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Faster than electron speed

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In this talk, we argue that 'electronics' need not be limited to the transistor action of carrying charge from a source to a drain as performed in 1950's, but may be based on the collective response of the electrons, as envisioned starting in 1920's with the work of the likes of Langmuir and Debye. Similarly, speed of photodetectors need not be limited by sweep-out of the optically generated carriers.

We have fabricated a semiconductor device in which reservoirs of electrons and holes respond to optical excitation through a wave that is generated in the reservoir, achieving speeds that are impossible if it were based on transport of charge. This large (> 8.5 micrometer) device has a full width half max (FWHM) of <2.5 ps and a tail of response <2 ps, which is the response expected from a device 50 times smaller. It also shows an unprecedented sensitivity of tens of thousands of photons, all performed at room temperature. In effect, what we show is that kicking a ball from point A to reach B takes much longer than lining up balls between A and B and kicking the first. Thus, we replace the rapid transfer of energy, for the slow transfer of mass. This allows us to overcome the important limitations of the (drift) velocity and effective mass in present day (opto) electronics. Applications of these micro plasma devices are in optical communications with nanowatts of light versus milliwatts, photovoltaics with moon light, night vision, and detection of terahertz radiation.

Biography

Bahram Nabet received his BSEE degree from Purdue University in 1977 and his MSEE and Ph.D. degrees from the University of Washington in 1985 and 1989, respectively. He joined the faculty of Drexel University in 1989 where he is presently Professor of Electrical and Computer Engineering, and affiliated Professor of Materials Science and Engineering. His areas of research are in optoelectronics, nanoelectronics, plasma electronics, and nanophotonics. He has developed devices that circumvent charge transport limitations, and nano-structures that absorb and emit light with orders of magnitude more efficiency compared to their bulk counterparts. He is co-author of two books and over 160 refereed publications.

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