Orbital and spin angular momentum interconversion of light beams in sum-frequency generation process from the surface of an isotropic gyrotropic medium

Annotation

In the present work we study the interaction between spin and orbital components of the angular momentum of electromagnetic waves in the sum-frequency generation process on the surface of a nonlinear isotropic chiral medium within undepleted pump approximation. Circularly polarized fundamental laser beams with multimode transverse structure are used. The sum-frequency generation (SFG) problem in the case of normal incidence of pump beams on the surface of a nonlinear medium is solved. The second harmonic generation (SHG) problem in the case of inclined incidence is solved, too. We derived formulas that confirm the conservation of z-projection of the total angular momentum in SFG process. Both bulk and near-surface responses of the medium are taken into account. We obtained formulas that confirm spin angular momentum conservation law and orbital angular momentum conservation law in the case of the nonlocal nonlinear response of bulk in SHG process. The interaction between the spin and orbital components of the angular momentum of the interacting waves is discussed. Classical and quantum explanations of particular features of three-wave mixing on the surface of a nonlinear medium are presented.