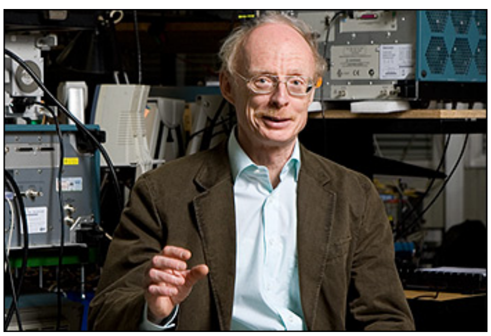
Laser Physics Turned 'Upside Down'

DARMSTADT, Germany, April, 15, 2010 — Using quantum dot lasers, researchers at Technische Universität Darmstadt have found a new method for generating tunable wavelengths and for more easily switching back and forth between two wavelengths. Prospective application fields are biomedicine and nanosurgery.

Researchers discovered an effect that turns the physics of semiconductor lasers 'upside down.' Laser action usually starts off with the emission of photons corresponding to transitions originating from the lowest energy level.

Emission of high-energy — short-wavelength — photons normally does not begin until the pumping current has been increased to well above the lasing threshold. Under the European Union's Fast-Dot Project — a program aimed at providing practitioners and researchers with pocket-size ultrahigh-performance lasers at a substantially lower cost — researchers from the university's Semiconductor Optics Group at the Institute for Applied Physics discovered that, under some circumstances, quantum dot lasers do emit first short-wavelength photons and then long-wavelength photons.



Professor Wolfgang Elsaesser. (Image: Katrin Binner)

"This inverted hierarchy of emission states … effectively allows generating intentionally custom-tailored wavelengths covering a range of interest in many applications," said Dr. Wolfgang Elsaesser, professor and team leader, adding that it also exploits the beneficial effects involved for improving pulse parameters.

Quantum dot lasers operable at high pulse-repetition rates can reach pulse energies that will allow modifying living cells; e.g., making accurately controlled incisions in cell structures while minimizing the attendant effects on cellular environments.

"They may be employed as high-precision scalpels, with which cell structures may be parted in controlled manners," Elsaesser said.

In addition, certain cell organelles might be deactivated or individual intracellular or extracellular molecules activated, which would open up unforeseen opportunities in molecular surgery and enable making incisions 2000 times finer than a human hair.

In the future, these quantum dot lasers might allow destroying cancer cells very specifically or applying them simultaneously either for corneal surgery or diagnostics.

For more information, visit: www.tu-darmstadt.de

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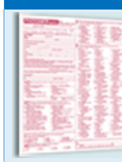

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