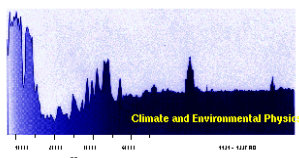


## Safety in the Lab

Dear colleagues,

Working in a lab bears certain risks which you should always keep in mind. This safety leaflet should make you aware of the most important sources of danger. If you detect other sources of danger not mentioned here, please immediately inform your supervisor.

If you click on the department logo, you will find a list of persons whom you have to / may contact for assistance if needed:



In case of an emergency

Emergency: 117 (Police)  
145 (Poisoning)

118 (Fire)  
4040 (Caretaker)

144 (Medical)  
8611 (Reception)

## General Information

Make yourself acquainted with the safety procedures, before you start to work in a lab. Let your predecessors instruct you and you yourself instruct your replacement. Localize the next fire extinguisher, the next dousing blanket. Where is the next water alarm unit? Where are the evacuation routes? Where can I find the documents on emergency procedures? Whom do I have to contact in case of an emergency?

The lab facilities are to be held in immaculate conditions at all times. You are responsible for keeping your work space clean. Food and beverages are in principle not allowed to be taken into any lab facilities. When handling chemicals there is always the danger of poisoning. Fruit juices for example, have high acidity content and therefore can attack and harm electronic equipment. It is advised to wash your hands thoroughly before handling any electronic apparatus.

Your own projects are not allowed to become potential dangers for others (i.e. cleaning personnel, co-workers, technicians, visitors).

## Electricity, High Voltage

### Current surge:

Example: At a resistance of approx. 1kOhm (hand-foot) you only need a 50V tension to bring yourself into mortal danger (see diagram below).

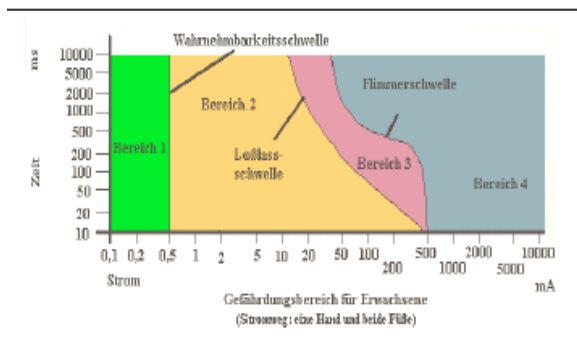
## Equipment with mains connection (230V)

According to the regulations of the SEV (Schweiz. Elektrotechnischer Verein) no changes may be made to any devices with a mains connection, nor may they be self-built without the responsible electronics-person examining and testing them before start-up. For this the electronics workshop is responsible.

## High Voltage

Exceptional care should be taken when working with high voltage. Wiring should be examined by a second person before start-up. The use of "trip wires" should be avoided at all costs. Only wiring with high voltage cables and plugs, which have been isolated accordingly are allowed to be used.

Experimental setups with bare wiring or freely accessible areas with high voltage are prohibited. The cables are to be maintained in a clearly laid out manner at all times. The grounding of cables and wiring is especially important. It is better to ask for competent help a few times too often rather than not to ask for any help at all. The workshop would rather help you in the process of wiring, than having to get called afterwards to fix a broken piece of equipment! In addition, working with high voltage is to be omitted, if only one person is in the laboratory, in particular at night and on weekends. Caution: also after switching the apparatus off sometimes there remains some high tension on certain parts (condenser). Long-term tests with high voltage are to be marked clearly with the name and the coordinates of the responsible in case of an emergency situation.



Bereich 1:	Wechselströme in diesem Bereich werden von den meisten Menschen gar nicht wahrgenommen.
Bereich 2:	Es ist ein Krabbeln zu spüren, auch schmerzhafte Verkrampfungen sind möglich. Direkte Schäden sind kaum zu befürchten.
Bereich 3:	Die Stromquelle kann auf Grund von Muskelverkrampfung nicht mehr gelassen werden.
Bereich 4:	Schwere Schädigung und häufig tödliche Stromwirkung, z.B. durch Herzkammerflimmern.

Stromweg	Körperwiderstand (minimal)
Hand - Hand	ca. 650 $\Omega$
Hand - Fuß	ca. 1300 $\Omega$
Hand - Füße	ca. 975 $\Omega$
Hände - Füße	ca. 650 $\Omega$

Der Hautwiderstand beträgt einige Tausend Ohm, kann bei hohen Spannungen aber bis auf Null absinken.

## ESD (Electro Static Discharge)

It is common knowledge that humans can become charged just by movement at times up to several 1000V. Often it just takes low tension to destroy active electronic equipment. This can happen just by standing near the apparatus without even touching it with your hands.

When working with highly-sensitive measuring devices or electronic components it is necessary to wear a ground strap. By simply wearing a ground strap one can prevent costly repairs.

## Toxic Substances/Chemicals

«All things are toxic, and nothing is without poison; just the dosis by itself makes something not be toxic»

General procedures when handling chemicals:

- Do not use substances of which you don't know their toxicity.
- Always look at the safety procedures labels on the packaging before handling toxic materials.
- Chemicals classified as class 1 are the most dangerous!
- Always use the fume hood when working with toxic substances
- Always wear safety goggles and gloves
- Do not use chemicals which are not clearly labeled
- Do not order more chemicals than needed for your work
- Disposing of empty- or partially-filled containers is only allowed after consultation of the responsible persons for toxic waste.
- Out-dated chemicals have to be properly disposed of
- No mixing of chemicals without knowing their reaction to one another (not even in the trash container)
- Keep your workspace tidy at all times, and stow unused bottles and containers in a safe place (danger of spills on the ground)



## Working with toxic gases

- Toxic gases (included in this are also gases which can repress oxygen intake for breathing) are only allowed to be handled in specially-equipped lab rooms ( Alarm system! i.e. Grosslabor). Persons who handle such gases have to be specially trained.

## Working with liquid nitrogen

- Contact with this product can cause severe coldburns so please be aware at all times when working with this substance that no fluid runs into your shoes.
- Especially when filling or emptying containers in a poorly ventilated room there is the possibility of oxygen getting repressed by the nitrogen without being felt. Danger of choking!
- The storage of liquid nitrogen in containers not intended for it, without pressure balance, can lead to bursting of the containers at ambient temperatures. When using containers made from synthetic material low-temperature embrittlement occurs and when the container bursts there is danger of splash damage.
- Taps may be installed only in areas with excellent ventilation. The faucet cocks should be as self-closing as possible. The filling of liquid nitrogen should only be done in very well ventilated areas.
- Always use during filling and handling of the Dewar vessels safety goggles and suitable protection gloves (material:i.e. leather or Kevlar). Always use facial protector masks when there is spraying danger.
- When transporting liquid nitrogen never ride in the same elevator.

### **Working with liquid helium**

- When working with liquid helium, generally the same rules and safety precautions apply as with liquid nitrogen.
- With liquid helium, which expands itself when exposed to heat, there is also the danger of explosion.
- Working with liquid helium is only permitted for specially-trained personnel from the LHEP (Laser High Energy Physics Group)

### **Working with radioactive substances**

- The closed radioactive sources are stored in the radioactivity lab on the 3<sup>rd</sup> floor of the institute and controlled by the LHEP (High Energy Physics Group). The radioactivity lab is periodically tested by the Dept of Health and the permit for further usage renewed. The permit is restricted to the handling of closed radioactive sources.
- The radioactivity lab is always locked-up, the material is controlled by the responsible person and given out only by way of a receipt.
- When giving out the radioactive material, the responsible person makes the user aware of the safety procedures and precautions when handling radioactive materials.
- The fire department of the city of Bern is informed about this radioactivity lab and knows how to proceed in case of a fire emergency.
- The handling of radioactive material is supervised by the assistants when students are present during lecture sessions or praktika.

### **Working in the underground lab**

- In the underground lab liquid nitrogen as well as liquid helium as cooling agents are used.
- Access to the underground lab is only allowed in company of a member from the LHEP Group, and the handling of lab equipment and apparatus are only allowed for qualified personnel from the LHEP Group.
- If liquid cooling agents evaporate very quickly there is the danger of choking. Therefore the oxygen content is monitored at all times and an automatic alarm warns the working personnel in case of lack of oxygen in the air.
- All users of the underground lab have to be informed about the security systems and the specialized emergency procedures prior to start their work in the lab.

### **Safety precautions when handling gas bottles**

- Gas bottles have to be protected from excessive heat, mechanical defects and corrosive substances.
- Place gas bottles in an easily accessible way.
- Full and empty gas bottles have to be stored separately and sorted accordingly by gas type
- Gas bottles should only be stored and transported with the screw-on protective cap
- Protect gas bottles from falling or rolling over
- In case of a leak or fire: close the bottle vents immediately. Overheated bottles should be doused intensively with cold water. Bottles containing acetylene have to be cooled down with all vents closed for a couple of hours.
- In workshops and labs there should only be stored as many reserve bottles as is needed for ensuring continuous operation.

- Bottle vents have to be opened slowly using both hands
- Bottle vents are neither to be oiled nor greased
- When the equipment is not in use or when the flasks are empty close all bottle vents.

### Working with lasers

- Class 1: the accessible laser beams are harmless
- Class 2: the accessible laser beams are only in the visible spectral range (400 nm to 700 nm). For short intervals (up to 0,25 s) these rays are harmless even for the eyes.
- Class 3 A: the accessible laser beam is harmful for the eyes when the radiation cross section is reduced by using optical instruments. Without reducing the cross-section, the transmitted laser beams in the visible spectral range (400 nm to 700 nm) is for short intervals (up to 0,25 s) and in the other spectral bands also for long intervals harmless.
- Class 3 B: the accessible laser beam is harmful to the eyes and in certain cases also to the skin.
- Class 4: the accessible laser beam is very harmful for the eyes and the skin. **Even diffuse straylight can be harmful.** These kinds of beams can cause burns or even explosions.

### Safety precautions when building lasers and paths for beams

- Laser areas – mostly whole rooms – have to be **clearly labeled**. When working with lasers limit accessibility to the area. Turn on warning lamp.
- Is the **Emergency/OFF button** available and easily accessible?
- Path of the beam should **not be at eye-height**, so you must also consider the position of your head when sitting!
- Beam paths should be tubed if possible
- When installing optical elements consider **possible reflexes** and after installation test the elements with a low-intensity laser beam in the beginning.
- Even diffuse reflexes most often have a highly-oriented portion.
- Unused areas of optical elements should be blacked-out (but please be aware of the invisible laser radiation!)
- Do not place optical elements **loosely** in the path of the beam
- Use **beam-catchers and shielding-protectors** when working with lasers. Through strategic placement of such a device the path of the beam becomes overviewable and secure!
- **New users** should be instructed by experienced personnel. **Guests** should be made aware of the dangers before entering any laser areas.

### Directives for protection from laser radiation in research laboratories

- **Each person is responsible** for their own security in their workspace!
- **Before doing any kind of work take a minute to consider the effects!**
- **Laser-protection gear i.e. protective adjustable goggles** must be worn and work must be done in well-lit rooms.
- Keep access ways free at all times and workspaces immaculately tidy.
- Before installing/expanding optical elements **block the laser beam**.
- If more than one person is working on the same experiment, free the laser beam only after notifying all the persons involved with the experiment.
- When bending down, close your eyes and look away.

- **Watches, jewellery, belt-clips etc.** can cause reflexes.
- Reflexes can also occur when using maintenance tools, so be especially careful.

### **Safety precautions in the workshop**

For the mechanical workshop of the Physics Institute the same rules and regulations apply as for the lab facilities mentioned in the safety leaflet “Safety Procedures in the Lab Facilities”. (power, toxic substances, gases, pressure tanks and liquid nitrogen).

Furthermore the personnel of the workshop are obliged to maintain the facilities, the machinery and work supplies as well as enforce the safety regulations accordingly and within in the range of the operation intended for the various working tasks needed.

### **General important work rules in the workshop are:**

- Smoking is prohibited (see posted signs)
- The wearing of protective goggles is mandatory for all work, especially when grinding, polishing or sawing materials (see posted signs in workshop area)
- Welding and soldering is not allowed without using the ventilation-machine (see posted sign in workshop area)
- Cleaning machinery is only permitted when all machines are at a stand-still.
- Cleaning towels, especially the used ones, must be disposed of in the specially-marked container (danger of self-detonation)
- Always wear closed shoes when working in the workshop area.
- It is strictly prohibited to use the fork-lift as a scooter/skate board. (see posted sign on fork-lift)
- Never work with open hair or loose clothing on machinery where you are in danger of getting tangled up. Do not wear gloves when grinding or drilling.
- When working with materials which create extensive dust, always use the suction apparatus. (band saw)
- Do not remove splinters without the proper tools.
- Crane installations and lifting devices should only be manned by persons who have the necessary experience to operate such machinery.
- Long bars protruding from the working-spindle should be guided or supported at all times.

Furthermore, the general rules of the House of Exact Sciences and the implementing regulations for small work of the technical employees for their personal needs. (See posted sign in the changing room area)

The use of the assistant workshop in room B76 is regulated in the guidelines of 23.04.2003.