GENERAL LABORATORY RULES
of Quantum Optics

Safety Instructions in accordance with §14 of the Ordinance on Hazardous Substances (GefStoffV) for laboratories in which activities involving chemical agents are carried out using chemical, physical or physico-chemical methods for preparation, analysis or application.

Responsible superior	Prof. Dr. Fedor Jelezko
Date	11.05.2023

Content

1. Scope of application

These General Laboratory Rules serve as safety instructions for the Institute of Quantum Optics of the University of Ulm especially with respect to preparational, analytical or applicational activities involving chemical agents in conjunction with chemical, physical or physico-chemical methods. It lays down basic rules of conduct in laboratories and safety precautions for the handling of hazardous substances as well as the implementation of behaviour in the event of danger, for first aid and for the disposal of hazardous waste. Relevant applications were additionally adapted and documented by the institute to the respective workplaces and work systems according to the safety precautions of the risk assessments of the institute, based on location and activity.

All employees of the Institute were instructed in the contents of these safety instructions before starting work for the first time. Employees are guaranteed access to these laboratory rules at all times. They must comply with the rules and sign them in the form of a certificate of instruction.

The specifications of the German Social Accident Insurance for "Safe work in laboratories" (DGUV I 213-850), the Ordinance on Hazardous Substances (GefStoffV) and the state of the art according to the Technical Rules for Hazardous Substances (TRGS) apply overridingly.

In case of discrepancies between the English and the German version of this Lab Rules, the German versions is given precedence.

2. Hazardous substances and hazards for humans and environment

Hazardous substances are substances and mixtures of substances with hazardous physico-chemical, toxicological or environmentally hazardous properties, as well as all substances assigned an occupational exposure limit (OEL, concentration of a substance in the air at the workplace).
A complete list can be found in the GefStoffV §2 and §3.

Labelling is carried out by the Globally Harmonized Systems of Classification and Labelling of Chemicals (GHS) in the form of easily identifiable pictograms and signal words, among other things. Substances whose non-hazardousness cannot be established beyond doubt are also considered hazardous substances.

Harm to employees and the environment from hazardous substances (e.g. poisoning, irritation, sensitisation) is possible through inhalation, absorption through the skin and mucous membranes or the digestive tract, as well as through fires and explosions.

Handling hazardous substances requires safety precautions depending on the type and degree of hazards. Hazardous substances may only be handled by competent persons who have been instructed in the handling of such substances and who have knowledge of the properties, effects, safety precautions to be taken, behaviour in the event of danger and first aid as well as proper disposal.

3. Safety precautions and rules of conduct

3.1. Technical precautions

All employees working in laboratories must have been instructed in the location, operation and use of the following technical safety precautions.

1. Ventilation

Laboratories must be equipped with technical ventilation systems that are functional at all times to ensure an air exchange rate of 25 m^3/h per m^2 of usable floor space (≙8-fold air exchange rate) of the laboratory. As a rule, windows must not be open during activities involving hazardous substances in order to keep the technical ventilation constant.

2. Fume hoods

Fume hoods must be operated in accordance with the state of the art and may only be used when in fully functional condition. In general, hazardous substances are only to be handled under fume hoods. The front sashes of the fume hoods must be kept closed during operation or opened no more than necessary to maintain the protective effect.
Fume hoods may not be used as storage locations for hazardous substances. Substances and equipment that are not needed immediately or in the course of the working day for the continuation of the work must be removed from the fume hood.

3. Emergency body and eye shower

The monthly testing of the functionality of emergency body and eye showers is organised by the institute and facility management and documented by the employees carrying out the testing. In addition, annual maintenance of the emergency body showers is carried out by Division V.

4. Fire-extinguishing facilities

The institute and facility management shall provide sufficient means for extinguishing fires in laboratories. The selection is made in cooperation with Division V, fire protection officers and occupational safety specialists. Fire extinguishing equipment must never be covered or made inaccessible. Fire extinguishers, containers for absorbent material and extinguishing sand containers must be replaced or refilled after each use.

5. Laboratory and fire protection doors

Laboratory doors must be kept closed during activities involving hazardous substances. Fire protection doors must always be kept closed. Fire protection doors must not be wedged or their closing mechanism blocked. They may only be kept open with the aid of hold-open systems properly installed via Division V.

6. First aid facilities

The provision of first aid facilities must be adequately organised by the institute or facility management. The employer shall ensure that sufficient first-aid materials, necessary equipment and, in the case of activities involving very toxic and toxic substances, antidotes against possible poisoning

are kept ready in first-aid boxes or cabinets. The contents of the first aid boxes must be checked regularly for completeness and supplemented with new material if necessary.

7. Escape and rescue routes

It must always be ensured that escape routes and emergency exits can be used quickly and safely.

8. Supply lines and fittings

The location and operation of the emergency shut-off devices for gas, electricity and water supply must be communicated to employees. After an emergency shutdown, the laboratory management must be informed.

9. Safety cabinets and storage facilities

Hazardous substances in larger quantities than hand use must be stored in suitable storage facilities, i.e. not in workrooms, or safety cabinets. No corrosive substances may be stored in safety cabinets for flammable liquids (unless they are themselves flammable, e.g. acetic acid). Acids and alkalis must be stored in special, corrosion-resistant chemical cabinets (acid-alkali cabinets).
Flammable liquids to be stored cool as well as extremely flammable and highly flammable substances may only be stored in explosion-proof refrigerators or freezers.
Gas cylinders must be operated in laboratories in safety cabinets with exhaust air connection installed by Dept. V-2 and through fixed pipes. An exception is possible for so-called lecture bottles, which, however, may also only be stored in suitable safety cabinets.

10. Glass and cannula waste

Work materials and waste with pointed or sharp edges such as glass and cannulae may only be collected and disposed of in suitable containers and without mixing with other waste.
Special care must be taken when handling cannulae. Do not put disposable cannulae back into the plastic sleeve after use.

3.2. Organisational precautions

1. Collection of information and documentation

Prior to procurement, storage and use of hazardous substances, a substitution check, identification of hazardous properties, potential exposure and pathways, and a fire and explosion hazard must be identified and assessed.
Safety data sheets of the hazardous substances must be provided in a suitable place and/or digitally.
All hazardous substances must be entered by the facility or institute in the DaMaRIS Dangerous Materials Registry and kept up to date at all times.

2. Risk assessment and safety instructions

Hazards must be assessed and safety instructions drawn up for all non-standard laboratory procedures involving hazardous chemical substances, as well as for devices and machines.

3. Hazardous substances

Only competent and instructed employees may carry out activities with hazardous substances.
Toxic hazardous substances must be stored under lock and key and inaccessible to unauthorised persons.

The number and quantity of hazardous substances in the workplace and during handling are adapted to normal laboratory conditions:

- At workplaces, flammable liquids with a flash point below 55 °C may only be stored for immediate use in containers of no more than 1 l nominal volume. The number of containers shall be limited to what is strictly necessary.
- Liquids shall be used in quantities not exceeding 2.5 l each.
- Toxic, carcinogenic, mutagenic or fertility-endangering liquids are used in quantities not exceeding 0.5 l each.
- Very toxic liquids are used in quantities not exceeding 0.1 l each.
- Solids are used in quantities of no more than 1 kg each.
- Toxic, carcinogenic, mutagenic or fertility-endangering solids are used in quantities not exceeding 0.5 kg each.
- Very toxic solids are used in quantities not exceeding 0.1 kg each.
- If no central gas supply is available for gases such as nitrogen, argon, hydrogen or propane, the smallest possible container size (maximum 50-l pressurised gas cylinder) is used.
- In the case of very toxic, carcinogenic, mutagenic or fertility-endangering gases, lecture bottles or small steel cylinders are used; if this is not possible, pressurised gas cylinders no larger than 10 litres are used. Spare cylinders are kept outside the laboratory.
- Gas cylinders used in this way (lecture bottles up to max. 50 l pressurised gas cylinder) are protected against falling over and taken to a safe place (suitable storage or safety cabinet) at the end of work.

Hazardous substances and chemicals may only be stored in containers whose shape and labelling do not allow confusion with food.
The labelling and marking of all hazardous substance containers (including waste containers) must be clearly identifiable and unmistakable with substance name and hazard pictogram(s) according to GHS (substance name(s), hazard symbol(s), hazard designation(s), hazard and precautionary statements, manufacturer).
For self-filled hazardous substances, the simplified labelling according to GHS with substance name, hazard pictogram(s) with hazard designation must be applied.
Filling and decanting operations should be designed in such a way that this is possible under the fume hood.

When handling very toxic, toxic or corrosive compressed gases, respiratory protection with a suitable gas filter must be kept available at the workplace.
A suitable shatterproof transport bucket must be used for the transport of hazardous substance containers.

4. Signage of areas

Appropriate signage in front of the entrances to laboratories must indicate hazards in laboratories such as laser or UV radiation, strong magnetic fields etc.

5. Use of lifts

Liquid nitrogen (LN2), liquid Helium (LHe) and compressed gas cylinders must not be transported together with persons in lifts. Safe transport is carried out as a "Chemiefahrt" by key switch without persons in the lift.

6. Youth and maternity protection

Young people between 15 and 18 years of age (e.g. older schoolchildren, trainees, students who are under age) are allowed to work with CMR substances in laboratories after instruction and under the supervision of competent employees.
As a general rule, pregnant women and breastfeeding mothers are not allowed to work in laboratories where hazardous substances are present. The extent to which pregnant women or breastfeeding mothers may still be allowed to carry out laboratory activities must be determined in a specific case-related risk assessment.

7. Open flames and hot surfaces

To avoid a fire and explosion hazard, open flames and hot surfaces (e.g. Bunsen burner, heat gun) must not be used near flammable liquids and gases. Bunsen burners may only be operated under constant supervision.

8. Presence

Out of normal working hours, it must be ensured organisationally that at least two employees of the institute are present in the laboratories during work, and those are informed of each other's activities and check each other's well-being.

9. Laboratory hours

Activities involving hazardous substances may only be carried out in the laboratories between 6am and 8pm. Any work going beyond this must be checked on the basis of a risk assessment with regard to hazards and further protective measures and approved by the institute management.
Chemical reactions which require cooling, involve flammable hazardous substances or are otherwise deemed hazardous and must be continued overnight may only be carried out in designated night laboratories. Exceptions are methods, which have especially designed and approved by the safety management.

10. Persons not employed by the institute or facility

Service technicians, craftsmen and cleaning staff receive area-specific instruction before work.

11. Work clothes

Work clothes and street clothes are to be changed and stored in designated rooms. Long hair must be tied up in such a way that no danger can arise.

3.3. Personal protective equipment

Personal protective equipment must not be worn outside the work area due to the risk of carry-over and must be cleaned separately from street clothes.
The institute management is responsible for organising cleaning.

1. Protective glasses

Eye protection can be dispensed with for activities and work processes for which an eye hazard can be permanently ruled out. In laboratories in which a permanently safe eye hazard cannot be ruled out, all persons must always wear protective goggles with an additional eye area cover. Spectacle wearers use over-specs over their own corrective glasses or goggles with corrective lenses. The potential eye hazard generally results from the valid safety data sheets, operating instructions and other protective regulations.

2. Lab coat

In laboratories with chemicals, a lab coat with at least 35% cotton content must be worn.

3. Work clothing and footwear

Only long trousers with a high cotton content and sturdy, closed, slip-resistant footwear may be worn in laboratories. Laboratory and street clothes are to be kept separately.

4. Protective gloves

If skin contact cannot be excluded by technical protective measures when working with hazardous substances, gloves resistant to the substance must be worn and changed before the penetration time has elapsed.
Gloves must not be worn outside the laboratory and must be removed for operating a telephone, opening doors or before using taps and the like.

3.4. Rules of conduct

1. Basic rules of conduct in laboratories

All employees are obliged to take care of their own safety and health and that of other employees to the best of their ability.

In the event of illness or injury, people are taken out of the danger zone and, if necessary, an emergency call is made. The emergency call center decides whether and in what form medical help should be sought. In the case of minor injuries, e.g. small cuts, the incident must be documented in the first-aid log and, if in doubt, seek medical help.

The management of the facility or institute organises that the employees keep order in laboratories. The laboratory rooms, work equipment and own laboratory space should be kept tidy and clean every day. Only work equipment and materials that are actually needed should be placed on the work tables. Contaminated containers, work equipment and installations must be cleaned as quickly as possible.

2. Hygiene

Skin protection plans have been prepared and are made available to employees near the washing facilities in the laboratories. Before and after activities and when leaving the laboratory, hands must be washed or cared for according to the skin protection plan.

Food and stimulants must not be brought into the laboratories, stored or consumed there. The use of cosmetics in the laboratory is prohibited.
Appropriate social areas shall be provided for storage and consumption. Food and beverages must not be prepared or stored in chemical or laboratory containers. Reheating of food and beverages is only permitted with equipment designed for this purpose.

Documentation and writing work may only be carried out at workplaces set up for this purpose and not on laboratory benches. Areas for writing work that are adjacent to areas for laboratory activities must be separated from these by means of a suitable splash guard.

Suitable office workplaces should be made available and used for long periods of work at the PC.

4. Behaviour in the event of a hazard

4.1. Basic behaviour in the event of a hazard and alarm plan

- Keep calm and avoid hasty, ill-considered action!
- Pay attention to your own safety when providing assistance
- Warn other persons at risk and ask them to leave the rooms if necessary.
- Carry out the instructions of the alarm plan. The alarm plan must be clearly visible near the laboratory telephone.

universität ulm

Alarm plan

in the event of accidents, fire,
other dangerous situations and technical defects

Personal injury Emergency: 112	• Remove persons from danger area. • In case of personal injury, immediately call emergency number. They decide, whether an emergency doctor or the campus first responder team is called. • Call first aider or provide first aid yourself.
Case of fire Fire service: 112	• In case of fire or burnt smell, immediately break and sound fire alarm or call fire service. • Warn co-workers. • When the fire alarm sounds, immediately evacuate the building. • Try to extinguish fire with hand-held fire extinguisher, but only if riskfree.
Violent criminal Police: 110	• Lock doors and barricade yourselves! • Police emergency number: 110. • Do not touch any weapons! • Try to flee only, if possible without risk! • Report to rescue workers after escape!
Hazardous substances Control room: 22222	These are, among others: • Leaked chemicals, smell of gas or chemicals. • Close off danger area. • Remove hazard. • If necessary, call control room for help or in case of a significant leakage directly call the fire service (112).
Radioactive substances Control room: 22222	• Close off danger area. • Remove hazard. • If necessary, call control room for radiation protection officer.
Infectious substances Control room: 22222	• Close off danger area. • Remove hazard. • If necessary, request biological safety officer via control room or directly call rescue service (112).
Technical defects Control room: 22225	These are, among others: • Malfunction of ventilation or lift, burst pipe, power failure. • Notify caretaker or control room.
Other disruptions of normal operations Control room: 22225	These are, among others: • Damaged traffic routes, icicles above traffic routes. • Suspected burglary, vandalism. • Notify caretaker or control room.

Own location (building/room)	First-aider / fire safety assistant	Contact in case of defect	Responsible caretaker

Stand: 11 / 2022

4.2. Fire

- Call 112!
- Protect people before protecting property.
- Fight only incipient fires and only without endangering yourself.
- Experiments should be stopped immediately, gas and electricity should be switched off by emergency stop and, if necessary, water should be switched off (cooling water should continue to run).
- Open doors and windows must be closed.
- Do not use lifts in case of fire.

4.3. Accidents with hazardous substances

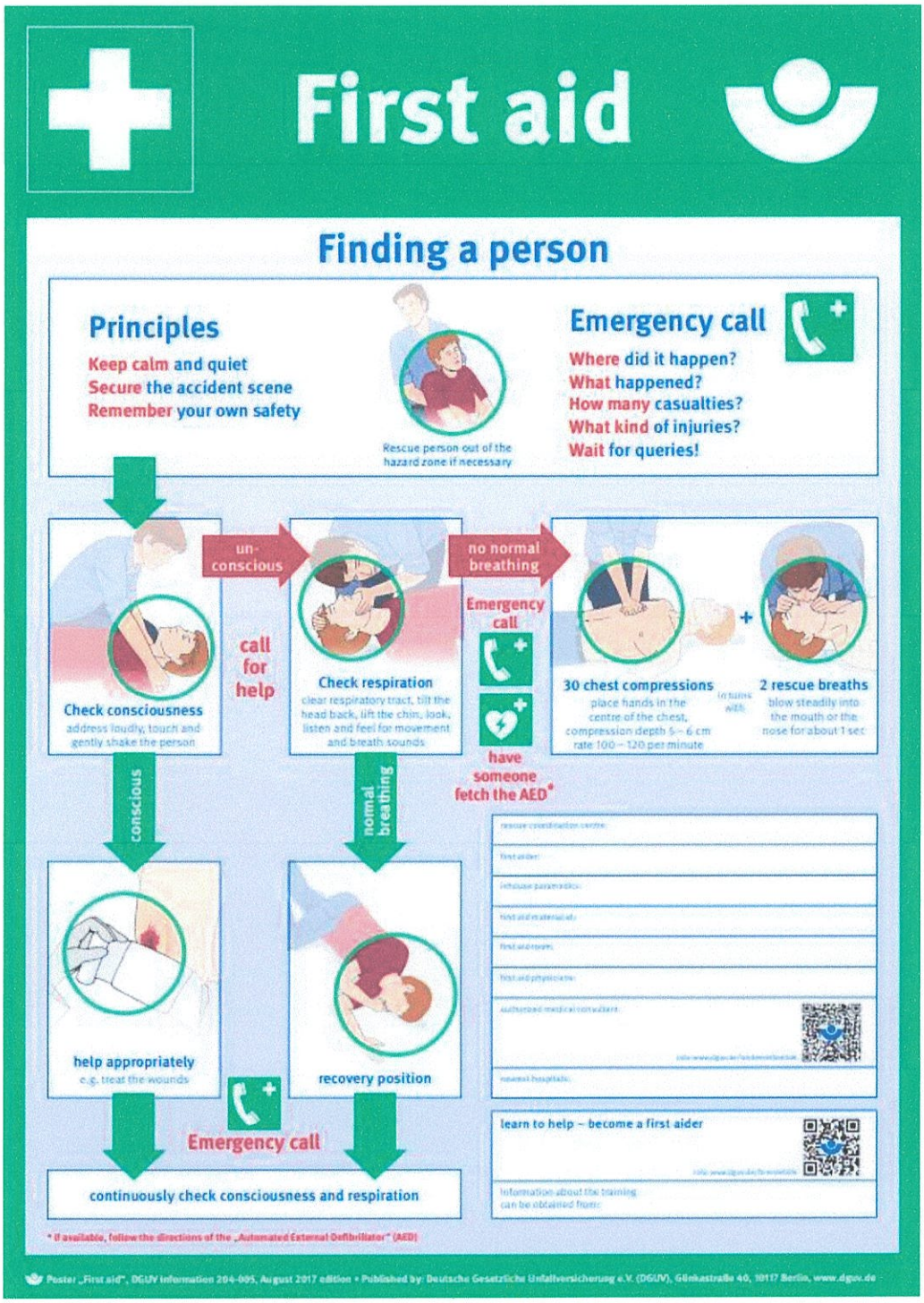
- In case of accidents involving hazardous substances, consult a doctor or the emergency ambulance, depending on the degree of severity and the hazardous substance. In severe cases, call 112! The safety data sheet must be kept at hand for the attending doctor.
- An accident report must be prepared afterwards.

4.4. Leakages or accidents involving hazardous substances and gases

- Protect people before protecting property.
- Close gas valves / activate emergency stop.
- Ensure good room ventilation (open windows, switch on ventilation system).
- Liquids should be absorbed with a suitable binding agent (Chemizorb). Contaminated binding agent is disposed of as hazardous waste.
- In case of spillage of flammable liquids, avoid sources of ignition.
- Follow the safety Instructions for the hazardous substances concerned.
- For gas sensors connected to the control room, alarm plans for further action were drawn up in cooperation with Dept. V-3.

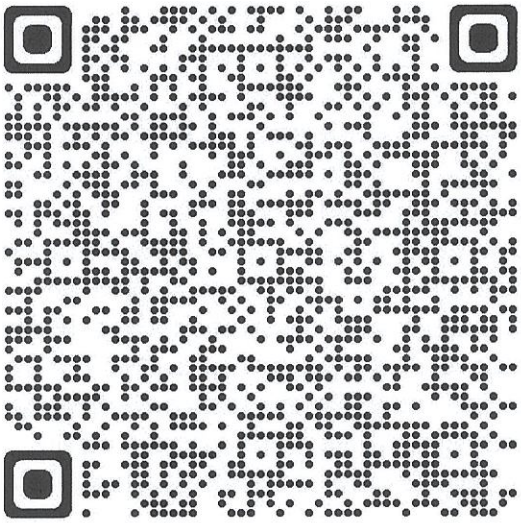
5. First aid

5.1. First aid general



5.2. First aid in case of accidents involving chemicals

- Ensure your own safety when providing any assistance.
- In case of contamination of clothing, the clothing must be removed.
- In case of skin contact, flush hazardous substances with plenty of water or use the emergency shower.
- In case of eye burns, use an emergency eye wash to flush the injured eye for 10 minutes or longer with the eyelid spread.
- Clean uninjured skin with water and soap; in case of poorly water-soluble substances, wash them off the skin with polyethylene glycol and rinse with water.
- Call 112 or, in less severe cases, contact the company doctor and provide information for the doctor (indication of chemicals, safety data sheets, symptoms of poisoning, treatment, leaflet).
- Secure vomit and chemicals.
- Take appropriate first aid measures in case of poisoning with hydrofluoric acid:



https://www.uni-ulm.de/einrichtungen/zuv/hauptseite-dezernat-v-gebaeudemanagement/abteilungen/arbeits-und-umweltschutz/gefahrstoffe-und-gefahrgut/flusssaeure/

5.3. First aid in case of persons on fire

- Extinguishing personal fires with body safety showers
- If the use of body safety showers is not possible, persons should be extinguished by spraying with a CO2 fire extinguisher from 1.5 m away. Do not aim permanently at one spot and never at the face.

6. Proper disposal

The **Regulations for the avoidance and disposal of hazardous waste** ("Ordnung zur Vermeidung und Entsorgung von gefährlichen Abfällen") of Ulm University as well as information from safety data sheets are to be applied.

6.1. Reduction of waste

The smallest possible quantities of hazardous substances should be used and procured for preparative and analytical work and research in order to ensure occupational safety and environmental protection.

Before disposing of qualitatively sound hazardous substances in original containers, these are to be offered via the chemicals exchange (DaMaRIS) for a period of one year.
Before purchasing a hazardous substance, the chemicals exchange should be checked and, if possible, a new purchase avoided.

6.2. Waste management

1. Collection point and documents

Hazardous waste can be dropped off every Tuesday and every Thursday from 10:30 to 11:30 a.m. in room 194, building part O26.
The transport service is responsible for the Safranberg and Michelsberg hospital areas.
Chemical transport for the off-campus facilities takes place every Tuesday and every Thursday morning by arrangement with the staff of the waste management department.

Necessary documents, i.e. the consignment note (document proving the disposal of hazardous waste) and the template for filling in the labels for disposal canisters, are provided by the staff of Dept. V-5 Waste Management and the associated website.

2. Hazardous substances

Hazardous substances that are no longer needed are collected and disposed of separately by waste type in closed containers. The canisters and collection containers issued by the waste management department are used.

Reactive hazardous substances such as alkali metals, peroxides, hydrides, azides, etc. must first be inactivated by conversion to less hazardous substances before disposal. This must be carried out expertly. If consultation is necessary, this can be obtained from the University's hazardous substances officer.

3. Glass and cannulae

Broken glass must be collected and disposed of in suitable containers. Contaminated broken glass must, if necessary, be disposed of in accordance with the aforementioned regulations for hazardous substances (deactivation).

7. Consequences of non-compliance

Non-compliance with the instructions may result in damage to health and property.
Damage caused as a result of intentional or grossly negligent non-compliance with the laboratory rules shall be considered to be at the expense of the laboratory employee causing the damage. The statutory provisions apply to liability issues.

In the event of non-compliance with the laboratory rules by laboratory employees, the responsible superiors and the laboratory management authorised to issue instructions reserve the right to take appropriate disciplinary measures, such as expulsion from the laboratory or, in particular, a disciplinary warning in the event of repeated cases.

02/05/23

Universität Ulm
Institut für Quantenoptik
Direktor: Prof. Dr. F. Jelezko
Albert-Einstein-Allee 11
D-89081 Ulm