Electromagnetic Wave Phenomena induced by Temporal Modulations and Switching

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Spacetime engineering of light-matter interactions has risen in the past years as a fascinating opportunity to unveil extra degrees of wave control. In this seminar, we will first go over a first-principles model of the electrodynamics of perfectly abrupt temporal interfaces and show how their particular microscopics may dictate different conservation laws, with different boundary conditions than usually assumed (also in the presence of dispersion). We will then combine these temporal parameterizations with spatial structuring in order to study parallel-plate waveguide temporal mode conversion induced by (i) plate conductivity switching, (ii) plate relativistic accelerated motion, and (iii) spatiotemporal modulation of a plasma. An overview of other interesting phenomena enabled by time variations will be given, including wave "freezing" and amplification across a non-Foster temporal slab, a spacetime surface plasmon polariton (SPP), or reflection/refraction across a temporal interface substantiating a transition from isotropic to anisotropic medium. We will also show that, by DC biasing an otherwise space- and time-dependent (positive) dielectric function, at a given frequency one can mimic a (negative) Drude response. We will finally describe a surface integral equation method for the full-wave simulation of time-periodic modulated media.