



BOOK OF ABSTRACTS

INTERNATIONAL CONFERENCE ON RADIATION APPLICATIONS

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TABLE OF CONTENTS

INVITED TALKS

Radioactivity in the oil exploration sector _____	1
Sheldon Landsberger	
Abscopal effects of radiation and nanoparticle hyperthermia with immune checkpoint inhibitor therapies _____	2
Robert Ivkov	
Current challenges in radiation protection in medicine _____	3
Olivera Ciraj-Bjelac	
The vascular tumor microenvironment: New challenges and therapeutic targets _____	4
Annette K. Larsen	
Radioactive aerosol particles in different environments and under different meteorological conditions	5
Alexandra Ioannidou	
Thermal ionization mass spectrometry measurement of ⁹⁰Sr as a challenge in Fukushima samples _____	6
Sarata K. Sahoo and Norbert Kavasi	

TOPICAL KEYNOTE TALK

Dynamics of irradiation: From molecules to nano-objects and from material science to biology _____	7
Eric Suraud, Mai Dinh, Paul-Gerhard Reinhard	

CONFERENCE ABSTRACTS

Natural radioactivity in waters in selected regions of uranium ore mining in Poland _____	8
Beata Kozłowska, Agata Walencik-Łata, Tadeusz Przylibski	
Indoor and outdoor origins contributing to indoor exposure to radioactive alpha activities in occupied homes _____	9
Choong-Min Kang, Man Liu, Petros Koutrakis	

Tritium and carbon-14 in releases of nuclear reactor facilities of various types _____	10
Evgeniy Nazarov, Alexey Vasilyev, Alexey Ekidin	
Comparison of energy response function of stilbene, BC501 and EJ309 neutron-gamma detection system _____	11
Annesha Karmakar, Anil. K Gourishetty, Aditya Kelkar	
Study of photo-neutron dosimetry spectrum using NTDs _____	12
Emad Hamed Ghanim, Noha Emad Khaled, Ahmed Rashad El-Sersy	
Core modeling of the research reactor IEA-R1 with the MCNP-6.2 computational code _____	13
Antonio Carlos Iglesias Rodrigues, Tufic Madi Filho, Davilson Gomes da Silva	
Study and development of neutron detectors using doped CsI crystals _____	14
Tufic Madi Filho, Maria da Conceição Costa Pereira, José Roberto Berretta, Lucas Faustino Tomaz, Miriam Nieri Madi	
Optical properties and radiation response of Li ion-doped CsI scintillator crystal _____	15
Maria da Conceição Costa Pereira, Tufic Madi Filho, José Roberto Berretta, Lucas Lucas Faustino Tomaz, Miriam Nieri Madi	
Utilization of wipe methods to determine the areal activity of selected surfaces of the urban infrastructure _____	16
Josef Holeček, Petr Otáhal	
Assessment of elemental B content in industrial diamonds using PGAA and Co, Fe, Ni, Cr, Mn and Si using thermal and epithermal NAA with Compton suppression _____	17
Edward Artnak, William Charlton, Sheldon Landsberger, Colin Brennan	
The Ruthenium-106 event, September-October 2017: Review and open questions _____	18
P. Bossew, F. Gering, E. Petermann, T. Hamburger, C. Katzlberger, M.A. Hernandez-Ceballos, M DeCort, K. Gorzkiewicz, R. Kierepko, J.W. Mietelski	
Radioecological monitoring of aquatic ecosystems in the vicinity of Rooppur NPP (People's Republic of Bangladesh) _____	19
Rena Mikailova, Aleksei Panov, Dmitrii Kurbakov	
Environmental risk assessment of bauxite residue by determining toxic elements and natural radionuclides _____	20
Banu Ozden, Colin Brennan, Sheldon Landsberger	
Evaluation of radioactivity in Montenegro soil using a statistical approach _____	21
Nevenka Antovic, Nikola Svrkota	
Heavy metals and radionuclides in muscles of fish species in the South Adriatic – Montenegro _____	22
Ivanka Antović, Danijela Šuković, Snežana Andjelić, Nikola Svrkota	

On the use of neutron activation analysis to probe the air pollution using plant biomonitoring – Egypt	23
Yasmen Sarhan, W. M. Badawy, Marina V. Frontasyeva, Wafaa Arafa, Abdel Azeem Hussein, Hussein El Samman	
Interception effect of radiocesium by forests after the Fukushima nuclear accident	24
Toshihiro Yoshihara, Vasyl Yoschenko, Hirohisa Yoshida, Hideyuki Matsumura	
Using the ¹⁴C activity measurements in tree rings near Ignalina Nuclear Power Plant to examine dilution peculiarities of the gaseous releases from the NPP	25
Rūta Druteikienė, Algirdas Pabedinskas, Evaldas Maceika, Žilvinas Ežerinskis, Justina Šapolaitė, Laurynas Juodis, Vida Juzikienė, Laurynas Butkus	
Scaling properties of the beryllium-7 activity concentrations in the surface air in Fenno-Scandinavia	26
Đorđe Stratimirović, Darko Sarvan, Miguel Angel Hernández-Ceballos, Jelena Ajtić	
Comparison of the beryllium-7, lead-210 and caesium-137 activity concentrations in the surface air along 45 °N in Serbia and Slovenia	27
Jelena Ajtić, Darko Sarvan, Marijan Nečemer, Dragana Todorović, Milica Rajačić, Jelena Krneta Nikolić, Vladimir Djurdjevic, Branko Vodenik, Denis Glavič Cindro, Jasmina Kožar Logar, Benjamin Zorko	
Response of <i>Lactobacillus spp.</i> in different physiological states to the oxidative stress induced by H₂O₂ and ionizing radiation	28
Kristine Kalneniece, Toms Kusins, Inga Balode, Liva Mazkalnina, Karlis Shvirksts, Mara Grube, Gunta Kizane, Vasilijš Bankovskis, Andrejs Grinbergs, Olga Muter	
Raman spectroscopy of NETosis: Search for spectral biomarker	29
Anastasia Marchenko, Kahramon Mamatkulov, Aleksandr Gur'ev, Konstantin Vereshchagin, Aleksandr Volkov, Grigory Arzumanyan	
Trace elements in moss samples using Neutron Activation Analysis	30
Chrysoula Betsou, Evdoxia Tsakiri, Nerantzis Kazakis, Konstantinos Eleftheriadis, Evangelia Diapouli, Marina Frontasyeva, Alexandra Ioannidou	
Assessment of natural radionuclide levels for tea samples in Najaf, Iraq	31
Ali Abojassim	
The tensile breaking strength of <i>Phragmites australis</i> (Cav.) Trin. ex Steud leaves as a chronic irradiation effect	32
Dmytro Ganzha, Dmytro Ganzha, Alexander Nazarov, Borys Sploshnoi	
Elemental analysis of TSP samples from Helsinki, Finland for the 1995–2005 period	33
Margarita Mantzari, Manousos Manousakas, Jussi Paatero, Alexandra Ioannidou	
The Metro Radon project as support for the implementation of the Basic Safety Standards	34
Peter Bossew	
Measurement of radon and thoron concentration levels in Disi soil (in Jordan) using CR-39 detectors	35
Tariq Hailat, Barakat Al-Bataina, Balázs Madas	

A compact electronic system for a photodiode neutron detector _____	36
Priscila Costa, Marcus P. Raele, Claudio Domienikan, Fabio E. Costa, Tufic M. Filho, Guilherme S. Zahn, Frederico A. Genezini	
Development of radiation detector with three different sensors for space applications _____	37
Buğra Kocaman, Mehmet Köprü, Murat Harmandalı, Ercan Yılmaz	
A novel He³-free detector for thermal neutrons to be used for hydrological observations: Limitations and emerging opportunities _____	38
Marcello Lunardon, Luca Stevanato, Cristiano Lino Fontana, Sandra Moretto, Gabriele Baroni, Paul Schattan, Vladimir Mares	
Radiation hard Monolithic CMOS sensors with small electrode size for the ATLAS experiment in the HL-LHC _____	39
Carlos Solans Sanchez, Florian Dachs, <i>et al.</i>	
Comprehensive characterisation of Tyndall National Institute RADFETs for commercial applications in various fields _____	40
Aleksandar Jaksic, Nikola Vasovic, Srboljub Stankovic, Russell Duane	
Electronic reader design with RadFET (p-MOSFET) dosimeter sensor _____	41
Nesrin Tekin, Ferdi Sarimli, Zeynel Abidin Sezer, Ercan Yılmaz	
Radiation induced defects in CMOS SPADs sensors _____	42
Marcello Campajola	
Development of MOS-FET dosimetry for high radiation environments _____	43
G. Kramberger, K. Ambrožič, B. Hiti, M. Zavrtanik, E. Yılmaz, H. Karacali, O. Yılmaz, U. Güner	
Stacked-NürFETs fabrication and characterization _____	44
Saleh Abubakar, Huseyin Karaçali, Aliekber Aktağ, Ercan Yılmaz	
Determination of minimum detectable dose and the effect of different filters on TLD 100H main thermoluminescence peak _____	45
Kemal Firat Oguz, Mehmet Yüksel	
Electrical characteristics and alpha particle detection performance of newly developed pin photodiode _____	46
Ercan Yılmaz, Emre Doğancı, Farid Ahmadov, Gadir Ahmadov, Azar Sadigov, Samir Suleymanov	
Novel reader circuit design for PIN photodiodes _____	47
Ercan Yılmaz, Zeynel Abidin Sezer	
Optical characteristics of as-grown and annealed Gd₃Al₂Ga₃O₁₂:Ce crystals under electron irradiation _	48
Evgeniia Zabelina, Oleg Buzanov, Nina Kozlova, Dmitry Spassky, Anna Kozlova, Petr Lagov, Yuri Pavlov, Valentina Kasimova	

Co-60 gamma irradiation effects on the crystallographic, morphological and electrical characteristics of Eu_2O_3 thin films	49
Ozan Yilmaz, Ercan Yilmaz	
Sensing characteristics of SnO_2 thin film gas sensor	50
Sinan Oztel, Senol Kaya, Zeynel Abidin Sezer, Erhan Budak, Ercan Yilmaz	
Irradiation effect on $\text{Er}_2\text{O}_3/\text{n-Si}$ structure under high gamma dose	51
Aysegül Kahraman, Berk Morkoc, Alex Mutale, Umutcan Gurer, Ercan Yilmaz	
Co-60 gamma radiation influences on the electrochemical, physical and electrical characteristics of rare-earth dysprosium Oxide (Dy_2O_3)	52
Umutcan Gurer, Ercan Yilmaz	
Possible usage of the temperature sensor structure as a dosimeter	53
Ramazan Lök, Hüseyin Karacali, Ercan Yilmaz	
Recycling of hazelnut shell: Synthesis of boron carbide by carbothermic reaction	54
Erhan Budak, Serdar Hizarci, Ercan Yilmaz	
CdZnTe solid-state detector characterization for its use as a spectro-dosimeter	55
Nikola Kržanović, Annette Röttger, Viacheslav Morosh, Maksym Luchkov, Stefan Neumaier	
GAGG:Ce scintillation fibers for high energy physics applications	56
Darius Dobrovolskas, Gintautas Tamulaitis, Eugenijus Gaubas, Mikhail Korjik	
Radiation destruction of TF-1 type glasses when irradiated with 21 MeV electrons	57
V. Kolokoltsev	
CdZnTe bulk crystal growth and surface processing technology at METU-CGL	58
Yasin Ergunt, Merve Pinar Kabukcuoglu, Ozden Basar Balbasi, Bengisu Yasar, Yunus Eren Kalay, Mehmet Parlak, Rasit Turan	
Optical characteristics of $\text{La}_3\text{Ga}_{5,5}\text{Ta}_{0,5}\text{O}_{14}$ and $\text{Ca}_3\text{TaGa}_3\text{Si}_2\text{O}_{14}$ crystals under electron and proton irradiation	59
Evgeniia Zabelina, Nina Kozlova, Oleg Buzanov, Anna Kozlova, Petr Lagov, Yuri Pavlov, Valeriy Stolbunov	
Methods for managing textural properties of nanopowders to create a drug delivery system based on SiO_2, $\text{SiO}_2\text{-MnO}_2$	60
Olga Zlygosteva, Sergey Sokovnin, Vladislav Ilves	
Production and characterization of $\text{Al}_2\text{O}_3\text{+Ag}$ composite nanopowders	61
Sergey Sokovnin, Maria Kiseleva, Michael Balezin	
The effect of Co-60 gamma irradiation on coal fly-ash geopolymer set times	62
Luka Rubinjoni, Srboljub Stanković, Katarina Karadžić, Boris Lončar	

Unique approaches to the optimization of liquid crystal material orientation _____	63
Andrei Toikka, Natalia Kamanina	
The use of Mössbauer spectroscopy for the analysis of products formed by the reaction of reactive dyes on wood's surface _____	64
Roberta Dagher, Tatjana Stevanovic, Véronic Landry	
Application of 2D NMR spectroscopy for structural elucidation of complex polysaccharide from sugar maple bark _____	65
Pierre Betu Kasangana, Tatjana Stevanovic	
Radiobiological research and dosimetry using a flat alpha source _____	66
Zygmunt Szefliński, Mateusz Filipek, Jakub Gotlib, Urszula Kaźmierczak	
The development of high temperature and mass-separation methods for selective production of medical radionuclides _____	67
Vladimir Panteleev, Anatoly Barzakh, Leonid Batist, Dmitry Fedorov, Victor Ivanov, Pavel Molkanov, Stanislav Orlov, Maxim Seliverstov, Yury Volkov	
Study of proton and photon-induced reactions on nat-Mo _____	68
Arshiya Anees Ahmed, Aleksandra Wronska, Andrzej Magiera, Mirosław Bartyzel, Magdalena Jaglarz, Arkadiusz Kisiel, Jerzy W. Mietelski, Ryszard Misiak, Adriana Wawrzyniak, Bogdan Was	
Pre-clinical analysis of boron neutron capture therapy of cancer _____	69
Alphiya Tsygankova, Evgenii Zavjalov, Kanygin Vladimir, Kasatova Anna, Kichigin Aleksandr, Guselnikova Tatiana, Roman Sibirtsev, Nikita Filin, Rinat Mukhamadiyarov	
Comparison of computational and experimental dose rates in neutron activation analysis facilities ____	70
Jose Parga, Sheldon Landsberger	
Characterisation of radioactive particles in coal ash via electron microscopy and synchrotron-based techniques _____	71
Ilemona Okeme	
Clinical significance of accreditation standards in laboratory for radioactivity application and diagnostics _____	72
Dragana Pap	
Personalized dose assessment for a patient with incompletely blocked thyroid in iodine misadministration accident _____	73
Tae-Eun Kwon, Wi-Ho Ha, MinSeok Park, Jin-Kyu Kang, Minsu Cho, Seongjae Jang, Kyeong Min Kim, Young Woo Jin	
Investigation of integral dose in pelvic region using different planning treatment techniques _____	74
Kemal Firat Oguz, Yonca Yahsi Celen, Berna Erdurmus Tirpanci, Mehmet Yuksel, Mustafa Topaksu, Oznur Eroglu Ermis	
Physical and technical aspects of intraoperative electron radiation therapy: Future perspectives ____	75
Anna Wysocka-Rabin	

Measurements of the radiation attenuation in bolus materials with silicone based rubber for applications in radiotherapy	76
Bogdan Ile, Marius Spunei, Serban Negru, Iosif Malaescu, Catalin Marin	
Dose in the HDR brachytherapy for gynecological cancer with the use of thermoluminescence dosimetry	77
Monika Paluch-Ferszt, Beata Kozłowska, Marcin Dybek	
Using the luminescent dyes for the assessment of liposome transport properties as the boron carrier for boron neutron capture therapy	78
Rinat Mukhamadiyarov, Vladimir Kanygin, Alfia Tsygankova	
Influence of the distance between implanted sources on the local control probability	79
Evgeniia Sukhikh, Andrey Vertinskiy, Leonid Sukhikh, Alexandr Taletsy, Mariya Tatarchenko	
Implementation of the EPID-based in vivo dosimetry system for the patient plan quality assurance	80
Andrey Vertinskiy, Evgeniia Sukhikh, Leonid Sukhikh, Yana Sutygina	
Designing the medical set-up of the proton beam of the Institute for Nuclear Research	81
Ivan Yakovlev, Sergei Akulinichev, Yuri Gavrilov	
Radiation-induced skin pigmentation after accelerated partial breast irradiation: Dose volume histogram analysis	82
Alena Demianovich, Dmitriy Sanin, Natalia Borysheva, Valeriya Martynova, Sergey Ivanov, Andrey Kaprin	
Preliminary evaluation of ArcCHECK® detector's usefulness for treatment plan verification in brachytherapy	83
Wojciech Bulski, Krzysztof Chełmiński, Adam Cichoński, Anna Wysocka-Rabin	
Applying MTF, NPS and DQE calculations to assess the exposure conditions in digital mammography studies	84
Ewa Fabiszewska, Anna Wysocka-Rabin, Katarzyna Pasicz, Michał Jarosz, Witold Skrzyński, Iwona Grabska	
A novel method to improve learning efficiency of artificial neural network algorithm to estimate dose distribution for radiation treatment	85
Yong Nam Kim, Hyeong-min Joo, Ik Jae Lee	
Advisability of eye lens dosimetry in nuclear medicine	86
Malgorzata Wrzesien, Leszek Krolicki, Lukasz Albiniak, Jerzy Olszewski	
Radiological risk assessment of phosphate mining in El-Sebaiya locality, Aswan zone, Egypt	87
E. H. Ghanim, A. Salman, S. Harb	
Lung cancer incidence and cancer risk from radioactivity – some data for the capital of Montenegro	88
Danko Zivkovic, Nevenka Antovic	
Uncertainties in internal dose assessment for intake of tritiated water	89
Tae-Eun Kwon, Wi-Ho Ha, Young Woo Jin	

A novel class of small molecular inhibitors with radioprotective properties _____	90
Jan Marek, Ales Tichy, Radim Havelek, Alzbeta Filipova, Lenka Andrejsova, Tomas Kucera, Lukas Prchal, Lubica Muckova, Martina Rezacova, Zuzana Sinkorova, Jaroslav Pejchal	
Nuclear state liability for damage resulting from nuclear activities _____	91
Lilian Madi, Gian-Maria Sordi, Edmir Araújo	
Preventive treatment of drying chamber with UV radiation and ozonization for protection against spoilage of raw smoked sausages _____	92
A.M. Abdullaeva, L.P. Blinkova, I.G. Seryogin, D.I. Udavliev, S. S. Shikhov, Yu. D. Pakhomov	
Application of the Monte Carlo method and the empirical approximate formulas by Taylor and Berger for the calculation of the Build-up factor in the fields of gamma and X radiation _____	93
Srboljub Stanković, Radovan Ilić, Predrag Marinković, Dragana Nikolić, Nikola Kržanović, Mirjana Radenković	
Efficiency of using the fluorescent method for the determination of conformational changes of bovine serum albumin in water quality assessment _____	94
Natallia Puzan, Ihar Cheshyk, Volha Shakhouskaya	
Changes of reproductive parameters of <i>D. melanogaster</i> females under the influence of Wi-Fi EMR router at different stages of development _____	95
Alena Tsukanava, Volha Shakhouskaya, Kseniya Fabusheva, Nataliya Veyalkina	
Evaluation of fertility of <i>D. melanogaster</i> individuals of the first-third generation contained in the conditions of constant influence of EMR of Wi-Fi router _____	96
Alena Tsukanava, Volha Shakhouskaya, Kseniya Fabusheva, Nataliya Veyalkina	
The influence of electromagnetic fields of anthropogenic origin on the molecule of bovine serum albumin _____	97
Natallia Puzan, Grigory Gorox, Ihar Cheshyk, Volha Shakhouskaya	
Radioprotective effect of Co(II) inosinate on the blood system cells of C57Bl/6 mice after single exposure to γ-radiation _____	98
Nataliya Veyalkina, Alena Kadukova, Alena Tsukanova, Kristina Shafarost, Asim Abdullayev, Elshan Shamilov	
Preliminary risk assessment study – Neurobiological effects in experimental long-time exposure to low GSM radiation _____	99
Soimita Suciu, Dana-Camelia Dabala, Adrian Florea, Alexandra Sevastre-Berghian, Emanoil Surducan, Vasile Surducan, Camelia Neamtu	
Assessment of radio-frequency radiation from selected mobile base stations in Zaria and Environs, Nigeria _____	100
Sadiya Umar, Nasiru Getso Nuradeen	

Blue light reducing software applications for mobile phone screens: Measurement of spectral characteristics and biological parameters _____	101
Spyridon Mitropoulos, Andrews Americanos, Stratos David, Ioannis Sianoudis, Katerina Skouroliakou	
Use of commercial and UV-induced phages for protection of chicken mince from contamination by microorganisms _____	102
A. M. Abdullaeva, L. P. Blinkova, Yu. D. Pakhomov	
Gamma and neutron irradiated animal archive: Evaluation of cancer incidence _____	103
Tatjana Paunesku, Alia Zander, Gayle Woloschak	
Radiation biology models arising from irradiated animal studies _____	104
Tatjana Paunesku, Gayle Woloschak	
Analysis of the capabilities of the programs Fiji, IPLab and DARFI in the study of DNA repair abilities in the cells of patients with a mosaic form of ataxia telangiectasia _____	105
Aleksandra Nozdracheva, Roman Ushakov, Nadezhda Pleskach, Mirya Kuranova	
Analysis of radiation effects of irradiated chicken eggs and meat with high-energy nanosecond electron beams _____	106
Ruslan Vazirov, Sergey Sokovnin, Balezin Michael, Anna Krivonogova	
Estimation of minimal effective doses of γ-irradiation on rat peripheral blood reaction _____	107
O.S. Izmetieva, L.A. Dzikovskay, L.P. Zhavoronkov	
Radioprotective and anti-stress properties of the drug “Pronumol” _____	108
L.A. Dzikovskay, T.I. Ivanova, O.S. Izmetieva	
Oxidative stress in the brain tissues after blood circulation disorders and its compensation by LED radiation _____	109
Victor Monich, Natalja Tiunova, Svetlana Malinovskaja, Vladimir Borsikov	
Oligofractionated irradiation of the solid Ehrlich ascites carcinoma in mice with a pencil scanning beam of protons _____	110
Tatiana Belyakova, Vladimir Balakin, Svetlana Zaichkina, Olga Rozanova, Helena Smirnova, Alexander Shemyakov, Nataliia Strelnikova, Svetlana Sorokina	
Possibility of application of proton therapy complex “Protomeus” for radiobiological investigation on animals _____	111
Tatiana Belyakova, Vladimir Balakin, Alexander Shemyakov, Svetlana Zaichkina, Olga Rozanova, Helena Smirnova	
Tumor stem cells _____	112
Svetlana Vasilievna Chulkova	
Results for immunomagnetic cell separation based on different protocols and magnetic force _____	113
Vladimir Jurišić, Miloš Kostić, Jovana Todosijević, Tanja Džopalić	

Possibilities of MR DTI for the planning of neuro-saving operations in local prostate cancer _____	114
Vladimir Kuplevatskiy, Darya Kuplevatskay	
Case Report: Synchronous breast and cervical cancer togetherness _____	115
Özlem Mermut, Esra Arslan	
Age increase and weight reduction effects on bone mineral density and content _____	116
Slavica Shubeska Stratrova, Dejan Spasovski	
Remodelling of collagen fibers in the uninvolved human colon mucosa 10 cm and 20 cm away from the malignant tumor _____	117
Sanja Despotović, Novica Milićević, Živana Milićević, Aleksandar Krmpot, Mihailo Rabasović, Aleksandra Pavlović, Vladimir Živanović	
A new concept for skin rejuvenation and skin repair and acne management. Fluorescence via eosin, safran and blue light _____	118
Susanne Hausdorfer, Gabi Rosca	
Multiple metastatic basal cell carcinoma (MMBCC): Role and usefulness of 18FDG-PET and Tc 99m – MDP bone scan in locating metastatic foci: Case report _____	119
Esra Arslan	
18FDG PET-CT findings in a case with cervix adenocarcinoma _____	120
Esra Arslan, Tamer Aksoy	
Accuracy of functional methods for detecting coronary artery disease with asymmetric dimethylarginine (adma), myocardial perfusion scintigraphy, or both as shifted test in detecting asymptomatic endothelial dysfunction in patients with systemic lupus erythematosus _____	121
Dejan Spasovski, Slavica Shubeska Stratrova	
Variation of oblique fissure of the right lung on sagittal Computed Tomography _____	122
Satoru Nakamura	
Analysis and change of vitamin status 25 (OH) D₃ in relation to the gender and age of patients from Kragujevac and the environment during the change of seasons _____	123
Marina Đokić Lišanin, Vladimir Jurišić, Uršula Golubović, Snežana Radivojević	
Does chronic low dose exposure to ionizing radiation and antineoplastic drugs of hospital workers lead to increased micronuclei frequency, oxidative stress and changes in complete blood count? _____	124
Jasminka Mrđanović, Slavica Šolajić, Branislava Srđenović Conić, Višnja Bogdanović, Dea Karaba Jakovljević, Vladimir Jurišić	
Cryosurgery method in the treatment of patients with skin cancer of the head _____	125
E. V. Kiva, I. N. Pustynskiy, S. V. Chulkova, A. V. Egorova	
Recurrent exposure of patients with chronic conditions in a small private medical center _____	126
Olga Irina Girjoaba	

Evaluation of cyto/genotoxic effects of X-rays in buccal mucosal cells in children subjected to sinus radiographs _____	127
Đurđica Milković, Mirta Milić, Marko Gerić, Marijana Nodilo, Mária Ranogajec-Komor, Goran Gajski	
Changes in the immune system after long-term radiation for cervical cancer treatment _____	128
Tatiana Mushkarina, Evgenija Kuzmina, Tatiana Konstantinova	
The long-term effect of therapeutic irradiation on the bone marrow cells after the treatment of Hodgkin's lymphoma _____	129
Evgenija Kuzmina, Tatiana Mushkarina, Tatiana Konstantinova, Tatiana Bogatyreva	
Peroxide scavenging enzymes and lipid peroxidation in children affected by celiac disease _____	130
Vesna Stojiljković, Ljubica Gavrilović, Snežana Pejić, Ana Todorović, Nataša Popović, Ivan Pavlović, Snežana B. Pajović	
Treadmill running changes gene expression of catecholamine biosynthetic enzymes only in the left adrenal medulla of adult rats _____	131
Ljubica Gavrilović, Sladjana Dronjak, Sanja Glišić, Vesna Stojiljković	
Interrelationship of prefrontal brain-derived neurotrophic factor and neuroendocrine system during chronic restraint stress _____	132
Nataša Popović, Vesna Stojiljković, Snežana Pejić, Ana Todorović, Ivan Pavlović, Snežana B. Pajović, Ljubica Gavrilović	
<i>In silico</i> screening for GSK-3β inhibitors as potential radioprotectors _____	133
Ljubica Gavrilović, Milan Senćanski, Draginja Radošević, Sanja Glišić	
ESR Investigation of X-ray Exposed Pharmaceuticals _____	134
Elif Tugce Sarcan, Asuman Tas, Mine Silindir-Gunay, Asuman Yekta Ozer, Seyda Colak, Baki Hekimoglu	
Comparison between two labeled EDTMP radiopharmaceuticals with ¹⁵³Sm and ¹⁷⁷Lu _____	135
Hesham M.H. Zakaly, Mostafa Mostafa, M. Zhukovsky	
Wild apple fruit extract as active substance in UV protection cream – Investigation of <i>in vivo</i> hypopigmentation efficacy _____	136
Dragana Stojiljković, Ivana Nešić, Vanja Tadić	
Skin photoprotection products with wild apple fruit extracts as source of bioactive polyphenols: A comparison of polar and non-polar solvents _____	137
Ivana Nešić, Dragana Stojiljković, Vanja Tadić	
Study of the regulatory effect of LED lighting of different spectral composition on the formation and growth of the lateral roots of <i>Arabidopsis thaliana</i> using an optimized method of plant cultivation _____	138
Tatiana Kudelina, Anna Krivobok, Tatiana Bibikova, Olga Molchan	

The effect of Co-60 gamma irradiation on coal fly-ash geopolymer set times

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Operations involving grout, mortar and concrete are commonly used in radioactive waste management. Materials based on Portland cement (OPC) have numerous applications, ranging from construction of facilities, radioactive shielding, production of different casings and containers, to waste conditioning procedures (solidification, cementation, grouting). These materials are well known and well standardized, and regulated both internationally and at the national level. OPC is readily available, cost effective and comes in formulations suited for the construction industry. In nuclear and radioactive waste management industries, some challenges with the use of OPC based materials have been recognized (including the durability of concrete under thermal stress, long term stability of OPC binders, and radiolysis of contained water), and have been addressed either by optimizing OPC material formulations, or by using alternative binders. One promising alternative binder is geopolymer, a type of alkali activated binder, solidified by cross linking aluminosilicates into an amorphous matrix. Geopolymer is formed by activation of fine powder with pozzolanic properties with an alkali solution of sodium silicate (water glass). During geopolymerization, water acts primarily as a solvent, unlike the reactions during the setting of OPC, where hydration plays a key role. Various base materials, ranging from metakaolin to byproducts such as fly-ash and blast furnace slag, can be used. Coal fly-ash is an inexpensive raw material with low CO₂ footprint (compared to OPC), with potential applications in radioactive waste conditioning. To our knowledge, the effect of ionizing radiation on geopolymer set time hasn't been explored. We have measured the initial and final set time for fly-ash geopolymer paste, based on the SRPS EN 196-3 standard, irradiated by gamma rays in a Co-60 reference field on position with air kerma rate of 3.42 mGy/s. The binder paste was prepared using fly-ash from TENT B power plant's electrostatic filters without further sieving, activated by water glass with module 1.5 and mixed with distilled water until satisfactory flow was obtained, and poured into sample and control molds. Initial and final set times for irradiated sample and non irradiated control were determined by Vicat apparatus. The irradiated sample demonstrated 11% shorter initial set time, and 16% shorter final set time, compared to control. These set times allow satisfactory working times for geopolymer grouts and mortars. The effect of ionizing radiation on set times and other properties of coal fly-ash based materials must be accounted for in all stages of application, from small scale testing and simulations, to full scale tests and production environments.