REVIEW

in competition for an academic position

"professor"

in a professional field 4.5. Mathematics

(Differential equations, Hamiltonian systems),

for the needs of Sofia University "St. Kliment Ohridski" (SU),

Faculty of Mathematics and Informatics (FMI),

announced in SG no. 56 of 30.06.2023 and on the FMI and SU websites

The review was prepared by Prof. Dr. Sci. Stefan Petrov Ivanov - FMI at SU, professional direction 4.5 Mathematics, scientific specialty "Geometry and Topology" (Differential Geometry), in my capacity as a member of the scientific jury for the competition according to Order No. RD 38-515/29.08.2023 of the Rector of Sofia University.

Only one candidate submitted documents for participation in the announced competition:
Associate Professor Dr. Sci. Ognyan Borisov Hristov, FMI-SU.

1. General description of the submitted materials.

The documents submitted by the candidate in the competition comply with the requirements of the Law on Research and Development, the Regulations on the Conditions and Procedure for the Acquisition of Scientific Degrees and the Occupation of Academic Positions at Sofia University "St. Clement Ohridski" (PURPNSZADSU) include:

- Application for admission to participate in the competition;
- European CV format;
- Diploma of higher education with application (copy) – №100664;
- Diploma for the scientific degree "candidate of mathematical sciences" (copy) - No. 23705/25.09.1995;
- Diploma for scientific degree "Doctor of Sciences" (copy) - №SU1017-01/20.03.2017;
- Certificate for scientific title "Associate Professor" (copy) - № 20984/19.12.2001.
- Certificate of work experience from SU, 216/03/07.2023;
- General list of scientific and academic publications;
- List of scientific and academic publications submitted to the competition;

- Annotations of the publications submitted, including self-evaluation of contributions;
- State Gazette announcing the competition (copy);
- Documents on academic work:
- Reference of the applicant's activities with undergraduate and postgraduate students;
- Textbooks and teaching aids submitted to the competition;
- Documents on research activities:
- Reference of participation in research and educational projects;
- Reference for participation in scientific forums;
- Scientific publications submitted to the competition;
- Evidence of scientific citations.

For participation in the competition the candidate Assoc. Prof. Ognyan Borisov Hristov has submitted a list of 6 scientific publications and 3 teaching aids, including 6 independent publications in prestigious foreign scientific journals with high impact factor (1 - Q1, 3 - Q2, 1 - Q3 and 1 in LNCS - Spinger edition), with one article invited by the journal Adv. Math. Phys. and another by invitation of the journal Symmetry. A list of citations and other documents (in the form of memos and certificates from an employer, project leader, funding organization, or project sponsor, references and reviews, awards, and other appropriate evidence) supporting the candidate's accomplishments is provided.

All 6 scientific articles are accepted for review, since they are after the acquisition of the scientific title of associate professor and 3 study aids. Of the scientific works, 5 are in journals with IF as the total IF = 13.203.

I have no notes or comments on the documents.

2. Brief biographical data of the applicant:

Associate Professor Ognyan Hristov was born on 27.07.1959. in the city of Lom, Bulgaria. As a student at SU "St. Cl. Ohridski", FMI, specialty "Mathematics", received a master's degree in Mechanics in 1984. In 1995 defended a candidate's thesis and obtained the scientific degree "Candidate of Mathematical Sciences" with a diploma from VAK, and in 2017 defended a doctoral dissertation on the topic "Algebraic, analytical and geometric studies on some finite and infinite-dimensional Hamiltonian systems" and obtained the scientific "Doctor of Sciences" degree at the University of St. Cl. Ohridski". From 1986 to 1989 is an assistant at the "Angel Kanchev" Technical University in the city of Ruse. In 1991 became an assistant at FMI at SU "St. Cl. Ohridski", in the period 2001-2002 he was an associate professor at the Faculty of Economics of the University of St. Cl. Ohridski", and from 2002 until now he is an associate professor at FMI at SU "St. Cl. Ohridski". He was a visiting professor at prestigious universities: University of Karlsruhe, Germany, 1993-94,

Warsaw University, Poland, 1997, Humboldt University, Germany, 2000, University of L'Akuila, Italy, 2004, University of Kanzas, USA, 2012, University of Groningen, Holland, 2012, University of Utrecht Holland, 2012, Warsaw University of Technology, Poland 2014. He is the leader of 3 and a participant in 1 scientific projects financed by the "Scientific Research Fund" at the MES.

3. General characteristics of the scientific works and achievements of the candidate

Assoc. Prof. Dr. Sci. Hristov's research is mainly in the field of differential equations and integrable Hamiltonian systems, which are of considerable interest in mathematics and mathematical physics, since many important objects in the nature are described by Hamiltonian systems. For example, the Klein-Gordon chain can be described by a Hamiltonian system, together with the widely known Klein-Gordon equation, is used in top-line DNA breaking, dislocations of crystals, important enough objects of considerable interest to learn about and describe the laws of the nature. A fundamental issue is the question of the integrability (nonintegrability) of a Hamiltonian system, i.e., the question of the existence (nonexistence) of a sufficient number or finding a complete set of independent first integrals, which essentially solves the system and allows one to study the geometry and dynamics of an integrable Hamiltonian system. The main research and contributions of Assoc. Prof. Hristov are precisely in this topical area of mechanics, mathematics and mathematical physics worldwide, where world-renowned scientists such as Duister-Maat, Ferhulst, Morales-Ruiz, etc. have worked.

For participation in the competition the candidate Prof. Dr. Ognyan Borisov Hristov has submitted 6 independent scientific publications in prestigious foreign scientific journals with high impact factor such as Nonlin. Dyn., Eur. Phys. J. Plus, Adv. Math. Phys., Discr. Cont. Dyn. Systems B, Symmetry with total IF = 13.203. It is worth noting , that one of the papers is by invitation of the journal Adv. Math. Phys. and another by invitation of the journal Symmetry.

All the scientific works presented by the candidate do not repeat those from previous procedures for obtaining a scientific title and academic position.

No plagiarism has been proven in the scientific works submitted to the competition.

Obviously, the presented scientific works significantly exceed the minimum national requirements (according to Art. 2b, paras. 2 and 3 of ZRASRB) and, accordingly, the additional requirements of SU "St. Kliment Ohridski", FMI for occupying the academic position of "professor" in the academic field and professional direction of the competition.

4. Characteristics and evaluation of the candidate's teaching activity

The candidate has a rich and fruitful educational and pedagogical activity in the Faculty of Economics and in FMI at SU "St. Kl. Ohridski". He has given lectures on Differential and Integral Calculus, Ordinary Differential Equations and Partial Differential Equations to students, he has given classes on linear algebra, geometry, analysis, ordinary and partial differential equations, numerical methods and analytical mechanics. He has read and given special courses to graduate students at the FMI, 10 in number, and in recent years I will note his special courses on Hamiltonian systems, algebraic groups and Galois differential theory, matrix groups. He has directed the seminar on Differential Equations for students as well as the seminar on Integrable Systems together with Assoc. Prof. A. Zhivkov. Under his supervision 12 master theses have been defended. Dr. Ognyan Hristov is the supervisor (together with Prof. Emil Horozov) of a PhD student who successfully defended his PhD thesis in 2015 and works now at FMI at SU "St. Cl. Ohridski". The candidate's rich pedagogical activity is also supported by 3 electronic study aids for students.

5. Analysis of the applicant's scientific and scientific-applied achievements contained in the materials for participation in the competition

Associate Professor Ognyan Hristov works in the field of the modern theory of Hamiltonian systems. A main topic in the candidate's works is the highly non-trivial question of finding a complete number of independent first integrals in an involution, which makes the corresponding Hamiltonian system integrable, as well as a proof of non-integrability of a given Hamiltonian system, which is also a sufficiently difficult problem.

It is well known that a Hamiltonian system can be non-integrable while its normal form (the normal form of the Hamiltonian is obtained by expanding it around a singular point with non-resonant terms removed using symplectic transformations) restricted to some order is integrable, such Hamiltonian systems are called "nearly" integrable.

One of the candidate's main results concerns the important Hamiltonian system describing the Klein-Gordon periodic chain. In [36] it is proved that the system is nonintegrable. However, this Hamiltonian system was found to be "nearly" integrable, i.e., its normal form, restricted to fourth order, is completely integrable. Moreover, its first integrals were written explicitly. This could lead to significant applications in DNA research.

It is worth mentioning as a meaningful main contribution of the candidate the work [39], where besides the previously found trivial integrability cases of the normal form of the Hamiltonian resonance 1:1:2:2, i.e. the system has 4 degrees of freedom, the candidate has shown the existence of more integrability cases, two of them being highly nontrivial. It should be noted that works on

the study of resonances with many degrees of freedom are quite non-trivial and there are relatively few examples studied.

It is well known that the Hamiltonian normal form of the 1:2:2 resonance restricted to order 3 is integrable. Ferhulst conjectured that higher order terms spoil the inintegrability. The work [37] supports this conjecture by showing that for a set of parameters in general position the system is nonintegrable. On the other hand, removing the terms that cause nonintegrability two nontrivial integrable cases are found, which in the general is not valid.

Another major contribution of the candidate is contained in [38], where the integrability of the generalized Hamiltonian system of Henon-Hailes is studied. It is shown rigorously that there is integrability only in the known integrable cases, i.e. it is proved that there are no other integrable cases.

The main results for the competition have been published in well-known international scientific journals, and I will mention Nonlin. Dyn., Eur. Phys. J. Plus, Adv. Math. Phys., Discr. Cont. Dyn. Systems B, Symmetry with a total cumulative Impact Factor of 13.203. The candidate has provided evidence for 54 citations (excluding self-citations) not used in other procedures , and I will note a citation in Comm. Math. Phys., Nonlinear Analysis -Theory Methods Appl., J. Diff. Eq., J. Math. Phys., Ann. Mat. Pura. Appl. et al.

I have essentially no critical notes and recommendations.

6. Personal impressions of the candidate

I know the man and scholar Ognian Hristov very well, I have excellent impressions of him as a person and I highly value his moral and professional qualities.

7. CONCLUSION

The documents and materials presented by Prof. Dr. Ognyan Hristov meet all the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria (ZRASRB), the Regulations for the Implementation of the ZRASRB and the Regulations on the Conditions and Procedures for obtaining scientific degrees and holding academic positions at SU "St. Climent of Ohrid" (PURPNSZADSU).

The candidate in the competition has submitted a sufficient number of scientific works published since the materials used in the defence of the degrees of 'Candidate of Mathematical Sciences' and 'Doctor of Science' and in his habilitation as Associate Professor. Prof. Dr. Ognyan Hristov works in the modern field of integrable and non-integrable Hamiltonian systems and his results in recent years could be substantially used in modern mathematics and mathematical

physics. The candidate's works have original scientific and applied contributions that have received international recognition, and a representative part of them have been published in well-known scientific journals and scientific proceedings published by international academic publishers. The scientific and teaching qualifications of Prof. Dr. Ognyan Hristov are unquestionable.

8. Conclusion on the application

Having read the materials and scientific works submitted in the competition and based on the analysis of their significance and the scientific and scientific-applied contributions contained in them, **I confirm** that the scientific achievements meet the requirements of ZRASRB, the Regulations for its application and the relevant Regulations of SU "St. Kliment Ohridski" for the candidate to occupy the academic position of "professor" in the scientific field and professional direction of the competition. In particular, the candidate satisfies the minimum national requirements in the professional field and no plagiarism has been found in the scientific works submitted for the competition.

I give my **positive assessment** to the application.

II. GENERAL CONCLUSION

Based on the above, **I recommend** the scientific jury to propose to the competent authority for the selection of the Faculty of Mathematics and Informatics at SU "St. Kliment Ohridski" to elect Associate Professor Ognyan Borisov Hristov to occupy the academic position of "Professor" in professional direction 4.5. Mathematics (Differential equations, Hamiltonian systems).

14.10.2023 г. .....

Prof. Dr. Sci. Stefan Ivanov