Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Waves and Fields in Epsilon-and-Mu-Near-Zero (EMNZ) Media

AHMED MAHMOUD, NADER ENGHETA, University of Pennsylvania — We investigate some of the unconventional characteristics of wave interaction with epsilon-and-mu near-zero (EMNZ) media, i.e., structures with both the relative permittivity and permeability near zero. We show that using an EMNZ medium one might in principle "open up" regions that behave as "single electromagnetic points" while being electrically large. We discuss some of the unusual effects that result from placing classical radiating dipoles within an EMNZ medium. This may provide us roadmaps to tailoring the radiation performance of more complex systems like quantum emitters. We suggest an idea for a possible implementation of a structure that would exhibit an EMNZ behavior and numerically demonstrate the possibility of having electrically large volumes behaving as EMNZ media. We finally discuss the limitations within which these structures are able to exhibit the aforementioned phenomena that take place in an idealized EMNZ medium. Time permitting, we also show both analytically and numerically that electromagnetic invisibility of arbitrarily-shaped, electrically large, perfectly electric conducting objects may be achieved when embedded in an EMNZ medium.

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Date submitted: 13 Nov 2013 Electronic form version 1.4