Synthesis of Stokes vortices using spatially varying half wave plate

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Polarization singularities are the critical points in inhomogeneously polarized light where one or more parameters defining state of polarization are not defined [1,2]. Critical points of ellipse field and vector field are termed as C-points and V-points respectively. Application of polarization singularities have been found in diverse fields like imaging, particle acceleration, robust beam generation, measurement of chirality etc. Polarization of light is measured using four measurable quantities, known as Stokes parameter. Hypothetical fields can be constructed using these Stokes parameters, known as Stokes fileds. Stokes fields and Stokes phases are given as $S_{ij} = S_i + iS_j$ and $\varphi_{ij} = \tan^{-1} S_j/S_i$ respectively, where (i=1,2,3 and $i \neq j$) and S_i is normalized Stokes parameter. Singularities in the Stokes phase are known as Stokes vortices [3]. Stokes vortices are the intersection points of zero crossing of S_i and S_j in the S_{ij} field. Stokes vortices in S_{12} Stokes field are used to identify polarization singularities. Stokes vortices of S_{23} field represents phase vortices in transverse components E_x and E_y of real field. Similarly, S_{31} Stokes vortices gives the phase vortices of linear polarization in the 45° rotated frame.

Stokes vortices generation has been demonstrated earlier using interferometric method [4,5]. In this article we present a simple and elegant method to increase or decrease the number of stokes vortices using spatially varying half wave plate [6]. We have done simulation study using MATLAB and some examples are shown in the figure below. Figure 1(a1) and 1(b1) give the polarization distribution of incident and transmitted beam from spatially varying half wave plate. Figure 1 (a3-a5) and 1(b3-b5) are the Stokes phase of incident and transmitted beam respectively. Zero contours of S_1 (red), S_2 (blue) and S_3 (black) of incident and transmitted beam are shown in figure 1(a2) and 1(b2) respectively. From figure 1(a4) and (b4) it can be seen that spatially varying half wave plate doubles the Stokes vortices of S_{23} field. Similar it can be seen from figure 1(a5) and (b5) that S_{31} Stokes vortices doubles after transmission.

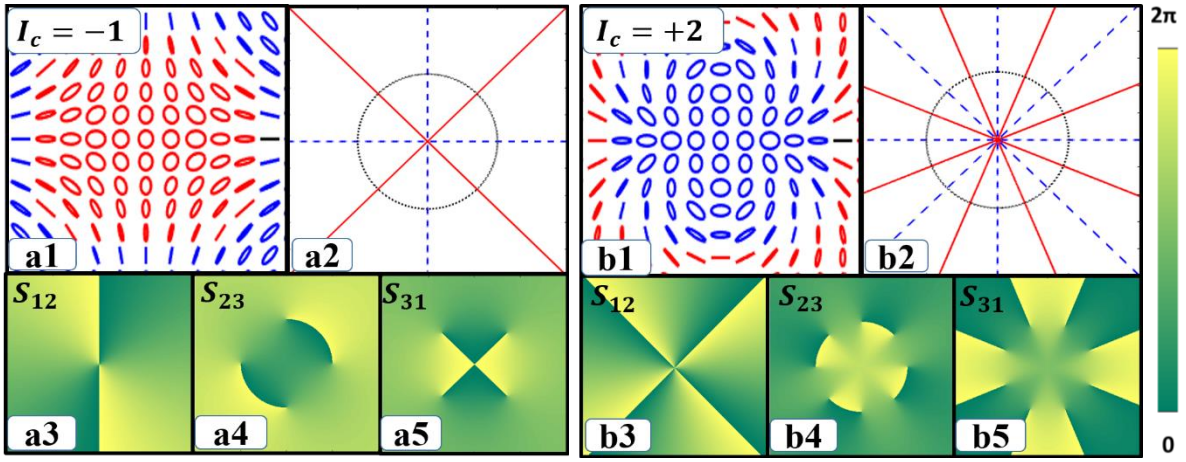

Fig. 1 Simulation results: (a1) and (b1): Polarization distributions, (a2) and (b2): zero contours of S_1(red), S_2(blue) and S_3(black) of incident and transmitted beams; (a3-a5) and (b3-b5): Stokes phase distributions of S_{12}, S_{23} and S_{31} Stokes fields respectively of incident and transmitted beam.

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