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# Dynamical Charge Inversion of Polarization Correlation Vortex Propagating through a Cylindrical Lens

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**Abstract:** Polarization correlations are analyzed in propagating vector speckle field generated by scattering of Poincaré beam. Dynamical charge inversion of the correlation vortex is observed when the speckles propagate through a cylindrical lens. 

## 1. Introduction

There is no way to eliminate speckles in the observations taken with the coherent light source. Optical speckles are considered as noise in most of the detection processes. While, there exist many applications of laser speckles such as speckle interferometry [1, 2], speckle photography [1, 2], speckle velocimetry [3], etc. Therefore, to extract information of interest and to process data with higher efficiency, it becomes necessary to investigate the speckles present in the recorded data. Polarization correlation proved its importance for extracting information in various fields, be it in the Biology [4, 5] or Quantum Optics [6].

Polarization correlation has already been investigated for non-propagating speckle fields [7]. It was observed that it contains information about the source of the speckles. We have further investigated polarization correlation in propagating vector speckle fields to know its behavior as speckle field propagates through optical elements such as spherical and cylindrical lenses.

## 2. Experimental Details

The experimental setup to analyze polarization correlation in propagating vector speckle field is shown in Fig.1. A diode-pumped solid-state laser (Coherent Verdi-V10) operating at wavelength 532 nm is used as a source. A polarization-sensitive SLM generating a Poincaré beam by collinear superposition of *x*-polarized Gaussian beam and *y*-polarized Laguerre Gaussian (LG) beam of charge $l = +1$, is scattered through a ground glass plate (GGP) with wavelength scale irregularities to generate vector speckle field [7, 8].

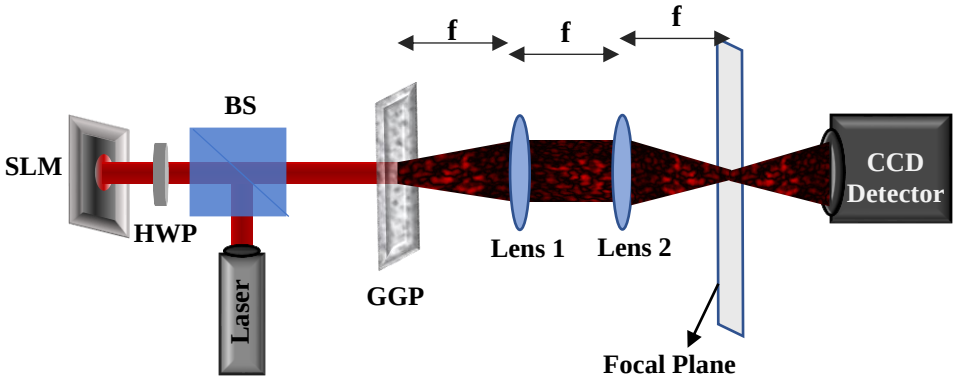


Fig. 1. Schematic of the Experimental set-up to analyze polarization correlation in propagating vector speckle field. BS: beam splitter; SLM: spatial light modulator; GGP: ground glass plate; HWP: half wave plate; f: focal length of the two lenses.

Generated vector speckle field is then allowed to pass through a spherical lens (lens 1). This lens is placed in such a way that it will give the Fourier transform of the speckle field at the plane just before lens 2. Lens 2 is the element of our interest. Polarization correlation in the field propagated through this lens is analyzed. We have used spherical and cylindrical lenses as lens 2 and determined the field at various planes before and after the focal plane of these lenses using Stokes polarimetry.

## 3. Results and Discussion

Figure 2 shows the results obtained for polarization correlation of the fields, propagated through spherical and cylindrical lenses, at the planes situated equidistant before and after the focal planes of these lenses with corresponding simulations.

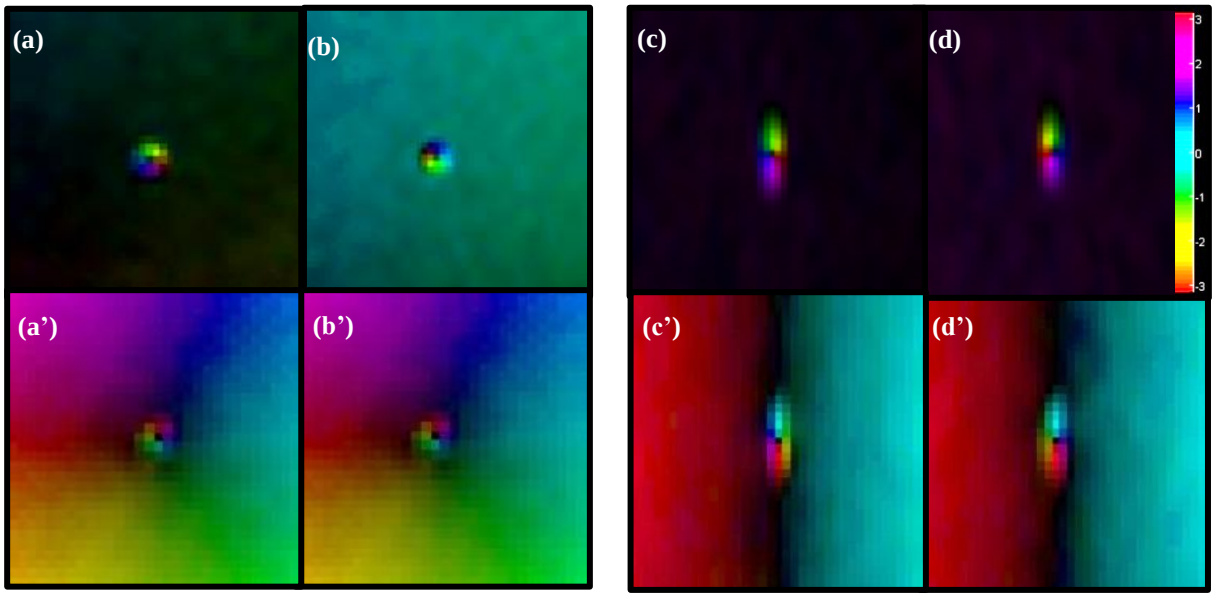


Fig. 2. Polarization correlation vortices. (a), (b) & (c), (d) are the experimental polarization correlation vortices before and after the focal plane for speckle propagation through spherical lens & cylindrical lens respectively. (a') - (d') are the corresponding simulation results.

As it can be noticed from Fig. 2 that, the experimental and simulated results are matching very well with each other with some constant phase difference. This phase difference may be arising due to the initial conditions of the simulation.

## 3. Conclusion

Polarization correlation in propagating vector speckle field has been investigated. Charge inversion in the polarization correlation vortex is observed when speckles propagate through a cylindrical lens.

## 4. References

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