optics notes

Gathered at the spring meeting of the Optical Society of America in Washington

LASERS

CO_2 device can shift wavelength

A carbon dioxide laser that is portable and self-contained, can shift the wavelength of its light, and will still put out a sizable amount of power (tens of watts) has been developed at NASA's Electronics Research Center in Cambridge, Mass. The CO_2 laser started out three years ago as a laboratory experiment that needed large stationary apparatus, pumps and continually flowing gas to produce a few thousandths of a watt of infrared radiation.

The wavelength of the laser's emission is shifted across the region between 9 and 11 microns by a sample of absorbing gas contained in a small compartment within the device. A small amount of propylene gas shifts the light from its customary 10.6 microns to 9.3; propane will shift it to 10.2 microns.

Another sample of absorbing gas in another compartment pulses the laser's output, turning it on and off some 50,000 times a second. On-time is about one microsecond, off-time about 20 microseconds.

The laser is all glass except for the windows and electrodes. A glassblower can build the body of the laser for about $200. For many applications, the common neon sign transformer (worth about $50) is an ideal power supply, according to Drs. Philip L. Hanst and John A. Morreal of NASA. Using a 9,000-volt neon sign transformer, the laser produces about 25 watts of power.

ACTIVE OPTICS

Alignment of space telescope tested

For years astronomers have been building telescopes on mountaintops to get them above as much air as they can. Now they have the opportunity to put telescopes into orbit—entirely outside of the obscuring atmosphere.

But telescopes built on earth will change their shape when they get into orbit and lose clarity. A large flat slab of material, such as a telescope mirror, is always slightly deformed by its own weight unless it is uniformly supported at all points.

Counteracting deformation can be built into a telescope for use on earth, where the weight stays the same, but if the same telescope is put into a zero-gravity environment, the deformation goes away and the reflecting surface is distorted.

The problem can be solved, says Dr. Hugh J. Robertson of the Perkin-Elmer Corp., Norwalk, Conn., if the mirror is built in small sections (whose distortion will be proportionately less). Each section should be separately mounted on equipment designed to adjust the alignment of the sections to compensate for any distortion that does occur.

Such a system, called active optics, has been built and tested at Perkin-Elmer. In a chamber that simulates zero gravity, the system aligned three segments of a 20-inch diameter mirror to a tolerance of a millionth of an inch.

Active optics will also lower the weight of a mirror, Dr. Robertson estimates. In a 400-inch telescope, a single mirror designed and constructed like those on Orbiting Astronomical Observatory spacecraft would weigh about 185,000 pounds, he figures. An active optics mirror of the same dimension made of 40-inch segments would weigh less than 20,000 pounds with its adjustment and control devices.

LASERS

How to split seconds

Scientists of the United Aircraft Research Laboratories, East Hartford, Conn., are generating laser pulses that last between a thousand-billionth and a hundred-billionth of a second. This is the time light takes to travel approximately one-hundredth to one-tenth of an inch.

The number of such pulses put out per second can be more than a billion, and the peak power of the pulses can be in the billions of watts. Dr. A. J. DeMaria reports the researchers believe that much higher peak powers could be generated if the laser amplifiers are redesigned so that they will not burn out.

Among the possible uses of such pulses is range-finding where distances of many miles could be measured to within fractions of an inch. The pulses can be used in high-speed photography, optical information processing, and in studies of optical and vibrational properties of materials. Falling on very fast photodiodes, these laser pulses can produce electrical pulses of about a ten-billionth of a second, a technique that should find many applications.

HOLOGRAPHY

Photography at a distance

Using a laser-hologram technique, a Stanford University group has made a photograph of a man from eight miles away.

It was done in the desert near Holloman Air Force Base in New Mexico. The man stood in front of a flat, light-reflecting surface on which was mounted a very efficient glass corner reflector. A one-joule ruby laser at 50 megawatts power served as light source, attached to a 48-inch telescope to receive the light reflected from the subject.

The resulting picture is crude, but the man's silhouette does appear, Stanford engineers say, and it was made at night under conditions impossible for ordinary photography.

Success through 16 miles of ground level atmosphere leads to the hope that the technique will be useful for photographing artificial satellites with a minimum of atmospheric distortion, group member Matt Lehmann reports.