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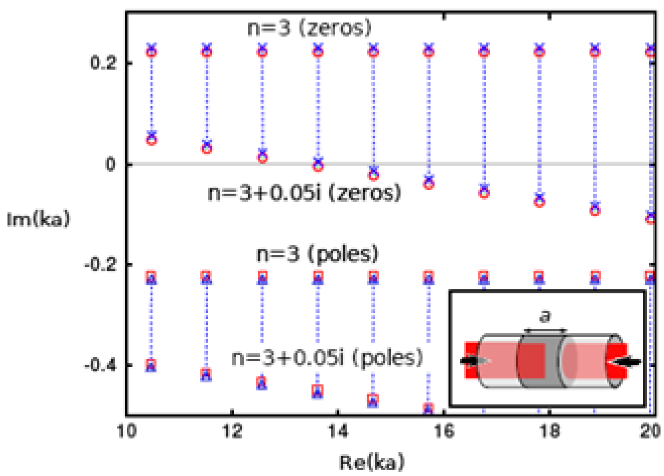
The Time-Reversed Laser to See the Light

Rather than emitting light, a time-reversed laser absorbs it. Perfectly.
By kfc



There's no question that lasers are cool devices. They work because in certain materials, the passage of a photon past an atom can trigger the release of another photon which goes on to release more photons and so on. This chain reaction generates an exponential increase in the number of photons, a key characteristic of lasing materials.

In the past, physicists always though that the photons had to be confined to cavity so that they bounced back and forth many times, stimulating the release of more photons with each traverse. But even that isn't necessary. In the last few years, various groups have shown that lasing can occur in random materials. That may seem even better but today lasers get an added boost of coolness thanks to some fascinating work by Yi Dong Chong and buddies at Yale University.

If the lasing process works in one direction, why can't it work in the other, they ask. The answer, it turns out, is that it can. Chong and co today show how certain materials can work like time-reversed lasers, so that instead of emitting light, they absorb it at specific frequencies. What's more, the absorption is perfect. Chong and co show in particular how this can be done with silicon, which is kind of useful for computing and communications. They say that the absorption can be thought of as an interference effect in which the reflected and transmitted parts of a coherent beam interfere perfectly. What happens to the energy that is absorbed?

Chong and co say that it is dissipated either as heat or as electron hole pairs but neglect to say how you can choose one outcome over the other, a potentially important point. Chong and co call their new devices coherent perfect absorbers or CPAs and a number of applications in communications spring to mind. They show that a single material can absorb perfectly at a number of different frequencies. However, they point out that if the material is bathed in broadband light, the effect averages out to the incoherent absorption level. That may place limits on how the idea can be applied to photovoltaics but these optics engineers are a clever bunch. They may well find a way to exploit it to harvest energy from the Sun.

Even so the ability to ensure perfect absorption of photon energies is a neat trick that is likely to find a number of applications elsewhere. Is it possible for lasers to get any cooler?

Ref: http://arxiv.org/abs/1003.4968: Coherent Perfect Absorbers: Time-reversed Lasers