Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

1-D, 2-D and 3-D Negative-Refraction Metamaterials at Optical Frequencies: Optical Nano-Transmission-Line and Circuit Theory NADER ENGHETA, University of Pennsylvania, ANDREA ALU, University of Pennsylvania — In recent years metamaterials have offered new possibilities for overcoming some of the intrinsic limitations in wave propagation. Their realization at microwave frequencies has followed two different paths; one consisting of embedding resonant inclusions in a host dielectric, and the other following a transmission-line approach, i.e., building 1-D, 2-D, or 3-D cascades of circuit elements, respectively, as linear, planar or bulk right- or left-handed metamaterials. The latter is known to provide larger bandwidth and better robustness to ohmic losses. Extending these concepts to optical frequencies is a challenging task, due to changes in material response to electromagnetic waves at these frequencies. However, recently we have studied theoretically how it may be possible to have circuit nano-elements at these frequencies by properly exploiting plasmonic resonances. Here we present our theoretical work on translating the circuit concepts of right- and left-handed metamaterials into optical frequencies by applying the analogy between nanoparticles and nanocircuit elements in transmission lines. We discuss how it is possible to synthesize optical negative-refraction metamaterials by properly cascading plasmonic and non-plasmonic elements in 1-D, 2-D and 3-D geometries.

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Date submitted: 30 Nov 2005 Electronic form version 1.4