



RAP 2023

**INTERNATIONAL CONFERENCE
ON RADIATION APPLICATIONS**

In Physics, Chemistry, Biology, Medical Sciences,
Engineering and Environmental Sciences

BOOK OF ABSTRACTS



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TABLE OF CONTENTS

Click on the title of the abstract to access it

INVITED TALKS

Advanced semiconductor microdosimetry for particle therapy and space

A.B. Rosenfeld, L.T. Tran, S. Guatelli, D. Bolst, S. Peracchi, B. James, V. Pan,
J. Vohradsky, M. Petasecca, M. Lerch, M. Povoli, A. Kok, T. Inaniwa _____ 1

New insights from climate change studies using temporal trends of marine environment indicators

Jasmina Obhodas, Andrija Vinković, Umberta Tinivella, Michela Giustiniani,
Vanessa Cardin, Manuel Bensi, Danijela Joksimović, Christos Tsabaris,
Branimir Radun, Tarzan Legović _____ 2

Novel isotope labeling approaches to determine organic matter transformations in the environment

Travis B. Meador, Stanislav Jabinski, Matthias Pilecky, Martin Kainz,
Leonard I. Wassenaar _____ 3

Developing radiopharmaceuticals for health

Giancarlo Pascali _____ 4

CONFERENCE ABSTRACTS

CALIBRA: A national research infrastructure for accelerator-based research and interdisciplinary applications

Sotirios Harissopulos, Anastasios Lagoyannis, Mihail Axiotis,
Andreas Germanos Karydas, Angelos Laoutaris, Ion Stamatelatos _____ 5

A contribution to the current debate on the rationale of the Linear-No Threshold Hypothesis (LNT)

Peter Bossew _____ 6

Heavily-doped lead tungstate scintillators for fast detectors of ionizing radiation

Gintautas Tamulaitis, Saulius Nargelas, Yauheni Talochka _____ 7

Novel diamond detector development for harsh neutron flux environments Kalliopi Kaperoni, Maria Diakaki, Michael Kokkoris, Christina Weiss, Michael Bacak, Erich Griesmayer _____	8
Development of a silicon carbide radiation detection system and experimentation of the system performance Jinlin Song, Xiaobin Tang, Pin Gong, Zhimeng Hu, Dajian Liang, Zeyu Wang, Peng Wang, Hong Ying, Haining Shi, Ao Liu, Zhifei Zhao, Song Bai _____	9
Effect of the activator material in Gd₂O₂S phosphor based EPID systems: A theoretical study Marios Tzomakas, Vasiliki Peppas, Antigoni Alexiou, Georgios Karakatsanis, Anastasios Episkopakis, Christos Michail, Ioannis Valais, George Fountos, Ioannis S. Kandarakis, Nektarios Kalyvas _____	10
Pulsed infrared stimulated luminescence of Ce³⁺ doped YAG crystals as a dosimetric tool Dorota Kuźnik, Anna Mrozik, Paweł Bilski, Yuriy Zorenko _____	11
Determination of thermal neutron dosimetry using nuclear track detectors Emad Ghanim, Sara Othman, Abdel Azeem Hussein, Hussein El-Samman, Ahmed El-Sersy _____	12
Spectral matching factor calculations between (Gd,Y)₃(Al,Ga)₅O₁₂ fluorescent screens of various activators and photodetectors Nikolaos Potiriadis, David Stratos, Marios Stogiannos, Panagiotis Liaparinos, Aikaterini Skouropoliakou, Ilia Kmendo, Georgy A. Dosovitskiy _____	13
LGAD sensors for application in proton CT Gregor Kramberger _____	14
Efficiency transfer factors calculation for gamma-ray detectors using multipurpose Monte Carlo codes Ioana Lalau, Aurelian Luca, Claudia Olaru, Mastaneh Zadehrafai, Mihail-Razvan Ioan, Andrei Antohe _____	15
ANET-2D Multichannel Compact Neutron Collimators for high intensity pulsed and continuous beams Marco Costa, Oriol Sans Planell, Francesco Grazzi, Francesco Cantini, Valeria Monti _____	16
Radionuclides transfer from soil-to-tea leaves and concomitant impact assessment Mayeen Khandaker, Nur Fadhilah Binti Mokhrizal, David Bradley, Hamid Osman _____	17

Investigation on Pixel-to-Pixel isolation by Trench and p-stop technologies under high charge density injection: Case study of segmented LGAD	
Gordana Lastovicka-Medin, Mateusz Rebarz, Gregor Kramberger _____	18
Angular correlation of gamma-gamma coincidence measurements for neutron activation analysis	
Sheldon Landsberger, Kevin Smith, Brandon De Luna, Stefano Marin _____	19
Characterization of the neutron flux through the RMC SLOWPOKE-2 pool via neutron activation analysis and MCNP modelling	
Daniel Huston, Pavel Samuleev, Fiona Kelly, Emily Corcoran _____	20
Measurements of Th/U ratio using different techniques: A comparative study	
Wafaa Arafa, Hala Bakeer, Eman Yousf, Ashry Ashry, Ahmed Abdelgawad, Ahmed El Sersy, Ibrahim El Aassy, Hussein El Samman _____	21
Comparing dosimetric and spectroscopic capabilities of handheld Na(Tl) γ-spectrometers	
Konstantinos Kamoutsis, Eleftheria Ioannidou, Ioannis Kaissas, Alexandra Ioannidou, Stylianos Xanthos _____	22
Evaluation of proficiency test results of gamma ray spectrometry in determination of anthropogenic and natural radionuclides	
Manjola Shyti, Erjon Spahiu _____	23
Evaluation of the primary quality control parameters on diagnostic radiographic equipment in governmental and private healthcare institutions in Albania	
Luljeta Disha, Manjola Shyti _____	24
Non-destructive determination of ^{90}Sr, ^{241}Am and ^{137}Cs activity in Chernobyl fuel particles using gamma-beta-spectroscopy coupled with autoradiography method	
Valentyn Protsak, Gennady Laptev, Kyrylo Korychenskyi _____	25
Assessment of radiation exposure in area of holiday cottages in Šumadija region, Serbia	
Mirjana Cujic, Ljiljana Jankovic Mandic, Danijela Maksin, Antonije Onjia _____	26
Activity determination of a ^{137}Cs radioactive source used in oil-welling company in Albania	
Dritan Prifti, Kozeta Tushe _____	27
Chemical decontamination technique used to minimize the radioactive waste from IFIN-HH	
Daniela Gurau, Ioan Iorga, Laura Zicman _____	28

Traceability of solid state detectors used for Half Value Layer measurements in diagnostic radiology

Milos Zivanovic, Ivana Komatina, Nikola Krzanovic _____ 29

Solid state detector energy response in W/Al mammography radiation quality series

Andrea Kojic, Nikola Krzanovic, Milos Zivanovic, Predrag Bozovic, Jelena Stankovic Petrovic, Ivana Komatina, Jelena Vlahovic _____ 30

A Time Series Forest Method for automatic classification of anomalous glow curves of LiF:Mg,Ti based thermoluminescent dosimeters

Dusan Topalovic, Marko Krajinovic, Jelena Vlahovic, Nikola Krzanovic, Predrag Bozovic, Jelena Stankovic Petrovic _____ 31

Quality control of NaI scintillation detector for gamma spectrometric determination of radon concentration

Ivana Vukanac, Milica Rajacic, Jelena Krneta Nikolic, Marija Jankovic, Natasa Sarap, Jelena Stankovic Petrovic, Andrea Kojic _____ 32

Impact of high gamma doses on structure, optical behavior and track parameters of polymeric NTD for γ -dosimetry

Sara Othman, Emad Ghanim, Asmaa El-Badawy, Intesar El-Mesady _____ 33

Measurement of radiation exposure dose using emergency detectors and OSL Helios reader

Renata Majgier, Katarzyna Szufa _____ 34

Progress in high resolution gamma-ray spectrometry of environmental samples at the Marine Environmental Radioactivity Laboratory, HCMR

Georgios Eleftheriou, Effrossyni G. Androulakaki, Christos Tsabaris, Filothei K. Pappa, Dionisis L. Patiris, Constantinos A. Kalfas _____ 35

Investigation of several new ionic liquids' behavior during $^{210}\text{Pb}/^{210}\text{Bi}$ Cherenkov counting in waters

Ivana Stojković, Nataša Todorović, Jovana Nikolov, Teona Teodora Borović, Milan Vraneš, Slobodan Gadžurić _____ 36

On site calibration of Ionization Chamber for ^{166}Ho at Gemelli Hospital in Rome by using portable ENEA TDCR detector

Maria Vaccaro, Amedeo Capotosti, Marco Capogni, Aldo Fazio, Teresa Scotognella, Luca Indovina _____ 37

Development of a method for characterization and segregation of metallic waste after decommissioning

Dimitrios Mavrikis, Angelos Markopoulos, Alexandra Ioannidou, Anastasia Savidou _____ 38

Radiological characterization of metallic waste on decommissioning by comparing real and simulated spectrum	
Angelos Markopoulos, Dimitrios Mavrikis, Alexandra Ioannidou, Anastasia Savidou	39
Analysis of DPRK's trade and prohibited items of UN sanction transactions	
Hansol Ko, Chansuh Lee	40
Role of the International Nuclear Security Educational Network (INSEN) in strengthening Nuclear Security Globally	
Alexandra Ioannidou	41
Experimental evaluation of different wireless sensor modules under Gamma radiation	
Jin Jiang	42
Monitoring of ²¹⁰Po and uranium in vegetables and fruits for Kuwaiti adults	
Aishah Alboloushi, Omar Alboloushi	43
Present problems of radiation protection quantities: Too many inconsistent quantities	
Jozef Sabol	44
Conceptual shielding design of sandwich walls for a particle therapy centre using Monte-Carlo simulations with FLUKA	
Redona Izairi Bexheti, Mimoza Ristova	45
Study of shielding properties of zinc borate doped polypropylene matrix	
Songül Akbulut Özen, Ömer Yunus Gümüő, Toygar Çardak, Ahmet Çelik, Ali Gürol, Recep İlhan	46
Prospective prussian blue - cellulose hybrid materials for the environmental and human protection from exposure to radioactive fallouts	
Ingars Reinholds, Kristine Saleniece, Uģis Eismonts, Maris Bertins, Andris Actins, Liga Avotina, Olga Mutere, Arturs Viksna, Gunta Kizane, Andrejs Grinbergs	47
Identification of biomarkers for acute radiation syndrome using various omic platforms and nonhuman primate model	
Vijay Singh	48
Indication of the magnetic fields influence by bioluminescent analysis	
Olena Gromozova, Victor Martyniuk, Ihor Hretskyi, Oleksandr Artemenko, Victoriia Kobernyk, Olexander Kisten	49
Improved measurement of potassium levels in rats using a <i>in vivo</i> neutron activation analysis system	
Sana Tabbassum, Pinjing Cheng, Frank Yanko, Rekha Balachandran, Michael Aschner, Aaron B. Bowman, Linda H. Nie	50

Application of the combined method of radiation sterilization for the effective processing and preservation of bone material of ancient animals

Nadezhda Nikolaeva, Vladimir Rozanov, Igor Matveychuk, Aleksandr Chernyaev, Saiyyna Nikitina, Dmitry Yurov, Milena Makarova ___ 51

The measurement of the dielectric parameters of blood erythrocytes in cancer patients

Liliya Batyuk, Nataliya Kizilova _____ 52

Effects of ionizing radiation on the concentration of volatile organic compounds in beef, turkey and salmon

Ulyana Bliznyuk, Polina Borshchegovskay, Timofey Bolotnik, Victoria Ipatova, Igor Rodin, Oleg Khmelevskiy, Alexander Chernyaev, Dmitriy Yurov _____ 53

Improvement of hydrogen fuel cells seen by positron annihilation spectroscopy

Mircea Lechintan, Mihai Straticiu, Florin Constantin _____ 54

Algorithm for calculation of depth dose distributions in materials when processing objects with electron beam

Sergey Zolotov, Ulyana Bliznyuk, Felix Studenikin, Alexander Nikitchenko, Polina Borshchegovskaya, Alexander Chernyaev, Natalya Antipina, Anna Nikolaeva _____ 55

Boron content determination in ore samples using Geant4-simulated PGNAAL and MCLLS algorithm

Onur Erbay, İskender Atilla Reyhancan _____ 56

Research activities at the Police Academy in Prague aimed at the detection and elimination of the CBRN threat

Jozef Sabol _____ 57

Challenges in the use of handheld radiation detection equipment and radioisotopes identification from front line officers (FLOs)

Kozeta Tushe, Dritan Prifti, Charles Massey, Issariya Chairam _____ 58

Radiological risk assessment of food crops grown in Rustenburg, South Africa

Peter Oluwadamilare Olagbaju, Bola Olarenwaju Wojuola _____ 59

LiF:Mg,Ti TLD angular dependence evaluation at low energy incident radiation

Nikola Krzanovic, Jelena Stankovic Petrovic, Milos Zivanovic, Marko Krajinovic, Dusan Topalovic, Andrea Kojic, Predrag Bozovic _____ 60

Status of radiation safety management for workers in KOMAC

Yeeun Lee, Yisub Min _____ 61

Space radiation quality factor for Galactic Cosmic Rays and typical space mission scenarios using a microdosimetric approach

Alexis Papadopoulos, Ioanna Kyriakou, Sébastien Incerti, Giovanni Santin, Petteri Nieminen, Ioannis Daglis, Weibo Li, Dimitris Emfietzoglou _____ 62

Doses in contrast-enhanced mammography dual-energy digital mammography versus doses in full-field digital detector mammography

Ewa Fabiszewska, Katarzyna Pasicz, Witold Skrzyński _____ 63

Comparison of gamma and X radiation attenuation characteristics for ordinary concrete, concrete with barite and concrete with limonite and steel

Ksenija Jankovic, Srboljub Stankovic, Anja Terzic, Marko Stojanovic, Dragan Bojovic _____ 64

Development of the safety indicator for Korea Multi-purpose Accelerator Complex

Yi-Sub Min, Jung-Min Park _____ 65

Applications of radioactive ^{197}Hg as a highly specific tracer for atmospheric mercury sampling and calibration studies

Igor Zivkovic, Jan Gacnik, Joze Kotnik, Sreekanth Vijayakumaran Nair, Radojko Jacimovic, Sergio Ribeiro Guevara, Andrea Jurov, Uros Cvelbar, Milena Horvat _____ 66

Nuclear and related analytical techniques used to study atmospheric deposition of trace elements and radionuclides in Europe, Asia and the Pacific Region based on moss analysis

Marina Frontasyeva _____ 67

Radiocarbon dating of planktonic foraminifera in sediment cores from the NE Mediterranean Sea: paleoceanographic and paleoclimatic reconstructions during the last 20 kyrs

Maria Triantaphyllou, Gregory Rousakis, Margarita Dimiza, Constantine Parinos, Elisavet Skampa, Dimitrios Velaoras, Alexandra Gogou _____ 68

Bioaccumulation of trace elements in keystone bivalve and fish species in the Bulgarian Black Sea ecosystem

Melania Istrati, Madlena Andreeva, Hristiyana Kanzova, Nesho Chipev, Albena Alexandrova, Vlad Vasilca, Tatiana Tozar, Mihai Straticiuc _____ 69

Heavy metal pollution history in marine sediments from Bosphorus and Istanbul's Black Sea coastal area by ^{210}Pb and ^{137}Cs chronology

Günseli Yaprak, İlker Sert, Jasmina Obhodas, Gennady Lptyev, Şule Aytaş, Ahmet Sinan Demirel, Doğan Yaşar, Hakan Savaş Sazak, Serkan Gürleyen, Haluk Yücel, Buket Canbaz Öztürk _____ 70

Gamma spectrometric measurement of radioactivity in soils profile samples of the Hadžići area, B&H

Mirza Nuhanović, Narcisa Smječanin, Nedim Mujić, Nedžad Gradašćević ____ 71

Assessment of trace metals contamination of port sediments on the Montenegrin Coast

Danijela Joksimović, Ana Perošević-Bajčeta, Rajko Martinović, Vladimir Živković, Danijela Šuković _____ 72

Conchix (shell organic matrix) – an innovative medium for the assessment of trace metals in marine environment

Rajko Martinović, Danijela Joksimović, Ana Perošević-Bajčeta, Ivana Čabarkapa, Hermann Ehrlich _____ 73

Distribution of heavy metals in bottom sediment samples at the Azerbaijan sector of the Caspian Sea

Famil Humbatov _____ 74

Assessment of the vertical distribution of natural and anthropogenic radionuclides in sediments of the Aral Sea

Almira Aidarkhanova, Natalya Larionova, Zhanna Tleukanova, Ainur Mamyrbayeva, Assiya Mulikova _____ 75

The research of the radionuclide contamination distribution in various types of water bodies at the Semipalatinsk test site territory

Almira Aidarkhanova, Natalya Larionova, Zhanna Tleukanova, Ainur Mamyrbayeva, Rinata Yermakova _____ 76

The ¹²⁹I AMS measurements for determining the nuclear pollution of the environment

Alexandru Razvan Petre, Mihaela Enachescu, Paul Emil Mereuta, Daniela Pascal, Decebal Alexandru Iancu _____ 77

^{238,239,240}Pu in the Antarctic ecosystems

Katarzyna Maria Szufa, Jerzy Wojciech Mietelski, Dariusz Sala, Maria Agata Olech _____ 78

Soil activity levels assessment for VVR-S nuclear Research Reactor Decommissioning area

Carmen A. Tuca, Laurentiu Done _____ 79

Can we see differences between the ¹⁴C activities of urban (Zagreb) and rural (Cvetković) sites (central Croatia)?

Ines Krajcar Bronić, Damir Borković, Tjaša Kanduč, Andreja Sironić, Jadranka Barešić _____ 80

Levels of natural and artificial radioactivity in infant powdered milk consumed in Albania and estimation of the annual effective dose	
Erjon Spahiu, Manjola Shyti _____	81
Impact of rapid warming on the mobile forms of uranium and thorium in soils – a model experiment	
Petya Kovacheva, Kristiana Atanasova, Miryana Varbeva _____	82
A study of the mobility of uranium and thorium in soils after freezing	
Petya Kovacheva, Kamelia Bineva, Miryana Varbeva _____	83
Study of the effect of Sr-90 on plant variability	
Elena Syssoyeva, Elena Polivkina, Alyona Yankauskas _____	84
Radiation dose rate and morphological changes in leaves of <i>Betula Pendula</i> Roth. and <i>Phragmites australis</i> (Cav.) Trin. ex Steud in some water ecosystems of the Chernobyl Exclusion Zone	
Dmytro Ganzha, Dmytro Ganzha, Dmitry Gudkov, Alexandr Nazarov _____	85
Relationship between Safecast ambient dose rate and indoor radon data	
Peter Bossew, Giorgia Cinelli, Eric Petermann, Petr Kuča, Jan Helebrant _____	86
Anomalous radon emission as pre-signal of moderate to strong earthquakes in Vrancea geotectonic active region in Romania	
Dan Savastru, Maria Zoran, Roxana Savastru, Marina Tautan _____	87
Soil gas radon measurement in urban area: A case study of Yerevan, Armenia	
Nona Movsisyan, Spartak Hovhannisyan, Konstantin Pyuskyulyan, Gayane Melkonyan, Olga Belyaeva _____	88
Citizen Science in radiation protection: A necessary approach to radon action plans	
Danila Carrijo da Silva Dias, Wanilson Luiz Silva, Nivaldo Carlos da Silva, Paloma França Machado _____	89
Climate effects of aerosols and ²²²Rn on COVID-19 pandemic in Bucharest metropolitan area	
Maria Zoran, Roxana Savastru, Dan Savastru, Marina Tautan _____	90
Introducing a regional database of radioactivity in the air – GRAMON	
Jelena Ajtić, Darko Sarvan, Milica Rajačić, Jelena Krneta Nikolić, Ivana Vukanac, Zorana Ilić, Alfred Vidic, Irma Didović, Jovan Janušeski, Jordanka Anusheva, Snezana Dimovska, Dejan Danilovski, Tomislav Anđelić, Ranko Zekić, Nikola Svrkota, Slavko Radonjić, Branko Vodenik, Benjamin Zorko _____	91

Revealing relationships between meteorological elements and airborne radioactive particles in ambient air of Kuwait

Anfal Ismaeel, Abdulaziz Aba, Abdullah Al-Dabbous, Mariam Malak, Aishah Al-Boloushi, Hanadi Al-Shammari, Omar Al-Boloushi _____ 92

Concentration levels of gross alpha and beta and annual effective dose in drinking waters of Albania

Florinda Cfarku, Irma Bërdufi, Manjola Shyti _____ 93

Assessment of lignite-fired power plants impact on radon activity concentrations

Gazmend Nafezi _____ 94

²¹⁰Pb and trace elements concentrations in Helsinki urban air, Finland

Eleftheria Ioannidou, Stefanos Papagiannis, Manos Manousakas, Chrysoula Betsou, Konstantinos Eleftheriadis, Jussi Paatero, Lambrini Papadopoulou, Alexandra Ioannidou _____ 95

Vertical distribution of radionuclides in a marine sediment core from the deep basin Northern of Skyros Isl., Aegean Sea

Spyridoula-Konstantina Roumelioti, Dionisis Patiris, Christos Tsabaris, Stylianos Alexakis _____ 96

Towards the implementation of a phantom for the low contrast evaluation of Electronic Portal Imaging Detectors (EPID): A theoretical study

Nektarios Kalyvas, Marios Tzomakas, Vasiliki Peppas, Antigoni Alexiou, Georgios Karakatsanis, Anastasios Episkopakis, Christos Michail, Ioannis Valais, George Fountos, Ioannis Kandarakis _____ 97

Radiobiologic evaluation of anatomical changes during weight loss in head and neck cancer

Islam Sagov, Ol'ga Stakhova, Evgeniia Sukhikh _____ 98

The implementation of a 3D verification system to analyze the effect of limiting the dynamic parameters of a multileaf collimator on the dose distribution

Andrey Vertinskiy, Evgenia Sukhikh, Leonid Sukhikh _____ 99

Comparison of various types of ionization chambers in terms of calibration coefficients

Iwona Grabska, Paweł Kukołowicz _____ 100

The effect of body mass index on patient radiation dose during lumbar discectomy and fusion utilising VirtualDose-IR software

Vasileios Metaxas, Fotios Efthymiou, Christos Dimitroukas, Harry Delis, George Gatzounis, Petros Zampakis, Fotios Tzortzidis, Dimitrios Papadakis, Constantine Constantoyannis, George Panayiotakis _____ 101

Relationship between patient radiation dose and procedural factors in anterior cervical discectomy and fusion utilising VirtualDose-IR software

Vasileios Metaxas, Christos Dimitroukas, Fotios Efthymiou, Harry Delis, George Gatzounis, Fotios Tzortzidis, Petros Zampakis, Andreas Theofanopoulos, Constantine Constantoyannis, George Panayiotakis _____ 102

Local diagnostic reference level for computed tomography of chest and abdomen in two Saudi cities

Amna Mohammed Ahmed, Hamid Osman, Alamin Musa, Afaf Mohamed Ahmed Medani, Mustafa Mahmoud, Magbool Alelyani, Mayeen Uddin Khandaker _____ 103

Evaluation of the effectiveness of Monte Carlo simulations to describe the excitation features of a Macro-XRF imaging spectrometer

Effrossyni Androulakaki, Kalliopi Tsampa, Andreas G. Karydas _____ 104

3 MV Tandetron beamline upgrade for ultra-high dose rate irradiation

Mihai Straticiu, Andrei-Theodor Hotnog, Mina Raileanu, Mihaela Bacalum, Melania-Beatrice Istrati, Decebal Iancu, Mircea Lechintan, Mihai Radu ____ 105

Comparative analysis of medical exposure to ionizing radiation – the 2021 National Report and the 2020/2021 UNSCEAR Report

Olga Gîrjoabă, Diana Mocăniță, Vasilica Ion _____ 106

Characteristics of the inexpensive 2D plastic scintillator detectors for radiotherapy departments

Beata Kozłowska, Grzegorz Wozniak _____ 107

Applications of 2D plastic scintillator detectors in radiotherapy departments

Grzegorz Woźniak, Beata Kozłowska _____ 108

Processing heterogeneity problem in the case of two-dimensional radiotherapy

Mostafa Y. A. Mostafa, Saleh A. Mohamed, Mahmoud S. M. Ali, Nada M. A. Abas, Mariam N. M. Kamel, Abdelrhman A. Ahmed, Amer Mohamed _____ 109

Development of a dynamic liver phantom for radiotherapy applications

Serdar Sahin, S. Kutay Ozen, Ferihan Ertan, Eren Sahiner _____ 110

Evaluating VMAT delivery accuracy using end-to-end test for different types of VMAT plans

Angela Dameska, Milena Teodosevska-Dilindarski, Dushko Lukarski _____ 111

Evaluation of dosimetric plan quality for glioblastoma treated with 3D conformal radiotherapy

Irena Muçollari, Aurora Cangu, Anastela Mano, Gramoz Braçe, Artur Xhumari, Jetmira Kerxhaliu, Blerina Myzeqari _____ 112

Outcome prediction in radiotherapy	
Olga Stakhova, Islam Sagov, Evgenia Sukhikh _____	113
LaCl₃:Ce crystalline scintillator thickness optimization for low radiographic X-ray tube voltages: A theoretical study	
Stavros Tseremoglou, Dionysios Linardatos, Christos Michail, Ioannis Valais, Athanasios Bakas, Konstantinos Ninos, Ioannis Kandarakis, George Fountos, Nektarios Kalyvas _____	114
Mapping the melanin concentration distribution in common nevus using hyperspectral imaging as prognostic diagnosis	
Dragos Manea, Mihaela Antonina Calin, Florin Stanescu, Viorel Parasca Sorin _____	115
Spectral characterization and detection of skin tumors based on hyperspectral imaging	
Mihaela Antonina Calin, Dragos Manea, Andrei Dumitrescu, Viorel Parasca Sorin _____	116
E-ROD – A new metric to evaluate the relative detectability of two digital mammography systems	
Anna Wysocka-Rabin, Magdalena Dobrzynska, Katarzyna Pasicz, Witold Skrzynski, Ewa Fabiszewska _____	117
Dental X-ray imaging: The construction of a novel teeth phantom	
M. Kalakos, A. Fountou, G. Fasoulas, G. Fountos, N. Kalyvas, P. Liaparinos _____	118
Infrared thermographic imaging of the human lower limb	
Agathi Kaloudi, David Stratos, Nektarios Kalyvas, Ioannis Kalatzis, Aikaterini Skouroliakou _____	119
Evaluation of a new procedure for stability checks of well-type brachytherapy chambers	
Ivana Komatina, Milos Zivanovic, Nikola Krzanovic, Milos Djaletic, Srboljub Stankovic _____	120
Simulation and characterization methods of proton beams for ultra-high dose rate irradiation	
Andrei-Theodor Hotnog, Mircea Lechințan, Melania-Beatrice Istrati, Decebal Iancu, Radu-Florin Andrei, Robert Sîrbu, Mihai Straticiuc _____	121
Experience of the calibration and testing laboratory in establishing and maintaining a management system in accordance with the ISO/IEC 17025 standard	
Iwona Grabska, Wioletta Ślusarczyk-Kacprzyk, Marcin Szymański, Paweł Kukołowicz _____	122

The number of radiation beams audited during TLD postal dose audit performed by the Secondary Standards Dosimetry Laboratory in Poland in the context of the COVID-19 pandemic

Iwona Grabska, Wioletta Ślusarczyk-Kacprzyk, Marcin Szymański _____ 123

Secondary Standards Dosimetry Laboratory (SSDL) at the Maria Skłodowska-Curie National Research Institute of Oncology – results of the 2018-2022 activity

Wioletta Ślusarczyk-Kacprzyk, Iwona Grabska, Marcin Szymański _____ 124

Results of the intermediate checks on the working standards used for routine calibrations of ionizing radiation dosimeters in a ⁶⁰Co gamma ray beam – experience from over a year of calibration laboratory activity

Iwona Grabska, Wioletta Ślusarczyk-Kacprzyk, Marcin Szymański _____ 125

The number of calibrations of electrometers with different types of ionization chambers performed by the calibration laboratory in Poland in the context of the COVID-19 pandemic

Iwona Grabska, Wioletta Ślusarczyk-Kacprzyk, Marcin Szymański _____ 126

Short wavelength UV in combination with cold storage can minimize postharvest gray mold losses in strawberry

Aruppillai Suthaparan _____ 127

Investigation of the OAM EM wave interaction with tissue at microwave and millimeter wave frequencies

Jelena Trajković, Slobodan Savić, Milan Ilić, Andjelija Ilić _____ 128

Examining the function of NK cells towards various target tumor cells

Vladimir Jurisic _____ 129

Evaluation of radiology devices quality compared to COCIR standards and the problems observed during the facing of the Covid 19 pandemic

Niko Hyka, Dafina Xhako, Partizan Malkaj _____ 130

Evaluation of planter fascia among patients with painful heel in Sudan: Sonographic findings

Amna Mohamed Ahmed, Nurein Mohamed A. Salam, Elamin Asma Ibrahim, Abukuna Mohamed Nur, Muna M.A. Abushanab, Babiker Awadelseed, Saida Abdelkreem, Hamid Osman, Waleed Alshehrani, Maueen Uddin Khandaker _____ 131

Comparison of different immunological techniques for the detection of anti-cytomegalovirus IgM antibodies in pregnant women

Blerta Laze _____ 132

Changes in various amino acid concentrations in the small intestine and pathogenesis of an intestinal injury caused by carbon-ion irradiation

Saori Nakamura, Nobuhiko Takai, Yoshino Katsuki, Akiko Uzawa, Ryoichi Hirayama, Yoshihito Ohba _____ 133

Investigation of proton irradiation induced effects in chondrosarcoma and bystander normal chondrocytes and endothelial cells

Mihaela Tudor, Mihaela Temelie, Antoine Gilbert, Anca Dinischiotu, François Chevalier, Diana Iulia Savu _____ 134

Radiosensitizing effect of ATM and ATR kinase inhibitors on glioblastoma

Ana-Maria-Adriana Şerban, Mihaela Temelie, Gro Elise Rødland, Antoine Gilbert, François Chevalier, Randi Syljuåsen, Diana-Iulia Savu ____ 135

The appearance of prion-like proteins in descendants of soybean planted under radionuclide contamination in Chernobyl aliened zone for several generations

Namik Rashydov, Djamal Rakhmetov _____ 136

Pilot lung cancer screening program in Serbia after 2-year results and challenges

Dragan Dragišić, Gordana Vujasinović, Jelena Đekić Malbaša, Ilija Andrijević, Dijana Bjelajac, Jelena Djokic, Sanja Vunjak _____ 137

The importance of immunization as a preventive measure in the fight against tuberculosis

Violeta Ilić Todorović, Jasmina Jovanović Mirković, Christos Alexopoulos, Bojana Miljković, Dragana Đorđević Šopalović, Zorica Kaluđerović _____ 138

The role of the pharmacist in the implementation of self-medication

Violeta Ilić Todorović, Jasmina Jovanović Mirković, Christos Alexopoulos, Momčilo Todorović, Nemanja Nenezić, Zorica Kaluđerović _____ 139

Health education of the population about the prevention possibilities of HPV infection

Milica Stanojević, Jasmina Jovanović Mirković, Christos Alexopoulos, Violeta Ilić Todorović, Svetlana Čapaković _____ 140

Vaccine prophylaxis as the key to success against polio

Milica Stanojević, Jasmina Jovanović Mirković, Christos Alexopoulos, Bojana Miljković, Marko Jovanović, Dragana Đorđević Šopalović _____ 141

Investigation of the effect of surface roughness on the structural features of dental implants

Neşe Benay Seken, Nilgün Baydoğan _____ 142

Evaluating changes in retinal nerve fiber layer and photopic negative response for patients under glaucoma treatment

Marsida Bekollari, Maria Dettoraki, Valentina Stavrou, Aikaterini Skouroliahou, Panagiotis Liaparinos _____ 143

Effects of seeds irradiation with a microwave on the properties of wheat

Hyam Khalaf, Mostafa Y. A. Mostafa, Mona Moustafa, Manar A. N. Mohamed, Alaa A. M. Kamel, Marwa A. S. Abd Algawad, Karim M. A. Mohamed, Rasha Kamal Helmeý _____ 144

Determination of the original dose of irradiated fruits by EPR spectroscopy

Katerina Aleksieva, Yordanka Karakirova _____ 145

Evaluation of gamma irradiation effects on antioxidant capacity of propolis

Ralitsa Mladenova, Nikolay Solakov, Kamelia Loginovska _____ 146

Detection of chemical changes in X-rayed potato tubers using fingerprinting technique

Yana Zubritskaya, Ulyana Bliznyuk, Polina Borshchegovskaya, Anna Malyuga, Valentina Avdyukhina, Natalya Chulikova, Sergei Zolotov, Mikhail Beklemishev, Alexander Nikitchenko, Alexander Chernyaev, Victoria Ipatova _____ 147

Development of a method to identify and quantify the content of the active form of protein molecules after exposure to radiation using enzymatic hydrolysis by trypsin

Oleg Khmelevsky, Ulyana Bliznyuk, Polina Borshchegovskaya, Irina Ananyeva, Alexander Chernyaev, Arkady Braun, Igor Rodin, Dmitry Yurov, Victoria Ipatova _____ 148

Valence distribution of As-76 atoms in arsenic thiocompounds irradiated with neutrons

Juan F. Facetti Masulli, Hector Colmán _____ 149

Radiation-induced catalysis in the presence of metal oxide nanoparticles produced by pulsed electron beam evaporation

Andrey Gerasimov, Mikhail Balezin, Vladislav Ilves, Sergey Sokovnin _____ 150

²³⁶U and its determination with accelerator mass spectrometry

Tomáš Prášek, Mojmír Němec _____ 151

Radioisotopic ratios in marine research – a multi-case study

Petros Leivadaros, Jan John, Mojmír Němec, Nikolaos Kallithrakas-Kontos _____ 152

Isotopic signature and mixing between groundwater, surface water and precipitation in the Zagreb aquifer area

Zoran Kovač, Jadranka Barešić, Nataša Todorović, Jelena Parlov, Andrea Sironić, Jovana Nikolov _____ 153

Concentration of selected radionuclides in high dust deposition areas: Consideration of depleted uranium

Abdulaziz Aba, Omar Alboloushi, Anfal Ismaeel _____ 154

Sorption of Europium and Cobalt using thermally modified winery waste

Eleftheria Kapsii, Fotini Noli, Panayiotis Tsamos _____ 155

Production yield analysis of $^{97,95}\text{Ru}$ radionuclides from Li-induced reactions

Ankur Singh, Moumita Maiti _____ 156

Visualizing industrial processes with gamma process tomography: A non-invasive approach

Daniela Gurau _____ 157

Assessment of Ho(III), Er(III) and Gd(III) uptake by cyanobacteria *Arthrospira platensis* using neutron activation analysis and their effects on biomass biochemical composition

Inga Zinicovscaia, Liliana Cepoi, Ludmila Rudi, Tatiana Chiriac, Dmitrii Grozdov _____ 158

Previous impoundment studies on Itaipu Dam: submerged biomass effect in water quality

Juan F. Facetti Masulli, Cesar Taboada _____ 159

Effect of mycelium-based biosorbent modifications on efficiency of strontium removal from aqueous solutions

Małgorzata Jakubiak, Natalia Perzyna, Miriam Wierska, Romuald Sęborowski, Monika Asztemborska _____ 160

Natural and artificial radionuclides in wood biomass used for heating – comparison of North-East Italy and imported wood pellets

Chiara Cantaluppi, Beatrice Morelli, Raffaele Cavalli, Nicolò Pradel, Rosa Greco _____ 161

Athermal healing of preexisting defect in crystalline silicon under local electronic excitation processes

Gihan Velişa, Eva Zarkadoula, Yang Tong, William J. Weber _____ 162

Structural characteristics of some bifunctional catalysts for rechargeable zinc-air batteries

Tanya Malakova, Kiril Krezhov, Gergana Raikova, Elena Mihaylova-Dimitrova, Peter Tzvetkov, Tatyana Koutzarova _____ 163

Biocompatible collagen-based hydrogels with a hybrid structure developed by e-beam irradiation technology

Maria Demeter, Andreea Mariana Negrescu, Anisoara Cimpean, Ion Calina, Anca Scărișoreanu, Mădălina Albu Kaya, Marin Micutz, Bogdana Mitu, Veronica Satulu, Marius Dumitru-Grivei _____ 164

Speciation of fission products in the grey phases of spent nuclear fuel: A study of novel complex sodium, barium, and strontium molybdates

Andres Lara-Contreras, Mohammad Affan, Jennifer Scott, Emily Catherine Corcoran _____ 165

Effects of preparation route on magnetic ordering near room temperature in Al-substituted Ba-Sr Y-type hexaferrites

Tatyana Koutzarova, Kiril Krezhov, Borislava Georgieva, Anatoliy Senyshyn _____ 166

Radiation-induced modification effects in covalent-network glass formers: phenomenological description within unified configuration-enthalpy diagram

Oleh Shpotyuk, Mykola Vakiv, Andriy Andriy, Roman Golovchak, Valentina Balitska, Mykhaylo Shpotyuk _____ 167

On the numerical criterion of radiation-modification efficiency in chalcogenide glasses

Oleh Shpotyuk, Andriy Kovalskiy, Jacek Filipecki, Roman Golovchak, Yaroslav Shpotyuk, Mykhaylo Shpotyuk, Vitaliy Boyko, Valentina Balitska _____ 168

Sequential dual ion beam irradiation effects on KTaO_3

Decebal Iancu, Maria Diana Mihai, Eva Zarkadoula, Yanwen Zhang, William John Weber, Gihan Velisa _____ 169

X-ray induced structural changes in germanium sulfide glasses

Roman Holovchak, Andriy Kovalskiy, Yaroslav Shpotyuk, Oleh Shpotyuk _____ 170

Radiation synthesis of microemulsion-based hydrogels loaded with lavender oil

Anca Scărișoreanu, Maria Demeter, Ion Călina, Marius Dumitru-Grivei, Marin Micutz _____ 171

Evaluation of biopolymers modified by ionizing radiation and cold plasma processing based on a multivariate statistical approach

Mirela Brașoveanu, Maria Demeter, Dorina Ticoș, Monica R. Nemțanu _____ 172

Gold nanoparticle-composite hydrogel synthesized by e-beam irradiation

Anca Scărișoreanu, Maria Demeter, Ion Călina, Mihaela Bojan _____ 173

Investigation and characterization of 2D materials and vdW heterostructures by application of Raman spectroscopy

Victoria Vartic, Grigory Arzumanyan, Kahramon Mamatkulov, Anna Geronina _____ 174

Photo-induced neutrophil extracellular traps: The role of cytochromes

Kahramon Mamatkulov, Darya Zakrytnaya, Yersultan Arynbeq, Nina Vorobyeva, Grigory Arzumanyan, Anka Jevremović _____ 175

Application of electron beam radiation for the development of conductive thermoplastic elastomers with improved mechanical and physicochemical properties

Gunta Kizane, Maris Bertins, Remo Merijs-Meri, Janis Zicans, Ingars Reinholds, Liga Avotina, Arturs Viksna _____ 176

Effect of surfactants on the luminescence of ZnO nano particles

Ioana Perhaita, Laura Elena Muresan, Lucian Barbu-Tudoran, Adriana Popa, Gheorghe Borodi _____ 177

Heavy metals effect on optical properties of zinc oxidic compounds

Laura Elena Muresan, Ioana Perhaita, Lucian Barbu-Tudoran, Gheorghe Borodi _____ 178

Proton irradiation effects on optical properties of undoped $Gd_3Al_xGa_{5-x}O_{12}$ single crystals

Dmitry Spassky, Andrey Spassky, Victor Lebedev, Fedor Fedyunin, Nina Kozlova, Evgeniia Zabelina, Valentina Kasimova, Oleg Buzanov _____ 179

Luminescence of undoped and RE doped $Na_3Sc_2(PO_4)_3$ under high energy irradiation

Nataliya Krutyak, Dmitry Spassky, Ekaterina Shabalina, Dina Deyneko, Irina Kudryavtseva, Vitali Nagirnyi _____ 180

Analytical investigations concerning copies after Roman Imperial Denarius – case study

Daniela Cristea-Stan, Lucian Munteanu _____ 181

Alloy composition studies on some silver coins from the Hellenistic period. Case study: posthumous Macedonian silver coins and imitations of Histrian coins - Apollo type

Daniela Cristea-Stan, Gabriel Mircea Talmatchi _____ 182

LiF:Mg,Ti TLD angular dependence evaluation at low energy incident radiation

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Accuracy of measurement in individual dosimetry monitoring service is achieved by performing calibration of dosimeters, ensuring that the measured values are traceable to the primary standard for the quantity of interest. Even though a dosimeter can exhibit remarkable performance in the reference calibration radiation field (e.g. ¹³⁷Cs), its performance can greatly differ under certain conditions. Effects of different influence quantities need to be examined to ensure that the dosimeters are reliable for use in a specific ionizing radiation practice. The most significant radiation characteristic influence quantities are the radiation energy, angle of incidence and dose (rate). International standards issued by IEC and ISO define radiation conditions and procedures for dosimeter type testing under effects of different radiation, environmental and mechanical influence quantities. Dosimeter performance is expressed in terms of relative response and is evaluated by comparing with defined limits of variation, taking into account the measurement uncertainty, according to [IEC 62387:2020, IEC, 2020].

A passive dosimetry system based on LiF:Mg,Ti thermoluminescent dosimeters (TLD) was tested for the effects of photon energy and angle of incidence in two dosimeter orientations, horizontal (up/down) and vertical (left/right), for the measurement of personal dose equivalent ($H_p(10)$ and $H_p(0.07)$). The dosimeters were read out on the Harshaw TLD™ Model 6600 Plus Automated Reader (Thermo Fisher Scientific, USA), calibrated in ¹³⁷Cs reference field. Low-energy X-ray reference field N-40, established according to ISO 4037-1:2019 [ISO 4037, ISO, 2019] and $\pm 45^\circ$, $\pm 60^\circ$ angles of incidence were used to examine the passive dosimetry system performance. Limits of variation from -29 % to +67 %, defined in [IEC 62387:2020, IEC, 2020] for energy and angular relative response, were used for performance evaluation.

The overresponses for $H_p(10)$ for 45° and 60° were (51 – 62) % and (76 – 88) %, respectively. The results for $H_p(0.07)$ for 45° and 60° were (66 – 69) % and (79 – 95) %, respectively. Thus, for both quantities it was observed that the criteria are met for the angle of $\pm 45^\circ$, while for $\pm 60^\circ$ neither comply with the standard, for both dosimeter orientations, when uncertainties are taken into account.

This shows that tested TLD system has high overresponse in low energy photon fields when larger angle of incidence values is encountered. The response could be improved if dosimeters are calibrated using appropriate reference calibration field or if different dosimeter holder is employed.

Keywords: individual monitoring, $H_p(10)$, $H_p(0.07)$, external radiation dosimetry

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