

**February 11th 2022
PVA EXPO, Prague**

Guidebook



fykos.org

fyziklani.org

/fykos

@fykosak

Dear participants of Fyziklani 2022!

I am really pleased we can meet again in person at the Fyziklani competition after a year's pause!

Even for us FYKOS organizers, the last two years were more difficult than we hoped. Lots of our activities had to be canceled or changed to an online form, including Fyziklani 2021. Although we missed the opportunity to meet and experience the competition together under one roof, your interest in Fyziklani did not drop – we have had more than 1900 participants. It served as a huge encouragement and a great motivation for us to embark on new years of the competition.

Thanks to the consistent safety measures, we are able to organize the Fyziklani 2022 in person, despite the ongoing pandemics. It was not an easy task, but seeing more and more applied teams keep assuring us that our effort is worth it.

This year's competition has been moved to the PVA EXPO Letňany. The enlargement of the room serves not only as a safety measure but also as a promise of higher capacity in the years to come to fulfill one of the main objectives of Fyziklani – to connect everyone who enjoys physics and competing.

It is also possible thanks to our new general partner, the Neuron Endowment Fund, and prof. Lenka Zdeborová. In addition to them, other new and traditional partners provided their support, for which we are very grateful. Indeed do check them out in this guide (where you might find some interesting bonuses as well).

I believe that we will enjoy this 16th Fyziklani together – and I hope we will continue meeting in person in the years to come :)

I wish you good luck and a lot of unforgettable experiences from the whole Fyziklani!



A handwritten signature in black ink, appearing to read "D. Dukala".

Daniel Dukala
Head organizer of Fyziklani

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Game Schedule

| | | |
|----------------------|--|--|
| 09:00 – 09:45 | Team arrival | Presence of teams before the competition. Please arrive in 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 | Special program Fyziklani International | Screening of short videos about the teams and countries they come from, shot by the participants themselves. |
| 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. |

Useful Contacts

| Name | Role | Phone number |
|----------------------|---|------------------|
| Kateřina Charvátová | Communication with the teams (accommodation, registration) | +420 775 152 896 |
| Veronika Hendrychová | Head of team registration | +420 732 383 025 |
| Daniel Dupkala | Head organizer of Fyziklani | +421 915 506 689 |
| Lubor Čech | Deputy head organizer of Fyziklani | +420 774 948 645 |
| Martin Vaněk | Head organizer of FYKOS | +420 739 584 436 |

For problems concerning accommodation or registration (delays, problems with travel) contact Kateřina Charvátová.

In case of other major problems, call other contacts listed in the table.

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

Patronage

Besides the main organizers and the sponsors, some important public figures and the capital city Prague significantly contributed and offered their patronage to the competition. We would like to thank them here.

Capital city Prague (Prague) is a historical city in the heart of Europe. It is the capital city of the Czech Republic, formerly Czechoslovakia, and it was the residential city of kings Rudolf II and Charles IV. Prague is the main tourist destination in the Czech Republic and home to one of the most famous ZOOs in the world. Thanks to the patronage of Prague, you will be able to enjoy a banquet in the mayor's residence.

The patronage was taken over by the mayor of Prague **MUDr. Zdeněk Hřib** who studied general medicine at the Third Faculty of Medicine at Charles University. During his studies, he completed an internship in Taiwan. He is the director of a public service company Institution for applied research, education and management in health care. He is the author of many articles in the professional and lay press. Furthermore, he is also active on the political scene as a member of the Czech Pirate Party.

The patronage of the competition has also been accepted by **prof. Lenka Zdeborová**, a successful scientist studying statistical physics and its interdisciplinary use. One of the focuses of her work is, for example, the study of the influence of phase transitions in computational problems on their time complexity. She has received many prominent scientific awards for her work. Last but not least, she won the Neuron 2021 Prize for promising young scientists in physics. Prof. Zdeborová decided to donate her prize money to developing talented students through the Neuron Foundation. In this way, she supported our seminar, which she had participated in and also organized in the past. We would like to thank prof. Zdeborová very much for supporting the competition through her patronage and also for her generous financial support, thanks to which Fyziklani can continue to grow.

The member of Chamber of Deputies of the Czech Republic **Mgr. et Mgr. Jakub Michálek** is the next patron. He graduated from Johannes Kepler Grammar School and studied at the Faculty of Mathematics and Physics and the Faculty of Law at Charles University. Therefore, he has experience and knowledge of both law and theoretical physics. He is interested in Czech opera and constitutional law. During his studies in physics, he was an organizer of FYKOS. He is also a member of the Czech Pirate Party and Chairman of its parliamentary group.



Zdeněk Hřib



Jakub Michálek



Lenka Zdeborová

Weekend Program after Fyziklani

Payments for Weekend Program after Fyziklani (not accommodation) are collected at the teams' presence on the day of the competition. Payments are possible only in cash in CZK.

Friday 11. 2.

19:00 – 20:30 **Analysis**

Analysis of competition's most interesting problems.

Lecture halls M1 (Ke Karlovu 3) and F1 (Ke Karlovu 5).

Saturday 12. 2.

08:30 – 09:30 **Transfer from the hotel**

Transfer to Campus Karlov.

09:30 – 10:30 **Lectures 1st set**

Particle Physics in Various Contexts, Physics of Computation.

10:45 – 11:45 **Lectures 2nd set**

Music of Spheres, Physics Chemistry.

12:00 – 14:00 **Lunch break**

Transfer to Palladium shopping mall at Náměstí Republiky.

14:00 – 16:30 **Old Town sightseeing**

The most significant sights of the old town.

National Technical Museum

Alternative program to sightseeing (entrance fee 50 CZK).

National Museum of Agriculture

Alternative program to sightseeing (free entry).

18:00 – 20:00 **Štefánik's Observatory**

Excursion and lecture in the planetarium,
eventual night-sky observation (entrance fee 70 CZK).

Prague's Planetarium

Excursion and a lecture at planetarium (entrance fee 90 CZK).

20:00 – 21:00 **Return to Hotel Duo**

Leisure time (no program).

Sunday 13. 2.

08:00 – 08:45 **Transfer from the hotel**

Transfer to the Campus of FMP CUNI in Troja.

09:00 – 11:30 **Excursions at FM CUNI**

Excursions in Troja Campus.

11:30 – 12:00 **The ending of Weekend after Fyziklani.**

The program on Saturday begins at 9:30 in the buildings of the Faculty of Mathematics and Physics of Charles University – Campus Karlov (Ke Karlovu 3, 5). On Sunday, the program starts early at 8:45 in Troja Campus (V Holešovičkách 2). On both days, there is planned an organized departure from Hotel Duo, on Saturday, departure from hotel is at 8:30. On Sunday, departure from the hotel is scheduled to 8:00. In case you plan to transfer on your own, please, be on time at the particular location. Please, also note that all **entrance fees must be paid in cash in CZK at team presence on Friday (February 11th, 2022)**, before the competition.

Lectures

Particle Physics in Various Contexts (CS only)

doc. Jiří Dolejší – lecture hall F1

The lecture shortly introduces the Standard Model of particle physics, i.e., what we already know about particles compared to what we are yet to find. Moreover, we will look into the plans for the future, whether it is worth further research in the field, what the connections are to the other fields of physics if it could be considered useful for the general public, and so on.

Physics of Computation (EN)

prof. Lenka Zdeborová – lecture hall M1

Algorithms are an indispensable tool behind many modern technologies. Many widely used algorithms, e.g. those used in machine learning when training artificial neural networks, are surrounded by mysteries and open questions. Our understanding of which practical problems are solvable with computers is still in its infancy. Physics gives us tools to unveil some of those mysteries and discover better algorithms. Phase transitions such as water freezing or evaporating play a key role in this adventure. If you want to know how physics is used in the domain of computer science and machine learning, come to listen.

Hudba sfér (CS only)

prof. Ondřej Santolík – lecture hall F1

There is no music without sound; however, not every sound sounds like music. We will listen to the sounds produced by electromagnetic waves at hearable frequencies recorded in the ionosphere by the first Czechoslovak probe Magnet 1 and its modern successors. We will go hunting for similar sounds into the magnetosphere and further into the heliosphere - into the solar wind and the solar system's planets. We will also learn in a nutshell how this "music of the spheres" is created, what mysteries are connected with it, and what new robotic probes we are preparing to reveal its hidden secrets.

Physics Chemistry (EN)

MScR B. Viliam Hakala – lecture hall M1

More than hundred years ago, basics of structural analysis were laid when x-rays were discovered. During 20th century, several Nobel Prizes were awarded for solutions of crystal structures of important compounds. These days, there is an increasing need for new magnetic, electronic, or electrochemical materials that can solve problems in modern science and technology. It was found that even the most basic materials can have interesting physical properties under extreme conditions, such as low temperatures or high pressures. In this talk we will have a look on how different materials behave under these conditions, describe experimental methods used to achieve them and discuss how the conditions influence the structures and properties of the materials.

Saturday Afternoon and Evening

Old Town sightseeing

Saturday 14:00 – 16:30

We will visit several historical places as well as places connected with physics. We'll meet at Náměstí Republiky in front of Palladium shopping centre.

National Technical Museum

Alternative program to sightseeing.

The museum, opened in 1908, shows the development of many technical fields and industry in the Czech Republic. There are 15 permanent expositions covering all sorts of technology like transportation or television studio.

National Museum of Agriculture

Alternative program to sightseeing.

We will visit the museum, which has been collecting evidence of agriculture as one of the most important human activities for more than a hundred years.

Prague's Planetarium

Saturday 18:00 – 20:00

We will take part in the evening screening of the Night Sky program.

Štefánik's Observatory (CS only)

Alternative program to planetarium visit.

We will watch the educational program and the exhibition, in case of favorable conditions we will observe the night sky.

Sunday Morning

FMP CUNI – The Faculty of Mathematics and Physics

We will visit selected laboratories of FMP CUNI.

Sunday 9:00 – 11:30

- **Training Reactor VR-1** (Vrabec) – we will look at a lightwater, zero power research reactor with enriched uranium. This unique teaching aid enables students to work with a real nuclear reactor.
- **Plasma Physics Group** (Plasma) – we will visit laboratories in which plasma is used to understand events in the interstellar gas clouds, to treat surfaces, or to create nanoparticles.
- **Astrophysics Group** (Kosm. fyz.) – within this block, we will get introduced to satellites whose twins were in space, and with lots of other exciting details regarding astrophysics.
- **Surface Physics Group** (Povrhy) – during the excursion we will get acquainted with the principles and tricks which enable us to figure the arrangement, chemical composition, and chemical properties of surfaces at an atomic level, and to learn how to configure them to perform best in practical applications.
- **Geophysics Department** (Geofyzika) – the block will be devoted to several geophysical phenomena from earthquakes to electromagnetism.
- **Silicon Detectors Group** (Detektory) – we will visit a workplace with a primary focus on experimental and particle physics regarding tests and simulations of silicon detectors.
- **Laboratory of Radiofrequency Spectroscopy** (Rf. spektroskopie) – we will dig into the world of a specific research method called radiofrequency spectroscopy which finds its applications e.g. in a study of an atomic, electron, and magnetic structure of various substances and materials.
- **Mössbauer Spectrometry Group** (M. spektroskopie) – we'll get acquainted with methods of Mössbauer spectroscopy which found their applications in a variety of research fields, especially in physics, chemistry, geology, biology and medicine.

Venues and Maps

PVA EXPO PRAHA

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

The history of PVA EXPO PRAGUE dates back to 1993, when the premises' administration presented the first projects in the field of architecture and building industry. Since then, we have built a modern exhibition center in Letňany, Prague, originally named the Prague Trade Fair Complex (PVA). Today's multi-functional complex hosts key exhibitions and fairs from a wide range of fields and offers facilities for corporate, sporting and cultural events.

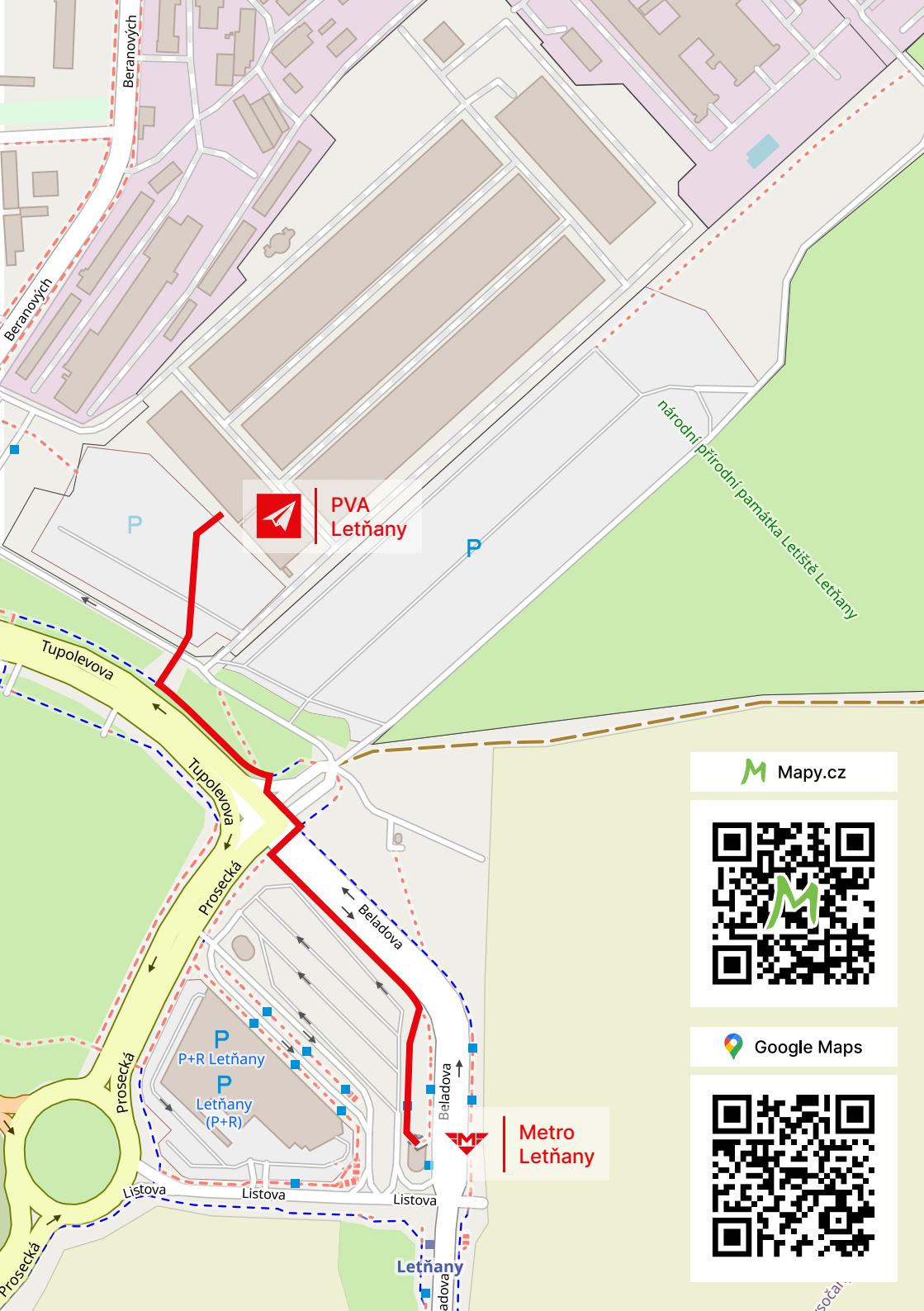
Transportation

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.

To get to **Náměstí Republiky** from Karlov Campus, we recommend using metro from I. P. Pavlova station with transfer from line C (red) to B (yellow) on Florenc station. Then, Náměstí Republiky is the very next station in Zličín direction. Another possibility is to use tram 6 (in the Palmovka direction) from I. P. Pavlova, which will get you to Náměstí Republiky as well.

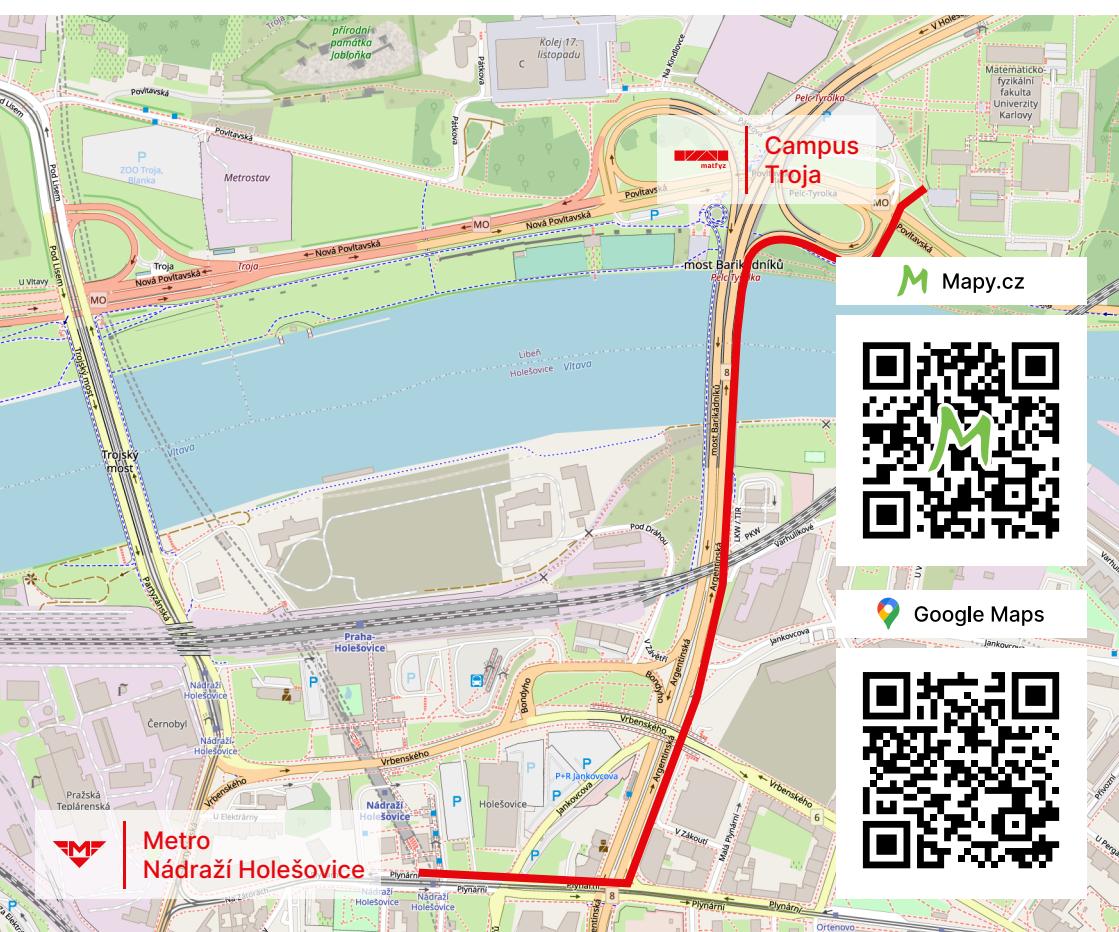
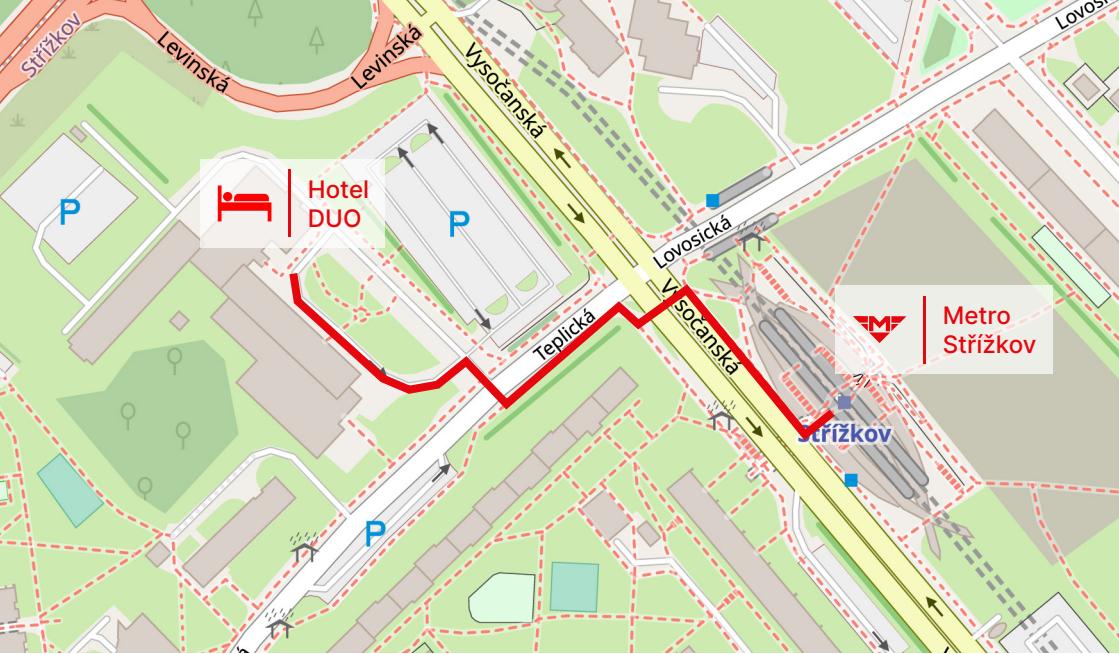


Mapy.cz



Google Maps





Google Maps





Recommended Apps

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

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

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

 M Mapy.cz app



 PID Lítačka app



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 **Teplická 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**.

Program for Teachers During the Competition

There will be roughly an hour-long lecture in a small lounge for the accompanying teachers, starting at 10:30.

Can you see atoms under an electron microscope?

Mgr. Lucia Bajtošová

An electron microscope is a fascinating tool that opened gates into the world of visualization of objects on micro- and nano- scales. Most people have probably heard of it, yet do you really know how it works and what it can show you? Is it just an improved version of the optical microscopes? We will explain the basic principles of electron microscopes, what we see and why do we see, what we see, and explore the newest successes and current obstacles of this experimental method.

Organizers

Daniel Dupkala (Head organizer of Fyziklani)

Studies 3rd year of MSc. Teacher Education of Physics and Mathematics at FMP CUNI. Daniel also works as a teacher of Physics and Mathematics at SPŠST Panská.

Lubor Čech (Deputy head organizer of Fyziklani)

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

Martin Vaněk (Head organizer of FYKOS, partners of Fyziklani)

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

Daniela Pittnerová (Deputy head organizer of FYKOS, consultant of Fyziklani)

Studies 2nd year of MSc. Surface and Plasma Physics at FMP CUNI.

Jaroslav Herman (Physics problems administrator and chief editor)

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

Michal Červeňák (IT Fyziklani)

Works at the Academy of Sciences of the Czech Republic.

Štěpán Stenclík (IT Fyziklani, propagation)

Studies 2nd year of MSc. Software and data engineering at FMP CUNI.

Veronika Hendrychová (IT Fyziklani)

Studies 2nd year of BSc. Mathematical informatics at FNSPI CTU.

Patrik Kašpárek (Leader of the accompanying program)

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

Karel Kolář (Erasmus+ program)

Works as editor at Prometheus publishing house.

Marcel Vasilák (PR and propagation)

Studies 2nd year of BSc. Energetics at Žilina University in Slovakia.

Tomáš Červeňák (Graphics)

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

Kateřina Charvátová (Communication with teams, applications administration, Erasmus+ program)

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

Radka Křížová (Communication with teams, Erasmus+ program)
Studies 2nd year of BSc. Physics at FMP CUNI.

Anežka Bakociová (Communication with teams, Erasmus+ program)
Studies 1st year of BSc. Physics at FMP CUNI.

Ema Wayan Danielová (Communication with teams, applications administration)
Studies 1st year of BSc. Physics at FMP CUNI.

Daniel Broško (Translations, web content)
Studies 1st year of MSc. Economics and finances at IES CUNI.

Eva Vochozková (Web content)
Studies 1st year BSc. Computer Science at FIT CTU.

Josef Trojan (Propagation, accompanying program)
Studies 1st year of BSc. Experimental Nuclear and Particle Physics at FNSPE CTU.

Marek Milička (Propagation, accompanying program)
Studies 1st year of BSc. Physics at FMP CUNI.

Robert Jurenka (Partners of Fyziklani)
Studies 2nd year of BSc. Physics at FMP CUNI.

Viktor Materna (Finances)
Studies 2nd year of BSc. Informatics at FMP CUNI.

Viačeslavas Šinkonis (Erasmus+ program)
Studies 1st year of BSc. Physics at FMP CUNI.

Jakub Dřevo (Erasmus+ program)
Studies 1st year of BSc. Physics at FMP CUNI.

Jitka Vysloužilová (Erasmus+ program)
Studies 1st year of BSc. Biophysics at FS USB.

Vojtěch David (Physics problems editor, problems administration, printing)
Studies 1st year of BSc. Mathematics at FMP CUNI.

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

Filip Ayazi, Anežka Bakočová, Jáchym Bártík, Daniel Broško, Tomáš Červeň, Ema Wayan Danielová, Vojtěch David, Jakub Dřevo, Daniel Fousek, Robert Gemrot, Veronika Hendrychová, Jaroslav Herman, Jindřich Jelínek, Robert Jurenka, Patrik Kašpárek, Karel Kolář, Adéla Kolembusová, Radka Křížová, Tereza Labudová, Jozef Lipták, Marek Milička, Štěpán Marek, Adam Mendl, Matěj Mezera, Jan Novotný, Kateřina Orságová, Šimon Pajger, Daniela Pittnerová, Josef Trojan, Tomáš Tuleja, Martin Vaněk

FYKOS.org

Organizers of the competition work under FYKOS (Internet Physics Competition), which is open to all high school students with interest in physics. We send eight new problems to contestants six times a year. They have about a month to solve these problems and submit their solutions, which we mark and send back with comments. Everyone can participate, so do not hesitate!

Best of the contestants can attend week-long camps in spring and fall. These camps are focused on physics lectures, but also include plenty of games and leisure activities. Along with Fyziklani, FYKOS organizes an online version of this competition – Fyziklani Online, which is held every year in late November, Day with Experimental Physics and Week with Applied Physics.

FYKOS

Faculty of Mathematics and Physics, Charles University

FYKOS and Fyziklani 2022 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.



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 2022. 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

The Neuron Endowment Fund

The general partner of the 16th 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 12 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 99 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.

The Neuron Endowment Fund has become the general partner of Fyziklani also 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 decided to dedicate her entire personal financial bonus to the needs of FYKOS (Physics Correspondence Seminar), which she once organized herself.



Gold Partner

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. Kalabria company supported Fyziklani by gifting 1200 bottles of Karáskova limonáda, which were given to participants to stay hydrated.



Silver Partners

Humusoft

Humusoft s.r.o. is an exclusive representative of MathWorks® company in the Czech and the Slovak Republic. They supplied 5 MATLAB suite licenses and other gifts.



Prometheus

Publishing house Prometheus, spol. s r. o. publishes many textbooks, collections, and other literature on physics and mathematics. Everyone in the Czech Republic is familiar with their Tables of math, physics and chemistry engineering handbook. Although most of the books are intended for secondary and primary schools and their teachers, they also offer titles devoted to the history and important personalities of mathematics and physics. The publishing house provided book prizes for the winners.



Partners

ConQuest Entertainment

ConQuest Entertainment was founded in 1990 as a purely Czech private company and is one of the leading distributors of entertainment products, such as video games, game consoles and accessories, kits, racetracks and more. ConQuest Entertainment supplied 6 Boffin electronic building kits for the winners, among other things.



Spolek pro Efektivní Altruismus

Effective altruism is a worldwide movement that seeks to find out where we can help the most using a rational approach and scientific methods. The focus is global, and we collaborate with groups around the globe to improve not only the Czech Republic or Europe but the whole world.



Doller

We are DOLLER and we help people's dreams come true. It began with an undated motivational Diary, which caused a huge boom. Customers truly fell in love with our original Czech-made Diary.

D O L L E R

Nowadays, it comes with other planning tools, which will please you by their functionality, simplicity and design, such as Journal, Notes, Calendar, and some minor things. However, planning is not everything. Therefore, we contacted top experts to organize personal and enterprise webinars together. We offer support in personal development, planning, and creativity. Regular recommendations in magazines such as Forbes and over 100 000 satisfied customers confirm that our work has a meaning. They all promote our motto Live your dreams!

Escape Point

"Intelligent entertainment" – an escape game that makes you think. Escape point provides 6 unique games with adjustable difficulty. Best teams will receive a voucher for a game of their choice.



Garko

The best teams will win medals from this company, which gave us a 20% discount. Garko is a Czech manufacturer of sports cups, awards and trophies. It also supports sports activities for seniors and youth.



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. Hobza's brothers gave us 20 boxes of crisps, and we believe that you will enjoy them just like us.



IAPS – The International Association of Physics Students

FYKOS organizers are members of the National Committee of the international organization IAPS (International Association of Physics Students), which interconnects physics students around the globe. They are united in 22 National Committees and 22 Local Committees, in addition to which IAPS has 150 individual members in other countries as well. The main venues held by this organization are the PLANCKS competition for college students and the international students' conference ICPS, which is organized by Mexico's committee this year. IAPS helps to organize science popularization events, such as FYKOS' Day with experimental physics (known as DSEF in Czech), which is usually part of the IAPS School Day event. IAPS also supported this year's Fyziklání financially within the IAPS Outreach Grant.



Lindt

Lindt is one of the world's leading chocolate manufacturers. This Swiss chocolatier, which has an origin going back to the year 1845, provided the competition with products from its confectionery assortment.



Vida!

Amusing science park stretching over 6000 m² at the Brno Exhibition Centre. All exhibits are interactive, and they will (almost) literally absorb you. Vida! donated 15 free tickets for you and your teacher.



Brief Rules

- Fyziklani is a three-hour-long team competition taking place in Prague, Czech Republic.
- The competition is held for 3 hours between 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.
- 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

- The competition is run with three categories, to which teams are assigned 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 a day before the competition begins.
- 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 to not allow late teams into the competition.

- Teams are required to register after their arrival and specify the details of the members of the team (years, schools, etc.). Teams are obliged to clarify 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 in 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 Organizational Regulations of Fyziklani, 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 Organizational Regulations of Fyziklani, 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 that commits a severe breach of rules.
- In the case of an extremely severe breach of the Competition Rules or the Organizational Regulations of Fyziklani, 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 them.
- 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 15. 1. 2021.
- These rules replace the previous version, come into effect on 15. 1. 2021.

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 | $20 \text{ }^{\circ}\text{C}$ |
| 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 | $0 \text{ }^{\circ}\text{C}$ | 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 | $4\,184 \text{ J}\cdot\text{kg}^{-1}\cdot\text{K}^{-1}$ |
| 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.

