

REVIEW

by Prof. Nedyu Ivanov Popivanov, Doctor Habil,
Institute of Information and Communication Technologies, BAS
in a competition for the academic position "Associate Professor"
for the needs of the Institute of Mathematics and Informatics - BAS,
by professional field 4.5. Mathematics, specialty "Differential Equations",
published in the State Gazette, issue 30 of 13.04.2021,
with a single candidate: Assistant Professor Dr. Borislav Tsonev Yordanov

1. Data for the competition

By order 105 of 15.06.2021 of the Director of the Institute of Mathematics and Informatics - BAS, I was appointed as a member of the scientific Jury of the cited competition. Only Assistant Professor Dr. Borislav Tsonev Yordanov submitted documents for participation in it. At the first meeting of the jury I was appointed as a reviewer. I present the review within the period provided in the regulations.

2. Details of the candidate

As. Dr. Borislav Yordanov was born in 1967. He graduated with a Master's degree in Mathematics from the Faculty of Mathematics and Informatics at Sofia University "St. Kl. Ohridski" in 1991, with research supervisor Vladimir Georgiev, currently Professor, Doctor Habil, University of Pisa, Italy. In 2002 Borislav Yordanov defended his dissertation and received a PhD degree from the University of Wisconsin - Milwaukee, USA (recognized in 2014 for educational and scientific degree "Doctor" in Bulgaria). The topic of the dissertation is: "Global solutions of nonlinear wave equations with damping".

Over the years, the candidate in the competition has held various research positions: at the Institute of Mathematics and Informatics - BAS he was a research associate between 1994 and 1998, an associate member in the period 2010 - 2013, and since 2013 he has been an assistant. Since 2002, he has held teaching and research positions successively at the University of California-Riverside, the University of Tennessee-Knoxville (USA), and at Hokkaido University (Japan), where he still works. The candidate's CV also shows that he has a solid pedagogical activity. He speaks English and Russian.

I received the following documents electronically:

1. Заявление_Йорданов.pdf
2. Autobiography_EO_Yordanov.pdf
- 3.1. diploma_magistar.pdf
- 3.2. diploma_magistar_prilozhenie1.pdf
- 3.3. diploma_magistar_prilozhenie2.pdf
- 4.1. diploma_phd_bulgaria.pdf 4. diploma_phd_usa.pdf
6. List of _publications_Yordanov.pdf
7. List_of_publications_for_the_Jordanov_competition.pdf
8. Научни приноси_Йорданов.pdf 9. Резюме на публикации_Йорданов.pdf
11. General list of citations.pdf

12. Цитирания за конкурса Йорданов.pdf
 13. State Gazette no. 108.pdf 14. udostoverenie_stazh.pdf
 19. Declaration_Jordanov_3.2.pdf
 20. Declaration_Jordanov_4.2.pdf
 Table-4-docent-IMI-2.2-Bjordanov_korigirana.pdf

3. General description of the presented scientific papers

The overall work of the only candidate in the competition, Assistant Dr. Borislav Yordanov (see "6. List of _publications_Yordanov.pdf") includes a total of 24 papers. For the present competition, he has submitted 18 scientific publications (see 7, above) with which he has not participated in other procedures. Of these, 12 are in Q1, 3 in Q2, 2 in Q3 and 1 in Q4. All presented publications are in the field of the announced competition and are published in prestigious and leading scientific journals in the field of differential equations: Journal of Differential Equations - 4 publ., Nonlinear Analysis - 2, Transactions of the American Mathematical Society -2, Journal of Mathematical Analysis and Applications -1, SIAM J. Math. Anal. - 2, J. Funct. Anal.- 1 et al. All are co-authored, with one or more co-authors from abroad. There is no formal division of results, so I accept equal participation for joint publications. For me, there is no doubt that the candidate has a great real personal contribution in all publications, but what exactly he is - I could not fix. The author has convincingly proved his ability to work with a number of colleagues, which is a definite positive quality.

I will explicitly note that the "Requirements for the scientific title of Associate Professor", adopted by IMI-BAS, have been met. This can be easily traced from (see Table-4-docent-IMI-2.2-Bjordanov_corrected.pdf). I will only note that the smaller number of points from projects is offset by the larger number of points from high quality publications. I will not go into details on this point!

4. General characteristics of the scientific activity of the candidate Apart from the most recent publication [1] from 2021, where elliptic equations are studied, the rest [2–18] of the presented scientific articles are related to the study of the behavior of solutions of Cauchy problems for linear or semilinear hyperbolic partial differential equations. . Here I will make a more general note, trying to explain more simply (even for non-specialists) the topic. A significant part of the results in the field of nonlinear analysis is related to in-depth research in the field of nonlinear (or semi-linear) partial differential equations. In this case, depending on the type of equations, either boundary value problems in a boundary domain or Cauchy-type problems are investigated. The first case is more typical of elliptic equations (including in recent years and, for example, for problems with fractional Laplacian in bounded domains, with inhomogeneous boundary data), and the Cauchy problem, or mixed problem, is studied for evolution equations and even for equations changing their type in the considered area. Moreover, since the

fundamental result of Pokhozhaev (1965) compared to the most elementary case of Laplacian with a degree addition, several cases arise depending on the degree of growth: subcritical, supercritical and, of course, critical, which is the most difficult to study. This critical indicator is related to a variety of important parameters for the equation and for the respective functional spaces. For example, in elliptic equations it is related to the classical identity of Pohozaev (proven, for example, for fractional Laplacian in 2014). Depending on the growth of the degree of nonlinearity, there may be a result for the non-existence of non-trivial solutions - in the super-critical case, or on the contrary - the existence of more than one non-zero solution in the sub-critical case. The most delicate is the critical case, when the additions are much more complex! In hyperbolic or diffusion equations, the critical parameters are determined relative to other parameters. There arise other situations related to the global existence (or non-existence) of a solution, exploding solutions, etc. Below I will comment in particular on these situations regarding the candidate's results.

We will follow the thematic classification of the works proposed by the candidate in his author's reference for the contributions:

A. Low-frequency approximations of the solutions of wave equations with linear attenuation and their applications In this direction belong publications [6, 10, 11, 12, 14].

B. Asymptotic behavior and smoothness of solutions of nonlinear attenuation wave equations [4, 5, 7, 13, 16]

C. Absence of global solutions of wave equations with power nonlinearity [2, 3, 17, 18].

4.1. Scientific contributions in thematic areas:

I will start with the results of C, i.e. articles [17, 18], as well as newer [2, 3], and I will illustrate the effects described above. In [17, 18], published in 2005 - 2006, a wave operator with a nonlinear addition of the type $|u|^p$ is considered. In the supercritical case - ie. for values of p greater than the critical Strauss index $p_0(n)$ (root

of a quadratic equation), the Cauchy problem is globally solvable. In the subcritical case, however, ie. $1 < p < p_0(n)$ the solution explodes for a finite time. In [17] it was found that the solution explodes in the critical case $p = p_0(n)$, but at $n > 3$. In [18] for an equation in which a positive potential is added, an explosion of the solution is shown again at $1 < p < p_0(n)$. The more recent works [2, 3] from 2019 again show the burst of the solution in the critical case, but in a more complex situation when the hyperbolic operator in the equation has variable coefficients and time-dependent scattering attenuation for $n \geq 2$. Lai and Takamura in 2018. have obtained a result for the explosion of the solution in the subcritical case $1 < p < p_0(n)$. In [2] this result is also extended for the critical case, using techniques from [3]. Estimates of the lifetime of the solution have been found. Series A, which includes articles [6, 10, 11, 12, 14], investigates Cauchy problems for dissipative wave equations with compact initial data. The technique also works in the presence of a linear attenuation, ie in the presence of a linear term with a minor derivative u_t .. In the works [11, 12] the linear homogeneous equation is considered, and in [14] - semi-linear to the global existence (or non-existence) of a solution, exploding solutions, etc. Below I will comment in particular on these situations regarding the candidate's results.

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Series A, which includes articles [6, 10, 11, 12, 14], investigates Cauchy problems for dissipative wave equations with compact initial data. The technique also works in the presence of a linear attenuation, ie in the presence of a linear term with a minor derivative u_t . In the works [11, 12] the linear homogeneous equation is considered, and in [14] - semi-linear equation with a nonlinear source of the form $|u|^{p-1}u$. With the help of appropriate weight energy estimates, the rate of decrease of the L^2 norm is estimated from the spatial variables of the solution when time t tends to infinity. The asymptotic behavior of the solutions of the linear equation at increasing t has been studied in [6, 10]. It is shown that their behavior is comparable to that of the solution for the corresponding parabolic equation and an estimate is obtained for their difference. That is, the so-called "abstract diffusion" is observed.

The articles from **cycle B**, i.e. [4, 5, 7, 13, 16] are devoted to Cauchy problems for wave equations with n spatial variables with more complex nonlinear attenuation of the form $|u_t|^{m-1}u_t$. In [4, 16] it was proved that the energy decreases polynomially at $1 < m \leq (n+2)/(n+1)$, which amplifies a previous result for a logarithmic decrease rate. For $m = 3$ and $n = 3$ for the radially symmetric case in [13] the existence and uniqueness of a k -smooth solution of the Cauchy problem with radial initial data for $u|_{t=0}$ and $u_t|_{t=0}$ by H^k and H^{k-1} , in general $k > 2$. In the case of radial initial data, the results are continued in [5] and for $m > 3$ using one-dimensional case techniques. The result obtained, in a sense, is a continuation of the result of Lions and Strauss.

For dimension $n = 3$, nonlinear attenuation equations are considered in [7].

4.3. Common feature

I find the topic interesting and difficult, and the author - very well informed in it. He actively uses the necessary technical apparatus, which allows him to overcome the many problems that have arisen. Having in mind the presented materials, As. Dr. Jordanov presents himself as a serious researcher, with a strong theoretical and applied orientation!

4.4. Citation

The relevance and significance of scientific contributions for me are indisputable. They even follow from the fact that most of the publications are in good specialized editions with impact factor or impact rank. I cannot fail to mention here the fruitful cooperation of the candidate with a number of co-authors from abroad. The citation data provided by the candidate can be summarized as follows: from the full list of 21 scientific papers of Assistant Professor Dr. B. Yordanov, Scopus noted 503 citations. I think this is a great achievement! In conclusion - the citation of the candidate deserves high praise and speaks of the indisputable popularity of certain of his results among the scientific community around the world. In addition, it significantly exceeds the citation requirements of the Rules of IMI-BAS.

4. Other findings relevant to the final evaluation

Teaching work I cannot give the applicant enough information on this activity from the submitted documents. However, the CV takes a serious study abroad. I do not find data on successfully defended PhD students of the candidate. Project activity According to the documents: the applicant does not have an active project activity, corresponding to his high scientific potential, reflected in his publications! I believe that he will be actively involved in this activity as well. 6. Remarks and recommendations I have no remarks and recommendations, except for those under item 5. 7. Personal impressions I do not know the candidate.

CONCLUSION:

Based on the above, it is clear that the only candidate in the announced competition, Assistant Professor Dr. Borislav Yordanov, fully meets the requirements of ZRASRB, the Regulations for implementation of ZRASRB, as well as the Regulations on the terms and conditions for holding academic positions at the Institute of Mathematics and Informatics - BAS. I believe that the scientific and teaching qualification of Assistant Professor Dr. Borislav Yordanov makes him worthy of the academic position of "Associate Professor".

The achieved scientific results by the candidate give me full grounds to propose to the scientific jury to evaluate positively Assistant Professor Dr. Borislav Yordanov for Associate Professor at IMI - BAS in Professional field: 4.5 Mathematics, specialty Differential Equations and to propose to the Scientific Council of IMI-BAS to be elected to this post.

08/10/2021
Sofia

Signature:
/ Prof. Nedyu Ivanov Popivanov /