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Article



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OLYMPIAD MOVEMENT IN PHYSICS

Abstract: The importance of the Olympiad movement is shown both for universities and for the students themselves. The author briefly talks about various Olympiads and tournaments in physics, in which SPbPU successfully took part in the last academic year.

Key words: Olympiad movement, student Olympiads and tournaments in physics, Unified State Exam, teaching physics, admission to universities.

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Introduction

All-Russian and especially international student Olympiads are one of the few (and perhaps the only) available tools for objective comparison of the competitiveness of students at various universities at the Russian and world level. At the international level, the most competitive Olympiads, attracting students from all over the world, are the Programming, Mathematics and Physics Olympiads [1]. This work will primarily consider student Olympiads and tournaments in physics. The importance of the Olympiad movement is shown, and then the main Olympiads and tournaments in physics in which SPbPU students take part are briefly considered.

The importance of the Olympic movement

Student Olympiads help identify talented students who can make a significant contribution to the development of science and technology. These events also promote the exchange of experience between students from different universities, which contributes to the development of cooperation in the field of science and education. Moreover, participation in such competitions helps students develop their complex problem solving, analytical thinking and critical thinking skills, which can be beneficial in their future careers. By solving complex Olympiad problems, students learn to analyze information, highlight key points, draw conclusions

and make decisions based on available data. This helps them develop their logic and ability to organize information, which is an important skill for a successful career in science and technology. Olympiad participants often learn to work in teams and collaborate with other participants, which is an important skill for a successful career in any field. In addition, participation in Olympiads can stimulate interest in studying new areas of knowledge and broaden the horizons of participants.

On the one hand, for student education, unlike school education, there is no global system for assessing the level of student preparation, such as PISA [2], TIMSS [3], PIRLS [4], ICILS [5], and other international large-scale assessments (ILSAs) [6]. On the other hand, those indicators that are used to assess the level of training of researchers and university teachers are mainly scientometric (the number of articles in prestigious scientific journals, the number of citations and the Hirsch index, etc.), and they are poorly applicable to assessing students, most of which do not have indexed scientific publications. Therefore, it is student Olympiads that are an objective indicator of comparing the competitiveness of universities; they provide the opportunity to compare the quality of student training within their subject area among various universities at the all-Russian and international level. Therefore, many international university rankings take into account the results of

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prestigious student Olympiads. This is also taken into account in some Russian rankings (see, for example, [7] - although, according to the author, the list of Olympiads taken into account in this ranking is missing several Olympiads in physics).

If we look at the Federal State Educational Standard of Higher Education - bachelor's degree in the field of study 03.03.02 Physics (Federal State Educational Standard of Higher Education 3++) [20], then participation in the Olympiad movement allows one to master the following universal competencies at a high level: UC-1. Able to search, critically analyze and synthesize information, apply a systematic approach to solve assigned problems; UC-2. Able to determine the range of tasks within the framework of the set goal and choose the best ways to solve them, based on current legal norms, available resources and limitations; UC-3. Able to carry out social interaction and realize his role in a team.

From the students' point of view, participation in such competitions provides an opportunity to demonstrate their abilities and receive recognition for their achievements. High places taken by a student at competitions can have a very positive impact on the portfolio and increase the chances of further employment. In addition, simply participating in competitions allows students to meet new people and expand their social circle, which can also be useful for future professional development.

Admission of applicants-winners of Olympiads into universities

It is clear that if a person successfully participated in the Olympiad movement during his school years, then the likelihood of successful participation in Olympiads during his student years will be greater than for someone who never participated in Olympiads at school. Therefore, for successful participation in Olympiads (in fact, of course, not only for this, but this is beyond the scope of this article), it is advisable for a university to recruit more schoolchildren who are successful in Olympiads. In recent years, according to Yandex Education and Rosobrnadzor, mainly (70% of the total number) such Olympiad winners go to 10 Russian universities [8]-[9]. And unfortunately, SPbPU is not included in this top ten universities. According to 2022 data [10], in terms of the number of successful Olympiad participants enrolled, SPbPU ranks 16th, it occupied approximately the same place in 2023, and the lag behind the leaders is very large. And we must also take into account that SPbPU receives winners of Olympiads in humanities, social, and technical subjects (and all of them are taken into account in total in [10]), while it is logical to assume that, for example, in the same MIPT and MPhI have many enrolled successful Olympiad participants in physics and mathematics. Moreover, this year at the same MIPT, the number of applications for admission from

Olympiad applicants this year increased by 42% compared to 2023 [11], so the gap is only increasing.

In addition, the overall level of students enrolled in the 03.03.02 "Physics" direction, if assessed by Unified State Examination scores, is much inferior to leading universities - for example, in the past 2023, the passing score for this direction at SPbPU was 201, and the average score for the exam was equal to 75.60. In my opinion, this is a disadvantage of working with applicants. At the same time, according to the author and his colleagues, the level of teaching physics in schools has fallen very much over the past decades. Simplification of Unified State Exam tasks in physics this year led to record scores for this exam [12], but, of course, did not improve knowledge of physics. Considering that the initial level of students wishing to participate in physics Olympiads was lower than that of the main competitors, it was decided to hold an elective in physics Olympiads at SPbPU, which, through the efforts of the author of the article (who conducts this elective) and on his enthusiasm, grew from the original planned semester to four semester. And this, it seems to me, has begun to bear fruit.

In general, it is now obvious that among strong applicants the prestige of IT fields is much higher than that of physics fields. Some time ago, when the author was teaching IT disciplines part-time, he helped prepare students for the IT-Planet Olympiad [13], where they won and took prizes. And until now, SPbPU students perform quite successfully at IT tournaments and hackathons. Some of these students successfully help create the IT infrastructure of SPbPU (for more details on the IT infrastructure of SPbPU, see works [14]-[19]). But IT Olympiads deserve separate consideration; in this work we are talking about physics.

What types of physics olympiads and tournaments are there? Firstly, the competition can be either only in the individual championship, or only in the team championship, or in both the individual and team championships. Secondly, the Olympiads can be in-person or online (in the case of online, proctoring is required) or mixed (qualifying rounds are online, the final round is in-person). Thirdly, an Olympiad or tournament can have several rounds (qualifying and final) or only a final round (in the latter case, a criterion for admission to the final round is needed so that the number of competitors is reasonable for one final round). Fourthly, there may be either restrictions on the course of Olympiad participants or there are no such restrictions (in physics, as a rule, there are either no restrictions or there are restrictions such as participation only for 1st-2nd year students or 1st-3rd year students). Fifthly, the tasks can be either only theoretical (solving physics problems) or with an experimental part. Sixthly, tasks for an Olympiad or tournament can either be announced in advance (sometimes several months before the final), or

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announced immediately at the final tournament, and accordingly the time for solving them is very limited.

Below, as an example, we will consider those physics Olympiads and tournaments in which SPbPU students took part in the 2023-24 academic year, and in all of which the author was a curator/leader of SPbPU students and teams (and often also a member of the jury). Their description is written in chronological order.

Physics Olympiads and tournaments in the 2023-24 academic year

Regional Student Olympiad in Physics [21] - interuniversity Olympiads in physics were revived with the active assistance of the academician of the Russian Academy of Sciences, Nobel Prize laureate in physics Zh. I. Alferov in 1998. Currently, the Olympiads are held by ETU "LETI" with the support of the Committee on Science and Higher Education under the Government of St. Petersburg. Students of SPbPU consistently take prize places in individual and team championships, last year was no exception.

All-Russian interuniversity championship in high-speed integration "Integrate!" was held for the first time in a team format in 2023 at NRNU MEPhI. Although this is not a physics competition, but a mathematics competition – teams of participants compete against time in calculating integrals and solving problems that reduce to them, but it is impossible to study theoretical physics without good integration skills. This competition is similar to the famous Annual MIT Integration Bee competition [23]. The SPbPU team won in one of the competition nominations.

The Open International Internet Olympiad in Physics was held at Seyitnazar Seydi Turkmen State Pedagogical Institute [24] for the third time. Students of SPbPU took part in this Olympiad for the first time and showed excellent results, winning both absolute first place and receiving diplomas of prize winners.

The All-Russian Student Tournament of Physicists [25] has been held since 2009. This is a competition between teams of university students to solve interesting scientific and technical problems, present and defend solutions to these problems in the form of Physics Battles. The winning team of this tournament represents Russia at the International Physicists' Tournament (IPT) [26]. We recently considered modeling one of the IPT problems [27]. This tournament is very different from other Olympiads - firstly, the tasks are posted several months before the final; secondly, the tournament itself is held in the form of physical battles, where teams take turns playing one of four roles: Speaker, Opponent, Reviewer, Observer; thirdly, not only the

theoretical but also the experimental part of the task is extremely important here. Recently it has been held every year in different universities. SPbPU took part in this tournament for the first time.

The International Engineering Physics Olympiad [28] was held at MEPhI for the sixth time. It is held in two areas – physics and mathematics. In physics, it is held in two stages. Students of SPbPU took part in it for the first time and several students became prize winners of the Olympiad.

The All-Russian Student Olympiad in Physics [29] was also held by NRNU MEPhI in two stages, and students from SPbPU also took part in it for the first time.

The Open International Internet Olympiad [30] has been held since 2008 and is one of the most massive Olympiads at present (more than 50 thousand university students and 15 thousand students of secondary vocational education participate annually in 17 disciplines of higher education and 7 disciplines of secondary vocational education). In physics it was also conducted in 2 rounds. This year, 2491 students from 88 universities participated in the first (university) round, and 274 students from 78 universities participated in the final (international) round. SPbPU students performed excellently, winning a gold, silver and three bronze medals in physics.

International physics competition for undergraduate and masters' students PLANCKS [31]. PLANCKS is an annual international theoretical physics competition that brings together students from around the world. The competition is held in 2 stages – regional and final (which this year was in Dublin, Ireland). The SPbPU team took part in the final tournament for the first time this year. The author of the article is the head jury of the regional (actually Russian) stage of the competition.

Also, SPbPU annually holds the Polytechnic Student Olympiad in Physics for 1st-2nd year students (this year was the ninth one), which is held by our Physics Department.

And finally, the author is the Organizer of the Mathematical Battles at SPbPU, since "mathematics is the language of physics".

Conclusion

The Olympiad movement is an effective means of developing the creative nature of thinking of the personality of a future scientist, and is also an objective indicator of the competitiveness of a university, and therefore should be intensively developed. This work also told about the participation of SPbPU in the physics Olympiad movement.

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