Polarization and energetic properties of Bessel wave fields

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Recently major attention of the scientists is attracted with Bessel light beams, frequently termed nondiffractional, at which the cross-section distribution of field amplitude is characterized by Bessel functions of the first kind. In the paper the new exact solutions of Maxwell equations and vector wave equation of Helmholtz featuring new types of modes of Bessel electromagnetic fields in homogeneous isotropic media are obtained. It has been shown, that the set of the solutions is multiparameter and consequently there is an arbitrariness in a choice of the basic types of modes. The polarization peculiarities of various types of Bessel wave fields are found for TE and TM-modes, for linear, circular and elliptic modes. The basic properties TE and TM of modes are obtained. The principle of reciprocity permitting to realize transition from E-modes to H-modes and back is justified. It has been established and analyzed the connections between various modes of nondiffractional fields in cartesian and cylindrical systems . The energy characteristics are calculated and the expressions for average density of energy and Poynting's vector of various types of Bessel waves fields are obtained. The found results can be used by description of mutual transformations of Bessel light fields of various types.