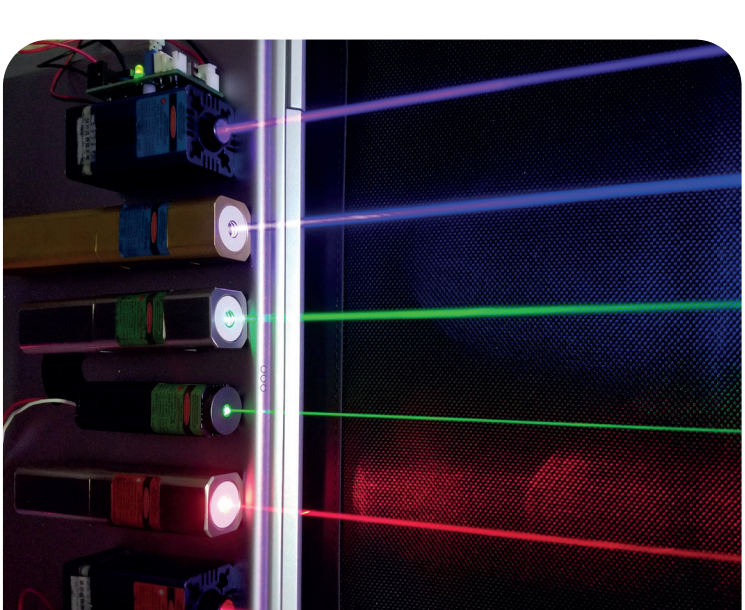


Different-colored laser lights

We all need and use light. With light, we can see and accomplish things. Without light, it would be hard to perform most of our daily tasks. But, did you know that some kinds of light not only enable us to use our tools clearly but can also be used as a tool themselves? Laser light is one kind of light that can be used for many things. It is used by doctors, surveyors, architects, diamond cutters, and clothing manufacturers. Lasers are found in our CD players, supermarket scanners, and telephone wires. A relatively recent invention, lasers can be found all over in our lives today. Read on to learn more about this fascinating invention with so many interesting uses.

WHY IT MATTERS

- Lasers have many practical applications and uses in our lives. We use and rely on lasers multiple times every day.
- Lasers have revolutionized and simplified the way medical procedures are done. For example, eye surgery can now be done easily and with little risk.

WHAT IS SPECIAL ABOUT LASER LIGHT?

Laser light is an extremely powerful form of light. In fact, it is so powerful that it can cut through metal—in just one second. Laser light is much stronger than regular light. Imagine a single wave in a bathtub. If you kept splashing and splashing the single wave, it would eventually become stronger and more powerful than the original wave. If this were done in the ocean, the wave movement would become even more powerful. Laser light is light that has been stimulated over and over until it becomes many, many times more powerful than the original light.

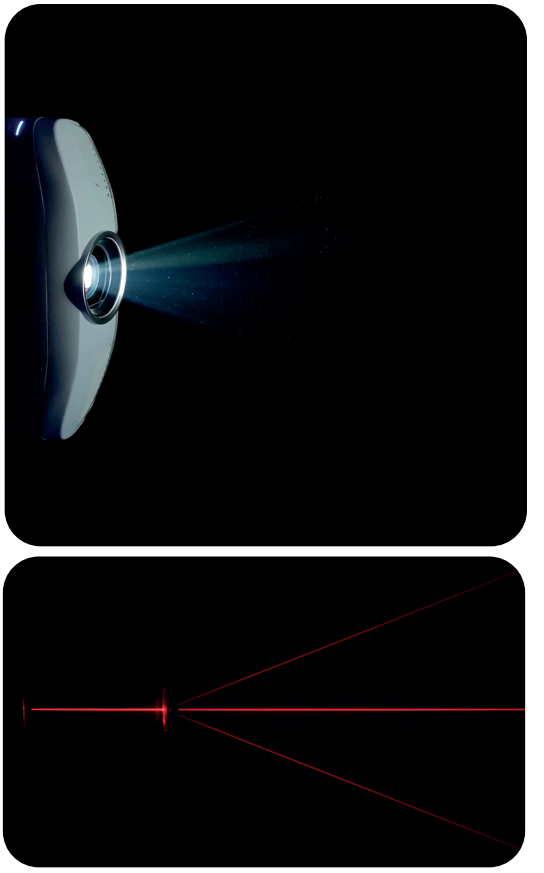
There are a few features specific to laser light that make it so powerful. Unlike regular light, which spreads out and becomes weaker as it travels, laser light stays together, so the beam does not weaken as it travels from the source. Regular white light is also made up of many different colors, which each travel in slightly different patterns. Laser light is made up of only one-color wavelength, so the light waves are identical and reinforce each other. We call laser light **coherent**[1] because of this quality.

1 **coherent** – held together; unified

HOW DOES LASER WORK?

Laser is an acronym. Its letters stand for "light **amplification**[2] by stimulated **emission**[3] of radiation." Regular light is produced by **spontaneous**[4] emission. This happens when one of the **electrons**[5] in an atom absorbs extra energy and then releases it in the form of a **photon**[6] of light. The atom lets out light so that it can return to its normal state.

To create laser light, the process of **stimulated**[7] emission must take place instead of spontaneous emission. If the released photon of light hits a second atom, a new photon of light is created, and the original one is retained as well. Together they create a stronger beam of light. The one photon of light has now created two, so we say that the light has been amplified. In other words, laser light has been made. Light amplification by the stimulated emission of radiation has occurred.



Regular light spreads and weakens as it travels (L), while laser light travels as a strong coherent beam (R).
Credit: *Laser light, D-Kuru, Wikimedia*

Laser light is often produced using a tool called a laser. What is needed to create a laser? The two main things needed to create a laser are a medium and an energy source. The medium is a set of atoms with electrons that can be stimulated. The energy source is something that can stimulate the atoms, for example, a flash lamp. (A flash lamp, as its name suggests, produces a flash of light.) A typical basic red laser light starts with a ruby crystal in a tube. The ruby crystal is the medium, as it contains many atoms with electrons. An energy source, such as a flash lamp, is positioned near the crystal tube. Every time the lamp flashes, atoms in the crystal absorb the extra energy (remember, light is energy) and then release a photon of light. These photons move up and down the tube. Every time a photon hits another atom, a new photon is created, and the original one remains as well. There will now be two photons of the same wavelength, creating a more powerful light than the original photon of light. The process of *l*ight *a*mplification by *s*timulated *e*mission of *r*adiation has occurred. There will be a mirror at one end of the tube and a partial mirror on the other. The two mirrors will keep the photons moving to and fro inside the tube, allowing more photons to create a stronger, more powerful light. The partial space in one mirror will allow some of the photons to escape as a strong and powerful laser beam.

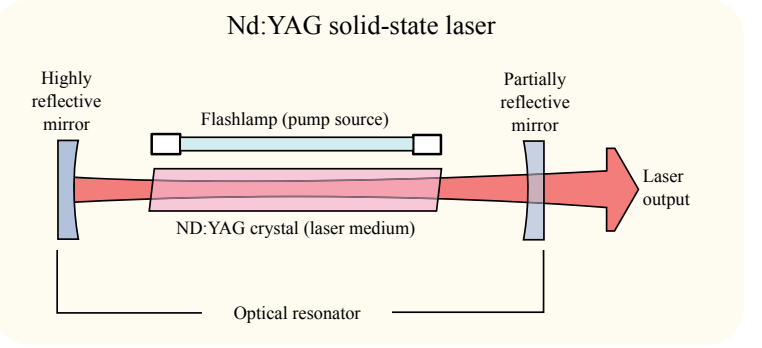


Diagram depicting the components of a typical laser
Credit: *Lakkasuko, Wikimedia*

2 **amplification** – making stronger
3 **emission** – release; discharge
4 **spontaneous** – automatic
5 **electrons** – parts of an atom that have a negative electrical charge
6 **photon** – particle of light
7 **stimulated** – triggered; activated

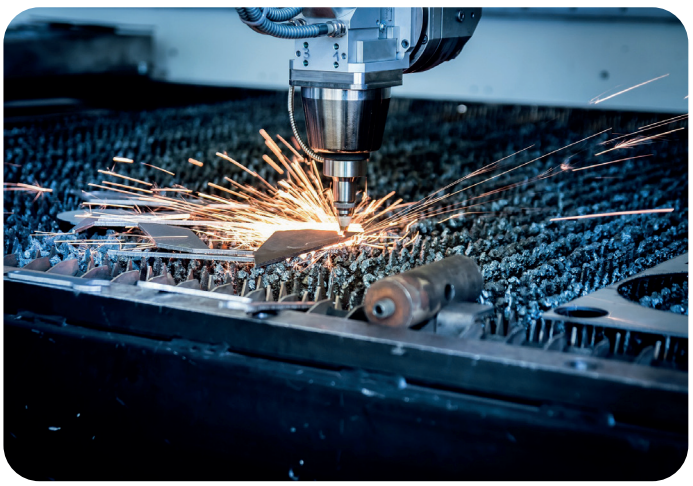
THE HISTORY OF LASERS

Albert Einstein first theorized in 1916 that, under the right conditions, excess energy could be released from atoms in the form of light. However, it was only many years later that the first laser was built.

In 1951, Charles Townes of New York invented a device called a maser. The maser works the same way as a laser, only with microwaves instead of light waves. Little practical application was ever found for the device; however, its invention sparked a wave of research into masers and, consequently, lasers.

In 1957, Townes spoke to his brother-in-law, scientist Arthur L. Schawlow, about his ideas for the maser device and his thoughts on possibly trying the same thing with light waves. He also spoke with a graduate student at Columbia University, Gordon Gould. Gould was the first to come up with the acronym "laser." The inventors published their ideas, which led to many groups trying to put together a laser.

The first person to succeed was Theodore H. Maiman. He used a photographer's lamp to stimulate the atoms in a ruby crystal. In 1960, he managed to produce red pulses of laser light.



Laser being used as a powerful cutting tool

Scientists had many great, imaginative ideas for lasers, but it took a few years until anything of practical use was invented. The first lasers to be widely used were made with helium-neon as the medium. These lasers could project straight lines of light, so they were used by contractors, builders, and surveyors as **alignment**[8] tools. Today, there are multiple kinds of lasers made with different mediums and stimulation sources, with a wide range of uses. Eye surgeons can use lasers to **weld**[9] the retina back into place instead of using a blade. Scanners at supermarket checkouts use laser. Communication networks rely heavily on lasers today, and many music players and printers use them too. Lasers also play a large role in the military, where they are used as weapons or to guide bombs to their targets. You might have even used laser in a game, such as laser tag.

A closer look shows us that laser is used in many different ways throughout our lives. Despite its already vast range of uses, scientists still have plans to develop the laser concept even further in the future. Keep watching to see what develops next!

7 **alignment** – arranged in a straight or correct position
8 **weld** – join; fuse

QUESTIONS

1. *These lasers could project straight lines of light, so they were used by contractors, builders, and surveyors as alignment tools.* **As used in this sentence, "project" most nearly means.**

A. predict

B. estimate

C. protrude

D. radiate

2. **In which sentence is the word "emission" used correctly?**

A. It is better for the environment when commuters use a bicycle rather than a car, because a car releases carbon emissions and other pollutants.

B. In order to use a favorite passage from a book in the school newspaper, the editor had to ask emission from the publisher.

3. **Mark each statement as T (true) or F (false).**

_____ Albert Einstein invented the laser in 1916.

_____ The maser differs from the laser in that the maser uses light beams.

_____ Theodore H. Maiman was the first to create a usable laser.

_____ Spontaneous emission occurs when an electron gains photons.

_____ Laser stands for "light amplification by stimulated emission of radiation."

4. **Number the following events in the order in which they take place.**

_____ When the moving photons hit other atoms, more new photons are created.

_____ Some photons escape as a powerful beam through a partial space in one mirror.

_____ The electrons in the crystal release photons.

_____ A ruby crystal or similar medium is stimulated by an energy source.

5. **What is the author's purpose in including the following sentence?** *Gould was the first to come up with the acronym "laser."*

A. The author's purpose is to highlight Gould's role in the early development of lasers.

B. The author's purpose is to describe the history of graduate education.

C. The author's purpose is to compare and contrast lasers and masers.

D. The author's purpose is to explain the meaning of the acronym "laser."

6. What was the main use of the maser device?

A. The maser device didn't have a practical purpose.

B. The maser device helped scientists develop microwaves.

C. Masers are used in the military to guide bombs and weapons.

D. The maser device used excited electrons to produce a beam of photons with a similar wavelength.

7. Which choice provides the best evidence for the answer to the previous question?

A. *Little practical application was ever found for the device.*

B. *The maser works the same way as a laser, only with microwaves instead of light waves.*

C. *Lasers also play a large role in the military, where they are used as weapons or to guide bombs to their targets.*

D. *To create laser light, the process of stimulated emission must take place instead of spontaneous emission.*

8. Consider the author's statement that "laser is used in many different ways throughout our lives." What details does the author offer to support this statement?

9. How did lasers change over time?

10. If lasers had not been invented, what would be different today?