

## REER REVIEW

for the competition for the academic position of “Associate Professor”  
announced by the Institute of Mathematics and Informatics  
at the Bulgarian Academy of Sciences  
in Newspaper of State, No. 89 of 16.10.2020  
Field of Higher Education: **4. Natural Sciences, Mathematics and Informatics**  
Professional Field: **4.5. Mathematics**  
Scientific Specialty: **Algebra and Number Theory**  
(**Commutative Group Rings and Abelian Groups**)

Written by: **Dr.Sci. Vesselin Stoyanov Drensky, Full Member of the Bulgarian Academy of Sciences, Professor** at IMI–BAS.

The only applicant: **Dr.Sci. Peter Vassilev Danchev, Chief Assistant Professor** at IMI-BAS.

- 1. Biographical data.** Chief Assistant Dr.Sci. Peter Danchev graduated from the Faculty of Mathematics and Informatics at Plovdiv University “Paisii Hilendarski”, specialty “Mathematics”, specialization “Algebra and Number Theory”. He defended his Ph.D. Thesis “Associative Rings with Unit and Weakly Unipotent Multiplicative Groups” in the Ph.D. program “Algebra and Number Theory” at IMI–BAS, where he later defended his Dr.Sci. Thesis “Some Classes of Noncommutative Rings and Abelian Groups” in Algebra and Number Theory. Since 2018 he has been an Assistant Professor at the Department of Algebra and Logic at IMI–BAS, and since 2019 he has been a Chief Assistant Professor. In the documents submitted for the competition there is no data about his work in the period from the obtaining his Master’s Degree to the employment at IMI–BAS. But from the CV in the documents for his participation in the competition for Chief Assistant Professor which are posted on the IMI website, it can be seen that in that period Dr.Sci. Peter Danchev as a student taught at the University of Plovdiv, and then for many years was a high school teacher and a part-time Assistant Professor at the Technical University of Sofia.
- 2. General characteristics of the research activity of the applicant.** The entire scientific career of Dr.Sci. Peter Danchev, from the time of his studentship till now, is concentrated in three classical branches of algebra – commutative and noncommutative ring theory and group theory, including meeting points with axiomatic set theory. His scientific productivity is really impressive. According to the documents presented for the competition he is an author or a coauthor of 372 scientific publications in 185 journals, with 84 publications in 48 journals with impact factor. There is no complete list of publications in the documentation, but it can be found on the website of the applicant in IMI

<https://math.bas.bg/wp-content/uploads/2020/12/TitlesDanchev.pdf>

The publications are for the period from 1993 until now. In my opinion, this list is incomplete because I have seen several papers published in 2020 and 2021 that are not yet included in the list. About 13% of the papers are coauthored, and this collaboration has been particularly active in the last 10 years. Among the coauthors there are also established mathematicians in the field. As I noted in my peer review for the Dr.Sci. Thesis of Dr.Sci. Peter Danchev, the joint papers speak of the ability to work in a team, and this is a quality that I personally appreciate. In addition, such a collaboration increases the efficiency because the research involves methods from different branches of algebra. Moreover, as far as I know, most of the research was performed from distance, without direct personal

contacts. The applicant states that his results have been cited more than 500 times, but there is no attached list of all citations. Attached is a list of 114 citations registered in the system SONIX, which is the official information system for the scientific activity at the Bulgarian Academy of Sciences. (Currently, the applicant has registered 101 publications in SONIX, for 40 of which he has registered 119 citations.) Among the citations are respectable ones, e.g. in the book by Fuchs on infinite abelian groups. The database of Zentralblatt für Mathematik which is freely accessible contains 323 papers by the applicant with 445 citations, including self-citations. The data in Mathematical Reviews are for 331 papers. However, it is well known that in both databases publications are reviewed with a certain delay, which is significant in the context of the COVID-19 pandemic, and there are issues of some journals that for unknown reasons are not covered by these databases.

3. **General description of the submitted materials.** The applicant has submitted for participation in the competition 23 scientific publications in journals published in the period 1997–2020. One of the papers is in quartile Q3, 3 are in quartile Q4, 4 are indexed in Scopus, and the others are in editions reviewed to in Zentralblatt für Mathematik and Mathematical Reviews. One of the papers is joint with Brendan Goldsmith, and the others are with the applicant as the only author. **The applicant stated that these 23 papers had not previously been used for other procedures.** For the competition, he submitted a list of 24 citations of 17 of these papers. **The presented table shows that the applicant completely covers the minimal requirements of IMI for participation in a competition for “Associate Professor”. In addition, he has at least 5 papers published in journals with impact factor or impact rank, which is also required by the rules of the Institute of Mathematics and Informatics at BAS. I did not find plagiarism in the works submitted for the competition.** I want to note that the paper [8] in Analele Universității București, Matematică is presented only with its abstract and not with its full text. In addition, the paper [17] is presented in its prepublication form instead of with its final published version. I assume that the applicant does not have the published electronic version of these two papers, but he could scan the offprints and present the scanned files.
4. **Main scientific and scientific-applied contributions.** I shall briefly discuss the main results contained in the presented papers of the applicant, as well as my evaluation of them. In the description of his scientific contributions the applicant has divided his publications into two groups: (1) Commutative group rings (papers [1, 2, 4, 6, 8, 9, 12–16, 18–23] from the list of publications presented for the competition); (2) Abelian groups (papers [3, 5, 7, 10, 11, 17]). In my opinion, the author has been slightly careless in the preparation of the abstracts of the submitted papers and the description of his contributions. My opinion is that one of the main goals of these documents is to explain to the general mathematical community and in particular to the algebraists in Bulgaria the contributions of the applicant and to convince them that these contributions meet the requirements for the corresponding academic position. Since only a small part of the algebraists in our country work in the theory of commutative group rings and in the theory of abelian groups, the applicant should present his results in more detail, and not sketch them briefly. For example, 7 papers [8, 9, 12–16] have a joint abstract of 4 lines, and in the description of the contributions there are only 8 lines for them. It would be reasonable for the candidate to use the abstracts of the published versions of the papers and to make the description of the contributions more accessible to the large algebraic audience.

**(1) Commutative group rings.** While the description of finite abelian groups has been well known for 150 years, the description of infinite abelian groups is far from complete. In the infinite case an essential role is played by subgroups which are defined in the language of ordinals in set theory. The paper [1] is devoted to the property of  $\sigma$ -summability introduced by Linton and Megibben in 1977. In the modular case it is proved that under natural restrictions for the ring  $R$  and the group  $G$  the normalized  $p$ -component  $S(RG)$  of the group ring  $RG$  is  $\sigma$ -summable if and only if the  $p$ -primary component  $G_p$  has the same property. A partial answer to a question posed in a paper by May in 1988 is also given, and it is proved that under certain restrictions, the isomorphism of two group rings implies the isomorphism of the  $p$ -primary components. In the semisimple case, it is proved that for  $p$ -groups the group of invertible elements of the group algebra and the normalized  $p$ -component are  $\sigma$ -summable if and only if the group is a direct sum of cyclic groups. In the paper [6] the applicant considers group algebras over a field of characteristic  $p$  of abelian groups with summable  $p$ -component. Conditions are given under which the  $p$ -component is a direct factor of the normalized  $p$ -component with a totally projective complement. It turns out that the summability of the  $p$ -component is preserved in isomorphic group algebras. The paper [4] calculates the Warfield invariants introduced by him in 1972 as a complement to the Ulm–Kaplansky invariants of the group of normalized units of group rings under various additional restrictions on the ring and the group. The next 7 papers [8, 9, 12–16] are devoted to the group of normalized units  $V(RG)$  of group rings and its decomposition into a product of subgroups. The following cases are considered:

In [8]: When  $V(RG)$  is a product of the group  $G$  and of the normalized  $p$ -component  $S(RG)$ .

In [9] and [12]: When  $V(RG)$  contains only trivial units, i.e.  $V(RG) = G$ .

In [13] and [14]: When  $V(RG)$  consists of elements that are linear combinations with coefficients from the group of a system of orthogonal idempotents of the ring.

In [15] and [16]: When  $V(RG)$  is the product of the subgroup of idempotent units of [13] and [14] with the group of normalized units of the torsion component of  $G$  or with the torsion component of  $V(RG)$ .

In the papers [18–23] in the terms of the ring and the group are characterized the group rings, the elements of which have a representation of a certain type. It turns out that the considered natural conditions force very strong restrictions on the group and the ring.

In [18], feebly nil-clean rings are considered (when each element is of the type  $q+e-f$ , where  $q$  is a nilpotent and  $e$  and  $f$  are commuting idempotents).

In [19]  $\pi$ -regular rings are studied (which are a generalization of the regular rings in the sense of von Neumann).

The paper [20] is devoted to feebly invo-clean rings (in which every element is of the form  $v+e-f$ , where  $v$  is an involution and  $e$  and  $f$  are idempotents).

The paper [21] is devoted to weakly invo-clean rings (where every element is of the type  $v+e$  or  $v-e$ , where  $v$  is an involution and  $e$  is an idempotent).

In [22] the weakly tripotent group rings are described (when for every element  $t$  it is valid that  $t$  or  $1-t$  is equal to its cube).

The paper [23] is devoted to periodic group rings (when each element has the property that two different degrees of it are equal).

**(2) Abelian groups.** The paper [3] discusses the so-called large subgroups of abelian groups. It is proved that a number of important properties of the group are true if and only if they are true for the large subgroup. In [5], a result is proved for the countable extensions of classes

of projective abelian groups for transferring important properties from the extension group. In [7] the important property for summability is studied and a number of theorems are proved, connecting this property with a similar property of a completely invariant subgroup. In [10] it was proved that each  $p$ -torsion quasi-complete abelian  $Q$ -group is bounded, and this result is transferred to a wider class of groups in [11]. The last paper [17] from this group is the only joint paper submitted for the competition. In it, the authors study the relationships between projectively invariant and completely invariant subgroups and projectively socle-regular groups.

Some of the papers presented in the competition consider important problems previously considered by other mathematicians and generalize results obtained by other authors. On the other hand, some of the papers continue previous research of the applicant, which is not related to the research of other authors. As an example, I shall point out that about 40% of the cited literature contains publications of the applicant, which for me is a proof that some of these results are not among the most central in the field. I explain this with the fact that for most of his scientific career the applicant has worked in isolation from a research team. I have found a positive trend in his scientific work of the applicant in the recent years, when he started working at IMI.

I shall note some negligence in the writing of the presented papers. For example, the definition of  $\sigma$ -summability in [1] literally copies the definition from the paper [5] of Linton and Megibben cited there. I would personally advise in such cases to say the same things in other words, especially since in the modern development of computer search engines such a coincidence would be detected, and this would lead to a negative reaction for the paper. In conclusion of my comments on the scientific contributions of the applicant, I shall note that the applicant knows very well the main problems and the literature in the field and uses a rich arsenal of methods. The correctness of the arguments in the considerations is not in doubt. I have not noticed any significant inaccuracies.

Although sketched only, the description of the achievements of the applicant correctly reflects the main contributions of the publications submitted for participation in the competition. But it seems to me that in some places in it the author shows a certain immodesty. As an example, I shall point out the statement that in absolutely all papers innovative methods are used, and significant technical difficulties due to the calculations of the corresponding cardinal invariants have been overcome. I agree that innovative methods have indeed been used and technical difficulties have been overcome, but the claim for absolutely all the papers seems exaggerated.

5. **Significance of the contributions to the science and the applications.** Most of the results obtained in the research papers of the applicant are interesting and meaningful. Many of them contain new facts about objects that are central to a number of areas of algebra and that have been studied before by other authors. The results and methods for their establishing have been used and can continue to be used successfully in other research in the field.
6. **Critical remarks and recommendations.** I have already noted the certain negligence in the preparation of the documentation for the competition. In addition, I shall note that many of the presented papers are in not very high level journals and are not the best achievements of the applicant. I am not sure that colleagues whose research interests are not close to those of the applicant will be convinced of his undoubted positive qualities after seeing that 6 of the papers are on 2, 3 or 4 pages and only two are longer than 10 pages. I am convinced that the

submitted materials are completely sufficient to meet the formal and scientific criteria for the academic position of Associate Professor, but I think that as a doctor of science, the candidate had to present a more representative collection of his results. In the future, I would recommend that the applicant choose more carefully the journals in which he publishes, especially since in many cases his results fully deserve better journals. I claim that my critical remarks are of a friendly kind. In conclusion, I would like to note that recently I have noticed positive changes in the work of the applicant. He has improved his collaboration with leading experts in the field, and in 2020 and 2021 he has papers in a number of high level journals such as J. Algebra, Proc. AMS, J. Algebra and its Appl., Linear and Multilin. Algebra, Commun. Algebra et al.

- 7. Personal impressions as a member of the Scientific Jury.** I know Dr.Sci. Peter Danchev for many years, but my personal impressions are mostly from the moment he started working at IMI. I have very good impressions of him as a colleague and scientist, including as a participant in a research project under contract with the Bulgarian NSF, of which I am the principal investigator. I have repeatedly attended his reports at the seminar of the section and always it was pleasant and interesting to listen to them.

### CONCLUSION

In the presented scientific works Chief Assistant Professor Dr.Sci. Peter Vassilev Danchev has received interesting results in modern branches of mathematics and has made significant contributions to the theory. Most of the results have already been used or can be used in similar studies by other authors. An essential part of the results have been published in good journals. Despite the critical remarks I made in my peer review, I have every reason to recommend Chief Assistant Professor Dr.Sci. Peter Vassilev Danchev to take the academic position of “Associate Professor” in the Field of Higher Education 4. Natural Sciences, Mathematics and Informatics, Professional Field 4.5. Mathematics, Scientific Specialty: Algebra and Number Theory (Commutative Group Rings and Abelian Groups).

Sofia, February 26, 2021

Signature:

(Acad. Dr.Sci. V. Drensky)