OPINION

for the competition for the academic position "Associate Professor"
announced by the Institute of Mathematics and Informatics
at the Bulgarian Academy of Sciences
in Newspaper of State, No. 89 of 16.10.2020
Field of Higher Education: **4. Natural sciences, mathematics and informatics**
Professional Field: **4.5 Mathematics**
Scientific Specialty: **Mathematical Methods in Physics**
(Algebraic and Statistical Methods)

Written by: **Vesselin Stoyanov Drensky,** Full Member of the Bulgarian Academy of Sciences, Dr.Sci., Professor at IMI–BAS
The only applicant: **Chief Assistant Professor Dr. Veselin Georgiev Filev** from IMI–BAS.

1. **Biographical data.** Chief Assistant Professor Dr. Veselin Filev graduated at the Faculty of Physics at Sofia University "St. Kliment Ohridski", specialty "Physics", specialization "Theoretical and Mathematical Physics" with a Bachelor's Thesis "AdS/CFT Correspondence in String Theory" and a Master's Thesis "Semiclassical Analysis of a Rotating String in Pilch-Warner Geometry" under the supervision of Prof. Radoslav Rashkov. He defended his Ph.D. Thesis "Aspects of the Holographic Studies of Flavordynamics" at the University of Southern California in Los Angeles in Theoretical and Mathematical Physics under the supervision of Prof. Clifford Johnson. The diploma was legalized by BAS in 2018. After that he was a postdoctoral fellow at the Institute for Advanced Studies in Dublin, Ireland, at the Max Planck Institute in Munich, Germany and again at the Institute for Advanced Studies in Dublin. Since March 2017 he has been an Assistant Professor at the Department of Algebra and Logic at IMI-BAS, and since March 2019 he has been a Chief Assistant Professor. Since the beginning of 2020 he has been an Adjunct Assistant Professor at the American University in Bulgaria.
2. **General characteristics of the research activity of the applicant.** The entire scientific career of Dr. Veselin Filev, since the time when he was a bachelor student and until now, is in modern fields of theoretical and mathematical physics. I would like to especially mention his aspiration to publish in the most authoritative journals in the field since his student years. His scientific productivity is really impressive. He is the author or co-author of 38 scientific publications, of which 34 are with impact factor (32 in quartile Q1 and one in each quartile Q2 and Q4), and 3 papers are with impact rank (SJR). In 3 of the papers the applicant is the only author, 15 papers are with one co-author, 9 – with two co-authors and 11 – with three co-authors. In my opinion, the joint publications are typical for the field, because various methods and techniques are used. In addition, for me this is a proof that Dr. Veselin Filev works very successfully in a team. He has joint publications with 20 other specialists, including world-renowned scientists. Among them are the scientific advisor of the Ph.D. Thesis Prof. Clifford Johnson (8 joint papers during his Ph.D. years) and the director of the School of Theoretical Physics at the Institute for Advanced Studies in Dublin Prof. Denjoe O'Connor (12 joint papers). I want also to mention that the applicant has presented a list of 813 citations of his papers. The most cited paper (published in 2007) has 145 citations, which in my opinion is an excellent achievement.
3. **General description of the submitted materials.** The applicant has submitted for his participation in the competition 7 scientific publications in journals published in the period 2012–2019. Of the papers 6 are in quartile Q1 (all in the Journal of High Energy Physics) with an impressive total impact factor of 36,819 and one is in the Proceedings of the Corfu Summer Institute 2015 with SJR 0,117. One of the papers is joint with Radoslav Rashkov, 2 – with Yuhma Asano, Samuel Kováčik and Denjoe O'Connor, 3 – with

Denjoe O'Connor and 1 – with Johanna Erdmenger and Dimitrios Zoakos. **The applicant has declared that these 7 papers have not been used before for other procedures.** They have been cited a total of 73 times. To participate in the competition, the applicant has submitted a list of 12 citations to 4 of these papers. Both the citing and the cited papers are in quartile Q1. **The presented table shows that the applicant fully satisfies the minimal requirements of IMI for participation in a competition for "Associate Professor".** In addition, **I did not find any plagiarism in the publications submitted for the competition.** An indirect proof of this is that the journals in which the papers are published are known for their thorough review of the submissions.

4. **Main scientific and scientific-applied contributions.** I shall briefly discuss the main results contained in the submitted papers of the applicant, as well as my evaluation of them. In the description of his scientific contributions the applicant has divided his publications into two groups: (1) Direct application of the extended AdS/CFT correspondence for Dp/Dq brane systems (papers [1] and [7] from the list of publications for participation in the competition); (2) Computer simulations of matrix models for direct testing of a low-dimension version of the AdS/CFT correspondence (Papers [2-6]).

   As the applicant notes in the description on his contributions, the publications for his participation in the competition are related to the holographic principle in the modern theory of quantum gravity and in particular to various generalizations of the AdS/CFT correspondence. The holographic principle is a tenet in string theories that assumes the property of quantum gravity that the description of a volume of space is encoded in the properties of the boundary of the domain, which is of lower dimension. As early as the late 1970s, it was noticed that string theory allowed a lower-dimensional description in which gravity appeared in what we would now call holographic. A typical example of such a holography is the AdS/CFT correspondence (AdS/CFT = Anti-de Sitter/Conformal Field Theory) or gauge/gravity duality. The correspondence provides a connection between two physical theories. On the one hand, these are the spaces of de Sitter, which are studied in the theories of quantum gravity in the language of string theory. On the other side of the correspondence are the conformal field theories, which refer to quantum field theories similar to the Yang-Mills theories for the description of elementary particles. The duality provides great opportunities for understanding both string theory and quantum gravity. As a proof of the important place that the AdS/CFT correspondence has in modern theoretical and mathematical physics, I would note that the paper by Juan Maldacena from the late 1990s which proposed the AdS/CFT correspondence is the most cited paper in the field of high energy physics and currently has over 20,000 citations.

   The first two papers submitted for the participation in the competition are dedicated to the AdS/CFT correspondence in the case of D3/D7 and D3/D5 brane system. (The brane is a physical object which generalizes the notion of a point particle to higher dimensions. Branes are dynamical objects which can propagate through spacetime according to the rules of quantum mechanics.) The oldest published paper [7] presented for the competition gives a new space-time construction, taking into account the effect of the probe D7-branes on the geometry. It turns out that the field theory of adjoint fields is noncommutative, which is an interesting phenomenon from an algebraic point of view. In the most recent publication [1], it again appears that there is a noncommutative configuration of the scalar fields in the adjoint representation. In the other 5 papers computer simulations of matrix models of the AdS/CFT correspondence are presented. The results are compared with the theoretical predictions of the AdS/CFT correspondence, which shows very good consistency with the theoretical results under various additional assumptions, for example for low and high temperatures. In the case of a holographic dual of the D0/D4-brane system, one of the most non-trivial tests was performed with complexity due to the

completely broken supersymmetry. This is also the first direct test in the presence of fundamental fields.

In conclusion of my comments on the scientific contributions of the applicant, I would note that he knows very well the main problems in the field and the published literature which allows him to use a rich arsenal of methods. The correctness of the arguments in the considerations is not in doubt. I have not noticed any significant inaccuracies.

The description of the achievements presented by the author correctly reflects the main contributions of the works submitted for the participation in the competition.

5. **Importance of the contributions to the science and the applications.** The results obtained in the research papers of the applicant are interesting and important. They contain new facts about objects that are central in a number of areas of theoretical and mathematical physics and many of which have been previously studied by other authors. The results and the methods of the applicant have been used and can continue to be used successfully in other studies of this kind.
6. **Critical remarks and recommendations.** I have no essential remarks on the applicant's works. I want to note that the documentation for the competition has been prepared extremely accurately.
7. **Personal impressions as a member of the Scientific Jury.** I know Dr. Veselin Filev from the moment he started working at IMI and I have excellent impressions of him as a scientist and colleague. I have attended many of his talks at the seminar of the department and at other forums. He has always been able to present the facts in a way that is accessible to a wide mathematical audience. I have no direct observations of his teaching at the University of Southern California in Los Angeles and at the American University in Bulgaria, but I know several of his students who spoke about him with respect and appreciation. In addition, I am aware of the high opinion for the scientific activity of the applicant given by a number of respected colleagues from the Institute for Nuclear Research and Nuclear Energy.

CONCLUSION

In the presented scientific publications Chief Assistant Professor Dr. Veselin Filev has established interesting results in modern areas and has made significant contributions to the development of new algebraic and statistical mathematical methods in theoretical and mathematical physics. Most of the results have already been used or can be used in similar studies by other authors. The results have been published in high level journals and proceedings of conferences and presented at recognized scientific forums. I recommend to the respectable Scientific Jury to suggest Chief Assistant Professor Dr. Veselin Georgiev Filev to take the academic position of “Associate Professor” in the field of higher education 4. Natural Sciences, Mathematics and Informatics, professional field 4.5. Mathematics, scientific specialty: Mathematical Methods in Physics (Algebraic and Statistical Methods).

Sofia, February 15, 2021 Signature:

(Acad. V. Drensky, Dr.Sci.)