Perturbation of V points by circularly polarized light

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Abstract: Polarization singularities can be described as superposition of orbital angular momentum (OAM) and spin angular momentum (SAM) states. We propose here a method to disintegrate V point polarization singularities into C point polarization singularities by perturbing it with circularly polarized beam. The total topological charge will remain conserved in this process.

1. Introduction

Optical phase singularities are intensity null points where phase is indeterminate whereas polarization singularities are Stokes phase singularities where any of the parameter that defines state of polarization of light, is undefined [1, 2]. C points and V points are polarization singularities in an inhomogeneously polarized optical fields. V points are intensity null points where both azimuth and handedness of the field are not defined. C points are points of circular polarization where azimuth of polarization ellipse is not defined. The gradient of azimuth around the singular point decides the topological charge of corresponding polarization singularity. V point singularities and C point singularities have lowest topological charge of ±1 and ±1/2 respectively. Hypothetical Stokes field S_{12} $(S_1 + iS_2)$ can be constructed using Stokes parameters S_1 and S_2. Phase singularities in Stokes field correspond to polarization singularity in actual optical field.

2. Disintegration of V points

Polarization singularities can be interpreted as superposition of orbital angular momentum (OAM) and spin angular momentum states (SAM) such that the net content of OAM is zero for V point singularities but non zero for C point polarization singularities [3]. In this article, we propose a method to disintegrate V point polarization singularities into C points polarization singularities by perturbing V point singularities with uniform amplitude circularly polarized beam. Such perturbation of V point can be realized experimentally as interference of V point with circularly polarized beam using simple Mach Zehender interferometer set up. Topological charge conservation in this process of perturbation will disintegrate a single V point with topological index ±1 into a pair of C points with topological charge ±1/2. Simulation results of disintegration of V point polarization singularity of index +1 and -1 into C point polarization singularities of index +1/2 and -1/2 are shown in Fig. 1.

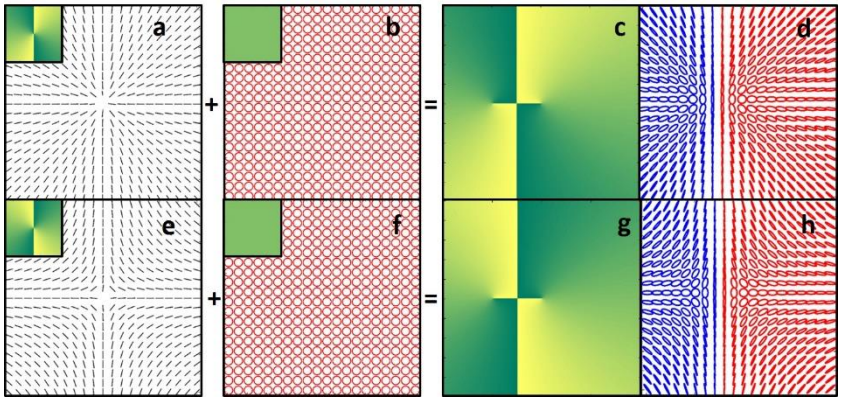

Fig. 1 Disintegration of V points into C points polarization singularities using interference with circularly polarized beam. (a, b, e, f) Polarization distribution of interfering beams with insets showing the Stokes phase. (c, g) shows Stokes phase of resultant beams and (d, h) shows polarization pattern of resultant beams.

4. References

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