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UCI LASER SAFETY NEWSLETTER

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The purpose of this newsletter is to keep laser operators on the UCI campus informed regarding laser safety news, bargains on laser safety equipment (including protective eyewear), novel/inexpensive methods for controlling laser hazards, lessons learned (laser accidents), tips to improve safety, etc. These Newsletters are distributed approximately every six months, or whenever a laser safety issue with substantial immediacy arises.

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COMMON LASER SAFETY MISCONCEPTIONS

There are many prevalent misconceptions regarding laser safety. Several of the most common ones are listed below:

* **New laser users are more likely to suffer laser accidents than experienced laser users.**

  Many people believe this because they feel that inexperience can lead to mistakes and accidents. **Historically, the reality is that most accidents occur with personnel who have more than 5 years of experience in operating lasers.** In some cases, individuals with 20 or more years of experience have suffered eye injuries! The reason for this is that new laser users often retain their fresh respect for the hazards of laser radiation for awhile, while very experienced personnel can sometimes become complacent and let their guard down.

* **Laser accidents rarely occur during laser beam alignment because laser operators are fully aware that hazards are maximized during alignment and thus take adequate precautions.**

  More accidents occur during beam alignment than during any other laser manipulation. This is because a) often quite a few mirrors need to be adjusted during alignment, so the likelihood of stray radiation increases dramatically, and 2) laser personnel frequently insist that they need to directly visualize the beam during alignment *(for visible beam lasers)*, and thus they avoid wearing protective eyewear.

  Whenever possible, wear suitable protective eyewear during beam alignments and utilize alternative means of detecting the location of the beam, such as beam cards. A better approach is to either reduce the power of the laser to a very low level while aligning the beam (less than 5 mW average power, if possible), or use a coaxial low power laser (such as a HeNe laser or a diode laser) for alignments.

  Several laboratories on campus do most of their alignments using ***laser pointers*** (power < 5 mW). Once all the optics are adjusted and the alignment is completed, the laser pointer is removed and the high power laser is operated with a beam following the same path.

* **More laser accidents occur during normal work hours (8 am – 6 pm) than after-hours because many more personnel are working during normal hours.**

  In proportion to the numbers of personnel operating lasers during normal hours vs. after-hours, the likelihood of laser accidents is far greater after-hours. This is primarily because a) persons can become fatigued late in the day, and make errors because of that, b) persons working at night might be more likely to try to hurry through their experiments due to the lateness of the hour, and c) personnel normally capable of offering help and support might not be available at night to advise laser operators when questions/problems arise.

* **Laser protective eyewear known to be protective against laser radiation at wavelength *x* is likely to be sufficiently protective at wavelength *y* if the two wavelengths are very close to each other.**

  It is very dangerous to make this assumption. In order to pass as much visible light as possible, the optical density (OD; degree of protection) of laser eyewear often drops off *dramatically* with wavelength away from the wavelengths at which protection is intended.

  An OD vs. wavelength curve for a pair of commercially available laser spectacles is presented below. This eyewear has a sizable OD (~ 6) for wavelengths between 200 nm and 532 nm. Thus, this would be a good eyewear choice for use with excimer lasers (ultraviolet emissions < 400 nm), argon lasers (488 nm, 514 nm, etc.) and "primary, doubled, tripled and quadrupled" Nd:YAG lasers (1064 nm, 532 nm, 355 nm, and 266 nm, respectively). It would not be a good choice for use with copper vapor lasers (510 nm, 578 nm) since the OD drops off very rapidly after 532 nm and very little protection is afforded at 578 nm!!

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MEMORABLE QUOTE

"Everything should be as simple as possible, but not simpler."

Albert Einstein

COST OF LASER SAFETY

While it is true that some laser safety supplies are quite expensive to purchase, in almost every case relatively cheap alternatives are available. Glass-lens protective spectacles and goggles can be almost prohibitively costly – sometimes approaching $500 or more per pair!! However, *polycarbonate plastic lens eyewear* is much less expensive, and it works just as well (some renowned laser safety experts say that plastic lens eyewear is even better!).

Commercially-available laser beam enclosures, curtains, and barriers are also very expensive. Fortunately, far less expensive options are readily available in most hardware stores:

* Rather than purchasing a costly beam enclosure, ***large-bore black polyvinyl chloride (PVC) tubing*** is often used to enclose beams on optical tables and when it is absolutely necessary for beams to cross walkways. The PVC tubing needs to be securely affixed so that is does not roll/move and thus create potentially hazardous open beam conditions.

* The beam curtains and barriers that are commercially available are excellent in controlling laser hazards, and they look great. However, the same functions can be served by purchasing ***sheets of aluminum or plastic*** (Lucite, etc.), spray painting them jet-black (to minimize reflected radiation), and securely mounting them to serve as beam barriers. These are an ideal means of shielding personnel from laser radiation at a very low cost.

  Care must always be taken to ensure that flammable materials are never exposed to direct high-power laser radiation for extended periods of time. Thus, cardboard and wooden beam barriers should only be used to contain stray/reflected visible or infrared laser radiation when the beam power is above about 1 W. Cardboard or wood barriers can be used to prevent exposures to ultraviolet radiation, as flammability concerns are negligible in that case.

MEMORABLE QUOTE

"I have not failed. I've just found 10,000 ways that won't work.."

Thomas Edison

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If you have any questions concerned with laser safety, please contact Rick Mannix of EH&S (x4-6098; rcmannix@uci.edu).

BE SAFE!!!