

OPINION

Prepared by Prof. Dimcho Solakov, Corresponding Member of BAS

Concerning: Competition for the academic position of "Associate Professor" in the professional field 4.4. Earth Sciences, Department of Seismology and Earthquake Engineering, published in the State Gazette no. 86 of 15.10.2021.

The opinion is prepared on the basis of order № 01-263 of 12.11.2021 and in accordance with the requirements of Section 4 of the Regulations for implementation in NIGGG-BAS of the Development of Academic Staff in the Republic of Bulgaria Act.

Candidate for the academic position "Associate Professor" Plamena Raykova-Tsankova, PhD - Chief Assistant in the Department of Seismology and Earthquake Engineering at NIGGG-BAS.

Education and professional qualification

Since 2009 Plamena Raykova-Tsankova (then physics student at Sofia University "St. Kliment Ohridski") has been working as a geophysicist at the National Institute of Geophysics, Geodesy and Geography (NIGGG) -BAS. In 2011 she received a bachelor's degree in astrophysics, meteorology, and geophysics. In April 2013 she received a master's degree in geophysics at the Faculty of Physics of Sofia University "St. Kliment Ohridski". In the same year she was appointed as a seismologist at NIGGG - BAS. In August 2013 began her PhD studies in: "Seismology and internal structure of the earth. In May 2017 she acquired PhD degree after defending a dissertation on the topic: Characteristics of for-aftershock and swarm type seismicity on the territory of Bulgaria and the surrounding area.

Implementation of the requirements for holding the academic position of "Associate Professor"

From the submitted report for fulfillment of the minimum requirements for holding the academic position "Associate Professor", defined in the regulations on the terms and conditions for obtaining degrees and for holding academic positions in BAS, respectively the requirements of Article 1A, subparagraph 2, it is established that Assistant Professor Plamena Raykova – Tsankova, PhD has 476 points of publications, citations, and projects

Criteria for professional **field 4.4. Earth sciences** are performed as follows:

From indicator A – 50 points. from dissertation on the topic: Characteristics of for-aftershock and swarm type seismicity on the territory of Bulgaria and the surrounding area;

From group of indicators B - 115 points, from 10 scientific publications that are referenced and indexed in world-famous databases of scientific information - Scopus, Web of Science, ERIH +;

From group of indicators D - 221 points from 31 scientific publications, including: publications that are referenced and indexed in world-famous databases; scientific monographs, publications in unreferred journals with scientific review or in edited collective volumes;

From group of indicators E - 60 points, from 15 citations:

- 9 citations in referenced and indexed in world-famous databases;
- 3 citations in monographs and collective volumes with scientific review;
- 3 citations in unrefereed journals with scientific review;

From a group of indicators E - 30 points, from participation in international and national scientific and educational projects.

It should be noted that Plamena Raykova-Tsankova very accurately and correctly calculated the points associated with each group of indicators.

Content and issues of publications

Contributions to the publications submitted in the competition can be grouped in the following main thematic areas presented below (the following numbers of publications correspond to the numbers in the attached list of publications in the competition).

1. Research and analysis of seismicity and seismogenic processes in seismo active zones on the territory of Bulgaria and its adjacent lands.

Plamena Raykova-Tsankova actively participates in the monitoring activities of NOTSSI. She also participates in research on the space-temporal variations of regional seismicity and seismic regime, based on information from NOTSSI. The results are published in most of the publications presented in the competition (1, 2, 9, 10, 21, 22). Areas with high to moderate seismic activity have been identified, as well as the trend of a changing seismic picture of low seismicity over time (publications 5 and 29). Additionally, strong historical earthquakes have been analyzed (publication 36) and a spatial correlation between low to moderate seismic activity and strong historical earthquakes has been demonstrated (publications 11 and 14).

The results of the 40-year monitoring activity of NOTSSI were used to create a catalog of earthquakes (with a magnitude of $M_w \geq 3.2$), realized in Bulgaria and the surrounding area for the period 1981-2019 (publications 28 and 31).

2. Assessment and analysis of the space - time distribution of clusters (foreshocks, aftershocks, swarms) on the territory of Bulgaria and its surroundings.

Plamena Raykova-Tsankova analyzes and estimates the space and temporal distribution of seismic clusters realized on the territory of Bulgaria and the surrounding area. Such groups (or clusters) of earthquakes are aftershock, foreshocks, and swarm seismicity.

From the three seismic clusters, aftershocks are the most accessible to observe and it is assumed that their realization is an expression of the viscoelastic relaxation of stresses in the area. Aftershock sequences are a source of information about the physical and mechanical properties of the environment in the zone and the processes taking place in it (publications 3, 6, 8). The parameters characterizing the spatial, temporal and energy distributions of aftershock events are an essential part of the seismogenic process (publications 24, 33, 38, 39).

If the foreshock events can be identified before the stronger main event, then this cluster would become a useful tool for earthquake prediction (publications 24, 39).

The swarm type of seismicity is an earthquake cluster of events with approximately equal magnitude, grouped in space and time. Swarm activity usually begins and decreases very abruptly over time (publication 17).

3. Spectral characteristics of different types of seismic sequences for the territory of Bulgaria.

For the study of the spectral characteristics of different types of clusters (foreshocks, aftershocks and swarms), realized in Bulgaria and its surroundings, a methodology has been developed that follows the Brune model. Spectral analysis of seismic waves is a major source of information about the epicenter and the environment of propagation. The spectrum of seismic waves can be used to estimate parameters of the seismic source, such as: seismic moment M_0 , stress drop $\Delta\sigma$, source radius and seismic moment magnitude (publications 19, 23, 33, 34, 35).

4. Seismic hazard assessment.

The first step in reducing seismic risk is to determine the seismic hazard at the regional and local level. The next step is to generate earthquake scenarios, including an assessment of the impact of different earthquakes on the elements of the social - economic system. Publication 27 presents an assessment of the seismic hazard for the territory of Bulgaria. Based on complex geological-geophysical and seismological information, a model of seismic sources (via GIS) with an impact on the seismic hazard on the territory of the country has been created. Maps of seismic hazard at maximum acceleration (g) for different return periods (95, 475 and 1000 years) have been generated.

For the cities of Ruse, Blagoevgrad, Plovdiv and Veliko Tarnovo earthquake scenarios have been developed in macroseismic intensity, maximum and spectral accelerations, and velocity (works 30, 32, 40, 41). The seismic scenarios are compared with the observed seismic impacts for the respective cities. The obtained results show that the seismic scenarios are reliable and can be applied both in urban and emergency plans and for seismic risk assessment. The use of such scenarios in combination with modern seismic engineering methods can greatly reduce the damage and casualties of future earthquakes.

Scientific - applied activity

Over the years, Assistant Professor Plamena Raykova-Tsankova completes active scientific and applied activities. She participates in 17 scientific and educational projects.

Numerous successive projects have been implemented to monitor regional and subregional seismicity around the Kozloduy NPP site. Seismicity in the region is studied and expert assessments are provided.

Plamena Raykova-Tsankova participates in projects related to registration, analysis, processing and interpretation of data from the Local Seismological Network (LSM) in the region of the town of Provadia.

She is an active participant in projects for analysis and assessment of seismic hazard, related to the design and seismic safety of high-risk facilities (Aurubis Bulgaria "Ada Tepe", "Lyulyakovitsa" tailings).

The applicant also participates in several projects, national and international, related to seismic risk reduction, environmental protection. Such as:

NATIONAL SCIENTIFIC PROGRAM Environmental protection and reduction of the risk of adverse events and natural disasters, package RP.I.10. Assessment of the dangers of catastrophic earthquakes and their consequences;

METHODOLOGY for analysis, assessment and mapping of the seismic risk of the Republic of Bulgaria;

SEISMIC RISK MANAGEMENT FOR BUILDINGS;

BLACK SEA SEISMIC NETWORK (Black Sea Earthquake Safety Net (work) -ESNET), Joint Operational Program of the Black Sea Basin 2007-2013

The candidate has participated in 21 conferences, scientific forums, and events, where she presented his results and analyzes.

In 2017, Assistant Professor Plamena Raykova-Tsankova won the award of the Bulgarian Academy of Sciences "Academician Ivan Evstratiev Geshov", which is awarded to young scientists up to 30 years for achievements in the field of climate change, risks and natural resources.

In 2018, Plamena Raykova-Tsankova won a one-year scholarship from the World Federation of Scientists for a project related to spectral characteristics for moderate earthquakes and clusters.

Conclusion

From the above facts, I give a positive assessment of the materials presented by Assistant Professor Plamena Raykova-Tsankova, PhD. I think that she is established specialist with proven qualities to occupy the academic position of "Associate Professor" in the professional field 4.4. Earth Sciences, Department of Seismology and Seismic Engineering. Its scientific and scientific-applied realization meet the requirements of the Development of Academic Staff in the Republic of Bulgaria Act (DASRBA), and the Ordinance of the Ministry of Education and Science for its application, as well as the Regulations for application of DASRBA in NIGGG-BAS.

Sofia
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