R E V I E W

by Prof. DSc Ludmil Kirilov Hadjiivanov (INRNE-BAS),
member of the scientific jury in the competition
for the academic position of "Associate Professor"
in professional field 4.5 "Mathematics",
scientific specialty "Mathematical Methods in Physics"
(Algebraic and Statistical Methods),
announced in the State Gazette, issue 89 from October 16, 2020

This review was prepared in compliance with order no. 216/14 Dec 2020 of the Director of IMI-BAS Acad. Veselin Drenski issued on the basis of art. 4 (2) of the Act for the Development of the Academic Staff in the Republic of Bulgaria, art. 2 (2) of the Regulations of its application, following a decision of the Scientific Council of IMI-BAS (record no. 11/27 Nov 2020). The review itself complies with the requirements of the Act for the Development of the Academic Staff in the Republic of Bulgaria, the Regulations for its implementation and the Regulations of the Institute of Mathematics and Informatics (IMI) at BAS.

As a member of the scientific jury I received all the documents submitted by the only applicant to the competition, Dr. Veselin Georgiev Filev.

Biographical data about the candidate

Vesselin Filev was born in 1979. He graduated from the Faculty of Physics at Sofia University "St. Cl. Ohridski" receiving a BSc degree in Physics (specialization "Theoretical Physics", with excellent results) in 2002, and a MSc degree (specialization "Theoretical and Mathematical Physics") in July 2003. Over the next few years he worked at the University of Southern California in Los Angeles on a dissertation on "Aspects of the holographic studies of flavor dynamics", which he defended on June 16, 2008. (The text of the dissertation is available at arXiv:0809.4701. Copies of the original PhD diploma from USC and of the corresponding certificate issued by BAS with no. 000066/20 Apr 2018 for its legalization, recognizing the "Doctor" degree in Theoretical and Mathematical Physics, are attached to the documents.) In the following years Dr. Vesselin Filev held postdoctoral positions in prestigious research centers in Europe such as the Institute for Advanced Study in Dublin, Ireland and the Max Planck Institute in

Munich, Germany. In the spring of 2017 he obtained an Assistant Professor position at the Institute of Mathematics and Informatics at the Bulgarian Academy of Sciences. In March 2019 he won a competition for Chief Assistant Professor at IMI, a position he currently occupies. Since the beginning of 2020 he has been a part-time lecturer at the American University in Blagoevgrad.

Fulfillment of the scientometric requirements

The current legislation of the so-called "development of the academic staff" in the institutes of the Bulgarian Academy of Sciences requires the implementation of the general minimum requirements for the respective scientific field, formulated in the Act and its regulations, which can be possibly modified (but not reduced) in the relevant Regulations of BAS and the institute in question. Thus, in our case the threshold scientometric requirements for participation in a competition for the academic position of "Associate Professor" are those formulated in Art. 2 (1) and Art. 3 (1) item 2 of Chapter Two of the existing Regulations on the terms and conditions for acquiring scientific degrees and for holding academic positions at the Institute of Mathematics and Informatics at the Bulgarian Academy of Sciences (last edition from 19 July 2019).

These requirements are as follows (by groups):
Group of indicators A – 50 points
Group of indicators Б – 0 points
Group of indicators В – 100 points
Group of indicators Г – 220 points
Group of indicators Д – 70 points
Group of indicators Е – 20 points.
In addition, at least 5 of the applicant's publications should be in journals with IF or SJR.

For the present competition Dr. Veselin Filev has presented certificates for the implementation of the above threshold requirements, as follows:
Group of indicators A – 50 points (availability of a PhD thesis, see above);
Group of indicators B – 100 points for 2 scientific publications in refereed journals indexed in Web of Science Q1, carrying 50 points each;
Group of indicators Г – 220 points for scientific publications in journals that are refereed and indexed, respectively

- in Web of Science Q1: 4, giving 50 points each (total of 200), and
- in Scopus: 1, giving 20 points;

Group of indicators Д – 72 points for 12 citations in scientific journals indexed in Web of Science, giving 6 points/citation;

Group of indicators Е – 2 x 10 points for participation in the following two contracts with the National Fund for Scientific Research:

- contract DN 08/3 "Gauge/gravity duality, black holes and string compactifications" from 2016;
- contract KP-06-N28/5 "Fundamental laws and holography" from 2018.

Six of the seven candidate's papers in groups В and Г appeared in the period 2016-2019 and one, in 2012. None of them has been used in previous procedures (Veselin Filev applied to the competition for Chief Assistant with two independent papers published in 2009 and 2014, respectively); this fact is also documented in the attached declaration of the applicant. All citations in Group Д are of four of the same seven papers.

The attached lists of a total of 38 scientific publications (of which 34 in journals with impact factor, 32 in the first quartile Q1, 28 in JHEP and 3 in Phys. Rev. D) and 813 observed independent citations (h-index 14) show that Dr. Veselin Filev actually participates in the competition with a small part of his scientific production.

Research activity and scientific contributions of the candidate

Of the 7 scientific papers of Dr. Veselin Filev submitted for the competition, 4 are with one co-author, 1 – with two and 2 – with three co-authors. Six of these papers are published in JHEP [IF (2019) = 5.875] and one in the Proceedings of the Corfu Summer School 2015, published in Proceedings of Science [SJR (2015) = 0.117]. No declarations were submitted by the co-authors about the individual contribution of the candidate but an indirect evidence that it is significant is provided by the fact that in all journal articles the names of the authors appear in alphabetical order and Veselin Filev appears three times as first and three times as second author. (The only exception is in the Proceedings of the Corfu Summer School where the talk was delivered by Denjoe O'Connor who thus naturally appeared as first author in the article.) The submitted 7 works have been cited more than 80 times by independent authors, and [1] and [3] alone (according to the numbering of the

literature in the attached Summary of the original scientific contributions) have a total of nearly 60 citations.

The above mentioned Summary itself reflects very well, in a concise form, the goals, the content and the contributions in the papers submitted by candidate. All of them are devoted, generally speaking, to the study of various manifestations of the so-called "holographic principle", connecting (in the sense of equivalence) a certain physical theory defined in a given volume with another, "living" on the border of the latter. Although various versions of this idea can be traced in earlier studies, it became famous after the appearance of Juan Maldasena's paper (in preprint form, in late 1997), in which arguments were put forward in favor of the hypothesis concerning the existence of a specific duality which acquired popularity under the name of 'AdS/CFT correspondence'. In its original form, the correspondence occurs between supergravity in a space with certain geometry (metric) and a conformal gauge theory (supersymmetric Yang-Mills) defined on its boundary. One of the key features of the duality is that the two theories are in opposite regimes with respect to the parameter characterizing the respective interaction (strong/weak coupling). To date, with its more than 16 000 citations, Maldasena's paper is the most cited publication in the field of theoretical physics ever. There are various reasons for this exceptional interest.

On one hand, the experimental confirmation of the existence of the Higgs boson in 2012 by two different LHC detectors was undoubtedly a triumph of the so-called Standard Model involving three of the four known interactions of elementary particles. When applicable, the perturbative calculations within the model have been confirmed experimentally, sometimes with a fantastic accuracy (for the anomalous magnetic moment of the electron the relative difference between the theoretical and experimental value $1 - a_{exp}/a_{th}$ is presently of the order of 10^{-12}). On the other hand, the first recording of gravitational waves in 2015 by the LIGO experiment confirmed an early prediction of Einstein's General Theory of Relativity that remained hypothetical for a century. Undoubtedly, such examples support our confidence in the predictive capabilities of the existing theoretical models.

Albeit looking stable, this construction however involves not only a number of unsatisfactory details but, more importantly, also significant conceptual weaknesses. We will only mention two well known problems illustrating this fact. A key issue such as quark confinement in Quantum Chromodynamics (QCD, the

color SU(3) gauge theory which provides the strong interaction part of the Standard Model) only allows a qualitative solution, as it is a typical example of strong coupling and hence, a non-perturbative phenomenon. Einstein's theory of gravitation, on the other hand, is a classical theory and does not have by itself a meaningful quantum field theoretical version.

Hopefully, superstring theory (or more precisely, the so-called M-theory) provides a possible solution to the latter problem. Used in both directions, the holographic principle, in turn, provides both conceptual and new technical possibilities for the study of different regimes in various interesting models, including QCD and some pertinent to condensed matter theory. These are just a few of the reasons for the great interest in this important and very competitive field of modern theoretical physics. The fact that the work of Dr. Veselin Filev in this field is definitely well received speaks by itself about its high quality.

The papers submitted for the competition are based on an extension of the original AdS/CFT correspondence that leads to gauge models including massive fields in the fundamental representation of the gauge group which makes them more realistic (the original AdS/CFT correspondence only involves fields in the adjoint representation). This is achieved by introducing appropriate additional flavour D_q-branes in the dual string theory in two different cases [1, 2]; an external magnetic field is also introduced. In the first article the so-called magnetic catalysis of the spontaneous breaking of chiral symmetry is investigated while in the second the phase structure of the gauge model is explored and a second order phase transition critical point is found. In [3, 4, 5, 6, 7] various thermodynamic properties of several matrix models (BFSS, Berkooz-Douglas, BMN) are studied by performing computer simulations. The obtained results are shown to agree with the predictions based on the holographic correspondence and thus provide positive tests for the relevant versions of the AdS/CFT.

Teaching activity

Dr. Veselin Filev has taught the following courses at the American University in Blagoevgrad in the calendar year 2020:
1. Finite Mathematics, spring and autumn semesters - 50 hours each
2. Statistics, spring semester - 50 hours
3. Mechanics and Thermodynamics (PHY110), spring semester - 50 hours

Evidence of lack of plagiarism

I am not aware of any sign of plagiarism in the scientific works of Dr. Veselin Filev. The mere fact that most of his papers have been published in the highly respectable Journal of High Energy Physics (JHEP), a refereed online journal published since 2010 by Springer (and before that, between 2002 and 2009, by IoP) and as electronic preprints in the arXiv (where algorithms for checking matches in the texts have been adopted) make a fraud practically impossible.

Personal impressions of the candidate

I have known Veselin Filev since 2003 when I was a reviewer of his master's thesis defended at the Faculty of Physics at Sofia University "St. Cl. Ohridski". At the time he impressed me with his in-depth knowledge of the area he was working in. Although sporadic, our further meetings and conversations, as well as his scientific talks which I attended, only confirmed my high opinion of his scientific qualities.

Conclusion

According to the submitted documents, the only candidate in the competition, Dr. Veselin Filev fulfills all the requirements of the Act for the Development of the Academic Staff in the Republic of Bulgaria, the Regulations for its implementation as well as the Regulations of the Bulgarian Academy of Sciences and of the Institute of Mathematics and Informatics at BAS containing the specific additional requirements for acquiring scientific degrees and holding academic positions. All my personal impressions and the available additional information support the conclusion that he is an internationally recognized expert in the scientific field of the competition. **I give a positive assessment of Dr. Veselin Filev's application for this competition and I recommend the esteemed members of the jury to propose the Scientific Council of the Institute of Mathematics and Informatics at BAS to elect Ass. Prof. Dr. Veselin Georgiev Filev for the academic position of "Associate Professor" at IMI-BAS in professional field 4.5 "Mathematics", scientific specialty "Mathematical Methods in Physics" (Algebraic and Statistical Methods).**

Sofia, February 15, 2021

Reviewer: ………………………
(Prof. DSc L. Hadjiivanov)