Axial Focusing Properties of Cosine-Gaussian Beam by a Lens with Spherical Aberration

Q. F. Wang, **X. Q. Wang**, **L. Wang**, **J. J. Lin**, **J. S. Tang**, **and K. Sheng**
Southwest Jiaotong University, China

Based on the expression for the axial light intensity of cosine-Gaussian beam by a lens with spherical aberration, the influence of the coefficient of the spherical aberration and Fresnel number of Gaussian beams on the axial intensity distribution is discussed. The numerical results show that for the lens with negative spherical aberration, near the best focal point, the axial light intensity changes slowly with the changing of propagation distance. So, the negative spherical aberration may be an approach for achieving the flattened laser intensity distribution alone propagation axis. When the parameters of the beam and the optical system satisfy some conditions, there are two axial light intensity maxima which are located on both sides of the geometrical focus of focused cosine-Gaussian beam. For the lens without spherical aberration, the maximum light intensity, or the best focal point is on the left side of the geometrical focus. For the lens with positive spherical aberration, the best focal position can leap to the right side of geometrical focus, z_{f2} from the left of it, z_{f1}, when the value of Fresnel number of Gaussian beams N_w changes, it is so-called focal switch. With the increasing of the coefficient of the spherical aberration kS_1, relative transition height $\Delta z_f = \mid z_{f1} - z_{f2} \mid$ increases, but the value of critical Fresnel number $(N_w)_c$ decreases. For example, when the coefficient of the spherical aberration equals 0.5 and 0.3, and, the critical Fresnel number equals 7.03 and 8.68 (when the transition occurs), the relative transition height Δz_f equals 0.246 and 0.146 respectively. It is also shown that when the coefficient of the spherical aberration is small, the value of critical Fresnel number $(N_w)_c$ decreases rapidly as the kS_1 increases. After about $kS_1 = 0.3$ the value of $(N_w)_c$ decreases slowly.