

# **R E P O R T**

by Prof. Stefka Hristova Bouyuklieva  
Faculty of Mathematics and Informatics,  
St. Cyril and St. Methodius University of Veliko Tarnovo  
about the competition for acquiring the academic position of  
“Associate Professor”  
at the Institute of Mathematics and Informatics,  
Bulgarian Academy of Sciences,

**Research area: 4. Natural Sciences, Mathematics and Informatics,**

**Professional field: 4.5 Mathematics**

**Scientific specialty: Combinatorics and Graph Theory.**

In the competition for the academic position of "Associate Professor", announced in the State Gazette, issue 14 / 10.02.2023 and on the website of IMI for the needs of section "Mathematical Foundations of Informatics" at the Institute of Mathematics and Informatics at Bulgarian Academy of Sciences, as a candidate participates Danila Dmitrievich Cherkashin.

## **1. General description of the presented documents.**

The presented documents are:

1. Application by Danila Cherkashin for participation in the competition, 22.03.2023.
2. Curriculum vitae in the common European format.
3. Diploma of completed higher education from St. Petersburg University.
4. Diploma for the acquired educational and scientific degree "doctor" from the Mathematical Institute "V. A. Steklov", Russian Academy of Sciences.
5. Diploma for recognition of ONS "doctor" from Bulgarian Academy of Sciences.
6. Complete list of the scientific publications of the candidate.
7. List of scientific papers for participation in the competition.
8. Copies of the papers for participation in the competition.
9. Signed author's reference for the scientific contributions of the works.
10. List of citations.

11. Information on the fulfillment of the minimum requirements for the academic position "Associate Professor" at IMI-BAS.

12. Transcript-extract from the protocol of the Scientific board of IMI-BAS for initiating the procedure.

13. Copy of the State Gazette with the announcement for the competition.

14. Certificate of internship in the specialty.

15. List of scientific research projects.

16. Certificate of fulfillment of the minimum national requirements under Art. 2b, paragraphs 2 and 3, and the requirements under Art. 2b, para. 5 of ZRASRB, as well as the minimum requirements of IMI-BAN.

17. Declaration that the works for participation in the competition were not used for the acquisition of the ONS "Doctor".

## **2. General characteristics of the candidate's scientific activity.**

Danila Cherkashin participates in the contest with 11 publications. Two of the papers are in Russian and the rest are in English. They have been published in international scientific journals. These articles were not used in the procedure for acquiring the educational and scientific degree "doctor", for which the candidate presents a declaration.

One of the presented papers has no coauthors, seven of them have one co-author, and three papers have two co-authors. According to the presented table, the candidate collects 50 points from his doctoral dissertation, 100 points from 3 papers that replace the habilitation monograph, 294 points from scientific publications in journals that are referenced and indexed in world-renowned databases with scientific information outside the habilitation work, 210 points of citations and 30 points for participation in projects. The candidate collects a total of 684 points, i.e. above the minimum requirements.

There is a difference between the numbering of the articles in the list of publications and in the description of the contributions. In addition, only 8 out of all 11 publications for the competition are presented in the list with contributions.

According to the presented table, Danila Cherkashin participated in three scientific projects of the Russian Research Fund: "Combinatorial, discrete, and enumerative geometry" (2016–2020), "Random graphs and hypergraphs: models and applications" (2016–2020), "Group theory, algebraic geometry, representation theory, motive theory, homological algebra" (2018–2020).

### **3. Analysis of the scientific achievements according to the materials submitted for participation in the competition.**

I assess the candidate's research contributions as theoretical. The candidate's scientific activity is in the field of graph theory, with most articles devoted to hypergraphs. Implicitly, extremal hypergraph coloring problems began with Hilbert's theorems in 1892 on monochromatic affine cubes and van der Warden's theorems in 1927 on monochromatic arithmetic progressions. Systematic research on such problems began in the 1960s with the works of Erdős and Hajnal.

The first paper looks different from the others and is related to topological dynamics in dynamical systems. The remaining 10 papers deal with various problems on graphs. Two main directions in these developments can be distinguished: coloring of hypergraphs and chromatic numbers.

Papers [2], [3] and [4] refer to chromatic numbers of metric spaces. In [2], a lower bound is presented for the minimum number of colors needed to color all points in Euclidean space in such a way that every two points at distance 1 have a different color. The article [3] is devoted to a generalization of the problem of chromatic numbers in the Euclidean plane. Euclidean spaces with small dimensions are considered in [4].

The papers [5]-[9] concern coloring of hypergraphs and with them the candidate continues the research from his doctoral dissertation. In [8] it was proved that for fixed  $n$  the sequence  $a_r = \frac{m(n,r)}{r^n}$  has a limit, where  $m(n,r)$  is the smallest number of edges in an  $n$ -uniform hypergraph that does not can be correctly colored with the  $r$  colors. The article [7] discusses the numbers  $m(3,r)$  in detail. The work [6] studied the coloring of the generalized Kneser graph  $K(n,k,s)$ , whose vertices are  $k$ -element subsets of a set with  $n$  elements, and edges connect two sets that have less than  $s$  elements in common. The publication [9] presents an overview of results related to extremal hypergraph coloring problems. It is about searching for a hypergraph with a minimum number of edges of a given class.

The last two publications are from 2022. In [10] a simple graph with  $n$  vertices whose edges have weights  $\pm 1$  is considered. In [11], the authors apply the bound on independence number via Lovász theta function to eventown problem and its generalizations over  $Z_n$ .

Danila Cherkashin has submitted a reference for 35 citations of the articles for participation in the competition, and 100 citations of all his articles since the beginning of his scientific career. There are discrepancies in the number of citations for the same article in the

two lists, and in addition, the first list contains papers that are not part of the competition. In Web of Science, 103 citations (without self-citations) are presented, h-index 7, with the most cited article [4].

#### **4. Conclusion**

**The above gives me a reason to believe that Danila Cherkashin is a highly qualified specialist who has proven his ability to conduct research at a high level. According to the presented documents, the candidate Danila Cherkashin fulfills all the requirements of the law and the Regulations to it and the Regulations for the specific requirements for acquiring academic degrees and occupying academic positions at BAS and IMI-BAS. I strongly recommend to the Honorable Scientific Jury to vote on a proposal to the Scientific Council of IMI - BAS to select Danila Dmitrievich Cherkashin for the academic position "Associate Professor" in**

**Research area: 4. Natural Sciences, Mathematics and Informatics,**

**Professional field: 4.5 Mathematics**

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30.05.2023

Member of the scientific jury:

/Prof. Stefka Bouyuklieva/