Ellipticity and Chirality Induced Effects in Polarization-Resolved Angular Patterns of Liquid Crystal Cells

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We study the angular structure of polarization of light transmitted through nematic liquid crystal (NLC) cells and present the results of our investigation into the polarization-resolved angular patterns emerging in the two-dimensional projection plane after the NLC cell and characterizing the polarization structures behind conoscopic images [1].

In our analysis we adopt the approach describing the geometry of angular distributions of the Stokes parameters in terms of the so-called polarization singularities: C-points (points of circular polarization) and L-lines (lines of linear polarization). Such singularities represent structurally stable topological defects that are known to play important part in modern optics and condensed matter physics [2].

For uniformly anisotropic cells, the exact solution to the transmission problem [1] is employed to compute the polarization patterns for a variety of the director structures and to interpret the experimental results measured in the homeotropically aligned NLC cell using the technique of Stokes polarimetry. The analytical results are also applied to characterize the structures of the polarization singularities.

For linearly polarized waves impinging on the homeotropic cell, the C-points are shown to be symmetrically arranged in chains formed by four rays along which they alternate in sign of the handedness and the topological index. It is found that the L-lines form a family of the circles separating the C-points. Two additional straight L-lines represent the cases when the incident light does not excite either of two eigenmodes in the NLC cell.

Ellipticity and polarization azimuth of the incident wave can be regarded as additional governing parameters that are found to have a profound effect on the polarization angular patterns. For the hometropic cell, we show both theoretically and experimentally that variations of the ellipticity parameter of the incident wave induce transformations of the angular pattern. These involve *creation/annihilation of the C-points* and reveal the effect of *avoided L-line crossings* [3]. By performing numerical analysis for the case of cholesteric liquid crystal cells we found that similar effects can be induced by changing the liquid crystal chirality.

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References

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