Referee Statement

on the contest for the academic position "Associate Professor", scientific domain 4.1 „Physics" ("Gravity. General Relativity"), published in The State Newspaper, No. 65/16.08.2019 with a single candidate **Dr. Petya Georgieva Nedkova**, Head Assistant Professor at the Faculty of Physics, Department of Theoretical Physics, Sofia University "St. Kliment Ohridsky"

Author: Corresp. Member of BAS, Prof. Emil Rafaelov Nissimov, INRNE, BAS

1. **General description of the submitted scientific materials.** The contestant has submitted all the documents required under the contest procedure: (a) lists of publications – a complete list of 25 publications and one with 20 selected works for the contest; (b) electronic copies of all publications and of a monograph co-authored by the contestant; (c) list of 159 independent citations from international citation data bases; (d) list of invitations to participate in international conferences; (e) list of memberships in internationally and nationally funded projects and contracts, including two major European COST networks (in one of the COST networks the contestant is a member of the Management Committee).
2. **Timeliness of the scientific topics.** The timeliness of the research topics of the contestant is indisputable. They include: new exact solutions and detailed investigation of all important physical features, such as the thermodynamics of compact astrophysical objects in modified theories of gravity in higher space-time dimensions. These theories are generalizations of classical Einstein's general theory of relativity.

   The main motivation comes from the importance of gravitational interactions in many fundamental areas in modern theory of elementary particles and astrophysics, such as Kaluza-Klein type of classical unified field theories of gravity and electromagnetism which start from higher (five) dimensional space-times; string theory as a theory unifying all interactions of elementary particles at very high energies, including gravity, specifically the holographic gauge-gravity duality; models of membrane universes (braneworlds scenarios).

   Modified theories of Einstein gravity have been long on the scientific scene with the aim to adequately describe the cosmological dynamics of the early universe, as well as its accelerated expansion in the late phase of the evolution, the explanation of the still "mysterious" dark matter and dark energy, clarification of the large-scale structure of the universe, explanation of the physical processes in strong gravitational fields.

3. **Short description of the main scientific achievements.**

(a) New exact solutions of Einstein and Einstein-Maxwell-dilaton gravity in higher dimensional space-time manifolds (D>4, D – dimension of the space-time manifold) have been found and their thermodynamic properties investigated. They describe: systems of black holes and Kaluza-Klein "bubbles"; static black holes on asymptotically locally flat gravitational instantons (of Taub-NUT and Taub-bolt type) in the 5-dimensional Einstein and Einstein-Maxwell-dilaton gravity; new exact solution for deformed black holes has been found.

(b) The classification of wormhole solutions in Einstein-Maxwell-dilaton gravity has been studied. For the first time a uniqueness theorem for static traversable wormhole solutions in the presence of phantom scalar and/or electromagnetic fields has been proved.

(c) Nontrivial solutions for scalarized black holes in generalized scalar-tensor gravity with coupling to the Gauss-Bonnet topological invariant have been found and the bifurcation of the solutions investigated.

(d) The images of the shadows of black holes, wormholes and naked space-time singularities have been obtained and their properties investigated in detail. For the first time in the literature shadows of rotating wormhole have been obtained – this result has been cited by the International Astrophysical Collaboration "*Event Horizon Telescope"*! Also, for the first time in the literature the image of an accretion disc around naked singularity in the presence of a scalar field has been investigated.

(e) Monograph – the contestant has co-authored a book **"*Mathematical aspects of static and stationary higher dimensional spacetimes*"**, which is due to be published by the Sofia University Publishing House M. Drinov. The exposition distinguishes itself with both high expert level and pedagogical thoroughness. Written in English, the book could be recommended as a vademecum for students, Ph.D.-students, post docs and researchers in the field of gravity, cosmology and theoretical astrophysics in the best universities in the world.

4. **Short estimation of the teaching activities.** The contestant has considerable teaching experience and a large teaching and pedagogical workload with lectures and exercises in variety of basic and special courses. She has supervised two successfully defended bachelor's thesises, one of which at an elite foreign university.

5. **Personal impressions.** The active participation of the contestant as a young scientist in two of our major collaborations (between my Institute of Nuclear Research and Nuclear Energy, BAS and the Faculty of Physics and Faculty of Mathematics and Informatics, Sofia University "St. Kliment Ohridsky", financed by the National Science Research Fund) have left most favorable impression on me. Dr. Nedkova has given several excellent talks on her works at our Institute's seminar during which she has demonstrated remarkable competence when answering the questions.

6. **Conclusion.** I believe that the contestant, Dr Nedkova, certainly meets the standard requirements for the contested academic position. Moreover, her credits are higher: her works are published in most elite scientific journals and conference proceedings in her field of research. The number of independent citations of her publications is higher than the average one in this field of theoretical and mathematical physics. Her numerous participations in nationally and internationally funded (most by invitation) projects are proving that Dr. Nedkova already enjoys international professional recognition and credibility. The nature of her major scientific achievement can certainly be defined as an acquisition of new knowledge about the fundamental laws in gravitational physics and astrophysics.
On the basis of the above estimates, I strongly recommend to the highly respected Faculty Council of the Faculty of Physics of Sofia University"St. Kliment Ohridski" to elect Head Assistant Professor Dr. Petya Georgieva Nedkova on the academic position "Associate Professor".

29.11.2019 Author of the Statement: 

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