Celebrating the laser

This month sees the 50th anniversary of the laser, with a host of activities taking place in celebration.

Many of those working in photonics will already know that this month marks the 50th anniversary of the first working laser. On 16 May 1960, Theodore Maiman made history when he observed lasing at 694.3 nm from a flashlamp-pumped 1-cm-sized ruby crystal with two silver-coated faces for cavity mirrors. The result was published as a brief note (that now seems incredulously short given its importance) in the 6 August 1960 issue of *Nature*.

Nature Photonics has been involved in two projects to celebrate the anniversary, both of which go live this month. The first is a special laser-themed issue of our *Technology Focus* supplement. Inside you'll find a series of short industry perspective articles, each describing the historical evolution and future outlook of a different laser technology — the semiconductor laser, excimer laser, Nd:YAG laser, Ti:Sapphire laser, quantum cascade laser and fibre laser. These are complemented by an interview with Charles Townes, the scientist who in the 1950s invented the maser — the forerunner to the laser, which

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relies on the same principle of stimulated emission but operates in the microwave region — and described how the idea could be used to make a laser. The *Technology Focus* research highlights section is also dedicated to a selection of some of the very first papers on various laser technologies. The interactive digital version of *Technology Focus*, which can be found at http://www.nature.com/nphoton/techfocus/index.html, also features video interviews with both Maiman and Townes, kindly provided by the Optical Society of America.

The second project published this month is a *Nature* 'Milestones' project dedicated to the photon. It is the result of an inter-journal collaboration between *Nature Materials*, *Nature Physics* and *Nature Photonics*, and gives a historical timeline of important scientific achievements related to the photon. It can be accessed at http://www.nature.com/milestones/photons and includes accounts of over 20 important milestones in the field, as well as a special collection of relevant review articles and primary research papers from Nature Publishing Group journals.

Finally I would like to draw attention to LaserFest, a collaboration between APS, OSA, IEEE and SPIE that was set up to organize educational activities dedicated to celebrating the 50th anniversary of the laser throughout the year. More information can be found at www.laserfest.org. ❐

Contrary to intuition

Noise, scattering and disorder — traditionally the enemies of optical researchers — are now being put to good use.

Disorder, chaos, noise and scattering are often considered as imperfections, and are thus a nuisance in optical systems. This is particularly true for imaging and transmission, where they create perturbations that distort and attenuate optical wavefronts, impair signal quality and destroy the spatial coherence of propagating light. As a result, it's no great surprise that much research has been carried out to eliminate or reduce their presence in applications such as communications and bio-imaging. However, contrary to intuition, it now turns out that such effects can be harnessed for beneficial use.

Indeed, two papers in this issue of *Nature Photonics* demonstrate this principle in the field of imaging. In the first, Ivo Vellekoop and colleagues describe how they exploit disordered scattering to improve the sharpness of a beam's focal spot[1]. Their trick is to use a spatial light modulator to control the phase of an optical field passing through a random scattering medium, together with a learning feedback algorithm, such that the transmitted light always interferes constructively at a given focal point, essentially exploiting the presence of the random scattering layer. Instead of a deterioration in beam quality, the researchers obtain a focal spot with a width considerably smaller than the diffraction limit of the lens used.

The second study involves the counterintuitive use of disorder in optics to amplify an image and recover it from background noise[2]. Dmitry Dylov and Jason Fleischer use dynamical stochastic resonance, in which signals are amplified at the expense of noise through nonlinear coupling, to reconstruct images hidden in noise as they propagate through a self-focusing medium. In essence, the energy exchange between the signal and noise — induced by nonlinear mixing — allows the image beam to 'pick up' the correct wave vectors out of the noise and thus amplify itself.

On the same theme, it should not be forgotten that *Nature Photonics* has already published two papers that describe the use of chaotically driven semiconductor lasers for generating high-quality random bit sequences of up to 300 Gbit s^{-1} for improved security in cryptography systems[3,4].

It will be interesting to see if this trend of harnessing often unwanted behaviour — rather than striving to eliminate it — will become increasingly popular in the future. ❐

References

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