Non-Diffractive Features of Vectorial Optical Vortices

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Vector optical vortices can show complex polarization patterns in position space due to combination of spin and orbital angular momenta. We demonstrate, both analytically and with simulations, that certain polarization features of optical vortex beams maintain constant transverse spatial dimensions independently of beam's divergence due to diffraction. These features show in the vicinity of phase singularity and involve longitudinal electric fields [1].

Furthermore, we analyze effective refractive index due to optical vortex interaction with matter modified by new quantum selection rules for the twisted photons [2-4]. It is shown that quadrupolar interactions alter electromagnetic constitutive relations, resulting in an updated wave equation in matter from spatial variation of matter's dielectric response. It may lead to new non-diffractive solutions for propagation eigenmodes that resemble orbitals for a 2D hydrogen atom.

References

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