Report

On a competition for an academic position "Associated Professor", in the field of higher education 4. Natural sciences, mathematics and informatics, professional advancement, 4.5 "Mathematics", specialty Equations of Mathematical Physics (Mathematical modeling in general relativity and quantum physics).

by Prof. DSc. Tsvatko Rangelov, Member of the Scientific Jury, Institute of Mathematics and Informatics, BAS.

1) The competition, with a term of 2 months, was announced in the State Gazette no. 82 of 27.09.2024 for the needs of the Institute of Mathematics and Informatics (IMI), BAS. Postdoctoral Reseacher PhD. Hamed Pejhan has submitted documents for participation in it. He graduated as: B.SC. in Physics from the Urmia University, Urmia, Iran in 2007; M.Sc in Mathematical Physics from Azad University (Science and Research Branch), Tehran, Iran in 2010. After postgraduate studies at Azad University (Science and Research Branch), Tehran, Iran he defended his PhD thesis "Krein quantization approach to vacuum energy" in 2015.

PhD Hamed Pejhan was successively Postdoctoral Researcher at Azad University (Science and Research Branch), Tehran, Iran (September 2015- March 2018) and Zhejiang University of Technology, Hangzhou, China (April 2018 - August 2021); Independent Researcher at Azad University (Science and Research Branch), Tehran, Iran (September 2021 - April 2023) and Postdoctoral Researcher (Established, R3): Institute of Mathematics and Informatics, Bulgarian Academy of Sciences, Sofia, Bulgaria (May 2023 - to present).

2) PhD Hamed Pejhan‘s scientific activity is in the field of Mathematical Physics and Group Representation Theory. The result of this scientific activity are contemporary publications, some of which are submitted in this competition.

There are presented a total list of 1 book, 21 papers in journals, 2 conference papers, from them 12 journal papers are presented in the competition. Articles

are published since 2010 in renowned Physic‘s and Mathematical Physic’s Journals, such as: Phys. Lett.B - 2; Phys. Rev. D - 5; Int. J. Mod. Phys. - 1; Eur. Phys. J. C - 2; Annals Phys. - 1: Int. J. Thoer. Phys. - 1.

All 12 publications are with Impact Factor (IF), Q1 are 10 publications [1 - 6, 8 - 10, 12], Q2 are 2 publications [7, 11]. All of the publications are co-authored with: Surena Rahbardehghan, Kazuharu Bamba, Mohammad Enyati, Mohammad Reza Tanhayi, Mohammad Vahid Takook, Marjan Elmizadeh. I accept that the candidate‘s contribution is equal to that of his co-authors.

It was presented a list of 28 citations (without self-citations) and among them 17 citations of the publications for the competition.

In connection with Art. 2 of the IMI Rules for the ”minimum required score by set of indicators” for the candidate PhD Hamed Pejhan is obtained the following: A - 50 points; B - 100 points; G - 440 points; D - 96 points, which means that this requirement was fulfilled.

3) The author‘s report correctly reflects the content and contributions in the works of PhD Hamed Pejhan. He works in actual and complex domain of physics and mathematical physics, connected with constructing elementary systems, within the global structure of de Sitter and anti-de Sitter spacetime and the principles of their representation theory. The applicant demonstrates competence in the subject of the competition, good awareness in the areas in which he works, the publications are written in clear and precise language. The results in the publications are new and perspective.

Note that PhD Hamed Pejhan in collaboration with M. Enayati, J-P. Gazeau and A. Wang published a monograph in Springer Nature (a preliminary version, https://arxiv.org/pdf/2201.11457.pdf),(1-st edition 2022, 2-nd edition 2024) ”The de Sitter (dS) group and its representations: an introduction to elementary systems and modeling the dark energy universe”. The monograph is not included in the materials for the competition, but it characterize the competence of the applicant in the field of Mathematical Physics and Cosmology.

I will analyze shortly the works presented for the competition, following the conditional division, made in the author's report.

3a) In the papers [2 - 4, 6, 9] are studied covariant quantization of the graviton field in de Sitter spacetime.

These studies contribute a rigorous, covariant formulation of the graviton two-point function in de Sitter spacetime, addressing infrared finiteness and advancing the understanding of massless spin-2 fields in a curved, de Sitter background.

From this group of papers I can mention [3, 4] - parts I and II of covariant formulation of the graviton two-point function in dS spacetime. The applicant consider linearized Einstein equation and examine possible vacuum states for the gravitons fields, with respect to onvariance, under dS group $S0_0(1,4)$.

3b) In the papers [10, 12] is studied exploration of conformal symmetry and the de Sitter graviton field in an expanded symmetry context.

These papers examine the implications of conformal symmetry on the graviton field, providing insights into the broader symmetry structures, that encompass dS spacetime. Note that in [12] a proper solution to the field equation in dS space is obtained, as a product of a generalized polarization tensor and a massless scalar field and then the conformally invariant two-point function is calculated, while in [10] considering the dS ambient space notation, a proper solution to the physical part of this field equation is obtained.

3c) In the papers [1, 5, 7, 8, 11] are studied Krein space quantization and vacuum energy problem.

These studies provide a comprehensive analysis of the vacuum energy problem within the Krein quantization approach. They are devoted to the understanding of quantum field theory in dS spacetime and its implications for gravitational dynamics. For example, in [11] is present a simple method to study the Casimir effect on a spherical shell for a massless scalar field with Dirichlet boundary condition, by applying the indefinite metric field (Krein) quantization technique.

4) I have no critical remarks.

5) Conclusion: I am giving a positive assessment of the works of PhD Hamed Pejhan and I believe that he fully satisfies the requirements of the ZRASRB for the competitive position, also in the submitted ones for the competition articles have no plagiarism.

I recommend the Scientific Jury to propose to the Scientific Council of the Institute of Mathematics and Informatics to select PhD Hamed Pejhan for Associate Professor in the professional field 4.5 "Mathematics", specialty Equations of Mathematical Physics (Mathematical modeling in general relativity and quantum physics).

January 11, 2025 Signature

T. Rangelov