A sonic boom in the world of lasers

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It was an idea born out of curiosity in the physics lab, but now a new type of 'laser' for generating ultra-high frequency sound waves instead of light has taken a major step towards becoming a unique and highly useful 21st century technology.

Scientists at The University of Nottingham, in collaboration with colleagues in the Ukraine, have produced a new type of acoustic laser device called a Saser. It's a sonic equivalent to the laser and produces an intense beam of uniform sound waves on a nano scale. The new device could have significant and useful applications in the worlds of computing, imaging, and even anti-terrorist security screening.

Where a 'laser',(Light Amplification by the Stimulated Emission of Radiation), uses packets of electromagnetic vibrations called 'photons', the 'Saser' uses sound waves composed of sonic vibrations called 'phonons'. In a laser, the photon beam is produced by stimulating electrons with an external power source so they release energy when they collide with other photons in a highly reflective optical cavity. This produces a coherent and controllable shining beam of laser light in which all the photons have the same frequency and rate of oscillation. From supermarket scanners to DVD players, surgery, manufacturing and the defence industry, the application of laser technology is widespread.

The Saser mimics this technology but using sound, to produce a sonic beam of 'phonons' which travels, not through an optical cavity like a laser, but through a tiny manmade structure called a 'superlattice'. This is made out of around 50 super-thin sheets of two alternating

semiconductor materials, Gallium Arsenide and Aluminium Arsenide, each layer just a few atoms thick. When stimulated by a power source (a light beam), the phonons multiply, bouncing back and forth between the layers of the lattice, until they escape out of the structure in the form of an ultra-high frequency phonon beam.

A key factor in this new science is that the Saser is the first device to emit sound waves in the terahertz frequency range… the beam of coherent acoustic waves it produces has nanometre wavelengths (billionths of a metre). Crucially the 'superlattice' device can be used to generate, manipulate and detect these soundwaves making the Saser capable of widespread scientific and technological applications. One example of its potential is as a sonogram, to look for defects in nanometre scale objects like micro-electric circuits. Another idea is to convert the Saser beam to THz electromagnetic waves, which may be used for medical imaging and security screening. High intensity sound waves can also change the electronic properties of nanostructures so a Saser could be used as a high-speed terahertz clock to make the computers of the future a thousand times faster.

Professor Anthony Kent from the University's School of Physics and Astronomy, says "While our work on sasers is driven mostly by pure scientific curiosity, we feel that the technology has the potential to transform the area of acoustics, much as the laser has transformed optics in the 50 years since its invention."

Source: University of Nottingham (news : web)