# The laser — hero or villain?

*from Bridget Marx*

*Although too often associated in people's minds with star wars weaponry the laser has become an invaluable tool in many varied and peaceful applications.*

In the early days the laser, for Light Amplification by Stimulated Emission of Radiation, was dubbed 'a solution looking for a problem', but in the last quarter of a century lasers have found application in areas as diverse as materials processing and the treatment of cancer.

The medical application of lasers is now in fact a major industry—out of an estimated total commercial laser market of about $400 million, at least one quarter is connected with medical and surgical applications. This market is growing at a rate of more than 30% per year and has become such a significant factor for the manufacturers of lasers that several companies have actually been bought out by medical conglomerates.

## Laser surgery

The laser was first demonstrated in 1960 by Theodore Maiman at the Hughes Research Laboratories in California, and the first 'medical' application came when Maiman's ruby laser was being used in animals' eyes, as a source for photocoagulation and by 1962 human patients were being treated. As new lasers became available these were quickly tried out in the medical field. The argon ion laser was first considered in 1965, the clinical trials were started in 1969 and the first commercial systems became available in 1971. The argon laser has proved a lot more successful for the treatment of vascular diseases of the retina than the original ruby systems and there are now many thousands of medical argon lasers worldwide. At the time of writing lasers in routine use in hospitals include the argon ion laser, the carbon dioxide laser, the Nd:YAG laser and, to a lesser extent, the krypton ion laser. Those at present in the early stages of development include the excimer, gold vapour and copper vapour lasers.

The laser is in many ways ideally suited to medical applications, providing as it does a light source that is powerful enough to destroy the target tissue yet is controllable in terms of power, spot size and wavelength. The light can be easily and efficiently taken to the required site either directly or by optical fibre. These advantages led to the rapid development of laser surgery in dermatology, ophthalmology and gynaecology. Other exciting areas are also opening up, such as photoradiation therapy for the treatment of cancer, laser recanalization of clogged arteries, laser welding of soft tissues, and even laser acupuncture for pain relief.

## Diagnostics

The direct surgical use of lasers is not the only clinical application of lasers, and after photocoagulation, the 'surgical' application which accounts for 40% of all water-cooled lasers in use, the makers of cytofluorescence equipment are among the biggest consumers of water-cooled ion lasers, accounting for a further 14% of the market. Lasers allow biological specimens to be analysed for their cell content and the different cells to be sorted into different containers depending on their light scattering characteristics. This method of detecting cancer cells is very straightfoward and cell-sorting equipment is to be found in many hospital laboratories.

## Non-medical

The largest market for lasers is still in academic and industrial research and development: nearly $100 million out of the total $400 million. A traditional area of pure research is spectroscopy, and other growth areas are laser Doppler velocimetry and holography. Holography these days is used not just for making pretty pictures, but also for making non-forgeable security passes and credit cards. And even spectroscopy has left the realms of pure research as we move into the age of laser isotope separation. (Laser isotope separation accounts for more than one eighth of the total CW dye laser market each year.) There is also a large part of the world's laser research effort concentrated in the field of optical-fibre communications, so that in the future telephone messages will not be relayed by an electrical signal along a wire but will be carried by a modulation of a laser beam that is being conducted along an optical fibre.

## Popularization

Apart from these scientific applications there is a plethora of relatively 'low-tech' areas where lasers are carving out a niche. The entertainment industry is a market sector worth several millions of dollars each year. Laser light shows are quite commonplace these days in discotheques or at big public gatherings, as demonstrated during the 1984 Olympic Games in Los Angeles. There are also schemes using lasers to project television images onto a large screen with enough brilliance to be seen in daylight. And there are markets that use large volumes of low-cost lasers. In the entertainment industry the home video and audio disk systems come into this category. There are also laser printers and bar-code reading scanners at supermarket checkouts: these account for about 10% of the laser market, using approximately 100,000 small lasers a year.

In heavier industries too, lasers are gaining ground. Highpower infrared lasers are used for cutting, drilling and welding in laser machine tools. Ultraviolet excimer lasers are used in photolithography and other developmental techniques in the semiconductor industry.

So how will history judge the laser as it emerges from its formative years: Hero or villain? It has proved its worth in the areas of scientific research and manufacturing. It is capable of many medical feats, from miracle cure to routine surgery. President Reagan's Strategic Defense Initiative is based on the hope that it has an equally destructive side to its nature. □

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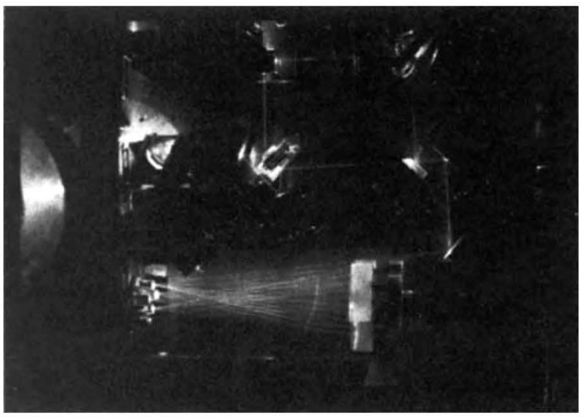

*The largest market area for lasers is still research and development. One application in which basic physics is tested is shown here. In this exotic application an argon ion laser is used to illuminate a long baseline interferometer for the detection of gravitational radiation. Interferometers with baselines of many kilometres are planned. The photograph shows an early prototype Michelson interferometer with a relatively short baseline. (Photo courtesy of Glasgow University.)*