

## REVIEW

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direction 4.1. Physical Sciences (Theoretical and Mathematical Physics)

About: the materials submitted for participation in a competition for the academic position  
"Associate Professor" at the University of Plovdiv "Paisii Hilendarski" in the  
field of higher education: **4. Natural Sciences, Mathematics and Informatics**; pro-  
fessional direction: **4.1. Physical Sciences (Physics of Wave Processes)**

### 1. Information about the competition

The competition was announced for the needs of the Faculty of Physics and Technology at the University of Plovdiv "Paisii Hilendarski" in the State Gazette, issue 96/17<sup>th</sup> of November 2023, and on the internet page of Plovdiv University "Paisii Hilendarski". I am appointed as a member of the scientific jury for this competition according to Order № RD-21-386/16<sup>th</sup> of February 2024 by the Rector of Plovdiv University "P. Hilendarski". Only one candidate has submitted documents for participation in the announced competition: **Anelia Mincheva Dakova-Mollova, PhD**, holding the academic position of "Chief Assistant Professor" in the "Physics" Department of the Faculty of Physics and Technology (FPT) at the University of Plovdiv "P. Hilendarski".

### 2. General presentation of the materials submitted for the procedure

The set of materials submitted by Ch. Ass. Prof. Anelia Mincheva Dakova-Mollova is in **accordance** with the requirements of the Regulations for the Development of the Academic Staff of PU "P. Hilendarski and includes the following documents: 1) application form to the Rector of PU "P. Hilendarski" for admission to participation in the competition; 2) curriculum vitae in the European format; 3) a higher education diploma with an acquired educational and qualification degree "master"; 4) a diploma for PhD degree; 5) a list of the scientific works; 6) the scientific works; 7) a list of the citations; 8) certificate of compliance with the minimum national requirements; 9) annotations of the materials under Art. 65 from the Regulations for the Development of the Academic Staff of PU (in Bulgarian and English) with extended habilitation certificate; 10) self-evaluation of the contributions; 11) statement of originality and authenticity of the attached documents; 12) work experience certificate; 13) documents for educational work; 14) documents for scientific research; 15) documents in accordance with the additional requirements of the FPT; 16) other documents.

The candidate, Anelia Dakova-Mollova, PhD, participates in the competition with **25 scientific publications** which do not repeat the scientific publications submitted for the academic position of Chief Assistant Professor nor those submitted for the acquisition of the PhD degree. As **an equivalent of a habilitation thesis**, i.e. according to the indicators of group B, **7 scientific articles** are identified, which by the time of submission of the documents have 23 independent citations. Six of these seven scientific articles are published in second quartile journals (Q2) and one in a journal with an impact rank (SJR). According to the indicators of group Γ, 18 scientific articles are presented, which are distributed by quartiles as follows: Q1 – 1, Q2 – 4, Q3 – 4, Q4 – 1 and SJR – 8. The

applicant's points for indicator groups B and  $\Gamma$ , related to the publication activity, are 130 and 257, respectively. For comparison, the minimum national requirements for indicator groups B and  $\Gamma$  correspond to 100 and 200 points.

The candidate's scientific works have **80 independent citations** in scientific publications, referenced and indexed in the scientific information databases Web of Science and Scopus. Anelia Dakova-Mollova's points for indicator  $\Delta$ , related to the citations of her scientific works, are 160, while the minimum national requirements for this indicator are 50 points.

**The publication activity** of Dr. Anelia Dakova-Mollova **fully satisfies** the minimum requirements for occupying the academic position "Associate Professor" in the Faculty of Physics and Technology of the PU, and **the number of citations** of her scientific works **exceeds the required ones many times over**.

Documents testifying to the candidate's active and multifaceted educational activity, as well as those certifying Anelia Dakova-Mollova's contributions to affirming and raising the prestige of the department, the faculty and the university are also submitted.

The submitted materials are very well arranged and carefully described, which gives a clear idea of the overall scientific research and teaching activity of the candidate.

### 3. Brief biographical data about the candidate

Dr. Anelia Dakova-Mollova was born in 1986. She is a graduate of PU "P. Hilendarski", from which she graduated with a Bachelor's Degree in Engineering Physics (2009) and two Master's Degrees - in Photonics and Modern Optical Technologies (2011) and in Advertising, Business Communications and Public Relations (2017). In 2016, Anelia Dakova-Mollova defended her dissertation entitled "Linear and Nonlinear Optics of Femtosecond and Autosecond Laser Pulses" at the Institute of Electronics – BAS for the award of the PhD degree in professional direction 4.1. Physical Sciences. From December 2018 to May 2019 and from April 2021 to September 2021, she held postdoctoral positions in the FPT at PU "P. Hilendarski".

During her studies in the Master's program "Photonics and Modern Optical Technologies", she worked as a part-time lecturer at PU "P. Hilendarski". In 2011, Anelia Dakova-Mollova was appointed as an assistant, and since 2017 she has held the academic position of "Chief Assistant Professor" in the FPT at PU "P. Hilendarski".

After the defense of her dissertation (2016), Anelia Dakova-Mollova, PhD has continued her research on linear and nonlinear effects with ultra-short optical pulses in the Institute of Electronics – BAS, where she worked as a physicist (from 2016 to 2022) and since 2022 has been appointed Chief Ass. Prof. The scientific council of the Institute of Electronics - BAS awarded Anelia Dakova-Mollova, PhD the prize in the "Academician Emil Djakov" Competition in 2018 for her scientific work in the field of Physical Electronics, Quantum Electronics and Radio-physics.

A. Dakova-Mollova, PhD has been a member of the organizational committees of 3 international and 9 national scientific forums. Currently, she is a member of the university committee on ethics and academic unity, the chairperson of the faculty committee on ethics in the FPT at PU, a member of the accreditation committee of the FPT at PU for professional direction 4.1. Physical Sciences and an authorized representative of the NACID for the FPT at PU.

Ch. Ass. Prof. A. Dakova-Mollova, PhD is a member of the international scientific organization "The Optical Society" and of the national scientific organizations "Union of Scientists in Bulgaria - Plovdiv" (deputy-chairman of the "Physics" section) and "Union of the Physicists in Bulgaria (UPB)" (deputy-chairman of UPB – Plovdiv).

#### 4. General characteristics of the candidate's activity

##### 4.1. Characteristics and assessment of the candidate's teaching activity

The teaching activity of Anelia Dakova-Mollova, PhD covers training in Bachelor's and Master's Degrees.

The candidate is the author of the **study programs of 8 study disciplines** (5 – for the Bachelor's Degree and 3 – for the Master's degree), related to the subject of the competition "Physics of wave processes" and intended for students studying at the Faculty of Physics and Technology at PU "P. Hilendarski":

- for the Bachelor's Degree: a) Mandatory - 1. Optical Communication Systems, 2. Fiber Optics and Optical Communications; b) Electives - 1. Photonic Methods for Recording and Processing Information, 2. Optical Methods for Processing Information, 3. Optical Methods in Medicine;
- for the Master's Degree: a) Mandatory - 1. Waveguide and Nonlinear Optics, 2. Photonic Technologies for Recording and Processing Information; b) Electives – 1. Femtosecond Optics.

In addition to the academic disciplines listed above, Ch. Ass. Prof. A. Dakova-Mollova has been reading lectures in Physics – part "Electricity, Magnetism and Optics" and part "Optics", as well as conducting seminar/laboratory classes in many academic disciplines studied in the FPT at the PU.

The candidate is **the author of 6 e-learning courses** intended for the students studying in undergraduate specialties of the FPT at PU "Paisiy Hilendarski" and **co-author of the e-learning course "Laser Technologies in Medicine"**, conducted jointly with a university teacher from the Faculty of Physics at SU "St. Kliment Ohridski" and intended for the Master's specialty in English "Medical Physics".

Anelia Dakova-Mollova, PhD, has been **the supervisor of 18 successfully defended diploma theses** (15 for Bachelor's degree and 3 for Master's degree) and **the reviewer of 6 diploma theses**. Her activity as an academic advisor at the University Center for Work with Young Scientists, Doctoral Students and Postdoctoral Students should also be taken into account.

A. Dakova-Mollova, PhD actively participates in various events to popularize physics. She is regularly a member of scientific juries at national student conferences and competitions.

The teaching activity of Ch. Ass. Prof. Anelia Dakova-Mollova reflects her quest to follow modern trends in training.

##### 4.2. Characteristics of the scientific research activity and scientific achievements contained in the materials for participation in the competition

The **25 scientific articles**, submitted for participation in the competition, published in the period 2018 - 2023, are in the field of Physics of Wave Processes and **fully correspond** to the scientific specialty for which the competition is announced. The candidate's scientific researches and results obtained are related to the propagation and interaction of optical pulses in nonlinear dispersive media, including: soliton regime of propagation of optical pulses; four-photon parametric processes and energy exchange between laser pulses and their components; propagation of optical vortex structures in isotropic nonlinear dispersive media.

The researches are mostly fundamental in nature, and some of the obtained results are applicable to the interpretation of real physical processes in fiber-optic communication systems.

The main scientific contributions in the scientific publications submitted for participation in the competition can be summarized as follows:

- The generation of broad-band bright and dark optical solitons in isotropic nonlinear dispersive media has been analytically studied based on the nonlinear amplitude equation [B4-1, B4-2, B4-3, B4-4,  $\Gamma$ 7-14,  $\Gamma$ 7-16]. For the cases of media with normal and anomalous dispersion, exact analytical solutions of the nonlinear amplitude equation, expressed by Jacobi elliptic functions, which describe periodic cnoidal waves propagating in single-mode optical fibers, have been obtained [B4-1, B4-3, B4-4]. It has been established that at certain values of the ellipticity modulus, these waves are reduced to dark [B4-3] and bright [B4-4] solitons. The evolution of both broadband laser pulses in optical fibers with normal dispersion [ $\Gamma$ 7-14,  $\Gamma$ 7-16] and a bright optical soliton in air transparency regions [B4-2] has been studied analytically;
- The possibility of forming optical solitons based on the Kudryashov equation by using the semi-inverse variational principle [ $\Gamma$ 7-11] and a combination of the Lie symmetry analysis and the Kudryashov approach for different types of nonlinearities [ $\Gamma$ 7-9] has been analyzed;
- The formation of bright and dark cubic-quartic optical solitons, based on the Fokas-Lenells equation [ $\Gamma$ 7-2,  $\Gamma$ 7-10,  $\Gamma$ 7-12] as well as of highly dispersive dark optical solitons by using the Laplace-Adomian decomposition method has been investigated;
- The energy exchange between broad-spectrum laser pulses and their components in nonlinear dispersive media has been analytically studied [B4-5, B4-6, B4-7,  $\Gamma$ 7-4,  $\Gamma$ 7-7]. The obtained nonlinear dispersion relations describe clear physical picture of balance between dispersion and different kinds of nonlinear phase modulations of linearly and circularly polarized solitons [B4-7]. The energy exchange between the electric field components [B4-5], the periodic energy exchange between the pumping, signal and idler waves [B4-6], the rotation of the polarization ellipse [ $\Gamma$ 7-4] and the periodic energy exchange between two laser pulses [ $\Gamma$ 7-7] have been analytically studied. The analytical technique proposed in [ $\Gamma$ 7-7] is applicable to pulses with arbitrary initial intensities, generalized phase and wave number mismatch.
- The conditions for generation and the propagation of optical vortex structures in isotropic nonlinear dispersed media have been analytically studied based on a system of nonlinear amplitude equations [ $\Gamma$ 7-3,  $\Gamma$ 7-5,  $\Gamma$ 7-6,  $\Gamma$ 7-8,  $\Gamma$ 7-13,  $\Gamma$ 7-15,  $\Gamma$ 7-17,  $\Gamma$ 7-18]. Analytical solutions describing the generation and the evolution of ring-like optical vortex structures in waveguides with anomalous dispersion have been found in the cases of a step profile of the refractive index [ $\Gamma$ 7-8] and a spatial dependence of the nonlinear refractive index [ $\Gamma$ 7-5]. The generation of optical vortices with spiral [ $\Gamma$ 7-6,  $\Gamma$ 7-13] and vector [ $\Gamma$ 7-15] structures has been obtained for gradient optical fibers. Exact analytical solutions of the system of nonlinear spatio-temporal amplitude equations describing optical vortex structures propagating in isotropic nonlinear optical fibers are also presented in [ $\Gamma$ 7-17] and [ $\Gamma$ 7-18].

In 6 of the 7 scientific publications replacing habilitation thesis, A. Dakova-Mollova, PhD is listed first among the co-authors and in one she is listed second.

In general, the scientific contributions in the candidate's works can be characterized *as an enrichment of existing knowledge by proving new facts and hypotheses*. Another aspect of research is *the development of original mathematical methods* for solving physical problems related to finding conditions for obtaining and stability of soliton waves.

The large number of independent citations (80) of the scientific works of Ch. Ass. Prof. Anelia Dakova-Mollova in scientific publications, referenced and indexed in the scientific information databases Web of Science and Scopus, clearly shows the importance of scientific contributions in them. Publications [Γ7-11], [Γ7-9] and [Γ7-12] have the most citations. They are cited in 18, 14 and 12 scientific papers, respectively.

In the period 2016 - 2022, some results of the scientific works submitted for participation in the competition were reported at 11 renowned international scientific forums, and 5 academic reports were presented by the candidate.

The researches leading to the published scientific results were financed by national and international organizations. Since 2013 Anelia Dakova-Mollova, PhD has participated in **two international research projects** (one of which is ongoing), **one national** and **two intra-university**. She has been **the supervisor of two contracts for partial funding** of the National Student Scientific Conference on Physics and Engineering Technology.

## 5. An assessment of the candidate's personal contribution

According to the author's contribution statement, the candidate's personal contribution can be summarized as follows: 1) finding exact analytical solutions of nonlinear partial differential equations describing the evolution of optical pulses; 2) finding analytical solutions of systems of nonlinear differential equations in order to study the energy exchange between pulses and the generation of optical vortex structures; 3) finding approximate solutions in order to study the influence of various factors on the pulse parameters; 4) analysis of the results obtained.

In 8 of the presented 25 scientific publications A. Dakova-Mollova, PhD is listed first among the co-authors, in 8 – second and in the remaining 9 – third and further back. Let me point out that in 7 of the scientific publications she is a co-author in an international team of authors.

The candidate's scientific research activity is well-known to the world academic community. A. Dakova-Mollova, PhD is often invited to review scientific articles for authoritative journals in the field of the Physics of Wave Processes, including Nonlinear Optics and Quantum Electronics. From 2017 until the moment of submission of the documents, A. Dakova-Mollova, PhD has been an anonymous reviewer of 11 scientific articles for the journals *Optical and Quantum Electronics*, *Optik*, *Journal of Optics*, *Optics and Laser Technology*, *Optics Communications* etc.

Based on the above, I have no doubts about the originality of the candidate's personal contribution.

## 6. Critical remarks and recommendation

I have no critical remarks about the content and the layout of the submitted documents.

I recommend A. Dakova-Mollova, PhD continue her research in this area, and also look up experiments described in the scientific literature that confirm some of the analytical results she obtained.

## 7. Personal impressions

I personally know Ch. Assist. Prof. Anelia Dakova-Mollova. I have been her teacher in Theoretical Physics. Even as a student, she has showed remarkable theoretical and applied mathematical skills. Currently, Anelia Dakova-Mollova, PhD, is a university lecturer who knows how to motivate students and a scientist with a valuable scientific production. I must also note her precision and excellent organizational skills.

## CONCLUSION

The documents and materials submitted by Ch. Assist. Prof. Anelia Dakova-Mollova, PhD **fully meet** all the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria, the Regulations for its Implementation and the relevant Regulations of PU "Paisii Hilendarski".

The candidate in the competition has presented a **significant** number of scientific works published after those used in the defense of the PhD degree and the acquisition of the academic position of Chief Assistant Professor. The scientific works of Ch. Assist. Prof. Anelia Dakova-Mollova, PhD contain original scientific contributions that have received international recognition. The candidate also has significant achievements in teaching practice. The scientific and teaching qualifications of Ch. Assist. Prof. Anelia Dakova-Mollova, PhD, **are indisputable**.

The achievements of Ch. Ass. Prof. Anelia Dakova-Mollova, PhD, in the teaching and research activities **fully correspond to the minimum national requirements** for occupying the academic position "Associate Professor", which coincide with those of the Faculty of Physics and Technology at PU "P. Hilendarski", adopted in relation to the Regulations of PU for the application of the Law on the Development of the Academic Staff in the Republic of Bulgaria.

Based on the above, I confidently give my **positive** assessment and **recommend** to the Scientific Jury to prepare a report-proposal to the Faculty Council of the Faculty of Physics and Technology at PU "P. Hilendarski" for the election of Ch. Assistant Prof. Anelia Mincheva Dakova-Mollova PhD, to the academic position of "Associate Professor" at PU "Paisii Hilendarski" in the field of higher education 4. Natural Sciences, Mathematics and Informatics; professional direction 4.1. Physical Sciences (Physics of Wave Processes).

March 31<sup>st</sup> 2024

Reviewer: .....

/ Assoc. Prof. Ekaterina S. Pisanova, PhD /