REPORT

on a competition for an occupation of the academic rank "associate professor" in the research area 4.5 Mathematics (Geometry), for the needs of Sofia University "St. Kliment Ohridski" (SU), Faculty of Mathematics and Informatics (FMI), published in DV, No. 21 from 13.03.2020.

The report is prepared by Assoc. Prof. DSc. Ognyan Borisov Christov, FMI, SU, as a member of the scientific juri of the competition, according to order No RD - 38-266 from 10.07.2020 of the Rector of the Sofia University.

Only one candidate - principal assistant professor D-r Alexander Vladimirov Petkov, FMI, SU has applied for participation in the competition.

1. A general description of the presented materials.

D-r A. Petkov has submitted 6 papers for the participation in the competition, as well as all necessary other documents such as: CV, certificate for higher education, certificate for a scientific degree, the list of all publications, author's reference, citation reference, reference for meeting the minimum national requirements under Article 2b, paragraphs 2 and 3 of ZRASRB etc.

The scientific publications presented for the competition do not repeat the works presented for the educational and scientific degree "doctor" . The author's reference accurately reflects the applicant's achievements. No plagiarism is found in the works submitted to the competition.

2. Applicant details.

M-r Alexander Petkov has a degree in mathematics from Sofia University. In the period 2011-2014 he was a PhD student in FMI, SU. In 2014 he successfully defended his PhD thesis under guidance of Prof. Stefan Ivanov. He was an assistant-professor in the Section of Geometry in FMI, SU during the period 2014-2020.

He was granted a post-doc position in Institute of Mathematics at Vienna University, Vienna, Austria during April - June and October - December 2017.

D-r Petkov was a visiting fellow in the University of Miami, Florida, USA during January-March 2018 and September-December 2019.

3. A general description of the applicant's scientific works and achievements.

The scientific interests of A. Petkov are connected with the String theory, Geometry of quaternionic-contact manifolds, Geometric analysis and PDE, Complex algebraic geometry.

The applicant has submitted for the competition 6 articles, not used in other procedures. He is the sole author in three paper and the rest works are co-authored. I regard as true, that the contributions of the co-authors are equivalent.

Some of the applicant's articles are published in extremely prestigious journals: Nonlinear Analysis: Theory, Methods & Applications, **IF 1.612**), Journal of Geometric Analysis (2014, **IF 0.971**), Journal de Mathématiques Pures et Appliquées (2018, **IF 1.961**). All these works are on a very high technical level. The total impact factor of the presented publications is **5.230**.

In my opinion, the results of presented papers are more than enough in quality for obtaining the academic degree "associate professor".

4. Description and evaluation of the applicant's teaching activity

The teaching activity of D-r Petkov includes lecturing on Basic Mathematics for the Geology students and seminar classes on Analytical and Differential Geometry in Faculty of Mathematics and Informatics. I personally have no direct impressions.

5. Analysis of the applicant's scientific achievements.

The works submitted by the candidate can be conditionally divided into two groups: first group - papers [3], [1-2], [5-6] and second group - paper [4], although in all of them the geometry of the quaternion-contact manifolds is studied.

A quaternionic contact structure on a real $4n+3$ dimensional manifold M is a codimension 3 distribution H locally given as the kernel of an $\mathbb{R}^3$-valued 1-form $\eta = (\eta_1, \eta_2, \eta_3)$, such that the two-forms $d\eta_{i_{|H}}$ are the fundamental forms of a quaternionic Hermitian structure on H. Such an H can be equipped with a conformal class of quaternionic Hermitian metrics $[g]$. Then (M, η) is quaternionic contact (qc) manifold.

The first group of papers deal with establishing the sharp lower estimate of the spectrum of the Sub-Laplasian on a compact quaternionic contact (qc) manifolds. This type of problem comes as an analogue of the results of Lichnerowicz and Obata in Riemannian geometry. Such a lower bound is found in [3] for (qc) manifold with dimensions grater than 7. The case in which this bound is reached is discussed In the papers [1] and [2] the sharp lower bound of the spectrum of the Sub-Laplacian in the 7-dimensional case.

In the paper [5] the quaternionic contact heat equation is considered. An energy functional is introduced and an entropy formula is derived. Roughly speaking, this formula gives the time evolution of the energy functional. Under certain assumptions, it is shown that the energy functional is non increasing.

The so obtained formula is used in [6] for obtaining the lower bound of the first eigenvalue of the Sub-Laplacian on a compact (qc) manifold. In this way an alternative proof of the results in [3] and [1] is found.

The Yamabe problem on a compact (qc) manifold is the problem of finding a metric $\bar{g} \in [g]$ on H for which the scalar curvature is constant. In [4] it is proved that the Yamabe problem has a solution on any compact (qc) manifold which is not locally qc equivalent to the standard 3-Sasakian sphere.

The applicant has reported his results at many seminars, workshops and conferences, to notice a few:

"Young Researcher Workshop on Geometry, Mechanics and Control", Paris, France, 2016
"Pure and Applied Differential Geometry", Leuven, Belgium, 2017
"Mirror Symmetry and Applications", Moscow, Russia, 2017
"Recent Developments in Higgs Theory", Moscow, Russia, 2018
"Primer Congreso del IMSA en la UNAM y el CINVESTAV", Mexico City, Mexico, 2019

D-r Petkov has participated in many scientific projects with National Fund for Scientific

Research and Sofia University.

6. Critical notes and recommendations.
I have no critical remarks.

7. Personal impressions.
I have known Alexander since 2008 and I highly evaluate his professional activity. His scientific articles present him as a serious researcher. As a person he is modest and reliable.

Conclusion.
After I got acquainted with the submitted materials and scientific works and on the basis of an analysis of their importance and the scientific achievements contained therein **I confirm** that the scientific achievements meet the requirements of ZRASRB, Regulations for its implementation and the corresponding Regulations of SU "St. Kliment Ohridski" for taking of the candidate the academic rank "associate professor" in the scientific field and in the research area of the competition.

I strongly recommend to the scientific jury to offer to the Faculty Council of FMI, SU "St. Kliment Ohridski" to choose principal assistant professor D-r Alexander Petkov to take the academic rank "associate professor" in the research area 4.5 Mathematics (Geometry).

August 03 2020   Prepared the report :
Assoc. Prof. DSc Ognyan Christov