

Specific Safety Regulations for the Division of Nuclear Physics

Introduction

This document contains specific safety regulations for the Division of Nuclear Physics, including rules and advice relating to the work environment. Special emphasis is placed on matters concerning personal safety.

All employees shall have read and understood the information in this document. This is to be certified by signing the form “Declaration”. This Declaration is to be repeated every year, at an annual information meeting organized by the Executive Committee.

This document is updated at least annually and when otherwise necessary (employees will be notified via email). You are invited to make suggestions for the improvement of this document.

Some links go to the nuclear physics' internal website, which requires you to be logged in with LUCAT. Therefore, first go to <http://www.nuclear.lu.se/> and log in to the internal pages.

The Department of Physics is engaged in systematic efforts in the areas of occupational health and safety, and the working environment (see the Department's intranet, <https://www.lth.se/fysikintra/organisation/arbetsmiljoe/> (in Swedish)). All employees are required to follow the General Rules for the Department of Physics and the Occupational Health and Safety Act in both teaching and research laboratories.

Mattias Olsson can help you when you need to use the chemistry labs at the Division of Nuclear Physics. Before being given access to the chemistry labs, you must have gone through the Division's Specific Safety Regulations with Mattias (this document) and have signed the corresponding declaration. Note that all use of chemicals and gas requires that a risk assessment be completed (see below).

Göran Frank is the Division's fire protection manager and director of flammable goods.

When working in the aerosol lab at IKDC, separate safety regulations must be followed. The superintendent of the aerosol lab, **Patrik Nilsson**, is responsible for occupational health and safety. Risk assessments should be reported to him. Before being allowed to work individually in the aerosol lab, the safety course organized by the superintendent must be completed. Work at Hyltemossa also falls under the regulations that apply to the aerosol lab. See also <https://www.cast.lth.se/>.

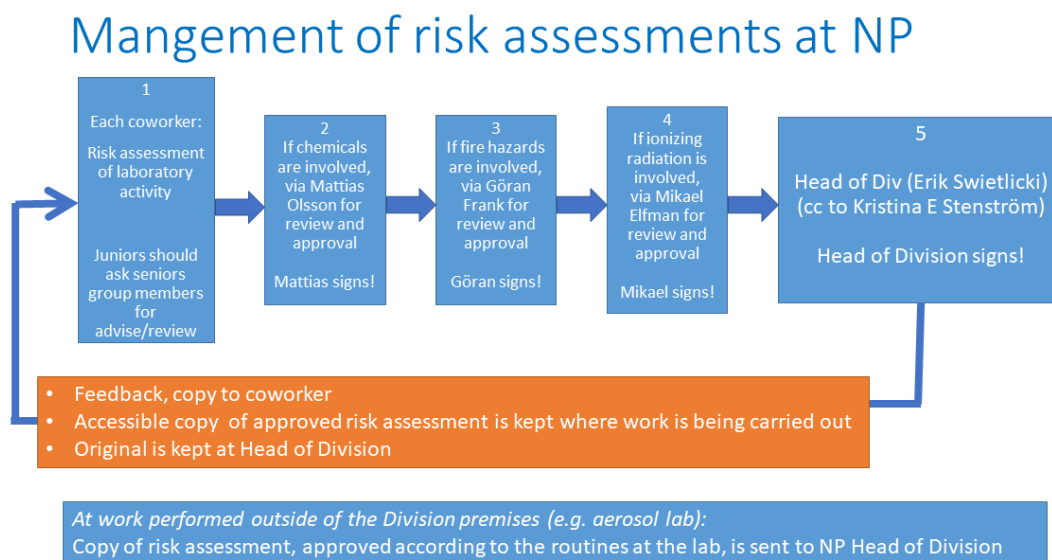
When working in the Microbeam hall, separate safety regulations must be followed, in particular regarding radiation safety. **Mikael Elfman** is responsible for occupational health and safety, including risk assessments for work at the Microbeam hall as well access to the lab (by the LU access card). Before being allowed to work individually at the microbeam hall, radiation safety instructions must be gone through with **Mikael Elfman**, who is the Division's radiation safety officer. The University's central radiation protection course must also be completed (see General safety regulations).

When working at external research establishments or other departments within the University, the local safety regulations must be followed.

Risk assessment

Risk assessment should be carried out in all cases where there is a risk of occupational injury, but also in other cases, for example, the risk of theft and computer hacking. Risk assessment must be carried out for each doctoral project and for laboratory practicals in undergraduate teaching. The Head of Division is responsible for ensuring risk assessments are carried out, and he or she should be able to be present them to the Head of Department.

The figure below summarizes the handling of risk assessments at the Division of Nuclear Physics (NP).



Risk assessments are to be carried out for all laboratory activities, as described below.

1. When starting a new project that may be associated with significant new risks, a written risk assessment of the project must *always* be made. This risk assessment is only valid for 1 year, and must then be updated. Material data sheets must not be older than 3 years when the risk assessment is made.
2. Risk assessment of laboratory operations should normally be made by the person who is to perform the work and in the system for management of chemicals KLARA. If there is a change in personnel, a new risk assessment should normally be made.
 - Contact **Mattias Olsson** regarding the risk assessment of chemical hazards. Risk assessments are to be reviewed by Mattias Olsson and approved by the Head of Division before work commences.

- Contact **Mikael Elfman** regarding the risk assessment of ionizing radiation. Risk assessments are to be reviewed by Mikael Elfman and approved by the Head of Division before work commences.
 - Contact **Göran Frank** regarding the risk assessment of flammable goods. Risk assessments are to be reviewed by Göran Frank and approved by the Head of Division before work commences.
3. When the risk assessment is made by someone other than the person who is going to perform the work, the person making the risk assessment is responsible for ensuring that the person who will carry out the work has read and understood the risk assessment, signs a declaration to this effect, and agrees to comply with the measures set out in the risk assessment.
 4. *The original* is to be kept by the Head of Division.
 5. A *copy* is to be kept so that it is readily accessible in the area in which the work is being carried out.

Help in performing and documenting risk assessments

Help in performing and documenting risk assessments can be found on the Division's intranet: (<http://www.nuclear.lu.se/hms/>). A template that can be used to document risk assessments is also available there. Make sure to take into special consideration risks associated with power failure, ventilation loss, working alone, and evacuation of premises.

For more information on how to formulate risk assessments, see The Swedish Work Environment Authority's checklist:

<https://www.av.se/globalassets/filer/checklistor/hantering-av-kemiskt-amne-riskbedomning-checklista-2011-03-15.pdf> (in Swedish).

Procedures and rules for all laboratory work at the Division of Nuclear Physics

General rules

- A risk assessment must be carried out before commencing new experiments or any new activity (see below). The validity of the risk assessment is 1 year.
- Use fume hoods and protective equipment, such as hearing protection, safety glasses, lab coat (cotton), respiratory protection and protective gloves, if not obviously unnecessary. Make sure the exhaust fan in the fume hood is working. When handling chemicals it is good practice to assume that they are all dangerous and harmful to health. The product data sheet provides more information on the material.
- The fume hood in B116 is shared by several divisions and research groups. If you need to use the fume hood, check that it is available in good time before starting work.
- The fume hood in B116 is equipped with an electric interlock. Note that only one of the two fume hoods in B117 is equipped with an electric interlock. Flammable goods may

only be used in the electrically locked fume hoods. Read the instructions for the fume hood air flow panel (Flowcheck V) before you start working in the fume hood.

Instructions are available in the lab.

- If the ventilation in the fume hoods is stopped or limited (alarm will be triggered) the laboratory must be evacuated immediately if the fume hoods contain hazardous chemicals that can present a risk at limited ventilation.
- It is forbidden to eat, drink, smoke or use snuff (*snus*) in the laboratory, and to apply cosmetics (including lip balm and hand cream or moisturiser).
- Clean lab coats are available for loan in the chemistry laboratory. Lab coats must not be worn outside the laboratory to prevent contamination of the workplace. Wash your hands after working in the lab.
- Gloves must not be worn outside the laboratory to prevent contamination.
- Contaminated protective clothing must be discarded or sent to the laundry. Contact Mattias Olsson if pollution involves health risks or risks to the environment.
- Eyewashes and full body showers are available in chemistry lab. Use them immediately if an accident occurs. The eye washes and emergency showers are checked once a year by Mattias Olsson.
- You must not work alone if dangerous operations are involved.
- When working with particularly dangerous chemicals, tasks or dangerous equipment, other personnel must be informed. If possible, no other work should be done in the lab in the meantime. Contact the lab manager before starting the work to plan the work. Affected employees must be notified in advance and information must be posted in the lab.
- Master's students may only perform laboratory work during normal working hours.
- If an experiment continues overnight or at weekends, the name and telephone number of the person responsible must be provided, together with the length of the experiment, on a notice in the lab.
- All incidents and occupational injuries must be reported to the Head of Division.
- All experiments must be clearly labelled with the name of the contact person.
- The labs must be kept clean. Equipment no longer in use must be put away. Keep the floor as clear as possible. Make sure cables etc. do not present a tripping hazard.
- Return equipment to its proper place after use.
- Always ask permission before borrowing equipment from any of the labs. The name of the person responsible for the lab is written on the lab door. Write a list of what you have borrowed (name, date, what has been borrowed).
- Equipment that is broken or behaves abnormally must be labelled, and the head of the research group informed.
- Electric hotplates and water baths must always be fitted with a timer. Electric hotplates must always be placed on a non-combustible surface. Ensure that there is a free space of at least 50 cm above any hotplate. Water baths must be made of metal and be equipped with overheating protection.

- Corridors are escape routes and must not cluttered with equipment, cupboards or appliances, etc.
- Make sure that you are acquainted with fire safety in the lab before you start any work.
- Windows must not be opened in B116 and B117.

Chemicals

- All newly purchased chemicals must be reported to Mattias Olsson. Enter name of purchaser, chemical name, CAS number (if available), number of cans / bottles and quantity. Storage location depends on the chemical's properties and is decided by Mattias Olsson. A chemical must not be moved permanently from one storage location to another before it has been discussed with Mattias Olsson.
- When purchasing chemicals that can be used in the manufacture of explosives, so-called explosive precursors, a product declaration is required. The product declaration is sent from the supplier and filled in by the buyer according to [instructions on the employee website](#). Examples of chemicals covered by the requirement are nitric acid > 3% by weight, sulfuric acid > 15% by weight and hydrogen peroxide > 12% by weight.
- Chemicals or other products that are directly imported, i.e., imported without going through a Swedish retailer or otherwise obtained outside Sweden's borders, may be subject to notification.
- When transporting dangerous chemicals inside or outside the laboratory use a suitable container, such as a bucket containing chemical absorbents intended for this purpose. When moving flammable goods between laboratories, there is special equipment and routines. See more under the heading flammable goods.
- The transport of personnel in the lift (elevator) together with dangerous/flammable substances is prohibited.
- Chemicals should be stored in ventilated chemical cabinets, not in the fume hood.
- All solutions/samples must be labelled with the contents, any necessary hazard symbol, the name of the owner and the date.
- A list of all the chemicals stored in a cupboard must be affixed to the cupboard.
- Only chemicals in use may be left standing on the laboratory bench. Chemicals/containers must not be stored on the floor.
- Chemicals/waste in fume hoods must be kept on trays so they cannot run down the drain. Waste is to be dealt with or sent for destruction/decontamination regularly so that large amounts of waste are not stored at the lab. Consult Mattias Olsson on storage until waste is collected or dealt with.
- Doors close to fume hoods or drawbenches must remain closed to ensure proper ventilation.
- On completion of the project, samples/waste must be dealt with by the person who carried out the experimental work. Chemicals that are no longer in use are to be returned to the respective stores. If samples etc. are to be saved, they must be labelled with the name of the supervisor or project manager.

- Work involving CMR compounds (Cancerogenic, Mutagenic, and toxic for Reproduction) requires a special investigation. A register of persons working with CMR compounds should be kept.
- Before working with epoxy (also in small amounts) a special education, given by LU-Bygg, is required.

Spills and waste

- Waste must be handled according to specific regulations (contact Mattias Olsson). All waste sent for destruction/decontamination should be documented at the Division.
- If specific measures or protective equipment are needed to clean up spills, this must be noted in the risk assessment.
- Spills should normally be wiped up immediately. If you are unsure of what to do, contact Mattias Olsson. In the event of a major spillage call the emergency services (tel. 112, NB: dial '0' first for an outside line if you are using an internal phone).
 - Liquid chemicals:
 - The chemical lab has buckets of vermiculite for the absorption of liquid chemical waste. **Note that vermiculite is not suitable for all types of chemicals, for example hydrofluoric acid and chemicals that react with water.** The risk assessment must tell what kind of absorbent should be used.
 - In the accelerator lab you can find absorbent and some related equipment (marked: Spillkit) close to the chemical cabinets.
 - After absorption sweep up the absorbent, place it in the appropriate container with the correct labelling, and treat it as hazardous waste. Use masks as vermiculite tends to form dust.
 - Small spills are to be wiped up with paper towels that should be dried in a fume hood before being disposed of in hazardous waste containers.
 - Solid chemicals:
 - Harmless chemicals are to be swept up or collected with paper and sorted.
 - Chemicals that are poisonous, corrosive, oxidizing, etc. are to be collected with paper towels and placed in the appropriate containers with correct labelling, and handled as hazardous waste (collection by SYSAV Kemi).
 - In the event of a major spillage: block off the area and inform those in the vicinity. Evacuate if necessary. If flammable solvents have been spilled check whether there is any electrical equipment running nearby which may cause sparking and, if possible, turn off the equipment, or the main switch to the lab. Call the emergency services tel. 112 (NB: dial '0' first for an outside line if you are using an internal phone).

Gases

- Gather as much information as possible about the gas you are going to work with. Study the safety data sheet carefully. If you have any questions, contact the gas supplier.
- Gas cylinders must be anchored in approved stands during both transport and storage. Gas cylinders are to be transported on carts intended for this purpose. The reducing valve must

be removed prior to transport. Valves should be handled with care, and must not be exposed to shock or impact. Gas cylinders are extremely dangerous if the neck/reducing valve is broken off, for example, if the cylinder falls. They must not be placed so that they are exposed to heat, or so that they can be knocked over. They should therefore always be chained (but not around the valve) – in such a way that they can be quickly removed – or on wheeled stands for gas cylinders.

- Check that you have the correct gas cylinder and valve or reducing valve. Gas cylinders may only be connected to a reducing valve with the same gas name as indicated on the bottle. Note that only hoses approved for connection to gas cylinders may be used.
- Gas hoses must not be left on the floor (tripping hazard).
- Pipelines to gas cylinders must be leak-tested, and these tests documented annually, after long breaks in work, and when changing a gas cylinder.
- Doors to rooms in which gas cylinders are stored are to be marked with the appropriate hazard sign for gas cylinders. This information is important for fire fighters in the event of fire.
- Flammable gases must be kept in ventilated spaces intended for the purpose, alternatively outdoor in the special location for gas bottle storage.

See also the National Board of Occupational Safety and Health regulations on the handling of gases: <https://www.av.se/arbetsmiljoarbete-och-inspektioner/publikationer/foreskrifter/gaser-afs-19977-foreskrifter/> (in Swedish).

The General Safety Regulations for Laboratories are always to be followed: https://www.nuclear.lu.se/fileadmin/nuclear/HMS/old/Generella_saakerhetsfoereskrifter.pdf (in Swedish).

Flammable goods

Flammable goods include flammable liquids and gases as well as fire reactive substances as hydrogen peroxide, organic peroxides and ammonium nitrate.

Flammable goods may be used in these laboratories:

- NUSTAR lab, room B118 and B119: Only ethanol and acetone in small volumes.
- Chemistry lab, room B116
- C-14 lab, room B117
- Accelerator lab, room E106, E107, E108

Work with flammable goods poses special risks and therefore there are specific instructions for handling and storage. Instructions can be found in the laboratories. Before working with flammable goods you must read the relevant parts of these instructions.

There are special instructions for ether (diethyl ether) as ether can form peroxides which can cause risk of explosion.

Flammable goods must be stored in ventilated cabinets. In NUSTAR lab may minor volumes be stored at the specially marked shelf. In the C-14 lab, the chemistry lab and the accelerator lab there are special cabinets for flammable goods.

Flammable goods placed on tables, benches, in experimental set-ups etc., must be limited to the daily consumption. OBS: This is also valid for small wash bottles e.g. with ethanol and acetone. After finished work, the flammable goods must be brought back to the storage location.

By transport of more than 1 litre of flammable goods (outside of the laboratory), a special wagon must be used. A transport wagon can be borrowed from the physics department post room (room C272, close to the reception).

Read more about use of flammable goods in laboratories here (unfortunately only in Swedish): <http://www.nuclear.lu.se/fileadmin/nuclear/HMS/hantering-pa-laboratorium-brandfarliga-varor.pdf>

For questions regarding flammable goods, contact the Division's manager of flammable goods Göran Frank.

Ionizing radiation

According to the University's common rules, everyone who handles radioactive sources, or stays in areas with elevated radiation levels, must have undergone the University's general radiation protection course or equivalent in-house training, and take part in the local radiation protection rules. A passive dosimeter must be worn during all work involving ionizing radiation. In the Microbeam hall, an active Electronic Personal Dosimeter (EPD), with pre-set alarm levels, must also be worn. Information regarding the University's general radiation protection course can be found here:

<https://www.hr-webben.lu.se/arbetsmiljo/stralsakerhet/joniserande-stralning>

Handling and disposal of radioactive waste: contact Mikael Elfman.

The Lund University management system for radiation protection (2020) regulates e.g. the required content of the mandatory radiation protection binder which must be located immediately inside the door to a space where radioactive sources / X-ray equipment / or laser equipment are handled and used. The content of the binder is commented on during the mandatory tour that precedes activation of access to the microbeam laboratory. In the near future, the instructions will also be posted in English (with the 2020 version).

Link to Lund University management system for radiation protection can be found here (in Swedish): <https://www.hr-webben.lu.se/arbetsmiljo/stralsakerhet/joniserande-stralning>

When working with radioactive samples or materials in the aerosol lab the regulations that apply to the aerosol lab must be followed (consult **Patrik Nilsson**).

Radioactive materials

All radioactive materials are to be stored in designated areas, accompanied by a list of the materials. Dose rates must be stated in the list.

Radiation dose

In all work activities, the radiation dose to humans must be as low as reasonably achievable (ALARA).

Risk assessments must include information on nuclide, activity and estimated dose rate (e.g. at 10 cm and 1.5 m, use eg <http://www.radprocalculator.com/Gamma.aspx>). Radiation physics uses this!

Accelerators

All those working at the **Microbeam accelerator** must have a passive integrating dosimeter as well as an active dosimeter with an alarm function (EPD, sensitive to gamma and neutrons). Both these dosimeters must be worn when in the vicinity of the accelerator. When working at other accelerators, in Sweden or abroad, you must follow the local radiation protection regulations.

When experiments are being carried out at the microbeam accelerator, **an operator responsible for the running of the accelerator** must be present. The task of this person is, among other things, to ensure compliance with the radiation protection regulations. This person also determines who has access to the accelerator hall.

Special rules apply for using deuterium beams, see SOP instructions.

An **operating log** is to be kept, including information on the kind of particles accelerated, the terminal voltage, the beam current, the target material and the name of the operator responsible, so that it is always clear when the accelerator is running who is responsible for radiation protection. Observations relevant to radiation protection should also be recorded.

When working alone with the microbeam accelerator a fall alarm must be used.

Visitors and student groups must be logged in a journal, which can be found at the dosimeters. An EPD is awarded to each visitor. Name, social security number, and dose are registered for visitors and students.

Rotating machines/tools

If a workpiece is not properly secured, it may rotate due to the force of the machine bit, and can lead to serious injury. Machines may only be used after appropriate instruction and permission has been granted for their use.

Heavy lifts/ladders

Be careful when lifting heavy objects or climbing, e.g., a ladder. Ask a colleague for help rather than run the risk of injury.

Electric shock

Be extremely careful with custom-built equipment, such as electric ovens, pumps, and variable voltage transformers, where faults can easily arise. Check that all equipment is properly grounded. If the plastic jacket on a high-voltage coaxial cable is defective or incorrectly fitted in SHV, MHV, or BNC connectors, the voltage can be such that it appears that the equipment is grounded. Reduce the voltage before removing such contacts. According to new regulations, a circuit breaker must always be used in sockets on lab benches.

Custom-built equipment intended for use in the aerosol lab must be approved by **Patrik Nilsson** before use.

For instructions on what to do when someone has suffered an electric shock, see https://www.nuclear.lu.se/fileadmin/nuclear/HMS/old/Livraeddning_vid_elskada.pdf (in Swedish) under the HMS tab on the Nuclear Physics intranet.

Liquid nitrogen

- Contact with liquid nitrogen can cause frostbite on the skin and eyes. Splashing liquid nitrogen in the eyes can lead to permanent damage. Therefore, always wear protective gloves and safety glasses when handling liquid nitrogen. The gloves should have collars (not elasticated tops), they should sit loosely, and be sufficiently rough to give a good grip. The material of the outer surface of the gloves should not become brittle at low temperatures, and the surface must be sufficiently watertight to prevent liquids from penetrating the gloves. Wear proper shoes not sandals.
- To get access to liquid nitrogen an education is required (given at the Department of Physics). You will then get access to the liquid nitrogen room, Q177.
- Liquid nitrogen must not be stored in sealed containers as there is a risk of explosion due to excess pressure.
- Vessels containing liquid nitrogen must be labelled.
- Ensure there is adequate ventilation when storing and handling liquid nitrogen as evaporation can cause suffocation.
- The transport of personnel in the lift (elevator) together with liquid nitrogen is prohibited because of risks resulting, for example, from a power failure. Two people should transport liquid nitrogen when using a lift: one on each floor.
- Ensure that vessels containing liquid nitrogen cannot tip or be overturned during transport or storage.
- Oxygen from the air can condense on the exterior of uninsulated equipment for liquefied gas that has a temperature below the boiling point of oxygen (about $-183\text{ }^{\circ}\text{C}$), for example, liquid nitrogen at low pressure. This leads to the enrichment of oxygen on the equipment, which can lead to an increased risk of fire. There is also a risk of ice forming on the outside of the equipment used for liquefied gas at temperatures below $0\text{ }^{\circ}\text{C}$.

Power outages

The following measures must be taken to reduce the consequences of a power failure.

- Only experienced personnel may start up the accelerator after a power failure.
- Machines that may be dangerous when restarted and equipment that can be damaged by an intermittent power supply must be equipped with no-volt protection.
- Information on the expected duration of power cuts during normal working hours, 08.00-16.30, can be obtained from the University switchboard by dialling 99 or +46 46 222 00 00. Outside normal working hours, contact Securitas, extension, 20700, or + 46 46 22 20700.

Reporting incidents

All accidents and incidents, and events that could have become incidents, are to be reported. This is an important part of work preventing risks. When you report incidents, you participate in preventing someone else from being injured.

Instructions on how to report incidents can be found at <https://www.hr-webben.lu.se/arbetsmiljo/tillbud-och-arbetsskada>

Ask for help from your safety representative when writing your report. An incident report can be made anonymously.

Serious occupational injuries must be reported to the Swedish Work Environment Authority within 24 hours.

Work injuries and incidents that include flammable goods must be reported to Räddningstjänst Syd. Göran Frank will help you. Forms for registration are available at <https://www.rsyd.se/foretag/brandfarlig-vara/>.

Erik Swietlicki

Head of Division

Dirk Rudolph

Deputy Head of Division

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Deputy Head of Division

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