Polarization Effects of Femtosecond Laser Pulses Due to Cubic Type Nonlinearity in Air

D A Georgieva¹ and L M Kovachev²

¹Faculty of Applied Mathematics and Computer Science, Technical University Sofia, 8, Kliment Ohridski Blvd., 1000, Sofia, Bulgaria. Contact Phone: +359877400763
²Bulgarian Academy of Sciences, Institute of Electronics, 72, Tzarigradsko Shoussee, 1784, Sofia, Bulgaria. Contact Phone: +359885855431
Contact Email: dgeorgieva@tu-sofia.bg

It is well known that during nonlinear propagation in isotropic media the nano- and picosecond laser pulses preserve their linear and circular polarizations. In the case of elliptical polarization the electrical field vector rotates proportionately to the pulse intensity. The rotation of field vector is homogeneous over the beam spot profile. These polarization effects are due to the Maker and Therhune nonlinear polarization. In the femtosecond region we investigate the generalized cubic nonlinearity of the type \((\vec{E} \cdot \vec{E})\vec{E}\). In this case the generation of optical signal wave spectrally shifted with GHz delay towards the higher frequencies is possible. We derive a vector system of nonlinear differential equation describing the evolution of the main and the signal waves and investigate numerically the polarization properties of both components. The numerical simulations show that the rotation angle of the electrical field vector is different in each point of the spot with maximum in the pulse centrum.