Resonance scattering by a dielectric sphere of a vector Airy beam

Han Sun[a,*], Renxian Li[a,b,], Jiaming Zhang[a], Ningning Song[a], Shu Zhang[a], and Bojian Wei[a]**

[a]*School of Physics and Optoelectronic Engineering, Xidian University, Xi'an 710071, China*
[b]*Collaborative Innovation Center of Information Sensing and Understanding, Xidian University, Xi'an 710071, China*

[*]*Presenting author (hsun_6@stu.xidian.edu.cn)*
[**]*Corresponding author (rxli@mail.xidian.edu.cn)*

Diffraction is one of the most important factors limiting the accuracy of instruments in optical systems. Since the concept of non-diffraction beams is put forward by Durnin [1], it has rapidly become a hot topic. An Airy beam, a novel non-diffraction beam, has some special characteristics such as self-recovery and self-bending. Resonance scattering analyses of Airy beams have some potential applications in optical manipulation, optical tweezers, imaging systems, and other fields.

In this paper, resonance scattering by a dielectric sphere illuminated by a vector Airy beam is investigated using the generalized Lorenz–Mie theory. A part of the non-resonant background is subtracted from the standard Mie scattering coefficients. Firstly, the electric fields of the vector Airy field is expressed using the angular spectrum decomposition [2]. The beam-shape coefficient is derived using multipole expansion of spherical harmonic functions. To further investigate the physical explanation of some special phenomena, the scattering coefficient of the dielectric sphere is expanded using Debye series [3]. The effects of parameters including the polarization, modulation parameter and transverse scale of Airy Beams are considered [4]. The advantage of the resonance method is that we can quantitatively describe the scattering using Debye series by separate diffraction effects from the external and internal reflections from the sphere.

References

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