Nonlinearities could be strengthened by photonic crystals

July 10 2007

Typically, photons can pass by one another unchanged. However, a number of important scientific and technological applications can be enabled by using matter as a medium for photons to talk with one another. The problem? These interactions are generally weak.

Now, in an upcoming issue of *Physical Review Letters*, MIT physicists led by Peter Bermel, a postdoctoral associate in the Research Laboratory of Electronics, discuss a scheme that can strongly enhance the strength of these interactions in a completely new way.

The work could have implications for telecommunications, optical computing, and, ultimately, quantum computing.

The MIT scheme consists of placing a nonlinear material inside a photonic crystal. The latter is characterized by its photonic bandgap, a range of frequencies for which photons are almost perfectly reflected. Its presence allows more time for nonlinear processes to take place. However, the nonlinear material is probed at a frequency just below the photonic bandgap.

For certain special materials, such as single nanocrystals of cadmium selenide, the degree to which this lifetime can be increased may be as much as a factor of forty at room temperature. For other materials, an enhancement of at least a factor of two is expected. Enhanced optical nonlinearities should allow much lower powers and volumes to be used in nonlinear devices.

This work was funded by the Army Research Office through MIT's Institute for Soldier Nanotechnologies.

Source: MIT