NERS Plasma, Pulsed Power, and Microwave Laboratory (PPML) Safety Practices

A guide to working safely in our lab

Areas to Discuss

- Lab Cleanliness and General Safety
- First Aid
- Personal Protective Equipment (PPE)
- Electrical Safety
- Chemical Safety and Chemical Waste Disposal
- Radiation Safety
- LASER Safety

Introduction

- Welcome to Michigan and to the Nuclear Engineering and Radiological Sciences Department, and to the Plasma, Pulsed Power, and Microwave Laboratory.
- The following is a basic presentation of the safety practices in PPML. It is based on standards set forth by U of M Department of Environmental Health and Safety (EHS)
- ehs.umich.edu

Overview

- All personnel working in this lab must complete the on-line Chemical Laboratory Safety course from Environmental Health Services (EHS), course # EHS_BLS025W, prior to engaging in any lab activity.
- The information provided in this presentation is specific to PPML and is not intended to supersede guidance from EHS. A more comprehensive and detailed explanation of all things safety related at University of Michigan can be found at EHS's website:
- ehs.umich.edu

Overview

- All labs at Michigan are required to have Standard Operating Procedures (SOP's). You can find lab specific SOP's for this lab in the Chemical Hygiene Plan (CHP), a large blue folder located in the book case on your right, in the alcove off the main tunnel just before entering the lab.

Overview

- You can also find hard copies of Material Safety Data Sheets (MSDS) in the CHP as well. An MSDS, sometimes called an SDS, is designed to give an individual a comprehensive understanding of a particular chemical that you may need to use in the lab. It is to your benefit to read and understand the MSDS for any chemical you will be using for the first time.

Overview

- Lastly, NO FOOD OR DRINK OF ANY KIND is allowed in the lab for any reason. This is an OSHA, MIOSHA, and EHS mandate. The purpose of this is to protect you from getting into the habit of eating or drinking in an area where you could accidently ingest something which could be hazardous to your health.

Lab Cleanliness

Lab Cleanliness

- It is everyone's responsibility to make sure that their work areas are cleaned daily of any unnecessary items such as trash, chemicals and chemical waste containers; carts, unneeded tools, etc.

- Keep your area a safe working environment, free of hazards for you and fellow lab members.

Lab Cleanliness

- Clutter can be dangerous. Looking for that certain tool that you know was “right here” can lead to an accident such as a chemical spill or the dropping of an expensive piece of equipment, and may also lead to potential injury to you or a fellow lab member.

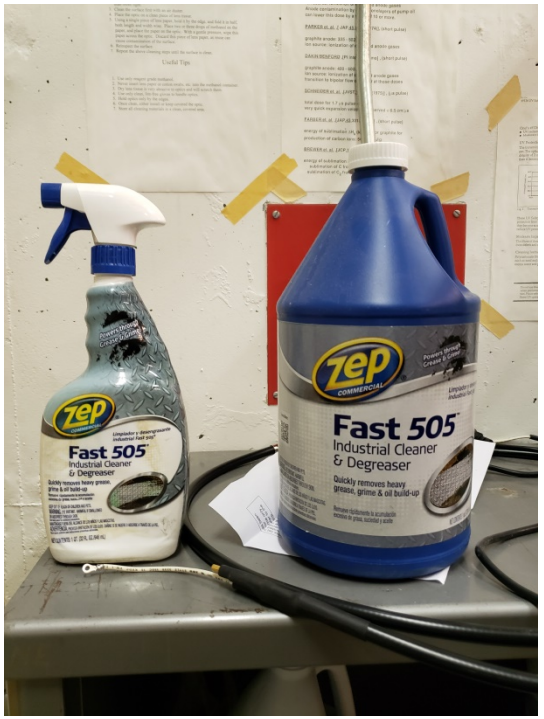
- The cleaner the lab is, the easier it is to find the things you are looking for. A clean lab is an integral part of a safe lab.

Lab Cleanliness

- Having a clean lab also presents a safe and professional looking environment for the multitude of visitors which tour our facility and department each year. It reflects positively on those visitors, our commitment to a safe space in which we conduct our research.

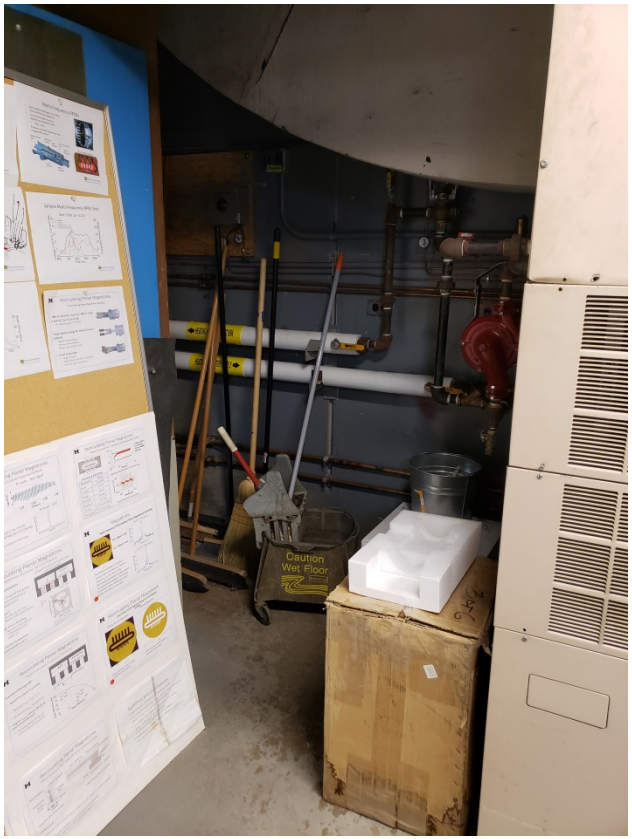
Lab Cleanliness

- General purpose cleaning chemicals like Simple Green and ZEP 505 are normally located on the shelf near the deep sink just inside the main lab.



Lab Cleanliness

- Brooms, dustpans, and mop & bucket, are located behind the MELBA screen room.



Lab Cleanliness

- Paper towels are located on top of the parts bins next to the fume hood.

Lab Cleanliness

- The paper towels and Kim Wipes are located next to each other on the parts bins. Do not use Kim Wipes for general cleaning. The are special lint free wipes used for cleaning vacuum materials and other sensitive equipment.

- Any paper towels that have been used with Simple Green or ZEP 505 are considered trash and do not need to be disposed of as Chemical Waste.

Lab Cleanliness

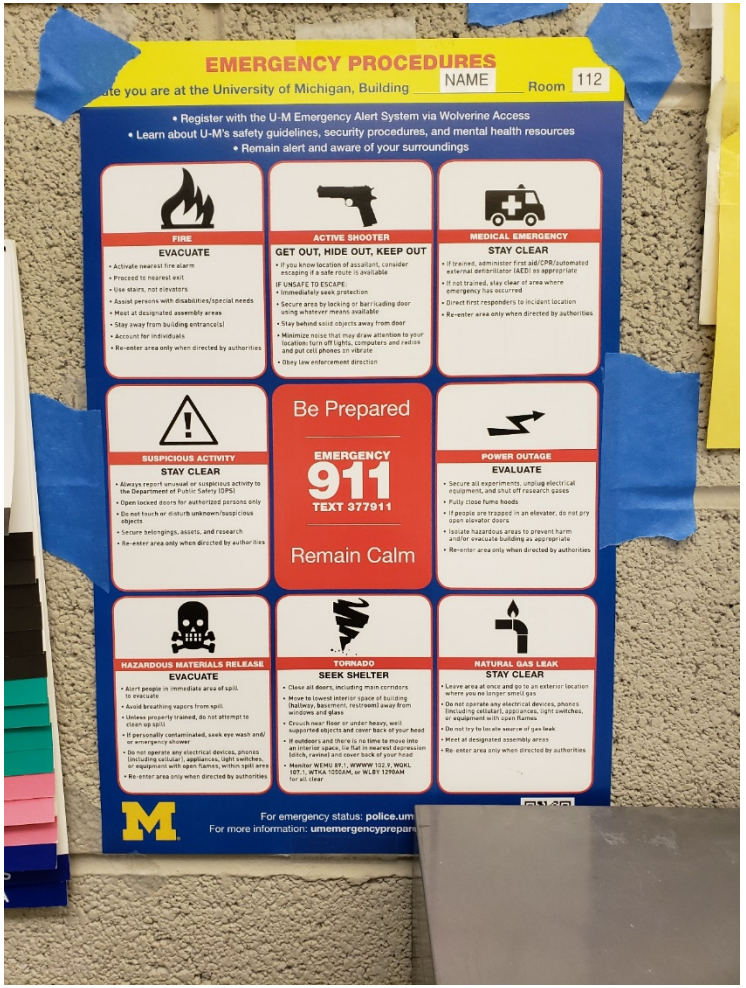
- When you are done with the cleaning supplies, please return them to their proper places so that others may easily find them when they need them.

- Paper towels that are used to pick up any chemical spill or for cleaning of chemical residue off equipment should be considered chemical waste and disposed of in accordance with UM/EHS chemical waste disposal practices.

General Safety

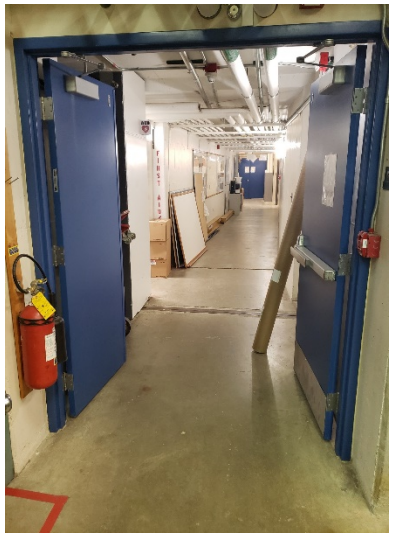
General safety

- There is a placard located just inside the front door of the lab. It gives instructions on what to do in various emergency situations. You should study it so that you will know what to do in any given situation.



General safety

- Emergency Egress:
- There two points of egress from the lab. The first being the front door and the second being the rear exit through the back of room 112C



General Safety

- In the event that you should have to leave the lab in an emergency, know your location in the lab and which exit is closest to you. Exit that location and meet with other lab members outside. DO NOT attempt to retrieve personal belongings. Our lab meets outside the NAME loading dock. You may only re-enter the building when you are told that it is safe to do so.

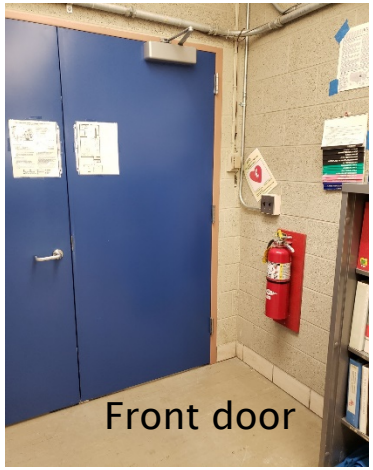
General Safety

- Fire Extinguishers.
- There are five(5) fire extinguishers located in the lab. Their locations are:
  - At the front door of the lab
  - At the lab end of the tunnel on your right
  - At the entrance to MELBA control room
  - Between Rooms 112B and 112C
  - Top of stairs of the rear mezzanine

You should familiarize yourself with their locations in the event you should need to use one.

General Safety

- Fire Extinguishers


Front door


Lab entrance


MELBA control room


112 B/C


Rear mezzanine

General safety

- In the event of a fire, only you can determine if you wish to fight the fire using an extinguisher. DO NOT be a hero.
- If you don't feel you can do it – LEAVE.
- If you feel the fire may be beyond your control – LEAVE.
- On your way out, activate the fire alarm by pulling down on the nearest pull station on your exit path. Be sure to also call 911.

General safety

- If you choose to try and extinguish the fire, grab the nearest extinguisher, pull the pin, and aim the horn at the base of the flames. Squeeze the trigger and with a sweeping motion, attempt to extinguisher the fire.
- If the fire continues to grow out of control, leave the area and call 911. DO NOT be a hero. Human life is more important than anything else.

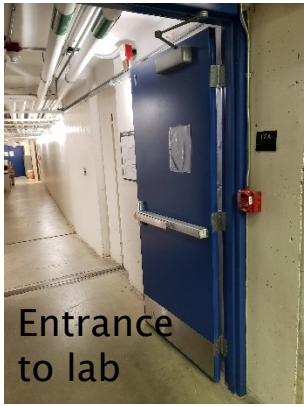
General Safety

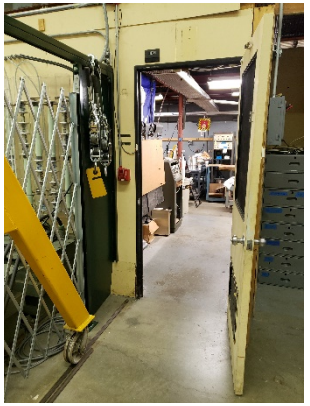
- Fire alarm pull stations.
- There are five pull stations in the lab. Their locations are:
  - At the front door end of the main tunnel.
  - At the lab end of the main tunnel, on your left.
  - On the wall next to the single door, to the right of the MELBA Marx cage.
  - In Room 112C to the left of the brown exit door.
  - At the top of the stairs behind Room 112C.

Familiarize yourself with their locations in the event you should need to pull one.

General Safety

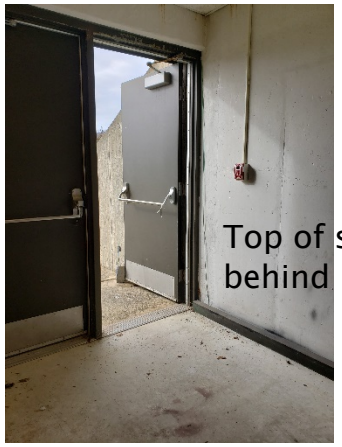
- Fire alarm pull stations





Room
112G
door

Room 112C
rear exit



Top of stairwell
behind Room 112C

General Safety

- Clothing and PPE:
- No matter the time of year, closed toed shoes and long pants must be worn in the lab and machine shop.
- Safety glasses must be worn at all times while in the lab. Safety glasses can be found on the bookshelf in the first aid/PPE alcove at the lab end of the tunnel. Take a pair and make them yours for the duration of your time in the lab.

General Safety

- In addition to safety glasses, whenever you are working with any chemicals in the lab, you should also wear a lab coat and use nitrile gloves.
- Whenever you are mixing chemicals or are working with acids, it should be done inside the lab fume hood with the sash lowered to the indicated level. The fume hood fan should be turned on by pressing the on button on the panel to the right of the fume hood.
- There are also face shields located in the first aid/PPE area should you wish to use one.

General Safety

- Occasionally, we will need to lift heavy objects in the lab, and that operation will require the use of one of the three overhead cranes. Whenever a crane is in use and an object is suspended from it, hard hats MUST be worn by all personnel in the area. Hard hats are located in the first aid/PPE alcove in the main tunnel.

General Safety

- There will be times when multiple lab personnel may be required to perform certain tasks.
- All personnel who are working as a part of that group have the authority to stop any process at any time if they feel it is unsafe.
- Work must cease at this point and a discussion as to the proper safety practices for the task is understood and acceptable to all members present. Only then may the task proceed.

First Aid

First Aid

- The lab's first aid kits, eyewash station, and AED, as well as PPE (Personal Protective Equipment) are currently located in a small alcove to your right in the main tunnel just before reaching the lab entrance.

First Aid

- Our lab has an impressive safety record but that record is only as good as the safety practices of lab personnel.
- That being said, we have two first aid kits in the first aid/PPE alcove, and a third located in room 112C, in the event of an accidental injury. These kits are complete to provide basic first aid for any cuts, scrapes, burns, or other physical injuries.

First Aid

- The first aid kits in the tunnel alcove have booklets in them giving basic information on first aid, CPR, and the use of an AED.
- If you have free time, it would be beneficial for you to look over these pamphlets.
- Performing CPR and using an AED requires training that cannot be provided in this presentation. UM offers training and it can be found at:
- https://sessions.studentlife.umich.edu/track/event/302

First Aid

- When administering first aid, you must determine if the injury is life threatening or not. If you are unsure, assume the worst and call 911. Give them the information they need. If someone is there with you, dispatch them to the outside of the building to meet with rescue personnel and show them the way to the lab.

First Aid

- If it is determined that the injury is not life threatening but requires follow on medical attention, the individual must be directed to Work Connections. A reporting form for work connections is located on the inside cover of the CHP located in the first aid/PPE alcove in the lab tunnel.

First Aid

- After the event is over, a report will need to be filed with EHS and will be reviewed by the department and CoE safety committees.
- Dr. Nick Jordan will work with you to file this report.

Personal Protective Equipment (PPE)

Personal Protective Equipment (PPE)

- The lab is equipped with various types of PPE.
- PPE in this lab include:
  - Safety Goggles (always required)
  - LASER safety goggles
  - Face Shields
  - Lab coats
  - Nitrile gloves
  - Elbow length gloves for use when needed to work or retrieve items from under transformer oil
  - Hard hats

Personal Protective Equipment (PPE)

- Safety glasses are required whenever working in the lab. Safety glasses are identified as having full lenses as well as side guards. If you wear glasses and they do not have side guards, they are not considered safety glasses.
- Safety glasses are located in the First Aid/PPE alcove in the lab tunnel. Select a pair and keep them for your use throughout your time in the lab.

Personal Protective Equipment (PPE)

- LASER safety glasses are a special type of safety glass and are treated to protect your eyes from specific light wavelengths. If you will be working with the lab's LASERs, be sure to wear the appropriate glasses for that LASER's wavelength.
- As a general rule the wavelength protection is inscribed on the edge of the glass lenses.

Personal Protective Equipment (PPE)

- Face shields are available for use in the lab.
- They are recommended for grinding operations when you do not wish to have sparks hitting you in the face and neck.
- They are required wear when moving acids between the acid cabinet and the fume hood. The acid cabinet is located on the floor opposite the fume hood.
- Face shields are located in the first aid/PPE alcove in the lab tunnel.

Personal Protective Equipment (PPE)

- Lab coats are required to be worn when working with any chemicals, especially acids.
- Lab coats may also be worn at anytime by personnel as an added layer of protection from dirt, grease, or oil.
- Lab coats are located in the first aid/PPE alcove in the lab tunnel. They come in five sizes; S,M,L,XL,XXL. Select one and keep it for your use throughout your time in the lab.

Personal Protective Equipment (PPE)

- Nitrile gloves are mandatory wear when handling acids.
- They should be worn when handling chemicals such as acetone, or alcohols such as isopropanol and methanol.
- They may be worn at anytime as a protection from dirt, grease, or oil.
- Nitrile gloves are located in the first aid/PPE alcove in the lab tunnel and come in four sizes; S,M,L,XL.

Personal Protective Equipment (PPE)

- There are special elbow length nitrile gloves available for you to wear when you need to work on equipment which may be submerged in transformer oil. They are primarily used to reduce the inconvenience of having to clean your arms of oil.
- Any disposable glove which has come into contact with acids, other chemicals, or oil should be treated as chemical waste and placed in the nearest chemical waste container.

Personal Protective Equipment (PPE)

- Hard hats are to be worn by all personnel whenever an overhead operation involving crane lifting of equipment or materials takes place.
- Hard hats may be removed once the material or equipment has been set down on the lab or mezzanine floors and the cranes have been homed and secured.
- Hard hats are located in the first aid/PPE alcove in the lab tunnel.

Electrical Safety

Electrical safety

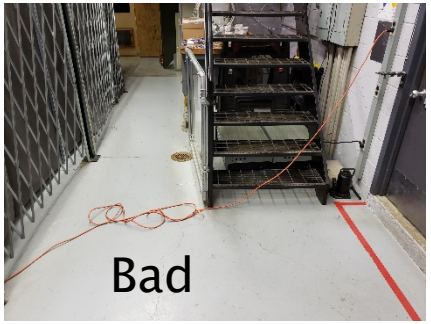
- Electrical safety is a priority in this lab because unlike other types of hazards, electricity cannot be seen.
- All major machines in this lab are interlocked to prevent them from being engaged in a high voltage mode.
- From time to time, these interlocks may need to be defeated for the purpose of troubleshooting equipment or systems. You should never defeat an interlock on these machines without proper authority and without a second person present.

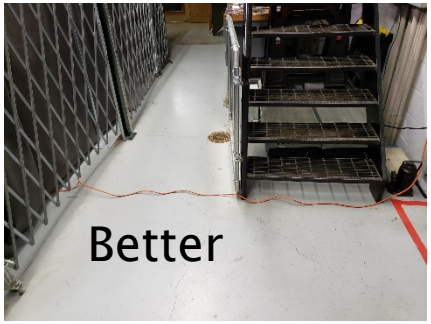
Electrical safety

- Whenever you need to use a piece of portable electrical equipment, you must strive to plug that equipment directly into a wall socket whenever possible. This cannot always be the case. Sometimes, you may need an extension cord.

Electrical safety

- If you need to use an extension cord, you must run that cord in such a manner as to minimize it as a trip hazard.





Electrical safety

- At times, you may need to plug in more than one item into an extension cord. There are a number of 6-way extension cords in the lab. Several have cords that are 15 feet in length.
- All 6-ways have surge protection. You must use these for multiple equipment hook up and the 6-way MUST be plugged directly into a wall outlet.
- The practice of plugging extension cords into other extension cords is commonly called “daisy chaining” and is prohibited by OSHA, MIOSHA, and EHS regulations.

Electrical Safety

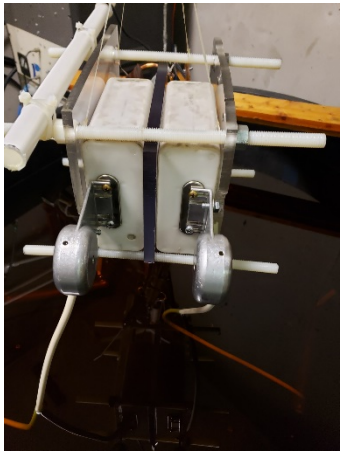
- Capacitors:
- We have many high voltage, high energy capacitors of all types and sizes. They are everywhere in the lab; in use and in storage. You may see one on a shelf or several stacked in a corner.
- Capacitors should be treated like a gun. We are taught to always assume a gun is loaded and you should ALWAYS assume that a capacitor is charged.

Electrical Safety

In order to make a capacitor safe for handling, it's terminals need to be shorted together. If you see a capacitor in the lab and have never shorted one, reach out to a senior grad student or Dr. Nick Jordan to show you the proper way to short one out.

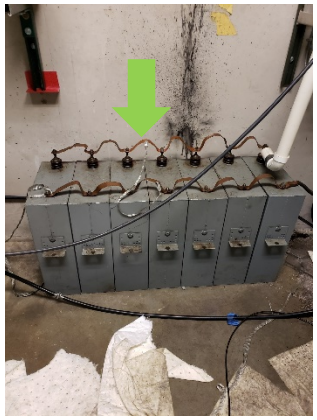
The following page shows some examples of the types of capacitors that are common in our lab. See if you can spot which ones are shorted and which ones aren't.

Electrical Safety



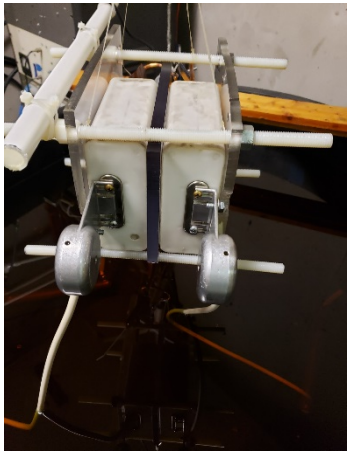
Electrical Safety

Grey caps shorted
White caps not



shorted

Not
shorted



Unknown

You
cannot
tell
without
Further
investiga
-tion

Electrical Safety

- Grounding:
- Whenever you shut off an energized circuit or are about to make physical contact with a circuit that has been energized and is now shut off, you should always ground any part of the circuit which could remain energized after power is removed.
- Some machinery in the lab is quite old and as such does not incorporate a quick dumping circuit. This means that any capacitors in that circuit could hold a charge for a long time.

Electrical Safety

- After a suitable amount of time once power has been removed, you should ground any and all electrical points that may have been energized. To do this, you will use a grounding stick.
- Grounding sticks are located throughout the lab and are identified as either a PVC or fiberglas rod with a metal end attached to a silver braid. This braid is generally attached at the other end to a ground source. Visibly confirm this.

Electrical Safety

- When grounding, hold the stick with one hand. Place the other hand behind you, preferably hooked in the waist of your pants. This action prevents you from accidentally becoming a discharge path.
- You should always have a second person with you when grounding a circuit.
- When you have sufficiently touched all points, only then is it safe to assume that the circuit is discharged.

Chemical Safety

Chemical safety

- There are a number of varied chemicals in the lab. They may be in solid, liquid or gas form. You should make yourself aware of any chemical's properties by studying it's MSDS (Material Safety Data Sheet).
- The MSDS folder is located in the first aid/PPE alcove in the lab tunnel. MSDS sheets are in alphabetical order.
- While we strive to keep up with the chemicals in the lab, it is a dynamic situation.

Chemical safety

- If you by chance do not find the particular chemical that you are looking for in the MSDS, EHS has a more comprehensive list on their website:
- ehs.umich.edu

Chemical safety

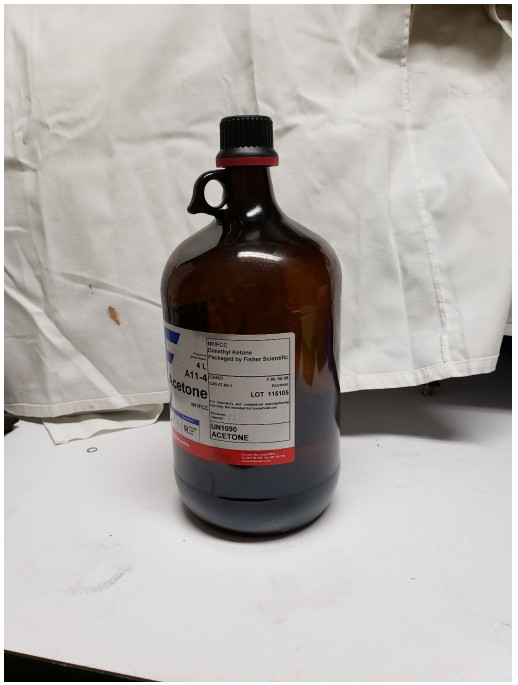
- Liquid chemical handling:
- The majority of our liquid chemicals are flammable in nature. They are stored in one of two FLAMMABLES CABINETS. These cabinets are bright yellow and are located in Room 112B, and next to the deep sink in the front of the main lab.

Chemical safety

- Some chemicals are stored in 4L glass bottles. These bottles have a glass carrying handle. DO NOT carry this bottle one handed by this handle. If it should accidentally snap, the bottle could fall to the floor and shatter.
- Depending on the amount and type of chemical, this could result in evacuation of the lab, and a call to EHS for a hazmat cleanup.

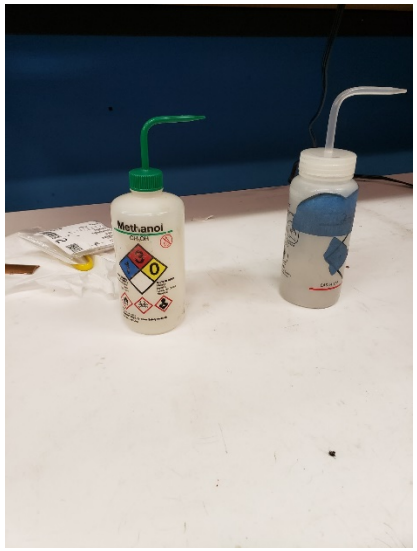
Chemical safety

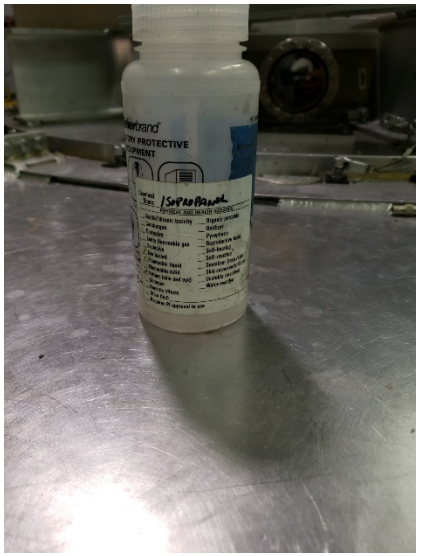
- You should always carry these bottles with two hands, one of them cradling it at the bottom.
- The only time you should need to transport one of these larger bottles is to refill smaller squirt type bottles.



Chemical safety

- All of the squirt bottles in the lab are identified either by a label from the manufacturer or a label that we place on them.





Chemical safety

- When refilling the smaller bottles, always:
- A) Verify that the chemical from the larger bottle is the same as the chemical in the smaller bottle.
- B) Use a funnel to refill. Never attempt to refill a small squirt bottle directly from the larger bottle. Funnels are located either on top of, or on the bottom shelf of, the flammables cabinet located in 112B.

Chemical safety

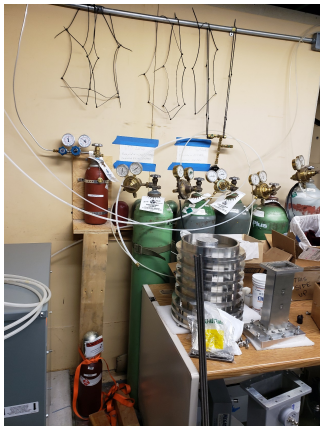
- When refilling, remove the cap of the small bottle and place the funnel into the top of the bottle.
- [Are you wearing the proper PPE for this task? If not, stop now and put on goggles, lab coat, and nitrile gloves.]
- Remove the cap of the larger bottle and slowly pour the chemical into the smaller bottle, keeping an eye out not to overfill.

Chemical safety

- Once the bottle is full, seal both the large bottle and small bottle and return the large bottle to the flammables cabinet that you got it from.
- If there is a small spill of the chemical at the fill site, simply wipe it up with a paper towel and dispose of it in the nearest chemical waste pail. If you cannot find one, start a new one and mark it as such using a yellow EHS chemical waste label.

Chemical safety

- Compressed gases:
- We use a number of different compressed gases. They are in many locations throughout the lab. The pictures below represent just a few.



Chemical safety

- The one thing you should notice about these pictures is that every gas bottle is anchored individually to a stationary item. This is a requirement that protects them from being accidentally knocked over.
- The pressure inside these gas bottles can exceed 2000psi. Were one of these bottles to fall and the neck snap, the bottle would instantly turn into a missile.
- It is therefore extremely important to properly handle these bottles.

Chemical safety

- When moving a gas bottle from a storage location such as beneath the front mezzanine stairs, or the loading dock, you MUST use a gas bottle dolly. It is a special dolly designed like a cradle with a chain that secures the bottle during transport.

- Our dolly can be found under the front mezzanine steps in front of where the spare gas bottles are stored.

Chemical safety

- There are generally two times when we move gas bottles. The first is when we are bringing them in from the loading dock to store beneath the mezzanine steps.
- To do this, you roll the dolly out to the loading dock and unchain the bottles on the dock. Choose a bottle to transport.
- Tilt it slightly to you and roll it on it's bottom edge to the dolly.

Chemical safety

- Set it on the base plate of the dolly, tightly against the cradle and chain it in place.
- Re-chain the remaining gas bottles on the loading dock ensuring that the chain is tightened enough to prevent tipping over of the gas bottles.
- Tilt the dolly so that it is now on all four wheels and roll it into the lab to store. To store it under the stairs, simply reverse the above procedure.

Chemical safety

- The second circumstance in which you will need to move a gas bottle is when you are changing it out. Before doing this task alone, you should be trained and observed by lab personnel who have experience in this process.

- To change out a bottle, you must first close the valve on the gas bottle. At this point, make a note of the pressure on the secondary gauge (gauge furthest from gas bottle)

Chemical safety

- If there is a valve on the supply tube coming out of the regulator secondary gauge, close it at this time.
- At this point, you may still notice some pressure on the regulator gauges. To bleed this out, turn the valve on the secondary gauge (gauge furthest from bottle) slowly in a clockwise direction. This will bleed out the small amount of pressurized gas left over.

  With zero PSI on the gauges, it is now safe to remove the regulator. Depending on the gas, the bottle valve will be either left or right hand thread. Left hand thread will have a cut line running along the center of the nut that connects it to the gas bottle.

Chemical safety

- Turn the nut in the appropriate direction using one of the large crescent wrenches to loosen it. Once loosened, the nut will unscrew easily by hand.

- Cradle the regulator in one hand while unscrewing it from the bottle. Once disconnected, lay it somewhere safe nearby and find the safety cap for the gas bottle. Screw it onto the neck thread. The bottle is now safe to move.

Chemical safety

- Unhook the bottle from it's support and move it to the gas dolly. Chain it in and take the empty bottle out to the loading dock.

- Once you've unloaded the empty one at the dock, return to the lab and retrieve a full bottle of the same gas you removed. Chain it to the dolly and transport it to the place you removed the other one from.

Chemical safety

- Reverse the process that you just went through to remove the other bottle, first securing the bottle to it's anchor. Then, taking off the safety cap, attach the regulator, making sure to tighten the nut, first by hand, then with the wrench.

- Slowly open the valve on the top of the gas bottle while watching the primary gas gauge. It should come up to a pre-determined point, somewhere between 2000 and 2500psi for a large bottle.

Chemical safety

- S-l-o-w-w-w-l-y open the valve on the secondary gauge, turning it counter clockwise until the gas pressure comes back up to the point that you had noted previously. If there is a valve on the output supply line, open it. This might cause a dip in pressure as the system re-pressurizes. Open the secondary gauge valve a little more to bring the pressure back up.

Chemical safety

- At this point, listen for any hissing that might be coming from the new connection. If you hear some, you may need only to tighten up the nut. Close the main valve on the bottle, tighten the nut, and retry. If you still can't find the source, or can't stop the hiss, secure the main valve and seek assistance.

Chemical safety

- NEVER move or transport a gas bottle with a regulator attached.

- NEVER move or transport a gas bottle without the safety cap on it. All bottles should have a safety cap somewhere nearby. Locate it and screw it on tightly before moving or transport.

Chemical Waste Disposal

Chemical Waste Disposal

- Proper disposition of chemical waste is required by law and should be done in the following manner:

- Waste products should be placed in a 5 gallon waste pail, 1 gallon waste pail, or 4L glass bottle. Solid or mixed waste will be placed in pails. Liquid waste must always be placed in glass bottles.

Chemical Waste Disposal

- These waste containers are located in the back of the first aid/PPE area which is in the alcove on your right in the tunnel, just before entering the lab. If the appropriate waste container is not available, or the supply is getting low, you can call EHS at to re-order supplies at no cost.

Chemical Waste Disposal

- A yellow chemical waste label should be filled out and placed in a readily seen location on the outside of the pail or bottle. Generally the lid of the pail is a good location. These labels are located in the first aid/PPE area of the lab.
- The waste container may be left in the area where you are working if you expect to generate more of the same type of waste in the near future. If it is a glass bottle, make sure that the cap is sealed closed and it is placed somewhere safe from being knocked over.
- Chemical waste MUST be identified by it's common name and not it's chemical formula, e.g. Acetone instead of C3H6O.

Chemical Waste Disposal

- Once chemical waste has been generated, it must be disposed of within 90 days. Since chemical waste is created by various individuals, it should be a coordinated effort among lab personnel.
- Once chemical waste is created, a manifest sheet should be started and dated. Manifest sheets can be found where you got the yellow sticker from.
- All information about the chemical waste should be recorded on the manifest and the manifest should be left in the tunnel with the sealed chemical waste.

Chemical Waste Disposal

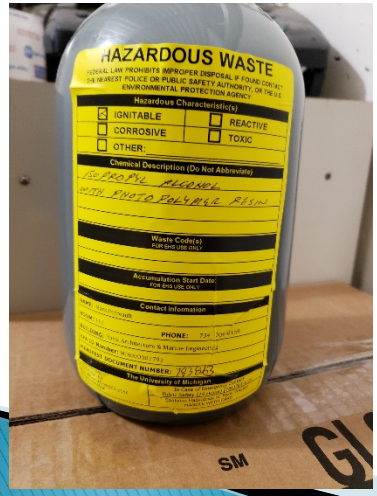
- Any additional waste generated should be added to the manifest and the date the manifest was started should be reviewed for the 90 day disposal requirement. If the date is close to 90 days or the manifest is full, EHS should be called at 3-4568 to do a chemical waste pick up. Be prepared to give the operator the information they ask for on the manifest.

Chemical Waste Disposal

- EHS will usually ask you if you wish to order more containers. This is a good time to replenish supplies. There is no cost for any chemical waste supplies. You can also order more supplies at any time by contacting EHS at 3-4568 and telling them you need waste containers. (e.g. 5 gallon pail, 1 gallon pail, glass bottles, yellow labels, manifests, etc.)

Chemical Waste Disposal

- Once the waste is picked up and new waste is generated, begin a new manifest. Don't forget to label each pail and each bottle. If you place multiple bottles into a box for safe transport, close the box and create a label of it's entire contents and attach that to the box



Radiation safety

Radiation Safety

- All personnel working in this lab are required to take RSS006_TAB Radiation Safety Orientation. This course can be found at EHS's website: ehs.umich.edu

- Although this lab does not currently work with any radioactive materials, we have several machines that generate microwave radiation and have the potential to generate x-ray radiation.

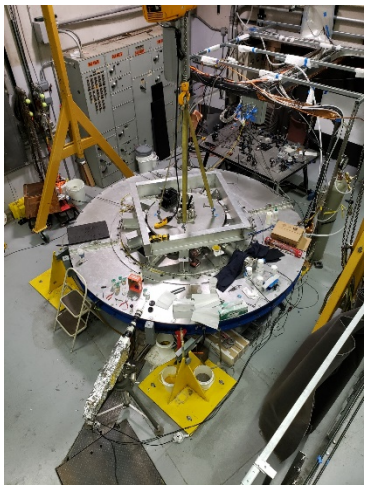
Radiation Safety

- These machines are:
- Michigan Electron Long Beam Accelerator (MELBA)
- Michigan Accelerator for Inductive Z-pinch Experiment (MAIZE, or simply “the LTD”) and
- Bestowed LTD from Ursa-minor Experiment (BLUE)

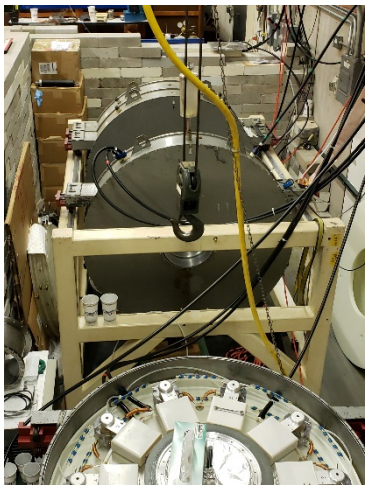
Radiation Safety

- These machines are interlocked while in operation and you will be trained by senior lab members on the safety specifics for each machine.

MELBA



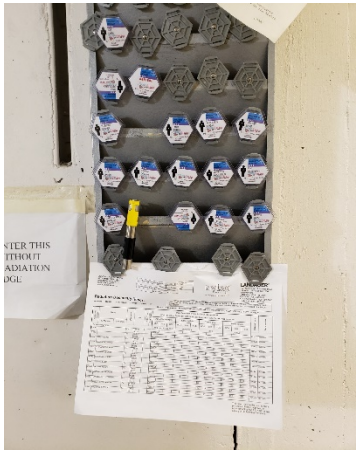
MAIZE



BLUE

Radiation Safety

All members of the lab are assigned radiation badges (dosimeter) to monitor your radiation exposure throughout your time here in the lab.



Radiation Safety

- The badges are changed out quarterly and tested. A report is generated and is available at all times at the office end of the tunnel on the badge rack. The report measures your annual and lifetime dosages of radiation.

- It is your responsibility to make sure that you are wearing your badge whenever these machines are in operation.

Radiation Safety

- You should never wear another person's badge.
- Do not wear your dosimeter outside the lab. Direct exposure to sunlight could provide false readings.

LASER Safety

LASER Safety

- All lab personnel who will be working with LASER's are required to take the course: EHS BLS005w Laser Basic Safety Training.

- This course can be found on EHS's website: ehs.umich.edu

LASER Safety

- Laser is an acronym for "**light amplification by the stimulated emission of radiation.**"

- A laser is a device that stimulates atoms or molecules to emit light at particular wavelengths and amplifies that light, typically producing a very narrow beam of radiation. The emission generally covers an extremely limited range of visible, infrared, or ultraviolet wavelengths.

LASER Safety

- Lasers range from Class I through Class IV, the latter being most dangerous. The Lasers that we use in our lab are Class IV and are considered high to severe for eye injury. It is critical that you DO NOT enter any area where an active beam is present without the proper eyewear.

- Once you have taken and passed the basic safety laser training, follow on specific training for our lasers will be provided to you by senior lab personnel.

LASER Safety

- Laser Goggles:
- Laser goggles are specialized safety goggles used for the express purpose of protecting your eyes from the harmful radiation generated by laser light.
- Not all laser goggles are the same. Each pair of goggles is specifically designed to protect your eyes from a particular bandwidth of light.

LASER Safety

- This bandwidth is inscribed on the goggles, usually on the lens somewhere, but sometimes on the arm. Make sure that you are wearing the proper goggles for the laser that is in use. If you are not sure, ask senior lab personnel.
- Do not enter the laser area without permission. Laser areas are interlocked with gate and laser curtain interlocks.

Summary

Summary

- A culture of safety in University of Michigan labs, including our lab, is every lab member's responsibility. Keeping the lab a clean and safe place to work will enhance your experience here at Michigan.

- As was mentioned in the beginning of this presentation, safety at Michigan is a complex undertaking and as such, we have an entire department dedicated to it, the department of Environmental Health and Safety (EHS).

- You are encouraged to look through their site at ehs.umich.edu

Summary

- This ends this basic safety presentation.
- If you have questions, you can direct them to your lab manager, Dr. Nick Jordan or to our two primary investigators for the lab, Professor Ronald Gilgenbach, and Professor Ryan McBride, who is also the Lab Director for PPML. On the rare occasion when they may not have an answer for you, they can make direct contact with our EHS representative who will provide you with the answer to your question.