Information mainly to teaching assistants (TA) handling radioactive sources in the student laboratory at Fysikum, Stockholm University

(update 2024-11-29)

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1. Education

a. Central SU course

All employees handling radioactive sources or working where ionizing radiation (above background) is present, must take the central course in radiation safety. The course is held twice a year and information is sent out by e-mail.

b. Safety introduction to new PhD students

All PhD students must have participated in the Introduction course (where radiation protection is a part), link:

Introduction to Doctoral Studies at the Department of Physics – itslearning

c. Introduction to safe practice in handling of sources

The radiation protection contact person at Fysikum is notified by the assistant director of studies if new TAs will work with labs involving ionizing radiation. If so, an information class about practicalities can be arranged in House 1.

2. Risk assessment of your lab exercise

A risk assessment for every lab exercise must be performed, and has to be updated every time the exercise is done. As TA you are involved in this process. The course responsible has access to the relevant documents. Information and templates are available here:

Råd och stöd till kursansvariga på Fysikum - Fysikum

3. Dosimeters

a. Personal dosimeter

Personal dosimeters should be worn at all times in the laboratory by the TA. If the group of students is small, everybody can be equipped. The dosimeter is checked out in room B4:0008 in the AlbaNova main building, corridor B41. Follow the check-out instructions present on the lap top. After the use, the dose obtained should be registered in an excel file.

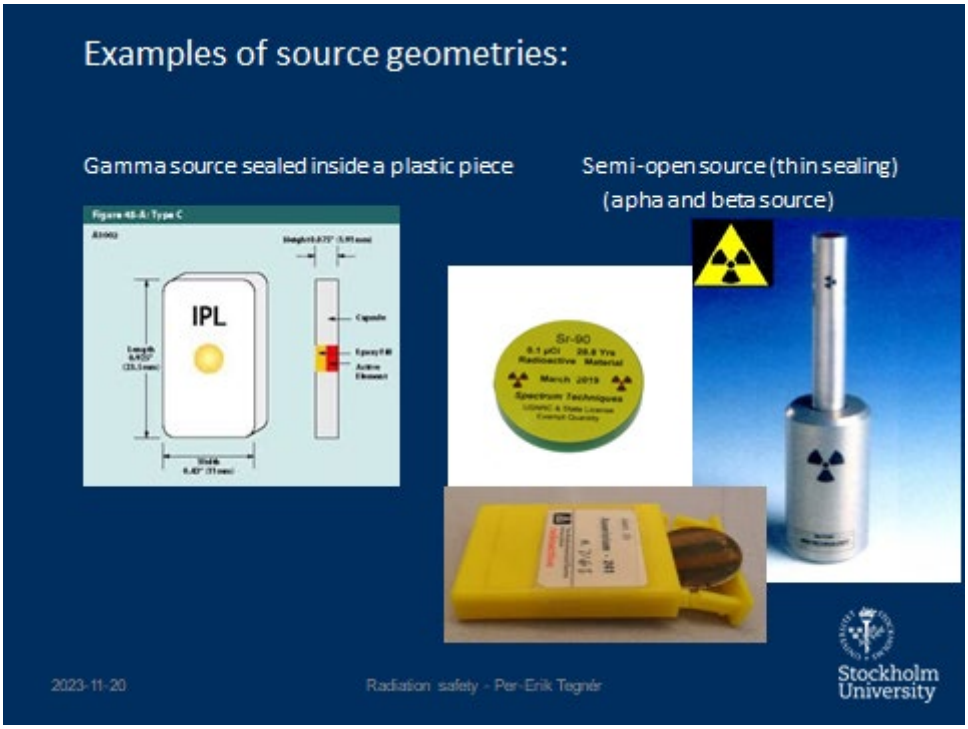
b. Hand-held dosimeter

Hand-held dosimeters are present in the source room (012:021) in House 1, and can be used to measure and thereby learn about the dose rate at different places in the lab, around an instrument/equipment etc.

4. Checking out sources for your lab exercise

a. <u>About types of sources</u>

- Gamma/beta/alpha sources for calibration and basic measurements: ~ 0,4 MBq
- High activity sources for the Compton lab (^{137}Cs): ~50 MBq
- High activity source(s) for the Mössbauer experiment (^{57}Co): ~370 MBq (when new!)
- Neutron source (Am-Be), present in the source room (House 1): ~10 GBq of ^{241}Am
- Neutron source (Ra-Be), present in a locked room in the basement of House 1: ~10 GBq of ^{226}Ra



b. <u>Checking-out system</u>

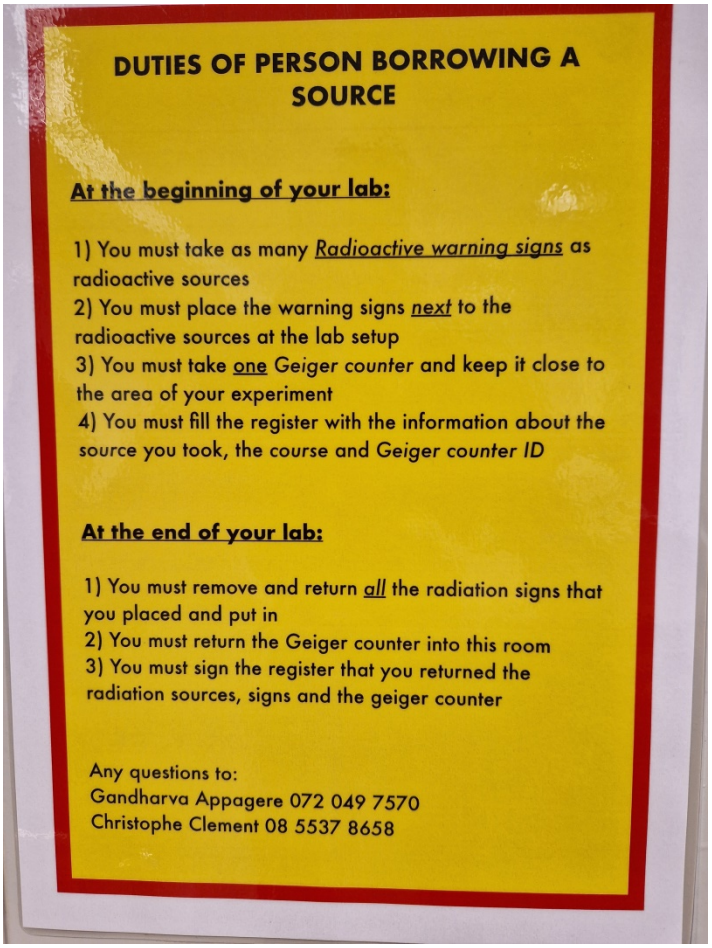
All sources for lab exercises, when not in use, are placed in the central storage at floor 0 in the main AlbaNova building. In order for the TA to collect sources needed, the sources are booked according to the information at the webpage:

Arbetsmiljö och lika villkor - Fysikum

Contact Gandharva Appagere (or Per-Erik Tegnér) if you have questions and in order to collect the sources from the central storage. In case of transporting any of the stronger sources, use lead containers and a trolley.

c. The source room in House 1 (012:021)

During the lab exercise period, the sources should be stored in the source room in House 1. When a source is to be used in a lab experiment it must be checked out by signing a list outside the source room. That procedure is specified in a note attached to the source room door, see below:



DUTIES OF PERSON BORROWING A SOURCE

At the beginning of your lab:

1) You must take as many *Radioactive warning signs* as radioactive sources
2) You must place the warning signs *next* to the radioactive sources at the lab setup
3) You must take one Geiger counter and keep it close to the area of your experiment
4) You must fill the register with the information about the source you took, the course and Geiger counter ID

At the end of your lab:

1) You must remove and return *all* the radiation signs that you placed and put in
2) You must return the Geiger counter into this room
3) You must sign the register that you returned the radiation sources, signs and the geiger counter

Any questions to:
Gandharva Appagere 072 049 7570
Christophe Clement 08 5537 8658

Instructions for checking out sources from the source room in House1.

When the lab course has ended, contact Gandharva Appagere (or Per-Erik Tegnér) for putting the sources back to the central storage.

5. Rules for working in the laboratory

a. Risk of contamination

By contamination we mean the spreading of radioactive material outside of its container.

- Sealed sources (gamma): small risk of contamination if handled correctly.
- Sealed sources for beta or alpha radiation: extreme care needed - thin sealing or protective layer. Never touch the sealing/layer, it may break and/or you may destroy the function of the source.
- Open sources: We should not handle those.
- If contamination is suspected – evacuate, report to radiation protection contact (Per-Erik Tegnér).
- Eating and drinking is strictly forbidden in the lab! Never bring food or drinks into the lab.

b. High-dose issues

Especially the high-activity ^{137}Cs sources, the Mössbauer sources and the Am/Be and Ra/Be neutron sources may cause high dose rates. The dose rate in a laboratory where personnel spend considerable time must not exceed 2 µSv/h (according to the SU radiation safety manual).

- As a TA you are responsible to check that this dose limit is respected.
- Use the hand-held dosimeter to check around the setup - make dose maps.
- Use (at least the TA) personal dosimeters.
- Keep order - you must know at all times where the sources are – everybody must be informed!
- Unattended equipment containing a source must be marked with contact information, date and time when the experiment is running.
- Sources not used cannot be left unattended in the lab – must always be stored in the source room.

Protection measures:

- If you are handling strong sources, always plan your work ahead.
- Keep the distance (dose rate is proportional to 1/distance^2).
- Limit exposure time.
- Use radiation protection if possible, e.g. lead bricks (do not drop on your feet).

c. General rules in House 1

To summarize, duties as a teaching assistant (TA):

- Inform students about good practices to minimize risks of contamination and dose exposure and look through the risk assessment together:
    - Handle sources with (extreme) care
    - Keep distance
    - Work fast but safe
    - Never eat or drink in the laboratory
    - Wash your hands when leaving the laboratory
- Inform students about acceptable dose levels (basic facts)
- The assistant must carry a personal dosimeter (if the group of students is small, each student can carry one)
- Use the hand-held dosimeter to check the dose levels.
- The TA ”checks out” sources to be used from the central storage in AlbaNova, by booking them here (Arbetsmiljö och lika villkor - Fysikum) and then pick them up with Gandharva Appagere (or Per-Erik Tegnér). Can be kept in House 1, the locked source room, during the course period.
- Unused sources during a lab period must be kept in the locked source room. It is not allowed to place them in the laboratory when you are not present (unless a measurement is ongoing or the source is mounted in a setup).
- Sources moved from the source room to the laboratory are checked out in a document outside of the source room.
- Keep track of all sources. Lock lab and source room when not present. Mark unattended equipment containing sources.
- Report accidents (e.g. a damaged source) immediately and to the university reporting system IA.
- When the lab course has ended, contact Gandharva Appagere (or Per-Erik Tegnér) for putting the sources back to the central storage.

6. Instructions related to some specific experiments/sources

a. The Mössbauer setup

The ^{57}Co source, with an initial activity of 370 MBq, is normally always mounted in the setup. When mounted, the setup should be marked correspondingly. The source is well shielded by lead bricks to the front and to the sides, but there is less shielding downwards, upwards and backwards (towards the wall). A chain around the equipment marks the area where unauthorized personnel are not allowed.

b. The Compton scattering setup

The strong ^{137}Cs source (activity around 50 MBq) in this experiment must be handled with care in order to minimize the dose. The TA is moving the source from the source room to the experiment, preferably using a plier to keep the distance, and then placing the source in the lead brick holder adapted for this purpose. Orient the holder so that the hole is not directed into the room, but rather towards a wall, so that no students or personnel are subject to a dose rate above the specified limit. The TA is checking the area around the equipment with the hand-held dosimeter.

c. The AmBe neutron sources

In the source room there are two AmBe sources with the purpose of being sources of neutrons, used for neutron activation lab experiments. The radioactive substance is ^{241}Am which is an alpha emitter, which is mixed with beryllium. The alpha particle interacts with beryllium (^{9}Be), a nuclear reaction that results in the emission of a neutron. The main dose comes from the gamma-ray emission from the daughter nucleus ^{237}Np. Since the gamma-ray energy is very low, 59 keV, it is rather easy to shield against the gamma rays. This is accomplished by water for one of the sources (owned by KTH) and by a piece of plastic for the other source (owned by SU). The main function of water/plastic is for moderating the emitted neutrons. The sources themselves are not allowed to be manipulated or removed (only by authorized personnel).

d. The RaBe neutron source

The RaBe source, which is placed in a locked room in the basement, has a similar worjing principle as the AmBe sources. However, for this source the radiation protection issue is much more severe. Even if the activity of the source, 226Ra, is similar to that of 241Am, the number and energy of the emitted gamma rays are much higher which increases the dose. The source, inside a plastic moderator, is placed behind a concrete wall, and is also shielded by lead upwards. It is used in cases where a higher neutron flux is needed.

7. Contact information

Source administration, lab equipment (Fysikum):

Gandharva Appagere, 0720497570, gandharva.appagere@fysik.su.se

Radiation protection contact at Fysikum:

Per-Erik Tegnér, 0705318013, tegner@fysik.su.se

Assistant director of studies (lab responsible, Fysikum):

Christophe Clément, christophe.clement@fysik.su.se

Lab safety coordinator at Fysikum:

Petra Björk, petra.bjork@fysik.su.se

Lab safety (SU):

Margaretha Vickes, margaretha.vickes@su.se

Radiation safety expert (SU):

Mats Jonsson, matsj@kth.se

Stockholm University Radiation Safety Manual