Physics Seminar
Michigan Technological University

October 7 (Friday) 2005, 3:00 to 4:00 pm
Room 101, Fisher Hall

Magnetic photonic crystals: spectral asymmetry, electromagnetic unidirectionality, frozen mode regime

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Abstract

Magnetic photonic crystals are spatially periodic structures composed of transparent dielectrics materials, at least one of which being magnetically polarized. Magnetization, either spontaneous or induced, is always associated with nonreciprocal gyrotropic effects, such as Faraday rotation. This can qualitatively change electrodynamics of the composite medium. In particular, magnetic photonic crystals of certain configuration can display strong spectral asymmetry, implying that electromagnetic waves propagate in one direction much faster or slower than in the opposite direction. This phenomenon is essentially nonreciprocal and unique to magnetic photonic crystals. It cannot exist in any homogeneous natural substance, either magnetic or non-magnetic.

The spectral asymmetry can result in electromagnetic unidirectionality. A unidirectional medium, being perfectly transmissive for electromagnetic waves of certain frequency, freezes the radiation of the same frequency propagating in the opposite direction. The frozen mode has nearly zero group velocity and drastically enhanced amplitude, compared to that of the incident wave.

Biography

Ilya Vitebskiy obtained his Ph.D. in Physics in 1979, from Donetsk State University (former USSR). In 1985 he was awarded the degree of Doctor of Physical and Mathematical Sciences. From 1975 though 1987 he was a research fellow in the Institute of Physics and Technology of Ukrainian Academy of Science, Donetsk (former USSR). From 1988 until 1995 he headed the department of theoretical physics in the Institute for Single Crystals, Kharkov (Former USSR). During the same period of time he also worked as professor of theoretical physics at Kharkov State University. At present he is a researcher at the University of California at Irvine, working in the area of electrodynamics of composite media. He has authored and coauthored 96 scientific papers in peer-reviewed journals. He is also a co-inventor in 4 awarded and 2 pending US patents.