How lasers work – the light fantastic. Dr. Stephen Ashworth

Dr. Stephen Ashworth, a Senior Lecturer UEA, delivered an extremely entertaining and informative presentation on the subject of lasers and how they work. He incorporated a series of practical demonstrations throughout his talk and managed to explain this somewhat complex subject in terms we could all understand.

“Laser” is an acronym for light amplification by stimulated emission of radiation. A laser is created when the electrons in atoms in special glasses, crystals, or gases absorb energy from an electrical current or another laser and become “excited.” The excited electrons move from a lower-energy orbit to a higher-energy orbit around the atom’s nucleus. When they return to their normal or “ground” state, the electrons emit photons (particles of light).

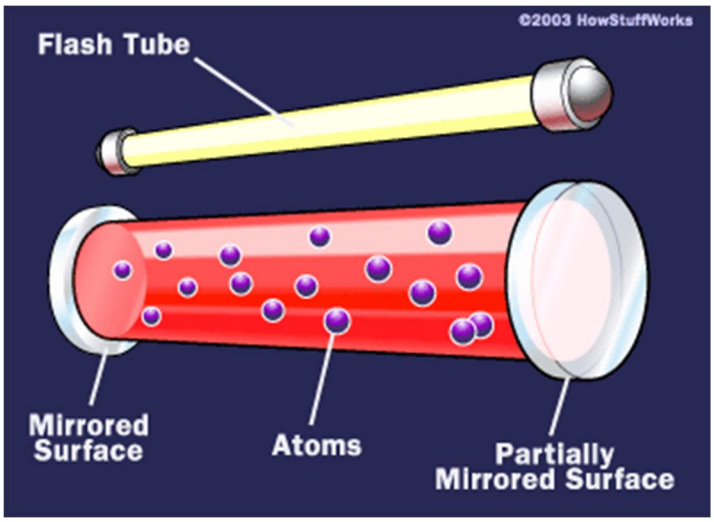
These photons are all at the same wavelength and are “coherent,” meaning the crests and troughs of the light waves are all in step. In contrast, ordinary visible light comprises multiple wavelengths and is not coherent.

Laser light is different from normal light in other ways. First, its light contains only one wavelength (one specific color). The particular wavelength of light is determined by the amount of energy released when the excited electron drops to a lower orbit. Second, laser light is directional. Whereas a laser generates a very tight beam, a flashlight produces light that is diffuse. Because laser light is coherent, it stays focused for vast distances, even to the moon and back.

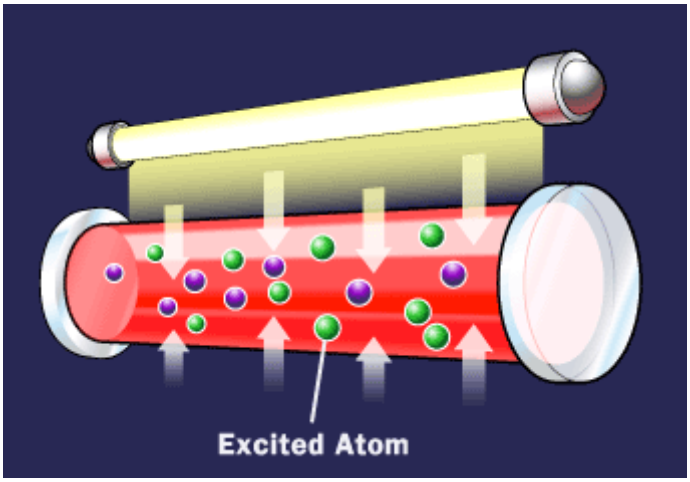
The first working laser was a ruby laser made by Theodore H. "Ted" Maiman at Hughes Research Laboratories in 1960. Some lasers, such as ruby lasers, emit short pulses of light. Others, like helium–neon gas lasers or liquid dye lasers, emit light that is continuous. Laser light does not need to be visible.

Lasers are now used in optical disk drives, laser printers, barcode scanners, DNA sequencing instruments, fibre-optic communications, laser surgery and skin treatments, cutting and welding materials, military and law enforcement devices for marking targets and measuring range and speed, and in laser lighting displays for entertainment. Research is also taking place into potential usage in the healthcare arena such as helping ‘clean’ arteries of plaque.

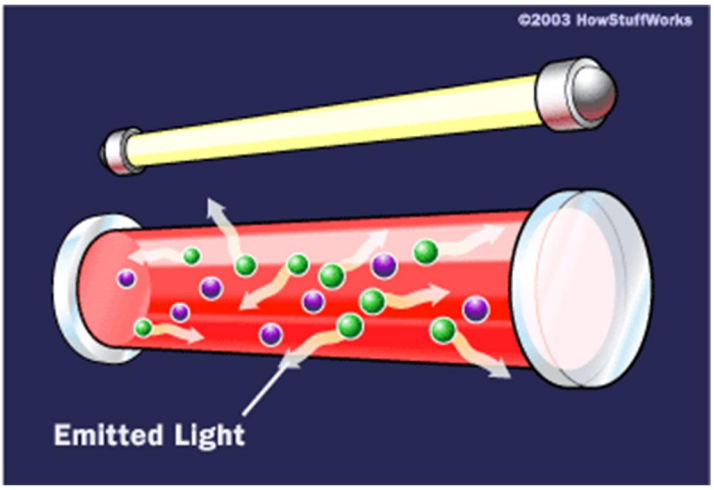
Below is an explanation of how ruby lasers work.
A ruby laser consists of a flash tube (like you would have on a camera), a ruby rod and two mirrors (one half-silvered). The ruby rod is the lasing medium and the flash tube pumps it.



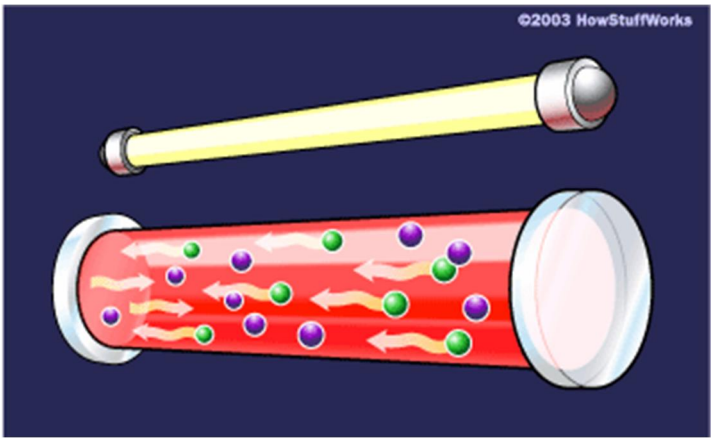
1. The laser in its non-lasing state



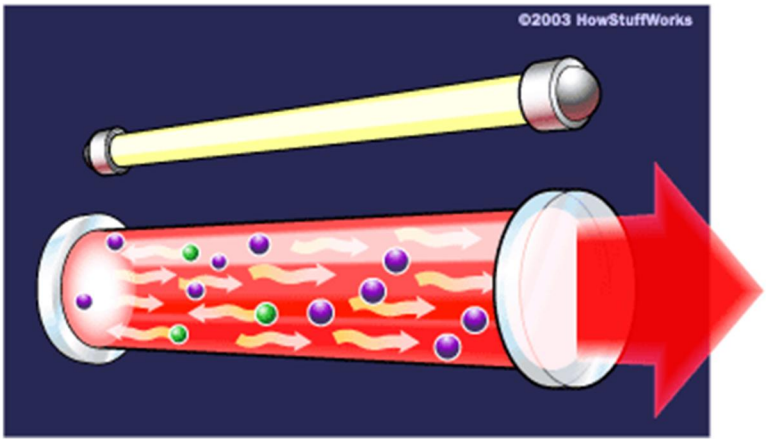
2. The flash tube fires and injects light into the ruby rod. The light excites atoms in the ruby.



3. Some of these atoms emit photons.



4. Some of these photons run in a direction parallel to the ruby's axis, so they bounce back and forth off the mirrors. As they pass through the crystal, they stimulate emission in other atoms.



5. Monochromatic, single-phase, columnated light leaves the ruby through the half-silvered mirror -- laser light!