



Swiss Young Physicists' Tournament 2022

ETH Zurich
26/27 March 2022



Source: ETH Zürich/Esther Ramseier

Welcome to the SYPT 2022

Dear participants, teachers and jurors

For more than two years Covid-19 has affected all our lives in various ways, and the activities around the **Swiss Young Physicists' Tournament** (SYPT) were no exception. In 2020 we were overwhelmed by the rapid development of the pandemic and the lockdown. In 2021 we were able to organise the SYPT as an online competition. Although the quality of the presentations and discussions was quite impressive, the experience came nowhere near that of a physical tournament.

We are glad to return with a proper tournament in 2022. After 2013 and 2016 this is already the third time we have the privilege that ETH Zurich has accepted to host the SYPT. The venerable main building in the heart of Zurich is the perfect venue for an unforgettable experience which will hopefully mark the re-launch back to the SYPT's former strength.

The SYPT is only possible thanks to the generous financial contributions of our partners. Furthermore, we are delighted to count on numerous volunteers, teachers and the organising committee to make the tournament successful.

It is my great pleasure to welcome you all to an exciting weekend in Zurich!



Samuel Byland (samuel.byland@sypt.ch), President Pro IYPT-CH

Visit www.sypt.ch for the latest information on the SYPT 2022.



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Swiss Young Physicists' Tournament

Where tomorrow's scientists meet.

IYPT

The **International Young Physicists' Tournament** (IYPT, see www.iypt.org), sometimes also referred to as „Physics World Cup“, is a scientific competition among secondary school students interested in physics. A so-called **Physics Fights** lines up three teams of five students each. They in turn present and discuss their solutions to one of the problems, criticise the opponent's solution and review the performances of the other teams. All three teams get scores from a jury.

The **problems** are published a year before the tournament. They are chosen such that no single correct solution exists. Each presentation will show different aspects of the problem. Careful preparation and creativity in solutions are as important for creating a good impression, as are correct school physics and mathematics.

In **preparing** for the IYPT students do not just learn how to tackle difficult physics problems, but also how to work in a **team**, use computers to **collect and analyse data**, **present** scientific results and **debate**. The Physics Fights are **in English**, helping the students prepare for their future at university where an increasing number of lectures and seminars are held in English.

Pro IYPT-CH

The **aim** of Pro IYPT-CH is that of making the idea behind the IYPT better known in Switzerland. It provides support for students and teachers in preparing problems and organises the selection of the Swiss team for the international tournament.

Since the first participation of Switzerland in the IYPT (2002) the number of students, teachers and schools participating has increased steadily. In 2005 Pro IYPT-CH organised the International Young Physicists' Tournament in Switzerland (Winterthur). This will be the eighth **national tournament** modelled on the international archetype.

If you would like to support Pro IYPT-CH and the SYPT and would like to be informed about our activities, you are very welcome to **become a member**. We also appreciate the help of former participants during the preparation for the SYPT and IYPT. Please contact Lioba Heimbach (see below) to get more information about membership or register online (www.sypt.ch).

President: Samuel Byland (president@sypt.ch)

Members: Lioba Heimbach (members@sypt.ch)

Website: www.sypt.ch

Agenda of the SYPT 2022

Date: Saturday/Sunday, 26/27 March 2022

Venue: ETH Zurich Zentrum (Rämistrasse 101)

Fees: Participation at the SYPT is **free**. Lunch (Saturday and Sunday) and dinner (Saturday) are offered by the organiser. Train tickets (half-fare) can be reimbursed via our website (www.sypt.ch) within two weeks after the tournament.

Saturday, 26 March

from 8:00	Registration & welcome coffee (Polysnack HG F 32)
8:30	Address of welcome (HG E 3)
9:00	Team photos (in front of HG E 3) / Jury meeting (HG E 3)
9:30	Physics Fights round 1
13:00	Lunch (Polysnack HG F 32)
14:00	Physics Fights round 2
18:00	Dinner (registration required)

Sunday, 27 March

from 8:00	Welcome coffee (Polysnack HG F 32)
12:00	Lunch (Polysnack HG F 32)
13:00	Final Fight (HG E 3)
15:45	Award ceremony & apéro

Problems for the SYPT 2022

- Invent Yourself:** Create a non-invasive device that determines the direction of fluid flow inside an opaque pipe. Optimise your device so that you can measure the smallest flow possible.
- Rayleigh Disk:** A disk suspended vertically by a thin thread is placed in an acoustic field. This device can be used to measure the intensity of sound by turning about the axis of the thread. Investigate the accuracy of such a device.
- Ring on the Rod:** A washer on a vertical steel rod may start spinning instead of simply sliding down. Study the motion of the washer and investigate what determines the terminal velocity.
- Unsinkable Disk:** A metal disk with a hole at its centre sinks in a container filled with water. When a vertical water jet hits the centre of the disc, it may float on the water surface. Explain this phenomenon and investigate the relevant parameters.
- Bimetallic Oscillator:** A simple electric oscillator can be made using a bimetallic contact-breaker. Investigate the relevant parameters that affect the frequency of such an oscillator.
- Tennis Ball Tower:** Build a tower by stacking tennis balls using three balls per layer and a single ball on top. Investigate the structural limits and the stability of such a tower. How does the situation change when more than three balls per each layer and a suitable number of balls on the top layer are used?
- Three-Sided Dice:** To land a coin on its side is often associated with the idea of a rare occurrence. What should be the physical and geometrical characteristics of a cylindrical dice so that it has the same probability to land on its side and one of its faces?
- Equipotential Lines:** Place two electrodes into water, supply a safe voltage and use a voltmeter to determine electric potential at various locations. Investigate how the measured equipotential lines deviate from your expectations for different conditions and liquids.
- Water Spiral:** If a stream of liquid is launched through a small hole, then under certain conditions it twists into a spiral. Explain this phenomenon and investigate the conditions under which the spiral will twist.
- Droplet Explosion:** When a drop of a water mixture (e.g. water-alcohol) is deposited on the surface of a hydrophobic liquid (e.g. vegetable oil), the resulting drop may sometimes fragment into smaller droplets. Investigate the parameters that affect the fragmentation and the size of the final droplets.
- Balls on Elastic Band:** Connect two metal balls with an elastic band, then twist the elastic band and put the balls on a table. The balls will begin to spin in one direction, then in the other. Explain this phenomenon and investigate how the behaviour of such a "pendulum" depends on the relevant parameters.
- Strange Motion:** Sprinkle small floating particles on the surface of water in a bowl. Bring a strong magnet above and near to the water surface. Explain any observed motion of the particles.
- Candle Powered Turbine:** A paper spiral suspended above a candle starts to rotate. Optimise the setup for maximum torque.
- Ball on Membrane:** When dropping a metal ball on a rubber membrane stretched over a plastic cup, a sound can be heard. Explain the origin of this sound and explore how its characteristics depend on relevant parameters.
- Boycott Effect:** If particles are suspended in a liquid that has a lower density than the particles, the particles will settle to the bottom of the container. The rate of settling can be affected by tilting the container that holds the liquid. Explain this phenomenon and investigate the effect of relevant parameters.
- Saving Honey:** When rotating a rod coated with a viscous liquid (e.g. honey), under certain conditions the liquid will stop draining. Investigate this phenomenon.
- Invisibility:** Lenticular lenses can be used to distort light and make objects disappear. Investigate how changing the properties of the lens and the geometry of the object affect the extent to which the object can be detected.

The official problem set for the IYPT 2022 can be found on iypt.org.

Regulations for the SYPT 2022

1. Swiss Young Physicists' Tournament

The **Swiss Young Physicists' Tournament** (SYPT) is a physics competition for students in secondary school. Participants are challenged to prepare a theoretical and experimental solution to a complex problem and to present and defend their solution in a debate (Physics Fight) against the opposing team's scrutiny.

The SYPT takes place on two consecutive days (e.g. Saturday and Sunday) before the International Young Physicists' Tournament (IYPT) of the same year (i.e. usually between March and May). The tournament is organised by the association Pro IYPT-CH.

In order to facilitate preparation for students wishing to participate at the SYPT, Pro IYPT-CH organises the **SYPT Online Coaching**, where a coach is assigned to each participant. The coach can give the students detailed explanation of what is required of them at the tournament.

The **problems** for the SYPT are identical to the ones at the IYPT. The problems are published online on www.iypt.org and on www.sypt.ch at least four months before the SYPT.

2. Website

Important information (deadlines, problems, results, etc.) about the SYPT and the Swiss team at the IYPT are published on the SYPT website (www.sypt.ch).

3. Eligibility and Application

Only students living in Switzerland and enrolled in a secondary school based in Switzerland can apply for the SYPT.

The final **deadline** for registration is published on our website at least two months prior to this deadline. This date applies both for students wishing to participate at the SYPT and the SYPT Online Coaching as well as for students who only wish to participate at the SYPT.

There are two possible ways to apply. In any case the deadline published on our website has to be respected:

- **School teams:** Any secondary school in Switzerland can nominate one or several **teams of three students**. As an exception the organiser may allow teams of two students.
- **Individual participants:** The organiser will try to match students applying as **individuals** with other students to form teams of three students.

Upon registration each student must choose an SYPT-problem. No problem can be chosen more times than the number of Physics Fights per round. Each student in a team must present the solution to a different problem.

4. Fees

There is **no participation fee** for the SYPT. Possible fees for the SYPT Physics Week are published on our website before the registration opens. At the SYPT food is provided by the organiser and/or the host. Pro IYPT-CH may partially or fully cover accommodation for participants. Eligibility is subject to the "Spesenreglement" of Pro-IYPT-CH.

Students may request financial support. Requests must be sent in written to the president of Pro IYPT-CH at least two weeks prior to the respective event.

Pro IYPT-CH has a limited budget for experimental equipment. Please contact the president of Pro IYPT-CH in due time if you would like to benefit from financial support. The exact procedure is defined by the "Beschaffungsreglement" of Pro IYPT-CH.

Swiss Young Physicists' Tournament

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5. Preparation

Pro IYPT-CH organises the SYPT Online Coaching during which students receive help and can prepare for the tournament.

In addition, Pro IYPT-CH seeks the support of **universities and research institutes** in order to allow the students to use adequate experimental equipment where the schools cannot provide this or to get in contact with experts in the respective field.

6. Fight Plan

All teams participate in three rounds of **preliminary Physics Fights**. The **fight plan** is published before the start of the first Physics Fights of each round. Each student in a team takes the role of Reporter, Opponent and Reviewer exactly once. The Physics Fights are in **English**.

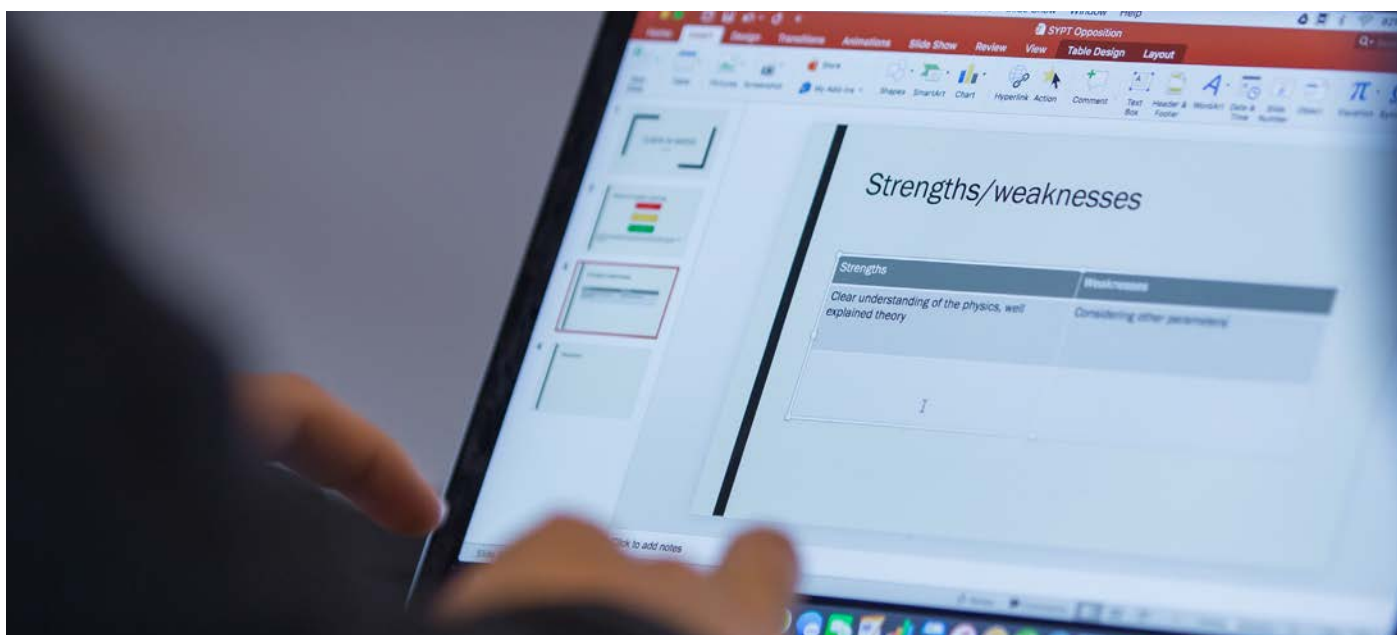
7. Physics Fight regulations

7.1. Stages and Time Schedule

A Physics Fight consists of three or four teams. The number of stages per Physics Fight corresponds to the number of teams. In each stage the roles of the **Reporter**, **Opponent** and **Reviewer** are assigned according to the tables below. If there are teams with less than three students, similar schemes apply. In a Physics Fight with four teams each team acts as an observer in one of the stages.

Physics Fight with three teams			
Stage	1	2	3
Team 1	Rep	Rev	Opp
Team 2	Opp	Rep	Rev
Team 3	Rev	Opp	Rep

Physics Fight with four teams				
Stage	1	2	3	4
Team 1	Rep	Rev	Opp	Obs
Team 2	Obs	Rep	Rev	Opp
Team 3	Opp	Obs	Rep	Rev
Team 4	Rev	Opp	Obs	Rep



The tasks for the three students actively involved in a fight are as follows:

- The **Reporter** presents his/her solution for the selected problem. The solution is expected to cover at least an important aspect of the problem with a theoretical model and experimental results verifying this model. The solution should be understandable for a secondary school student.
- The **Opponent** asks clarifying and critical questions and points out possible shortcomings and mistakes in the solution presented by the Reporter. He/She shows the presentation's strengths and weaknesses. The discussion has to be based on the solution presented by the Reporter (not on the Opponent's). A good Opponent should lead the discussion in a way that both participants can learn something new.
- The **Reviewer** comments on the performances of both Reporter and Opponent.

At the start of a round the jury members and the teams briefly introduce themselves.

The Physics Fight follows a strict timetable (see table below). After the time reserved for a phase has been used up no new thought may be added. If the preparation time is exceeded, the time for the next phase is shortened accordingly.

Phase	Time (total 45')
Presentation of the Reporter	12'
Clarifying questions of the Opponent to the Reporter	2'
Preparation of the Opponent	3'
Review of the presentation (maximum 5') and discussion between Opponent and Reporter	11'
Summary of the discussion by the Opponent	1'
Questions of the Reviewer to the Reporter and the Opponent	3'
Preparation of the Reviewer	2'
Review of the performances of the Reporter and the Opponent by the Reviewer	4'
Concluding remarks of the Reporter	2'
Questions of the jury to all three teams	5'
Jury grading	-

7.2. Team work and aids

During a Physics Fight the team members are allowed to communicate with each other. Support from outside the team (e.g. from their physics teacher) is strictly forbidden. The use of internet during a fight is strictly forbidden.

During each stage of a Physics Fight there is only one active participant per team. The other team members are allowed to help with short comments or give technical support.

8. Jury

The Jury is organised by Pro IYPT-CH. There are at least three jurors in each Physics Fight of which one acts as chairperson and ensures that the SYPT regulations are obeyed.

At the end of each stage the jury assesses the performances and every juror shows integer marks from 1 to 10 for each of the teams involved in the stage. The **score** for a team corresponds to the weighted average (highest and lowest mark with 50 %, all others with 100 %) multiplied by 3 (Reporter), 2 (Opponent) and 1 (Reviewer). The score for each role is rounded to two decimals. The final score of each fight is rounded to one decimal.

9. Ranking

The grades of each fight are used to make a team and an individual ranking. Participants are only ranked in the individual ranking according to article 12. Both rankings will be published.

10. Final Fight

The three teams with the **highest total score** after three rounds qualify for the **Final Fight**. In case of two teams in third place with the same total score the more balanced individual scores are preferred. In the Final Fight the third team after three rounds presents first, the first team last.

Within thirty minutes after announcing the participants of the Final Fight, the teams notify the organiser of their favourite problem. If two teams intend to present the same problem, the better-placed team has higher priority. The accepted problems are announced immediately.

The Final Fight follows the same regulations as the normal Physics Fights. Each team member has to be on stage in at least one role. In a team of two the reporter may be on stage only once.

11. Team Qualification

This article only applies if Pro IYPT-CH decides to send a team to the international tournament.

The organiser (in cooperation with the jury) **invites up to nine** (in exceptional cases ten) participants (SYPT champion and up to six or seven more) for the team qualification where the Swiss team for the IYPT is selected.

Only participants in the individual ranking (see article 12) are eligible to participate at the team qualification.

12. Absence of a team member

In case one or more team members are unexpectedly **unable to attend** a Physics Fight, the team must inform the organisers immediately. Students withdrawing may be charged a fee according to the terms of participation.

The team is expected to perform the roles of the missing team members. The grades the remaining team members receive in these stages count as follows:

- The grades in the opposition count 25% and the grades in the review count 50% for the team ranking. The grades in the report do not count for the team ranking.
- The other fractions (75% opposition, 50% review) are made up out of the average grades the present team members received in their originally planned stage. The weighted average of these marks is then counted as the final grade for the team ranking.
- The grades in these stages do not influence the individual ranking.

In case a team is reduced to only one team member, the remaining team member may find one additional helper who is eligible to participate at the SYPT and is not active in another fight. The helper is not allowed to take a role on stage. The organisers then must be informed immediately.

A participant must perform at least one report and one opposition in the three preliminary physics fights in order to be ranked in the individual ranking.

13. Disciplinary action and Violations of Regulations

Participants or teams that violate the SYPT regulations can be sanctioned by a point deduction of up to 10 points per participant or disqualification.

All participants must behave in an appropriate manner. Unfair behaviour can lead to point deduction of up to 10 points per participant or disqualification.

The final decision on any possible sanctions is taken by Pro IYPT-CH.

14. Appeal

In case one or several participant(s) or juror(s) feel(s) an action or behaviour of an individual or group does not comply with the SYPT regulations, he or she may choose to report this. The procedure is as follows:

For incidents not concerning grading:

- For incidents occurring during a Physics Fight:
The incident must first be reported to the chair of the jury. In case the matter cannot be resolved, the incident may be reported to the organisers. Pro IYPT-CH will decide on further actions or consequences.
- For other incidents:
The incident must be reported to the organisers. Pro IYPT-CH will decide on further actions or consequences.

For incidents concerning grading:

- The incident must be reported to the organisers no later than one hour after the respective fight round has finished. The report must include a justification why the grading should be reconsidered. Pro IYPT-CH will then make a final decision. Pro IYPT-CH will in any case justify its decision towards the involved parties.

Note: A retrospective change of a grade or its weighting will only be considered in extreme cases. Due to organisational reasons any change of grades will only influence the individual ranking.

15. Responsibilities

The regulations have been approved by the association Pro IYPT-CH.

Zurich, 20/03/2022



Swiss Young Physicists' Tournament

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Ranking, Team Qualification and Awards

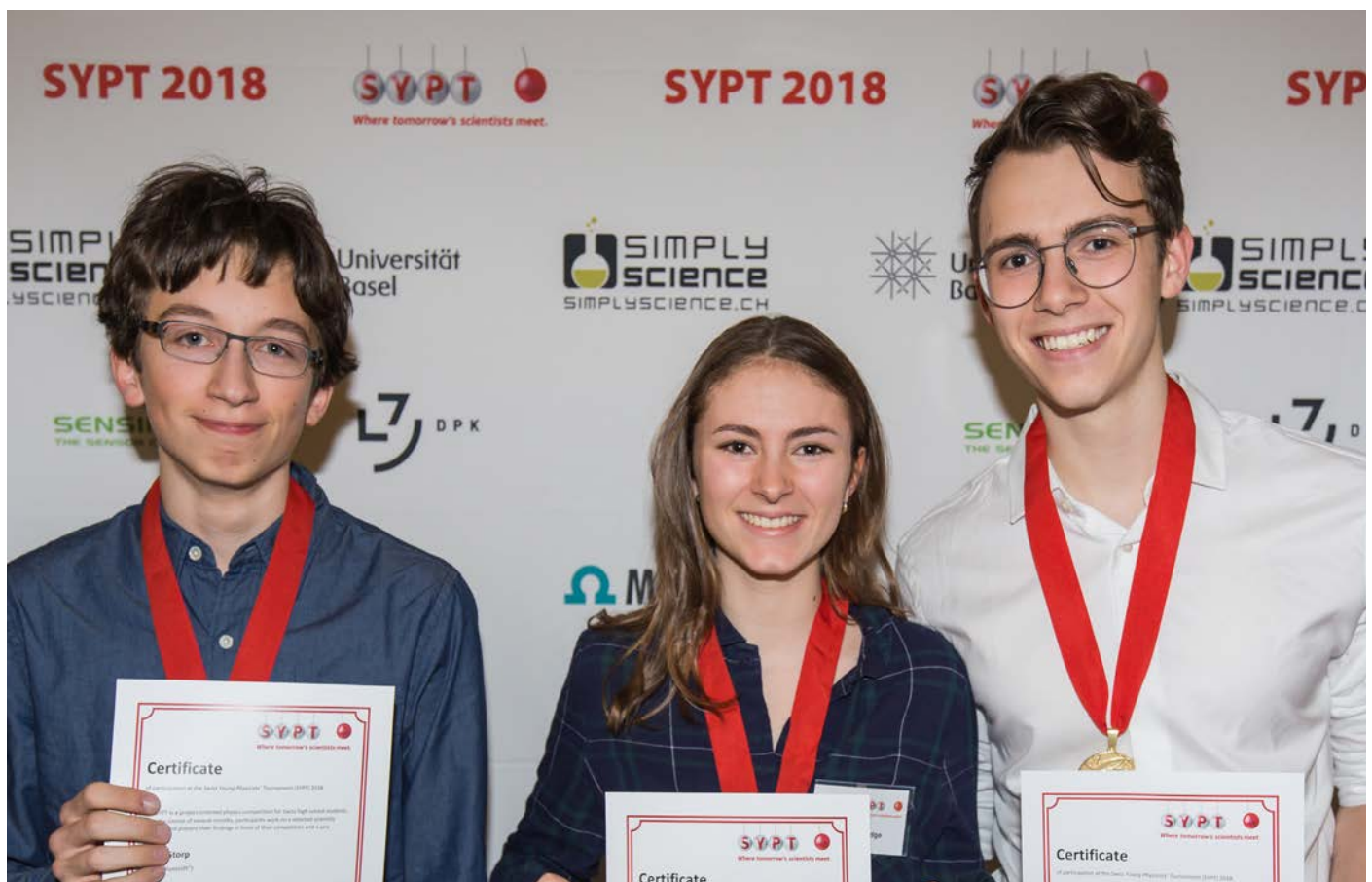
In addition to the **team ranking**, a ranking of the scores of all participants (**individual ranking**) is published. The latter is based on the weighted sum of all individual scores in the first three rounds.

The team with the highest score in the Final Fight wins the **SYPT Team Competition**.

Nine participants qualify for the **IYPT team qualification**. They are selected by Pro IYPT-CH (in cooperation with the jury) based on their skills shown during the physics fights. Students participating in the team qualification have to prepare a second problem and participate in the team qualification event. The date of the team qualification will be announced to the invited students.

All participants receive a **certificate** confirming their successful participation at the SYPT, and a small gift. The final teams and up to five additional teams will be awarded with medals and attractive prizes.

Rankings are published on www.sypt.ch.



Pro IYPT-CH and the SYPT are greatly supported by:

ETH

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Swiss Federal Institute of Technology Zurich



Swiss Academy of Sciences
Akademie der Naturwissenschaften
Accademia di scienze naturali
Académie des sciences naturelles



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Notes

Notes



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