

February 10th 2023
PVA EXPO, Prague

Guidebook



fykos.org



fyziklani.org



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[@fyziklani](https://www.instagram.com/fyziklani)



Fyziklani2023

Dear participants of Fyziklani 2023!

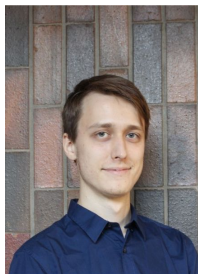
It is my pleasure to welcome you to the 17th year of Fyziklani. Over the years, Fyziklani has grown considerably to become the largest physics team competition in Europe, which piqued interest of a record-breaking number of 250 teams from more 21 countries.

For the second time, the competition is held in the large premises of PVA Expo Prague, which allows us to organize the entire event in one place and thus continue to bring together all students interested in physics and related fields. However, Fyziklani is not just a competition. As usual, during its week, a rich accompanying program is held, including lectures, excursions, panel discussion, but also a party or a banquet. I firmly believe that you will find the program interesting and I hope that it will further help to fulfill the main goal of the competition – to celebrate the beauty of physics.

With all this, however, comes a higher complexity and difficulty of preparation, and the quality of the whole event lies on the enormous amount of work done by the entire organizing team, without which the competition would not have been possible and to whom I would like to thank for everything they have helped to prepare for you. My thanks also extend to a personal level, as this is the first year for me as the head organizer, and it was the experience of others thanks to which we managed to pull it off.

Fyziklani would also not have been possible without our partners, for whose support we are very grateful. This year's general partner is ESPR (European Summer Program on Rationality), which not only helped us cover the costs of the competition but also gave 12 teams from the Philippines, Romania, Brazil, and other countries the opportunity to participate in Fyziklani 2023.

I wish you a lot of great memories, the best of luck at the competition, and I hope that we will all enjoy the entirety of Fyziklani together!



A stylized, handwritten signature in black ink, which appears to read 'David'.

Vojtěch David
Head organizer of Fyziklani

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Game Schedule

09:00 – 09:45 Team arrival at PVA EXPO

Presence of teams before the competition.
Please arrive on time to speed up the process.

10:00 – 10:25 Opening ceremony

Explanation of the rules and course of competition. Initiation.

10:30 – 13:30 Competition

Participants compete for 3 hours. During the competition, a program is prepared for the accompaniment.

13:45 – 14:00 Presentation about FYKOS

Presentation about FYKOS during the break before announcement of results.

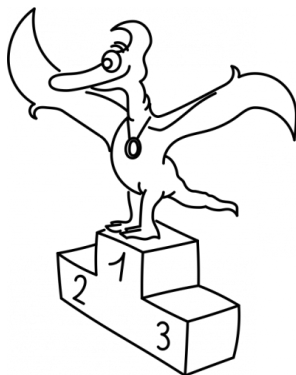
14:00 – 14:45 Announcement of results

Presentation of valuable prizes to the winning teams and awarding diplomas. The end of the contest.

14:45 – 14:50 Joint photo shoot of the winners

Ceremonial immortalization of the competition winners.

There will also be a lecture for teachers during the competition. More information can be found in the accompanying program section.



Useful Contacts

Name	Role	Phone number
Kateřina Charvátová	Communication with the teams on the day of the game	+420 775 152 896
Veronika Hendrychová	Head of the competition registration	+420 732 383 025
Radomír Mielec	Accompanying program	+420 730 621 947
Robert Gemrot	Accommodation	+420 705 216 492
Vojtěch David	Head organizer of Fyziklání	+420 730 974 923

For problems concerning arrival at accommodation contact Robert Gemrot, in case of delays or problems with travel on the day of the game contact Kateřina Charvátová. In case of complications during the accompanying program, please contact Radomir Mielec. Only call Vojtěch David in case of emergency.

You can also contact us by email at **fyziklani@fykos.cz**.

Accommodation – Hotel Duo

Hotel Duo is a four star hotel. It is located near the metro station Střížkov. Besides 654 rooms, Hotel Duo also offers many high-quality services for leisure time and business affairs. The hotel address is **Teplicka 492, 190 00, Prague, Czech Republic**.

Check-in, Check-out

You can **check-in from 15:00**. On the departure day, please leave your room, take all your belongings, and **check-out before 10:00**.

Venues and Maps

PVA EXPO, Prague

Competition takes place at PVA EXPO, Prague at **Beranových 667, 199 00 Praha 9, Czech Republic.**

Transportation

To get to the **competition venue**, take metro line C (red, goes from the Main Railway Station or the Florenc Bus Station in the Letňany direction) – get off at the **Letňany** (terminus). Then walk for about 5 minutes to get to **PVA EXPO building**.

From accommodation in Hotel Duo, you can reach metro station Střížkov by a 5-minute walk. Then, metro line C (red) will get you to both Letňany and **Nádraží Holešovice**, from where you can get to **Troja Campus** (V Holešovičkách 2) by 10-minute walk.

The best way to access **Karlov Campus** (Ke Karlovu 3, 5) is by walk from metro station **I. P. Pavlova** (line C), or Karlovo náměstí (line B). The map shows recommended route from metro station I. P. Pavlova.

You can get to the **Faculty of Natural Sciences** by going down the stairs at Karlov Campus. You can see the route on the map.

Recommended Apps

For easy orientation during Fyziklani, you can use Mapy.cz app, which enables users to download map of Prague that works even in offline mode.

M Mapy.cz app

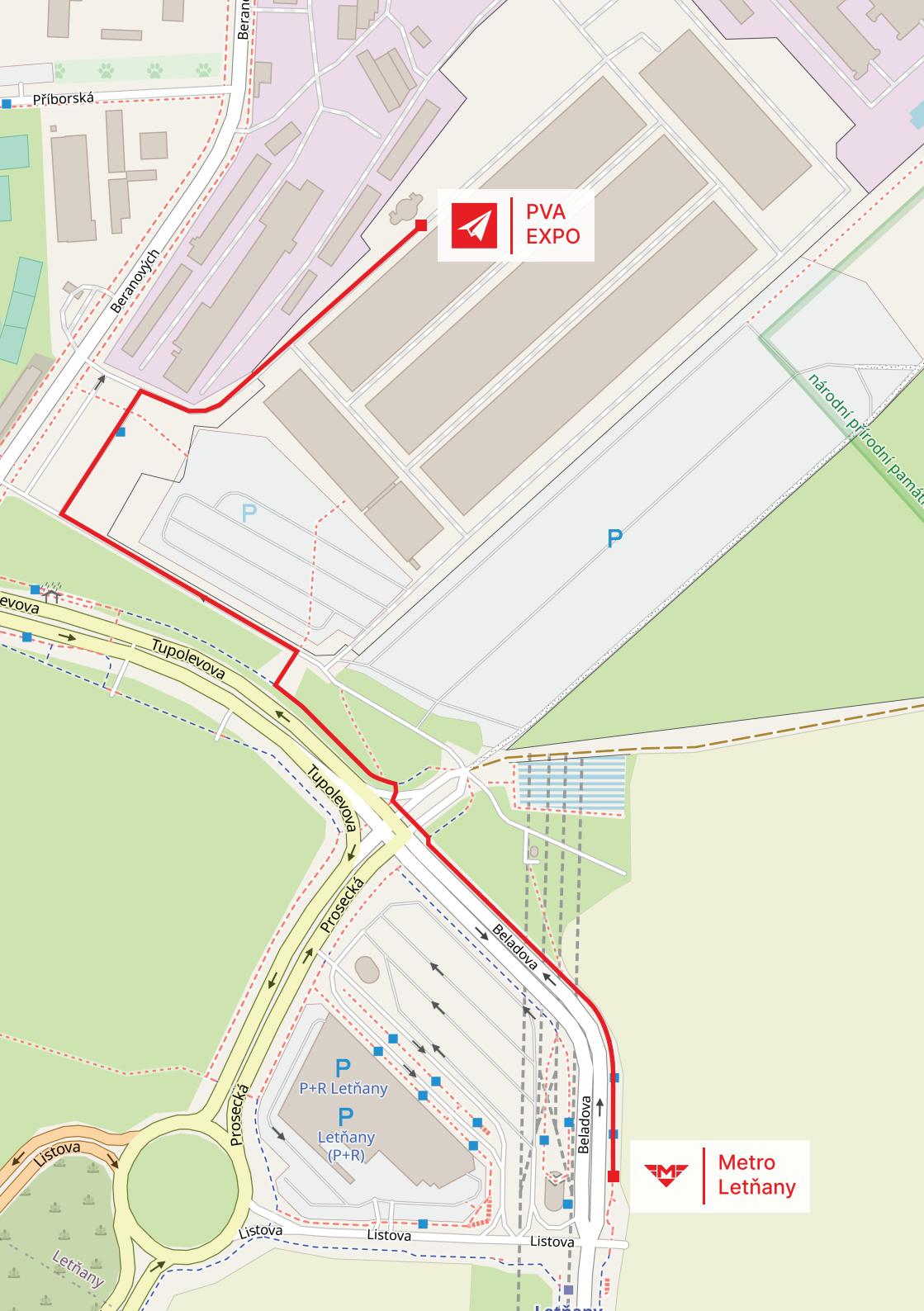


Prague has well-developed public transportation. To search connections, or to buy tickets with card, we recommend to use the official app PID Lítačka.

PID Lítačka app



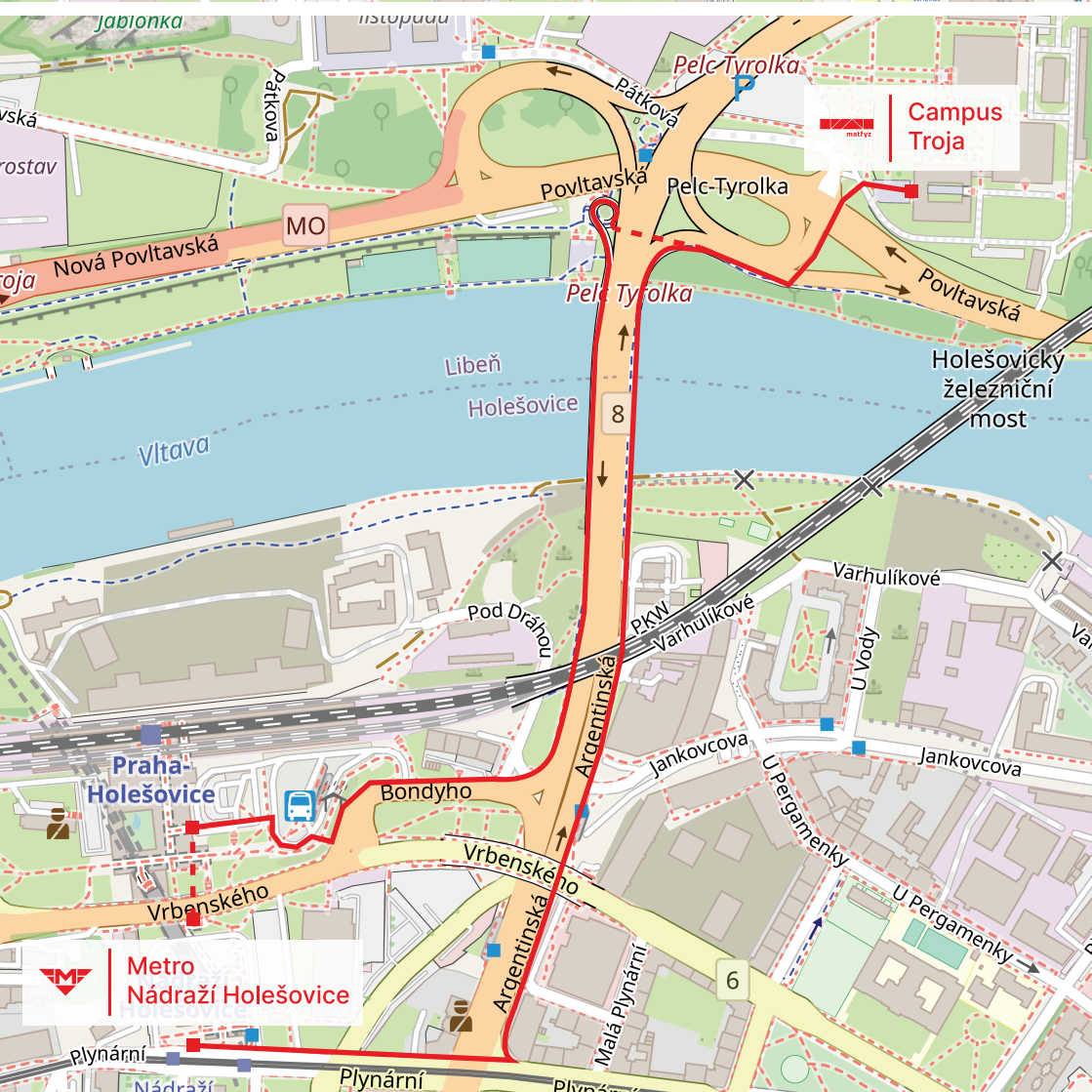
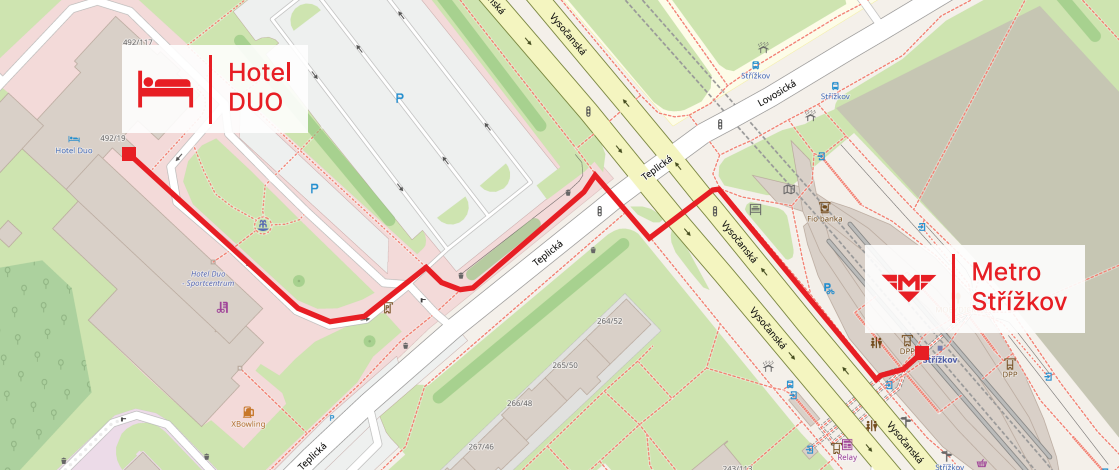
You can download both apps here (works for Android and iOS).



PVA
EXPO



Metro
Letňany

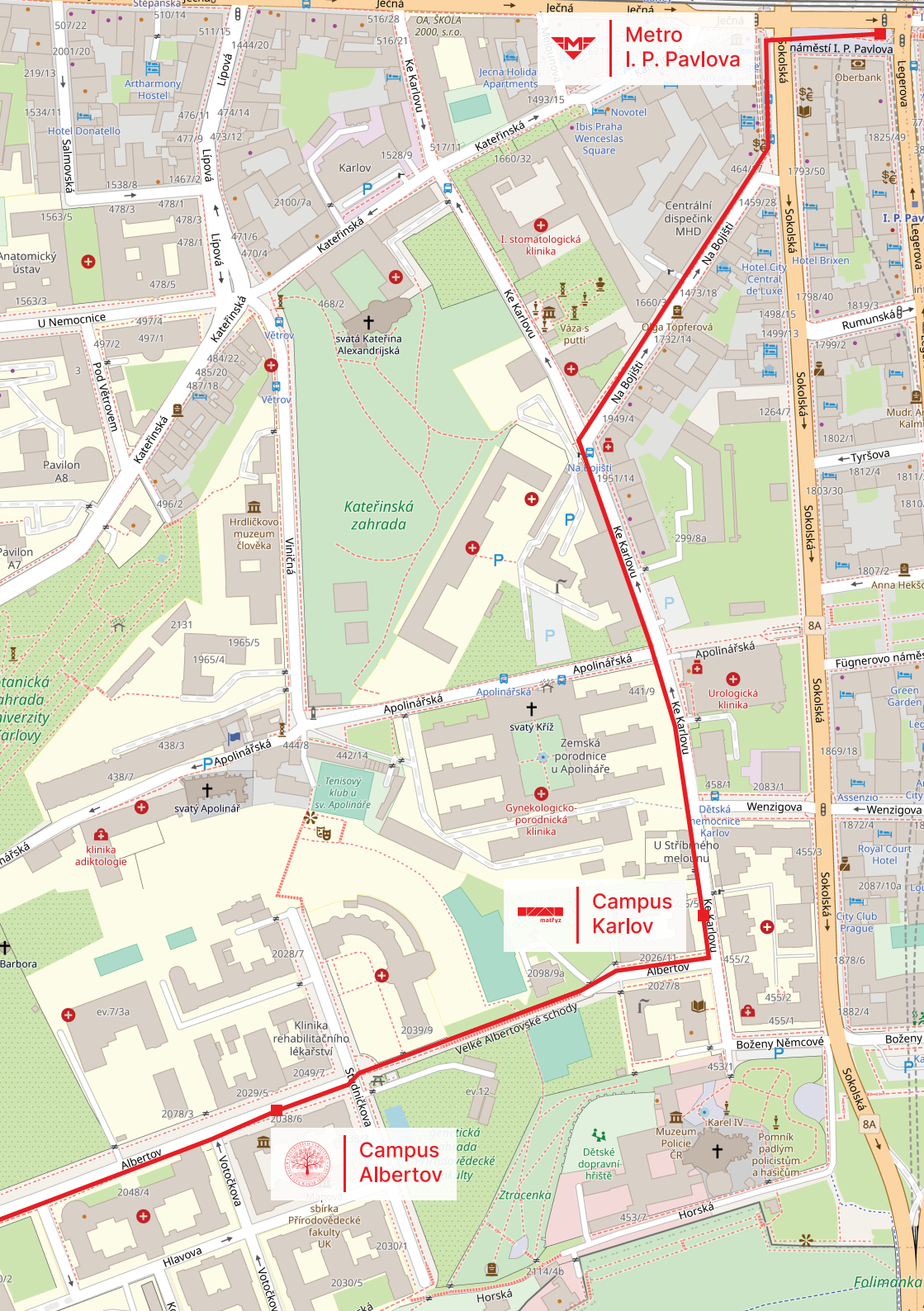




Metro
Karlovo náměstí



P.M. Club



Metro
I. P. Pavlova



Campus
Albertov



Campus
Karlov

Accompanying program

Monday 6. 2.

afternoon

Arrival

Since Monday afternoon, participants with accommodation can come to Hotel Duo.

Tuesday 7. 2.

09:00 – 09:30

Opening ceremony and welcome

Ceremonial opening of the accompanying program.

09:30 – 11:30

Icebreakers and get-to-know-you games

13:30 – 17:30

Trip around Prague focused on famous places related to physics

A walk around cultural monuments with a focus on places related to the history of physics.

17:30 – 18:30

Nation's evening preparations

The hall for the Nations' evening will open and participants will have the opportunity to prepare their stands.

18:30 – 22:30

Nation's evening

Presentation of national foods, music, and culture.

Wednesday 8. 2.

08:00 – 16:00

Trip to the Karlštejn Castle

A trip to one of the most iconic places of the Czech culture and history, the Karlštejn Castle.

19:00 – 21:30

Presentations of science

Presentation of science and famous scientists from the participating countries.

Thursday 9. 2.

09:00 – 15:30

One Day with Physics at FMP CUNI

Day full of lectures and excursions at FMP CUNI.

19:00 – 20:30

Panel Discussion with Scientists

Discussion with Czech scientists about their work in physics.

Friday 10. 2.

09:00 – 15:00

Fyziklani

The competition.

17:30 – 19:00

Analysis

Presentation and analysis of solutions to this year's problems from Fyziklani.

19:00 – 23:59

Party

Evening party to celebrate Fyziklani – informally and without alcohol.

Saturday 11. 2.

10:00 – 12:00

Lectures

Lectures from excellent Czech scientists and special guest from Germany.

14:00 – 17:00

Excursions

Visits to cutting-edge labs in Prague and its surroundings.

19:00 – 22:00

Buffet

Ceremonial dinner with other contestants.

Sunday 12. 2.

09:30 – 10:00

Closing ceremony

Closing ceremony and group photo.

10:00 – arbit.

City Rallye

Fun game will guide you through Prague and also keep your brain cells busy. The game might end earlier depending on how fast you are.

Tuesday

Nations' evening – Hotel Duo, hall Amsterdam

Tuesday 18:30 – 22:30

The Nations' evening will be an opportunity for all foreign participants to get to know each other's cultures and learn something new about them. Each team will prepare a small introduction of their country, which may include food, clothing, songs, dances or other cultural enrichment.

Wednesday

Trip to the Karlštejn Castle

Wednesday 08:00 – 16:00

On Wednesday, the participants will also look outside Prague for Czech monuments, specifically for one of the icons of Czech culture, the Karlštejn Castle. We will travel there and back by train. We will also have lunch and some free time to discover the castle surroundings.

The tour of the castle itself takes place from 11:00 to 12:00.

Presentations

Wednesday 19:00 – 21:30

Presentation of science and famous scientists from abroad by local participants. The presentation will take place in the auditorium of IFF UK on the Troja Campus in **N1** and **T1**.

Thursday

Lab tours – Troja Campus

Thursday 09:00 – 12:00

Please arrive no later than 9:30 a.m. at the Troja Campus to the "T" auditorium.

For more information visit

<https://fyziklani.org/schedule/detail#excursions-troja>



Lecture – Troja Campus

Thursday 14:00 – 15:30

Lecture of Mgr. Fedor Juraj Ph.D. called "Quantum computing: Time to cool down" will take place in the **N1** lecture hall at the Troja Campus.

Panel discussion – Troja Campus, N1 and T1

Čtvrtek 19:00 – 20:30

During the panel discussion, several scientists will share their personal experiences in English to give you a closer look at life and work in science work.

doc. Ing. Vladimíra Petráková, Ph.D.

She engages in nanotechnology and its application in biophysics. She is a group leader at the J. Heyrovsky Institute of Physical Chemistry CAS. She is a co-founder of the non-profit organization Czexpats in Science.

Mgr. Anna Fučíková, Ph.D.

She engages in biophysics and semiconductor nanoparticles. She received the Neuron Prize in 2015 for her research. She works at the Institute of Physics of the CAS, FMP CUNI, and UCT.

RNDr. Antonín Fejfar, CSc.

He engages in the physics of thin films of nanostructured semiconductors. He is a member of the Science Council of the CAS and since 2017 he has been Deputy Director of the Institute of Physics of the CAS.

RNDr. Martin Kozák, Ph.D.

He engages in electron microscopy and received a prestigious ERC grant for his research. He works at the Department of Chemical Physics and Optics of the FMP CUNI.

Mgr. Aleš Podolník, Ph.D.

He engages in the study of edge plasmas in tokamaks. He works at the Institute of Plasma Physics of the CAS. He was the head organizer of FYKOS and the 2nd to 4th year of Fyziklani.

Friday

Problem Analysis

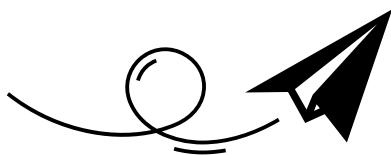
Friday 17:30 – 19:00

Presentation and analysis of the solutions to this year's problems from Fyziklani. It will take place at the Campus Karlov in lecture halls **F1** and **F2**.

Party

Friday 19:30 – 23:00

Come and meet the other competitors and organizers after Fyziklani. The party will take place at **Trojická 10, Praha 2** in **P.M. Club** and you can look forward to DJ Stayer. All of that in a friendly mood and without alcohol.



Saturday

Lectures

The lectures will take place at the Faculty of Natural Sciences at Albertov.

First block

Sobota 09:30 – 10:30

Introduction to Femtosecond X-ray science [EN]

prof. Dr. Christian Bressler – Velká geologická posluchárna

Can we possibly ever image with atomic-scale spatial resolution the detailed structural changes during an ongoing chemical reaction? Femtosecond X-Rays have the required temporal resolution and offer atomic-scale structural resolution, and this presentation will introduce the current instrumental and scientific efforts to resolve with razor-sharp precision such ultrafast processes.

Fyzikální kabaret [CZ]

prof. RNDr. Jiří Spousta Ph.D. – Mineralogická posluchárna, 9:30

This lecture is only available in Czech.

Historie světla [CZ]

Mgr. Miroslav Kloz Ph.D. – Levá rýsozna

This lecture is only available in Czech.

Second block

Sobota 10:45 – 11:45

Seeing atoms as they move: a surface science approach to catalysis [EN]

Zdeněk Jakub, Dr. Techn. – Velká geologická posluchárna

Modern society fully depends on catalytic processes, as the vast majority of chemicals, fertilizers, fuels or pharmaceuticals require catalytic steps during production. Unfortunately, the best catalysts are often the rarest of metals such as Pt, Rh or Ir, and the demand is increasing due to the ongoing shift to carbon-neutral economy. In this talk I will show how surface physics helps in development of new catalysts, and how we use atomically-defined model systems to unravel the reaction mechanisms on novel single-atom catalysts.

Génius Einstein a jeho teorie gravitace [CZ]

prof. RNDr. Jiří Podolský, CSc., DSc. – Mineralogická posluchárna

This lecture is only available in Czech.

Špatná fyzika ve filmu [CZ]

Ing. Jan Kaufman – Levá rýsozna

This lecture is only available in Czech.

Excursions

UT – Institute of Thermomechanics [CZ+EN]

Saturday 13:55

Meet: Metro C Ládví – behind the metro exit – 13:40

Laboratory of Rotational Laser Vibrometry (M. L. Mekhafia [EN]) – non-contact measurement of vibrations of rotating blades in turbomachinery

Opto-Acoustic Laboratory (K. Zoubková [CZ]) – laser-ultrasound techniques for evaluation of mechanical properties of materials

Laboratory of Hydrogen Technologies (M. S. Garapati [EN]) – nanostructured catalytic layers for hydrogen fuel cells

ELI – ELI Beamlines [EN]

Saturday 14:10

Meet: Metro C Kačerov – behind the metro exit – 13:25

ELI Beamlines Facility is a leading laser research centre and part of The Extreme Light Infrastructure ERIC. ELI Beamlines has developed and operates four leading edge high-power femtosecond laser systems reaching unprecedented intensities, which enable pioneering research not only in physics and material science but also in life science, laboratory astrophysics, chemistry with strong application potential.

GOL – Tokamak GOLEM [EN]

Saturday 14:05

Meet: In front of the lecture hall – Albertov 6 – 13:35 – 13:25

Tokamak GOLEM was the first functional experimental device designed for basic research on microwave plasma heating in Tokamak-type vessels. Until May 1976, the facility was located at the Institute of Atomic Energy I. V. Kurchatov in Moscow. Then it was handed over to the Institute of Plasma Physics of the Academy of Sciences of the Czech Republic on the basis of a contract on co-operation and division of labour in the field of high-frequency plasma heating.

The aim of the work on this device was to determine the conditions for efficient absorption of high-frequency waves in the region between the lower hybrid and electron cyclotron frequencies and to investigate the possibility of excitation of toroidal current by means of high-frequency waves. The new tokamak is located in the building of CTU, Faculty of Nuclear and Physical Engineering under the name GOLEM and is used for study purposes.

MACH – Dpt. of Physical and Macromolecular Chemistry [EN]

Saturday 14:00

Meet: In front of the lecture hall – Albertov 6 – 13:50

The research in the department was primarily focused on electrochemistry; other branches of physical chemistry have become popular in 60's. Currently, variety of branches of modern physical chemistry, ranging from experimental to theoretical physical chemistry and chemical physics, biophysical chemistry and macromolecular chemistry, are actively investigated in the department.

BIO – BIOCEV [EN]

Saturday 14:45

Meet: Metro C Kačerov – behind the metro exit – 14:00

In the context of Czech (and European) science, BIOCEV represents a cutting-edge comprehensive platform for the development of modern biotechnology and biomedicine. The centre combines traditionally strong fields of engineering and natural sciences, such as virology or chemistry. The quality of the scientific model is also reflected in the highest rating of the five large projects submitted to the Research and Development for Innovation Programme.

BIOCEV research groups focus on detailed understanding of organisms at the molecular level. Their results are directed towards applied research and the development of new treatments for serious health problems. The end results of the research work at the BIOCEV centre include drugs targeted to the precise site of damaged metabolism or protein and tissue engineering. BIOCEV research teams have already published more than 590 scientific outputs, including articles in prestigious international journals.

CUK – Institute of Physics [EN]

Saturday 14:00

Meet: Metro A Hradčanská – behind the metro exit – 13:45

FZU – Institute of Physics is one of the Czech Republic's most successful research institutions. Our international scientific teams work to push the boundaries of knowledge along six main research directions in physics – elementary particle physics, condensed matter physics, solid-state physics, optics, plasma physics and laser physics. The inspirational environment at FZU provides top basic, applied and interdisciplinary research and training for students.

Sunday

City Rallye

Sunday 10:00 – arbitrary

The City Rallye will take you through Prague. You will form small teams and together solve various tasks related to the streets of the capital city. It is not just an ordinary walk, you will have to engage your mind as well. The end of

the game is not fixed, it depends on you, but no later than 5 p.m. We will meet at 9:30 a.m. at the **Karlov Campus** for the closing ceremonial, joint photo and subsequent explanation of the rules of the game.

Program for teachers during the competition

PVA Letňany, Friday

- | | |
|-------|--|
| 10:30 | Ing. Petr Dvořák, Ph.D.: Electron microscopy: a ticket to the nanoworld? [CZ] |
| 11:20 | Break |
| 11:35 | Ing. Petr Dvořák, Ph.D.: Optical metasurfaces: optic components of the future? [CZ] |
| 12:30 | The end |

The lecture will only be held in Czech, the slides, however, will be in English.

Organizers

Vojtěch David (Head Organizer of Fyziklani)
Studies 2nd year of BSc. Mathematics at FMP CUNI.

Daniel Dupkala (Deputy Head Organizer of Fyziklani)
Graduated from MSc. Teaching physics and math at FMP CUNI. Works at Media Communications and PR Office of FMP CUNI.

Martin Vaněk (Head Organizer of FYKOS)
Studies 1st year of MSc. Physics at FMP CUNI.

Veronika Hendrychová (IT, Team Registrations, Management of Fyziklani)
Studies 3rd year of BSc. Mathematical informatics at FNSPE CTU.

Elena Chocholáková (Deputy Head Organizer of FYKOS)
Studies 1st year of BSc. Physics at FMP CUNI.

Daniela Dupkalová (Consultant of Fyziklani, Management of Fyziklani)
Graduated from MSc. Surface and Plasma Physics at FMP CUNI.

Michal Červeňák (IT)

Works at the Academy of Sciences of the Czech Republic.

Jaroslav Herman (Physics Problems Administrator and Chief Editor)

Studies 3rd year of BSc. Physics at FMP CUNI.

Jakub Dřevo (Marketing, PR, Accompanying Program)

Studies 2nd year of BSc. Physics at FMP CUNI.

Patrik Kašpárek (Accompanying Program)

Studies 2nd year of BSc. Physics at FMP CUNI.

Petr Kahan (Accompanying Program)

Studies 1st year of BSc. Solid State Engineering at FNSPE CTU.

Simona Švecová (Accompanying Program)

Anežka Bakočová (Communication with Teams)

Studies 2nd year of BSc. Physics at FMP CUNI.

Ema Wayan Danielová (Communication with Teams, Applications)

Studies 2nd year of BSc. Physics at FMP CUNI.

Kateřina Charvátová (Communication with Teams)

Studies 1st year of MSc. Biophysics and Chemical Physics at FMP CUNI.

Radomír Mielec (Communication with Teams)

Studies 1st year of BSc. Physics at FMP CUNI.

Tomáš Červeň (Graphics)

Studies 2nd year of MSc. Physics at FMP CUNI.

Daniel Broško (Translations)

Studies 2nd year of MSc. Economics and finances at IES CUNI.

Dávid Brodňanský (Partners of Fyziklani, Accompanying Program)

Studies 1st year of BSc. Physics - nanotechnologies at MUNI.

Jitka Vysloužilová (Partners of Fyziklani)

Studies 2nd year of BSc. Biophysics at FS USB.

Viačeslavas Šinkonis (PR)

Studies 2nd year of BSc. Physics at FMP CUNI.

Viktor Materna (Finances)

Studies 3rd year of BSc. Informatics at FMP CUNI.

Adam Krška (Typography, TeX, Printing)

Studies 1st year of BSc. Information Technology at FIT BUT.

Jan Bajer (Translations and preparation of the Guide)

Studies 1st year of BSc. Nuclear Engineering at FNSPE CTU.

Participated in the preparation of problems, reviews, and translations:

Jaroslav Herman, Dávid Brodňanský, Marek Jankola, Daniel Broško, Nicolas Gavornik, Elena Chochořáková, Adam Krška, Tomáš Tuleja, Vojtěch Votruba, Daniela Dupkalová, Daniel Dupkala, Karel Kolář, Jan Pijáček, Šimon Pajger, Josef Trojan, Jiří Blaha, Adéla Kolembusová, Kateřina Rosická, Martin Vaněk, Jan Bajer, Denisa Zdvořilá, Anežka Bakočová, Radka Křížová, Jozef Lipták, Adam Mendl, Tomáš Červeň, Ema Wayan Danielová, Vojtěch David, Daniel Dupkala, Daniel Fousek, Jiří Kohl, Albert Havlíček, Veronika Hendrychová, Juraj Jánošík, Jindřich Jelínek, Jakub Kliment, Matúš Klimko, Aneta Pjatkanová

FYKOS

Fyziklani is organized by FYKOS – a group with the aim of inspiring and educating high-school students in physics and related fields. FYKOS is under the patronage of FMP CUNI and has a rich 36-year history of organizing educational events.

The keystone activity of FYKOS is a correspondence competition of the same name. It is open to all high-school students with an interest in physics. We publish eight new problems six times a year. Participants have about a month to solve these problems and submit their solutions, which we mark and send back with comments and helpful feedback.

The best contestants of FYKOS can attend week-long camps in spring and fall focused on physics education, including lectures or experiments, but also offer plenty of engaging games and leisure activities. Along with Fyziklani, FYKOS organizes an online version of the competition – Physics Brawl Online, which is held every year in late November – and also many other events, such as the Day with Experimental Physics.



FYKOS

Faculty of Mathematics and Physics, Charles University

FYKOS and Fyziklani 2023 are under the auspices of the Faculty of Mathematics and Physics at Charles University (FMP CUNI). You can find more information at mff.cuni.cz/en.

The Charles University is the oldest university in Central and Eastern Europe and it is the best-ranked university in said region (e.g. in the Academic Ranking of World Universities). It was founded in the year 1348 by Charles IV. The MFF UK was founded in 1952.



matfyz

The Ministry of Education, Youth and Sports of the Czech Republic

The Ministry of Education, Youth and Sports of the Czech Republic (MEYS) is one of the announcers of Fyziklani 2023. The competition is also listed in the list of competitions maintained by MEYS.

MEYS is responsible for public administration in education, for developing educational, youth and sport policies and international cooperation in these fields.



General Partner

ESPR

The General Partner of Fyziklani is ESPR (European Summer Program on Rationality), an engaging and intensive workshop for mathematically gifted pupils which helps them acquire rigorous quantitative, but also other practical skills and techniques useful in many areas of life – from game theory and mathematical logic, communication skills and rational reasoning, to cognitive science. ESPR is all about better thinking and how that translates into better doing. After the camp ends, ESPR instructors continue to help the participants develop or start and build their own projects.

The program is normally held in Oxford in the summer and is free of charge for participants (with travel and other costs reimbursed). In addition to ESPR, the same group co-organises WARP, the winter version of this workshop.

For more information, visit espr-camp.org



Platinum Partners

The ČEZ Foundation



For twenty years, the ČEZ Foundation has been fulfilling its mission to support public benefit projects across the Czech Republic. It supports safe movement of children, education, sports, culture and a better environment. It helps even the smallest municipalities and local organizations that have nowhere else to turn. Handicapped and sick people, the elderly and people affected by natural disasters or emergencies such as Covid, the tornado in Moravia or the war in Ukraine. It involves everyone who is not indifferent to the fate of others in its charitable activities, whether they are employees of CEZ Group or the general public through the EPP Help through movement app. "Helping others brings not only a good feeling, but also the knowledge of how important it is to have someone nearby who listens and can support you in a difficult moment," says Michaela Ziková, Director of the ČEZ Foundation.

The Neuron Endowment Fund



The platinum partner of the 17th year of the Fyziklani is the Neuron Endowment Fund for the Support of Science, whose primary mission is to increase the prestige of scientists, develop a network of modern patronage, and connect the world of science and business.

For 13 years, the Neuron Endowment Fund has been awarding the prestigious Neuron Prizes – for promising scientists, connecting science and business, and the Neuron Prize for exceptional discovery or long-term work. During its existence, the fund has distributed 134 million Czech Crowns from patrons' donations among 111 Czech scientists in seven fields – mathematics, medicine, physics, chemistry, biology, computer science, and social sciences. The highest expertise of the laureates is guaranteed by The Scientific Council, composed of Czech and leading international experts of each scientific field, which is responsible for their selection.

Other activities of the fund include the Neuron Expedition, financial support for field scientific research all over the world, the Neuron Club, meetings of scientists and business people on current topics, and support for student scientific competitions and events. Newly, an internship program in Israel is open for undergraduates. The Neuron Endowment Fund has become the general partner of Fyziklani thanks to the excellent Czech scientist Lenka Zdeborová, winner of the Neuron Prize 2021 for promising young scientists in the field of physics. Lenka Zdeborová generously decided to dedicate her entire personal financial bonus to the needs of FYKOS, which she used to organize herself.

Silver Partners

Kalabria

Kalabria company was founded in 1911 and made its breakthrough by producing Calabria lemon juice from lemons imported from the Calabria region in South Italy – hence the name. Nowadays, it produces several kinds of lemonades and syrups in typical local flavors – in some cases innovated for the 21st century. The authentic taste of the lemonade is guaranteed by the use of the highest quality ingredients and experienced manufacturing processes. Calabria company supported Fyziklani by gifting 1500 bottles of Karáskova limonáda, which were given to participants to stay hydrated.



**KARÁSKOVY
LIMONÁDY
A SIRUPY**

Quark Magazine

Quark magazine is a science and technology magazine for all the curious. It puts even complex topics in plain language. Every month from 1995 until now, it has been bringing 56 pages of the latest information about science, research, discoveries, and new technology in Slovakia and around the world. It is the only original Slovak periodical focused on the popularization of science and technology. Since 2013, its publisher has been the Slovak Centre of Scientific and Technical Information. Everyone can read Quark monthly either in print or on the website www.quark.sk. The printed version can be bought at newsstands or ordered in the eStore of the CVTI SR, where an electronic version is also available. Quark has provided us with 1200 magazines and other gifts.



Faculty of Science, Charles University



FACULTY OF SCIENCE
Charles University

The Faculty of Science is one of the 17 faculties of Charles University. By providing its premises for the accompanying program to this year's Fyziklani, it has become its silver partner.

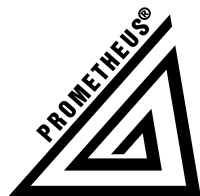
The faculty offers bachelor (B.Sc.), Master (M.Sc.) and Doctoral (Ph.D.) study programmes in the fields of biology, chemistry, geography, geology and environmental protection. Information on individual Bachelor's and Master's programmes can be found on the website <https://prirodovedcem.cz/>. The brand new bachelor programme called simply "Science" combines the study of physics, chemistry and biology and is taught in English.

Our faculty is one of the leading Czech scientific institutions in terms of scientific performance and grant funding. Scientific work is at the core of study at our faculty. Our students are involved in working in scientific teams already during their undergraduate studies. Top-class facilities await you – in addition to the existing buildings, the faculty has new premises in a joint workplace with institutes of the Academy of Sciences of the Czech Republic BIOCEV. In a friendly academic environment, you can discuss the latest findings with Czech and international science personalities.

We have an exceptional incentive scholarship for incoming students who have been successful in Science Olympiads and other competitions. Successful students in the upper years are rewarded with a scholarship for outstanding performance.

Partners

Prometheus



Prometheus, spol. s r. o. publishes textbooks, collections and other literature dealing with physics and mathematics. Their physics tables are known to everyone in the Czech Republic. Most of the books are intended for primary and secondary school students and their teachers, but they also offer titles dealing with history and important people contributing to mathematics and physics. Prometheus has supplied book prizes for the winners.

Czech Association for Effective Altruism

Effective altruism is a worldwide movement that seeks to find out, using a rational approach and scientific methods, where we can do the most good and then put these findings into practice. The focus is global, and they collaborate with groups around the world. The association has donated books for the winners.



Humusoft

Humusoft s.r.o. is a Czech company that since its foundation has divided its efforts equally between the production and sale of instrumentation and software. It is the exclusive representative of the American company MathWorks, Inc. for the Czech Republic and Slovakia. HUMUSOFT s.r.o. also participates in the development of MATLAB® / Simulink® system superstructures. They provided 5 MATLAB® & SIMULINK® Student Suite licenses and other donations for the competition.



MINDOK

MINDOK is a publisher of modern board games for children and adults alike. These games include Carcassonne, Black Stories and a range of SMART games. But also a range of other games, designed for all playful people from the youngest children to the most demanding gamers. We have been operating on the Czech market since 2007 and during that time we have released more than 100 different games.



Casio (FAST ČR)

Quality, design and functionality are key requirements in the development of calculators. In product development, Casio implements the brand mission of "Reliability and Durability" by uncompromisingly addressing all three basic requirements with the application of advanced technologies. The company donated 15 calculators.



Hobžovy Strážnické brambůrky (Hobža's crisps)

"We are not chips, we are crisps, crisps from Moravia!" – family company taking pride in quality and taste, making sure the crisps really taste the way they should. Hobža's brothers gave us 30 boxes of the crisps and they believe they will come in handy during the competition.



VIDA! science centrum



VIDA! is an amusing science park near the Brno trade fair complex and is for literally anyone. Maybe toddlers won't be able to fully appreciate it but otherwise everybody will find something for themselves to enjoy. And you will even learn something on top. Covering the area of over 6 200 m² are 180 interactive exhibits that will allow you to discover how the world around us works. VIDA! science centre donated 30 free tickets and a number of small presents.

Merkur Toys



Merkur Toys is a traditional Czech company that has been producing metal kits under the MERKUR brand for more than 100 years. With the advent of modern technology, it has expanded its traditional kits to include elements of electronics, robotics and mechatronics. The production program is also focused on creating teaching aids and equipment for schools.

Escape Point



"Intelligent entertainment" – an escape game that makes you think. Escape point provides eight unique games with adjustable difficulty, but beware, the clock is ticking. They donated 5 vouchers for a game of one's choice for the best teams.

Doller



To win Fyziklání, to run a marathon, to write a book – whatever is your dream, Doller will be your best friend on that road. It is a motivation diary, with which you can start whenever you want – it's undated. As Doller likes to support interesting events, they decided to support Fyziklání by donating 15 Doller journals.

Brief Rules

- Fyziklani is a three-hour-long team competition taking place in Prague, Czech Republic.
- The competition is held for teams of up to 5 high-school students, who attend two different high schools at most.
- At any instance, every team should have 7 tasks accessible. Solutions of the tasks should be written on the paper that states the problem and delivered to the judges. In the case of a correct solution, the team earns points and gets a new task straight away. In case of an incorrect solution, the team gets the task back to correct their answer.
- Every problem solved on the first try is awarded 5 points, on the second try with 3 points, on the third try with 2 points and with 1 point otherwise.
- The only way to get a new problem is to solve another one correctly; you can't skip problems. In an exceptional case the judge can ask how the team found the solution.
- Solutions are accepted in standard form, i. e., with correct units. Fractions should be simplified. You should use constants like π and round the numbers correctly.
- It is allowed to use any written or printed materials. Electronic gadgets are strictly forbidden (except for calculators).

Full Rules of Fyziklani

Participation in the Competition

- If a team wants to participate, it must register through <https://fyziklani.org>.
- By registering for the competition, each team agrees to follow the Organizational Regulations of Fyziklani and these Competition Rules and confirms they have made themselves acquainted with them.
- A team consists of 1–5 members.
- Members of the team must all be members of a school equivalent to high school (pre-university education) or lower educational stage.
- A team must consist of members belonging to at most two schools.
- Students of a single school can compete at most in four distinct teams. In the case of unfilled places or other similar conditions, the organizers reserve the right to make an exception to this rule.

- The name of a team can't spread political or religious views, can't be rude or insulting, or be in any other way inappropriate. The chief organizer has a right to change the name of such a team, to censor it or to disqualify the team completely.
- By registering in the competition, you agree with publishing the results of your team in the form of basic information (your name, surname, category, school and points) in the results table on the website, handbooks and yearbooks of FYKOS.

Designation into Categories

- Teams compete in three categories, to which they are placed based on the following algorithm.
- Each player has a coefficient based on the expected year of graduation. If a player studies the last year of secondary education, he gets a coefficient of 4. If he studies the penultimate year, he gets a coefficient of 3 and so on. A minimum possible coefficient is 0.
- The coefficient of a team is calculated as the arithmetic mean of the coefficients of individual members (they are added together and divided by the number of members).
- The team is assigned the lowest category whose conditions it satisfies:
 - category A: team coefficient ≤ 4 ,
 - category B: team coefficient ≤ 3 and at most two members have a coefficient 4,
 - category C: team coefficient ≤ 2 , no member has a coefficient 4 and at most two members have a coefficient 3.
- A team can compete in category A even if its coefficient places it into a lower category if they choose to do so during the registration.
- Organizers reserve the right to move a team back to the lower category, or conversely move a team to category A if the need arises. The team will be notified of such a change at least one day before the competition.
- All categories share the same set of problems.
- Each category of the competition has a separate list of results.

Arrival to the Competition

- Teams are required to arrive on time. Organizers reserve the right not to admit late arriving teams to the competition.

- Teams are required to present themselves upon arrival and provide accurate information about their members (years, schools, etc.). Teams are obliged to point out any changes in their composition.
- Each team will obtain an envelope with the first seven problems. The team is forbidden to open this envelope until they are instructed to do so by the leader of the room, inside which they are competing.

The Competition System and Awarding of Points

- The competition lasts 3 hours.
- At the beginning of the competition, each team receives 7 problems, which they try to solve.
- If the team thinks it has arrived at the correct solution of a problem, they send one of the members to one of the examiners, who tells the member whether that solution is correct or incorrect. The designated member must present the paper with the problem with a solution clearly marked on the paper.
- The examiners have the right to request a team to describe the steps used to produce the solution.
- The presenting member selects the correct examiner based on the label on the problem sheet. The proper algorithm for this selection will be explained before the competition starts.
- If the solution is incorrect, the examiner marks this on the problem sheet and the presenting member returns to the team and continues solving this problem.
- If the solution is correct, the examiner marks the problem sheet with the number of points obtained and forwards the presenting member to the distributor, from whom the presenting member receives a new problem sheet.
- The problems are awarded points based on the attempts needed to solve the problem, in the following way: a single attempt – 5 points, two attempts – 3 points, three attempts – 2 points, and four or more attempts – 1 point.
- The aim of the team is to receive as many points as possible.
- During the competition, the up-to-date results of all teams are projected in all rooms. These are hidden 30 minutes before the competition finishes.
- If there is a serious issue discovered with one of the problems during the competition, organizers reserve the right to modify the problem or to remove the problem from the competition completely, excluding any right to compensation to any of the teams.

- During the competition, all the participants are allowed to communicate only with the members of their team or with the organizers. Any interaction with teachers, other teams, etc. is strictly forbidden.
- Teams are permitted to use any literature in printed, paper form. It is forbidden to use the Internet during the competition. Furthermore, teams are permitted to use calculators and writing or drafting supplies. The calculator mustn't allow access to the Internet or any other form of communication (devices like mobile phones, tablets, laptops, smart watches and similar are hence strictly prohibited to be used as calculators).
- All supplies that the competitors use or have in their surroundings during the competition, can be requested to be disclosed to the organizers for a control.

Conclusion of the Competition and Announcement of Winners

- The end of the competition is announced by the lead organizer of the room, in which the team competes.
- After the announcement of the end of the competition, no team is allowed to send a member to the examiners. If a presenting member was standing in a queue to an examiner when the end was announced, the member is allowed to stay there and their solution will be examined, but they are forbidden to use any writing supplies.
- If the winning team, or any other awarded positions, can't be determined purely by the number of points obtained, the order will be decided on several criteria in the following order: higher average points awarded per submitted problem, higher number of problems awarded 5 points, higher number of problems awarded 3 points, lower team coefficient, earlier date and time of team registration and random draw.

Breach of Rules

- In the case of a substantial suspicion of a breach of the Competition Rules or the Rules of Conduct, the chief organizer has a right to perform extraordinary measures to confirm or rebut the suspicion and to prevent the continuation of disallowed conduct.
- In the case when a team breaches some of the Competition Rules or the Rules of Conduct, the consequences to that team will be decided by the chief organizer or by a committee designated for this task by the chief organizer.

- In the case of a breach of rules of a lesser magnitude, the chief organizer or a committee designated for this task by the chief organizer can decide on removal of a certain number of points of a team based on the severity of the breach.
- Organizers are allowed to disqualify a team, which commits a severe breach of rules.
- In the case of an extremely severe breach of the Competition Rules or the Rules of Conduct, the Central Committee of the competition may decide on a ban on participation in the competition in the subsequent years or another punishment, to the members of the team and/or to any of the schools they come from.
- Extremely severe breaches of rules involve especially any intentional attempt to obtain the problems or their solutions before the competition, their publication or disclosure to other participants of the competition. Any intentional attempts to impede the smooth running of the competition to the other participants or to the organizers, or an attack on the competition server, are also understood as extremely severe breaches of rules.

Final Remarks

- Organizers reserve the right to make minor changes in the rules before the start of the competition.
- Resolution of any potential conflicts or issues, not covered by these rules, is decided by the chief organizer or an organizer designated by him.
- A team has a right to appeal against a decision of the chief organizer, but no later than 14 days since the decision has been made. The appeal will be processed by the Central Committee of the competition, which will decide the case no later than 40 days after the appeal has been made.
- These rules have been ratified by the Central Committee of the competition Fyziklani on September 23, 2022.
- These rules replace the previous version and come into effect on September 23, 2022.

You can find full Organizational Regulations of Fyziklani at:
<https://fyziklani.org/rules/organizational-regulations>.

List of Constants

Fundamental physics constants

speed of light in vacuum	c	$2.998 \cdot 10^8 \text{ m}\cdot\text{s}^{-1}$
permittivity of free space	ε_0	$8.854 \cdot 10^{-12} \text{ F}\cdot\text{m}^{-1}$
permeability of free space	μ_0	$1.257 \cdot 10^{-6} \text{ H}\cdot\text{m}^{-1}$
gravitational constant	G	$6.674 \cdot 10^{-11} \text{ m}^3\cdot\text{kg}^{-1}\cdot\text{s}^{-2}$
Planck constant	h	$6.626 \cdot 10^{-34} \text{ J}\cdot\text{s}$
reduced Planck constant	\hbar	$1.055 \cdot 10^{-34} \text{ J}\cdot\text{s}$
elementary charge	e	$1.602 \cdot 10^{-19} \text{ C}$
electron mass	m_e	$9.109 \cdot 10^{-31} \text{ kg}$
proton mass	m_p	$1.673 \cdot 10^{-27} \text{ kg}$
atomic mass unit	u	$1.661 \cdot 10^{-27} \text{ kg}$
Avogadro constant	N_A	$6.022 \cdot 10^{23} \text{ mol}^{-1}$
Boltzmann constant	k_B	$1.381 \cdot 10^{-23} \text{ J}\cdot\text{K}^{-1}$
molar gas constant	R	$8.314 \text{ J}\cdot\text{mol}^{-1}\cdot\text{K}^{-1}$
Stefan-Boltzmann constant	σ	$5.670 \cdot 10^{-8} \text{ W}\cdot\text{m}^{-2}\cdot\text{K}^{-4}$

Astronomical constants

mass of Earth	M_\oplus	$5.974 \cdot 10^{24} \text{ kg}$
mass of Sun	M_\odot	$1.989 \cdot 10^{30} \text{ kg}$
equatorial radius of Earth	R_\oplus	$6.378 \cdot 10^6 \text{ m}$
equatorial radius of Sun	R_\odot	$6.957 \cdot 10^8 \text{ m}$
nominal solar luminosity	L_\odot	$3.828 \cdot 10^{26} \text{ W}$
solar constant	K	$1361 \text{ W}\cdot\text{m}^{-2}$
astronomical unit	au	$149.6 \cdot 10^9 \text{ m}$

Other useful constants

gravity of Earth	g	$9.81 \text{ m}\cdot\text{s}^{-2}$
normal pressure	p_a	101.325 kPa
normal temperature	t	20°C
air density ¹	ρ	$1.20 \text{ kg}\cdot\text{m}^{-3}$
speed of sound in air ¹	c_s	$343 \text{ m}\cdot\text{s}^{-1}$
Zero-point of Celsius scale	0°C	273.15 K

Properties of water¹

specific latent heat of vaporization	l_v	$2.26 \cdot 10^6 \text{ J}\cdot\text{kg}^{-1}$
specific latent heat of fusion	l_t	$3.34 \cdot 10^5 \text{ J}\cdot\text{kg}^{-1}$
heat capacity	c	$4184 \text{ J}\cdot\text{kg}^{-1}\cdot\text{K}^{-1}$
molar mass	$M_{\text{H}_2\text{O}}$	$18.02 \text{ g}\cdot\text{mol}^{-1}$
index of refraction	n	1.333
density	ρ	$998 \text{ kg}\cdot\text{m}^{-3}$
dynamic viscosity	μ	$1.005 \cdot 10^{-3} \text{ Pa}\cdot\text{s}$
surface tension	σ	$7.27 \cdot 10^{-2} \text{ N}\cdot\text{m}^{-1}$

¹Under normal conditions.

Organizers



FYKOS



matfyz

General partner



ESPR

Platinum partners



NADACE ČEZ



Neuron

Silver partners



KARÁSKOVY
LIMONÁDY
A SIRUPY



Magazin o vědě a technice



FACULTY OF SCIENCE
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