

Conical refraction with flat-topped vortex hollow beam through biaxial crystals

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<https://doi.org/10.1016/j.ijleo.2024.171651> 

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Abstract

This paper presents a new theoretical method to determine conical refraction (CR) with a light beam by examining the flat-topped vortex hollow beam in a biaxial crystal. The analytical formula for the considered CR is derived in a closed form. Some graphical representations are plotted to show how the source beam parameters N and M , the control parameter ρ_0 of CR between the cylinder radius R_0 and the waist radius ω , and the propagation distance z , affect the transverse intensity pattern behind the biaxial crystal. Results show that the circularly polarized flat-topped vortex hollow beams entering the crystal will transform the classical double-ring pattern into a multi-ring one consisting of bright rings. The evolution properties of CR with vortex beams upon propagation is also discussed and compared with the reference beam. Through numerical simulations, we established a good agreement between the integrated expressions method and our analytical formula. The present study generalizes the cases of the circularly polarized Gaussian and the flat-topped Gaussian transformed by the CR in a biaxial crystal.