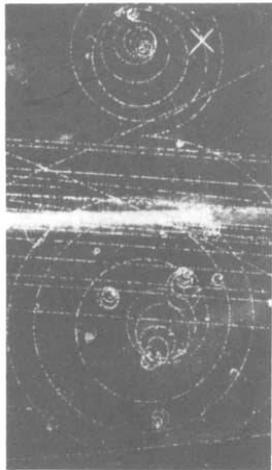


$$\partial_\mu F^{\mu\nu} = j^\nu$$

$$\varepsilon^{\alpha\beta\mu\nu} \partial_\alpha F_{\mu\nu} = 0$$

$$R_{\mu\nu} - \frac{1}{2} g_{\mu\nu} R = \frac{8\pi G}{c^4} T_{\mu\nu}$$

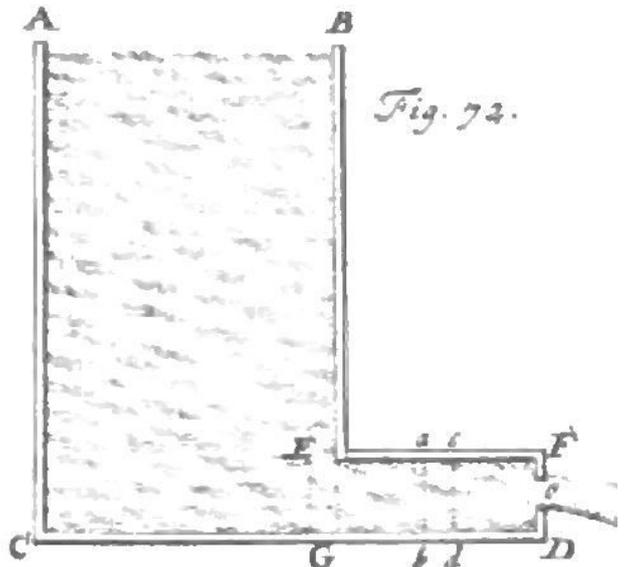
Digital АУРТ



2020

$$\hbar \partial_\mu \psi = mc \psi$$

$$\left(\frac{\partial}{\partial t} + \mathbf{u} \cdot \nabla \right) \mathbf{u} = \frac{1}{\rho} \nabla \sigma + \mathbf{g}$$



Dear participants of the 23rd AYPT!

It is a pleasure for me to once again be part in the organization of the 23st anniversary of the AYPT and I want to welcome all of you who made it here this year. Every year many teams from Austria and from abroad meet together, to compete. However, preparation has already started several months ago, and I am sure it was a long road for every one of you to be here. But now the time has come to show your work and we are all excited to see you present your ideas. So, go ahead, enjoy the competition and never stop working on your dreams!



Dr. Gerhard Haas

Head of the Local Organizing Committee

Especially in the technological and industrial sectors we urgently need well-trained people in the fields of mathematics, computer science, natural sciences and technology. We have to start early enough to interest our young people in such subjects, introduce them and ideally inspire them.



Dr. Friedrich Santner

CEO Anton Paar GmbH

With digitization and technological change, science and technology are becoming essential fields of knowledge in our society. As a high-tech company, it is important to us to encourage enthusiasm for MINT subjects at an early stage. The Physics World Cup is a good example of talent and interest promotion of young talents at the highest level. By investing in the training of qualified young people, we contribute to strengthen Austria as a research and innovation location in Europe.

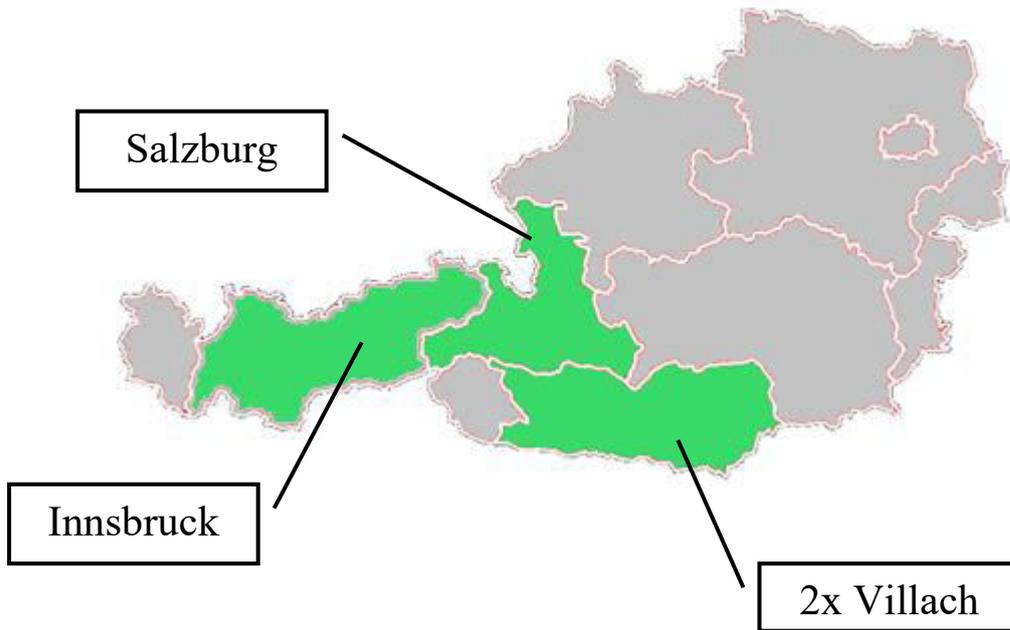


Dr. Sabine Herlitschka

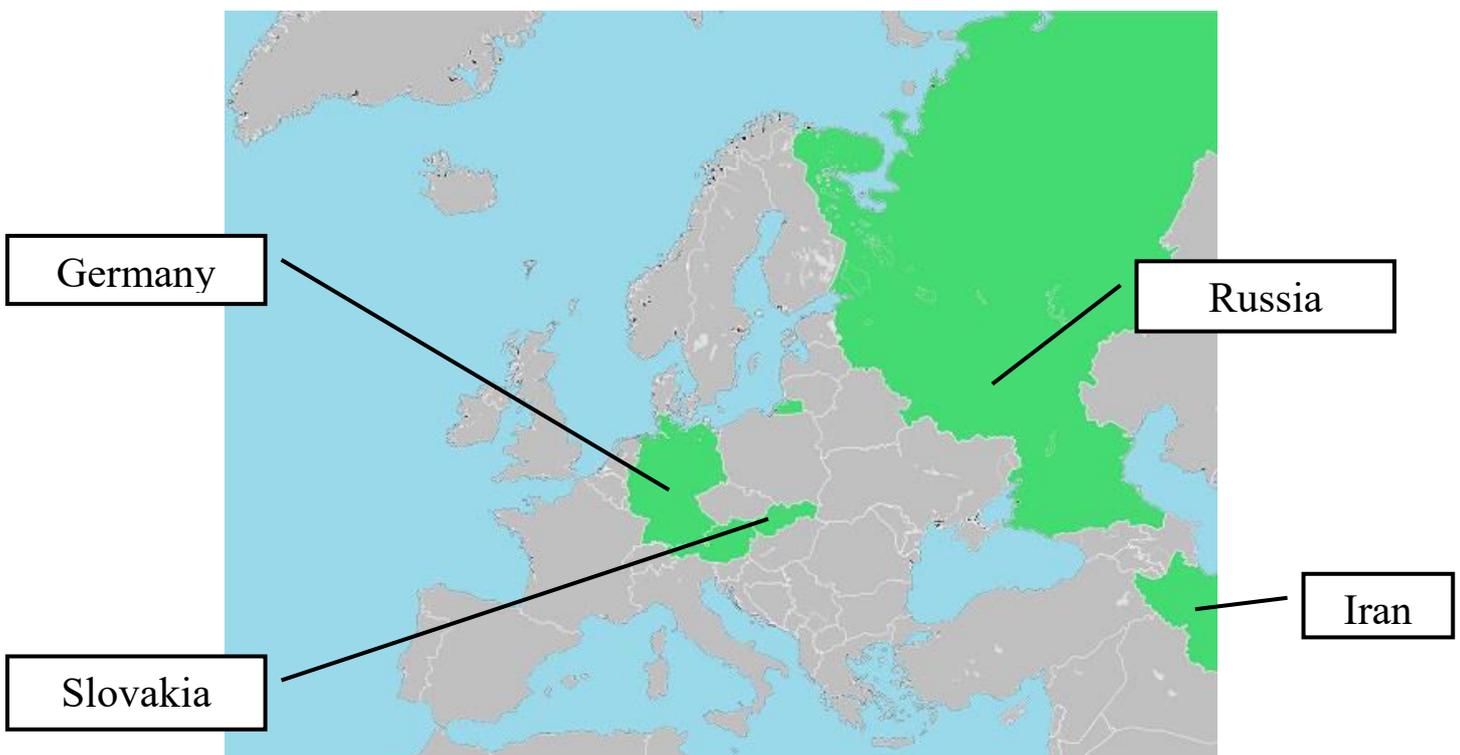
Chairman of the Board at Infineon Technologies Austria AG

Teams participating in the 23rd AYPT 2020

Austrian Teams



Foreign Teams



Official Online-Rooms for the digital AYPT 2020

The AYPT will be held this year in online meeting-rooms using the platform [Zoom-Web-Conference](#). We will provide a **meeting room for every** fight. Further, a meeting room called the **Aula** will be opened continuously during the tournament for events like the opening and award ceremony, the Jury briefing and the finals, but also to raise questions or simply talk with each other in the breaks or in the evenings. We therefore try to occupy the Aula with a member of the AYPT organization throughout the tournament.

The links to the rooms will be shared on the [website](#) of the digital AYPT. (username and password were sent to the participants via email)

Official Schedule for the AYPT 2020

Thursday, April 16th 2020

18:00-18:45 : Opening Ceremony in the **Aula**

18:45-19:30 : Jury Briefing also in the **Aula**

Friday, April 17st 2020

09:00-11:30 : 1st Fight in the corresponding fight-room

11:30-14:30 : Break

14:30-17:00 : 2nd Fight in the corresponding fight-room

18:30-open End : Online ‘BBQ-Party‘ (to keep the traditions) in the **Aula**

Saturday, April 18th 2020

09:00-11:30 : 3rd Fight in the corresponding fight-room

11:30-14:30 : Break

14:30-17:00 : Finals in the **Aula**

17:00-17:05 : Short break

17:05-17:30 : Award Ceremony in the **Aula**

Policy throughout the digital Austrian Young Physicists Tournament

This policy should clarify under which circumstances audio and video recordings are authorized during the course of the digital Austrian Young Physicists tournament (short AYPT). This policy is also to be followed by jurors and chairs as well as team leaders.

The general public (including participants, visitors, supervisors and members of the Jury, etc.) is not permitted to make video or audio recordings during the stages of the tournament. Only officials and members of the organization committee have the permission to make recordings.

Personal recordings may be taken at the tournament (excluding the stages) as long as (i) they are only used for personal non-commercial purpose; (ii) they are not in conflict with European and Austrian law (see §78 Urheberrechtsgesetz/Austrian copyright law).

Notwithstanding the foregoing, the AYPT organization committee reserves the right to prohibit any recording during the tournament for any reason.

The Regulations of the Austrian Young Physicists' Tournament

I. Austrian Young Physicists' Tournament

The Austrian Young Physicists' Tournament (AYPT) is a competition among teams of secondary school students in their ability to solve complicated scientific problems, to present solutions to these problems in a convincing form and to defend them in scientific discussions, called Physics Fights (PF). It is carried out by the association "AYPT – Forschungsforum junger Physiker" according to the articles of association, appendix A. The Organizing Committee for the AYPT is selected by the Executive Committee of the association.

II. The problems of the AYPT

The problems of the AYPT will be the same as for the IYPT (International Young Physicists' Tournament), in accordance with Article II of the Regulations of the International Young Physicists' Tournament

III. The participants of the AYPT

1. The Austrian teams

Any team composed of students enrolled in Austrian secondary schools is eligible for participation.

2. Foreign teams

The Organizing Committee may invite any number of foreign teams. Those teams compete in the same way as the others but they are not taken into account when compiling the Austrian National Team (see Section XIV).

3. The membership of the teams

The AYPT team is composed of three secondary school students. The secondary school graduates could participate in the AYPT in the year of their graduation. The participation of university students is not allowed. The composition of the team cannot be changed during the Tournament. The team is headed by a captain who is the official representative of the team during the PF.

4. Team Leader

The team is accompanied by a team leader.

IV. The Jury

The Jury is nominated and organized by the Organizing Committee. The Jury consists of at least three members. Team leaders may be included in the Jury. The team leaders cannot be members of the Jury in the PF where their teams participate and should not, if possible, grade the same team more than twice.

V. The agenda of the AYPT

The AYPT is carried out in a period determined by the Organizing Committee. All teams participate in the Selective PFs. Selective PFs are carried out according to a special schedule determined by the Organizing Committee according to the number of participating teams, following the rule that, if possible, no team meets another team more than twice. This schedule should be known before numbers are ascribed to the teams by lot. The best teams participate in the Final PF.

VI. The Physics Fight regulations

Two or three teams participate in a PF this year, depending on the total number of teams. In the course of a PF the members of a team communicate only with each other.

The chair of the Jury will be in the meeting room 15 minutes before the PF.

Before the beginning of a PF, the Jury and the teams are introduced.

A PF is carried out in two (or three) stages. In each Stage, a team plays one of the three roles: **Reporter**, **Opponent** or **Observer**. There will be **no Reviewer** this time. In the subsequent Stages of the PF, the teams change their roles according to the schemes:

Stage \ Team	1	2
1	Opp	Rep
2	Rep	Opp

Stage \ Team	1	2	3
1	Opp	Rep	Obs
2	Obs	Opp	Rep
3	Rep	Obs	Opp

VII. The Stage regulations

<i>The performance order in the Stage of a PF:</i>	<i>Reserved time in minutes</i>
Start of the Zoom Meeting, links are shared.....	5
Preparation of the Opponent.....	30
Meeting in Zoom again.....	5
Opposition screen sheets.....	4
Discussion.....	10
Opponent summarizes Discussion.....	1
Closing remarks of Reporter.....	2
Jury Questions.....	5
Grading.....	5
Jury Feedback.....	5
Pause.....	10
Total.....	82

In the Final PF the procedure of challenge is omitted.
The official language of the AYPT is English.

VIII. The teams performance in the Stages

The Reporter presents the essence of the solution to the problem, attracting the attention of the audience to the main physical ideas and conclusions.

The Opponent puts questions to the Reporter and criticizes the report, pointing to possible inaccuracy and errors in the understanding of the problem and in the solution. The Opponent analyses the advantages and drawbacks of both the solution and the presentation of the Reporter. The discussion of the Opponent should not become a presentation of his/her own solution. In the discussion, the solution presented by the Reporter is discussed.

The Observer does not participate actively in the PF

During one PF only one member of a team takes the floor as Reporter or Opponent; other members of the team are allowed to make brief remarks or to help with the presentation technically. During the Final PF any team member can take the floor only once.

IX. The rules of problem-challenge and rejection

1. Preparation

Prior to the Tournament, each single participant prepares a report on one of the problems and publicly announces their choice during the opening ceremony. Thereby, the problem is assigned to the individual participant for

the course of the Tournament. In the following, the chosen problem will be referred to as the participant's assigned problem. Within a team, no two team members may have the same assigned problem.

2. Selective PF

The Opponent may challenge the Reporter on any of the problems assigned to a member of the Reporter team that the Reporter team has not presented before. The team member whose assigned problem is challenged has to accept the challenge and act as Reporter in this stage.

If possible, the Opponent must challenge a problem which has not already been presented in the same PF.

Unless the same problem is presented twice in a PF, different members of a team have to take the roles of Opponent and Reporter.

3. Final PF

In the Final PF, teams choose which of their three assigned problems they wish to present again. All problems presented in the Final PF have to be different. In case teams choose the same problem, priority of selecting problems for the Final is determined by the TSP (see section XII), in case of equality by lot.

All teams hand in a prioritization of their assigned problems before they leave the fight room at the end of the last Selective PF. After the results of the Selective PFs are known, the choice of the teams participating in the Final is published immediately through the communication channels.

X. The grading

After each stage the Jury grades the teams, taking into account all presentations of the members of the team, questions and answers to the questions, and participation in the discussion. Each Jury member shows integer marks from 1 to 10. The mean of the highest and the lowest marks is counted as one mark which is then added to the remaining marks. This sum is used to calculate the mean mark for the team. The mean marks are multiplied by various coefficients: 3.0 for the Reporter and 2.0 for the Opponent.

In the Final, grading is done in secret. Jurors write down their grades on the grading sheets, sign them, and give them to the Final's Fight Assistants. The Chair asks the jurors of the highest and lowest grades to justify and explain their grades. This is done without mentioning the actual grade. The results are kept secret until they are officially announced during the award ceremony. After the announcement, all grading sheets and the detailed results are published online so that anyone can check the result.

SCORESHEET

fight (round no.): _____ stage: _____ room: _____ problem no.: _____ Juror's name & signature: _____
 reporter: _____ opponent: _____

REPORTER

Start from 1 and add/subtract

1 + + - =

REPORT

	phenomenon explanation	theory/model	relevant experiments	comparison between theory and experiment	own contribution	task fulfillment	science communication	DISCUSSION WITH OPPONENT	ANSWERS TO JURY and OPPONENT QUESTIONS
0	almost no	almost no	almost no	almost no	almost no	misunderstood	unclear, chaotic	relevant arguments/responses	reporter's conduct at the discussion
1	some	some	some	some	review of sources, cited	partly	partly clear	too few	poor
2	fair	fair	fair	not well fitting	some own input	average	average	some	partly fine
3	good	good	well performed, sufficient number	deviations qualitatively analysed	+ some interesting results	some aspects above average	some aspects well done	many	good
4	detailed	quite detailed, correct	+ results explained	+ theory limits explained, conclusive	considerable experimental or theoretical	interesting solution	overall clear, demonstrative	+ data/theory supported	some aspects efficient
5	demonstrative	detailed, complex, completely testable	+ reproducible, convincing analysis	well fitting, deviations analysed, conclusive	greater extent than expected	greater extent than expected	demonstrative overall clear, well communicated	proved deep understanding	overall efficient
6	deep and comprehensible, shows physical insight								
7									

NOTES:

OPPONENT

Start from 2 and add/subtract

2 + + - =

OPPOSITION (SPEECH)				DISCUSSION WITH REPORTER				ANSWERS TO JURY QUESTIONS	
understanding of presentation	relevant topics and prioritisation	own opinions presented	time management	relevant topics and prioritisation	own opinions presented	opponent's conduct of the discussion	ANSWERS TO JURY QUESTIONS		
0	almost nothing	irrelevant	poor	irrelevant	too few	poor	0	concise and correct or no questions asked	
1	some main points	too few	reasonable	too few	some	some aspects fine	-1	some incorrect, inconclusive or too long	
2	main points	some	fair	some	some correct	good	-2	deeply incorrect or show deep misconceptions	
3	all relevant points	most	efficient	most	many correct	some aspects efficient			
4	practically all points	well prioritised	+ all time used	well prioritised	+ improvement suggestions	overall efficient			

NOTES:

XI. The resulting parameters

1. For a team in the PF

The sum of points (SP) is the sum of mean marks, multiplied by the corresponding coefficients and rounded to one decimal.

2. For a team in the Tournament

The total sum of points (TSP) equals the sum of SP of the team in all Selective PFs.

XII. The Final

The three teams having the highest TSP in the Selective PFs participate in the Final. In case teams have equal TSP, their participation in the Final is decided by which team won more Selective PFs, in case of equality by lot.

The order of presentation in the Final is determined by position by entering the final: the higher the *position*, the higher the number in the scheme of section VI.

XIII. The final team ranking of the AYPT

The winner of the Final obtains the 1st place. If two or three teams have the same SP result in the final, the winner is nominated according to the highest TSP. The other two teams participating in the Final share the 2nd place. For teams not participating in the Final, the Organizing Committee decides, according to the TSP obtained, which teams will share the 3rd place.

XIV. Compiling the Austrian National Team

After the end of the AYPT the decision about the composition of the Austrian national team is made according to the procedure outlined in appendix A of the articles of association.

XV. The status of the regulations of the AYPT

The regulations are established by the Executive Committee of the association and may be changed only by the Executive Committee.

Accepted by email, 2016-08-24

Problems for the AYPT 2019

Note: According to the regulations of the AYPT the problems for the AYPT are the same as for the IYPT. These problems, which have been formulated by the IOC, are used in the AYPT in accordance with article 2 of the IYPT regulations.

1. Invent Yourself

Build a simple motor whose propulsion is based on corona discharge. Investigate how the rotor's motion depends on relevant parameters and optimize your design for maximum speed at a fixed input voltage.

1. Invent Yourself

Design an instrument for measuring current using its heating effect. What are the accuracy, precision, and limits of the method?

2. Inconspicuous Bottle

Put a lit candle behind a bottle. If you blow on the bottle from the opposite side, the candle may go out, as if the bottle was not there at all. Explain the phenomenon.

3. Swinging Sound Tube

A Sound Tube is a toy, consisting of a corrugated plastic tube, that you can spin around to produce sounds. Study the characteristics of the sounds produced by such toys, and how they are affected by the relevant parameters.

4. Singing Ferrite

Insert a ferrite rod into a coil fed from a signal generator. At some frequencies, the rod begins to produce a sound. Investigate the phenomenon.

5. Sweet Mirage

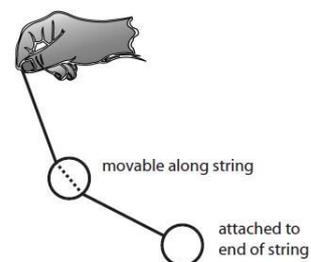
Fata Morgana is the name given to a particular form of mirage. A similar effect can be produced by shining a laser through a fluid with a refractive index gradient. Investigate the phenomenon.

6. Saxon Bowl

A bowl with a hole in its base will sink when placed in water. The Saxons used this device for timing purposes. Investigate the parameters that determine the time of sinking.

7. Balls on a String

Put a string through a ball with a hole in it such that the ball can move freely along the string. Attach another ball to one end of the string. When you move the free end periodically, you can observe complex movements of the two balls. Investigate the phenomenon.



8. Soap Membrane Filter

A heavy particle may fall through a horizontal soap film without rupturing it. However, a light particle may not penetrate the film and may remain on its surface. Investigate the properties of such a membrane filter.

9. Magnetic Levitation

Under certain circumstances, the “flea” of a magnetic stirrer can rise up and levitate stably in a viscous fluid during stirring. Investigate the origins of the dynamic stabilization of the “flea” and how it depends on the relevant parameters.

10. Conducting Lines

A line drawn with a pencil on paper can be electrically conducting. Investigate the characteristics of the conducting line.

11. Drifting Speckles

Shine a laser beam onto a dark surface. A granular pattern can be seen inside the spot. When the pattern is observed by a camera or the eye, that is moving slowly, the pattern seems to drift relative to the surface. Explain the phenomenon and investigate how the drift depends on relevant parameters.

12. Polygon Vortex

A stationary cylindrical vessel containing a rotating plate near the bottom surface is partially filled with liquid. Under certain conditions, the shape of the liquid surface becomes polygon-like. Explain this phenomenon and investigate the dependence on the relevant parameters.

13. Friction Oscillator

A massive object is placed onto two identical parallel horizontal cylinders. The two cylinders each rotate with the same angular velocity, but in opposite directions. Investigate how the motion of the object on the cylinders depends on the relevant parameters.

14. Falling Tower

Identical discs are stacked one on top of another to form a freestanding tower. The bottom disc can be removed by applying a sudden horizontal force such that the rest of the tower will drop down onto the surface and the tower remains standing. Investigate the phenomenon and determine the conditions that allow the tower to remain standing.

15. Pepper Pot

If you take a salt or pepper pot and just shake it, the contents will pour out relatively slowly. However, if an object is rubbed along the bottom of the pot, then the rate of pouring can increase dramatically. Explain this phenomenon and investigate how the rate depends on the relevant parameters.

16. Nitinol Engine

Place a nitinol wire loop around two pulleys with their axes located at some distance from each other. If one of the pulleys is immersed into hot water, the wire tends to

straighten, causing a rotation of the pulleys. Investigate the properties of such an engine.

17. Playing Card

A standard playing card can travel a very long distance provided that spin is imparted as it is thrown. Investigate the parameters that affect the distance and the trajectory.

The Association AYPT – Forschungsforum junger Physiker

The history of the AYPT dates back to the year 1999 when the first tournament took place. In 2002 the legal association AYPT – Forschungsforum junger Physiker has been founded (originally named “AYPT – Österreichisches Turnier junger Physiker”) to organize further AYPTs, to represent Austria in the IYPT and to promote the goals behind the AYPT and IYPT.

Detailed information about the association AYPT – Forschungsforum junger Physiker can be obtained on the official website <http://www.aypt.at/> which is available in German and English language.

Membership

If you would like to support the association in realizing further AYPTs and promoting the cause of AYPT and IYPT then please consider becoming a member of the association. An application form is provided within this booklet. Just cut it out, fill it out and hand it to one of the organizers. Further forms can be obtained from the organizers or from the website www.aypt.at. For legal reasons the application form is provided in German language only. Non-German speakers can contact the organizers for help in filling out the form if necessary.

There are two different types of membership:

- ordinary membership
- extraordinary membership

Ordinary members have to pay an annual membership fee of (at least) 10 Euro. Donations in terms of (voluntary) higher fees are always welcome.

Extraordinary members only support the goals of the association ideational and do not have to pay a minimum fee but donations are welcome from them as well.

Extraordinary members are, in contrast to ordinary members, not entitled to vote in the general assembly. Details can be found in the Articles of Association, available on the website www.aypt.at.

Antrag auf Mitgliedschaft

Ich stelle Antrag dem Verein „AYPT – Forschungsforum junger Physiker“ als

ordentliches Mitglied ^{*)}

(jährlicher Mitgliedsbeitrag: 10 Euro)

außerordentliches Mitglied ^{*)}

(jährlicher Mitgliedsbeitrag: Freie Spende)

*) zutreffendes bitte ankreuzen

beizutreten.

Persönliche Daten:

Frau Herr

Titel:

Vorname(n):

Nachname:

Adresse:

Straße und Hausnummer:

Postleitzahl: Ort:

Sonstiges:

Email Adresse:

Telefonnummer (optional):

Faxnummer (optional):

Ich bestätige, dass ich das vorliegende Formular vollständig und korrekt ausgefüllt habe. Ich erkläre mich damit einverstanden, dass meine Angaben elektronisch gespeichert und verwaltet werden. Eine Veröffentlichung der Angaben (ausgenommen Name) im Mitgliederverzeichnis findet nur auf meinen ausdrücklichen, jederzeit widerrufbaren Wunsch statt. Keinesfalls werden meine Daten an Dritte weitergegeben.

Ich erkläre mich mit den Statuten des Vereins einverstanden.

Ort, Datum: Unterschrift:

Sponsors and Supporters

The association AYPT - Forschungsforum junger Physiker thanks all its sponsors and supporters. Without their support it would not be possible to execute the AYPT.





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Anton Paar