ELECTRICAL & RADIATION SAFETY
IN THE ADVANCED LABS
Department of Physics
University of Washington

You are required to **READ THIS ENTIRE HANDOUT and sign your name to that effect** before doing any of the Physics 433 lab work. Most of the experiments involve the use of **HIGH VOLTAGE** and **RADIOACTIVE MATERIALS**, and failure to follow safe practices with these may result in personal injury, equipment destruction, or government sanctions against the University.

NEVER WORK ALONE IN THE LAB. At least one other person must be present in the lab for you to work on any experiment or exercise.

1. HIGH VOLTAGE SAFETY & Proper Use of Electronic Equipment

To ensure your own safety and to prevent damage to equipment in the lab, certain precautions must be followed.

1. Use the correct cables. All of the high voltage (SHV) connectors at the ends of cables are marked with red to distinguish them from signal (BNC) connectors. Further, the BNC connectors do not mate with the SHV connectors, even though the connector types resemble each other. If you find that a connector will not fit a receptacle, check to make sure you have not grabbed the wrong type.

2. Before connecting or disconnecting any high voltage cable, make sure that the high voltage power supply is in the STANDBY mode. **NEVER connect or disconnect a high voltage cable with the high voltage applied.**

3. All of the devices in this laboratory requiring high voltage use POSITIVE high voltage (center connection positive with respect to ground), *except for the photomultiplier tubes on the muon lifetime experiment.* The high voltage power supplies have polarity switches for reversing the polarity of the high voltage output. The polarity switches should remain in the POSITIVE position (except on the muon lifetime experiment). **Under no circumstances change the polarity with the high voltage on, as this will damage the power supply.**

4. In this course you will be assembling photomultiplier tube (PMT)/detector combinations and then wrapping them with light tight material. Do not apply high voltage to a photomultiplier tube unless the tube and attached detector have been completely wrapped with light blocking material to prevent exposure to ambient light. If a PMT is exposed to room light with the high voltage applied, it will be ruined; a replacement costs around $400.

5. Throughout this course you will be plugging and unplugging electronics modules from NIM crates. The modules are powered from the crate through the connector at the

rear of the module. Before plugging or unplugging any module, make sure that the crate power is OFF. It is possible to damage the electronics in the modules by plugging or unplugging them with the crate power on.

6. Keep all cable ends and connectors off the floor. If cable ends or connectors get stepped on, they get out of round, and not only become useless themselves, but damage other connectors when you attempt to put them together. Connectors and cables cost anywhere from $10 to $70 each—the damage bill adds up quickly!

2. RADIATION SAFETY

Even though the radioactive sources used in this lab have relatively low activity, Washington State Law, University policy and good common sense require that you follow these rules when working with radioactive sources:

1. **Never work alone in the lab.** At least one other person must be present in the lab for you to work on any experiment or exercise.

2. **Never eat or drink in the lab.** Since the lab contains radioactive material, Washington State Law mandates that no eating, drinking, or food preparation is allowed in the lab. One of the most common ways people expose themselves to harmful radiation is by inadvertently ingesting radioactive material.

3. **Follow the principles of ALARA:"As Low As Reasonably Achievable" to minimize exposure to radioactive sources.** The ALARA guidelines focus on three modes of reducing exposure: TIME (make it small), DISTANCE (make it large) and SHIELDING (use it when time and distance are insufficient.) Here are some examples of these principles in action:

   TIME: Return all radioactive sources to the lead-lined case when you are done taking data. Do not leave the sources lying out in the lab when they are not being used. You should try to arrange your experiments so that you minimize the time that a particular source is out in the lab. For example, set up all of the other equipment and check it out for proper operation in your experiment before getting the source from the case. Then, return the source to the case as soon as your measurements are made, before you analyze the data. If you need to pause for a significant time to discuss something with the instructor or your partners, return the source to the case during this time.

   Do not handle the sources any more than is necessary. Before doing an exercise, think about how to configure the equipment with the goal of moving the source from the storage area to the experiment location with minimum fuss and manipulation.

   DISTANCE: Many of the sources are held in plastic rods at the end in a colored cap. Hold such sources by the clear end of the rod such that the source end is held away from your (and others') body. Remember that the source intensity falls off as $1/r^2$—a doubling of the source distance reduces the intensity by a factor

of four. Other kinds of sources should be handled with tweezers or tongs, when practical.

Do not touch touch the exposed part of sources. Some sources have the radioactive material deposited in a foil coating at the "front" of the source. If you touch the foil, you may contaminate yourself by rubbing the material onto your fingers.

SHIELDING: You may construct shielding enclosures with lead bricks available in the lab to protect yourself from gamma sources. These bricks have been carefully taped to avoid having the lead come in contact with the table tops. *Please place the bricks on the table so as to avoid marking or denting the table surfaces.* When handling the lead, use the gloves provided to protect yourself from getting lead on your skin.

If you wish to check the effectiveness of your shielding, you may use the survey meters kept on top of the storage case.

4. If you think there may be radioactivity where it should not be, or if you find that a source is missing, contact the professor, lab staff or TA immediately.