

## REFEREE REPORT

*on competition for occupation of the academic position "Associate Professor" in the professional field 4.1 "Physical Sciences (Particle Physics)", published in the State Gazette №93/26.11.2019 for the needs of the Faculty of Physics at Sofia University "St. Kliment Ohridski"*

*with only one candidate Head Assistant Professor Dr. Peicho Stoev Petkov, Faculty of Physics, Sofia University*

*by the member of the scientific jury Prof. Roumen Vassilev Tsenov, Dr.Sci. (Department of Atomic Physics, Sofia University "St. Kliment Ohridski")*

I know Mr. Petkov and have had observations about his development as a lecturer and researcher since his studies at the Faculty of Physics, in particular from 1998 until now. During this time, he developed himself as a physicist with a wide erudition and exceptional ability to work, as well as with a strong affinity for the difficult work of teaching, as well as a friendly and helpful colleague.

After receiving her master degree in physics in 2001, Peicho Petkov became a doctoral student in elementary particle physics and then a physicist at the Department of Atomic Physics at Sofia University. He defended his dissertation for his PhD degree in 2009, and in 2013 he won a competition and became Head Assistant Professor in the department, which position he occupies until now.

Dr. Petkov's teaching duties are related to conducting lectures, seminars and practical classes in a considerable number of particle physics courses, accelerators and detectors of high-energy ionizing radiation, modeling of interactions of biologically important molecules, programming in UNIX environment. He supervised five student theses. For all his years as a university lecturer he has a teaching load far exceeding the accepted standards at Sofia University. As it is seen, his teaching work is intense, extensive in subject matter and successful. In this respect he is fully prepared to fulfill the duties of Associate Professor.

Dr. Petkov's research is mainly related to the experimental particle physics, in particular, in the experiment CMS (Compact Muon Solenoid) at the Large Hadron Collider (LHC) at the European Center for Nuclear Research (CERN). His main accomplishments are in the design, construction, testing, installation in the detector, and operation of the system of Resistive Plate Chambers (RPC) for measurement of the characteristics of muons produced in proton-proton collisions at TeV energies. This system is impressive in terms of total area, number of registration channels and physical characteristics.

P. Petkov has a significant role in all stages of:

- development and construction of a part of the resistance plate chambers for the CMS muon system, carried out by a group of experts from the INFN (Istituto Nazionale di Fisica Nucleare) section in Bari (Italy), Institute of Nuclear Research and Nuclear Energy of the Bulgarian Academy of Sciences and the Faculty of Physics, Sofia University;
- development of the trigger system of the chambers test stand in Sofia;
- study of the characteristics of the chambers and the stability of their basic operating parameters over time;
- maintenance and inspection of the chambers during the planned technical shutdown of the LHC in 2013-2014;
- collecting data from the passage of cosmic rays through the RPC and proton-proton collisions at the LHC in 2010-2012 and 2015-2018;
- study of the evolution over time of the characteristics of the RPC system.

As a result of ensuring excellent functionality and high parameters of the RPC system of the CMS detector, important physical results have been achieved where this system plays a key role. The results were obtained by investigating the interactions of protons with protons in energy in the center of mass system 7 TeV. It is worth noting:

- first lowering the upper bounds to observe the rare decays of the “beauty” neutral mesons  $B_s^0 \rightarrow \mu^+\mu^-$  and  $B^0 \rightarrow \mu^+\mu^-$ , and then observe them with statistical significance of six standard deviations for the decay  $B_s^0 \rightarrow \mu^+\mu^-$  and three standard deviations for the decay  $B^0 \rightarrow \mu^+\mu^-$ . That was made possible by combining the data from the CMS and LHCb experiments;
- search for unknown light resonances that decay into pairs of muons;
- measurement of the cross section for production of hadrons containing b-quarks, as well as pairs of hadrons containing b- and anti-b-quarks, whereby the “beauty” hadrons decay to states containing muons;
- search for a light pseudoscalar Higgs boson that decays into a pair of muons;
- search for Higgs bosons beyond the Standard Model, decaying into pairs of light bosons, with four muons expected.

In the RPC team of the CMS collaboration, Dr. Petkov also has a number of other research and coordination functions, described exhaustively in his author's reference. The fact that the team entrusted to their colleague P. Petkov to perform these important functions is a testament to the qualities of Dr. Petkov as a researcher, as well as a coordinator and leader of scientific experiments. The high opinion of him and his work by his CMS colleagues, expressed in the letters of the RPC Project Coordinator in the CMS Collaboration, Dr. Gabriela Pugliese, Associate Professor at the Interuniversity Department of Physics at the University of Bari and the Polytechnic University there.

I would like to mention here the work, research and publications that Dr. Petkov has in a very promising interdisciplinary field: applications of supercomputers in physics

research in general and, in particular, in modeling of interactions of complex biologically important macromolecules, performed with the use of supercomputers. His publications in this field, his reports in scientific forums and his participation in projects funded by the National Science Fund (see the full list of publications and CV in the competition documents) show that he is developing himself as a very valuable specialist in the extremely interesting interdisciplinary field of overlapping of simulation techniques developed in particle physics, their adaptation to supercomputer platforms and methods for modeling the interactions of macromolecules. More importantly, his interests are adequately reflected in his teaching work (reading courses and supervision of diploma theses), which greatly supports the development of this modern interdisciplinary field in the Faculty of Physics at Sofia University.

Peicho Petkov submitted for the competition 20 publications in journals with high impact factor, which were not used in his PhD thesis. They are in the following journals:

- Physical Review Letters - 3 papers (2010, 2011, 2012)
- Journal of Instrumentation - 8 papers (2010, 2012, 2013, 2013, 2014, 2014, 2018, 2018)
- Physics Letters B - 3 papers (2013, 2016, 2018)
- Nature - 1 paper (2016)
- Journal of High Energy Physics - 3 papers (2011, 2011, 2012)
- Nuclear Instruments and Methods A - 2 papers (2009, 2010).

Observed by the applicant citations of these publications by January 2020 are 149.

Submitted publications can be divided into two groups. In the first group (K1, K2, K4, K9, K11, K13, K14, K15, K18, K19, a total of 10 papers) are those publications, which describe the construction, operation, measured characteristics and their behavior over time of the RPC system of the CMS detector. I am convinced that in these publications Peicho Petkov made a major, decisive contribution. The achieved high and stable parameters of the system, as well as ensuring its long-term performance during the data collection, for which the candidate is the major contributor, give him reason to include in the list of papers for the competition 10 more publications that report on important physical results achieved, for which the excellent features of the CMS muon system have played an important role. On this basis, I consider that Dr. Petkov has made a significant contribution to the achievement of these results.

The complete list of the applicant's publications at the time of submission of the application documents (January 2020) includes 701 titles. Of these, 693 are in the field of Particle Physics and are presented for publication by the CMS collaboration, and 8 are in the field of modeling of interactions of biological molecules. The total number of citations noted is 17451 (excluding self-citations, data is from the SCOPUS system) and the Hirsch index is 61. These unusually high scientometric indicators are due to the participation of Dr. Petkov as a co-author in the CMS collaboration publications.

Naturally, a team of more than 2,000 researchers whose results are eagerly awaited literally from around the world will publish frequently and many. Therefore, the scientometric indicators of a researcher should be approached carefully and without unnecessary emotions, and they should be considered in the context of the specific field in which he or she works and the rules adopted there for compiling the list of authors of publications.

The publications and information presented in the competition materials submitted by the applicant comply with the minimal national requirements under Art. 2b of the Law on Development of the Academic Staff in the Republic of Bulgaria (ZRASRB) and Art. 53 of the Regulation for its implementation by the Council of Ministers of the Republic of Bulgaria. The requested data under Art. 54 of the above Regulations are presented and they certify the fulfillment of the minimal national requirements.

In addition, the applicant fulfills the recommended requirements of the Faculty of Physics of Sofia University for the position of Associate Professor, which are higher than the minimal national requirements.

**CONCLUSION:** As a result of my acquaintance with the materials presented for the competition, as well as my personal observations on the development of Peicho Petkov as a researcher and lecturer, I testify that his teaching and scientific work meets the requirements of:

- ZRASRB and the Rules for its application to the Council of Ministers;
- Sofia University Regulations and Criteria of the Faculty of Physics;
- the criteria of the physical community in Bulgarian higher education institutions and research institutes for academic growth

to occupy the academic position of Assistant Professor.

Therefore, I strongly recommend to the Faculty Council of the Faculty of Physics of Sofia University to elect Head Assistant Professor Dr. Peicho Stoev Petkov, for the academic position of Associate Professor at Sofia University "St. Kliment Ohridski".

08.03.2020

Sofia

(Prof. Roumen Tsenov, Dr.Sci.)