Abstract Submitted
for the DPP14 Meeting of
The American Physical Society

Unusual stimulated Raman scattering in a plasma metamaterial
EDUARDO P. ALVES, RICARDO FONSECA, LUIS O. SILVA, GoLP/Instituto de Plasmas e Fusao Nuclear, Instituto Superior Tecnico, Universidade de Lisboa, Lisbon, Portugal — Electromagnetic (e.m.) metamaterials using plasmas have recently been demonstrated to exhibit extraordinary e.m. features [Sakai, 2012]. We aim to exploit plasma nonlinearity combined with metamaterial structures to assess new and unexplored nonlinear e.m. phenomena. We have developed a unique numerical framework to study nonlinear plasma processes in the presence of a strong background magnetic permeability (e.g., background SRR metamaterial [Pendry, 1999]). We combine the particle-in-cell method, to describe the plasma dynamics self-consistently, with a dispersive-FDTD Maxwell solver to incorporate the effects of a strong background magnetic permeability [Taflove, 2000]. This framework allows us to investigate the extraordinary character of fundamental nonlinear plasma effects in the presence of a strong magnetic permeability, which is generally neglected in standard plasma physics. In this work, we explore stimulated Raman scattering (SRS) in a plasma metamaterial. We have generalized the SRS theory to incorporate the effect of an arbitrary background magnetic permeability. The generalized theory is in good agreement with our numerical framework and we demonstrate the unusual operation of SRS in a parameter window that is not accessible in a simple plasma medium.

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Date submitted: 11 Jul 2014 Electronic form version 1.4