Using Lasers to vaporize asteroids!

After a meteor crashed into Russia on February 15, 2013, causing a lot of death and destruction, scientists have been thinking about ways to protect the earth from these collisions. Physicist Philip Lubin from UC Santa Barbara in California is working on a project called DE-STAR that will convert the light energy from the sun into high energy laser beams that can be used to either deflect or vaporize asteroids. Lubin's research team also predicts that DE-STAR can be used to measure what an asteroid is made of and determine if it contains any rare elements. In this way, laser technology could be used to mine for valuable metals in outer space! DE-STAR may even allow for deep-space travel, because it would provide the huge power source necessary to accelerate spacecraft!

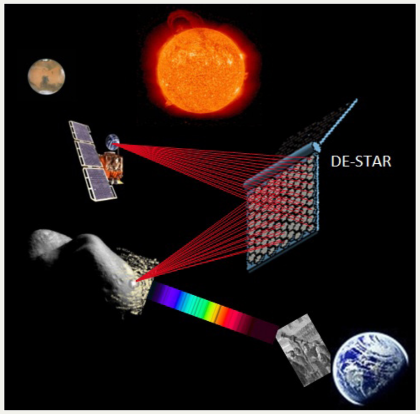


Image credit: Philip Lubin.

Another Application: Laser Tag!!

Actually, the light used in laser tag is usually not truly laser light—it is LED! Visible light is used so that the players can see the beam, but it is actually infrared light that allows players to "tag" each other. Sensors built into the vests that the players wear contain what are called "photoconductors." When a beam of infrared light hits the photoconductor, it causes an electric current to flow. Mechanisms in the vest detect this current and register that the player has been "hit."

Bibliography

Gannon, Megan. "Asteroid-Targeting System Could Vaporize Dangerous Space Rocks." Space.com. Space.com, 15 February 2013. Web. 15 September 2013.

"Laser Facts". Nobelprize.org. Nobel Media AB 2013. Web. 15 Sep 2013.

Weschler, Matthew. "How Lasers Work." Howstuffworks.com. Discovery, 1 April 2000. Web. 15 September 2013.

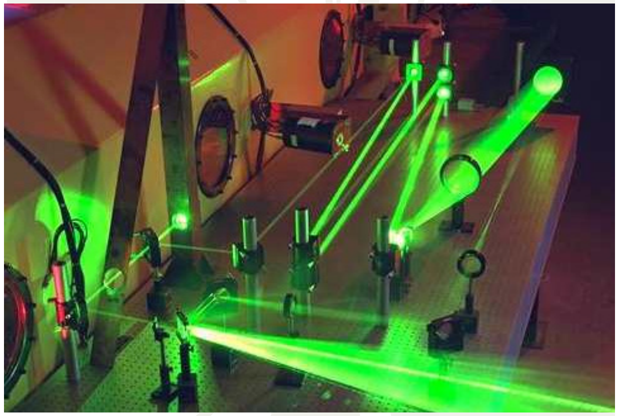
Williams, Brent, David Wiliams, Josh Thompson, and Lauren Bradford. "Laser Tag; why it is important/uses." UNC.edu. The University of North Carolina at Chapel Hill, N.d. Web. 15 September 2013.

New York Space Grant Consortium

raise Cornell

Physics Brochures Series by Sarah Marie Bruno, '16 Distributed Courtesy of X-Raise Cornell and NASA/New York State Space Grant Consortium.

LASERS!



HELPING TO FURTHER

PUBLIC UNDERSTANDING

OF PHYSICS CONCEPTS

Lasers!

When you think of lasers, you probably think of the snazzy, futuristic weapons used in Star Wars and Star Trek. You may not know, however, that these sleek beams of light are actually found in a lot of everyday appliances: DVD and CD players, amplifiers, printers, and the devices that the police use to check for speeding all use lasers!

But what is a laser? Why does laser light behave differently than the "ordinary" light from a flashlight? If you compare a flashlight and a laser pointer, you can see that a beam of light from a flashlight spreads out as it travels, while the laser beam remains focused. This is because laser light is "coherent" and "monochromatic." "Coherent" means that the emitted light waves are "lined up" with each other—their peaks and troughs occur in sync. "Monochromatic" means that the light waves are all the same color.

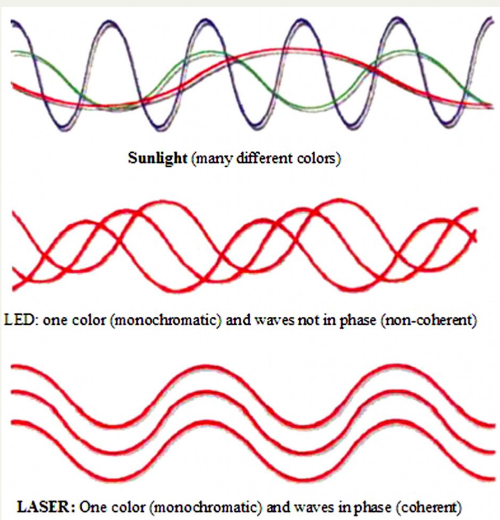
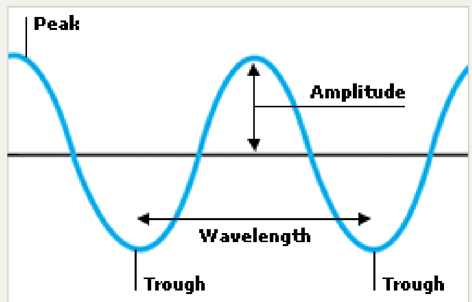


Image from Discover magazine.

Let's back up a little bit—you have probably heard before that light can be thought of as both a wave and a particle. Light behaves like an oscillating wave, moving up and down as it moves forward in space, but it also acts like a particle.

Max Planck discovered in 1900 that light is "quantized." This means that light cannot travel in a random amount, but is bundled into little packages of energy called photons. In other words, the photon is the smallest unit of light energy. You cannot have half a photon or two and three quarters photons—you can only have whole number multiples.

For now, though, let's focus on the wave properties of light, because that will help us to understand lasers. The distance up and down that the wave travels is called its amplitude, while the horizontal distance between peaks is the wavelength. For visible light, wavelength determines the color of the light.



Light waves with shorter wavelengths have more energy than light waves with longer wavelengths. For example, UV rays can give you a sunburn, because they have a very short wavelength and therefore have a lot of energy. Radio waves, on the other hand, have a long wavelength and are perfectly safe for humans.

The entire range of light waves from gamma to radio waves is called the "electromagnetic spectrum." Visible waves are only a small part of this spectrum, so humans are actually blind to most forms of light!

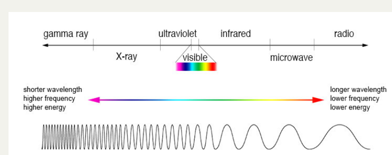


Image from NASA Goddard Space Flight Center.

Now let's get back to lasers! Sunlight and the light from most flashlights and light bulbs is made up of a bunch of different types of waves from across the electromagnetic spectrum, which all combine to form white or yellow light. Lasers are unique, because they are perfectly uniform—all the light waves in a laser have the same wavelength and are lined up with one another or "in phase." LED light is similar to laser light in that all of the waves are the same color, but it is not coherent light, because the waves are not in phase.

Since most natural light sources tend to be incoherent and non-monochromatic, people have to create laser light. The word "laser" is actually an acronym for "light amplification by stimulated emission of radiation." This acronym is a fancy way to summarize how laser light is produced. Energy is added to a substance called a "medium" until a great number of atoms in the medium are "excited" to a high energy level. The more excited the atoms are, the more energy they will eventually release as light when they return to their relaxed or "ground" energy state. This is the "stimulated emission of radiation." When certain wavelengths of light are released, they can cause other atoms to become excited and to emit light with the same wavelength! Mirrors are also used to reflect the laser light and intensify it before it is released. This is the "amplification."

Because so much light energy is concentrated into such a narrow beam, laser light can be very dangerous. This is similar to the difference between poking a balloon with your finger and poking it with a pin. The pin doesn't poke the balloon any harder than your finger, but it acts in such a tiny space that the balloon pops. In the same way, a narrow beam of visible light can cause a lot of harm, even though visible light is normally perfectly safe. As a result, scientists working with lasers often need to wear special goggles to protect their eyes.