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BOOK OF ABSTRACTS

**Eleventh International Conference on Radiation,
Natural Sciences, Medicine, Engineering, Technology and Ecology**

June 19 - 23, 2023 | Hunguest Hotel Sun Resort | Herceg Novi | Montenegro

TABLE OF CONTENTS

Click on the title of the abstract to access it

PLENARY LECTURES

Dejan Trbojevic, Design of the Affordable FLASH Proton Therapy Facility with Permanent Magnets ..1

BIOCHEMISTRY

Aušra Nemeikaitė-Čėnienė, Violeta Jonušienė, Lina Misevičienė, Audronė Marozienė, Narimantas Čėnas, Cytotoxicity of nitroaromatic drugs: a role of sulfone group 2

Šaćira Mandal, Association of free fatty acids with glucose in newly diagnosed Type 2 diabetes 3

Zorica Mrkonjic, Zorana Srećkov, Mirjana Bojović, Gordana Racić, Igor Vukelić, Olivera Nikolić, Marija Lesjak, Dried fruits of *Sorbus torminalis* L.Crantz. as functional food 4

Safiya Herenda, Edhem Hasković, Determination of the inhibitor effect of thiourea on urease activity.5

Timothej Patočka, Surya Gupta, Felice Mastroleo, Jean-Yves Matroule, Rob Van Houdt, How to wake up space-related bacteria from a copper-induced dormant state..... 6

Lyudmila Velkova, Aleksandar Dolashki, Karina Marinova, Petar Petrov, Dimitar Kaynarov, Nevena Ilieva, Ventseslav Atanasov, Pavlina Dolashka, Mechanism of antibacterial action of bioactive peptides from the *Helix aspersa* mucus.....7

Ioana Nicolau, Alexandra Bumbacaru, Codruta Badescu Singureanu, Niculina Hadade, Mihaela Matache, Design and synthesis of multidentate organic ligands for protein-based supra molecular constructs 8

BIOENGINEERING

Alexander Pogrebnyak, Maxim Pogorielov, Vladimir Buranych, Danagul Aubakirova, Iryna Savitskaya, Characterization, Mechanical and Biomedical Properties of Titanium Oxynitride Coating..... 9

Avgustina Danailova, Svetozar Stoichev, Velichka Strijkova, Characterization and degradation of natural polysaccharide multilayer films10

BIOINFORMATICS

Irma Ibrišimović, Elvir Čajić, Damir Bajrić, Julija Šćekić, Use of neural networks in bioengineering.. 11

Nicolas Callebaut, Jacky Liévin¹, Emilie Cauët, Quantum chemical study of the charge transfer in an ionized complex of three stacked guanines 12

Gennady Agre, Duana Toneva, Silviya Nikolova, Nevena Fileva, Dora Zlatareva, On application of some machine learning algorithms for sex identification based on linear mandibular measurements derived from CT scans13

Belmina Saric Medic, Anesa Jerković-Mujkić, Nikolina Tomic, Jasmin Ramic, Naida Lojo-Kadric, Lejla Pojskic, *In silico* validation of grapefruit seed extract (GSE) as antibiotic enhancer against MRSA strains 14

BIOMATERIALS

Aleksandra Maletin, Milica Jeremić-Knežević, Daniela Đurović-Koprivica, Bojana Milekić, Tatjana Puškar, Ivan Ristić, Degree of monomer conversion in dual cure resin-based dental cements material 15

Yaroslav Bobitski, Adriana Barylyak, Joanna Kisała, Titanium with a surface structured by ultrashort laser pulses - a new direction in the technology of dental implants 16

Iuliana Urzica, Agota Simon, Catalin Logofatu, Cristian Udrea, Petronela Gheorghe, Microfluidic properties of laser exposed metallic surface	17
Petronela Gheorghe, Adrian Petris, Iuliana Urzica, Adina Mirela Anton, Optical limiting properties of a new class of DNA-based materials functionalized with natural chromophores	18
Asya Azieva, IPSCs more effectively differentiate into neurons on PLA scaffolds with high adhesive properties for primary neuronal cells.....	19
Iuliana Urzica, Agota Simon, Catalin Logofatu, Cristian Udrea, Petronela Gheorghe, Microfluidic properties of laser exposed metallic surface	20
Petronela Gheorghe, Adrian Petris, Iuliana Urzica, Adina Mirela Anton, Optical limiting properties of a new class of DNA-based materials functionalized with natural chromophores	21

BIOMEDICINE

Anastasiia Miliutina, Elena Kovaleva, Anna Eremkina, Alina Elfimova, Natalia Mokrysheva, Clinical decision support system in the Russian registry of chronic hypoparathyroidism.....	22
Milica Jeremic Knezevic, Aleksandar Knezevic, Jasmina Boban, Daniela Djurovic Koprivica, Aleksandra Maletin, Bojana Milekic, Tatjana Puskar, A role of vitamin D in temporomandibular disorders.....	23
Daniela Djurovic Koprivica, Milos Kuzmanovic, Milica Jeremic Knezevic, Bojana Milekic, Aleksandra Maletin, Tatjana Puskar, Protection of dentists and dental staff from inhalation of aerosols	24
Bojana Milekic, Milica Jeremic Knezevic, Aleksandar Knezevic, Daniela Djurovic Koprivica, Aleksandra Maletin, Tatjana Puskar, Sanja Vujkov, Ivana Gusic, Temporomandibular disorders in fibromyalgia patients.....	25
Silviya Nikolova, Diana Toneva, Dora Zlatareva, Bilateral and sex distribution of pterygospinous bridge in Bulgarians	26
Dora Zlatareva, Gennady Agre, Diana Toneva, Silviya Nikolova, Nevena Fileva, Decision trees for sex estimation based on mandibular measurements: A CT study	27
Katarina Bačulov, Nataša Vučinić, Branislav Bajkin, Mihajla Djan, Ivana Mijatov, Jelena Stojčević-Maletić, Impact of epidermal growth factor receptor gene RS1468727 polymorphism on the survival of patients with oral squamous cell carcinoma	28
Jelena Podgorac, Branka Petković, Prenatal exposure to an antiepileptic combination (levetiracetam and valproic acid) throughout gestation and postnatal sensorimotor development in mice	29

BIOPHARMACEUTICALS

Katarina Rajković, Petar Milić, Vesna Vučić, Aleksandra Arsić, Ivana Vuksanović, Sanja Jeremić, Fatty acids profiles of <i>Juglans nigra</i> l. leaf	30
Dolashka Pavlina, Kermedchiev Momchil, Velkova Lyudmila, Dolashki Aleksandar, Synergistic effect of snail mucus compounds and plant extracts for wound healing	31
Isabella Barbosa, Emilia Seo, Verena Honegger, Antonio Munhoz Junior, Leila Miranda, Leonardo Andrade E Silva, Mandelic and hyaluronic acids nanoemulsions in PVP, PEG and agar hydrogels	32
Daniel Todorov, Anton Hinkov, Kalina Shishkova, Alexander Shkondrov, Ilina Krusteva, Pavlinka Dolashka, Ludmila Velkova, Stoyan Shishkov, Antiviral treasure hunt: Novel compounds from plants and invertebrates	33

BIOPHYSICS

Sashka Krumova, Asya Petrova, Stefani Petrova, Svetozar Stoichev, Nia Petrova, Daniel Ilkov, Tsonko Tsonev, Petar Petrov, Violeta Velikova, Polymeric stabilized micelles affect pea seed germination and plant growth in concentration-dependent manner	34
Claudia Gabriela Chilom, Marcela Elisabeta Barbinta-Patrascu, Sorina Iftimie, Adriana Elena Balan, Enache Adrian, Daniela Oprea, Monica Enculescu, Human serum albumin nanoparticles for targeting colon cancer cells	35

Stanislav Pohorielov, Mykola Kokodii, Volodymyr Timaniuk, Igor Krasovskyy, Iryna Hariachevska, Darya Gurina, Denys Protektor, Measurement of thermophysical parameters of human hair..... 36

BIOTECHNOLOGY

Jelena Ilic, Pathogenicity of *Fusarium* isolated from weed growing in potato fields37

CANCER RESEARCH

Anna Czaja, Magdalena Zdrowowicz, Janusz Rak, Halogen substituted 4-Thio-2'-Deoxyuridines as photosensitizers: in vitro studies 38

Bernd Kaina, Senescence and death induced by radiation and alkylating drugs in cancer therapy 39

Magdalena Podolak, Piotr Roszczenko, Volodymyr Horishny, Roman Lesyk, Krzysztof Bielawski, Anna Bielawska, Anticancer properties of novel Thiazolidinone derivatives tested in MDA-MB-231 breast cancer cell lines. 40

Ioana Ileana Fidel^{1,2}, Georgiana Giubega¹, Liviu Neagu¹, Petrișor Gabriel Bleotu¹, Mihai Iovea³, Edward Hermann³, Monica Mirea³, Marian Neagu³, Laura Nita⁴, Mihai Adrian Vodă¹, Diana Serafin¹, Roxana Popescu¹, Mădălin Roșu¹, Ovidiu Tesileanu¹, Paul Romeo Vasos, Setup and protocol for high dose-rate irradiation of glioblastoma cells using secondary radiation from a high-power laser 41

Vladimir Jurisic, Investigation of EGFR in odontogenic tumor 42

Masaki Tan, Radiation hormesis effect on cancer patients in Hibakusha 43

COVID-19

Dejana Bajić, Jovan Matijašević, Ljiljana Andrijević, Dejan Dobrijević, Mladena Lalić Popović, Bojan Zarić, Ilija Andrijević, Nemanja Todorović, Diandra Pintać, Jelena Čanji Panić, Prognostic role of fibrinogen level on Covid-19 mortality 44

Rodney Jones, Andrey Ponomarenko, Roles of age, gender, vaccination history and SARS-Cov-2 variants in all-causes of mortality: unexpected outcomes in a complex system..... 45

Naida Lojo-Kadric, Jasmin Ramic, Nikolina Tomic, Belmina Saric Medic, Lejla Pojskic, Study of olfactory and taste receptors variation possibly associated with dysosmia/disgeusia symptoms in Covid 19 46

Jelena Stojčević Maletić, Katarina Bačulov, Vanja Gavrilović, Data from the Vojvodian study regarding the effect of heat inactivation on the detection of the severe acute respiratory syndrome Coronavirus 2 (SARS-Cov-2) using quantitative real-time reverse transcription-polymerase chain reaction (QRT-PCR) 47

Loredana Pazara, Monica Tudorache, Daniela Dusa, Claudia Simona Cambrea, Rheological red blood cell changes in mild SARS –Cov2 infections 48

ELECTROCHEMISTRY

Sasa Sladic, Batteries versus supercapacitors: recent trends in applications 49

Boryana Karamanova, Emiliya Mladenova, Antonia Stoyanova, Electrochemical performance of supercapacitors based on carbon material electrodes in different electrolytes 50

Svetlana Veleva, Boryana Karamanova, Antonia Stoyanova, Activated carbon xerogel as an electrode material in supercapacitor systems 51

Richard Katona, Gergő Bátor, Edit Tóth-Bodrogi, Tibor Kovács, Electrochemical examination of chemical decontamination technologies in the aspects of radioactive wastes management 52

ENVIRONMENTAL CHEMISTRY

Margarita Goldberg, Dmitriy Valeev, Nadejda Donskaya, Alexander Fomin, Olga Antonova, Anatoliy Konovalov, Vladimir Komlev, Mesoporous hydroxyapatite powders containing molybdate anions obtained by the hydrothermal method as a promising heterogeneous catalyst 53

Tamara Tatrishvili, Omar Mukbaniani, Nikoloz Kvinikadze, Tinatin Bukia, Nana Pirtskheliani, Environmentally Friendly Composite Materials with Bamboo and Trimethoxysilylated Polystyrene .	54
Tamar Makharadze, Marina Soselia, Giorgi Makharadze, Measurement of complex formation process of lead (II) with fulvic acids isolated from natural waters at pH=9	55

ENVIRONMENTAL PHYSICS

Anna Cwanek, Agnieszka Burakowska, Ewa Nalichowska, Edyta Łokas, Multivariate analysis of airborne radioactivity in the polar region (Hornsund, Svalbard) since the beginning of the 21 st century	56
Sorin Ioan Deaconu, Marcel Topor, Mihai Alexandru Blaj, Geothermal energy used in cascade for power plant, residential heating, greenhouses and fishing farms	57
Liliia Deva, Iryna Yaremchuk, Tetiana Bulavinets, Hryhoriy Barylo, Pavlo Stakhira, Levani Skhirtladze, Oleksandr Bezvikonnyi, Dmytro Volyniuk, Juozas Vidas Grazulevicius, Yellow-green high-efficiency TADF OLED with phenoxazine and quinoxaline as emitter	58

ENVIRONMENTAL POLLUTION

Edyta Łokas, Giovanni Baccolo, Caroline Clason, Przemysław Wachniew, Nozomu Takeuchi, Krzysztof Zawierucha, Dylan Beard, Roberto Ambrosini, Francesca Pittino, Andrea Franzetti, Philip Owens, Anna Cwanek, Katarzyna Koltonik, Isotopic signatures of plutonium in the global cryosphere.....	59
Aleksandra Mihailović, Selena Samardžić, Robert Lakatoš, Savka Adamović, Jordana Ninkov, Nebojša Ralević, Sofija Forkapić, Arsenic, cobalt, chromium, and nickel content in topsoil of industrial areas	60
Gordana Dević, Marija Pergal, Miodrag Pergal, Characterization of air quality in the surrounding environment due to the emissions of TEKO Kostolac Power Plants, Serbia	61
Raluca Mihaela Ivan, Fabrication of hybrid nanostructures by laser technique for water decontamination.....	62
Renata Gagić-Serdar, Miroslava Marković, Ljubinko Rakonjac, Tomislav Stefanović, Bio-monitoring on ICP sample plots Level II using lichen as the biological indicator for air pollution in Serbia	63
Elda Marku, Jonida Tahiraj, Pranvera Lazo, Spiro Drushku, Aurel Nuro, Bledar Myrtaj, Implementation of an early warning system for marine pollution in Albania through Interreg ADRION Project SEAVIEWS	64
Iva Belovezhdova, Valentina Lyubomirova, Boyan Todorov, Optimization of sample preparation for GC-MS analysis of pahs in solid waste samples.....	65
Laura Mingilaitė, Robertas Poškas, Water vapor condensation on vertical tube bundle from biofuel flue gas.....	66
Adam Begu, Ala Donica, Tamara Begu, Comparative study of active and passive biological monitoring in the city of Chisinau	67
Mirjana Radenković, Dusan Topalović, Mirjana Cujic, Antonije Onjia, Monitoring of biomass and biofuels contribution to atmospheric pollution by using nuclear techniques.....	68

FOOD SAFETY AND HEALTH

Pavel Nekhoroshkov, Jacques Bezuidenhout, Inga Zinicovscaia, Marina Frontasyeva, Nikita Yushin, The risks assessment in consumption of mussels (<i>Mytilus galloprovincialis</i>) from the different regions: microelement contribution study.....	69
Ivica Vujcic, Slavica Porobic, Slobodan Masic, Milena Marinovic-Cincovic, Production of liqueur from green walnuts using ionizing radiation	70
Marijana Ačanski, Marko Ilić, Kristian Pastor, Aleksandra Savić, Mirjana Vasić, Đura Vujić, Legume authentication method based on GC-MS analysis of lipid components coupled to multivariate statistics.....	71
Svetla Gateva, Gabriele Jovtchev, Tsveta Angelova, Ana Dobрева, Milka Mileva, Cytoprotective and genoprotective potential of <i>rosa damascena</i> mill. Hydrosol.....	72

Tsveta Angelova, Gabriele Jovtchev, Svetla Gateva, Tsvetelina Gerasimova, Margarita Topashka-Ancheva, Ana Dobрева, Milka Mileva, Does hydrosol from *Rosa centifolia* l. Have genotoxic effect on different types of test-systems *in vivo* and *in vitro*?73

GREEN CHEMISTRY

Younes Abghoui, Towards a greener tomorrow: the promise of hydrogen fuel cells and sustainable hydrogen production74

Patrycja Makoś-Chelstowska, Edyta Śłupek, Dominika Sikorska, Patrycja Janicka, Jacek Gębicki, Lignocellulosic biosorbents modified with deep eutectic solvents for purification of gaseous fuel streams75

Edyta Śłupek, Patrycja Makoś-Chelstowska, Jacek Gębicki, New generation of green sorbents for desulfurization of biogas streams76

Arkadiusz Zarski, Janusz Kapusniak, *Starch* wars - looking for ecofriendly packaging materials77

HEALTH AND ENVIRONMENT

Nina Bagdasaryan, Fatima Mafagel, Valeriy Elichev, Tatyana Aksenova, Sergei Karapetov, Cytokines of mixed oral fluid in the dynamics of the treatment of patients with catarrhal gingivitis against different levels of reactivity 78

Inga Zinicovscaia, Ludmila Rudi, Liliana Cepoi, Tatiana Chiriac, Alexandra Peshkova, Anastasia Cepoi, Dmitrii Grozdov, Accumulation and effect of silver nanoparticles functionalized with *Spirulina platensis* on rats79

MATERIALS SCIENCE

Mirjana Ristić, Suzana Samaržija-Jovanović, Vojislav Jovanović, Marija Kostić, Tijana Jovanović, Gordana Marković, Marija Kojić, Milena Marinović - Cincović, Functional materials based on renewable raw materials: hydrochar and chitosan as formaldehyde scavengers in urea-formaldehyde composites 80

Marta Kuwik, Karolina Kowalska, Joanna Pisarska, Wojciech Pisarski, Near-infrared luminescence properties of germanate based glasses as a function of glass modifier TiO₂81

Karolina Kowalska, Marta Kuwik, Joanna Pisarska, Wojciech A. Pisarski, Thulium-doped barium gallo-germanate glasses modified by titanium dioxide: optical investigations for near infrared applications 82

Nikola Bednarska-Adam, Marta Kuwik, Tomasz Goryczka, Wojciech Pisarski, Joanna Pisarska, Luminescence characterization of olivine-type ceramic phosphors Li₂MgGeO₄:RE³⁺ (RE: Pr³⁺, Er³⁺, Ho³⁺, Tm³⁺) 83

Sergei Baranovskii, Alexey Nenashev, Dirk Hertel, Florian Gebhard, Klaus Meerholz, Energy scales of compositional disorder in alloy semiconductors for device applications 84

Nikolina Nikolić, Jelena Spasojević, Una Stamenović, Ivana Vukoje, Julijana Tadić, Vesna Vodnik, Zorica Kačarević-Popović, Aleksandra Radosavljević, Gamma irradiation-induced synthesis and characterization of bi-layered Au-(PNiPAAm/PVA) hydrogel nanocomposites 85

Ivana Savic Gajic, Ivan Savic, Zorica Svircev, Optimization of acid treatment of brown seaweed biomass (*Laminaria digitate*) during alginate isolation 86

Miloš Janeček, Jiří Kozlík, Josef Stráský, Tomáš Chraska, Microstructure and mechanical properties of biomedical alloys spark plasma sintered from elemental powders 87

Leonid Vasylechko, Vasyl Hreb, Vitalii Stadnik, Yaroslav Zhydachevskyy, Synthesis and crystal structure of new mixed niobates La_{1-x}Y_xNbO₄ and La_{1-x}Gd_xNbO₄ 88

Aigul Sarkeeva, Radik Mulyukov, Multilayer laminate manufactured from near-alpha titanium alloy89

Ondřej Pašta, Marcin Kopeć, Debris fretting testing in PWR conditions 90

Miroslav Vlcek, Radiation sensitivity of chalcogenide glasses thin films prepared by spin coating 91

Svetlana Vladimirovna Likhomanova, Larisa Olegovna Fedorova , Natalyi Vladimirovna Kamanina, Sensitized polyvinyl alcohol structures under the mechanical and vacuum UV treatment 92

Larisa Fedorova, Andrei Toikka, Natalia Kamanina, Shungite influence on the ITO-coatings basic features: mechanical, spectral, wetting parameters change	93
Veronica Anastasoae, Roxana Tomescu, Catalin Parvulescu, Oana Brincoveanu, Iuliana Mihalache, Adrian Dinescu, Dana Cristea, Plasmonic nanoaggregate arrays for fluorescence intensity improvement.....	94
Volodymyr Ivashchenko, Alexei Onoprienko, Aleksandr Pogrebnyak, Petro Scrynskyy, Olena Olifan, Andrii Kovalchenko, Dmytro Vedel, Petro Mazur, Radiation-resistant high-entropy boride (TiZrNbHfTa)B ₂ coatings: Experiment and theory.....	95
Petronela Gheorghe, Adrian Petris, Ileana Rau, All-optical spatial phase modulation in dye-doped DNA films.....	96
Olga Maksakova, Vyacheslav Beresnev, Sergiy Lytovchenko, Bohdan Mazilin, Cathodic arc deposition and characterization of tungsten-based nitride coatings with effective protection.....	97
Svitlana Goncharova, Alexander Goncharov, Alexander Pogrebnyak, Structural features and practical application of films of transition metal carbidonitrides.....	98
Marija Pergal, Jelena Brkljačić, Ivan Pešić, Gordana Dević, Biljana P. Dojčinović, Bratislav Antić, Gordana Tovilović-Kovačević, Organic-inorganic nanocomposites for biomedical applications	99
Ivan Pešić, Dana Vasiljević Radović, Sanja Ostojić, Milena Rašljić Rafajilović, Vesna Radojević, Marija V. Pergal, Preparation of MXene reinforced polymer nanocomposites	100
Nevena Celic, Goran Štrbac, Imre Gut, Nenad Tadić, Ondrej Bosak, Svetlana Lukić-Petrović, The investigations of mechanical stability of highly transparent UVC-blocking ZnO-SnO ₂ /PMMA nanocomposite coatings.....	101
Maria Argirova ¹ , Denitsa Yancheva ¹ , Stefan Tapanov ² , Simeon Stoyanov ¹ , Bistra Stamboliyska, IR and micro-Raman study of the inorganic and organic painting materials used in the murals of Orlitsa convent, Rila monastery.....	102
Nikolay Lumov, Maria Argirova, Iliya Nikolov, Denitsa Yancheva, Saint George the Zograf Monastery, Mount Athos: pigments, binders and other organic materials identification.....	103
Sandra Zarska, Damian Kulawik, Wojciech Ciesielsk, New batteries, environmentally friendly, based on nanotubes - an inspiration for the energy industry.....	104

MEDICAL DEVICES

Vojislav Antic, Nebojsa Petrovic, Jelena Petrovic, Vera Artiko, Possibilities of modern CZT SPECT-CT gamma cameras in NET diagnostics	105
---	-----

MEDICAL IMAGING

Harmen Bijwaard, Karin Bol, Colinda Vroonland, Artificial Intelligence for radiographers: reviewing current applications, providing future vision and setting up e-learnings.....	106
Ashkan Ajeer, Robert Moss, A step closer to a benchtop x-ray diffraction computed tomography (XRDCCT) system.....	107
Renzo Campanella, Functional neuroimaging in states of impaired consciousness	108
Sara Novak, Kaja Čeh, Valentina Perc, Ludvik Drobne, Bojana Crnobrnja, Barbara Šetina Batič, Veronika Kralj Igljč, Damjana Drobne, The breast cancer architecture and extracellular vesicles investigated by FIB/SEM	109
Barbara Blasiak, Armita Dash, Frank C. J. M. van Veggel, Peter Latta, Boguslaw Tomanek, Molecular magnetic resonance imaging of prostate cancer using Core/Shell nanoparticles and mice animal model.....	110
O. Dynnyk, M. Zhaivoronok, S. Mostovyi, Multiparametric ultrasound diagnosis of nonalcoholic fatty liver disease as a pathological continuum.....	111
A.A. Kirik, O.P. Sharmazanova, N.V. Deresh, V.V. Shapovalova, Digital radiography and tomosynthesis in the diagnosis of lung changes with covid-19.....	112

Yuri Kovalenko, Larisa Urina, Economic and logistical justification of the use of tomosynthesis in clinical practice	113
V.V. Lagoda, S.V. Potemkin, I.O. Mykhalyk, The use of tomosynthesis for differential diagnosis of lung diseases	114
S. Miroshnichenko, A. Nevgasimyy, Yu. Kovalenko, 25 years of the x-ray technologies center of association of radiologists of ukraine: from digital screening radiography to tomosynthesis.....	115
V.B. Myakynkov, The role of tomosynthesis in the diagnosis of breast pathology	116
V.V. Shapovalova, S.V. Potemkin, N.V. Deresh, O.P. Sharmazanova, Digital radiography and tomosynthesis in the diagnosis of pulmonary tuberculosis	117
O.P. Sharmazanova, L.K. Urina, G.A. Kirik, M.O. Uryna, The use of tomosynthesis in the diagnosis of bone pathology.....	118
Yu. Kovalenko, O. Dynnyk, O. Sharmazanova, L. Svatko, Mobile diagnostic teams to help the primary chain of medicine.....	119
L. Urina, O. Sharmazanova, M. Urina, The experience of using the tomosynthesis in pediatric radiology.....	120
Ya. Yakobchuk, Yu. Kovalenko, S. Balashov, Advantages of using x-ray diagnostics in primary healthcare facilities.....	121
M. Zhaivoronok, O. Dynnyk, S. Mostovyi. New possibilities of ultrasound diagnostics (US) at the level of primary medical care (PMS).....	122

MEDICAL PHYSICS

Marcin Szymański, Wioletta Ślusarczyk-Kacprzyk, Iwona Grabska, Long term stability of $N_{D,w}$ calibration coefficient for Farmer type ionization chambers	123
Iwona Grabska, Wioletta Ślusarczyk-Kacprzyk, Marcin Szymański, Results of interlaboratory comparisons in the field of testing of thermoluminescent detectors in terms of absorbed dose to water	124
Wioletta Ślusarczyk-Kacprzyk, Iwona Grabska, Marcin Szymański, TLD postal dose audit in Poland – 2022 results	125
Marcin Szymański, Magdalena Bojarojć, Anna Jabłońska, Barbara Kuśmierska - Piątek, Stereotactic Body Radiation Therapy - dosimetric and mechanical preparation of linear accelerator	126
Saerom Sung, Minjae Lee, Hyung Joo Choi, Hyemi Kim, Chul Hee Min, Sei Hwan You, Yeon Soo Yeom, Hyun Joon Choi, Simulation study of C-arm CT/SPECT imaging-based patient dose verification with TOPAS for online adaptive brachytherapy	127
Mariacristina Guarrera, Antonino Amato, Pablo Cirrone, Alma Kurmanova, Daniele Margarone, Salvatore Tudisco, Giada Petringa, Prague: Proton RANGe measure Using silicon carbide.....	128
Maria Laura Perez-Lara, Robert Moss, Matthew Wilson, Towards the development of a Compton Camera based on HEXITEC detectors for in vivo range verification in proton beam therapy.....	129
Maria Poncyłjusz, Andrzej Radkowski, Dariusz Garmol, Magdalena Kisiel, Oskar Madetko, Improvement of the treatment procedure based on dose verification and deformable image registration.....	130
Nikola Šegedin, Hrvoje Hršak, Sanja Dolanski Babić, Slaven Jurković, Determination of volume averaging correction factors for ionization chambers of different effective volumes in narrow Co-60 beams	131
K. Zervou, A.P. Stefanoyiannis, K. Vasiliou, A. Bakas, Artificial Intelligence algorithms in Mammographic Imaging: a preselection tool, a stand-alone reader or a possible Ethics' violator?	132

MEDICINAL CHEMISTRY

Malgorzata Rybczynska, Artur Sikorski, Multicomponent crystals of nimesulide: design, structures and properties.....	133
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Dunja Jovanovic, Ana Filipovic, Bojan Bondzic, Aleksandra Bondzic, Influence of the structures of THIQ derivatives on their inhibitory properties toward acetyl- and butyrylcholinesterase.....	134
Mirjana Čolović, Goran Gajski, Ana-Marija Domijan, Marko Gerić, Nada Savić, Tatjana Parac-Vogt, Danijela Krstić, <i>In vitro</i> genotoxicity assessment of a monolacunary Wells-Dawson nanocluster as a promising contrast agent candidate	135
Vyara Velcheva, Kaspar Hegetschweiler, Angel Ugrinov, Georgi Momekov, Galina Gencheva, Platinum(IV) complexes of the 1,3,5-triamino-1,3,5-trideoxy-cis-inositol- synthesis: structure and antiproliferative properties	136
Slava Tsoneva, Marian Hristov, Andgela Todorova, George Valev, Teodora Vasileva, Stoyanka Nikolova, Petya Marinova, Anthranilic acid amide and its complex with Cu(II) ions	137

MEDICINE – CASE REPORTS

Marijana Maneska, Vladimir Ristovski, Not a myocardial infarction	138
Zorana Đaković, Aleksandra Marjanović, Zorana Babić, Hair loss after covid 19 - case series	139
Irena Stoilova, Penka Kostadinova, Vanya Birdanova, Cases of vibration disease in workers exposed to prolonged vibration	140
Jasmin Ramić, Nikolina Tomić, Naida Lojo-Kadrić, Belmina Šarić Medić, Lejla Pojskić, Huntington's disease case report: intermediate number of repeats expansion in paternal transmission	141

MICROWAVE, LASER, RF, UV AND SOLAR RADIATIONS

Zsuzsanna Vecsei, Zsófia Szilágyi, Bertalan Pintér, György Thuróczy, Personal radiofrequency exposure measurements at a summer music festival	142
Jelena Jovanovic, Vesna Panic, Borivoj Adnadjevic, About the influence of different external fields on the swelling kinetics of PMAA hydrogels	143
Victoria Zaryabova, Tsvetelina Shalamanova, Michel Israel, Mihaela Ivanova, Exposure assessment of electromagnetic field from telecommunications sources in populated areas in correlation with public concern	144
Mihaela Ivanov, Michel Israel, Tsvetelina Shalamanova, Victoria Zaryabova, Problems with the implementation of the European legislation for the protection from laser radiation in the working environment.....	145

NEUROSCIENCE

Feng Ru Tang, Early life irradiation-induced hypoplasia and impairment of neurogenesis in the dentate gyrus are mediated by Microrna- 34a-5p/T-cell intracytoplasmic Antigen-1 pathway.....	146
Reni Kalfin, Maria Lazarova, Valya Grigorova, Diamara Uzunova, Miroslava Stefanova, Borislav Minchev, Polina Petkova-Kirova, Aleksander Dolashki, Lyudmila Velkova, Lyubka Tancheva, Pavlina Dolashka, Beneficial effects of <i>Helix aspersa</i> extract in Parkinson's disease	147
Lyubka Tancheva, Reni Kalfin, Maria Lazarova, Borislav Minchev, Valya Grigorova, Diamara Uzunova, Miroslava Stefanova, Polina Petkova-Kirova, Albena Alexandrova, Elina Tzvetanova, Almira Georgieva, Ventseslav Atanasov, Alexander Dolashki, Lyudmila Velkova, Pavlina Dolashka, How to fight Alzheimer's type dementia: the role of snail extract.....	148

NEUTRON AND HEAVY ION RADIATIONS

Emanuele Vincenzo Pagano, Latest results on NArCoS: a new correlator for neutrons and charged particles with high angular and energy resolution	149
Gianluca Santagati, Emanuele Vincenzo Pagano, Some results for the study of the efficiency and cross-talk probability by using GEANT4 simulations for the neutron correlator NArCoS	150
Aleksandra Paveleva, Evgeniy Altynbaev, Dmitry Trunov, Research station for tomographic and radiographic studies of large objects and the possibilities of its application	151

NUCLEAR MEDICINE

Aleksandr Khalikov, Lilit Vaganyan, Andrey Vasilev, Valery Verbenko, Djan Karlin, Natalya Kuzora, Vladimir Maksimov, Fedor Pak, The medical proton complex of NRC “Kurchatov Institute” – PNPI152	
Natalya Kuzra, Aleksandr Khalikov, Vladimir Maksimov, Fedor Pak, Lilit Vaganyan, Dose planning system for the proton beam therapy complex	153
Dragana Sobic Saranovic, Arsen Ristic, Danijela Zamaklar Trifunovic, Aida Afgan, Isidora Grozdic Milojevic, Jelena Petrovic, Vera Artiko, Importance of nuclear medicine in diagnosis of transthyretin cardiac amyloidosis (ATTR-CM)- single centre experience	154
Aida Afgan, Jelena Petrovic, Vera Artiko, Nuclear medicine procedures in the follow-up of patients with medullary thyroid carcinoma	155
Pragya Das, Incomplete fusion reactions for enhanced production of radioisotopes: scope in nuclear medicine	156
Milena Dimcheva, Peter Trindev, Comparison of dose calibrator accuracy using standardized sources as a part of multicentre clinical assessment in Bulgaria	157

ONCOLOGY

Andreea Lazescu, Claudiu Daha, Ioan Burlanescu, Dragos Mitulescu, Renal cancer in adjuvant setting – present and future direction	158
Andreea Lazescu, Ioan Burlanescu, Cristian Surcel, Prostate cancer - mHSPC, a new perspective	159

PHARMACEUTICAL SCIENCES

Vedada Čeljo, The relationship between the pH value of Midazolam syrup made in the Clinical Pharmacy of the UKCS and the degree of sedation of pediatric patients	160
Patryk Nowak, Artur Sikorski, New multicomponent crystals derived from acridine and selected hydroxybenzaldehydes: structural diversity and physicochemical examination	161
Aleksandar Dolashki, Pavlina Dolashka, Lyudmila Velkova, Synergistic effect of snail natural products and plant extracts with practical application	162
Tsenka Grancharova, Stanislava Simeonova, Bissera Pilicheva, Plamen Zagorchev, Photothermal performance of bimetallic Ag-Fe nanoparticles obtained by green synthesis	163
Stanislava Simeonova, Tsenka Grancharova, Bissera Pilicheva, Plamen Zagorchev, Development, characterization and stabilization of magnetic iron oxide nanoparticles for targeted drug delivery and magnetic hyperthermia	164

RADIATION CHEMISTRY

Magdalena Datta, Adrian Szczyrba, Magdalena Zdrowowicz, Olga Ciupak, Dariusz Wyrzykowski, Sebastian Demkowicz, Janusz Rak, 8-benzylamino-2'-deoxyadenosine as a potential radiosensitizer of DNA damage	165
Tomasz J. Wasowicz, The overabundance of excited hydrogen atoms produced in the H ₂ ⁺⁺ furan reaction	166
Ana Vico Cobos, Isabel María Pérez de Vargas Sansalvador, Miguel M. Erenas Rodríguez, Miguel A. Carvajal Rodríguez , Francisco Santoyo-González , Damián Guirado Llorente, Antonio M. Lallena Rojo, Alberto J. Palma López, Luis Fermín Capitán-Vallvey, Research and characterisation of novel flexible materials for radiochromic film design	167
Edoardo Renaldin, Talip Zeynep, Nicholas Philip van der Meulen, Robert Eichler, Gaia Dellepiane, Saverio Braccini, Cyclotron production of thulium-167 for medical applications	168
Aleksandar Lazarević, Sanja Petrović, Dragan Cvetković, Jelena Zvezdanović, Bojana Danilović, Tatjana Anđelković, Natalija Đorđević, Antimicrobial activity of PPIX-SUV liposomes against <i>Escherichia coli</i> and <i>Pseudomonas aeruginosa</i>	169
Marc Benjamin Hahn, In situ monitoring of the influence of water on DNA radiation damage by near-ambient pressure X-ray photoelectron spectroscopy	170

RADIATION DETECTORS

- Gintautas Tamulaitis, Saulius Nargelas, Yauheni Talochka, Augustas Vaitkevicius, Processes limiting performance of heavily-doped lead tungstate scintillators 171
- Toshiyuki Onodera, Keitaro Hitomi, Crystal evaluation and gamma-ray detection performance of press mold thallium bromide semiconductors 172
- A. Aniskevich, Valerijs Ivanovs, Victor Ivanov, M. Piskunovs, S. Stankevich, Parts for gamma radiation detectors made of electrically conductive thermoplastic filaments by additive 3D printing 173
- David Zoul, Patricie Halodová, Pavel Zháňal, Ladislav Viererbl, Antonín Kolros, David Dobrev, Petr Večerník, Non-destructive testing of alternative materials for storing radioactive waste using computed 3D gamma tomography 174
- Madalina Cruceru, Small detectors with inorganic scintillator crystals of CsI(Tl) for gamma radiation and heavy ions detection 175
- Isidoro Ruiz-García, Pedro Martín-Holgado, Pablo Escobedo, Alberto J. Palma, Miguel A. Carvajal, Temperature effect on the sensitivity of PIN diodes used as gamma dosimeters 176
- Olena Aksimentyeva, Igor Olenych, Yuliia Horbenko, Lubomyr Monastyrskii, Orest Dzendzeliuk, Graphene based nanostructures for ionizing radiation sensing 177
- Hyung-Joo Choi, Yoon Soo Chung, Hyun Joon Choi, Kyunghoon Cho, Hakjae Lee, Yong Hyun Chung, Chul Hee Min, Performance evaluation of gamma emission tomography to interrogate partial defects of spent nuclear fuel assembly 178
- Juan Alejandro de la Torre González, Isidoro Ruiz García, Damian Guirado Llorente, Miguel Ángel Carvajal Rodríguez, Marta Anguiano Millán, Antonio Miguel Lallena Rojo, Study of the angular dependence of a photodiode-based dosimeter using Monte Carlo simulation 179
- Nataša Nikolić, Slavica Porobić, Julijana Tadić, Ivica Vujčić, Marija Kojić, Jelena Ladarević, Dušan Mijin, Sensory properties of new films based on poly(vinyl-alcohol) and pyridone azo dyes 180
- Juan A. Moreno-Pérez, Damián Guirado, Santiago Becerril, Pedro Martín-Holgado, Irene Álvarez, Alberto J. Palma, Rafael Vila, Miguel A. Carvajal, Ionization chamber for gamma measurement in harsh environments: calibration and first steps 181
- Antonio Pousibet Garrido, Pablo Escobedo Araque, Damián Guirado Llorente, Goran Ristic, Alberto José Palma López, Miguel Ángel Carvajal Rodríguez, NFC-based dosimeter with stacked pMOSFET configuration for enhanced sensitivity 182
- Francesco Bonforte, Simona Lamorte, Michele Ferrarini, Daniele Introini, Characterization of a MSND detector inside a rem counter 183
- Maria da Conceição Costa Pereira, Tufic Madi Filho, José Roberto Berretta, João Paulo da Silva Alves, Scintillation characteristics of pure cesium iodide crystals and doped with Tl⁺, Br⁻ and Li⁺ ions for use as radiation detectors 184
- Damian Komar, Ilya Lagutskiy, Andrey Antonov, Vladimir Antonov, Spectrometric gamma radiation detection units based on high-resolution crystals SrI 2(Eu) and LaBr3(Ce) 185
- Ilya Lagutskiy, Damian Komar, Andrey Antonov, Vladimir Antonov, Practical aspects of the application of lithium-containing scintillators in neutron detection tasks 186
- Stefan D. Ilić, Milija Sarajlić, Dana Vasiljević-Radović, Russell Duane, Goran S. Ristić, Pre-charged floating gate MOSFET as an ultraviolet dosimeter 187

RADIATION EFFECTS

- Jaber Al-Marri, Mosab Subeh, Yehia Manawi, Huda Al-Sulaiti, Investigation of natural radioactivity in soil and vegetation samples from farming lands in Qatar and estimation of their health effects 188
- Nikola Mitrović, Damian Guirado, Danijel Danković, Alberto J. Palma, Goran Ristić, Miguel A. Carvajal, Successive irradiation and thermal annealing of commercial p-channel LDMOSFETs 189
- Michal Jelínek, Aleš Jančář, Břetislav Mikel, PMMA optical fibre irradiated with Co-60 for optical fibre sensors 190

Sandra Veljković, Nikola Mitrović, Igor Jovanović, Emilija Živanović, Albena Paskaleva, Goran Ristić, Danijel Danković, Effects of self-heating and NBTI-induced stress on p-channel power VDMOSFETs	191
--	-----

RADIATION MEASUREMENTS

Byoungil Jeon, Myungkook Moon, Automatic calibration of radiation portal monitor using deep learning	192
Eunjoong Lee, Youngyoung Ji, Sungyeop Joung, Wanuk Gi, Byoungil Jeon, Development of dose distribution analysis algorithm for airborne radiation monitoring.....	193
Wanook Ji, Eunjoong Lee, Sungyeop Joung, Yoomi Choi, Youngyoung Ji, Radiation survey at the Fukushima restricted area	194
Dusan Mrdja, Jovana Knezevic Radic, Danijel Velimirovic, Kristina Bikit, Jan Hansman, Sofija Forkapic, Analysis of low-energy part of big-volume HPGe detector background spectrum	195
Sergii Ubizskii, Oleksandr Poshyvak, Yaroslav Zhydachevskyy, Analysis of the possibility of recognizing radioisotopes by measuring the absorbed dose using passive detectors with different atomic numbers	196
Tomas Nemes, Dusan Mrdja, Calibration of HPGe detector with non-calibrated sources.....	197
Esra Uyar, Modeling of germanium crystal in determination of ⁴⁰ K efficiency by Monte Carlo method	198
Soo Min Lee, Bo-Wi Cheon, Chul Hee Min, Assessment of dose distribution for uniform irradiation in large-scale gamma irradiation facility based on Monte Carlo simulation	199
Ales Jancar, Jiri Culen, Filip Mravec, Zdenek Matej, Fast digitizer card with integrated peak analysis	200
Gabriele Auriemma, Anna Bianchi, Anna Selva, Valeria Conte, Environmental microdosimetry in very low dose rate radiation fields	201
Péter Pál Necz, Péter János Varga, Márk Tamás Baross, Balázs Gyulai, József Krausz, György Thuróczy, Measurement of RF exposure around indoor private 5G network antennas in university environment.....	202
Nataša Sarap, Marija Janković, Jelena Krneta Nikolić, Milica Rajačić, Ivana Vukanac, Quantification of radioactive metabolite Sr-90 in environmental samples	203
Ahmet Murat Şenışık, Handan Tanyıldızı Kökkülünk, Mahmut yüksel, Investigation of radiation doses emitted by patients injected with ¹⁸ F-FDG in PET/CT	204
Marija Jankovic, Natasa Sarap, Jelena Krneta Nikolic, Milica Rajacic, Ivana Vukanac, Ivana Jelic, Marija Sljivic-Ivanovic, An influence of the final volume of samples during the electrolysis of water, on counts for tritium activity determination.....	205
Antonio De Donato, Pierluigi Carconi, Marco Capogni, Andrea Petrucci, Pierino De Felice, Inter-laboratory comparison of surface emission rate measurements of wide area sources.....	206
Sheldon Landsberge, Cassidy Reis, Optimization of neutron activation analysis of rare-earth elements	207
Elio Tomarchio, A fast coincidence-summing correction procedure for gamma spectrometric measurements in close geometries.....	208
Stevan Andrejić, Nevena Zdjelarević, Jovana Knežević, Radionuclide analysis of the simulated contaminated surface sample for the purpose of IAEA-TERC-2022-01/02 Proficiency Test	209
Robert-Cs. Begy, ²¹⁰ Pb dating method: applicability and limitations	210

RADIATION PHYSICS

Ulyana Bliznyuk, Polina Borchegovskaya, Timofey Bolotnik, Alexander Chernyaev, Natalia Chulikova, Irina Gordonova, Victoria Ipatova, Oleg Khmelevsky, Anna Malyuga, Zoya Nikitina, Igor Rodin, Felix Studenikin, Dmitry Yurov, Sergey Zolotov, Yana Zubritskaya, The complexity approach to food irradiation: how to increase the efficiency of processing	211
--	-----

Viviane Pierrard, Edith Botek, Alexandre Winant, Space radiation variations during solar energetic particle events and geomagnetic storms	212
Jacques Bezuidenhout, Estimating geothermal and background radiation hotspots from primordial radionuclide concentrations in geology of South Africa.....	213
Haris Dapo, Current status of the Turkish accelerator and radiation laboratory.....	214
Kristina Bikit, Dusan Mrdja, Gergő Hamar, Gábor Galgóczi, Jan Hansman, Botond Csatlós, Dezső Varga, Imaging of low atomic number materials via muon induced secondary particles	215
Anastasiia Chekhovska, David Chvatil, Tamara Krasta, Ivana Krausova, Vaclav Olšansky, Daina Riekstina, Photoactivation study of ¹⁶³ Tb β-decay.....	216
Stephen Kearney, Robert Moss, Joydip Ghosh, Paul Sellin, Mingqing Wang, A perovskite-thermoplastic composite for 3D printing novel radiation detectors	217
Michał Jurkowski, Tomasz J. Wasowicz, Electron-induced dissociative ionization of the pyridine molecules.....	218
Robert Moss, Nyma Nassren, Alwin Ho, Robert Speller, A new approach to directional radiation detection.....	219
Georgiana Giubega, Andrei Berceanu, Gabriel Cojocaru, Ioan Dancus, Edward Hermann, Mihai Iovea, Alexandru Lazar, Monica Mirea, Yoshihide Nakamiya, Liviu Neagu, Marian Neagu, Florin Negoita, Laura Nita, Saidbek Norbaev, Jian Fuh Ong, Madalin Rosu, Antonia Toma, Lidia Vasescu, Ovidiu Tesileanu, Preliminary results of laser-driven gamma imaging studies with 100TW laser at ELI-NP	220

RADIATION PROTECTION

Predrag Kuzmanović, Katarina Savić, Slobodanka Bogdanović Vasić, Dušan Mrđa, Sofija Forkapić, Kristina Bikit, Jovana Knežević Radić, Radiation exposures of staff in diagnostic radiology in Serbian general hospitals.....	221
Manssour Fadil, GANIL calculation team collaboration, Nuclear calculation and simulation studies for the nuclear safety in GANIL.....	222
Yoomi Choi, Sora Kim, Jiyeon Kim, Minchae Kim, Wanook Ji, ByungIl Min, Kyungsuk Suh, Hyeonjeong Kim, Dose assessment according to location and energy using machine learning based on Monte Carlo simulation data	223
Luljeta Disha, Manjola Shyti, CT number accuracy and uniformity comparison for four CT scanners in different hospitals in Albania.....	224
Kristine Saleniece, Andris Actins, Arturs Viksna, Ugis Eismonts, Ingars Reinholds, Gunta Kizane, Maris Bertins, Andrejs Grinbergs, Development of caesium antidote enterosorbents for the protection in the case of radioactive fallout	225
Ricardo Luis Ramos, Mario Pietro Carante, Alfredo Ferrari, Paola Sala, Valerio Vercesi, Francesca Ballarini, Space radiation damage: calculation of astronauts' doses and comparison with dose limits	226
Jozef Sabol, Vadim Chumak, Estimated actual and potential radiation safety and nuclear security situation in Ukraine in the context of the ongoing military operations	227
Károly Bodor, Development of drones for radiation protection applications.....	228
Cristina Ratero Talavera, Gonzalo García, Nuria García-Herranz, Air activation studies in the new proton therapy center planned for the Marques de Valdecilla University Hospital (HUMV), Santander (Spain).....	229
Jung Hwan Jang, Jae Kook Lee, Zu Hee Woo, Comparative Analysis of Internal Dose Conversion Coefficients due to Inhalation of Particulates for Workers according to the ICRP OIR Update: Zircon Industries	230
Giuseppe Giannattasio, Alessio Castorriani, Antonio D'Angola, Michele Ferrarini, Francesco Bonforte, Three-dimensional computational fluid dynamics investigation of the dispersion of radioactive cloud	231

Krzysztof Zaczek, New design for Hp(10) standard	232
Miklós Hegedűs, Esther Osei Akuo-ko, Anita Csordás, Edit Tóth-Bodrogi, Tibor Kovács, Implications of the relative strictness of building material indices.....	233
V. Sivakumar, A.D.K.M. Weerasekara, D.M.T. Gnanarathne, C.P. Jayalath, A. Jayasinghe, K. Wijayaratne, T.M.W.J. Bandara, Attenuation properties of minerals found in Sri Lanka for high-energy photons	234
Can Ilgın, Berrin Yalçın, Kübra Turan, Özlem Mermut, Begüm Ökten, Do the physicians and technicians in a radiation oncology clinic differ in received effective doses? A retrospective dosimetry analysis for a 5-year period	235
Ioan Iorga, Elena Neacsu, Carmen Alexandra Tuca, Laurentiu Done, Evelina Ionescu, Dose assessment and shield estimation for the dismantling of the combustible radioactive waste incinerator combustion chambers model simulation concept using microshield code.....	236
Jozef Sabol, Problems of the unified system of quantities in radiation protection for the risk assessment due to external and internal exposure.....	237
Igor Belyaev, Lucian Zastko, Leonardo Makinistian, Andrea Tvarožná, Fernando Ferreyra, Mapping of static magnetic fields near the surface of mobile phones.....	238
Ksenija Janković, Srboľjub Stanković, Anja Terzić, Dragan Bojović, Marko Stojanović, Gamma and X radiation attenuation characteristics for ultrahigh properties of concrete, concrete with barite and concrete with magnetite and steel	239

RADIOBIOLOGY

Regina Kozhina, Alla Boreyko, Mariia Zadneprianetc, Elizaveta Ilyina, Eugenia Kuzmina, Elena Kulikova, Svetlana Tiouchnik, Vladimir Chausov, The repair inhibitors effect on DNA damage in melanoma B16 Cells	240
Nikolino Žura, Ivona Žura Žaja, Ana Shek Vugrovečki, Josip Miljković, Krešimir Malarić, Porin Perić, Silvio Vince, Suzana Milinković Tur, Velimir Berta, Saša Androci, Krešimir Tomašić, Marinko Vilić, Blood cell count after <i>in vitro</i> exposure at frequencies of 5G in pig.....	241
Miroslava Stankovic, Tijana Milovanovic, Uros Kovacevic, Medicinal plants as potential radioprotectors	242
Jasna Paradiž, Determining the genetic vulnerability of plants due to ionizing radiation: a comprehensive analysis of the cytogenetic balance and responses of the <i>Allium</i> root meristem to various radiation doses	243
Alessandro Bartoloni, Space Radiobiology with the Alpha Magnetic Spectrometer detector data: Dose-Effects Models for Carcinogenesis risk prediction	244

RADIOCHEMISTRY

Tatiana Poliakova, Vladislava Zubkova, Daniil Novichkov, Alexander Trigub, Alexey Averin, Anna Krot, Mikchail Volgin, Iurii Nevolin, Petr Matveev, Mikchail Grigor'ev, Alexandre Fedoseev, Structural regularities in double sulphates of trivalent actinides	245
Vladimir Sladkov, Montserrat Filella, Veronika Zinovyeva, Problems in metal hydrolysis studies: the U(IV) case.....	246
Nikolay Aksenov, Radiochemical research program at SHE Factory: first results	247
Aleksandr Bodrov, Gospodin Bozhikov, Yurii Albin, Andrey Golczman, Nikolay Aksenov, The development of a theoretical approach to the chromatographic separation of transplutonium elements with an application for the identification of nuclear transfer reaction products.....	248
Alexander Madumarov, Nikolay Aksenov, Gospodin Bozhikov, Ilya Chuprakov, Andrey Goltsman, Yury Popov, Alexandr Svirikhin, Research on properties of superheavy elements copernicium and flerovium in a gas phase chemistry setup	249

RADIOECOLOGY

- Jovana Knežević Radić, Sofija Forkapić, Kristina Bikit, Jan Hansman, Danijel Velimirović, Dušan Mrđa, Predrag Kuzmanović, Utilization of Cherenkov radiation for ^{226}Ra determination in water samples..... 250
- Yihua He, Anne-Hélène Le Jeune, Clarisse Mallet, Susanne Sachs, Robin Steudtner, Harald Foerstendorf, Vladyslav Sushko, Gilles Montavon, Olivier Peron, Vincent Breton, Aude Beauger, Thorsten Stumpf, Interaction of uranium with diatoms..... 251
- Magdalena Gembal, Paweł Czerski, Małgorzata Warenik-Bany, Levels of ^{137}Cs in game animals in Poland 252
- Paweł Czerski, Magdalena Gembal, Małgorzata Warenik-Bany, Assessment of radioactive contamination with the ^{90}Sr isotope of dairy products 253
- Milena Hristozova, Radoslava Lazarova, Ivanka Yordanova, Viktoria Nedyalkova, Content of natural and man-made radionuclides in Antarctic mosses..... 254
- Mihajlo Vićentijević, Dubravka Vuković, Marija Pavlović, Slobodan Stanojević, Branislava Slavata, Produced radionuclides in foods of animal origin 2016-2022 255
- Lordford Tettey-Larbi, Amin Shahrokhi, Esther Osei Akuo-ko, Edit Tóth-Bodrogi, Tibor Kovács, Surveying the NORM contamination of soils, sediments and water, due to mining activities from the lower basin of river Pra in the Central and Western Regions of Ghana..... 256
- Amin Shahrokhi, Tuvshinsaikhan Ganbaatar, Edith Tóth-Bodrogi, Tibor Kovács, Earthworm as environmental radioactive bioindicator: the behavior and sensitivity of earthworm organs to changes in the concentration of the radioactive substance257
- Máté Novák, Péter György, Zsolt Homoki, Edit Tóth-Bodrogi, Anita Csordás, Tibor Kovács, Preliminary results of the radioecological survey in the Bakony region, Hungary 258
- Máté Fehérvári, Lordford Tettey-Larbi, Edit Tóth-Bodrogi, Gergely Tóth, Tibor Kovács, Soil radon exhalation measurements in Transdanubia, Hungary 259
- Giovanna-Rosa Fois, Dariana Llanes Vega, Alexis Pereda, Luca Terray, Patrick Chardon, Sofia Kolovi, Vincent Breton, Lydia Maigne, Simulation of the radiation exposure of microorganisms living in submarine hydrothermal systems using GATE and Geant4-DNA Monte Carlo simulation tools 260
- Jovana Knežević, Ivana Maksimović, Dalibor Arbutina, Environmental remediation of complex site: challenges and lessons learned261
- Milena Hristozova, Radoslava Lazarova, Ivanka Yordanova, Viktoria Nedyalkova, Radionuclides in volcanic ash on Livingston island, Antarctica..... 262
- Codrin-F. Savin, Robert-Cs. Begy, Anca Avram, ^{210}Pb dating as a fundamental tool in retrospective analyses of peatland recent carbon dynamics in the context of global climate change..... 263

RADIOLOGY

- Aleksandar Ristić, Jovana Ljujić, Ivana Jevtić, Irena Sabo Vojnić, Boris Nikolajević, Bojan Stipić, Pero Stupar, Comparison of stroke visualization with standard and „stroke“ window CT settings – how helpful is it?..... 264

RADIOPHARMACOLOGY

- Mirjana Đurašević, Katarina Rajković, Zorana Milanović, Sanja Vranješ-Đurić, Drina Janković, Marija Mirković, Zorica Obradović, The prediction of radioprotective dose of a *Juglans nigra* L. leaf extracts in diagnostic irradiation using response surface methodology 265

RADIOTHERAPY

- Serap Çatlı Dinç, Müge Akmansu, Hüseyin Bora, Aybala Üçgül, Eren Çetin, Petek Erpolat, Eray Karahacıoğlu, Ertuğrul Şentürk, Evaluation of the clinical acceptability of the Artificial Intelligence Automatic Contouring: an example of the use of artificial intelligence in prostate radiotherapy..... 266
- Kata Dabić-Stanković, Katarina Rajković, Jovan Stanković, High-dose-rate brachytherapy in patients with localized prostate cancer: an analysis of therapeutic parameters 267

Wilmmer Alexander Arcos Rosero, Angélica Bueno Barbezán, Carlos Alberto Zeituni, Maria Elisa Chuery Martins Rostelato, Gold radioactive nanoparticles for brachytherapy	268
Goran Kolarevic, Drazan Jaros, Dejan Ignjatic, Tatjana Ignjic, Measurement of pretreatment verification MV doses in radiotherapy	269
Bo-Wi Cheon, Hyun-Joon Choi, Chul Hee Min, Experiment study on using Prompt Gamma–Positron Emitter Tomography (PG–PET) system for verifying dose distribution in carbon ion therapy.....	270
Alessia Embriaco, Paola Martucci, Vanessa De Coste, Serenella Russo, Christian Fiandra, Pierino De Felice, Michele Stasi, Dosimetry audit for Italian radiotherapy centres	271
Vanessa De Coste, Paola Martucci, Alessia Embriaco, An Italian intercomparison for radiotherapy dosimetry in different field sizes.....	272
Yuriy Zorenko, Janusz Winiecki, Sandra Witkiewicz-Lukaszek, Paulina Michalska, Seweryn Jakubowski, Sergiy Nizhankovskiy, Oleg Sidletskiy, Pawel Bilski, Anna Mroziak, Development of TL and OSL materials for the analyzation of dose and energy distributions of photon beams for radiotherapeutic applications	273
Janusz Winiecki, Yuriy Zorenko, Sandra Witkiewicz-Lukaszek, Vitaliy Gorbenko, Sebastian Maleszka, Agnieszka Orzechowska, Bogna Sobiech, The concept of a detector for in vivo dose measurements in brachytherapy based on advanced OSL materials.....	274
Dražan Jaroš, Petar Janjić, Goran Kolarević, Tatjana Ignjić, Left sided breast cancer with deep inspiration breath hold: comparison of dose distribution of hybrid (IMRT+VMAT) and 3D conformal treatment planning.....	275
Andreea Aurelia Mihailescu, Virgil Baran, Costin Ghioca, Barbulescu Eugen, Small field dosimetry overview	276

RADON AND THORON

Ivana Vukanac, Milica Rajačić, Iris Borjanović, Comparison of results of radon level measurements obtained with charcoal canisters and airthings detectors during summer at TCAS	277
Sofija Forkapić, Robert Lakatoš, Jan Hansman, Ljiljana Gulan, Selena Samardžić, Kristina Bikit, Predrag Kuzmanović, Jovana Knežević Radić, Dose assessment from exhalation and gamma spectrometry measurements of soils and stones as building materials	278
Mila Pandurovic, on behalf of DARWIN Collaboration, Radon background in rare event searches at DARWIN experiment	279
Rikus le Roux, Jacques Bezuidenhout, Radon concentrations in the Sudwala cave, South Africa	280
Konstantin Kovler, Andrey Tsapalov, Temporal uncertainty as a key parameter for the international standardization of indoor radon measurements	281
Michael Zhukovsky, Vyacheslav Izgagin, Alexandra Onishchenko, Measuring technique of the average equivalent equilibrium concentration of thoron in modern buildings.....	282
Gergely Tóth, Miklós Hegedűs, Amin Shahrokhi, Anita Csordás, Tibor Kovács, The relative benefits of different spatial evaluation methods for visualizing geogenic radon	283
Coretchi Liuba, Overcenco Ala, Ababii Aurelia, Gîncu Mariana, Capatina Angela, Relation between radon concentration, number of smokers, and lung cancer morbidity in the conditions of the Republic of Moldova	284
Luigi Rinaldi, Marco Capogni, Francesco Cardellini, Pierino De Felice, First national intercomparison on radon active monitor at INMRI-ENEA Casaccia research center	285
Judith Pena Dembo, Péter Völgyesi, Zsuzsanna Szabó, Kristály Ferenc, Csaba Szabo, Geochemical and structural properties with regard to radon and thoron behavior in adobe building materials: study case from three different areas in Angola	286

WASTE MANAGEMENT

Marija Kojić, Slavica Porobić, Đurica Katnić, Milena Marinović-Cincović, Ivica Vujčić, Jelena Petrović, Marija Simić, Thermal and adsorption study of the spent mushroom substrate and its hydrochar ...	287
--	-----

Povilas Balčius, Dalia Grigaliūnienė, Modelling of radionuclide transfer through the concrete barrier of the near-surface repository under different environmental conditions	288
Valdas Ragaišis, Povilas Poškas, Audrius Šimonis, Development of the concept for derivation of conditional clearance levels for an industrial waste disposal facility at Ignalina NPP	289
Asta Narkūnienė, Gintautas Poškas, Multiphysics simulation to support analysis of engineered materials in geological repository	290
Elena Neacsu, Laura Ruxandra Zicman, Mihaela Daniela Nicu, Laurentiu Done ,Low and intermediate level aqueous radioactive waste treatment in a modular installation	291

OTHER TOPICS

Ivan Savic, Ivana Boskov, Ivana Savic Gajic, Microwave-assisted extraction of antioxidants from black locust flowers (<i>Robinia pseudoacacia flos</i>)	292
Ivana Vučenović, Aurélien Crochet, Tina Andrejević, Nevena Stevanović, Darko Ašanin, Fabio Zobi, Miloš Djuran, Biljana Glišić, Zinc(II) complex with 4-ethynyl-2,2'-bipyridine: synthesis, characterization and DNA/BSA interactions	293
Violeta Georgieva-Hristozova, Radiation protection for children in preschool age – how to prepare kindergarten teachers to safeguard children's health	294
Dragana Radošević, Nikola Vučinić, Mirjana Udicki, Zorka Drvendžija, Nikola Knezi, Nikolina Pupovac, Supraorbital notch and supraorbital foramen of the skull: osteometric analysis and clinical significance	295
Roxana Tomescu, Catalin Parvulescu, Veronica Anastasoae, Dana Cristea, Flexible technologies for anti-counterfeit holographic metallic microparticles	296
Aleksandr Sergeev, Anna Titova, Viktor Sedov, Diana Orlova, Zhanna Lyutova, Alina Borisenkova, Marina Suyasova, Lutetium endometallofullerenes: preparation and properties	297
Petar Matić, Nevenka Đorđević, Lazar Tomić, Dragana Žarković, Miloš Mladenović, Dalibor Arbutina, Importance of fire protection in the event of an emergency – PC NFS experience	298
Violeta Stefanović, Valentina Dinic, Jovica Jovanović, Work-related health disorders among computer users	299
Petre Cătălin Logofătu, Cristian Udrea, Iuliana Urzică, Florin Garoi, Physical encryption-compression and decryption-decompression of data using the Fourier transform	300
Rene Panzer, Leigh D. Ruddock, Oluwaseun W. Adedoyin, Xinrui Zhang, Emily J. Martinez, Ingrid Lehman-Andino, David P. DiPrete, Konstantinos Kavallieratos, <i>o</i> -Sulfonamidophenols and analogs as extractants for integrated actinide and cesium removal from alkaline high-level waste	301
Michaela Davis ¹ , Rachell Morris, Dentition in the identification of human remains	302
Dragana Žarković, Miloš Mladenović, Ivana Maksimović, Marko Jevtić, Saša Božić, Nebojša Bilanović, Dalibor Arbutina, Managing the nuclear safety/security interface at the public company "Nuclear Facilities of Serbia"	303
Renzo Campanella, Science and art in the development of human progress	304



Functional materials based on renewable raw materials: hydrochar and chitosan as formaldehyde scavengers in urea-formaldehyde composites

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<https://doi.org/10.21175/rad.abstr.book.2023.19.1>

In this work, urea-formaldehyde (UF) resins modified with chitosan and hydrochar, biomaterials known as adsorbents, were analyzed.

The most polluted places on our planet are apartments. The danger of pollution in the home has increased tremendously, as housing technology has turned to better thermal insulation and cheaper materials. One of the possible dangers is UF adhesive, which is most often used for the production of wooden panels, such as plywood, chipboard or, Medium-density fibreboard (MDF). The main disadvantage of these adhesives is the emission of formaldehyde (FA) from wood products. It is desirable to reduce the percentage of free FA in the resin itself because it is known that FA vapors even in low concentrations can cause chronic respiratory diseases, while higher concentrations can cause death in just a few minutes. Apart from free FA in the resin itself, which is spontaneously emitted due to its low resistance to moisture, hydrolysis of the UF resin can also occur, which implies the breaking of the bonds in the resin (methyl ether) and additional emission of FA into the environment. There are various ways to reduce FA emissions from products bonded with UF resin. One way is the addition of various substances known as “scavengers” of free FA in the resin.

In this work, the biomaterials chitosan and hydrochar were used as “scavengers” FA in UF composites. As a new functional material, hydrochar is usually prepared from biomass and solid waste such as agricultural and forest waste, sewage sludge, livestock, and poultry manure. The wide application of hydrochar is due to its ability to remove pollutants, rehabilitate contaminated soil and reduce the greenhouse effect. Hydrochar, which was synthesized for this experiment, was obtained from the spent mushroom substrate by the hydrothermal carbonization at 180°C, autogenous pressure (2-10 MPa), and water medium in a hydrothermal reactor. The liquid phase in the hydrothermal carbonization system plays an important role because it affects the increase in the number of surface functional groups and forms a rich pore structure on the surface of the hydrosoot. In general, hydrochar is a carbonaceous material with similar properties to activated carbon, so it behaves well as an adsorbent.

Chitosan, like hydrochar, is also a functional material. Chitosan is a natural linear polysaccharide containing reactive amino and hydroxyl groups. The starting material for the production of chitosan is chitin, which is found in the shell of crabs, shells and the wings of beetles. It is characterized by hydrophilicity, biocompatibility, and biodegradability, and is non-toxic. Since chitosan is the only cationic polysaccharide of natural origin, it is considered suitable for various biomedical and pharmaceutical research as a carrier of the active substance in medicine, but also as an excellent adsorbent for anionic dyes.

Determination of free FA in modified UF resins was performed using the disulfite method. The results showed that the percentage of free formaldehyde in chitosan-modified UF resin is 0.1%, while the percentage of free FA in biochar-modified resin is 0.5%. These results are in accordance with the structure of chitosan, which also contains amino groups, so during the in vivo synthesis of UF composites, there is an additional binding of FA with chitosan. The hydrolytic stability of the modified UF resin was determined by measuring the concentration of liberated FA in the modified UF resins, after acid hydrolysis. The percentage of liberated FA in both modified UF composites after acid hydrolysis was similar (2.8% for the UF/chitosan composite and 2.5% for the UF/hydrocarbon composite, respectively).

TITLE: Book of Abstracts
EDITOR: Prof. Dr. Goran S. Ristić
TECHNICAL EDITING: Aleksandar Ristić, MD
COVER DESIGN: Vladan Nikolić, PhD
YEAR OF PUBLISHING: 2023
PUBLISHER: RAD Centre, Niš, Serbia
FOR THE PUBLISHER: Prof. Dr. Goran S. Ristić
CD BURNING AND COPYING: RAD Centre, Niš, Serbia
PRINT RUN: Electronic edition - 50 CDs (CD-R)
ISBN: 978-86-901150-6-8
www.rad-conference.org

CIP - Каталогизација у публикацији Народна библиотека Србије, Београд

539.16(048)(0.034.2)
57+61(048)(0.034.2)

**INTERNATIONAL Conference on Radiation, Natural Sciences,
Medicine, Engineering, Technology and Ecology (11 ; 2023 ; Herceg
Novi)**

Book of abstracts [Elektronski izvor] / Eleventh International Conference on Radiation, Natural Sciences, Medicine, Engineering, Technology and Ecology (RAD 2023) 19–23.06.2023, Herceg Novi ; [editor Goran S. Ristić]. – Electronic ed. - Niš : RAD Centre, 2023 (Niš : RAD Centre). - 1 elektronski optički disk (CD-ROM) ; 12 cm

Sistemski zahtevi: Nisu navedeni. - Nasl. sa naslovne strane dokumenta. - Tiraž 50.

ISBN 978-86-901150-6-8

a) Јонизујуће зрачење -- Дозиметрија -- Апстракти b) Биомедицина -- Апстракти

COBISS.SR-ID 121386249