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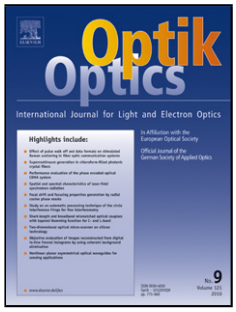

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BEHAVIOR OF THE CENTRAL INTENSITY OF A HOLLOW-GAUSSIAN BEAM AGAINST THE TURBULENCE

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Abstract

In this paper, on the basis of the extended Huygens-Fresnel diffraction integral in the paraxial approximation a principal theoretical expression of on-axis average intensity of Hollow-Gaussian light beam propagating through a turbulent atmosphere is developed. The impact of some factors including the turbulent strength and the beam parameters such as the beam order, the wavelength and the waist width on the variation of the on-axis intensity distribution characteristics are performed and discussed analytically and numerically in the study using the principle theoretical finding. The analysis of the numerical results shows that the atmospheric turbulence affects much the Hollow-Gaussian beams of higher wavelength. Also, as far as the turbulent strength increases, as much as the Hollow-Gaussian beam is more affected. Finally, it is pointed that the atmospheric turbulence has a great influence on the Hollow-Gaussian of lower order beam.

Keywords: *Dark hollow beams; Hollow-Gaussian beams; Gaussian beams; Turbulent atmosphere; Axial intensity.*

1. Introduction

The so-called dark hollow beams with zero central intensity have attracted great attention in the past years because of their wide applications in optical trapping particles [1, 2], optical tweezers [3], optical metrology [4] and optical communications [5]. Several models are devoted in the literature to describe dark hollow beams including hyperbolic-sine-Gaussian beams [6], controllable dark-hollow beams [7] and Hollow-Gaussian beams [8]. Since its introduction, in 2003, by Cai et al. [8] as new useful mathematical approach of dark hollow beams, the Hollow-Gaussian beams receive considerable interest by many optic researchers [9-17]. The propagation properties of Hollow-Gaussian beams through paraxial aligned and misaligned optical systems have examined by Cai and He [9] and Cai and Zhang [10], respectively. Before, Hollow-Gaussian beams have been studied extensively by other physicists in several optical systems such as fractional Fourier transform [11], circular annular aperture [12], turbulent atmosphere [13], unixial crystal [14] and strongly nonlocal nonlinear media [15]. Also, the focal shift of Hollow-Gaussian beams passing through a thin lens is studied analytically and numerically by Zhao et al. [16]. The same research group [17] has investigated and discussed the radiation forces exerted by a highly order Hollow-Gaussian beam on a dielectric spherical particle.

On other hand, due to their applications in free space, in remote sensing and in optical communications [18, 19], the propagation of laser beams through turbulent media is another subject that attracts the attention of a lot of optic researchers [20-43]. In this context, the propagation properties of dark Hollow-Gaussian beams such as flat-topped annular beams [28], Bessel-Gaussian beams [29], partially coherent controllable hollow beams [30], Hermite-cosine-Gaussian beams [31] and higher order Cosh-Gaussian beams [32] in turbulent atmosphere have been extensively studied by scientists. The average intensity and the on-axis

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