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EDITORIAL

Dear reader,

We are pleased to present the second issue of Atom Indonesia, Volume 50 No. 2 (2024). This second issue contains ten articles discussing various aspects and applications of nuclear science and technology. The authors of these articles are not only from different national institutions, but also from international institutions as well.

"Radon Concentration in Biological Samples of Smokers and Non-smokers Using Lexan Detector" was written by A. A. Alkufi from University of Babylon, College of education for pure sciences, Department of Physics, Babylon, Iraq and Education Directorate of Najaf, Ministry of Education, Al-Najaf, Iraq in collaboration with M. H. Oleiwi of the University of Babylon, College of Education for Pure Sciences, Department of Physics, Babylon, Iraq and A. A. Abojassim from University of Kufa, Faculty of Science, Department of Physics, Al-Najaf, Iraq. This study was conducted in the Najaf Governorate, Iraq, to analyze the radon concentration in biological samples from smokers and non-smokers. The samples, including blood serum, urine, hair, and nails, were used as biomarkers to determine the presence or absence of radon (^{222}Rn). Using a natural exposure method, the nuclear track detector (Lexan, Belgium) was used to measure these radon concentrations in the samples. Seventy-five samples of blood serum, urine, hair, and nails were collected from healthy smokers and fifty samples from healthy non-smokers in five age groups. This study was based on age and smoking to compare the results and determine their effects on radon concentrations. The results show that the mean values of radon concentrations (in Bq/m^3) in blood serum, urine, hair, and nails for smokers were 54.7 ± 22.1, 62.9 ± 23.1, 34.7 ± 11.2, and 41.7 ± 15.2, respectively. Mean radon concentrations (in Bq/m^3) in blood serum, urine, hair, and nails of non-smokers were 24.2 ± 6.0, 30.0 ± 6.3, 18.7 ± 5.2, and 21.6 ± 6.9 respectively. The results and comparisons indicate that radon concentrations depend on the variables on which this study was based (age and smoking). Smokers and non-smokers had different radon levels in all biological samples. The P-value was <0.001, which means it was statistically significant. According to the results of the study samples within the study area, the mean values of (^{222}Rn) for biological samples were higher in smokers than in non-smokers.

"Carbone or Oxygen Therapy: A Comparative Dosimetric Study Using PHITS Code" was explored by H. El Bekkouri, E. Al Ibrahmi, M. El-Asery, A. Bardane, C. El Mahjoub, Z. Sadoune from the Department of Physics, Faculty of Science, Ibn Tofail University, Morocco in collaboration with A. Didi from the National Energy Center of Nuclear Science and Technology (CNESTEN), Rabat, Morocco. Compared to conventional radiotherapy (X-rays or γ-rays), charged particle therapy shows greater potential for treating deep-seated and radioresistant tumors. Currently, all centers offering hadron therapy use proton or ^{12}C ion. Ongoing research is exploring the possibility of using others heavier ions, such as oxygen ion ^{16}O or helium ion ^{4}He. In this study, the Monte Carlo method using the Particle and Heavy Ion Transport code System (PHITS) was used to investigate the dose deposited by incident particles of ^{12}C ion with energies of 200 and 300 MeV/u, as well as ^{16}O ions with energies of 237.5 and 358.5 MeV/u. In this study, we investigated the depth dose distribution of carbon and oxygen ion beams by comparing their energy deposition in a water phantom and the impact of secondary particles. At lower energies, oxygen ions are more advantageous than carbon ions because they have slightly higher peak input ratios. This property allows higher doses to be delivered to tumor targets or lower doses to healthy surrounding tissues.

"Preliminary Study of Micronucleus Frequencies and Responses in Thyroid Cancer Patients After Treatment with ^{131}I Therapy" was written by I. K. H. Basri, D. Ramadhani and T. Kisnanto from Research Center for Radioisotope Technology, Radiopharmaceuticals and Biodosimetry, National Research and Innovation Agency (BRIN), Tangerang Selatan, Indonesia in collaboration with Y. Lusiyanti, D. Tetriana, S. Purnami and V. A. Suvivan from the Research Center for Safety, Metrology dan Nuclear Quality, National Research and Innovation Agency (BRIN), Tangerang Selatan, Indonesia, and A. R. Dewi and M. R. A. Gani from Dharmais National Cancer Center Hospital, Jakarta, Indonesia. Radioiodine has become the most widely used to treat an overactive thyroid (hyperthyroidism) and thyroid cancer worldwide.

The aim of the present study was to investigate the association between micronuclei (MN) frequencies, and follow-up responses after treatment of thyroid cancer patients with iodium-131(^{131}I). The detection of the MNs assay was carried out by Giemsa staining from lymphocytes obtained from twenty-four thyroid cancer patients one week after receiving ^{131}I treatment at Dharmais Cancer Center Hospital, Jakarta, Indonesia. Follow-up for clinical and laboratory responses grouped into good (stable) and poor (progressive, refractory, and drop-out patients) responses, was observed one and six months after treatment. All patients received radioiodine with an activity dose of 30 - 200 μCi. The mean MN frequency was 14.22 in the good response group and 17.22 in the poor response group. There was no statistically significant difference in MN frequency ($p>0.05$) between the two groups of patients after six months of treatment.

"A Neutronic Study of A Low-Enriched Uranium-Fueled Microreactor Cooled with A Sodium Heat Pipe System Using The Open MC Code" was carried out by A. Bourenane from Materials and Energies Research Laboratory (MERL), Faculty of Science and Technology, University Amine Elokkal El Hadj Moussa Eg Akhamouk, Tamanrasset, Algeria and Nuclear Research Center of Birine, BP 180 Ain Oussera, Djelfa, Algeria in collaboration with M. Dougdag and M. L. Yahiaoui from Nuclear Research Center of Birine, BP 180 Ain Oussera, Djelfa, Algeria and L. Hamidatou from Nuclear Research Center of Draria, Sebbala, Algiers, Algeria. The development of Small Modular Reactors (SMRs) represents a pivotal shift in nuclear technology, with an emphasis on improved safety, efficiency, and adaptability. This study examines Toshiba's MoveluX, an innovative micro-reactor, exemplifying advancements in reactor miniaturization suitable for limited spatial environments and hybridization with other energy sources. In this paper, the performance and safety of the MoveluX are rigorously evaluated using the OpenMC code, with an emphasis on critical parameters such as the effective multiplication coefficient and the reactivity worth of control devices. A 3D model of the given microreactor was built based on Toshiba's designs and features a solid core and a heat pipe cooling system. Preliminary results confirm the accuracy of the model, and analysis of the neutron spectrum and flux indicates significant fission occurring in the U-238 isotope. Furthermore, the investigation extends to the thermal aspect within the fuel elements, uncovering a significant power density at the interfaces between fuel and moderator. Overall, this research makes a significant contribution to the field of microreactor design and optimization.

"Evaluation of Tumor Control Probability and Normal Tissue Complication Probability of Breast Cancer Treatment Plan in Post Mastectomy Radiation Therapy" was written by S. Herwiningsih, F. Yuana, R. Latifah, A. Hidayat, D. P. Rahmahtullah and I. Alviani from the Department of Physics, Faculty of Mathematics and Natural Science, Universitas Brawijaya, Malang, East Java, Indonesia in collaboration with F. K. Hentihu from the Department of Radiotherapy, Lavalette Hospital, Malang, East Java, Indonesia. Radiotherapy is widely used in the treatment of cancer, including breast cancer treatment, which can be treated after patients have undergo mastectomy. This study aims to evaluate tumor control probability (TCP) and normal tissue complication probability (NTCP) of three-dimensional conformal radiation therapy (3DCRT) and intensity modulated radiation therapy (IMRT) treatment planning in post-mastectomy breast cancer radiation therapy. Twenty clinical breast cancer treatment plans delivered using 3DCRT were evaluated retrospectively. The IMRT plans were created for the same patients. The dose-volume histograms of each plan were extracted from the Treatment Planning System (TPS) computer which were then used to compute the TCP and NTCP for each plan. The TCP was calculated using the Poisson model and the NTCP was calculated using the Lyman-Kutcher-Burman (LKB) model. The NTCP was calculated for normal lung tissue, heart, esophagus, and spinal cord. The results show that the TCP of the 3DCRT and IMRT plans are not significantly different, with a value of above 99 %. The NTCP of the left lung is lower in the IMRT plans while the NTCP of the esophagus is lower in the 3DCRT plans. The NTCP for the heart, spinal cord, and right normal lung are zero in all plans.

"Atmospheric Nitrogen Plasma-Induced for Embedding NH2@Cubic-Bicontinuous Mesoporous Silica as Uranium (VI) Adsorbent Candidate in Seawater" was studied by N. S. Pamungkas and D. Wongsawaeng from Research Unit on Plasma Technology for High-Performance Materials Development, Department of Nuclear Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok, Thailand in collaboration with D. Swantomo from Polytechnic Institute Nuclear Technology, National Research, and Innovation Agency, Yogyakarta, Indonesia and K. Kamonsuangkasem and S. Chio-Srichan from Synchrotron Light Research Institute (Public Organization), Muang District, Nakhon Ratchasima, Thailand.

This work aims to achieve interesting progress in uranium extraction by introducing a promising strategy that utilizes atmospheric nitrogen plasma-induced amine modification of CBC (Cubic Bi-continuous) material, providing a compelling pathway to enhance CBC's adsorption properties specifically for uranium harvesting. CBCs mesoporous silica samples were prepared by mixing the Pluronic F-127 as a template and TEOS (Tetraethyl Orthosilicate) as silica sources in the sol-gel process under acidic conditions. The obtained CBCs were treated using nitrogen plasma at room temperature (RT) under atmospheric pressure in a customized-borosilicate plasma reactor. Subsequently, the treated CBSs were grafted with amine groups. The final samples were characterized using SAXS (Small Angle Synchrotron X-ray Scattering) to determine the phase and structure, SEM-EDS (Scanning Electron Microscopy-Energy Dispersive Spectroscopy) analysis to quantify the presence of silica, oxygen, and embedded nitrogen, and Specific Surface Area (SSA) Analyzer using Brunauer-Emmett-Teller (BET) method to determine the specific surface area and pore size distribution. The SAXS profiles indicate that the obtained samples can be classified as CBCs Im3m mesoporous silica. The presence of silica, oxygen, and nitrogen was verified through SEM-EDS analysis, with approximate compositions of 36-37 %, 51-62 %, and 0.7-1.0 %, respectively. The use of SSA analysis further supported the findings, confirming the typical adsorption isotherm IV model. The specific surface areas were measured to be 371 m^2/g for pure CBC, 573 m^2/g for P1-CBC, and 607 m2/g for P2-CBC. The pore size distribution analysis revealed mesoporous characteristics within the material, with pore sizes ranging from 4 to 6.5 nm. On a batch laboratory scale, the material achieved the highest adsorption capacity of 15.68 mg-U(VI)/g-NH2@P1-CBC from natural seawater after 1 hour of contact time.

"Effects of Patient Dose Reduction Efforts on Image Quality for Thoracic CT in a Moroccan Hospital" was written by Z. Saga, A. Rahmouni and A. Rezzouk from the Laboratory of Solid-State Physics, Department of Physics, Faculty of Science Dhar El Mahraz, Sidi Mohamed Ben Abdellah University, Morocco in collaboration with L. Belaroussi from Occupational Health Department-CHU Hassan II-Fez, Epidemiology and Health Sciences Research Laboratory, Faculty of Medicine, Pharmacy and Dentistry, Sidi Mohamed Ben Abdellah University, Route of Sidi Harazem, Morocco, M. Talbi from Higher Institute of Nursing Professions and Health Techniques, Rabat / Department of Physics, laboratory of materials and subatomic physics, Faculty of Sciences, Ibn Tofail University, Kenitra, Morocco and Ibn Tofail University, Faculty of Sciences, Department of Physics, Nuclear Physics and Techniques Team, Morocco and M. El Mansouri from Ibn Tofail University, Faculty of Sciences, Department of Physics, Nuclear Physics and Techniques Team, Morocco. Thoracic CT imaging is a highly recommended medical imaging modality. It is accompanied by a high exposure to radiation due to the number of examinations carried out, which requires efforts to reduce the CT dose index (CTDI) while trying to preserve image quality. To this end, this study proposed the possibility of introducing two new imaging protocols for chest tomography. A 16-slice HITACHI SUPIA CT scanner and two phantoms were used to investigate CTDI vol and image quality; the first phantom was made of PMMA and the other of AAPM model 610. Three tube voltages were studied by varying the intensity of the tube current (mA): 120 kVp (120-160-210-230) mA, 100 kVp (160-200-240-290) mA, and 80 kVp (230-260-300-350) mA. The values for noise uniformity and accuracy, contrast-to-noise ratio (CNR), and spatial resolution (SR) were determined using IndoQCT c22a. 92 software. The first thoracic protocol proposed with 100 kVp compared to 120 kVp resulted in a 27.51 % reduction in CTDIvol, a 20 % increase in mA, and a 19.50 % increase in noise. The CNR showed a slight regression of 23.08 %. For the second scan procedure at 80 kVp, the CTDIvol was reduced by 53.32 %, while noise was increased by 53.95 %. There was no statistically significant difference in CNR and SR ($p > 0.05$) when kVp and mA were reduced compared to the routine protocol. It is suggested that it is possible to adopt two new acquisition protocols at 100 kVp and 80 kVp while reducing the patient exposure dose (CTDIvol) by 28 % and 54 %, respectively, and taking into account the effect of varying these parameters on image quality. Their decisions must be made by integrating and considering clinical issues and a good understanding of the pathophysiology and imaging results of the suspected condition. Consequently, radiologists and technicians should always be involved in improving imaging practices in such a way as to make more effective use of radiation.

"Bibliometric Analysis of the Literature on Carbon Ion Therapy Using VOSviewer Software and Dimensions Database" was carried out by H. El Bekkouri, E. Al Ibrahmi, M. El-Asery, A. Bardane, C. El Mahjoub, and Z. Sadoune from Department of Physics, Faculty of Science, Ibn Tofail University, Kenitra B., Morocco in collaboration with A. Didi from the National Energy Center of Nuclear Science and

Technology, Rabat, Morocco. This aim of this study is to carry out a bibliometric assessment of the worldwide research literature and historical research results on carbon ion therapy for cancer treatment. To carry out this work, we used the VOSviewer software and the Dimensions database. The VOSviewer software tool examined 2,500 publications exported from the Dimensions database. The results show a notable upward trajectory in academic research on carbon ion therapy since 1994, with 2020 showing the highest volume of publications. “Biomedical and Clinical Sciences”, “Physical Sciences”, “Oncology and Carcinogenesis”, and “Medical and Biological Physics” are the most important research categories. “Physics in Medicine and Biology” and “Medical Physics” are the leading journals for research publications on carbon ion therapy. Scrutiny based on term occurrences demonstrates the shift in research interest towards carbon ion radiation therapy. The analysis of bibliographic couplings concerning different countries revealed that Japan is the most dynamic and prolific country based on the number of publications (659) and citations (13734), followed by Germany with 590 publications and 19679 citations. These analytical studies provide a thorough overview of academic publications dedicated to using carbon ions for tumor treatment. This data is anticipated to be highly valuable for researchers seeking to pinpoint the most recent developments and emerging trends in this field of research.

“Radiological and Toxicity Hazards Estimate of Drinking Water in Al-Diwaniyah, Iraq” was written by M. A. Abbas from Department of Physics, College of Education, University of Al-Qadisiyah, Al-Qadisiyah, Iraq in collaboration with H. A. Hammood from Education Department of Shatrah, General Directorate of Education in Thi-Qar, Thi-Qar, Iraq and D. J. Salman from Education Department of Abu Al-Khaseeb, General Directorate of Education in Basrah, Basrah, Iraq. In this work, analyses of ^{222}Rn concentration and effective ^{226}Ra content in all available types of drinking water in Al-Diwaniyah city, Iraq, were achieved by using CR-39 detectors technique. The annual effective dose from ^{222}Rn and ^{226}Ra distribution by three age groups were calculated. Radiological and chemical hazards were also calculated in drinking water samples. Drinking water samples were taken from tap water, water treatment plants, reverse osmosis water, and bottled drinking water in Al-Diwaniyah city. Effective ^{226}Ra content level in some tap water samples were bigger than recommended value WHO for drinking water (1 Bq/L), but far below maximum acceptable limit of 370 Bq/L according to IAEA. All other values of ^{222}Rn concentration and effective ^{226}Ra content, annual effective dose, cancer morbidity and mortality hazards, and the lifetime average daily dose caused by consumption ^{226}Ra in drinking water were less than recommended limits. Therefore, ^{222}Rn concentration and effective ^{226}Ra content in drinking water obtained in this work cannot give rise to radiological and chemical threats to population. However, for greater safety, it is recommended that tap water should not be used directly as drinking water. This work will provide important new data on the possible health effects of drinking water in Al-Diwaniya city.

“Non-Dimensional Number Analysis on Natural Circulation Flow Changes Inside Straight-Pipe Heat Exchanger of Water Cooling Tank in FASSIP-02 Test Loop” was conducted by E. P. Ariesta, Deendarlianto and A. S. Al Amin from Department of Mechanical and Industrial Engineering, Faculty of Engineering, Gadjah Mada University, Yogyakarta, Indonesia in collaboration with P. H. Setiawan, H. A. Gunawan, and M. Juarsa of the Research Center for Nuclear Reactor Technology, National Research and Innovation Agency (BRIN), Tangerang Selatan, Indonesia. The FASSIP-02 test loop is a large-scale experimental facility for studying natural circulation flow rate phenomena to improve passive safety systems of nuclear reactors. Heat transfer in the piping system will result in pattern and magnitude of the natural circulation flow being formed, so it is essential to investigate the heat dissipation capabilities, which will later be applied in nuclear passive cooling systems. The heat transfer behavior of passive cooling systems in large-scale facilities can be quantified with non-dimensional numbers. This research analyzes heat transfer in a straight heat exchanger by comparing non-dimensional numbers based on the Dittus-Boetler and McAdams correlation with the correlation generated from experimental data. The analysis results show that the predicted McAdams correlation with the experimental correlation is higher than 83 %. Meanwhile, Dittus Boetler's correlation prediction with the experimental correlation is smaller than 71 %. The dominance of momentum diffusivity in the cooling process shows the characteristics of thermal behavior with the Prandtl number. In addition, all-natural circulation flow variations occur in a turbulent flow regime that increases with increasing water temperature in the heating tank.

On behalf of Atom Indonesia, I would like to thank you all for your contributions and endless support that have enabled Atom Indonesia to achieve an outstanding performance over all the years. This outstanding performance could not have been achieved without the great efforts and cooperation of the editors, reviewers, management personnel, authors, and readers.

Editor in Chief