

## **A Brief History of Lasers:**

Max Plank published work in 1900 that provided the understanding that light is a form of electromagnetic radiation. Without this understanding the laser would not have been invented. The principle of the laser was first known in 1917, when physicist Albert Einstein described the theory of stimulated emission. However, it was not until the late 1940s that engineers began to utilize this principle for practical purposes. At the onset of the 1950's several different engineers were working towards the harnessing of energy using the principal of stimulated emission.

At the University of Columbia was Charles Townes, at the University of Maryland was Joseph Weber and at the Lebedev Laboratories in Moscow were Alexander Prokhorov and Nikolai G Basov.

At this stage the engineers were working towards the creation of what was termed a MASER (Microwave Amplification by the Stimulated Emission of Radiation), a device that amplified microwaves as opposed to light and soon found use in microwave communication systems. Townes and the other engineers believed it to be possible to create an optical maser, a device for creating powerful beams of light using higher frequency energy to stimulate what was to become termed the lasing medium. Despite the pioneering work of Townes and Prokhorov it was left to Theodore Maiman in 1960 to invent the first Laser using a lasing medium of ruby that was stimulated using high energy flashes of intense light. Townes and Prokhorov were later awarded the Nobel Science Prize in 1964 for their endeavors.

The Laser was a remarkable technical breakthrough, but in its early years it was something of a technology without a purpose. It was not powerful enough for use in the beam weapons envisioned by the military, and its usefulness for transmitting information through the atmosphere was severely hampered by its inability to penetrate clouds and rain. Almost immediately, though, some began to find uses for it. Maiman and other engineers developed laser weapons sighting systems and powerful lasers for use in surgery and other

areas where a moderately powerful, pinpoint source of heat was needed.

Today, for example, Lasers are used in corrective eye surgery, providing a precise source of heat for cutting and cauterizing tissue.

For a full and detailed explanation of the Laser through the years see the History Outline below.

<b>Outline History of the Development of the Laser</b>		
<b>Date</b>	<b>Name</b>	<b>Achievement</b>
1900	Max Plank	Provided the understanding that light is a form of electromagnetic radiation
1916	Albert Einstein	Theory of light emission. Concept of stimulated emission.
1928	Rudolph W Landenburg	Confirmed existence of stimulated emission and negative absorption.
1940	Valentin A Fabrikant	Noted possibility of population inversion.
1947	Willis E Lamb R C Rutherford	Induced emission suspect in hydrogen spectra. First demonstration of stimulated emission.
1951	Charles H Townes	The inventor of the MASER (Microwave Amplification of Stimulated Emission of Radiation) at Columbia University - First device based on stimulated emission, awarded Nobel prize 1964.
1951	Charles H Townes Joseph Weber James P. Gordan	Inventors of MASER at University of Maryland.
1951	Alexander M. Prokhorov Nikolai G. Basov	Independent inventors of MASER at Lebedev Laboratories, Moscow. Awarded Nobel prize 1964.

1954	Robert H. Dicke	“Optical Bomb” patent. Based on pulsed population inversion for superradiance and separately Fabry-Perot resonant chamber for “Molecular Amplification and Generation system”.
1956	Nicolas Bloembergen	First proposal for a three-level solid state MASER at Harvard University.
1957	Charles H Townes	Sketches an early optical MASER in his lab book.
1957	Gordon Gould	First document defining a LASER; notarized by a candy store owner. Credited with patent rights in the 1970s.
1958	Arthur L Schawlow Charles H Townes	First detailed paper describing “Optical MASER”. Credited with invention of LASER. from Columbia University.
1959	Gordon Gould	Applies for LASER related patents
1959	John D. Myers	First stroboscopic X-Ray system at Pennsylvania State University. Precursor to X-ray LASER.
1960	Arthur L Schawlow Charles H Townes	LASER patent No. 2,929,922.
1960	Theodore Maiman	Invented first working LASER based on Ruby. May 16 <sup>th</sup> 1960, Hughes Research Laboratories.
1960	Peter P Sorokin Mirek Stevenson	First Uranium LASER - Second LASER overall. Nov. 1960 IBM Labs.

1960	Ali Javan, William Bennett Donald Herriot	First helium-neon LASER at Bell Labs Dec. 1960, First gas laser and first CW laser.
1961	Lloyd G. Cross	First commercial laser company, Trion Instruments was founded in March, First spinning prism Q-switched Ruby LASER. Third Ruby LASER, Trion became Lear-Siegler, Laser Systems Center in 1962.
1961	Robert Rempel	Co-founded Spectra-Physics, which became the 2 <sup>nd</sup> company to make LASERS.
1961	A G Fox and T Li	Theoretical analysis of optical resonators at Bell Labs.
1961	Elias Snitzer	First glass LASER and clad laser rods at American Optical.
1961	Leo F. Johnson, K. Nassau	First neodymium crystal LASER at Bell Labs
1961	Ralph R. Soden Scotch Plains Le Grand (Larry) G. Van Uitert	First continuous wave operation of rare earth doped crystal LASER at Bell Labs. Patent No. 3,177,155.
1961	John D. Myers	Fourth Ruby LASER at Cornell Aeronautical Laboratory.
1962	Fred J. McClung	First electro-optic Kerr cell Q-switch.
1962	Robert Hall Nick Holonyak	Invention of semi-conductor LASER at General Electric Labs.
1962	Alan White Dane Rigden	First helium neon (HeNe) visible CW LASER at Bell Labs.
1962	Fred Brech Lloyd G. Cross	First LASER Induced Breakdown Spectroscopy (LIBS) chemical analysis system at Jarrell-Ash & Trion Instruments.
1963	Robert Keyes Theodore Quist	First diode pumped solid state LASER, uranium doped calcium fluoride at MIT Lincoln Labs.

1963	Logan E Hargrove Richard L Fork M. A. Pollack	First mode locked acousto-optic Q-switch.
1964	Emmett Leith Juris Upatnieks	First display of LASER holograms of 3D objects. April 3, at Spectra-Physics.
1964	John D. Myers	First field demonstration of a Ruby LASER rangefinder/ceilometer at Cornell Aeronautical Laboratory.
1964	Elias Snitzer	First fiber LASER & first fiber LASER amplifier at American Optical.
1964	John D. Myers	First demonstration of LASER propulsion. Cornell Aeronautical Laboratory.
1964	Joeseeph E Geusic Richard G. Smith H M Markos L G Van Uiteit Bob Thomas Leo Johnson	Inventor of first working Nd:YAG LASER at Bell Labs.
1964	Kumar N Patel	Inventor of CO <sub>2</sub> LASER at Bell Labs.
1964	William Bridges	Invention of Argon Ion LASER at Hughes Labs.
1965	John D. Myers	First Gigawatt LASER (Ruby) oscillator/amplifier system at Lear-Siegler, Laser Systems Center
1965	John D. Myers	First dual frequency LASER ceilometer at Lear Siegler Laser System Center.
1965	George Pimentel J V V Kasper	First chemical LASER at University of California, Berkley.
1965	John D. Myers	First frequency-doubled LASER rangefinder at Lear Siegler Laser System Center.
1966	Ed Gerry Arthur Kantrowitz	First 10+ Kilowatt CO <sub>2</sub> LASER at Avco Everett Research Lab.

1966	James Hobart	Founded first commercial CO2 LASER company Coherent Radiation (now Coherent Inc.) Hobart was an employee of Trion Instruments the first commercial laser company founded by Lloyd G. Cross in 1961.
1966	William Silfvast Grant Fowles and Hopkins	First metal vapour LASER - Zn/Cd - at University of Utah
1966	John D. Myers	First plane position indicating LASER radar at Lear Siegler Laser System Center.
1966	Peter Sorokin John Lankard	First dye LASER action demonstrated at IBM Labs.
1966	Mary L. Spaeth	First tunable dye LASER at Hughes Research Labs
1967	John D. Myers	First commercial Nd:Glass LASER rod at Owens-Illinois.
1967	Bernard Soffer B. B. McFarland	First wavelength tunable dye LASER at Korad.
1967	John D. Myers	First Gigawatt Nd:Glass LASER oscillator/amplifier system at Owens-Illinois.
1969	Keeve M. Siegel	First commercial fusion LASER research program at KMS Industires.
1969	G M Delco	First industrial installation of three LASERS for automobile application.
1969	John D. Myers* Carl Sulter** Tom Crow***	Invention of samarium filters for Nd:YAG LASER at *Owens-Illinois, **Hughes Aircraft & ***Martin Marietta.
1970	Nikolai Basov Yu M. Popov	First Excimer LASER at Lebedev Labs, Moscow based on Xenon (Xe) only.
1970	Alferov' Group Mort Panish Izuo Hayashi	First CW semiconductor LASER at Ioffe Physico-Technical Inst. & Bell Labs

1972	Charles H, Henry	First quantum well LASER
1973	Lloyd Cross	First commercial LASER hologram company at Multiplex Company
1974	J. J. Ewing and Charles Brau	First rare gas halide excimer LASER at Avco Everet Labs.
1976	Jim Hsieh	First InGaAsP diode LASER at MIT Lincoln Labs.
1976	John M J Madey's Group	First free electron LASER at Stanford University.
1980	Geoffrey Pert's Group	First report of X-ray LASER action, Hull University, UK.
1981	Arthur Schawlow Nicolas Bloembergen	Awarded Nobel Physics Prize for work in non-linear optics and spectroscopy.
1982	Peter F. Moulton	First titanium sapphire LASER at MIT Lincoln Labs
1984	Dennis Matthew's Group	First reported demonstration of a "laboratory" X-ray LASER from Lawrence Livermore Labs.
1985	John D. Myers	First commercial LASER eye surgery device and method, US patent No. 4,525,942 and UK patent No. GB 2 157 483 A at Kigre, Inc.
1987	David Payne	First erbium fiber LASER amplifier
1994	Jerome Faist Federico Capasso Deborah L. Sivco Carlo Sirtori Albert Hutchinson Alfred Y. Cho	First quantum cascade multiple wavelength LASER at Bell Labs
1994	Nikolai Ledentsov	First quantum dot LASER at Ioffe Physico-Technical Institute.
1996	Wolfgang Ketterle	First pulsed atom LASER at MIT
1996		First Petawatt LASER at Lawrence Livermore

		National Labs.
1997	Wolfgang Ketterle	First atom LASER at MIT Lincoln Labs.
2004	Ozdal Boyraz Bahrom Jalali	First silicon Raman LASER at the University of California, Los Angeles
2006	John Bowers	First silicon LASER
2007	John Bowers Brian Koch	First mode-locked silicon evanescent LASER
2010		First 10 Petawatt LASER at Lawrence Livermore National Labs.