

STATEMENT

**on the procedure for acquiring a scientific degree “Doctor of Physical Sciences”
in scientific field 4. Natural Sciences, Mathematics, and Informatics,
professional field 4.1 Physical sciences (Physics of atoms and molecules)),
Faculty of Physics,
at Sofia University “St. Kliment Ohridski” (SU).**

This statement is written and submitted by Assoc. Prof. Nikolay Ivanov Minkovski, Head of Department “Mathematics and Physics” – University of Forestry, Sofia, professional field 4.1. Physical sciences (Physics of wave processes, nonlinear optics), appointed to the academic jury for this procedure by the Rector of SU in accordance with № ПД 20-127 / 22.01.2021 г.

Dissertation topic: "Quantum optical analogues"

Author of the dissertation: Assoc. Prof. Dr. Andon Angelov Rangelov

I. General description of the submitted materials

1. Data on the submitted documents

The candidate Assoc. Prof. Dr. Andon Rangelov presented a dissertation and abstract, as well as the mandatory tables for the Faculty of Physics from the Regulations on the terms and conditions for obtaining scientific degrees and holding academic positions at Sofia University "St. Kliment Ohridski". Also presented are a professional CV, copies of the diploma for higher education and the diploma for educational and scientific degree “doctor”, declaration of plagiarism, a complete list of citations of the articles on which this dissertation is based.

The documents submitted for the defense by the candidate comply with the requirements of the Academic Staff Development Act (ZRASRB), the Regulations Act for the Implementation of ZRASRB (PPZRASRB), the Rules of Procedure and the Regulations on the Terms and Conditions for Acquisition of Scientific Degrees and Academic Positions at Sofia University “St. Kliment Ohridski” (PURPNSZADSU).

The report for fulfillment of the minimum requirements for the scientific degree “Doctor of Physical Sciences” in professional field 4.1 “Physical sciences” contains in tabular form data by groups of indicators A, Б, Г and Д – 906 total points.

2. Information about the Candidate

Andon Rangelov graduated in 2002 from the Faculty of Physics at Sofia University "St. Kliment Ohridski". During the period 2004-2008 he was a full-time doctoral student at the Faculty of Physics of the Sofia University "St. Kliment Ohridski". He defended his doctoral dissertation in 2008 on "Coherent control of quantum systems with pulsed fields". In the period 2009-2012 he was an assistant, and in the period 2012-2015 he was a senior assistant at the Faculty of Physics of the Sofia University "St. Kliment Ohridski". In 2015 he was elected associate professor at the same place where he continues to work to this day.

3. General characteristics of the candidate's scientific achievements

a) the scientific publications included in the dissertation work fulfill the minimum national requirements (under Art. 2b, para. 2 and 3 of ZRASRB) and respectively the additional requirements of Sofia University “St. Kliment Ohridski” and in particular of the Faculty of Physics of Sofia University for obtaining the educational and scientific degree “Doctor of Physical Sciences” in the scientific field 4. Natural sciences, mathematics and informatics and professional field 4.1. Physical sciences;

Assoc. Prof. Rangelov's dissertation is based on 32 articles, which have been published in many prestigious international journals, 24 of them are with Q1, 6 journals are with Q2 and 2 are with SJR. These are journals such as Optics Letters, Journal of the Optical Society of America A, Physical Review A, Applied Optics, Journal of Optics, Photonics Research, Advances in Chemical Physics, Reviews of Modern Physics, Optics Communications.

All articles are devoted to theoretical and experimental research in the field of coherent quantum light control, and a successful analogy has been made between classical optics and quantum mechanics. Theoretically substantiated and experimentally realized light control devices in several optical fibers, new schemes of broadband optical polarizers, broadband retarders, broadband polarization rotators, highly efficient frequency conversion schemes. These developments are especially important in the time in which we live, we are on the verge of successful realization of the first optical quantum computers. This is a clear indicator of the importance and relevance of this dissertation.

b) the scientific publications included in the dissertation do not repeat those from previous procedures for acquiring a scientific title and academic position (list of articles used for the scientific degree "doctor" and attached);

c) there is no legally proven plagiarism in the submitted dissertation and Autoreferate.

4. Characteristics and evaluation of the teaching activity of the candidate

Teaching activity of Assoc. Prof. Rangelov is Quantum Transitions (lecture and exercises for a master's program); Electrodynamics (lecture and exercises for students in Engineering Physics); Quantum mechanics (exercises for students in Engineering Physics).

5. Content analysis of the scientific and scientific-applied achievements of the candidate contained in the materials of the dissertation

The dissertation presents several significant scientific results:

The creation of broadband polarization wave plates consisting of suitable sequences of half-wave and quarter-wave plates is demonstrated theoretically and experimentally.

Theoretically and experimentally, it is a demonstration of a device operating as a broadband polarizing rotator.

A technique for controlled and stable conversion of polarization by an optically anisotropic medium is shown theoretically and experimentally. The technique is analogous to the stimulated Raman adiabatic transition (STIRAP).

Efficient broadband frequency generation using composite nonlinear crystals (MgO:LiNbO₃ with composite segment design and periodic design) constructed in a similar way as composite polarizing rotators and composite wave plates.

Broadband optical insulators (broadband Faraday rotator, nonlinear adiabatic optical insulator based on a periodically polished KTP crystal with a variable length) are theoretically substantiated and experimentally realized.

Controllable broadband splitters of light beams in optical waveguides (based on a photorefractive SBN crystal) have been developed theoretically and experimentally.

The application of the adiabatic approach and the quantum-mechanical analogies make the dissertation original and interesting.

Scientific contributions can be evaluated as new scientific methods (adiabatic evolution (RAP), quantum-mechanical analogy, stimulated Raman adiabatic transition, composite optical pulses) and as achievements with great future practical significance - polarization control, frequency mixing, simultaneous control of optical beams in several waveguides.

The dissertation is based on 32 publications. They have been cited more than 151 times in prestigious international journals. Some of the articles have been cited many times. This speaks of the international interest in the scientific work of Assoc. Prof. Rangelov and the international recognition of his scientific results. The Scopus system so far shows 61 articles, 894 citations and a Hirsch index of 16, which is a very good achievement. This shows the quality of the scientific production of Assoc. Prof. Rangelov, as well as its impact in the international aspect. He is the first author of many publications and has made a major contribution to the theoretical models of all experiments. Many of the co-authors are from abroad, from the USA, from Australia, from Germany, from Italy. The scientific journals in which the publications are published have a very high impact factor, for example Reviews of Modern Physics - 45, Journal of Optics -2.38, Physical Review A. -2.8, Optics Letters -3.7.

6. Critical remarks and recommendations

The dissertation is well written, the analogies are convincingly presented, the conclusions are correct. Assoc. Prof. Rangelov has used rich scientific material, 163 articles have been cited in the dissertation, both new and basic, classical.

7. Personal impressions of the candidate

I was a member of a scientific jury with Assoc. Prof. Rangelov and my impressions are very good. Andon Rangelov is an established physicist in the field of linear and nonlinear optics, electrodynamics, quantum mechanics.

8. Conclusion

After getting acquainted with the presented dissertation, Autoreferate and other materials, and based on the analysis of their significance and contained in them scientific and scientific-applied contributions, I confirm that the scientific achievements fulfill the requirements of ZRASRB and the Regulations for its application. and the relevant Regulations of Sofia University "St. Kliment Ohridski" for acquiring the educational and scientific degree "Doctor of Physical Sciences". The candidate demonstrates deep knowledge of his field and the capacity to develop it in a new and important way. In particular, the candidate satisfies the minimum national requirements in the professional field and no plagiarism has been established in the dissertation, Autoreferate and scientific papers submitted at the procedure.

I give my positive assessment of the dissertation.

II. GENERAL CONCLUSION

Based on the above, I hereby recommend to the scientific jury to award **Assoc. Prof. Andon Angelov Rangelov Ph.D.** with a scientific degree "Doctor of Physical Sciences" in the scientific field 4. "Natural sciences, mathematics and informatics" professional field 4.1. Physical Sciences.

18.04.2021

Member of the Scientific Jury:

(Assoc.Prof. Nikolay Minkovski)