Vortex Electromagnetic Wave Propagation in Magnetized Plasma

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In recent years, there have been many researches focusing on vortex electromagnetic wave (VEMW) with orbital angular momentum (OAM). An important feature of OAM is that it has an infinite number of modes. Due to the orthogonality of different modes, VEMW can realize multi-channel information transmission in the form of non-interference and superposition multiplexing at the same frequency, which is helpful to improve the channel's spectrum utilization rate. Thus, VEMW has a wide range of applications in communication and radar detection.

VEMW is very sensitive to atmospheric turbulence, which leads to helical phase front distortion and OAM mode diffusion [1,2]. It is necessary to consider the influence of particles on the propagation of VEMW in the atmosphere. In this paper, we study the propagation characteristics of VEMW in magnetized plasma using the finite-difference time-domain model.

The simulation results show that VEMW is reflected at the cut-off height of each mode, and standing waves occur when the propagation is stable. In addition, VEMW maintains the vortex state in the ordinary wave propagation region, while the vortex state is distorted in the slow extraordinary wave propagation region. Due to the linear interaction between VEMW and plasma, the plasma also presents a vortex state. This propagation model of VEMW can provide some theoretical support for the application of VEMW in ionospheric heating and shortwave communication.

References

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