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IRPS

The 12th International Topical Meeting on Industrial Radiation and Radioisotope Measurement Applications (IRRMA-12)

King Saud University

Riyadh – Saudi Arabia
26 – 30 January 2025

12th IRRMA Riyadh 2025

BOOK OF ABSTRACTS

A brief history of IRRMA

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Abstract:

The purpose of this presentation is to provide a review of the series of conferences that is known by the acronym IRRMA, which stands for Industrial Radiation and Radioisotope Measurement Applications. The IRRMA series was the brainchild of Dr. Robin Pierce Gardner, Professor of Nuclear and Chemical Engineering at North Carolina State University. The first IRRMA conference was held in 1988 as a Topical Meeting of the Isotopes and Radiation Division (IRD) of the American Nuclear Society (ANS). It was held in Pinehurst, North Carolina. Although Dr. Gardner was the force behind this conference, he asked William Troxler of Troxler Electronics to be General Chair. In view of the success of the original IRRMA conference, Dr. Gardner and I decided to host a follow-up conference in 1992. Subsequent to that, IRRMA grew into a series, leading up to the current, IRRMA-12, which is being held in Riyadh, Saudia Arabia. The author has been fortunate to be involved in some capacity in all of the IRRMA conferences. Eventually, IRRMA was formally aligned with the International Radiation Physics Society (IRPS), much to the delight of Dr. Gardner and myself. The IRPS holds tri-annual symposia that focus on the fundamental aspects of radiation interactions and applications whereas the IRRMA series focuses more on applications of radiation. The IRPS began sponsoring the International Conference on Dosimetry and its Applications, the most recent of which was ICDA-4 and was held in Valencia Spain in 2023. This led to a convenient situation with IRPS sponsoring a symposium every third year, and triennial IRRMA and ICDA conferences until the COVID-19 pandemic and the Russian invasion of Ukraine interfered. Unfortunately, Dr. Gardner passed on in 2023 at the age of 89 years. A brief tribute to Robin will be shared and each of the conferences in the series will be briefly summarized.

Abstract ID: 010

A Story of Copper

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Abstract:

Copper is the most investigated X-ray source and target, the most studied with X-rays, one of the metals of the ancients. One of the most studied materials in history. Whereas hydrogen has defined and led to quantum mechanics, relativistic quantum mechanics and quantum electro-dynamics, and silicon has been developed as the core of the chip and nanotech industry, copper is one of the most stable and useful of transition metals. So, we should understand it. Really well! So, we should be a able to tell a Story of Copper. This presentation will be such a story. However, the ending is complex, the physics is complex, and indeed we do not understand the X-ray spectra of copper yet, nor of any other material less well studied. There is a great and bright future for research and science for copper. We will present past and future challenges with copper and with X-ray spectra.

Abstract ID: 011

The 12th International Topical Meeting on Industrial Radiation and Radioisotope Measurement Applications (IRRMA-12)
Riyadh – Saudi Arabia, 26 – 30 January 2025

Luminescence and radiation sensing across a wide range of doses and dose rates: Industrial and Biomedical Application

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Abstract:

We are developing radioluminescence (RL) and passive light-generating systems for a range of applications, initial studies concerning doped silica optical fibers and time-resolved radiation dosimetry. Merits for biomedical interests include high spatial-and-temporal resolution, wide dynamic range, and real-time operability in various *in vivo* and *ex vivo* environments. For Ge-doped optical fibers irradiated using a linac at rates between 0.1- and 600 MU/min (and pulse durations of a few μs), linear response has been obtained with counting circuit gate times of between 50 and 100 μs, responses being largely free of the degrading effects of afterglow. Subsequent radiation processing dosimetric studies have concerned evaluation of kGy doses using undoped silica fibers of differing hydroxyl (OH) content. For electron doses from 10- to 70 kGy, increase in OH content has been observed to provide the greater sensitivity while reduction in OH content leads to a shift towards longer wavelength for the peak wavelength of the RL spectrum. For the low dose regime of NORM (naturally occurring radioactive material) and contaminant depositions internal to pipework, various of the more conventional active devices have difficulty in localizing the presence of the beta active radionuclide ^{210}Pb, most particularly in relation to downstream gas pipelines. Characterization has been made of an optical fiber system based on a LYSO:Ce scintillator, tested to-date for a range of μGy/h dose rates. Results point to a number of potential applications, not least verification of contaminant-free pipework subsequent to cleansing operations using high-pressure water jetting, also various industrial and security scenarios applications.

Abstract ID: 012

XRF line enhancement from Compton ionization for unpolarized and linearly polarized excitation

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Abstract:

The Compton effect is a well-known scattering process. When the incoming photon energy is enough larger, it represents a possible mechanism of ionization for the inner shells of atoms. The produced vacancies can be filled by spontaneous atomic relaxation, an analogous process to photo-absorption. A preliminary description using the Waller-Hartree approximation [1] shown that for K-lines this contribution is relevant for high excitation energies and low-Z elements. A more detailed description of the XRF line enhancement from Compton ionization was then performed, for unpolarized excitation, in the framework of the Boltzmann photon transport equation. Compton scattering was described with the impulse approximation (IA) to obtain the energy behavior [2]. In this article, the computation in [2] is extended to L and M shells and shows that the enhancement term becomes relevant also for medium-Z elements. It is given a formula to compute the correction in deterministic and Monte Carlo codes. It is also shown that the number of electrons by shell is not constant but changes with the energy. The contribution is illustrated with examples involving low- and medium-Z elements. For the first time, the extent of the XRF line enhancement by Compton ionization is computed for linearly polarized excitation by using the expressions described in [3]. It is shown that the Compton ionization enhancement can be responsible of the polarization dependence present in some L and M characteristic lines.

[1] G.V. Pavlinski and Yu. Pornoy, X-ray Spectrometry 43 (2014), 118-121.

[2] J.E. Fernández, V. Scot, E. Di Giulio, Spectrochimica Acta Part B: Atomic Spectroscopy 124 (2016), 56-66.

[3] J.E. Fernandez, J.H. Hubbell, L.V. Spencer, A.L. Hanson. Radiation Physics and Chemistry 41 (1993) 579-630.

Abstract ID: 013

Artificial Intelligence in Radiotherapy: Present Status and Future Perspectives

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Abstract:

The integration of Artificial Intelligence (AI) in radiotherapy has ushered in a new era of precision medicine, enabling more personalized and effective cancer treatments. This talk will provide an overview of the current applications of AI across the radiotherapy workflow, including tumor delineation, treatment planning, dose prediction, and adaptive therapy. By leveraging advanced machine learning algorithms and deep neural networks, AI has demonstrated significant potential in improving treatment accuracy, reducing clinician workload, and enhancing patient outcomes.

Key challenges, such as data standardization, interpretability of AI models, and integration into clinical workflows, will be addressed, alongside ethical considerations and regulatory requirements. The presentation will also explore future perspectives, including the role of real-time AI-driven decision support systems, multi-modal data integration, and federated learning to overcome data privacy concerns.

Through case studies and emerging research, the talk aims to highlight how AI is reshaping the field of radiotherapy and its implications for the future of cancer care, emphasizing the need for interdisciplinary collaboration to unlock its full potential.

Abstract ID: 014

Two-Phase Xenon Time Projection Chambers for Dark Matter Searches

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Abstract:

Dark matter, an elusive form of matter that makes up approximately 27% of the universe, remains one of the most profound mysteries in physics. Understanding its nature is crucial for completing our understanding of the cosmos. Detecting dark matter particles, such as Weakly Interacting Massive Particles (WIMPs), requires detectors with extraordinary sensitivity.

Two-phase xenon Time Projection Chambers (TPCs) are the leading technology for WIMP detection. These detectors use liquid xenon as both the target and detection medium, leveraging its scintillation and ionization properties to identify and precisely reconstruct particle interactions. The simultaneous detection of scintillation and ionization signals also enables powerful discrimination between nuclear recoils (potential dark matter signals) and electronic recoils (background noise). The ability to reconstruct 3D positions allows for target fiducialization and multiple-scattering identification, both of which are crucial for achieving datasets with extremely low background levels. Additional advantages include scalability, ease of obtaining large target masses, and excellent self-shielding properties.

Liquid xenon TPCs hold a leading position in the global effort to uncover dark matter, as demonstrated by experiments like LUX, XENONnT, and LUX-ZEPLIN (LZ). These detectors have achieved unprecedented sensitivity and have pushed the frontiers of dark matter detection by setting the world's most stringent limits on WIMP-nucleon interaction cross-sections. Recently, results from LZ have established the best-ever limits on these cross-sections.

In this talk, we begin by examining the properties of xenon as a detection medium and the operational principles of dual-phase Xe-TPCs, including their energy calibration. Next, we present the key features and advantages of liquid xenon TPCs for dark matter searches. Finally, we discuss the current status of ongoing experiments and proposed next-generation initiatives, highlighting the associated technological challenges.

Abstract ID: 015

Dose tracking in radiodiagnostic imaging

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Abstract:

The technological and scientific developments in radiodiagnostic imaging have led to a notable increase in the exposure of patients. This evidence has led to a strengthening of the requirements concerning information to be provided to patients, the recording and reporting of doses from medical procedures, the use of diagnostic reference levels.

All modalities equipped with digital detectors (CT, radiographic units with flat panel, mammography equipments, mobile and fixed fluoroscopic machines, CBCT) guarantee the availability of dosimetric indices for each performed investigation. Dose monitoring implies the registration of these indices.

Obviously, the data could be collected manually, but usefull and powerful RDIM (Radiation Dose Index Monitoring) software can be found on the market. They provide automated collection, storage and analysis of large amounts of digital data: personal and morphological data of the patient, dosimetric indices, technical parameters selected during the acquisition. RDIM allows multi-modality and multi-manufacturer data collection. Integrated statistical analyses are provided and analysis can be generated by patient, by study or by modality. They have the capability to identify procedures that do not meet dose specifications (defined from the user) and send alert by email to specified supervisors. The last versions can also estimate absorbed dose by organs and effective dose, dose to embio or fetus for pregnant women, skin dose map for interventional procedures.

The potentiality and the requirements for a correct use of these software will be described. The proper tracking and awareness of the dose indicators can help to improve the performance and the avalabity of a dosimetrical database can support the optimization process in diagnostic radiology. But RDIM systems are complex platforms and expert medical physics should be engaged to ensure the quality of the data, the reliability of the system, and the accuracy of their results.

Abstract ID: 016

$LaBr_3$(Ce) detectors equipped with Silicon photomultipliers

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Abstract:

LaBr3(Ce) crystals are getting widespread for gamma-ray detection, based on their good energy resolution and excellent timing resolution. The UK built FATIMA array [1] consist of 36 crystals with a diameter × length = 1.5” × 2”, coupled to fast R9779 Hamamatsu photomultiplier tubes.

Recently, due to the rapid advancement of semiconductor technology Silicon photomultipliers emerged as a promising alternative to the well-established PMTs. Here I present a new readout system based on large area Silicon PMs developed for the FATIMA array [2]. Its timing resolution as well as energy resolution is similar to that of traditional PMTs. Noteworthy that a temperature effect compensation circuit was also developed, with the aim to maintain a good stability of the gain during long measurements.

[1] M. Rudigier et al, Nucl. Instrum. Methods Phys. Res. A 969 ,163967 (2020).

[2] S. Pascu et al., Nucl. Instrum. Methods Phys. Res. A 1070 ,170001 (2025).

Artificial Intelligence in Industrial and Medical Applications

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Abstract:

Artificial Intelligence (AI) has rapidly transformed both medical and industrial sectors, offering innovative solutions that improve efficiency, accuracy, and decision-making. In medicine, AI is revolutionizing diagnostics, personalized treatment plans, and drug discovery, with applications ranging from medical imaging analysis to predictive algorithms for patient outcomes. Machine learning and deep learning models can detect patterns in complex medical data, assisting clinicians in early disease detection, reducing human error, and enabling more precise interventions. For instant, AI system works by analyzing the mammogram in detail, comparing it to a large database of known cases, and producing a risk assessment, often in the form of a probability score that indicates whether a patient may have cancer. This information is then used to guide further diagnostic steps, such as biopsy or follow-up imaging. In some cases, AI-assisted tools can help clinicians prioritize cases that require urgent attention, improving workflow and ensuring that high-risk patients receive timely.

In industrial applications, AI optimizes production processes, enhances predictive maintenance, and streamlines supply chains through data-driven insights. Automation powered by AI improves manufacturing efficiency, safety, and resource management, while autonomous systems and robots perform complex tasks with minimal human supervision. This dual application of AI in both sectors not only drives innovation but also presents ethical, regulatory, and security challenges that must be addressed to ensure the responsible of these technologies.

The integration of AI promises to reshape healthcare delivery and industrial operations, offering significant benefits while requiring careful consideration of potential risks and societal impacts.

Abstract ID: 018

Occupational exposure in medical and industrial activities: Cancer risk and deterministic effect probabilities

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Abstract:

Occupational radiation exposure can occur in various industrial and medical settings, including nuclear power plants, medical facilities, food irradiation, mining and mineral extraction, industrial radiography, and research Laboratories. To prevent the workers from radiogenic risks, dose limits were set to be 20 mSv per year to avoid the incidence of deterministic effects and to reduce the probability of cancer effects. The International organizations UNSCEAR, ICRP, and IAEA have devoted significant time to improving radiation safety in IR over the last few years. Several combined factors, such as prolonged localized fluoroscopy, multiple radiographic exposures, and repeated procedures, can cause acute radiation injury to the skin. This review explores the sources of occupational radiation exposure in medical imaging, the factors influencing exposure levels, and the strategies to minimize exposure and ensure the safety of healthcare workers. The study showed that workers in interventional medical procedures may exceed the annual dose limits, while some incidents were reported during industrial activities. The primary sources of occupational radiation exposure in medical imaging include X-ray machines, fluoroscopy units, and nuclear medicine equipment. Factors such as the type of procedure, the duration of exposure, and the distance from the radiation source can influence the level of exposure.

Radiogenic Risks and effective dose from Paediatrics Computed Tomography procedures

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Abstract:

Given the heightened sensitivity of pediatric patients to ionizing radiation and the radiation exposure associated with CT scans relative to other radiographic modalities, it is imperative to monitor CT doses in pediatrics . This study, which sought to quantify kid dosages during brain CT procedures, underscores the continuous need for improvement in pediatric computed tomography practices. The research was performed retrospectively using a Siemens Somatom Definition AS CT scanner. The investigation was conducted in the radiology department of a referral hospital in Dammam, Saudi Arabia. Data on pediatric radiation doses, encompassing CTDIvol, DLP, and exposure characteristics, were gathered from the hospital system for three age categories (3 months to <1 year, 1-5 years, and 6-12 years) , along with clinical indications and demographic data for each patient. The data were analyzed utilizing Microsoft Excel version 2016 and the Statistics Package for Social Sciences (SPSS) program version 26 to compute the Mean, first quartile (Q1), median, third quartile (Q3), and Standard Deviation (S.D.) of dosage values for each age group. A total of 165 patients were categorized into three age groups (3 months to <1 year, 1-5 years, 6-15 years), with an average of 48 individuals per group. The Mean and range for juvenile brain CT DLP (mGy.cm) were 380 (360-390), 500 (490-508), and 640 (635-660), whereas the CTDIvol (mGy) values were 27 (29–35), 38 (42–45), and 48 (50-520), respectively. The radiation exposures generally conform to the established diagnostic reference limits (DRL). Ongoing efforts are necessary to refine the imaging procedure according to clinical indications, patient dimensions, and staff training to achieve improved dose reduction results.

Abstract ID: 020

Patient Radiation Safety and Risks in Medical Imaging: Challenges and Opportunities

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Abstract:

Medical imaging has transformed healthcare by delivering vital diagnostic and therapeutic information. However, ionizing radiation in CT and X-ray imaging must be balanced against diagnostic advantages and patient safety issues. This review research will examine medical imaging patient radiation safety problems and possibilities to limit radiation exposure and maximize diagnostic output. Varied imaging facilities and techniques produce varied radiation dosages, which is a big issue. This heterogeneity is due to equipment, imaging techniques, and operator experience. Standardizing processes, optimizing dosage parameters, and adopting quality control are essential for safe radiation activities. Patient-specific characteristics affect radiation risk. Radiation exposure has longer-term impacts on children and vulnerable populations such as pregnant women. Thus, pediatric and prenatal imaging must examine individual risk factors, justify imaging methods, and follow the "as low as reasonably achievable" (ALARA) approach. Technological advances may improve patient radiation safety. Iterative reconstruction methods, sophisticated image processing, and innovative detector technologies can lower radiation doses without affecting picture quality. Using AI in medical imaging can optimize procedures, automate dose-reduction methods, and increase diagnostic accuracy. Radiation safety requires good communication and patient participation. Explaining imaging risks and advantages, resolving patient concerns, and including patients in shared decision-making can build confidence and enhance radiation safety. Finally, the safety of medical imaging patients' radiation is a challenge. Implementing new technology, following best practices, and prioritizing patient care can help medical imaging professionals decrease risks and improve diagnostic outcomes with ionizing radiation. These will enable reliable, effective, and patient-focused imaging techniques.

Abstract ID: 021

Enhancing CT Imaging Protocols for Disabled Patients

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Abstract:

This survey study explores current practices, challenges, and potential improvements in CT imaging protocols for patients with disabilities. Targeting healthcare professionals such as radiologic technologists, radiologists, and nurses, it assesses the modifications made in positioning, communication, and technical adjustments to accommodate disabled patients effectively. The survey includes multiple sections covering patient comfort, motion reduction, imaging parameters, staff training, and the use of immobilization devices. Problem of Study: Patients with disabilities often experience unique challenges during CT imaging, such as difficulty remaining still, discomfort, or communication barriers. These factors can lead to suboptimal image quality, increased scan times, and heightened stress for patients and healthcare providers. Despite these challenges, standard imaging protocols are often not tailored to the needs of disabled patients, resulting in gaps in care quality. This study addresses the problem of adapting CT imaging protocols to meet the specific needs of disabled patients, aiming to identify solutions that improve imaging outcomes and patient experience while maintaining safety and efficiency. Aim: The primary aim of this study is to gather insights from healthcare professionals to improve CT imaging protocols specifically for patients with disabilities. By understanding the practical challenges and strategies currently in use, the study aims to develop recommendations for enhancing patient care and optimizing imaging techniques. The study focuses on patient positioning, comfort, communication, motion artifact reduction, and staff training. Conclusion: This study underscores the need for tailored CT imaging protocols to better serve patients with disabilities. Key improvements include providing additional positioning aids, adjusting imaging parameters for patient-specific needs, and enhancing staff training in patient communication and handling techniques. Addressing these areas can improve image quality, reduce patient discomfort, and promote a more inclusive approach to CT imaging, ultimately fostering higher-quality care and a better patient experience.

Abstract ID: 022

AI in Radiation Medicine: Addressing Global Challenges

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Abstract:

Healthcare systems worldwide are currently facing significant challenges, including population aging and rising costs, which impact both high-income and low-income countries. In cancer care, these challenges are particularly pronounced, as the global incidence of cancer is projected to increase substantially in the coming years. This surge will drive greater demand for radiological sciences, including radiology for screening and early detection, nuclear medicine, and radiotherapy. Consequently, the need for skilled workforces across all radiological specialties, including medical physics, is expected to grow significantly, placing additional strain on existing educational programs. These pressures could potentially compromise the sustainability of healthcare systems.

Artificial intelligence (AI) presents a promising opportunity to address these challenges by optimizing resources and identifying patients who are most likely to benefit from radiological procedures, both diagnostic and therapeutic. Furthermore, AI has the potential to enhance workforce productivity and quality by automating routine tasks and streamlining procedures. While numerous AI-based solutions are already available on the market and could play a pivotal role in improving system sustainability, standardized methodologies for assessing the quality of these systems remain limited. Additionally, applying AI models in contexts different from those in which they were trained can lead to suboptimal outcomes. This lecture reviews the current state of AI applications in radiological sciences, with a particular focus on their implications for low- and middle-income countries and the global challenges facing the field. A cooperative global initiative aimed at developing predictive dose tools for radiotherapy applications will also be presented.

Abstract ID: 023

Recent updates on radiotherapy treatment using image-guided radiation therapy (IGRT) and cone-beam computed tomography (CBCT)

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Abstract:

Cancer ranks as a primary cause of mortality worldwide, with approximately 19.3 million new cases identified in 2020. The prevalence of cancer differs markedly among diverse locations and people owing to variables such as lifestyle, environmental exposures, and genetic predispositions. Radiotherapy is an essential therapeutic method for several malignancies, designed to administer accurate radiation dosages to tumors while reducing harm to adjacent healthy tissues. Image-guided radiation therapy (IGRT) has transformed this methodology by allowing real-time viewing and monitoring of tumor displacement during treatment. Cone-beam computed tomography (CBCT) is an essential element of image-guided radiation therapy (IGRT), delivering high-resolution three-dimensional pictures of the patient and tumor before each treatment session. This facilitates precise tumor location and modification of treatment strategies, resulting in enhanced tumor coverage and fewer adverse effects. The benefits of IGRT utilizing CBCT include enhanced accuracy, diminished radiotherapy side effects through the reduction of radiation exposure to healthy tissues, improved tumor control via precise targeting and dose administration, and the facilitation of personalized treatment plans tailored to each patient's unique anatomical and tumor characteristics. Although IGRT utilizing CBCT improves treatment precision and diminishes adverse effects, it is crucial to recognize the intrinsic dangers linked to radiation exposure. Prolonged radiation exposure might elevate the likelihood of subsequent malignancies and other enduring health issues. Consequently, it is imperative to enhance treatment planning and administration to reduce radiation exposure to healthy tissues while ensuring efficient tumor management. IGRT utilizing CBCT signifies a substantial progression in radiotherapy, providing several benefits for precision, safety, and effectiveness. Ongoing research and technology innovations will enhance the accuracy and safety of this therapeutic approach, ultimately resulting in improved results for cancer patients.

Abstract ID: 024

Advancement in Fiber Optic Dosimetry System for FLASH Radiotherapy

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Abstract:

The development of accurate and reliable radiation dosimetry systems is critical for advancing radiotherapy and ensuring environmental safety in high-dose-rate scenarios. Traditional dosimetry techniques often fall short in measuring ultra-high dose rates, such as those produced by FLASH radiotherapy setups. This presentation discusses this gap using fiber optic radiation dosimetry systems. The study leverages Tsinghua University's state-of-the-art FLASH facility, capable of delivering electron beams with dose rates exceeding 500 Gy/s and instantaneous rates of up to 500 kGy/s. The facility features variable pulse widths (2–4 microseconds) and pulse repetition frequencies (1–300 Hz), enabling controlled experiments across a wide range of parameters. We have developed and tested an advanced fiber optic dosimetry system, incorporating specially designed Ge-doped scintillating optical fibers to achieve precise and real-time dose measurements. These optical fiber scintillators, optimized for high radiation resistance and sensitivity, were evaluated under varying beam conditions, including doses from 1 to 10 Gy, pulse repetition frequencies of 100–300 Hz, and energy of 6 MeV. Preliminary results demonstrate the system's capability to accurately resolve pulse-by-pulse dose information, with insights into dose linearity, temporal response, and reproducibility. These findings validate the potential of fiber optic dosimeters as robust alternatives to conventional systems, offering significant advantages in terms of speed, precision, and adaptability to high-dose-rate environments. This work represents a step forward in the integration of fiber optic technology into advanced dosimetry applications, paving the way for enhanced radiation monitoring in FLASH clinical settings.

Abstract ID: 025

Response of a passive TLD600-TLD700/RPP neutron spectrometer

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Abstract:

The oldest, reliable and commonly used device to measure the neutron spectrum is the BONNER sphere spectrometer (BSS). This spectrometer is a set of polyethylene spheres with 0 to 18 inches diameter having in the centre a thermal neutron detector. If the detector is a ^{6}LII(EU) scintillator, a $^{10}BF_3$ or ^{3}HE proportional counter the spectrometer is active, if the thermal neutron detector is AU. In or DY foil or is a pair thermoluminescent dosimeter (TLD 600 and TLD 700) the spectrometer is passive. In the last six decades the BSS have evolved to different spectrometers like the rotating, the nested cylinders,, the water-pumping, the multi-shells, the cylindrical, the multi-detector and the nested cubes spectrometers. The aim of this work was to estimate the neutron response of a novel passive spectrometer made of 20.5 x 20.5 cm^2 polyethylene plates having two pairs of TLD600 and TLD700 being in the centre or the 0.5 cm-thick plate (bare case), adding 2 cm-thick (one in front and another in rear position) a regular parallelepiped (RPP) is structured, thus pairs of 2 cm-thick plates are added until the final form is a 20.5 x 20.5 x 20.5 cm cube. Using MONTE CARLO methods, with the MCNP6 code, the response function for 10^9 to 20 MEV neutrons of bare and the five RPP were estimated to have the matrix response being the ^{6}LI(n, α) reactions in each TLD. In addition, the neutron fluence in each TLD was estimated. The neutron source was a 20.5x20.5 cm plates emitting the neutron onto the RPP, during transport neutron can be captured by hydrogen producing 2.22 MEV γ-rays; thus, the absorbed dose due to induced γ-rays in each TLD was estimated. For each RPP the matrix function for each TLD have the same shape; however for the TLD600 is some orders of magnitude larger than the TLD700 matrix function because the ^{6}LI weight fraction in TLD600 is approximately 1000 times larger than in the TLD700, on the other hand the absorbed dose due to γ-rays is approximately the same in both TLD types.

Abstract ID: 026

Radiation Dose Measurements and Radiation Protection in Pediatric Radiology

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Abstract:

In recent years, concerns about the risks of ionizing radiation in pediatric patients have grown significantly. The intense increase in radiological examinations, along with the emergence of new, complex radiographic procedures, has resulted in a substantial rise in radiation doses received by patients. Pediatric tissues are particularly sensitive to radiation, making children more vulnerable to specific diseases. Furthermore, their longer life expectancy increases the likelihood of developing radiation-induced neoplasms.

Regulatory authorities, including the ICRP, IAEA, EC, Image Gently Campaign, and various national and regional societies, have highlighted the critical importance of addressing radiation protection in pediatric radiology. However, the relationship between pediatric radiation doses and associated risks remains uncertain and is a matter of significant concern. Limited quantitative data in the literature further complicates the evaluation of current protection measures and their effectiveness.

This study aims to: (1) present the current global state of the art in pediatric dosimetry, (2) report on the situation in Latin America and the Caribbean (OPRIPALC), (3) provide an overview of studies conducted in various regions of Brazil, and (4) present findings from recent studies on pediatric dose measurements in hospitals in Curitiba, Brazil.

This work is supported by CNPq, CAPES, Fundação Araucária, and FAPESP.

Keywords: pediatric radiology, radiation protection, diagnostic radiology, interventional radiology

Abstract ID: 027

Role of Radiation Physicists in Bone Mineral Density Measurements

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Abstract:

In general most Medical Physicists are working in either radiotherapy departments or radio diagnosis departments. In Egypt and other countries few medical physicists are working in a hospital in general or at particular medical practice. As example few Medical Physicists are working for Bone mineral density (BMD) measurements. In the present study and in brief Bone Mineral density (BMD) measurements shall be outlines. Historically BMD measurements were done using mono energetic gamma ray source, such as Americium-241, its gamma ray energy is 59.6 keV. It was used to measure the BMD for the hands of students as part of Medical research project in Egypt. Furthermore BMD measurement were done using sources with dual gamma ray energies such as Gadolinium Ga 153 with energies (44 and 100 KeV), or using x-rays known as Dual-energy X-ray absorptiometry (DXA, or DEXA) and it is a means of measuring bone mineral density (BMD) using spectral imaging. Two X-ray beams, with different energy levels, are aimed at the patient's bones. Alternatively BMD measurements were done using Ultrasound source. Recently I was examined in DEXA unit and the measurement was at RadiusUD region as follows BMD in g/cm2(0.465) and young Adult T-Score(1.1) and age matched z-score (0.2.). In the present study medical physicists should be encouraged to take part in measurements of Bone Mineral Density research and developments.

Abstract ID: 028

Targeting of the first-in-class humanized hAnnA1 antibody in ovarian cancer preclinical mouse models

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Abstract:
Ovarian cancer, one of the most fatal gynecological cancers, is often detected at an advanced stage with widespread peritoneal metastasis, which limits treatment options. Despite advancements in early detection and standard treatments such as surgical cytoreduction and chemotherapy, survival rates remain low, highlighting the urgent need for improved therapeutic approaches. In this study, we explored the potential of a first-in-class humanized hAnnA1 antibody, specifically designed to target a modified form of annexin A1 (AnnA1) enriched in tumor caveolae, as a targeted therapy for ovarian cancer. Leveraging radioisotope-labeled hAnnA1, we investigated its efficacy in preclinical ovarian cancer mouse models. Our methodology involved radiolabeling hAnnA1 with Zr-89, followed by imaging and biodistribution studies using PET/MRI in mice implanted with luciferase-positive SKOV-3 ovarian cancer cells. Results demonstrated high specificity and accumulation of radiolabeled hAnnA1 in ovarian cancer cells, with significantly higher uptake compared to the control IgG. Furthermore, biodistribution analysis confirmed that radiolabeled hAnnA1 selectively localized in ovarian tumor tissue, with minimal uptake in non-target organs.
These findings suggest that hAnnA1 is a promising therapeutic candidate for targeted alpha therapy (TAT) in ovarian cancer, offering a new strategy to improve treatment outcomes for patients with advanced-stage disease. Further studies are warranted to evaluate its therapeutic efficacy and potential clinical applications.

Abstract ID: 050

The Efficiency of GM detector for the detection of Beta, and gamma contamination on the surface of nitrile glove and an artificial in-vitro skin

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Abstract:

This study assesses the efficiency of decontamination incase of radioactive spill of gamma and beta happens during a regular day in the Nuclear medicine department. This research is focused more on decontamination efficiency on normal plastic surfaces, and artificial In vitro skin. a commercial decontaminating agent, bleach, In vitro artificial skin, and gloves were used in the standard level of decontamination. In this experiment we were able to remove the radioactive spill to background level. The results indicate the efficiency of the geiger counter after decontamination of the radioactive spill on the surface and artificial skin.

The Geiger counter is a well-known instrument used for detecting radiation, particularly in cases of suspected radioactive contamination or during nuclear emergencies. Despite its complex structure and ion collection process, the instrument's readings are not always 100% accurate, and specific steps must be taken to ensure accurate readings. The Geiger counter can detect various types of ionizing radiation, including alpha, beta, and gamma, but it has a higher efficiency in detecting alpha and beta radiation compared to gamma radiation. The instrument is filled with 90% Helium or Argon gas and alcohol vapors, and high voltage is applied to produce enough signals for ion detection. While the instrument's efficiency in detecting gamma radiation is relatively low, it is still commonly used for detecting nuclear radiation

Abstract ID: 051

Enhancing Calibration in Radioactive Particle Tracking (RPT) Using GEANT4 Simulations Combined with a Semi-Empirical Model

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Abstract

Since the 1980s, radioactive particle tracking (RPT) has been essential for visualizing multiphase industrial flow systems, offering unique three-dimensional insights into flow dynamics. The RPT process involves three key stages: calibration (counting known tracer particles and their positions), tracking (identifying counts with unknown positions), and reconstruction (using algorithms to estimate tracer positions). Calibration is critical to ensure accurate tracking and reconstruction, as any error in this step significantly affects the RPT data's precision. Yet, calibration is often limited by experimental constraints and the assumptions in traditional Monte Carlo simulations. To address these limitations, we employed a GEANT4-based Monte Carlo code combined with a semi-empirical model to simulate the RPT calibration process for a gas-liquid bubble column. The GEANT4 code effectively simulates the counts received by detectors, while the semi-empirical model reduces computational costs by generating additional calibration points. Using 28 scintillation detectors and 441 tracer positions, our approach overcame solid angle limitations in conventional methods and accurately captured photon interactions. Our simulations were validated against experimental data from an automated RPT calibration technique, showing a maximum relative deviation of 5%. Nonetheless, when the primary event count in the GEANT4 model was suboptimal, the counts were overestimated. The semi-empirical model enhanced the calibration by refining the mesh level and increasing the number of calibration points, resulting in a more precise tracer position estimation.This optimized calibration process supports higher accuracy in RPT applications, ultimately improving data reliability for multiphase flow analyses. Further details on the GEANT4 simulations and semi-empirical model will be shared in the presentation.

Abstract ID: 052

Simulation of Radiation Attenuation Properties of C_2H_4-Sb_2O_3 Polymer composites using GEANT4 Monte Carlo Code and XCOM

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Abstract

Plea Polymer composites are becoming attractive for radiation shielding purposes because of their durability, lower cost and lightness. The study investigates the linear attenuation coefficients and the degree of heaviness of high-density polyethylene (HDPE) polymer – antimony oxide composites and concrete. This study was carried out to know the radiation shielding properties of HDPE polymer composites against concrete. The attenuation coefficients were calculated using GEANT4 Monte Carlo code and percentage of heaviness was derived from the densities of each sample. Polymer sample with 15% antimony-oxide has a higher LAC than concrete at 32.5 keV, 36.5 keV and 40.3 keV by 69.6%, 68.9% and 70.4% respectively. Similarly, the sample with 10% has a higher LAC than concrete at 32.5 keV, 36.5 keV and 40.3 keV by 49.5%, 47.9% and 51% respectively. All the HDPE-Sb2O3 composites are at minimum 30% lighter than concrete.

Abstract ID: 053

Development of a Novel Design of Gamma-Ray Densitometry (GRD) Technique for Multiphase Flow Systems

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Abstract:
To reduce its reliance on fossil fuels, Saudi Arabia is looking to its petrochemical industry as a vital part of Vision 2030's goals. This industry offers a strong foundation for creating jobs, lowering emissions, and diversifying the economy away from oil. A big piece of this effort lies in choosing the right kind of multiphase reactors, which play a major role in streamlining production by minimizing the need for extra separation, mixing, and blending units. By doing so, they not only make the process more cost-effective but also help reduce pollution right at the source, making the entire operation more environmentally friendly. In both the nuclear and petrochemical sectors, as well as in R&D, radioisotope-based measurement techniques have become common tools. These techniques are used for everything from monitoring and inspection to troubleshooting and optimization, and they're widely valued for their reliability, accuracy, and cost-effectiveness. Among these, Gamma-Ray Densitometry (GRD) stands out as a powerful method for monitoring and mapping multiphase flow systems—especially when dealing with complex flows involving two or more phases. GRD is nondestructive and doesn't use hazardous materials, making it a safe and pollution-free option. Its high level of accuracy and ability to produce detailed flow maps make it ideal for studying complex flow systems. In this project, we developed a new design for GRD using the GEANT4-based Monte Carlo simulation tool. This simulation helped us evaluate different GRD settings, like the strength of the radiation source, the shape of the source, the window, and the detector's collimation setup. We validated these simulations with experimental data from a gas-liquid bubble column and improved the GRD platform design to solve common alignment issues between the source and detector collimation. The presentation will cover the results of these simulations and the enhancements we made to the GRD design.

Abstract ID: 054

Organ dose distribution in anteroposterior (AP) abdominal radiography: Phantom-Based study

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Abstract:

Purpose: X-ray imaging units commonly display non-homogeneous radiation intensity throughout the imaging area. The lack of uniformity makes it difficult to accurately measure the radiation dose that organs receive. Existing dosimetry techniques do not possess the required accuracy for precise, organ-specific dose measurements, hindering progress in patient safety and enhancement of medical imaging procedures. Our study emphasizes mapping radiation doses in abdominal organs using optically stimulated luminescent dosimeters (OSLD), with the objective of improving dose accuracy and patient care quality in diagnostic imaging. **Method:** A Kyoto Kagaku phantom placed lying down on the table bucky in a front to back orientation. The distance from the source to the image was fixed at 100 cm. Exposure settings consisted of kVp values of 64.5, 70, and 75, along with mAs values of 14, 20, and 25. Multiple nanoDot OSLDs were positioned on the phantom's surface to measure the entrance skin dose (ESD) at locations that align with the liver, kidneys, and spleen. **Results:** The measured average entrance skin dose (ESD) for abdominal organs at selected X-ray exposure settings, revealed non-uniform radiation distribution across the imaging field. Results indicated the kidneys received the highest ESD (6.32, 1.98, and 5.05 mGy), followed by the liver (4.43, 1.46, and 3.65 mGy) and spleen (4.16, 1.58, and 3.53 mGy). These findings emphasize the importance of precise organ-specific dosimetry due to varying radiation sensitivities and potential health implications for different organs in the imaging area. **Conclusion:** This study confirms non-uniform radiation intensity across abdominal regions in X-ray imaging and emphasizes accurate dosimetry's role in patient safety. It reveals significant dose differences among organs, advancing understanding of organ-specific exposure in diagnostic imaging. These findings highlight the need to optimize imaging protocols to minimize radiation exposure to sensitive organs, enhancing patient care quality in radiology.

Keywords: Organ dose mapping, Diagnostic imaging, Abdominal radiography, Radiation protection, Patients' safety.

Abstract ID: 056

Estimation of personal dose equivalent and skin doses during interventional radiology imaging

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Abstract:

Eye lens opacities are radiosensitive tissues to ionizing radiation exposures. It was estimated that eye lens opacities occur in up to 59% of the screening sample, and cardiac catheter personnel may be subjected to higher doses that exceed the annual dosage limit. Employees of interventional cardiology (IC) exposed to dispersed radiation from patients and leaking radiation should have an accurate yearly radiation dose exposure assessment. This study aims to quantify the annual effective dose received by cardiac surgeons, nurses, and radiography technicians during IC procedures. The data were collected from staff members working at IC for a year. The occupational dosage was determined using calibrated thermos-luminescent dosimeters (TLD-100, LiF: Mg, Ti) and an automated TLD reader (Harshaw 6600). Deep dose (Hp(10)) and skin doses (Hp) of ionizing radiation exposure were studied (0.07). The total mean and range of cumulative dosage for the present monitoring period (mSv) for baritone and skin doses, respectively, were 3.7 (0.5 - 16.0) and 4.4 (0.6 - 18.0). Cardiologists are usually exposed to more annual exposure than nurses and technicians. The exposure revealed significant occupational exposure changes depending on the pathophysiology of the patient, the machine configuration, and the cardiologist's expertise. Staff members who follow radiation protection protocols properly shield the thyroid and trunk. An eye lens dose assessment is advised for cardiologists and nurses to confirm that the exposure limit is not exceeded.

Keywords: Occupational dosimetry; TLD; annual exposure; Effective dose

Abstract ID: 057

Recent Advancements in Neutron Imaging and Its Applications

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Abstract:

Neutron imaging has advanced considerably in recent years, providing new capabilities for applications across various fields, including materials science, engineering, and biology. This study highlights recent technological advancements that have improved neutron imaging resolution, sensitivity, and adaptability, making it a more effective tool for non-destructive testing and analysis. Key developments include enhancements in neutron detectors, data processing algorithms, and neutron source technology, which collectively enable higher-resolution imaging and faster acquisition times. These innovations have expanded neutron imaging applications, such as in-situ monitoring of fluid flow in porous media, characterization of fuel cells, and structural analysis of composite materials. This work presents state-of-the-art neutron tomography and radiography systems to evaluate different materials under diverse environmental conditions. The results demonstrate that modern neutron imaging can resolve fine structural details and detect light elements with high accuracy, surpassing traditional imaging techniques like X-rays, particularly for hydrogenous and low-Z elements. These findings underscore the expanded utility of neutron imaging for industrial and research applications, contributing to advances in materials characterization, quality control, and the development of new materials. In conclusion, the recent advancements in neutron imaging technologies have not only broadened its applicability but also reinforced its role as a crucial non-invasive technique in various scientific and industrial sectors.

Abstract ID: 058

Monte Carlo Model Validation for Range Verification in Proton Therapy with an In-Beam Dual-head PET System

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Abstract:

The study aims to develop a Monte Carlo simulation model to validate proton-activated positronemitting isotope distributions, particularly 12C and 16O, detected by an in-beam Dual-Head Positron Emission Tomography (DHPET) system during pencil beam proton therapy. To assess the accuracy of the Monte Carlo model, we used a high-density polyethylene (HDPE) phantom (C2H4, density = 0.95 g/cm³) irradiated with proton beams to generate a positron emitter map for range verification. Proton energies from 70 to 230 MeV were applied to encompass the full energy range used in proton therapy. Monte Carlo simulations were conducted using GATE/Geant4 software, modeling a Sumitomo DHPET system with dimensions of 164.8 mm×167 mm and a spatial resolution of 2 mm, using BGO crystal arrays coupled with a photomultiplier tube. The simulation model incorporated updated experimental cross-section data for nuclear reactions involving 11C and 16O, which are critical for modeling proton-activated isotopes in tissue. To ensure comparability with the commercial Sumitomo DHPET, we also used back-projection to reconstruct 2D activity distribution maps from simulated PET coincident events. Upon comparing experimental and simulated results, the 1D profiles of 11C activity distribution showed high consistency, with a minimum deviation of 0 mm and distal fall-off range differences within 4.0 mm after sensitivity and attenuation corrections. Across the entire energy range (70-230 MeV), a mean deviation of 1.44 mm (with a standard deviation of 1.17 mm) was observed, with higher precision in the lower energy range (70-140 MeV; mean deviation of 1.19 mm) than in the higher range (150-230 MeV; mean deviation of 1.67 mm). In summary, this study demonstrates the effectiveness of a DHPET-based Monte Carlo model for proton therapy range verification, underscoring the need for a robust activity verification tool that integrates simulations and experimental data to enhance accuracy in treatment planning.

Abstract ID: 059

Monitoring Radioactivity in Qatar's Seawater: Implications for Marine and Human Health

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Abstract:

Radioactive substances in seawater can originate naturally from the Earth's crust, with elements like uranium, thorium, and radium leaching into the ocean. Additionally, cosmic rays from space and human activities, such as nuclear power plants and accidents, introduce radionuclides, which can affect marine life and human health. In Qatar, where seawater is essential for desalination and marine food sources, the presence of these substances poses potential risks. Recently, slightly elevated levels of radionuclides were detected in Qatar’s seawater, though still below thresholds found in nuclear-affected regions. This anomaly underscores the importance of continuous monitoring to safeguard the environment and public health.

A study along Qatar’s coast involved 147 sampling points, up to 5 kilometers offshore, and included sampling at various depths to assess the vertical distribution of radionuclides. To ensure thorough analysis, a range of sophisticated instruments was employed. ICP-OES (Inductively Coupled Plasma Optical Emission Spectroscopy) and ICP-MS (Inductively Coupled Plasma Mass Spectrometry) were used to detect and quantify trace elements and isotopes. IC-5000 (Ion Chromatography) was utilized for identifying and quantifying ions. Gross alpha/beta proportional counters measured total radiation levels, while liquid scintillation counting was applied for detecting low-level beta and some alpha radionuclides. Finally, gamma spectrometry was employed to identify and quantify gamma-emitting radionuclides, such as cesium-137 and potassium-40.

The analysis revealed that while concentrations of radionuclides like tritium and potassium-40 were consistent with global levels, cesium-137 was notably lower, and levels of lead-210 and polonium-210 showed some variability. These findings highlight the need for ongoing research and monitoring to protect Qatar’s marine environment and ensure public safety. The study also paves the way for advancements in seawater treatment and contaminant removal technologies.

Abstract ID: 060

Photon activation and production cross sections from $_{nat}$Ti, $_{nat}$Fe, $_{nat}$Ni, $_{nat}$Cu, $_{nat}$Ag, $_{nat}$Mo, $_{nat}$Au and Pb induced by proton H^+ and heavy ions C^{q+}, Cu^{q+}

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Abstract:

In a broader spectrum, the interaction of charged particles with materials has been extensively investigated within the framework of 1) nuclear activation of radionuclides for medical & industrial applications and 2) X-ray production cross sections measurements in the context of multiple ionization (MI) due to creation of multiple vacancies in projectile and material elements during interaction. A series of experiments are conducted on 5MV tandem accelerator at National Centre for Physics Islamabad using proton induced prompt gamma activation of thick metals $_{nat}$Ti, $_{nat}$Fe, $_{nat}$Ni, $_{nat}$Cu, $_{nat}$Ag, transition metal $_{nat}$Mo, $_{nat}$Au and post transition Pb in the energy range from 1.0/u to 3.5/u MeV 1) in order to produce the radioisotopes and 2) investigation of charge state (q=1-4) impact of heavy ions C^{q+} and Cu^{q+} on the X-ray emission from thick targets foils $_{nat}$Ti, $_{nat}$Fe, $_{nat}$Ni, $_{nat}$Cu, $_{nat}$Ag, $_{nat}$Mo, $_{nat}$Au and Pb. We have indigenously designed and developed the CF Flange to hold the 2x2 NaI(Tl) detector outside the chamber at 30º Nuclear beam line and investigated the radioisotopes production and compared with Tayles. The findings indicate that higher ion charge states indeed influence the x-ray production cross sections (XPCS) due to nuclear charge careening, while established theories such as the plane wave Born approximation (PWBA), ECPSSR, electron capture (EC), and binary encounter approximation (BEA) are discussed. A discernible relative peak shift and broadening of X-rays are identified due to multiple ionization from MeV heavy-ions impact. Modifications of fluorescence yield (FY) and the Coster-Kronig (CK) transition.as a function of ion charge state are elucidated. These measured values offer a contribution towards ion beam quantitative analysis utilizing MeV heavy ions alongside mass spectroscopy.

Abstract ID: 061

Environmental Investigation of Radioactive Building Material and Lithological Rock on Main Boundaries Thrust (MBT)

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Abstract:

The investigation is conducted on radioactive building materials including different local manufactured cements, sand, bricks and first time lithological rock from Main Boundary Thrust (MBT) near about the National Centre for Physics QAU, Islamabad. High tech, NaI(Tl) and High Purity Germanium detector was used for gamma spectroscopy. The mentioned sample were dried on

105º C for 24h and leave it for equilibrium. All samples were scanned for 14000s inside the Pb container to reduce the back ground. Radiation's signature is found in our samples. These radiations either come from the different type of rocks which are used in building materials or from the soil, sand. Radioactive materials usually contain three major radioactive elements, Uranium U^{235}, Thorium (Th^{232}) and Potassium (K^{40}), which emits gamma radiations and makes it radioactive. Daughter nuclide from the decay series of these radioactive elements also play an important role in the outdoor effective dose received by the human globally. The decay chain of Uranium also gives radium and radon. Decay series of radium further becomes a source of radiation in the soil whereas emission of radon gas from the soil makes is useful as a precursor of earthquake. Therefore, activity concentration of these radioactive element is measured at Ramli, site, Islamabad which lies directly above a fault line and main boundary thrust (MBT). The average specific activity for Thorium, Radium and Potassium measured and discussed with the recommended ranges of UNSCEAR. From these results outdoor and indoor hazard index, gamma index, radium equivalent, alpha index, outdoor effective dose, outdoor annual effective dose, and outdoor excessive lifetime cancer risks were calculated. All the calculated values showed the satisfactory results which lies within the recommended standards of UNSCEAR.

Abstract ID: 062

Characterization of a graphite calorimeter as a secondary standard dosimetry

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Abstract:

Recently, FLASH radiotherapy (FLASH-RT), delivering radiation at ultra-high dose rates, (over 40 Gy per sec) has emerged as a new approach in the field of oncology. FLASH-RT maintains the effect of suppressing tumors while allowing less damage to the adjacent normal tissues, which is referred to FLASH effect. However, the mechanism behind the FLASH effect has not yet been clearly examined. Also, comprehensive research is still required to identify the optimal conditions to maximize the FLASH effect. Therefore, it is crucial to accurately measure that the planned dose of FLASH-RT corresponds exactly to the dose absorbed by the human body. Owing to high precision and ability to manage the rapid dose delivery, a graphite calorimeter has been considered as a suitable dosimeter for FLASH-RT. Although many studies have been reported on the graphite calorimeter as a primary standard dosimeter, enabling accurate dose measurements with very low uncertainty, its practical application in clinical settings requires improvements in usability. In other words, the demand for a graphite calorimeter as a secondary standard dosimeter, emphasizing ease of use even with slightly higher uncertainty, would increased as well. In this study, we developed a disk-shaped graphite calorimeter to function as a secondary standard dosimeter and evaluated its performance using both 6–12 MeV LINAC electron beams and 100 MeV proton beams. For conventional electron beams, the calorimeter demonstrated stable repeatability and high linearity across multiple measurements, achieving a type A uncertainty of 1.0%. Furthermore, it successfully measured the absorbed dose of FLASH proton beams.

Abstract ID: 063

Low-energy ion beam irradiation modification of rice seeds to induce brown-planthopper resistant mutants

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Abstract:

Low-energy ion beam irradiation (LEIBI) of biological living materials for biotechnological applications is an emerging radiation technology. Different from high-energy ion beam irradiation, LEIBI works at ion energy of 10 – 10^2 keV, instead of MeV or higher, with merits of low cost and simple facilities and operation while maintaining comparable efficiencies for biological modifications, advantageously suitable for laboratories in developing countries. Mutation induction is one of the LEIBI applications for agricultural improvements. A large number of crop mutations have been LEIBI-induced. This research applied un-mass-analyzed low-energy and high-fluence (accelerated by 60, 80 and 100 kV, respectively, to fluences in an order of 10^{16} atomic-ions/cm^2) nitrogen ion beam irradiation of Thai jasmine rice (KDML105) seeds aimed at induction of favorable mutations of brown planthoppers (BPHs) resistance. BPHs constitute one of the most devastating annual threats to Thai jasmine rice, which is BPH-susceptible. As a novel mutation induction technique, the N-ion beam irradiation succeeded in inducing and screening of BPH-resistant mutants. Three rice mutants were obtained, exhibiting moderate resistance to BPH demonstrated by analyses of antixenosis, antibiosis and catalase activity after infestation tests. The methods and results of the tests are presented. Genomic sequence analysis of catalase genes in one of the mutants, which exhibited the highest catalase activity after the BPH infestation, revealed a number of point mutations in the non-coding region of catalase gene *CATALASE ISOZYME A* (*CATA*), as compared with its wild-type. Physical mechanisms involved in the mutation induction are discussed in terms of energetic ion interaction with DNA in the rice seed cells.

Abstract ID: 064

X-ray emissions and production cross sections from thick silver induced by multiply-charged MeV He- and C-ion irradiations

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Abstract:

Heavy ion irradiation induced X-ray production has been an active research topic, due to its applications in materials analysis with high sensitivity. Multiply-charged MeV heavy ion irradiation of thick samples have been more challenging in studying the X-ray emission. In this work, X-ray emissions from thick silver samples induced by heavier and multiply charged helium (He1+,2+) and carbon (Cq+, q = 1 – 4) ion beam irradiations at energy of 1 – 16 MeV are studied. The work includes the X-ray production cross section (XPCS) measurement and calculation for the thick samples based on the Merzbacher-Lewis relation, investigation of the ion charge state effect on the XPCS, modification of the theoretical calculation of the XPCS with the fluorescence yield (FY) and the Coster-Kronig (CK) transition for heavy ion and high ion charge states, and observation of X-ray energy shifts and peak broadening induced by high-energy heavy ions. The measured total Ag K- and L-shell XPCSs as a function of the combined ion energy and charge states are compared with prevalently theoretical predictions. It is found that higher ion charge states indeed affect the XPCS compared to low-charge-state cases, whereas popular theories do not include this effect. Peak shifts and broadening of Ag X-rays are distinguished due to the multiple ionization, which is the basic cause of the modification for the theoretical calculation, from C-ion impact. Modified FY and CK transition as a function of the ion charge state are narrated. Physical mechanisms involved in the X-ray production are discussed in terms of Z1/Z2 against v1/v2, where Z is the atomic number and v is the velocity and 1 and 2 represent the projectile and the target. The Ag XPCSs are discussed in relevance to those of the same group elements such as Cu and Au as well as other group elements.

Abstract ID: 065

Using of Cytokinesis Block Micronucleus Assay to monitor the risk of excessive radiation exposure in lymphocytes

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Abstract:
The cytokinesis-block micronucleus assay (CBMN) as Rapid biodosimetry tool is required to assist with triage in the case of ionizing radiations exposure, whether medical, occupational or accidental that leads to deleterious biological consequences like mortality or carcinogenesis. Here, we aimed to evaluate the relationship of DNA damage parameters; micronuclei (MNi) frequencies, binucleated cells (BNCs) and nuclear division index (NDI) of peripheral blood lymphocytes cells (PBLcs) taken from healthy donors with x-ray radiation dose rate.We performed prospective analysis on 20 peripheral blood lymphocytes samples taken from healthy volunteers. The blood samples were irradiated with single X-rays doses of 320 KeV with dose rate of 0.913 Gy/min and blood samples were exposed at the dose levels of 0, 0.5, 1, 2, 3, 4, and 5 Gy. The blood samples were then cultured for 72 h at 37°C and processed following the International Atomic Energy Agency standard procedure with slight modifications. We observed significantly increase in the average number of micronuclei with increasing radiation dose as compared with control subjects, the highest average number of MNi (400.700±14.343) was found in irradiated female lymphocytes at 5Gy dose, while minimum average numbers of MNi (0.700±14.343) was in non-irradiated female lymphocytes samples. The number of micronuclei in BNCs cells for healthy tended to be greater in females relative to males at lower doses of radiation (0.5- 2Gy), but this effect was not statistically significant at high doses (3–5 Gy). Average numbers of binucleated cells and nuclear division index were significantly decreased by increasing radiation dose as compared with control groups. The increased number of nuclei following high radiation doses could represent a negative impact on public health especially that of workers exposed to radiation.

Abstract ID: 066

Radiation dose to kidney voluntary donors & disorders during renal scan using ^{99m}Tc (DTPA & DMSA)

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Abstract

Renal scintigraphy has provided clinically important functional and morphological evaluation of the Kidneys since the beginning of the transplantation procedures. also plays an essential role in diagnosing various kidney conditions This procedure can be performed with different radiopharmaceuticals. Patients undergoing renal scintigraphy receive a radiation dose to be assessed. This study aimed to estimate the effective dose through dose auto-calculation to voluntary kidney donors and kidney disorder patient undergoing 99mTc (DMSA, DTPA) renal scan. The study involved 88 patients described as follows 16 patients were donors and,13,6,46, UTI, hydronephrosis, renal cancer and renal stone respectively underwent renal scans. The demographic information for all patients was 41.64 ± 15.74 years, with a mean weight of 159.93 ± 21.47 kg and mean height of 65.05 ± 13.57 cm. The activity dose administered in mCi was 5.06 ± 0.81, while the dose auto-calculated was 4.30 ± 0.92 mCi. The study was conducted in real clinical settings without considering potential factors affecting the measured dose, such as exposure parameters and machine performance. The patients' effective dose during renal scintigraphy was found to be lower than that reported by the ICRP (3.6 and 5.2 mSv) with administered activity of 740 MBq of Tc-99m-DTPA). This variation can be attributed to the lower administered activity in this study. Renal scintigraphy is utilized for monitoring patients with kidney problems and is a highly sensitive technique for estimating residual function in atrophic kidneys. The injected dose was calculated by auto-calculation formula then effective dose has been estimated using computer software depending on conductive activity. The highest dose to the kidneys is self-dosing and is due to the charged particles released as 99mTc breaks down of the radiopharmaceuticals used here, the highest dose to the kidneys is caused by 99mTc-DMSA and the lowest by 99mTc-DTPA. In conclusion, this study underscores the importance of optimizing radiation doses in renal scintigraphy to ensure patient safety while maintaining diagnostic efficacy. It highlights the need for further research to explore factors influencing radiation doses and to develop guidelines for dose optimization in renal imaging procedures, particularly in populations such as voluntary kidney donors and patients with kidney disorders.

Keywords:. Effective dose, , 99mTc, DTPA, DMSA. Renal Scan.

Abstract ID: 067

Association of -^{99m}Tc Sestamibi Dose with Perfusion Deficits and Ejection Fraction in Patients Undergoing Myocardial Perfusion Imaging

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Abstract:

Myocardial perfusion imaging (MPI) with Tc-99m Sestamibi is essential to assess myocardial blood flow and function. Previous studies have shown possible associations between radiopharmaceutical dose and measures of cardiac performance, such as ejection fraction (EF). However, the implications of different doses of Tc-99m Sestamibi on myocardial perfusion deficits remain insufficiently investigated. This study aims to clarify the relationship between the administered dose of Tc-99m Sestamibi and the resulting perfusion deficits assessed by the stress ejection fraction (stress EF) and the ejection fraction at rest (rest EF) in a different group of patients with different cardiovascular pathologies. The study involved a total of 59 participants, aged 39 to 85 years (60.31± 11.59), were included. Body Mass Index (BMI) ranged from 18 to 45 (26.85±7.04). Participants underwent MPI, and Stress Ejection Fraction (StressEF) values ranged from 27 to 88 (59.59±15.41), while Rest Ejection Fraction (RestEF) ranged from 31 to 87 (55.93±13.78). The administered Tc-99m Sestamibi dose varied from 15 to 30 mCi, with a mean dose of 17.54 mCi (±3.98). The data showed that there is a significant prevalence of cardiovascular disease among participants, with chest pain (20.3%) and ischemic heart disease (IHD) (8.5%) as the most common diagnoses. The electrocardiogram (ECG) results showed that 61% of the participants had normal results, while in some cases a reduced wall thickness and hypokinesia were observed. Correlation analysis revealed a significant negative relationship between the dose of Tc-99m and both StressEF ($r = -0.603$, $p < 0.001$) and RestEF ($r = -0.580$, $p < 0.001$). One-way ANOVA showed significant differences in StressEF ($F = 11.097$, $p < 0.001$) and RestEF ($F = 9.549$, $p < 0.001$) between the different dose groups. Regression analysis showed that the model including age, BMI, Auto History, and Dose explained 45.9% of the variability in stress EF ($p < 0.001$), with BMI emerging as a significant predictor ($p = 0.008$). In conclusion, this study shows that higher doses of Tc-99m Sestamibi are associated with reduced ejection fractions, highlighting a potential dose-dependent effect on myocardial function during MPI. These results highlight the need for dose optimization in clinical practice to improve diagnostic accuracy and patient outcomes. Future research should further investigate the mechanisms underlying these associations and their implications for patient management.

Keywords: Myocardial perfusion imaging, Tc-99m Sestamibi, ejection fraction, stress ejection fraction, rest ejection fraction, cardiovascular conditions.

Abstract ID: 068

A National Survey of Shielding Adequacy in Diagnostic Imaging Rooms in Major Public Hospitals in Ministry of Health Across Saudi Arabia

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Abstract:

Scattered and leaked radiation during X-ray examination procedures can pose a significant health risk to both healthcare workers, patients, and Public. Ensuring the integrity of shielding in X-ray rooms is a fundamental aspect of quality control within radiology departments. This study evaluated the shielding adequacy of diagnostic imaging rooms in major public hospitals in MOH across Saudi Arabia. A total of 74 X-ray examination rooms were surveyed in 26 hospitals, covering CT scan, general X-ray, mammography, and panoramic radiography rooms.

Overall, the X-ray examination rooms were found to be adequately shielded for the protection of workers, patients, and the Public. However, variations in radiation exposure were observed between different provinces and types of X-ray examinations. Instantaneous dose rates in and around CT rooms were generally higher than in other rooms. The highest recorded dose rate was found behind the leaded glass window of a general X-ray room at Makkah-1 hospital, exceeding even those in CT scan rooms. The study highlights the importance of regular assessments of shielding adequacy and the need for continued efforts to improve radiation protection practices in diagnostic radiology departments.

Abstract ID: 070

Remediation of Uranium-Contaminated Groundwater Utilising Adsorption via Fe-Metal Organic Frameworks adsorbent

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Abstract:

Uranium pollution in groundwater constitutes a significant global concern owing to the element's radioactive and toxic characteristics, which provide substantial public health hazards, including renal impairment and heightened cancer rates, while also jeopardising environmental ecosystems through bioaccumulation. Contemporary remediation techniques sometimes encounter obstacles concerning expense, intricacy, and ineffectiveness, especially in groundwater containing conflicting ions. This study aims to investigate the development and application of a novel iron-based metal-organic framework (Fe-MOF) for the adsorption of uranium from contaminated water. Fe-MOF was synthesised via the solvothermal method, wherein iron nitrate nonahydrate and Imidazole interacted in methanol under regulated heating, resulting in the creation of a novel crystalline structure capable of uranium adsorption. X-ray diffraction (XRD) validated the effective synthesis of the Fe-MOF combination, whereas Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray Spectroscopy (EDS) elucidated its surface shape and elemental composition. Batch adsorption studies were performed to evaluate critical operational parameters, such as contact time, pH, temperature, and adsorbent dosage. A maximum uranium adsorption of 64.9% was attained at 35°C, demonstrating a strong pH dependence, with best removal at pH 4. The augmentation of Fe-MOF dosage markedly enhanced the adsorption ability, achieving a maximum removal rate of 62.80% at 100 mg. Competing ions, including lead (Pb) and chromium (Cr), affected the adsorption efficiency; nonetheless, the Fe-MOF exhibited significant selectivity for uranium. The research finds that Fe-MOF is an efficient, freshly synthesised chemical for uranium extraction, providing a cost-effective and feasible alternative for the remediation of uranium-contaminated groundwater, even amidst competing ions. These findings offer significant insights for enhancing MOF-based adsorbents in environmental remediation applications.

SHI and Gamma Irradiation Induced Modifications of Engineering Polymers/ SSNTDs and Their Potential Applications

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Abstract:

In this talk we are briefly described the basic methods of radiation/ion beam-induced modification of engineering polymers and their applications. Swift Heavy Ion and Gamma irradiation techniques are playing a crucial role for modifications in structural, chemical, optical and surface morphological properties of materials. The energy loss of the incident ions described by the mean depth at which particle is embedded. Trajectory of incident ion described by the elastic and inelastic collision, high energetic ions (>2MeV) interact in elastically with the target and electronic energy stopping (Se) occur similarly low energetic ions (It has been well established that when polymers are subjected to radiations (ions or gamma radiations), the processes like radical formation, chain scission, cross-linking, formation of double or triple bonds, etc. take place with the emission of light gaseous products. The efficiency of these modifications depends on the structure of materials/polymers and the ion beam parameter (energy, fluence, mass, charge etc.) and nature of the target. Positron Annihilation Lifetime Spectroscopy (PALS) is a unique, non- destructive technique and capable of determining size distribution, fraction and density of free volume holes in polymers. Ortho-positronium (o-Ps) pick off annihilation lifetime, the long-lived component in the lifetime spectra, is very sensitive to structural changes in the polymers and is correlated directly to the free volume hole size. The industrial and biomedical high grade quality polymers were purchased from Good fellow, U.K. and Bayer A.G., Germany and some polymers were synthesized by chemical method. Solid State Nuclear Track Detectors were irradiated and exposed to gamma radiation at different fluencies and different doses at Variable Energy Cyclotron Centre (VECC), Kolkata, India and Inter University Accelerator Centre, New Delhi, India. After modified engineering polymers/materials by SHI and Gamma radiation were characterized by different techniques such as: Positron Annihilation Lifetime Spectroscopy (PALS), Atomic Force Microscopy (AFM), Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR) and UV-visible Spectroscopy. The aim is to investigate the behaviour of the effects of the irradiation as well as gamma radiation as the size of the nano scale free volume in SSNTD's material is varied. The results will be discussed during the presentation.

Abstract ID: 072

Exploring the 100 MeV Titanium Ion Beam Irradiation Effects on the Structural, Optical and Chemical Properties of PTFE Polymer Films

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Abstract

Polytetrafluoroethylene (PTFE) polymers are very adaptable in a variety of applications due to their distinctive qualities, which include low friction, great chemical resistance, exceptional heat stability, and non-stick qualities. PTFE's dielectric strength, thermal stability, and chemical inertness make it ideal for insulation in ion beam sources, ion implantation masks, and sample holder coatings [1]. The structural and chemical properties of this polymer can be altered by high energy ion beam irradiation. The durability, accuracy, and effectiveness of the ion beam equipment are enhanced by PTFE through component protection, enhanced material selectivity, and reliable operation in high-energy and high-radiation environments [2]. Under regulated energy and scan rate settings, several PTFE sheets were subjected to 100 MeV titanium ions in an ion fluence range of 10^{11} to 10^{12} ions/cm^2. Multiple characterisation techniques were then used to analyse the irradiated materials such as X- ray diffraction (XRD), UV- visible, Fourier transform infrared (FTIR) spectroscopy, scanning electron microscopy (SEM) and atomic force spectroscopy (AFM). The detailed results will be addressed during the presentation.

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Abstract ID: 073

Impact of High Energy (MeV) Titanium Ion Beam Irradiation on the Physico-Chemical Properties of PMMA Films: A Comprehensive Analysis

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Abstract

Ion beam therapy serves as a powerful technique for altering the properties of polymeric materials. This process involves the deposition of substantial energy, resulting from the inelastic interactions of highly energetic ions (MeV range) with the orbital electrons in the polymer material. These interactions help to modify the physico- chemical properties of the polymers [1]. Among the category of various polymers, PMMA is a polymer that is susceptible to ion beam. It shows drastic modifications of structural, optical, chemical and electrical properties under controlled ion beam therapy [2-3]. The different PMMA films were irradiated with 100 MeV Titanium ions in the ion fluence range of 10^{11}-10^{13} ions/ cm^2 under controlled energy and scan rate circumstances. The irradiated samples were characterized with different techniques. To look for changes in the polymer's structural nature, degree of crystallinity, and average crystallite size following ion irradiation, structural investigations were performed using X- ray diffraction. FTIR and UV-visible spectroscopy were used to gather further information on the changes in optical and chemical properties, respectively. The surface modifications were analysed using SEM and AFM studies. Results will be discussed.

References:

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Abstract ID: 074

Influence of Low Energy Ion Beam on WO_3-SnO_2 Nanocomposite Thin Films for NO_2 Gas Sensing Properties

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Abstract

The various nanostructured materials have attracted significant attention in the domain of gas sensing on account of various active sites on the surface, high specific surface area, and also exhibit crystal facets with significant surface reactivity. These types of gas sensors are predominantly utilized for quality of air, breath and environment analysis. Among various gas sensors metal oxide nanocomposites have attracted significant attention in the past few years on account of promising fast response, sensitivity and appreciable selectivity. Also elevated demand for health and environmental monitoring, the sensors are required to exhibit low detection limits in ppb range, higher selectivity and response and also display real time monitoring. There are distinct ways to enhance the sensing ability like functionalization of sensing materials, fabricating heterojunction and using field effect as gas sensor. Various efforts have been made to enhance the gas sensing properties of metal oxide-based gas sensors like doping, with distinct metal functionalization, fabrication of heterojunction and engineering of morphology. Post-treatment of sensing layers like irradiation is considered to be significant route to engineer the sensing characteristics of various sensing materials. Here in the present work, we probe the prospect to explore the WO_3-SnO_2 nanocomposite thin films and study the fundamental mechanism of gas sensing for ion beam implanted nanocomposite materials at different fluences from 1×10^{15}, 5×10^{15}, and 1×10^{16} ions/cm^2. The morphological, optical and crystal structure of pristine and ion beam implanted thin films were studied by various characterization techniques like X-ray diffraction (XRD), UV-Visible, PL spectroscopy, X-Ray photoelectron spectroscopy (XPS), Raman spectroscopy, Atomic force microscopy (AFM). The results will be discussed during the presentation.

Abstract ID: 075

Ion Beam Engineering of WO_3-TiO_2 Nanostructured Thin Films Grown by RF Sputtering

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Abstract

Swift heavy ion beam is a unique method for introducing numerous alterations of solids that include track creation/formation, atomic transport, phase transition etc. The defects created by ion beam treatment of different metal oxides alter the morphological, structural, and optical characteristics. When energetic ions pass through target materials, they produce two types of energy losses i.e nuclear and electronic energy loss. In swift high energy ion beam treatment of thin films, electronic energy loss dominates nuclear energy loss. As a consequence, the present work we conducted by SHI is based on the alteration of the characteristics of tungsten oxide and titanium dioxide (WO_3-TiO_2) nanostructured thin films grown by RF sputtering method on glass and silicon substrates. The thin films were irradiated by a 100 MeV titanium (Ti) ion beam with various fluences at 1×10^{12}, 5×10^{12}, 1×10^{13} and 5×10^{13} ions/cm^2. The effect of ion irradiation on surface topography of nanocomposite thin films was analysed by Atomic Force Microscopy (AFM). The optical properties were studied using UV–visible spectroscopy and Tauc's method was used to calculate the optical energy band gap. The structural properties were studied by X-ray diffraction (XRD) and Raman spectroscopy. The chemical composition of pristine and swift ion beam irradiated WO_3 thin films at varying fluences was investigated by X-ray photoelectron spectroscopy (XPS). The detailed results will be discussed during the presentation.

Abstract ID: 076

Enhancing Backscatter X-Ray Imaging: An Advanced AI Algorithm for Material Identification

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Abstract:
This research presents an innovative artificial intelligence (AI)-based system designed to enhance material identification in backscatter X-ray imaging system. Traditional backscatter X-ray systems, although effective in identifying organic chemicals, frequently have difficulties in precisely distinguishing between various material types in intricate settings. To address this restriction, we created a machine learning model specifically engineered to assess backscatter data and classify materials according to their distinct scattering characteristics. The algorithm was trained on a comprehensive dataset of diverse materials using deep learning and pattern recognition techniques, leading to enhanced detection accuracy and classification efficiency. Initial findings indicate the algorithm's ability to accurately recognize and distinguish various material kinds, implying potential uses in security screening, industrial inspection, and medical imaging. This breakthrough signifies a substantial progression towards more dependable, efficient, and accurate backscatter X-ray imaging systems, with extensive applicability in real-world contexts where precision is critical.

Abstract ID: 077

Enhancing Landmine Detection Using Backscatter Gamma Imaging: A Comparative Study of Cs-137 and Co-60 Sources for Subsurface Identification

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Abstract:
Landmine detection is a significant challenge that plays a crucial role in enhancing safety. This study explores the feasibility of using backscatter gamma imaging for identifying buried landmines. Initially, Geant4 Monte Carlo simulations were conducted to model the interactions of gamma rays with buried landmine targets. To ensure the validity of these simulations, experimental verification was performed with a mobile backscattering system. Subsequently, the study investigates the effectiveness of two gamma sources, Cs-137 and Co-60, in detecting landmines at various depths through further Geant4 simulations. Results indicate that Co-60, due to its higher gamma energy, offers improved penetration, detecting landmines buried at depths of up to 7.5 cm with slightly enhanced accuracy compared to Cs-137. These findings demonstrate the potential of Co-60-based backscatter gamma imaging for shallow-depth landmine identification and provide a basis for future work in optimizing detection capabilities for field applications

Abstract ID: 078

TeO_2: as a key component in improving radiation shielding of B_2O_3-based glass systems

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Abstract:

New glasses with enhanced radiation shielding characteristics have potential applications in different fields requiring radiation protection. This works aim to develop new B_2O_3-TeO_2-5Bi_2O_3-20ZnO-CaO glass systems for radiation shielding application. The concentration of TeO_2 increases from 15 to 30 mol%, resulting in an increase in the density from 4.070 to 4.498 g/cm^3. The nuclear radiation shielding properties for the prepared glasses were determined using Phy-X software in the 0.122-0.968 MeV energy range. The results revealed that increasing the TeO_2 led to an increase in the linear attenuation coefficient. Conversely, the tenth value layer (TVL) decreased. The mass attenuation coefficient ratio between the two glasses with 30 and 15 mol% TeO_2 remained above one, suggesting that the glass with higher TeO_2 content had better attenuation performance. The half value layer (HVL) values of the tested glasses were also compared at 0.245 MeV, and the HVL values are equal to 0.687, 0.661, 0.637 and 0.614 cm for the glasses with 15, 20, 25 and 30 mol% TeO_2 respectively. The radiation protection efficiency values for all the prepared glasses are close to 100% at 0.122 MeV, demonstrating their full shielding capability against low energy radiation.

Abstract ID: 079

Investigating the Potential Use of Different Adsorbents to Mitigate Soil Contamination

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Abstract:

This research will address the topic of soil contamination that results from radiological or heavy metal impact. Many radiological or heavy metal source emit harmful substances such as lead, and toxic nuclides like cesium. These dangerous substances accumulate in the soil, and the plants absorb them through their roots. This is harmful to us as humans because these are carcinogenic substances and can cause altered DNA and cell mutations. It is also detrimental to the environment because it reduces agricultural productivity, by killing microorganisms in the soil and causing plant issues like stunted growth, chlorosis, and dysfunctional photosynthesis. So this research will focus on using adsorptionbased remediation techniques to treat the soil. This can be done using silicates, bentonites, and zeolites which have been investigated in this research with the objective to enhance the environments surrounding nuclear institutions or any heavy metal source. This research aims to find an ideal adsorbent with ideal application methods to help mitigate polluted soil. Methods like ICP-MS were used to analyze the differences in concentration of the substances found in soils before and after contamination + remediation like cesium with zeolite, and SEM to investigate the chemical components of the soil before and after a contaminant and adsorbent were used like lead with silicate. Throughout this investigation, it has been concluded that lead is very ideal in being absorbed by the soil, reaching Almost 100% with or without an adsorbent, but especially with silicate. In addition, Cesium showed outstanding results with one of the zeolites used reaching 86% adsorption which could be investigated further. This means that we can study the ideal soil conditions and ratios to reach 100% adsorption. This is relevant to the research because it helps direct us to the next step to reaching the ideal adsorbate, and soil conditions; to tackle the issue of soil pollution and minimize the risk of contamination spreading.

Abstract ID: 080

Assessment of radiation protection practices in dental clinics in Jeddah, Kingdom of Saudi Arabia

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Abstract:

Radiation use has increased, including increased demand for dental rays where radiosensitive organs (thyroid gland and eyes) are often exposed. Therefore, dental clinic workers' awareness and practices of radiation therapy require assessment. We therefore assessed the awareness of radiation protection protocols among dental clinic workers in Jeddah. This cross-sectional study determined risks associated with dental radiography. Questionnaires were completed during visits to different dental institutions and clinics, including educational institutions and private and general medical centres. The questionnaire assessed dental workers' perceptions of radiation exposure and the risks associated with dental radiography. Differences between categorical data were analysed using the chi-squared test or Fisher's exact test, as appropriate. Of 300 participants who completed the questionnaires, most (in their 20s [132, 44%]; 30s [107, 36%]) were general dentists, followed by dental assistants, radiographers, and endodontists. There were 133, 106, 38, 10, and 4 participants working at private institutes, university hospitals, regional general hospitals (>300 beds), general sector (<300 beds), and other hospital types, respectively. Overall, 55, 97, 66, 39, 18, and 25 participants had <1, 1-5, 6–10, 10-15, 16-20, and >20 years of experience, respectively. More than half of dental clinic workers were highly knowledgeable about radiation protection, aware of its significance for both patients and staff, and actively sought information about it. However, general hospital dental practitioners had the least radiation protection practices; therefore, general hospice radiation protection awareness is recommended.

Abstract ID: 081

What imaging modality is best for diagnostic accuracy of axillary lymph node in breast cancer patients?

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Abstract:

Accurate detection and staging of axillary lymph nodes in breast cancer are essential for treatment planning and prognosis. Imaging modalities such as ultrasound (US), magnetic resonance imaging (MRI), and mammography play a critical role in assessing nodal involvement. This study aimed to evaluate advancements in these imaging techniques, compare their diagnostic accuracy, sensitivity, and specificity, and assess their clinical utility and limitations in preoperative staging and treatment monitoring. A retrospective analysis was conducted on 47 breast cancer patients who underwent US, MRI, and mammography for axillary lymph node assessment, with histopathological findings as the reference standard. Diagnostic performance metrics, including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy, were calculated. MRI demonstrated the highest sensitivity (72.2%) and overall accuracy (66%), with moderate specificity (62.1%). Both US and mammography showed lower diagnostic performance, with accuracies of 59.6% each. Invasive ductal carcinoma (IDC) was the most common subtype (74.5%), and no significant associations were observed between affected side, breast cancer subtype, and patient age. MRI is the most sensitive imaging modality for axillary nodal staging but has limitations in specificity and cost. A multimodal imaging approach may enhance diagnostic accuracy and improve patient management. Further research should explore advanced imaging techniques and cost-effective strategies to optimize outcomes.

Abstract ID: 082

Radon and Thoron Concentrations in Rural Aligarh Homes: Insights into Exposure Risks and Environmental Health

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Abstract

The findings of this research uses LR-115 type-II plastic track detectors with a twin chamber dosimeter to assess indoor radon and thoron concentrations as well as inhalation doses in different types of dwellings in the rural Aligarh District of India. Radon (CRn) and thoron (CTh) levels were tested in 100 residences over a three-month period, with an emphasis on the impact of ventilation techniques and building materials. The findings show that there is a large variation in radon concentrations, with average values of 13.6 ± 2.7 Bq/m³ and maximum levels of 53.9 ± 5.3 Bq/m³. Thoron concentrations average 6.51 ± 0.8 Bq/m³. Interestingly, radon levels were greater in unplastered homes than in plastered ones, especially those with granite floors. According to the study, homes close to industrial regions had noticeably higher radon concentrations, perhaps as a result of the increased radioactive element content of the soil and building waste. With an average dosage of 1.6 mSv/y, the inhalation dose estimates varied from 1.0 to 2.4 mSv/y, falling short of the 3 mSv/y action threshold set by the International Commission on Radiological Protection. These results highlight the possible health hazards of indoor radon exposure in the area, especially for particular home styles. This study is important because it shows how urgently awareness and mitigation measures about radon exposure in Indian homes are needed. It establishes the foundation for upcoming studies and public health campaigns targeted at lowering exposure risks in rural areas, ultimately leading to better environmental health standards, by offering vital data on indoor radon and thoron levels.

Abstract ID: 083

Microscopic evaluation of nanoparticle dose enhancement by inverse Compton scattering source using Monte Carlo simulation

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Abstract:

Radiotherapy with nanoparticles has been widely investigated, showing an energy dependence performance. However, a radiation device providing energy tuneable X-ray is challenging for clinical usage. Therefore, a compact radiotherapy equipment providing energy tuneable X-rays is required and Inverse Compton Scattering (ICS) source can offer quasi-monochromatic and continuously energy tuneable X-rays, enabling optimization of radiation enhancement effect for various nanomaterials. This study simulated enhanced radiotherapy at microscale with an ICS source using the Geant4. A combination of Livermore and DNA physic list was used for simulating the energy deposition in an improved tumor model. The dose enhancement factor (DEF) of two typical nanomaterials, i.e., gold nanoparticles (GNPs) and hafnium oxide, was evaluated and compared with the conventional X-ray tube. DEF of GNPs showed an energy dependence and the largest DEF of GNPs was 17.89 at 36 keV with monochromatic beam. ICS source displayed a similar performance in term of DEF (17.88 at 34 keV), which was higher than X-ray tube (12.80), due to the narrow bandwidth. Given the different properties of nanoparticles and tumour arrangement, the optimal energies were different. The simulation model was further improved showing DEF for GNPs and hafnium oxide were 22.82 and 9.25, at 28 keV and 24 keV, respectively. In conclusion, the implementation of an ICS source, with a higher DEF at optimal energy, is feasible for enhanced radiotherapy. The continuously energy tuneable property makes it possible the application of enhanced radiotherapy with different nanomaterials and the compact footprint of ICS source sheds light on the future clinical application of nanoparticle enhanced radiotherapy. Future works will focus on the multiscale simulation and experiment.

Abstract ID: 084

Advanced Spectroscopic Techniques for Enhanced Detection of Radon Gas in Varied Environments

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Abstract:

In this study, the detection and evaluation of radon gas concentrations across various environments, specifically targeting water, ice, air, and vacuum, were advanced. Radon, a naturally occurring radioactive gas, poses significant health risks, making accurate measurement crucial. Advanced techniques such as Stopping and Range of Ions in Matter (STIM) and Rutherford Backscattering Spectrometry (RBS) were employed to achieve this goal. A proton beam was utilized as the primary radiation source, allowing for the identification of energy characteristics and intensities of transmitted and reflected proton beams that interact with radon gas. Considering the high costs associated with experimental setups and the complexity of measuring specific radon concentrations, Monte Carlo simulations were applied to assess how proton energy responses vary across different radon concentrations. This simulation approach not only minimizes the financial burden of physical experiments but also enhances the accuracy of radon measurements by enabling controlled variations in radon levels. Specific energy values were revealed that exhibit distinct increasing or decreasing trends correlated with varying radon concentrations. These energy signatures serve as reliable indicators for detecting radon presence in diverse environments. Overall, this study contributes to the development of more effective radon detection methods, highlighting the potential of advanced spectroscopy techniques combined with simulation-based assessments to optimize measurement accuracy under various environmental conditions.

Keywords: Radon detection; STIM spectroscopy; RBS spectroscopy; Monte Carlo simulation; Proton beam; Radon concentration

Abstract ID: 085

Neutron activation analysis of palaeontological samples at the VR-1 training reactor

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Abstract:

The isotopic structure reveals information about an object's composition, his origin, usage history, and movement, as well as the metabolic cycles of elements in living organisms and the changes in elements after death, burial, and fossilization. For study of cultural heritage, the non-destructive analytical techniques represent the most appropriate tools. One such method is neutron activation analysis (NAA), which can provide valuable compositional data on archaeological samples, assisting archaeologists and palaeontologists by identifying elemental markers that facilitate the comparison of fossil samples across various archaeological sites. At the low-power Training Reactor VR-1, palaeontological samples from the Pavlov I and Milovice IV archaeological sites in the Czech Republic were analysed using instrumental NAA. Fragments of mammoth, historical wolf, and reindeer remains, provided by the Institute of Archaeology of the Czech Academy of Sciences, were irradiated in a vertical channel with a thermal neutron field ($\varphi = 2\times10^9$ $cm^{-2}s^{-1}$) at the maximum reactor power (80 W). Nuclear gamma-ray spectrometry enabled the determination of the composition of the activated samples, and identifying elements such as Al, Mg, Na, Cl, K, As, Fe, Sr, Mn, Br, I, Ba, Au, and U. The concentrations of Na, Sr, Mg, Al, As, K, and U were successfully measured. These isotopic markers can be useful in tracking the migration patterns of individuals, understanding their choice of locations, assessing the level of fossilization, and analysing depositional and post-depositional history. This research at the VR-1 training reactor aims to showcase the potential of NAA in the social sciences and humanities, highlighting its capacity to expand interdisciplinary, non-destructive research possibilities.

Abstract ID: 086

Investigating the impact of various Nanoparticle materials at different concentrations as radiosensitizers for proton therapy using Geant4 toolkit

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Abstract:

Radiotherapy purposes to deliver a concentrated radiation dose to the tumour, several researchers have suggested using nanoparticles (NPs) to enhance dose distribution within the tumour volume. NPs in radiation therapy function by doping specific materials inside the tumour, thereby increasing the therapeutic radiation dose within the tumour through enhanced scattered radiation from the NPs. There are specific materials can be used as radiosensitizers, such as Au, Gd, Pt, Ag, and Bi due to their unique characteristics, such as their strong photon attenuations of photons, higher mass-energy absorption coefficients in comparison with soft tissues, biocompatible and low toxicities, allowing for an increased dose to the target without impacting surrounding healthy tissue. This study investigates the impact and physical characteristics of these NPs of different concentrations during proton therapy, using Geant4 toolkit. The simulation model involves a water phantom positioned 300 mm along the Z-axis from the beam nozzle of the pencil proton beam. The phantom dimensions of 20×20×40 cm, incorporating a sensitive target with a volume of 1×1×1 cm doped with different NPs elements of different concentrations. Twenty simulation models were conducted, each irradiated with a 70 MeV pencil proton beam to evaluate the impact of NPs as radiation dose enhancers, compared to case without NPs in the target volume. The results indicate an increase in electron production ratios ranging from 15 to 110, with Au and Pt producing the highest electron output due to their high electron density, where there is a correlation between electron production and NPs concentration. Additionally, nuclear reaction rates, such as (p, g) and (p, n), increased by factors of 1.1 to 1.5 and 1.1 to 1.3 for g-ray and neutron emissions, respectively.

Abstract ID: 087

Radiation Processing for Developing PVA-alginate Biomaterials: Properties Evaluation and Characterization

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Abstract:
Synthetic materials produce microplastics, and the scarcity of natural resources as an alternative to petroleum-based materials concerns sustainable bio-materials development. Natural polymers have been utilized in different sectors due to their biocompatibility, biodegradability, and availability. The alginates as natural polymers have been characterized as producing degradable biofilms using the casting method. The samples have been examined using GPC-MALLS, SEM-EDS, DSC-TGA, and FTIR for both treated and untreated samples of sodium alginate. The alginate films (thickness: 0.08 and 0.144 mm) were irradiated to examine their physico-mechanical properties. The molecular weight (Mw) reduction (84 %) and viscosity average molecular weight (Mv) reduction (69 %) caused sensitivity to γ-radiation. The sample showed high sensitivity to radiation and depicted that the Mw decreased because of γ-radiation and Mw> Mv. The gelling ability showed an increasing trend in adding salt ($CaCl_2$) with Ca^{2+}, whereas glucono-delta-lactone (GDL) performed a good hard hydrogel production. The neat alginate and alginate-polyvinyl alcohol-based biofilms showed remarkable changes causing the radiation on their physico-mechanical properties. The remarkable microstructural images observed porous structure which may be interconnected porosity with alginate also observed. Induced radiation created a strong bond on alginate films, and they absorbed higher energy for glass transition. The hydrogel of PVA-alginate is a good study for biodegradable packaging materials for reducing synthetic packing materials. Thus, the experiment's findings have shown significant interaction in the characterization and evaluation of the samples for developing sustainable biomaterials.

Keywords: Alginate, biofilms, characterization, mechanical properties, PVA-alginate films, solubility

Abstract ID: 088

Feasibility of a Silver Chloride-Infused Polyvinyl Alcohol (PVA) Dosimeter Enhanced with Zinc Oxide Nanoparticles for Therapeutic Dose Range Applications in Radiotherapy

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Abstract:

This study aims to evaluate the use of silver chloride (AgCl) and zinc oxide (ZnO) nanoparticles within a polyvinyl alcohol (PVA) matrix as a promising 3D dosimeter for clinical radiotherapy applications. Initially, radiochromic gel dosimeters were prepared by incorporating AgCl into PVA, with further enhancements achieved by adding ZnO nanoparticles to the PVA-AgCl formulation. Dosimeter samples were then irradiated with high-energy photons (X-rays) at doses up to 30 Gy, using a medical linear accelerator with photon energies of 6 MV and 10 MV and a dose rate of 600 cGy/min. The optical response of both unirradiated and irradiated dosimeter samples was measured using UV-Vis spectroscopy, capturing absorbance changes indicative of dose exposure. Upon irradiation, the initially transparent dosimeter samples developed a grey hue, with peak absorbance recorded at 435 nm. UV-Vis analysis recorded a strong linear correlation in dose response (R^2 better than 0.9889) and a sensitivity of 0.00955. This analysis demonstrated a clear, direct correlation between absorbed dose and color change, with the ZnO nanoparticle enhancement improving dose sensitivity. The PVA-AgCl-ZnO dosimeter exhibited high sensitivity, excellent dose linearity, and independence from dose rate and energy, marking it as a promising candidate for precise 3D dosimetry. In conclusion, this newly developed PVA-based dosimeter, enriched with AgCl and ZnO nanoparticles, shows strong potential for advanced applications in radiotherapy dosimetry.

Keywords: polyvinyl alcohol, silver chloride, zinc oxide, 3D dosimetry, radiotherapy

Abstract ID: 089

Evaluation of Hospital Preparedness for Responding to Nuclear and Radiological Emergencies in Kingdom of Saudi Arabia

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Abstract

Aiming to evaluate and enhance preparedness measures across various facilities. The research utilized a mixed-methods approach, incorporating quantitative surveys distributed to facility managers and qualitative interviews with emergency responders and regulatory officials. Data were gathered from a diverse range of nuclear and radiological sites to assess existing emergency response protocols, training effectiveness, and resource allocation. Results revealed significant discrepancies in preparedness levels; many facilities lacked comprehensive emergency response plans and regular training exercises. Furthermore, the study identified critical communication gaps between facility operators and local emergency services, which could impede timely and effective responses during a crisis (Harris et al., 2021; Smith & Lee, 2020). Facilities that engaged in proactive training and established collaborations with local agencies reported higher readiness levels, highlighting the importance of community involvement in emergency planning (Johnson, 2022). The findings indicate an urgent need for standardized readiness guidelines and enhanced cooperation among all stakeholders to create a cohesive emergency response framework. The study concludes that improving FRNRE is vital for minimizing risks associated with nuclear and radiological incidents. Recommendations include the development of uniform training programs, implementation of regular drills, and the establishment of robust communication networks. These initiatives are crucial for strengthening overall readiness, ensuring public safety, and protecting the environment against potential nuclear and radiological threats. By addressing the identified gaps and promoting best practices, facilities can significantly enhance their preparedness and response capabilities (World Health Organization, 2019).

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Abstract ID: 090

The use of fabricated Ge-doped optical fibres and TLD-100 in the preliminary small field photon dosimetry audits

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Abstract:
This study compares the feasibility of two germanium (Ge)-doped optical fibre types, cylindrical (CGedOF) and flat (FGedOF), in comparison to the commercial detector of TLD-100 powder, for their application in radiotherapy small-field dosimetry audits. The investigation encompassed the assessment of response sensitivity, dose-response linearity, signal fading, field size (FS), dose rate, and beam energy dependence under 6- and 10 MV photon beams. A preliminary small-field dosimetry audit was conducted to evaluate the accuracy of the absorbed doses measured with these detectors versus the TPS. The results demonstrated that the mean sensitivity of CGedOFs (1.001 ± 0.53%) was marginally superior to that of FGedOFs (1.004 ± 1.00%), whereas that of TLD-100 was unity. At 56 days post-irradiation, CGedOF exhibited the highest signal fading (23.6%), followed by FGedOF (10.7%), and TLD-100 (8.2%). When normalised to 10 cm × 10 cm FS, the detectors' response varied significantly with FS, ranging from 0.968 – 0.971 (2 cm × 2 cm FS) and 0.987 – 0.997 (2 cm × 5 cm FS). All detectors indicated dose rate independence, with a measurement uncertainty of < 1.07% at 100 – 600 cGy/min. TLD-100 appeared to be the least energy-dependent (< 1.0% variation) compared to CGedOF (< 8.8%) and FGedOF (< 8.9%). The preliminary audit results from two radiotherapy centres (10 beams) revealed that the ratio of the dose determined by the detectors to the dose calculated by the TPS was within the acceptance limit of ±5%. The combined uncertainty of absorbed dose determined from CGedOF, FGedOF, and TLD-100 was estimated to be 1.8%, 2.6%, and 1.5%, respectively. In conclusion, the evaluation of GedOFs revealed highly favourable characteristics, indicating significant potential for use as an alternative detector in radiotherapy small-field dosimetry audits.

Keywords: Ge-doped optical fibres, TLD-100, small field dosimetry audit

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Abstract ID: 091

Studies for experimental imaging of in-phantom absorbed dose in BNCT and Hadron Therapy

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Abstract:
There is a growing interest towards radiotherapy methods that exploit the high linear energy transfer (LET) and the high relative biologic effectiveness (RBE) of slow charged particles, such those generated in thermal-neutron reactions $^{10}B(n,\alpha)^{7}Li$ (in boron neutron capture therapy, BNCT) and protons or carbon ions at the end of their path (in Hadron Therapy). For the treatment planning of both such radiotherapies, it is necessary to evaluate the RBE-weighted absorbed dose. For dosimetry purposes, it would be advantageous to perform in-phantom imaging of the absorbed dose. Non-gaseous detectors, which are necessary to obtain dose images, show a reduction of sensitivity with increasing the LET of radiation. This topic was studied in our laboratory both for BNCT and Hardon Therapy. In the case of BNCT, the problem can be solved more simply, despite the multiplicity of neutron interactions in tissue. The charged particles generated by the ^{10}B reaction always have the same energies which they release inside the cell itself so that, by means of appropriate detector calibration, precise results can be attained. Dissimilar calibrations, with suitable methods, allow to obtain the other components of the absorbed dose, important for determining the dose in healthy tissue. Concerning Hadron Therapy, the peculiarity is that, for a patient treatment, hundreds of pencil-beams (PBs) of charged particles with different energies are required, so that each position in the treated volume is reached by particles with different energy, LET and RBE. The proposed solution consists in the correction of the acquired images using a dedicated software that requires data to be determined for the used PBs, such as PB broadening versus depth and dosimeter sensitivity quenching as a function of depth and of initial particle-energy. The proposed methods have been applied to Fricke-gel dosimeters and EBT3 films and the results have confirmed their reliability.

Estimation of Effective Radiation Dose for Adult and Pediatric in Computed Tomography Examinations

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Abstract:

Effective dose estimating in routinely computed tomography (CT) scans reveal the likelihood and risk of developing cancer, especially in youngsters who are particularly radiosensitive. The purpose of this study is to estimate the reference effective dose for adult and pediatric patients undergoing common (head, chest and abdomen) CT examinations. And to establish local Diagnostic Reference Levels (DRLs). Data for 425 patients: (224 (52.72%) pediatric and 201 (47.29%) adult patients) whole-body CT scans were collected from four different hospitals/centres in Khartoum state, Sudan. These are Alya Hospital (A), Alzaytouna Hospital (B), Ibn AL Haitham Specialist Hospital (C) and Modern Medical Center (D). using the following machines: two Toshiba Aquilion 64 slices, one Siemens Sensation 16 slices and one General Electric 16 slices. The effective dose was calculated during whole-body scans using the dose-length product (DLP) which is provided automatically by the scanner multiplied by a conversion factor following (ICRP 2007 publication 102). Measurements were acquired for the head, chest and abdomen of both pediatric and adult patients. The mean effective dose (mSv) results were: 2.94 for pediatric and 6.79 for the adult patients; 3.57 mSv for paediatrics and 2.13 mSv for adult patients; 3.16 mSv for pediatric and 4.59 mSv for adult patients for head, chest and abdomen respectively. The DRLs for aforementioned examinations established depending on third quartile of CTDI and DLP of data. The study found significant variations that can be attributed to a variety of factors, including manual errors from the technologist due to the lack of professional training which may lead to using the same protocols for adults and paediatrics, or other technical error like not activation tube current modulation, that maintain image quality and radiation dose according to signal to noise ratio detection.

Keywords: Pediatric; adults; effective dose; cancer risks; whole-body computed tomography; radiation hazards.

Abstract ID: 094

Study of the higher frequency response of superheated emulsion detector to neutrons from (p,n) reaction

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Abstract

Superheated emulsion detector (SED) has its widespread applications in neutron dosimetry due to its unique sensitivity to neutrons while insensitivity to gamma-rays or cosmic muons under controlled threshold of the detector. In addition to the neutron dosimetry, it is also been used as neutron spectrometry and dark matter search experiment. For such applications, the characterization of the response of the detector to neutrons of various energies is essential. In the present work, the high frequency response of SED has been measured with quasi-mono-energetic neutrons from Li(p,n) and Be(p,n) reactions and the results are compared with the measurement from the 241Am-Be source. The experiment has been performed at the cyclotron, VECC, Kolkata, India with proton beam of energy 10MeV at the average room temperature of 16.9 ± 0.3°C. The quasi-mono-energetic neutrons were produced by the 7Li and 9Be targets separately with the proton beam of current 3.5 nA from the cyclotron. The SED has been fabricated at the laboratory by suspending the droplets of the superheated liquid, C2H2F4 (b.p. -26.3oC) in aquasonic gel matrix. The acoustic pulses were acquired by the high frequency acoustic sensor of frequencies higher than the audio frequency until about 1 MHz and the data was collected by a programmed LabView hardware and software. The collected data has been analysed using a PYTHON code for the Pvar and FF parameters. The similar experiment has also been carried out with the neutrons from 241Am-Be source at the laboratory. The results show that the Pvar - FF distribution is wider for the quasi- mono -energetic neutrons and narrower for the Am-Be neutron which is opposite as observed earlier at the low frequency. The present study is important to calibrate the detector for the neutron detection at higher frequencies with SED.

Abstract ID: 095

Assessment of Radiation Exposure Levels in Patients Undergoing Diagnostic X-ray Procedures

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Abstract:
This research focused on the radiation dose patients received during seven common X-ray procedures at King Khalid Hospital in Majmaah. The study involved 712 patients, comprising 528 males and 184 females. The effective dose (ED) and effective surface air Kerma (ESAK) at the patient's entrance were calculated based on the X-ray tube's output and exposure parameters. These values were then used to compute conversion coefficients, which help convert the measured physical quantities into effective doses, an essential factor in radiation safety. The analysis also included the examination of the 75th percentile distributions of ESAK and KAP. The results were compared with findings from researchers in different regions of the country and abroad. Uncertainty values (U) are reported along with the mean data for entry surface air Kerma (ESAK), kerma area product (KAP), and effective dose in this paper. All X-ray procedures resulted in measured values of ESAK (0.15–5.2 mGy), KAP (0.11–1.54 Gy

A technological review on the application of artificial intelligence in radiotherapy

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Abstract:
Radiotherapy is a prevalent mode of treatment among cancer patients. The radiation treatment field has witnessed significant advancements in the last three decades. Recent technological progress, such as robotics, intensity modulation, and three-dimensional visual navigation, has paved the way for the next substantial progression—artificial intelligence (AI). AI is poised to supplant manual labor-intensive tasks through its technological sophistication, enhancing precision and uniformity. Given the escalating social burden of cancer patients, the need for efficient and standardized management is imperative. Artificial intelligence's novelty can potentially improve real-time capabilities, particularly in personalized and adaptive radiation, with enhanced imaging for real-time intervention. Moreover, artificial intelligence possesses the ability to synthesize and analyze vast databases. This article underscores the pivotal role of AI in augmenting imaging and treatment planning, conducting quality assurance, and predicting outcomes in the context of radiation therapy. The review will expound on deep learning and more traditional machine learning methodologies.

Abstract ID: 097

Enhancing HTGR Spherical Fuel Element Fabrication via Optimized Dispersion Fuel Pressing Techniques

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Abstract:
High-Temperature Gas-cooled Reactors (HTGR) are advanced nuclear reactors that use helium as a coolant and graphite as a moderator, allowing for high thermal efficiencies and the potential for hydrogen production. HTGRs offer enhanced safety, high thermal efficiency, and fuel integrity at extreme temperatures, making them ideal for sustainable and versatile nuclear power applications. It commonly uses TRISO (Tri structural-isotropic) fuel which consists of uranium fuel particles encapsulated in multiple protective layers, enhancing safety by containing fission products even under extreme conditions. TRISO fuel fabrication is challenging due to the precise layering required for each particle, strict quality control to ensure fission product containment, and the need for advanced materials to withstand high temperatures. This work presents an in-depth analysis of the dispersion fuel press process for HTGR, focusing on the optimization of key parameters that influence the quality of HTGR fuel elements. Through comprehensive simulations performed utilizing COMSOL Multiphysics (FEM), this study systematically investigates the effects of pressing pressure and TRISO-coated particle count on the stress during the press process of spherical fuel elements. Further, the Mises stress distribution within a graphite sphere embedded with TRISO coated particles is thoroughly investigated under two different applied pressures (20 MPa and 35 MPa) to determine the effect of stress behaviour.

Abstract ID: 098

A systematic review study of computed tomography DRLs in Saudi Arabia: Highlighting discrepancies with SFDA guidelines and the importance of CTDIvol

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Abstract:

Due to the increasing number of Computed Tomography (CT) examinations, and the importance issue of radiation dosage reduction, a systematic review was conducted, aimed to ensuring the average radiation doses published from previous studies were within the scope of the recommendations issued by the Saudi Food and Drug Administration (SFDA) report. This review was implemented in the Taif city carried in the first third of 2024. Data was collected through published studies across different databases including Web of Science, Pub Med, Google Scholar, and Science Direct, as well as three main organizations, International Commission on Radiological Protection, International Atomic Energy Agency and SFDA. Following the collection of 18 studies in Kingdom of Saudi Arabia (KSA) and a same number globally, the average values for adults in CT chest, brain, and abdomen/pelvisexaminations conducted in KSA were as follows: based on the volume computed tomography does index (CTDIvol) (14.23, 47.5 and 21 mGy), and for dose length product (DLP) were (397, 882.3, and 662.97 mGy.cm) respectively, globally were (12.49, 49.69 and 14.8 mGy) based on CTDIvol while for DLP were (512, 1000.1 and 939.4 mGy.cm) respectively. For pediatric brain examinations in KSA for ages (0-5 years) and (6-15 years) based on the CTDIvol were (23.84, 32.79 mGy) and for DLP (386.65, 606.94 mGy.cm respectively, while for international published literature the average were (25.75, 49 mGy) and for DLP (349.25, 290.5 mGy.cm) respectively. The average doses for brain and chest examinations in KSA fell within the range of SFDA guidelines. However, the abdomen/pelvis examination exceeded the SFDA recommended range, this review highlights the need for further efforts to optimize CT protocols in KSA, particularly for abdomen/pelvis examinations, to ensure compliance with SFDA guidelines and minimize radiation exposure to patients. Future studies should focus on assessing CTDIvol index to align with SFDA guidelines

Abstract ID: 099

Macroscopic symbol ɯ transferring cross section from microcosmos to macrocosmos

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Abstract:

We are living in the macrocosmos. Consider a beam of radioactive particles, t.ex. neutron or photon. The intensity of radiation is reduced by a homogeneous layer of the thickness x. Pierre Bouguer (1698-1758) was the first, who found log(I/I0) = -µx. Logarithmus of radiation intensity is a linear function of the absorbing layer x. µ is called the linear attenuation coefficient. We consider different kind of attenuation events as absorption and scattering of atoms. An event has microscopic value σ, cross section. We starts to find those cross section values for elements in tabulations. Let us suppose that the beam has the transverse section A. We must start from microcosmos of atoms. We take the microscopic value of the cross section σ given in units b (barn = 10-28 m2). Every atom has its own σ, a cross section area. The values σ of different type cross sections are tabulated from different measurements made around the world. They vary with energy. The attenuation of the beam logarithmus depends also linearly on the density of the matter. We know that a mole of matter has the number N = 0.602 1024 atoms. N is the number of Avogardo. The matter has the number of N$\boldsymbol{\rho}$/M, i.e. density of atoms. M is the mass of the atom in matter. When one considers the attenuation of radiation, then for each atom is an area σ, which must be multiplied with N$\boldsymbol{\rho}$/M to get the density of the attenuation events. In the layer dx the attenuation of intensity dI = -I N$\boldsymbol{\rho}$/MdxAσ/A = -Nσ/M$\boldsymbol{\rho}$dx. Now we define Nσ/M= ɯ. ɯ is a new symbol for radiation physics. It has been called the mass attenuation coefficient for photon (Hubbell, Selzer). For neutron ɯ$\boldsymbol{\rho}$(=µ) is called the macroscopic cross section (Beckurts, Wirtz). With integration we find I/I0 = exp(-ɯρx), where thus ɯ is the new symbol (the letter ɯ is the letter a or alpha in Armenian).Both ɯ,$\boldsymbol{\rho}$ and x have the similar position. You see that I/I0 = exp(-µx), where µ = ɯ$\boldsymbol{\rho}$. The last law can be written: ɯ = µ/$\boldsymbol{\rho}$. If you have n layers of different matters xi thick, then in the exponent is the sum ɯi$\boldsymbol{\rho}$ixi, for i∢[1,n]. For scatterings often the consideration of the build-up factors are demanded — Let us think that one goes the length s = km in time T = 10 min. The other asks velocity and one writes s/T = 6 km/h, instead of v = 6 km/h, of walk.

Abstract ID: 0100

A Study of Secondary Particles Production from Carbon Ion Beam for Radiotherapy.

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Abstract:

Precise radiotherapy using carbon ion therapy hinges on effective monitoring of radiation dose distribution within a patient's body. This accuracy is vital for targeting tumors while protecting surrounding healthy tissues. In our study, Monte Carlo (MC) simulations were employed to track secondary proton doses produced by a 4.48 GeV carbon ion beam. Initial Geant4 simulations identified secondary particles (including protons, gamma rays, alpha particles, neutrons, and tritons) generated from carbon ion interactions with water, allowing us to analyze their relationship with the carbon ion beam. Interaction Vertex Imaging (IVI) was particularly useful for dose monitoring, as it mapped the origins and quantities of secondary particles, especially protons. IVI leverages ion fragmentation's charged particles to track their trajectories, helping to determine range information from their origin, or vertex. Our simulations revealed a significant correlation between certain secondary particles and the range of the carbon ion beam. We noted an increase in generated protons with deeper target depths, due to the growing inelastic cross-section as energy diminishes. Nonetheless, our findings indicated that multiple Coulomb scattering could cause notable deviations between the reconstructed proton path and the primary beam, especially at lower energy levels. Additionally, among various photon types, 4.4 MeV photons exhibited the strongest spatial correlation with dose deposition. Using straight-line trajectory analysis and Si detector positions, we developed a back-projection algorithm to reconstruct vertices, confirming a close match between reconstructed and actual positions.

Abstract ID: 0101

Standardization and Optimization of Diagnostic Reference Levels for CT Imaging of the Chest, Abdomen, and Pelvis in the Madina Region, Saudi Arabia

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Abstract:

Objective: This study aimed to establish region-specific Diagnostic Reference Levels (DRLs) for CT scans of the chest, abdomen, and pelvis in the Madina region of Saudi Arabia, addressing concerns regarding ionizing radiation exposure.

Methods: A detailed analysis was conducted to compare radiation doses from CT imaging with national and international DRLs. Data from multiple healthcare facilities in the region were statistically evaluated to establish optimal DRLs that balance diagnostic effectiveness with patient safety.

Results: The study identified DRLs for the chest, abdomen, and pelvis that either match or fall below current national and international standards. The proposed DRLs for CTDIvol were 10.9, 11.8, and 13.9 for the chest, abdomen, and pelvis, respectively, and 394.2, 569.4, and 748 for DLP, reflecting a conservative approach to reducing radiation exposure.

Conclusions: These findings underscore the importance and practicality of developing localized DRLs to enhance patient safety in CT imaging. By aligning these levels with global benchmarks, the study contributes to the ongoing international discussion on radiation safety and serves as a model for region-specific optimization in radiological practices. This approach is essential for maintaining high standards in patient care and radiological safety.

Abstract ID: 0102

Measurement of Neutrons on a Solar Eclipse Day using Superheated Emulsion Detector

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Abstract:

Superheated Emulsion Detector (SED) consists of a large number of micron-sized droplets of superheated liquid suspended in a visco-elastic gel. The droplet of the superheated liquid vaporizes when energy is deposited by the particle or radiation passing through the SED. It is known to detect neutrons, gamma-ray etc under certain operating temperature and pressure range. The SED used in the present experiment has been prepared in our laboratory by dispersing the droplets of R-134a liquid. In the present experiment, a measurement has been carried out on a solar eclipse day to study the neutrons during the solar eclipse. The variation of neutron-induced counts for the background on a normal day and a solar eclipse day has been studied. The experiment was carried out at the laboratory in SINP, Kolkata, India on 26 December 2019 which was an annular solar eclipse day that started at 8:06 am and the eclipse ended at 11:10 am. Another measurement was done on 31 January 2020 at the same place for the similar duration (~ 3.08 hrs) and with similar experimental set up. The SED was placed in a water bath by controlling the temperature at 40 ± 1 ^{o}C and the acoustic signals were measured using an acoustic sensor. The analysis indicates that the bubble nucleation counts both on solar eclipse day and normal day are mostly from the neutrons. The experimentally observed count shows that the initial count rate is higher on the day of the solar eclipse compared to the normal day. The expected count rate of bubble nucleation for the background neutron on a normal day has also been calculated. The measurement with the present setup shows an enhancement of the neutron-induced count on a solar eclipse day as compared to the normal day.

Abstract ID: 0103

Utilizing dual-energy mouse Cone-beam CT for proton animal treatment planning

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Abstract:
In small animal studies, computed tomography (CT) provides crucial three-dimensional (3-D) data to support effective pre-clinical experimental planning. In proton therapy, accurate dose calculations depend on converting CT numbers to relative stopping power (RSP), While Single-Energy CT (SECT) has been the standard, Dual-Energy CT (DECT) is emerging as a more effective alternative, offering higher accuracy of Stopping Power Ratios (SPR). This study aims to develop a Hounsfield unit calibration for animal cone-beam CT (CBCT) using both single-energy and dual-energy CT to advance proton therapy research. For this purpose, an electron density phantom with known elemental composition underwent CBCT scanning at 40 and 60 kV. For SECT, stopping power ratios were calculated by applying stoichiometric calibration to CT numbers from the 60 kV scan, while DECT utilized Saito's method (2017) to enhance RSP calculations. Accuracy was assessed by comparing SPR values from both methods to theoretical SPR values derived from Bethe's formula, with root mean square error (RMSE) used as the evaluation metric. The results confirm that animal CBCT provides adequate image quality, comparable to small animal CT, is suitable for effectively visualizing internal organs, and accurate Hounsfield unit data for RSP estimation, with dual-energy CBCT applicable for establishing the calibration curve. Dual-energy CBCT demonstrated lower sensitivity than the stoichiometric calibration approach, achieving an RMSE of 1.03% compared to 1.71% for single-energy CBCT. The maximum differences between the reference and calculated values were -1.4% (for cortical bone) and 4.04% (for skeleton bone -ribs) for DECT and SECT, respectively. This indicates dual-energy CBCT's theoretical advantage in estimating SPRs for animal CBCT over the stoichiometric method. The study demonstrates that dual-energy animal CBCT is a reliable tool for pre-clinical proton therapy research and can enhance the accuracy of these studies.

Abstract ID: 0104

The 12th International Topical Meeting on Industrial Radiation and Radioisotope Measurement Applications (IRRMA-12)
Riyadh – Saudi Arabia, 26 – 30 January 2025

Scanning protocol influence on relative electron density-CT number calibrations and radiotherapy dose calculation for a Halcyon Linac

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Abstract:

Purpose: Tissue Relative Electron Density (RED), determined via CT-based Hounsfield Unit (HU) values, is affected by CT scanning parameters, particularly tube voltage and current. This study examined the effects of these parameters on RED-CT number calibration curves to improve dose calculation accuracy in radiotherapy treatment planning. Methods: An electron density phantom (CIRS) was scanned at 200 mAs with tube voltages of 80, 110, and 130 kVp. Corresponding images were used to generate RED-CT number conversion curves. Treatment plans were created for each voltage, with the 130 kVp plan as the reference. Comparisons were made via isodose distribution and dose analysis. Results: Tube voltage had the greatest impact on high-density materials, such as bone, while low-density materials showed less variation. CT numbers for a titanium rod remained consistent regardless of voltage or current. Tube current had minor effects on calibration curves at higher voltages but was more pronounced at lower settings. Beam hardening artifacts caused by high-density materials in the phantom influenced RED values for other plugs, emphasizing the need for protocol adjustments to minimize these artifacts. Conclusion: Accurate RED-CT number conversion is significantly influenced by high-density materials, which cause beam hardening artifacts, impacting dose calculation precision. The study highlights the importance of optimizing CT scanning protocols to minimize artifacts and improve the accuracy of RED values in radiotherapy treatment planning.

Abstract ID: 0105

Detection and quantification of uranium in solid samples with non-destructive X-ray fluorescence analysis

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Abstract:
Detection of uranium and its quantification in solid samples is important in several fields. These are characterization of uranium ore deposits in geology, contamination of an environment after uranium mining and processing, detection of the illegal transport or manipulation wirh nuclear materials in nuclear forensics, and even an analysis of uranium glass in objects of a cultural heritage. Uranium is a radioactive element, but due to the long half-life of its main isotopes, it shows very low specific activity. In addition, its radioactive decay is followed by low intensity of emitted X-rays and gamma radiation. Therefore, the detection of traces of uranium cannot be based on measurements of uranium radioactivity. On the other hand, an instrumental analytical method, X-ray florescence analysis (XRF), enables quick and non-destructive analysis of various materials with a good spatial resolution. This paper summarizes the XRF techniques which are suitable for analyses of various samples with the different uranium content and the different aims of the investigations. The handheld XRF devices are intended for an analysis of rather larger areas (at least a couple of millimeters in diameter). They are useful for investigation of uranium glass or for an initial survey of geological samples. A detailed analysis of geological samples requires large area XRF mapping or micro-XRF mapping of uranium and other elements. They make us possible to draw correlations between individual elements, and thus to characterize the deposits. On the other hand, identification of traces of nuclear materials must be performed with XRF setups specialized on detection of these heavy elements, whereas signal of other elements should be suppressed. Such XRF devices with monochromatic or narrow excitation X-ray spectrum can achieve low detection limits.

Abstract ID: 0106

Radioisotopes Produced at King Faisal Specialist Hospital and Research Centre.

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Abstract:
More than 15 Radioisotopes produced at King Faisal Specialist Hospital and Research Centre (KFSH&RC) to manufacture radiopharmaceuticals for more than 40 years. We will discuss the production method of the isotopes, target and targetry configuration. We will high light the development in the production method and Cyclotron and Radiopharmaceuticals Production activities within the forty years to match the available technology and the increasing demand for Radioisotopes, the production of radioisotopes specially very short half-life enabled the hospitals in the Kingdom of Saudi Arabia to perform patient's investigations and diagnosis that can't be done without the availability of these isotopes locally. For the excellence work and activities, the department recognised as training centre by the International Atomic Energy Agency and some of our staff recognised as External Expert Since 1994.

Abstract ID: 0107

Impact of rare earth oxides on the gamma radiation shielding features of borate based glasses

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Abstract:
Three glass sample with the formula 70B2O3-10CaO-10Na2O-5ZnO-4BaO-1M, where (M=Er2O3, Nd2O3 or CeO2) were prepared using the melt quenching method to examine their radiation shielding properties. The radiation shielding behavior of these glasses was investigated using Phy-X software over the energy range of 0.015-15 MeV, focusing on the impact of component on their shielding features. The densities of these glasses are 2.879, 2.856 and 2.869 g/cm3 for those containing Er2O3, Nd2O3 and CeO2, respectively. The linear attenuation coefficient (LAC) for the glasses follows the order: Er2O3>Nd2O3>CeO2. The maximum LAC is found at 0.015 MeV, with values of 46.46, 41.05 and 36.95 cm-1for glasses containing Er2O3, Nd2O3 and CeO2, respectively. The LAC decreases with increase the energy, with a significant difference observed between the LAC values at 0.015 and 0.02 MeV. The effective atomic number ($Z_e$ff) was calculated, with the maximum $Z_e$ff observed in the photoelectric effect region: 31.02 at 0.015 MeV, 30.82 at 0.02 MeV, and 25.94 at 0.08 MeV for the glass containing Er_2O_3.The half value layer (HVL) was calculated at different energies. The HVL for the three glasses was found to be 0.015, 0.017 and 0.019 cm for the glass with Er2O3, Nd2O3 and CeO2, respectively. The HVL increases with increase the energy, with one expectation at 0.04 MeV, where the HVL shows a sudden decrease. The mean free path (MFP) for the glasses was reported, and the effect of the radiation energy and the chemical composition of the glasses on the MFP was discussed. The MFP follows the order: Nd2O3> CeO2> Er2O3. The MFP at 0.1 MeV found to be 0.726 cm for the glass containing Er2O3, 0.826 cm for the glass containing Nd2O3, and 0.937 cm for the glass containing CeO2.

Abstract ID: 0108

Effect of ZnO particle size on the gamma-ray shielding ability of the $45B_2O_3$-30BaO-25ZnO glass system

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Abstract:

New glass compositions, including the $45B_2O_3$-30BaO-25sZnO system, have been investigated, where 's' represents the ZnO particle size (Micro, Nano, and Micro+Nano). The morphological characteristics and various sizes of ZnO particles were analyzed prior to the glass preparation process. Three glass compositions of varying thicknesses were prepared using the melt-quenching technique. Their shielding characteristics were experimentally evaluated using the narrow beam method with an HPGe detector, various gamma sources, and a lead collimator. The experimental linear attenuation coefficients (LAC, cm^{-1}) at 0.060 MeV were 15.154, 15.483, and 16.032 cm^{-1} for Micro, Nano, and Nano+Micro particle sizes, respectively. The LAC data were further used to calculate other radiological parameters, including the half-value layer (HVL), mean free path (MFP), and tenth-value layer (TVL). Furthermore, the radiation shielding efficiency (RSE) of the prepared glass materials was evaluated. The RPE of all three glass types was determined, revealing that the sample containing nano ZnO exhibited the highest RPE. The relative deviation among the nano, micro, and nano/micro glass samples was also analyzed, highlighting differences in LAC values, with the nano-glass consistently showing higher values across all energies. The results suggest that nano-sized ZnO particles play a crucial role in optimizing the gamma-ray shielding capabilities of borate glasses, underscoring their potential for advanced radiation protection applications.

The Saudi National Diagnostic Reference Levels (NDRLs) - Nuclear Medicine

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Abstract

The Saudi Food & Drug Authority (SFDA) has led the first governmental initiative to establish the Saudi National Diagnostic Reference Levels (NDRLs) in the Kingdom of Saudi Arabia. This is to promote dose optimization in alignment with international guidance as well as the SFDA strategic objectives. The SFDA previously published the Saudi NDRLs for various imaging modalities, including CT, general X-ray, and mammography. Now, the SFDA is extending the NDRL project to include nuclear medicine. The SFDA has established the NDRLs in nuclear medicine for commonly performed protocols, such as tumor imaging, bone imaging, thyroid imaging, myocardial perfusion imaging, and renal imaging. The SFDA collected the administered dose activity in Megabecquerel (MBq) for the selected protocols from several major hospitals across the Kingdom to diversify the patient population and geographic location. This will maximize diagnostic effectiveness while minimizing unnecessary radiation exposure. This extension to the NDRL project advocates for dose optimization in nuclear medicine. In the future, the SFDA will consider establishing NDRLs for additional imaging modalities. This will significantly advance the regulatory framework for medical imaging in the kingdom, promoting continuous quality improvement and national standards for radiation safety and medical imaging.

Abstract ID: 0110

Experimental Study on Borotellurite Glasses: Unveiling the Radiation Attenuation Effects of BaO and Er_2O_3

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Abstract:
Ionizing radiation is useful in many scientific and technological applications. Radiation protection is essential for safeguarding individuals, electronics, the environment, and animals, while also ensuring the preservation and expansion of its applications. Glass is one of the most commonly used materials for radiation shielding purposes. This work focuses on the preparation of borotellurite glasses doped with heavy metal oxides such as BaO, Bi_2O_3, and Er_2O_3, and the investigation of their radiation attenuation parameters. A narrow beam experiment was conducted to evaluate the attenuation factors of the prepared glasses. A positive relationship was observed between the linear attenuation coefficient (LAC) and the concentration of Er_2O_3, whereas an inverse relationship was noted between the LAC and the energy of the radiation. The LAC for the Er_2O_3-free glass at 0.059 MeV is 19.729 cm^{-1}, while for the sample with 3 mol% Er_2O_3, it is 26.113 cm^{-1}. As the energy increases to 0.662 MeV, the LAC for the Er_2O_3-free glass and the glass with 3 mol% Er_2O_3 are 0.426 cm^{-1} and 0.461 cm^{-1}, respectively. The mean free path (MFP) of the glasses exhibited an inverse relationship with increasing Er_2O_3 content, as the MFP decreased with the addition of more Er_2O_3. For the glass containing 1 mol% Er_2O_3, the MFP values are 0.046 cm, 2.285 cm, and 3.556 cm at 0.059 MeV, 0.662 MeV, and 1.173 MeV, respectively. The half-value layer (HVL) was calculated, and the results indicated that the addition of Er_2O_3 causes a decrease in the HVL, suggesting an improvement in the radiation attenuation performance of the prepared glasses as more Er_2O_3 is added.

Abstract ID: 0111

Gamma radiation shielding effectiveness of PbO_2-doped borosilicate glasses: transmission factor and attenuation analysis

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Abstract:

In this study, the integration of PbO_2 into a borosilicate glass system was investigated for enhanced radiation shielding properties. Glass samples with varying PbO_2 concentrations (31, 33, 35 and 37 mol%) were prepared using the melt-quenching method. The density of the glasses increases from 4.579 to 5.044 g/cm^3 as a result of increase the PbO_2 content. The radiation attenuation factors were experimentally determined at 0.059, 0.662, 1.173 and 1.333 MeV, using HPGe detector. The results indicate that increasing PbO_2 content notably influences the mass attenuation coefficient and the effective atomic number. The tenth value layer (TVL) increased significantly with rising energy levels. For the glass sample containing 31 mol% PbO_2, the TVL increased from 0.177 cm at 0.059 MeV to 5.325 cm at 0.662 MeV, and to 9.094 cm at 1.333 MeV. Similarly, for the glass with 37 mol% PbO_2, the TVL increased from 0.146 cm at 0.059 MeV to 4.733 cm at 0.662 MeV, and to 8.231 cm at 1.333 MeV. The results also showed that PbO_2 has an inverse effect on the TVL, where adding more PbO_2 leads to a decrease in the TVL. At 0.662 MeV, increasing the PbO_2 content from 31 to 37 mol% reduces the TVL by approximately 11.12%. The transmission factor (TF) for the glass with a thickness of 2 cm was investigated, and results showed that the TF is nearly 0 at 0.059 MeV, indicating that the glass provides complete shielding at this low energy. The TF increases with rising energy, reaching 37.8–42.11% at 0.662 MeV, indicating that more photons penetrate the glass as the energy increases.

Abstract ID: 0112

Radiation Shielding and Waste Recycling: CRT Glass in Polyester Resin Composites

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Abstract:

This study evaluates a composite material composed of polyester resin combined with crushed cathode ray tube (CRT) glass for its effectiveness in shielding against ionizing radiation, particularly gamma rays. The research aimed to assess the attenuation and mechanical properties of polyester resin composites incorporating varying amounts of CRT glass to evaluate their gamma radiation shielding efficiency. Six composite samples were prepared with varying proportions of CRT glass (0% to 50%) mixed with polyester resin (100% to 50%). These samples were exposed to gamma radiation across an energy range of 0.060 to 1.333 MeV. The linear attenuation coefficients (LAC) were measured using a high-purity germanium (HPGe) semiconductor spectrometer. The experimental results were compared with theoretical values calculated using the Phy-X program, demonstrating strong consistency between the two. In addition to the LAC, other critical parameters were calculated, including the mass attenuation coefficient (MAC), transmission factor (TF), and mean free path (MFP). The sample with the highest CRT glass content (poly-CRT-50) showed the best shielding performance, with a maximum mass attenuation coefficient of 0.4054 cm^{-1} at the lowest energy level of 0.060 MeV, highlighting its excellent attenuation capabilities. The study concluded that incorporating CRT glass significantly improves the shielding effectiveness of polyester resin against gamma radiation. The findings suggest that composites made from polyester resin and CRT glass are effective materials for radiation protection, particularly against ionizing photons. This research holds promise for advancing waste management and electronic waste recycling while contributing to the development of innovative materials for radiation shielding applications.

Abstract ID: 0113

Borate glasses for radiation protection: efficiency boost through Nd_2O_3 and BaO inclusion

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Abstract:

Glass is necessary due of its transparency, compared to other materials. Due to its distinctive characteristics, radiation shielding applications have started using it, especially for optical clarity. This study investigates the radiation shielding properties of borate glasses and evaluates the effect of BaO and Nd_2O_3 on their half value layer, radiation protection efficiency and other related shielding parameters. The density of the glasses increases from 3.610 to 4.316 g/cm3 as the Nd_2O_3 content increases from 2 to 8 mol%. The linear attenuation coefficient (LAC) was measured using narrow beam geometry, and the results were validated through Phy-X software. A strong agreement was observed between the two methods, with the difference in LAC values obtained from experimental measurements and Phy-X software being less than 7% at all energy levels. The half value layer results showed a decrease in the thickness of the glasses needed to shield 50% of the photons as the concentration of Nd2O3 increased. The half value layer decreases from 0.097 cm to 0.043 cm at 0.059 MeV due to the increase in Nd2O3 from 2 to 8 mol%, which suggest that a HVL decreases by 44%. The half value layer decreases from 0.097 cm to 0.043 cm at 0.059 MeV as the concentration of Nd_2O_3 increases from 2 to 8 mol%, indicating a 55.7% reduction in HVL. At 0.662 MeV, the HVL decreases by 17.9% as the content of Nd_2O_3 increases from 2 to 8 mol%. The radiation protection efficiency (RPE) results indicate an improvement in the glasses' ability to shield photons with add more Nd_2O_3 content. The RPE increases from 23.9% to 28.3% at 0.662 MEV and from 18.4 to 21.4% at 1.173 MeV due to increase the Nd_2O_3 content from 2 to 8 mol%.

Abstract ID: 0114

Study of the influence of micro-and nano-scale ZnO particles on the radiation shielding capability of B_2O_3-PbO-BaO-ZnO glass system

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Abstract:

In the present work, a new glass series consisting of 45 mol% B_2O_3, 20 mol% PbO, 15 mol% BaO, and 20 mol% ZnO was fabricated using ZnO particles of varying sizes: 20 µm (micro ZnO), 20 nm (nano ZnO), and a combination of 10 µm + 10 nm ZnO. Three glass samples were fabricated with different thicknesses. The ionizing photon shielding ability was measured experimentally using various point gamma sources, including ^{241}Am, ^{60}Co and ^{137}Cs, along with high-purity-germanium (HPGe) detector. The attenuation capability was assessed by calculating the linear attenuation coefficient (LAC) and related parameters, including half value layer (HVL) and radiation protection efficiency (RPE). The RPE of all three glasses was determined, with the sample containing nano ZnO exhibiting the highest RPE. The relative deviation among the nano, micro and nano/micro-composite glasses was analyzed, with the nano-glasses exhibiting higher LAC values across all energies. The experimental mean free path (MFP, cm) at 0.059 MeV (emitted from ^{241}Am) was 0.066, 0,064 and 0.062 cm for the micro, nano and nano+micro glasses, respectively. The results in this work demonstrate the potential of nano-sized ZnO particles to improve the radiation protection performance of the lead borate glasses for different shielding applications.

Abstract ID: 0115

The impact of PbO2 in PbO2-BaO-CaO-B2O3-Y2O3 glass: Physical, Mechanical and shielding characterization

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Abstract

In this study, the effect of lead (IV) oxide (PbO_2) on the properties of PbO_2-BaO-CaO-B_2O_3-Y_2O_3 glasses was evaluated. An increase in glass density from 4.204 to 4.725 g/cm³ was observed as the PbO_2 concentration increased from 10% to 19%, indicating structural changes. These changes resulted in enhanced elastic properties, with young's modulus rising from 30.110 to 30.944 GPa and the bulk modulus from 17.653 to 17.860 GPa. The transmittance factors (TF) were assessed at various glass thicknesses, revealing that higher PbO_2 concentrations reduced the TF, indicating improved gamma radiation shielding. Additionally, the half-value layer (HVL) values decreased with increasing PbO_2 content across all tested energies, confirming that glasses with higher PbO_2 content exhibit superior shielding performance compared to those with lower concentrations. The transmission factor is zero at 0.059 MeV, indicating that the glasses provide complete shielding against very low-energy gamma radiation. As the energy increases to 0.662 MeV, a significant rise in the transmission factor (TF) is observed, with values reported as 71%, 69%, 68%, and 67% for the prepared glasses. This indicates a reduction in the attenuation performance of the glasses at higher energy levels. The maximum transmission factor (TF) is observed at 1.33 MeV, with a TF of approximately 80%, indicating that a significant proportion of photons can penetrate the glasses, leaving only about 20% effectively shielded.

Abstract ID: 0116

Radioactivity and Attenuation Efficiency of different Ceramic Samples Selected from Different Countries

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Abstract

A study was conducted to evaluate the natural radioactivity of seven ceramic samples selected from different countries and analyze their ability to reduce or absorb gamma rays. The study included measuring the concentrations of natural radionuclides, such as Uranium-238, Thorium-232, and Potassium-40, using the high-purity germanium (HPGe) detector technique. The radioactivity rates were measured to determine the extent to which the samples conform to international standards for construction materials. All samples showed natural radioactivity within the permissible limits according to the International Atomic Energy Agency (IAEA) standards. The ability of each sample to attenuate gamma rays was measured using mathematical equations based on the linear attenuation coefficient (LAC), with a focus on common radioactive energies such as Cesium-137 and Cobalt-60 sources. The attenuation efficiency of the ceramic samples varied significantly depending on the material density, chemical composition and the presence of some heavy metals. The LAC at 0.0662 MeV ranges from 1.367 to 1.856 cm^{-1}, while at 1.333 MeV ranges from 0.0892 to 0.1091 cm^{-1}. Some samples showed high attenuation efficiency at low and medium radiation energies, making them suitable for use in engineering applications as radiation barrier materials. This study provides important insights into the potential of ceramics not only as building materials but also as effective radiation barriers. The attenuation properties can be improved by modifications in the chemical composition and addition of density-enhancing components. These results open up prospects for the development of new environmentally friendly and effective radiation shielding materials.

Abstract ID: 0117

Optimizing Radiation Shielding: Superior Performance of Nano-Scale PbO, Bi_2O_3, and WO_3 Composites

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Abstract

In this study, we investigated the radiation attenuation capability of composite materials containing PbO, Bi_2O_3, and WO_3, formulated as solid pellet-shaped samples composed of micro- and nano-sized powders. All samples had the same mass and radius but varied in thickness. An HPGe detector was used to measure the number of photons penetrating the samples, with photon energies selected in the range of 60 to 1333 keV from Am-241, Co-60, and Cs-137 γ-ray sources. Our evaluation focused on empirically comparing the radiation shielding properties of micro- and nano-sized samples using six parameters: Linear Attenuation Coefficient (LAC), Mean Free Path (MFP), Half Value Layer (HVL), Tenth Value Layer (TVL), Transmission Factor (TF%), and Radiation Shielding Efficiency (RSE%). The analysis of these results showed a clear superiority of nanocomposites in radiation shielding compared to microcomposites across all six parameters. At an energy level of 0.0595 MeV, the LAC for PbO in nano and micro forms is 24.557 cm^{-1} and 23.567 cm^{-1}, respectively. For Bi_2O_3, the LAC values are 24.419 cm^{-1} for nano and 16.042 cm^{-1} for micro. Similarly, for WO_3, the LAC is 16.257 cm^{-1} for nano and 15.784 cm^{-1} for micro. At 0.662 MeV, the LAC for PbO in nano and micro forms is 0.544 cm^{-1} and 0.531 cm^{-1}, respectively. These findings indicate that with PbO, Bi_2O_3, and WO_3 in both micro and nano sizes at equal masses, it is possible to create lighter and more efficient radiation shields using the nano-sized composites.

The 12th International Topical Meeting on Industrial Radiation and Radioisotope Measurement Applications (IRRMA-12)
Riyadh – Saudi Arabia, 26 – 30 January 2025

Implementation and Validation of Beam Models for the Elekta Synergy Linear Accelerator

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Abstract:

This study assesses and compares the actual beam parameters with those calculated by the treatment planning software (TPS) on the Elekta Synergy linear accelerator at Phuc Thinh General Hospital, Vietnam. Photon beams of 6 MV and 10 MV were analyzed for varying field sizes and depths using a three-dimensional water tank phantom (48×48×48 cm^3) to measure the percentage depth dose (PDD) and profile for open fields (2×2 to 40×40 cm^2) and 60^0-wedge fields (5×5 to 20×20 cm^2). Additionally, the same measurement configurations were accurately simulated in the Monaco treatment planning system using a virtual water phantom of dimensions 60×40×60 cm^3. Data were analyzed using the Monaco Commissioning Utility and IBA's MyQA-Accept software. The Gamma index method was applied with 3%/3mm, 2%/2mm, and 1%/1mm criteria to compare calculated and measured point doses. For the 10 MV photon, excellent agreement between the measured and calculated PDD and profiles was observed across all field sizes. The Gamma passing rates were almost 100% when using the 3%/3mm and 2%/2mm criteria. The 40×40 cm^2 field size showed the lowest passing rate for beam profiles when evaluated with the stricter 1%/1mm criterion, but the passing rate still exceeded 85%. A similar pattern was observed for the 6 MV beam, showing strong agreement in both the PDD and dose profiles with the 3%/3mm and 2%/2mm criteria. However, when the more stringent 1%/1mm criterion was applied, the PDD for the 2×2 cm^2 field dropped to 87.5%. Additionally, the beam profile showed lower match rates for larger fields like 30×30 cm^2 and 40×40 cm^2. Point-dose validation revealed absolute dose differences within 1%. This study verifies the accuracy of the beam model and dose delivery while highlighting areas for improvement, such as optimizing the multi-leaf collimator (MLC). Continuous validation is recommended to maintain accuracy and treatment quality.

Abstract ID: 0119

Role of DEXA scan and bone turnover biomarkers clinical assessment of changes in bone density.

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Abstract:
Improvements in bone density/erosion and turnover may not go hand in hand with a positive clinical response to biological anti-inflammatory drugs assesed by disease activity score 28 (DAS28) in RA patients. This study aimed to understand how biologic anti-inflammatory drugs affect bone density, erosion, and turnover in RA patients. We examined bone mineral density (BMD) and bone turnover biomarkers. The study population consisted of 62 RA patients, 49 (79%) of whom were female and 13 (21%) of whom were male. The patients ranged in age from 40 to 79 years old. The patients' BMD was measured using a DEXA scan, and their plasma levels of bone turnover biomarkers CTX and osteocalcin were quantified utilizing an ELISA. BMD of the hip and lumbar spine in responder patients rose after therapy by 0.001g/cm2 (0.11 percent, p0.001 vs. before treatment) and 0.0396g/cm2 (3.96 percent, p0.001 vs. before treatment), respectively. Clinically non-responder patients' DAS28 revealed minor reductions in hip BMD values of -0.008g/cm2 (-0.78 percent, p0.001 vs. before therapy), as well as an improvement in lumbar spine BMD of 0.03g/cm2 (3.03 percent, p0.001 vs. before treatment). After 12 weeks of therapy, the CTX levels in responder patients dropped from 164 125 pg/ml to 131 129 pg/ml. Osteocalcin levels in non-responder patients increased substantially from 11.6 ng/ml to 14.9 ng/ml after 12 weeks of therapy compared to baseline (p = 0.01). Treatment with biologic anti-inflammatory medicines decreases widespread bone loss in RA patients' hip and lumbar spine. The beneficial effects of therapy on BMD were not associated with changes in disease activity of RA patients. Changes in plasma levels of bone turnover biomarkers such as sCTX and osteocalcin confirmed the treatment's beneficial effects.

Abstract ID: 0120

Assessing the radiation shielding potential of borate glasses enhanced with PbO_2, BaO, and Y_2O_3 Additives

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Abstract

As radiation is increasingly used across various professions, it is essential to develop effective radiation shields that protect patients and employees from high-energy photon exposure. Glass is one of the most common materials used for radiation shielding, especially those containing heavy metal oxides. In this work, we developed new borate glasses for radiation shielding, doped with heavy metal oxides (PbO_2 and BaO) and a rare earth oxide (Y_2O_3). The radiation shielding properties of the prepared glasses were experimentally measured using an HPGe detector and various radioactive sources. The results showed that the linear attenuation coefficient (LAC) is high at 0.059 MeV (ranging from 13.662 to 17.979 cm^{-1}) and decreases with increasing energy, reaching minimum values between 0.204 and 0.235 cm^{-1} at 1.333 MeV. The chemical composition is a major factor affecting the LAC, with results showing that the LAC increases as more PbO_2, BaO, and Y_2O_3 are added to the glasses. This suggests that increasing the amounts of these three components enhances the glass's radiation shielding performance. The half-value layer of the prepared glasses is very small at 0.059 MeV, ranging between 0.039 and 0.051 cm. This indicates that a very thin layer of these glasses is sufficient to stop 50% of the incoming radiation intensity. As the energy increases, the HVL also increases (ranging from 1.821 to 2.166 cm at 0.662 MeV), indicating that a greater glass thickness is necessary for applications requiring high-energy radiation.

Abstract ID: 0121

Evaluating the awareness level among radiographers regarding proper handling and safety concerns of radioactive materials in Salmaniya medical complex

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Abstract:
Nuclear medicine (NM) procedures are widely used in hospitals worldwide for both the diagnosis and treatment of ailments. Medical radiation accidents and unintentional events are thus more likely to occur due to their frequent usage and radioactive medical waste, which increases the likelihood and risk of patient and staff exposure as well as accidental or unintentional public exposure. Therapeutic techniques have received additional consideration in this paper’s discussion since they might result in serious contamination events and increase patient risk from incorrect administrations, including tissue responses from radiopharmaceutical extravasation. This study aims to determine and measure the level of awareness among radiographers regarding the proper handling and safety concerns of radioactive materials at Salamaniya Medical Complex (SMC) by handing out an online questionnaire that touches on radioactive material management using a non-probability convenience sampling method. The study will employ a mix of qualitative and quantitative data, collected concurrently rather than sequentially simultaneously through surveys, observations, and dose records. A mixed method allows the strengths of each method to offset the weaknesses of the other, providing a more comprehensive and understanding view of radiographers’ current knowledge of radioactive materials' safe handling according to international safety protocols. Furthermore, this paper reviews findings and presents advice for incident prevention based on studies and discussions from the literature review. The findings indicated a below-average knowledge rate among SMC radiographers. A considerable number of respondents displayed insufficient knowledge of established safety protocols for the handling and management of radioactive materials. To guarantee adherence to radiation safety laws, it has thus been concluded that mandating enhanced education and training in radiation safety principles for all medical personnel is highly recommended.

Abstract ID: 0122

Study of (n, 2n)$(\boldsymbol{n}, \boldsymbol{2n})$ reaction cross section for ^{96}Ru isotope within the neutron energy range of 8-20 MeV

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Abstract

Ruthenium is one of the important isotopes, which are produced as a fission product in nuclear power reactors and used in the reprocessing of spent nuclear fuel. The ^{96}Ru (n,2n)(n,2n) ^{95}Ru reaction cross sections were measured at the 8.34±0.69, 11.39±0.69, 14.21±0.81 and 17.17±0.81 MeV neutron energies by activation technique. The induced γ-ray activity of the targets was measured offline with high-resolution HPGe detector. The ^{7}Li (p, n)(p, n) reaction was used to produce high-energy quasi-monoenergetic neutrons for the target irradiations. The proton beam was used from the 14UD BARC-TIFR Pelletron accelerator facilities at Mumbai, India. The neutron flux was monitored using the standard ^{27}Al (n, α)(n, α) ^{24}Na monitor reaction. The cross sections were also theoretically calculated using statistical model codes TALYS-1.95 and EMPIRE 3.2.2 from 8 to 21 MeV energies by combinations of the different nuclear level densities (NLDs), optical potentials (OMPs) and preequilibrium models (PEQs) as well as γ-ray strength functions (γ-SFs) and this allow the extrapolation to higher neutron energies. In addition, the present measured cross sections data are compared with the existing literature data available at EXFOR database and latest evaluated data of the ENDF/B-VIII.0, JEFF-3.3, JENDL-5.0 and TENDL-2021 libraries. The present results show good agreement with some of the previous experimental data and with the theoretical values calculated by TALYS-1.95 code. In theoretical calculations optimum input parameters were chosen in such a way to reproduce the existing and present experimental cross sections. However, the ^{96}Ru(n,2n)^{95}Ru reaction cross sections at these neutron energies were studied first time to resolve the discrepancy between previous cross sections. Present work will provide better description of the level density models and pre-equilibrium process for the (n,2n)(n,2n) reaction cross sections. The present results will be helpful in nuclear data libraries in the fast neutron energy region, which is primary importance in nuclear technology, fuel structural materials and candidate neutron absorbers.

Abstract ID: 0123

Optimization of Calibration Factors and Recovery Coefficients for Lu-177 SPECT/CT Using Phantoms

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Abstract:

The success of the Lutetium-177 (177Lu) therapeutic approach requires a precise calibration and quantification of the imagine system and the integration of hybrid and voxel dosimetry. This study presents insights gleaned from the Kuwait Cancer Control Center's (KCCC) extensive experience in determining 177Lu calibration factors (CF) and recovery coefficients (RCs). A Jaszczak phantom was filled with 177Lu and a SPECT/CT scan was performed with a dual-energy window protocol. The main photopeak is set to 208 keV ± 10% and scatter correction windows to ±5%. The Jaszczak phantom provided CF values, while the NEMA Image Quality phantom assessed RC across varying sphere-to-background concentration ratios. SPECT acquisition employed MELP collimators with 60 projections (10s/projection, 128x128 matrix, and zoom 1.0). Reconstruction utilized hybrid recon (5i, 16ss) with resolution recovery, scatter correction, and attenuation correction.The CF derived from the Jaszczak phantom was 10.6 CPS/MBq. RCs varied significantly with sphere size, highlighting the dependence of quantification accuracy on spatial resolution. Utilizing RCs for partial volume effect correction and scatter correction were crucial for improving resolution recovery of smaller spheres (<10 mm). This study establishes robust calibration and recovery protocols for 177Lu SPECT/CT imaging, facilitating enhanced accuracy in dosimetry calculations. The use of optimized energy windows and advanced reconstruction algorithms significantly impacts quantification reliability. These findings support the standardization of 177Lu imaging protocols and enable tailoring of Radionuclide Therapy (RNT) directly to individual patients by incorporating patient-specific information.

Abstract ID: 0124

Development of a Web-Based Tool for Single Time-Point Absorbed Dosimetry Calculation Using the Hänscheid Approximation

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Abstract

Lutetium-177 (177Lu) radionuclide therapy has emerged as a promising radionuclide therapy(RNT). The success of this therapeutic approach requires a precise dosimetry method. The Hänscheid dosimetry method provides an efficient RNT dosimetry estimate from a single time point image. This method simplifies dose calculations for 177Lu based therapies, reducing the need for multiple time-point acquisitions. This study presents a novel web-based application to enable dose calculations without the reliance on expensive workstations. A Python-based web application, developed using the Streamlit framework, was designed to implement the Hänscheid approximation. Users input parameters such as: Target organ (e.g., left kidney), Total counts from the imaging system, Time elapsed after administration, imaging acquisition parameters (time per projection, number of images), organ volume, calibration factor of the imaging system.

The app outputs the estimated absorbed dose using the Hänscheid methodology, providing a cost-effective alternative to high-end software solutions. The web app demonstrates accurate dose calculations comparable to those from advanced commercial workstations. It is user-friendly, requires minimal computational resources, and is accessible via any device with an internet connection—validation with clinical datasets: ±10% deviation from Hermes-based calculations. The developed web app offers a practical and accessible solution for absorbed dosimetry calculation using the Hänscheid approximation. It is particularly suited for clinics without access to high-cost imaging workstations, democratizing advanced dosimetry tools for broader clinical use.

Abstract ID: 0125

Distribution and Hazards of Radionuclides in Black Shales: A Case Study in El Hommr Area.

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Abstract:
El-Hommr area is about 20 km away from the Abu Zenima City Southwestern Sinai, Egypt. It is surrounded by medium and low topography post-Paleozoic sediments (sandstone, shale, carbonaceous shale and claystone). The radionuclides concentration were measured using NaI(Tl) detector. This study is mainly discuss the radionuclides distribution and calculate their environmental impacts. The mean activity concentrations of the measured samples of ^{238}U, ^{232}Th, ^{226}Ra, and ^{40}K are 96.04 ± 48.60 Bqkg^{-1}, 117.10 ± 15.80 Bqkg^{-1}, 103.51 ± 18.28 Bqkg^{-1}, and 517.64 ± 70.73 Bqkg^{-1}, respectively, which are higher than the world average concentrations. U-Th relationship and with their ratios confirm the uranium migration out. K intercept with the two radionuclides indicated the role of alteration processes in uranium mobilization. The descriptive statistical analysis for the measured natural radionuclides activity levels in El Hommr black shale samples illustrates the normal distribution of ^{238}U, while the rest are asymmetric. ^{226}Ra and ^{40}K skewed to the lower values left tail, while ^{232}Th distribution skewed to the higher values right tail levels, the tailing feature to the left indicates the migration of ^{238}U, ^{226}Ra, and ^{40}K radionuclides and so lowering their values in the El Hommr samples. From the overall factor analysis, it can be deduced that ^{40}K and ^{232}Th dominantly increase the radioactivity in all samples of El Hommr black shale. The risk factors are lower than the internationally recognized standards, whereas radiological impact are elevated, indicating that the El-Hommr area is unsuitable for use as a construction material.

Abstract ID: 0126

Dosimetric Impacts on Radiation Beam Numbers in Intensity Modulated Radiotherapy (IMRT) Planning for Head-and-neck, Breast and Pelvis Cancer using Halcyon Linear Accelerator

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Abstract:
This study evaluates the dosimetric effects of varying beam numbers (9, 11, and 13) in Intensity Modulated Radiotherapy (IMRT) planning on the Halcyon linear accelerator at ShingMark University Hospital. By comparing different beam numbers, the study seeks to identify the advantages and disadvantages of each approach and provide appropriate recommendations for medical physicists in IMRT planning on the Halcyon system. IMRT plans with 9, 11, and 13 beams were created for patients with common cancer types, including head-and-neck, breast and pelvic cancers. These plans were evaluated based on dose uniformity in the Planning Treatment Volume (PTV), dose coverage for PTV, maximum and minimum doses, and Organ-at-Risk (OAR) dose limits in accordance with RTOG 0615 protocol. The 11-beam plan for breast cancer offers better target coverage, with higher PTV dose coverage and a lower maximum dose than the 9-beam and 13-beam plans. The 13-beam plan reduces the heart's mean dose by 4.91% compared to 11-beam and 10.17% compared to 9-beam, and also lowers the V20 lung dose. For pelvic cases, there was no significant difference in tumor control efficacy between the beam plans (<0.2% variation for D98 and D2 of PTVs), but the 13-beam plan better spares healthy organs, reducing the V40 dose to the bowel by 1.51% and 10.52% compared to 11-beam and 9-beam. For head and neck cancer, the 13-beam plan provides better target coverage and sparing of critical structures, with improved D95% values for the PTVs. Radiation time with the 13-beam plan increases by just 22-25 seconds compared to 11-beam, with higher doses of 170 MU for breast and 200 MU for pelvis cases. The 13-beam approach consistently demonstrates superior performance. It provides better target coverage and dose distribution, while effectively sparing critical structures. For breast cancer, the 11-beam plan can be considered more effective when factoring in both irradiation time and total MU.

Abstract ID: 0127

Application of Volumetric Modulated Arc Therapy (VMAT) for Craniospinal Irradiation Using Elekta Synergy Linear Accelerator at Hue Central Hospital

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Abstract:
Craniospinal irradiation (CSI) is crucial for treating central nervous system malignancies like medulloblastoma and high-risk brain tumors with meningeal spread potentia. Traditional 3D-conformal radiotherapy (3D-CRT) requires multiple field junctions, increasing the risks of dose inhomogeneity and unnecessary exposure to healthy tissues. This study investigates the use of VMAT on an Elekta Synergy linear accelerator with 160 leaf Agility multi-leaf collimator at the Hue Central Hospital, Vietnam. Five pediatric patients were treated using VMAT with a prescribed dose of 23.4 Gy in 13 fractions. Immobilization was achieved using vacuum bags and thermoplastic masks in a supine position. Planning CT scans were performed with 3-mm slice thickness, and treatment plans were created using the Monaco treatment planning system, v6.1.4.0. VMAT plans incorporated two isocenters with overlapping arcs to ensure comprehensive craniospinal coverage. Key parameters, including conformity index (CI), homogeneity index (HI), monitor units (MU), and dose to organs-at-risk (OARs), were analyzed. Mechanical and positional uncertainties, including simulated ±3 mm patient shifts, were also evaluated. The planning target volume (PTV) achieved exceptional coverage, with V95% averaging 99.27 ± 0.52% and hotspot volumes (V107% and V110%) minimized to 1.96 ± 0.39% and 0.05 ± 0.07%, respectively. The CI and HI averaged 0.93 ± 0.02 and 1.06 ± 0.01, indicating outstanding plan quality and dose uniformity. OAR doses, including those for critical structures like the lenses, lungs, heart, and kidneys, adhered to planning constraints, minimizing potential long-term side effects. Treatment efficiency was demonstrated with an average MU of 1197.56 ± 88.49, showcasing the practicality of the approach. This study demonstrates the successful implementation of VMAT for CSI on the Elekta Synergy system. The results highlight excellent PTV coverage, minimal hotspot volumes, and high plan quality with optimal conformity and homogeneity indices. Doses to OARs remained within safe limits, minimizing potential adverse effects.

Abstract ID: 0128

Research on advanced high-precision noninvasive beam detectors for radiotherapy linear accelerator

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Abstract:

In radiation medicine, FLASH represents an emerging ultra-high dose rate radiotherapy (UHDR). This technique delivers radiation to tumors at extremely high dose rates (exceeding 40 Gy/s or higher) within a very short duration, significantly reducing damage to normal tissues while achieving more effective and safer radiation therapy. However, as FLASH advances, electron beams with energies reaching tens of MeV require larger accelerator systems with increased mechanical dimensions. Conventional medical accelerators only utilize image guidance radiation technology (IGRT) and multi-leaf collimators (MLC) mounted behind the target for beam or radiation collimation, resulting in a lack of more effective methods and tools to monitor and control beam-related parameters. Currently, the accelerator team at Tsinghua University is developing a high-precision beam measurement detector capable of providing noninvasive and accurate beam parameters, such as beam position and beam bunch charge, displayed in real-time on the control interface. The detector primarily consists of electromagnetic sensors and radio frequency electronics, which can ensure non-interfering measurement of the beam without disrupting its trajectory and characteristics. The detector performance has been tested in beam experiments at the Xi'an High-Brightness Light Source, which beam energy is 48MeV. The results of beam position accuracy are 0.93 μm in the x-direction and 0.72 μm in the y-direction. Additionally, the bunch charge resolution reached 0.31 pC. Another beam noninvasive detector has been tested in Tsinghua Thomson Scattering X-ray Source (TTX), the results of beam position measurement accuracy of the X direction is 10um and the Y direction is 5um. Therefore, these two kinds of beam noninvasive detectors can be flexibly selected according to the beam detection requirements of different medical accelerators. In 2025, a high-precision beam measurement detector will operate in a very compact inverse Compton scattering gamma-ray source (VIGAS) to provide support in biological radiation imaging. This technology provides effective data to assess beam quality and support instantaneous high-dose radiation therapy. It provides evaluations of beam parameters for treating tumors at various depths and types, enhancing diagnostics for high-energy medical accelerators and promoting more precise therapeutic procedures.

Abstract ID: 0129

Measurement of reaction cross-section of Yttrium and Zinc at neutron energy of 14.96 MeV

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Abstract:

The application of Yttrium as a high-temperature moderator and Zinc as structural material in nuclear reactors makes them significant constituents in future nuclear energy projects. The previous data on selected reaction cross sections are meagre and discrepant. The D-T fusion reaction was used to produce monoenergetic neutron beam of energy 14.96 MeV. The radioactivity was induced by bombarding the isotopes of Yttrium and Zinc at an incident angle of 0˚. The experiment was performed at the Neutron and Ion beam Irradiation Facility, Institute of Plasma Research, Gujarat (India) using Neutron Activation Analysis and offline gamma-ray spectroscopy. A reference reaction of 27Al(n,α)24Na has been used to estimate the neutron flux. The activities produced in the samples were counted using a pre-calibrated HPGe detector with a resolution of 2.1 keV at 1.33 MeV γ-ray energy of 60Co. Detector Efficiency was calibrated using a parametric function with minimum value of chi-square statistic. An attempt has been made to construct the covariance matrix for uncertainty quantification, and to understand the propagation of various parametrical errors to the final cross section value. Theoretical calculations were performed using Nuclear Statistical codes such as TALYS-2.0 and EMPIRE-3.2.2 by employing different optical model parameters and contribution from various reaction mechanisms. The cross-section values were also produced using default nuclear level density models (NLDs). The results were compared with the previously reported data from EXFOR and Evaluated data from ENDF to refine the nuclear data and to increase the predictive power of Nuclear Simulation codes.

Estimated of fast neutron induced reaction cross section on Indium and Tellurium at 14.96 ± 0.03 MeV

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Abstract:
The estimation of neutron-induced reaction cross sections is significant for various applications in advanced nuclear reactor design, safety monitoring and contributes to improving the accuracy of the nuclear reaction databases. The neutron induced reaction cross sections for Indium (In) and Tellurium (Te) have been measured at neutron energy of 14.96 ± 0.03 MeV relative to the 27Al(n,α)24Na monitor reaction using an activation technique. The 'In' is employed in nuclear reactors for the control rods, radiation shielding, and neutron flux monitoring and 'Te' contributes to reactor's safety owing to its role in volatile fission product behaviour. The experiment was performed at Neutron and Ion Irradiation Facility at Institute for Plasma Research (IPR), Gandhinagar, India. Monoenergetic neutrons were generated via Deuterium-tritium (D-T) fusion reaction where deuterium ions (D+) were accelerated using DC electrostatic accelerator on the stationary Titanium Tritide (TiT) target. The indued gamma activities of the targets were recorded offline using a high-resolution High Purity Germanium (HPGe) detector. In addition to the experimental data, covariance analysis has been used to estimate the uncertainty and correlation between the current experimental data, accounting for the combined uncertainties from all the parameters involved in the measurement. This approach enhances confidence in the data reliability and pinpoints areas requiring refinement. The measured cross section data was scrutinized, compared with the previous reported experimental data (EXFOR) and evaluated libraries (ENDF/B-VIII.0, JEFF-3.3, JENDL-5, TENDL-2023). Theoretical calculations were also included using EMPIRE 3.2.2 and Talys 2.0 codes from threshold to 20 MeV with various statistical models for optical model potentials (OMPs), nuclear level densities (NLDs), pre-equilibrium emissions (PEs), and ϒ-ray strength functions (ϒ SFs). This work emphasizes the importance of high precision experimental data to validate and refine the evaluated libraries and theoretical models.

Abstract ID: 0131

Review of Naturally Occurring Radioactive Materials and Applied Radiation-based Technologies Management in the Oil and Gas Industry

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Abstract:

For nearly a century, radiation-based technologies have been positively contributing to industry, medicine, agriculture, and research. For example, oil and gas industry utilizes many radiation sources in various applied radiation-based technologies. Those technologies, in addition to the Naturally Occurring Radioactive Materials (NORM) in the earth crust, represent the main source of radioactivity that may exist in drilling, production, and formation evaluation phases. The effects could be contaminated wastes and produced fluids on the surface or contamination of the tested subsurface formations and fluids. All equipment, tools, and machinery have hazards associated with their use, and radiation-based technologies are no different. However, radiation-based technologies are valuable tools and widely used by the oil and gas industry in areas, such as oil and gas exploration, production, industrial inspection, refineries, laboratory analysis, and security inspection. The objectives of this study are to review and outline several activities in the oil and gas industry, where radioactive materials are implemented. Summarizing how the radioactive materials (used or produced) are managed. Also, summarizing how the proper operating and protection procedures are applied to maximize the benefits and minimize the risks of such technologies. This work would provide a clear picture for beginner petroleum engineers, and other workers in the oil and gas industry on the implementation, utilization, and protection procedures when dealing with radioactive-based materials, equipment, and waste.

Ce^{3+}- doped borophosphate scintillating glass for X-ray imaging application

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Abstract:

The Ce^{3+} doped borophosphate glasses were synthesized using the melt quenching technique. The physical, optical, luminescence, luminescence and scintillation properties were investigated. The addition of CeF_3 shows an increasing of in density and refractive index. The glasses exhibited strong absorption in the ultraviolet (UV) region. Photoluminescence measurements under direct Ce^{3+} excitation revealed intense emissions at 340-346 nm from f-d transition [1-3]. Notably, the glass doped with 0.50 mol% of CeF_3 demonstrated the highest emission intensity due to concentration quenching. The radioluminescence spectra show similar pattern with photoluminescence with highest integral scintillation efficiency of 45% compared with BGO crystal. The highest photoluminescence quantum yield (PLQY) is 52.4%. In addition, the decay time under X-ray irradiation was faster than that under UV excitation. Alpha excitation was used to study pulse high spectrum. This glass has a potential for using as the scintillator in X-rays imaging system.

Abstract ID: 0133

Engineering and Optimization of Thermoluminescent Materials for High-Sensitivity Radiation Therapy

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Abstract:

Thermoluminescent materials are pivotal in radiation therapy due to their high sensitivity and tissue equivalency. This review examines radio-photoluminescence (RPL), thermally stimulated luminescence (TSL), and optically stimulated luminescence (OSL), focusing on their mechanisms, challenges, and strategies for optimizing dosimetric properties. The synthesis and doping of various phosphors have advanced their performance, enhancing their sensitivity to photons, electrons, neutrons, and gamma radiation. Specifically, dopants such as lanthanides and alkali metals play a crucial role in modifying the trapping and recombination centers within host lattices, influencing dose-response, linearity, and annealing stability. Engineering these materials involves addressing decay, fading, and sensitivity enhancement through innovative processing and co-doping strategies. Despite significant progress, challenges remain in fully understanding charge traps and their effects on TL and OSL peaks. This review highlights the prospects of Li+, Ag+, Ba^{2+}, and rare-earth-doped phosphors for robust applications in solid-state dosimetry. Future research should focus on understanding defect dynamics under thermal and optical stimulation to optimize material properties. This work aims to inspire researchers to innovate new phosphors and expand their clinical and diagnostic applications in radiation therapy.

Abstract ID: 0134

Enhanced Sensitivity for Ethanol and Acetone using Gamma Irradiated TiO2 Chemoresistors

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Abstract:

TiO2 chemiresistors were made using atomic layer deposition and irradiated with some selected gamma doses. Among several test chemical vapours and gases, there were significant enhancements to ethanol and acetone (£ 50 ppm) after gamma irradiation with 200 kGy. The sensitivity enhancements for ethanol and acetone detection were 219 and 182%, respectively, in comparison to the non-irradiated counterparts when operated at T = 350 ºC. We have seen an increase in the grain size which could be responsible for the increased sensitivity towards ethanol, acetone and other gases compared to the non-irradiated sample. The observation of increased sensitivity at irradiation doses ≥ 125 kGy could be explained by the presence of more oxygen vacancies in the irradiated films at higher gamma irradiation doses. The limit of detection for irradiated TiO2 chemiresistors was found to be about 6 ppm for both ethanol and acetone vapours. All in all, our findings suggest that gamma ray irradiation could be used as an attractive tool for the modification and manipulation of the sensing properties of metal oxide based sensors.

Abstract ID: 0135

Machine Learning Analysis of Diagnostic Reference Levels for Radiation Dosage From Routine Computed Tomography Examinations.

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Abstract:

Background: Computed tomography (CT) has become important in clinical practice for better understanding illnesses and assisting in patient diagnostics. However, the widespread use of CT has raised concerns about increased patient exposure to ionizing radiation. In recent years, diagnostic imaging, especially CT scans, have increased in number globally. As a result, patient radiation exposure has increased. This rise has prompted international and national health-care organizations to take action and stay up with such developments in order to meet the expected rise in the use of ionizing radiation in medicine. Diagnostic Reference Levels (DRLs) serve as a key tool for dose optimization in medical imaging. The use of artificial intelligence (AI) in various CT imaging examinations makes it simpler to identify patient doses that are exceptionally high or low.

Methods: This research employed an observational analytic study design, a retrospective data analysis, evaluation and comparative study conducted to determine DRLs for routine CT exams. The study was collaborate with Riyadh Third Health Cluster to collect radiation exposure data from CT studies at one hospital to establish national DRL in examination techniques. We reduce outliers from an actual dataset of dosage data from over 5,000 patients grouped into standardized protocols (Brain, Chest, KUB, Abdomen and Pelvis). Furthermore, Machine learning (ML) models were applied to manage the data and predict optimized dose levels. Model performance was evaluated using mean square error (MSE), mean absolute error (MAE), and R^2 metrics.

Results: Various ML algorithms were compared to identify the most accurate for each protocol. We selected the optimal analytical technique for each protocol based on standard dosimetry parameters to precisely measure the dosage level should apply in each CT exam.

Conclusion: ML and AI provide effective tools for optimizing CT radiation doses. It may be a helpful tool to reduce CT radiation dose.

Abstract ID: 0136

Dose assessment for workers in the steel industry who discover and handle scrap metal raw materials containing radioactive materials

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Abstract:

In Taiwan, there are laws and regulations that require steel companies with smelting furnaces to establish a steel radiation detection system. Door frame radiation detectors are installed at the entrance of the steel plant to monitor the radiation of incoming scrap steel raw materials (radiation anomalies) and shipped out manufactured steel products. To ensure effective prevention of scrap metal raw materials containing radioactive substances from entering the factory or accidental melting of radioactive substances. If anomalies in steel radiation are detected, the ionizing radiation authority must be notified and follow-up treatment must be carried out. This study investigates and analyzes the steel radiation anomalies reported by the steel industry, establishes a dose assessment model for personnel who handle radiation anomalies, and evaluates the dose that relevant workers may receive. From 2020 to 2023, there were a total of 153 cases of radiation anomalies notified, including 15 cases of artificial nuclear species and 138 cases of natural radioactive materials. This study analyzes and compiles the characteristics of radiation anomalies, and proposes the dose assessment results that relevant workers may accept.

Abstract ID: 0137

Dose assessment of the helper in veterinary X-ray room during the X-ray examination

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Abstract:

The number of veterinary hospital is growing rapidly in recent two decades in Taiwan. Due to the helper, usually the pet breeder or an assistant in the veterinary hospital, usually needs to accompany the pet inside the X-ray room during the X-ray inspection in most cases, the helper in the X-ray room is also exposed to the scattered X-ray radiation. The purpose of this study is to investigate the exposed doses of the helpers inside the X-ray inspection room during veterinary diagnostic inspection procedures. A plastic scintillation survey meter (Atomtex AT1121) was used to measure the doses at the position of the helper stand in the X-ray room. Over 250 veterinary hospitals were inspected on-site in this study. By means of setting a survey meter at the position of the helper's body which was assumed at a distance of 50 cm from X-ray field center, and considering the conditions of with/without wearing a lead apron respectively, the ambient dose is measured by the survey meter and then transfer into effective dose by considering the conversion factors. The effective doses at the helper's positions in cases of without wearing a lead apron during the x-ray inspection are in the range of 2.49×10^{-4} to 1.35 μSv per animal care, and the effective dose with lead apron are in the range of 4.0×10^{-8} -3.8×10^{-2} μSv.

Optimizing pediatric radiography: assessing image quality and reducing radiation dose using a contrast-detail phantom

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Abstract
The search for optimal digital image quality in medical imaging is closely bound to minimizing patient radiation exposure. This study investigates the relationship between major radiographic parameters—tube potential (kVp), current-time product (mAs), and additional filtration—and their impact on image quality and patient dose. The Contrast-Detail Phantom (CDRAD 2.0) was employed to assess image quality at various depths within an acrylic phantom. A systematic evaluation was conducted across a range of kVp settings (60–85 kVp), mAs values (0.5–10 mAs), and copper filter thicknesses (0.1 and 0.3 mm), reflecting clinical practices in pediatric chest radiography protocols. The findings reveal that increasing kVp to higher energy levels contributes more significantly to image quality than mAs. These insights highlight the critical role of optimizing radiographic techniques to enhance diagnostic accuracy while minimizing patient radiation exposure. By carefully selecting kVp and mAs settings, radiologists can significantly improve the safety and efficacy of digital X-ray radiography.

Abstract ID: 0139

Air Monitoring System at King Faisal Specialist Hospital and Research Centre.

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Abstract:

King Faisal Specialist Hospital and Research Centre (KFSH&RC) produces approximately ten isotopes, most of which are produced regularly, along with managing a few isotopes generated by nuclear reactors. The air monitoring system is an essential part of the facility to monitor, control and keep record of airborne radioactive contamination, to protect workers and public from inhalation or ingestion of radioactive materials for operation with compliance to the local regulations. We will discuss the operation of air monitoring system and its components from every source of radioactivity until air exhausted safely including different types of radiation detectors, interlocks, control, filters, real time data logging, inspection and measurement at any time in case of incident, also we will discuss the measures to reduce the release to allowed quantity.

Monte Carlo Simulation of Head Scatter and Radiation Leakage of a 6 MV Photon Beam from an Agility Head Using FLUKA

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Abstract:
Most studies in the literature focus on in-field dosimetry, with relatively few addressing the accuracy of linear accelerator (Linac) models in leakage or out-of-field regions. This study aims to investigate leakage radiation from a Linac using Monte Carlo simulations. The Elekta Synergy linear accelerator equipped with an Agility head was modeled using the FLUKA code, and the model was validated against measured data, including dose profiles and percentage depth doses.

Simulations were compared with measurements taken using a PTW Spherical Chamber (TK-30) positioned at 45°, 90°, 135°, and 180° relative to the source, with a source-to-chamber distance of 100 cm. The ion chamber was also modelled in the simulations. Based on the linear attenuation coefficients corresponding to the mean energy of the photon spectrum at each position, the required lead thickness to match the measured data was calculated. To reduce simulation uncertainty, the deposited dose at each position was calculated using energy fluence and the mass energy absorption coefficient, eliminating the reliance on photon track length. The simulation was then rerun with the calculated lead shielding in place, resulting in simulated data closely aligned with the measured values. At 90°, the difference between the measured and simulated dose was less than 10%, representing the best agreement, as the ion chamber does not have a uniform response outside the 48 keV–^{60}Co energy range.

Abstract ID: 0141

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Feedback Patterns and Trainees' Perceptions: Insights for SCFHS and Newly Accredited Medical Physics Residency Programs in Saudi Arabia

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Abstract:

Feedback is a cornerstone of residency training, fostering professional growth, competency development, and excellence in clinical practice. This study examines feedback patterns and trainees' perceptions across Saudi Commission for Health Specialties (SCFHS) accredited programmes, emphasising formative feedback during workplace-based assessments (WBAs). While the newly accredited Medical Physics residency programmes in Therapeutic and Diagnostic Radiology are considered, the scope extends to insights from trainees in other SCFHS-accredited residency programmes. A validated questionnaire was developed and distributed across multiple disciplines to assess the quality, frequency, and perceived impact of feedback. The curricula for these programmes emphasise competency-based education, guided by the Canadian Medical Education Directives for Specialists (CanMEDS) framework, highlighting feedback as essential to achieving milestones in professionalism, medical expertise, and collaborative practice. The Medical Physics curricula specifically emphasise competencies, such as radiation safety, dose optimisation and quality assurance, which require precise and actionable feedback to ensure mastery. The WBAs, including Direct Observation of Procedural Skills (DOPS) and Mini-Clinical Evaluation Exercise (Mini-CEX), serve as formative assessment methods, relying on timely feedback to achieve learning. Trainers are expected to provide consistent, high-quality feedback despite the challenges posed by clinical workload and diverse training environments. Structured feedback will enhance technical proficiency and professional confidence, supporting competency development across SCFHS residency programmes. By integrating feedback within the SCFHS accreditation standards, this study highlights the importance of aligning educational strategies with the learning objectives and outcomes of different training programmes. Although data collection is ongoing, this research highlights the potential for feedback to foster a feedback culture, address gaps in assessment practices, and elevate residency training quality. The findings are expected to provide actionable recommendations for standardising feedback delivery across programmes, ensuring relevance to both foundational and specialised competencies. This work contributes to the growing evidence of feedback's critical role in clinical training and patient care.

Abstract ID: 0142

Radiation Protective Windows for Industry and Medical Applications

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Abstract:

The glass specimen with the composition $5Bi_2O_3$: 13.5BaO : $0.01Sb_2O_3$: 6.4CaO : $20Na_2O$: $55.09SiO_2$ was developed for large-scale production as a radiation shielding window for industry and medical applications. The glass specimens were created using the melt-quenching method. The Compton Scattering Technique (CST) was employed for variation of the gamma rays energy range from 0.225 MeV to 0.662 MeV. The radiation shielding behaviors were measured and compared with theoretical predictions from the WinXCom and PHITS Monte Carlo simulation. Additionally, the X-ray shielding properties of the glass were also investigated using the PHITS simulation. The density, molar volume, and refractive index showed consistent trends, and the B1 specimen had higher transmission than other glasses. Parameters of radiation shielding such as $\mu_m \mu m$, effective atomic number (Z_{eff}), and electron density (N_{eff}) increased with higher Bi_2O_3 content and decreased at higher energy levels, aligning with theoretical predictions and PHITS results. The half-value layer (*HVL*) indicated superior shielding properties compared to other materials. The increased Bi_2O_3 content enhanced the density and shielding effectiveness, reducing photon scattering events and improving energy absorption (EABF) and exposure buildup factors (EBF). The B1 sample demonstrated potential for use as radiation shielding windows due to its excellent transmission performance and practical applicability.

Abstract ID: 0143

Volumetric Modulated Arc Therapy (VMAT) For Total Body Irradiation (TBI) VS Conventional TBI

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Abstract:

This case report explores the use of volumetric modulated arc therapy (VMAT) for total body irradiation (TBI) versus conventional TBI. A 3-year-old female patient diagnosed with Lymphoid leukemia, acute, without mention of remission who had total body irradiation (TBI) as part of a conditioning regimen for an allogeneic hematopoietic stem cell transplant (HSCT). The plan was created in Montacarlo using five 6 MV photon dynamic arcs twice a day. A dose of 12 Gy delivered in fractions over three days was prescribed under general anesthesia. The treatment volume split into five parts, the head, chest, abdomen, pelvis and lower extremities. VMAT provides an excellent dose distribution for the target volume compares to conventional TBI. However, achieving this goal was a challenge faced by the radiation therapists due to patient position was affected by time, patient movement and patient-resistance to anesthesia. positioning the patient during treatment was highly sensitive; even minor movements led to d ose discrepancies that may have interfered with the effectiveness of the treatment. Consequently, because the treatment was going to take a long period of time, the patient's positioning and anesthesia needed constant monitoring and adjustment as necessary to ensure that the delivery was quite accurate. The extended treatment time, along with the high degree of coordination required between members of the radiation therapy team. While a conventional TBI takes around 40m. This case took around 2-3 hours per fraction. Hence the possibilities of Setup-error and Random-error increased than in conventional TBI. Moreover, due to the young age of the patient, the medical professional did not prefer the increment of anesthesia dose that may lead to cardiac arrest. Hence, the continuous movement of the patient occurred, and it was problematic to keep her in the same position during the entire treatment. Although VMAT for TBI is a promising treatment modality, the increase in complexity and resource demands compared to conventional TBI should be carefully weighed when selecting the appropriate treatment strategy in pediatric patients. In addition, VMAT was found to be an optime treatment technique for total body irradiation yet a requirement of high skilled radiation therapist was essential.

Abstract ID: 0144

Quantitative Assessment of 3D-Printed Vials as Cost-Effective Alternatives to Standardized ACR Vials for PET/CT Quality Assurance

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Abstract:

This study investigates the quantitative and statistical performance of 3D-printed vials as alternatives to standardized American College of Radiology (ACR) vials for PET/CT quality assurance. Using standardized uptake values (SUV) as the primary metric, including SUVmax, SUVmean, and SUV heterogeneity, the study evaluates the clinical and statistical equivalence of the vials. PET/CT imaging was performed on four pairs of original ACR vials and 3D-printed vials designed to replicate the physical dimensions and volumes of the originals. Statistical analyses, including paired t-tests and percentage difference calculations, were employed to evaluate quantitative accuracy, while contrastto-noise ratio (CNR) and coefficient of variation (COV) analyses assessed image quality and heterogeneity. Results indicated no statistically significant difference in SUVmax between the original and 3D-printed vials ($p > 0.05$), with percentage differences ranging from 0.84% to 57.98%. CNR analysis demonstrated comparable contrast performance, though increased SUV heterogeneity in 3D-printed vials, particularly in smaller volumes, suggested higher variability. This heterogeneity was quantified by COV, which was notably higher in 3D-printed designs, likely due to material properties and inconsistencies in manufacturing processes. The findings highlight the potential of 3Dprinted vials as viable tools for quality assurance in PET/CT imaging, especially in resource-limited settings, while emphasizing the need for optimization in material density and printing resolution. Statistical validation and imaging analysis underscore the promising role of 3D-printed vials in reducing reliance on commercially standardized alternatives. This research contributes to advancements in the field of medical physics, proposing cost-effective and accessible solutions for ensuring the quantitative accuracy of PET/CT imaging in clinical and research applications.

Abstract ID: 0145

Skin dose assessment using direct and indirect measurement for pregnant patient undergoing abdominal fluoroscopy procedure

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Abstract:
Radiation exposure in complex Interventional Radiology (IR) procedures, especially involving pregnant patients, can be high. Monitoring the patient's Peak Skin Dose (PSD) post-procedure is essential, but direct measurement can be time-consuming. This study evaluates the accuracy of PSD measurements in pregnant patients undergoing abdominal procedures using both direct and indirect methods.We measured PSD using Thermoluminescent Dosimeters (TLDs), Gafchromic EBT3 Film, and GE DoseWatch software. Direct measurements were taken with TLDs and EBT3 Film placed on the patient's skin, while indirect measurement was simulated using GE DoseWatch. The procedure was performed with a Philips Allura Xper FD20/15. Results showed TLD PSD values were very low (0.002 to 0.016 mGy), while EBT3 Film and GE DoseWatch yielded PSD values of 190.98 mGy and 173.34 mGy, respectively, with a ±10.18% difference. An uncertainty of around ±25% is considered acceptable for PSD measurements in IR.While Gafchromic XR-RV3 is the most accurate for PSD measurement, we used EBT3 Film because it was available in our hospital and still sensitive to the doses used in IR. The radiation dose monitoring system (GE DoseWatch) showed comparable results with tolerable deviation and is reliable for determining PSD in the absence of EBT3 Film.TLDs can also be used with methodological adjustments to cover the full beam during irradiation. Despite the high-risk nature of the procedure for pregnant patients, the measured PSD was approximately 0.2 Gy—10% lower than the threshold for early transient erythema (2 Gy).

Microstructural, Thermal Analysis, And Gamma-Ray Shielding Properties of Bricks Made of Various Local Natural Materials (an Approach to Repurpose Nigerian and African Local Materials for Application in Technology)

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Abstract:
The current work deals with preparation of five bricks samples based on natural rocks (clay, granite, laterite, basalt) for the radiation shielding applications, with the purpose of putting local materials from Nigeria and Africa into technological uses. The XRD diffraction pattern was used to identify the crystal structure of the prepared bricks. Additionally, the scanning electron microscopy (SEM) and energy-dispersive X-ray techniques were utilized to examine the morphology structural and chemical composition of the prepared bricks. Moreover, the Differential Thermal Analysis (DTA) and Thermogravimetric Analysis (TGA) were applied to evaluate the wight loss in the brick samples when exposure to the temperature differential that occurs when a sample and a reference are heated in order to investigate the thermal behaviour of materials. Furthermore, the radiation shielding properties of prepared brick samples were examined to check the ability of the prepared materials in attenuating the gamma-ray photons. The examination showed that the basalt and granite bricks have the highest linear attenuation coefficient among the prepared bricks. Their linear attenuation coefficient over the energy interval of 0.033-2.506 MeV varied between 22.332-0.097 cm^{-1} (for basalt bricks) and 35.633-0.096 cm^{-1} (for granite bricks). The study shows also that the thicker thicknesses of fabricated brick samples have suitable shielding properties to be used in shielding of the high energetic gamma-ray photons.

Abstract ID: 0147

Evaluation of radiation shielding and mechanical properties of Palm Nut Shell Ash modernized concrete: a comparative analysis

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Abstract:

This study transverse over the modernization of ordinary concrete to improve its gamma ray shielding purposes by partially replacing cement with Palm Nut Shell Ash (PNSA). The mechanical, physical and gamma ray shielding properties of four fabricated samples of concretes (CPNSA1, CPNSA2, CPNSA3, and CPNSA4) with varying PNSA ratio were investigated. The adopted W/C (water-to-cement) ratio was 0.5 for the entire mixtures. The results revealed that, when the content of Palm Nut Shell Ash (PNSA) is increased from 0 to 0.15 kg, the concrete density decreased from 2.40 to 2.25 g/cm^3, accompanied by raise in porosity from 14.5% to 21.5% as well as rise in the water absorption from 6.8% to 8.6% for 7 days of curing, 6.4% to 8% for 14 days of curing, and 5% to 7% for 28 days of curing, which may be associated with overall concrete voids. Even though when PNSA is added to the concrete matrix, there is an observable decrease in the mechanical features such as flexural strength, compressive strength and elastic modulus. So that, our concrete samples are characterized future radiation shielding ability. After the computations by Monte Carlo N-Particle (MCNP) code Phy-X/PSD simulation software, it was observed that concrete sample CPNSA2 proved the superior mass linear attenuation coefficient (LAC), confirming higher gamma ray attention ability. The current study further compares the μ values with previous literatures, indicating an aggressive gamma radiation shielding capacities. The results from this study further lamented on the importance of prioritizing thickness of a material in gamma ray shielding purposes. Also, it provides a useful key in developing concrete compositions with modernized properties of gamma ray's attention. Generally, this work presented a detailed insight for the optimized performance of concretes, displaying its prospect for the purpose of shielding against the low and intermediate gamma ray energy.

Abstract ID: 0148

Raman Structural Fingerprints of Amyloid in Human Tissues

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Abstract:
Amyloid fibrils are β-sheet-rich protein aggregates that are closely linked to several diseases. To comprehend the metabolite and structural changes in amyloid formation, it is essential to study the Raman spectroscopic signature and biochemical characteriztics of amyloid fibrils. Herein, we evaluated the use of Raman spectroscopy with a 532-nm laser excitation source for the metabolite characterization of amyloid tissues. Raman spectroscopy provides reliable information not only regarding the secondary structure of proteins, but also in distinguishing between normal and amyloid containing tissues. The ultimate goal is effective diagnosis in real time. Specifically, in this study, nine normal control and 13 pathological amyloid tissues were investigated. Second derivative analyses of amide-I and amide-III bands, registered with β-pleated amyloids structure inside human tissues, were highlighted. Another feature of Raman spectroscopy is the abundance of amyloid structural details detected in the “fingerprint” between 600 and 1800 cm^{-1} in the Raman spectral region. Moreover, spatially resolved Raman spectra reveal molecular heterogeneity between the amide group and lipids in amyloid structures found in other different types of human tissues. For greater accuracy, the intensity of amyloid and control tissues was subjected to the Mann Whitney U test, resulting in a p-value = 0.006 for amide group characteriztic peaks. Other than that, ratiometric analysis demonstrated significant differences in amide I and lipids between amyloid and control tissue, with attributed significant peak intensities at 1660 cm^{-1} and 1440 cm^{-1}, respectively. This research revealed that Raman spectroscopy is capable of characterizing the fingerprint signature for amyloid in human tissue.

Abstract ID: 0149

Compliance of International Obligations under Comprehensive Safeguards Agreement for Power and Research Reactors in Saudi Arabia

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Abstract:

Compliance with International obligations under the respective safeguards agreement is not just an obligation but a crucial demonstration of the States' commitments to the non-proliferation of nuclear weapons. Abiding by its pledge is essential for a state to provide confidence to the international community that the nuclear program is used exclusively for civilian purposes. The Kingdom of Saudi Arabia (KSA) is a party to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) and has signed a bilateral comprehensive safeguards agreement (CSA), INFCIRC/746, with the International Atomic Energy Agency (IAEA). Due to the country's limited nuclear material or activities, it is currently being monitored through the original standard text of the small quantities protocol (SQP), which will be effectively rescinded by the end of 2024. Recently, the KSA has made significant progress in developing its nuclear power generation infrastructure to diversify its energy mix program. It has planned to construct two large nuclear power reactors, and one low power research reactor will be operational soon. With the start of 2025, the CSA will be fully enforced in the KSA. As an SQP country with minimal experience in nuclear materials and/or facilities, preparing for international legal obligations to show transparency in its nuclear energy program for the peaceful use of nuclear energy is a complex and crucial challenge. More importantly, KSA's ambitions to utilize its domestic uranium resources to develop an indigenous nuclear fuel cycle pose significant additional safeguards obligations and implementation challenges for the country. This paper analyses the international commitments associated with adopting the full-scope comprehensive safeguards agreement for verification and the corresponding challenges that will emerge in its implementation for Power and Research reactors in Saudi Arabia. The most important areas include an effective State system of accounting for and control of nuclear material, preparation of initial physical inventory listing, inspection regimes, human capacity building, and nuclear import/export control, to name a few.

Abstract ID: 0150

Low Dose Hyper-Radiosensitivity In Normal Human Cells Following Proton Irradiations

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Abstract:

Hyper-radiosensitivity (HRS) is a phenomenon where cells exhibit enhanced sensitivity to low doses of ionising radiation, challenging the target theory of radiation-induced effects. This study investigates the HRS response in AG1522 human fibroblast cells exposed to low-dose proton irradiation, a modality increasingly utilised in precision radiotherapy. The cells were irradiated with a range of selected low- and high doses of 0.2, 0.4, 0.6, 1, 2, 3, 4 and 5 Gy with a specific interest at the doses below 1 Gy. The cellular responses were analysed using clonogenic survival assays and advanced fluorescence microscopy. The results suggested the HRS effect at doses below 0.2 Gy, with a marked transition to induced radio-resistance (IRR) at higher low doses of 0.4 and 0.6 Gy related to proton beam energy. Proton irradiation demonstrated delayed biological effects, including persistent nuclear deformities and elevated frequencies of giant-nucleated cells (GCs), indicative of genomic instability. The absence of the HRS at low doses of 0.2 Gy is often reported in cell cultures following exposure to high linear energy transfer (high-LET) radiation *in vitro*, such as protons, whereas such response was more pronounced with X-rays. However, the manifestation of the IRR at the doses of 0.4 and 0.6 Gy indicated the existence of HRS incorporated in the clustered DNA breaks, which may have occurred below the lowest dose used in the experiments reported in this study. These findings emphasise the role of radiation quality and linear energy transfer in shaping cellular radiosensitivity. The study provides critical insights into radiobiological parameters and the mechanistic underpinnings of HRS in normal human cells exposed to protons, with implications for optimising radiotherapy protocols. Identifying cellular responses specific to proton irradiation contributes to a deeper understanding of low-dose radiation effects, enhancing strategies for minimising normal tissue damage while maximising therapeutic outcomes in clinical settings.

Abstract ID: 0151

Study of Nuclear Reaction Cross-sections for Reactor and Astrophysical Applications

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Abstract:

The accurate knowledge of fast neutron and proton induced reaction cross sections for different isotopes of fuel, structural materials and fission products is important for safe and controlled operation of advanced nuclear reactor facilities. In reactor physics, nuclear reactions occur within nuclear power plants and research reactors. These reactions involve the manipulation of atomic nuclei to release large amounts of energy. Fission and fusion are prominent nuclear reactions that are essential for generating power in nuclear reactors. Nuclear reactions have also profound implications in astrophysics. Stellar nucleosynthesis, the process by which elements are formed within stars, relies on a complex network of nuclear reactions. These reactions shape the composition and evolution of stars, providing crucial insights into the origin of elements in the universe.We have been involved in the measurements of reaction cross-sections for several years and have measured several nuclear reaction cross-section data for neutron-induced reactions such as (n,γ), (n,p), (n,2n), (n, α), and proton induced nuclear reactions (p, n), (p, γ), etc., which are important for nuclear reactors [1,2]. It is also observed in the EXFOR data library that there is a scarcity of data or a large discrepancy in the measured data. The measurements were performed at the TIFR Pelletron facility, Mumbai, India. The method of analysis was standard activation analysis in which materials are irradiated with the interested particle beam and then the activity produced is measured with a high-purity HPGe detector. The measured data were supported with the nuclear modular codes predicted data such as TALYS and EMPIRE codes. The data/results are also useful to understand the predictability of the several models available in such codes. The results will be discussed during the meeting.

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Exploring the Efficacy of High Dose Rate (HDR) Brachytherapy Based on Ultrasound Guided for Prostate Cancer Treatment: A Novel Approach at KFMC (SaudiArabia)

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Abstract:

Prostate cancer remains a significant global health challenge, requiring innovative diagnostic and therapeutic approaches. This study evaluates the effectiveness of ultrasound-guided high-dose-rate (HDR) brachytherapy for prostate cancer at King Fahd Medical City, marking the first use of advanced technologies by a Saudi medical team. HDR brachytherapy was performed using Iridium-192 (Ir-192) sourceT1/2= 74 days , which were selected over Cobalt-60 (Co-60)T1/2=5.27 years for their intermediate energy (380 keV) and superior dose distribution, balancing penetration depth and sparing surrounding healthy tissues. Compared to Co-60, which emits higher energy photons (1.25 MeV) requiring increased shielding and producing steeper dose gradients, Ir-192 allows for more precise targeting in anatomically sensitive areas like the prostate. Additionally, Ir-192's shorter half-life (74 days) supports frequent recalibration for treatment accuracy, contrasting with Co-60's long half-life (5.27 years), which reduces replacement frequency but necessitates more complex safety protocols. The study utilized transrectal ultrasound (TRUS) imaging for needle insertion and endocavityballoon placement to facilitate accurate treatment planning. Remote after-loader devices ensured real-time monitoring and safe radiation delivery. Results from five cases—four treated with HDR brachytherapy and external beam radiotherapy (EBRT) and one salvage case post-EBRT—demonstrated significant reductions in prostate-specific antigen (PSA) levels and tumor volumes after six months. These findings underscore the advantages of Ir-192 in HDR brachytherapy, including its precision, adaptability, and compatibility with advanced imaging modalities, establishing it as the preferred source for effective prostate cancer management .

Abstract ID: 0153

Knowledge of Radiation Protection Among Medical Students in Jeddah, Saudi Arabia

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Abstract

Background: Medical imaging significantly enhances diagnostic accuracy and treatment planning but poses risks associated with exposure to ionizing radiation. Awareness and knowledge of radiation protection and principles of ionizing radiation exposure are critical for mitigating their associated risks.

Aim: This study aimed to assess the awareness and knowledge of radiation protection principles among medical students in Jeddah, Saudi Arabia to identify gaps in radiation safety.

Methods: A cross-sectional descriptive study was conducted on 372 students from various health programs at Batterjee Medical College and other institutions in Jeddah during the academic year 2024. A structured, self-administered questionnaire assessed awareness and knowledge, categorized into five performance levels ranging from "Very Poor" to "Very Good." Statistical analyses, including correlation and ANOVA, were used to explore the relationship between demographic variables and knowledge scores.

Results: Awareness levels were generally high, with 62.9% of participants scoring "Very Good." However, knowledge scores were notably lower, at over 50% below average levels. Radiology students outperformed their peers from other disciplines, yet significant gaps in fundamental knowledge, such as the ALARA principle and dose equivalence, persisted. A moderate positive correlation ($r = 0.301$, $p < 0.001$) was observed between the awareness and knowledge levels.

Conclusion: While awareness of radiation protection is relatively high among medical students in Jeddah, knowledge deficiencies highlight the need for educational intervention. Incorporating radiation safety lectures and training into medical curricula will effectively minimize radiation-related risks for healthcare professionals.

Keywords: Awareness, radiation protection, medical student, Jeddah, Saudi Arabia

Optimized Production of Medical Isotopes for Targeted Alpha Therapy using Hybrid Reactor Systems

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Abstract:
This study explores the production of the medical radioisotopes like Actinium-225 (225Ac) for targeted alpha therapy, using an innovative Hybrid Reactor Systems – also called accelerator-driven system (ADS) reactor. These isotopes are essential for treating various cancers, and the current limited supply of 225Ac motivates the investigation of alternative production routes. The proposed ADS model consists of two zones: a fast neutron spectrum zone in the core center, which also functions as a waste transmuter, and an outer thermal neutron spectrum zone that irradiates Radium-226 (226Ra). Monte Carlo simulations were used to evaluate the isotope yield, transmutation behavior, and activity of the reactor model. The results indicate that the ADS reactor can efficiently produce Thorium-229 (229Th) from neutron irradiation of 226Ra, which subsequently decays to generate 225Ac and 213Bi. The simulation demonstrated that, compared to a critical reactor with similar parameters, the ADS reactor significantly improves isotope production efficiency and reduces the time required to reach maximum yield. With optimized target placement, the ADS model achieved higher yields of 229Th by maintaining an effective neutron flux, leveraging both fast and thermal neutrons in a mixed-spectrum environment. The findings suggest that this ADS-based approach can provide a viable alternative for medical isotope production, enhancing the availability of key alpha-emitting radioisotopes. Further research could focus on refining the ADS design and assessing the feasibility of scaling up for routine production.

Abstract ID: 0155

Organ dose distribution in anteroposterior (AP) abdominal radiography: Phantom-Based study

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Abstract:

Purpose: X-ray imaging units commonly display non-homogeneous radiation intensity throughout the imaging area. The lack of uniformity makes it difficult to accurately measure the radiation dose that organs receive. Existing dosimetry techniques do not possess the required accuracy for precise, organ-specific dose measurements, hindering progress in patient safety and enhancement of medical imaging procedures. Our study emphasizes mapping radiation doses in abdominal organs using optically stimulated luminescent dosimeters (OSLD), with the objective of improving dose accuracy and patient care quality in diagnostic imaging. **Method:** A Kyoto Kagaku phantom placed lying down on the table bucky in a front to back orientation. The distance from the source to the image was fixed at 100 cm. Exposure settings consisted of kVp values of 64.5, 70, and 75, along with mAs values of 14, 20, and 25. Multiple nanoDot OSLDs were positioned on the phantom's surface to measure the entrance skin dose (ESD) at locations that align with the liver, kidneys, and spleen. **Results:** The measured average entrance skin dose (ESD) for abdominal organs at selected X-ray exposure settings, revealed non-uniform radiation distribution across the imaging field. Results indicated the kidneys received the highest ESD (6.32, 1.98, and 5.05 mGy), followed by the liver (4.43, 1.46, and 3.65 mGy) and spleen (4.16, 1.58, and 3.53 mGy). These findings emphasize the importance of precise organ-specific dosimetry due to varying radiation sensitivities and potential health implications for different organs in the imaging area. **Conclusion:** This study confirms non-uniform radiation intensity across abdominal regions in X-ray imaging and emphasizes accurate dosimetry's role in patient safety. It reveals significant dose differences among organs, advancing understanding of organ-specific exposure in diagnostic imaging. These findings highlight the need to optimize imaging protocols to minimize radiation exposure to sensitive organs, enhancing patient care quality in radiology.

Keywords: Organ dose mapping, Diagnostic imaging, Abdominal radiography, Radiation protection, Patients' safety.

Abstract ID: 0156

Radiation exposure for patients with speech impairment

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Abstract:

Patients with speech impairment often require specialized medical imaging procedures to diagnose and monitor underlying conditions. However, these procedures involve exposure to ionizing radiation, which can pose potential health risks, especially for developing children. This research, however, offers promising solutions that can mitigate these risks and improve the quality of care for these vulnerable patients. This work explores the challenges of balancing diagnostic needs with radiation exposure minimization in this vulnerable patient population. The data were collected from King Khalid Hospital, Alkharj. X ray machine from Siemens Luminos DRF was used to acquire all the images. All patients underwent Antero posterior and lateral projections Average kVp was 75 kVp, and the effective dose per exam was 1.5 ± 0.5 mSv. Optimizing imaging protocols, using advanced imaging techniques, and employing effective radiation protection measures are crucial to mitigate these risks. This research underscores the importance of collaboration among healthcare providers, radiologists, and medical professionals in addressing these challenges and ensuring the best possible care for pediatric patients with speech impairment.

Abstract ID: 0157

Study of radiation exposure to patients during cardiac catheterization

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Abstract:

Cardiac catheterizations are becoming increasingly common and are often the treatment of choice for many clinical conditions, resulting in increasingly lengthy patient radiation exposure. This study aimed to measure patient radiation exposure during cardiac catheterization procedures at King Khalid Hospital and Prince Sultan Cardiac Center. The measurements involved 45 operations. Patient exposure was calculated using the kerma Area Product (KAP) meter. The mean ESAK was 4642.07 µGy.m2 for the patients, while the third quartile was 5770.96 µGy.m2; these values are minimal compared with those reported by similar studies. The study concluded that the primary operator received a relatively high dose directly from the department's poor radiation protection. The dose values are comparable to those in the recent literature.

Abstract ID: 0158

Pediatric Radiation Effective dose during Computed Tomography

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Abstract:

Children are more sensitive to ionizing radiation than adults due to factors such as rapid cell division rate, longer life expectancy, and developing organs. Therefore, it is essential to protect them from radiation exposure to minimize cancer risk and prevent deterministic effects. This study estimates the effective dose from pediatric computed tomography (CT) brain, head, neck, and abdomen procedures. Over a period of nine months, 155 CT procedures were conducted at King Faisal Specialist Hospital and Research Center using six CT machines from different vendors. The mean and range of patients' age (y) are 5 (1.2-13). The mean DLP(mGy.cm) and CTDIvol (mGy) were 500 and 700 per CT procedure for age groups 0-5 and 6 to 13 years, respectively. The study revealed that 6.1% and 10% were higher than the national Saudi Diagnostic Reference Level (DRL). Therefore, it is recommended to reduce the scan length to ensure that patients receive the lowest possible radiation dose while maintaining the image quality. Optimizing the radiation dose is necessary by using the lowest radiation dose possible to obtain diagnostic-quality images. It is crucial to precisely adjust CT scan parameters to the child's size and specific clinical needs to reduce the projected carcinogenic risks.

Abstract ID: 0159

Evaluation of patients and staff during Nuclear Medicine examinations in Saudi Arabia

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Abstract

Nuclear Medicine (NM) staff are subjected to ionizing radiation from external sources, primarily gamma-ray emitters. Prior research indicated that nuclear medicine professionals may incur a significant yearly radiation dose during preparation, administration, and imaging procedures. This study seeks to evaluate the yearly radiation dose equivalent for nuclear medicine workers (physicians, technicians, and nurses) over a span of eight consecutive years. Occupational exposure data from 2015 to 2022 were acquired from the NM department of King Saud Medical City, Saudi Arabia. The yearly exposure data for 16 NM workers were categorized into three physicians, 11 technologists, and two nurses. Thermoluminescent dosimeters (TLD) composed of lithium fluoride (LiF: Mg, Ti) (TLD-100, Harshaw, USA) were employed to measure staff radiation exposures. The TLD chips were contained into TLD dosimeter holders of type 8814 Harshaw. Occupational exposures were measured quarterly as deep doses (Hp(10), mSv).The mean and range of the yearly external radiation dose (Hp(10), mSv) during eight years for nuclear medicine physicians, nuclear medicine technicians, and nurses were 1.3 (1.1-1.4), 2.1 (1.8-2.5), and 1.4 (0.8-2.0), respectively. Significant disparity in annual exposure per employee within the NM department. Hotlab workers and nurses experienced the most radiation exposure relative to nuclear medicine physicians. The research indicated that the yearly radiation exposure for NM staff remains within the annual dosage threshold of 20 mSv/year. Annual dosages shown significant variability across personnel, attributable to workload and operator experience. Minimizing dosages to NM workers is attainable by operator training and rigorous compliance with protective protocols.

Abstract ID: 0160

Blood Irradiation in Medicine: Ensuring Safe Transfusion

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Abstract

Globally, millions of units of blood and blood components are transfused worldwide; Significant differences exist between countries in the age distribution of transfusion recipients and the underlying reason of transfusions. Blood transfusion, a critical life-saving medical intervention, is not without its risks, particularly the potential for transfusion-transmitted illnesses (TTIs) and transfusion-associated graft-versus-host disease (TA-GvHD). To mitigate this risk, blood irradiation, a commonly used procedure, involves exposing blood products to ionizing radiation. This effectively inactivates lymphocytes and harmful microorganisms, such as viruses, bacteria, and parasites, while minimally affecting the blood's vitality. This study explores the fundamentals of blood irradiation, its role in preventing TA-GvHD, reducing TTIs, and the factors that influence its effectiveness. It also discusses the potential challenges and limitations of blood irradiation, including its impact on blood components and the need for rigorous quality control. Blood irradiation is a critical safety measure in modern blood transfusion practices. By effectively inactivating lymphocytes and pathogens, it ensures the safety of blood recipients.

Abstract ID: 0161

Assessment of Radiation dose Metrics in Nuclear Medicine

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Abstract:
Radiotherapy and nuclear medicine are essential elements in the diagnosis and care programs for cancer and other diseases. The objectives of this survey were to assess the frequency and radiation doses of radiation therapy treatment courses and nuclear medicine procedures; and to estimate (for nuclear medicine): the mean effective dose in each procedure, annual collective effective dose and the annual dose per caput effective dose to Sudan population from nuclear medicine. Two radiotherapy centres and five nuclear medicine departments representing all existing facilities providing these services in Sudan at the time of the study were included. The total annual frequencies were 75.6 per million population, 0.16 per 1000 population and 0.7 per 100000 for radiotherapy, diagnostic nuclear medicine and therapeutic nuclear medicine treatments procedures, respectively. The estimated total annual collective and total annual per caput effective doses for diagnostic nuclear medicine procedures were 17 man Sv and 0.0004 mSv, respectively. In nuclear medicine, the major contribution to the collective dose was from the bone scan procedures (58%). In this survey, the range of the prescribed doses for the treated organs was within the guidelines in the literature. The results of this survey will contribute to assessing the population dose and the following trends in medical imaging at the national level.

Abstract ID: 0162

Radiation dose and attributed cancer risk in Computed tomography coronary angiography (CTCA) using 256-row detector CT scanner

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Abstract:

Coronary artery disease is a major cause of mortality and morbidity worldwide. Coronary computed tomography angiography (CTCA) provides detailed imaging of the artery vessels. Herein, we sought to evaluate the patient radiation dose and attributed cancer risk to patients who underwent CTCA.

Radiation dose data and related information were analyzed for 232 patients who underwent CTCA. software. Effective doses were calculated from the extracted DLP values using the DLP-to-E conversion coefficient given in the CT-expo 2.5 dosimetry software. Total lifetime risk of cancer incidence by age at CTCA exposure using ICRP risk coefficients [1]. The reported doses in CCTA Median (Interquartile range) DLP as 268 mGy.cm (100-492), CTDIvol as 2.92 mGy (1.57-20.01) and effective dose of 5.21 mSv (2.16-10.7). These values are well below the DRLs reported in the literature for CTCA, which are ranging from 671 to 1510 mGy.cm in DLP, whereas CTDIvol DRLs ranged from 26 to 70 mGy[2]. The estimated Total lifetime risk of cancer incidence by age at exposure for CT coronary angiography (CTCA) (per 106) ranged from to 58-426 for male patient and to 260-1025 for female patients. The 256-row scanner provided CCTA scans at significantly lower radiation doses and is important for providing updates on the current DRLs on CTCA to incorporate the dose reduction features of modern CT scanners.

Reference

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2. UK Health and Security Agency, 2022. Guidance-National diagnostic reference levels (NDRLs) from 13 October 2022.

Abstract ID: 0163

Assessment of Radiation Doses in Interventional Cardiology Procedures in a Pediatric Hospital

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Abstract:

The present study aimed to establish local Diagnostic Reference Levels (DRL) within an interventional cardiology unit at an exclusively pediatric hospital in Brazil. DRL values were derived from dose reports generated by post-procedure equipment. Data from 215 procedures conducted over a 5-year period (2019-2023) were analyzed, categorizing them into therapeutic and diagnostic interventions and further delineating them by clinical procedures. Local DRLs were identified as the third quartile of patient dose data distributions, encompassing both product kerma area (P_{KA}) and kerma at the reference point ($K_{a,r}$) across various age groups and weight ranges. A linear correlation between patient weight and age facilitated age-based weight estimation. Despite its significant contribution to P_{KA}, cine mode accounted for only approximately 4% of the total procedure time. While noteworthy, fluoroscopy time was not deemed the most reliable predictor of P_{KA}. Mean fluoroscopy time and cine mode image count remained consistent across all procedures, irrespective of patient weight or age. Significantly, therapeutic procedures demonstrated elevated radiation dose values in contrast to diagnostic procedures.

Abstract ID: 0164

Evolving the cerebellum: Insight into Age-Related Functional Changes

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Abstract:

This study employed resting-state functional magnetic resonance imaging (fMRI) to investigate the influence of aging on cerebellar functional connectivity, both within the cerebellum itself and between the cerebellum and several large-scale cortical networks. Although historically associated primarily with motor coordination, the cerebellum has emerged as a crucial node for higher-order cognitive functions. In this study, we examined connectivity across 10 cerebellar lobules, the vermis, and four deep cerebellar nuclei in relation to the default mode, frontoparietal, salience, sensorimotor, visual, and language networks in a relatively large sample of healthy younger and older adults. Our findings revealed increased connectivity within the posterior cerebellum in older adults, in contrast to the conventional view that functional connectivity generally decreases with age. Notably, connectivity between the cerebellum and the default mode as well as frontoparietal networks was especially enhanced, suggesting potential compensatory mechanisms that support cognitive functioning in aging. Furthermore, cerebellar nuclei demonstrated particularly strong connectivity with the visual network, highlighting an evolving role for the cerebellum in integrating visual and motor processing as individuals grow older. Our findings highlight the dynamic nature of cerebellar connectivity and have significant implications for understanding neural compensation and its role in preserving cognitive and sensory-motor functions in aging populations.

Abstract ID: 0165

Using of Cytokinesis Block Micronucleus Assay to monitor the risk of excessive radiation exposure in lymphocytes

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Abstract:
The cytokinesis-block micronucleus assay (CBMN) as Rapid biodosimetry tool is required to assist with triage in the case of ionizing radiations exposure, whether medical, occupational or accidental that leads to deleterious biological consequences like mortality or carcinogenesis. Here, we aimed to evaluate the relationship of DNA damage parameters; micronuclei (MNi) frequencies, binucleated cells (BNCs) and nuclear division index (NDI) of peripheral blood lymphocytes cells (PBLcs) taken from healthy donors with x-ray radiation dose rate.We performed prospective analysis on 20 peripheral blood lymphocytes samples taken from healthy volunteers. The blood samples were irradiated with single X-rays doses of 320 KeV with dose rate of 0.913 Gy/min and blood samples were exposed at the dose levels of 0, 0.5, 1, 2, 3, 4, and 5 Gy. The blood samples were then cultured for 72 h at 37°C and processed following the International Atomic Energy Agency standard procedure with slight modifications. We observed significantly increase in the average number of micronuclei with increasing radiation dose as compared with control subjects, the highest average number of MNi (400.700±14.343) was found in irradiated female lymphocytes at 5Gy dose, while minimum average numbers of MNi (0.700±14.343) was in non-irradiated female lymphocytes samples. The number of micronuclei in BNCs cells for healthy tended to be greater in females relative to males at lower doses of radiation (0.5- 2Gy), but this effect was not statistically significant at high doses (3–5 Gy). Average numbers of binucleated cells and nuclear division index were significantly decreased by increasing radiation dose as compared with control groups. The increased number of nuclei following high radiation doses could represent a negative impact on public health especially that of workers exposed to radiation.

Abstract ID: 0166

Monte carlo simulation with Geant4 for designing an accelerator-based neutron source for boron neutron capture therapy (BNCT)

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Abstract:
This research aims to investigate neutron flux for boron neutron capture therapy (BNCT) using GEANT4 Monte Carlo simulations to model cyclotron-based epithermal neutron sources. It focuses on optimizing the beam-shaping assembly (BSA) and phantom design, alongside evaluating neutron shielding requirements and therapeutic potential. The study models 10 MeV proton beams interacting with beryllium sheets to generate fast neutrons. A BSA was developed, incorporating a filter, moderator, reflector, and collimator to moderate the neutrons to therapeutic energies suitable for BNCT, achieving a high epithermal neutron flux. The BSA is designed to shape the neutron beam while facilitating its transmission and scattering through the shielding materials of the collimator wall, which consist of lithium fluoride (LiF) grafted with 50% polyethylene (PE-LiF) and pure polyethylene (PE), across an energy range of approximately 0.1 MeV. The shielding thickness of the collimator wall was analyzed for compounds with varying proportions, ranging from 5 to 30 cm. Replacing 50% of pure polyethylene with a lithium fluoride compound significantly enhanced shielding efficiency, reducing neutron transmission and increasing scattering. This improvement was quantitatively assessed through scatter and transmission factors. The scatter factor increased by 95.2% at 15 cm and 86.7% at 10 cm, while the transmission factor decreased by 85.7% at 15 cm and 72.7% at 10 cm. Neutron flux at 15 cm was reduced by a factor of three compared to pure polyethylene. Beyond this point, the thickness had minimal effect on neutron flux attenuation. Additionally, we simulated the neutron count rate distribution at the exit port of the BSA, which can be recorded by a water phantom. The results showed a significant reduction in neutron flux, reaching the range of 0.5 eV to 10 keV, where treatment can be effectively achieved.

Abstract ID: 0167

Evaluating Radiation Dose Variability in Pediatric Abdominal and Pelvic Radiography

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Abstract:
Pediatric abdominal and pelvic radiography is commonly used in trauma cases and for diagnosing lesions in radiation-sensitive organs. However, due to children's smaller body size, they absorb a higher dose of radiation, making them more vulnerable to radiation effects. This study aims to evaluate radiation doses in pediatric abdominal and pelvic exams, with the goal of improving protocol optimization and developing Diagnostic Reference Levels (DRLs) to protect the pediatric population without compromising diagnostic quality. The study was conducted at a pediatric hospital in Brazil, with 279 patients participating, using Shimadzu digital equipment designed for pediatric radiography. Anthropometric data (weight, height, and thickness of the area to be radiographed) and technical parameters (voltage, mAs, focus-to-skin distance) were collected. Radiation dose was measured using Ka,i (incident air kerma) and KAP (kerma-area product). Statistical analysis involved correlations between patient characteristics and radiation doses. The analysis revealed significant variability in doses, especially in older children (>10 years), due to anatomical differences and potential inconsistencies in protocols. For younger children (<1 year), standardized protocols showed less variability. A stronger correlation was observed between thickness and weight than between thickness and age, suggesting that weight-based adjustments are more effective for heavier patients. Cases exceeding international DRLs were identified, indicating the need for protocol improvements. The results highlight the importance of adjusting protocols based on patient thickness and weight to optimize radiation dose, especially for older children.

Abstract ID: 0168

Development of a Geant4 Monte Carlo Simulation for Mammographic X-Ray Tube

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Abstract:
Monte Carlo is a powerful method to generate mammographic X-ray spectrum. It allows a flexible and accurate geometry of mammography system. It is widely used for modelling imaging system such as Fluoroscopy, Computed Tomography, and radionuclide imaging (SPECT and PET) and for radiotherapy applications. It could represent a major contribution to dose calculation in situations where the usual clinical algorithms reach their limits (dose at entry and exit, presence of very high or very low densities). Geant4 version11.1.0 used throughout out this research work because the geometry of mammography system can be flexible and reliable and it is based on the library which is widely used, in X-ray mammography, we will take an example of the most commonly used, namely the Molybdenum/Molybdenum pair. The first task of this study aimed to generate and validate X-ray spectra of different anode of molybdenum, rhodium and tungsten using in mammography and breast phantom modeling by MIRD model by Geant4. The generation of x-rays in mammography and radiological imaging uses a particular process. The generation of an electromagnetic spectrum specific to this pair give a good agreement with literature. These finding may be an essential purpose to a next step, which define X-ray spectrum at the exit breast phantom.

Abstract ID: 0169

Assessment of Effective Doses in Male and Female Patients Undergoing Mammography

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Abstract
Breast cancer is a common malignancy for females (25% of female cancers) and also has a low incidence in males. It was estimated that 1% of all breast malignancies occur in males with a mortality rate of about 20%, with an annual increase in incidence. Risk factors include age, family history, exposure to ionizing radiation and high estrogen and low of androgens hormones level. Diagnosis and screening are challenging due to limiting effectiveness of breast cancer screening. Therefore, patients may expose to ionizing radiation that may contribute in breast cancer incidence in males. In literature, limited studies were published regarding radiation exposure for males during mammography. The objective of this research is to quantify patient doses during male mammogram and to estimate the projected radiogenic risk during the procedure. In total, a total of 8 male and 6489 female patients were undergone mammogram for breast cancer diagnosis during two consecutive years. Th mean and range of patient age (years) is 41 (34-70) for male and 45.2 (26-77.) for female. The mean and standard deviation (SD) of the Glandular dose in (mGy) was 8.26 (0.84-9.32) for male and 8.39 (12.3-55.0) for female, respectively. The mean, SD and range of patients' effective dose (mSv) per single breast procedure was 0.99 (0.101-1.12) for male and 1.01 (0.05-7.15) for female. Male and Female patients received high radiation dose per mammogram. With increasing incidence of male and female breast cancer, proper guidelines are necessary for the mammographic procedure are necessary to reduce unnecessary radiation doses and radiogenic risk.

Keywords: Male breast cancer; mammography; Radiation risk; Effective dose

Abstract ID: 0170

Radiation dosimetry during CT angiography examinations

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Abstract:

Computed tomography (CT) is the principal source of ionizing radiation exposure for the general public, accounting for approximately 70% of the total collective doses from medical assessments in developed countries. Prior research indicated that patients were administered greater dosages during contrast-enhanced CT angiography compared to standard CT procedures. The present study is to evaluate the sensitive organs and effective dosages associated with lower extremity angiography. One hundred eleven patients (61.3% male and 38.7% female) had contrast-enhanced CT examinations. All imaging procedures were conducted teachers' hospital, Khartoum, Sudan. The average patient age is 59 years, with a standard deviation of 24, ranging from 19 to 75 years. The patient's exposure was quantified by CTDIvol (mGy) and DLP (mGy.cm) at 8.1 ±3.1 (range: 2.5-17.0) and 2915±89 (range:350-6439), respectively. The average effective dosage is17.5 mSv, with a range of 3.6 to 43 mSv, The mean cancer risk per contrast enhanced CT procedure is around one cancer case per 1700 procedures. The estimated effective dose is higher in comparison to earlier reported researches. Reduction of patient effective dose is possible by tailoring the imaging protocol according to the patient need.

Radiological Interpretation of Hemorrhagic Posterior Reversible Encephalopathy Syndrome (PRES) with Breast Cancer Patient on Chemotherapy: Case Report.

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Abstract

This case report highlights the occurrence of hemorrhagic posterior reversible encephalopathy syndrome (PRES) in a 52-year-old female patient with a history of breast cancer, metastatic to bone and liver, who was undergoing chemotherapy with Palbociclib and Letrozole. The patient presented to the emergency department with a two-week history of headache, blurred vision, and vertigo. A comprehensive neurological evaluation and MRI indicated interval progression of the multifocal cortical and subcortical areas of low T1 and high T2/FLAIR signal intensity involving the bilateral cerebral hemispheres, predominantly involving the frontal, parietal, and occipital lobes with involvement of the watershed distribution, consistent with hemorrhagic PRES. Following, the patient exhibited unstable vital signs and developed left-sided upper motor neuron facial weakness, followed by a rapid decline in her Glasgow Coma Scale (GCS) score and subsequent resuscitation efforts. Despite initial management, her condition deteriorated, leading to respiratory distress, necessitating transfer to the intensive care unit (ICU). The patient's condition continued to worsen, underwent cardiac arrest declared dead on day 13th of admission. This case underscores the potential neurotoxic effects of chemotherapeutic agents that may contribute to the development of posterior reversible encephalopathy syndrome (PRES) in susceptible patients. By enhancing awareness and understanding of these potential complications, healthcare providers can facilitate timely diagnosis and intervention, ultimately improving patient outcomes in the oncology setting.

Abstract ID: 0172

Evaluation of triple photon-positron annihilation using ^{18}F and ^{124}I in positron emission tomography for hypoxia detection

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Abstract:

This work uses the triple photon-positron annihilation and compares oxygenated and deoxygenated samples for hypoxia assessment using F-18 and I-124. The oxygen level was quantified using three high-purity Germanium detectors (HPGe-D) and support circuits to detect photon-positron annihilation. Coincidence and peak to valley methods were used to assess the yield of triple photon-positron annihilation. Coincidence is reliable and provides comparable values for samples between F 18 and iodine 124. Therefore, this technique could be used in positron emission tomography, opening up new possibilities for non-invasive techniques for hypoxia assessment.

Abstract ID: 0173

Challenges Faced by Radiology Department Workers in Dealing with Disabled Patients

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Abstract:

This survey examines the challenges observed by radiology department personnel in delivering care to impaired patients, intending to improve service delivery, workflow, and care quality. The study captures data on the experiences of multiple jobs within radiology including radiologists, technologists, nurses, and administrative staff across various imaging modalities and shifts. It tackles the variety of disabilities seen, from physical and sensory impairments to cognitive and behavioral problems, and assesses the level of comfort and unique challenges staff find in working with these patients. Objective: This survey aims to explore the challenges radiology staff encounter when working with disabled patients and identify opportunities for improvement in service delivery, workflow, and care quality. Key themes explored include communication difficulties, physical and logistical constraints, departmental resources and training availability, and workers' emotional and mental well-being. The survey evaluates the perceived effects on workflow and the sufficiency of organizational assistance for accommodating impaired patients. Additionally, it invites staff to offer potential enhancements, such as expanded training, new equipment, and policy changes, while also studying the role of assistive technology in improving patient relationships. Findings from this survey aim to advise radiology department management on areas requiring improvement and help develop targeted plans to maximize treatment for impaired patients, increase staff well-being, and promote inclusive and accessible radiography practices.

Abstract ID: 0174

Establishing Diagnostic Reference Levels for Cardiac Interventional Procedures

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Abstract

Medical exposure to ionizing radiation during interventional tests can have detrimental consequences on patients, including cancer and tissue responses at specific thresholds. Cardiac catheterization procedures are routinely conducted in cardiac catheter labs for various clinical indications. This comprehensive research aimed to assess the radiation dosage received by patients undergoing percutaneous coronary interventions (PCI) cardiac catheterization procedures. One hundred surgeries were meticulously conducted across four hospitals in Khartoum, Sudan. Calibrated Kerma area product meters, known for their accuracy, were employed to measure patient dosages. The effective dosage was derived using the National Radiological Protection Board (NRPB) software application, a widely accepted tool. The average KAP (Gy.cm2) per PCI operation was 8.02±0.75 (6.86-9.74), 5.91±0.52 (5.02-6.99), 7.64±0.63 (6.24-8.51), and 12.94±3.96 (9.51-22.71) for Hospitals A, B, C, and D, respectively. The total effective dosages varied from 4.2 to 20 mSv for each surgery. The effectiveness of patients is compared to recently published research. The Diagnostic Reference Level (DRL) was established based on the third quartile value for the PCI procedure.

Abstract ID: 0175

Studies of ^{nat}Gd(p,x) nuclear reaction cross-sections for optimized production of theranostic ^{155}Tb radionuclide via AVF cyclotron

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Abstract:
Terbium-155 is a promising radionuclide for theranostic applications in nuclear medicine due to its suitability for single-photon emission computed tomography imaging and its potential as a diagnostic partner for therapeutic radiolanthanides like lutetium-177 and yttrium-90. However, the availability of 155Tb in sufficient quantity and quality for medical use remains a challenge. One potential solution is its production using medical cyclotrons via the ^{155}Gd(p,n)^{155}Tb and ^{156Gd}(p,2n)^{155}Tb nuclear reactions. Therefore, accurate production cross-sections for ^{nat}Gd(p,x) nuclear reactions are essential for optimizing the production parameters of ^{155}Tb radionuclide. This study measured the production cross-sections of the ^{151,152,153,154m,g,155,156m,g,160}Tb isotopes from natural gadolinium irradiated with 30 MeV protons from AVF Cyclotron of RIKEN, Japan, and employed a stacked-foil activation technique combined with HPGe gamma-ray spectrometry. On the basis of the obtained results, the production yield and purity were calculated to assess the optimal production parameters of important ^{155}Tb. Our measured data show partial agreement with existing literature data, theoretical data from the TENDL-2023 library, and predictions from the EMPIRE-3.2.2 model code. The data obtained from this study are valuable for improving the predictive capabilities of these model codes.

Abstract ID: 0176

Generation of Electrical Power using Siphon Effect

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Abstract:
The siphon effect in water or in a hydraulic system is an effect caused by a fluid inside a pipe. Siphon effect can be used as a sources of renewable energy, which uses the natural flow of moving water to generate electricity, similar the artificial dams. Hydro power is typically associated with big rivers, bigger dams and huge reservoirs, so by using siphon effect we can generate electricity. When we have the water head and water flow data, we can know exactly how to calculate the hydro turbine generator wattage. Water head is the vertical distance between the highest and lowest points of the stream and water flow is the amount of water passing a point, measured in liters per second. The power calculation is: head x flow rate x gravity x 0.75. For example, a 5m head with a 14 liter per second flow rate will give: 5m x 14L/s x 9.81 x 0.75 = 515 watts of power. The proportion of water that is safe to use will vary with the type and condition of the stream. In all cases the siphon effect will be effective. In general, the efficiency of siphon effect depends on the type of the turbine system and operating conditions (speed and flow rate of water). In additionally, siphon effect does not introduce any pollutants, environmentally friendly, low cost and save money. Siphon effect will be reducing emission of carbon gas which cause global warming. So by using siphon technique we can protect the environment against greenhouse gases and improve people health.

Abstract ID: 0177

Focused ultrasound for opening blood-brain barrier and drug delivery monitored with positron emission tomography

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Abstract:
Focused ultrasound (FUS) is a minimally-invasive technology used for treatment of many diseases, including diseases related to the colon, uterus, prostate, and brain. Although it has been mainly used for ablative proce dures, the ability of FUS to open the blood-brain barrier (BBB) presents a promising new application. However, the mechanism of BBB opening by FUS remains unclear. This review focuses on the use of FUS to open the BBB for enhancing drug delivery and investigating how Positron Emission Tomography (PET) provides insight into the underlying mechanism.

Abstract ID: 0178

Development of an algorithm for assessment of C-arm and ultrasound quality control imaging

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Abstract

Recently, it has been noted that mobile X-ray machines have spread in hospitals and patient wards to comfort patients and in emergency cases. This requires taking precautions and applying the regulations of the Nuclear and Radiation Regulatory Authority in the Kingdom of Saudi Arabia, which include periodic quality control, ensuring the radiation dose, and checking leakage. herefore, in this study, we conducted the most critical annual quality control tests for seven mobile X-rays and 5 C-Arm X-rays for tube and generator performance, radiation output, half-value layer, beam alignment, focal spot size, dose area product (DAP) meter accuracy, mechanical safety, and equipment condition. For mobile X-ray, we found that the average mini percentage error of kVp, maximum percentage kVp error, Entrance Skin Dose (ESD), mini dose for linearity, maximum dose for linearity, HVL, air Kerma and mAs were 1.23% kVp, 0.27% kVp, 0.91 mGy/min, 0.86 mGy/min, 0.90 mGy/min, 3.27 mm, 0.82 mGy/min and 11.45 mAs respectively; in the same time found that the average of mini percentage error of kVp, maximum percentage kVp error, Entrance Skin Dose (ESD), mini dose for linearity, maximum dose for linearity, HVL, air Kerma and mAs were o.06 % kVp, 1.8 % kVp, 7.59 mGy/min, 8.25 mGy/min, 0.90 mGy/min, 4.67 mm, 0.82 mGy/min and 11.45 mAs respectively. All the tests were less than some previous studies for mobile X-rays and high for others. All the machines were new, so the values were closed together.

Abstract ID: 0179

Review of various methods for occupational eye lens dosimetry in X-ray interventional procedures

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Abstract

Purpose: elevated operator’s eye dose in interventional cardiology can exceed the threshold for tissue reaction results in eye lens opacities and cataract [1]. There monitoring eye lens dose is important to prevent tissue rection and to comply with dose limits [2]. Here, we review the different methods used for eye lens dosimetry in X-ray interventional procedures so as to guiltiness that can help promote radiation protection of the eye lens in interventional procedures. .

Methods: We reviewed recent scientific literature on various method used eye lens dose measures as weel as recent development in dosimeters for direct eye lens dose measurements as well Updated data on indirect eye lens dose assessments.

Results. results are summaries on recent development on dosimeters for the direct measurement of the and methods direct eye lens dose measurements, active electron dosimeters (APDs) for real-time measurement. Updated data were extracted from the literature on conversion coefficient used for indirect eye lens dose assessments. Different methods are summarized for optimization of occupation exposure in X-ray interventional procedure.

Conclusions: This study provides a review of recent research efforts in eye lens dosimetry to provide up-to-date information and methods for eye lens dose estimates and may help promote occupational dose optimization in interventional cardiology and radiology.

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2. ICRU Report 95: new operational quantities for external radiation exposure. Journal of the ICRU. Volume 20 Issue 1, December 2020

Abstract ID: 0180

Occupational Exposure during Cardiac Cath Procedures

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Abstract

Cardiac catheterization procedures involve the use of ionizing radiation, posing potential occupational hazards to healthcare workers. The radiation exposure levels vary significantly depending on the specific procedures performed, the equipment used, the radiation safety practices in place, and the individual work habits of the staff. The constant evolution of imaging technology underscores the urgency of detailed occupational radiation dose assessment for cardiology department personnel. This study aimed to assess the deep (Hp (10), mSv) and shallow ((Hp (0.07), mSv) equivalent doses received by staff involved in cardiac procedures. The occupational exposure was quantified using a thermoluminescent dosimeter (TLD-100 (LiF: Mg, Ti). The occupational exposure was quantified for 25 cardiologists, nurses, and technologists during three consecutive years. The average and range of the occupational doses in terms of (Hp(10), mSv) and shallow ((Hp(0.07), mSv) for the years 2020, 2021 and 2022 were 1.9 (0.17-7.04) & 1.7 (0.18-8.2), 7.7 (0.34-53.5) & 14.5 (0.37-154.5), and 1.2 (0.31-3.8) & 1.4 (0.3-4.6), respectively. The staff received a wide range of equivalent doses due to the procedure type, experience level, and use of radiation protection measures. This study highlights the importance of implementing and optimizing radiation protection protocols, including using lead aprons, thyroid collars, and proper positioning, to minimize occupational radiation exposure during cardiac catheterization procedures.

Abstract ID: 0181

Pioneering Progress: Canadian Leadership in Nuclear Science for Health, Energy, and Sustainability

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Abstract:

Canada has been a global leader in the nuclear industry for decades, with significant contributions to medical isotope production. Most recently, Canadian Nuclear Laboratories (CNL) has delivered mid-scale production of actinium-225 (Ac-225) at the cyclotron facility owned by the University of Saskatchewan, marking a key milestone in isotope innovation. The production of Ac-225 by proton irradiation of radium-226 (Ra-226) expands the availability of this rare isotope, and enables clinical trials that are critical to improve targeted cancer therapies. Canada is also a pioneer in medical isotopes production using power reactors: CANDU reactors play a vital role in producing essential isotopes such as lutetium-177 (Lu-177) and cobalt-60 (Co-60), with Canada securing over 50% of the global supply of Co-60. Saskatchewan has been central to these advancements, with a rich history in nuclear medicine dating back to the establishment of the first radon plant at the University of Saskatchewan in 1931. In 1945 Harold Johns, supervised the radium and X-ray therapy machines installed at the Saskatchewan Cancer Clinics. In 1951 the first calibrated cobalt machine has been installed at the University Hospital. The creation of a Positron Emission Tomography (PET) suite at USask in 2013 and 2020 enhanced diagnostic capabilities for both human and veterinary applications. Furthermore, the production of therapeutic isotope copper-67 (Cu-67) via the irradiation of zinc-68 (Zn-68) at the electron linac located at the Canadian Light Source (CLS) demonstrates the continued innovation in medical isotope production. The province continues to be a key player in uranium extraction, providing more than 50% of the world's uranium supply. Befitting with its forward-looking character, the province of Saskatchewan is now engaged in the deployment of Small Modular Reactor and a Micro Modular Reactor project for energy futures.

Abstract ID: 0182

Effective dose to patients from various X-ray interventional cardiology Procedures

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Abstract:

In this study, the objective was to estimate the effective doses (EDs) of patients undergoing interventional cardiology procedures in Sudanese hospitals and to investigate their dependence on various procedural parameters. Patient- and dose-related information was retrospectively extracted from the Digital Imaging and Communications in Medicine (DICOM) header for 3,332 patients from six hospitals. Effective dose values were calculated for coronary angiography (CA), percutaneous coronary intervention (PCI), CA+PCI, and pacemakers using DAP to ED conversion coefficients [1]. A conversion of 0.12 05 mSv/(Gy·cm2) for CA procedure and 0.22 mSv/(Gy·cm2) for therapeutic cardiac procedures was employed. The average effective dose values ranged from 3.65-6.43 mSv in CA procedures, 12.41-26.40 mSv in PCI, 32.12-48.0 mSv in CA/PCI, and 5.59-18.70 in Pacemaker procedures. ED values were primarily influenced by higher DAP values resulting from prolonged fluoroscopy procedures, as demonstrated in CA/PCI procedures. Higher effective dose values were anticipated when using 0.4 mm of Cu filtration, resulting in conversion coefficients of 0.29 ± 0.05 mSv/(Gy·cm2) [2]. The effective dose is crucial for determining the contribution of interventional cardiology procedures to population exposure and for comparing the radiation detriment with other radiological procedures involving ionizing radiation.

Keywords: X-ray fluoroscopy; cardiac intervention; patient dose; effective dose ; Radiation Protection.

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Abstract ID: 0183

Measurement of staff radiation dose at radiology and nuclear medicine departments

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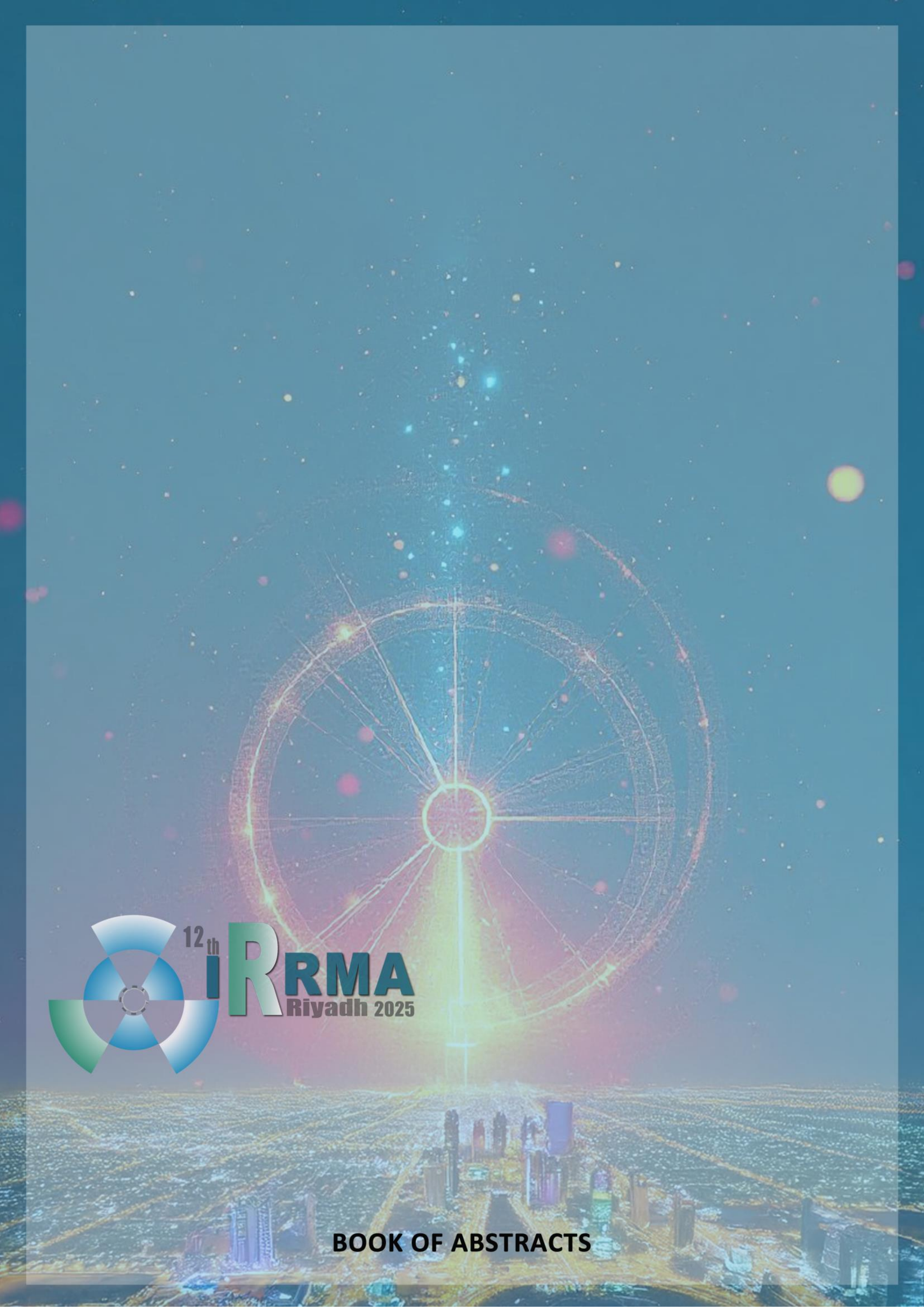
Abstract:

Precise measurement and monitoring of occupational radiation exposure in medicine ensures that exposure remains below established limits, minimizing the risk of radiation-induced health effects. This work evaluates the occupational radiation exposure for radiologists and technologists working in radiology and nuclear medicine departments over three consecutive years. This study was carried out at King Khalid Medical City at King Saud University. The nuclear medicine equipment comprises one gamma camera and two SPECT/CT machines. In contrast, the radiological imaging machines consist of four CT scanners, nine X-ray machines, six mobile X-rays, and eleven C-arms X-ray machines. The occupational exposure was quantified for 18 Nuclear medicine radiologists, 42 technologists at the Radiology Department, and 13 radiology technologists working at CT machines. all staff occupational doses were quantified using thermoluminescence dosimeters (TLD). The dose was monitored every three months. The range of staff dose ranges from 0.2 to 1.6 per year over the last five years, ranging from 2019 to 2023. The occupational dose during 2020 was the lowest due to the COVID-19 shutdown. The personal equivalent dose (Hp10) is below the annual dose limits (20 mSv per year) recommended by the Saudi Food and Drug Administration (SFDA) and the International Atomic Energy Agency (IAEA). The results showed that adherence to dose limits demonstrates the successful implementation of robust radiation protection programs within the departments due to optimized techniques, adequate shielding, and staff training. The occupational dose in this medical city is comparable to previously published data in Saudi Arabia and other countries.



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