Propagation of V-point singularity through diamond shape aperture

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Fraunhofer diffraction pattern is apparently Fourier transform of the aperture function. But when the beam possesses orbital angular momentum (OAM) it exhibits strangely different diffraction patterns that abides by charge conservation rule [1]. The azimuthally varying phase of scalar-field singularities effecting diffraction patterns has been rigorously discussed in the literature considering various shape of the apertures. This aspect has already been utilized in phase retrieval and OAM detection [1]. In this work, peculiar diffraction behaviour of vector-field singularities [2, 3], that are superposition of oppositely charged OAM beams in orthogonal polarized states, on passing through a diamond shaped aperture is investigated. Integrating spatially inhomogeneous polarization to the diffracting beams although increases the inherent complexity, unveils interesting polarization transformations. It is found that vector-field singularities can be transformed into elliptic-field singularities (C-points) on ***off-axis illumination*** of the aperture. These elliptic-field singularities appear in the form of orthogonal pair of lemon (star) fields following index conservation (refer to Fig. 1). Furthermore, for the first time, we report the handedness conservation of polarization singular fields on diffraction which has been completely overlooked till date. Coexistence of C-points of opposite handedness demands appearance of L-line in between which

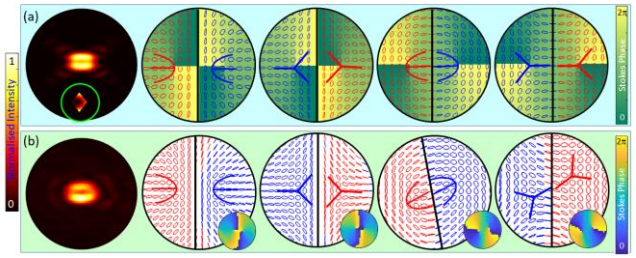

Fig. 1. (a) Simulated and (b) experimentally obtained intensity patterns, polarization distributions, Stokes phase map on diffraction of an off-axis unit-index V-point through a diamond-shaped aperture. In the simulation Stokes phase is shown as background and in experiment it is shown as inset. Appropriate symbols are used to identify lemons, stars and L-lines. In all the figures two different colours of SOP (red for RCP and blue for LCP) are used to distinguish handedness.

has also been shown. On the other hand, for the case of ***on-axis illumination,*** i.e., when the polarization singular point coincides with the centroid of the aperture the higher order V-point disintegrates into unit index V-point and on propagation these V-points recedes away from each other (See Fig.2).

References

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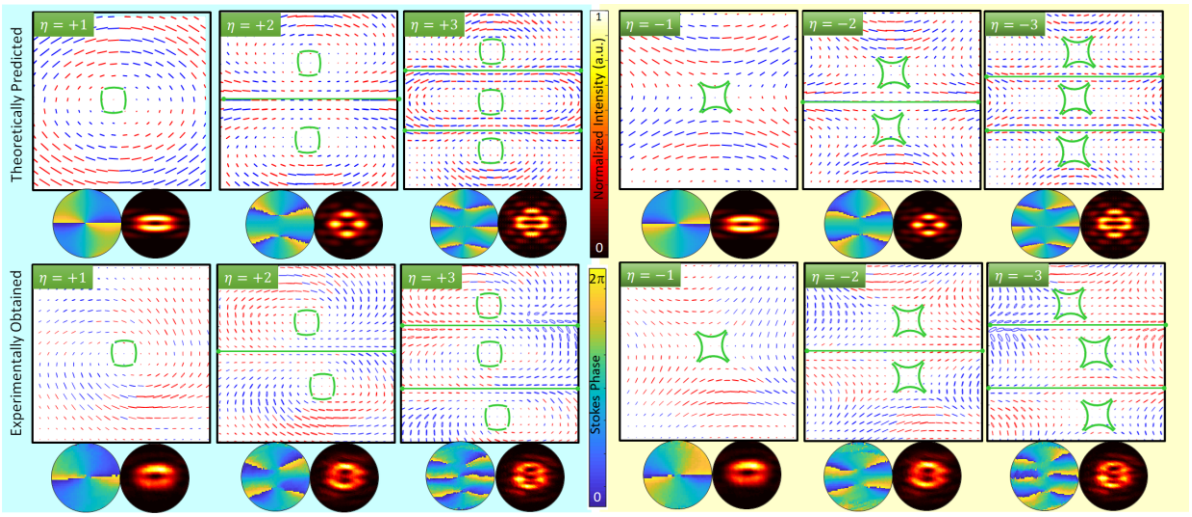

Fig. 2. Diffraction of various order (η= ±1 to ±3) V-point singularity through a diamond shaped aperture when the centroid of the aperture and polarization singular point coincides. Stokes phase map and the diffracted intensity pattern is appended with the respective polarization distribution in each of these cases.