Laser lab beaming discoveries

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From the outside, the laser laboratory in Klamath Hall is less than inviting.

Pasted on its thick wooden door is a decal that reads, "Laser Danger! Beams can injure eyes and body tissue." Above the entrance, a yellow strobe light ominously warns, "Lasers in Use."

Inside, the reason behind these precautions is clear.

"This is a Class Four laser," Chemistry Professor John Hardwick explains, pointing to a metal box about three feet long.

"That means it can cause permanent eye damage before you can blink," he said. "Your blink response is no protection whatsoever."

With those words, Hardwick dispenses a pair of amber safety glasses and begins a tour of the University's Shared Laser Facility.

The Shared Laser Facility was created in 1985 by a group of professors from the University's Physics and Chemistry departments. Funded by the state and the National Science Foundation, it is a place where faculty and graduate students can explore the properties of lasers and their uses in studying molecules.

What is a laser? The term "laser" is an acronym for Light Amplified by Stimulated Emission of Radiation. Light is provided by an electrical source, and is amplified when it passes through a certain medium. This medium could be a rare gas, a ruby, or even fluorescent dye.

When light passes through this medium, it stimulates the atoms of that medium to radiate light in the same direction as the original beam. The result is a beam-like, ultra-pure frequency of light — a laser.

The laser Hardwick demonstrates is an argon ion gas laser.

"You can't see the laser light coming out here," he said, pointing to the empty space in front of the laser's discharge tube. "That's because of the glasses we're wearing; they totally filter out that light."

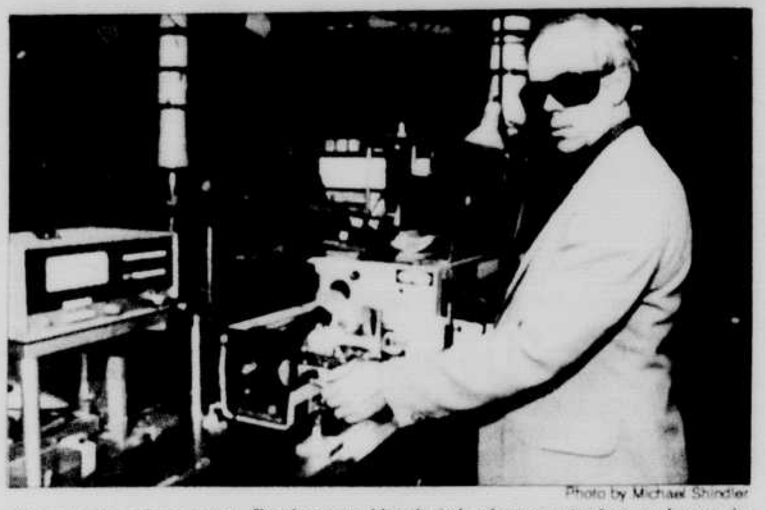

Photo by Michael Shindler

University chemistry Professor Hardwick demonstrates a laser in Pacific Hall's Shared Laser Facility.

The only evidence of the laser is a pale, amber dot projected onto a black sheet of metal. But when peeking over the top of the protective glasses, the amber dot explode into a brilliant, green flash, blindingly bright. With the glasses on again, only the amber dot is visible.

The argon laser is used to power a dye laser. In a dye laser, light is passed through fluorescent dye, the same dyes that color clothes, photographs and even Easter eggs. The process by which this light is converted is the subject of lab director Aaron Koskelo, who is currently on leave.

Lasers are also used as tools for studying the way molecules bind. Chemistry Professor Thomas Dyke is using an infrared laser to study constituents of the upper atmosphere, such a sulfur dioxide.

Dyke said there are questions about the extent that these molecules trap radiation in the atmosphere or affect the Earth's heat balance.

"The reason lasers are so useful in this study is that all of the laser's power is concentrated in a very narrow frequency," he said.

When the laser hits a sulfur dioxide molecule, "the molecule vibrates and absorbs the light, and some of the laser is missing when it returns," Dyke said.

This missing portion of the beam tells researchers at what frequency the molecule vibrates. Knowing the frequency provides information about the strength of the molecule's bonds, and in this case, how sulfur dioxide pairs with other molecules.

Although this project may have implications for studies of the "greenhouse effect," Dyke said his research is much more basic.

"If we want to understand what happens in the atmosphere, we must first understand these basic interactions," he said. "We really won't know what's going on until we do this first."

Chemistry Professor Bruce Hudson is also studying molecules with lasers using a yttrium aluminum garnet, or YAG, laser. He is currently involved with two projects. The first involves firing extremely short pulses of the YAG laser to study the individual motions of atoms and proteins. These laser pulses are imperceptible to the human eye, typically lasting only a trillionth of second.

"We're particularly interested in studying the effect of genetic mutations, and how they affect the ability of protein to move at the atomic level," Hudson said.

Hudson also also uses the YAG laser to study how molecules react to radiation. Ultraviolet radiation from the sun is major factor in breaking down molecules in the atmosphere, such as chlorine dioxide.