REVIEW REPORT

on the competition for academic position "Associate professor"

Professional field: 4.1 Physics Sciences (Experimental nuclear physics)

Faculty of Physics, Sofia University “St. Kliment Ohridski”

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The review report was prepared by Prof. Kiril Assenov Krezhov, Institute for Nuclear Research and Nuclear Energy (INRNE) - BAS, in his capacity as a member of the Scientific Jury in accordance with Order № РД 38-38 / 20.01.2022 of the Rector of Sofia University.

A single candidate Chief Assistant Dr Strahil Boychev Georgiev, Faculty of Physics, SU “St. Kliment Ohridski” has submitted documents to occupy the announced academic position.

I. General description of the submitted materials

1. Applications details

The documents submitted by the candidate for the call comply with the Bulgarian national requirements and rules for acquiring scientific degrees Development of Academic Staff in the Republic of Bulgaria Act (DASRBA) and in the Regulations for its implementation (RIDASRBA), the Regulations on the terms and conditions for acquiring scientific degrees and holding academic positions at Sofia University "St. Kliment Ohridski ”(PURPNSZADSU) and the document “Additional Requirements for Candidates for Academic Positions at the Faculty of Physics of Sofia University”.

For participation in the competition the Chief Assistant Strahil Georgiev presents a list and copies of a total of 30 titles, incl. 28. publications in foreign and Bulgarian scientific journals, 2 publications in materials of scientific forums, and gives data on the number of independent citations of the presented publications in the Scopus database, as well as information on impact factor/rank (IF / SJR) of these works.

The competition documents give a good idea of the candidate's activities. A CV, diplomas for bachelor's, master's and doctoral degrees, list and copies of publications, references to citations, author's reference to the contributions, etc. are included. Certificates from the employer and copies of pages from the employment record are presented proving that the nearly 17 years of work of the candidate as of the date of submission of documents for the competition took place in the Faculty of Physics of Sofia University as “Physicist” and “Chief Assistant”. Attached is an official reference and copies of the individual reports on the employment of Chief Assistant Strahil Georgiev, official note for successful scientific management of 3 defended diploma theses - 2 for Master (2019-1,

2020-1) and 1 for Bachelor (2013), information is given (Acronym and contract No) for his participation in 10 national and international research projects, some of which are co-financed by the Bulgarian Fund “Scientific Research”.

2. Details of the candidate

The candidate Strahil Georgiev was born in 1980 in the town of Pleven. He received his high school diploma from the ‘’Geo Milev’’ Mathematical high school in his hometown. From 1999 to 2005 he was enrolled in the bachelor's and master's degree programmes at the Faculty of Physics of Sofia University. In 2005 he obtained a Master's degree in Physics, majoring in Medical Physics, with the defence of a thesis on "Measurement of ^{222}Rn in homes and soil gas in the area affected by the uranium mining industry" with supervisor Prof. Dobromir Presyanov, then Assoc. Prof. Dr. Since January 2007 he has been enrolled in a regular doctoral programme at the Department of Atomic Physics of the Faculty of Physics of Sofia University, and in 2010 he was discharged with the right to defence. In 2012 he acquired the educational and scientific degree “Doctor” in the professional field 4.1. Physical Sciences after successively defending a dissertation entitled "Nuclear Physical Methods for the Study of the Migration of Radioactive Noble Gases" with supervisor Prof. D. Presyanov and scientific consultant Assoc. Prof. Krassimir Mitev.

The candidate worked at the Faculty of Physics of Sofia University as a physicist in the period December 2004 - June 2013. He holds the position of Chief Assistant from 06.03.2013 until now, conducts seminars and practical exercises, participates in the maintenance of equipment at the Laboratory "Experimental Nuclear Physics", and has a lecture activity.

3. General characteristics of the scientific works and achievements of the candidate

Chief Assistant S. Georgiev has attached a list of 75 titles of scientific papers in which he is a co-author and gives data on 85 independent citations and Hirsch's index h = 5. In general, topical problems in the field of radiation dosimetry and radioecology have been worked out in connection with the measurement and assessment of radioactivity in the environment. This type of research is traditional for the group "Radiation Dosimetry and Radiation" at the Department of Atomic Physics and for their deepening and successful development the candidate has contributed with his investigations, for which he obtained the educational and scientific degree "Doctor" and held the academic position of "Chief Assistant".

The first 47 titles include Chapter 4 (Retrospective radon measurements: techniques and perspectives) in a book (Handbook on Radon, Nova science Publishers), 35 articles published in international journals with impact factor Rad. Meas. (8), Appl. Rad. Isot. (6), Nucl. Instrum. & Meth. (5), IEEE.Trans. Nucl. Sci. (4), Rad. Prot. Dos. (4), J Env. Radioact. (4), J. Radioanal. Chem. (1), J. Radioanal. Nucl. Chem. (1), Intern. J. Environ. Res. Public Health (1), as well as 11 articles published in refereed series with impact rank AIP Conf. Proc. (1) and IEEE - Nucl. Sci. Symp. (10).

Another 28 titles are reports at national and international conferences, including the Third East-European Radon Symposium (TEERAS 2017, Sofia), IEEE-Nucl. Sci. Symp. Record (Oslo-2008, San Diego-2015, Atlanta-2017, Sydney-2018), the traditional national symposiums "Metrology and Metrological Assurance" and others.

For participation in the competition, Chief Assistant Georgiev presents a reduced list of 30 scientific papers, reflecting important stages in the development and application of methods for measuring the activity of radioactive noble gases (RBG). The developed methods have been applied to study the migration of the natural radioisotopes radon (^{222}Rn) and thoron (^{220}Rn), as well as the technogenic ^{85}Kr and ^{133}Xe, whose appearance in the environment is related to the operation of nuclear power plants and some chemical/pharmaceutical industries. The publications are co-authored with 4-7 co-authors, among whom are Prof. D. Presyanov and Assoc. Prof. K. Mitev, and in 7 articles there are foreign co-authors.

Of the presented list of these 30 scientific papers, the first **7** ([1] - [7]) have been published in Nucl. Instrum. & Meth. in Phys.Res. (3), Rad. Meas. (2), Rad. Prot. Meas. (1) and the Bulgarian BgNS Transactions (1) and contain results that have been included in the candidate's doctoral dissertation, and the next **4** [8] - [11]; IEEE - Nucl. Sci. Symp. (2), Nucl.Instrum. & Meth.A (1), Rad.Meas. (1)) have been used in support of the grounds for successfully taking the position of Chief Assistant. Some of the results in the dissertation are presented in other reports, which have been published in proceedings of international conferences but are not among the materials for this competition.

The mandatory table (reference summary) for the fulfilment of the minimum national requirements (DASRBA and RIDASRBA), and the requirements of Sofia University (PURPNSZADSU) and the Faculty of Physics has been prepared by the applicant in good faith on the basis of scientific papers [12] - [30] in full compliance with the requirements. The Table shows that with the 19 scientific publications ([12] - [30]) submitted for participation in the competition, not used in previous procedures, as well as on the basis of other documents, the candidate has or exceeds the required points in different sections/groups of indicators, so that he fully meets the requirements for the position of "Associate Professor" at the Faculty of Physics of Sofia University.

In my opinion, there is no reason to suspect plagiarism in these scientific papers, as they largely implement new ideas and concepts. They have been published in reputable peer-reviewed journals with a high impact factor, in which plagiarism testing is generally mandatory and performed with professional software tools.

4. Characteristics and evaluation of the teaching activity of the candidate

The individual reports of the candidate, registered in the Department of Educational Activities of SU regarding his participation in teaching activities after taking the position of Chief Assistant,

provide information on 3345.8 hours of classroom and 3618.4 hours of total employment during the winter and summer semester and conducting semester exams.

Regarding his teaching activities, the candidate in his CV notes lectures on "Experimental methods of nuclear physics in medicine" and conducting practical exercises on "Dosimetry and radiation protection", "Radioactivity in the environment and radioecology", "Experimental methods of nuclear physics in medicine ", " Metrology of Ionizing Radiation ", "Atomic and Nuclear Physics", "Geometric Optics", " Physics".

According to the presented official report on the academic employment of the candidate from the Department of Education of Sofia University, he had 2104 hours of classroom employment and a total academic employment of 2298 hours in the last 5 academic years.

Despite the incompleteness of the accompanying documentation regarding the educational activity, it is clear that the reported educational activity of Chief Assistant Strahil Georgiev significantly exceeds the minimum study load of 540 hours, specified as a criterion in the additional requirements of the Faculty of Physics for holding the position of "Associate Professor".

5. Characteristics and analysis of the candidate's scientific works and achievements

The research topics in the scientific works submitted by the candidate for participation in the announced competition are in the field of applied nuclear physics and are related to the development of methods for the detection of certain radioactive noble gases (222Rn, 220Rn, 85Kr and 133Xe) and determination of their distribution in the environment. A possible ultimate goal of these studies is to obtain reliable information for decision taking on current and important issues of public importance such as the radon problem for the population and occupational exposure of various categories of staff, as well as the emergence of high concentrations of technogenic isotopes 85Kr and 133Xe, which may be a sign of a nuclear test, an accident with nuclear fuel or a radiopharmaceutical.

The basis of the research conducted with the active participation of the candidate is the development of the proposed by Prof. D. Presyanov in 1999 original method for measuring radioactive noble gases by absorption in polycarbonate materials based on bisphenol-A, which are used for the production of CDs (CD/DVD). These materials have proven to be very suitable for radon detectors, because the relationship between the concentration of radon and the number of tracks of α-particles of 222Rn and its daughter products is strictly linear. In epidemiological studies, retrospective measurements are important and the CD / DVD method for determining the cumulative activity of radon and subsequently of thoron takes a worthy place among other passive methods with direct counting of scintillation tracks in emulsions and solid-state detectors.

With the active participation of the candidate were carried out: **a**) validation of the CD / DVD method and assessment of its accuracy and reproducibility against various environmental factors, **b**)

development of a new method for combined retrospective measurements of thoron (^{220}Rn) and radon (^{222}Rn) using polycarbonates, **c**) theoretical and experimental study of the possibilities for combining the polycarbonate method with liquid-scintillation technique, **d**) validation and evaluation of the sensitivity of the polycarbonate method for measuring technogenic RBG (^{133}Xe and ^{85}Kr) by investigating the processes of sorption and desorption and the coefficients of distribution of these gases in polycarbonate samples for air and water media, e) radon research with diffusion chambers and as a result of the experimental studies and numerical modeling of the processes the parameters of diffusion measuring chambers have been improved.

I accept and agree with the systematization of the scientific and applied contributions in publications [12-30] in four main areas as proposed by the candidate in his summary of contributions, as follows:

1. Elaboration, development and practical application of methods for measuring radon and thoron based on the formation of traces of alpha particles in CD/DVD [12,13, 16,18,23,25,28]

2. Elaboration, development and practical application of methods for measuring radon and other radioactive noble gases (RBG) based on absorption in polymers [14,15,17,19,20,26]

3. Investigation of the absorption properties of polymeric materials, including plastic scintillators, absorbing RBG. Development and elaboration of methods for determining the partition coefficient and diffusion length of RBG in polymers [21,22,24,27,29]

4. Development and validation of approaches to reduce the temperature shift in radon detectors with anti-thoron polymer membranes [30].

In my opinion, among the contributions of the candidate, for which he has indicated a leading or significant participation, the most distinctive are, as follows:

- for thoron measurements, it is proposed and achieved an improvement of the CD / DVD method, which in its initial version was influenced by the presence of radon as high radon concentrations limit both minimum and maximum measured concentrations. Analysis of the traces of alpha particles from the "back" (marked side) of the disk provides evidence of almost complete elimination of the effects of radon [18] and experimentally shows a multiple increase in the sensitivity of the method to thoron. This allows parallel measurements of radon and thoron, both at low concentrations (typical of most homes) and at high concentrations, typical of the so-called radon-prone areas;

- an approach is proposed [15] for producing fine polycarbonate sawdust (powder), which allows for increasing the area/volume ratio while preserving the absorption properties of the polycarbonate and leads to an increase in the amount of absorbed RBG by a factor of several times, speeding up the sampling and improving the sensitivity of the method;

- a significant temperature dependence of the diffusion length L_D and the partition coefficient K of radon-222 for several polymers, including plastic scintillators, has been established experimentally [29] and theoretically analysed, which is essential for the practical

application of polymers as absorbers for RBG as well as diffusion barriers. The analyses employ a theoretical model to describe the processes of absorption and desorption of RBG in polymers, developed by the candidate in his doctoral dissertation, and it is shown that L_D and K are sufficient to analytically describe the relationship between RBG concentration in the environment and RBG activity in the absorbent polymer. Several approaches for the determination of L_D and K in polymers are developed and these parameters are determined for several polymers with wide application in practice;

- three approaches based on the protection of polymer membrane detectors [30] are proposed, using the results for K and LD in [29] when choosing a membrane. A theoretical model describing the process of radon and thoron transport across the membrane into and out of the detector volume has been adapted. The model allows through selecting a suitable membrane to reduce (incl. eliminate) the thoron influence and to assess and report the temperature effect on the detector response. The transport of radon and thoron across the protective membrane has been studied using a PIPS detector-based detection system similar to the primary thoron standard at the Henri Becquerel National Laboratory (LNHB), CEA/Saclay, France. This detection system has proven to be very suitable for studying the permeability of such membranes.

The scientific and applied contributions of the candidate are in the field of elaborating and developing novel measuring methods and obtaining new experimental data. The publications contain technical details and all measurements are strictly documented. In essence, the research with the participation of the candidate marks a stage in the development of cumulative methods that measure the time-integrated volume activity of radionuclides used to measure RBG in buildings, water and soil gas. Significant progress has been made in improving the polycarbonate method for measuring RBG both in the development and validation of a theoretical model to describe the processes of their sorption and desorption in the polymer material, facilitating and guiding specific experiments and providing a basis for specialized development of software.

The analysis of the candidate's materials gives grounds to conclude that he has participated actively and at a high professional level in the design and development of specialized equipment and software for recording and processing experimental data. I believe that the candidate has made a significant contribution in each of the areas in which he has worked. The h-index determined by the candidate is 5, and all 19 scientific publications submitted for the competition are with IF / SJR: 5 with quartile Q1, 13 with Q2 and 1 with Q3.

6**. Critical remarks and recommendations**

I have no critical remarks on the presentation of the problems under consideration, the approaches to setting and solving the tasks and the results obtained. I also have no objections in principle to the reliability of the presented results and conclusions.

7. Personal impressions of the candidate

I don't have.

8. Conclusion on the application

After reviewing the materials and scientific works presented and on the basis of the analysis of their importance and the scientific and applied contributions contained therein, I confirm that the scientific achievements meet the requirements of DASRBA and RIDASRBA, the relevant Regulations of Sofia University "St. Kliment Ohridski" and the additional requirements of the Faculty of Physics for holding the academic position of Associate Professor in the professional field of the competition.

I think that the presented scientific works provide the necessary convincing arguments for scientific and applied contributions, and the candidate is a highly qualified specialist in dosimetry and radiometry in the field of metrology, able to formulate and solve current problems in the diagnosis of radon and other radioactive noble gases. There is convincing evidence that Chief Assistant Dr. Strahil Georgiev meets the requirements for the position of "Associate Professor" at the Faculty of Physics of Sofia University "St. Kliment Ohridski". In particular, the candidate satisfies the minimum national requirements in the professional field and no plagiarism has been established in the scientific papers submitted for the competition. I give my positive assessment of the candidacy.

II. OVERALL CONCLUSION

Based on the above, I recommend the Scientific Jury to propose to the Faculty Council of the Faculty of Physics of Sofia University "St. Kliment Ohridski" to elect Chief Assistant Dr. Strahil Boychev Georgiev for the academic position of "Associate Professor" in the professional field 4.1 Physical Sciences (Experimental nuclear physics).

April 18, 2022. Prepared by the reviewer:

Professor Doctor of Science Kiril Krezhov

(academic position, scientific degree, name, surname)