Research Highlights

THE AUSTRALIAN NATIONAL UNIVERSITY

Research School of Physical Sciences and Engineering

Aussies Take World Record for Stopping Light

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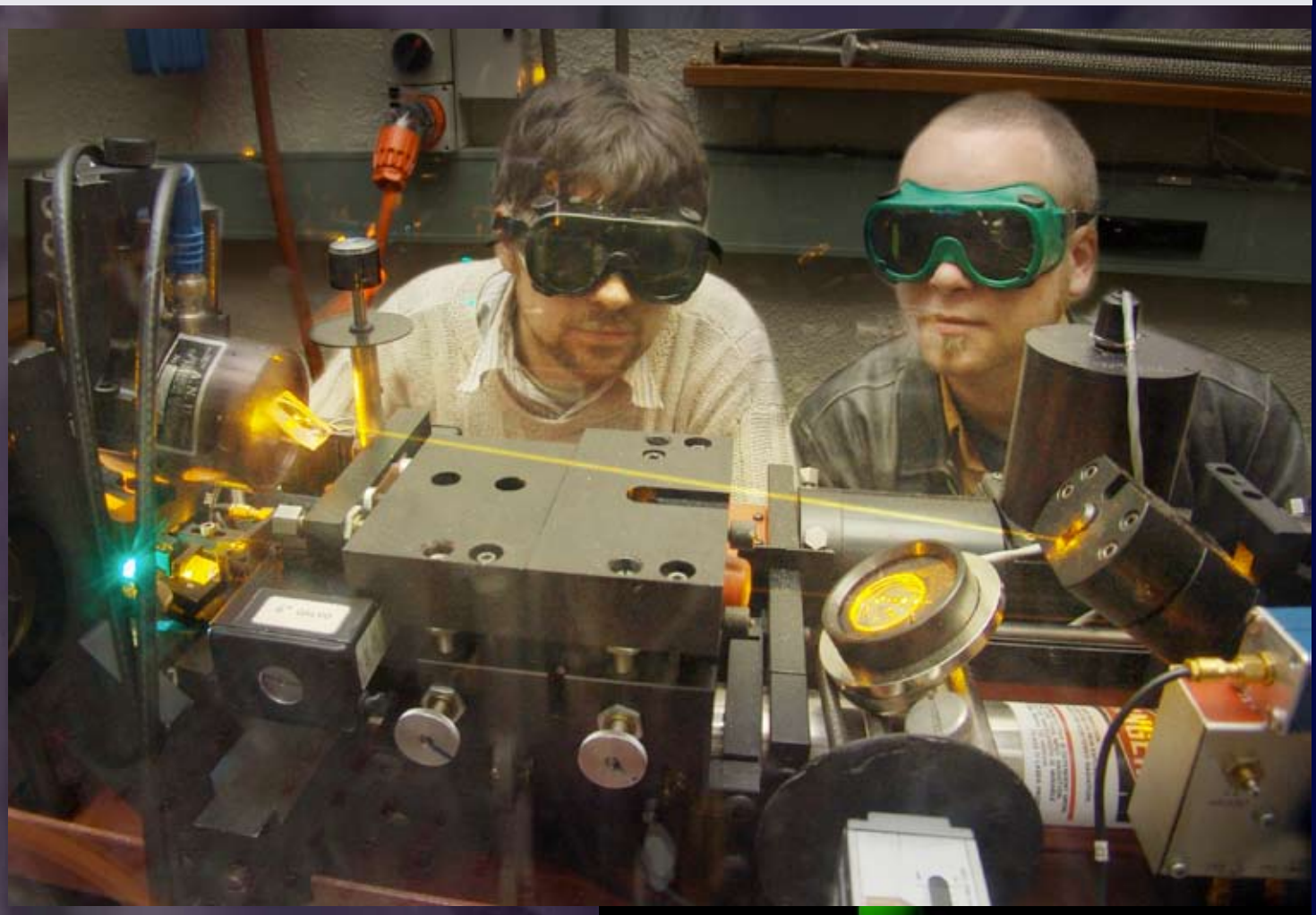
As part of their research into the emerging technologies of quantum computation and encryption, researchers at the ANU have managed to stop light with storage times longer than one second. While they were able to stop light previously, researchers hadn't been able to stop it for very long - about a thousandth of a second. These early experiments were carried out in an atomic gas and were limited by movement of the atoms. The researchers at ANU have been able to increase storage times one thousand-fold, using solid state materials in carefully controlled magnetic fields.

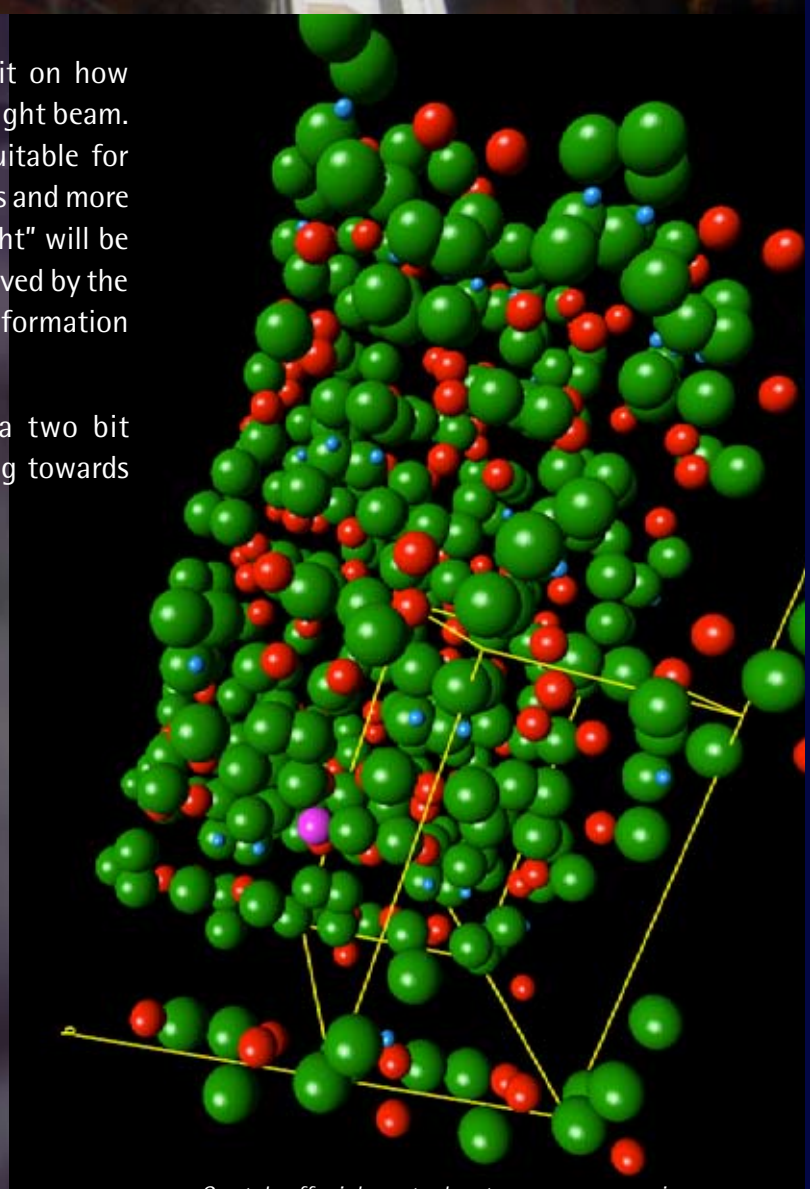
One of the tenants of Einstein's theory of relativity is that no effect can propagate faster than light in a vacuum. What he didn't say was how slow light could be. Light slows down by about a third in normal glass and goes a bit slower than that in some special materials, but until a few years ago it was hard to make light do anything other than travel really fast.

A phenomenon called electromagnetically induced transparency allows a material that would usually be opaque to become transparent by applying an auxiliary laser beam. This auxiliary laser beam, called the coupling beam, also changes the speed of the light. Not only does this enable very slow propagation velocities, but if the coupling beam is slowly turned off light can be stopped completely and then recalled when the coupling beam is turned back on.



The Heisenberg uncertainty principle places a limit on how accurately one can measure and then regenerate a light beam. Because of this conventional memories are not suitable for quantum computation and communication networks and more exotic memories such as one based on "stopped light" will be required. The dramatic increase in storage time achieved by the ANU team brings the promise of these quantum information processing technologies closer to reality.

The team's previous accomplishments include a two bit quantum logic gate and they are currently working towards the goal of a 6-bit quantum processor.



Crystals offer inherent advantages over gasses in stopped light and quantum computing technologies

World Records for Stopping Light

2001 Philips et al. 100 us in atomic vapor
2001 Liu et al. 800 us in ultracold trapped atoms
2002 Turukin et al. 250 us in a solid
2004 Julsgard et al. 4 ms in atomic vapor
2005 Team ANU 2.3 seconds in solid.

Current ANU technology exceeds worlds nearest competitor by over 500 times

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