had organized US-Pakistan Workshop: International Nathiagali Summer College from 2011 to 2017. She has also done a professional role at Woman & Minorities and reforming stem education. She is a permanent member of American Physical Society, American Chemistry Society, American Vacuum Society, American Association of Physics Teachers, and American Association for the Advancement of Science, Materials Research Society. She has more than 42 years of teaching experience at different international universities. She had also been Chair of the Department of Physics from 2006 to 2015. Also, she has 38 years of teaching and research experience in visiting appointments. On average, she is doing 12–20 invited talks per year. She is currently associated with the University of Central Florida, Orlando, as a Pegasus Professor in the Department of Physics.

Engr. Noman Sajjad

Engr. Noman Sajjad has done his BE in Mechanical Engineering, Masters in Energy System, Masters in Mechatronics and Masters in Industrial Management. He has also done his MBA from IBA with a major in Marketing & HR. He is also a globally recognized certified Project Management Professional with certification in Six Sigma as well. He has worked in Oil industry for 6 years and associated with Amreli Steels Since 2006, and has overall working experience of 21 years. He has been instrumental in the installation of the Largest Steel Melt shop billet manufacturing facility, STATE of ART Steel rolling Mill, and Solar plant.

Prof. Dr. Muhammad Akram Shaikh

Prof. Dr. Muhammad Akram Shaikh is working as Director General in Pakistan Scientific & Technology Information Centre (PASTIC), a subsidiary of Pakistan Science Foundation under Ministry of Science & Technology. He is author of more than 40 journal/conference papers of national/international repute. In addition, he is involved as editor/ co-editor/ reviewer of national/international journals and Session chair/ PC member of national/international conferences at various national/international forums. His research areas of interest include Knowledge Engineering, Scientific & Technological Databases, Information Processing, Data Mining & Data Warehousing, Big Data & Analytics, Software Engineering, Automation & Control, Social Networks, Virtual Reality and Graphics.

INVITED SPEAKERS

(BIOGRAPHIES)

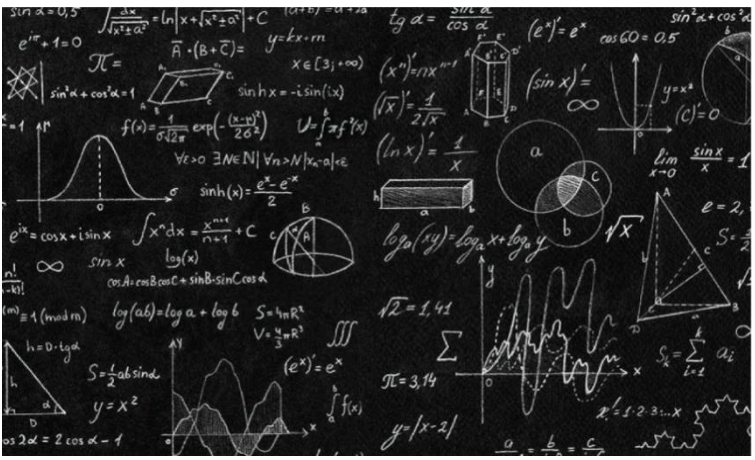
Dr. Jocelyn Bell Burnell

Dr. Jocely Bell Burnell received a BSc Hons degree in Physics from The University of Glasgow in 1965. She had completed his Ph.D. from The University of Cambridge in 1968. She had done various training courses as well in the field of Physics. She has authored and co-authored around 70 scientific research papers and published them in various journals, ad conferences in international repute, and 35 Quaker publications. She is also an author of several international books. She has more than 50 years of scientific and management experience. She had got an experience of lectureship and visiting positions in various international institutions. She has around 48 years of teaching experience. Currently, she is associated with the University of Dundee as Chancellor, Visiting Professor in the University of Oxford, and Professional Fellow, Manfield College.She discovered the first radio pulsars in 1967. The discovery was recognised by the award of the 1974 Nobel Prize (to her research supervisor) in Physics.

Dr. Shahnaz Perveen

Dr. Shahnaz Perveen has seven years of research experience in Natural Product Chemistry. Four processes have been leased out, developed forty-two processes, which are ready for lease. In addition, she has published three hundred & fifty-three (353) research publications with a total impact factor of 530.481 and a citation index of 3978. Nine national patents and two international patents are in her credit. The blockbuster achievement was to develop standardized ink for stamp pads to use in elections. On the eleventh hour, the formulation was prepared and manufactured (Patent No. 142431 dated:25-5-2017). She completed the PSDP Project "Establishment of Patent Advisory Cell" as a Project Director funded by MoST. This project aimed to develop the culture and awareness of Intellectual Property Rights in the country. She was awarded PAS Gold Medal 2020 in Chemical & Pharmaceutical Sciences by the Pakistan Academy of Sciences. She has also received "Tamgha-e-Imtiaz" from his Excellency in 2020. She was also a recipient of the Research Productivity Award (RPA) from the Pakistan Council for Science & Technology (PCST). With her contributions, Pakistan Science Foundation (PSF) awarded her as Active Scientist & Technologist of Pakistan 2005.

KEYNOTE



ABSTRACTS

ICAPE21 KN_01	**Artificial Intelligence-assisted Decision Support for Individualized Lung Cancer Radiotherapy** *Wazir Muhammad*
ICAPE21 KN_02	**A Review of Artificial Intelligence Applications in Medical Physics** *Hamid Saeed Raza, Sohail Sabir*
ICAPE21 KN_03	**Exoplanets, the Future Homes after the Sun** *Sultana N. Nahar*
ICAPE21 KN_04	**The Application of Graphene in Space** *Yarjan Abdul Samad*
ICAPE21 KN_05	**Role of Artificial Intelligence in Autonomous Navigationin GPS-Deprived Areas - Current and Future Technologies** *Syed Naeem Ahmed*
ICAPE21 KN_07	**STEEL in Buildings & Infrastructure** *Engr. Noman Sajjad*
ICAPE21 KN_08	**Access to Scientific Information- Role of PASTIC** *M. Akram Shaikh*

ICAPE2 1-KN-01

Artificial Intelligence-assisted Decision Support for Individualized Lung Cancer Radiotherapy

Wazir Muhammad*

Department of Physics, Charles E. Schmidt College of Science, Florida Atlantic University
[*]E-mail: wmuhammad@fau.edu

Abstract—Recently various radiation therapy techniques have been employed to improve tumor dose conformity while sparing organs-at-risk (OAR) in lung cancer patients. While modern radiotherapy techniques are able to treat the tumor efficiently, there are two major weaknesses in the process: (1) a one-protocol-for-all approach has been used in the clinics in treating different lung cancer patients; and (2) there are large variations in the quality and efficiency of the treatments, depending heavily on the experience and expertise of the clinicians and institutions. Hence, it is critical to develop a clinical decision support tool that can suggest an individualized treatment based on the patient's health and clinical conditions, as well as previous optimized and successful treatments for similar patients. In this project, we hypothesize that various health and clinical parameters such as gender, age, tumor volume, OARs, separation between tumor and OARs, radiation treatment history, integrated dose can be incorporated into a deep learning model for optimal radiotherapy strategy for individual lung cancer patient. Therefore, the goal of this project is to develop a deep reinforcement learning (DRL) model that utilizes individual patient data and multi-institutional patient data for individualized lung cancer radiotherapy. Specifically, we propose three aims to achieve the goal. (1) Develop a framework for an anonymized treatment data collection, analysis and categorization based on treatment techniques and individualized parameters. The framework will be designed to coordinate and integrate various types of evidence and measurements of individualized parameters into scores for the lung cancer treatments. An anonymized patient treatment dataset including EMR data, radiation treatment planning data and follow-up data will be collected from 21st century Oncology. (2) Build a reinforcement learning model for individualized treatment strategy in terms of dose coverage to the tumor target and OARs per Quantitative Analysis of Normal Tissue Effects in the Clinic (QUANTEC). (3) Evaluate the DRL model performance against the standard treatment protocols for lung cancer radiotherapy. If implemented successfully, we envisage that a novel personalized treatment optimization tool will be available to support clinical decisions for highly individualized lung cancer radiotherapy management. The developed tool will be very helpful to reduce treatment-related morbidity and lung cancer mortality in the long run.

Keywords: OAR, DRL model, QUANTEC.

ICAPE21-KN-02

A Review of Artificial Intelligence Applications in Medical Physics

Hamid Saeed Raza*, Sohail Sabir*

Pakistan Nuclear Regulatory Authority, Islamabad, Pakistan
**E-mail: hamid.saeed@pnra.org, sohail.sabir@pnra.org*

Abstract—The purpose of this research is to assess current perceptions, practices and needs pertaining to artificial intelligence (AI) in the field of medical physics. AI is dedicated to giving machines the ability to perform human-like cognitive functions. Since it is showing superior performance than well-trained human beings, AI is expected to change profoundly every area of science. The purpose of this review is to summarize the main applications of AI in medical physics and its associated major challenges. Recent advances in machine learning based on an increased availability of clinical data have increased application of AI in medical physics. However, the use of AI is not without a downside, as an inadequate AI can potentially deteriorate the quality of healthcare and put patients at risk. Moreover, it is anticipated that the AI will reduce the need for clinical medical Physicists. As a medical physicist, one should pursue beyond the concept of technical competence towards measuring and optimizing the diagnostic value. Moreover, medical device manufacturers are increasingly applying AI to innovate their products. Health institutions are also developing algorithms to address the specific needs. Qualified medical physicist experts (MPEs) play key role in safety and performance assessment of such tools. It is also important for MPEs to be well informed about the current regulatory framework for such medical devices. In this paper, new visions and suggestions to orientate medical physics to successfully face new challenges related to the application of AI in medical physics are summarized. Moreover, the research will also provide guideline related to AI, for the education and training of Medical Physicists (MPs).
Keywords: MPEs, Artificial Intelligence, Training of Medical Physicists

ICAPE21-KN-03

Exoplanets, the Future Homes after the Sun

Sultana N. Nahar*

Department of Astronomy, The Ohio State University, Columbus, USA
**E-mail: Nahar.1@osu.edu*

Abstract—The sun is the source of our energy. But it has a lifetime and will expand to a red giant star and engulf the earth when it will die. This has prompted

the need to search in the space for homes in other planets for continuation of human race. We believed that there were other planets, called exoplanets that belong to other stars, but did not have any evidence until about 1992. We got the first image of an actual planet in 2004. We gain knowledge of far away astronomical objects through the light or radiation that is emitted by them and reach us. The radiation carries wealth of information of the physical conditions, constituent elements and their abundances, chemical evolution, etc. Planets do not emit radiation that can be detected. There are other confirmatory ways to detect them. Almost 5000 exoplanets have been detected. Our one main objective is to find habitable planets where environment is suitable for human race to survive. I will discuss all these and the underlying science of four dominant radiative atomic processes that give out or absorb photons and how spectroscopy of the lines created during the processes reveal information to understand these objects and make the next steps.

Keywords: Exoplanets, Atomic processes, Spectroscopy

ICAPE21-KN-04

The Application of Graphene in Space

Yarjan Abdul Samad*

University of Cambridge, UK
**E-mail: yy418@cam.ac.uk*

Abstract—Graphene and related materials (GRMs) are being produced via several techniques and most scalable of those is the liquid phase exfoliation (LPE). In this presentation production of GRMs via LPE will be discussed. Development of graphene-based composites, aerogelsand textiles will also be discussed. Current and impending space applications of graphene based aforementioned components will be elaborated.

Keywords: GRMs, Aerogel, Liquid phase exfoliation

ICAPE21-KN-05

Role of Artificial Intelligence in Autonomous Navigation in GPS-Deprived Areas - Current and Future Technologies

Syed Naeem Ahmed*

Department of Physics, Laurentian Univesity, Canada
**E-mail: naeem@clickmox.com*

Abstract—Use of artificial intelligence in robotics applications has been gaining widespread acceptance over the past several years. The positioning and

navigation of robots in three-dimensional space in GPS-deprived areas are generally handled with some kind of Simultaneous Localization and Mapping (SLAM) algorithm. Though a lot of progress has been made in this field, a robust system that also produces highly accurate 3D scenes with high positional accuracy is still to be realized. The addition of machine and deep learning with SLAM provides an interesting method of producing rich 3D maps with object classifications, accurate localization and positioning, system robustness and real-time updates. Another advantage of this approach is its near-seamless inclusion in the existing IoT stack for big data applications. Such an approach requires large GPU-core AI hardware whether the system is based on vision sensors, LiDAR or both. This talk is a review of existing technologies in this area and future directions.

Keywords: LiDAR, SLAM, Autonomous Navigation.

ICAPE21-KN-08

Access to Scientific Information- Role of PASTIC

Muhammad Akram Shaikh*

Director General, Pakistan Scientific and Technological Information Centre (PASTIC), QAU Campus, Islamabad, Pakistan
**E-mail: dg@pastic.gov.pk*

Abstract—Information is an asset necessary for the development and prosperity of a society. It is an essential material required for making decisions from the government to the personal level. Development across all spheres (scientific and technological, industrial, social, economic) is dependent on access to S & T information and its sharing is an effective and empowering means of enabling progress and growth. Pakistan Scientific & Technological Information Center (PASTIC) realizing the need of time had adopted the modern techniques of information handling and dissemination for providing speedy access to all types of scientific and technological information. This talk will shed some light on the role of PASTIC, its services and S&T knowledge resources developed by PASTIC.

Technical Session 01

Space Physics

ICAPE21 O31_01	**Autocorrelation Functions, Cosmology and Investigating the CMB Cold Spot with EMU-ASKAP Radio Continuum Survey** *Syed Faisal Ur Rahman*
ICAPE21 O42_02	**Estimation of Maximum Usable Frequency using Earth-Ionosphere geometry for Pakistan** *Siddique Hira, Tahir Afnan, Gul Iffat, Waris Bismabinte, Ansari Alisha, Javaid Saba*
ICAPE21 O85_03	**Study the Neutrinos: An innovative Way to Explore the Universe** *Muhammad Ayub Khan Yousufzai*
ICAPE21 O31_04	**Dark Energy and Properties of Space** *Muhammad Zakir*

ICAPE21_O31_01

Autocorrelation Functions, Cosmology and Investigating the CMB Cold Spot with EMU-ASKAP Radio Continuum

Syed Faisal Ur Rahman[1,2]

[1]*Visiting faculy, University of Karachi, Karachi*
[2]*Visiting faculty, Institute of Business Management, Karachi*
[*]*E-mail:faisalrahman36@hotmail.com,faisalrahman.vf@iobm.edu.pk*

Abstract—Galaxy angular-power spectrum and autocorrelation functions (ACFs) provide information about the distribution of matter by using galaxy counts as a proxy. In this study, we are going to estimate autocorrelation angular power spectrum and angular autocorrelation function for EMU-ASKAP 5 sigma sources and then compare them with results from NVSS. We will also use SUMSS data to compare ACF results using Landy-Szalay estimator. EMU-ASKAP will provide excellent opportunity to observe universe with high sensitivity and is likely going to observe millions of high redshift sources which will help in studying the clustering of the large-scale structures, constraining cosmological parameters and exploring mysteries like the existence of a cosmoic cold spot or the CMB cold spot as observed by both Planck and WMAP probes. We will discuss some possible ways, the CMB cold spot puzzle can be explored further by using the galaxy clustering, integral source cout and galaxy bias analysis with a highly sensitive survey like EMU-ASKAP.

Keywords: Cosmology, Radio astronomy, EMU-ASKAP, CMB cold spot, Galaxy Surveys

ICAPE21_O42_02

Estimation of Maximum Usable Frequency using Earth-Ionosphere geometry for Pakistan

Siddique Hira[1*], Tahir Afnan[2], Gul Iffat[1], Waris Bisma binte[1], Ansari Alisha[1], Javaid Saba[1]

[1]Department of Physics, NED University of Engineering and Technology,
[2]SUPARCO,afnan.tahir27@gmail.com
**E-mail:hsiddique345@gmail.com*

Abstract—We report the estimation of the Maximum Usable Frequency of F2-layer for 3000 km circuit (MUF(3000)F2) using Earth-ionosphere geometry. In this study, it is assumed that the virtual height of F2-layer may replace peak height to estimate M(3000)F2 . The monthly hourly medians of ionospheric parameters are extracted for Karachi (geog. coord. 24.9ºN, 67.3ºE) & Multan (30.2ºN, 71.5ºE) during 1996, 1992, & 1989 representing low, moderate & high solar activity years, respectively. The MUF(3000)F2 estimated using spherical geometry shows large deviation and greater Root Mean Square Error values on comparison with MUF(3000)F2 directly observed from ionosonde. In order to reduce the error, linear regression analysis technique is used and applied on independent data set of years 1995, 1993 and 1991 representing low, moderate and high solar activity to compute corrected MUF(3000)F2, respectively. It is found that corrected MUF(3000)F2 is in good agreement with observed MUF(3000)F2, decreasing RMSE values for the stations and years under study. The results of this study would be helpful in MUF estimation and in improving radio services for smooth HF communication over study region.

Keywords: Ionosphere, MUF, M(3000)F2, hmF2, h'F2.

ICAPE21_O85_03

Study the Neutrinos: An innovative Way to Explore the Universe

Muhammad Ayub Khan Yousufzai*

Department of Applied Physics and Institute of Space Science and Technology, University of Karachi
**E-mail:ayubzai@yahoo.com*

Abstract—It has been known for several years that ordinary matter in the universe is made of atoms having a nucleus in its centre (Inside the nucleus there are protons and neutrons) around which electrons go around. Neutrinos are known as neutral leptons that are not well measured for a long time and the detection of neutrinos is very difficult, because of the fact that neutrinos rarely interact with other matter. Recently some laboratories in the world are detecting neutrinos coming to earth after supernova bursts. This presentation describes the elements of neutrino interaction with other particles, then the model's predictions on neutrino-electron interactions and experimental limits on neutrino mass with leptonic mixing angles. Wave packet treatment along with the pictorial description of neutrino oscillations will also be manifested. In this communication we intend to study the parametric estimation of neutrino flux from Supernova bursts under solar quiet and active conditions for extraterrestrial reign of Northern Hemisphere. As we know that Neutrinos are known as leptons, are of three kinds called the electron neutrino, muon neutrino and the tau neutrino (νe, νμ, ντ). This kind of study is being carried out first time in Pakistan. The salient features of the standard solar model are distinguished for solar neutrino that is most exciting subject in the world of physics with implications of chlorine, water and gallium detectors result for neutrino properties. Some forthcoming detectors such as Sudbury Neutrino Observatory (SNO) will also be offered. Neutrino flux will be assessed using mathematical Statistical approaches of analysing data sets obtained from different observatories mentioned in this paper. This investigation will be useful for public and private organizations in the region. This information will provide an inclusive perceptive for budding and seasoned researchers to carry on investigation in neutrino dynamics.

Keywords: Neutrino Flux, Deep Space, SNO Detection Station, Manifestation of Spectral Contribution, Solar Model, Heavy water & Salt water.

ICAPE21_O66_04

Dark Energy and Properties of Space

Muhammad Zakir*

Department of Physics, University of Karachi, Karachi, Pakistan
**E-mail:zk1322436@gmail.com*

Abstract—This paper is all about a new concept which is space density. Using Concept of space density helps us understanding fundamental properties of space and with the help of which I derived Equation for dark energy. This paper includes some mathematical argument and explain the experimental observation regarding the acceleration of the universe due to dark energy. It also explains the theory of relativity in the simplest why without using space-time curvature instead it uses the concept of space density. It gives the mechanism for time dilation and length contraction also explain why the speed of light appears slower in denser medium. (Although it doesn't slow down according to theory). This also introduces a new idea what I call the teleportation of information to distant areas (stars OR galaxies within shortest possible time). This all can easily be explained in the term of space Density with mathematical argument.

Keywords: Space density, Dark energy, Generalization of STR and GTR.

Technical Session 02

Simulation and Modelling

ICAPE21 O59_05	**A Brief Look at the Application of Functional Renormalization Group Within the Two-Flavor Quark Meson Model to Study the QCD Phase Diagram** *Muniba Fatima, Amber Jamal, Imran Siddiqui*
ICAPE21 O50-06	**Algorithm and Implementation of Human Following Co-bot using 2D LiDAR** *Rabeea Khan, Zeeshan Yousaf, Asif Memon, Sajid Hussain, Abdul Muttalib*
ICAPE21 O28-07	**New Models for Estimation of Solar Radiation for Five Cities of Pakistan** *Atteeq Razzak, Zaheer Uddin, M. Jawed Iqbal*
ICAPE21 O06-08	**Density Functional Simulation of ThS2 to Investigate Structural, Electronic, Optical and Vibrational Properties** *R. M. Arif Khalil, Muhammad Iqbal Hussain, Nyla Saeed, Fayyaz Hussain*
ICAPE21 O19-09	**Solution of Schrodinger and Dirac Equation for Hydrogen Molecular Ion Using Hartree-Fock Method** *Mahsheeda Syed, Imran Ahmad*
ICAPE21 O98-10	**Theoretical Analysis of (i) $4f^3 6s^2$ (ii) $4f^2 5d^2 6s$ (iii) $4f^2 5p^6 s^2$ Configurations of Praseodymium (Pr-I)** *Roohi Zafar, Saba Javaid, Zaheer Uddin*
ICAPE21 O72-11	**Teaching Pandemic Modelling Using SIR Model and Numerical Estimation of Ro of Covid-19 Data** *Fayzan Ahmed, Majid Iqbal, Arshad Iqbal, Zaheer Uddin*

ICAPE21_O59_05

A Brief Look at the Application of Functional Renormalization Group within the Two-Flavor Quark Meson Model to Study the QCD Phase Diagram

Muniba Fatima*, Amber Jamal, Imran Siddiqui

Department of Physics, University of Karachi, Karachi, Pakistan
**E-mail:naqvimuniba@yahoo.com*

Abstract—The study of the phase transition from hadrons to the quark gluon plasma is accompanied with the critical phenomenon, an active field of research in particle physics. The quest of such transitions lead to the understanding of the deconfinement and chiral symmetry restoration, describe by the massless current quark mass. Study of the entropy density and the chiral condensate in both cases, respectively, reveal the requirement of different critical exponents to study these transitions. The phase transition is well described by the quark number susceptibility, chiral susceptibility, order parameter and the critical exponent, etc The QCD phase diagram, which is a function of temperature, T, and baryon chemical potential, μB, locate the critical end point CEP and provide a way to analyze such transitions. Among other theoretical methods to explain the phase transitions, such as Lattice QCD, Mean Field Approximation method, the functional renormalization group (FRG) within two-flavor quark meson model is an effective way to study critical phenomenon. In this paper, we will cover a detail look of using this methodology to locate the critical end point and solving the chaos of phase transitions in QCD.

Keywords: Functional Renormalization Group, Two-flavor quark meson model, QCD phase diagram**.**

ICAPE21_O50_06

Algorithm and Implementation of Human Following Co-bot using 2D LiDAR

Rabeea Khan*, Zeeshan Yousaf, Asif Memon, Sajid Hussain, Abdul Muttalib

Institute of Industrial Electronics Engineering, NEDUET, Karachi, Pakistan
**E-mail: rabeeakhan.28@iiee.edu.pk*

Abstract—Co-bots - Collaborative robots are designed to interact directly with humans in close proximity. Some human-robot collaborative applications like surveillance, clinical services, media outlets, defense, and social associations, may require an autonomous robot to have the ability to distinguish and track a person and to follow him around. Smart suitcases and smart trolleys are practical applications of human detection and following co-bots. Initially seen as a special case of object tracking, the task of person following with autonomous robots before long turned into a challenging task of its own especially when using a short-range sensor like laser range scanner. Therefore, we have proposed and implemented an effective algorithm for intelligent detection, tracking, and following a specified target person. The decision is being made by the control unit based on the information obtained from 2D LIDAR mounted at knee height, hence, enabling the mobile co-bot to follow the target in a dynamic environment without any collision.

Keywords: 2D LIDAR, Co-bot, Human following Co-bot, Human Detection and Following, Laser Range Scanner, Robotics

ICAPE21_O28_07

New Models for Estimation of Solar Radiation for Five Cities of Pakistan

Atteeq Razzak*, Zaheer Uddin, M. Jawed Iqbal

Department of Mathematics, University of Karachi, Karachi, Pakistan
**E-mail: atteeq.razzak@uok.edu.pk*

Abstract—The increasing demand for electricity due to the change of lifestyle of common man has put immense pressure on fossil fuels, a rapid depletion of fossil fuel has made scientists and engineers search and adopt alternative sources of energy. Renewable energies e.g., wind, hydro, biogas, and solar, etc. are a good alternative to conventional sources of energy. In this paper, we developed three models for direct beam solar radiation (BSR), diffuse solar radiation (DSR), and global solar radiation (GSR) for five cities (Karachi, Hyderabad, Lahore, Quetta, and Peshawar) of Pakistan. In these model BSR, DSR and GSR are given as a function of day-number. Three types of solar radiations have been calculated through the models developed in this study and the results are compared with the corresponding values calculated by the standard clear sky ASHRAE model. A good agreement is found between these values. For validation of results, Root means square error (RMSE), Mean Absolute error (MABE), Mean Absolute percent error (MAPE), and chi-square ($\chi 2$), and coefficient of determination are calculated and found to be in the accepted range. It has also been found that DSR, BSR, and GSR have an inverse relation with latitude.

Keywords: Solar, Solar radiations, ASHRAE Model, Modelling, Global, Beam and Direct solar radiation.

Density Functional Simulation of ThS2 to Investigate Structural, Electronic, Optical and Vibrational Properties

R. M. Arif Khalil*, Muhammad Iqbal Hussain, Nyla Saeed and Fayyaz Hussain

Materials Simulation Research Laboratory (MSRL), Department of Physics, Bahauddin Zakariya University, Multan, Pakistan
**E-mail:muhammadarif@bzu.edu.pk*

Abstract—We have investigated the structural, electronic, optical and vibrational properties of Thorium disulfide (ThS_2) in Pnma symmetry through density functional theory (DFT). The structural properties are explored using CASTEP simulation code along with Generalized Gradient Approximation. The value of lattice parameters (a= 7.27Å, b= 4.33Å and c= 8.56Å) calculated in the present work are found in good agreement with the former studies. The electronic properties containing the electronic band structure shows direct energy band gap such as 0.995eV, thus, it belongs to semiconducting materials. The optical analysis reveals that maximum absorption occurred in UV range of the electromagnetic spectrum. The vibrational properties are carried out through density functional perturbation theory which confirms no imaginary or negative frequency in the phonon spectrum, leading to its dynamical stability. The modes of vibrations are explored through spectroscopy. Thermodynamic properties are calculated using harmonic approximation to check the thermodynamically stability of the system.

Keywords: ThS_2, Density Functional Theory, Electronic Properties, Vibrational Properties, Optical Propert

ICAPE21_O19_09

Solution of Schrodinger and Dirac Equation for Hydrogen Molecular Ion Using Hartree-Fock Method

Mahsheeda Syed, Imran Ahmad

Department of Physics, University of Karachi, Karachi, Pakistan
**E-mail:*mahsheda@hotmail.com

Abstract—Hydrogen molecular ion H + is considered as one of the interstellar molecular ion, accurate energy calculations of this molecule may help to perceive astronomical phenomenon. Furthermore, due to its simplicity it can be considered as a reference molecule to understand other molecules. In this regard, Schrodinger and Dirac equations were solved for Hydrogen molecular ion H+ using a numerical method, Hartree-Fock Self Consistent Field (HF SCF) using python with pySCF module for calculation of energy. The calculations were brought for different schemes of Hartree-Fock, Restricted Hartree-Fock (RHF), Unrestricted Hartree- Fock (UHF), Restricted Open shell Hartree-Fock (ROHF) and Dirac Hartree-Fock (DHF). Ground state energies, Dissociation energy and bond length were calculated. The energies calculated were found to be in good agreement with experimental and theoretical results. The work was extended for Hydrogen molecule H2, Helium Hydride HeH, and Helium Hydride ion HeH+. Hartree-Fock method is found to be reliable numerical method to deal many-body calculations

Keywords: Hartree-Fock, Hydrogen molecular ion, Self Consistent Field

ICAPE21_O98_10

Theoretical Analysis of (i) $4f^36s^2$ (ii) $4f^25d^26s$ (iii) $4f^25p6s^2$ Configurations of Praseodymium (Pr-I)

Roohi Zafar*, Saba Javaid, Zaheer Uddin

Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan
**E-mail:roohizj@neduet.edu.pk*

Abstract—Term symbols are a shorthand method to designate characteristics of atomic and ionic levels. The first-hand information we get from term symbols are spin multiplicity and orbital and total angular momentum for different electronic states of atoms and ions. With more than two electrons in open shell the term structure becomes very complex, many terms arise having the same (SL). With the help of these term values we can calculate coupled wave function of the configuration. For the specific terms having same total orbital angular momentum L and total spin angular momentum S Coupled wave function can be written as a linear combination of the pure parentage wave functions. These wave functions are important to calculate because several spectroscopic quantities e.g. energy, transition probability etc. can be calculated with the help of these wave functions. Praseodymium belongs to f block elements; it has an open f shell configuration. It is very rich in fine levels. In this study we have investigated three different electronic configurations of Pr I, namely, 4f^3 6s^2,4f^2 5d^2 6s and 〖4f〗^2 6ps^2. Total numbers of terms arising from each configurations found and total number of fine levels corresponding to each configuration are also determined. Using Russell-Saunders method of coupling of angular momenta we found 4f^3 6s^2,4f^2 5d^2 6s and 〖4f〗^2 6ps^2generate 17, 304 and 28 terms respectively. We also calculated 18 coupled wave functions of configuration 〖4f〗^2 6ps^2.
Keywords: LS coupling, Coupled wave function, Spectroscopic terms, Atomic structure, Praseodymium.

ICAPE21_O72_11

Teaching Pandemic Modelling Using SIR Model and Numerical Estimation of Ro of Covid-19 Data

Fayzan Ahmed[1,3], Majid Iqbal[1,2*], Arshad Iqbal[4], Zaheer Uddin[1]

[1]*Department of Physics, University of Karachi, Karachi, Pakistan*
[2]*Fazaia Inter College, Malir Cantt, Karachi, Pakistan*
[3]*Department of Radiology, Liaquat National Hospital and Medical College, Karachi, Pakistan*
[4]*Department of Chemical Engineering, Dawood University of Engineering & Technology, Karachi, Pakistan*
**E-mail:fayzan_007@yahoo.com*

Abstract—A contagious disease transmits from human to human or animal to human. At present world is encountered with such a disease, known as COVID-19. More than half a million people have died due to this pandemic. The pandemic started in china and spread within no time in other parts of the world. Italy and USA are the most unfortunate countries as large number of deaths occurred in these two countries. No doubt this contagious disease has created social as well as economic problems for all over the world especially underdeveloped countries. The disease easily transmits to a healthy person during social contacts. Kermack and McKendrick developed a model Known as SIR (Susceptible Infected and Recovered), it deals with the rate of transmission of disease and rate of infection. It gives a trend of infectious disease in large population. The model helps epidemiologist and health policy makers to understand the probable transmission of disease and to take possible and effective measures to control or reduce the spread of virus. The factor Ro, known as reproductive number, can be considered as threshold value for the disease to be an epidemic. In this study we used SIR model to study the effect of COVID-19 in Pakistan. Three coupled differential equations of SIR model have been solved by numerically using COVID-19 data for Pakistan. The Ro estimated by the current Pakistan COVID-19 data is found to be 2.656 from which control measures will cause a decrease in Ro. Due to reduction in Ro the apex of the infected population curve predicted to be ranges from 26% to 3% and time to reach the apex ranges from 161 to 710 days. Also the current data is compared with the numerical values by solving the SIR model. However, the model has limitations due to which parameters can be roughly calculated that might match the actual values to some extent. The application of model is simple and students can easliy learn about the computational techniques used to solve the coupled differentail equations

Keywords: Basic reproductive number, Ro, SIR model, epidemic, pandemic, COVID-19, Runge-Kutta 4th order RK4, mathematical model, contagious, infected population curve.

Technical Session 03

Medical Physics

ICAPE21 O21_12	**Audit of Treatment Planning System for Small Photon Fields** *Asad Yousuf, Abdul Qadir*
ICAPE21 O69_13	**Radiation Levels Measurement at Workplace of Cyclotron PET/CT Facilities (in Karachi) Using Tl Dosimeters** *Kauser Perveen, Ayesha Mohsin, Hira Nadeem, S. Mishkat Ali Jafri, Khalid Hussain, Abdur Rehman*
ICAPE21 O73_14	**Al_2O_3: C-Based OSLD System Characterization for Diagnostic X-rays** *Muhammad Bakhsh Nizamani, Jeannie Hsiu Ding Wong, Siraj Ahmed Abbasi*
ICAPE21 O68_15	**Bladder and Rectum Related Late-Toxicity after Radiotherapy of the Prostate Cancer** *Asrar Ahmad, Sajjad Ahmed Memon, Syed Shahid Iqbal*
ICAPE21 O70_16	**Microcapsules Modified with Core−shell Ferrite Nanoparticles: Applications in Drug-Release** *Masood Atif, Del Pino Pablo, Parak Wolfgang J*
ICAPE21 O71_17	**Assessment of Medical Exposure of Patients in Interventional Cardiology** *Sajjad Ahmad, Maryam Shoaib, Wazirzada*
ICAPE21 O74_18	**A review of the IAEA approach towards the Code of Ethics in Medical Physics Practices** *Nasir Ilyas, Salman Farrukh, Mishkat Ali Jafri*

ICAPE21_O21_12

Audit of Treatment Planning System for Small Photon Fields

Asad Yousuf*, Abdul Qadir

Aga Khan University Hospital, Karachi, Pakistan
**E-mail: asad.yousuf@aku.edu*

Abstract—Objective: The aim of this study is to conduct an internal and external audit of the Eclipse™ treatment planning system for small, MLC defined, mega voltage (MV) photon fields, with multiple dosimeter against standard dataset produced by Radiological physics center (RPC). In this study MLC defined, multiple small field size output factors were measured and calculated for 6 MV & 18 MV x-ray beams using the RPC recommended methods. Beam datasets were measured at 10 cm depth and 100cm SSD for a 10×10 cm^2 secondary jaws setting with MLC defined field sizes of 6×6, 4×4, 3×3, 2×2 and 1×1 cm^2. Measurements were made in a solid water phantom with NanoDot, Gafchromic EBT3 film and PinPoint® ion chamber. The measured output factors were compared with those calculated by the Eclipse™ treatment planning system (TPS). Output factors measured by nanoDot™, Gafchromic® EBT3 films and PinPoint® chamber for 6 MV photon beam were in close agreement about 1.5% with the standard RPC data set. For 18 MV, however, nanoDot™ showed a max of 7 % deviation, whereas with the EBRT3 and Pinpoint chamber the discrepancy was less than 2%. The TPS at our institute has been accurately commissioned for small field photon dose delivery. The RPC provided standard dataset is crucial for institutes interested in conducting external audits of their TPS commissioning.

Keywords: Small field photon dosimetry, nanoDot™, Gafchromic, quality assurance, treatment planning.

ICAPE21_O69_13

Radiation Levels Measurement at Workplace of Cyclotron PET/CT Facilities (in Karachi) Using Tl Dosimeters

Kauser Perveen[1*], Ayesha Mohsin[1], Hira Nadeem[2], S. Mishkat Ali Jafri[1], Khalid Hussain[1], Abdur Rehman[1]

[1]*PNRA – Pakistan Nuclear Regulatory Authority*
[2]*NED University of Engineering and Technology, Karachi, Pakistan*
[*]*E-mail:* kauser.parveen@pnra.org

Abstract—To measure the dose in controlled area and supervised area of four different Cyclotron- PET/CT Facilities of Pakistan using TLDs for verification of Regulation 27 of PAK-904 (Regulations on Radiation Protection) and Requirement 24 of IAEA GSR Part 3. Cyclotron is the most widely used proton particle accelerator for production of short-lived radionuclides particularly F-18 for diagnostic purpose in oncology imaging. Currently, only F-18 is being produced in Pakistan. F-18 is tagged with glucose analogue and converted into [18F] FDG by synthesis process. [18F] FDG emits positron and, via annihilation process, produces two gamma photons of 511keV energy, which is of great concern for occupational safety. In this study, calibrated Thermoluminescene dosimeters (TLD-100) were annealed and placed in ten different locations of four Cyclotron-PET/CT facilities for determination of dose in work area. In the selected cyclotron facilities, one out of four is unshielded cyclotron and other three are self-shielded. Ten TLDs were placed in preselected controlled and supervised areas of facilities for the duration of 30 days. After four weeks of exposure, TLDs were removed and assessed on TLD reader for dose evaluation. The evaluated results of radiation levels from TLDs are in good agreement with the criteria for classification of areas as defined in Regulations on Radiation Protection (PAK/904). The measured doses of work area are well below the defined regulatory dose limits for controlled area (>6mSv/yr) as well as supervised area (>1mSv/yr) except in unshielded cyclotron vault. It is concluded that the facilities have established strong radiation safety measures for minimization of occupational exposure.

Keywords: Radiation levels, Cyclotron-PET/CT, TLD

ICAPE21_O73_14

Al_2O_3: C-Based OSLD System Characterization for Diagnostic X-rays

Muhammad Bakhsh Nizamani[1*], Jeannie Hsiu Ding Wong[2], Siraj Ahmed Abbasi[1]

[1]*Pir Abdul Qadir Shah Jeelani Institute of Medical Sciences, Gambat, Pakistan*
[2]*Department of Biomedical Imaging, Faculty of Medicine, University of Malaya, Kuala Lumpur*
**E-mail:mbnizamani@hotmail.com*

Abstract—Al_2O_3:C-based optically stimulated luminescent dosimeter (OSLD) system was characterized and evaluated for personal and in vivo dose measurements in diagnostic radiology. The system characteristics, such as dose linearity, reader accuracy, reproducibility and energy dependence, were explored. The suitability of the nanoDotTM dosemeters was evaluated by measuring in vivo dose measurement and image perturbation. The nanoDotTM dosemeters were observed to produce a linear dose with ±2.8% coefficient variation. A slight energy dependence (±6.1%) was observed between 60 and 140 kVp. The InLight® microStar reader demonstrated good accuracy and a reproducibility of ±2%. The total uncertainty for a single dose measurement using this system was 11%, but it could be reduced to 9.2% by applying energy dependence correction.
Keywords: OSLD, nanoDot, Image perturbation, Low energy X-rays.

ICAPE21_O68_15

Bladder and Rectum Related Late-Toxicity after Radiotherapy of the Prostate Cancer

Asrar Ahmad*, Sajjad Ahmed Memon, Syed Shahid Iqbal

NIMRA – Nuclear Institute of Medicine and Radiotherapy, Jamshoro, Sindh, Pakistan
**E-mail: asrarchm@gmail.com*

Abstract—To study the correlation between dose volume histogram (DVH) parameters of organs at risks (OARs) and the late radiation-induced toxicities among prostate cancer patients who underwent radiotherapy. In total 110 prostate cancer patients received (59.4—77.4) Gy with 1.8 Gy per fraction using 3D conformal radiotherapy without image guidance from year 2000 to 2008. Patients had two subgroups: with- and without operation, and no endorectal balloon was used for prostate immobilization. Based on planning CT data, DVH parameters were acquired after making relevant subcontours of the delineated OARs. For scoring the late side-effects of radiotherapy using radiation therapy oncology group (RTOG) guidelines, a questionnaire was used with a baseline before radiotherapy and toxicity scores after 6, 18, 30, 54 months and later after radiotherapy. Statistical analysis of the acquired data was performed using Mann-Whitney tests and binary logistic regression tests for determination of normal tissue complication probability. Increase in micturition frequency of grade 2 or above ($G \geq 2$) or above was observed for increase in volume of the urinary bladder base to 60 Gy. Increase in stool frequency of $G \geq 2$ was observed for increase in relative volume of rectum at 65 Gy and increase in bowel incontinence of $G \geq 2$ was observed for irradiation of absolute volume of anus to 20 Gy. Conclusions: The bladder base is relevant part of urinary bladder regarding increase in micturition frequency by irradiation to higher doses. Even lower doses to the anus could cause bowel incontinence.

Keywords: Prostate cancer, Radiotherapy, 3D-CRT, late side-effect.

ICAPE21_O70_16

Microcapsules Modified with Core−shell Ferrite Nanoparticles: Applications in Drug-Release

Masood Atif[1*], Del PinoPablo[2], Parak Wolfgang J.[3]

[1]*Biophotonics, Department of Physics, Philipps Universität of Marburg, Germany*
[2]*Dept. BioNanoTools, Universidad de Santiago de Compostela, Spain*
[3]*Institut fürNanostruktur- und Festkörperphysik, University of Hamburg, Germany*
**E-mail: Atif_cancer@hotmail.com*

Abstract—In the context of biomedical applications, magnetic nanoparticles (MNP) have been applied due to three main relevant properties: i) MNPs can be manipulated using magnetic field gradients, ii) MNPs provide T2-weighted contrast in Magnetic Resonance Imaging (MRI) and iii) MNPs produce heating upon excitation with alternating magnetic fields (AMF), which can be harnessed in hyperthermia treatment. Due to biocompatibility issues, iron oxides are the most common material employed for the fabrication of MNPs. However, besides size and shape, the magnetic properties of MNPs can be tailored by adjusting their composition, thereby optimizing their performance for a particular application. The motivation of this study is to synthesize size-controlled composite core shell MNPs, where the core and the shell will be made of different magnetic materials, with maximal hysteresis losses under AMF. The MNPs will be then incorporated within the shell of multifunctional polyelectrolyte microcapsules. These hollow capsules fabricated using the LbL assembly technique are versatile multifunctional materials, which can be designed to: i) encapsulate different macromolecules in the cavity, ii) entrap MNPs within the polymer shell, and iii) present an engineered surface with specific properties (e.g., targeting, antifouling, etc.). Ultimately, the capsules with MNPs in the shell and loaded with different macromolecules will be used as drug-release systems under AMF, as in previous own work where light was used as trigger.

Keywords: Nanoparticles, Magnetic Nanoparticles, Alternating magneting field, Layer by layer microcapsules.

ICAPE21_O71_17

Assessment of Medical Exposure of Patients in Interventional Cardiology

Sajjad Ahmad*, Maryam Shoaib, Wazirzada

Pakistan Nuclear Regulatory Authority (PNRA), Islamabad, Pakistan
**E-mail: sajjad.safi@pnra.org*

Abstract—Medical exposure of patients varies for the same type of interventional cardiology procedure in different hospitals depending on various factors i.e. physician training, experience, type of angiography machine, patient size, complexity of the case etc. There may be chance of high radiation exposure to patients due to prolonged use of radiation during complex interventional procedures. To avoid unnecessary radiation exposure to patients in interventional cardiology procedures, diagnostic reference levels (DRLs) are needed to be established and used. Data of 259 adult patients who underwent interventional cardiology procedures i.e. coronary angiography (CA) and percutaneous coronary intervention (PCI) was collected from five hospitals. Hospitals' reference levels and local DRLs have been determined in terms of dose-area product (DAP)/ air kerma-area product (PKA), number of images acquired and fluoroscopy time per procedure. Furthermore, locally determined DRLs are compared with the DRLs suggested by IAEA. The locally determined DRL values in terms of dose-area product (DAP)/ air kerma-area product (PKA), number of images acquired and fluoroscopy time per procedure are 48 Gy-cm^2, 515 and 5 minutes respectively for CA procedure; and 138 Gy-cm^2, 1361 and 12 minutes respectively for PCI procedure.

Keywords: Interventional cardiology, Coronary angiography (CA), Percutaneous coronary intervention (PCI), Diagnostic reference levels (DRLs), Dose-area product (DAP).

ICAPE21_O74_18

A review of the IAEA approach towards the "Code of Ethics in Medical Physics Practices"

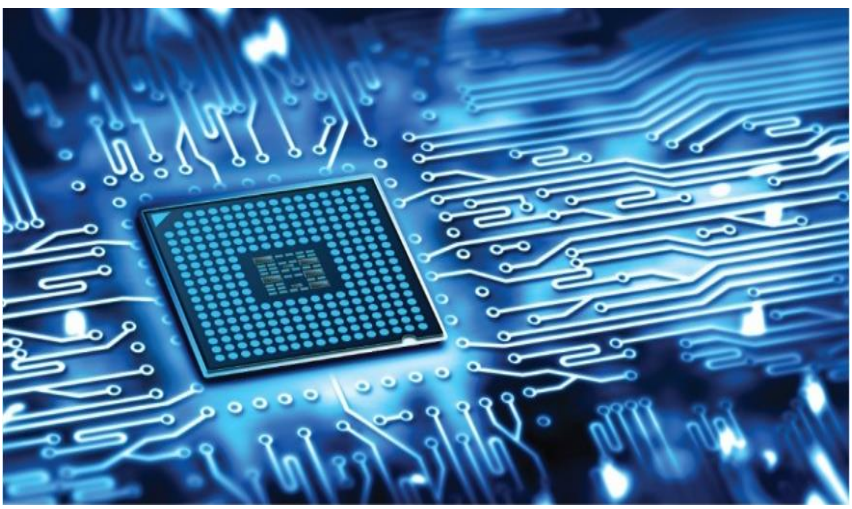
Nasir Ilyas[1*], Salman Farrukh[2], Mishkat Ali Jafri[3]

[1]*ISPA, University of Karachi, Karachi, Pakistan*
[2]*Atomic Energy Medical Centre, JPMC, Karachi, Pakistan*
[3]*Institute of Business Administration, Karachi, Pakistan*
**E-mail: nasir.ilyaaz@gmail.com*

Abstract—To introduce and highlight the importance of the "Code of Ethics" for medical physics practices through IAEA approach. The code of ethics in medical physics practices is an essential and necessary tool. Several professional bodies like the AAPM, COMP, etc. have developed code of ethics for medical physics practices and medical physics community for their countries. Likewise, the IAEA has, through its publication "Roles and Responsibilities, and Education and Training Requirements for Clinically Qualified Medical Physicists, Human Health Series (HHS 25), 2013, has elaborated a code of ethics for member states, which may also be applicable to the medical pysics community in Pakistan. The IAEA HHS 25 has adopted the contents of the AAPM publication on Code of Ethics. Its major sections include principles and guidelines. The principles address to an individual medical physicist like quality management, patient privacy, limitation of own knowledge, laws and regulatory requirements, relationships, communication, re-training and reporting of incidents. The guidelines include the topics of academic freedom, honesty, competence, professionalism, confidentiality, conflict of interest, social norms, regulatory compliance, whistle blowing for protection, etc. This section also contains the information regarding conduct of research and its ethical consideration like ownership of research, funding, etc.

Keywords: IAEA Publications, Code of Ethics in Medical Physics

Technical Session 04



Electronics

ICAPE21 O15_19	**Redesigning and Advanced Automation of Vibrating Sample Magnetometer** *Syed Shabhi Haider, Muhammad Zahir Iqbal, Abbas Khan*
ICAPE21 O16_20	**Improved Optical Performance of AlGaN-Based Far UVC LEDs with Introducing p-AlN Electron Blocking Layer** *Tariq Jamil, Muhammad Usman, Habibullah Jamal, Sibghatullah Khan*
ICAPE21 O61_21	**Theoretical Analysis of High Breakdown Voltage Characteristics in Normally-Off 4H-SiC VJFET Using Commercial TCAD Simulator** *Muhammad Khalid, Malik Muhammad Hafeezullah, Saira Riaz, Shahzad Naseem*
ICAPE21 O20_22	**Quantization Error in Time-To-Digital Converters** *Asad Aslam, Muhammad Zishan*
ICAPE21 O40_23	**A Survey on Wireless Sensor Network and Cryptography** *Hassan Waseem, Anas Khan, Syed Ahmed*
ICAPE21 O57_24	**Optimization of Air-Conditioning Control to Enable Energy Saving** *Kavita Dennis, Nyenge Raphael, Munji Mathew*

ICAPE21_O15_19

Redesigning and Advanced Automation of Vibrating Sample Magnetometer

Syed Shabhi Haider*, Muhammad Zahir Iqbal, Abbas Khan

Nanotechnology Research Laboratory, Faculty of Engineering Sciences, GIK Institute of Engineering Sciences and Technology, Swabi, Khyber Pakhtunkhwa, Pakistan

E-mail:shabhishah96@gmail.com

Abstract—An alternate and integrative approach has been adopted to reconstruct the outdated version of vibrating sample magnetometer (Lake Shore Series 7300) by interfacing lock-in amplifier and Keithley 2400 source meter using self-designed LabVIEW program. The reconstructed setup is perfectly interfaced through the LabVIEW and accurately calibrated for the magnetic field sweep (both +ive and -ive magnetic fields) and magnetization values, maintaining the sensitivity of the reconstructed machine up to ~10-6 emu. Furthermore, various magnetic materials (Ni, NiFe, Fe70Ni3Si3B3P8, bulk metallic glass, and Fe/rGO) were deliberately tested for clarity and reproducibility of the reconstructed machine. The resulting outcome validate the successful integration and advanced automation of vibrating sample magnetometer setup.

Keywords: Vibrating sample magnetometer, Reconstruction, LabVIEW, Magnetic materials, Magnetic hysteresis

ICAPE21_O16_20

Improved Optical Performance of AlGaN-Based Far UVC LEDs with Introducing p-AlN Electron Blocking Layer

Tariq Jamil*, Muhammad Usman, Habibullah Jamal, Sibghatullah Khan

Faculty of Engineering Sciences, Ghulam Ishaq Khan Institute of Engineering Sciences and Technology, Swabi, KPK, Pakistan
**E-mail:tjamilshah@gmail.com*

Abstract—The severe carrier leakage poorly influencing the optoelectronic performance of AlGaN-based Far ultraviolet light-emitting diodes (UVC LEDs). In this study, the influence of the p-AlN layer on the carrier leakage in 232 nm UV LEDs was numerically investigated. We introduced the p-AlN electron blocking layer (EBL) for the reduction of lattice mismatch between epi-layers i.e. last quantum barrier (LQB), p-EBL, and the p-AlGaN layers. The simulation results demonstrated that with p-AlN, we not only enhanced the hole concentration in the active region but also suppressed the electron leakage impressively. It is worth noting that the p- AlN layer after LQB worked as an efficient p-EBL, due to its higher effective conduction band upset. The radiative recombination rate and internal quantum efficiency (IQE) are also enhanced impressively due to the optimization of carriers in the active zone. It is worth noting that the LED with p-AlN layer exhibited efficiency-droop-free, which intensively degrading the optical performance of UV LEDs. So, based on these remarkable results, we highly believe that this study, providing a realistic approach for the development of highly efficient UVC LEDs (232), which has a crucial role in the disinfection processes.

Keywords: p-AlN, UVC LEDs, Optical performance, IQE.

ICAPE21_O61_21

Theoretical Analysis of High Breakdown Voltage Characteristics in Normally-Off 4H-SiC VJFET Using Commercial TCAD Simulator

Muhammad Khalid[1*], Malik Muhammad Hafeezullah[2,3], Saira Riaz[4], Shahzad Naseem[4]

[1]*Department of Physics, University of Karachi, Karachi, Pakistan*
[2]*Institute of Computer Science & Mathematics, University of Sindh, Jamshoro, Pakistan*
[3]*Department of Physics, Balochistan University of Information Technology, Engineering and Management Sciences, Quetta, Pakistan*
[4]*Centre of Excellence in Solid State Physics, University of the Punjab, Lahore, Pakistan*
** E-mail: mkhalid@uok.edu.pk*

Abstract—The effects of temperature from ambient to 500˚C on breakdown voltages in normally-off 4H-SiC VJFET have been simulated using Sentaurus TCAD. The simulation was carried out using the Lackner model. Negative gate bias was applied to be directly related with increase in breakdown voltages. Furthermore, the breakdown voltages investigated with increasing temperature as the obtained voltages decreases due to negative temperature coefficient of device. The dependence of breakdown voltage on drift doping at various channel widths was also observed. The improved breakdown voltage i.e. 14 kV with drain leakage current of 10-8 A indicates relatively high electric field of 2.2 MV/cm. Furthermore, the finite element simulation was performed in order to study the variation of electric field inside device with effect of temperature as well as negative gate bias. During the study, it has been observed that punch through behavior at drain terminal is highly responsible for high breakdown voltages. Finally, the Lackner model has shown the capability to correlate the data with published experimenta data. The high breakdown voltage and low leakage current with adjustable channel width would make 4H-SiC VJFET a desirable device for high voltage power applications.

Keywords: Normally-off, electric field, breakdown voltage, temperature, leakage current

ICAPE21_O20_22

Quantization Error in Time-To-Digital Converters

Asad Aslam*, Muhammad Zishan

Department of Electronic Engineering, Sir Syed University of Engineering and Technology, Karachi, Pakistan
**E-mail:asad_bhatti30@yahoo.com*

Abstract—Methods of time interval measurement can be divided into asynchronous and synchronous approaches. It is well known that in asynchronous methods of time-interval measurement, uncertainty can be reduced by using statistical averaging. The motivation of this paper is an investigation of averaging in time interval measurements, especially in a synchronous measurement. In this article, authors are considering the method of averaging to reduce the influence of quantization error on measurement uncertainty in synchronous time-interval measurement systems, when dispersion of results, caused by noise is present. A mathematical model of averaging, which is followed by the results of numerical simulations of averaging of measurement series is presented. The analysis of results leads to the conclusion that in particular conditions the influence of the quantization error on measurement uncertainty can be minimized by statistical averaging, similar to asynchronous measurements.
Keywords: Time interval measurement, Time-to-digital- converter, Quantization error, Averaging

ICAPE21_O40_23

A Survey on Wireless Sensor Network and Cryptography

Hassan Waseem*, Anas Khan, Syed Ahmed

Department of Electronic Engineering, Sir Syed University of Engineering and Technology, Karachi, Pakistan
**E-mail:hassankhan30@outlook.com*

Abstract—Wireless Sensor Network is a network made up of distributed sensor nodes that collects data from the environment and transmits it along the network. Since it is a wireless network that sometimes is even used in hostile environment, protection of that data is essential as it is vulnerable to multiple type of security threats. Cryptography is one of the protocols used for providing security at the node level, to this type of network. In this paper, we will discuss WSN, its working, security requirements, threats it faces and how different types of Cryptographic Algorithms work to protect the data and will conclude which

type of Cryptographic method is the most suitable for the security of the sensitive data collected by WSNs.

Keywords: Wireless Sensor Network, Cryptography, Rivest cipher (RC5)

ICAPE21_O57_24

Optimization of Air-Conditioning Control to Enable Energy Saving

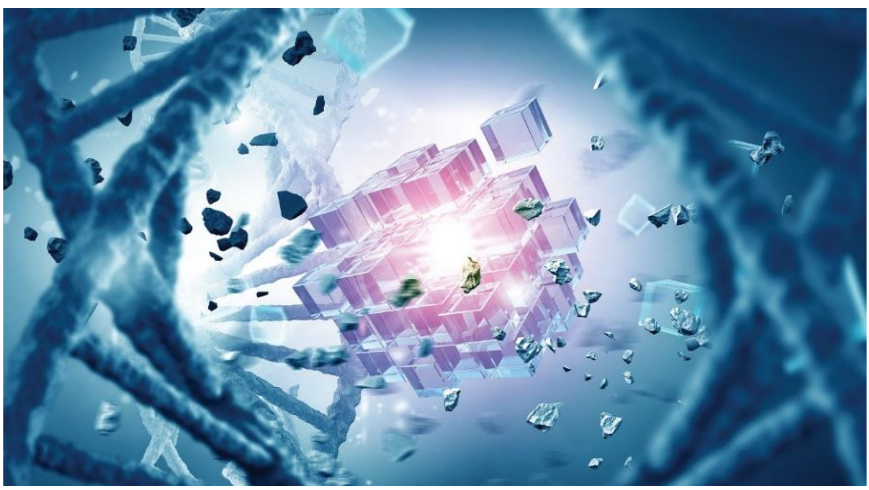
Kavita Dennis*, Nyenge Raphael, Munji Mathew

Kenyatta University, Kenya
**E-mail:kavitamwania@gmail.com*

Abstract—Residential and commercial space cooling demands are increasing steadily throughout the world. This has led to high growth in demand for air conditioning systems. Technology is playing a key role in digitization of these systems with sensors and microcontrollers being used extensively. Energy conservation remains the main focus of scientists and engineers. In line with working towards developing energy efficient systems, we carried out a research to optimize the control of air conditioners for energy conservation purposes. This research was geared towards having an energy efficient system. In this research, temperature, proximity and passive infrared detectors have been used as smart sensors. The system is designed such that when room occupants' approach a room, the system is activated and rapid cool down or warm up achieved within a predetermined time depending on the size of the room. As long as there is occupant in the room, the system quickly settles into the set conditions. When there is no one in the room, the system need not to be working and therefore it switches off. This helps in energy conservation hence reducing bills paid by home owners and companies in case of commercial use. The designed prototype is able to detect room occupancy, responds perfectly to temperature changes as well as human presence in the field of view of the PIR with an overall performance efficiency of 55.95% which is a good start towards actual implementation of an energy efficient A.C. system.

Keywords: Energy conservation, Energy efficiency, Performance efficiency, Air conditioning system.

Technical Session 05



Material Sciences

ABSTRACT NO.	TITLE & AUTHORS
ICAPE21 O52-25	**Study of Structural, and Magnetic Properties of Copper-Magnesium (Cu-Mg) Nano-Ferrite Materials ($M_xCu_{(0.5-X)}Mg_{(1-2x)}Fe_2O_4$) upon Transition Metals (M = Ni, Zn, Co) Substitution** *Manoj Kumar, Ghulam Mustafa, Muhammad Khalid, Junaid Kareem Khan*
ICAPE21 O54-26	**Effect of Transition Metals (M = Cu, Zn, Co) Substitution on Structural & Electrical Properties in Nickel Magnesium Ferrites ($M_xNi_{(0.5-X)}Mg_{(1-2x)}Fe_2O_4$) Nano Particles** *Sehrish Inam, Ghulam Mustafa, Uzair Majeed, Muhammad Khalid*
ICAPE21 O55-27	**Study of Co-Ni Based Ferrites with Metal Ions Substitution for Microwave Application** *VardahAkram, Junaid Kareem, Muhammad Khalid, Ghulam Mustafa*
ICAPE21 O37-28	**Development of Graphene-Polyaniline Based Nanocomposites for Supercapattery Applications** *Hafiz Taimoor Ahmed Awan, Jameel-Un Nabi, Muhammad Zahir Iqbal*
ICAPE21 O91-29	**Effect of La+3 doping on Structural and Magnetic Properties of Manganese-Zinc (Mn-Zn) Mixed Spinel Ferrites Nanoparticles** *Ghulam Mustafa, Muhammad Khalid, Junaid Kareem Khan, Zaheer Uddin, Arif Akhtar Azam, Muhammad Kashif*
ICAPE21 O89-30	**Structural and Magnetic Properties of Sol-Gel Febricated Lanthanum-Dopped Mn-Co Based Ferrites Nanoparticles** *Junaid Khan, Muhammad Khalid, Ghulam Mustafa, Zaheer Uddin, Arif Azam, Muhammad Kashif*

ICAPE21_O52_25

Study of Structural, and Magnetic Properties of Copper-Magnesium (Cu-Mg) Nano-Ferrite Materials ($M_xCu_{(0.5-X)}Mg_{(1-2x)}Fe_2O_4$) upon Transition Metals (M = Ni, Zn, Co) Substitution

Manoj Kumar[1*], Ghulam Mustafa[1], Muhammad Khalid[2], Junaid Kareem Khan[1]

[1]*Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan*
[2]*Department of Physics, University of Karachi, Karachi, Pakistan*
**E-mail:manoj.kumaar91@yahoo.com*

Abstract—We have studied the effect of substitution of transition metals (Ni, Cu, Co) in Magnesium ferrite $MgFe_2O_4$. Copper substituted magnesium ferrite $CuMgFe_2O_4$, Cobalt substituted $CuMgFe_2O_4$, Nickel substituted $CuMgFe_2O_4$ and Zinc substituted $CuMgFe_2O_4$ were all prepared using sol-gel auto combustion method. XRD analysis shows that the crystallite size varies as a function of ionic radius of metal substitution. FTIR results confirms the spinel ferrite structure as it shows the vibrational bands for $CuMgFe_2O_4$, $NiCuMgFe_2O_4$ and $CoCuMgFe_2O_4$ at 530 cm^{-1} and 410 cm^{-1} for tetrahedral A-site and octahedral B-site respectively; only the vibrational bands are shifted for $ZnCuMgFe_2O_4$ that can be attributed to the cation redistribution between tetrahedral and octahedral sites. The force constant lies in the range of 1.75 N/m to 1.90 N/m for tetrahedral site and 0.70 N/m to 0.87 N/m for octahedral. Vibrating sample Magnetometry (VSM) shows the saturation magnetization is lesser than its bulk counterpart that may be attributed to the surface effect of magnetic particle's that produces dead magnetic layer at the surface of nanocrystals which decreases the magnetization. The coercivity values for $CuMgFe_2O_4$, $NiCuMgFe_2O_4$ and $ZnCuMgFe_2O_4$ are small i.e. they have applications in recording media, and high coercivity in $CoCuMgFe_2O_4$ represent that it has become a hard magnet that has potential applications in high-fidelity recording and video tapes.

Keywords: Magnesium Ferrite, VSM, FTIR, Xray Diffraction

ICAPE21_O54_26

Effect of Transition Metals (M = Cu, Zn, Co) Substitution on Structural & Electrical Properties in Nickel Magnesium Ferrites ($M_xNi_{(0.5-X)}Mg_{(1-2x)}Fe_2O_4$) Nano Particles

Sehrish Inam[1*], Ghulam Mustafa[2], Uzair Majeed[2], Muhammad Khalid[1]

[1]Department of Physics, University of Karachi, Karachi, Pakistan
[2]Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan
**E-mail:sehrishinam@uok.edu*

Abstract—In this recent era of technology ferrite nano-composites are subject of interest and have applications in extensive fields of life. In Magnesium ferrite ($MgFe_2O_4$) the metal ions are distributed between tetrahedral (A) and octahedral (B) sites in a unit cell formed by oxygen ions. Synthesis is done by auto combustion Sol-Gel method at 600°C for 3 hours. Structural properties are studied by XRD, and FTIR analysis. Electrical properties are studied by Electrical Impedance analyzer. The impact of replacing Ni ions by cobalt, zinc and copper on the structural parameters of the system, the crystal sizes with substitutions were observed with crystallite size in the range of 15nm – 36nm. The variation of the lattice parameter, lattice strain and stacking fault are also determined. FTIR results showed that the spectra comprised of two particular absorption bands, first at about the range of 531-539cm^{-1} informed about tetrahedral [A] site, and second was observed in the range of 409-413cm^{-1} is evidence for octahedral [B] site and single-phase structure. Dielectric results are carried out by RF Impedance analyzer (E4991A) in the frequency range of 1MHz-1GHz. Results shows that dielectric study is truly dependent on frequency. It gives the decreasing trend for dielectric loss and dielectric constant with increasing frequency, remarkable dielectric losses were found in zinc. AC conductivity is drastically decreasing for varying dopant. At low frequencies highest AC conductivity is found for zinc doped nickel magnesium ferrite. Synthesized nanoparticles are found to be potential candidate for microwave devices.

Keywords: Nanotechnology, ferrites, transition metal, Transition Metals, XRD, FTIR.

ICAPE21_O55_27

Study of Co-Ni Based Ferrites with Metal Ions Substitution for Microwave Application

Vardah Akram[1*], Junaid Kareem[1], Muhammad Khalid[2], Ghulam Mustafa[1]

[1]Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan
[2]Department of Physics, University of Karachi, Karachi, Pakistan
**Email: vardahakram@gmail.com*

Abstract—Spinel ferrites (AB_2O_4) are highly resistive ceramic materials with high stability in high frequency range that is key factor for their utilization in microwave applications. In this work sol-gel technique was adopted for the synthesis of Co- Ni spinel ferrite with transition metals ions substitution (M=Mn^{+2}, Zn^{+2}, Cu^{+2}) having general formula ($MxNi_{(0.5-x)}Co_{(1-2x)}Fe_2O_4$) with (x=0,0.25). Synthesized sample obtained in powder form were sintered at 600°C for 3 hours. The impact of replacing Ni^{+2} ions with Mn^{+2}, Zn^{+2} and Cu^{+2} ions on the structural parameters and dielectric properties was investigated by XRD, FTIR and impedance spectroscopy. The XRD pattern confirmed the formation of single-phase FCC structure. The crystallite size estimated by Scherrer's formula was found in the range of 20.05 nm – 27.16 nm. The lattice parameter, lattice strain and stacking fault were also determined. FTIR results showed two characteristic absorption bands of ferrites which confirm the vibration of M-O(Metal-Oxygen) bond straching, first in the range of 540-550cm^{-1} correspond to tetrahedral site, and second was observed in the range of 404-415 cm^{-1} correspond to octahedral site. RF Impedance spectroscopy of metal substituted samples was carried out in the frequency range of 1MHz- 3GHz on impedance analyzer. Dielectric parameters (dielectric constant, impedance, Ac conductivity, electric modulus) are found truly frequency dependant. Dielectric loss and dielectric constant showed decreasing trend with increasing frequency. Subsitution of Mn^{+2} gives significant increase in dielectric constant as compared to others. The Cole-Cole plots of electric modulus signify the individual semicircles which affirm contribution of grain and grain boundraies in the conduction mechanism. AC conductivity increases for each sample with the frequency. It was found that 0.5MHz-1.75Mhz dielectric constant almost remains constant, this stable region leads toward utilization of these materials for high frequency applications.

Keywords: Spinel ferrite, Sol-gel, Dielectric, Absorption Band

ICAPE21_O37_28

Development of Graphene-Polyaniline Based Nanocomposites for Supercapattery Applications

Hafiz Taimoor Ahmed Awan[1,3]*, Jameel-Un Nabi[2], Muhammad Zahir Iqbal[3]

[1]*Department of Physics, University of Okara, Punjab, Pakistan*
[2]*University of Wah, Quaid Avenue, Wah Cantt 47040, Punjab, Pakistan*
[3]*Nanotechnology Research Laboratory, Institute of Engineering Sciences & Technology, Khyber Pakhtunkhwa, Pakistan*

**E-mail: hafiztaimoor_2011@hotmail.com*

Abstract—The development of low-cost mixed phased nanomaterials is an appropriate choice for highly efficient energy storage devices. Here, we utilized graphene and polyaniline for supercapattery application. Polyaniline is prepared via polymerization procedure and then doped with different weight ratios (25%, 50% and 75%) in graphene. The best sample is chosen for real device assembly (supercapattery) evaluation after the electrochemical measurements done in three electrode assembly. The sample having graphene with 75% doped polyaniline reveals the best electrochemical performance in three electrode assembly. This sample is further utilized for supercapattery device fabrication. The fabricated device exhibits the specific capacity 206 C/g at the current density of 0.6 A/g. This real device also reveals the energy and power density of 45 Wh/kg and 5600 W/kg respectively. The capacity retention of the device is tested in which the asymmetric device demonstrates the cyclic life of 137% after the two thousand charge discharge cycle. The versatile strategy of developing nanocomposite materials pave the way to synthesize other graphene based doped nanomaterials with superior electrochemical performance for asymmetric energy storage devices.

Keywords: Graphene, Supercapattery, Life Span, Energy Density, Power Density.

ICAPE21_O91_29

Effect of La^{+3} doping on Structural and Magnetic Properties of Manganese-Zinc (Mn-Zn) Mixed Spinel Ferrites Nanoparticles

Ghulam Mustafa[1,2*], Muhammad Khalid[2], Junaid Kareem Khan[1,2], Zaheer Uddin[2], Arif Akhtar Azam[2], Muhammad Kashif[2]

[1]Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan
[2] Department of Physics, University of Karachi, Karachi, Pakistan
**E-mail:gmkhan@neduet.edu.pk*

Abstract—A series of rare earth element lanthanum (La)-doped manganese-zinc (Mn-Zn) ferrites $Mn_{0.7}Zn_{0.3}Fe_{2-x}La_xO_4$ with doping concentrations (x = 0.0, 0.05, 0.1, 0.15, and 0.2) is synthesized via a sol–gel auto-combustion method. Structural properties are determined with the help of X- ray diffraction (XRD) and Fourier transform spectroscopy (FTIR). The effect of La doping on magnetic properties of Mn-Zn ferrites is also discussed. XRD analysis confirms the existence of pure FCC spinel phase. No impurity peak was detected which suggest that the introduction of an adequate amount of La^{+3} cations in the ferrite can substitute the Fe+3 ions on octahedral sites. The lattice constant decreases initially due to strain produced by La^{+3} ions replacement. At higher doping concentrations, the lattice constant increases due to the large ionic radius of La^{+3} as compared to Fe^{+3} ion. Crystallite size of as prepared samples was determined by Debye–Scherrer formula. The crystallite size was found in the range of 10 to 14 nm. FTIR results show two characteristics bands near about 540 cm^{-1} and 420 cm^{-1} which confirms the formation of tetrahedral and octahedral sites in spinel ferrite. Magnetic measurements were done by VSM which reveal that coercivity, saturation magnetization, and remanent magnetization decreases at low concentrations up to x = 0.15 and increases at higher concentrations of La^{+3} doping.

Keywords: Rare earth element, XRD, FTIR, VSM, Spinel Ferrites

ICAPE21_O89_30

Structural and Magnetic Properties of Sol-Gel Febricated Lanthanum-DoppedMn-Co Based Ferrites Nanoparticles

Junaid Khan[1,2*], Muhammad Khalid[1], Ghulam Mustafa[1], Zaheer Uddin[1], Arif Azam[1], Muhammad Kashif[11]

[1]*Department of Physics, University of Karachi, Karachi, Pakistan*
[2]*Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan*
[*]*E-mail:junaidkk@neduet.edu.pk*

Abstract—Currently, cubic spinel ferrites are prime focus because of their unique structural, dielectric, and magnetic properties. Their magnetic properties make them stronge candidate for the applications like magnetic resonance, transformer cores, targeted drug delivery, and magnetic storage devices. In this work Mangnese-Cobalt spinel ferrite ($Mn_{0.7}Co_{0.3}La_xFe_{2-x}O_4$), with step size x = 0.05 and (x = 0.0-0.2) were prepared in powder form via Sol-Gel auto-combustion technique. The as prepared samples were grinded and annealed at 600°C for 4 hours. X-rays Diffractrometry (XRD), Fourior Transfom Infrared Spectroscopy (FTIR) and Vibrating Sample Magnetometer (VSM) were used for the structural and magnetic properties analysis. XRD pattern reveals formation of pure single phase FCC structure of La^{+3} doppedMn-Co ferrites. The crystallite size drops from 14.142 nm (x = 0.00) to 9.927 nm (x = 0.20). The lattice parameter, lattice strain and stacking fault were also determined. FTIR analysis showed two characteristic absorption bands of ferrites which confirm the vibration of M-O(Metal-Oxygin) bond stretching, first band lies around 543cm^{-1} corrospond to tetrahedral site, and second band was observed in the range of 415cm^{-1} corrospond to octahedral site. Hysteresis loop obtained fromVSM data conformed the soft ferromagnetic behavior of Mn-Co spinel ferrites further it is found that Coercive Field, Remanent Magnetization, Anisotropy Constant and Saturation Magnetization decreases with the increased doping concentration of Lanthanum ions. This research conclude that the prepared samples are suitable for utilization in magnetic applications.

Keywords: Spinel ferrite, Sol-gel, Coercive Field, Remanent Magnetization

Technical Session 06

Women in Physical Science

ICAPE21 **O101-31**	**What is THAT? The discovery of pulsars** *Jocelyn Bell Burnell*
ICAPE21 **O102-32**	**Life Time Achievements of Dr. Shahnaz Peveen, T.I.** *Shahnaz Perveen*
ICAPE21 **O103-33**	**International Society of Muslim Women in Science** *Sultana N. Nahar*

ICAPE21_O101_31

What is THAT? The discovery of pulsars

Jocelyn Bell Burnell*

University of Cambridge, UK
**E-mail: jocelyn.bellburnell@physics.ox.ac.uk*

Abstract—In this talk I will describe the accidental discovery of pulsars (pulsating radio stars), describe these amazing objects and show how they are being used to advance our understanding of physics.

ICAPE21_O102_32

Life Time Achievements of Dr. Shahnaz Peveen, T.I.

Shahnaz Perveen*

PCSIR, Karachi, Pakistan
**Email:* dr_shahnaz_perveen@yahoo.com

Abstract— Dr. Shahnaz Perveen T.I., working as a Director General / Chief Scientific Officer in PCSIR Laboratories Complex, Karachi has joined PCSIR in July 2000. She accepted a challenge when Mr. Imran Khan (now PM) Leader of Opposition levelled serious allegations of rigging in the elections for National Assembly of Pakistan (General election) held on 11th May 2013. The verification of voters' thumb impressions would help identify rigging, satisfy those protesting against it and discourage such practices in future. As a result of the complaints, the Election Commission of Pakistan (ECP) requested PCSIR to develop a standard ink to be used in elections based on the following criteria: The ink to dry in five seconds; no excessive ink be applied on thumb; ensure constant flow of ink in application; high quality impression to be obtained; easy extraction of thumbprints; ridges of thumbs be distinctly visible; minimum 12 miinutiae be available on the thumb prints.

Next elections of Local Bodies in Balochistan were scheduled to be held on 7th December 2013. The reputation of ECP was at stake**.** PCSIR had a net 27 days to carry out research, develop the ink with required specifications, get it approved by NADRA, and then the ink was used in the elections. A patent of the ink is granted on 25th May 2017 in Pakistan. The ink can now only be manufactured by PCSIR.

She completed syntheses of various medicinally important compounds i.e., anhydrovinblastin: a key intermediate in the synthesis of vinblastine, which is the most powerful anti-tumor drug and N-4- nitrophenyl-N'-4'-nitrophenylurea, which is the highly active against peptic ulcer and pancreatic cancer. A patent on this compound has already been granted in United Kingdom and in Pakistan.

I successfully completed PSDP Project "Establishment of Patent Advisory Cell" as a Project Director funded by MoST. The purpose of this project was to develop the culture and awareness of Intellectual Property Rights in the country.

ICAPE21_O103_33

International Society of Muslim Women in Science

Sultana N. Nahar*

Department of Astronomy, The Ohio State University, Columbus, USA
**E-mail: Nahar.1@osu.edu*

Abstract—The International Society of Muslim Women in Science (ISMWS) was founded in 2010. It has grown to its current form of over 300 members from 31 countries. It encourages Muslim females in choosing fields in science, basic or applied, and helps to retain them in the fields. Science is an integral part of life. Its advances require both men and women. Women hold half of the intellectual power of human race. ISMWS has been very effective in building the supportive network, making collaborations among members, connecting institutions in different countries, giving recognition, providing an overall extraordinary enthusiasm for staying in science and making contributions in the respective scientific fields. Members are very pleased to share their achievements with other members through the ISMWS newsletters, sincerely support each other, and show strength in unity. Staying in science, particularly with a family, means facing many challenges. The other hard challenge is to survive with enthusiasm in the field in contributing to science. There is a serious need for morale, professional, and financial support for the Muslim women in science, particularly in developing and in countries where they are minorities. This presentation will introduce ISMWS, invite Muslim women to be part of ISMWS and seek ideas on resolving the financial and social issues.

Keywords: Women, Science, Society

ICAPE-2021

POSTERS

ICAPE21 P43_01	**Study of Variations In Observed Muf (3000)F2 And Its Comparison With The Predicted Muf (3000)F2 For Model Validation Over Pakistan For Solar Cycle 22** *Sanah Hussain, M. Saoud, Rubab Manzar, Kanza Shoukat*
ICAPE21 P29_02	**Membership and Age Determination of Open Clusters Using Gaia Data** *M Adam, Noor-ul-ain Khan, Nabeel Ahmed, Ayesha Noor, Khushlim Khan, Junaid Kareem Khan*
ICAPE21 P97_03	**Statistical Analysis of Sq (H) Variations During Abnormal Quiet Days (Aqds) for Eia Region Geomagnetic Observatories of Honolulu and Sonmiani During 2008-20** *Ayesha Akram, Rabia Batool, Iqra Afzal, Mirza Haseeb Ahmed Baig, Ghulam Mustafa, Muneeza Ali*
ICAPE21 P32_04	**Simulation Model for Plotting Desired Orbital of Atom** *Kousar Shaheen, Hifza Waheed*
ICAPE21 P09_05	**Theoretical and Computational study of Thin Elastic Orthotropic Rectangular Plate under Free Vibrations** *Yasir Mehmood, Ali Riaz*
ICAPE21 P17_06	**Theoretical Investigation of Rydberg Energy Levels of Sodium Atom** *Syed Hassan Ahmed, Mehrosh Jabeen, M. Zeeshan, Kashan Ashraf, Roohi Zafar*
ICAPE21 P36_07	**Comparison Between Patients' Doses Received at Cobalt-60 and LINAC Accelerators** *Saira Bashir, Rashida Bashir, Ahmad Adnan*
ICAPE21 P76_08	**Gamma Knife Quality Assurance at NCCI** Asad Zameer, A. Sattar M. Hashim
ICAPE21 P35_09	**Comparison of 80 and 100 cm SAD Cobalt-60 Teletherapy Unit Dosimetric Data** *Kousar Shaheen, Hifza Waheed, Romaisa Sadiq, Shahzil Atiq, Salman Farrukh, Saba Javaid*
ICAPE21 P78_10	**Comparison of TG-43 and Model Based Dose Calculation Algorithms (TG-186) in HDR Brachytherapy** *Siraj Muneer, Asdar-ul-Haque, Salman Farrukh Shakeel-ur-Rahman*

ICAPE21 P96_11	**Shielding Calculations and Occupational Exposure Assessment at CT-Scan Machine** *M. Faiq khan, Hasan Hemani, Maham Saleem, Sufyan Naeem*
ICAPE21 P86_12	**Comparison Between Three-Dimensional Conformal Radiotherapy and Intensity Modulated Radiation Therapy Plan for Craniospinal Irradiation Cases** *Zainab Ronaque, Bisma Sajid, Rimza Elahi, Ayesha Mansoor, Bushra Ibrahim, Iqbal Tariq*
ICAPE21 P14_13	**Sensitivity and Dose Rate Effects of MAGAT and MAGIC Polymer Gels for 3D-Dosimetry in Radiation Therapy with Different Oxygen Scavenger Concentrations** *Muzafar Khan*
ICAPE21 P44_14	**Towards Alzheimer's Disease Detection by Convolution Neural Networks** *Taha Muneeb Baluch, Maaz Uddin, Abdul Wahab Khan*
ICAPE21 P45_15	**Development of Independent Monitor Unit (Mu) Calculation for Eclipse AAA Model** *Onaiza Mujahid, Abdul Qadir Jangda, Junaid Kareem Khan, Asad Yousuf*
ICAPE21 P25_16	**Transcranial Direct Current Stimulation (tDCS): A Promising Therapy for Attentional Enhancement** *Hira Shahid, Osama Ejaz, Parisa Sattar, Muhammad Miqdad Khan, Fatima Zubair, Marium Mukhtar, Umer Farooq, Muhammad Nehal, Humnah Shaikh, Hira Ashfaq Lodhi, Muhammad Abul Hasan*
ICAPE21 P_17	**Transcranial Direct Current Stimulation (tDCS): An Effective & Non-Medicated Treatment for Psychological Disorders** *Osama Ejaz, Hira Shahid, Parisa Sattar, Umer Farooq, Muhammad Nehal, Hamna Sheikh, Muhammad Miqdad Khan, Fatima Zubair, Marium Mukhtar, Hira Ashfaq Lodhi, Muhammad Abul Hasan*
ICAPE21 P41_18	**Comparison Between Same Technique, Small & Large Field Treatment Plans** *Sanober Muhammad Hanif, Aleena Shah, Anum Zahid, Sobia Iqbal*
ICAPE21 P99_19	**Comparison on Dose Distributions of Volumetric Modulated Arc Therapy and Intensity Modulated Radiation Therapy** *Anas Saleem, Sanober Amin, S. M. Baqar, Hira Nazim, Iqbal Tariq*

ICAPE21 P33_20	**Review of Research Works Related to Loss of Power due to Incorrect Inclination of Photovoltaic Module** *M. Ammad Shoaib, Basit Ali, M. Faisal Khan, Yusra Tahir*
ICAPE21 P11_21	**Hydrothermally Synthesized Cobalt Based Nanocomposites for High Performance Electrochemical Energy Storage Conversion Devices** *Hafiz Taimoor Ahmed Awan, Jameel-Un Nabi, M. Zahir Iqbal*
ICAPE21 P53_22	**The Impact of Divalent Metals Substitution on Structural and Physical Properties of Aluminum Substituted Magnesium Nano Ferrites** *Syeda Fasahat Batool, Ghulam Mustafa, Uzair Majeed, Junaid Kareem Khan, Muhammad Khalid*
ICAPE21 P67_23	**Effect of Mg Doping on the Optical Properties of Zinc Oxide Nanostructures** *M. Rahim, Shahid Nazar, Umiza Mashal, Rida Ahmed, M. Khalid. Kiran Naz, Arif Akhtar Azam, M. Kashif*
ICAPE21 P81_24	**Prediction of Viscosity of Cobalt Ferrite Based Nanofluids at Various Temperatures and Volume Fraction using the Multilayers ANN Model** *Malik M. Hafeezullah, M. Khalid, Junaid Kareem Khan, Ghulam Mustafa, Zubair Ahmed Kalhoro, Abdul Waseem Shaikh*
ICAPE21 P83_25	**Effect of Nickel Substitution on $Zn_{0.3}Ni_xMg_{0.7-x}Fe_2O_4$ (X = 0.0, 0.1, 0.2) Spinel Ferrite Nanoparticles** *Sibtain Ali, Nasir Abbas, Junaid Kareem Khan, M. Khalid, Ghulam Mustafa, Kiran Naz, Farhan Aziz, Asif Hussain, M. Yasin*
ICAPE21 P79_26	**Synthesis and Characterization of Cr^{+3} Substituted $SrCr_xFe_{12-x}O_{19}$ Nanoparticles** *Syed Abbas Sibtain, M. Khalid, Fatima Ashraf, Murtaza, Saqib Anjum, Yamna Siddiqui*
ICAPE21 P82_27	**Effect of Chromium Doping in Nickel Ferrites on Dielectric Properties** *Naimatullah Channa, M. Khalid, Maqsood Ahmed, Ali Dad Chandio*
ICAPE21 P84_28	**Structural, Dielectric and Surface Study of Cr^{+3} Substituted $BaCr_xFe_{12-x}O_{19}$ Nanoparticles via Sol-Gel Route** *Yamna Siddiqui, Uroosa Siddiqui, Muhammad Khalid, Murtaza Saleem, Syed Abbas Sibtain, Saqib Anjum*
ICAPE21 P80_29	**Influence of Ni^{2+} Doping on the $MgFe_2O_4$ Nanoparticles to Investigate the Structural, Impedance and Dielectric Properties**

	Asif Hussain, Ghulam Mustafa, Junaid Kareem Khan, Muhammad Khalid, Muhammad Saeed Akhtar, Muhammad Yasin, Arif Akhtar Azam, Nasir Abbas, Muhammad Kashif
ICAPE21 P13_30	**Thermal Annealing Effects on Structural and Optical Properties of Capping Free ZnS Nanoparticles Synthesized by Co-Precipitation Method** *Duaa Kamran, M. Sohail Qureshi, Syed Haziq Ali, Nasir Hussain, Tahir Jamal*
ICAPE21 P62_31	**Structural, Dielectric, Impedance and Electric Modulus Properties of Ni0.5Mn0.5Fe2O4/La0.2Bi0.8FeO4 Nanocomposites for High Frequency Device Applications** *Arif Akhtar Azam, Muhammad Khalid, Ali Dad Chandio, Junaid Kareem Khan, Ghulam Mustafa, Muhammad Kashif, Zaheer Uddin*
ICAPE21 P63_32	**Structural, Dielectric, Impedance and Electric Modulus Properties of Nickel Doped Mg-Zn Based Spinel Ferrites Nanoparticles** *Kiran Naz, Muhammad Khalid, Junaid Kareem Khan, Muhammad Rahim, Zaheer Uddin, Arif Akhtar Azam*
ICAPE21 P65_33	**Electrical Properties of $Cu_{0.05}$ $Co_{0.95}$ Fe_2O_4/ (1– x)$La_{0.15}$ $Bi_{0.85}FeO_3$ Nanocmposites for High Freauency Devices** *Muhammad Kashif, Muhammad Khalid, Ali Dad Chandio, Junaid Kareem Khan, Ghulam Mustafa, Arif Akhtar Azam, Zaheer Uddin*

ICAPE21_P43_01

Study of Variations in Observed MUF (3000)F2 and its Comparison with the Predicted MUF (3000)F2 for Model Validation over Pakistan for Solar Cycle 22

Sanah Hussain*, Muhammad Saoud, Rubab Manzar, Kanza Shoukat

Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan
**E-mail: hmaqayyum@ue.edu.pk*

Abstract—There is vital importance to find suitable values of the Maximum Usable Frequency (MUF) because of its numerous applications in communication using HF (high frequency) band (3-30MHz). This project is aimed to investigate the seasonal, diurnal, and yearly variations in MUF(3000)F2 and comparison of the ionosonde MUF data with that of the predicted data obtained from Global MUF prediction models, namely IRI-2016 (International Reference Ionosphere), VOACAP (Voice Of America Coverage Analysis Program), Ionospheric Communications Enhanced Profile Analysis and Circuit Prediction Program (ICE PAC), SMM (SUPARCO MUF Model) and REC 533 for the Solar Cycle 22. The locations under study include three different stations in Pakistan i.e. Karachi, Islamabad, and Multan lying in mid or low-latitude regions. Two statistical methods are employed to calculate the accuracy of each model. Results of the comparisons will determine the best-fit model for this particular region, at a specific time and solar activity. These results will enable us to use the most valid model to predict the most reliable values of MUF over different latitudes in Pakistan and assist researchers in the improvement of these models by considering the driving forces at play and in the development of MUF models for the targeted region.

Keywords: MUF, Hf, MUF(3000)F2, Solar Activity, Solar Cycle

ICAPE21_P29_02

Membership and Age Determination of Open Clusters using Gaia Data

Muhammad Adam[1]*, Noor-ul-ain Khan[2], Nabeel Ahmed[3], Ayesha Noor[4], Khushlim Khan[5], Junaid Kareem Khan[6]

[1]Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan
[2] SUPARCO, Karachi, Pakistan
**E-mail:adam4001997@cloud.neduet.edu.pk*

Abstract—Open Cluster studies are crucial for understanding the overall stellar evolution and galactic morphology. However, clusters do suffer from field contamination (background and foreground stars), so it is important to obtain cluster memberships before doing any concrete cluster studies. In this study we aim at determining the membership of open cluster using data from Gaia Mission. We are using the Gaussian Mixture Model (GMM) to segregate likely cluster members from field stars. The five astrometric parameters (positions, parallax, and proper motions) will be used to identify member stars for the clusters under study. In the second stage, we will be determining the age, reddening, distance modulus and metallicity values for the open clusters by fitting theoretical isochrones to their Color magnitude Diagram (CMD)..

Keywords: Galacitc studies, Open Clusters, Astrometry, photometry, Gaussian Mixture Model

ICAPE21_P97_03

Statistical Analysis of Sq (H) Variations During Abnormal Quiet Days (AQDS) for EIA Region Geomagnetic Observatories of Honolulu and Sonmiani During 2008-20.

Ayesha Akram[1*], Rabia Batool[1], Iqra Afzal[1], Mirza Haseeb Ahmed Baig[1], Ghulam Mustafa[1], Muneeza Ali[2]

[1]Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan
[2] SUPARCO, Karachi, Pakistan
**Email:a12ayeshaakram@gmail.com*

Abstract—This study investigates the occurrences of the Abnormal Quiet Days (AQDs) at low latitude observatories of Sonmiani (25.20 N, 66.75 E) and Honolulu (21.32 N, 202.00 E) using the H-component of the geomagnetic field for the Solar Cycle 24/25. Both the observatories are coastal bodies that lie at the crest of Equatorial Ionization Anomaly (EIA). Statistical analysis has been performed to examine monthly, seasonal, and annual occurrence of AQDs. It has been found that AQDs mostly occur during the solar minima phase of the solar cycle 24/25 i.e. 2008-09 and 2018-20 respectively and occur less frequently during the solar maxima phase i.e. 2013-15. The observed seasonal variation exhibits that the winter season is more influenced by AQDs as compared to summer and equinox. The frequency of peak occurrence of H-component from (0930 LT to 1430 LT) is observed as Normal Quiet days (NQDs). It is also been found that post-noon AQDs (after 1430 LT) are more frequent than pre-noon AQDs (before 0930 LT).
Keywords: Sq (H), Abnormal Quiet Days (AQDs), Solar cycle, Sonmiani, EIA region

ICAPE21_P32_04

Simulation Model for Plotting Desired Orbital of Atom

Kousar Shaheen*, Hifza Waheed

Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan
**E-mail:kousarshaheen039@gmail.com*

Abstract—The polar graphs and hydrogen eigenstate probability distribution plots are misinterpreted by students of science, so, in this project an effort is made to solve this problem. Orbitals or probability distribution can be visualized and interpreted easily in Cartesian coordinates system, so, by using explicit form of Associated Laguerre Polynomials and Hypergeometric function of Associated Legendre Polynomials, I transformed probability distribution function of atom from polar coordinate system to Cartesian coordinate system and generated a general equation, using this general equation, a simulation model is simulated in python programming language, by which, we can plot desired orbital of desired orbit of an atom just by mentioning principle quantum number, angular momentum quantum number and magnetic quantum number.
Keywords: Probability Distribution Function, Associated Laguerre Polynomials, Associated Legendre Polynomials, Hypergeometric function.

ICAPE21_P09_05

Theoretical and Computational study of Thin Elastic Orthotropic Rectangular Plate under Free Vibrations

Yasir Mehmood*, Ali Riaz

Pakistan Institute of Engineering and Applied Sciences (PIEAS), Karachi, Pakistan
**E-mail: yasirmehmood071@gmail.com*

Abstract—In this research free vibration analysis of thin elastic orthotropic rectangular plate has been investigated both theoretically and analytically with different boundary conditions. The natural frequencies has been calculated using analytical method based on Rayleigh Ritz method. To validate the theoretical results and to demonstrate the accuracy of this approach, the plate was discretized and finite element analysis (FEA) of the same plate was performed in ANSYS. First four natural frequencies of the orthotropic plate having dimension 250 x 100mm was calculated by performing modal analysis in ANSYS. The accuracy of the theoretical model was validated. The effects of the geometrical parameters was investigated on two different materials of the plate i.e glass and polymer. The results showed a good agreement between theoretical and analytical approach. In the end the passive vibration control has been achieved with two different boundary conditions.

Keywords: Free Vibrations, Finite Element Method, Modal analysis, Orthotropicplate

ICAPE21_P17_06

Theoretical Investigation of Rydberg Energy Levels of Sodium Atom

Syed Hassan Ahmed*, Mehrosh Jabeen, Muhammad Zeeshan, Kashan Ashraf, Roohi Zafar[1]

Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan
**E-mail: syedhassanahmed.edu@gmail.com*

Abstract—Weakest bound electron potential method is a non-relativistic theory to study Rydberg levels and energies. We have used this theory and have evaluated quantum defects and Rydberg energies of Na-I (neutral atom). Necessary experimental data is obtained from experimental studies of available data at National Institute of Science and Technology (NIST). NIST updates the spectral data regularly, still the data is incomplete. Quantum defects and Rydberg

levels energies for sodium atom Na-I have been calculated in this study. Martin formula is used to calculate quantum defect, which are then used to calculated energies. Moreover, Weakest bound electron potential model theory also called Semi empirical method that works very well for unperturbed spectral series. In this work two spectrum level like series of sodium 2p6nP1/2 and 2p6nD3/2 are studied. The first configuration results in Core Penetration series while second configuration results in Core Polarization series.

Keywords: Quantum defects, Rydberg atoms, Sodium, Weakest bound electron potential model, Martin's equation

ICAPE21_P36_07

Comparison between Patients' Doses Received at Cobalt-60 and LiNAC Accelerators

Shanza Aijaz*, Sara Khan, Rabeeah Khatri, Kiran Mudassir, Muhammad Naveed, Saba Javaid

Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan
**E-mail:shanzaaijaz80@gmail.com*

Abstract—LINAC and Co-60 teletherapy machines are used for radiotherapy of cancer patients and differ in beam quality and dosimetric parameters. 3DCRT is a technique used in radiotherapy treatment planning and delivery. 6 & 15 MV LINAC (ONCOR of M/s Seimens) and a latest 1.25 MeV Cobalt-60 unit (Equinox-100 of M/s Best Theratronics Three patients of Ca. Esophagus and four patients of pelvic tumors were planned for the two modalities with resolution of the calculation matrix set as 0.13×0.13 cm2 on Prowess Panther TPS version 5.51. The Dose-Volume Histograms (DVH) for esophagus plans show almost same values of D100 and D95 and V95 for GTV (within 1.2 %) but V100 is 92.8 % for LINAC and 86.7 % for Co-60 machine (6.1 % better coverage of tumor in LINAC). For organs (combined lungs, spinal cord, heart and skin) at risk (OARs), minimum, maximum and mean doses are within 0 – 9.1 %, 0.2 - 5.8 % and 0.2 – 7.0 % differences respectively. For pelvic tumors, values of D100, D95 and V95 for CTV are within 3.6 % but V100 is 99.2 % for LINAC and 63.7 % for Co-60 machine (35.5 % better coverage of 100 % volume of tumor in LINAC). OARs (femor, urinary bladder, rectum and skin) mean doses are higher in case of Co-60 (0 – 16.1 %). The very large difference in tumor coverage and OAR doses strongly recommends the use of LINAC for such tumors

Keywords: LINAC & Co-60 with SAD=100 cm, 3DCRT, DVH, Dosimetric parameters, Patient dose

ICAPE21_P76_08

Gamma Knife Quality Assurance at NCCI

Asad Zameer*, A. Sattar M. Hashim

Department of Radiosurgery, Neurospinal& Cancer Care Institute (NCCI), Karachi, Pakistan
**E-mail: zameer.asad@gmail.com*

Abstract—This quality assurance program is designed for stereotactic radiosurgical units (Gamma knife) to check and maintain the unit to preclude accidents and comply with current regulations. Gamma Knife has been in use at Neurospinal& Cancer Care Institute (NCCI) for 13 years. A comprehensive quality assurance program has been developed. It includes the physics and dosimetry parameters and safety checks required by Regulatory Body. The program, based on over 13 years of experience in measurements, and used during the treatment of over 1000 patients, is separated into three aspects, namely physics, dosimetry, and safety. The NCCI program hopefully will indicate out-of-tolerance problems. Some quality assurance items are checked on a daily basis prior to patient treatment, while other aspects are checked on a weekly, monthly, and/or annual basis. A complete list of items with their respective time tables and tolerances is provided. Although experience shows very small margins of error, larger values were chosen to account for variations in equipment and techniques. Items included in this quality assurance program should indicate and/or preclude problems encountered in the use of this unit.
Keywords: Stereotactic Radiosurgery, Quality assurance, Gamma knife

ICAPE21_P35_09

Comparison of 80 and 100 cm SAD Cobalt-60 Teletherapy Unit Dosimetric Data

Kousar Shaheen*, Hifza Waheed, Romaisa Sadiq, Shahzil Atiq, Salman Farrukh, Saba Javaid

Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan
**E-mail: kousarshaheen039@gmail.com*

Abstract—In Karachi, teletherapy units are available in only a selected few hospitals, and even there, are widely used in widely ranging orientations. Most of the units have not been updated to a standardized orientation due to a lack of resources.In this study we aim to work on one such variation, namely, source to axis distance (SAD) of the cobalt-60 unit and note how it impacts dose delivery.In context of radiotherapy, SAD is defined as a technique in which the distance

between the source of radioactivity and the depth of the target is set based on the radiation efficiency.The comparison between the dosimetric parameter at 80 and 100 SAD are expected to comply with the comparison charts of British Journal of Radiation. Dosimetric parameters being compared are surface dose, percentage depth dose (PDD) and penumbra.The result obtained at multiple depth and field sizes deviate from standard BJR readings by a permissable ±2% only.This study helps adaptation of a treatment plan become easier and efficient. Furthermore, the unit is quality assured to be compliant with international standard. As well as help us compensate for changes in treatment planning without repeating the entire process of collecting data for the new standards.

Keywords: Teletherapy Unit, PDD, SAD, Penumbra, Field Size.

ICAPE21_P78_10

Comparison of TG-43 and Model Based Dose Calculation Algorithms (TG-186) in HDR Brachytherapy

Siraj Muneer[1*], Asdarul Haque[2], Salman Farrukh[1], Shakeelur Rahman[3]

[1]PIEAS-Pakistan Institute of Engineering and Applied Sciences, Islamabad, Pakistan
[2]AEMC-Atomic Energy Medical Center, Karachi, Pakistan
[3]INMOL-Institute of Nuclear Medicine & Oncology, Pakistan
**E-mail: msmuneer78@gmail.com*

Abstract—To determine the discrepancy between homogeneous dose calculations using the TG-43 formalism compared with a heterogeneous dose calculation algorithm (BrachyVisionAcuros). Additionally, to quantify the dose in adjacent organs-at-risk (OAR). 18 cervical cancer patients treated with vaginal cylinder applicators with varying diameter and CT/MR tandem, ovoid high dose rate applicators were examined. The Gamma Med plus unit version 15.6 was used in this study (Varian Medical Systems, Palo Alto, USA). All plans originally calculated with TG 43 dose formalism were recalculated using the Model Base Dose Calculation Algorithms MBDA (TG 186). The High-Risk Clinical Target Volume and organs at risk (rectum and bladder) were contoured along with extra contours of significant inhomogeneity like air in cavity and high-density plastic cylinder tandem-ovoids composition. The tissue of patient was modelled as homogenous water (liquid). Treatment plans were generated per GEC- ESTRO guidelines on dose constraints for the HR-CTV and the OAR's. Dose Volume Histograms (DVH) were generated from which D95 and D100 for HR-CTV and D0.1cc, D1.0cc and D2.0cc for Bladder and Rectum were calculated from each

plan for TG 43 and MBDCA dose formalisms for comparison. Mean absolute difference in the above metrics was calculated for each plan. The plans using the cylindrical applicators with different diameter calculated with the MBDCA algorithm showed an average 2.75±0.39% reduction in D95% dose to 3.16±1.21% reduction in Target D100 dose, 3.1±1.10% and 3.4±0.66% reduction in coverage on average to OAR's bladder and rectum respectively. Result plane using fletcher applicators with different length calculated with the MBDCA algorithm showed average 3.51±0.28% reduction in D95% dose to 5.50±1.76% reduction in Target D100 dose, 3.0±0.3% and 4.28±1.25% reduction in coverage on average to OAR's bladder and rectum respectively. The doses calculated with Acuros relative to TG-43 were consistently lower for all clinical dosimetric parameters for HDR brachytherapy treatment of the cervix, similar to the other reports in the literature for the CT/MR tandem and ovoids. The difference is the sum of attenuation of applicator and the inhomogeneity. As TG-43 consider the applicator, tumor, and OAR's of same density i.e., water.

Keywords: TG-43, MBDA, Brachytherapy, Heterogeneity, BrachyVision, Cervix Cancer

ICAPE21_P96_11

Shielding Calculations and Occupational Exposure Assessment at CT-Scan Machine

M. Faiq Khan*, Hasan Hemani, Maham Saleem, Sufyan Naeem

Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan
**E-mail: faiqkhan9997@gmail.com*

Abstract—The ionizing radiations are used in a variety of applications like medicine, industry, R&D, etc. These radiations offer considerable benefits if used properly and with precautions. However, there are several deterministic effects and stochastic effects of the ionizing radiations. CT scan is one of those applications which offer higher radiation doses to humans. In order to avoid the harmful effects of radiations from a CT scan machine, several technical and administrative measure are take like shielding calculations, occupational and public dose assessment, etc. There are several safety standards and protocols which describe radiation safety measures to be taken in case of a CT scan machine. These safety standards will be applied to measure the safety parameters like shielding, doses to workers and public, doses from various points at the CT machine, etc. will be calculated and monitored at various CT scan centres in Karachi city.

Keywords: CT Scan, Shielding Calculations, Occupational exposure, Public dose assessment

ICAPE21_P86_12

Comparison between Three-Dimensional Conformal Radiotherapy and Intensity Modulated Radiation Therapy Plan for Craniospinal Irradiation Cases

Zainab Ronaque[1]*, Bisma Sajid[2], Rimza Elahi[2], Ayesha Mansoor[2], Bushra Ibrahim[2], Iqbal Tariq[2]

[1]Dr. Ziauddin Hospital, Karachi, Pakistan
[2]Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan
**E-mail: zainabronaq@gmail.com*

Abstract—To compare three-dimensional conformal radiation therapy (3DCRT) and Intensity-modulated radiation therapy (IMRT) treatment plans to simplify the process and improve efficiency in radiotherapy treatment planning for craniospinal irradiation (CSI) treatment. Image data of five patients who received CSI treatment in 2019 were used, the prescription was 36Gy in 20 fractions. Two treatment plans were created for each patient, one was with the 3DCRT and other one with IMRT. The comparative study was conducted using the parameters of homogeneity index (HI), conformity index (CI), and doses to the organs at risk (OARs). By comparing the 3DCRT plan with the IMRT plan, the averaged homogeneity index is 0.129 and 0.0865, respectively, and the averaged conformity index is 0.769 and 0.9412, respectively. IMRT plan gives more satisfactory sparing of OARs than 3DCRT plan. IMRT for CSI treatment can create plans with satisfactory CI and HI. Consequently, IMRT provides a simple and efficient choice for CSI treatment when compared with 3DCRT.

Keywords: Craniospinal irradiation, Homogeneity index, Conformity index, Organs at risk

ICAPE21_P14_13

Sensitivity and Dose Rate Effects of MAGAT and MAGIC Polymer Gels for 3D-Dosimetry in Radiation Therapy with Different Oxygen Scavenger Concentrations

Muzafar Khan*

Nuclear Medicine, Oncology and Radiotherapy Institute (NORI), Islamabad, Pakistan
** E-mail: mohmand169@yahoo.com*

Abstract—Introduction: Magnetic resonance imaging [MRI] based polymer gel dosimetry [PGD] offers three dimensional [3-D] information on dose distributions to verify planned and actual dose in radiation therapy. Many of the proposed polymer gels [PG] have shown a dose response dependency on dose rate. Most often Methacrylic Acid Gel Inititated by Copper [MAGIC] type gels are used. For very sensitive dosimetry, Tetrakis Hydroxymethyl Phosphonium Chloride [THPC] is used as an Oxygen Scavenger [OS] in methacrylic acid gelatin [MAGAT] type gel. The aim of this study was to report the dose response for a range of dose rates with respect to different os concentrations. Methods: Polymer gels were manufactured in house using gelatine, water, methacrylic acid and different OS based on THPC or ascorbic acid. A linear accelerator and X-ray machine [YXLON] were used for irradiation to cover a large range of different dose rates. T2 weighted MR scans of the gels were performed on a Siemens 7T scanner. From the resulting T2 values, R2 maps were generated, which is related to the dose levels, obtained from the cross-calibration with an ionization chamber. Results: For MAGAT, in the high dose regime the dose rate had a higher effect on dose response than in the low dose regime. The sensitivity [□R2/□D] was found to decrease from 2.5s-1Gy-1 at 0.1Gy/min to 1.67s-1Gy-1 at 0.3 Gy/min. MAGIC with an increased concentration of OS showed reduced dose sensitivity, which dropped from 0.3s -1Gy-1 to 0.1s-1Gy-1 at dose rates of ≅4 Gy/min, typically used in clinical routine. With increasing ascorbic acid concentration the linear dose range extended from 50 up to 65 Gy and advantageously the dose response is not as sensitive on dose rate. Summary/Conclusion: MAGAT was found to be most sensitive, but showed the highest dose rate dependency. An increased OS concentration in MAGIC reduced the dose rate effect. For dosimetric applications no or minimal dose rate dependency is important.
Keywords: Sensitivity, Dosimetry, Polymer gel, 3D dosimetry

ICAPE21_P44_14

Towards Alzheimer's Disease Detection by Convolution Neural Networks

Taha Muneeb Baluch*, Maaz Uddin, Abdul Wahab Khan

PAF – Karachi Institute of Economics & Technology (PAFKIET), Pakistan
** E-mail:tahamuneeb351@gmail.com*

Abstract—Alzheimer's disease is an extensive area of research from past two decades. Bio- informatics always help the personnel in the field of medical in the findings of a particular thing. Deep Neural Networks use heavy computation to extract out the features of an image. Being an important and powerful class of deep neural networks Convolution Neural Networks has shown outrageous performance in regards of pixels. We employed a deep neural network based on a convolution neural network for the detection of Alzheimer. Data set of Alzheimer Disease Neuro-Imaging Initiative is used. Several pre-processing techniques were implemented on the dataset for quality data. The model has given 95.216%.

Keywords: Convolution Neural Network, Deep Learning, Alzheimer's Disease Neuro-Imaging Initiative(ADNI), Open Access Series Of Imaging Studies(OASIS)

ICAPE21_P45_15

Development of Independent Monitor Unit (Mu) Calculation for Eclipse AAA Model

Onaiza Mujahid[1*], Abdul Qadir Jangda$_2$, Junaid Kareem Khan[1], Asad Yousuf[1]

[1] NED University of Engineering & Technology, Karachi, Pakistan
[2]Aga Khan University Hospital, Karachi, Pakistan
** E-mail: onaizamujahid@gmail.com*

Abstract—Since the beginning, the need of verification of Monitor Unit has been a quality measure in radiation therapy. In this study we verified the MUs of phantom based treatment plans and 3DCRT (CT based) treatment plans for different sites of patient. The MUs were verified with Eclipse Analytical Anisotropic Algorithm (AAA) supplied by Varian Medical Systems. The monitor unit of each field was verified by the independent MU calculation MATLAB based GUI programming and compared it with the treatment planning system calculations. In general aspect, the independent MU calculation programme is found in good agreement with the Eclipse AAA Model. For 6MV energy beam,

the minimum percentage of error was found to be 0.01% in phantom planning and 0.49% in CT based patient MU verification. The maximum percentage of error was within 4% for phantom planning and 3.85% for CT based patients. For 18MV energy beam, the maximum percentage error was found to be 0.63% in phantom based planning, and minimum was found to be 3.23%. The CT based 18MV patients' error was in between 0.31% to 4.4%.These results indicate that the deviation of MUs was less than 5% with good overall agreement with the Treatment Planning System MUs. Limitation of contour irregularity and inhomogeneity measurement was observed as the cause of percentage error.
Keywords: Monitor Units, Eclipse AAA, MU verification, Treatment Planning

ICAPE21_P25_16

Transcranial Direct Current Stimulation (tDCS): A Promising Therapy for AttentionalEnhancement

Hira Shahid[1]*, Osama Ejaz[1], Parisa Sattar[1], Muhammad Miqdad Khan[2], Fatima Zubair[2], Marium Mukhtar[2], Umer Farooq[2], Muhammad Nehal[2], Humnah Shaikh[2], Hira Ashfaq Lodhi[2], Muhammad Abul Hasan[3]

[1]Neurocomputation Laboratory, National Centre of Artificial Intelligence, Karachi, Pakistan
[2]NED University of Engineering and Technology, Karachi, Pakistan
**E-mail: hirashahid@neduet.edu.pk*

Abstract—Attention is a fundamental constituent of cognitive function that is influenced by cortical activation of the dorsolateral prefrontal cortex (DLPFC). This study aimed to investigate whether Transcranial Direct Current Stimulation (tDCS) administration over DLPFC affects cortical activation and attentional performance. A total of 40 young and healthy participants performed the Stroop color-word matching task. The participants were randomly assigned to the two stimulation conditions i.e. active and sham. The tDCS stimulation of 1mA was induced over DLPFC for 30 mins for 5 consecutive days. The modulation of cortical activation was examined with 31 channel EEG recording based on an international 10-10 EEG system. The results obtained from this study demonstrated an increase in the alpha power of the active group only. A significant increase in Stroop task performance ($p<0.05$) was also observed for the active group in contrast to the sham group. The findings of this study imply that tDCS can be used as an effective therapy for improving cognitive capabilities.
Keywords: tDCS, Dorsolateral prefrontal cortex, Cognition, Attention, Stroop task

ICAPE21_P26_17

Transcranial Direct Current Stimulation (tDCS): An Effective & Non-Medicated Treatment for Psychological Disorders

Osama Ejaz[1]*, Hira Shahid[1], Parisa Sattar[1], Umer Farooq[2], Muhammad Nehal[2], Hamna Sheikh[2], Muhammad Miqdad Khan[2], Fatima Zubair[2], Marium Mukhtar[2], Hira Ashfaq Lodhi[2], Muhammad Abul Hasan[3]

[1]Neurocomputation Laboratory, National Center of Artificial Intelligence, Karachi, Pakistan
[2]NED University of Engineering and Technology, Karachi, Pakistan
**E-mail: osamaejaz@neduet.edu.pk*

Abstract—More than 264 million people worldwide suffer from depression, and anxiety problems caused by constant stress affect one in every thirteen people. Transcranial Direct Current Stimulation (tDCS) offers a potential solution for the treatment of depression, anxiety, and stress. This study aimed to determine the long-term effects of tDCS on depression, anxiety, and stress. A total of 40 participants (20 healthy and 20 depressed patients) were recruited for this study. Participants were randomly assigned to two groups i.e. active and sham. The stimulation of 1mA was administered to the Dorsolateral Prefrontal Cortex for 5 consecutive days. The neurological change was investigated using a 31 channel EEG recording based on a 10-10 electrode placement system along with psychometric assessment using a standard DASS-21 scale. Results revealed reduced theta power along with a significant reduction in DASS-21 score ($p<0.05$) for the active group. Whereas, no significant improvement was observed in the sham group. The results for this study suggested that tDCS have a beneficial effect on the treatment of Depression, Anxiety and Stress.

Keywords: tDCS, Depression, Anxiety, Stress, DASS-21, Neurological, Psychometric


ICAPE21_P41_18

Comparison between Same Technique, Small & Large Field Treatment Plans

Sanober Muhammad Hanif*, Aleena Shah, Anum Zahid, Sobia Iqbal

Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan
**E-mail:sanober.mh.khatri@gmail.com*

Abstract—In radiation therapy, high energy radiations are used to treat tumors and cancerous site. The aim of this mode of treatment is to deliver uniform and homogeneous prescribed dose to the treatment volume or water phantom, with the consideration of saving healthy tissues as much as possible. To achieve this task many ways and many techniques such as choice of type and energy of radiation, number of treatment fields, dose dilevered from each beam, choice of applicators and relevant accessories have to be considered. The management of all such requirements using suitable software in the treatment plan. This study will be conducted in two categories of field sizes i.e small and large field sizes with different technique. It is planned to conduct on water phantom. In this study the treatment plans 'parameters VS sparing of healthy tissues' will be studied and try to get insight of its dynamics.

Keywords: Homogenous dose, Water phantom, Different techniques, Small and large fields, Treatment Parameters

ICAPE21_P99_19

Comparison on Dose Distributions of Volumetric Modulated Arc Therapy and Intensity Modulated Radiation Therapy

Anas Saleem[1], Sanober Amin[1], S. M. Baqar[1], Hira Nazim[2], Iqbal Tariq[1]*

[1]Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan
[2]Dosimetrist at Radiology Department, Ziauddin Cancer Hospital, Karachi, Pakistan
**E-mail: aqbal@neduet.edu.pk*

Abstract—Intensity Modulated Radiation Therapy (IMRT) is a radiation therapy technique which modulates its radiations in order to conform to the tumor

volume and sparing the normal tissues. However, the radiation delivery time of IMRT is bit longer which is not very comfortable for patient. Volumetric Modulated Arc Therapy (VMAT) on the other hand has shorter delivery time compared to IMRT. But on the basis of delivery timing we can't judge a radiation technique. Due to difference in delivery timing, it is better to compare the dose distribution resulting from both techniques. In this study, 10 prostate cancer patient cases are taken and used to compare the radiation modalities IMRT (7 fields) and VMAT (dual arc). 7 equidistant fields of IMRT were set up at a difference of an angle of 50 degree with single isocenter to treat patient. Dose Volume Optimizer (version 11.0.31) is used for optimization of IMRT plan. In VMAT dual arc with one isocenter is used. Progressive Resolution Optimizer (version 11.0.31) is used for optimizing VMAT plan. The resulting dose distribution resulting from each of the techniques extracted out and compared. Comparison was done on the basis of dose receiving by PTV and the doses receiving by OAR. VMAT showed refinement in saving OAR compared to IMRT. VMAT provides higher dosage to PTV than IMRT. We also get better results of VMAT in the percentage amount at different OAR. By evaluating all the results we conclude that the Volumetric Arc Therapy (VMAT) (dual arc) is generally more efficient compared to IMRT for prostate cancer patient.
Keywords: VMAT, IMRT, Dose Volume Optimizer

ICAPE21_P33_20

Review of Research Works Related to Loss of Power due to Incorrect Inclination of Photovoltaic Module

M Ammad Shoaib[1*], Basit Ali[2], M Faisal Khan[1], Yusra Tahir[1]

[1]Department of Electrical Engineering. Hamdard University, Karachi, Pakistan
[2]Department of Electrical Engineering, Bahria University, Karachi, Pakistan
**E-mail: mammadsiddiqui11@hotmail.com*

Abstract—Solar energy is the cleanest and easily accessible renewable energy source available on earth. Its utilization has been increasing day by day in the whole world using photovoltaic (PV) modules. The electrical power generated by the PV module depends not only on the irradiance but also on the incidence angle between the sunlight and the module. Earth revolves around the sun which affects irradiance seasonally and it differs from summer to winter. Therefore, inclination angle of PV module needs to be changed in each season. Due to same tilt angle or inclination angle of PV module in all seasons, the module (in some months) receives better irradiance as compared to other months of the year, causing losses in PV panels output. Different mathematic models, methods and techniques have been used to calculate the losses in the output of PV modules which are being

summarized and reviewed in this paper. This review paper will help and guide researchers about the research gaps related to inclination angle of PV modules.

Keywords: Renewable energy, Photovoltaic module, Inclination angle & Irradiance

ICAPE21_P11_21

Hydrothermally Synthesized Cobalt Based Nanocomposites for High Performance Electrochemical Energy Storage Conversion Devices

Hafiz Taimoor Ahmed Awan[1,3*], Jameel-Un Nabi[2], Muhammad Zahir Iqbal[3]

[1]Department of Physics, University of Okara, Punjab, Pakistan
[2]Department of Physics, University of Wah, Punjab, Pakistan
[3]Ghulam Ishaq Khan, Institute of Engineering Sciences & Technology, Khyber Pakhtunkhwa, Pakistan
**E-mail: hafiztaimoor_2011@hotmail.com*

Abstract—An eloquent procedure is adopted for the preparation of cobalt oxide (Co3O4) and cobalt phosphate (Co3(PO4)2) by hydrothermal route pursued by calcination. Co3O4/Co3(PO4)2 composite has been prepared to enhance the electrochemical properties of material for energy storage applications. The as-synthesized materials are electrochemically scrutinized through CV, GCD and EIS. Furthermore, the device (Co3O4/Co3(PO4)2//AC) has been formed by sandwiching the composite electrode with the activated carbon and obtained the maximum specific capacity of 149 C/g at the current density of 0.4 A/g. The fabricated device shows the energy density of 35.2 Wh/kg and power density of 4250 W/kg with the capacitance retentively of 80% after the continuous 2000 charge discharge cycles. This hybrid device (Co3O4/Co3(PO4)2//AC) demonstrated an exquisite performance for electrochemical energy storage applications.

Keywords: Supercapacitors, Electrochemical Energy Storage Devices, Cobalt Oxide, Cobalt Phosphate, Nanocomposites

ICAPE21_P53_22

The Impact of Divalent Metals Substitution on Structural & Physical Properties of Aluminum Substituted Magnesium Nano Ferrites

Syeda Fasahat Batool[1*], Ghulam Mustafa[1], Uzair Majeed[1], Junaid Kareem Khan[1], Muhammad Khalid[2]

[1]Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan
[2]Department of Physics, University of Karachi, Karachi, Pakistan
**E-mail: fasbatool@gmail.com*

Abstract—Forsskaoleatenacissima (Nettle Desert) belongs to the family Urticaceae is themagnesium-based nanophase ferrites with divalent substitution by cobalt, zinc and copper are synthesized by sol gel method. The morphological and electrical properties of nanoparticles of spinel ferrites are investigated through different characterization techniques including X-ray diffraction (XRD), Fourier transform infrared (FTIR) Spectroscopy and impedance analysis. XRD results confirmed formation of nanoparticles with single phase having lattice constant around 8.3 nm and particle size in the range 15-22 nm. The lattice constant increases due to the substitution of divalent cations of large ionic radii than nickel. FTIR spectra verify the occurrence of two fundamental characteristic absorption bands of 425-430 cm-1 and 460-490 cm-1 due to vibrations of cations in octahedral and tetrahedral sites respectively. Dielectric constant, dielectric loss, loss tangent, real part of impedance, imaginary part of impedance, real part of electric modulus, imaginary part of electric modulus and AC conductivity are studied with the help of impedance spectroscopy in the range of 1–3 GHz. At higher frequency, the maximum value of dielectric constant is obtained due to contribution of dipolar and ionic polarizability which vanishes in high frequency region. AC conductivity of synthesized nanoparticles is increased by increasing applied frequency which is explained by hopping mechanism. The values of electric modulus are used to investigate effects of polarization, pattern of relaxation and mechanism of conduction in ferrites. The cole-cole plots describe the conductive behavior of grains and grain boundaries.

Keywords: Magnesium ferrite, Nanoparticles, spinel ferrite, Sol-gel

ICAPE21_P67_23

Effect of Mg Doping on the Optical Properties of Zinc Oxide Nanostructures

Muhammad Rahim[1,2*], Shahid Nazar[3], Umiza Mashal[2], RidaAhmed[1], Muhammad Khalid[2], Kiran Naz[3], Arif Akhtar Azam[2], Muhammad Kashif[2]

[1]Department of Basic Sciences DHA Suffa University Karachi, Pakistan
[2]Department of Physics University of Karachi, Pakistan
[3]Departmt of Physics Federal Urdu University Karachi, Pakistan
**E-mail:Muhammad.rahim@dsu.edu.pk*

Abstract—The optical characteristics of Mg doped Zinc Oxide nanoparticles were investigated in this research. This synthesis was done at 300 oC by using simple co-precipitation method. The samples were characterized using X-Ray Diffraction (XRD) and a Scanning Electron Microscope (SEM). The chemical composition of the samples was determined using EDX. In addition, UV-Visible spectroscopy was used to investigate the optical properties of the samples. According to XRD analysis wurtzite structure is being found in both pure and Mg doped ZnO nanoparticles. The particle size was observed to decrease with increasing Mg content. As compared to ZnO, the XRD trend of Mg-doped ZnO indicates a peak change towards lower 2θ values. This change is due to the crystal structure deformation caused by incorporated Mg+2 ions on Zn+2 sites. For various values of x, SEM images of synthesized samples indicate that the nanoparticles have rod, spherical, and sheet-like morphologies. The EDX examination affirms the samples' purity within the detection limits. Using UV-Visible spectroscopy in the 200 nm to 1000 nm range, optical absorption analysis indicated that the band gap of pure sample increased as the Mg concentration increased. The UV-Visible spectra of pure and Mg doped ZnO samples show distinct peaks in the UV region. The UV peak in both pure and Mg doped ZnO spectra is due to free exciton transitions, while the absorbance peak in the visible region of the UV-Visible spectra for Mg doped ZnO sample is related to radiative transitions of electrons captured at oxygen vacant sites with holes trapped at singly ionized oxygen vacancies.

Keywords: Metallic dopped nanoparticles, Zinc oxide nanopartilces, Optical properties of zinc oxide nanopaetiles

ICAPE21_P81_24

Prediction of Viscosity of Cobalt Ferrite Based Nanofluids at Various Temperatures and Volume Fraction using the Multilayers ANN Model

Malik Muhammad Hafeezullah[1,2], Muhammad Khalid[3*], Junaid Kareem Khan[4], Ghulam Mustafa[4], Zubair Ahmed Kalhoro[1], Abdul Waseem Shaikh[1]

[1]*Institute of Computer Science and Mathematics, Jamshoro, Pakistan*
[2]*Department of Physics, Balochistan University of Information Technology, Engineering and Management Sciences, Quetta, Pakistan*
[3]*Department of Physics, University of Karachi, Karachi, Pakistan*
[4]*Department of Physics, NEDUET, Karachi, Pakistan*
**E-mail:khalid.mesp@gmail.com*

Abstract—The heat transfer is not possible using the poor thermal conductivity of the conventional fluids such as oil pure water, ethylene glycol and other polymers. In order to enhance the heat transfer there is a need to add some nanoparticles in the base fluids. The rheological behavior in Nano fluid can be determined by change in viscosity values. It is necessary to study those parameters that can make the changes in the viscosity values. For this purpose, the Cobalt ferrite (CoFe2O4) nanoparticles were synthesized using the sol-gel method. The structure was confirmed using the X-ray diffraction analysis. The particle size was determined using Scherrer formula and the value was found in 18 nm. Scanning electron microscopy was performed to determine the shape and size of nanoparticle. Nanofluids with different volume of fractions as 0, 0.5 and 1% were prepared using the standard method. The values of viscosity with different temperatures ranging from 30 to 50 ºC were determined using the falling ball instrument. In addition, viscosity of nanofluids decreasing with increasing the temperature as well as increasing with increasing the volume fraction of cobalt based nanofluids. The viscosity of nanofluids using the predicted models was analyzed and correlated with experimental value. Mean square error (MSE), mean absolute percentage error (MAPE) and root mean square error (RMSE) were determined using the MATLAB software in order to determine the accuracy of the predicted Models.

Keywords: Nanofluids, Spinel ferrites, Viscosity, Nanoparticles, Cobalt ferrite

ICAPE21_P83_25

Effect of Nickel Substitution on $Zn_{0.3}Ni_xMg_{0.7-X}Fe_2O_4$ (X = 0.0, 0.1, 0.2) Spinel Ferrite Nanoparticles

Sibtain Ali[1], Nasir Abbas[2], Junaid Kareem Khan[1], Muhammad Khalid[3*], Ghulam Mustafa[1], Kiran Naz[4], Farhan Aziz[2], Asif Hussain[3], Muhammad Yasin[3]

[1]Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan
[2]Deaprtment of Applied Physics, University of Karachi, Karachi, Pakistan
[3]Department of Physics, University of Karachi, Karachi, Pakistan
[4]Institute of Space Science and Planetary Astrophysics, University of Karachi, Karachi, Pakistan
**E-mail: khalid.mesp@gmail.com*

Abstract—Synthesis and characterization of Ni2+ doped Zn0.3 Nix Mg0.7-x Fe2 O4 nanoparticles with (x = 0.0, 0.1, 0.2) have been prepared via sol-gel auto combustion method. All these samples were annealed at 600 ^{0}C for 3 hours in muffle furnace. Crystalline structures of all samples were characterized by using X-ray diffraction analysis. The obtained results have cubic structure (FCC) with preferred orientation along (311) plane. Crystalline size was calculated by Debye-Scherrer formulae and was obtained in range of 16 to 19 nanometre. Effect of doping on the structural parameters such as lattice constant, unit cell Volume, dislocation density, stacking fault, lattice strain, micro-strain and packing factor were also studied. The scanning electron microscopy was used to study surface morphology and the obtained images showed that the size of nanoparticles was affected significantly by the Ni incorporation. A cation distribution has been proposed and based on this some theoretical parameters have been calculated which supports our experimental results. Analysis of the complex impedance data confirmed that reactive and capacitive properties of synthesized materials are mainly attributed due to the processes that are associated usually with the grain boundary. The complex impedance spectra, i.e., cole-cole plots, were composed circles showing the presence of grain and grain boundary contributions of nanoparticles. The electrical modulus spectroscopy suggested the frequency dependant relaxation process within Ni+2 doped Zn-Mg Nanoparticles

Keywords: Spinel ferrites, Structural properties, Dielectric properties, Sol-gel.

ICAPE21_P79_26

Synthesis and Characterization of Cr+3 Substituted SrCrxFe12-xO19 Nanoparticles

Syed Abbas Sibtain[1], Muhammad Khalid[1*], Fatima Ashraf[2], Murtaza[3], Saqib Anjum[2], Yamna Siddiqui[1]

[1]Department of Physics, University of Karachi 75270, Pakistan
[2]Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan
[3]Department of Physics, Lahore University of Management Sciences (LUMS), Lahore, Pakistan
**E-mail: khalid.mesp@gmail.com*

Abstract—Sol–gel auto-ignition technique was used for the synthesis of Cr3+ substituted strontium ferrites with compositions of SrCrxFe12-xO19 (x = 0.0, 1.0, 2.0, 3.0, 4.0). Sintering was performed of all prepared samples at 700^0C for 3 h in a muffle furnace to achieve crystalline nature of hexagonal phase. X-ray diffraction analysis confirmed the prepared samples are hexagonal in phase for each composition. The crystallite size determined with the help of Scherer's formula, which found in the range of 47-60 nm. The lattice strain, micro strain, stacking fault and dislocation density were found using XRD data are varied with increasing Cr3+ contents in place of Fe3+. FTIR analysis confirmed the effect of Cr+3 substitutions which occupied the octahedral site. Frequency dependent dielectric constant and dielectric tangent loss, impedance, electric modulus and AC conductivity were determined for all the compositions. The results revealed that their values varied with increasing frequency and chromium contents as well. The increase in Cr+3 contents results in decreased in dielectric constant and dielectric tangent loss that favours the use of materials in high frequency applications. The surface properties of the samples were investigated using FESEM. The results showed that there is a significant effect on the grain size and distribution with increasing chromium ion contents. The observed results confirmed that the chromium ion substitution has significant effect on the structural, dielectric and surface properties.

Keywords: Hexa ferrite, Nanoparticle, X-ray diffraction, FTIR, SEM, dielectric

ICAPE21_P82_27

Effect of Chromium Doping in Nickel Ferrites on Dielectric Properties

Naimatullah Channa, Muhammad Khalid*, Maqsood Ahmed, Ali Dad Chandio

University of Wah, Pakistan.
E-mail: musammir.khan@uow.edu.pk

Abstract—Cr doped nickel ferrites were fabricated through sol gel self-combustion route, the product is annealed at 600°C to achieve stable crystal structure. Particle size is confirmed through X-ray diffraction (XRD). The results reveal that sample exhibit face cantered cubic (FCC) structure and structural parameters are influenced by Chromium content. The frequency (1–107Hz) dependant dielectric parameters of ferrites were observed. Strong dispersion is observed at high frequencies. The grain size and grain boundary contribution were determined by modulus spectroscopy which is based on the Cole-Cole plot. Furthermore, the product is suitable for microwave devices and dielectric properties in increased by chromium content in nickel ferrites.

Keywords: Hexa ferrite, Nanoparticle, X-ray diffraction, FTIR, SEM, dielectric

ICAPE21_P84_28S

Structural, Dielectric and Surface Study of Cr^{+3} Substituted $BaCr_xFe_{12-x}O_{19}$ Nanoparticlesvia Sol-Gel Route

Yamna Siddiqui[1], Uroosa Siddiqui[2], Muhammad Khalid[1]*, Murtaza Saleem[3], Syed Abbas Sibtain[1], Saqib Anjum[2]

[1]Department of Physics, University of Karachi, Karachi, Karachi, Pakistan
[2]Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan
[3]Department of Physics, Lahore University of Management Sciences, Pakistan
**E-mail: khalid.mesp@gmail.com*

Abstract—Barium hexaferrite nanoparticles have remarkable properties and it can be utilized for microwave application and magnetic recording media. In this research paper, Cr3+ ion substituted BaCrxFe12-xO19 (x = 0.0, 1.0, 2.0, 3.0, 4.0) nanoparticles synthesized through sol–gel chemical route. All the samples were annealed for 3hrs at 700°C in a muffle furnace. These samples were characterized through XRD, FTIR, impedance analyzer and SEM. The structural parameters

was determined such as phase purity, lattice constant and crystallite M-type nanocrystallinehexaferrites XRD analysis was executed. X-ray diffraction (XRD) pattern verified the prepared nanoparticles are M-type hexaferrites. Scherer formula was used in order to determine the crystallite sizes which lies between 30-50 nm. Cr3+occupied the octahedral sites in the M-type hexa ferrites which was confirmed through FTIR analysis. The effect of Cr3+ ion on grain size and their distribution were studied through scanning electron microscopy. The electrical properties were studied in the applied frequency range from 20 Hz to 20 MHz through impedance analyzer. The electrical parameters such as impedance, electric modulus and the real and imaginary parts of dielectric constant of prepared hexaferrite were examined for all samples. To investigate these electrical parameterw, a corresponding circuit model was applied that is connected with the grain and grain boundaries. The prepared hexaferrites nanoparticles in the nanometer series with tremendous electrical properties have significance in the high frequency applications.

Keywords: Hexaferrites, Sol-gel, XRD, SEM, FTIR, Dielectric.

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Influence of Ni^{2+} Doping on the $MgFe_2O_4$ Nanoparticles to Investigatethe Structural, Impedance and Dielectric Properties

Asif Hussain[2], Ghulam Mustafa[1], Junaid Kareem Khan[1], Muhammad Khalid[2*], Muhammad Saeed Akhtar[3], Muhammad Yasin[2], Arif Akhtar Azam[2], Nasir Abbas[2], Muhammad Kashif[2]

[1]Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan
[2]Department of Physics, University of Karachi, Karachi, Pakistan
[3]Division of Science, University of Education, Lahore, Pakistan
**E-mail: khalid.mesp@gmail.com*

Abstract—Nickel substituted $MgFe_2O_4$ spinel ferrites with doping concentrations of (x= 0.0, 0.03, 0.06, 0.09, 0.12) were synthesized by Sol-gel auto combustion Method. Nanoparticles in powder form were grinded and then annealed at temperature 600℃ in order to investigate variation occur in structure, dielectric and impedance of the prepared material. X-ray diffraction analysis employed to study the effect of substitution of the Ni2+. XRD technique was to investigate the lattice spacing, orientation of single crystal, lattice constant, bulk density, x-ray density, dislocation density, stacking fault, and lattice strain. Impedance analyser was used to study about the dielectric properties of the

material including real and imaginary part of dielectric constant, dielectric loss, AC conductivity, impedance with varying frequency and the influence of changing microstructure. The FTIR analysis was carried out to determine the frequency band at the octahedral and tetrahedral sites. The obtained crystallite size as well as value of dielectric constant would have a great potential for high frequency applications

Keywords: Zn-Ni spinel ferrite, Sol-gel auto combustion, X-ray diffraction, electrical properties.

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Thermal Annealing Effects on Structural and Optical Properties of Capping Free ZnS Nanoparticles Synthesized by Co-Precipitation Method

Duaa Kamran*, Muhammad Sohail Qureshi, Syed Haziq Ali, Nasir Hussain, Tahir Jamal

Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan
**E-mail:duakamran65@gmail.com*

Abstract—Nanotechnology is the science that deals with the matter at scale 1 billionth of a matter and is also the study of manipulating matter at the atomic and molecular scale. Recently particulate systems like nanoparticles have been used as a physical approach to alter and improve the quality of human life. Nanomaterials are not simply another step in the miniaturization of materials. They often require very different production approaches. These are several processes to create nanomaterials, classified as 'top-down' and 'bottom-up'. Capping free Zinc Sulphide nanoparticles are synthesized from aqueous solutions of Zinc Chloride (ZnS_2) and Sodium Sulphide (Na_2S) in air at 70°-90°C by co-precipitation method. Then the prepared and annealed samples have been characterized by X-ray diffraction (XRD). Annealing of the ZnS nanoparticles in air in the temperature range, 150° – 550°C, leads to the increase in crystallite size accompanied by decrease in optical band gap. Different types of nanoparticle materials used in UV Sensor, Chemical Sensor, Biosensor, Catalytic Activities.

Keywords: Annealing, Optical absorption, ZnSnano particles, XRD, UVvis

ICAPE21_P62_31

Structural, Dielectric, Impedance and Electric Modulus Properties of $Ni_{0.5}Mn_{0.5}Fe_2O_4/La_{0.2}Bi_{0.8}FeO_4$ Nanocomposites for High Frequency Device Applications

Arif Akhtar Azam[1*], Muhammad Khalid[1], Ali Dad Chandio[2], Junaid Kareem Khan[2], Ghulam Mustafa[2], Muhammad Kashif[1], Zaheer Uddin[1]

[1]*Department of Physics, University of Karachi, Karachi, Karachi, Pakistan*
[2]*Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan*
**E-mail: syedhassanahmed.edu@gmail.com*

Abstract—The field of nano-Physics have played vital role in this modern era. There is a need of modern time to use high frequency devices with great effect. The role of nanoparticles has significant effect in recent technologies, such as electronics, mechanical systems, metallurgical engineering and information technology, military and medical technologies. Many methods have been used for the preparation of nanoparticles but the reliable, economical and feasible method is sol-gel auto combustion method. For more advancement in the field of nano physics, the nanocomposite are now more valuable for making reliable high frequency devices. In this regard, (1-x) $LaBiFeO_4$ /x$NiMnFe_2O_4$ (LBFO/NMFO) nanocomposites were prepared by sol gel auto combustion method while bearing concentration is 0.1, 0.2, 0.3, 0.4 and 0.5. All these samples were annealed at 600°C for 3 hours in a muffle furnace to achieve crystalline nature of the prepared ferrites. The preparation of composites such as $LaBiFeO_4$ and $NiMnFe_2O_4$ which were mixed together. The crystalline structure was studied through the X-ray diffraction (XRD). The presence of functional groups of the prepared nanoparticles was investigated by Fourier transform infrared spectroscopy (FTIR). The surface morphology was performed by the scanning electron microscopy (SEM). The study of dielectric properties such as A.C. conductivity, dielectric constant, dielectric tangent loss and electric impedence analyser of the synthesized composites. On the basis of these investigations, it was found that both the real and imaginary parts of the dielectric constant decreased with increasing applied frequency. It is reported that the dielectric behavior ruled due to Maxwell Wagner polarization process and also found the phases of pervoskite-spinel composites where the grain size in the range of nanometers.

Keywords: XRD, SEM, FTIR, Dielectric Properties

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Structural, Dielectric, Impedance and Electric Modulus Properties of Nickel Doped Mg-Zn Based Spinel Ferrites Nanoparticles

Kiran Naz[*1], Muhammad Khalid[1], Junaid Kareem Khan[2], Muhammad Rahim[3], Zaheer Uddin[1], Arif Akhtar Azam[1]

[1]*Department of Physics, University of Karachi, Karachi, Pakistan*
[2]*Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan*
[3]*Department of Physics, DHA Suffa University, Karachi, Pakistan*
**E-mail: knleo1993@gmail.com*

Abstract—The series of nickel substituted magnesium-zinc spinel ferrites (Mg0.3NixZn0.7-xFe2O4) has been fabricated with varying nickel concentrations (x = 0.00, 0.05, 0.10, 0.15, 0.20) by adopting sol-gel auto combustion technique. The structural analysis was done by X-ray Diffraction Analysis (XRD), which confirms that the prepared nanomaterials are spinel ferrites because of the presence of secondary phase. The crystallite size was controlled by optimizing the synthesis parameters such as molarity of solutes, magnetic stirring speed, temperature, quantity of citric acid, annealing in an enveloping surrounding, and hence the crystals with crystallite size of 13 nm to 17 nm were obtained. The variations in structural parameters due to the incorporation of nickel in magnesium-zinc spinel ferrite nanoparticles, like crystallite size, lattice constant, X-ray density, bulk density, dislocation density, micro strain, stacking fault, surface area have been analyzed. Impedance Analyzer (IA) was used to get the dielectric properties of the prepared nanoparticles in the frequency range of 20 Hz to 20 MHz. The dielectric constant and dielectric tangent loss and AC conductivity depicted that the Mg0.3NixZn0.7-xFe2O4 nanoparticles can be employed as dielectric in low frequency region (below 1000 Hz) and can have good conduction in high frequency devices. This nature belongs to the microstructural differences between the resistive and conductive grain boundaries that come up with the dielectric relaxation in the synthesized nanoparticles. The structural, dielectric and FTIR suggested that the prepared spinel ferrites can have remarkable applications in high as well as low frequency regimes.

Keywords: Spinel ferrite, Nanoparticles, XRD, FTIR, Dielectric

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Electrical Properties of $Cu_{0.05}$ $Co_{0.95}$ Fe_2O_4/ (1 – x)$La_{0.15}$ $Bi_{0.85}FeO_3$ Nanocomposites for High Freauency Devices

Muhammad Kashif[1*], Muhammad Khalid[1], Ali Dad Chandio[2], Junaid Kareem Khan[2], Ghulam Mustafa[2], Arif Akhtar Azam[1], Zaheer Uddin[1]

[1]Department of Physics, University of Karachi, Karachi, Pakistan
[2]Department of Physics, NED University of Engineering and Technology, Karachi, Pakistan
**E-mail: m_kashif493@yahoo.com*

Abstract—Progress in nanomaterial research has revolutionized the way we design devices, procedures and materials. Cobalt based spinel ferrites have secured emerging applications and hence need to be probed more deeply. Series of (1 – x)La0.15Bi0.85FeO3 were synthesized with concentrations of (x = 0.1, 0.2, 0.3, 0.4 and 0.5) using sol-gel auto combustion method. Structural analysis was done using X-Ray diffraction (XRD) analysis. Active nature of the grain boundaries is shown in the low frequency region in Z' plot followed by a descending trend which then transforms into a constant behavior indicates the gradual increase in the conducting grain activity which reaches an optimum value at higher frequencies. Gradual increase in the value of real part of modulus M' with increase in frequency shows increasing electrode effect which is due to increase in short-range mobility of charges. The values of ε′ are very high for all concentrations in low frequency region due to large amount of charge accumulation at grain boundaries due to which charge polarization increased. The significant variation in dielectric constant, impedance and electric modulus was observed. This behavior is observed is due to some relaxation phenomenon occur at high frequency which was attributed due the hopping of electron. The obtain dielectric constant has very significant value for high frequency device applications.

Keywords: Nanocomposites, Spinel ferrite, Sol-gel, Impedance, Dielectric

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