Physics Lab

ETH zürich

D PHYS

Information for students in the bachelor program Physics

If any information below appears unclear, please do not try to guess and ask Practicum Heads via E-mail or in a zoom session.

This information is valid from HS21 onwards

(Reminder: in 2016 a new naming for the laboratories has been adopted: the name AP I was replaced by P1, AP II by P2, VP I by P3, VP II by P4.)

What are the education goals of the Advanced Physics Practicum?
The course P3 is compulsory for all students of the Physics bachelor program. The P4 is equivalent to a Semester-work or a theoretical Proseminar. The aim of both P3 and P4 is to learn how to independently prepare and carry out complex experiments, to evaluate the data, to interpret them, and to summarize the results in a scientific report. This procedure corresponds to the typical activity of an experimental physicist.

Which experiments are offered?
P3/P4 offers experiments covering areas of physics treated in the lectures Physics I-III. In addition, there are experiments in the fields of nuclear and particle physics, solid state physics and optics (quantum electronics), directly following the activities of the DPHYS Institutes.
Some experiments focus more on learning experimental techniques, some more on data analysis.

How many experiments I have to perform successfully?
Compulsory P3 (5th Semester, or after completion of examination block II):
All students in the Bachelor's degree program Physics have to complete 4 experiments after Examination Block II. Complete an experiment means collect and analyse the data, write a report graded by a teaching assistant.
Optional P4 (6th Semester, or after completion of compulsory P3): In the sixth semester of the bachelor program (or after the compulsory P3): 4 experiments have to be completed if no experimental/theoretical semester work and no theoretical Proseminar is done. The experiments can be selected only among the ones specifically intended for P4 on the Labs webpage.

How much time do I have to plan for the VP practicum?
As a guideline, plan about 225-270 hours (7 ECTS credits). This counts as two full days a week, which is a substantial portion of your workload during the semester. To plan your time you should consider the preparation of the experiments, the execution, the data evaluation, the drafting and correcting the report, as well as the final discussion. Unlike a compulsory lecture, you spend all your efforts during the semester and do not spend time on exams and their preparation.

Do I have to register electronically for the practicum?
Compulsory P3: Electronic enrollment for 402-0000-09 Physikpraktikum 3 is required in order for the credits to be transferred to you.
Optional P4: Only those who choose P4 instead of a proseminar or a semester work may register for 402-0000-10 Physikpraktikum 4.

When is an experiment considered completed?

1. An experiment must be performed by a student under the guidance of a teaching assistant (TA)

2. In the course of experimental activities, a log-book (a notebook, not a collection of separate sheets) must be kept

3. The completion of the measurements is confirmed by the assistant in the lab book by signing under *"Measurement finished"* (or by updating the student status in the TA webpage)

4. The student then writes a report within three weeks from this moment and hands it over to the assistant. This is confirmed by the assistant in the lab book with a signature under *"report handed in"* (or by updating the student status in the TA webpage)

5. The report will be reviewed, usually returned for corrections, and finally graded by the assistant. Two grades are assigned: one for the experimental work, the second for the report writing. The grades are used as feedback for the student. Upon returning the report, the assistant will conduct a conversation with the student and give her/his assessment of the work done and suggestions for future experiments. The TA final confirmation is given in the lab book with a signature under *"hand in report to Profs"* (or by updating the student status in the TA webpage).

6. Starting from HS21 we DO NOT request anymore the students to discuss the reports with the practicum Academic Heads. The reports will be uploaded to a common polybox folder by the TAs and the grades entered by the Academic Heads to the database.

> **Students who want to discuss their report/experiments with the Academic Heads are very welcome to do so! Just send an email to praktika@phys.ethz.ch to setup a zoom meeting.**

An experiment is considered to be successfully completed if the assistant confirms this with their signature of the report.

When the P3/P4 Practicum labs are opened?

During the semester: Mon-Wed, Fri 8:00 to 18:00. On Thursday and during the semester break, the P3/P4 labs are closed. Please follow the current information on the VP Practicum homepage https://vp.phys.ethz.ch/

Is there a compulsory attendance?

At the beginning of each semester the students must attend an introductory lecture on the laboratory and on safety rules. The attendance has to be confirmed by the teacher's signature.
Starting from FS21, the signature is replaced by an online moodle safety-test.
A successful completion of the test is required before being assigned to any experiment.
Mondays are "presence days" for students (on Mondays, the assistants must be available to students).

Do I have to report an absence?

Please report in advance your absences to the teaching assistants. This allows the assistants to plan their time.

When and where the P3/P4 experiments are assigned?

The experiments are assigned by the Academic Heads *online using a zoom-room.*
Please look the current information at the VP website https://vp.phys.ethz.ch/ .

What do I have to bring to the assignment?

For the first assignment, the Academic Heads will verify that you passed the Moodle safety test.
Subsequently, to receive the next experiment assignments you will need to have:

- from the most recent experiment: "*Measurement finished*" confirmed by the TA
- from the penultimate experiment: "*Report handed in*" confirmed by the TA

What are the deadlines to hand in the reports to the TAs?
The following deadlines apply: compulsory P3 and optional P4: reports will be considered only if registered as " *report handed in*" in the database before the end of the semester. No further extension of time can be granted. Experiments, for which the measurements have been finished (*"measurement finished*"), but without having submitted a report in time, i.e. before the semester end ("*report handed in*") will be invalid, i.e. they cannot be accounted for. The final version of the report can be handed in the first week of the following semester to the TA, provided that the TA provides the final grades and update the students status to *"hand in report to Profs"*.
Please allow some time for the TA to read your report – hand in your report at least a couple of days before the official deadline.

Can I choose my four experiments by myself?
The students should select experiments from as many different areas as possible. The practicum heads help with the selection. Remember that the desired experiment can currently be occupied by another student(s) or not available for other reasons (e.g maintenance).

Can I also do an experiment in a team?
Some experiments can be conducted individually others in groups of (maximum) two students. One can see from the list of experiments when this option is available. The group signs up together at the regular assignments time. Experiments involving cryogenic liquids or power lasers must always be performed in a team of two.

I did an experiment in a team with a colleague. Can we perform the data analysis together or write a joint report?
No. Each student performs an independent analysis and submits her/his own report.
This means:
1. Each student evaluates the data independently and produces own representations / plots / images of the measured data.
2. Each student carries out an independent error analysis, fits, hypothesis testing, etc…
3. Each student writes her/his own report independently.

If similar reports are submitted, the report will not be accepted and an the completion of an extra experiment will be required.

What are the necessary conditions to get the ECTS credits?
Each of the four successful experiments is usually weighted equally: 1 point. In exceptional cases (prearranged with Academic Heads), an experiment may be counted worth for 2 points (e.g., solving special tasks, testing new experiments, improving experimental setups, or experiment instructions). The astronomy week and other advanced experiments listed on the Lab website counts as 2 points.
Compulsory P3 and ***voluntary P4*** 7 ECTS credits are awarded for four successfully collected points.

How and when are the semester performance results electronically registered in MyStudies?
No grades are issued but only "passed" or "failed". "Passed" is issued if the above conditions (4 experiments with accepted reports) are met. "Failed" is not issued under regular circumstances. The credits are only entered at the end of the semester. Since the final registration is done through the Study Secretariat, delays may occur. The semester performance can also be registered later (for example in the following semester).

Can I continue experiments during the semester break?
No, during the semester break, the experiments are revised and when necessary repaired by the technical staff. Therefore, only in exceptional cases and after prior approval by the Academic Heads the experiments can be prolonged during the semester break.

Can I carry out the four experiments into two semesters?
Compulsory P3: Those who do not successfully collect four points all four experiments within the first semester can complete the missing experiments in the following semester, but:
- if 3 points are collected in one semester, the fourth point can be obtained during the following semester.
- if 2 points are collected in one semester, the two remaining points can be obtained during the following semester by completing 3 experiments (one experiment more!)
- if only 1 point is collected in one semester, the course is invalidated and the student will have to collect all four points in the following semester. A new enrollment in P3 is not necessary in this case.
It is not possible to distribute the experiments over more than two semesters.
Please note the deadlines given above for the submission of the fourth report.
Optional P4: All four experiments must be completed during the Spring semester. Prolongation over the following fall semester is not possible! The fourth report must be entered in the database before the end of the semester as a "report submitted".

Can I replace the compulsory P3 with a semester work?
This is only possible in rare exceptional cases. A written proof must be provided that the necessary experimental skills are acquired. This is determined solely by discussing it with the Academic Heads.

Where can I get material for the experiments?
Some experiments require specific pieces of equipment that can be obtained in HPP J 14:
- fuses, tools, basic electronic components
- Cables and photographic material
- Digital cameras

For cryo-liquids, please coordinate with the TA and the technical staff to place the order and consider a normal delivery time of about 2 days.

What rules do I have to keep in mind when experimenting?
1. Follow the safety instruction you were given at the introductory session
2. You are fully responsible for the equipment from the very beginning of the experiment till the end (up to obtaining „*measurements finished*“).
3. At the beginning, you have to immediately check whether the devices and the setup are complete and operational. Defects must be reported to the assistant with no delay.
4. The first time you access an experiment you must have read the manual and be accompanied by the TA, which will drive you through the setup.
5. Before turning on a piece of equipment, whenever in doubt ask the assistant. The reason is your own safety and the lifetime of the devices. Work prudently and attentively.
6. You can request additional equipment / devices from the assistant. You cannot take materials from other workplaces (not even temporarily).
7. Changes and repairs must be planned and carried out together with the teaching assistant.
8. Ensure order and cleanliness at your workplace.
9. Upon leaving the workplace, switch off all electrical power and close all water, gas and pneumatic valves, etc..

How do I manage my lab journal/log-book?
Your lab journal (hardcover, no loose sheets) contains
- Your work subject (Topic of the experiment)
- Settings of the equipment
- Results of the measurements that you carefully fill in in prepared tables
- The progress of the measurements and the experiment and all special observations
- Provisional graphical representations and evaluations
- The assistants' visas for "*Measurement finished*" and "*Report handed in*".
- All entries must have a date.
- Include seemingly obvious things that allows you to trace back all the experimental steps you took.

While a physical lab journal is still to be preferred, in recent years some students moved to electronics log-book. Those are accepted provided they do not interfere with taking appropriate notes.

How should my report be structured?
After the measurements have been completed a report has to written and submitted to the assistant. Detailed instructions, slides and a tutorial, together with a LaTeX template for writing the report are available on the website (see https://vp.phys.ethz.ch/index.php?page=berichte/).
In essence, the report should be as close as possible to a scientific paper and include the following sections:

1. An abstract, max. a quarter of a page
2. Goal of the experiment / Brief theoretical introduction
3. Description of the setup
4. Description of addressed problems/phenomena
5. Description of the measurement with error estimation, plots, fits, etc..
6. Discussion of measurements and comparison with models
7. Summary of the result (what was achieved, max. ¼ page)
8. One appendix summarizing the main safety concerns of the experiment.

Which style/approach do I have to follow in my report?
The style rules are based on the practices that are also used in scientific journals of physics. You will also find detailed information on the web page https://vp.phys.ethz.ch/index.php?page=berichte. Further advice can be asked to the teaching assistants.
Some general editorial rules:

1. Formulas are often parts of a sentence. At the end of the formula is a point if the sentence stops there
2. Between number and unit is a distance, units are always upright. Examples: correct: 12 mm, incorrect: 12mm, 12*mm*, 12 *mm*, *12* mm, etc.
3. The first sentence of a section should not simply repeat the title
4. A sentence should not begin with a number or a variable. Example: incorrect: *n* is an integer. right: The variable *n* denotes an integer.
5. Experimental physics does not know "zero" neither as a measurement result nor as an uncertainty. Any effect is always smaller than a certain measurement accuracy, or as the measurement error.
6. Figures have well legibly labeled axes, a complete legend with explanation of all curves, symbols, etc., even if it is already in the text.

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