ACADEMY OF SCIENCES AND ARTS
OF THE REPUBLIC OF SRPSKA

ALMA MATER
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United Nations
Educational, Scientific and
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State Commission of
Bosnia and Herzegovina
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XII МЕЂУНАРОДНИ НАУЧНИ СКУП

# САВРЕМЕНИ МАТЕРИЈАЛИ 2019

# ПРОГРАМ РАДА
# И
# КЊИГА АПСТРАКАТА

XII INTERNATIONAL SCIENTIFIC CONFERENCE

# CONTEMPORARY MATERIALS 2019

# PROGRAMME
# AND
# THE BOOK OF ABSTRACTS

Бања Лука, 1 – 3. септембар 2019. године
Banja Luka, September 1st to 3rd, 2019

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*Academy of Sciences and Arts of the Republic of Srpska*

COORGANIZER

*Alma Mater Europaea*

UNDER THE PATRONAGE OF

*Ministry for Scientific and Technological Development, Higher Education and Information Society*

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*Power Utility of the Republic of Srpska*
*University Clinical Center of Republic of Srpska*
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*TUESDAY, SEPTEMBER 3, 2019*
10.00 - 13.30, Small Hall 1st floor

*УТОРАК, 3. СЕПТЕМБАР 2019. ГОДИНЕ*
10.00 - 13.30, мала сала I. спрат

## ORAL PRESENTATIONS
### *THE ROUND TABLE "THE INFLUENCE OF RADON AND TORON TO THE HEALTH OF POPULATION"*

## УСМЕНЕ ПРЕЗЕНТАЦИЈЕ
### *ОКРУГЛИ СТО "УТИЦАЈ РАДОНА И ТОРОНА НА ЗДРАВЉЕ СТАНОВНИШТВА"*

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   *The Importance of Radon Research*

2. Perko Vukotić, Ranko Zekić, Tomislav Anđelić, Nikola Svrkota, Aleksandar Dlabac
   *Radon survey in the buildings of pre-university education in Montenegro*

3. Predrag Kolarž, Zdenka Stojanovska, Zoran Ćurguz, Zora Žunić
   *Diurnal and spatial variations of radon and its influence on ionization of the nearground atmospheric layer*

4. Zdenka Stojanovska, Zoran Ćurguz, Predrag Kolarž, Zora S. Zunić
   *The indoor radon and thoron concentrations in schools of Skopje (Republic of North Macedonia) and Banja Luka (Republic of Srpska) cities measured by raduet detectors*

5. Vanja Radolić, Marina Poje Sovilj, Denis Stanić, Igor Miklavčić
   *Radon concentrations in educational institutions (schools and kindergartens) in Republic of Croatia*

6. Feriz Adrović, Ema Hankić
   *Measurement of radon activity concentation in building materials used in Bosnia and Herzegovina*

7. Zoran Ćurguz, Zdenka Stojanovska, Rosaline Mishra, Balvindar K. Sapra, Ilja V.Yarmoshenko, Predrag Kolarž, Aco Janičijević, Zora S. Žunić
   *Long-term measurements of equilibrium equivalent radon and thoron progeny concentrations in Republic of Srpska dwellings*

8. Maida Kahvić Isović
   *Activities on the legal framework for the protection against the radon in Bosnia and Herzegovina*

9. Zoran Ćurguz, Dragoljub Mirjanić
   *The research of radon in the institutions of Republic of Srpska*

# DIURNAL AND SPATIAL VARIATIONS OF RADON AND ITS INFLUENCE ON IONIZATION OF THE NEARGROUND ATMOSPHERIC LAYER

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**Abstract**: The most abundant and efficient source of air ionization in the lower layer of the atmosphere is radon. As an alpha emitter, radon plays cruciant role in the earth atmospheric electricity. Besides physical, radon and ions have a significant biological role concerning human health: radon is health hazard while the ions are beneficial ingredient of the air we breathe. Measurements were made using continual radon monitor Rad-7 and air ion counter CDI-06. Diurnal and spatial variations of both atmospheric constitutens are mutually related and dependant mostly on radon exhalation potential, meterological parameters, aerosol concentration and formation of temperature inversion layer. Indoor concentrations are related to radon accumulation and partiallz influenced by external radon concentration.
**Key words**: radon, air ions, ionization, atmophere, air, natural radioactivity.

# THE INDOOR RADON AND THORON CONCENTRATIONS IN SCHOOLS OF SKOPJE (REPUBLIC OF NORTH MACEDONIA) AND BANJA LUKA (REPUBLIC OF SRPSKA) CITIES MEASURED BY RADUET DETECTORS

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**Abstract**: Radon ($^{222}$Rn) and thoron ($^{220}$Rn) are natural radioactive gases, generated in the terrestrial materials. They are the main sources of public exposure to ionising radiation in indoor environment worldwide. Differences in half-lives of

$^{222}$Rn ($T_{1/2}$=3.8 d) and $^{220}$Rn ($T_{1/2}$=55.6 s) lead to its different indoor behavior. Several studies of indoor $^{222}$Rn and $^{220}$Rn in Northern Macedonia have been performed, starting with measurements in dwellings in 2008 and continuing with measurements in schools during 2012. The surveys in the Republic of Srpska began later (in 2011) with the simultaneous $^{222}$Rn and $^{220}$Rn measurements in the dwellings and schools of Banja Luka cities. This paper, as a result of our cooperation, summarizes the results and general conclusions obtained from $^{222}$Rn and $^{220}$Rn measurements in schools of capitals. In both cities, the measurements were made using Raduet − nuclear tracer detectors; deployed at distances: >0.5m (Skopje) and 0.2m (Banja Luka); and exposed in a period: March 2012 - May 2012 (Skopje) and April 2011 -May, 2012 (Banja Luka). Results for $^{222}$Rn and $^{220}$Rn concentrations in both cities have a log-normal distribution. The $^{222}$Rn geometric mean value of 71 Bq/m$^3$ in Skopje are higher than in Banja Luka city (GM = 50 Bq/m$^3$). Among other factors that affect $^{222}$Rn variations, this difference could be related to the different exposure time of detectors. Furthermore, the dispersion of the $^{222}$Rn results in each city expressed through geometric standard deviation is relatively low: GSD = 2.13 (Skopje) and GSD = 2.11 (Banja Luka) indicating relatively homogeneous data sets. The $^{220}$Rn concentrations in Banja Luka (GM = 51 Bq/m$^3$) were higher than in Skopje (GM = 11 Bq/m$^3$). It is obvious that in the case of $^{220}$Rn, the exposure period did not play a significant role. One of the reasons for this difference could be the position of the detectors as well as the different building materials in the schools. On contrary, the dispersion of the $^{220}$Rn results in Skopje (GSD = 3.38) was greater than in Banja Luka (GSD = 2.07).

**Key words**: radon, thoron, gas, school.

## RADON CONCENTRATIONS IN EDUCATIONAL INSTITUTIONS (SCHOOLS AND KINDERGARTENS) IN REPUBLIC OF CROATIA

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Radon concentrations in educational institutions (schools and kindergartens)are systematically measured by track etched detectors from 2012 and it is still ongoing. Detectors are exposed for a year in every playroom in kindergartens and selected classrooms and offices (such as: libraries, teaching staff offices, administrative offices etc.) evenly distributed across areas and floors in schools. In total, around 6000 radon detectors in 874schools and 341 kindergartens were exposed. The obtained average radon concentrations were higher than the reference value

segment of global protection for the protection of the population from ionizing radiation. This paper presents the first results of a study of the radon activity concentration in building materials used in Bosnia and Herzegovina. Measurements were made using a professional Alpha GUARD system. The mean values of the activity concentration of the exhaled radon of exploratory building materials varied from 10 Bq/m$^3$ to 101 Bq/m$^3$.

**Key words**: Building materials, Radon activity concentration, Radon exhalation rate.

## LONG-TERM MEASUREMENTS OF EQUILIBRIUM EQUIVALENT RADON AND THORON PROGENY CONCENTRATIONS IN REPUBLIC OF SRPSKA DWELLINGS

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**Abstract**: The long-term measurements of radon and thoron equilibrium equivalent concentrations (EERC and EETC) were carried out the first time in Republika Srpska in 25 schools of its capital Banja Luka and in its wider surroundings. After this successful survey the measurements continued using the same type of the LR115 nuclear track detectors, i.e., Direct Radon Progeny Sensors/Direct Thoron Progeny Sensors (DRPS/DTPS), which were deployed in the 36 dwellings nearby the investigated schools. The aim of this study was to give possible scientific contribution considering an explanation of EERC and EETC behavior in indoor environment. The detectors were exposed for one year period at 15–20 cm distance from the walls. The EERC and EETC were found to vary in the range from 6.3 to 14.4 Bqm$^{-3}$ and from 0.10 to 1.1 Bqm$^{-3}$, with geometric mean 9.3 and 0.36, respectively. The same variance of EER and EET concentrations, measured in living and bedrooms of buildings built with different construction