REVIEW

Of Materials Submitted for Participation in Contest
For Occupying Academic Position Full Professor
in Professional Field 4.5. Mathematics
(Probability and Statistics),
At Sofia University "St. Kliment Ohridski",
Faculty of Mathematics and Informatics
Candidate: Ass. Prof. Ognyan Borisov Christov, DSci
Reviewer: Prof. Nadezhda Kostadinova Ribarska, DSci
October 29th, 2023

I am writing this review in my capacity as a member of the scientific jury, according to Order No. RD-38-519/29.08.2023 of the Rector of Sofia University.

Associate Professor Ognyan Borisov Christov, DSci is the only one candidate in the contest for occupying the academic position "full professor" in: scientific area 4. Natural Sciences, Mathematics and Informatics, professional field 4.5. Mathematics (Differential equations, Hamiltonian systems) for the needs of Sofia University "St. Kliment Ohridski", Faculty of Mathematics and Informatics, announced in State Gazette no. 56 of 30.06.2023 and on the Internet sites of FMI and Sofia University "St. Kliment Ohridski". He was born in 1959 in Lom. He graduated in the FMI of the Sofia University "St. Kliment Ohridski" in 1984. He acquired the degree of "candidate of mathematical Sciences" in 1994, and in 2017 he acquired the degree of "Doctor of sciences" after successfully defending his dissertation work titled "Algebraic, analytic and geometric studies on some finite- and infinite-dimensional Hamiltonian systems". In the period 1986 - 1989 he was an assistant professor at the Angel Kanchev Technical University, Ruse. From 1991 until now, he has been working at the University "St. Kliment Ohridski" – initially as an assistant professor (from 1991 to 2001), and from 2001 until now – as an associate professor. Associate Professor Christov was visiting professor at many prestigious universities around the world: 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.

Associate Professor Ognyan Christov has submitted for participation in the contest a full set of documents and materials, which complies with the

Regulations on the Academic Staff Development in the Republic of Bulgaria, the Regulations for their application and with the respective regulations for acquiring scientific degrees and holding academic positions of Sofia University "St. Kliment Ohridski".

Associate Professor Christov's scientific interests are in the field of differential equations with a focus on integrability and non-integrability of Hamiltonian systems. The importance of Hamiltonian systems in modern science is undeniable – they are used as models in a great part of physics and combine classical problems, modern methods, and extremely important applications. The candidate is an authority in his field.

Associate Professor Ognyan Christov is a teacher, who is valued and respected by the students at FMI. He he was tutoring students in linear algebra, geometry, analysis, ordinary and partial differentials equations, numerical methods and analytic mechanics. He lecturesd in Calculus 1 and 2, Ordinary differential equations and Partial differential equations. Particularly impressive is the variety of difficult elective courses led by him: Hamiltonian Systems and Chaos: analytical methods, Non-integrable dynamic systems and motion of a rigid body around a fixed point, Dynamical systems, Hamiltonian systems, Differentiable approach in theory of the general economic equilibrium, Analytical theory of differential equations, Calculus of variations and applications in economics, Algebraic groups and differential theory of Galois, Matrix groups (with A. Bozhilov). Furthermore he has lectured on dynamical systems for PhD students at the University of Tuzla, Bosnia and Herzegovina, in May 2011. For me personally particularly important are the lecture notes written by associate professor Christov: on Ordinary differential equations, Dynamical systems and Hamiltonian systems. I looked through them with pleasure and will use them on occasion. I am sure they are essential for students studying the disciplines in question. Associate Professor Ognyan Christov supervised 12 Master students who successfully defended their Master thesis and he was the scientific advisor of one doctoral student who successfully acquired his PhD degree – Georgi Georgiev (recently he became associate professor in our faculty).

Associate Professor Ognyan Christov is an active member of the scientific community. He has participated in many scientific projects with the National Scientific Fund of and with the Scientific Fund of University of Sofia.Moreover, associate professor Christov was the leader of three scientific projects with the National Scientific Fund , one of which was awarded the second prize of the Ministry of Education and Science. He was Head of the Differential Equations Department from April 2018 to March 2019, and recently he became the head of the Master program Mathematical Methods in Economics at FMI.

Associate Professor Ognyan Christov participates in the current competition with 6 peer-reviewed articles. One article is published in Nonlinear

Dynamics (with impact factor 5.022/2020 and falls into quartile Q1); three articles are published in journals, falling into groups with quartile Q2, one article is published in Advances in Mathematical Physics (quartile Q3) and one article is in Lecture notes in computer sciences (with impact rank 0.302/2018). The candidate is the only author of all articles in the list. None of these articles has been used in a previous procedure, and five of them were published in the last five years.

The scientific papers submitted for the competition satisfy the minimal requirements of the law (under Art. 2b, para. 2 and 3 of ZRASRB) and the additional requirements of Sofia University "St. Kliment Ohridski" for occupying the academic position "Full Professor" in the scientific area and the professional field of the competition. In fact, the minimal requirements are significantly exceeded.

Five of the six papers presented for the competition study the integrability/non-integrability of Hamiltonian systems, as well as the stability of the regular behavior of the trajectories under small perturbations (KAM theory). The techniques used are extremely difficult, requiring in-depth knowledge of geometry, analysis and algebra. The systems studied are important because they arise from and are used in a wide class of physical problems. The research presents a significant difficulty not only because of the complexity of the mathematical techniques, but also from a computational point of view. In some cases, numerical simulations have been made, which complement the theoretical considerations.

Articles [35] and [36] are devoted to the analysis of the Klein-Gordon lattice. In [35] this system is considered for a small number of degrees of freedom $n = 2, 3, 4, 5, 6$, and in [36] the general case with an arbitrary number of degrees of freedom is considered. Assuming periodic boundary conditions and a normal form of second order, depending on two parameters, a complete study (at least with respect to one of the parameters) of the integrability of the normal form of fourth order is made. I think that these results are a serious achievement of the candidate.

In [37], an analytic Hamiltonian with equilibrium at zero is considered. The second-order normal form is assumed to be positive definite, and the frequencies are in 1:2:2 resonance. The integrability of the normal form up to order four is studied. It is shown that for a large family of parameters this normal form does not admit an additional integral. Two cases of complete integrability are found, one of which cannot be explained by an available symmetry.

In the paper [38] the candidate proves that no other values exist of the parameters other than the known ones for which the Hénon-Heiles system is integrable using the Morales-Ramis approach.

In [39], again an analytic Hamiltonian with equilibrium at zero is considered, the second-order normal form is assumed to be positive definite, and the frequencies are in resonance 1:2:1:2. The integrability of the normal form of order three is studied by simplifying it to a normal form depending only

on four parameters. For the normal form thus simplified two new integrable cases are found and a non-integrability theorem is proved for the remaining parameter values.

The article [23] is devoted to the study of the stationary solutions of the Fisher-Kolmogorov-Petrovsky-Piskounov equation, assuming that the diffuse parameter $\varepsilon > 0$ is small. A singularly perturbed boundary-value problem is stated, estimates for the number of spikes and number of solutions to the boundary-value problem are given.

In total, Associate Professor Christov has published 40 articles in peer-reviewed scientific journals, which altogether have over 129 citations. The rank of the journals and the rank and the quantity of the citations are impressive and indicate that the candidate's works are appreciated by the mathematical community. The candidate is the only author of the majority of his publications, and almost all of his co-authors are PhD students or junior colleagues. This speaks of the leadership position of Associate Professor Christov.

No plagiarism was found in the publications submitted for assessment.

I have known associate professor Ognyan Hristov for more than 40 years. I admire his uncompromising integrity, his collegiality and above all his great desire to make new mathematics and new mathematicians. I have witnessed the respect of his colleagues.

CONCLUSION:

The scientific achievements of Associate Professor Ognyan Christov, both in terms of quality and quantity, do not leave any doubt in the positive assessment of his research and pedagogical activity.

I strongly recommend the scientific jury to prepare a report-proposal to the esteemed Faculty Council of the Faculty of Mathematics and Informatics of Sofia University to elect Associate Professor Ognyan Borisov Christov for the academic position "Full Professor" of Sofia University "St. Kliment Ohridski" in Scientific Area 4. Natural sciences, Mathematics and Informatics, Professional field 4.5. Mathematics (Differential equations, Hamiltonian systems).

29.10.2023

(Prof. N. Ribarska, DSci)