COMMUNICATIONS PHYSICS

EDITORIAL

https://doi.org/10.1038/s42005-020-0370-y OPEN

Celebrating 60 years of laser

This month marks the 60th anniversary of the invention of the laser. Here, we highlight a few of the many developments of a technology that has revolutionised our lives. To celebrate, our editors have chosen a collection of articles published in *Communications Physics* that showcase the breath of research and applications in this field.

The first laser was realised on the 16th May 1960 by Theodore Maiman from Hughes Research Lab in Malibu (USA). His device flashed a bright red spot onto a photo-detector, providing the first experimental demonstration of a working (ruby) laser and the first man-made coherent light source. The results were published as a brief note in *Nature* in August 1960. The experiment was built on theoretical foundations laid by Charles Hard Townes and Arthur Leonard Schawlow, which in turn were inspired by Einstein's theoretical work on stimulated light emission.

> The unprecedented developments, realisations, and uses of the laser keep moving forward, and the above are just a few of perhaps the most captivating examples of not only how physics has advanced laser technology, but also of how lasers have allowed new insights into physics across scales and disciplines.

Sixty years on, lasers are ubiquitous in our daily life, from facial recognition in smartphones, to laser cutters and welding machines, particularly in the semiconductor industry, from laser surgery to light entertainment shows, to name just a few. Lasers have revolutionised communications and high-precision measurements with applications in research, hospitals, factories, offices, the military, and our own homes.

While the first everyday commercial use of lasers was a supermarket barcode scanner in 1974, nowadays it would be quite challenging to imagine a world without laser technology, albeit not impossible. In fact, travelling, shopping, manufacturing, surgery, and research today would be very different without it[1]. While the majority of people know the word laser, and associate it with at least something in their everyday life, perhaps not many in the general public know that LASER is an abbreviation for Light Amplification by Stimulated Emission of Radiation.

In research, and subsequent commercial applications, lasers operate in a large spectrum of frequencies and adopt several types of amplification principles, from gas lasers, excimers and chemical lasers, to solid state lasers. Perhaps, the best known solid-state laser is the Ti:sapphire, also used as a mode-locked laser to produce high power ultrashort pulses, which in turn provide the foundation for laser communication and femtosecond lasers. Solid-state lasers have evolved into optical fiber lasers, often using erbium or ytterbium ions as active species. All these developments have earnt multiple prizes, including several Nobel prizes, and have received significant attention for commercial applications, generating an industry worth millions.

Only 10 years ago, the 50th anniversary of the laser sparked a flourish of activities and celebrations (e.g. http://www.laserfest.org/). And yet laser technology keeps moving forward at a relativistic (pun intended) speed, achieving many new developments in the past decade.

In such a short period of time, laser technology has made it possible to boost our knowledge in multiple directions. Large facilities (e.g. National Ignition Facility, Shanghai Superintense Ultrafast Laser Facility (SULF), Extreme Light Infrastructure (ELI)) race to build powerful petawatt class lasers that will inevitably reveal new physics once fully operational. Laser-based space technology has made gravitational wave detection a reality reaching new heights when placed in space with the Laser Interferometer Space Antenna (LISA).

LiDARs (laser imaging, detection, and ranging), the light equivalent of the radar, have been demonstrated since the 1960s. Today they are associated with vehicle tracking, but in the past 5 years LiDARs technology has moved even further, with their integration in mobile phones and tablets for augmented reality, having direct societal impact.

Nanotechnology has made lasers increasingly small (see ref. [2] for a recent review), opening the door to uses spanning from sensors to photonic devices. Lasers may also hold the key to the feasibility of quantum computers, from squeezed light (e.g. ref. [3]) to valleytronics (e.g. ref. [4]).

The unprecedented developments, realisations, and uses of the laser keep moving forward, and the above are just a few of perhaps the most captivating examples of not only how physics has advanced laser technology, but also of how lasers have allowed new insights into physics across scales and disciplines. Needless to say, a full list of major developments in laser technology or its applications would be very long indeed.

To celebrate the anniversary of the laser, we have assembled a collection (https://www.nature.com/collections/ecfhjjahjf) of research articles, reviews and comments published in *Communications Physics* in the past three years, showcasing the breath of research in this rich field.

We are very confident that, by the next anniversary, new breakthroughs based on this technology will enable exceptional discovery not only in physics, but across the spectrum of sciences and more practical daily applications.

Published online: 22 May 2020

References

1. Through the laser mirror. *Nat. Phys.* **16**, 497 (2020).
2. Eaton, S. et al. Semiconductor nanowire lasers. *Nat. Rev. Mater.* **1**, 16028 (2016).
3. Asavanant, W. et al. Generation of time-domain-multiplexed two-dimensional cluster state. *Science* **366**, 373–376 (2019).
4. Langer, F. et al. Lightwave valleytronics in a monolayer of tungsten diselenide. *Nature* **557**, 76–80, (2018).