PEER REVIEW

of a competition for the academic position "Associate Professor"
at FMI of the Paisii Hilendarski University of Plovdiv,
higher education field 4. Natural sciences, mathematics and informatics,
professional field 4.5. Mathematics (Computational Mathematics),

published in Newspaper of State, issue 31 of 12.04. 2019.

The peer review is prepared by Prof. Dr.Sci. Stefka Nikolaeva Dimova,

Sofia, j.k. “Hristo Smirnenski”, bl. 62, A, ap. 54

By order No P33-3779 / 12.07.2019 of the Rector of the Paisii Hilendarski University of Plovdiv I have been appointed a member of the Scientific Jury in the field of higher education 4. Natural sciences, mathematics and informatics, professional field 4.5. Mathematics (Computational Mathematics).

The only candidate in the announced competition for Associate Professor is ass. prof. Dr. Pavlina Hristova Atanasova. All required documents for participation in the competition (in paper and electronic form) are properly prepared and arranged.

Overall opinion on the works presented in the competition.

In order to participate in the competition, the candidate submitted 19 scientific publications, 3 of which have been presented in the competition for Assistant Professor, as well as 3 teaching materials.

From the scientific publications 3 are single-author papers, 3 are with two co-authors, 5 - with three co-authors, 8 are with five or more co-authors. Pavlina Atanasova has been working for 6 years in the Laboratory of Information Technologies (LIT) of the Joint Institute of Nuclear Research (JINR) in Dubna, Russia, in research teams dealing with important applied problems, and it is naturally a part of her works to be co-authored with specialists at LIT and the Laboratory of Theoretical Physics (LTP). In addition, large-scale application tasks require the creation of interdisciplinary teams, bringing together specialists in the specific subject area, in the field of computational mathematics and computer science (numerical methods and algorithms, programming at different levels).

The most widespread thematic area in the candidate's works presented is a Numerical Study of Josephson Structures, so widely used in modern technology and with even greater future prospects. It is a continuation of the research in the doctoral thesis of Dr. P. Atanasova. The tools for investigation of such problems are mathematical modeling and computational experiment as a methodology for scientific and applied research. **The main contributions in these studies are: the successful combination of relevant modern numerical methods for solving nonlinear multi-parameter problems; creation of algorithms and program complexes; conducting a detailed numerical experiment to study the processes in such structures**.

Parallel to the diversification and complication of the physical structures - long Josephson junctions (LJJ) without (works 3 and 5) and taking into account the second harmonic in the decomposition of the Josephson current in the Fourier series (works 4, 6, 7, 8, 10), multilayered Josephson Structures (stacks) (works 11, 13, 14, 16) and Josephson Structures under the Impact of Magnetic Impulses (works 18 and 19) - also undergo the diversification and complication of the corresponding mathematical models. These are: the perturbed sine-Gordon equation, its stationary variant and the corresponding Sturm-Liouville problem, the double sine-Gordon (SG2) equation, systems of ordinary differential equations (ODEs), systems of nonlinear partial differential equations (PDEs).

Appropriate numerical methods and algorithms were used to study the mathematical problems - a continuous analog of the Newton method for solving nonlinear stationary differential problems; finite difference methods for solving the linear problems arising at each step of the iteration process - fourth-order Numerov method; three-point space approximation and fourth-order Runge-Kuta method for the nonlinear system of PDEs; a two-step Gauss-Legender method for stiff systems of ODEs. These methods have been computer implemented and impressive numerical experiments have been made to study the processes in the various Josephson structures.

I was particularly impressed by the works 6 and 10 (joint works with E. Zemlyanaya), where a bifurcation analysis of the static magnetic flux distributions in long Josephson junctions, described by SG2, is made. The numerical study approach itself is interesting - instead of solving the initial boundary value problem for the PDE, a nonlinear boundary value problem for the ODEs system, obtained by jointly solving the relevant stationary and Sturm-Liouville problems, is solved. The same approach is used in papers 7 and 8 (jointly with E. Zemlyanaya and N. Alekseeva), where the existence of coherent flux configurations described by SG2 is investigated.

In her author's report, the candidate writes that the numerical experiments in works 6 and 10 were performed by using the program complex she had created. In both works, there is no mention of such program complex. The same applies to "a new software complex was developed in analogy with the one used in [5]", but neither in 5 nor in 4 such complex is mentioned.

The complexity of the model in the case of multi-layered Josephson structures (PDE system) and taking into account of the inductive and capacitive coupling between the individual junctions, necessitates the use of modern computing architectures and parallel implementation of the algorithms. Papers 11 and 13 present two variants of parallel implementation of I. Rachmonov's algorithm for solving the PDE system and for calculating the current-voltage (CV) characteristics by using the MPI technology. The efficiency of the two algorithms is compared. The works 14 and 16 contain the results of investigation of the physical characteristics of the Josephson junctions system (number and length of the junctions) and their effect on the electromagnetic radiation. It should be noted that the studies were performed in the case of a weak inductive coupling between the stacked junctions (S = -0.05), but strong radiation can be obtained (as shown by the real experiments) at a very strong one (S ~ -0.499…). This substantially complicates the computational task and I suppose it will be a subject of future research.

Wolfram Mathematica-based user software is developed by the candidate to solve the ODE system that describes processes in JJ under the action of magnetic impulses. In the case of a stiff ODE system, the two-step Gauss-Legendre method (implicit Runge-Kutta method) is implemented.

Two papers in the area of Analytical Studies are presented: work 12 on the existence of continuous solutions of Volterra linear integral equations and work 15 on the impulse differential equations.

The candidate participates in the competition also with 3 teaching materials, 2 of which are single-author works and they are editions of the Paisii Hilendarski University Publishing House - Plovdiv. For the teaching material, which is a joint work, a Distributing Protocol is presented certifying the equal participation of the co-authors. I think that the developed teaching materials are very useful both to the students for whom they are intended and for the teachers in their work on illustrating the theory and the practice of the numerical methods for solving different classes of mathematical problems.

Reference to the publications and the citations
of ass. prof. Dr. Pavlina Atanasova

Three of the 19 scientific papers presented in the "Associate Professor" competition are in Impact Factor journals (overall IF = 3.021 - based on Web of Science), with grades Q2, Q3 and Q4 respectively; 9 publications are in SJR indexed journals (total SJR = 2.206).

The works of Ch. P. Atanasova have not been submitted for the acquisition of the educational and scientific degree "Doctor" (2011), which satisfies the requirements within the meaning of the ZRASRB, the Rules for the implementation of the ZRASRB and the Rules of the Plovdiv University "Paisii Hilendarski"

The candidate provides a list of 12 citations, 7 of which are in journals with IF (total IF = 6.759) and grades Q1 to Q4. Unfortunately, the citations with numbers 5 and 8 are duplicated, but after the reduction the requirements of the law are still fulfilled.

Thus, the minimum national requirements for points by groups of indicators for the acquisition of the academic position “Associate Professor” are fulfilled.

The additional requirements of the FMI at Plovdiv University for holding the position are fulfilled, namely - at least 5 publications in journals; at least 3 publications in IF journals and evidence of at least 5 citations.

I have not found "plagiarism" in the candidate's works within the meaning of the ZRASRB.

Assistant professor P. Atanasova has participated in 17 research and educational projects (4 national and 13 international, mostly joint projects with JINR-Dubna). The applicant is the leader of 9 projects.

CONCLUSION.

From all that has been said so far about the works of ass. prof. P. Atanasova presented for the competition, is clear that they have made serious contributions in the field of computational mathematics and its application for investigation of serious and important scientific and scientific-applied problems. Having in mind also her very good teaching and learning activity, I am fully convinced that assistant professor Pavlina Atanasova meets the requirements of the ZRASRB, the Rules for the

implementation of the ZRASRB, the Rules of the Plovdiv University “Paisii Hilendarski” for application of the ZRASRB for the occupation of the academic position "Associate Professor".

My conclusion on borrowing from ass. prof. Dr. Pavlina Hristova Atanasova, the academic position "Associate Professor", announced in the competition, is POSITIVE.

I propose to the distinguished scientific jury to unanimously propose to the Faculty Council of FMI, PU “Paisii Hilendarski” to select the candidate Assistant Professor Pavlina Hristova Atanasova for the academic position “Associate Professor” in the field of higher education 4. Natural sciences, mathematics and informatics, professional field 4.5. Mathematics (Computational Mathematics).

05.09.2019 Signature: .....

Sofia /Prof. Dr.Sci. Stefka Dimova/