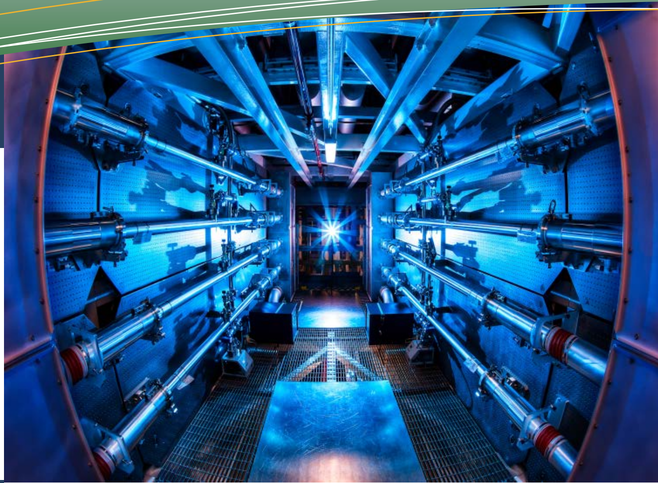
Volume 1
Issue 3

Laser Lessons News Letter



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"Our safety program is only strong when we keep the lines of communication open and remember that we are responsible for our own and, through our actions, our co-workers safety. Speaking up prevents the small things from becoming a huge "GOTCHA" for both you and your co-workers. BE SAFE!"

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Introduction

Welcome to the third edition of our quarterly Laser Safety Newsletter. In this issue we will cover beam control and interlocks along with a couple of recent laser off-normal/near misses. As you will see, it is ever so important to keep safety first in your work, pay attention to what you are doing, and communicate.

Beam Control

Much time is spent looking at "the big picture" when setting up a new laser project. Many resources are invested in trying to create the "perfect" lab in terms of safety. Taking a step back, we may find that sometimes the "perfect" lab can be realized with minimal cost. In this issue we will discuss some very inexpensive and practical ways to control your beam path.

In setting up a desired laser system, one might quickly think of interlocks and full containment. These are great, but for the most part, they are put in place to protect the unsuspecting and uniformed person who may happen upon the laser. What about you and other laser workers who are familiar with the operation?

In many instances, due to our R&D environment and operational constraints, we may not be able to fully enclose the experiment. This leaves us with few options. Beam control is one of them.

Remembering that Laser Protective Eyewear (LPE) is the last line of defense in protection against a laser exposure, we should take great effort in controlling and containing the beam path. Much can be done with fairly inexpensive pieces of diffusely reflective material. It can be cut, bent, and molded into shape to suit our needs.

The first and easiest way to contain a laser beam is with the use of apertures (Figure 1). These are simple and work great, especially for long beam paths. What happens if an optic is slightly misaligned or worse yet, bumped? With apertures, the misaligned beam will only travel far enough to dump onto the aperture plate. Commercial apertures are available, but they are just as easily made by cutting a hole into a piece of anodized aluminum or similar material.

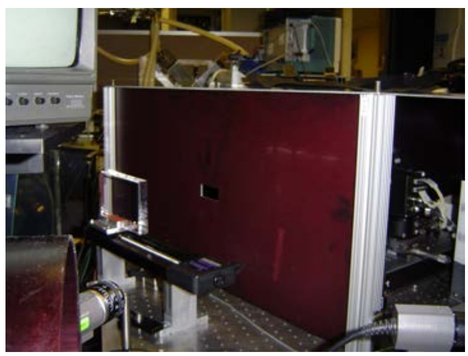
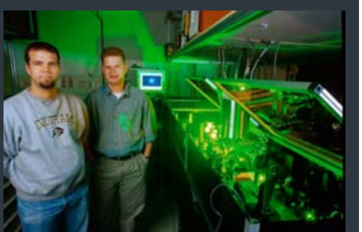


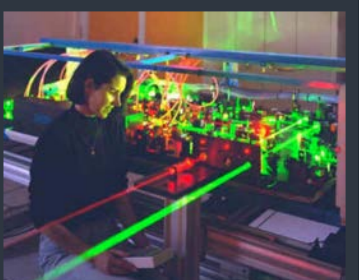
Figure 1. Aperture

One needs to be sure that the incident beam intensity is not too great as to cause burning or cutting of the aperture material. It is also important to make sure that the material is not a specular reflective surface for the wavelength being used.

If utilized just after a directing optic or mirror, apertures can prevent a slight misalignment from significantly straying.

What is wrong?





Answer: No Eyewear is being worn.

Wear your eyewear!
BE SAFE!

Figure 2. Perimeter guards with beam blocks

Beam Control (cont.)

Another means of containing a laser beam is to use perimeter guards or beam blocks (Figure 2). Beam blocks used behind turning mirrors, especially periscopes, are vital to worker safety. Perimeter guards, when used, prevent burn holes in clothing and the questions that follow. These items, when used in conjunction with apertures, provide an easy and inexpensive method of beam control.

What happens when we are dealing with a beam intensity that elevates the required optical density (OD) up over 6? Eyewear manufacturers are limited by their testing equipment to fully certify LPE much higher than 7.0. Also, do you really want to have the potential for exposure to such a high irradiance beam? We are talking a protection factor of greater than one million.

When looking at the need to protect from several different wavelengths, there may not be a single pair of LPE available to cover all that is needed. In this case, one could use a simple beam tube for containment of the unprotected or high irradiance beam. Beam tubes can be made of just about anything, from plastic to PVC to iron pipe. Just be sure that the material that you use is sufficient to contain a misaligned beam without burn through (Figure 3).

Other tools that can assist in beam control are IR viewers and ccd cameras. These tools can be of great assistance in alignment or looking for stray reflections.

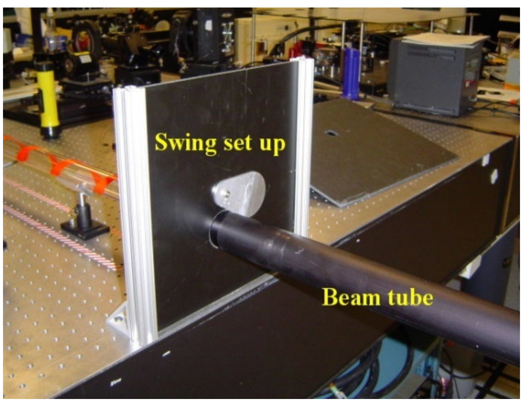


Figure 3 Beam Tubes

The use of a ccd camera allows one to stay clear of an invisible beam while keeping their hands free.

Lastly one of your greatest tools in beam control is preplanning. A well thought out beam path, taking into consideration locations you may need to frequent on the optical table, is invaluable. "Knowing" your beam line ensures that you can enclose or cover any potential trouble spots up front.

Incident #1

Recently, while aligning a new laser, the laser operator detected a slight burnt plastic smell. He immediately stopped what he was doing and investigated.

The operator believed that something dipped into the beam line. Apertures were being employed, but the travel distance in between was long and the beam was invisible. An IR viewer was being used to spot the beam.

The worker decided to install a beam tube to prevent anything from entering the beam path between the apertures. In situations like this, it is very important to report any unexpected occurrences to your team and to your management. While this was a minor issue, if the worker had thought that it was not worth mentioning or fixing, another worker could have easily ended up with a very serious injury.

Our safety program is only strong when we keep the lines of communication open and remember that we are responsible for our own safety, and through our actions, our co-workers safety. Speaking up prevents the small things from becoming a huge "GOTCHA" for both you and your co-workers. BE SAFE!

Safety Control Systems

The ANSI Z136.1 Standard "for the Safe Use of Lasers" and the LLNL *ES&H Manual*, Document 20.8 "Lasers", both call for the use of Entryway

Controls to be employed with Class 3b and Class 4 lasers.

Entryway controls may be any one of the following:

1. Non-Defeatable
2. Defeatable
3. Procedural (Administrative)

At LLNL we use all three types. The primary is the defeatable type. Defeatable Entryway Controls simply mean that we employ a momentary bypass system allowing access into the area. With this type of interlock control, the design must ensure that a stray beam cannot exit the laboratory while the system is bypassed.

Safety Interlocks

If you look around the Institution from lab to lab, one thing will become very apparent: There are many different types of safety interlock systems in use. This is because of changing technology and choice of vendors combined with the difference in time between each system installation and replacement.

It does not matter the era or model of interlock control system that you are using, as long as it functions properly. All of these safety systems operate in basically the same manner. There is the “brain” which monitors the system, and control mechanisms that react when the system’s integrity is compromised.

There are also manual mechanisms (emergency stops) used to send a signal directly to the brain to place the laser in a safe mode.

Our basic interlock system consists of the Interlock Control Module, two information (status) panels, two emergency stop buttons and shutter or power supply controls. This is the typical setup for a lab, but may be modified depending on the room size and number of lasers being controlled.

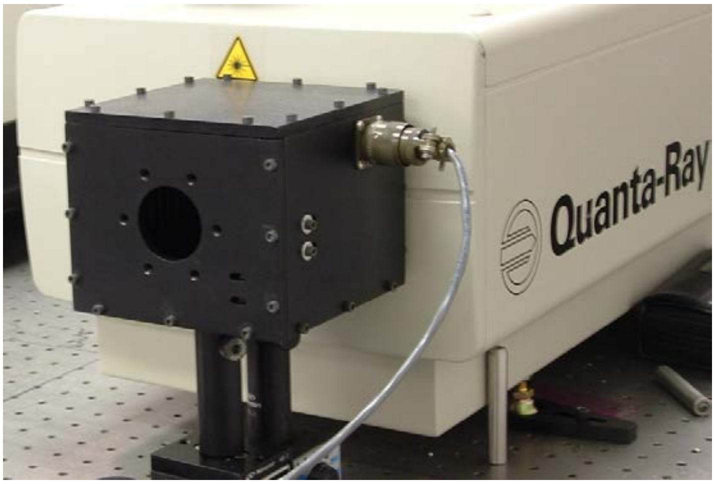


Figure 4. Laser with shutter

In the situations where we use defeatable interlocks, there will be an access panel with a key pad. A code is entered to allow the system to be bypassed for approximately 10-15 seconds. On the inside of the lab there will be either a button or motion detector to allow temporary bypassing of the system for egress. Motion detectors are not encouraged and should only be used in situations where they cannot be triggered away from the direct vicinity of the door.

The status panel, whether on the interior of the lab or at the entrance, indicates the status of the laser and may provide information on any PPE requirements. The “emergency off” button allows for an individual to place the laser into a safe mode very quickly. This could be activated by a laser worker themselves, or in the case where a worker is incapacitated, emergency personnel should be able to quickly locate and engage the button.

In most cases, our interlock systems are connected to shutter controls (Figure 4). A shutter control allows for the laser to be placed into a safe state, but still remain energized. This is great for systems that require a very long time to reach stability.

No matter the type of system, defeatable or non-defeatable, all interlock systems require a periodic check to ensure that they are functioning properly. Some systems may require a check as simple as opening a door and verifying the move to a safe condition, while others may be more complex and require a complicated checklist to complete. Verification that your interlock check has been completed should be readily available to the LSO, DLSO, or designee.

It is important to remember that the Entryway Control Systems are not to be modified, tampered with, or overridden in any way not covered or authorized within the IWS. It is also important to remember that at no time shall a laser operation authorized to operate under interlock control be operated under Administrative Control, unless reviewed and approved by the LSO.

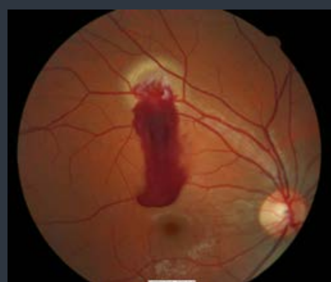
When operating under Administrative Controls, it is important to remember that all safety aspects of the operation are prone to operator error. Simple things such as indicating the hazard (via signage and lights) within the lab are steps that must be taken and completed by the operator. Communication with others who have access to the laboratory is vital to safety when operating in this mode.

Famous last words:

I thought I knew where the beam was.

I only took them off for a second.

I thought I could see better without the eyewear on.



I knew better…I knew better!

Your eyewear is as important to your operation as the operation is itself.

Don’t speak these famous last words.

Wear your eyewear! BE SAFE!

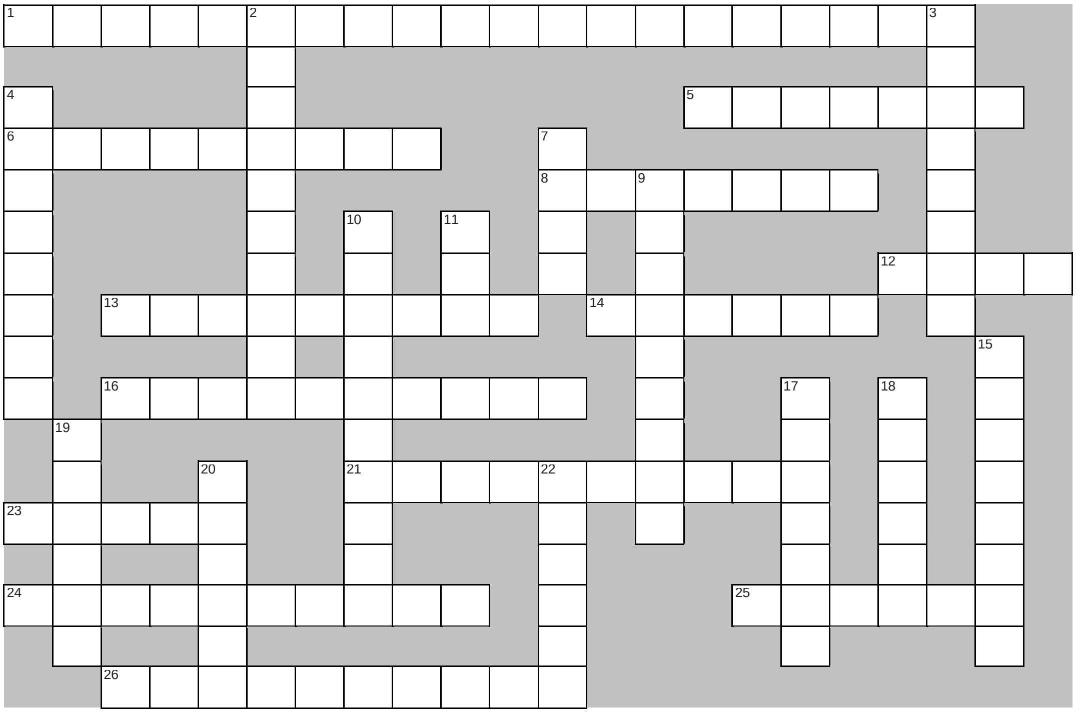
Incident #2

Recently, a worker at a DOE facility, was operating a laser with the laser beam contained in an enclosure (quasi Class 1). In order to generate a laser pulse outside of the enclosure (Class 4), the worker must request a trigger through a computer in the lab space. The worker, not expecting a hazardous situation, saw a bright blue flash in the lab while working on a separate task. The worker immediately shut down his laser system and began to track down the problem. Management was notified and all laser operations in the facility were subsequently shut down.

With all laser operations secured, a test of the trigger and interlock systems was conducted. From an adjacent lab space, a trigger was requested to determine functionality of the system. It was discovered that previous modifications to the system allowed the trigger request to be sent from the lab computer, to a server, and then to all connected laser labs, authorizing a laser pulse in all labs. This meant that if a laser was operating in any one of the labs (quasi Class 1) and a trigger was requested for the specified lab, the trigger was sent and authorized a laser pulse (Class 4) to any of the operating labs. This mode of operation was completely unknown and unexpected by the facility. The entire system was traced hand over hand and the trigger system was physically removed preventing this mode of operation.

This incident shows just how important it is to know the functionality of your safety interlock system and any laser, shutter, or trigger controls that are connected to it. This is especially true if the system can control lasers or shutters in another lab space. In order to really understand your interlock control system you should have a detailed interlock check procedure that can test for any failure or override modes that may be inherent in the system. Also, if any modifications are to be made to your safety interlock system, it is critical that the LSO be notified and that there is an independent check of proposed changes by a knowledgeable person. This will ensure that your safety system is truly safe and is an actual engineered control!

Crossword Puzzle



ACROSS

1. Welder's Flash.
5. Shortest President of United States standing 5'4".
6. Used to reduce the beam hazards of a Class 4 laser.
8. Person with crystalline lens removed.
12. The difference between a Class 3b and Class 4 laser is that a Class 4 laser can start a ______.
13. A _______ guard provides protection from a stray beam around the edge of an optical table.
14. The critical information regarding the protection afforded by a pair of Laser Protective Eyewear is usually imprinted on the frame or _____.
16. The pedigree document where required ODs for lasers can be found.
21. Political party formed in 1854 out of sentiment for the abolition of slavery.
23. This part of LPE generally comes with a lifetime warranty.
24. 19____ was the year that the voting age was reduced to 18 from 21.
25. Fibrous shell surrounding the eye.
26. Located outside the laser control area, lists OD and wavelength info.

DOWN

2. Phased out in 2004, it was the oldest surviving American automobile marquee.
3. Involves the use of rods for vision (dark adapted).
4. Used to safely transmit laser radiation from one optical table to another.
7. Kennedy and _____ are the only US presidents buried in Arlington.
9. Farsightedness.
10. The only part of the United States that Columbus visited.
11. Large particle scattering.
15. The _____ curve, provided by the manufacturer, can assist in determining OD coverage for wavelengths not listed on the eyewear.
17. The first person to sign the Declaration of Independence.
18. The first person to discover that the universe is in fact expanding.
19. Provides approximately 70% of the refractive power to the eye.
20. Last man to walk on the moon.
22. Laser Protective Eyewear should not be used if the lenses are scratched or ______.