R E P O R T

by Prof. Dr. Sci. Stefan Petrov Ivanov,
on the competition for the academic position of a "full professor"
at SU „St. Kl. Ohridski“, Faculty of Mathematics and Informatics
announced in DV No 67 from 4.08.2023
Scientific field: „4. Natural sciences, mathematics and informatics“
Professional field: „4.5 Mathematics“ (Finite geometries)

1. General description of the application documents

There is a single applicant for the position – Assoc. Prof. Assia Petrova Rousseva - Landjeva, DSc. The candidate presents 18 publications in refereed scientific journals, as well as one textbook. The candidate presents the full text of all papers and another documents supporting the application like certificates, letters from employers, project menagers and coauthors.

2. Biographical data

Assia Rousseva graduates from FMI, Sofia University in 1988. In the period 1993–2009 she is an assistant in department „Geometry“ at FMI, SU. Since 2009 she is an associate professor at the same department where she is working at present.

Assia Rousseva received her PhD degree in 2005 at the Institute of Mathematics and informatics, BAS, for a thesis entitled „Arcs in finite projective geometries and their application in coding theory“. In 2020 she received the degree Doctor of Sciences for with a thesis „Finite geometries and codes”.

3. General description of the research papers

The candidate applies for the position with eighteen scientific papers published in the following mathematical journals:

- Designs, Codes and Cryptography - 4
- Advances in Mathematics of Communications -1
- Results in Mathematics -1
- Discrete Mathematics - 1
- Problems of Information Transmission - 1
- Comptes Rendus de l'Academie bulgare des Sciences - 3
- Electronic Notes in Discrete Mathematics (Scopus) - 2
- IEEE Xplore - 1

- Lecture Notes of the Institute of Computer Sciences, Social Informatics and Telecommunications Engineering (Scopus) - 2
- Annual of Sofia University, Faculty of Mathematics and Informatics (ZBl) -1
- Proceedings of the Int. Workshop on Optimal Codes (ZBl) - 1

Eleven of these papers are published in journals having an impact-factor (Q2-6 papers, Q3-2 papers, Q4-3 papers), five are indexed by Scopus or Web of Science and two are refereed in Zentralblatt. In one paper the candidate is the sole author. Ten of the papers are with one co-author, six are with two co-authors and one is with three co-authors. The candidate presents letters which confirm that her contribution is equal to that of the other coauthors.

The scientific results from these papers are presented at several prestigeous international scientific conferences and workshops:

- ALCOMA (Germany, 2010, 2015),
- WCC (France, 2015, 2019),
- Combinatorics (Italy, 2012, 2014, 2016, 2018,2022),
- Finite Geometries (Kloster Irsee, 2014, 2017, 2023),
- Finite Fields and Their Applications (Italy, 2017)
- International Conference on Optimal Codes and Related Topics (Boston, 2018, 2023, Fulda, 2016, 2019)

Assia Rousseva presents also a book entitled „Aspects of combinatorics“ (379 pages) published by the New Bulgarian University

4. Teaching activities

Assia Rousseva has been teaching at the Faculty of Mathematics and Informatics since 1987 and all her teaching activities are entirely in Department of Geometry at FMI, SU. During the years she has been consecutively an instructor, assistant professor and (since 2009) an associate professor. She teaches mainly in the programs „Informatics“, „Mathematics and Informatics“, „Physics and Mathematics“ (Faculty of Physics), where she gives lectures in various mathematical disciplines. She is the principal lecturer in several courses: „Geometry“ for 3rd year students (a course created by Ch. Lozanov and G. Eneva in whose development A. Rousseva has participated actively), „Geometry“ for students from the programme „Mathematics and Informatics“, „Analytical geometry“ for 1st year students, „Descriptive geometry“.

Together with Prof Landjev she created the course „Finite geometries“ for students in the Master's program Algebra and applications.

5. Description of the scientific results

All presented papers are devoted to problems from coding theory. In most of them, with the only exception of paper [2], the questions are formulated in finite geometric terms and are solved using algebraic and combinatorial methods.

A considerable part of all papers deals with the so-called extendability problem for linear codes, which can be formulated equivalently as a problem about extendability of arcs or about reducibility of blocking sets [2,4,10,12,13,16]. In these papers the question of the extendability of a certain arc is reduced to the structure question of the existence of a hyperplane in the support of a special blocking set in the dual space. This allows the use of various classical structure results about blocking set. An original contribution is the introduction of a special object called ($t \mod q$)-arc, whose structure is connected with the extendability problem. The introduced objects are also interesting in their own right and in papers [2,4,10] the candidate achieves a significant progress in explaining their internal structure.

Several papers deal with constructions of affine blocking sets that are optimal or close to optimal with respect to the well-known bounds of A. Bruen, S. Ball, and Ball-Blokhuis. In [17] an infinite class of affine blocking sets is constructed meeting the Bruen bound. The blocking sets in this class are a sum of skew lines meeting the hyperplane at infinity in an arc with special properties. In [7] a general construction is described which yields four optimal affine blocking sets in the geometries $\mathrm{AG}(4s+1,4)$, lying on the stronger Ball bound. These are the first examples of blocking sets achieving equality in the Ball bound.

Papers [5] and [6] are devoted to binary non-linear codes with two distances (called somewhat ambiguously two-weight codes). These papers contain several exact values, as well as several upper bounds for the maximal cardinality $A(n,\{d_1,d_2\})$ of a binary code of fixed length n and fixed distances d_1 and d_2. Using a general method by N. Alon, L. Babai and H. Suzuki the general bound

$$A(n,\{d_1,d_2\}) \leq \binom{n+2}{2}$$

is also proved.

In [11] the authors investigate arcs in $\mathrm{PG}(r,q)$ with the property that the multiplicities of the hyprplanes are contained in an interval of length 2, It is proved that in geometries of dimension $r \geq 3$ there exist just trivial arcs obtained as the sum of several copies of the complete space $PG(r,q)$ with addition or removal of at most two further points. In the plane though, there exist non-trivial examples like the ovals, the hyperovals, the Hermitian curve in $\mathrm{PG}(2,4)$, the $(15,3)$-arc in $\mathrm{PG}(2,7)$ etc.

In [1] the problem of determining the p-rank of the incidence matrix of the projective Hjelmslev plane over an arbitrary chain ring is investigated. The problem is solved (without

the use of computer) for both chain rings with four elements. Bounds are proved for the ranks of the planes over an arbitrary chain ring.

The candidate presents also the textbook „Aspects of combinatorics“. It contains material on sixteen subjects from combinatorics: there are six chapters on enumerative combinatorics, six chapters on extremal graph theory, two chapters on extremal set theory, a chapter on finite geometry and a chapter on designs. The book follows the lectures given by the two authors at the Faculty of Mathematics and Informatics and at the New Bulgarian University. The last two chapters are more advanced and the book looks in this part more like a survey on these two subjects.

6. Critical remarks.

None.

7. Personal remarks.

I know very well Assia Rousseva as a person and mathematician. I have a most favourable impression of her professional and moral qualities. I am convinced that she is a serious researcher with deep knowledge of her field of research.

8. Conclusion.

Assoc. Prof. Assia Rousseva is an established scientist in the field of finite geometry with numerous contributions in this area of research. In the same time she is an excellent teacher who takes various courses in geometry. She has all the merits and professional qualifications for the position of full professor at Sofia Univesity, Faculty of Mathematics and Informatics. The presented publications by the candidate have not been used in previous applications. In the presented papers I did not observe plagiarism of any kind.

The above gives me reason to give a **positive** assessment of the candidacy of **Assoc. Prof. Assia Petrova Ruseva-Landjeva** and confidently recommend to the Scientific Jury to propose to the Faculty Council of the Faculty of Mathematics and Informatics at Sofia University „St. Kliment Ohridski“ to elect Associate Professor Asya Petrova Ruseva for a **“full professor”** in the field of higher education „4. Natural Sciences, Mathematics and Informatics“, professional field “ 4.5 Mathematics“.

Sofia, 16.11.2023

Prof. Dr Sci. Stefan Ivanov