

The seventh open Experimental Physics Olympiad (EPO6)

Saturday 7 December 2019 Skopje, R. Macedonia

The Day of the Inductance

Main organizers Sofia Branch of Union of Physicists of Bulgaria (SBUPB) and <http://bgphysics.eu/> and Society of Physicist of Macedonia <http://www.dfrm.org>

This activity is part of Bulgarian STEM platform

https://en.wikipedia.org/wiki/Science,_technology,_engineering,_and_mathematics

<https://www.mon.bg/bg/100447>

<http://www.stemcoalition.eu/members/ministry-education-and-science>

This activity is part of the Society of Physicist of Macedonia

<http://www.dfrm.org>

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Email of the Olympiad: epo@bgphysics.eu

Gallery of former Olympiads: <http://pc.cd/xeb>

Tasks from former Olympiads:

[1] <http://arxiv.org/pdf/1511.04328>, [2] <http://arxiv.org/pdf/1602.06114>,

[3] <http://arxiv.org/pdf/1602.08090>, [4] <https://arxiv.org/pdf/1605.00493.pdf>

[5] <https://arxiv.org/pdf/1801.00022.pdf>

From its very beginning, the Experimental Physics Olympiad (EPO) is worldwide known; all Olympiad problems have been published in Internet [1–5] and from the very beginning there were 120 participants. In the last years high-school students from 7 countries participated and the distance between the most distant cities is more than 4 Mm. Let us describe the main differences between EPO and other similar competitions.

- Each participant in EPO receives as a gift from the organizers the set-up, which one worked with. So, after the Olympiad has finished, even bad performed participant is able to repeat the experiment and reach the level of the champion. In this way, the Olympiad directly affects the teaching level in the whole world. After the end of the school year, the set-up remains in the school, where the participant has studied.
- Each of the problems is original and is connected to fundamental physics or the understanding of the operation of a technical patent.
- The Olympic idea is realized in EPO in its initial form and everyone willing to participate from around the world can do that. There is no limit in the participant's number. On the other hand, the similarity with other Olympiads is that the problems are direct illustration of the study material and alongside with other similar competitions mitigates the secondary education degradation, which is a world tendency.
- One and the same experimental set-up is given to all participants but the tasks are different for the different age groups, the same as the swimming pool water is equally wet for all age groups in a swimming competition. We will briefly mention the problems of former 4 EPOs. The setup of EPO1 was actually a student version of the American patent for auto-zero and chopper stabilized direct current amplifiers [1]. The problem of the second EPO [2] was to measure Planck constant by diffraction of a LED light by a compact disk. A contemporary realization of the assigned to NASA patent for the use of negative

impedance converter for generation of voltage oscillations was the set-up of EPO3 [3]. EPO4 [4] was devoted to the fundamental physics – to determine the speed of light by measuring electric and magnetic forces. The innovative element was the application of the catastrophe theory in the analysis of the stability of a pendulum. In short, the established traditions is a balance between contemporary working technical inventions and fundamental physics. And in 5th Olympiad (EPO5) follows [5] the established tradition. In all countries study programs it is mentioned that heat is connected with atomic motion. But even a comparatively simple example of the Maxwellian velocity distribution of molecules is not illustrated with an experiment even in very good universities. The reason for this is because vacuum technology is very expensive and requires professional work. On the other hand, the electronic measurements are foolproof and thousand times cheaper. That is why, if we want to study the energy of the thermal fluctuations that is described by the temperature and Boltzmann constant.

Organizers of EPO7 are the Sofia Branch (SB) of the Union of Physicists in Bulgaria (UPB) together with Society of Physicists of the Republic of Macedonia (SPRM) and as a whole it is an activity of Balkan Physical Union (BPU). First EPOs 1-6 was organized by SBUPB together with Regional Society of Physicists of Strumica; special thanks to MSc in physics education Stojan Manolev and D-r Vasil Jordanov.

The SB UPB and SPRM and Society of Physicists has been organizing these Olympic competitions since 2011, and over time they became a traditional part of the informal out of school education in physics. Each student will be placed in an age group called S, M and L, according to the grade in which they study. For example, for the Bulgarian school system S would correspond to students enrolled in grades 7 and 8, M to 9 and 10 and L to 11 and 12 grades. A separate group of university students will compete in XL category. Each one of the age groups will have its own ranking. Students that are in their preparatory year and are not studying physics may also participate in the Olympiad and will be placed in group S. The assignment at the Olympiad is a collection of many related multipart problems with increasing difficulty. Experimental assignments make up the main portion of problems given to students. However, there will also be several theoretical questions which will help to assess student's ability to solve a problem.

Registration for the Olympiad can be done only electronically. For the guests of the country the deadline for registration is **November 25, 2019**. For further details on the registration, see the end of this message. Applications for participation in the Olympiad are accepted until the specified deadlines. The most up to date version of this message is available here: <http://bgphysics.eu>.

Motivation

Physics teachers in the past have regularly expressed certain hesitations regarding their participation in the Olympiad. Some may not feel adequately prepared in the field of electric phenomena and electronics. We, the organizers, would like to emphasize that we are making our best efforts to allow physicists-enthusiasts, who love a challenge and strive to expand their knowledge, to participate in the Olympiad. We believe that the experimental setups developed for the Olympiad participants will help improve the overall education in Physics and stimulate and motivate the students to continue their education in science and technology. Also, the experimental setups will help in the renovation of the physics classrooms and enhance the future work and professional growth of physics teachers. We expect the future Olympiads in experimental physics to become an important forum of fellow physics teachers, supplementing the social life of the Collegiate. The analysis of the four previous Olympiads showed that even untrained students learnt a lot via their participation in the Olympiads and later were able to

demonstrate the new knowledge to their classmates. In addition, the Olympiads complement extracurricular training which is critical for preparation of future science and technology professionals.

Rules and program

Students will be required to complete all assignments individually on their own.

Experimental setups will be provided by the organizers.

Registration **on the day of the Olympiad, Saturday December 7th, will take place from 8:30 to 10:30 in the Faculty of Natural Sciences and Mathematics in University of Skopje. The Olympiad will be officially opened at 10:30.** Students have to wear an ID and upon registration the participants will be divided into groups and put in different rooms. The Olympiads will run from 11:00 to 15:00. At 13:00 students will receive a sandwich and mineral water. The regulation prohibits the use of cell phones and devices giving Internet access; students need to hand over their phones to the accompanying teacher or a proctor. During the first 2 hours (i.e., until 13:00 pm) students are not allowed to leave the audience. At 15:00 all students have to submit their solutions and notes, including the experimental results, and then receive a certificate of participation. If desired, a student can also take a homework assignment which will be graded and rewarded separately.

Collocated with the Olympiad, an educational workshop will be held from 11:00 to 15:00 in a different auditorium. In the workshop the authors of the task will describe: investigated phenomenon, physical problem, experimental setup, and measurements. Registered teachers will use their own setup. This workshop is open to all interested teachers and accompanying parents. Regular registered teachers receive a diploma for successful completion of the workshop.

The jury designated by SB of UPB, will announce the results of the students' rankings at 18:30 on the same day: the diplomas for the 3rd, 2nd, 1st prize, absolute champion and special awards will be presented.

With any comments and/or suggestions you can reach the organizing committee at epo@bgphysics.eu.

Preparation for the Olympiad: Methodological Guide

All measurements will be made with multimeters; students have to carry with them 2 multimeters. Students have to be familiar with their scales and limitations; with their internal resistance for example. The participants have to have some experience with processing of experimental data with their calculator.

In addition to assembling electric circuits and performing measurements, it is required from the participants to be able to present the experimental results in the form of tables and graphs. Some problems will be associated with graphical representation of the experimental data. It is assumed that the student may submit experimental data on graph paper and perform data analysis based on the graph; to draw linear regression and to evaluate the slope and the constant term. For example to investigate Ohm law, it is necessary to present experimental data in a table, then graphically, and to determine the slope of the approximating straight line.

The assembly of simple electric circuits and their analysis has been the basis of experimental tasks of former Olympiads. We are repeating: **Participants must carry with them one calculator and two digital multimeters and be experienced with using them.** If the multimeter is connected as an ammeter, do not attempt to measure the maximum current supplied by the battery since this drains the battery quickly and it may damage the multimeter. The proctors will be monitoring that the students are using **only the following aids: multimeters, calculator, pen and pencil and ruler.**

Organizational issues:

1. For up to date version of the program refer to the website of the Sofia branch of the UPB <http://bgphysics.eu/> The most important thing to check is whether your name is included in the list of registered participants, which will be published on the website on December 3, 2019.
2. Participation slots for the Olympiad are filled in order of registration of participants and are limited by the number of experimental setups prepared.
3. The Committee for the carrying out of the Olympiad, is determined by the SPRM includes the authors of experiments and fellow physicists.
4. Participants in the competition will receive a certificate of participation. The ranking results will be published on the website of the SB of UPB.
5. All problems presented to the participants are copyrighted, original and not published until the start of the Olympiad.
6. To participate in the Olympiad it is not required to have special training. The organizers encourage the participation of all students, regardless of their age, who can use a multimeter and make simple measurements. More junior students are also encouraged to participate in order to gain experience for the future Olympiads.
7. Students are required to bring with them only the following aids: 2 multimeters, calculator, ruler and something to write with. Mobile telephones and all Internet devices in the lecture hall for the duration of the competition are forbidden.
8. Participants make travel arrangements to Skopje, R. Makedonia on their own.
9. Late participants would need to arrange for their accommodation on their own with *informational assistance from the organizers*.

Feedback

We the organizers value the opinions and suggestions of the other physics teachers and educators, for the problems given at the Experimental Physics Olympiad. Each teacher accompanying a registered student will be given the opportunity to review the problems and the experimental setup in a separate auditorium. Teachers will obtain certificate for participation in the course. Your opinion is indispensable for the preparation of the next editions of the Olympiad.

Registration for participation

- 1) The registration fee for participation of **15 EUR** for each participating student and teacher at the day of the Olympiad for the international participants guests of the country.
- 2) Please send an e-mail to epo@bgphysics.eu immediately after the bank transfer.
- 3) A student is considered registered if he/she completes the bank transfer and sent the e-mail.
- 5) The list of registered students and a separate list of accompanying registered teachers will be posted on the website of the Sofia Branch of UPB on December 3rd, 2019
- 6) Teachers accompanying students and receiving a certificate of participation in the training course are also required to register by November 25, 2019
- 7) Participation of late entrants may also be possible; there will be announcement on the Web site of the Sofia Branch of UPB.
- 8) For participants from Bulgaria, the participation fee is payable only via transfer to the bank account of the Union of Physicists in Bulgaria, which serves Sofia Branch:
Bank: UniCreditBulbank, Branch "Sveta Nedelja", Sofia
IBAN: BG91UNCR70001520373231

SWIFT (BIC): UNCRBGSF

Sveta Nedelya Sq. №7, BG1000 Sofia, Bulgaria.

9) For accounting, participants from Bulgaria can receive an invoice issued by SB of UPB upon request.

Accommodation

Accommodation during the event will be in private hostels with shared rooms for the students

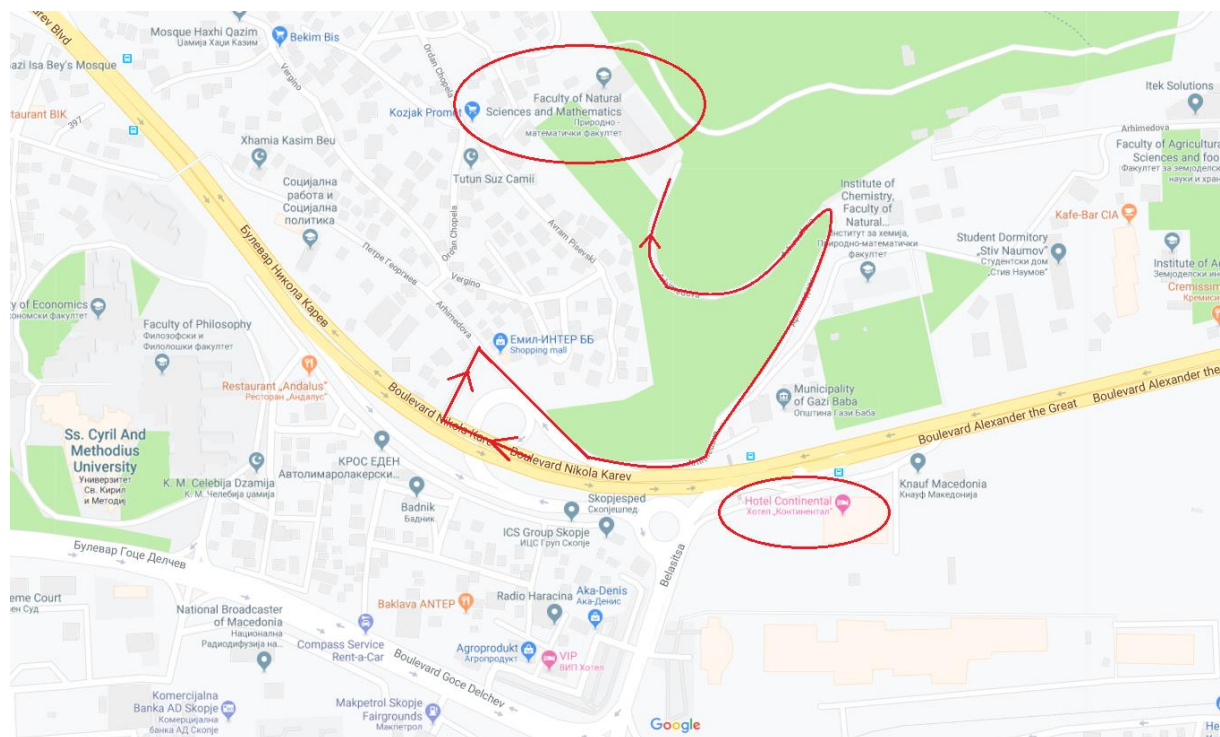
And private or hotel accommodation for the representatives and professors.

Details on the accommodation will follow.

Location Information

The Faculty for natural sciences and Mathematics in Skopje, Macedonia is located close to the city center.

Address: St. Arhimedova 3, Gazi Baba, 1000 Skopje, Macedonia



If you have any questions do not hesitate to write to the email address of the Olympiad epo@bqphysics.eu (the abbreviation comes from the Experimental Physics Olympiad).

Latest version of this announcement 06.11.2019. For the current version of the message visit <https://sites.google.com/a/bgphysics.eu/bgphysics/deynosti/epo>