Geophysical Research Abstracts, Vol. 9, 10248, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-10248

Guided UWB transient phenomena in anisotropic plasmas

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One of the intensively investigated electromagnetic phenomena is the propagation of real transient UWB (ultra wide band) signals in different media. These transients occur frequently in Earth's natural environment, e.g. signals excited by lighting discharges, wave-particle interactions or interplanetary effects. But the theoretical problem is more general, as all the switching on-off like events on electric circuits and on wave guides generate UWB phenomena. Therefore, it is important to find closed formed solutions of Maxwell's equations for transients that avoid every monochromatic assumption during the derivation. Here we present a theoretical solution method on the one hand that delivers the mentioned closed formed, general full-wave solution of signals excited by temporarily and spatially transient functions, and on the other hand, display some numerical calculations of these UWB signals in a wave guide filled by homogeneous anisotropic plasma in comparison with unordinary VLF phenomena recorded on board the DEMETER low-Earth-orbit satellite. We have observed by detailed, fine-structure analysis of the electric component of ICE DEMETER data base numerous signals with unusual, furcating spectra ("X"-type whistlers). The spectral behavior (modal furcating) of these anomalistic, whistler-like events shows remark-

able similarities to the calculated waveforms modeled by guided transients propagating in anisotropic plasma. This investigation offers the possibility to determine the excitation and the medium parameters along the propagation path and to realize a very precise monitoring of the electromagnetic environment of the Earth and other planets.