

Accepted Manuscript

Scattering of a vector Bessel vortex beam by a charged sphere

Shuhong Gong, Renxian Li, Yu Liu, Jiaming Zhang

PII: S0022-4073(18)30135-3
DOI: [10.1016/j.jqsrt.2018.05.001](https://doi.org/10.1016/j.jqsrt.2018.05.001)
Reference: JQSRT 6082

To appear in: *Journal of Quantitative Spectroscopy & Radiative Transfer*

Received date: 25 February 2018
Revised date: 1 May 2018
Accepted date: 2 May 2018

Please cite this article as: Shuhong Gong, Renxian Li, Yu Liu, Jiaming Zhang, Scattering of a vector Bessel vortex beam by a charged sphere, *Journal of Quantitative Spectroscopy & Radiative Transfer* (2018), doi: [10.1016/j.jqsrt.2018.05.001](https://doi.org/10.1016/j.jqsrt.2018.05.001)



This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Scattering of a vector Bessel vortex beam by a charged sphere

Shuhong Gong^{a,b}, Renxian Li^{a,b,*}, Yu Liu^a, Jiaming Zhang^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*

Abstract

The interaction of a vector Bessel vortex beam (VBVB) with a charged sphere is investigated using generalized Lorenz-Mie theory (GLMT). The charges carried by the sphere are expressed by the surface conductivity σ_s . The incident VBVBs are expanded using a series of beam shape coefficients (BSCs), whose analytical expressions are derived using the angular spectrum decomposition method (ASDM). The expanded coefficients of the scattered fields are calculated by considering the boundary conditions on the surface of the sphere, which are different from that for the case of neutral sphere. The effects of the carried charges on the scattering, absorption, and extinction coefficients are considered, with particular emphasis on the effect of the order, polarization, and half-cone angle of the beams. Various polarizations including linear, circular, radial, azimuthal, and mixed polarizations are considered. Numerical results show that the scattering, extinction, and absorption efficiencies are very sensitive to the beam parameters including polarization, half-cone angle, and order. Thus in practice, the scattering, extinction, and absorption caused by charged particles can be enhanced or reduced by choosing proper beam parameters according to practical demand. Such results have many potential applications. For instance, it is of help to improve the quality of wireless communication by reducing the attenuation caused by charged particles. It can also improve the precision for particle sizing using phase Doppler anemometry by enhancing the scattering of charged spheres.

Keywords: vector Bessel vortex beam, charged sphere, generalized Lorenz-Mie theory, angular spectrum decomposition method, polarization

1. Introduction

An optical vortex beam [1] has an axial phase singularity, and is characterized by a spiral phase term of $\exp(il\phi)$, where l is the topological charge of the beam and ϕ is azimuthal angle in the cylindrical coordinate system. The topological charge l is defined as how many twists the beam experiences in one wavelength of propagation. Such beam has lots of applications in various fields including optical trapping and manipulation [2–7], optical communications [8, 9], LADAR (laser detection and ranging) sensing [1], biology, and so on. Many researchers have been devoted to the generation of optical vortex beams [1, 10–14]. Up to now, optical vortex beams can be generated by imposing a spiral phase distribution on the the input beam, which can be realized by spiral phase plate [15], diffractive optical elements [16, 17], spatial light modulator (SLMs) [18], optical fibre [10], and so on. The propagation of optical vortex beams has also been widely studied.

Vector beams [19] have spatially varying state of polarization. In recent years, vector beams, especially cylindrical vector beams which have spatially varying state of polarization with cylindrical symmetry, have attracted attention, since the high numerical aperture (NA) focusing of such beams results in unusual electric field distribution in the focal region [20, 21]. For instance, a radially polarized beams, a typical cylindrical vector beam [22–24], has a strong longitudinal component in focal points and has a smaller spot size. The

*Corresponding author at: School of Physics and Optoelectronic Engineering, Xidian University, Xi'an 710071, China.
E-mail address: rxli@mail.xidian.edu.cn (R. Li).

Download English Version:

<https://daneshyari.com/en/article/7845897>

Download Persian Version:

<https://daneshyari.com/article/7845897>

[Daneshyari.com](https://daneshyari.com)