Making light work: The 50-year odyssey of the laser

May 12 2010, by Richard Ingham

Fifty years ago next Sunday, a 32-year-old engineer called Theodore Maiman switched on a gadget at Hughes Research Laboratories in California, and watched as pulses of light sprang from a pink ruby crystal.

It was a geek eureka: the moment when the laser was born. And the world would change forever. But not just yet.

When Maiman's great invention was announced, the response was essentially "Doh?" as people tried to figure out what it was and what use could be made of it.

That was swiftly followed by an "Eek!" when the press came up with some scary headlines.

"LA Man Discovers Science-Fiction Death Ray," said one, reflecting the zeitgeist of 1960, when the Cold War mixed promiscuously with B-movies about aliens.

Since then, the laser has revolutionised life. It brings, sends and stores data in vast batches at light speed, measures material and cuts it with sub-millimetric precision.

It can be found in things as everyday as supermarket bar-code scanners -- the first scanned object was a packet of Wrigley's chewing gum in 1974 -- just as it can be found in hi-tech self-targeting bombs, sniper's

sights, adaptive optics in astronomical telescopes and research into nuclear fusion, the ultimate in clean energy.

Lasers drive your CD and DVD player. They make holograms and light shows. They probably marked, cut and welded the frame of your car. They will smooth your wrinkles, zap your cancer, correct your short-sightedness.

And if you are reading this story online, think of the lasers that got it to you -- more than million lasers power the Internet, shuttling terabytes of data through optical fibre.

"The story of the laser is incredible," Tim Holt, head of the Institute of Photonics at the University of Strathclyde, Scotland, said in an interview.

"Along with the integrated circuit, the laser has been the most revolutionary technology of the last 50 years."

The conceptual pathway that leads to the bog-standard laser pointer starts with the brain of Albert Einstein.

In 1917, Einstein put forward the theory of stimulated emission, in which a photon, or light particle, causes an excited atom to emit an identical photon.

It was 1953 before the US physicist Charles Townes put the phenomenon to the test, with a "maser" -- Microwave Amplification by Stimulated Emission of Radiation -- in which microwaves were used as the atom-exciter.

Townes and a colleague, Arthur Schawlow, then had the idea of using visible light rather than microwave, although it was Maiman who made the concept work. "Light" replaced "Microwave" in the acronym, and the

word Laser entered the vocabulary.

The first laser beam was light amplified by a solid ruby rod, but within months this was followed by a helium neon laser, devised at the rival Bell Laboratories, also in 1960.

In 1962 came the first big practical breakthrough, a laser made of a diode of gallium arsenide, whose principle provides the backbone of small commercial laser devices today.

More than 10 Nobel prizes have been awarded for laser research, both in conceptual work but also in the practicalities of using laser pulses for storing and moving data.

Today, the top end of research is "femtosecond" lasers, in which ultra-fast lasers alter the "spin" of electrons in individual atoms to provide a more compact, denser storage on hard drives.

A prototype femtosecond laser tested by French physicists last year is able to retrieve data with a burst of just a millionth of a billionth of a second, a performance that notionally could accelerate the performance of present hard discs by up to 100,000 times.

"Lasers have given us a step in capability that is truly mind-boggling," said David Hanna, a professor in opto-electronics at the University of Southampton, England.

"Their possibilities will not be fully digested or exhausted for a very long time to come."

Laser: A timeline

Following is a timeline of the laser, which was born 50 years ago on May

16:

- 1917: Einstein proposes the theory of "stimulated emission," by which a photon, or light particle, induces an atom to emit an identical photon.

- 1953: American physicist Charles Townes builds forerunner of the laser, a "maser," for Microwave Amplification by Stimulated Emission of Radiation.

- 1957: Gordon Gould, a doctoral student under Townes, coins the term "laser," theorising that light could be used to excite atoms into making a coherent beam of light. Later files a patent; legal dispute lasts nearly three decades.

- 1960: First laser, built by Theodore Maiman of Hughes Research Laboratories in California, becomes operational.

- 1961: Laser used for first time in surgery, to destroy retinal tumour.

- 1962: Invention of the semi-conducting diode laser, the mainstay of small commercial lasers today.

- 1969: Laser's use in telemetry makes headlines. A beam bounced back by a mirror deployed by the Apollo 11 crew measures the distance between Earth and the Moon to within a few metres (yards).

- 1971: Lasers enter the arts, with light shows and the awarding of the Nobel Prize to Dennis Gabor, a British-Hungarian, for holography.

- 1974: First supermarket bar-code scanner.

- 1975: IBM introduces first commercial laser printer.

- 1978: First laser disc player, made by Philips, but high cost is a barrier to success.

- 1982: First Compact Disc player. First CD to be pressed is "52nd Street" by Billy Joel.

- 1983: President Ronald Reagan makes "Star Wars" speech, sketching vision of space-based laser weapons.

- 1988: North America and Europe are linked by first fibre-optic cable, which uses laser pulses to transport data.

- 1990s: Lasers become established in manufacturing processes, including integrated circuits and car manufacturing.

- 1991: First laser surgery to correct short-sightedness. Gulf War sees first use of laser-guided munitions.

- 1996: Toshiba sells first digital versatile disc (DVD) player.

- 2008: French neurosurgeons use fibre-optic laser and keyhole surgery to destroy brain cancer.

- 2010: US National Nuclear Security Administration says quest for nuclear fusion clears a key hurdle, with the use of 192 laser beams to compress tiny balls of fuel made from deuterium and tritium.