Mathematical Physics

Fractional Integro-Differential Equations for Electromagnetic Waves in Dielectric Media

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We prove that the electromagnetic fields in dielectric media whose susceptibility follows a fractional power-law dependence in a wide frequency range can be described by differential equations with time derivatives of noninteger order. We obtain fractional integro-differential equations for electromagnetic waves in a dielectric. The electromagnetic fields in dielectrics demonstrate a fractional power-law relaxation. The fractional integro-differential equations for electromagnetic waves are common to a wide class of dielectric media regardless of the type of physical structure, the chemical composition, or the nature of the polarizing species (dipoles, electrons, or ions).

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