

Referee Report
on the competition for the academic position
Associate Professor
in the professional field 4.1 Physical Sciences
(General relativity and relativistic astrophysics),
for the needs of Sofia University "St. Kliment Ohridski",
Faculty of Physics, announced in the Government
Bulletin no. 30/15.04.2022

This report was prepared by: Assoc. Prof. Dr. Petya Georgieva Nedkova, Sofia University, Faculty of Physics, as a member of the scientific jury of the competition according to Order No. RD-38-260 / 27.05.2022 of the Rector of Sofia University.

A single candidate has submitted documents for participation in the announced competition: Assistant Professor Dr. Kalin Viliyanov Staykov, Faculty of Physics, Sofia University "St. Kliment Ohridski".

I. General description of the submitted documents

1. Details of the application

The documents submitted by the applicant for the competition comply with the requirements of ZRASRB, RAPRRRB and the Regulations on the conditions and procedure for acquiring academic degrees and occupying academic positions at Sofia University "St. Kliment Ohridski" (PURPNSZADU). In order to participate in the competition, the applicant Kalin Viliyanov Staykov presented a list of 13 papers published in international scientific journals with a high impact factor (11 publications in Q1 journals, one publication in a Q2 journal and one publication in a Q3 journal). In addition, 5 other documents are presented in support of the applicant's achievements, which include a teaching record, an employment record, a student supervision record, a copy of the contract for research funding and a proof of participation in the scientific collaboration LISA).

Additional remarks and comments – None.

2. Details of the applicant

Kalin Staykov is born in 1990. In 2013 he acquires a bachelor degree in Applied Physics from the Faculty of Physics, Sofia University, while in the next year he acquires a master degree in Theoretical and Mathematical Physics from the same faculty. In the period 2014-2016 Kalin is a PhD student in Sofia University under the supervision of Prof. Stoytcho Yazadjiev and defended his

thesis on the topic “Numerical modeling of the structure and the properties of the astrophysical compact objects”. His dissertation is recognized as the best PhD thesis in the Faculty of Physics which was defended in 2016. In 2017 Kalin Staykov becomes a Head Assistant Professor in the Faculty of Physics, Sofia University, having held this position until now. He has been invited as a guest researcher at Tuebingen University, Germany, performing several short-time research visits. In the period 2018-2019 the applicant serves as an assistant editor of the Bulgarian Journal of Physics. In 2022 he is awarded the scientific award “Pythagoras” of the Bulgarian Ministry of Education for young scientists in the natural science and engineering.

3. General characteristics of the applicant's scientific work and achievements

Kalin Staykov works in the field of the modified theories of gravity and relativistic astrophysics. His scientific interests include the generation of numerical solutions of the gravitational field equations describing compact objects in the alternative theories of gravity and the investigation of their astrophysical properties, in particular the emission of gravitational waves and the quasiperiodic oscillations from the accretion disk.

Analyzing the presented materials, it can be reasonably and definitely stated that:

a) the scientific works exceed the minimum national requirements (under Art. 2b, par. 2 and 3 of ZRARB) and the additional requirements of Sofia University “St. Kliment Ohridski ”for the academic position of Associate Professor in the scientific field and the professional direction of the competition;

b) the scientific papers submitted by the applicant do not repeat those of previous procedures for the acquisition of a scientific title and academic position;

c) there is no proven plagiarism in the scientific works presented at the competition.

4. Characterization and evaluation of the applicant's teaching activity

In the last 5 years the applicant has been teaching 6 different subjects in the bachelor program of the Faculty of Physics in Sofia University. He has been a lecturer in the courses “Ordinary differential equations”, “Vector and tensor calculus” and “General relativity” as well as a teaching assistant in the courses “Calculus I”, “Ordinary differential equations”, “Vector and tensor calculus”, “Complex analysis” and “Partial differential equations”. His teaching activity during this period exceeds the average teaching activity for the academic staff of the Faculty of Physics. Kalin Staykov has supervised 2 bachelor students and 1 master student, all of whom having defended successfully their theses.

5. Analysis of the scientific and applied scientific achievements of the candidate according to the materials for participation in the competition

The scientific contributions of the applicant can be classified as follows:

- a) Generation of new numerical solutions to the gravitational field equations describing neutron stars in the scalar-tensor theories of gravity and investigating their properties. The investigations focus on particular types of relations between the physical characteristics of the neutron stars such as mass, moment of inertia, compactness, Love numbers, oscillation modes. Deviations from certain universal relations between these properties can serve as an indication for the equation of state of the neutron star or as an experimental confirmation for a particular modified theory of gravity. The results are published in 4 papers in Physical Review D и 2 papers in the European Physical Journal C.
- b) Generation of new numerical solutions to the gravitational field equations describing scalarized black holes and neutron stars in the Gauss-Bonnet gravity. Different mechanisms for the formation of compact objects with scalar hair within the Gauss-Bonnet gravity are explored. The solutions may arise as bifurcations of unstable branches in General Relativity or may constitute completely independent branches of solutions, which are not supported without the Gauss-Bonnet invariant. The results are published in 3 papers in Physical Review D и 1 paper in the European Physical Journal C.
- c) Observational properties of compact objects in the alternative theories of gravity: quasinormal modes and quasiperiodic oscillations from the accretion disk. This research direction studies the possibility to observe the compact objects, which were constructed theoretically by the applicant, by means of gravitational-wave experiments or experiments in the electromagnetic spectrum. Two observational channels are investigated – the oscillations of the compact objects in the final stage of emission of gravitational waves, and the resonance frequencies of the X-ray emission from the accretion disk. The results are published in 1 paper in Physical Review D, 1 paper in the European Physical Journal Plus and 1 paper in Astrophysics and Space Science.

All the investigations of the applicant constitute original scientific contributions and can be classified as expanding the current knowledge. Kalin works at the frontier of the contemporary astrophysics and his research level completely corresponds to the achievements of the leading scientific groups in the world. The applicant has described in detail his contribution in the publications presented for the competition stating that he has substantial contribution in 9 of them. He has declared more than 378 independent citations according to the scientific database Inspirehep and h-index 11. In addition to the publications, which are submitted for the competition, Kalin Staykov is a co-author in 5 more publications in international journals with an impact factor and 3 publications in conference proceedings. He has been the project leader of 1 successfully completed research project funded by the National Science Fund, and has participated in several others as a team member including international COST actions. Based on the described arguments, I consider that the scientific achievements of the applicant substantially exceed the minimal national requirements for the academic position Associate Professor and his research activity deserves the highest recognition.

6. Critical notes and recommendations

I have no critical remarks about the candidate.

7. Personal impression of the applicant

I know Kalin Staykov since his PhD studies when I have attended his talks at various research seminars and conferences. Later on, we have been team members in several research projects and co-organized several scientific conferences. He has been my teaching assistant in the course "Partial differential equations", hence I am also familiar with his teaching activity. I have the most favorable impression from all the academic activities of the applicant. In my opinion Kalin has developed into a successful young scientist, who has a professional and responsible approach towards all the aspects of the academic occupation.

8. Conclusion on the application

Having become acquainted with the materials and scientific works presented in the competition and on the basis of the analysis of their importance and the scientific and applied contributions contained therein, I confirm that the scientific achievements fully satisfy the requirements of the ZRASRB, the Regulations for its implementation and the corresponding Regulations of Sofia University "St. Kliment Ohridski " for the academic position of Associate Professor in the scientific field and professional direction of the competition. The applicant substantially exceeds the minimal national requirements in the professional field and no plagiarism has been established in the scientific works submitted for the competition. I am convinced in giving positive assessment of the application.

II. Overall Conclusion

Based on the above, **I strongly recommend** the Scientific Jury to propose to the Faculty Council of the Faculty of Physics at Sofia University "St. Kliment Ohridski " to elect Assistant Professor Dr. Kalin Viliyanov Staykov for the academic position "**Associate Professor**" in the professional field 4.1 Physical Sciences (General relativity and relativistic astrophysics).

27.08 2022 г.

Signature:

(Assoc. Prof. Dr. Petya Nedkova)