

Program for the 8th WPhC-Congress 2018

“Student Competitions and their role in (Gifted) Education”

conference venue: Austrian Educational Competence Centre Physics (AECC Physik), University of Vienna, Porzellangasse 4/2/2; A-1090 Vienna
 Accommodation: Hotel Atlanta, Währinger Strasse 3, A-1090 Vienna (www.hotelatlanta.at/gb/)
 Lunch and dinner: Restaurant "D'Landsknecht", Porzellangasse 13, A-1090 Vienna (<http://members.chello.at/~landsknecht/English/>)
 Restaurant "Schubert", Schreyvogelgasse 4-6, A-1010 Vienna (<http://www.restaurant-schubert.at/en/home/>)

Talks: 2 Keynotes [1x 60 min and 1x 45 min]
 6 longer talks of 35 min + 10 min discussion [45 min slots]
 8 short talks of 20 min + 10 min discussion [30 min slots]

Workshops: 3 Workshops of 60 min

Additional sessions for favorite problems [45 min] and very brief presentations [45 min]

Tuesday, February 20th 2018

all day *Arrival day*

19:00 – 21:00 *Dinner* *D'Landsknecht*

Wednesday, February 21st 2018

07:00 – 08:30 *Breakfast* *Hotel*

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| 09:00 – 09:30 | Welcome and opening of 8 th WPhC-Congress “Whizz-kids” | Helmuth Mayr – WPhC President | <i>AECC</i> |
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| 09:30 – 10:30 | Keynote: “Gifted Education in Austria and relevant Studies with regard to Competition and Olympiads” | Elisabeth Bögl | Chair: Mayr |
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10:30 – 11:00 *Coffee Break*

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| 11:00 – 11:45 | Keynote: “Popperschule – gifted education” | Eleonore Steigberger | Chair: Mayr |
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| 11:45 – 12:30 | Talk: “Competitions of the young German Physical Society” | Hannes Vogel | |
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| 12:30 – 13:00 | Talk: “IYPT: From student competition to real science” | Martin Plesch | |
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13:15 – 14:45 *Lunch* *D'Landsknecht*

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|---------------|--|-----------------|----------------|----------------------|
| 15:00 – 15:45 | Talk: “Eötvös Competition - a small competition with great influence” | Péter Vankó | Chair: Plesch | AECC |
| 15:45 – 16:30 | Talk: “Bridging the gap – Supportive measures for students in the German Physics Olympiad” | Stefan Petersen | | |
| 16:30 – 17:00 | <i>Coffee Break</i> | | | |
| 17:00 – 17:30 | Talk: “How large is the term gifted education” | Sandu Golcea | Chair: Pathare | |
| 17:30 – 18:00 | Talk: “Selected problems from Polish Physics Olympiad” | Jan Mostowski | | |
| 19:00 – 21:00 | <i>Dinner</i> | | | <i>D’Landsknecht</i> |

Thursday, February 22nd 2018

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|---------------|---|-------------------|----------------------|-----------------|
| 07:00 – 08:30 | <i>Breakfast</i> | | | <i>Hotel</i> |
| 09:00 – 9:30 | Talk: “Is Cross-Age Peer Tutoring a Useful Approach to the Preparation of Students for the Physics Olympiad?” | Marianne Korner | Chair: Mayr | AECC |
| 09:30 – 10:30 | Workshop: “Some Interesting Experiments Used on YPT” | Paul Pshenichka | | |
| 10:30 – 11:00 | <i>Coffee Break</i> | | | |
| 11:00 – 12:00 | Workshop: Four low cost experimental exercises for an introductory physics course | Paul Stanley | Chair: Haraldsdottir | |
| 12:00 – 13:00 | Workshop: “Experimental problems in high level competitions (IPhO, GPhO, EUPhO)” | Mihkel Heidelberg | | |
| 14:00 – 18:30 | <i>Excursion (with packed lunch and combined with dinner)</i> | | | |
| 18:30 – 20:30 | <i>Dinner</i> | | | <i>Schubert</i> |

Friday, February 23rd 2018

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|---------------|---|----------------------------|-----------------|----------------------|
| 07:00 – 08:30 | <i>Breakfast</i> | | | <i>Hotel</i> |
| 09:00 – 09:45 | Talk: “Overview of Physics Competitions in the Czech Republic with emphasis on those organised by Charles University” | Karel Kolář | Chair: Stanley | <i>AECC</i> |
| 09:45 – 10:30 | Talk: “The role of European and International Physics Olympiads in shaping the educational path of students.” | Jaan Kalda | | |
| 10:30 – 11:15 | Talk: “Project Tumbleweed” | Josef Pürmayr and students | | |
| 11:15 – 11:45 | <i>Coffee Break</i> | | | |
| 11:45 – 12:15 | Talk: “Indian National Olympiad Program and its contribution to the undergraduate education” | Shirish Pathare | Chair: Golcea | |
| 12:15 – 12:45 | Talk: “Six decades of physics competitions in Macedonia – challenges and perspectives” | Lambe Barandovski | | |
| 12:45 – 13:15 | Talk: “Students’ personal growth during the participation in physics competitions” | Paul Pshenichka | | |
| 13:30 – 14:45 | <i>Lunch</i> | | | <i>D’Landsknecht</i> |
| 15:00 – 15:45 | Session: “My favorite problem in a physics competition” | Everybody | Chair: Petersen | <i>AECC</i> |
| 15:45 – 16:30 | Session: brief presentations on selected topics | | Chair: Petersen | |
| 16:30 – 17:00 | <i>Coffee Break</i> | | | |
| 17:00 – 18:00 | WFPPhC meeting Presentation of the WFPPhC Award | | | |
| 19:30 – 21:30 | <i>Dinner</i> | | | <i>Schubert</i> |

Saturday, February 24th 2018

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| 07:00 – 10:00 | <i>Breakfast</i> | | | <i>Hotel</i> |
| all day | <i>Departure</i> | | | |

Abstracts for the 8th WFPhC-Congress 2018

“Student Competitions and their role in (Gifted) Education”

Keynotes

Keynote 1: “Gifted Education in Austria and relevant Studies with regard to Competition and Olympiads”, Elisabeth Bögl
(Wednesday, February 21st 2018 9:30-10:30)

Which personal traits were relevant for Edison’s development of the light bulb? Which characteristics in general are considered crucial for an ideal development of one’s potential and talent?

To provide a differentiated answer to these questions various aspects of gifted education in Austria are considered. Legal policies of GE since 1962 contrast alarming test results of PISA, showing a decrease of so-called ‘top performers’. There is an obvious need for action regarding a nationwide systemic implementation of gifted education methods and programs. The discussion of renowned current giftedness models reveals which components are relevant for the intended development of potential to excellence, and how they can be productively supported. Furthermore, the results of various studies regarding Olympiads will be presented.

Keynote 2: “Popperschule – gifted education”, Eleonore Steigberger, Austria
(Wednesday, February 21st 2018 10:30-11:00)

In the keynote I intend to outline the school’s philosophy of personalised learning. I shall briefly talk about the development the school has gone through in its 20 years of existence and how intensive school development and dialogue with our learners has shaped our concept of giftedness and enhanced our learning culture.

Another look will be taken at the implementation of more traditional measures of gifted pedagogy such as acceleration, enrichment and grouping within the school’s framework.

Talks

Talk 1: “Whizz-kids“, Helmuth Mayr
(Wednesday, February 21st 2018 9:00-9:30)

This is a report on basic characteristics of gifted students, based on the experience made as teacher and trainer of such students.

I started with this training in 1982 and am still doing this job.

Talk 2: “Competitions of the young German Physical Society”, Hannes Vogel
(Wednesday, February 21st 2018 11:45-12:30)

Communicating the results of their research is an essential competence of physicists. By offering a platform of scientific exchange for youths they can meet peers with common interests and experience discussion. Since 2015 the young German Physicists Society (jDPG) holds conferences for pupil where they can try scientific practice by presenting own works e.g. from physics competitions in lectures and poster sessions. We will talk about the education programme of the jDPG and discuss the idea of holding an international science conference for pupils.

Talk 3: “IYPT: From student competition to real science”, Martin Plesch
(Wednesday, February 21st 2018 12:30-13:00)

International Young Physicists’ Tournament (IYPT, www.iypt.org) is a world-wide competition for teams of high school students that solve open physics problems. Contrary to many other

competitions, solutions of IYPT problems are not known in advance and the expectations are being formed during the course of the competition. Before that, students are expected to find existing work, perform experiments, develop theory and use all gained knowledge to prepare a presentation about their solution, which has to be defended in a tough physics discussion.

In my talk I will introduce a case study of one of the IYPT 2017 problems – Gee Haw Whammy Diddle. This purely mechanical scientific toy is widely used in different occasions, from serious educational meetings to illusionist's shows. A few scientific papers were devoted to this phenomenon, suggesting different explanations of what is happening there. Using widely accessible experimental equipment (an iPhone, tone generator and subwoofer) students were able to quickly find inconsistencies in these works. In cooperation with their leaders they formulated a novel theory explaining the phenomenon and confirmed the theory by upscaled experiments and numerical simulations. The outcome of the work was preliminary accepted to the prestigious Nature Scientific Reports journal.

**Talk 4: “Eötvös Competition - a small competition with great influence”, Péter Vankó
(Wednesday, February 21st 2018 15:00-15:45)**

The Eötvös Competition in Hungary is probably the oldest physics competition in the world: it was organized first time in 1894. According to the number of participants it is a small event but it has a much greater significance in the country and it has also an international impact. It had an important role in some outstanding Hungarian successes at the International Physics Olympiads and it was a major inspiration for the first European Physics Olympiad.

In the talk a brief history of the competition, some famous winners, some typical problems and some unexpected solutions are presented.

**Talk 5: “Bridging the gap – Supportive measures for students in the German Physics Olympiad”, Stefan Petersen
(Wednesday, February 21st 2018 15:45-16:30)**

International student competitions primarily address the best students of the participating countries and are therefore tailored to the skills and needs of those top performers. In contrast to this, the preceding national competitions typically not only aim at selecting the national teams of their countries but often have a much broader focus. At least at the lower levels of the competitions they usually provide a wide range of interested students with opportunities to test their skills and train their abilities. This potential contribution towards (gifted) education on a broader scale can be hampered by the perceived gap between school curricula and the demands of the competitions.

In my talk I will describe how we try to bridge this gap between school physics in Germany and the mastery of physics necessary for the International Physics Olympiad by introducing various supportive measures at different stages of the German Physics Olympiad.

**Talk 6: “How large is the term gifted education”, Sandu Golcea
(Wednesday, February 21st 2018 17:00-17:30)**

In recent years, more and more Physics competitions have begun to appear, which lack a well-defined, declared goal. Most of them overlap, at least by name, with established international competitions that have become well-known. Their relevance, beside that of being Physics competitions, remains to be proved in time.

Most of them require a sheet of paper and a pencil, and the students are presented problems that show the intelligence of the authors – by no means the educational abilities of the “gifted” students. Others fall in the opposite extreme: the only test is the experimental one, so sophisticated that it can make you believe that you participate in an inventions contest, not a Physics contest designed for pupils.

The visible result in established competitions is that even organizers are too embarrassed to present the individual scores obtained by each participating student, so they prefer to show to the public just the order that resulted after the rating – as if the purpose of the contest would be the establishing of a hierarchy or the fight for short-lived medals. In the case of experimental-type contests, the interest is so low, that nobody can even remember one of the topics from last year!

Considering these observations and other characteristics of the competitions, there is one question to be asked: how are these competitions helping the gifted students?

I ask you again: “How large is the term gifted education?”

Taking into account the motivation presented above, the International Young Physicists' Tournament is becoming a more and more attractive competition, for an increasing number of students. In 2020, Romania will be hosting, in the city of Timișoara, the 33rd Tournament. The competition is less known in Romania, a country that started participating in 2013. There still is no mass base in Romania, only a small group of enthusiastic professors, which are trying to make the competition better known in the country.

Starting with the year 2017, the competition: EUROPEAN IYPT – JUNIORS TRAINING is organized in Romania. From the 12 European countries that will participate in IYPT Beijing 2018, 6 have also participated here: Poland, Serbia, Slovakia, Sweden, Ukraine and Romania. The declared purpose of this competition is to train, from a technical point of view, for the IYPT World Tournament in 2020. The emphasis will be placed not on the Competition itself, this being the reason why no advertisement was made regarding the final ranking in the press or the media. The wish of the organizers was to present the Tournament to a large number of professors in Romania, to create a base for the selection of the 5-6 Romanian teachers necessary for the International Jury.

**Talk 7: “Selected problems from Polish Physics Olympiad”, Jan Mostowski
(Wednesday, February 21st 2018 17:30-18:00)**

I will start with a brief presentation of the Polish Physics Olympiad format. Next, I will present several questions given to participants in the last few years. They include short qualitative questions and longer theoretical and experimental problems. The selection of questions will be such that each of them illustrates a specific educational challenge. On this basis I will discuss some more general problems of physics education on the high school level, both for gifted and average students, and will stress the role of competitions.

**Talk 8: “Is Cross-Age Peer Tutoring a Useful Approach to the Preparation of Students for the Physics Olympiad?”, Marianne Korner
(Thursday, February 22nd 2018 9:00-9:30)**

This talk introduces the teaching method of Cross-Age Peer Tutoring (CAPT) and discusses its potential benefit in the students' training for the Physics Olympiad. Based on the content matter, which is formulated in the syllabus of the IPhO and the required problem solving skills, CAPT offers an additional methodical approach to the support of the students' development in order to prepare them for the demands of high-level Olympian tasks. CAPT is a teaching method which is constructivist-oriented and, therefore, can optimally facilitate the students' conceptual understanding.

**Talk 9: “Overview of Physics Competitions in the Czech Republic with emphasis on those organised by Charles University”, Karel Kolář
(Friday, February 23rd 2018 9:00-9:45)**

There is a wide range of competitions in physics in the Czech Republic. This contribution should bring an overview of possibilities for participation in high (upper secondary) school and lower

secondary school students (studying levels 3 or 2 by ISCED 2011) there. We compare the contests - their target groups, schedules, and how they try to motivate for participation.

There is a variety of different competitions. Some of them are for individuals like Fyzikální olympiáda (FO; translation Physics Olympiad), Astronomická olympiáda (AO; Astronomy Olympiad), Fyzikální korespondenční seminář (FYKOS; The Internet Physics Competition, or Physics Correspondence Seminar) and Výpočty fyzikálních úkolů (Výfuk; literally - "calculation of tasks in physics").

There are also many team contests. Trendy kind of them is when they compose only several hours of problem-solving like FYKOSí Fyziklání (Physics Brawl), Fyzikální Náboj (Physics Náboj), Fyziklání online (Online Physics Brawl) and Náboj Junior. On the other hand, there are some long-term team competitions like Turnaj mladých fyziků (TMF; Young Physicists' Tournament) or Pohár vědy - Olympiáda fyziky a dalších věd (Science Cup - Olympiad in Physics and Other Sciences).

There are also some other competitions which are multidisciplinary - e.g. M&M - correspondence competition in physics, mathematics and informatics for ISCED 3 individuals, or Přírodovědný klokan (Kangaroo Science Contest).

Many of those competitions are financed, organised or co-organised by Faculty of Mathematics and Physics at the Charles University (FMP CU) - FYKOS, Physics Brawl, Online Physics Brawl, Fyzikální Náboj, Výfuk and Náboj Junior. We focus more on those competitions although we try to describe the entire scene of Czech physics contests.

**Talk 10: “The role of European and International Physics Olympiads in shaping the educational path of students”, Jaan Kalda
(Friday, February 23rd 2018 9:45-10:30)**

In the first part of my talk, I'll give a summary of the first European Physics Olympiad - discussion of the problems, statistical analysis of the competition results, and overview of the format of the competition. I also give a brief overview of the last Nordic Baltic Physics Olympiad (former Estonian-Finnish Olympiad), and the first two Gulf Physics Olympiads (the competition for the states of the Persian Gulf). I argue that conceptually challenging problems encourage students selecting physics for their undergraduate studies; this is backed up with data regarding Estonian and Saudi Arabian IPhO team members.

In the second part of my talk I analyse the distribution of the scores of IPhO, IMO, IOI, and IChO, and compare these data with the distribution of sport records (e.g. 100m sprint and weight lifting). I show the presence of a novel universal distribution law which can be used for intriguing extrapolation.

**Talk 11: “Project Tumbleweed”, Josef Pürmayr and students
(Friday, February 23rd 2018 10:30-11:15)**

Students of the Sir Karl Popper School talk about how they perceived their learning progress during developing an innovative, wind driven Mars Rover. The project got a lot of media attention, won a European youth space contest (Odysseus) and got invited to test the Rover in a Mars Analogous Mission in Oman.

Furthermore, the role of the teacher in the project is going to be analyzed.

**Talk 12: “Indian National Olympiad Program and its contribution to the undergraduate education”, Shirish Pathare
(Wednesday, February 23rd 2018 11:45-12:15)**

The Indian National Olympiad Program was established with a clear objective to attract talented / gifted kids to basic sciences. In the long run of 20 years, efforts have been proved fruitful as many students have started opting for sciences as their career, either immediately after their pre-university career or after their engineering degree.

Another prominent advantage of the olympiad program is that various olympiad experiments are proving useful even at the undergraduate level. Not only the innovativeness of the experiments but also the approach of attacking an experimental problem is proving useful. Students and teachers learn new procedural techniques and methodologies as they perform these experiments. They extend these methodologies to their regular experiments. It was found that teachers are even adopting the various assessment techniques which are used in olympiad examinations. The innovations during the experimental development also leads to a great help to simplify the existing apparatus in the undergraduate laboratories. In my presentation I would discuss these aspects.

**Talk 13: “Six decades of physics competitions in Macedonia – challenges and perspectives”, Lambe Barandovski
(Friday, February 23rd 2018 12:15-12:45)**

Physics competitions play an important role in the education of highly talented primary and secondary school students, opening new possibilities to extend their knowledge in physics. Physics competitions in Macedonia are organized by the Society of physicists of Republic of Macedonia (DFRM) and the Institute of physics, Faculty of natural sciences and mathematics, for more than six decades. First state competition for gifted high school students in Macedonia was held in 1957 and first state competition for primary school students was held in 1977. Due to the high interest of the students for these competitions, later on, physics competitions in Macedonia were organized on two levels (regional and state) and from 2014 on three levels (municipality, regional and state). First participation of high school students from Macedonia at the International physics Olympiad was in 1997.

Preparation of the competitions and work with the gifted students was found to be really challenging. Due to lack of financial support by Ministry of the science and education of Republic of Macedonia, especially in the past decade, the organization of the competitions on each level, is made fully on voluntary base by the members of DFRM. The biggest problem is the participation of the team on the International Physics Olympiads. Although many initiatives from DFRM were made to change the legislation and these competitions to be fully funded by the Ministry, like in the many neighboring countries, until now, there is no positive feedback.

**Talk 14: “Students’ personal growth during the participation in physics competitions”, Paul Pshenichka
(Friday, February 23rd 2018 12:45-13:15)**

Our high school students participate at different physics competitions in Ukraine: 1. The National High School Students Physics Olympiad; 2. The National UYPT (Ukraine Young Physicists Tournament) Team Competition in Ukraine; 3. The National Junior YPT Team Competition in Ukraine; 4. The Physics Contest of MASU (Minor Academy of Sciences of Ukraine). 5. The “Lion” Physics Contest in Ukraine (the number of participants is approximately 100,000-150,000 students yearly).

The students participate at competitions of all levels, as well as in Olympiads, Science Fairs and Tournaments. The number of winners in Physics and Astronomy at city/regional/national and international competitions during the last three years is: 2015 in total 18 students, 2016 (in total 15 students, 2017 (in total 16 students); 24 Diploma, one gold, one silver and five bronze medals.

But beside the numerical results there is an even more essential impact of participation in competitions, and that is their passion for science and education in general. During the last three years I supervised a team of 5 high school students and keep an eye on their personal and scientific evolution. All of them showed good individual results at City, Regional and National Contests in Physics. As a team they were formed during preparation for the UYPT and are keeping their efficiency till now.

They are also good in other fields: mathematics, Computer Science and linguistics. These students have also another task: to prepare the upcoming generation for the future competitions.

Workshops

Workshop 1: “Some Interesting Experiments Used on YPT”, Paul Pshenichka (Thursday, February 22nd 2018 9:30-10:30)

Many hydro- and aerodynamics phenomena we can explain using a small number of principles like the Bernoulli Effect, Karman Carpet or Magnus Effect. Let's observe an IYPT problem: “Explain the behavior of a Ping Pong ball in an air- or water-stream”. The first experiment in a vertical water stream is simple, the equilibrium of the ball is provided by two equal and opposite forces: the resistance force and the weight of the ball.

The next interesting question is why the ball doesn't escape the stream in its transverse oscillations even if you incline the stream. All such cases we can explain using the Bernoulli Effect. When the stream hits the ball at the side, it starts to rotate remaining the dynamic stability. Now we have to take in account the Magnus effect which increases the lateral stability. Some interesting periodic structures in the sky or on the seashore are caused by Karman Carpets emerging if the wind velocity exceeds the Reynolds limit. It is also possible to bring sand in a container to the state that it behaves like liquid. The explanation of the phenomena is the same as in the other related cases.

Workshop 2: “Four low cost experimental exercises for an introductory physics course”, Paul Stanley (Thursday, February 22nd 2018 11:00-12:00)

We highlight four low cost experiments that can be done in an introductory physics course. With topics ranging from light to electrostatics to fluids to sound, the minimal equipment needs are supplemented by free smart phone apps or kitchen equipment. Though low cost, the physics is rich and provides a way to engage students from diverse backgrounds who might be reluctant to otherwise use science equipment for fear of breaking something. Participants will be welcome to copy or modify any examples to suit local needs, and encouraged to further experiment with developing physics based experiments that are the equivalent of "back of the envelope" activities.

Workshop 3: “Experimental problems in high level competitions (IPhO, GPhO, EUPhO)”, Mihkel Heidelberg (Thursday, February 22nd 2018 12:00-13:00)

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