Review

by Prof DSci. Dr Petko Iliev Nenovski (retired)

on

scientific publications submitted for participation in a competition for obtaining the academic rank PROFESSOR in the professional field 4.4. Earth Sciences, published in State Gazette No. 98 of December 13, 2019

Documents for participation in the announced competition have been submitted by only one candidate - Dr. Veneta Hristova Guineva, Associate Professor at the Atmospheric Optical Investigations Section in the Stara Zagora Department of the Space Research and Technology Institute (SRTI) at Bulgarian Academy of Sciences.

I. Assessment of compliance with the minimum national and BAS requirements (SRTI).

Veneta Hr. Guineva is a graduate of Sofia University "Kl. Ohridski ". She graduated with a degree in radiophysics and electronics in 1980. The topic of her diploma thesis is "Self-influence in the propagation of surface waves in gas-discharge plasma". She started working at the United factories for storage devices in Stara Zagora and started her academic career in 1983 at the Central Laboratory for Space Research at Bulgarian Academy of Sciences as a physicist, after that research associate II deg. (since 1990) and research associate I deg. (since 2001). Veneta Guineva defended her scientific-educational degree in 2001. The thesis topic is "CO^+ in the Halley comet spectrum by data from the three-channel spectrometer on board VEGA-2". She habilitated in 2008 (senior research associate II deg.) at the Observatory (Stara Zagora), a Department of SRTI.

Dr. Veneta Guineva's scientific work at CLSR at BAS starts with the processing and analysis of data from the scanning spectrophotometer "EMO-5" on board the satellite "Bulgaria 1300" and later from the three-channel spectrometer (TKS) in the visible and the near UV range under the VEGA (Venus-Halley) project under the INTERKOSMOS program. Dr. V. Guineva becomes Head of the Comet Research Problem Group. Subsequently, she is orientated to the measurement and analysis of absorption spectra in the atmosphere, the absorption of solar radiation from molecular oxygen. Object of the study are processes in the near-Earth space, the middle atmosphere and the mesopause, physics of the trace gas constituents in the atmosphere, influence of the solar activity on weather and climate, etc. It follows from the aforesaid that the professional and scientific orientation of Assoc. Prof. Dr. Veneta Guineva is adequate to the direction of the announced competition and makes her a fully suitable candidate in the competition for the academic position of Professop in the "Atmospheric Optical Investigations" section of Stara Zagora Department of the Space Research and Technology Institute (SRTI) at Bulgarian Academy of Sciences (BAS).

To participate in the competition, Assoc. Prof. Dr. V. Guineva has presented a complete list of publications and reports: 172 publications and 292 oral presentations and posters in thematic collections, scientific journals and proceedings of scientific conferences in English and

Bulgarian. 76 of the publications are presented for participation in the Professor Competition. These works (76) are within the thematic scope of the competition and are accepted for review. The present review has been prepared on the materials provided by the applicant, namely: CV, self-report (presented in tabular form) for compliance with the minimum national requirements, as well as the enhanced requirements of BAS (respectively SRTI); habilitation reference for the scientific contributions; author's reference for the publication activity, citations and scientific contributions, analysis of citations of publications with the name Veneta Guineva; list of research projects with scientific guidance (8) and participation (16) in national and international projects and contracts. Over 75% of the complete list of projects and contracts completed are internationally involved.

From the 76 publications, submitted for the Professor academic competition, 13 are with Impact Factor (IF) and/or Impact Rank (SJR) issues, 9 are in refereed and/or indexed journals without Impact Factor, and the other 54 - in non-refereed peer reviewed scientific papers or in edited collective volumes. The number of papers in Impact Factor journals is: 3 in each Adv. Space Res. and JASTP, 2 in each Geomag. & Aeronomy and Solar-Earth Physics, 1 (one) in each SEDOPTICA, Chemical Phys. Lett. and Comptes rendus de lÁcademie bulgare des Sciences. The high impact factor of the journals is an absolutely well-founded criterion for the fact that the publications of Assoc. Prof. V. Guineva are internationally known and their author is recognized as a scientist and renowned expert in the international scientific community in the field of her work.

In 37 of the publications, submitted for the competition, Assoc. Prof. Veneta Guineva is the first author (~ 50%) and in 10 – the second author (~ 14%). In the other works her contribution is also evident. It can be reasonably concluded that the participation of V. Guineva in the submitted papers for review is decisive and/or determinant.

The documentation submitted by the applicant for the competition is sufficiently exhaustive, and the provided reference for the minimum required points. by groups of indicators for Professor according to Decree No. 26 of 13.02.2019 is complete and correct. The total score of points on the required groups of indicators exceeds the required ones, as well as the higher requirements in the BAS.

II. Research activities and results.

The applicant has presented and classified the main scientific and applied contributions in 5 groups - physics of auroral processes, spectral modeling, trace gas constituents, climatic changes (variations and trends in temperature), devices for optical research.

II.1. Substorms Physics (Studies Physical Processes during substorms).

These studies are the biggest part of the publications, submitted for the competition (32 out of 76).

The studies include ground based and satellite data/observations of geomagnetic and auroral disturbances caused by various "drivers" in the solar wind (magnetic clouds, high-speed (recurrent) streems, regions of increased density in front of these structures (the so-called Sheath and CIR), etc.), analysis of auroras that accompany such events. Understanding the mechanisms of generation of geomagnetic and auroral disturbances is the key to the so-called "Space Weather" and its significance and relevance has been and is still the focus of a number

of space projects and programs by ECA, NASA, Russia, Japan, India, etc., incorporating magnetometer networks and satellites as IMAGE, POLAR etc. In their research and analysis, Assoc. Prof. V. Guineva et al. have used data from riometers, optical observations, ground based magnetic measurements (Scandinavian IMAGE magnetometers), as well as data on solar wind (SW) parameters and interplanetary magnetic field (IMF).

The scientific contributions of Assoc. Prof. V. Guineva are: establishing a high correlation between the dynamics of optical emissions, the streams of precipitating charged particles (electrons) and the terrestrial magnetic field under various manifestations of the solar wind and geomagnetic conditions; matching the auroral bulge with the highest energy precipitating electrons; proposed definition and criterion for determining the polar boundary of the substorm bulge by optical measurements; classification of substorms into "different groups and subgroups" according to the geomagnetic conditions and their characteristics; she introduced a concept and criterion for the structured recovery phase of a geomagnetic storm. I would summarize the above studies as disclosure (morphology of) the substorm phenomenon, establishing the structure of the substorm in its various phases, relationships between the structure of the substorm (its dynamics) and the parameters of the solar wind, and the so-called drivers in it. Questions and/or comments arise (which is absolutely normal in such a complex research). How do the results obtained by the author compare with magnetic data from previous and current space projects and missions (e.g. Swarm)? What are the characteristics of the accompanying magnetic disturbances in and above the auroral ionosphere? Is there any correspondence between the disturbances in the ionosphere and the magnetosphere (mediator) with those observed in the SW and IMF and on the Earth's surface? The substorm phenomenon is observed at middle latitudes. Is it possible? What distinguishes the mid-latitude substorm from the substorm at auroral latitudes?

Generally speaking, the physical mechanisms that are key during substorms have not yet been fully revealed. However, the significant contributions made to the physics of the substorm suggest that V. Guineva will continue her research in this important area.

II.2, II.3. Use and development of models and study of the trace gas constituents in the atmosphere (31 publications) and II.4.

The bigger part of the theory and theoretical models of Assoc. Prof. Dr. Guineva are devoted to the trace gases in the Earth's atmosphere. Due to the common object of study – trace gas constituents in the atmosphere and their impact on climate and climate change, I combine two of the basic scientific contributions identified by the candidate in Groups II and III (taken from the Habilitation Extended Reference). Here some of the results partly included in Group IV (climate change) are included as well.

1. Method for processing data on the amount of stratospheric NO_2 in the atmosphere. The resulting monthly morning series can be described by a simple model containing a linear trend and a seasonal component consisting of a harmonic term (with a period of 1 year). Evening time series contain an additional harmonic term with a period of 6 months. When comparing the long-term NO_2 trends over Stara Zagora and other stations (mid-latitude and subtropical) the time series are homogenized by linear regression between neighbor stations, interpolation and filling the gaps of missing data with seasonal averages. This approach for homogenizing time series of the stratospheric NO_2 content has been applied for the first time (a novelty). Multiple regression has been used involving various influencing factors such as solar activity,

aerosols, the El Nino phenomenon, QBO (so called quasi-biennial oscillations). No effect of solar activity and QBO on stratospheric NO_2 (R1.5) has been found. So far, there is no unanimous point of view on the global trend of NO_2 and its trends for the two hemispheres.

2. Another trace gas in the atmosphere that is the subject of careful research by the applicant is the carbon dioxide (CO_2). It is considered to be the main climate driver of global warming. Variations in atmospheric CO_2 content and the influence of various factors on CO_2 emissions have been investigated (R2.4). Two different models of CO_2 sinks are suggested. It has been found out that the observed content and plateau in the concentration of CO_2 in the atmosphere is explained by the presence of such additional sinks.

Global temperature anomalies data are analyzed by the use of multi-regression models. Temperature effects other than those related to CO_2 are excluded. The temperature distributions obtained in this procedure follow closely the change in CO_2. The close relationship between temperature change and the greenhouse effect of CO_2 is shown. The slowdown in CO_2 emissions from 1939 to 1950 and the associated concentration of CO_2 in the atmosphere, generated at least partially by human activity, cause a slower increase in temperature anomalies during this period. It is concluded that CO_2 is the leading variable in the relationship: surface temperature $-CO_2$.

The effect of CO_2 concentration on the temperature course above the Earth's surface and above the ocean for the Northern Hemisphere (N22) has been investigated. The temperature evolution in the Northern and Southern hemispheres is predicted based on long-time changes of CO_2 and the Atlantic multidecadal oscillation index (R1.7). According to the author's forecast the Northern Hemispheric temperatures are modulated by the Atlantic multidecadal oscillation influence and will not change in the coming decades (to about 2040), after that an acceleration of the temperature increase rate is expected, similar to the one during the last 3 decades of the 20th century. The temperatures in the Southern hemisphere will increase almost linearly and don't show significant periodic changes due to Atlantic multidecadal oscillation. The concrete warming rates of course are strongly depending on the future atmospheric CO_2 content.

3. The ozone content by data of the device GUV 2511 has been investigated. GUV 2511 was installed at Stara Zagora Observatory, a department of SRTI-BAS, in 2015. It was provided under the project BG161PO003-1.2.04-0053 "Information Complex for Aerospace Monitoring of the Environment "(ICASME), implemented with the financial support of Operational Program "Development of the Competitiveness of Bulgarian Economy 2007-2013", co-financed by the European Regional Development Fund and the national budget of Republic of Bulgaria. GUV 2511 is designed to measure incoming radiation in 6 broadband channels (10 nm full width at ½ of maximum (FWHM)) at 305, 313, 320, 340, 380, 395 nm and the irradiance in visible range from 400 to 700 nm. (N24, N36, N40). From these measurements, the total ozone content (TOC) of the atmosphere can be retrieved, the UV index (UVI) and the cloud optical depth can be determined. The advantage is that the device has no moving components, works stable and fast. Allows ozone and UV index determination even under cloud cover conditions. This distinguishes it from the Microtops II instrument (implemented in NIGGG, BAS). Data preprocessing is proposed and implemented, which also takes into account the impact of cloud cover.

TOC cannot be determined directly from the ratios of the GUV 2511 measured irradiances at different wavelengths. Methods have been developed to determine the ozone content in the stratosphere (N10, R2.7). They include radiation transfer models incorporating the UV range. The TUV (Tropospheric Ultraviolet and Visible) model developed by Madronich, version 4.1 is used. The spectra have been calculated for the geographical location of the Stara Zagora Observatory for various TOCs, zenith angles and surface albedo. For filter response functions, a Gaussian with a width at ½ of maximum 10 nm is used. Stamnes tables (Stamnes et al., 1991) for radiation ratios at 340 and 313 nm have been obtained. The ozone content values are determined by interpolation from the calculated tables for the measured ratios and zenith angles for the time when the measurements were made. The TOC values obtained from the GUV data follow closely the multi-annual seasonal mean as determined by TOMS measurements (NASA project), observing the ozone peak in March and larger variations in spring, typical for middle latitudes. For almost cloudless days, TOCs are very close to the seasonal average of TOMS. On cloudy days, larger variations are observed and these values are usually greater than those on clear days.

A correlation of 0.97 (!) has been found between the TOC of ground measurements (in Stara Zagora) and the TOC of satellite measurements from OMI (continuation of TOMS). The GUV 2511 instrument is not calibrated against a Dobson spectrometer or Brewer instrument, hence no systematic deviation between the results of the two instruments can be settled. The author notes, however, that measurements in Stara Zagora make it possible to determine the daily TOC with an error (mean relative standard deviation) of 3.1% corresponding to about 10 DU.

In this regard I have the following comment/question: Have data and results from measurements of TOC in Sofia (conducted in NIGGG) been used?

4. The following contribution is also noteworthy: The determined values of the biologically active UV index for Stara Zagora cloudless conditions are in good agreement with the ones obtained for Sofia by measurements during satellite passages, published on the website of Themis (http://www.temis.nl /uvradiation/UVindex.html). The developed scheme for one-day forecast of TOC and UVI (N14, N42) is based on interpolation of satellite data to a network with better resolution for the territory of Bulgaria. A correction of the values of TOC and UV index for the surface elevations and for different values of the albedo for snow, soil and vegetation and beach sand by parameterization is envisaged. The correction factors are determined by the Madronich Tropospheric Model for the Ultraviolet and Visible Area (TUV). The analysis of the results during the test period (19.09.2019 - 19.10.2019) shows that the forecast gives TOC and UV index with sufficient accuracy.

5. A method for determining the physical characteristics of clouds based on measurements performed by the GUV 2511 instrument. A characteristic describing cloudiness has been determined (N30, R2.7). The optical depth of the cloud cover is obtained depending on the ratio of real measured intensities and intensities on clear days. To account for the influence of cloudiness, 3-dimensional look up tables have been calculated using the Madronich TUV model, which determined the ratio of solar radiation unaffected by ozone (340 nm) and radiation absorbed by ozone (313 nm) for different total column ozone content (TOC), optical cloud depth and zenith angles. TOC is determined by the actual values of the radiation ratios by spline interpolation of the 3D tables. The statistical analysis shows that the combination of the two

algorithms (2D and 3D) for retrieval of the TOC from the measurements of GUV 2511 allows obtaining TOC with uncertainties of about 8.5 DU, corresponding to 2.6% (1 sigma value).

III. Scientific and applied activities

The contributions of Assoc. Prof. Dr. V. Guineva, mentioned in "Design of devices for optical measurements" in the "Author's reference" have a scientific and applied nature. Her contributions in this area have a definite, applied character, to which I pay special attention due to possible future applications.

The main articles describing the instrument and the method for calculating the profiles of O_2 concentration, pressure and temperature using the vertical profile of Lyman alpha (ASLAF instrument (Attenuation of the Solar Lyman Alpha Flux) are: R1.2, R1.11, N12, N33, N50, N52-54. As it is known, the launch of the rocket unfortunately turned out to be unsuccessful, i.e. there is no data to be processed and analyzed, despite this unpleasant incident (common in space research) the activities on the ASLAF instrument (modeling, design, block diagram, electronics, measurement methodology, transfer function, calibration, electromagnetic compatibility and others aspects) best illustrates the inevitable merging of scientific objectives and their application related to monitoring and environmental control.

The main merit for the production of the ASLAF device goes to Assoc. Prof. Dr. V. Guineva. The Project Funding under the National Science Fund was insufficient. Veneta Guineva managed to attract and organize colleagues from the Atmospheric Physics Group at Stockholm University, who covered the costs of the electronic elements and provided an ionization chamber. Despite many difficulties, the device was designed in accordance with all requirements (size, weight, and quality), successfully passed all tests conducted in Sweden (with the valuable support of colleagues with experience in instrument making from SRTI). The technical implementation of the instrument (ASLAF) proves (one more time) the professionalism, expertise, integrity and world-class of our specialists in the field of space research. With this experiment (ASLAF) Assoc. Prof. Dr. V. Guineva manifested her expertise and experience in organizing and working in a large international team.

The implementation of the ASLAF instrument is a request for the applied nature of her scientific activities in favor of the development of the research experimental base and of the need of physical processes monitoring related to the solar activity impact and climate change.

In the context of the applied aspects of the research, conducted by Assoc. Prof. Dr. V. Guineva, let me mention the author's certificate from the faraway 1988, which is not included in the works for the current competition: I. Kostadinov, R. Werner, P. Stoeva , V. Guineva, B. Boychev, Method and device for producing of ideal surface with equal brillincy, Author's certificate - BG44163A, 14.10.1988, Reg. Number 803841IA / 01.07.1987, European Patent Office:
http://v3.espacenet.com/textdoc?DB=EPODOC&IDX=BG44163&F=0&QPN=BG4416 3

IV. Organizational, public and promotional activities

It is evident from the author's reference that Assoc. Prof. Dr. V. Guineva has been the leader of 8 research projects, 3 of which are under EU FP6. She is a participant in 16 more projects, or a total of 24 at the moment – a convincing indicator of expertise and teamwork as well as competencies in organizational activities.

The public and organizational activities of Assoc. Prof. Dr. V. Gyineva include lectures, interviews, posters etc. She was a guest lecturer in Andoya (Andoya Rocket Range), Norway, where she presented the activities of the Stara Zagora Department (since its formation) and respectively her activities on the various stages of the ASLAF device creation (Attenuation of the Solar Lyman Alpha Flux). Assoc. Prof. Dr. V. Guineva also made such presentations to the Atmospheric Physics Group at Stockholm University, Sweden and presented the activities of SRTI (as a whole) to the participants in the popular Annual Seminar "Physics of Auroral Phenomena" in Apatity, Russia.

Veneta Guineva has given lectures in a popular form to students and people interested in physics in schools and community centers, dedicated to the activities of international and national projects (IC-Bulgaria 1300, VEGA) as well as on general physicsl topics.

She has popularized research (her or joint with colleagues) on various projects by presenting information about the activities carried out in the Stara Zagora Department at various events such as the Night of the Scientists, organized in the city (the library in Stara Zagora). She has given interviews for Radio Stara Zagora and/or local and national newspapers). She has led visitors or organized groups to the Observatory, St. Zagora, has participated in joint exhibitions intended for public attention.

V. Personal impressions by the applicant

I have known Veneta Guineva since the time when she carried out her diploma work in the laboratory "Plasma Physics" at the Department of Radiophysics and Electronics (SU), after that when she entered the CLSR at BAS, later transformed into the Institute for Space Research at BAS. I have had the opportunity to follow her performances at scientific conferences, congresses and so on in Bulgaria and abroad, to be convinced of her serious, responsible approach to solving her scientific tasks and related activities. I highly appreciate the consistency shown in the scientific work and the accomplished scientific achievements. Over the years Assoc. Prof. Dr. V. Guineva has proven herself as a scientist, expert and leader with valuable organizational experience in the implementation and realization of scientific and scientific-applied projects. I am convinced of her professional commitment, natural modesty and personal qualities, which, undoubtedly, will contribute to higher achievements, success for the section "Atmospheric Optical Investigations", Stara Zagora Department, SRTI, BAS.

VI. Opinions, recommendations and notes on the activities and achievements of the candidate

The author's reference is complete, correct and sufficient for the purposes of the competition. I fully accept the information provided. My recommendations, comments and questions as appropriate are included in the relevant sections above.

Additional information has been requested for the organizational and public activities, which has been provided by the applicant.

The presented scientific publications, reports, citations, management and participation in projects and space experiments, organizational and promotional activities of Assoc. Prof. Dr. Veneta Guineva meet the requirements for the academic position of Professor. They fully correspond to the direction of the announced competition.

VII. Conclusion

Based on the opinion expressed above on the announced in SG, issue 98 of 13.12.2019 competition documentation, I strongly recommend to the esteemed Scientific Jury and Scientific Council of SRTI, BAS to confer the academic rank PROFESSOR to Assoc. Prof. Dr. Veneta Hr. Guineva, Atmospheric Optical Investigations, St. Zagora Department.

April 21, 2020

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Prof, DSci. Dr Petko Nenovski

ВЯРНО С ОРИГИНАЛА

БЪЛГАРСКА АКАДЕМИЯ НА НАУКИТЕ
ИНСТИТУТ ЗА КОСМИЧЕСКИ ИЗСЛЕДВАНИЯ И ТЕХНОЛОГИИ