

REPORT

**on the competition for academic position “Associate Professor”
in professional field 4.5. Mathematics (Geometry),
for the needs of Sofia University “St. Kliment Ohridski” (SU),
Faculty of Mathematics and Informatics (FMI),
announced in SG, issue 21/ 13.03.2020 and on the Website of FMI and SU**

This report is prepared by **Prof. Velichka Vassileva Milousheva** from the Institute of Mathematics and Informatics at the Bulgarian Academy of Sciences, as a member of the Scientific Jury on this procedure according to Order № ПД 38-266 / 10.07.2020 of the Rector of the Sofia University “St. Kliment Ohridski”.

Only one applicant has submitted documents for participation in the announced competition: **Senior Assistant PhD Alexander Vladimirov Petkov**, Faculty of Mathematics and Informatics, Sofia University “St. Kliment Ohridski”.

I. General description of the presented documents

1. Information about the documentation

The documents presented by the applicant for the competition satisfy the requirements of the Act on Development of the Academic Staff in the Republic of Bulgaria, the Regulations for its application, and the Rules for the conditions and regulations for acquiring scientific degrees and occupying academic positions in the Sofia University “St. Kliment Ohridski”.

For participation in the competition, the applicant **Alexander Vladimirov Petkov** has presented a list of **6** scientific papers, **5** of them being publications in prestigious journals with impact factor and **1** of them – in the Annual of Sofia University “St. Kliment Ohridski”. A list of the applicant's citations is also presented, as well as all other required documents (official notes, certificates for working experience, references for participation in projects and other relevant evidence), supporting the applicant's achievements.

2. Information for the applicant

According to the submitted CV, the applicant Alexander Petkov was born in 1985, graduated with a Bachelor's degree in Mathematics in 2008 and a Master's degree in Dynamical Systems and Geometry in 2010 at the Sofia University “St. Kliment Ohridski”. In the period 2011 - 2014 he was

a full-time doctoral student at FMI at the Sofia University with a supervisor Corresponding Member Stefan Ivanov. On April 29, 2014 he defended his dissertation on “Riemannian and sub-Riemannian manifolds with structures”, after which he held positions as a mathematician and senior assistant at the Department of Geometry at FMI, Sofia University, where he currently works. In the period 2017 - 2019 Alexander Petkov has several quarterly scientific specializations in Vienna and Miami. From April 1 to December 31, 2019 he held a position as a young scientist at the Sofia University “St. Kliment Ohridski” under the National Research Program “Young Scientists and Postdoctoral Students”.

3. General characteristic of the scientific work and achievements of the applicant

The research interests of Alexander Petkov, from the time of his Master’s thesis, afterwards in his PhD thesis, and up to now, are in the field of sub-Riemannian geometry (in particular, the geometry of quaternionic contact manifolds), contact geometry, geometry of hyper-Kähler manifolds with torsion (HKT-manifolds). The main scientific results of the applicant are related to problems successfully developed both abroad and by the Bulgarian school in Geometry which has received its international recognition. The scientific contributions of Alexander Petkov in the presented papers can be characterized as enrichment of existing knowledge, combined with using and introducing new hypotheses and methods. They show his ability to build on existing theories and characterize him as an established scientist in his field.

According to the presented list of publications, Alexander Petkov applies in the current competition for the academic position “Associate Professor” with **6** scientific publications. All of them were published in the period 2013 - 2020. The publications can be classified according to the place of publishing as follows: **3** papers in journals with impact factor in quartile **Q1**, **2** papers in journals with impact factor in quartile **Q4** and **1** paper reviewed in Zentralblatt and MathSciNet. Three of the publications presented in this competition are independent, the rest of them are co-authored. I accept as equal the participation of the applicant in all papers in which he is a co-author.

It can be concluded from the submitted documents and declarations that:

a) the scientific publications meet the minimal national requirements (Item 26, # 2 and 3 of the Act on Development of the Academic Staff in the Republic of Bulgaria) as well as the additional requirements of the Sofia University “St. Kliment Ohridski” for occupying the academic position “Associate Professor” in the scientific field and professional field of the competition;

b) the scientific publications submitted for the competition have not been used in previous applications for acquiring a scientific degree or occupying an academic position;

c) no plagiarism has been established in the scientific papers submitted for the competition.

4. Characteristic and evaluation of the teaching activities of the applicant

The applicant Alexander Petkov possesses a long-year and rich teaching activity in the Faculty of Mathematics and Informatics at the Sofia University. He has taught lectures and mainly exercises in the following mathematical courses: Differential Geometry, Geometry, Analytical Geometry, Linear Algebra and Analytical Geometry (for chemical and physical specialties), Mathematics (for specialty Geology) in various Bachelor and Master programs.

5. Analysis of the scientific and scientific-applied achievements of the applicant contained in the documents and publications presented for the competition

The publications presented for participation in the competition are in the field of quaternionic contact geometry, which is an example of sub-Riemannian geometry. The main approach used in the investigations is the study of the spectrum of the sub-Laplacian (a sub-elliptic operator, a natural analogue of the Laplacian in the Riemannian geometry).

In paper [3], a Bochner type formula for the sub-Laplacian on a quaternionic contact manifold is found and as a consequence, in the compact case a lower bound of the eigenvalues of the sub-Laplacian is established for dimensions greater than 7. It is shown that the lower bound is reached on the 3-Sasakian sphere. A hypothesis is stated that among all compact quaternionic contact manifolds the lower bound is reached only in the case of the 3-Sasakian sphere. This hypothesis is proved in the case of a compact 3-Sasakian manifold. In papers [1] and [2], the 7-dimensional case, which is not considered in [3], is studied.

Paper [5] concerns the quaternionic contact heat equation. The energy functional for this equation is introduced and an entropy formula is derived, which is used to prove that the energy functional is monotone non-increasing, provided a certain positivity condition (the Lichnerowicz-type positivity condition used in [1] and [3]) is satisfied. The derived entropy formula is applied in paper [6] to establish a lower bound of the first eigenvalue of the sub-Laplacian on a compact quaternionic contact manifold, which satisfies a Lichnerowicz-type condition, as well as an additional condition for essential positivity of the so-called C-operator.

In paper [4], it is shown that the Yamabe problem in the quaternionic contact geometry has a solution on any compact quaternionic contact manifold, which is non-locally quaternionic contact equivalent to the standard 3-Sasakian sphere.

Completing the analysis of the scientific results in the papers submitted for the competition, I would like to note that the most important of them have been presented at a number of international conferences and represent a novelty in science having direct application in various fields of Mathematics and Physics.

According to the documents submitted by the applicant, Alexander Petkov has **14** citations (without self-citations), most of which are by foreign authors in renowned scientific journals. His results have been presented at a total of **31** national and international forums, **16** of which are abroad (in Belgium, Czech Republic, France, Germany, Italy, Mexico, Russia, Serbia, Spain, USA).

6. Critical remarks and recommendations

I have no significant remarks to the documentation presented for the competition. The documents and necessary references submitted by the applicant are prepared precisely, except for the list of all citations, which includes a lot of self-citations. I attribute this to the imperfection of the system “Authors” of the Sofia University, where the list of all citations was extracted from.

I have no critical remarks on the applicant's scientific work. The review of the documents presented at the competition shows that Alexander Petkov is working on problems of current interest in modern fields of mathematics. As a recommendation, I would note that it would be good to indicate in the author's reference the perspectives for future work on the topic and for application of the achieved results in future research.

7. Personal impressions of the applicant

I have known the applicant Alexander Petkov from his participation in seminars, conferences and other scientific forums. My impressions of his talks and personal conversations on the subject of his research are very good. He shows serious knowledge in the field he works, has good skills to communicate and present his results convincingly.

8. Conclusion for the application

After my careful and critical reading of the documentation and the publications presented for the competition and my analysis of their significance and the scientific and scientific-applied contributions, **I confirm** that the scientific contributions of **Alexander Vladimirov Petkov** meet the requirements of the Act on Development of the Academic Staff in the Republic of Bulgaria, the Regulations for its application, and the Rules for the conditions and regulations for acquiring scientific degrees and occupying academic positions in the Sofia University “St. Kliment Ohridski” for occupying the academic position “**Associate Professor**” in the scientific field and the professional field of the competition. In particular, the applicant meets the minimal national requirements in the professional field and no plagiarism has been established in the scientific papers submitted for the competition.

I give my **positive** evaluation for the application.

II. GENERAL CONCLUSION

Based on the above, **I recommend** the Scientific Jury to propose to the Council responsible for the election of the Faculty of Mathematics and Informatics at the Sofia University “St. Kliment Ohridski” to elect **Senior Assistant PhD Alexander Vladimirov Petkov** to occupy the academic position “**Associate Professor**” in the professional field 4.5 Mathematics (Geometry).

September 1, 2020

Referee:

(Prof. Velichka Milousheva)