From theory to the first working laser

Laser history—Part I

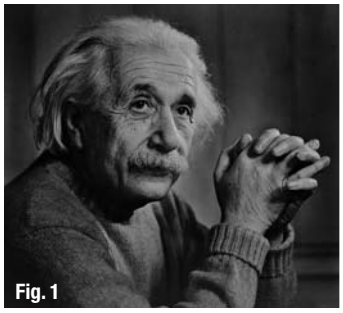
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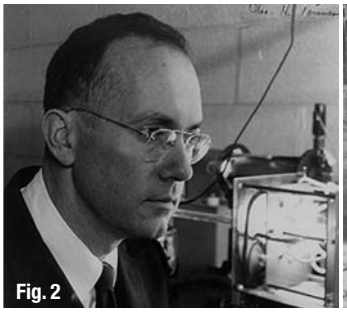
_The principle of both maser (microwave amplification by stimulated emission of radiation) and laser (light amplification by stimulated emission of radiation) were first described in 1917 by Albert Einstein (Fig.1) in "Zur Quantentheorie der Strahlung", as the so called 'stimulated emission', based on Niels Bohr's quantum theory, postulated in 1913, which explains the actions of electrons inside atoms. Einstein (born in Germany, 14 March 1879–18 April 1955) received the Nobel Prize for physics in 1921, and Bohr (born in Denmark, 7 October 1885–18 November 1962) in 1922.

In 1947 Dennis Gábor (born in Hungarian, 5 June 1900–8 February 1972) developed the theory of holography, which requires laser light for its realization. 1963 the first successful holographic trials were done by Emmet N. Leith (born in the USA, 12 March 1927–23 December 2005, National Medal of Science Award among others) and Juris Upatnieks (born in Lithuania, 7 May 1936–today, 19 US patents) using a ruby laser. Both were nominated for the Nobel Prize. Gábor received the 1971 Nobel Prize in Physics for the invention and development of the holographic method. To a friend he wrote that he was ashamed to get this prize for such a simple invention. He was the owner of more than a hundred patents.

In 1954 at the Columbia University in New York, Charles Townes (born in the USA, 28 July 1915–today, Fig. 2) and Arthur Schawlow (born in the USA, 5 Mai 1921–28 April 1999, Fig. 3) invented the maser, using ammonia gas and microwaves which led to the granting of a patent on March 24, 1959. The maser was used to amplify radio signals and as an ultra sensitive detector for space research. The two scientists also theorized and published papers about a visible maser, an invention that would use infrared and/or visible spectrum light. However, they did not proceed with any further research at the time. Townes was awarded with the Nobel Prize

1913	Niels Bohr (born in Denmark, 7 October 1885–18 November 1962) explains along his quantum theory how electrons could act in the atom model. Nobel Prize in 1922.
1917	Albert Einstein (born in Germany, 14 March 1879–18 April 1955) postulates first description of stimulated emission in his work "Zur Quantentheorie der Strahlung", based on Bohr's atom model. Nobel Prize in 1921.
1947	Dennis Gábor (born in Hungary, 5 June 1900–8 February 1972) develops the theory of holography, which requires laser light for its realization. Nobel Prize 1971.
1954	Charles Townes (born in the USA, 28 July 1915–today) and Arthur Schawlow (born in the USA, 5 Mai 1921–28 April 1999) develop a device that stimulates the emission of microwaves. Nobel Prizes in 1964 and 1981.
1957	Gordon Gould (born in the USA, 17 July 1920–16 September 2005) is the first to use the acronym laser in his work "Some rough calculations on the feasibility of a LASER".
1960	Theodore Maiman (born in the USA, 27 July 1927–5 May 2007) builds the first working laser with his assistant Charles Asawa.


Fig. 1


Fig. 2

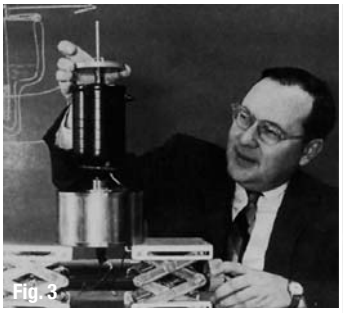

Fig. 3


Fig. 4

Fig. 1_Albert Einstein (Photo: Yousuf Karsch)
Fig. 2_Charles Townes (Photo: Academy of Achievement)
Fig. 3_Arthur Schawlow (Photo: Stanford University News Service)
Fig. 4_Author with ruby laser prototype (Photo: Ingenegeren)

in Physics in 1964 (together with Bassow and Prokhorov) and Schawlow in 1981 together with Nicolaas Bloembergen (born in the Netherlands, 11 March 1920–today) and Kai Siegbahn (born in Sweden, 20 April 1918–20 July 2007) for their contribution to the development of laser spectography.

In 1957 Gordon Gould (born in the USA, 17 July 1920–16 September 2005), came up with important concepts, as well as the word laser. He patented optically pumped and discharge excited laser amplifiers, laser uses and optic communications. He idolized Edison and his ambition from childhood was to be an inventor. In 1957 his first ideas for the laser came to him one night "in a flash" and he wrote „some rough calculations on the feasibility of a LASER". That was the first use of this acronym. Due to a misunderstanding with his attorney, he did not file for a patent until 1959, after other laser researchers already filed. Since his original patent application contained a number of different inventions, it was put through a series of five separate interferences by the Patent Office, resulting in issuing Gould's first basic laser patents in 1977. In 1991 he was induced in the National Inventors Hall of Fame.

50 years ago, on 16 May 1960, at Hughes Aircraft Company, Theodore H. Maiman (born in the USA, 27 July 1927–5 May 2007) let the worlds first monochromatic, collimated, coherent, pulsed (red) light beam shine with a wavelength of approximately 694 nanometres. He succeeded in building the first operable laser, small enough to fit in his hand, based on a synthetic ruby rod which served as the active medium, which worked on the first try. The idea of using a photographic flash for illuminating the ruby crystal came from his assistant Charles Asawa.

Theodore H. Maiman was inspired by the article of Townes and Schawlow which appeared in the Physics Review in 1958 with the title: "Infrared and Optical Masers". One year later the race to build the first laser started and was won by Maiman who said his favourable academic background, the quest for simplicity, a maverick spirit and unconventional thinking helped him achieving this goal. Although several other scientists had already discounted its suitability for such a task, Maiman persisted that ruby would work as an active medium, along his calculations of the fluorescence quantum efficiency. His first paper was rejected by the Physical Review Letters and a shorter version was published in the journal Nature in the United Kingdom in August of 1960. In 2000 Maiman published the story of his discovery of the laser in "The Laser Odyssey" and described the laser as "a solution seeking a problem".

Maiman was nominated twice for the Nobel Prize. He received the Fannie and John Herz Science Award, the 1984 Wolf prize and the 1987 Japan Prize (equivalent to the Nobel Prize). After he was introduced into the National Inventors Hall of Fame in 1984, he met his second wife Kathleen on the flight home. Mrs. Kathleen Maiman attended the 16th Congress of the ALD in April 2008 in San Diego, California. She received the ALD T.H. Maiman Award as post hum honour for her late husbands breaking work and contribution to science. Mrs. Maiman brought along a model of the ruby laser for the congress delegates to see and to hold (Fig. 4).

_Sources

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