

## PEER REVIEW

on a competition for occupation of the academic position “Associate Professor” in professional field 4.1. Physical Sciences (Astronomy and astrophysics) for the needs of the Faculty of Physics of St. Kl. Ohridski University of Sofia, announced in the Newspaper of State No. 54 on July 29, 2021

with a candidate: Assist. Prof. Vladimir Vesselinov Bozhilov, PhD, Department of Astronomy, Faculty of Physics, St. Kl. Ohridski University of Sofia

reviewer: Prof. Tsvetan Borissov Georgiev, DSc, New Bulgarian University, Sofia

### I. GENERAL DESCRIPTION OF THE SUBMITTED MATERIALS

#### 1. Data about the candidacy

The available documents of the candidate correspond to the requirements of the State and the University. Dr. Bozhilov, with *h*-index 8, has submitted a list of 22 chosen articles. 17 of them are presented for the competition, [6-22]. They are published in international journals, e.g. 9 in Mon. Not. Roy. Astron. Soc. (MNRAS, UK, with IF 5—6 and 1 in Nature with IF 42. Four recommendation notes are presented, as follows: from the President of the collaboration WEBT (The Whole Earth Blazar Telescope), from the Head of the Department of Astronomy, from the Head of the Project NDeGRA and from the journal Astronomy and Astrophysics (A&Ap, EU) about the acceptance of the paper [20].

The candidate Dr. Bozhilov (born in 1986) is a former pupil of the School of French Language and Culture in Sofia (2004). He has acquired Master degree in Astronomy and Astrophysics in 2009 at the Faculty of Physics of St. Kl. Ohridski University of Sofia and PhD degree in professional field 4.1. Physical Sciences (Astronomy and Astrophysics) in 2014 at the Faculty of Physics of St. Kl. Ohridski University of Sofia. The thesis is entitled “Communications in the Science” and the supervisor was Assoc. Prof. Evgeni Ovcharov, PhD. The candidate is an Assist. Prof. in the Department of Astronomy from 2015 and since 2018 he is a member of the Council of the Faculty of Physics. In the period 2015—2021 he is a teacher of bachelor and master students in the field of more than 10 scientific courses.

Out of his scientific and teaching activity, regarded below, Dr. Bozhilov poses more than 20 impressive activities as scientist in the society and education, including Editor-in-Chief of the journal *Znanie* (Knowledge; 2014--2018), national coordinator about the astronomical education at the IAU (since 2020), national contact person for the subprogram European Council of Science Research (since 2017), founder and coordinator of the Planetarium of the Children's scientific Centre "Muzeiko". He carried out the Annual Prize for contribution to the science in the Sofia University "Alma Mater" (2012).

Dr. Bozhilov is co-author of 2 books – "Archaeo-logica. 1. Heuristic approach to the sacred symbols and knowledge (2009, Ch. Smolenov, Ch. Mihailov, V. Bozhilov) and Life in the Universe (2010, V. Bozhilov, K. Nam). Dr. Bozhilov was a referee of the manual *Astronomy Today* (2014, Pearson Book). He is also translator and scientific editor of 10 popularization books.

Dr. Bozhilov has been the head of 8 scientific and education projects with one of them with cash income for the University of about € 47 000, as well a member of 11 other projects.

## **2. Characteristic of the scientific publications and achievements of the candidate**

Dr. Bozhilov is author and co-author of commonly 48 publications. He has submitted 22 chosen journal articles (15 with Q1, 3 with Q2 and 3 with Q4) with 206 independent citations. The articles are published in journals with JR, as follows: 1 in *Nature*, 9 in *MNRAS*, 3 in *A&A*, 1 in *Astrophysical J.*, 2 in *J. of Cosmology and Astrophysical. Particles*, 1 in *J. of High Energy Astrophysics* and 5 others. Other 8 articles are printed in journals with SJR and 3 are published conference reports with full text. Other 16 articles are also listed. Dr. Bozhilov was a participant in conferences with 14 reports and 3 posters.

Dr. Bozhilov participates mainly in the international collaboration WEBT for investigations (photometric, spectral, polarimetric and all-waves) of blazars – the most variable active galactic nuclei). He has also scientific contributions (articles) about the particle detectors, education and teaching SETI, creation of a student observatory. I consider all contributions as highly professional.

As a continuation of the above mentioned I argue:

- a) The scientific contributions of Dr. Bozhilov meet the requirements for occupying the academic position "Associate Professor" under the Law of Development of the Academic Staff in Republic of Bulgaria and the relevant Regulations and Specific Requirements;
- b) The scientific contributions of Dr. Bozhilov do not repeat the results of his previous

dissertation;

- c) The scientific contributions of Dr. Bozhilov do not contain proved plagiarism from other scientific articles.

### **3. Characterization and evaluation of the teacher activities of the candidate**

Dr. Bozhilov poses large teaching experience. Being a student he has been a teacher of physics and informatics in English language in the Private School “Avicena” (2008—2009). The academic teaching activity of Dr. Bozhilov started in 2015 and continues till now. In the recent years (2017—2020) he had more than 1000 hours in auditorium periods and more than 1700 hours other periods. He has given lectures and seminars of Communication in astronomy, History of astronomy, Solar system and exoplanets, Aerospace technologies. He was a teacher of bachelor and master students in the disciplines General astrophysics, Photometric methods, Physics of the variable stars, Astroseismology, Cosmology etc., commonly more than 10 disciplines. Dr. Bozhilov has 13 graduated bachelors and masters.

I consider the teaching activity of Dr. Bozhilov is large and highly professional.

### **4. Analysis of the scientific and science-applying activity of the candidate**

The papers [1—5] are connected with the PhD of Dr. Bozhilov and I do not comment them. The four articles, [6—9], presented as the **habilitation contribution**, are the most impressive. They are published in Nature – 1 and in MNRAS – 3, with 137 independent citations. The essences of these articles follows.

6. Larionov V.M. et al. (53 co-authors, Bozhilov is No.15), Exceptional outburst of the blazar CTA 102 in 2012: The GASP-WEBT campaign and its extension, 2016, MNRAS, 461/3, 3047–3056. (43 cit.)

The international program of the Whole Earth Blazar Telescope (GASP–WEBT) collaboration campaign in optical and NIR bands, with an addition of previously unpublished archival data and extension through fall 2015, allows comparison of this outburst with the previous activity period of this blazar in 2004–2005. It is found a remarkable similarity between the optical and  $\gamma$ -ray behavior of CTA 102 during the outburst, with a time lag between the two light curves of  $\approx 1$  h, indicative of connectivity of the optical and  $\gamma$ -ray emission regions. The relation between the  $\gamma$ -ray and optical fluxes is consistent with the synchrotron self-Compton (SSC) mechanism.

7. Raiteri C.M. et al. (86 co-authors, Bozhilov is No.11), Blazar spectral variability as

explained by a twisted inhomogeneous jet, 2017, *Nature*, Vol. 552, 7685, 374-377. 65 cit.)

The results of optical-to-radio-wavelength monitoring of the blazar CTA 102 are reported. It is shown that the observed long-term trends of the flux and spectrum are best explained by an inhomogeneous, curved jet that undergoes changes in orientation over time. The authors propose that magnetohydrodynamic instabilities or rotation of the twisted jet cause different jet regions to change their orientation and hence their relative Doppler factors. In particular, the extreme optical outburst of 2016–2017, of six magnitudes, occurred when the corresponding emitting region had a small viewing angle. The agreement between observations and theoretical predictions can be seen as further validation of the relativistic beaming theory.

8. Carnerero M.I., et al. (70 co-authors, Bozhilov is No.13), Dissecting the long-term behavior of the BL Lac object Mrk 421, 2017, *MNRAS*, 472/4, 3789–3804. (21 cit.)

Long-term multiwavelength monitoring of blazar Mrk 421 is accomplished by international collaboration. The source behavior in the period 2007–2015, characterized by several extreme flares is studied. The ratio between the optical, X-ray and  $\gamma$ -ray fluxes is strongly variable. The  $\gamma$ -ray flux variations show a fair correlation with the optical ones starting from 2012. Broad-band spectral energy distributions with simultaneous near-infrared and optical data is build. They show strong variability in both flux and X-ray spectral shape and suggest a shift of the synchrotron peak up to a factor of  $\sim 50$  in frequency. The interpretation of the flux and spectral variability is compatible with jet models including at least two emitting regions that can change their orientation with respect to the line of sight.

9. D'Ammando F., et al. (99 co-authors, Bozhilov is No.12), Investigating the multiwavelength behavior of the flat spectrum radio quasar CTA 102 during 2013-2017, 2019, *MNRAS*, 490/4, 5300-5316. (8 cit.)

Unprecedented  $\gamma$ -ray flaring activity with four outbursts was observed during 2016 November–2017 February. They have corresponding events in the near-infrared, optical, and UV bands, with the peaks observed at the same time. A general agreement between X-ray and  $\gamma$ -ray activity is found. The  $\gamma$ -ray flux variations show a general, strong correlation with the optical ones with no time lag between the two bands and a comparable variability amplitude. This  $\gamma$ -ray/optical relationship is in agreement with the geometrical model that has successfully explained the low-energy flux and spectral behavior, suggesting that the long-term flux variations are mainly due to changes in the Doppler factor produced by variations of the viewing angle of the emitting regions. The difference

in behavior between radio and higher energy emission would be ascribed to different viewing angles of the jet regions producing their emission.

The majority of **the other 13 submitted articles**, [10—22], are also devoted to blazars – CTA 102, Mkn 421, BL Lac, 3C 279 in the international WEBT collaboration. The scientific activity of Dr. Bozhilov is related mainly to the investigations of the astrophysics of the blazars. The candidate has expertise in the photometry and polarimetry - observations (measurements with modern instruments in the Rozhen National Observatory), data processing and interpretation of the results.

**The personal contributions** of Dr. Bozhilov poses high professionalism, mainly in the photometric part of the investigations.

The President of the WEBT Dr. Massimo Villata (INAF-Osservatorio Astrofisico di Torino, Italy) has confirmed that “Dr. Bozhilov has performed the following actual work and has contributed to the papers by:

- He carried out optical observations and related data reduction;
- He reviewed and contributed to the final manuscripts.
- He also acts as the contact point between the WEBT and the team of the Department of Astronomy at the Faculty of Physics, University of Sofia”.

The Head of the Department of Astronomy Assoc. Professor Evgeny Ovcharov, PhD, confirms that Dr. Bozhilov has significant contribution to the papers of GASP-WEBT and CTA-MAGIC.

**The character** of the contributions of Dr. Bozhilov is experimental check of theory by obtaining of new knowledge. The main result of the long period international investigations with his participation is outstanding in the title of the publication in the Nature (article No. 7): Blazar spectral variability is explained by a twisted inhomogeneous jet. The scientific contributions of the candidate can be characterized as enrichment of the existing data and knowledge.

## **5. Critical notes and recommendations**

The candidate poses numerous publications that have been the subject of strict peer review. He has also large teaching and social activity. I have no notes and recommendations.

## **6. Personal impressions about the candidate**

My indirect personal impressions of the candidate are that he is an affirm scientist and uni-

versity teacher with a large store.

## 7. Conclusion about the candidacy

Based on the analysis of materials submitted under the procedure, I **confirm** that the overall activity of Dr. Bozhilov meets the requirements for occupying the academic position “Associate Professor” under the Law of Development of the Academic Staff in Republic of Bulgaria and the relevant Regulations and Specific Requirements. I give a **positive** assessment to his application.

## II. GENERAL CONCLUSION.

On the base of the upper review I **recommend** to the scientific jury to propose to the Honorable Faculty Council of the Faculty of Physics of “St. Kliment Ohridski” University of Sofia **to elect Assist. Prof. Vladimir Vesselinov Bozhilov, PhD**, on the academic position “Associate Professor” in professional field 4.1. Physical Sciences (Astronomy and astrophysics).



October 15, 2021

Reviewer:

(Prof. Tsvetan Borissov Georgiev, DSc)