REPORT

by Prof. D.Sci. Angela Slavova Popivanova

Institute of Mathematics and Informatics, Bulgarian Academy of Sciences

for the academic position of Associate Professor in Professional field 4.1 Physical Sciences,

Scientific subject: General theory of relativity and relativity astrophysics

In the competition for Associate Professor announced in Government Journal vol. 67 from 28.07.2020 and on the web site of Sofia University "St. Kliment Ohridski" for the needs of Department of Theoretical Physics the only candidate is Principal Assist. Prof. Dr. Galin Nikolaev Gyulchev.

1. Short biography

Principal assistant professor Dr. Galin Gyulchev graduated the professional high school in electronics in Veliko Turnovo in 2000. In 2004 he graduated as Bachelor in the Physical Faculty of Sofia University "St. Kliment Ohridski", and in 2006 he became a master in Treoretical and Mathematical physics. He defended Ph.D. thesis entitled "Gravitational Lenses", with scientific adviser Prof. Stoycho Yazadzhiev.

Dr. Gyulchev have been working as a physicist in the Institute of astronomy and national astronomical observatory of the Bulgarian Academy of Sciences from 2004 to 2008. In 2008 he became an assistant professor at the Department of Physics, Biophysics and Radiology of the Medical Faculty of Sofia University, and in 2011 he became principal assistant professor there. Since 2019 he is a principal assistant professor at the Department of Theoretical Physics of the Physical Faculty of Sofia University. He have been for a short visit at the University of Tubingen, Germany in 2019. He gave talks in many international conference in Bulgaria and abroad.

Pedagogical activities of principal assist. prof. Dr. Gyulchev includes lectures on Theoretical astrophysics, Partial differential equations, Mathematical methods of physics, Introduction in the physics of black holes, Electrodynamics, Mathematical methods in optometrics, and two courses in English on ordinary differential equations and Partial differential equations. He has delivered seminars on Partial differential equations, Mathematical methods in Physics, Mathematical methods in optometrics, Mathematics I, Methods of medical physics, Ordinary differential equations (in English), and practicum in Physics (in Bulgarian and English).

Dr. Gyulchev was the leader of 2 research projects in Sofia University and he participated in 10 research projects, from which 4 with the Bulgarian National Fond and 1 in the frames of the Program "Development of the human resources". He is co-founder of the branch "Cosmos" of the Union of Physicists in Bulgaria and is member of the board of this union.

2. General description of the presented materials.

The participant principal assist. prof. Dr. Galin Gyulchev presented the following materials in the competition:

- Monographs - 1;
- Publications - 19.

The publications can be classified as follows:

According to the type:

- Publications in scientific journals - 11;
- Reports at the conferences - 8.

According to the rating:

- Publications with IF - 11;
- Publications with SJR - 6;
- Publications in conference proceedings- 2.

According to the co-authors:

- One co-author - 10;
- Two coauthors – 4;
- Three and more coauthors – 5.

The impact factor of the presented publications is 49,4.

2. Citations of the candidate's publications

- Citations – 337;
- H-index - 7.

The publications, impact factor and the rating of them are much more that the scientific criteria according to the Statutes for the conditions and regulations for acquiring academic degrees and occupying academic posts in the Physical Faculty at Sofia University and LADASRB. I accept the monography, papers and reports for this report.

4.Characteristics of the activities of the candidate.

4.1. Pedagogical activities

According to the pedagogical activities' tables shown in the application documents of Principal Assist. Dr. Galin Gyulchev it is obvious that during the last 5 years he has more lectures and seminars than the full norm at Sofia University. He has been advisor of the diploma thesis of a person who defended in 2010 at the Astronomical Observatory of Sofia University.

4.2. Scientific and scientific applied activities.

Principal assist. prof. Dr. Galin Gyulchev has 1 monography (B1): Galin Gyulchev, Stoycho Yazadzhiev "Gravitation lenses", University Press "St. Kliment Ohridski", 2017, 340 p. This monograph deals with the theory of gravitational lenses and it is the first professional book of its kind in Bulgarian, dedicated to this rapidly evolving field of modern astrophysics. The publication presents some of the authors' research in two of the main areas for studying the effects of light deflection in curved spacetime, based on the propagation of light in the asymptotically flat part of spacetime and in areas where spacetime has a significant curvature. The results of the observations led by the alternative theories of gravity are discussed, in the limit cases of small and large deviations of the rays as a subject of study are charged static and charged rotating black holes, as well as static and rotating naked singularities, considered as candidates for gravitational lenses.

Dr. Gyulchev has results in both classical and relativistic theory of gravitation lenses. His research achievements can be classified in the following topics:

i). Study of the relativistic effect of the gravitation lens which is created by compact objects in the case of strong deflection - A.6, A.9, A.10, Б.2, Б.6, Б.7, Б.8 publications. In these papers the effect of gravitation lenses is studied in details, as well as the conclusions of the observations of the different theories of gravitation in the strong deflection limits. Pure singularities are investigated in the theory of Einstein massless scalar field and black holes, which are obtained in the frames of Einstein –(anti)-Maxwell –(anti) dilaton theory of gravitation.

ii). Study of frequencies of quasinormal modes of the black holes and their connection to the relativistic effect of gravitational lenses and investigation of quasiperiodic oscillations - A.5, A.7, Б.5 publications. In these papers relatively simple connections are established between quasinormal modes and relativistic effect of the gravitational lenses. Analytical derivation of the equation of photon sphere is obtained for static and spherical symmetric space-time of the frequencies of the quasinormal modes and their direct connection to scalable quantities characterizing relativistic images.

iii). Obtaining of the shadows of compact objects – publications A.4 and Б.1. The shadows of the compact objects are modelled and analyzed in different physical scenarios. Numerical codes are developed and their physical interpretation is presented.

iv). Construction and investigation of relativistic images of accretion disk in space-time of the compact objects – publication A.1. For the first time the image of accretion disk around compact object which is not a black hole is investigated in this paper.

v). Investigation of the effect of the gravitational lens created of compact objects in the case of weak deflection – publications A.2, A.3, A.8, A.9, Б.4. This cycle of papers is devoted to the nonrelativistic effect of the gravitational lenses which is due a class of phantom black holes and space time tunnels of the charged, stationary, axially symmetric Kerr-Sen dilaton-axion black hole. This effect can arise from stationary, axially symmetric pure singularities in the case of weak deflection.

vi). Investigation of the relativistic effect of the gravitational lens created from the cup of galaxies in the case of weak deflection – publication Б.3. In this paper the effect of the gravitational lens is studied from the galaxy cup Coma Cluster (Abell 1656) and the change of the deflection angle and the focal length is estimated.

From the above analysis I can say that Dr. Gyulchev have presented very large scientific achievements in both classical and relativistic theory of gravitational lenses.

5. Critical notes

I don't have essential critical notes. I only want to recommend in her future investigations to publish papers only be herself.

<u>Conclusion:</u> Based on the above report I positively recommend principal Assist. Prof. Dr. Galin Nikolaev Gyulchev to be elected for Associate Professor in Professional field 4.1 Physical Sciences, Scientific subject: General theory of relativity and relativity astrophysics for the needs of the Department of Theoretical Physics at Physical Faculty of Sofia University "St. Kliment Ohridski".

18.11.2020 г. Signature: 
Sofia

(Prof. D.Sci. Angela Slavova Popivanova)