REVIEW

From: **Assoc. Prof. Dr. Irena Alexandrova**

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

The review was prepared on the basis of order № 01-263 from 12.11.2021 and according to a decision of the Scientific Council of NIGGG-BAS (Minutes № 42 / 12.11.2021), and in accordance with the requirements in Section 4 of the Regulations for application in NIGGG-BAS of the Law for the development of the academic staff in the Republic of Bulgaria.

Candidate for the academic position "Associate Professor": Dr. Plamena Raykova-Tsankova Chief Assistant in the Department of Seismology and Seismic Engineering at NIGGG - Bulgarian Academy of Sciences.

Short biographical data and characteristics of the candidate's scientific interests

Since 2009 Plamena Raykova-Tsankova (then a 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 he received a master's degree in geophysics from the Faculty of Physics of Sofia University "St. Kliment Ohridski "with the topic of the thesis:" Aftershock activity after the earthquake of May 22, 2012. ". In the same year she was appointed seismologist at NIGGGG - BAS and enrolled in full-time doctoral studies in the professional field 4.4. Earth Sciences with a supervisor Cor. dfn. Dimcho Solakov and scientific consultant Assoc. Prof. Dr. Stella Simeonova. In May 2017 he acquired ONS "Doctor" after defending a dissertation on "Characteristics of after-shock and swarm type activity for the territory of Bulgaria and the surrounding area." In the same year she received an award for young scientist - "Academician Ivan Evstratiev Geshov" for the youngest scientists under 30. In 2018, Plamena Raykova-Tsankova won a one-year scholarship from the World Federation of Scientists with a project related to the use of geophysical data for creating a seismotectonic model, a major component in the assessment of seismic hazard

Requirements for holding the academic position of "Associate Professor"

From the reference made for the 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, paragraph 2 is established, that ch. Assistant Dr. Plamena Raykova - Tsankova has a total of 476 items from publications, citations and contracts

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

Indicator A: 50 points - Dissertation for the award of educational and scientific degree "Doctor" in professional field 4.4. Earth Sciences, specialty "Seismology and Internal Structure of the Earth" on the topic: Characteristics of for-shock and swarm type activity for the territory of Bulgaria and the surrounding area;

Indicator B: 115 points, out of 10 scientific publications in publications that are referenced and indexed in world-famous databases with scientific information - Scopus, Web of Science, ERIH +;

Indicator C: 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;

Indicator D: 60 points, from 15 citations in scientific journals:

9 citations in referenced and indexed in world-famous databases;

3 citations in monographs and collective volumes with scientific review;

3 citations in unreferred journals with scientific review;

Indicator E: 30 points, from participation in international and national scientific and educational projects.

Content and issues of publications

The contributions in the publications presented at the competition can be grouped in the main thematic areas presented below. (The publication numbers below correspond to the numbers in the attached list of competition publications.)

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

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

Participates in the creation of a catalog of earthquakes (with a magnitude of MW≥3.2), realized on the territory of Bulgaria and adjacent lands for the period 1981-2019 (publications 28 and 31) and is supplemented by earthquakes that occurred in 2020 (publication 28).

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

The spatial - temporal distribution of seismic clusters realized on the territory of Bulgaria and the surrounding area is analyzed and assessed. Such groups (or clusters) of earthquakes are aftershock series and swarm seismicity.

Of the three seismic clusters, aftershock events are the most accessible to observe and it is assumed that their realization is an expression of the viscoelastic relaxation of stresses in the medium. The aftershock series are a source of information about the physical and mechanical properties of the environment in the foci zone and about 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 preceding the stronger main event can be identified, then this cluster would become a useful tool for earthquake prediction (publications 24, 39).

A seismic swarm is an earthquake cluster of events of approximately equal magnitude, grouped in space and time. Swarm activity usually begins and subsides very abruptly over time (publication 17).

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

A methodology for studying the spectral characteristics of different types of clusters (foreshocks, aftershocks and swarms) implemented in Bulgaria and the surrounding area has been developed, which 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 M0, shear stress $\Delta\sigma$, radius of the source and seismic moment magnitude (publications 19, 23, 33, 34, 35).

4. Seismic hazard assessment.

An objective assessment of the expected impacts is needed for a balanced solution of the socio-economic problems related to earthquakes, the most important of which is anti-seismic construction.

The first step in reducing seismic risk is to determine the seismic hazard at the regional and local level.

The next step is - earthquake scenarios, including an assessment of the impact of different earthquakes on the elements of the socio-economic system.

Development 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 (in a GIS environment) 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 recurrence 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 speed. The results are published in papers 30, 32, 40, 41. The forecast scenarios are compared with the observed seismic impacts for the respective cities. The obtained results show that the forecast 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 and applied activity

Chief Assistant, Dr. Plamena Raykova-Tsankova has actively participated in 17 projects:

- Projects for monitoring regional and subregional seismicity around the Kozloduy NPP site.
- Projects related to registration, analysis, processing and interpretation of data from the Local Seismological Network (LSM) in the area of the town of Provadia.
- Projects for analysis and assessment of seismic hazard, related to design and seismic security of high-risk facilities (Aurubis Bulgaria "Ada Tepe", "Lyulyakovitsa" tailings).
- 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 Earthquake Safety Net (work-ESNET), the Joint Operational Program of the Black Sea Basin 2007-2013

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

Personal impressions and opinion of the reviewer

I have known Plamena Raykova since 2009, when during her studies at Sofia University "St. Kliment Ohridski ", Faculty of Physics, started working in the Department of Seismology at NIGGG. I have excellent impressions of her successful development as a researcher. Her entire scientific activity presents her as a productive researcher, performing with the necessary competence research and their applications in the field of seismology. That is why I am convinced of the future positive development of Plamena Raykova-Tsankova at NIGGG-BAS.

Conclusion

My overall assessment of the presented scientific achievements is high. Sufficient scientific, scientific-applied and applied contributions have been received, meeting the requirements of

the Law for the Development of the Academic Staff in the Republic of Bulgaria. Based on this, I find it reasonable to propose Plamena Raykova-Tsankova to take the academic position of "Associate Professor" in the professional field 4.4. Earth Sciences, "in the Department of Seismology and Seismic Engineering.

Sofia

20.01.2022

Reviewer:

/ Assoc. Prof. I. Alexandrova PhD /