

Who invented the laser?

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Bell Labs Historical Contributions to Laser Technology

1958: Arthur L. Schawlow and Charles H. Townes invent the laser, then publish "Infrared and Optical Masers" in the American Physical Society's *Physical Review*. The paper describes the basic principles of the laser, initiating this new scientific field.

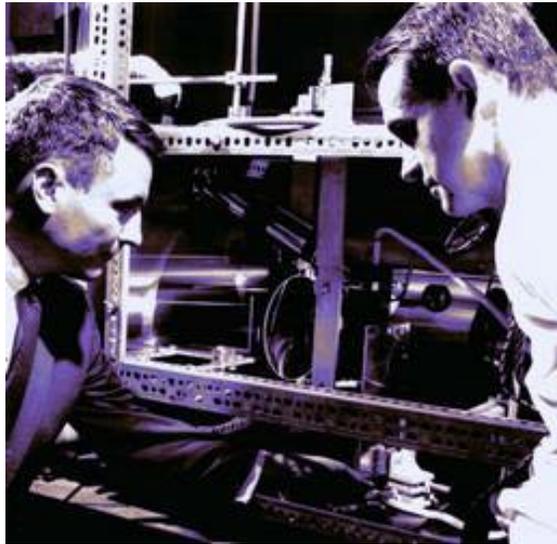
1959: First proposal of gas lasers excited by electrical discharge.



1960: **Ali Javan, William Bennett, and Donald Herriott adjust the helium neon laser, the first laser to generate a continuous beam of light at 1.15 microns and the first of many electrical discharge pumped gas lasers.**

1961: First continuous operation of an optically pumped solid-state laser in Nd:CaWO₄ at 1.06 microns by L.F. Johnson, G.D. Boyd, and K. Nassau, and R.R. Soden.

1961: First description of the Gaussian modes of the confocal optical resonator by G.D. Boyd and J.P. Gordon.



1961: Willard S. Boyle, left, and Donald F. Nelson, Bell Laboratories scientists who developed the continuously operating ruby laser, examine the apparatus designed to convey pumping light to one end of a trumpet-shaped crystal.

1962: Extended Gaussian Mode Theory presented by G.D. Boyd and H. Kogelnik.



Kumar Patel, and rear, left to right, Walter A. Faust, Ross A. McFarlane, and William R. Bennett, Jr., develop the five noble gas lasers, and lasers using oxygen mixtures.

1964: Discovery of LiNbO_3 as an efficient phase matchable nonlinear optical material by G.D. Boyd, Robert C. Miller, K. Nassau and W.L. Bond.



1964: C. K. N. Patel shown here with the high-power 10.6 micron carbon dioxide laser which he developed at Bell Labs.

1964: First Nd:YAG laser (uses neodymium-doped yttrium aluminum garnet crystals) by J.F. Geusic and R.G. Smith.

1965: First tunable laser light source (laser-pumped optical parametric oscillator using LiNbO₃) by J.A. Giordmaine and Robert C. Miller.

1965: Two lasers phase-locked for the first time, an important step toward optical communications.

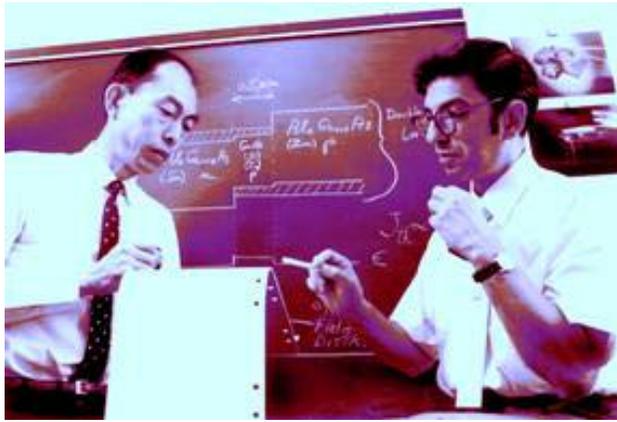
1965: Laser used to create first two-color hologram.

1966: Discovery of optically induced refractive index changes in LiNbO₃, leading to its use in holographic material, by A. Ashkin, G.D. Boyd, and J.M. Dziedzic.

1967: Method devised for measuring single laser pulses of approximately 1 picosecond (trillionth of a second) duration.

1969: Herwig Kogelnik publishes a seminal paper on "Coupled Wave Theory for Thick Hologram Gratings," important in understanding the practical diffraction efficiencies of volume holograms.

1970: [A. Ashkin](#) publishes a paper on the acceleration and trapping of particles by optical radiation pressure.



1971: Izuo Hayashi and Morton Panish design the first semiconductor laser that operates continuously at room temperature.

1972: Laser beam used to form electronic circuit patterns on ceramic.

1973: Hasegawa and Tappert predict optical fibers can support solitons.

1976: First demonstration of a semiconductor laser operating continuously at room temperature at a wavelength beyond 1 micron, the forerunner of sources for long-wavelength lightwave systems.

1977: Solid-state laser with lifetime of 1 million hours, or 100 years, overcoming initial short lifetimes.

1980: L.F. Mollenauer, Roger Stolen and J.P. Gordon first observe solitons in optical fibers.

1983: Linn Mollenauer and Roger Stolen create the soliton laser, which generates solitons, ultra-short pulses that travel great distances without dispersion.

1983: Won-Tien Tsang patents the cleaved coupled-cavity laser; based on an idea patented in 1965, this semiconductor device features output that can be tuned electronically from one ultrapure single-frequency to another.

1985: Light pulses of 8-femtosecond duration generated (8 quadrillionths, or millionths of a billionth, of a second) by W. Knox.

1985: [Steven Chu](#), L. Hollberg, J.E. Bjorkholm, A. Cable and A. Ashkin first observe the optical cooling of atoms, called "optical molasses".

1986: S. Chu, J.E. Bjorkholm, A. Ashkin and A. Cable first observe atom trapping.

1986: [A. Ashkin](#), J.M. Dziedzic, J.E. Bjorkholm and S. Chu demonstrate the first optical tweezer trapping of submicron Rayleigh particles and macroscopic particles.

1986: A. Ashkin and J.M. Dziedzic demonstrate the first optical tweezer trapping of viruses and bacteria.

1987: A. Ashkin, J.M. Dziedzic and Yamane first observe the trapping and manipulation of living cells using infrared optical tweezers. This technique is having a major impact on biology and medical research.

1991: Colliding-pulse mode-locked laser generates the world's shortest (600 femtoseconds) and fastest (350 billion on/off cycles

per second) light pulses with a monolithic semiconductor laser.

1991: World's smallest semiconductor lasers, five microns in diameter, 400 atoms thick, operate in "whispering gallery mode."

1992: First commercial application of novel synthetic diamond material, combined with an advanced metallization bonding technique from Bell Labs, in microelectronic submounts for high-power semiconductor lasers.

1993: World's fastest telecommunications lasers: single-mode, which emits light at one wavelength of light, operating at 22.5 billion cycles per second; and multi-mode, which emits light over several wavelengths, operating at 25 billion cycles per second.

1993: First self-focused lasers. Zone lasers, a new class of laser structure, use vertical-cavity geometry, emitting light vertically from their surface instead of horizontally as conventional, edge-emitting lasers do. Unlike conventional lasers, they need no lenses to focus their light on a specific point.

1994: Quantum cascade (QC) lasers. A fundamentally new type of semiconductor laser that operates like an electronic waterfall.

1996: Room-temperature and high-temperature QC lasers.

For information on what's happening today, see [Bell Labs and Lucent Contributions to Laser Research](#).

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