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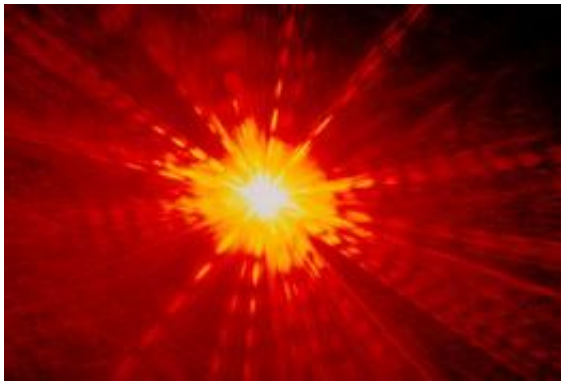
News

Physicists reverse the laser

Backwards laser could move sensors forward.

Geoff Brumfiel

The world's first functioning reverse laser has been built, in which a slice of silicon converts laser beams into heat.



A reverse laser can perfectly absorb photons.

HANK MORGAN / SCIENCE PHOTO LIBRARY

A laser that sucks in a bright beam instead of emitting it may seem counterproductive, but the researchers say that it could one day be used in ultrasensitive sensors and better telecommunications devices. The results are published in today's issue of *Science*[1].

Lasers create coherent beams of identical light particles, or photons. The most basic types consist of an inert gas placed between two mirrors. When photons pass into the laser cavity, they excite the electrons of the gas into a semi-stable quantum state. Passing photons can cause the electrons to drop to a lower energy state, releasing still more, identical photons. The photons multiply as they bounce between the mirrors and interact with other electrons, until the laser creates a glittering beam of light.

Going backwards

That is how things work going forwards in time, but researchers led by physicists Hui Cao and Douglas Stone at Yale University in New Haven, Connecticut, wondered what would happen if they rewound the clock. In principle, it should be possible to make lasers absorb photons: the rules of quantum mechanics mean that the process is the same going forwards or backwards.

In practice, it is another matter. Researchers would have to shine a perfectly adjusted beam of photons into a laser to get it to run in reverse. It would be tough to do with a conventional laser, but Cao and her colleagues believed it could work with a silicon wafer. Calculations showed that by carefully engineering input beams of photons, a slice of silicon could act as a reverse laser.

Cao and her group used a 110-micrometre silicon wafer on an optical bench, along with a tunable infrared laser. They split the laser beam into two and shine it into both sides of the silicon slice. The front and back of the slice act as mirrors and the silicon in-between takes the place of the gas found in a common laser. Tuning the incoming beam's frequency and other properties causes the photons to become trapped between the surfaces of the silicon. As the photons bounce back

and forth, the silicon absorbs them until all the photons are sucked up by the device and converted into heat. "It's just like playing a movie of a laser backwards," says Cao.

Fresh thoughts

The reversal experiment is exciting because nobody had thought of it before, says Marin Soljačić, a physicist at the Massachusetts Institute of Technology in Cambridge. "It is surprising to have something so new and quite fundamental discovered in such a mature field," he says.

Cao says that the silicon device itself might not be that useful because it works in only very particular circumstances, but the concept of a reverse laser is a powerful one. Similar devices are used in sensors for optical communication, and their efficiency could be improved by thinking about time-reversal, says Cao. Moreover, backwards lasers would make very sensitive sensors because they could convert a faint laser signal into detectable electrical or thermal energy.

Soljačić says that although it is too early to say exactly what a backwards laser will be used for, he is sure it will be good for something. "New things like this typically find many applications, often in places where we do not expect them," he says.

References

1. Wan, W. *et al. Science* **331,** 889-892 (2011). | **Article** | **OpenURL** | | **ChemPort** |

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it seems to be a null effect if laser and anti laser is there. may be i don,t know. **#18175**

Report this comment Posted by: **Israr Khan** | 2011-02-19 08:28:08 AM

When electric current passed through a wire, the magnetic needle deflected; Michael Faraday demonstrated this to the then Patron of British Royal (?) society - (I think the Patron was King of **#18212**

England), What is the relevance ? - the Patron asked ; Mr Faraday replied that " A child is born, Please wait till he grows up "
I Hope THAT reverse laser is as significant as the simple deflection of magnetic needle, when an electric current flows ..

Report this comment Posted by: **srinivasan venkataraman** | 2011-02-21 03:07:30 PM

It was Oersted who showed deflection of a magnetic needle due to electric current. Faraday discovered induced emf/alternating current. **#19743**

Report this comment Posted by: **Santosh Bhaskaran** | 2011-04-09 12:49:08 AM

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