

REVIEW

**for occupying of academic position “Associate Professor” on competition
in professional direction 4.1 Physical Sciences,
for the needs of Sofia University „St. Kliment Ohridski (SU),
Faculty of Physics, published in State Gazette No. 54 of 29 June 2021**

The review is prepared by: **Assoc. Prof. Dr. Mitko Konstantinov Gaidarov, INRNE-BAS,**
as a member of the scientific jury on 4.1 Physical Sciences (General Physics)
on competition according to Order № RD 38-374 / 21 July 2021 of the Rector of Sofia University.

The **only candidate** who submitted documents for participation in the announced competition:
Chief Assistant Dr. Plamen Veskov Petkov, SU “St. Kliment Ohridski”

I. General Description of the Presented Materials

For each candidate an information is required on points 1-8:

1. Candidature Data

The presented by the candidate documents on the competition satisfy the requirements of the Law of Development of Academic Staff in Republic of Bulgaria, its application regulations and the Regulations of the same matter of SU “St. Kliment Ohridski”.

The candidate Chief Assistant Dr. Plamen Veskov Petkov has presented for participation in the competition list of 19 titles including 10 publications in Bulgarian and foreign scientific journals, 7 publications in proceedings of scientific forums, 1 monograph and 1 book chapter. Also, 7 enclosures of other documents are presented certifying coordination of one national project and participation in 8 national and international projects, certificate for a good execution of a joint project with Kozloduy NPP, supervision of 4 diploma students, as well as certificates from the employer supporting the candidate’s achievements.

I have the following remarks to the presented documents. Publications 17 and 22 from the list of selected publications for the current competition are reports of presentations in conference proceedings, they do not appear in none of the three groups publications according to the additional requirements of the Faculty of Physics, but they are estimated with 15 points each. It could be the case if one looks on the publication list of Dr. Petkov that is generated by the system “Authors” of SU “St. Kliment Ohridski”, in which these two publications are counted as refereed book chapters. Furthermore, publication 13 from the same list should bring 12 points, but not 15, as a journal publication with quartile Q4 (see Journal Citations Reports). In publication 20 from the list of selected

publications, which corresponds to publication 27 from the list of all publications, the authors are not indicated. In my opinion, the presented lists must follow some order: chronological, by groups or other indication. The candidate teaching activity is described only numerically without information on the teaching disciplines. The information on the supervision of four diploma students (Annex 4) does not contain details about the diploma works-whether they are for obtaining “Bachelor” degree or “Master” degree.

2. Candidate’s Data

Chief Assistant Plamen Petkov was born on 16 September 1966 r. in Nova Zagora. He finished high education with excellent mark in Leningrad State Technical University in St. Petersburg, Russia, in 1992, as engineer on thermal physics (subject “Thermal Physics”). He got there the degree “Master of Technical Sciences”. In 2011 he became a “Master” in chemistry in the Faculty of Chemistry in SU “St. Kliment Ohridski” after a successful defense of diploma work in the field of colloid systems in the current science and technologies. After successful defense of a doctoral thesis titled “Interactions of monolayers of charged particles at a liquid interface and their surface pressure” the Faculty of Chemistry and Pharmacy at SU “St. Kliment Ohridski” has awarded in 2016 Plamen Petkov a doctoral degree in the field of 4.2 Chemistry (Theoretical Chemistry-Macrokinetics). I would like to note the experience Dr. Petkov got during his specializations carried out by different programs in the Argonne National Laboratory, USA, and in the Illinois University, USA, which helped him in his future professional career and growing in the field of nuclear engineering and thermodynamics analyses using specialized software.

From professional point of view Dr. Petkov has a rich experience in the nuclear energy field: operational work in the electricity production sphere, development and testing of severe accident procedures in VVER-1000, fuel behavior analyses when the normal reactor operation is broken and others. In this period (1992-2010) spent in Kozloduy NPP the candidate without any doubts gained helpful skills in team work, administrative experience in personnel leadership and analyticity accompanied with the corresponding expertise when taking operational decisions. After 2010 and till now the main activity of Dr. Petkov is related with teaching and research as chemist till 2016 and Chief Assistant in the Department “Atomic Physics” at the Faculty of Physics starting 1 April 2017.

3. General Record of the Scientific Works and Achievements of the Candidate

The candidate’s scientific achievements presented for the current competition are result of his continued research on previous problems that were subject of his PhD Thesis and work as a Chief Assistant. This comes out from the 4 publications included in the list of selected publications that in fact are not counted in this competition and represent part of publications from previous procedures. The list of all publications presented by Dr. Petkov includes 27 works totally. It seems to me that the co-authorship with outstanding scientists and my private impressions from the candidate give

me the reason to say that there is no plagiarism in the presented works in this competition, which to a large extent are original and innovatory regarding to the considered conceptions in them.

The main scientific areas in which Dr. Petkov has worked and continues working are related with uncertainty analyses for evaluation of nuclear reactors VVER-1000 and validation of the limits of their safety from one side, and from another side, study of surface properties of monolayers of particles at the liquid/gas border and capillary bridges between two plane interfaces. Moreover, there is no dependence between the published papers in the several last years on the preferred two main research areas. The published works are performed on a high scientific level. Substantial experimental and theoretical results are achieved, which could find a broad practical application. Dr. Petkov has delivered 10 oral and poster presentations at national and international scientific forums, where he had presented his obtained results. For the needs of Second Nuclear Power Unit in Kozloduy NPP Dr. Petkov together with a colleague of him proposed a technical solution for a fast implementation of a system to collect large data records.

After accounting for the remarks on point 1 of the present review I give an opinion that the scientific works fully correspond to the minimal national requirements regarding the Law of Development of Academic Staff in Republic of Bulgaria and the additional requirements of SU "St. Kliment Ohridski" for occupation of academic position "Associate Professor".

4. Record and Evaluation of the Candidate's Teaching Activity

It is clear from the presented documents that the candidate has an auditory employment equal to 885 hours and total school employment equal to 1244 hours. In this way the additional requirements of the Faculty of Physics for occupying of academic position "Associate Professor" are satisfied.

5. Instructive Analysis of the Candidate's Scientific and Applied Achievements Contained in the Documents of the Present Competition

The candidate does not point essential contribution only in one of his publications. In the half of them he is a leading author, which makes me sure that the scientific and applied achievements of Dr. Petkov are to a large extent result of his efforts.

An innovative methodology for statistical treatment of measuring devices of nuclear equipment is proposed. This methodology is based on Shannon information entropy, which is applied to the uncertainty bounds of the measured quantity. The Shannon's entropy is computed in the form of entropy coefficient in order to identify the possible form of the probability density function. As a result, the total uncertainty in the transport of the corresponding signal is obtained, which includes: perturbations in the measurement medium, sensor characteristics, intermediate signal transformations and properties of the output signal. The main hypothesis of the proposed methodology is related with study of trends and small variations at normal operation of the nuclear power plant equipment that could not be evaluated analytically, but statistically and to determine the char-

acteristics of pseudo-random statistical distribution. An illustrative example of the application of the developed method is its application to the evaluation of the normal operation of the intermediate circuit of main circulation pumps for VVER-440/B230. The collection of data is based on a proposed own system of the candidate and uses the MELCOR 1.8.4 computer code, in which original author modifications are introduced.

A part of the achievements of Dr. Petkov are related to project development of innovative small modular reactor of fast neutrons, whose characteristics make it closer to the IV generation reactor facilities. Moreover, this small modular reactor STAR-LM pretends for an economical validity and has a potential for simplifying the strategies of management of nuclear power plants. The projects can be considered as a new alternative approach in the process of construction and safety of nuclear reactors. The presented monograph for the current competition is namely devoted to this part of research.

The role of the capillary bridges between two plane interfaces both experimentally and theoretically is another part of research, in which Dr. Petkov works successfully. The contributions here can be searched for in the determination of a range of definition of existence of liquid capillary bridges, their characteristics up to the points of discontinuation of their existence, as well as establishment of the capillary bridges profiles when contractile and stretching external forces are acting. This new knowledge is reviewed in the presented book chapter devoted to the capillary bridges.

Interesting and new original results are obtained when investigating the surface properties of monolayers of particles in the liquid/gas border. An analytical formula is proposed for the dependence that reflects the many-body interactions in the monolayer as a reversed proportionality of the distance between charged particles in it in the form of Fourier expansion. A very good agreement with the experimental curves is shown and at large distances the experimentally obtained asymptotic dependence is confirmed. The appearance of aggregates in the monolayer of charged particles is studied, which leads to increase of the two dimensional pressure. At the same time the candidate shows theoretically this increase as a linear function of the square root of the aggregation number. Two observed effects of electrolyte adding in liquid phase are of particular interest that lead to opposite directions in the behavior of the two dimensional pressure. Also, a criterion of establishment whether source of electrostatic repulsion between particles are charges on the border particle/air or particle/water is proposed. This part of the candidate's research is closely related with the subject of his PhD thesis.

On the basis of the obtained results shown in the presented publications for this competition I consider that the candidate has substantial contributions in each of the research areas, in which he has worked. The number of independent citations has to be added, which are 132 and with 107 of them he participates in the competition thus fully satisfying the additional requirements for the position "Associate Professor" in the Faculty of Physics. The estimated by the candidate h-index is 5 and 7 of the presented publications have impact-factor (3 with quartile Q1, 3 with Q2 and 1 with Q4).

6. Critical Remarks and Recommendations

I do not have critical remarks in respect to the manner of presentation of the problems and the obtained results. In my opinion, the scientific works possess the necessary precision, argumentation, completeness and appropriate use of literature.

7. Private Impressions for the Candidate

My private impressions for the candidate are dated from my student years in the Leningrad State Technical University in St. Petersburg, Russia, where I have also finished my high education. Dr. Petkov was known with his sense of curiosity and during conversations he showed good knowledge of different physics subjects. I would add also his management skills, communication with people and governing experience, participation and coordination of scientific projects.

8. Opinion of Candidature

After I considered the presented for the competition materials and scientific works and based on the analysis made of their significance and the contained scientific and applied contributions, I give a **positive** mark of the candidature. Here I would like to mention the candidate's active work with students and PhD students, more particularly in the organization and preparation of two teams, which have won the first student hackathon on atomic subject—"HackATOM". Moreover, Dr. Petkov is a Committee Member on scientific problems and uncertainties analysis of reactor systems at the Nuclear Energy Agency. Despite my remarks regarding publications 17 and 22 from the list of selected publications of the announced competition, which in case to be not considered as book chapters would reduce the total sum of 300 points, necessary to apply for the academic position "Associate Professor" according to the national requirements and those of regulations of SU "St. Kliment Ohridski", and guided by the whole research and teaching activities and candidate's general record, I consider that Dr. Petkov possesses the necessary qualities and potential for scientific excellence in the scientific field and professional direction of the competition.

II. FINAL DECISION

In the light of the above mentioned, I **recommend** the scientific jury to propose to the competent authority on selection at the Faculty of Physics of SU "St. Kliment Ohridski" to select Chief Assistant Dr. Plamen Veskov Petkov to occupy the academic position "Associate Professor" in professional direction 4.1 Physical Sciences.

21 October 2021

Review prepared by: Assoc. Prof. Mitko Gaidarov