

## STATEMENT

in a competition for the academic position of "Associate Professor" in the professional field 4.1 Physical sciences, specialty "General Theory of Relativity and relativistic astrophysics", announced in GN, №67 / 28.07.2020 for the needs of Faculty of Physics at Sofia university, with candidate: Galin Gylchev, Ph.D. , Head assistant

Member of the scientific jury: Petko Nedialkov, PhD, Associate Professor

### **1. General characteristics of the research and applied research activity of the candidate**

The candidate's research activity is focused in the field of the modified theories of gravity and the general theory of relativity, covering phenomena from relativistic astrophysics. In particular, the subject of his research is the relativistic effect of the gravitational lens at extreme angles of deflection of light rays; the "spectrum" of quasi-normal black hole modes; the shadows of compact objects, including black holes and space-time tunnels, the relativistic images of accretion disks in space-time of compact objects, including black holes and bare singularities; the effect of the gravitational lens created by compact objects at small angles of deviation of light rays and the non-relativistic effect of the gravitational lens created by clusters of galaxies at small angles of deviation of light rays.

In order to obtain 2D distributions of the surface brightness in the plane of view around the studied objects as a function of their orientation to the viewing ray and other parameters characterizing the approximations considered by them, the authors apply both analytical modeling and numerical simulations in a pure form and the intermediate semi-analytical approach.

The minimum national requirements for holding the academic position of "associate professor" in a professional field 4.1. Physical sciences are satisfied: according to indicator A the candidate has acquired PhD degree, according to indicator B (publications equivalent to a monographic work) the candidate has 175, with required 100 points; according to indicator D (publications outside the monograph) there are 235, with the required 200 points. Respectively, the sum of the points according to indicator E (citations) is 140, with 50 points required.

### **2. Assessment of the pedagogical preparation and activity of the candidate**

According to a certificate from the Human Resources Department, available in the package of documents to the competition, the only candidate has held the academic position of "assistant" from 20.11.2008 to 31.03.2011, and from 01.04.2011 – it is Head assistant. His teaching activity for the period since 2015 is reflected in individual reports, which show that his average annual workload exceeds the required one about 1.5 times. Separately, his teaching experience, expressed both in work experience and in total study load, far exceeds the required full study load for two years. Dr. Galin Gylchev has led exercises, as well as assigned lectures in the Bachelor's and Master's degrees at the Medical Faculty of Sofia University, Dept. "Physics, Biophysics and Radiology", and from the academic year 2019/20 - at the Faculty of Physics of Sofia University, Dept. Theoretical physics, although it is not clear from the attached reports in which disciplines.

Although the candidate does not have a special pedagogical qualification, I am sure that his teaching is at an extremely high level.

### **3. Main scientific and applied contributions**

The main scientific contributions of the candidate are in the field of the modified theories of gravity and the general theory of relativity, covering phenomena from relativistic astrophysics. Here I will give an example with only three of the most significant in my opinion contributions that meet the national requirements for holding the academic position of "Associate Professor" in the professional field 4.1. Physical sciences. According to the criterion B-item 3 (habilitation work-monograph) Head Assistant Galin Gylchev presented the monograph "Gravitational Lenses", University Publishing House "St. Kliment Ohridski ", 2017, co-authored with Stoycho Yazadjiev, whose reviewer I had the pleasure to be and which will long remain the only professional scientific introduction to the theory of gravitational lenses, written in Bulgarian. According to criteria B-item 4 and D-item 7 (scientific publications in journals that are referenced and indexed in world-recognized databases with scientific information), the candidate has submitted 7 publications with his leading contribution. I will omit the three of the publications [B-4: 1-3], which are from before 2011, and I will illustrate the contributions with the two most recently published publications, in which Galin Gylchev is the first co-author. In [G-7: 7], 2D distributions of the surface brightness of a Novikov-Thorne accretion disk in the vicinity of a non-rotating Janis-Newman-Winicour singularity are obtained, and we consider the case when the solution has a photon sphere. It has been found that the image of the accretion disk is smaller and its brightness has a more pronounced maximum compared to Schwarzschild's black hole solutions. In [G-7: 4] the shadow of rotating passable space-time tunnels is studied, taking into account the role of the neck for the formation of its image. It has been found that in certain classes of tunnels the neck affects the contour of the shadow.

The majority of the contributions in the presented publications are the personal work of the candidate. This is evident not only from his place among the co-authors, but also from the reference, where there is even more differentiated information about his personal contribution, which is almost everywhere leading. Very convincing is the assurance of Prof. Stoycho Yazadjiev, which explicitly states that "Galina Gylchev has made a significant contribution to the application of analytical techniques and the creation of numerical codes used to obtain scientific results and their physical interpretation in articles." Most contributions can be described as "proving with new means significant new aspects of already existing scientific fields".

The candidate's scientific works have been published in the most prestigious journals in theoretical physics and astrophysics and have been cited many times in the world's leading journals in the same field.

### **4. Significance of contributions to science and practice**

The candidate has significant scientific results in the theory of gravitational lenses in the context of both the general theory of relativity and some alternative theories of gravity, such as the compact astrophysical objects studied and the related phenomenological effects are subject to experimental verification.

Regarding the quantitative indicators of the additional requirements to the candidates for the academic position of "Associate Professor" at the Faculty of Physics of Sofia University "St. Kliment Ohridski" in the professional field 4.1. Physical sciences, they are also fully implemented. The candidate has documented teaching experience, equivalent to 5 years of full-time, with a required 2-year, classroom employment at Sofia University and scientific guidance of a successfully defended graduate. In group indicators B and D the candidate has 10 with the required 7 publications from group I, as the 10 publications are entirely from a quartile with the most prestigious publications - Q1. With a required significant contribution in at least 4 of the Group I publications, the applicant has a significant

contribution in 7 publications, 5 of which have been published in the last 3 years with a required 1 such publication. In case of required 1 management or 1 participation, the applicant has submitted evidence for management of 2 national projects and participation in 5 international or national projects. Its h-index is 8, with a nominal requirement of 5. The criterion for the sum of points on the citations indicator (E), which is 140, is also met, with 100 points according to the additional requirements.

## **5. Critical remarks and recommendations**

I have neither general or formal remarks, nor recommendations to the scientific works of the candidate.

## **CONCLUSION**

The presented scientific papers contain enough and impressive scientific and applied contributions. On the basis of the acquaintance with the presented scientific works, their significance, the scientific, scientific-applied and applied contributions contained in them, I find it justified **to propose** Galin Gylchev to acquire the academic position of "Associate Professor" in the professional field 4.5 at the Faculty of Physics, Sofia university.

Date: 08 Nov 2020

JURY MEMBER: