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Undulator Induced Transparency in 3D: Theory and Simulation
YOAV AVITZOUR, GENNADY SHVETS, Department of Physics, University of Texas at Austin — Recent theoretical studies have found that the phenomenon of Electromagnetically Induced Transparency (EIT) has a classical counterpart in plasmas. A right hand circularly polarized electromagnetic field propagating along the magnetic field in a magnetized plasma is strongly absorbed when the field frequency matches the electron cyclotron frequency. However, the absorption is canceled by the presence of a second, "drive" field, when the frequency of the drive matches the difference between the electron cyclotron frequency and plasma frequency. When the electron plasma and cyclotron frequencies are identical, the zero frequency electromagnetic field can be replaced by a static helical undulator, yielding the so-called Undulator Induced Transparency (UIT). The theory of UIT in 1D has been extensively studied. It was shown that various exotic propagation modes can be obtained in the UIT regime, e.g., a dramatic slowdown of the group velocity of the wave, resulting in efficient compression of the wave energy, which in turn can be used for electron or ion acceleration. However, the 1D theory does not allow for any transverse variation in the problem, and the extension of the theory to a more realistic 2D or 3D geometry is not straightforward. We present here a full 3D theory of UIT, and compare it with the more intuitive 1D theory. We then apply the theory to study numerically the properties of UIT inside a waveguide.

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