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Title:Frequency transformer: Appropriate and different models for a building-up and collapsing magnetoplasma medium
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Abstract:The interaction of an electromagnetic wave with a time varying medium is governed by the property of conservation of the wavenumber. This property can be utilized to construct a frequency transformer. The time variation in the relative permittivity of the medium is easily produced in a magnetoplasma medium by altering the ionization level. The change of the ionization level can be produced by the dynamic control of the source of ionization. The switching-on action of the source produces a build-up plasma, whereas a switching-off action produces a decaying plasma. Simple mathematical models, however, for the two cases are different. In the case of building-up plasma, the model has to ensure the continuity of the current density and in the case of decaying plasma, the average drift velocity of the surviving electrons has to be continuous. Using these two appropriate models, the effect of the time variation of the plasma frequency as well as the background magnetic field of the magnetoplasma medium are studied. Switching off the external magnetic field for the wave in the magnetoplasma medium converts a whistler wave to a wiggler magnetic field. Similar results are obtained with an intensification of the source wave as well as frequency upshift of the whistler wave for the collapsing plasma medium. By controlling the static magnetic field parameters and the level of ionization, the frequency shift ratio can be changed and the frequency transformer becomes tunable. The principle of frequency up-shifting using plasma permits the generation of signals from easily obtainable frequency bands and upshifts them into frequency bands not easily obtainable by other methods. © 2011 Springer Science+Business Media, LLC.