Department of Physics and Astronomy Laboratory Safety Plan (DLSP)

A SAFETY MANUAL DESIGNED TO SUPPLEMENT THE COLBY COLLEGE LABORATORY SAFETY PLAN (LSP)

STUDENTS

IN THE CASE OF AN EMERGENCY:

- If you are in immediate danger such as a fire, or large chemical spill, pull the fire alarm, evacuate the area and building, and call Security at Extension 5911, or from a mobile phone at 859-5911, from a safe location. Locate the members of your lab personnel outside at a prearranged meeting space.
- Notify your instructor or supervisor if not in immediate danger. Phone numbers for people responsible for the room are listed on the door labels outside of each lab. DO NOT LEAVE THE AREA UNTIL HELP ARRIVES.
- Never attempt to handle an emergency or a spill by yourself. Always find a partner and notify Security at extension 5911 or 859-5911 from a mobile phone.
- DO NOT attempt to handle any emergency situations that make you feel uncomfortable. Please evacuate the area and call for immediate assistance (use information on door signs).
- THE COLBY EMERGENCY CAMPUS SIREN: If you hear the alarm siren atop the Mudd building sound, listen for and follow any verbal instructions given at the end of the tone. If you cannot clearly understand the instructions, go to the Colby College homepage (www.colby.edu) and follow the instructions given there.
- When the Health Center (HC) is open, all students with minor/moderate injuries should go to the HC for evaluations. The HC is open 8-8 Monday-Friday and 12-8 Saturday-Sunday.
- Off hours or for more serious injuries should go to the ER for evaluation either transported by Security or if need be City ambulance.

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1.0 PURPOSE

1.1 This Departmental Laboratory Safety Plan (DLSP) has been drafted as a general guidance document listing the specific safety requirements to work in a Department of Physics and Astronomy laboratory at Colby College. This plan supplements the existing campus-wide Laboratory Safety Plan (LSP). The LSP/DLSP complies with the requirements of OSHA's Laboratory Safety Standard, 29 CFR 1910.1450.

2.0 SCOPE

2.1 The requirements of this DLSP apply to all faculty, staff, students, and student employees that work, whether for academic credit or for employment, in the Department of Physics and Astronomy laboratory facilities at Colby College.

3.0 REFERENCE DOCUMENTS

3.1. Prudent Practices in the Laboratory; The National Academies Press: Washington, DC, 2011

3.2. OSHA, Occupational Exposure to Hazardous Chemicals in Laboratories, 29 CFR 1910.1450

3.3. Colby College Laboratory Safety Plan (LSP)

3.4. Chemistry Department Laboratory Safety Plan (Chemistry DLSP)

4.0 DEFINITIONS

4.1. **Cryogenic liquids**: Materials with boiling points of less than -73C (-100F). This includes liquid nitrogen, helium, oxygen, hydrogen and argon. A slush mixture of dry ice with isopropanol is a common cryogen used at Colby College.

4.2. **DLSP:** Department Laboratory Safety Plan

4.3 **Laser**: A device emitting intense visible or invisible electromagnetic waves with the capability of causing eye damage or other physiological injury.

4.4. **Material Safety Data Sheet (MSDS) or Safety Data Sheet (SDS)**: Chemical and hazardous material information sheets specifying chemical hazards in compliance with the OSHA Hazardous Communications Standard.

4.5. **Personal Protective Equipment (PPE)**: Protective clothing or gear used to protect individual laboratory and studio personnel from various physical, chemical and other hazards.

4.6. **Physical Plant Department (PPD)**: Colby College's facility maintenance department.

4.7. **Satellite Accumulation Area (SAA)**: Accumulation areas for specific hazardous waste streams.

4.8. **Hazardous Waste Accumulation Site (HWAS):** Accumulation areas for full hazardous waste containers from the campus SAAs, Keyes Room 4.

5.0 RESPONSIBILITIES

Responsibilities for oversight, implementation and maintenance of the Physics and Astronomy DLSP are assigned below. Identified personnel may designate tasks assigned to them to a qualified employee, student or consultant, as appropriate.

5.1. Chemical Hygiene Officer (CHO):

The college Director of Safety will oversee the college LSP and act as the CHO. Responsibilities of the CHO include the following:

- The CHO will consult with the Department of Physics and Astronomy faculty and staff to maintain and revise the DLSP annually by reviewing, creating, and revising safety rules and regulations based on risk assessments, incidents and near misses, and new hazardous procedures introduced by new faculty members or changes in faculty research projects,
- conduct biannual inspections of laboratories and photography darkrooms and submit the results to the administration,
- oversee the supervision, implementation and revision of Moodle based Laboratory Safety Training Module, and the laser, radiation and biohazard safety training programs used to train students in the Department of Physics and Astronomy.

5.2. Departmental Chairperson (Physics and Astronomy):

The department chairperson will assume overall responsibility for maintaining the Department specific DLSP. Additional responsibilities of the department chairperson include the following:

- Support the CHO in the implementation of the DLSP,
- verify that all PIs in the Department are familiar with the contents of the LSP and department specific DLSP,
- provide budgetary support to ensure compliance including adequate personal protective equipment and third party training if required,
- serve on the Lab Safety Committee,
- appoint a Departmental Safety Coordinator.

5.3. Lab Safety Committee (LSC):

Members of the college LSC will meet at least quarterly.

- The Department Chairperson and/or Department of Physics and Astronomy Safety Coordinator will report any concerns or revisions of the DLSP to the LSC.

5.4. Principal Investigator (PI)/ Laboratory Supervisor:

- The PIs/staff member will support the CHO and department chairs in the implementation of the LSP and department specific DLSPs, and
- contact the CHO to report revisions to laboratory facilities or procedures and will work directly with the Departmental Chairperson and/or the Departmental Safety Coordinator to ensure revision of the DLSP.
- Students shall not be used to communicate Environmental Health and Safety (EHS) issues between faculty and staff.

- Faculty are directly responsible for enforcing safety policies in their laboratories and field sites. This includes confirmation that visitors, students, staff, and faculty have received the required safety training, are following safe laboratory/field procedures as described in the LSP/DLSP, are trained in the proper operation of instrumentation and scientific apparatus used in their work, understand the specific hazards of their substances and procedures used in their laboratory/field work, and are disposing of wastes properly. It is the responsibility of individual faculty to provide sufficient oversight of their laboratory and field sites so that safety policies are consistently enforced.
- In the event of either a chemical spill or an accident that results in human injury, fire, or physical damage, the laboratory/field site supervisor must complete a spill or accident report form within 24 hours and submit it to the Physics and Astronomy Departmental Safety Coordinator (DSC), who will send it to the CHO.
- Supplemental to our departmental safety training, faculty are responsible for implementing and enforcing the Laser, Radiation and Biohazard Safety Training programs, under the direction of the CHO, when students use these procedures in the laboratory.

5.5. Departmental Safety Coordinator (Physics and Astronomy):

The Department Safety Coordinator (DSC) will act as a liaison between the department(s) and the Safety Committee. Responsibilities include:

- Annual revision of the DLSP,
- work with the departmental chairperson to ensure LSP/DLSP compliance,
- serve on the Lab Safety Committee,
- facilitate access to the Colby College Moodle Online Safety Training Course for all students working with chemicals in the Department of Physics and Astronomy, not including students enrolled in general Physics and Astronomy courses,
- update the chemical inventory, prepare chemical labels and check for peroxide forming chemicals,
- maintain a small inventory of safety equipment to help implement the DLSP: gloves, NFPA labels, peroxide test strips, safety solvent bottles, general use lab goggles, glass and sharps waste receptacles,
- oversee and biannually inspect spill kits and first aid kits in the Department of Physics and Astronomy for quality and content,
- annual update of the emergency contact information and standard operating procedures (SOP, if any) included as door signage on every working laboratory, prep room, inventory and storage door in the Department of Physics and Astronomy,
- weekly update of the MSDS/SDS hardcopy library which is accessible from the Colby Environmental, Health, and Safety webpage at http://www.colby.edu/humanresources/environmental-health-and-safety/colby-msdssds/

5.6. Physics and Astronomy Laboratory Personnel (includes faculty, staff and students):

- Faculty and staff are required to complete safety training designed by the CHO.
  All faculty and staff are urged to attend the Department of Physics and Astronomy safety training.
- Students are required to complete the safety training designed by the CHO and the departmental safety training outlined by the Departmental Safety Coordinator

(approved by the Department of Physics and Astronomy). The departmental safety training will reinforce the safety procedures outlined in the DLSP and the location and use of safety equipment. Students are required to complete the training and sign a safety agreement that assures that they understand and agree to follow the LSP and the Physics and Astronomy DLSP prior to working with chemicals or lasers in a laboratory. (LSP, APPENDIX D).

- Comply with specific behavior outlined in this DLSP including the wearing of the appropriate personal protective equipment at all times, good housekeeping practices, proper laboratory conduct and the immediate communication of any spills, illnesses, and accidents.

5.7. PPD Services Personnel:

- All PPD members who work or may work in any Physics and Astronomy laboratory or studio will be trained by the CHO on LSP/DLSP awareness and will obtain information about the workplace before any work is started.
- All PPD members are urged to contact the Department Safety Coordinator if they have any questions or concerns.
- PPD personnel will refuse to enter or render services to any laboratory in an unsafe condition and will report findings to their immediate supervisor.
- All PPD personnel must adhere to the PPE requirements described on the door signage before entering or rendering services to any Department of Physics and Astronomy laboratory.

5.8. Radiation Safety Officer (RSO):

- Work with the faculty in the Department of Physics and Astronomy to implement the Radiation Safety Training Program.

5.9. Laser Safety Officer (LSO):

- Work with the faculty in the Department of Physics and Astronomy to implement the Laser Safety Training Program.

6.0 LAB SAFETY REQUIREMENTS

The following includes basic guidelines for maintaining a safe working environment in all Department of Physics and Astronomy laboratories at Colby College. The guidelines are specific to the following laboratory activities: work with chemicals in teaching and research laboratories and work with lasers, in either teaching or research. For work with radioactive sources and use of the machine shop, consult the CHO and the department chair. For use of the Collins Observatory, consult with astronomy faculty members.

6.1. Laboratory chemical safety guidelines:

6.1.1 Any and all faculty, staff, students, and visitors who use chemicals in teaching or research laboratories must adhere to all the relevant guidelines contained in Section 6.1 of the Chemistry DLSP. Any Physics and Astronomy personnel who need instruction in how to comply with the Chemistry DLSP should consult with the CHO and the Physics and Astronomy chair and the department LSC.

6.2. Requirements for the Buddy System:

6.2.1. Outside of normal work hours (Monday through Friday, 9 AM – 5 PM), or in the absence of other faculty, staff, or students within earshot, students are not permitted to work alone in Colby Physics and Astronomy labs while using

hazardous materials or performing hazardous procedures. A partner must be within earshot, (a minimum of the same building and same floor), and must be aware of what to do in the case of an emergency.

6.2.2. If a student wishes to study and/or work in a laboratory where no hazardous substance or procedure is involved anywhere in the laboratory (by self or other working students), the student may do so at any hour of the day without a partner, but the student must abide by the general safety rules outlined in the LSP/DLSP.

6.2.3 Students are permitted to work alone in a laboratory with lasers provided they have received the appropriate training, and agree to abide by the general safety rules outlined in the LSP/DLSP, plus any additional requirements made by the lab PI.

6.3. General Requirements:

6.3.1. Personnel are not permitted to play loud music or wear headphones/earbuds while working while working with hazardous materials or processes in the laboratory.

6.3.2. Visitors, including students not working in the laboratory, are permitted as long as they are wearing the correct PPE and escorted by trained authorized personnel. Visitors must be trained and sign the Lab Safety Training Acknowledgement before they will be allowed to work in the laboratory or studio. The Departmental Chair should be notified of non-Colby visitors.

6.3.3. Minors, not enrolled at Colby, are permitted in the laboratory only when involved in educational or classroom activities. The lab PI or instructor must accept responsibility for ensuring that appropriate safety procedures are followed, including the wearing of applicable PPE and providing an equivalent safety training experience to that available to Colby faculty, staff, and students.

6.3.4. Know the location and operation of all the safety equipment in your workspace.

6.3.5. Prep rooms are working labs. Students employed to help prepare chemicals and instrumentation for Physics and Astronomy courses must follow all safety procedures outlined by the LSP and DLSP. The faculty member teaching the course is responsible for the supervision of this student.

6.4. Requirements for Personal Protective Equipment:

6.4.1. All Physics and Astronomy laboratories and chemical inventory rooms require appropriate protective eyewear to be worn at all times when chemicals are being handled by any worker in the space. PI's and laboratory personnel need to be familiar with appropriate protective eyewear that they need to use for their application, or to be trained to use the appropriate eyewear by the CHP. Specific types of goggles not supplied by the department, but required for extra precautions, can be supplied by the PI or Department Safety Coordinator.

6.4.2. Laser goggles are useful in some circumstances when lasers are being used, and it is the responsibility of the lab PI to make these available to anyone working in the lab when needed.

6.4.3. Gloves are provided by the Department of Physics and Astronomy on request. No single glove material provides effective protection for all uses. Review the MSDS/SDS to determine of the gloves is compatible with the procedures you are using. Inspect all gloves for rips and tears before use. Do not use expired gloves.

- Consult the Chemistry DLSP for application-specific guidance on the appropriate choice of glove material.
- Gloves must be removed before exiting the workplace, handling a doorknob or phone, using instrumentation or a computer etc. The gloves are never disposed of in the hallway waste receptacle. Put new gloves on when you return to work. If you must use a glove for protection while moving hazardous materials to a different location, etc., take one glove off and use the bare hand to manipulate the doorknob, etc. and carry the material in the gloved hand.

6.4.4. The use of lab coats or aprons is not required in the Department of Physics and Astronomy. The use of lab coat or apron will, however, provide an additional protective layer against a spill or burn and is highly recommended.

6.5. Requirements for Personal Hygiene:

6.5.1. Unless specifically given permission by the lab PI or lab instructor, students must refrain from eating, drinking (including water), chewing gum, applying skin care products or lip balm and smoking in the laboratory. Never store food or drinks for human consumption in a lab freezer or refrigerator. Food and drink may be placed outside of the lab door if necessary.

6.5.2. The Department of Physics and Astronomy has safety compliant cabinets for the proper storage of flammable, acidic, basic, toxic chemicals, located in Mudd 319. Improper storage of chemicals in working hoods, on bench tops or on the floor is prohibited.

6.6. Equipment Specific Lab Safety Requirements:

6.6.1. Laboratory Chemical Hoods: Laboratory chemical hoods are one of the most important components used to protect personnel from exposure to hazardous chemicals and other harmful agents.

- Never modify a hood in any way to adversely affect its performance.
- Fume hoods in the department of Physics and Astronomy that are used in any way with chemicals must adhere to the guidelines for fume hood use which are described in the Chemistry DLSP.
- Never use a hood for chemical storage. Only a labeled spill kit and NFPA labeled vented safety bottles may be kept long term basis in a hood.

6.6.2. Equipment requiring supplemental safety training by the PI or qualified laboratory instructor:

- Laser systems (laser), several teaching and research labs in Mudd. As of June 2015, there are no college-wide SOPs for working with lasers, so anybody using lasers in the Department of Physics and Astronomy should consult the lab PI, the LSO, or the DSC for guidance on the appropriate safety procedures. **Also, see APPENDIX A for basic laser safety information.**
- Nuclear Physics Laboratory (radiation hazard), Mudd 306

6.6.3. Equipment warranting extra instrumental safety procedures by the PI or qualified laboratory instructor:

- Vacuum systems (general safety precautions), several teaching and research labs in Mudd.
- Collins Observatory (general safety precautions)

7.0 REQUIREMENTS FOR CHEMICAL LABELING, TRANSPORT AND STORAGE

7.1. Chemical Labeling Requirements:

7.1.1. All Department of Physics and Astronomy laboratories must maintain proper chemical labeling. Primary containers must have an intact label as printed by the manufacturer. If the label has become damaged or missing on usable chemicals review the MSDS/SDS to determine the correct language and re-label the container. (LSP, APPENDIX A and APPENDIX C)

7.1.2. Secondary containers used for long-term storage in laboratories must be marked with the product name as well as an NFPA diamond. This refers to any solid or liquid chemical that has been transferred or mixed from a primary container. Review the MSDS/SDS to determine the correct language and label the container. (LSP, APPENDIX A and APPENDIX C)

7.1.3. Single use day containers under the control of the laboratory personal using the container do not have to be labeled.

7.2. General Chemical Transport and Storage Requirements:

7.2.1. Gas cylinders are found in use throughout the department. These cylinders must be properly supported with a cylinder sleeve that is attached to a permanent surface, never free standing. They should be labeled as IN USE. An appropriate regulator must be used. Regulators are gas specific. All cylinders not in use shall have regulators removed and caps installed.

- Use appropriate carts for transporting gas cylinders. The designated cart is housed in Mudd 319. Always use the chain to support the gas cylinder on the cart.

7.2.2 Long-term storage of some chemicals (acetone, methanol, ethylene glycol, propylene carbonate, mixed and unmixed laser dyes, etc.) is allowed in the chemical storage cabinets in Mudd 319.

7.2.3 PI's should develop a plan for long-term storage of chemicals for which the cabinets in Mudd 319 are not appropriate with the assistance of the Chemistry department DSC, and, with the agreement of the Chemistry department chair and DSC, should use Chemistry department storage facilities if at all possible. If use of Chemistry department storage facilities is not feasible, the PI shall consult with the CHO and Physics chair about establishing an alternative storage system.

8.0 WASTE MANAGEMENT

8.1. Types of Laboratory Waste:

Lab waste may fall into a number of different categories and management requirements. It is the responsibility of the faculty member who oversees the laboratory to properly characterize and manage the waste generated in their labs. (The list below is fully comprehensive, and includes categories of waste not presently in use in the department of physics and astronomy.)

This section describes procedures for dealing with chemicals presently in use in the Department of Physics and Astronomy. Any PI or lab instructor who needs to dispose of chemicals not described here should consult the Chemistry DLSP and LSC.

8.1.1. Laboratory waste will fall under one or more of the following categories.

- Solid waste
- Hazardous waste
- Radioactive waste
- Biomedical waste

8.2. Hazardous Waste:

8.2.1. Per Federal and States laws, the properties of hazardous waste are defined as any substance that exhibits one or more of the following hazardous characteristics: IGNITABILITY (flash point less than 140F), CORROSIVE (pH less than 2 or greater than 12.5), REACTIVITY reactive to water, shock, heat, and/or pressure, or gives off toxic gases, or unstable and reacts rapidly or explosively, and TOXICITY (that which will leach more than a specified amount of heavy metals, pesticides, and carcinogens/mutagens). If you find a waste at your site that has no product information, please contact the CHO. Do not assume that the waste is nonhazardous. The MSDS/SDS, bottle label and manufacturer's information are also resources in determining if the laboratory waste is a waste is hazardous.

8.2.2. The Department of Physics and Astronomy discourages the use of and limits the accumulation of a class of chemicals which, when a certain shelf -life is exceeded, form explosive peroxide crystals. These chemicals not only place individuals and facilities at risk, the disposal of them, upon crystallization, require excessive monetary and other resources.

- Any and all instances in which a peroxide-forming chemical is being used in the Department of Physics and Astronomy, the safety guidelines in the Chemistry DLSP shall be followed. In particular, storage and tracking of such chemicals needs to be coordinated with the Chemistry DSC in a manner which is fully consistent with the Chemistry DLSP.

8.2.3. The Department of Physics and Astronomy limits the use of mercury thermometers, manometers, barometers, etc. to research laboratories and instrumental use. Mercury is a toxic heavy metal that must be treated as a hazardous waste.

- Non-mercury thermometers are highly recommended for all teaching laboratories. Such have red, blue or green nontoxic liquid and can be disposed of in a glass waste container. Do not put non-mercury thermometers in the general trash.
- Broken mercury thermometers do not go into the general trash, glass waste or sharps waste. Follow the Chemistry DLSP guidelines for clearing up mercury spills and disposing of broken items containing mercury.

8.2.4. Hazardous waste must be accumulated/stored in a Satellite Accumulation Area (SAA) prior to disposal to the Hazardous Waste Storage Room in Keyes Room 4 (HWSA) by hazardous waste trained personnel.

8.2.5. The SAAs on campus listed in the LSP, APPENDIX B. A waste generator can use any of the campus SAAs as long as the SAA is approved and compatible with the waste. The SAAs are clearly labeled and are monitored weekly for proper use. Each SAA has reminder sheets for waste identification, proper use, and separation based on incompatibilities.

- All Physics and Astronomy SAAs contain a properly labeled separate jug for each hazardous waste stream that is separated from incompatible waste by secondary containment whenever spaced permits.

8.2.6. Guidelines for safe use of a SAA in the Department of Physics and Astronomy follow:

- Identify if the waste is a hazardous or nonhazardous waste. Hazardous waste must be added to the SAA when work has been completed. It cannot be stored in any other container, even if labeled, closed, under a hood or accumulated while using an instrument. Use the MSDS/SDS. Nonhazardous waste can be put down a laboratory sink drain with copious amounts of water. Sink pipes are curved and can allow chemicals to accumulate in the plumbing. Chemical fumes, odors and unwanted reactions with unknown chemicals in the plumbing can be avoided by using lots of water upon disposal.
- Choose the properly labeled waste container that suits your hazardous waste.
- Check the label on the container to be sure that your waste is compatible with what is already in the container. If there is a compatibility issue, use a different SAA. Use the MSDS/SDS.
- You can move this container under a nearby hood to transfer the waste if it is difficult to use the SAA due to space constraints. After transferring the waste, always put the waste container immediately back into the SAA area.
- Check to see that the container is not leaking, bulging, etc.
- Remove the lid and use a funnel to add your waste. Spilling solvents will make the label illegible and potentially result in mixing of incompatibly waste. When complete, replace the lid and make sure that it is secure.
- Use a sharpie marker to label the contents added. Please use the chemical name, not a structure or formula. The MSDS/SDS and the important information concerning incompatibilities and disposal are easier to locate by chemical name.
- Disposal of mercury-containing equipment items (e.g., thermometers, manometers, etc.) should be carried out in coordination with the Physics and Astronomy and Chemistry LSCs.

8.3. Biomedical and Radioactive Waste:

8.3.1 The disposal of radioactive and biohazard wastes is described in the Colby College Radioactivity and Biohazard plans and will not be addressed in the DLSP. Contact the CHO or PI for information about radioactive and biohazard waste.

8.4. Sharps:

8.4.1. Needles and scalpels must never put in the general trash. All sharps must be disposed of in a designated sharps container. There are only two sharps containers in the Department of Physics and Astronomy, one on the 3rd floor of Mudd, and one on the 4th. Anyone using a needle or scalpel needs to be aware of the locations of the sharps containers, which may be obtained from the LSC. If the

sharps container has a biohazard label included by the manufacturer, remove or cross off the biohazard information. Syringes that do not contain any hazardous materials may be put in the general trash. When full, the sharps container must be closed securely and placed in the waste room, Keyes 4, for disposal. This does not include syringes and sharps contaminated with biohazards or radioactive materials, which must be managed specifically as biohazard or radioactive waste. Anyone using syringes and sharps that may become contaminated with biohazards or radioactive materials needs to inform the Department of Physics and Astronomy Safety Coordinator, and ensue that there is a disposal protocol in place for these items.

8.5. Empty Bottles and Containers:

8.5.1. Empty bottles and containers need to be cleaned out, removed from inventory and disposed of properly.

- Air out empty flammable solvent bottles or odiferous containers under a hood before using the trash.
- To avoid unwanted smells, fumes or fires in trash cans, rinse all chemical containers well before disposal. Empty the liquid waste in an SAA if hazardous.
- It is recommended that the labels are removed or crossed out using permanent marker before disposal.
- Place the washed and empty containers in the labeled "empty bottle bins" that are located in every Department of Physics and Astronomy laboratory and prep room. The Department of Physics and Astronomy Safety Coordinator will routinely check the bins for container removal. If the container has a label, it will be removed from the departmental chemical inventory. If it does not have a label, the container with be placed in the appropriate waste receptacle.
- If a general bottle is damaged or broken, use the glass waste receptacle. Do not place in the general trash. When the glass trash container is full, please close, secure the lid with tape, and label as trash. Properly labeled secured glass boxes may be put into the dumpsters.
- Unbroken general glass containers can be placed in the general trash receptacle.
- Recycling an empty container is highly recommended.

9.0 HAZARD COMMUNICATION

9.1. Door Signs:

9.1.1. Every Department of Physics and Astronomy laboratory, prep room, inventory and storage door will display a current list of the contact personnel for that workspace and GHS pictograms showing the hazards located in that room. This information is essential in the case of an emergency. (LSP, APPENDIX C). It is advisable that signage should also include a "No food or drink allowed" sticker.

9.1.2. The Department of Physics and Astronomy will also include Hazard Identification forms (HIF) and, if applicable, Standard Operating Procedures (SOP), that will further aid in the identification of hazardous materials and/or procedures specific to that workspace. These forms are included in the package so that emergency personnel unfamiliar to the workspace can readily identify what

hazards are present and where the hazards are located in the workspace before they enter the room. The HIF will identify the specific hazard and the location of each. The SOP will identify a specific hazard and/or procedure and how to best respond to that particular hazard.

9.1.3. All door signage, HIFs and SOPs are reviewed and updated annually to ensure that he information is correct and current.

9.2 MSDS/SDS:

Physics and Astronomy faculty, staff and students are also encouraged to use readily available online MSDS/SDS sheets, which are available at http://www.colby.edu/humanresources/environmental-health-and-safety/colby-msdssds/

10.0 LABORATORY EMERGENCIES

The Department of Physics and Astronomy uses door signage to display emergency information specific to every laboratory, prep, inventory and storage room. Included either on the door or inside the workplace is a green and white sticker that will display the location of the nearest spill kit and first aid kit.

10.1. General Guidelines:

- Everyone working with chemicals in the Department of Physics and Astronomy should know what to do in the case of an injury, spill, fire, accident and any other emergency specific to that workplace. No one should start to work until they know the location and how to operate the emergency equipment, the location of available exits, their role in emergency response and how to report the emergency to summon help and document the event. All faculty, staff and students must be trained to know what to do in the case of an emergency. This is reviewed on page 2 of the DLSP and in all safety training modules.
- If you cannot assess the conditions well enough to be sure of your own safety, do not enter the area. Call emergency personnel and describe the situation as best you can.
- In the event of an accident or injury, do not leave the area until reporting the accident to a faculty member or Security.
- A written spill (LSP, APPENDIX E) and accident report (LSP, APPENDIX F) must be submitted to the CHO following the verbal report within 24 hours. The CHO will alert the Departmental Safety Coordinator of the event.
- When the Health Center (HC) is open, all minor/moderate student injuries should go to the HC for evaluations. The HC is open 8-8 Monday-Friday and 12-8 Saturday-Sunday.
- Injured victims must always be accompanied by other students or by Security when traveling to the Health Center or local hospital.

10.2. Chemical Injury Response:

10.2.1. General treatment of contaminated personnel:

- If an individual is injured, has ingested or is contaminated with a hazardous substance, the responder must tend to that individual before implementing spill control. If possible, obtain information about the materials being used and provide copies of the MSDS/SDS to the Health Center or other medical provider.
- For small areas of skin, immediately flush with flowing water for no less than 15 minutes.
- Large scale chemical contamination may require the use of an emergency shower (LSP, APPENDIX G). There is an emergency shower located in Mudd 319. Bystanders must immediately contact Security at 859-5911 to summon emergency assistance.

10.2.2. Chemical burns to the eyes: Chemical eye burns result from eye contact with strong bases and acids. In the event of a chemical eye burn, the injured person must flush their eyes for 15 minutes in the emergency eyewash. There is an emergency eyewash located in Mudd 319. Bystanders must immediately contact Security at 859-5911 to summon emergency assistance. (LSP, APPENDIX G).

10.3. Physical Injury Response:

10.3.1. In the case of a minor injury, a first aid kit may be used to stabilize the wound if necessary seek medical attention. All personnel who work in a laboratory in which hazardous materials are used must be familiar with the location and use of the first aid kit.

10.3.2. In the event of a minor cut, seek immediate medical attention at the Health Center or local hospital. For large laceration immediately contact Security at 5911 (859-5911 from a mobile phone) and remain with the victim.

10.3.3. Immediately call emergency personnel if the injured person appears to be unconscious. Stay with the victim until help arrives.

10.3.4. If the victim is having convulsions, immediately call emergency personnel. If it is safe to enter the area, remove anything from the area that may cause harm to the victim. Stay with the victim until help arrives.

10.3.5. If the victim has a cryogenic burn, immediately call emergency personnel. Do not apply heat. Loosen clothing to promote circulation and flush the area with tepid water to reduce freezing. Stay with the victim until help arrives.

10.4. Spill Response Guidelines:

10.4.1. All personnel who work in a laboratory in which hazardous materials are used must be familiar with the location and use of the spill kit.

10.4.2. Since we have no hazardous chemicals in regular use, the Department of Physics and Astronomy does not presently have an established protocol for dealing with chemical spills, nor do we have spill kits or other appropriate equipment for dealing with them. Any PIs or lab instructors wishing to use hazardous chemicals need to inform the department chair and the Physics and Astronomy

LSC so that the necessary spill kits and safety equipment (gloves, overalls, etc.) can be acquired, and appropriate procedures for dealing with spills established.

10.4.3. In the event that a PI or lab instructor wishes to use hazardous chemicals intermittently, and on a short-term basis, the spill containment procedures in the Chemistry DLSP should be followed.

10.4.6. The Department of Physics and Astronomy does not maintain a Respirator Program.

10.5. Fires Response Guidelines:

10.5.1. Only trained responders are permitted to fight fires at Colby College. In the event of a fire alarm, if possible, stabilize any experiments and exit the building as quickly as possible. Congregate with the other building occupants at a safe distance from the building. Do not leave the area until told to do so by the responders.

10.5.2. The designated area for the Department of Physics and Astronomy to meet in the case if a fire is on the Bixler Building lawn adjacent to the Chemistry Building.

10.5.3. Fire Response Procedures:

- The extinguishers are only to be used by trained personnel in the case of a small containable fire. Notify the CHO as soon as possible after an extinguisher is used. The CHO will notify the fire department and will see that the used extinguisher is replaced.
- Know your exit routes.
- Know the location of the nearest fire extinguisher, fire alarm-pull station, fire blanket, telephone, emergency contact list, safety showers.

11.0 RECORDS

11.1. Copies of the Physics and Astronomy DLSP are located in the Safety office, Security office, the secretary's office, and on the Department of Physics and Astronomy web page.

11.2. Copies of the LSP are located in the Safety office, Security office, and the secretary's office for the programs and departments covered under this plan.

12.0 TRAINING

12.1. All laboratory personnel (including faculty, staff, research/honors students and classroom students) who work with chemicals or lasers are required to be safety trained before starting any work in the Department of Physics and Astronomy. All personnel will review, understand and follow all applicable safety rules and regulations that apply to the workplace and sign a safety agreement (LSP, Appendix D) that assures that they understand and agree to follow the Physics and Astronomy DLSP.

12.2. For students who work with chemicals, training sessions will include the requirements and use of the LSP/DLSP, MSDS/SDS, PPE, general safety rules, the location and use of emergency equipment including safety eye washes, showers, spill and first aid kits, chemical management, and emergency procedures for accidents and spills.

12.2.1. Supervising staff and faculty (the PI or laboratory instructor) are responsible for identifying which students need chemical safety training, and notifying the department chair and LSC which students need to receive such training.

12.2.2. Supervising staff and faculty are responsible for ensuring that students receive the required training, obtaining signed safety agreements, and ensuring they are filed with the LSC.

12.2.3. The Department of Physics and Astronomy requires successful completion of the Colby College Moodle Safety Training Session.

12.2.4. The Department of Physics and Astronomy Safety Coordinator (LSC) will show documentation of this training by maintaining copies of the signed safety agreements.

12.2.5 Additional training may be required for special procedures specific to a laboratory. The PI responsible for that lab will be required to deliver and enforce that training.

12.3. For students who work with lasers, the training will consist of hazard identification, standard safety procedures, availability of protective equipment. (See Appendix B.)

12.3.1. Supervising staff and faculty (the PI or laboratory instructor) are responsible for identifying which students need laser safety training.

12.3.2. Supervising staff and faculty are responsible for ensuring that students receive the required training, and obtaining signed safety agreements.

12.3.3. Supervising staff and faculty members (the PI or laboratory instructor) are responsible for documentation of this training by maintaining copies of the signed safety agreements.

12.4. It is the responsibility of the supervising faculty member to train faculty and staff employees who will work with chemicals and lasers when employment begins, or when they begin working with chemicals or lasers. For work with chemicals, the training will consist of the contents of the LSP/DLSP, the employee's right to know about workplace hazards, the departmental labeling system and policies, use of MSDS/SDS, the determination of hazards, protective measures, location and operation of safety equipment, emergency procedures and reporting. For work with lasers, the training will consist of hazard identification, standard safety procedures, availability of protective equipment. (See Appendix B.)

13.0 ENFORCEMENT

13.1. Failure to follow the policies and procedures outlined in the LSP/DLSP could result in disciplinary action as prescribed by the relevant following documents: the Student Handbook; the Staff Handbook; and the Faculty Handbook, not to mention serious injury and/or property damage.

13.2. To insure that the guidelines in this document are being followed, the Colby EHS Director (CHO) and the Department Chair will conduct a biannual compliance inspection of each laboratory in the Department of Physics and Astronomy. At least one of these inspections may include a representative(s) from a non-Colby third party.

14.0 ACKNOWLEDGEMENT

14.1 By signing the Physics and Astronomy DLSP the following departmental personnel are certifying that they have reviewed these procedures and safety requirements, find the contents acceptable, and agree to ensure their implementation within the Department of Physics and Astronomy.

_____	_____
Matthew Bayliss	Date
_____	_____
Robert Bluhm	Date
_____	_____
Charles Conover	Date
_____	_____
Dale Kocevski	Date
_____	_____
Lisa Lessard	Date
_____	_____
Jonathan McCoy	Date
_____	_____
Elizabeth McGrath	Date
_____	_____
Duncan Tate	Date

APPENDIX A: LASER SAFETY TRAINING OUTLINE

Dept. of Physics and Astronomy

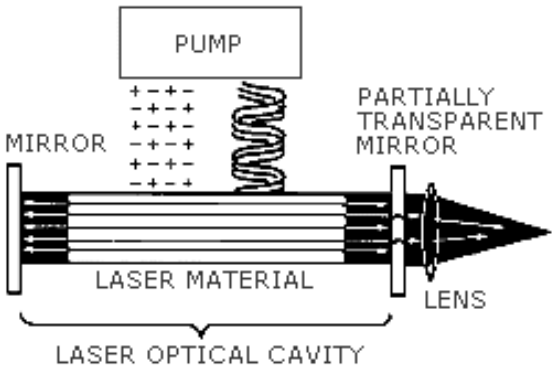
INTRODUCTION

The term LASER is an acronym for Light Amplification by Stimulated Emission of Radiation. Laser light is extremely intense, and highly directional. The light can absorbed by surfaces that it strikes and raise the temperature of the surface. The skin is sensitive to that temperature rise, but damage to eyes is the main concern with lasers used at Colby College.

HOW DOES A LASER WORK?

Light is amplified in a laser by atomic processes called stimulated emission. A laser consists of an appropriate lasing medium, a power source (pump) which excites the atoms in the lasing medium so that they can amplify light, and an optical cavity which repeatedly passes light back and forth through the laser material. A schematic diagram of a laser is shown in Fig. 1.

FIGURE 1- COMPONENTS OF A LASER



LASER LIGHT PROPERTIES

Laser light has the following properties:

- it is monochromatic
- it is very intense
- it has low divergence
- it is coherent.

Lasers can either be pulsed or continuously on (called *continuous wave*).

LASER REFLECTIONS

There are two principal types of laser reflections.

- Specular Reflections: Reflection from mirror-like surfaces. A laser beam undergoing specular reflection may be dimmed but still maintains the properties of laser light – monochromatic, intense, low divergence, and coherent. In the laboratory you must be aware of beams reflected from mirror-like surfaces; these include windows, watch faces, telephone faces, glossy plastic, and jewellery.

- Diffuse Reflections: Reflection from rough surfaces such as paper or matte painted surfaces. Diffusely reflected beams are divergent and do not have the same properties as laser beams.

BIOLOGICAL EFFECTS OF LASER BEAMS

A. **EYE INJURY**. Because of the low divergence, a laser beam does not dim significantly with distance. A laser beam of sufficient power can theoretically produce retinal intensities at magnitudes that are greater than conventional light sources, and even larger than those produced when directly viewing the sun. Permanent blindness can be the result.

B. **THERMAL INJURY**. The most common cause of laser-induced tissue damage is thermal in nature, where the tissue proteins are denatured due to the temperature rise following absorption of laser energy.

The thermal damage process (burns) is generally associated with lasers operating at exposure times greater than 10 microseconds and in the wavelength region from the near ultraviolet to the far infrared (0.315 μm-10^3 μm). Tissue damage may also be caused by thermally induced acoustic waves following exposures to sub-microsecond laser exposures.

WAVELENGTH AND LASER DANGER

The wavelength (color) output from a laser depends upon the laser material, but it is in or near the optical (visible) region of the electromagnetic spectrum. All laser beams are dangerous, and the biological effects are listed in Table I. Of greatest concern is laser exposure in the "retinal hazard region," consisting of Visible and Infrared A light. Light with wavelengths between 400 nm and 1400 nm is FOCUSSED by the eye and can damage the retina. Retinal damage is permanent.

TABLE I. SUMMARY OF BASIC BIOLOGICAL EFFECTS OF LIGHT

Photobiological spectral domain	Eye effects	Skin effects
Ultraviolet C (0.200-0.280 μm)	Photokeratitis	Erythema (sunburn) Skin cancer
Ultraviolet B (0.280-315 μm)	Photokeratitis	Accelerated skin aging Increased pigmentation
Ultraviolet A (0.315-0.400 μm)	Photochemical UV cataract	Pigment darkening Skin burn
Visible (0.400-0.780 μm)	Photochemical and thermal retinal injury	Photosensitive reactions Skin burn
Infrared A (0.780-1.400 μm)	Cataract, retinal burns	Skin burn
Infrared B (1.400-3.00 μm)	Corneal burn Aqueous flare IR cataract	Skin burn
Infrared C (3.00-1000 μm)	Corneal burn only	Skin burn

LASER HAZARD CLASSES

Class I: cannot emit laser radiation at known hazard levels (typically continuous wave: cw 0.4 μW at visible wavelengths). These lasers are considered "intrinsically safe."

Class I.A.: a special designation that applies only to lasers that are "not intended for viewing" such as a supermarket laser scanner. The upper power limit of Class I.A. is 4.0 mW.

Class II: low-power visible lasers that emit above Class I levels but at a radiant power not above 1 mW. Eye protection is provided by the human aversion reaction to bright light.

Class IIIA: intermediate power lasers (cw: 1-5 mW). Hazardous for intrabeam viewing – viewing of the direct beam or a specular reflection.

Class IIIB: moderate power lasers (cw: 5-500 mW, pulsed: 10 J/cm^2 or the diffuse reflection limit, whichever is lower). In general Class IIIB lasers are not a fire hazard, nor are they generally capable of producing a hazardous diffuse reflection.

Class IV: High power lasers (cw: 500 mW, pulsed: 10 J/cm^2 or the diffuse reflection limit) are hazardous to view under any condition (directly, specularly reflected, or diffusely reflected/scattered) and are a potential fire hazard and a skin hazard. Significant controls are required of Class IV laser facilities.

TABLE III. LASER CLASSIFICATIONS--SUMMARY OF HAZARDS

	Applies to --- wavelength ranges ---				---------- Hazards ----------		
Class	**UV**	**VIS**	**NIR**	**IR**	**Direct ocular**	**Diffuse ocular**	**Fire**
I	X	X	X	X	No	No	No
IA	--	X*	--	--	Only after 1000 sec	No	No
II	--	X	--	--	Only after 0.25 sec	No	No
IIIA	X	X**	X	X	Yes	No	No
IIIB	X	X	X	X	Yes	Only when laser output is near Class IIIB limit of 0.5 Watt	No
IV	X	X	X	X	Yes	Yes	Yes

Key: X = Indicates class applies in wavelength range.
* = Class **IA** applicable to lasers "not intended for viewing" ONLY.
** = CDRH Standard assigns Class **IIIA** to visible wavelengths ONLY. ANSI Z 136.1 assigns Class IIIA to all wavelength ranges.

Direct exposure on the eye by a beam of laser light or its specular reflection should always be avoided with any laser, no matter how low the power.

GLOSSARY OF LASER TERMS.

Absorb To transform radiant energy into a different form, with a resultant rise in temperature.

Aversion Response (Blink Reflex) Movement of the eyelid or the head to avoid an exposure to a bright light. It can occur within 0.25 seconds, and it includes the blink reflex time.

Beam A collection of light rays that may be parallel, convergent, or divergent.

Coherence A term describing light as waves which are in phase in both time and space. Monochromaticity and low divergence are two properties of coherent light.

Collimated Light Light rays that are parallel. Collimated light is emitted by many lasers. Diverging light may be collimated by a lens or other device.

Collimation Ability of the laser beam to not spread significantly (low divergence) with distance.

Continuous Wave (CW) Constant, steady-state delivery of laser power.

Diffuse Reflection Takes place when different parts of a beam incident on a surface are reflected over a wide range of angles in accordance with Lambert's Law. The intensity will fall off as the inverse of the square of the distance away from the surface and also obey a Cosine Law of reflection.

Divergence The increase in the diameter of the laser beam with distance from the exit aperture.

Helium-Neon (HeNe) Laser A laser in which the active medium is a mixture of helium and neon. Its wavelength is usually in the visible range. Used widely for alignment, recording, printing, and measuring.

Infrared Radiation (IR) Invisible electromagnetic radiation with wavelengths which lie within the range of 0.70 to 1000 μm. These wavelengths are often broken up into regions: IR-A (0.7-1.4 μm), IR-B (1.4-3.0 μm) and IR-C (3.0-1000 μm).

Intrabeam Viewing The viewing condition whereby the eye is exposed to all or part of a direct laser beam or a specular reflection.

Laser An acronym for light amplification by stimulated emission of radiation. A laser is a cavity with mirrors at the ends, filled with material such as crystal, glass, liquid, gas or dye. It produces an intense beam of light with the unique properties of coherency, collimation, and monochromaticity.

Laser Medium (Active Medium) Material used to emit the laser light and for which the laser is named.

Laser System An assembly of electrical, mechanical and optical components which includes a laser. Under the Federal Standard, a laser in combination with its power supply (energy source).

Maximum Permissible Exposure (MPE) The level of laser radiation to which a person may be exposed without hazardous effect or adverse biological changes in the eye or skin.

Optical Cavity (Resonator) Space between the laser mirrors where lasing action occurs.

Optical Radiation Ultraviolet, visible, and infrared radiation (0.35-1.4 μm) that falls in the region of transmittance of the human eye.

Output Power The energy per second measured in watts emitted from the laser in the form of coherent light.

Pulsed Laser Laser which delivers energy in the form of a single or train of pulses rather than a continuous beam.

Pumping Addition of energy (thermal, electrical, or optical) into the atomic population of the laser medium, necessary to produce a state of population inversion.

Reflection The return of radiant energy (incident light) by a surface, with no change in wavelength.

Resonator The mirrors (or reflectors) making up the laser cavity including the laser rod or tube. The mirrors reflect light back and forth to build up amplification.

Ultraviolet (UV) Radiation Electromagnetic radiation with wavelengths between soft X-rays and visible violet light, often broken down into UV-A (315-400 nm), UV-B (280-315 nm), and UV-C (100-280 nm).

Visible Radiation (light) Electromagnetic radiation which can be detected by the human eye. It is commonly used to describe wavelengths in the range between 400 nm and 700-780 nm.

Wavelength The length of the light wave, usually measured from crest to crest, which determines its color. Common units of measurement are the micrometer (micron), the nanometer, and (earlier) the Angstrom unit.

APPENDIX B: Door Signage

Mudd 305

Modern Physics Lab

AUTHORIZED PERSONNEL ONLY

Prof. Duncan Tate: Ext. 5866, Home no: 877-0094

Prof. Charles Conover: Ext. 5864, Home no. 465-9594

Prof. Jonathan McCoy: Ext. 5865

IN AN EMERGENCY CALL COLBY SECURITY AT 859-5911

PPE must be worn when using chemicals or hazardous procedures:


Safety Glasses


Gloves

Laboratory Chemical Hazards:


Flammable Liquids

(Chemical Hazard Sheet Enclosed)

Mudd 306

Nuclear Physics Lab

AUTHORIZED PERSONNEL ONLY

Prof. Duncan Tate: Ext. 5866, Home no. 877–0094

Lisa Lessard: Ext. 5870

IN AN EMERGENCY CALL COLBY SECURITY AT 859-5911

PPE must be worn when using chemicals or hazardous procedures:

Safety Glasses

Gloves

Mudd 308

McCoy Research Lab

AUTHORIZED PERSONNEL ONLY

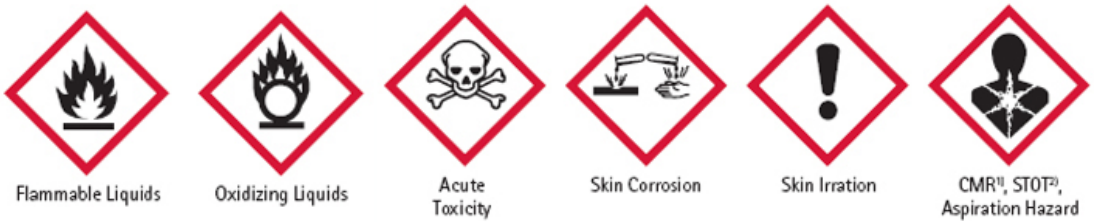
Prof. Jonathan McCoy: Ext. 5865

Office Next Door: Mudd 305

IN AN EMERGENCY CALL COLBY SECURITY AT 859-5911

PPE must be worn when using chemicals or hazardous procedures:

Laboratory Chemical Hazards:



Mudd 312

Tate Research Lab

AUTHORIZED PERSONNEL ONLY

Prof. Duncan Tate: Ext. 5866, Home no. 877-0094

IN AN EMERGENCY CALL COLBY SECURITY AT 859-5911

PPE must be worn when using chemicals or hazardous procedures:


Safety Glasses


Gloves

Laboratory Chemical Hazards:


Flammable Liquids

Mudd 315/316

Conover Research Lab

AUTHORIZED PERSONNEL ONLY

Prof. Charles Conover: Ext. 5864, Home no. 465-9594

IN AN EMERGENCY CALL COLBY SECURITY AT 859-5911

PPE must be worn when using chemicals or hazardous procedures:


Safety Glasses


Gloves

Laboratory Chemical Hazards:


Flammable Liquids

Mudd 319

Physics Chemical Prep Room

AUTHORIZED PERSONNEL ONLY

Prof. Charles Conover: Ext. 5864, Home no. 465-9594

Prof. Duncan Tate: Ext. 5866, Home no. 877-0094

IN AN EMERGENCY CALL COLBY SECURITY AT 859-5911

PPE must be worn when using chemicals or hazardous procedures:


Safety Glasses


Gloves

Laboratory Chemical Hazards:


Flammable Liquids

Mudd 324

Optics Lab

AUTHORIZED PERSONNEL ONLY

Prof. Duncan Tate: Ext. 5866, Home no. 877-0094

Prof. Charles Conover: Ext. 5864, Home no. 465-9594

Prof. Jonathan McCoy: Ext. 5865

IN AN EMERGENCY CALL COLBY SECURITY AT 859-5911

PPE must be worn when using chemicals or hazardous procedures:


Safety Glasses


Gloves