

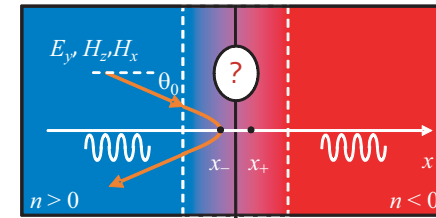
Photonic Metamaterials: From Linear to Nonlinear Optics



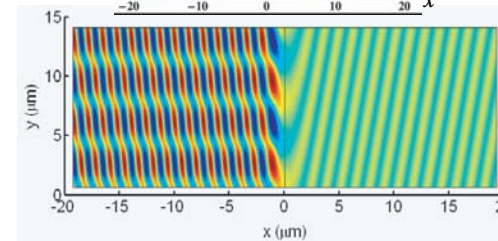
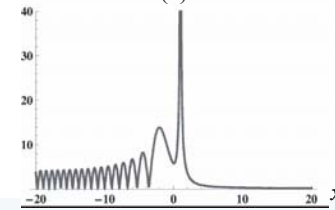
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1993, MS in Physics, Moscow State University
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We describe how metamaterials enable such nonlinear optical phenomena as optical bistability, gap solitons, self-oscillations, and novel regimes of modulation instability in directional couplers with no feedback.



$\text{Re}(n) = 0$



3:00 pm, Monday, March 29, 2010
Goergen 101, Sloan Auditorium
Refreshments provided.

Photonic Metamaterials: From Linear to Nonlinear Optics

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Abstract: Metamaterials open unparalleled opportunities for "engineering" previously inaccessible values of refractive indices from positive to near-zero and even negative values, and new avenues for light manipulation. While an enormous progress has been made in the field of linear optics of uniform metamaterials, including negative index of refraction, magnetism in optics, and subwavelength focusing, light interactions with graded-index and nonlinear metamaterials is a fascinating, relatively new and highly unexplored branch of metamaterials research. In this talk, I will discuss new phenomena that we predicted in so-called "transition metamaterials", or materials with the refractive index gradually changing from positive to negative values, and in nonlinear guided-wave metamaterial structures.

In particular, recently, we investigated a new class of graded-index metamaterial with the effective dielectric permittivity and magnetic permeability gradually changing from positive to negative values, referred to as transition metamaterials. These materials reveal several peculiar optical phenomena including anomalous electromagnetic field enhancement and resonant absorption, opening unprecedented opportunities for linear and especially nonlinear optical applications. Therefore, in our current research, we explore a variety of these applications ranging from low-intensity nonlinear optical devices for wavelength conversion and high-harmonic generation, to optical communication elements integrated with nanoelectronics, and new biomedical sensing applications.

On the other hand, we have discovered an entirely new regime of nonlinear optical light propagation in directional couplers made of positive and negative index metamaterials. Oppositely directed phase and energy velocities in a negative index channel enable such nonlinear optical phenomena as optical bistability, gap solitons, self-oscillations, and novel regimes of modulation instability in these couplers. These effects have no analogies in conventional nonlinear directional couplers with no external feedback mechanism, and thus open new opportunities for the development of optical storage and logic applications.

Biography: Natalia M. Litchinitser earned a Ph.D. degree in Electrical Engineering in 1997 from the Illinois Institute of Technology and a Master's degree in Physics in 1993 from Moscow State University in Russia. Prof. Litchinitser joined the faculty of the department of Electrical Engineering at the State University of New York at Buffalo in 2008. Prior to coming to the State University of New York at Buffalo, she conducted research at the University of Michigan, Ann Arbor. Natalia Litchinitser previously held a position of a Member of Technical Staff at Bell Laboratories, Lucent Technologies and of a Senior Member of Technical Staff at Tyco Submarine Systems. Natalia Litchinitser's research interests include linear and nonlinear optics in metamaterials, photonic devices, and optical communications. Natalia Litchinitser authored 5 invited book chapters, over 70 journal and conference research papers, and over 20 invited conference talks. She served a Guest Editor for a Special Issue of the Journal of Selected Topics in Quantum Electronics on Metamaterials, a Special Issue of Optics Communications on "Nonlinear Optics in Metamaterials," and as a member of the Advisory Board of Optics Communications.