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Sasers

A little big noise

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The birth of a new technology?

BACK in 1964 an editorial in *Wireless World* lamented the apparent uselessness of a new technology called "light amplification by the stimulated emission of radiation". The article agreed heartily with Sir Robert Cockburn, a noted physicist, who had recently suggested that the applications of lasers, as a newly coined acronym for the devices dubbed them, were "somewhat limited".

Moviestore

Next time, Mr Bond, I'll use a saser

Four decades later, lasers are a multibillion-dollar technology, found in everything from supermarket scanners to DVD players—not to mention the fibre-optic cables that have revolutionised telecommunications. But now imaginations are being stretched again, this time by the sonic equivalent of lasers. Sound amplification by the stimulated emission of radiation has been a laboratory curiosity for several years, but a new prototype "saser" could thrust the technology into the limelight. It has just been described in *Physical Review Letters* by Borys Glavin, of the Lashkarev Institute of Semiconductor Physics, in Ukraine, and Anthony Kent, of Nottingham University, in England.

The coherent beams that sasers produce consist of sound, rather than light, and are composed of packets of sonic vibration called phonons, rather than packets of electromagnetic vibration called photons. In a laser, the photons are produced by excited electrons releasing their energy after colliding with other photons. The result is a beam in which the photons all have the same frequency and also oscillate in step. And as long as an external power source keeps pumping the electrons into an excited state, the laser will continue to shine.

The saser devised and built by Dr Glavin, Dr Kent and their colleagues works similarly. It is constructed from thin layers of semiconductors, an arrangement called a superlattice. This lattice consists of sheets a few atoms thick which serve to trap electrons. The electrons are pumped into an excited state by running an electric current through the lattice. The difference is that instead of using photons to stimulate the release of this energy, the researchers use phonons (in other words they give the lattice a good, though very precise, shaking). Phonons then beget phonons, bouncing back and forth between the layers of the lattice, until eventually they overflow the structure and start to escape in the form of a phonon beam.

The researchers are particularly excited because their saser is the first to combine a simple electrical input with a high-frequency output, so it is cheap to run yet powerful. In addition, superlattices can be made using routine industrial techniques, so the device should be easy to mass-produce. And, unlike Sir Robert, they can even think of applications.

These rely on the fact that the sound emitted has a wavelength in the order of nanometres (billionths of a metre). This is much smaller than, for example, medical ultrasound, which is measured in millimetres. It could therefore be used to take sonograms of things, such as defects in microelectronic circuits, whose dimensions are measured in nanometres. Nanometre sasers might also serve in the trendy field of quantum computing, which aims to exploit the inherent uncertainties of quantum theory to do lots of calculations in parallel. That is because their wavelength is exactly right to “talk” to structures called quantum dots, the tiny crystalline blobs that form the storage elements of one type of quantum computer. Existing lasers small enough to fit on computer chips have difficulty generating photons of the right wavelength.

Beyond that, it is anyone's guess. But perhaps saser physicists don't need to hunt too hard for an application. Looking at the experience of the laser, applications are more likely to be hunting for them.