Technology

From the Health Physics Society annual meeting in Baltimore

Hazards of multicolor laser beams

Growing use of multi-wavelength lasers is presenting a problem of sorts. Analyses of the potential health risks posed from accidental irradiation by direct or reflected beams from these devices have not yet been performed, notes Terry L. Lyon, a physicist with the Army's Environmental Hygiene Agency at the Aberdeen Proving Ground in Maryland. He believes secondary beams from some of these new lasers (using dyes, or using frequency-doubling or -tripling crystals) may pose a greater injury risk than the primary beam used for molecular excitation.

One could try to estimate hazards by summing up the individual effects associated with each component wavelength. In most cases, however, this would offer an overly conservative risk estimate. For a more realistic evaluation, Lyon has developed a rather complex mathematical formula. Users plug in values for things such as beam frequencies, intensities and a user's distance from the light source to calculate the spectral hazard.

Eyes will be the primary organ requiring protection. Assuming you've determined from Lyon's formula what you need protection from, where does one go for the appropriate eyewear? That's a good question, says Wesley Marshall, who works with Lyon at Aberdeen. "Eye protection which is custom formulated to eliminate all possible wavelengths encountered in a specific project is not available," he says, if the wavelengths encountered fall in widely separated spectral regions. And in fact, he notes, some photochemistry projects will subject laser users to light from both the blue and red ends of the visible spectrum.

What to do? Build your own goggles, he suggests, using combinations of commercially available filter glasses. For example, clip-on filters for red wavelengths—similar to those sunglasses which clip onto prescription eyeglasses — may be coupled to wrap-around goggles designed to protect against dangerous blue frequencies. The object is to specifically block out only the hazardous frequencies, leaving as undistorted and bright as possible the spectral band of peak visual acuity.

When laser eye protectors fail

David H. Sliney has a word of caution for those prescribing laser eye protection. At very high beam intensities, some filter materials "such as certain organic dyes exhibit the phenomenon of saturable absorption," he says, such that "you can have a very dramatic, and indeed very dangerous situation take place: The filter can become momentarily transparent." This occurs, he explains, when "the photon flux is so enormous that every single absorbing molecule is occupied."

Working for the Laser Microwave Division at the Army's Aberdeen Proving Ground in Maryland, he said, "There have been a couple of instances where we've had sample filter materials sent to us for tests by manufacturers." When a continuous-wave laser or a monochronometer system was used, the filter would register a density of 6 (the higher the number, the more it filtered). But irradiated with an ultra-short pulsed light source of 10 megawatts per square centimeter intensity, he said, "low and behold, instead of density 6, you get only 1 or 2."

Until lately, he says, "the only culprits we found were plastic materials using organic dyes." Luckily, he says, they were never mass marketed. "However," Sliney says, "Wesley Marshall in our group recently saw this effect in glass," with orange filters under test in eyewear to cope with multi-wavelength lasers. This has "made us worried that our assumption up to this date — that glasses don't saturate — is wrong," he says.

"It is virtually impossible to detect this problem with any filter [including glass] if you only have a continuous-wave source," he emphasizes. But before anyone panics, he adds that "most of the glass [filter] materials that are conventionally used" have been tested by his laboratory, and "we found no saturable absorption, even at intensities of terawatts (10^{12}W)/cm^2."

Biomedicine

From the meeting in San Antonio, Tex., of the Endocrine Society

Blaming the control of the control

In the body's complex cascades of hormone interactions, abnormalities at various points can result in the same clinical signs. Cushing's syndrome, for example, is due to excessive amounts of a hormone, cortisol, produced by the adrenal cortex. The high hormone level leads to obesity of the trunk, wasting and weakness of the limbs, skin changes and eventually such serious conditions as high blood pressure, diabetes, stomach ulcers, fragile bones and depressed immune response.

Sometimes Cushing's syndrome is caused by an adrenal tumor overproducing the hormone cortisol directly. In other cases, it is the result of excessive secretion of a pituitary hormone, adrenocorticotrophic hormone (ACTH), which stimulates the adrenal cortex production of cortisol. In turn, the ACTH excess is usually due to a tumor of the pituitary gland. But there has been a controversy whether Cushing's syndrome ever may be due to excessive amounts of yet another hormone, which stimulates the pituitary to release ACTH.

Direct evidence for such an abnormality now has been reported by Sylvia Asa and colleagues at the University of Toronto and at Emory University in Atlanta. They described a patient with a tumor of the hypothalamus. The tumor contained corticotrophin releasing factor (CRF), the substance that stimulates release of ACTH from the pituitary gland. When they removed the tumor, they relieved the symptoms of Cushing's syndrome. They say this is the first documented case of a hypothalamic tumor containing CRF and it indicates that excess hypothalamic CRF may be implicated in some cases of Cushing's disease.

Alcoholism in the bones

Alcoholics tend to have decreased bone mass and increased incidence of bone fracture. But scientists have not known whether these changes, a form of osteoporosis, are secondary to such factors as poor nutrition and liver dysfunction. Scientists from Loma Linda University and Jerry Pettis Veterans Administration Hospital in Loma Linda, Calif., now report animal studies indicating that the bone loss may be due, at least in part, to direct effects of ethanol on bone. Experiments with embryonic chick cells and embryonic chick bone grown in the laboratory demonstrate that ethanol (in concentrations measured in the blood of intoxicated persons) can decrease the proliferation, and therefore the number, of bone-forming cells, interact with other chemical factors to inhibit bone formation and increase release of collagen from the bone. John Farley and colleagues suggest the effects are mediated by changes in the fluidity of the bone cell membranes, because the effects of ethanol were mimicked with other solvents, such as ethylene glycol and DMSO.

Sex hormones, fat and diabetes

Sex hormones influence the characteristics of fat cells in women and their risk of diabetes, report scientists at the Medical College of Wisconsin in Milwaukee. Ahmed Kissebah and colleagues find that subtle differences in the ratio of male to female sex hormones determines whether excess calories result in enlarged fat cells deposited above the waist or in greater numbers of normal-size fat cells deposited in the buttocks and thighs. Kissebah has reported previously that women who gain weight above the waist are particularly susceptible to diabetes (SN: 1/23/82, p. 52). After examining the hormone levels in the blood of 80 healthy women and measuring their blood sugar levels in response to insulin, he says that an increase in the male-to-female sex hormone ratio contributes to insulin resistance, a stage that precedes diabetes. He advises, "Early detection of an increase in the male-female sex hormone ratios should be a signal to women that they are at a higher risk for diabetes. Active measures should be taken to keep their weight down."