Reflection, Transmission and Absorption of Vortex Beams Propagation in Inhomogeneous Magnetized Plasma

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Abstract

Based on angular spectrum expansion and 4*4 transfer matrix method, an investigation on reflection, transmission, and absorption of vortex beams in inhomogeneous magnetized plasma is presented. The reflected and transmitted electric fields are expressed by the inverse Fourier transform of the product of the reflected and transmitted coefficients and the angular spectrum amplitude of the incident beam. The reflection, transmission, and absorption of the power are also shown. The intensity profiles of reflected and transmitted beams, as well as the effects of electron number density, radial index, and magnetic field on the intensity profiles are simulated and discussed. According to the numerical simulation, due to the effect of the magnetic field, for a linearly polarized incident beam, the reflected and transmitted beams are no longer linearly polarized and consist of principal polarization and cross-polarization components. The cross polarization components cannot be ignored, and increase with an increase in the magnetic field. Intensity distortion of cross polarization components is more evident in comparison with the principal polarization components. The incident angle has a significant impact on the magnitudes of reflected and transmitted intensities. It can also be concluded that the transmission of power can be increased by increasing the incident frequency and decreasing the incident angle. The method to study the propagation of vortex beams in an inhomogeneous plasma has a fundamental significance in the application of vortex wave communication technique, such as blackout problem observed in the flight of hypersonic vehicles.