REVIEW

On the competition for the occupation of the academic position Associate Professor in the specialty 4.1. Physical Sciences (Particle Physics) published in the State Gazette № 93, November 26, 2019, for the needs of the Faculty of Physics of Sofia University "St. Kl. Ohridski" with the sole candidate Chief Assistant Dr. Peycho Stoev Petkov of SU.

Member of the Scientific Jury: Prof. DSc. Ivan Vankov, INRNE - BAS

1. Analysis of the presented materials.

P. Petkov is a phd. He defended his dissertation on "Research and optimization of the characteristics of resistance plate cameras (RPC) for the CMS detector" in 2009. Its subject corresponds exactly to the scientific field in which the subject of the competition is.

Of the more than 600 publications, in which he co-authored, the candidate presented 20 articles in which his contribution is most clearly distinguished. All are published in international journals with Impact Factor as follows:

Physical Review Letters - 3 articles.
Journal of Instrumentation - 8 articles.
Physics Letters B - 3 articles.
Nature – 1 article.
Journal of High Energy Physics - 3 articles.
Nuclear Instruments and Methods A - 2 articles.

17 of these journals have a quartile Q1 and 3 – a quartile Q2.

The candidate also provided a list of 149 noted independent citations to these scientific publications.

With all these indicators, Dr. P. Petkov **fully meets the recommended requirements** of the Faculty of Physics of Sofia University for an associate professor.

Compliance with the minimum national requirements under Art. 2b of the ZRASRB:

From the table presented by the applicant, it can be seen that with the submitted scientific publications and their citations, **he fulfills the requirements** of the law and its regulations.

2. General characteristics of the scientific and applied research, and the pedagogical activity of the applicant.

2.1 Research and development activities.

P. Petkov has a work experience of about 18 years, during which he worked mainly in the field of particle and high energies physics: experimental studies in elementary particle physics, development and investigation of particle physics detectors, high-performance processing of experimental data, etc. He has also dealt with supercomputer complexes, modeling the interaction of biological molecules, molecular dynamics, applications of machine learning methods, and more.

As most relevant activities related to the subject of this competition should be indicated:

- development and production of resistance plate cameras (RPCs) for the CMS detector muon system;
- study the characteristics of these cameras;

- settings and technical maintenance of the same cameras during the accumulation of experimental data with the CMS detector;
- collection of data on the detection of cosmic rays and collisions of muons in the LHC in the periods 2010-2012 and 2015-2018;
- development of a trigger system for the RPC test bench in Sofia.

2.2. Pedagogical activity.

Dr. Petkov has lectured and led seminars and laboratory exercises at the Faculty of Science of Sofia on the following topics:

- "General Physics 8", obligatory for specialty CCTF - seminars;
- "Ionizing accelerators and detectors in medicine", compulsory for special MPh - lectures and seminars;
- “UNIX Programming”, optional for all subjects - lectures;
- “UNIX Programming – Practicum”, optional for all specialty classes;
- "Information technology", obligatory for the special MPh - workshop;
- "Modeling the interaction of biological molecules" - optional for all specialties - lectures and practical classes;

With this activity, the applicant **fully meets the recommended requirements** of the Faculty of Physics of Sofia University for the position of Assistant Professor.

3. Basic scientific and methodological contributions

3.1. Scientific contributions.

- Using data mainly from the CMS muon system, upper limits are set to observe rare events such as $B^0_s \rightarrow \mu^+\mu^-$ и $B^0 \rightarrow \mu^+\mu^-$.
- With the leading role of the CMS muon system an upper limit of 6.4×10^{-4} is found for the partial probability of observing the Higgs boson decay of two muons.
- The background deviations were estimated in the search for light resonances that break down into pairs of muons;
- The cross section for the production of hadrons containing b-quarks is measured: $\sigma(pp \rightarrow b+X \rightarrow \mu+X^*) = 1.32 \pm 0.01(stat) \pm 0.30(syst) \pm 0.15(lumi)\mu b$.
- The cross section σ ($pp \rightarrow bbX \rightarrow \mu\mu X^*$) was measured to obtain b and anti-b quarks, which decay into pairs of muons in the final state.

3.2. Methodological contributions.

- In 2010 - 2011, a procedure was developed to scan the performance of the RPCs when the high-voltage power supply was changed. It provided better stability and homogeneity of the RPC system operation. Thus in the first three years of its operation, the quantity of operating channels was very high - 97.5%. At the same time, problems in this system caused the failure of CMS data collection due to differentmalfunctions in only 1.5% of cases.
- During the planned technical shutdown of the LHC in 2013-2014 (Long Shutdown 1) fixed hardware problems in RPC's high voltage power supply as well as in detector electronics are solved.
- The leak tightness of the RPC gas slits in the cylindrical part of the CMS has been studied.

4. Significance of contributions to science and practice.

The contributions of Dr. Petkov are very important for the science. In the CMS experiment, extremely new and important physical results were obtained, including the ones mentioned above. The muon system is an integral part of the CMS and plays an extremely important role in obtaining reliable physical results.

5. To what extent the contributions received are a personal matter of the applicant.

The most accurate answer to this question is given in the letter from RPC-CMS Project Manager Dr. Gabriella Pugliese. It outlines the important role and decisive involvement of P. Petkov in the preparation and conduct of RPC experiments. Of these, I should note:

- participation in the assembly and investigation of the characteristics of RPC prototypes in Bari, Italy and Sofia;
- participation in control tests and measurement of RPCs characteristics on specially designed muon telescopes in Bari and the construction of a muon telescope at INRNE-Sofia in order to measure the efficiency of cameras;
- creating software tools to control the quality of the data received before storing it in the database;
- personal involvement in conducting continuous CMS measurements;
- participation in measuring the effectiveness and spatial resolution of RPCs;
- a space muon pass-through dataset leading to the first physical result obtained using all CMS subsystems, even before the LHC started operating: the ratio of the showers of the positively charged and negatively charged space muons at the ground; the measured value of 1.2766 ± 0.0032 (stat.) $\pm$ 0.0032 (syst.) is the most accurate at this time and is independent of the muon impulse (for impulses below 100 GeV/cm);
- measuring the relative position of each RPC station with respect to the DT cameras in the $r\varphi$ direction and determining the spatial resolution of the RPC system.

All this leads me to conclude that the scientific contributions made were largely obtained with the personal involvement of the applicant.

6. I have no critical remarks and recommendations.

CONCLUSION

The analysis of the applicant's scientific, applied and pedagogical activity undoubtedly shows his high qualification and extensive experience in experimental research and elementary particles and high-energy physics. The submitted scientific papers contain original scientific results of great importance for the development of this scientific field. Dr. Pugliese's in her letter also characterize him as an internationally recognized scientific researcher.

Given the topicality, importance and international recognition of his scientific achievements, I strongly suggest that Dr. Peycho Stoev Petkov, Chief Assistant, be elected to the academic position of Assistant Professor in the professional field 4.1. Physical sciences (Elementary particle physics) in the Faculty of Physics of Sofia University.

Sofia, 03/04/2020

Prepared by:

(Prof. Ivan D. Vankov, DSc.)